Jan. 12, 1932. R. P. SIMMONS 1,841,302

WELL DRILLING APPARATUS

Original Filed May 18, 1927 5 Sheets-Sheet 1

Fig. 1.

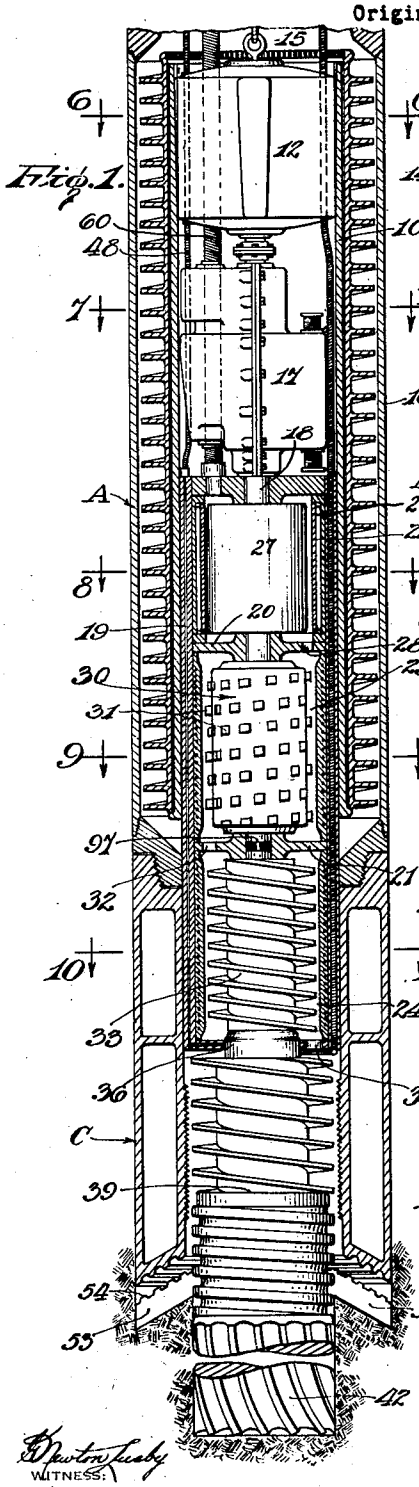
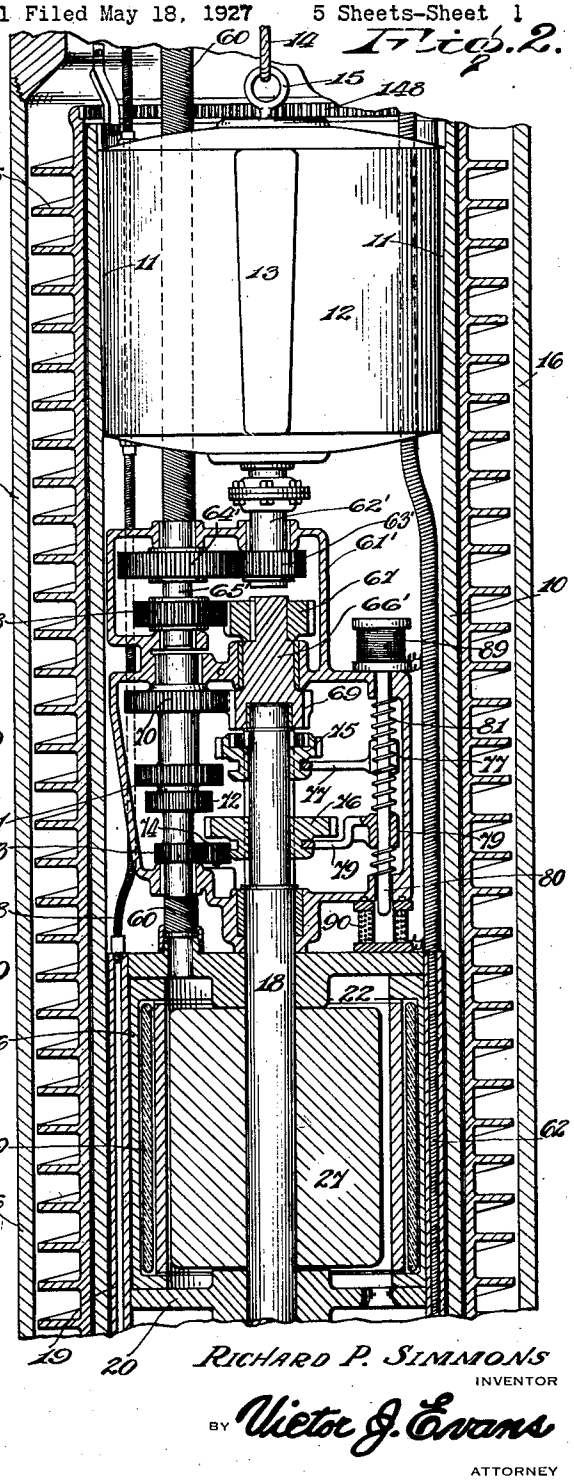


Fig. 2.



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WITNESS:

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WELL DRILLING APPARATUS

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Fig. 3.

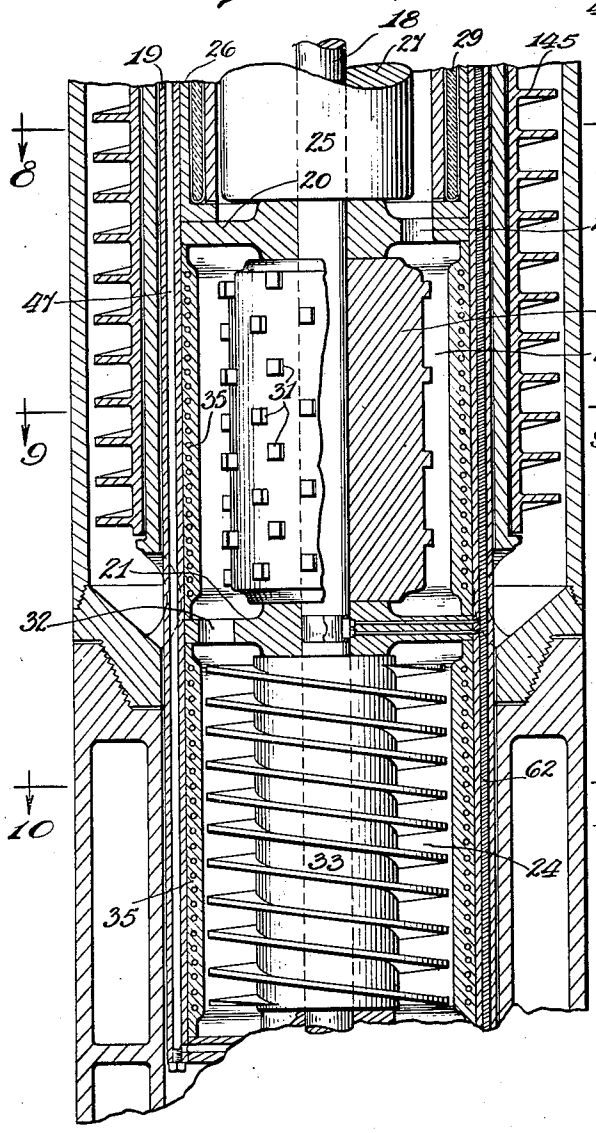


Fig. 8.

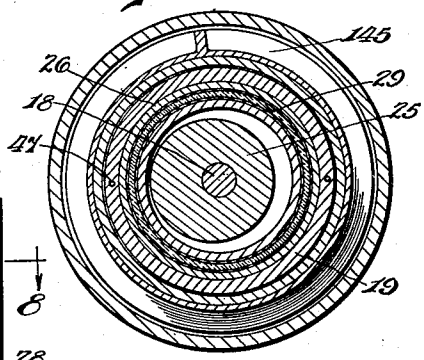


Fig. 9.

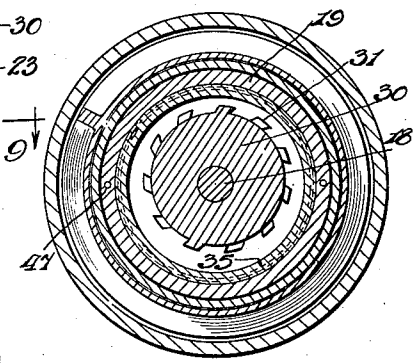
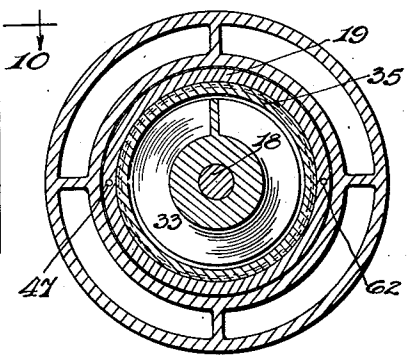


Fig. 10.



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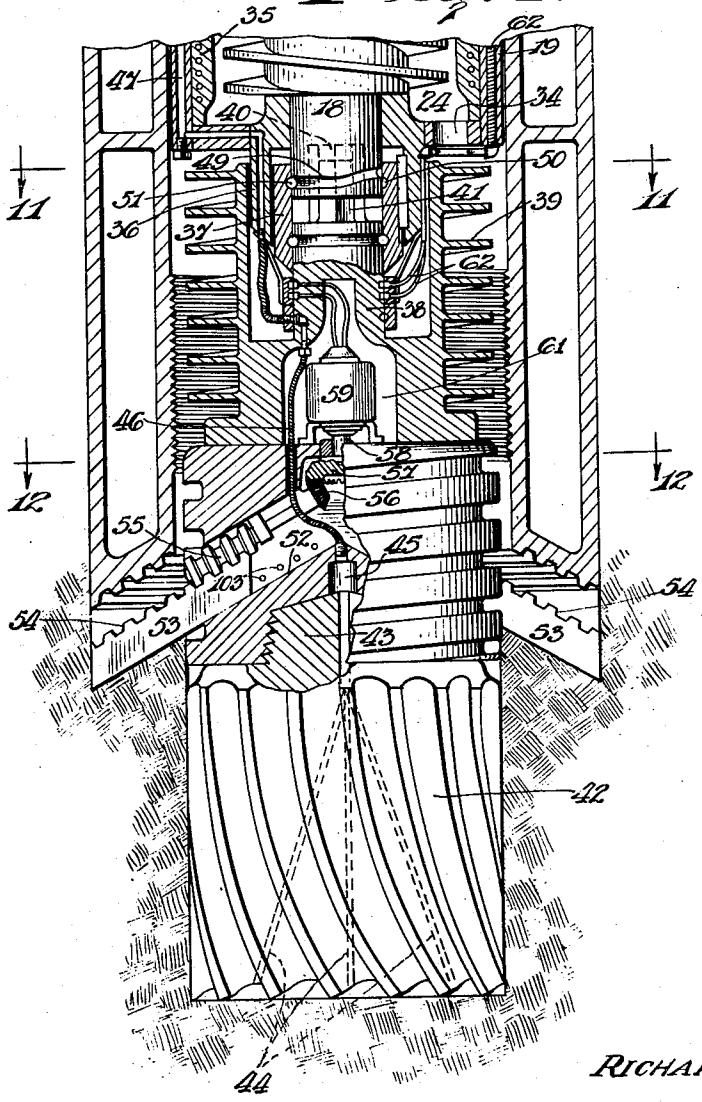
WITNESS: Newton Jueby

Jan. 12, 1932. R. P. SIMMONS 1,841,302

WELL DRILLING APPARATUS

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Fig. 4.



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Jan. 12, 1932. R. P. SIMMONS 1,841,302

WELL DRILLING APPARATUS

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Fig. 6.

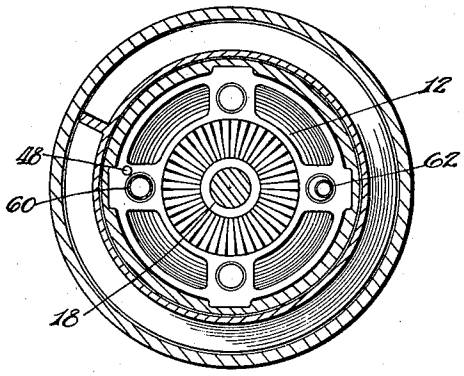


Fig. 7.

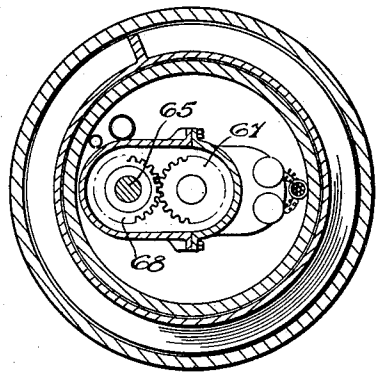


Fig. 13.

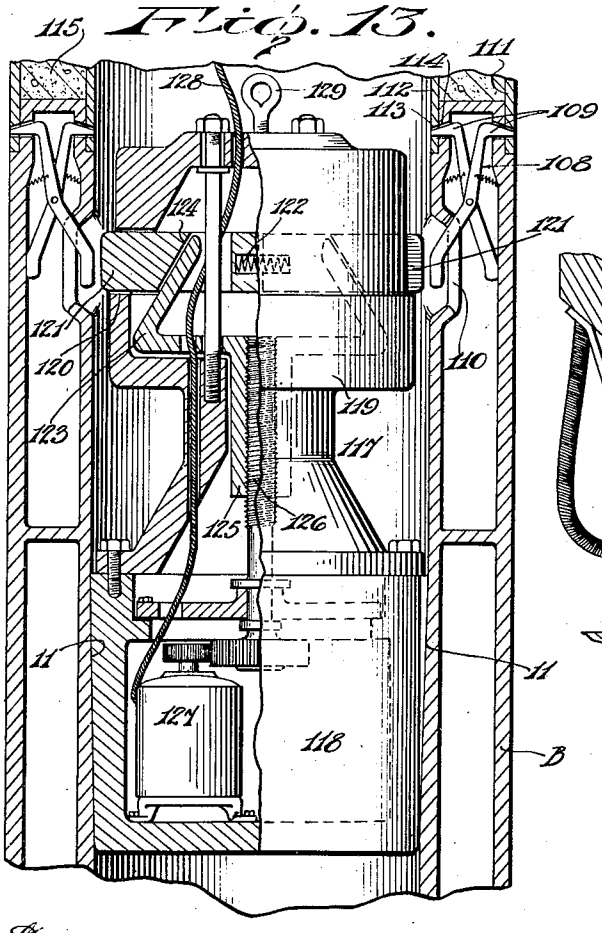
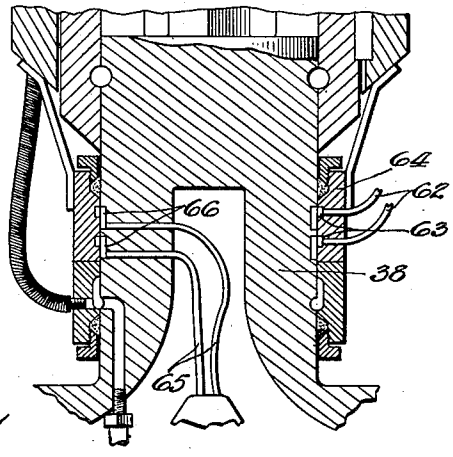


Fig. 5.



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WITNESS: Newton Lusby.

Jan. 12, 1932. R. P. SIMMONS 1,841,302

WELL DRILLING APPARATUS

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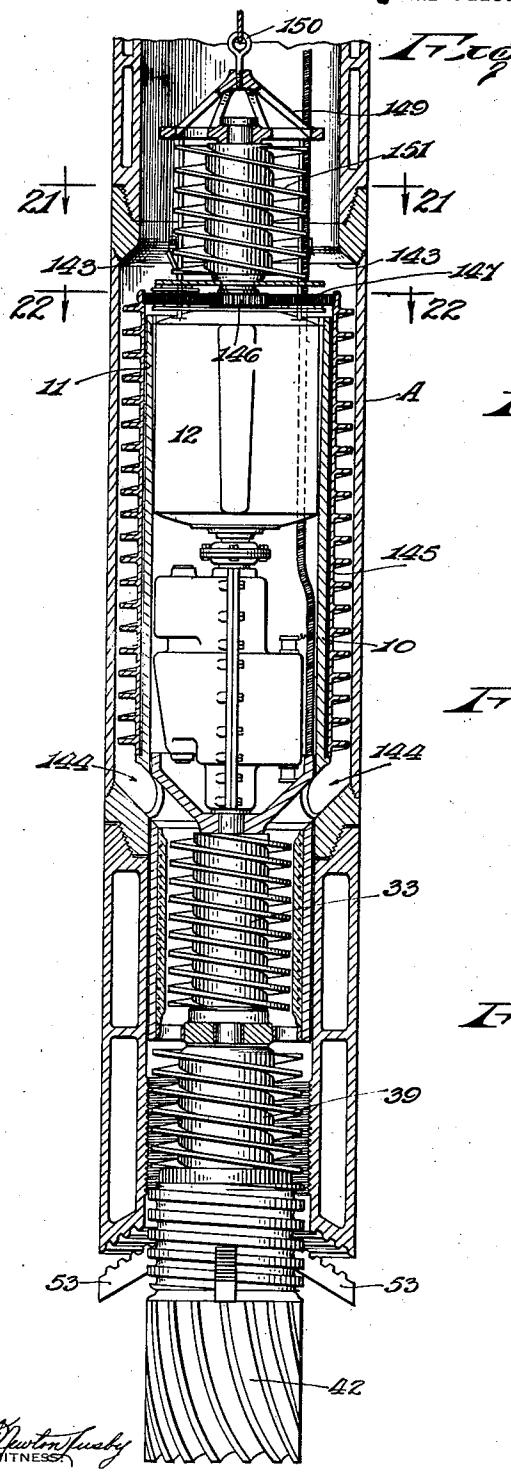


Fig. 14.

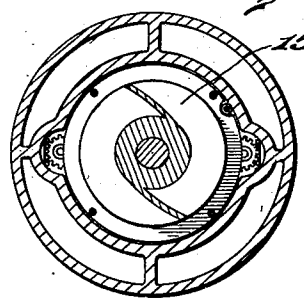


Fig. 15.

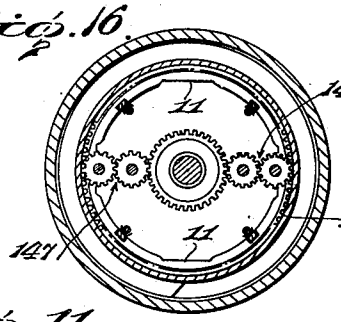


Fig. 16.

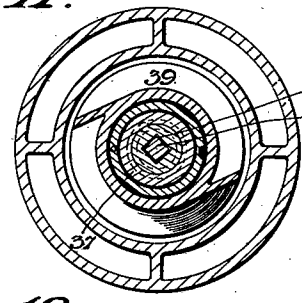


Fig. 11.

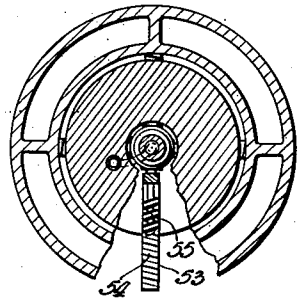


Fig. 12.

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Patented Jan. 12, 1932 1,841,302

UNITED STATES PATENT OFFICE

RICHARD P. SIMMONS, OF NEW YORK, N. Y.

WELL DRILLING APPARATUS

Application filed May 18, 1927, Serial No. 192,449. Renewed March 14, 1930.

This invention relates to improvements in well drilling apparatus and has for its primary object, the provision of a means for removing the drilled substance from the well to the surface of the earth during the drilling operation to greatly reduce the time and expense now required to drill a well.

Another object of the invention is to lift the drilled earth and rock a predetermined distance by the use of a system of conveyors, crush the drilled earth and rock into disintegrated particles and simultaneously dry the particles by passing the crushed mass through a heater, and lifting the dried particles to the surface of the well by air, water or steam.

Another object is the provision of a well drilling machine having an electric motor driven rotary drill, the speed of which may be varied to suit the strata of rock or dirt being drilled through, and which speed is controlled from the surface of the well.

With these and other objects in view, the invention resides in certain novel construction and combination and arrangement of parts, the essential features of which are hereinafter fully described, are particularly pointed out in the appended claims, and are illustrated in the accompanying drawings, in which:—

Figure 1 is a vertical longitudinal sectional view through my improved well drilling apparatus.

Figure 2 is an enlarged vertical sectional view through the upper portion of the apparatus.

Figure 3 is a similar view through the crusher and conveyor.

Figure 4 is a similar view through the lower portion of the apparatus.

Figure 5 is an enlarged detail vertical section through the current distributor mechanism.

Figure 6 is a horizontal sectional view on the line 6—6 of Figure 1.

Figure 7 is a horizontal sectional view on the line 7—7 of Figure 1.

Figure 8 is a horizontal sectional view on the line 8—8 of Figure 1.

Figure 9 is a horizontal sectional view on the line 9—9 of Figure 1.

Figure 10 is a horizontal sectional view on the line 10—10 of Figure 1.

Figure 11 is a horizontal sectional view on the line 11—11 of Figure 4.

Figure 12 is a horizontal sectional view on the line 12—12 of Figure 4.

Figure 13 is a sectional elevational view showing the latch actuating device.

Figure 14 is a vertical longitudinal sectional view of a slight modified form of my invention.

Figure 15 is a horizontal sectional view on the line 21—21 of Figure 14.

Figure 16 is a horizontal sectional view on the line 22—22 of Figure 14.

Like reference characters refer to like parts throughout the several figures of the drawings.

Referring more particularly to the drawings, the reference character A designates a non-rotatable tubular housing head including an inner cylinder wall 10 having beveled seats 11 provided adjacent the top thereof for the reception of an electric motor 12, which motor has flat beveled portions 13 for co-action with the seats 11. The motor is inserted into the tubular housing head by lowering the same by a cable 14 having connection with an eye 15 provided on the top of the motor casing. When lowered into the tubular housing head, the motor automatically seats itself and therefor the same cannot pass a predetermined point.

The tubular housing head section A also includes an outer cylinder wall 16 which is integral with the inner cylinder wall 10 but spaced therefrom to provide air pockets therebetween. The opposed ends of the casing A are respectively threaded to an upper tubular housing head casing section B and a lower tubular housing head casing section C, both of which have inner and outer spaced walls disposed in vertical alignment with the inner and outer walls of the section A.

Enclosed within the inner cylinder 10 and disposed below the motor is a speed transmission 17 for varying the speed from the motor driven shaft to the driven shaft 18 which latter shaft extends downward and terminates adjacent the bottom of the casing C.

A casing 19 fits snugly within the inner cylinder wall 10 and is closed at opposite ends to provide a bearing for the driven shaft 18. The casing 19 is divided by spaced partitions 20 and 21 into three separate compartments 22, 23 and 24 and which I shall refer to as a pulverizer compartment, crusher compartment, and conveyor compartment, respectively. The compartment 22 houses a pulverizer 25 which comprises a stationary ring 26 and an eccentric rotor 27 fixed to the shaft 18. An inlet 28 is provided in the partition 20 for the passage of the dirt and rock to be pulverized after passing through the crusher now to be described. An electric heating coil 29 surrounds the ring 26 for heating the same whereby the pulverized particles are thoroughly dried as they pass therethrough for a purpose to be hereinafter mentioned.

Fixed to the shaft 18 and housed within the compartment is a crusher 30, having outwardly extending spirally arranged teeth or lugs 31 extending from the periphery thereof. The crusher is also eccentrically mounted with respect to the walls of the housing so that the mass to be crushed enters through the inlet 32 provided in the partition 21 and is carried around and crushed against the side wall of the housing.

Fixed to the shaft 18 and disposed in the compartment 24, is a spiral conveyor 33 which lifts the drilled substance from the lower end of the casing 19, the end wall of which is provided with an inlet 34. The crusher 30 and the conveyor 33 are surrounded by an electric heating coil 35 which dries the drilled mass as it is lifted therethrough.

The shaft 18 terminates just below the conveyor 33 and depending from the end wall of the casing 19 is a stationary collar 36 within which the lower end of the shaft 18 extends. Slidable but non-rotatable within the collar 36 is a sleeve 37 which overlaps the end of the shaft 18 and a stub shaft 38 provided on a screw conveyor 39. The lower end of the shaft 18 is provided with a square socket 40 for receiving the squared reduced shank 41 extending from the stub shaft 38. The conveyor 39 is keyed for rotation with the driven shaft 18 but is reciprocal with respect thereto to lift the drilling tool 42 a slight distance from the bottom of the well hole during the drilling operation. The tool 42 is detachably associated with the lower end of the conveyor 39 by providing a reduced threaded stud 43 thereon for threading engagement in a socket provided in the bottom of the conveyor 39. The drilling tool 42 is provided with diverging passages or jets 44 which communicate with a compartment 45 within the body of the conveyor for the passage of compressed air or its equivalent used in blowing the drilled substance to the surface of the well. An air line or conduit 46 leads from the chamber 45 to the air inlet duct 47 provided in the wall of the casing 19, and to which a flexible hose 48 is connected, which hose leads to a compressed air pump or tank (not shown) and which is disposed on the surface.

For imparting a periodical reciprocating movement to the grinding tool 42, I provide a cam shape or irregular groove 49 in the lower end of the shaft 18 and which co-acts with a groove 50 provided in the inner wall of the sleeve 37 to form a ball race for the reception of a loose ball bearing 51. It will be obvious that when the high spot of the cam groove passes over the ball, the conveyor 39 and drilling tool will be moved upward, during which movement, the drilling tool will have a biting, slicing and chipping effect also an opportunity to cool as it is lifted from engagement with the substance being drilled. Slidably mounted on inclined tracks 52 provided in the body of the conveyor 39, are expansible and contractible bits 53 which are adapted to cut the walls of the well beyond the plane of the drilling tool 42. The upper faces of the bits are provided with spaced teeth 54 for co-action with a worm shaft 55. The inner ends of the worm shafts are provided with beveled gears 57 for constant mesh with a ring gear 57 carried by the driven shaft 58 of an electric motor 59 disposed within a compartment 61 provided in the conveyor 39. The conveyor 39 is constructed of two separate sections fixedly connected together in order to facilitate the insertion of the motor 59 and its operating parts.

In order to supply current to the electric heaters and motor 59, I pass a cable 62 through the casing 19 to the surface of the well to a suitable source of supply, and certain of the wires within the cable lead to the motor 12 and heating coils hereinbefore mentioned. Two conductor wires 62 lead to contacts 63 provided in a stationary collar 64 which encircles the stub shaft 38. To cause a contact to be constantly effected between the conductor wires 62 and the wires 65 leading to the motor 59, during rotation and reciprocation of the stub shaft 38, I connect the wires 65 to contact rings 66 which are insulated apart and engage the respective contacts 63 during the upward movement of the stub shaft 38. The rings 66 are sufficiently wide enough to accommodate for the slight upward movement of the stub shaft, whereby current may pass to the motor 59 without interruption.

From the description thus far, the operation of the apparatus is as follows:—In starting to drill a well, it is first necessary to provide a hole of a width and depth to receive the tubular housing head sections A and C, which may be dug by the use of a drill now employed for this purpose. When the desired depth is reached, the sections A and C are lowered therein and the drill unit is lowered into the sections for a distance to cause

the motor 12 to come to rest on its seat 11. The drilling tool 42 and bits 53 contact with the bottom of the partially drilled well and the motor 12 turned on. Rotation will then be imparted to the driven shaft 18 through the transmission 17 which will turn the drill tool 42, to bore into the earth, and rotate the bits 53 to cut that portion of the earth not touched by the drill 42 whereby to produce a hole of a size equal to the diameter of the sections A, B and C. The weight of the unit causes the boring tools to automatically move downward under the control of the cable 14 as the drilling operation proceeds. The tubular housing head and its following sections are suspended from the surface of the well in any suitable manner to prevent the bottom of the same from dropping down upon the bits 53. However, the tubular head is gradually lowered as the depth of the well increases. Either air, water or steam under pressure passes from a suitable source of supply down through the hose 48, inlet 47, conduit 46 to the chamber 45 from where it passes through the jets or ducts 44 to the end of the drilling tool and thence upward about the conveyor 39, through the passage 34, chamber 24, opening 32, chamber 23, opening 28, chamber 22, and thence to a discharge or return hose 60 leading to the surface of the well. The air tends to lift the loose dirt and rock in its travel from the bottom of the well, but its primary purpose is to blow or pump the pulverized material to the surface. The drilled material is lifted upward by the conveyors 39 and 33 to the crusher 30, through the openings 34 and 32, and which crusher reduces the density of the particles of material after which the column of air or water passing through the crusher, carries the same into the pulverizer 25 through the opening 28. The material is reduced to powdered form by the pulverizer and is blown upward through the discharge pipe 60 to the surface of the well. As the material passes through the crusher and pulverizer, the same is dried by the heating coils hereinbefore mentioned to prevent the crushed and finally pulverized particles from adhering to each other.

The transmission 17 hereinbefore mentioned is of the usual well-known construction in order that the driven shaft 18 may be rotated at different forward speeds depending upon the material being drilled. It will be appreciated that the drilling tools will be rotated at a slower speed when drilling through rock, than if the same were drilling through sand or soft dirt. The transmission comprises a casing 61′ within which the shaft 62′ of the motor 12 extends and which shaft carries a gear 63′ which constantly meshes with a larger gear 64′ fixed to a counter-shaft 65′ which is journalled in the casing. A stub shaft 66′ is also journalled in the casing and is disposed in axial alignment with the shafts 62′ and 18, one end of the stub shaft having a gear 67 fixed thereto for constant meshing engagement with another gear 68 fixed to the counter-shaft 65′, and a gear 69 provided on the other end of said stub shaft. The gear 69 constantly meshes with a gear 70 on the counter-shaft for imparting a reduced speed thereto. The counter-shaft 65′ also has a gear 71 thereon for obtaining an intermediate speed, a gear 72 for low speed and a gear 73 meshing with an idler gear 74 for producing a reverse rotation of the driven shaft 18 when the sliding gears now to be described are respectively engaged therewith.

A double acting gear 75 is slidably mounted on the top end of the driven shaft 18 and when in neutral position, the same is disposed in the position shown in Figure 2 of the drawings. A larger gear 76 is also mounted on the driven shaft 18 and is adapted to engage with the low gear 72 or the idler gear 74 depending upon the direction of movement of the same. The gear 75 is actuated by a yoke 77 fixedly mounted on a sliding counter-shaft 78 while the gear 76 is actuated by a yoke 79 fixed on a sliding counter-shaft 80. The yokes 77 and 79 are held in a neutral position by equalizing springs 81 which encircle the shafts 78 and 80 and abut opposite sides of the yokes. When the yoke 77 is actuated in one direction, it will move the gear 75 into co-acting engagement with the gear 71 to drive the shaft 18 at an intermediate speed but if moved in an opposite direction it will cause the said gear to mesh with the gear 69 which will rotate the shaft 18 at high speed.

The gears 75 and 76 are selectively controlled from the surface of the well by electric means which includes solenoids 82 and 82′ for receiving the respective ends of the counter-shaft 78 and which acts as the core of the solenoids. The solenoids 82 are arranged in separate electric circuits 83 and 84 with a battery 85 and a knife switch 86 having contacts 87 and 88 for engagement by a switch arm 89′. It will be observed that if the switch arm is moved to engage the contact 87, the solenoid 82 will be energized and will move the core or counter-shaft to cause the gear 75 to mesh with the intermediate gear 71 against the action of the equalizing springs 81. When the circuit is broken, the springs tend to move the core or counter-shaft to neutral position. However, if the switch arm is moved to engage the contact 88, the circuit 83 is closed and will cause the gear 75 to engage gear 69 to drive shaft 18 at high speed.

The counter-shaft 80 is actuated in a similar manner by solenoids 89 and 90 which are arranged in circuits 91 and 92 with an electric switch 93 and the battery 85. The switch 93 comprises contacts 94 and 95 and a switch

arm 96'. When the switch arm is engaged with contact 94, the circuit 91 is closed to energize the solenoid 89 to put the gears in low speed, and when engaged with contact 95, a reverse speed is obtained by reason of the energizing of the solenoid 90. High speed is obtained by shifting the gears in a manner now employed in automobiles, that is, by first going through the low and intermediate gear.

After the well has been drilled, the drilling apparatus is hoisted to the surface of the well by pulling upward upon the cable 14, but the sections A, B and C are left at the bottom of the well. The concrete after being poured into the wall form is left to dry, after which the shell sections 111 and 112 are lifted to the surface and uncoupled as the screw joints appear. However, in order to release the catch device 108 from the lower shell section, it is necessary to lower a separate dog actuating device 117 into the well and which device is shown in Figure 15 of the drawings. The device 117 comprises a base 118 having beveled side walls for seating upon the seat 11 provided in the inner wall of the section A. Rising from the base 118 is a casing 119 which is provided with slots 120 for the extension of shoes or blocks 121 normally held in a retracted position by contractile springs 122. The blocks are disposed in horizontal alignment with the tails of the dogs 109 and openings 110, so as to engage and retract the bills of the dogs from the slots 113 and 114. The blocks are expanded by a conical shaped head 123 which engages beveled faces 124 on the blocks, and which head is slidably and non-rotatably mounted within the casing 119. The conical head is provided with a tubular extension 125 having internal screw threads for coaction with a screw 126 which is driven by an electric motor 127 mounted in the base 118. A cable 128 containing the wires leading to the motor extends upward through the casing 119 to the surface of the well. An eye 129 is provided at the top of the casing 119, to which a cable is attached for facilitating the lowering and lifting of the device into and out of the well. To expand the blocks 121, the motor 127 is turned on which rotates the screw shaft 126 causing the upward movement of the head 123 to set up a wedging action between the same and the blocks. This action expands the blocks outward beyond the casing and into engagement with the tails of the locking dogs to retract the same. The lowermost shell sections 111 and 112 are now released and are free to be lifted out of the well. When the shell sections have been removed, the device 118 is lifted to the surface by actuating the motor in an opposite direction to lower the head 123 to permit the springs 122 to retract the blocks within the casing 119.

In Figure 14 of the drawings, I have shown a slightly modified form of my invention wherein the use of the crusher and pulverizer are dispensed with and also the pneumatic means for blowing the drilled material to the surface. In this form, the material is lifted to the top of the apparatus by a system of conveyors which will now be described.

The inner wall 10 of the casing section A is provided with outlet openings 143 disposed above the level of the motor and inlet openings 144 disposed above the conveyor 33 and the drilled material is lifted between the inner and outer walls of the section A. A cylindrical spiral conveyor 145 is rotatably mounted between the walls of the section A intermediate the inlet and outlet openings. Rotary motion is imparted to the conveyor 145 by the motor 12, whose drive shaft extends above the motor and has a gear 146 mounted thereon. Two gear trains 147 are respectively disposed on opposite sides of the axis of the motor shaft and which impart rotation to the conveyor 145 through an annular series of gear teeth 148 provided on the top of the conveyor internally thereof. The cylindrical conveyor 145 is also shown in the preferred form for operation with such a unit now being described when the necessity arises.

The top of the motor shaft is journalled in a spider 149 having an eye 150 to which a cable is attached for lowering and raising the apparatus into and out of the well. A spiral conveyor 151 is fixed to the motor shaft and picks up the drilled material as it passes up through the openings 143. The drilled material accumulates above the conveyor 151 but the same tends to force the accumulated mass to the surface. This form of unit may be used when drilling through soft dirt and also when a geologist desires to obtain an untouched specimen of the earth or rock.

From the foregoing description, it will be appreciated that the advantages of my invention over the present method of drilling a well are numerous, as it is unnecessary to remove the apparatus from the well after the drilling operation is begun, other than for replacing the drilling tools or bits as they become worn. The drilled material is automatically removed from the well and a concrete casing formed about the walls of the well during the drilling operation. By this apparatus a well may be drilled in decidedly less time now than the method now followed and which is well known to one skilled in the art.

The principle embodied in this invention may be slightly changed to work in a horizontal position instead of vertical, and will be found most useful in digging subways, tunnels under rivers and wherever a horizontal passage is desired. The only changes necessary would be in increasing the size of

the units to facilitate the boring of holes of larger diameters.

While I have described what I deem to be the most desirable embodiment of my invention, it is obvious that many of the details may be varied without in any way departing from the spirit of my invention, and I therefore do not limit myself to the exact details of construction herein set forth nor to anything less than the whole of my invention limited only by the appended claims.

What is claimed as new is:—

1. In an apparatus of the class described, the combination of a tubular housing head, drilling means extending from the lower end of said tubular housing head, pulverizing means, conveyor means for lifting the drilled material from the bottom of a well to said pulverizer means, and pressure means for lifting the pulverized material to the surface of a well.

2. In an apparatus of the class described, the combination of a tubular housing head, drilling means extending from the lower end of said tubular housing head, pulverizer means, conveyor means for lifting the drilled material from the bottom of a well to said pulverizer means, and pressure means for lifting the pulverized material to the surface of a well and heating means for drying the drilled material during its travel to said pulverizing means.

3. In an apparatus of the class described, a tubular housing head adapted to move downwardly into a well during the drilling of the same, a driven shaft journalled for rotation within said housing head, a drill element carried by the end of said driven shaft and extending beyond the lower end of said housing head, and means for lifting the drilled material from the bottom of a well to the surface thereof, said means including a series of screw conveyors, crushing and pulverizing means, and pressure means for lifting the drilled material after being pulverized.

4. In an apparatus of the class described, well drilling means, pulverizer means, lifting means for raising the drilled material from the bottom of a well to said pulverizer means, and pressure means for lifting the pulverized material to the surface of the well.

5. In an apparatus of the class described, well drilling means, pulverizer means, heating means, and lifting means for successively raising the drilled material from the bottom of a well and passing it through said pulverizer means and said heating means to the surface of a well.

6. In a well drilling apparatus, a tubular housing, a driven rotatable shaft journalled in said housing, a drill extending beyond the lower end of said housing, a spiral conveyor, and a pulverizer within said tubular housing all operatively connected to said driven rotatable shaft for simultaneous operation thereby.

In testimony whereof I affix my signature.

RICHARD P. SIMMONS.