M. T. CHAPMAN.

WELL SINKING APPARATUS.

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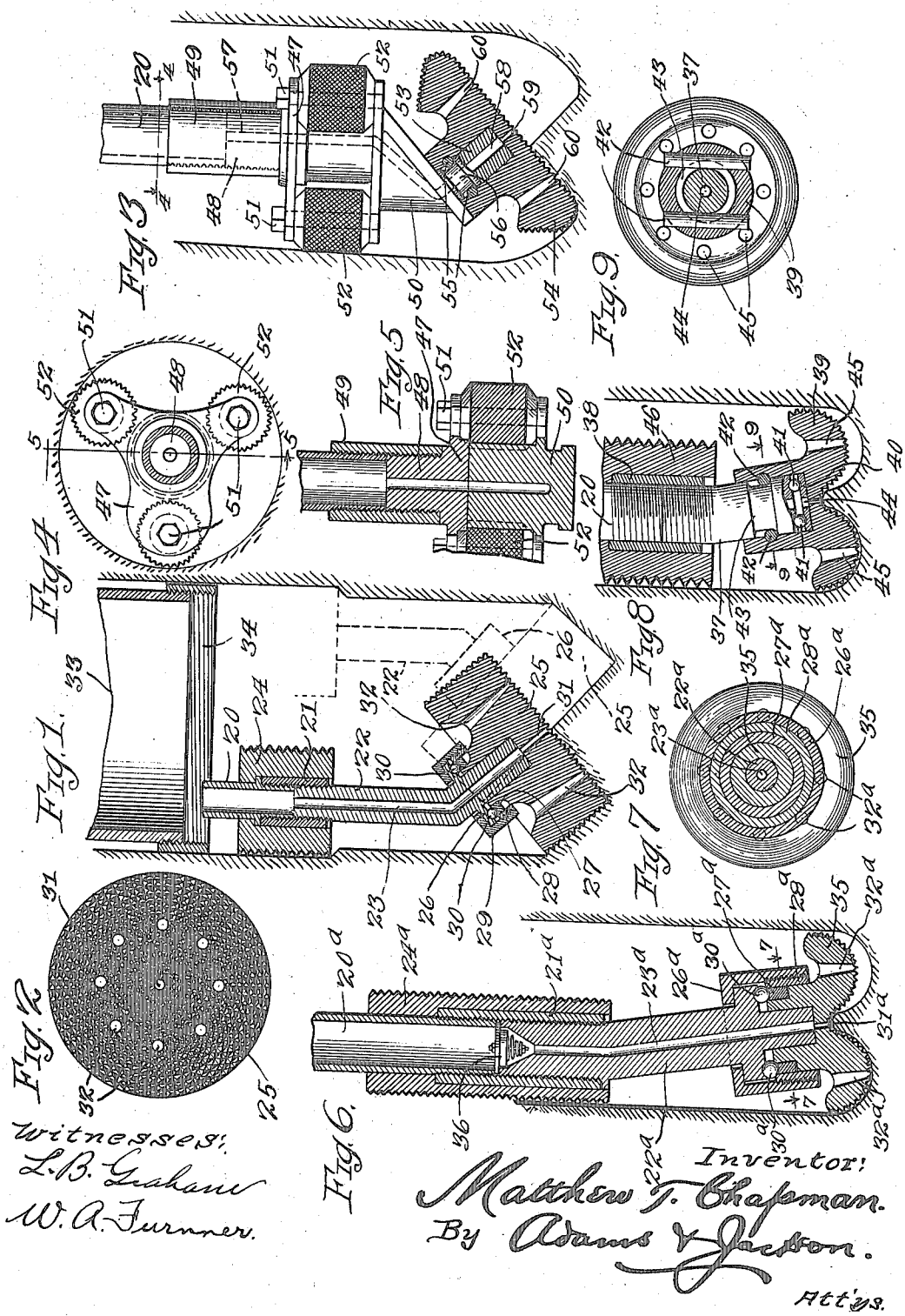

Witnesses:
L. B. Graham
W. A. Turner.

Inventor:
Matthew T. Chapman.
By Adams & Jackson.
Att'ys.

UNITED STATES PATENT OFFICE.

MATTHEW T. CHAPMAN, OF AURORA, ILLINOIS, ASSIGNOR TO THE AMERICAN WELL WORKS, OF AURORA, ILLINOIS, A CORPORATION OF ILLINOIS.

WELL-SINKING APPARATUS.

1,248,614. Specification of Letters Patent. Patented Dec. 4, 1917.

Original application filed April 14, 1913, Serial No. 761,006. Divided and this application filed May 18, 1914. Serial No. 839,381.

To all whom it may concern:

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

This invention relates to well sinking apparatus of the type shown in Letters Patent No. 1,104,409, granted July 21, 1914, upon my application, 761,006, filed April 14, 1913, of which this application is a division, and particularly to the tool mounted upon the lower end of the boring pipe. It is one of the objects of my invention to provide a new and improved form of drill operating in a peculiar manner designed especially for boring through hard strata such as would very quickly dull a rotary drill of the ordinary type. It is another object of my invention to provide a drill capable of boring a hole of considerably greater diameter than that necessary for the withdrawal of the drill, whereby the drill can be withdrawn from the well through a well tube which has been lowered into the bore following closely upon the drill as it advances. It is another object of my invention to provide an effective boring means comprising a drill adapted to be cast with a straight circular bottom face covered with sharp protuberances or teeth, the drill being preferably cylindrical in form provided with sharp protuberances also about its periphery. It is another object of my invention to provide a boring means adapted to be mounted on the lower end of a boring pipe such that upon the rotation of the boring pipe the drill does not rotate with the boring pipe but instead is gyrated or continuously and progressively tipped. It is another object of my invention to provide a boring means adapted to be mounted on the lower end of a boring pipe such that upon the rotation of the boring pipe the drill does not rotate with the boring pipe but instead creeps about the bore, being given a single complete rotation about the well for every six or eight or more complete rotations of the boring pipe. It is another object of my invention to provide a boring means, the progressively-changing lowermost edge of which will groove out the bottom of the hole in advance of the center and edges of the hole, leaving an upwardly-extending central point. It is another object of my invention to provide a boring means which will scrape upward at one side of the hole and at the same time scrape downward at the opposite side of the hole, while at the same time the progressively-changing lowermost part of the drill will be digging into the earth or rock and crushing the particles that have been torn loose. It is another object of my invention to provide a boring means adapted to be mounted on the lower end of a boring pipe such that when the boring pipe is rotated at a high rate of speed the drill is tipped rapidly, the progressively-changing downwardly-moving part of the drill being brought into contact with the earth or rock with an effective blow. As will be readily understood, in the use of such a boring means at high speed, when there are one or more points or parts of the hole of a particularly hard and tough nature as compared to the greater portion of the surface of the hole being acted on by the drill, as the softer parts are cut away faster the progressively-changing downwardly-moving part of the drill will be brought into contact with the particularly hard points with an exceedingly heavy blow such as a boring bit of the ordinary type probably could not withstand without breaking. It is another object of my invention to improve boring means of this type in sundry details hereinafter pointed out. The means by which I have accomplished my object are illustrated in the drawings and are hereinafter specifically described.

In the drawings,—

Figure 1 is a central vertical cross-section through the lower end of a boring pipe equipped with the preferred form of my improved boring means, showing the boring means cutting a hole of such a diameter that the boring means can be withdrawn up-

ward through the well tube which is shown as following the drill as boring progressses;

Fig. 2 is a bottom view of the drill illustrated in Fig. 1;

Fig. 3 is a central vertical section through a modified form of drill;

Fig. 4 is a section on line 4—4 of Fig. 3;

Fig. 5 is a section on line 5—5 of Fig. 4, partly broken away;

Fig. 6 is a central vertical section through another modified form of drill;

Fig. 7 is a section on line 7—7 of Fig. 6;

Fig. 8 is a central vertical section through still another modified form of drill; and

Fig. 9 is a section on line 9—9 of Fig. 8.

Referring now to Figs. 1 and 2, which show the preferred form of my invention, 20 indicates a boring pipe having a coupling sleeve 21 mounted thereon by means of screwthreads, said coupling sleeve serving to connect to said boring pipe an axle member 22 provided with a longitudinally-extending duct 23 leading therethrough and communicating with the interior of said boring pipe. Revolubly mounted upon said coupling sleeve 21 and upon the boring pipe thereabove is a cylindrical reamer 24 having a knurled, chiseled, or toothed periphery. The lower end of the axle member 22 extends at an angle relative to its upper end, whereby the drill 25 mounted on the lower end of said axle member is held at an angle from the horizontal. 26 indicates a circumferential flange formed with the axle member 22 provided on its lower face with a groove for a series of anti-friction balls. 27—28 indicate collars shrunk upon the upper end of the drill 25, the collar 27 being provided with a groove opposite to the groove in the flange 26. The reason for the use of collars 27—28 is that the drill 25 is preferably to be cast of manganese steel which is so hard and tough that it is very difficult to machine it. The sleeve or collar 28, however, may be readily provided with screw-threads by means of which the drill as a whole is secured upon the axle member 22 through the medium of a flanged sleeve 29, the lower end of which is screw-threaded upon the sleeve 28, anti-friction balls 30 being interposed between the flange 26 and the collar 27. The drill 25 has formed in it a central opening 31 communicating with the duct 23 in the axle member 22, and is provided also with a plurality of tapered openings 32.

As has been set forth above, the drill 25 is designed especially for boring in hard strata such as would very quickly dull a drill rotated in the ordinary manner. Ordinarily it is not necessary to use a drill of this type until the boring has progressed some little distance so that by the time it is desirable to use the drill 25 there will be a comparatively heavy line of boring pipe supported by the drill as it is driven. Inasmuch as the boring pipe is revolubly mounted in the drill 25, the drill is not rotated with the bar, but is gyrated or continuously and progressively tipped. As shown in Fig. 2, the lower face of the drill is toothed or chiseled so that the tool is adapted to dig into the earth or rock and break loose particles therefrom which are crushed by the further operation of the tool and are floated upward by the water delivered through the pipe 20. As the particles are broken loose and are crushed by the movement of the drill the broken particles assist the boring tool in digging into the stratum being penetrated. The particles of rock and gritty substance are forced into the earth and then torn loose again, assisting in this way in the boring. This result is accomplished without any material wear upon the drill itself. It is sometimes found to be a good policy to drop into the well a quantity of very hard irregular shaped particles, such as "adamantine," that can be forced into the strata and torn loose again for assisting in the boring. I have found that when such a substance as adamantine is used the particles of such substance are forced into the solid rock or are carried around the hole acting as auxiliary cutting elements. This form of drill is also particularly adapted to a jumping action inasmuch as there are no parts of the drill particularly likely to be broken through the striking of a crushing blow. This form of drill is also extremely unlikely to catch in the bottom of the well. When a drill catches in the bottom of a deep well the continued rotation of the upper end of the pipe causes the pipe to shorten considerably in length causing the pipe to feed at an abnormal rate through the turning means. When, thereafter, the drill is forced loose from the bottom the pipe again stretches out to its normal length very suddenly due to the elasticity of the steel pipes, lifting the turning devices and the turntable at the top of the well and sometimes bringing them down again upon the rotary with a destructive blow. Very often in a case of this sort the mechanism is broken and a serious delay is encountered. Any improvement in drilling apparatus which can overcome this tendency is accordingly of very great importance. Inasmuch as the drill is tipped, the weight of the boring pipe is supported by that part of the drill which is tipped the farthest down. This part of the drill is removed slightly from the outside edge of the well, by reason of which the drill is caused to creep slowly about the well in the same direction in which the

boring pipe is rotated, in addition to its gyratory or tipping movement. This insures that at every point about the periphery of the well a different part of the drill shall be effective at each revolution of the boring pipe, so that the well is kept circular and straight under normal conditions regardless of any undue wearing of any one portion of the drill.

It will be understood that as the boring pipe rotates its lower end will be caused to have a gyratory motion in the well. This gyratory motion of the boring pipe serves to bring the reamer 24 into contact with the wall of the well, reaming out the hole slightly and reducing irregularities therein.

As the drill 25 is tipped progressively in the bottom of the well with the weight of the boring pipe thereon, as above described, the progressively-changing lowermost edge of the drill will drill out the bottom of the hole in advance of the center and edges of the well, leaving an upwardly-extending central point. As the gyration of the drill continues the central portion of the drill will cut away the central point, while one side edge of the drill will be scraping upward on the side of the hole and at the same time the opposite side edge of the drill will be scraping downward. At the same time the lowermost part of the drill will be digging into the earth or rock and crushing the particles that have theretofore been torn loose. If the drill is set at a comparatively great angle from the horizontal the action of the lowermost part of the drill as it shifts progressively about the hole is in the nature of a blow and is very effective especially in some formations.

As the rotation of the boring pipe 20 continues, a stream of water is forced downward through the pipe, the water having a tendency to escape through the joint between the drill 25 and the lower end of the axle member 22 as well as through the opening 31, which is of a reduced size, thus washing out and lubricating the bearings. By the provision of the openings 32 through the drill, the water is permitted to churn upward through the openings, thus assisting in the assimilation of the borings whereby they may be floated upward and out of the well.

33 indicates a well tube provided with a coupling 34 on its lower end, said well tube being adapted to be kept lowered into close proximity to the drill 25 as boring progresses. As can be seen from an inspection of Fig. 1, the boring means comprising the reamer 24 and the drill 25 can be withdrawn readily through the well tube 33. This makes it possible to use my improved drill for boring in strata where it is necessary to keep the well tube lowered into close proximity to the drill.

Referring to Figs. 6 and 7, which illustrate a slightly modified form of device, the parts are indicated by the same reference characters but with the addition of an exponent *a*. In this modified form the drill 35 is set at a considerably smaller angle than that shown in Fig. 1, the bottom face of the drill being substantially hollowed out instead of being straight as in said Fig. 1, the drill being much thinner, and its sides being curved instead of straight. This form of drill set at the angle shown would bore a hole of very little greater diameter than that of the drill itself. I have shown also in this figure a valve 36 of any approved type adapted to open downward to permit water to enter the duct 23^a from the boring pipe but to prevent the upward movement of water therethrough, which would carry the boring up into the duct and close the passage.

In Figs. 8 and 9 there is illustrated another form of drill. In this form of device an axle member 37 is secured to the lower end of the boring pipe 20 by means of a coupling sleeve 38. The drill 39 has the lower end of the axle member 37 inserted in a suitable socket therein, in the end of which socket there is provided a hardened plate 40 which is provided with suitable grooves for anti-friction balls 41 which engage also a suitable groove in the lower end of the axle member 37. The upper end of the drill is provided with openings therethrough for the insertion of pins 42 which work in a groove 43 in the axle member 37 for holding the drill against withdrawal from the axle member. The axle member 37, the plate 40 and the drill 39 are provided with a central duct 44 for the passage of the supply of water from the hollow boring pipe 20. The drill 39 is also provided with openings 45 therethrough corresponding to the openings 32 of the form shown in Fig. 1. A reamer 46 is fixed upon the coupling 38.

Figs. 3, 4 and 5 show still another form of boring means operating in a slightly different manner by reason of the reaming means which hold the drill centered relative to the hole being drilled. In this device 47 indicates a bracket having a screw-threaded lug 48 rising therefrom by which said bracket is connected to the lower end of the boring pipe by means of a screw-threaded coupling sleeve 49. 50 indicates a bracket secured in position in contact with the bracket 47 by means of screws 51, said screws also revolubly supporting reamers 52. The bracket 50 terminates at its lower end in a circular stud 53 extending at an angle of substantially forty-five degrees from the perpendicular. Upon the stud 53 is revolubly mounted a drill 54 which is kept in position on the stud 53 by means

of pins 55 extending through the drill and working in a groove 56 extending circumferentially about said stud. The lug 48 is provided with a centrally located longitudinally extending duct 57 communicating with the hollow boring pipe 20 and connecting at its lower end with a similar duct 58 in the bracket 50. The drill 54 is provided with a central duct 59 communicating with the lower end of the duct 58 in the bracket 50. The drill 54 is also provided with openings 60 extending therethrough. As will be readily understood the action of the reaming devices 52 is substantially the same as that of the reamers heretofore described except that the action is more continuous. In the construction here shown also the reamers serve to keep the lower end of the boring pipe and the drill centered in the hole. This is of especial importance when the drill is passing from a hard stratum into a soft one or from a soft stratum into a hard one. In cases where the drill has been passing for a considerable distance through a stratum of comparatively yielding material and arrives at a stratum of rock or other hard material, the reamers serve to hold the boring pipe centrally of the hole while the drill is penetrating the first few inches of the rock sufficiently to be guided thereby.

So far as I am aware, I am the first in the art to provide for gyrating a drill whereby the edges of the drill are brought down into forcible contact with the bottom of the hole. It will be understood that, when the boring pipe is rotated at high speed and is composed of a great number of sections so as to be correspondingly very heavy, the blow between successive points of the edge of the drill and the bottom of the hole is very sharp, and therefore I consider this feature of very great importance. The claims upon this feature of the invention are to be construed accordingly.

As will be best seen from an inspection of Fig. 1, the line of boring pipe sections by which the axle member is turned for gyrating the drill is positioned at one side of the hole being bored almost directly over the lowermost cutting edge of the drill. It will be understood that as the boring pipe and the axle member are rotated causing the drill to gyrate about the upwardly-extending point in the center of the hole being bored, the boring pipe is also shifted about the hole being kept at all times substantially over the progressively-changing lowermost portion. In this way the weight of the boring pipes is made to be very effective in forcing the drill in the cutting operation. In the operation of the boring means shown in Fig. 1 the drill 25 is given only a small portion of a rotation for each complete rotation of the axle member 22 in the drill. That is to say, as the drill 25 is gyrated by the rotation of the boring pipe the drill creeps about the hole being bored as above explained. This creeping motion of the drill in combination with the tipping motion of the drill causes the drill to have a most effective twisting and crushing action upon the particles of rock which have been torn loose in the operation of boring and which have not been washed upward by the stream of water.

So far as I am aware I am the first in the art to provide a boring means comprising a drill adapted to be gyrated independently of the rotation of the drill, and my claims are to be construed accordingly.

From an inspection of the drawings it will be seen that the axis upon which the drill is revolubly mounted extends diagonally with respect to the axis of the boring pipe, the drill being positioned, in the constructions illustrated in Fig. 1 and certain of the other figures, upon the portion of its axis which diverges diagonally downward from the axis of the boring pipe rather than upon the portion which diverges diagonally upward; that is to say, the drill is located below the intersection of the axis of the boring pipe with the axis of the drill rather than above such intersection. While I prefer to locate the drill in this position, as is specified in certain of the claims, it will be understood that I do not limit myself to this feature of construction except as is specifically claimed.

What I claim as my invention and desire to secure by Letters Patent, is—

1. In a well sinking apparatus, the combination of a drill, and means for giving said drill a progressively-tipping gyration in the hole being bored comprising a boring-pipe, and means revolubly connecting said drill to said boring-pipe upon an axis extending at an angle to the boring-pipe, the rotation of the boring-pipe relative to the drill in operative position in said hole serving to swing the boring-pipe about the center of the hole.

2. In a well sinking apparatus, the combination of a drill, and means for giving said drill a progressively-tipping gyration in the hole being bored comprising a boring-pipe, and means revolubly connecting said drill to said boring-pipe upon an axis extending at an angle to the boring-pipe, the rotation of the boring-pipe relative to the drill serving to swing the boring-pipe about the center of the hole, said drill extending laterally beyond said connections and beyond the lower end of the boring-pipe whereby the connections are kept free from the walls of the hole.

3. In a well sinking apparatus, the com-

bination of a boring-pipe adapted to be rotated in the hole being bored, and a drill revolubly connected with said boring-pipe on an axis positioned at an angle to the boring-pipe, the engagement of the drill with the lower end of the hole serving upon the rotation of the boring-pipe to swing said boring-pipe about said hole, the centrifugal force of the swinging boring-pipe having the effect of bringing the drill forcibly into contact with the sides of the hole.

4. In a well sinking apparatus, the combination of a boring-pipe adapted to be rotated in the hole being bored, and a drill revolubly connected with said boring-pipe on an axis positioned at an angle to the boring-pipe, the engagement of the drill with the lower end of the hole serving upon the rotation of the boring-pipe to swing said boring-pipe about said hole and to give the drill a progressively-tipping gyration in the hole.

5. In a well sinking apparatus, the combination of a boring-pipe the lower end of which is free to move laterally, and a drill revolubly connected with said boring-pipe on an axis diverging diagonally downward from the axis of said boring-pipe, said drill extending laterally at all sides beyond the axis of the boring-pipe.

6. In a well sinking apparatus, the combination of a boring-pipe the lower end of which is free to move laterally, and a single drill revolubly connected with said boring-pipe on an axis diverging diagonally downward from the axis of said boring-pipe and adapted by itself upon the rotation of the boring-pipe to open a hole of a diameter to accommodate the rotating boring-pipe as said pipe is swung by the gyration of the drill.

7. In a well sinking apparatus, the combination of a boring-pipe the lower end of which is free to move laterally, and a drill in alinement with said boring-pipe and revolubly connected therewith on an axis extending diagonally relative to the axis of the boring-pipe, said drill having a toothed lower face the general alinement of which is at right angles to the axis about which the drill is revolubly mounted.

8. In a well sinking apparatus, the combination of a boring-pipe the lower end of which is free to move laterally, a drill, and means for connecting said drill with said boring-pipe in alinement with the pipe and revoluble on an axis extending diagonally relative to the axis of the pipe, the extreme horizontal dimensions of the drill as supported diagonally on the boring-pipe being comparatively much greater than the extreme horizontal dimensions of the boring-pipe at its lower end and the means for connecting the drill with the pipe.

9. In a well sinking apparatus, the combination of a boring pipe, a circular drill, and connections between said boring pipe and said drill by which said boring pipe is revolubly mounted relative to said drill, said connections comprising a bar mounted on the lower end of said boring pipe at an angle thereto, a flange on said bar, a flanged sleeve mounted on said bar engaging the flange thereof, and a collar secured upon said drill and having screw-threaded connection with said flanged sleeve.

10. In a well sinking apparatus, the combination of a boring pipe, a circular drill, and connections between said boring pipe and said drill by which said boring pipe is revolubly mounted relative to said drill, said connections comprising a bar mounted on the lower end of said boring pipe at an angle thereto, a flange on said bar, a flanged sleeve mounted on said bar engaging the flange thereof, a collar secured upon said drill and having screw-threaded connection with said flanged sleeve, and anti-friction devices interposed between the lower face of said flange and said drill.

11. In a well sinking apparatus, the combination of a boring pipe adapted to be rotated in the hole being bored, and means actuated by the rotation of the boring pipe for moving the lower end of said boring pipe substantially in a circle about the center of the hole being bored, comprising an axle member fixedly mounted on the lower end of said boring pipe, and a drill pivotally connected to said axle member upon an axis extending at an angle relative to the boring pipe.

12. In a well-sinking apparatus, the combination of a boring pipe adapted to be rotated in the hole being bored, and means actuated by the rotation of the boring pipe for moving the lower end of said boring pipe substantially in a circle about the center of the hole being bored, comprising a substantially cylindrical drill pivotally connected to said boring pipe on an axis extending at an angle relative to the boring pipe, said drill being provided with substantially chisel-shaped teeth on its circumferential periphery and its bottom face adapted to strike into the walls of the hole by reason of the vibration and gyratory movement of the drill under the influence of the rotating boring pipe.

13. In a well sinking apparatus, the combination of a boring pipe adapted to be rotated in the hole being bored, and means actuated by the rapid rotation of the boring pipe for moving the lower end of said boring pipe substantially in a circle about the center of the hole being bored, comprising a toothed drill pivotally connected to said boring pipe on an axis extending at an angle

relative to the boring pipe, the rotation of the boring pipe having the effect of continuously tipping and gyrating the drill upon its angularly-disposed axis and the centrifugal force generated by the swinging of the boring pipe having the effect of bringing the teeth of the drill forcibly into contact with the bottom and the side walls of the hole being bored whereby such teeth strike a substantially continuous succession of quick heavy blows.

MATTHEW T. CHAPMAN.

Witnesses:
W. H. De Busk,
W. A. Furnner.