(No Model.) 6 Sheets—Sheet 1.

M. T. CHAPMAN.

WELL SINKING APPARATUS.

No. 443,070. Patented Dec. 16, 1890.

Fig. 1.

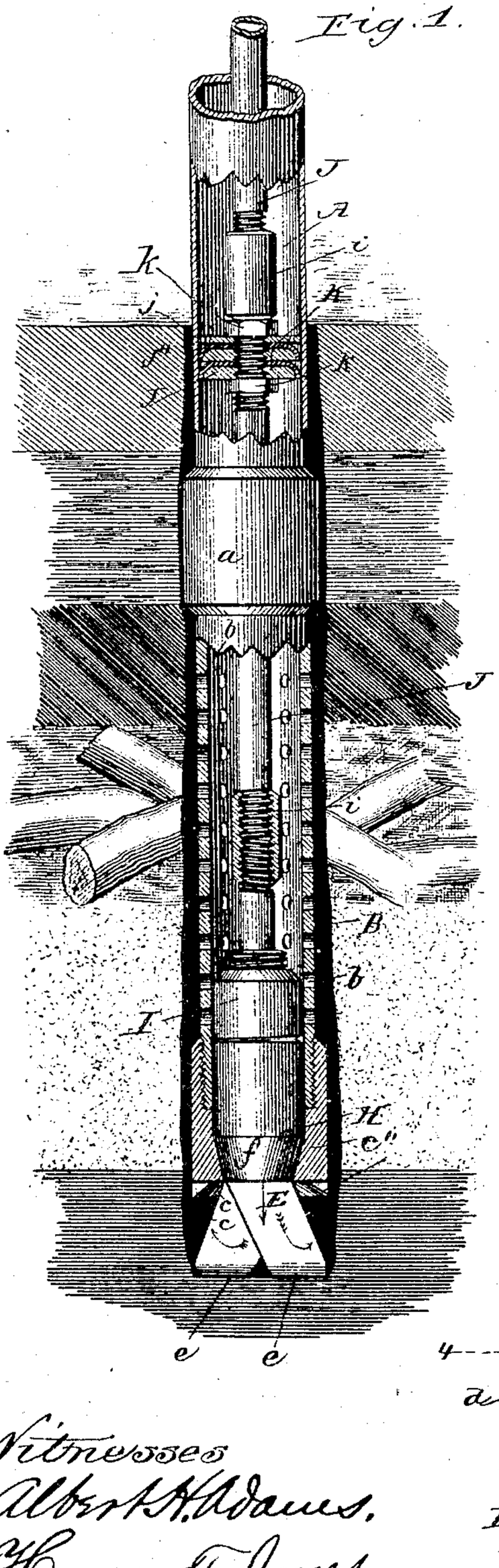


Fig. 2.

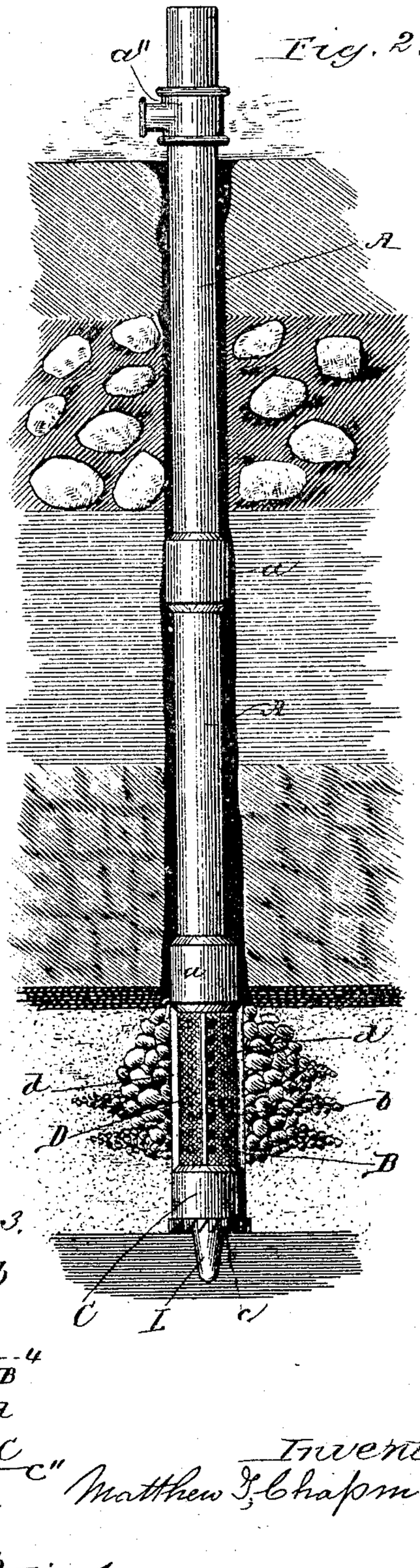


Fig. 3.

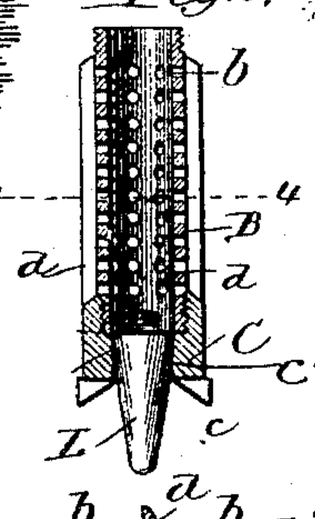
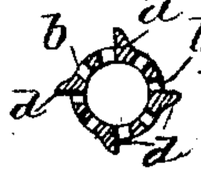


Fig. 4.



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(No Model.) 6 Sheets—Sheet 2.

M. T. CHAPMAN.

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Fig. 5.

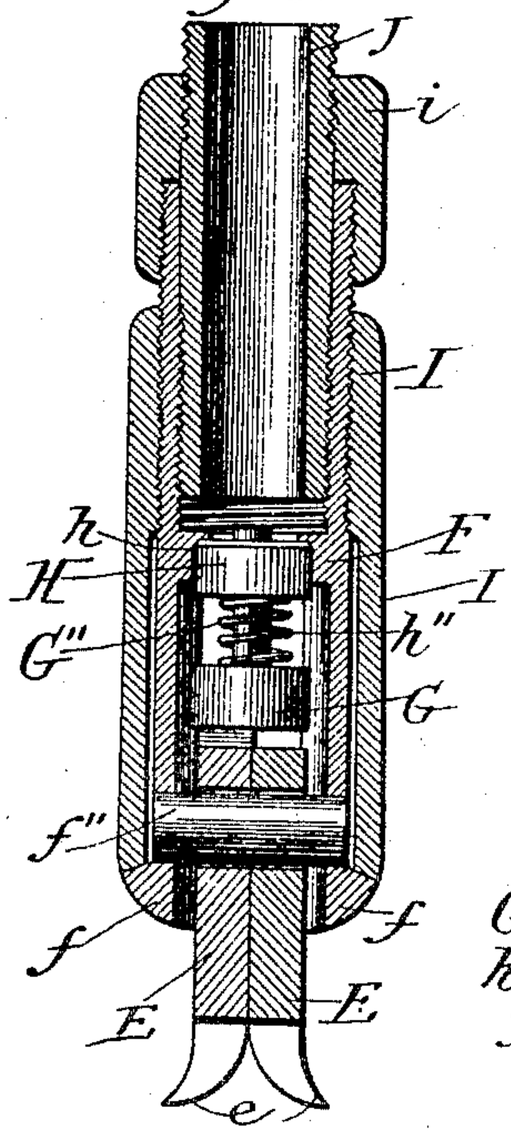


Fig. 6.

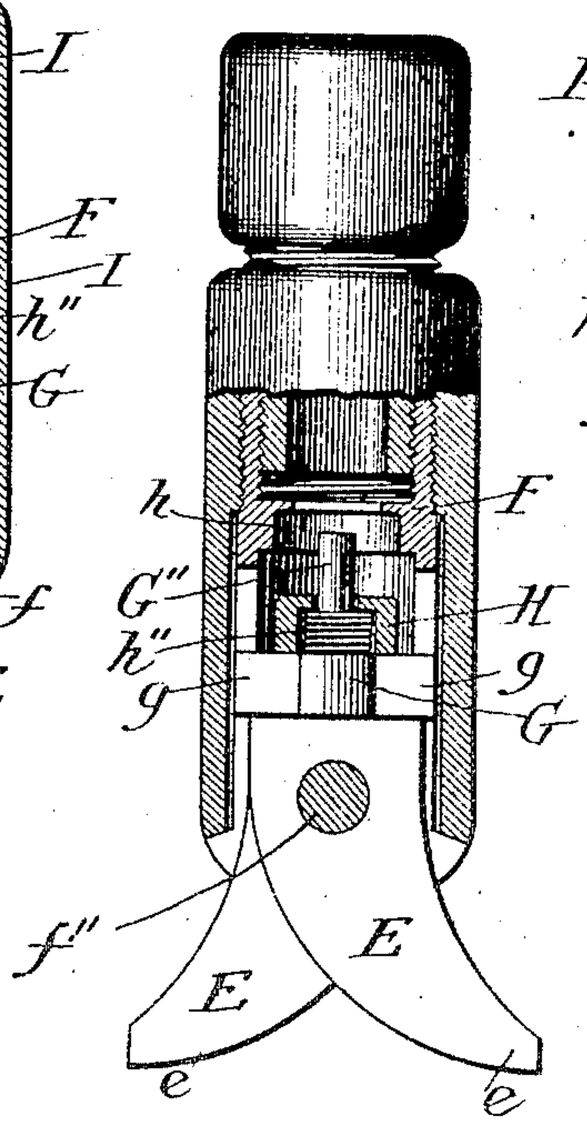


Fig. 7.

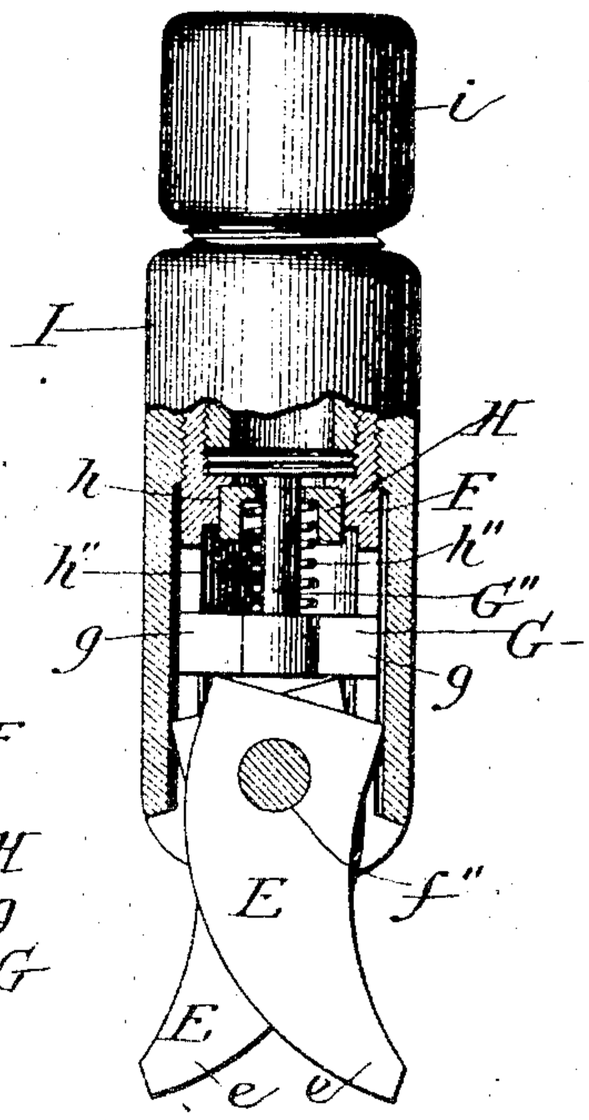


Fig. 8.

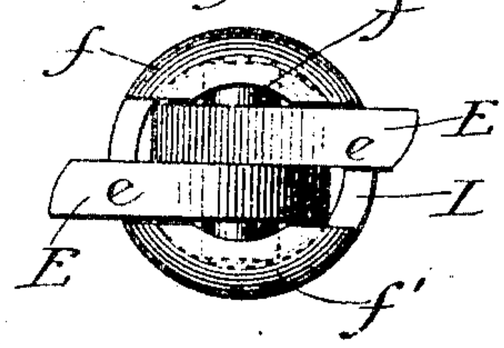


Fig. 9.

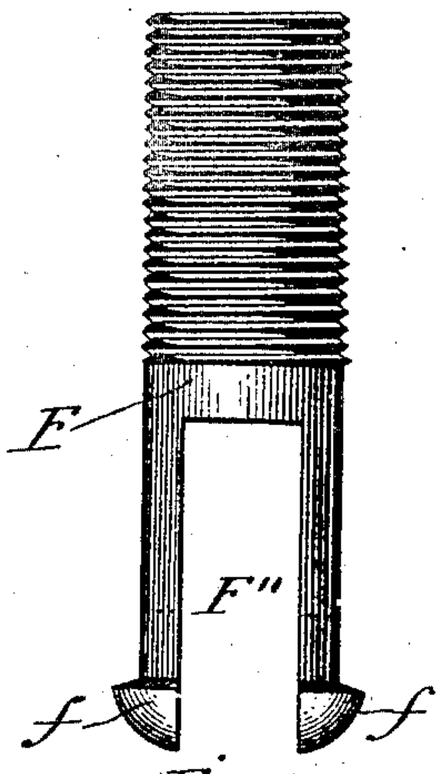


Fig. 10.

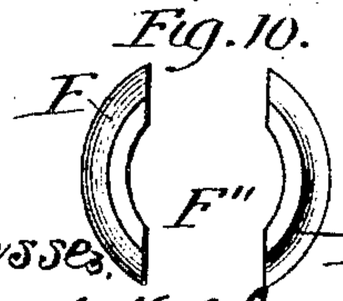


Fig. 11.

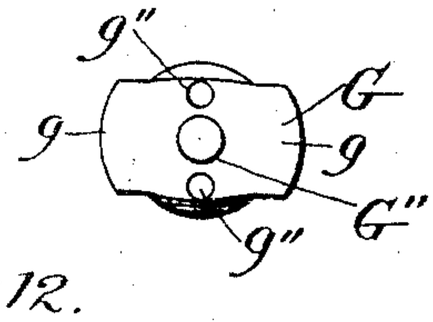
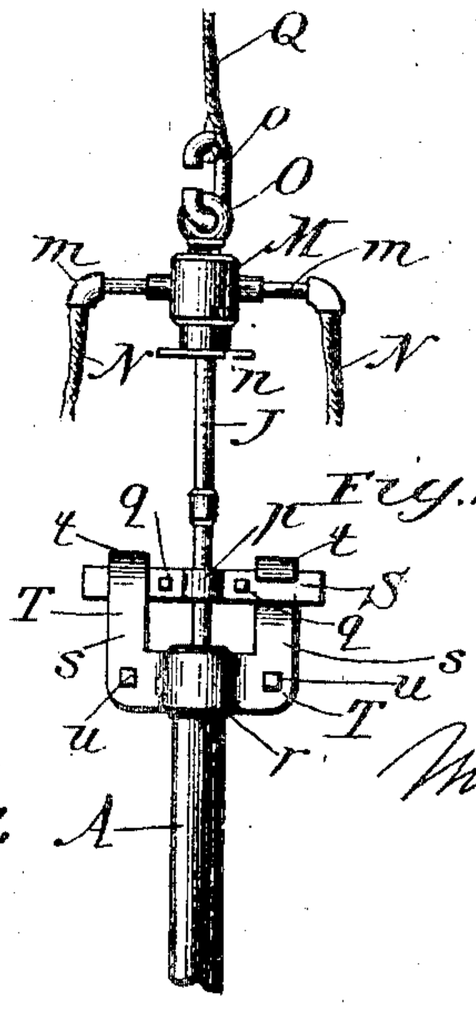


Fig. 12.



Witnesses.
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Fig. 13.

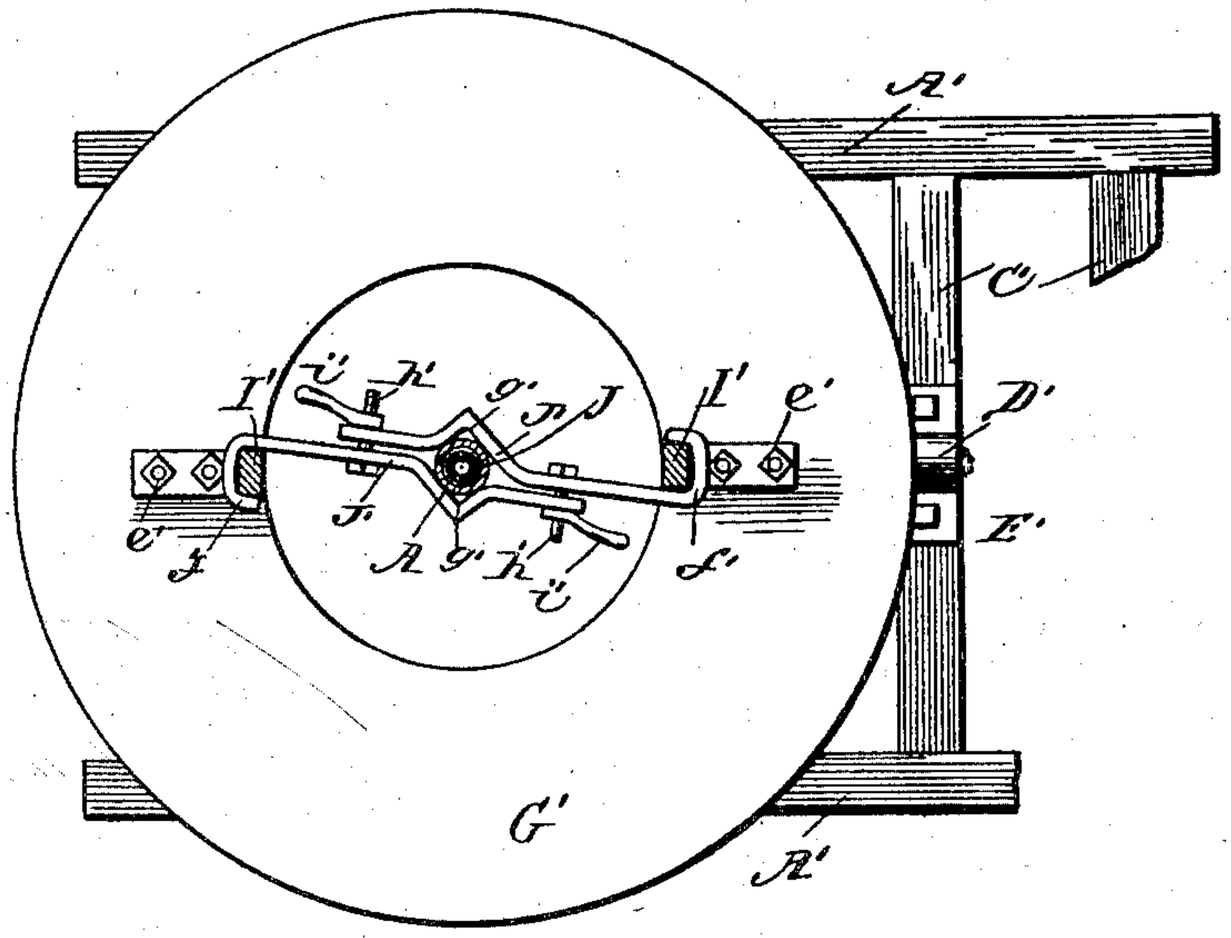
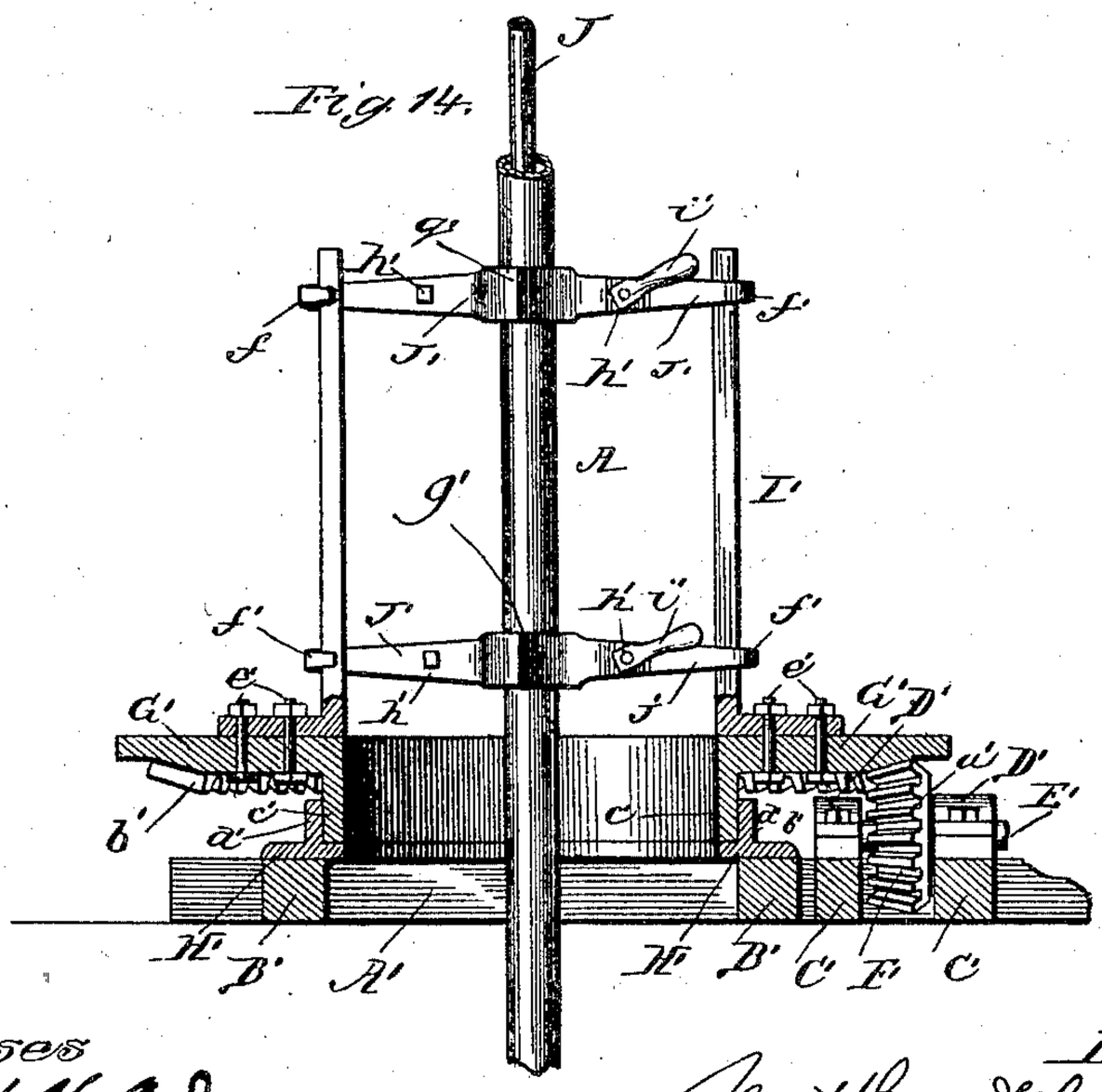


Fig. 14.



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WELL SINKING APPARATUS.

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Fig. 15.

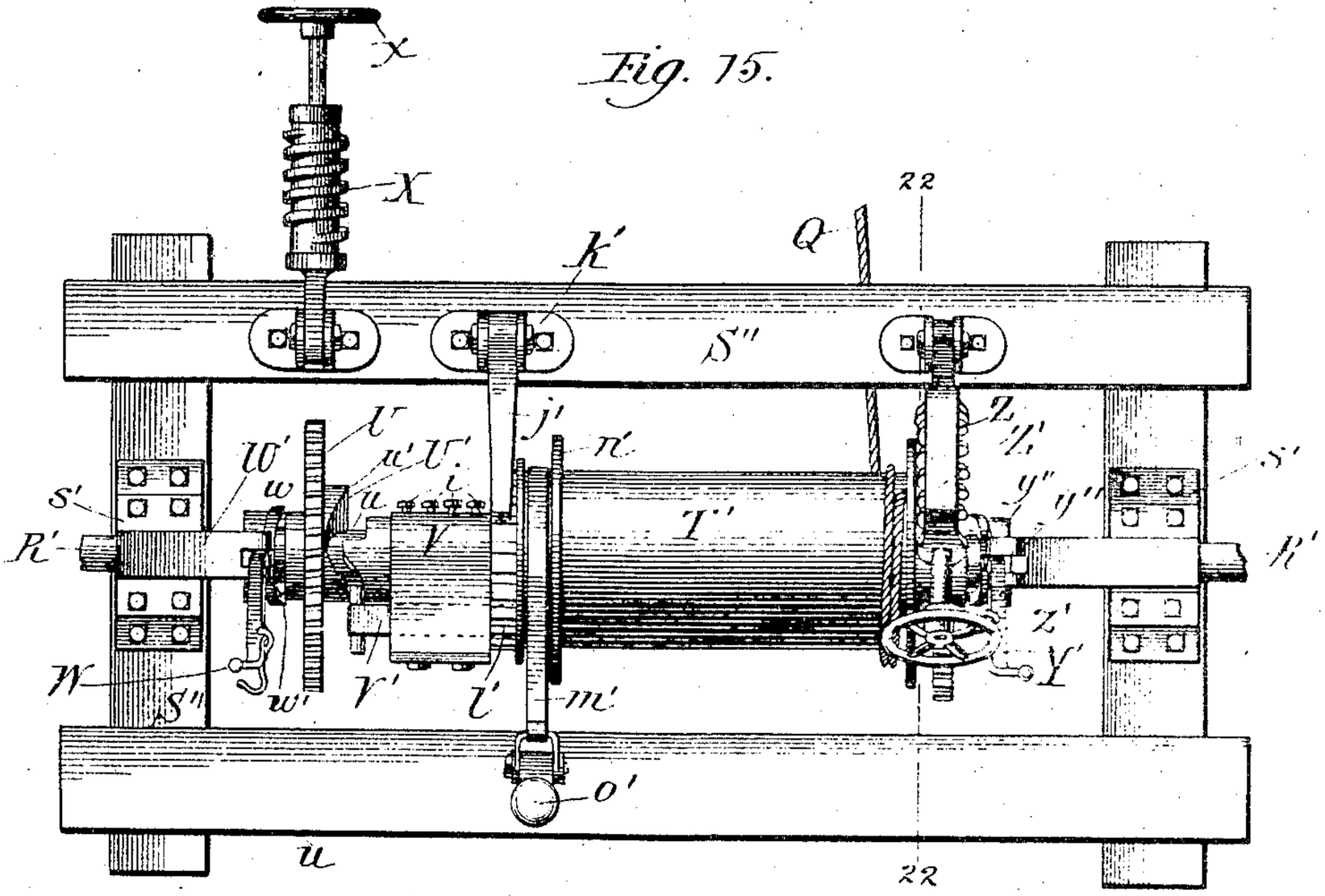


Fig. 16.

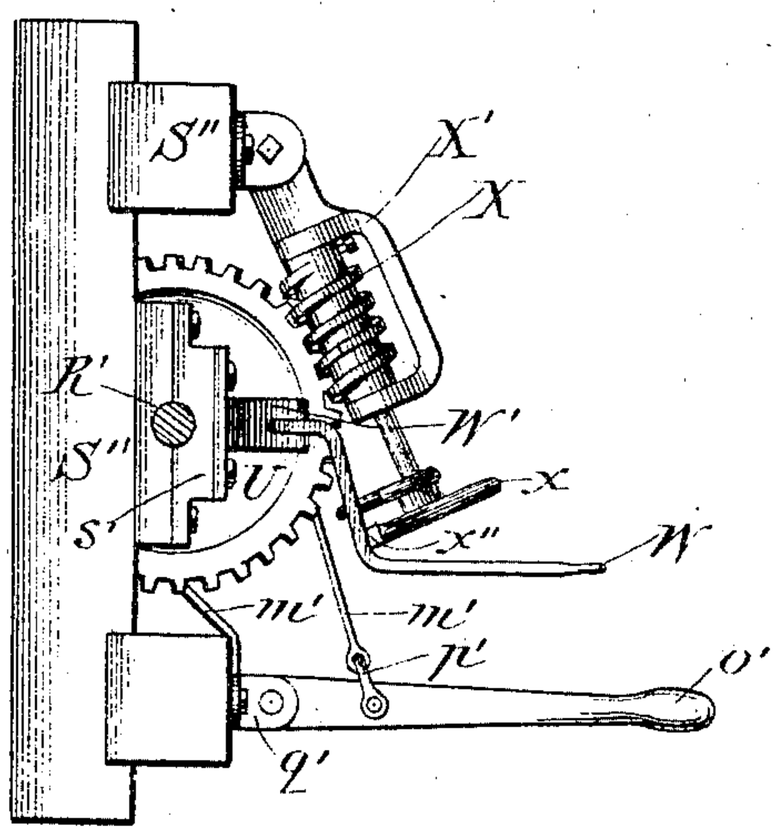
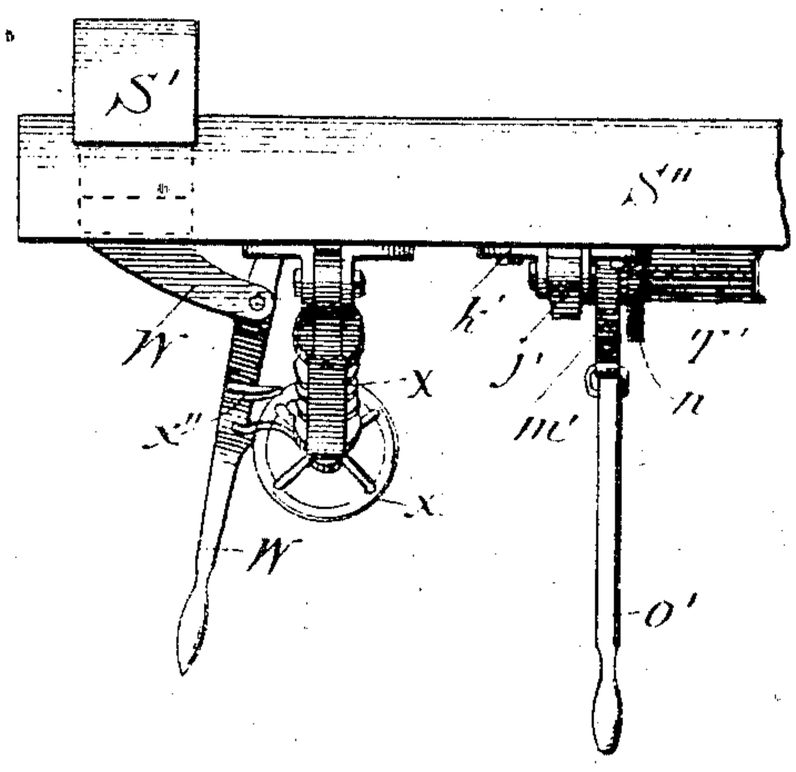


Fig. 17.



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WELL SINKING APPARATUS.

No. 443,070. Patented Dec. 16, 1890.

Fig. 18.

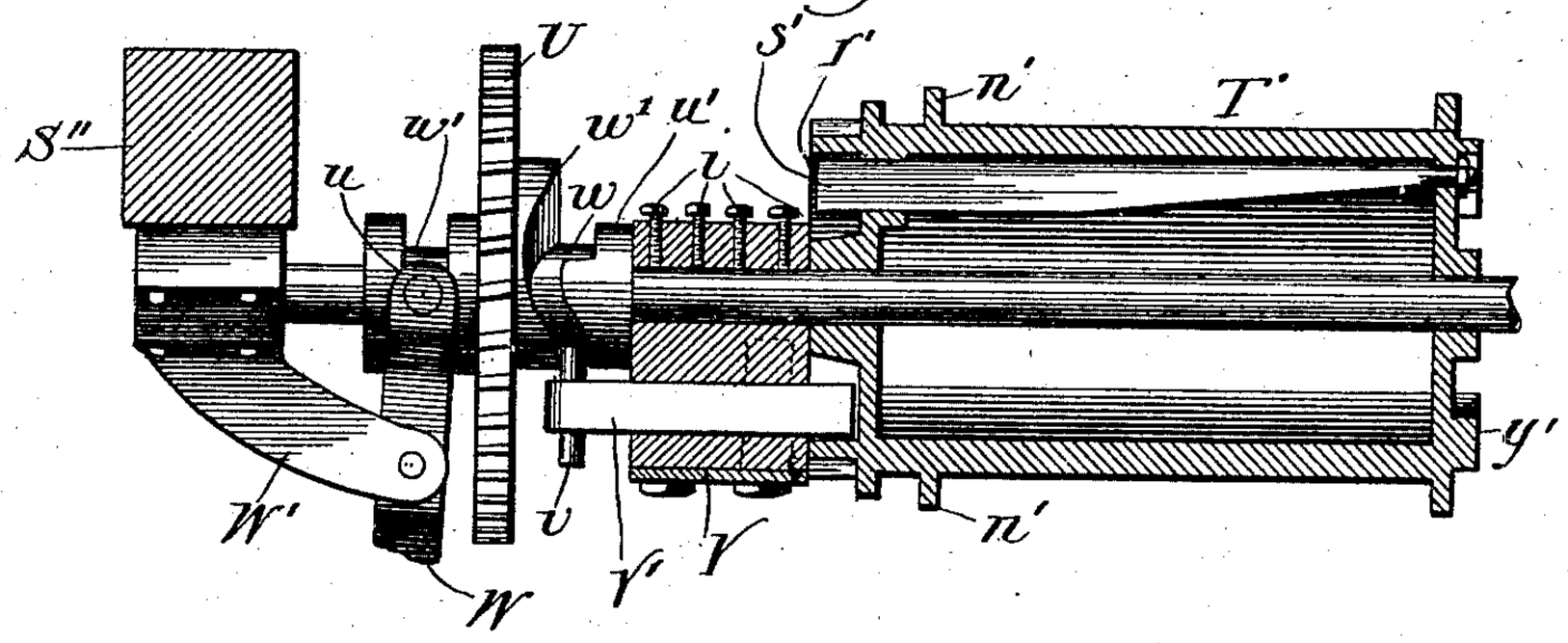

Fig. 19.

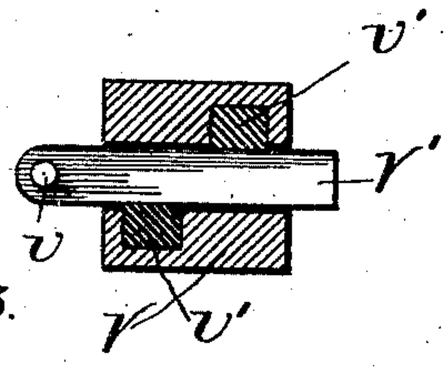

Fig. 20.

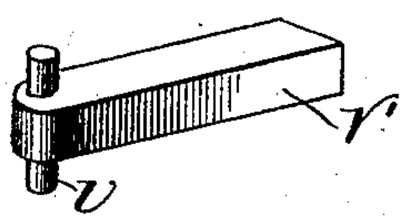

Fig. 21.

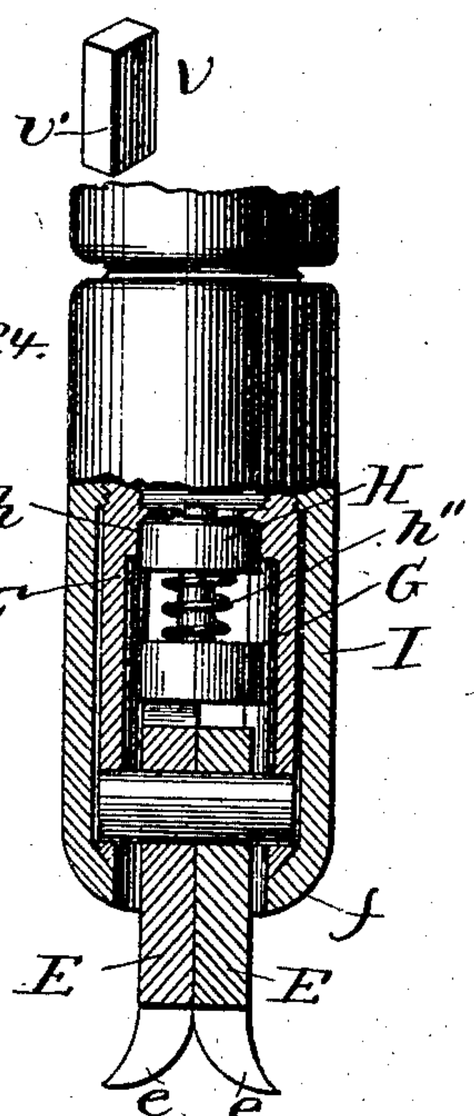

Fig. 22.

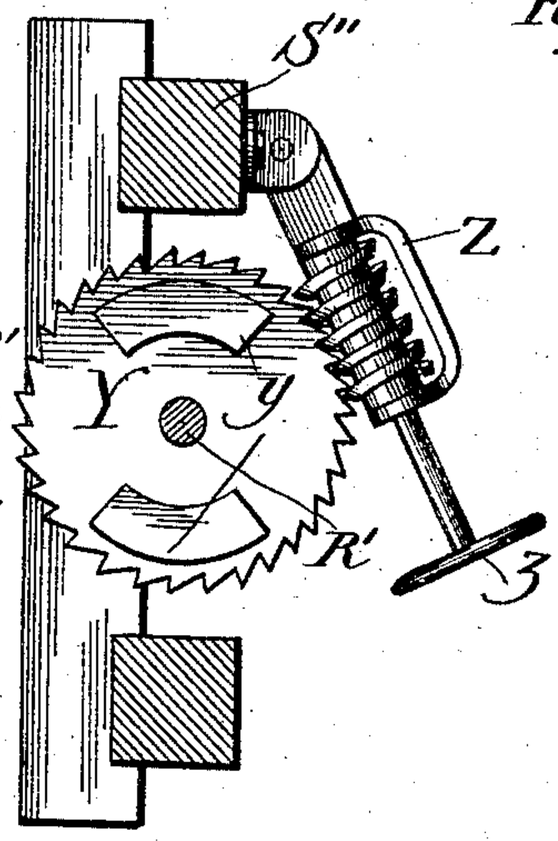

Fig. 23.

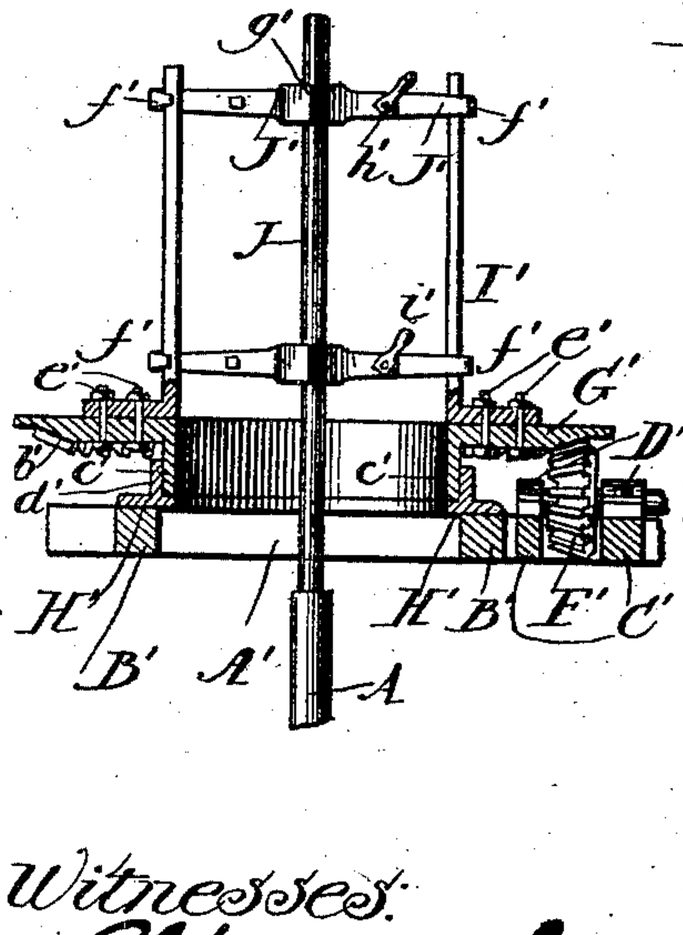

Fig. 24.

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M. T. CHAPMAN.

WELL SINKING APPARATUS.

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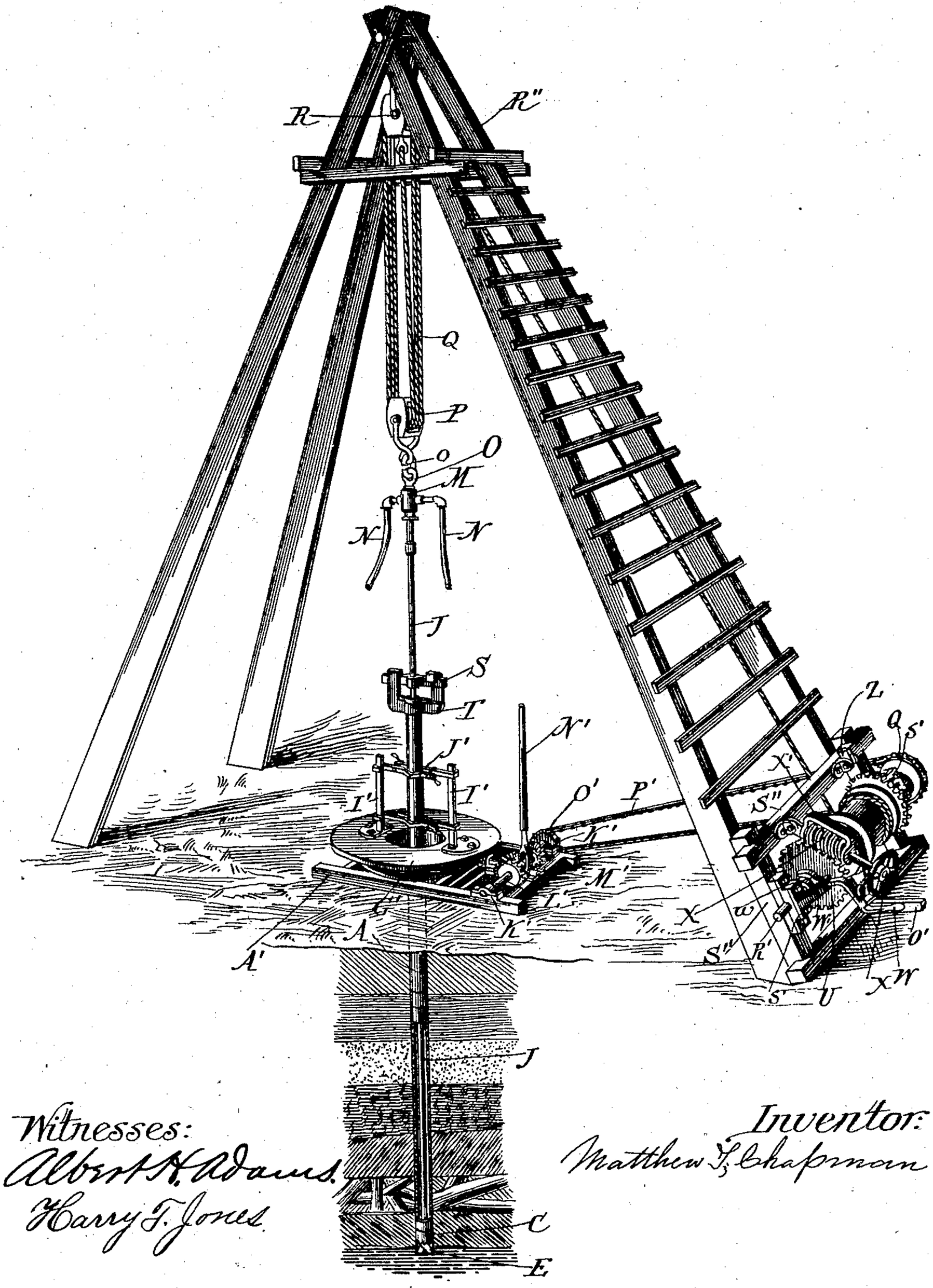
Fig. 25.



Witnesses:
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Harry F. Jones

Inventor:
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UNITED STATES PATENT OFFICE.

MATTHEW T. CHAPMAN, OF AURORA, ILLINOIS, ASSIGNOR TO HIMSELF AND MARK C. CHAPMAN, OF SAME PLACE.

WELL-SINKING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 443,070, dated December 16, 1890.

Application filed July 5, 1888. Serial No. 278,996. (No model.)

To all whom it may concern:

Be it known that I, MATTHEW T. CHAPMAN, residing at Aurora, in the county of Kane and State of Illinois, and a citizen of the United States, have invented new and useful Improvements in Well-Sinking Apparatus, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is an elevation, partly in section, showing the well-tubing with a rotary cutter and a drill-tube with an expansion-drill. Fig. 2 is an elevation showing the well-tubing and its filter with the plug for closing the end of the filter. Fig. 3 is a detail in section of the filter with the plug therein. Fig. 4 is a cross-section of the filter at line 4 4 of Fig. 3. Fig. 5 is a vertical section through the expansion-drill. Fig. 6 is an elevation, partly in section, showing the blades expanded. Fig. 7 is a similer view showing the blades closed. Fig. 8 is a bottom view of the expansion-drill, showing the blades expanded. Figs. 9 and 10 are details, being side and bottom views of the blade-carrier. Fig. 11 is a detail, being a bottom view of the expanding piston. Fig. 12 is a detail showing the manner of connecting the tubing and drill-tube to rotate them together. Fig. 13 is a plan view of the rotary clamping device. Fig. 14 is a sectional elevation of the rotary clamping device. Fig. 15 is a side elevation of the winding-drum. Fig. 16 is an end elevation of the winding-drum. Fig. 17 is a detail showing the device for regulating the position of the cam for operating the latch of the winding-drum. Fig. 18 is a longitudinal section of the winding-drum, some parts being in elevation. Fig. 19 is a detail of the latch and head. Fig. 20 is a detail showing the latch. Fig. 21 is a detail showing the cushion for the latch. Fig. 22 is a section at line 2 2 of Fig. 15, showing the device for holding and turning the drum by hand, some parts being omitted. Fig. 23 is a detail showing the rotary clamping device clamping the drill-tube. Fig. 24 is a detail, being a modification of the expansion-drill. Fig. 25 is a perspective showing the apparatus in working position.

The objects of this invention are to improve the apparatus for sinking wells by means of rotary and reciprocating drills, which may be used separately or together in connection with a water-supply, and to improve the tubing, and means for closing it when the well is complete. I accomplish these objects by improving the construction and operation of the different parts and the entire apparatus as a whole, as illustrated in the drawings, and hereinafter specified.

That which I claim as new will be pointed out in the claims.

In the drawings, A represents a well-tubing formed, as usual, of sections coupled together by couplings *a*, and, as shown in Fig. 2, provided with a coupling *a''*, having a side nozzle near its upper end for the discharge of water. This tubing A is to be of any desired diameter.

B is the lower end section or filter of the tubing, which has perforations *b*, for the entrance of water, and ribs *d* on its circumference.

C is a rotary drill or cutter head, which is provided with cutting-teeth *c* on its lower edge, as usual, and at its upper end is screwed onto the filter B. This drill has a taper or shoulder *c''* on its interior lower edge, as shown in Figs. 1 and 3.

D is a wire-cloth or perforated screen secured to the section B between the ribs *d*. The ribs *d* are a protection for the wire-cloth from injury when the tubing is rotated while the well is being sunk. This wire-cloth D and the perforated end or section B form a filter for the tube when completed.

E are the blades of an expansion-drill, each having cutting-edges *e*, as shown in Figs. 1, 5, 6, 7, 8, and 24.

F (see Figs. 9 and 10) is a socket having a slot F'' part-way of its length to receive the drill-blades E, which are pivoted in the lower end of the slot F'' by a pivot *f''*. As shown in Fig. 9, the socket F has a shoulder or taper *f* on its exterior lower edge corresponding with the taper or shoulder *c''* of the drill-head C, which furnishes a means of support for the expanding drill from the tubing A.

G is the expanding piston which fits within the socket F and at its lower end is provided

with wings *g*, which fit in the slot F″, as shown in Figs. 6 and 7. This expanding piston has openings *g″* for the passage of water, as shown in Fig. 11, and a central stem G″, as shown in Fig. 5, 6, and 7.

H is a cap or collar loosely mounted on the stem G″ of the expanding piston G and adapted to fit in a recess *h* in the socket F, and held up in the recess by a spring *h″*, which rests on the top of the piston-head G.

I is a head or casing in which the socket F is located. This casing is screwed onto the socket F, and the socket F is coupled to the drill-rod by a coupling *i*, which is screw-threaded so as to screw on in the reverse direction from the rotation intended for the drill.

J is the drill-tube for the expansion-drill.

K is a packing formed of two plates *j j*, and a suitable packing *j″* between the plates *j*. This packing is secured on the drill-tube J by a suitable coupling *k*, as shown in Fig. 1.

L is a conical plug, which fills the lower end of the drill-head C, fitting the taper or shoulder *c″*. After the well has been sunk the plug is dropped into the tubing to close the bottom of the tubing, so that the water must enter through the perforated end or filter B.

M (see Figs. 12 and 25) is a water-supply head having supply-hose N attached thereto by couplings *m*, and secured to the drill-tube J by a stuffing-box *n*.

O is a swivel secured to the supply-head M.

P is a pulley-block connected with the swivel O by a link *o*.

Q is a hoisting-rope. This rope Q may run through an upper pulley-block R and the lower block P, as shown in Fig. 25, or it may be attached directly to the swivel O by a link *o*, as shown in Fig. 12.

S are clamping-bars to clasp the drill-rod J, each bar having a bend *p* to fit against the rod, and the bars S are clamped to the rod by bolts *q* passing through them.

T are clamping-bars for attachment to the tubing A and to the clamping-bars S. Each bar at its center is formed with a bend *r* to fit the tube A, and at its outer end with an arm *s*, having at the upper end a hook *t* to fit over the ends of the clamping-bars S. The clamping-bars T are secured together and clamped onto the tubing A by suitable bolts *u*. These clamping-bars S and T form a connection between the tubing A and the drill-tube J, by which the drill-tube J can be rotated from the rotation of the tubing A or the tubing can be rotated from the rotation of the drill-tube J, and in case it is desired not to have the common rotation by loosening either the clamping-bolts *q* or *u* the connection between the tubing A and the rod J is broken, and either one can be rotated without rotating the other.

The tubing A and the rotary cutter C are sunk by rotation in the ordinary manner until the friction on the side of the hole prevents further rotation and descent by force of gravity, or the cutter C ceases to act. When this point is reached, an expansion-drill and its tube J is inserted in the tubing A to work with the tubing or independent thereof, as may be necessary. When the expansion-drill is used, it is of a diameter to fit the cutter-head C. Such expansion-drill can be worked either by raising and dropping or by rotation, as desired. The expansion-drill and rotary cutter herein are designed to work together or separately. When the expanding drill is used to sink the hole below the tubing, the head must be smaller than the end of the cutter C in order to pass through it.

The parts of the expansion-drill are assembled by placing the spring *h″* on the stem G″ of the expanding piston G and the cap H on the stem G″ above the spring, and then inserting the expanding piston G in the blade-carrier F, with the wings *g* in the slot F″ and the cap H in the recess *h*. The blades are then inserted in the carrier F and secured by the pivot-pin *f″*.

The casing I is screwed onto the carrier F from the upper end until it comes in contact with the shoulder *f*, as shown in Figs. 5, 6, and 7, or it is screwed onto the carrier F from the lower end, as shown in Fig. 24, in which case the shoulder or bevel *f* is on the casing I. The casing thus forms a covering for the blades and carrier and also prevents the withdrawal of the pivot-pin *f″*.

The expanding drill is used by inserting the head I, with the parts connected thereto, and the drill-tube J, into the tubing A until the shoulder *f* at the lower end of the carrier F, or a suitable taper at the lower end of the head I, as shown in Fig. 1, rests upon the shoulder or flange *c″* of the drill-head C, and when in place the tubing A and the drill-tube J can be rotated together by connecting them one with the other through the clamping-bars S and T, or they can be rotated independently, or the drill-tube J can be reciprocated, or both tubing and tube can be reciprocated.

The drill-blades are expanded by the expanding piston G, which presses upon the corners of the blades, as shown in Figs. 6 and 7. The expanding piston G is pressed down by the force of the water in the tube J, which forces down the cap H and the piston G through the spring *h″*, which forces the blades open. The water passes down around the cap H and through the holes *g″* in the expanding piston G, or around the edges of said piston to the point of cutting. The water thus used washes away the cuttings of the drill, keeping the drill-hole clear. The blades E will remain expanded as long as there is a water-pressure in the tube J. When the water-supply is cut off, the spring *h″* will lift the cap H into the recess *h*, and the piston G will rise, relieving the pressure on the blades and allowing the drill-blades E to be closed. By this means the expansion of the blades E is controlled by the water-supply.

When the rotary cutter C has become worn

out, the drill-hole can be extended by the expansion-drill without raising the tubing. The shoulder or bevel *f* on the carrier F comes in contact with the shoulder or bevel *c''* on the drill-head C, and the force of the water expands the blades E below the drill-teeth *c*, when the tubing A and tube J can be rotated or reciprocated together, as necessary for the work to be done, or the tube and expansion-drill can be operated alone. The shoulder or bevel *c''* is also designed to form a contact-face for the plug L, which is driven into the tubing to close the lower end when the well is complete, thus permitting the water to enter through the filter B only. The wire D of the filter is protected during the descent of the tubing A by the ribs *d* on the filter B.

In using the expanding drill no removal of the tubing of the well is necessary, and when the well is complete the tubing, with its filter, is in place, thus obviating the necessity of pulling up the tubing, which would allow the walls of the well to cave in.

In order to rotate the drill-tube J and tubing A together, the clamping-bars S and T are used. When it is desired to rotate the drill-tube J from the tubing A, the bars S and T are applied, as shown in Fig. 12. When it is desired to rotate the tube J, the clamp is applied, as shown in Fig. 23. Whenever it is desired to rotate either the tubing A or tube J alone, the clamping-bars S and T are loosened or removed. By means of the hooks *t* on the bars T, which hook over the bar S, and the shoulder *f* of the carrier F of the expansion-drill, which rests on the shoulder *c''* of the rotary cutter C, the tubing A and the tube J are locked together, so that they can be reciprocated together by the rope Q.

The water-supply head M is attached to the tube J, which supplies the water for washing away the cuttings at the point of cutting and also opens the expansion-drill. The packing K prevents the water from passing up through the tubing and forces it to pass up outside of the tubing. When it is desired to give a sudden force or impetus to the water, the tube J is raised in the tubing A and dropped, which causes the packing K to force the water below it out below the cutter C, thereby removing any clogging at that point.

In order to rotate both tube J and tubing A together or separately, and to reciprocate them together or separately, and to raise either alone or both together, I provide the following combined clamping device and winding-drum:

A' represents the side pieces of the frame.

B' are cross-pieces for supporting the bottom plate of the clamp.

C' are cross-pieces for supporting the driving-shaft.

D' are the journal-boxes in which the driving-shaft is mounted.

E' is the driving-shaft for the rotary clamps.

F' is a beveled gear-wheel secured to the shaft E'.

G' is a plate having on its under side leaves or cogs *b'*, to mesh with the leaves *a'* of the wheel F'.

H' is the bottom plate, bolted or otherwise secured to cross-piece B', and having an annular flange *d'*, which lies outside of the flange *c'* of the plate G', which flanges *c'* and *d'* furnish a bearing and support for the plate G'.

I' are uprights, secured to the plate G' by bolts *e'* on opposite sides of the central opening of the plate and in line, as shown in Fig. 13.

J' are clamping-bars, each bar at its outer end having a hook *f'* to pass around the uprights I', and each bar having at its center an angular bend *g'* to bite against the tubing A. The bars J' are attached to each other by bolts *h'* and hand-nuts *i'*, by means of which the two bars J' can be drawn together to cause the angular bends *g'* to firmly bite the tubing. By using two bars J', each having an angular bend *g'*, the center of the tube clamped will always be in the line between the hooks *f'*, so that tubes of different diameters can be clamped and not interfere with the engagement of the hooks *f'* with the two uprights I'.

As shown, two sets of clamping-bars J' are used. One set is attached near the lower ends of the uprights I' and the other near their tops. As the tubing descends and the bars reach their limit of descent, they are loosened and raised alternately. By this means the tube will be continually rotated.

K' are journal-boxes on the side pieces A'.

L' is a shaft mounted in the journal-boxes K'.

M' is a sliding clutch-gear on the shaft L'.

N' is a lever for moving the clutch-gear into or out of mesh with the gear which drives the shaft E'.

O' is a sprocket-wheel for driving the shaft L'.

P' is a drive-chain.

Q' is a sprocket-wheel over which the chain P' runs.

R' is the power-shaft to which is secured the sprocket-wheel Q'.

S' are journal-boxes for the shaft R'.

T' is a winding-drum loosely mounted on the shaft R'.

R'' is a derrick by which the ropes for operating the drill are supported.

S'' is a frame, which carries the winding-drum and is secured to the derrick R''.

j' is a pawl hinged to a bracket *k'* on the frame S''.

l' is a ratchet-wheel secured to or formed with the winding-drum T', and with which the pawl *j'* engages.

m' is a brake-band which encircles the end of the winding-drum T', being protected from the rope on the winding-drum by a flange *n'*.

o' is a lever for operating the brake-band *m'*. The lever *o'* is hinged to a bracket *q'* on the frame S'', and connected to the band *m'* by a link *p'*.

U is a gear-wheel loosely mounted on the

driving-shaft R′. This wheel U has a hub U′, in which is a cam-groove *u* and a face-cam *u′*.

V is a head or block, which is keyed onto the shaft R′ by set-screws *i* and is provided with a sliding latch V′. The latch V′ is provided with a pin *v* in its outer end, which runs in the cam-groove *u*. This pin *v* is preferable to the forgings on the latch heretofore used, because when worn it can be readily and cheaply renewed. The inner end of the latch V′ runs in a groove *r′* in the end of the drum T′ and engages with a catch or block *s′*, secured in the drum T′. The block or head V is provided with cushions *v′*, made of rubber or other yielding material, as shown in Figs. 19 and 21, to relieve the shock of the engagement of the latch V′ with the catch *s′*.

W is a lever pivoted to a bracket W′ on the frame S″, and provided with a collar *w*, which runs in a groove *w′* in the hub of the wheel U.

X is a worm-gear to engage with the wheel U, mounted in a frame X′, which is hinged to the frame S″. The worm-gear X has a hand-wheel *x*, by which it can be rotated. As shown in Fig. 15, the worm-gear X can be turned up out of engagement with the wheel U.

The lever W has a beveled shoulder *x″* to engage with the hand-wheel *x* for lifting the worm-gear X out of engagement with the wheel U when the latch V′ is thrown out of engagement with the winding-drum.

Y is a ratchet-wheel loosely mounted on the shaft R′. This wheel has a clutch *y* on its interior face to engage with a clutch *y′* on the end of the winding-drum T′. This wheel Y is moved longitudinally on the shaft R′ by a lever Y′, which is pivoted to a bracket Y″ on the frame S″, and has a collar *y″*, which encircles the hub of the wheel Y.

Z is a worm-gear to engage with the wheel Y, said gear being mounted in a frame Z′, which is hinged to the frame S″. The worm-gear Z has a hand-wheel *z*, by which it can be rotated.

Z″ is a hooked link for connecting the levers *y′* and worm-gear Z.

z″ is a shoulder on the lever Y′ for lifting the hand-wheel *z*.

When the lever Y′ is moved to throw the clutch on the wheel Y out of engagement with the winding-drum, the worm-gear Z is at the same time thrown out of engagement with the wheel Y.

The operation of the rotating and reciprocating device is as follows: The power-shaft R′, which is driven by steam or horse power, drives the shaft E′ through the sprocket-wheel Q′, chain P′, wheel O′, shaft L′, and bevel-wheels M′. The shaft E′ rotates the plate G′ through the beveled gear F′. The tubing A, as shown in Figs. 13 and 14, or tube J, as shown in Fig. 23, is inserted through the opening in the center of the plate G′, and is clamped by the clamping-bars J′ on the uprights I′. The bars J′ are drawn together by the bolts *h′* and hand-nuts *i′* or other suitable means to cause the angular bends *g′* to bite onto the tube or tubing. The rotation of the plate G′, carrying the uprights I′, rotates the tube or tubing through the clamping-bars J′. The descent of the drill carries the clamping-bars J′ downward on the uprights I′, because they are simply hooked onto the uprights I′. As the clamping-bars reach their limit of descent, they are loosened and raised alternately without stopping the machinery. Whenever it is desired to stop the rotation of the tube or tubing, the clamping bars J′ are loosened by unscrewing the hand-nuts *i′*, or if it is desired to stop the entire rotating device the clutch M′ is thrown out of gear by the lever N′. By the use of the bars S and T, already described, the tube and tubing are rotated together. This rotary clamping device is very simple and effective and can be used in connection with the winding-drum for reciprocating device, because it is so easily thrown out of or into use, and also because it permits a longitudinal movement in the tube or tubing.

The operation of the winding-drum is as follows: The rotation of the power-shaft R′ rotates the head or block V, and the latch V′ engages with the catch *s′* on the winding-drum, winding the rope Q onto the drum and lifting the drill-tube. The pin *v* runs in the cam-groove *u* until the cam *u* draws the latch V′ away from the catch *s′*, releasing the winding-drum, which is rotated in the reverse direction by the weight of the drill-tube on the rope Q. When the pin *v* passes the releasing point in the cam-groove *u*, it is immediately returned by the cam-groove *u*, forcing the latch V′ again into the groove *r′* to engage again with the catch *s′*. As the cam-groove *u* returns the latch quickly, I provide the face-cam *u′* to engage with the end of the latch V′ and assist the cam-groove *u* in returning the latch. The face-cam *u′* being farther from the center of rotation than the cam-groove *u*, it moves more rapidly and will accordingly move the latch V′ into engagement with the winding-drum catch with a quick positive movement. By continuously rotating the head or block V it is evident that the drum will be alternately wound forward and allowed to be unwound, alternately lifting and dropping the drill tubing or tube. By rotating the wheel U forward or backward by the worm-gear X the position of the cam *u* is changed, so as to release the latch later or sooner, as may be necessary, thereby regulating the drop of the drill as needed. The rope Q can be continuously wound onto the drum for raising the drill-tube by raising the worm-gear X out of engagement with the gear-wheel U, allowing the wheel U to rotate with the head V, as shown in Fig. 15. When it is desired to throw the latch V′ out of engagement with the catch *s′* of the winding-drum, so that the drum can be held stationary or unwound, the lever W is moved to the right, moving the wheel U

and head V to the left, withdrawing the latch V′ from engagement with the catch *s′*, and lifting the worm-gear X by the engagement of the shoulder *x″* with the hand-wheel *x*, thereby permitting the head or block V and wheel U to rotate with the shaft without engaging with the drum T′. The latch V′ is rectangular in cross-section and the pin *v* projects on each side of the latch V′, so that when the pin *v* or the end of the latch V′ becomes worn the latch can be taken out and turned over, presenting a new face for engagement with the catch *s′*, and a new pin *v* to run in the cam *u*. The drum is held against backward rotation by the pawl *j′* and ratchet *l′* when it is desired to hold the drum stationary. When it is desired to allow the weight on the rope Q to descend, the pawl *j′* is lifted and the rotation of the drum is controlled by the brake *m′*, as usual. When it is desired to hold the drum stationary or turn it slowly forward or backward in raising weights, the clutch *y* on the wheel Y is thrown into engagement with the clutch *y′* on the drum T′ and the worm-gear Z is held firmly in contact with the wheel Y, preventing the rotation of the drum T′ and wheel Y. When desired, the worm-gear Z can be rotated by the hand-wheel *z*, turning the drum forward or backward, as desired, thus operating the drum independently of the power shaft R′. The link *x′* of the lever W and the link *y″* of the lever Y′ are designed to hold the worm-gears to which they are respectively applied in engagement with their gear-wheels. These links are preferably made detachable from the worm-gears, so that the worm-gears can be lifted independently of the levers W or Y′; but it is evident that they may be made so as to lift the worm-gears without the use of the shoulders on the levers W and Y′.

As shown in Fig. 22, the wheel Y has ratchet teeth or cogs to hold more firmly against the worm-gear and to permit the drum T′ to rotate forward with the shaft R′ when the worm is in engagement, permitting the rope to be wound on the drum, while preventing unwinding and avoiding injury to the cogs when the drum T′ is rotated from the opposite end.

In my former patents, No. 258,889, dated June 6, 1882; No. 371,548, dated October 18, 1887, and No. 382,689, dated May 15, 1888, are shown devices for a similar purpose; but the latches there shown are thrown into engagement with the drum by springs instead of by a cam, which gives the latch a positive motion in my present device.

It is evident that the form of the cam on the wheel U may be varied, as is necessary for the form of latch used, the present form of cam and latch being best now known to me.

By means of the clamping-bars S and T and the shoulders *f* and *c″* the tubing A and tube J are locked together, so as to be rotated together, and by means of the hydraulic expansion-drill the drill-blades are expanded by the water while the weight of the rod J is supported on the tubing A. By means of the rotary clamp and the winding-drum the tubing A and tube J can be rotated or reciprocated simultaneously or separately and the motion of the tube or tubing can be changed from rotation to reciprocation, or vice versa, without stopping the machinery. The tube can also be lifted without stopping the power or held stationary or lowered slowly or quickly, as may be necessary.

The different parts are all operated and controlled in such manner that one operator can easily control the working of the drill.

The feed of the drum is controlled by the worm-gear X, so that as the drill descends the rope can be gradually let out by the operator by turning the hand-wheel *x*.

What I claim as new, and desire to secure by Letters Patent, is as follows:

1. In an expanding drill, expansion-blades E and blade-carrier F, having recess *h*, in combination with an expanding piston G, having wings *g* and passages *g″*, stem G″, cap H, and spring h^2, substantially as described.

2. In an expansion-drill, the combination of the blades E, the slotted blade-carrier F, having shoulder *f* and pivot *f″*, and the head or casing I, screwed onto the carrier and adapted to protect the carrier and hold the pivot in place, substantially as described.

3. In an expansion-drill, the combination of the well-tubing A, the drill-tube J, the blades E, the blade-carrier F, the head or casing I, the packing K, and the couplings *i* and *k*, substantially as described.

4. The combination, with the well-tubing A and drill-tube J, of the connected clamping-bars S and T for clamping the well-tubing and drill-tube together, substantially as described.

5. The well-tubing A, provided with a rotary cutter C, having an interior shoulder *c″*, and a drill-tube J, provided with an expansion-drill having a shoulder *f*, in combination with the connected clamping-bars S and T, substantially as described.

6. The combination of the well-tubing A and clamping-bars T, provided with hooks *t* and having angular bends to grasp the tubing A, with the drill-tube J and clamping-bars S, having angular bends *p* for grasping the tube J, substantially as described.

7. The combination of the tubing A and tube J, supported at its lower end by the tubing A, with clamping-bars S and clamping-bars T, having hooks *t* for locking the tubing and tube together, substantially as described.

8. In a well-sinking apparatus, the combination, with the drill-tube J, of the rotary plate G′, having uprights I′, two adjustable clamps J′, adapted to engage said drill-tube and uprights and to be separably adjusted while rotating with the plate G, a support for said plate, and means for rotating the plate, substantially as described.

9. The combination of the tubing A, provided with a rotary cutter C, having a shoulder c'', the tube J, provided with an expansion-drill having a shoulder f, and the connected clamping-bars S and T, the latter provided with hooks t, substantially as and for the purpose described.

10. The winding-drum T′, provided with a catch, in combination with the head V, latch V′, and a cam which both engages and disengages the latch with the catch, substantially as described.

11. The rotary head V and latch V′, in combination with the wheel U, carrying a cam which both engages and disengages the latch V′, substantially as described.

12. The combination, with a winding-drum and an operating-latch, of a cam for causing the latch to engage with the winding-drum and a cam for causing the latch to be disengaged from the winding-drum, substantially as described.

13. A latch V′, a wheel U, carrying a cam for operating the latch V′, and a worm-gear X, in combination with a lever W, adapted to throw both the worm-gear X and the latch V′ out of operation at the same time, substantially as described.

14. A reversible latch for a winding-drum, having its opposite sides parallel and provided with a pin v on opposite sides to coact with a cam, substantially as described.

15. The wheel U, carrying a cam for operating the latch of a winding-drum, in combination with a worm-gear X and hand-wheel x, and lever W, having a shoulder x'' for disengaging the worm-gear from the cam-wheel, substantially as described.

16. The wheel U and worm-gear X, in combination with the wheel U, hand-wheel x, and lever W, having shoulder x'', substantially as described.

17. The combination, with the winding-drum T′, having the catch s' and an engaging and disengaging cam, of the head V, latch V′, and cushions v', substantially as described.

18. The combination of the tubing A, tube J, and a clamping device for locking them together, with a reciprocating winding-drum, substantially as specified, whereby the tubing and tube can be reciprocated together.

19. The winding-drum having a catch, in combination with the driving head or latch and the engaging and disengaging cams for operating the latch, substantially as described.

20. The combination, with a winding-drum having a catch, a rotating head, and a latch carried by said head and adapted to engage said catch, of a relatively fixed cam adapted to be engaged by said latch and to move said latch into position to positively engage and disengage the drum-catch on each rotation of the head, substantially as specified.

MATTHEW T. CHAPMAN.

Witnesses:
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ALBERT H. ADAMS.