(No Model.) 3 Sheets—Sheet 1.

F. GARDNER.

APPARATUS FOR BORING WELLS.

No. 478,791. Patented July 12, 1892.

Fig. 5

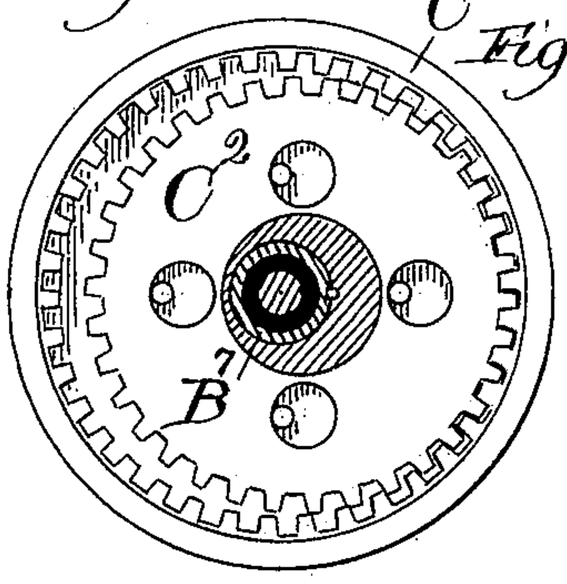


Fig. 1.

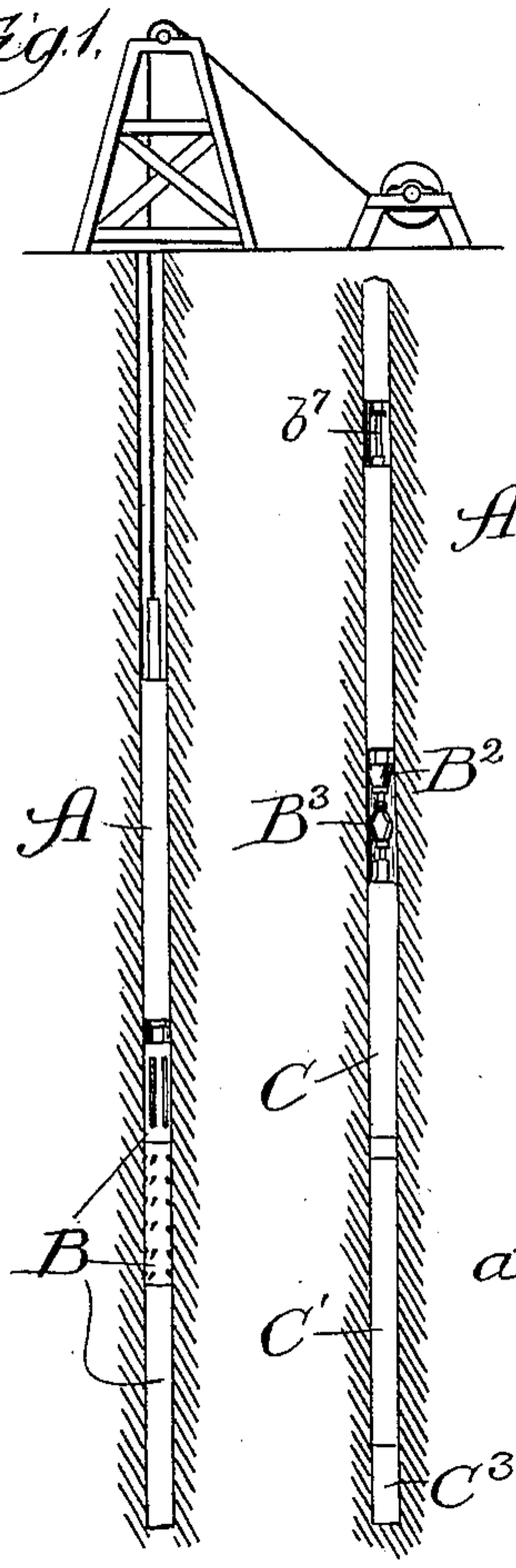


Fig. 2

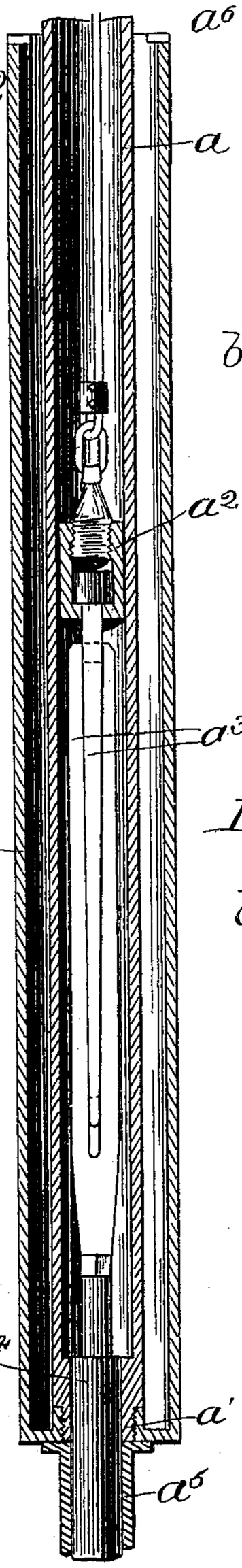


Fig. 3.

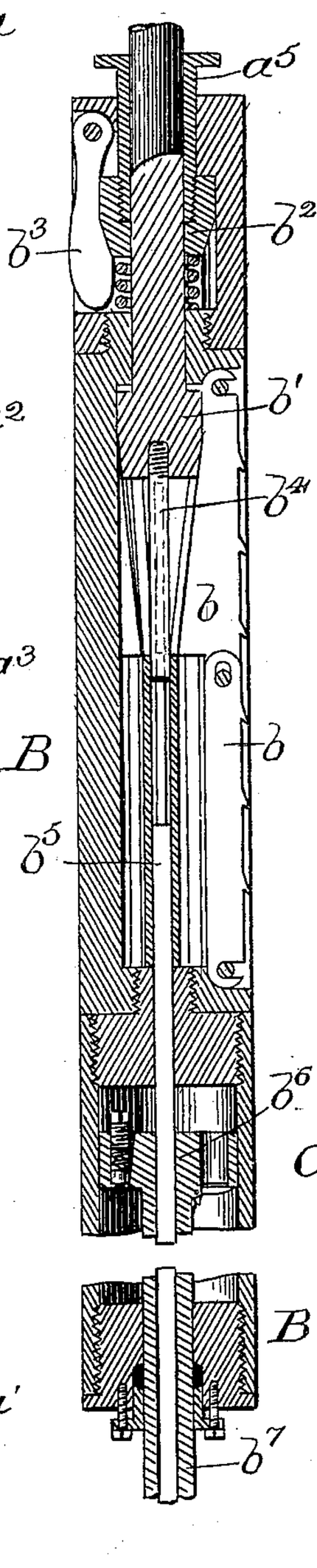
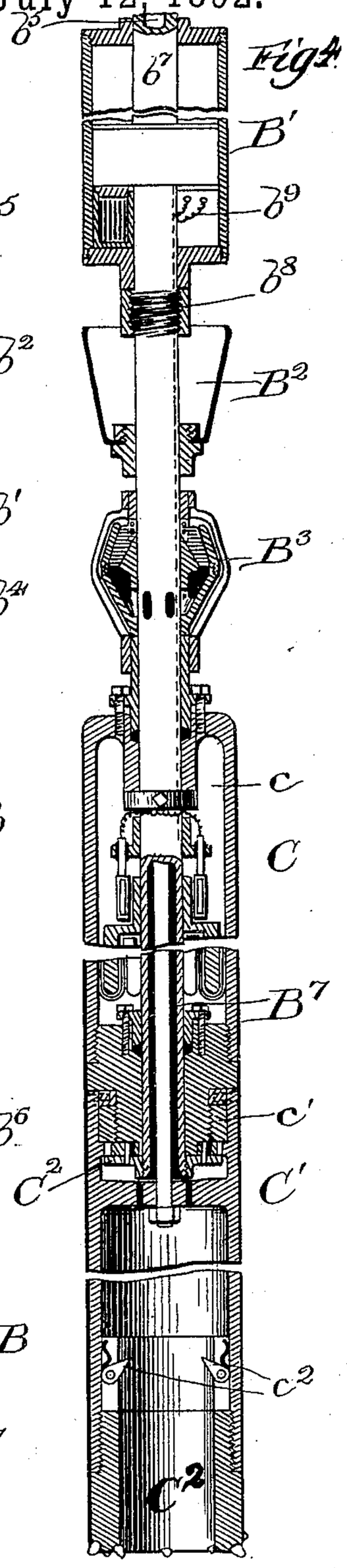


Fig 4.



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APPARATUS FOR BORING WELLS.

No. 478,791. Patented July 12, 1892.

Fig. 6.

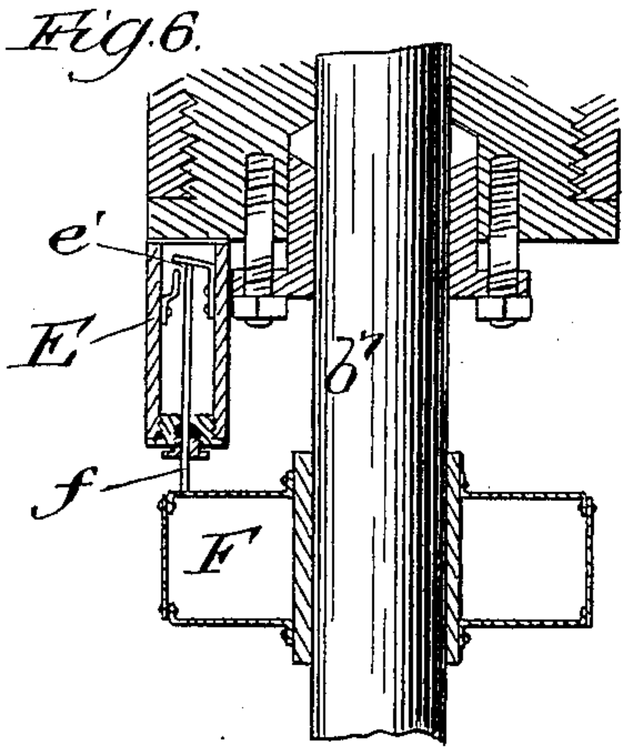


Fig. 7.

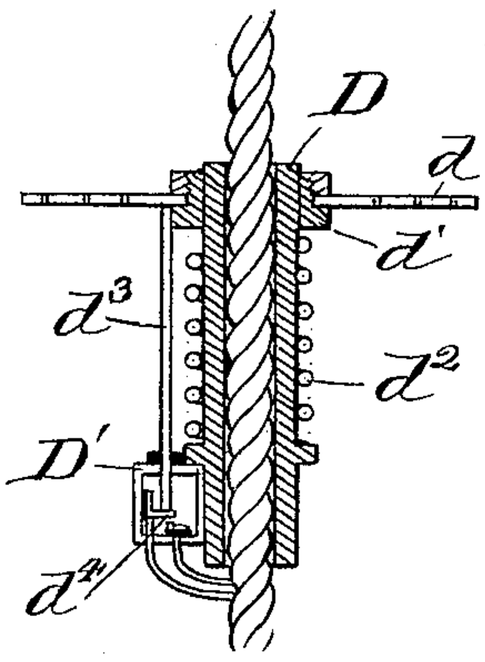


Fig. 8.

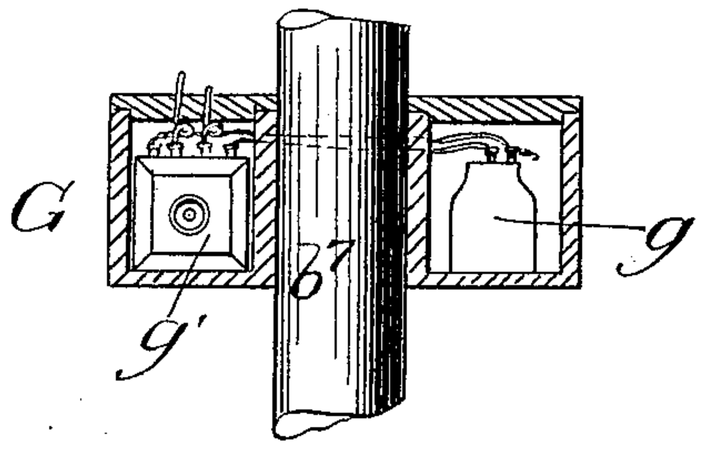
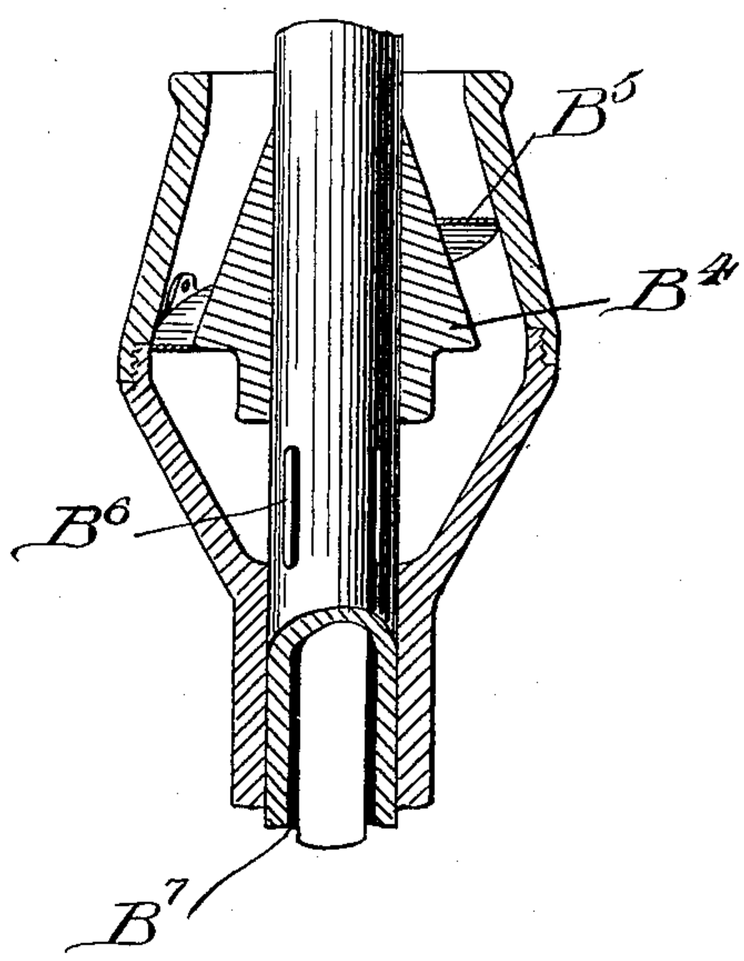


Fig. 9.



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(No Model.) 3 Sheets—Sheet 3.

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APPARATUS FOR BORING WELLS.

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Fig. 11.

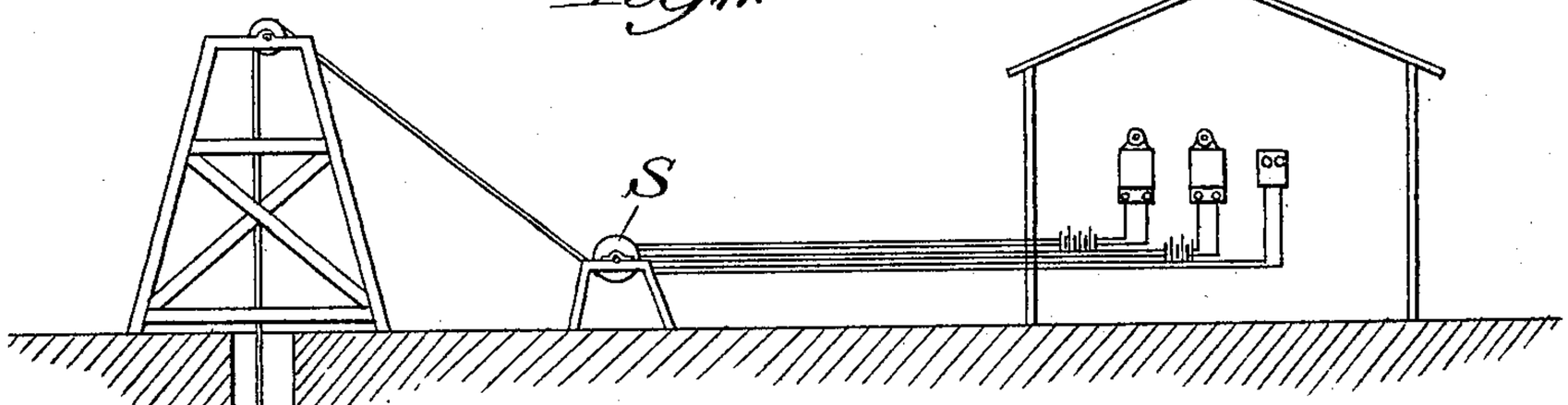
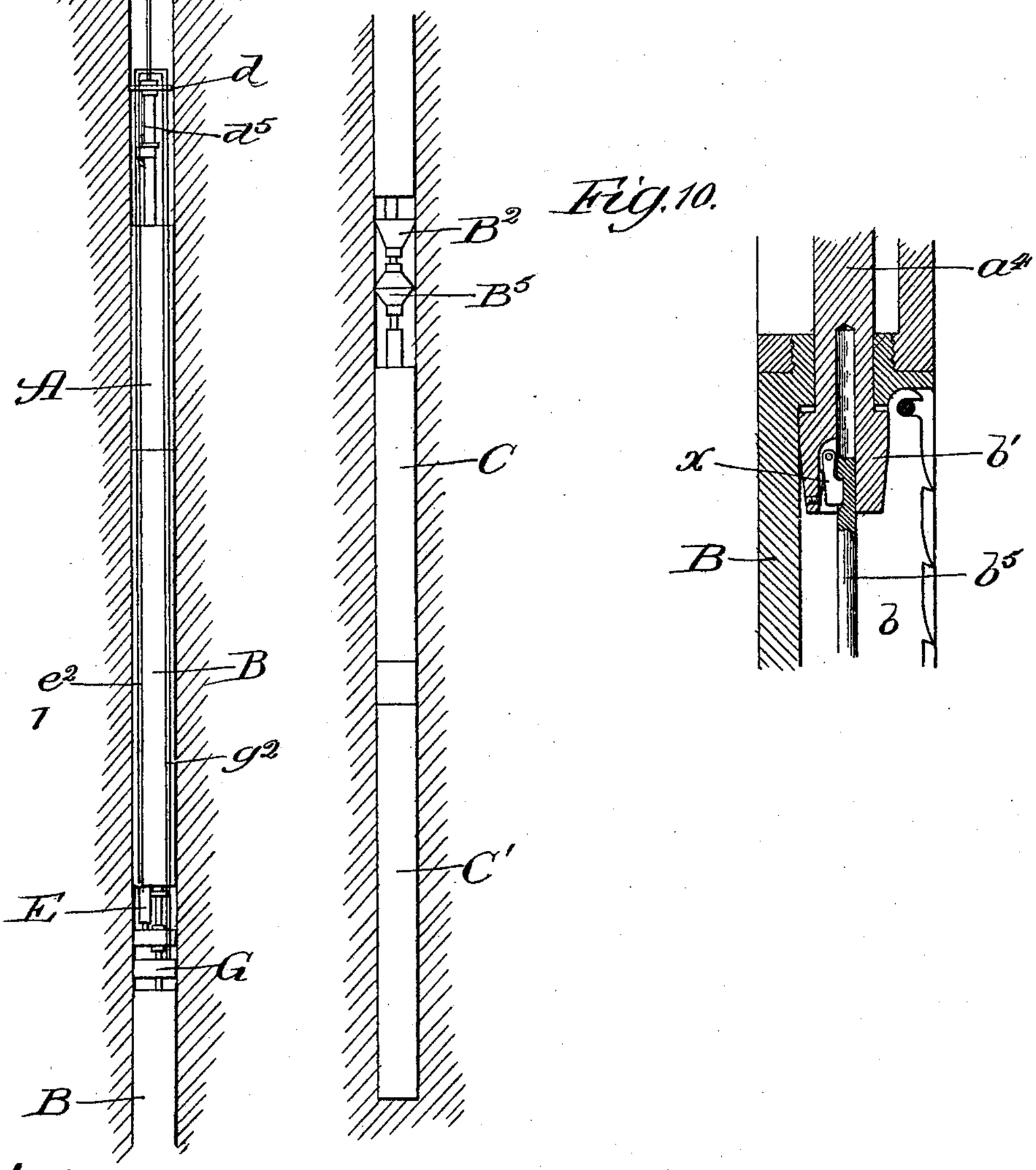


Fig. 10.



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By Banning & Banning & Payson,
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UNITED STATES PATENT OFFICE.

FULTON GARDNER, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO SAMUEL T. WHITE, OF SAME PLACE.

APPARATUS FOR BORING WELLS.

SPECIFICATION forming part of Letters Patent No. 478,791, dated July 12, 1892.

Application filed October 16, 1891. Serial No. 408,867. (No model.)

To all whom it may concern:

Be it known that I, FULTON GARDNER, a citizen of the United States, residing at Chicago, Illinois, have made certain new and useful Improvements in Apparatus for Boring Wells, of which the following is a specification.

This invention is intended as an improvement upon that described and claimed in Letters Patent of the United States No. 455,037, issued to me June 30, 1891; and my invention consists in the features, details of construction, and arrangement hereinafter described and claimed.

In the drawings, Figure 1 represents a transverse vertical section of a well in which my boring apparatus is arranged. Fig. 2 is a transverse vertical section of the upper portion of my improved boring-tool. Fig. 3 is a transverse vertical section of a continuation of the tool from the point where it ends at the bottom of Fig. 2. Fig. 4 is a transverse vertical section of a continuation of the tool from the point where it ends at the bottom of Fig. 3. Fig. 5 is a plan view of the differential gears by which the cutting device and the motor are caused to rotate at different rates of speed. Figs. 6, 7, 8, and 9 are vertical sections of details that will be hereinafter described. Fig. 10 is an enlarged sectional detail of certain locking mechanism hereinafter described, and Fig. 11 is a broken sectional diagrammatic view of my various improvements as the same are intended to appear in use.

It will be understood that my improved boring-tool is intended to be operated from the surface of the ground to great depths in the boring of Artesian wells or other holes in mineral prospecting and for similar purposes and that the tool itself, with its various parts, is intended to descend into the earth with the progress of the hole.

Many parts of the boring apparatus are intended to be constructed and arranged as in my other patent, to which reference has been made, and I shall only enter into minute or detailed explanations of those features employed in my present apparatus and not in my patent which I regard as new and intend to form the subject of claims. My description, therefore, of many parts will necessarily be brief and general, and for minute description reference is made to my patent above mentioned.

In making my improved boring device or tool I make it of three principal vertical sections, of which the upper and lower are intended to be revoluble and the intermediate or middle section non-revoluble as to its exterior shell or case. I have shown these three sections, respectively, in the second, third, and fourth figures of my drawings.

In the construction of the upper section I employ a hollow tube or shell A, which may be of any desired length and diameter and made of such thickness of wall as will afford the desired strength. I arrange within this shell another tube or shell a of less diameter, so that there may be an annular space between the outer and the inner tube. These tubes are intended to be fastened together at the lower end, as shown at a', by screw-threading or in any other convenient and efficient manner, so that they may be revolved together. At the point a', where they are united together, the inturned end of the outer tube makes a bottom to inclose the lower end of the annular space between the two tubes above mentioned; but such space is preferably left open at the top.

Within the inner tube is arranged a swivel a^2, that is intended to have the lower end of the hoisting-cable attached to it and that will permit the rotation of the tube without rotating the cable. In the lower end of this swivel, link, or connection is arranged a jar mechanism, which I will designate by the letter a^3, that is intended to be similar to the jar mechanism ordinarily employed with percussion-drills, and I need not pause to describe its construction and arrangement in detail. It is sufficient to say that it is intended to impart blows of the requisite force at such time as may be desired to the shaft a^4 for the purpose of operating the holding device, which I will presently reach in my description.

Below the revoluble section A of the apparatus I arrange a non-revoluble section B, by which I mean that it is non-revoluble as to its outer shell or case. This section is held from rotating as the tool is working downward by

means of a holding device b b, described at length in my other patent. It is this holding device that the jar mechanism a^3, mentioned above, is intended to operate by forcing the wedge-shaped block b' at the lower end of the shaft a^4 downward against the inclined internal surface of the links b b, (shown in Fig. 3 of the drawings,) so that the teeth shown on the outer edges of these links will sufficiently engage the surface of the rock through which the hole is being drilled to prevent the section B from rotating. This holding device, however, is only intended to operate in the downward movement of the apparatus as the drilling progresses, and it does not operate as the apparatus is moved upward in the hole already drilled. Cases sometimes arise where it is necessary to work the machine upward as well as downward, and other holding devices than the ones b b must be employed. In case a caving takes place in the hole above the boring apparatus or obstructions otherwise fall into the hole, so that it becomes necessary to make the device work its way upward through such obstructions in order to remove it, I prefer to leave the annular space between the inner and outer tubes of the upper section A open at the top, as above described, so that the material falling into the hole will fill such space. The falling of the material onto or into the upper section increases its weight and causes it to more nearly approach the top of the section B.

I have arranged on a sliding piece a^5, surrounding the shaft a^4, a wedge-shaped block b^2, resting on a coil-spring, which under the normal weight of the upper section of the apparatus holds the wedge-shaped block b^2 in a certain position.

I arrange a number of steel blades b^3, hung on pivots at their upper ends, around that portion of the section B in which the wedge-shaped block b^2 is located. I preferably employ six of these hanging blades, although any desired number may be used. In their normal condition they hang within the surface of the case or section B and do not protrude laterally beyond such surface to interfere with the downward movement or progress of the apparatus. When a caving has occurred, however, and débris has fallen upon or into the upper section A of the apparatus, so as to increase the weight of such section, the wedge-shaped block b^2 is forced down against the resistance of the spring and its inclined external surfaces, operating against the inwardly-inclined backs of the hanging knives, operate as a cam to force them out beyond the surface of the section, so that they bear against the wall of the hole and hold the section B from rotating. The top of the upper section is provided with a cutting-face a^6 of any suitable construction to cut through the obstructions or débris with which the hole may have become filled above the apparatus, and as the section B is held stationary by means of the hanging knives b^3 the upper section may be rotated so that the apparatus can be worked upward as well as downward. In order to revolve the upper section with its cutting-faces a^6, so as to work the apparatus upward to bore its way out in case of a caving, I provide means for locking the rotating shaft b^5 and the shaft a^4 to cause them to rotate together when the apparatus is drawn upward. As before explained, the shaft a^4 does not rotate as the apparatus is boring downward, but bears down so that its beveled head b' presses the holding-blades b out to prevent the section B from rotating. I arrange in the beveled head b' a clutch X, (shown in Fig. 10,) which engages with a notch in the shaft b^5 when the apparatus is drawn upward. It is shown thus engaged in Fig. 10. A hole is provided in the shaft a^4 above the top of the revolving shaft b^5, so that when the apparatus is let down to work downward the head b' will slide down to push the holding devices b out and at the same time disengage the clutch x from the shaft, so that the shaft b^5 will be permitted to rotate without rotating the shaft a^4; but when the shaft a^4 is drawn upward as the apparatus is lifted by the cable to work upward the clutch is drawn into the notch of the shaft b^5, so as to engage it and impart rotation to the shaft a^4, which rotates the upper section, and thus puts its cutting-blade a^6 into operation to bore upward as the apparatus works its way out.

In the lower end of the section B in a proper cylindrical space (shown in Fig. 3) is arranged a hydraulic feeding device b^6. As this feature, however, is described in my other patent above mentioned, I will pass it by with a reference for more minute description to such patent. I will simply say that the piston-rod b^7, by which the hydraulic feeding mechanism is operated, is hollow, so that the shaft b^5 may pass down through and revolve in it as it passes on its way to the cutting device or tool. The piston-rod b^7 may be either square or cylindrical in form, as desired, and I shall in my further description treat it as cylindrical. I arrange on the piston-shaft b^7 a collar b^8, which may be held in a fixed position on such shaft by screw-threads or in other convenient way. It affords a shoulder on which is arranged a storage-battery B'. This storage-battery may be of any of the well-known constructions and contain any desired number of cells, so as to get the requisite electrical efficiency for the purposes intended. It is intended to afford or supply the power for the operation of the motor by which the cutting-tool is rotated and operated. It also serves as a means for imparting the necessary weight to the drilling tool to make it cutting or penetrating.

The electrical circuit b^9, passing from the storage-battery to the motor, may be arranged in a channel or groove in the shaft b^7, as indicated in dotted lines in Fig. 4. At a convenient place on the shaft b^7, and preferably below the storage-battery, I arrange a flexible

cup B^2 for trapping the débris as it flows up from the drill around the sides of the apparatus. As this feature, however, is described in my patent above referred to, it need not be here described or explained in detail.

At a suitable point on the shaft b^7, and preferably below the flexible cup, is arranged a pump B^3, that is intended to rotate around the shaft and to be rotated and made operative by the rotation of the drilling-tool. This pump may be fastened or supported upon the shaft in any convenient or desired way. Its parts consist of wings B^4, which stand out from the surface of the shaft b^7, and vanes B^5, which are attached to the inner surface of the rotating shell inclosing the pump, so as to rotate around the wings B^4. These vanes are arranged in a spiral position, so that they operate as a screw to catch and force the water which enters at the top of the pump-shell or inclosing case and force it downward between the wings B^4, around the shaft b^7, and through the slots B^6, which may be provided with a screen, if desired, so that it enters the interior of the shaft b^7 and is forced down between it and the rotating shaft b^5. The water thus forced into this space is carried down by the constant forcing in of water at the top of the pump through the magnet-stem of the motor, keeping the same cool, and on down through the core-barrel and under the carbons or cutting devices at the bottom of the apparatus, so as to keep the same clean and cool, and upward again with the cuttings or débris, around the outside of the apparatus, and into the hole already bored above the same. The water is represented in Figs. 4 and 9 as B^7 and in solid black. The pump is mounted on the top of the lower section C, so as to rotate with it, and both the pump and the section C rotate around the non-revoluble shaft b^7. In the upper end of the revoluble section C of the apparatus is arranged a motor c in suitable space to receive it. This motor may be of any desired construction and arrangement and is preferably like that shown and described in my patent above mentioned. It is intended through proper connections to impart rotary motion to the upper section A and the lower section C and cause them to revolve at any desired rate of speed. I contemplate revolving the section C at a high rate of speed and the cutting-tools at a lower rate of speed. I have therefore arranged the lower portion C′ of the section C so that it may be separately revolved from the upper portion of the section. To effect this, I suspend the lower portion C′ on a collar c' in any convenient way so that it may be suspended and rotated on such collar separately from the upper portion. To impart different speeds of rotation to the upper and lower portions of the sections C, I employ differential gears C^2, which may be of any desired construction and arranged in any desired manner so as to secure the desired result. I have shown in Fig. 5 a peculiar construction of such differential gears, which may be employed, if desired, although any other suitable gears for the purpose may be used. As I do not make the differential gears by themselves or separately considered the subject of claim, I will not describe the construction and arrangement in detail. The lower portion C′ of the section C of the apparatus forms a core-barrel of cylindrical form with a space C^3 in it, in which the core of rock may extend the desired distance as the cutting operation of the tool progresses down around it. After the tool has been worked down the requisite distance to form the amount of core desired the apparatus is raised with the hoisting device and cable so that the teeth c^2 catch against and detach the core left standing by the descent of the cutting-tool around it, so that the same can be hoisted and removed with the cutting apparatus.

As the cutting apparatus descends into the earth, it is important that the operator should constantly know that the hole above the apparatus remains clear and is not being filled up by excavations that may take place from various causes, as without such knowledge there is danger that the cutting apparatus will become so embedded and obstructed in the hole that it is impossible ever to remove it, thus occasioning not only the loss of the tools, but of all the work that had been done in boring the hole before the excavation took place. In order that I may constantly know that the hole is clear above from the cutting apparatus, I arrange on the cable at a desired point above the top of the apparatus, and preferably in proximity thereto, a short tube or shell D, which may be clamped to the cable. This shell is provided at its top with a wooden or other fragible disk of sufficient diameter to fill the bore, while permitting it to readily move up or down within the same. This disk is provided with perforations or holes, so that as it is moved up or down passage is afforded for water through it to keep it from being obstructed in its movement. The disk is arranged on a collar d' or similar support, which is held by a spring d^2 at a normal position above the bottom of the tube or shell D. A bar or rod d^3 depends from this disk into a small box D′, which is intended to be watertight, and in which I arrange two contact-points d^4, connecting with an electrical conductor leading to the top of the hole and connected to an electrical magnetic bell in the room of the operator. If now obstructions or débris should begin to fall into the hole above the boring apparatus and onto the disk d, such disk would be pressed down below its normal position, so that the rod d^3 would bring the contact-points d^4 together, thus closing the circuit and causing the bell in the operator's room to be rung. He would thus be immediately apprised of any excavation that took place in the hole, and thereby enabled to immediately reverse the machinery and cause the boring apparatus to move upward instead of downward to bore its way up

through the obstructions which had begun to accumulate.

In describing in detail the arrangement of the disk, contact-points, and other devices intended to ring the electric bell in the operator's room and sound an alarm I have merely intended to describe the form and arrangement shown in my drawings, and do not desire or intend to limit myself to the details of construction and arrangement shown, as I consider it new to interpose between the boring apparatus and the mouth of the hole a device that will be operated upon by accumulating obstructions to close an electric circuit and ring a signal-bell or sound an alarm in the operator's room.

In boring deep wells it may happen that crevices or other openings will be reached, so that the supply of water to keep the cutting devices cool and clean may be exhausted or lost without the knowledge of the operator at the surface of the ground, so that before he becomes apprised of the state of things at the bottom of the hole his cutting device will have become burned out or destroyed, entailing heavy loss. In order to immediately apprise the operator of any less or serious diminution of water at the point where the cutting devices are operating, I arrange an electric signaling device intended to cause an electric bell or alarm in the operator's room to be sounded and notice given. I have shown such a signaling device in Fig. 6 of the drawings. In the particular arrangement there shown I suspend a water-tight tube or box E in any convenient manner to the bottom of the hydraulic feeding device, although it can be located at any other point, if preferred. I arrange a float F, surrounding the shaft b^7, that is adapted to be held at a normal position on such shaft when the requisite supply of water is present, and in such normal position the float, by means of an upwardly-extending rod f, holds two electrical contact-points e', separate from each other. The moment, however, that an insufficiency of water occurs through any cause the float sinks below its normal condition and permits the electrical contact-points to come together and close an electric circuit leading from them, through the apparatus and tube, to the operator's room to sound the alarm. The arrangement of parts above described may be varied at pleasure. I have merely described them in detail to show one practical way of arranging a signaling device which would descend with the boring apparatus and by closing the circuit whenever an insufficiency of water occurs through any cause convey a warning or notice to the operator, so that he can immediately stop the operation of the cutting devices until a sufficiency of water has been pumped in or otherwise supplied, and I do not, therefore, limit myself to mere details of construction and arrangement.

It is also desirable, in boring deep wells or holes, to provide means by which the operator can constantly inform himself as to the state of the boring devices and the conditions under which they are working, although they may be hundreds or thousands of feet in the earth, the same as if he were present to examine them with his eye and note their operations. In order to provide him with means of thus being constantly apprised of the conditions under which the work is being done, I arrange on the shaft b^7 at any convenient point a water-tight inclosing box or case G, in which a battery g and a telephone-transmitter g' may be arranged. The transmitter has electrical connection with a telephone-receiver in the room of the operator, so that the various noises and sounds caused by the operation of the cutting devices will be transmitted to the telephone-receiver. The operator by listening can thus hear the operation of the cutting devices, the action of the water, or other noises that may occur at the bottom of the hole, though thousands of feet away. He can thus detect by changes in the character of the sounds transmitted to him changes in the condition of things under which the boring apparatus is working, and be enabled thereby to regulate his actions accordingly.

In Fig. 11 I have shown a view leading down into the shaft with the signaling devices D, E, and G arranged at their appropriate places in the same. The electric wires from the apparatus D are represented as arranged in a channel or groove d^5, and the wires from the signaling device E are represented as passing up the boring apparatus in a channel e^2, and the wires from the apparatus G are represented as running up in a channel g^2. All of these wires enter the cable at the top of the boring apparatus and pass up the cable to the hoisting-drum S, where they leave the end of the cable and pass to their respective signaling apparatus located in the operator's room, as shown in Fig. 11. Of course any other arrangement than grooves or channels in the side of the boring apparatus that will bring the electric wires into the cable at the top of the apparatus may be employed, if preferred, and I have simply illustrated these channels or grooves in the outside of the apparatus as one practical way of leading the wires from the signaling devices to the cable at the top of the apparatus, so that they can be carried on up in the cable to the top of the hole or shaft being drilled.

What I regard as new, and desire to secure by Letters Patent, is—

1. The combination, with a boring-tool, of a holding device adapted to be set into operation only as the boring-tool is worked upward, substantially as described.

2. The combination, with a boring-tool, of a storage-battery of a diameter adapted to enter the bore of the well and follow up the boring-tool and electrical conductors from said storage-battery to an electrical motor, substantially as described.

3. The combination, with a boring-tool, of

a pump mounted on the tool, the pump being of a size to enter the bore of the well and follow the tool in its descent, whereby it may operate from below the surface and while under water, substantially as described.

4. The combination, with a boring-tool, of a pump mounted on the tool and an electric motor between the cutting portion of the tool and the pump, imparting rotary motion to both, the pump being of a size to enter the bore of the well and follow the tool in its descent, whereby it may operate from below the surface and while under water, substantially as described.

5. In combination with a boring-tool, an electric signaling device adapted to follow the tool down the hole and to be set in operation by a weight thereon and an electrical conductor running from such signaling device to the room of the operator to sound an alarm, substantially as described.

6. In combination with a boring-tool, an electric signaling device carried down the hole with the boring-tool and set in operation by diminution of water in the hole and an electrical conductor running to the room of the operator to sound an alarm, substantially as described.

7. In combination with a boring-tool, a telephonic transmitting device carried down the hole with the tool, an electrical conductor running to the room of the operator, and a telephonic receiving device whereby the operator may at all times be apprised by listening of the condition of things at the bottom of the hole, substantially as described.

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