Oct. 6, 1931. W. J. NEWMAN 1,826,087

APPARATUS FOR DRILLING WELLS

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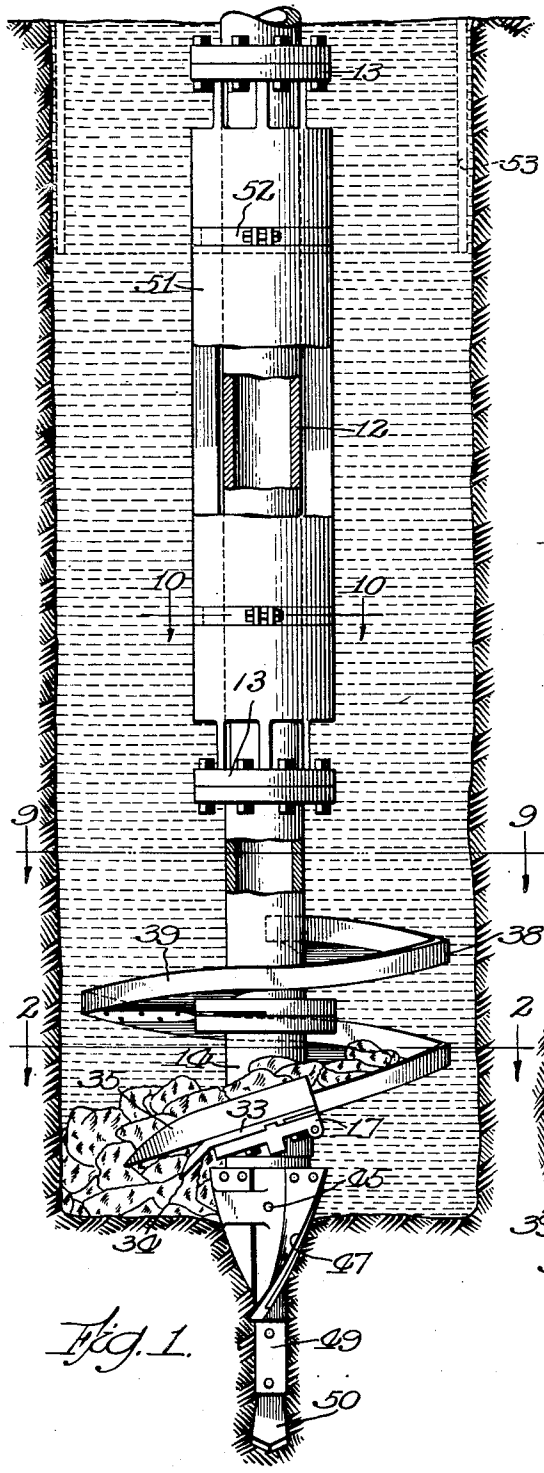


Fig. 1.

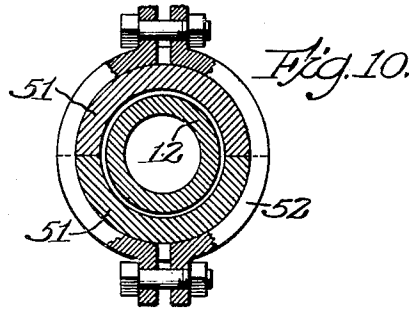


Fig. 10.

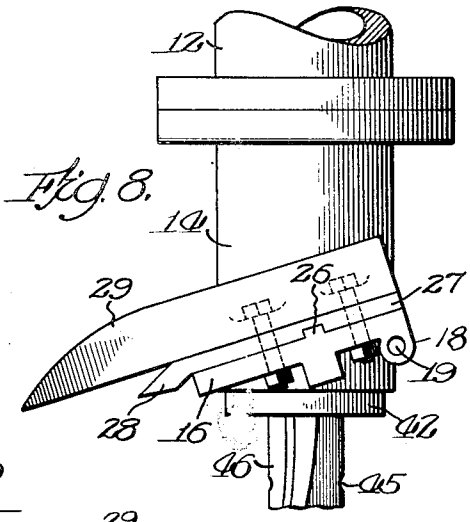


Fig. 8.

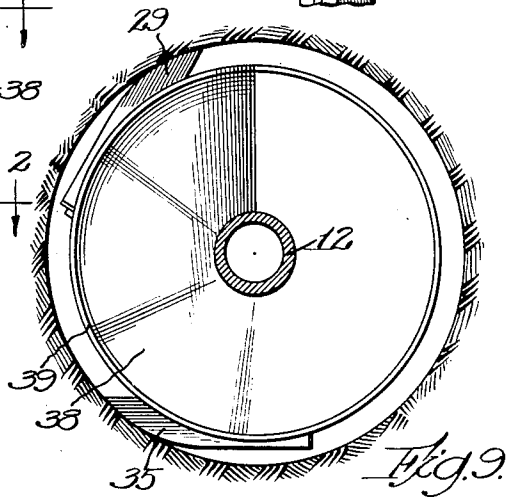


Fig. 9.

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Fig. 2.

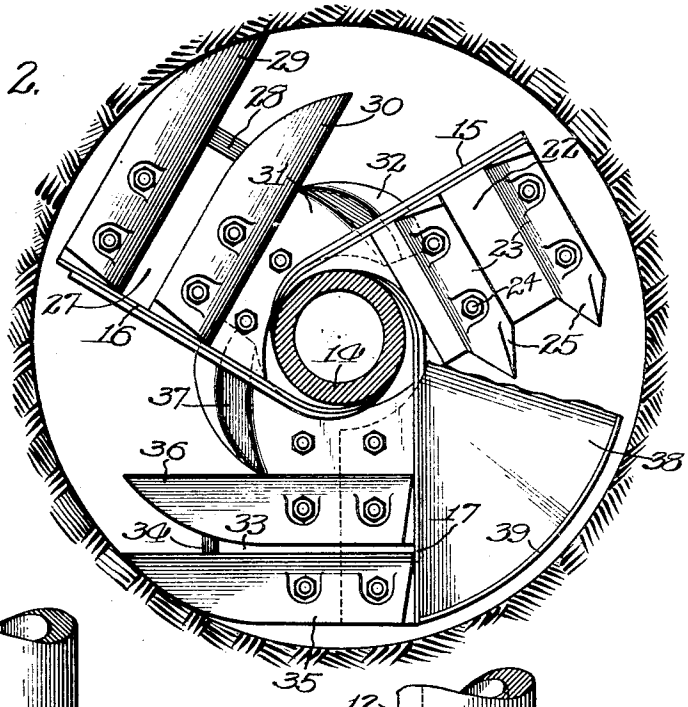
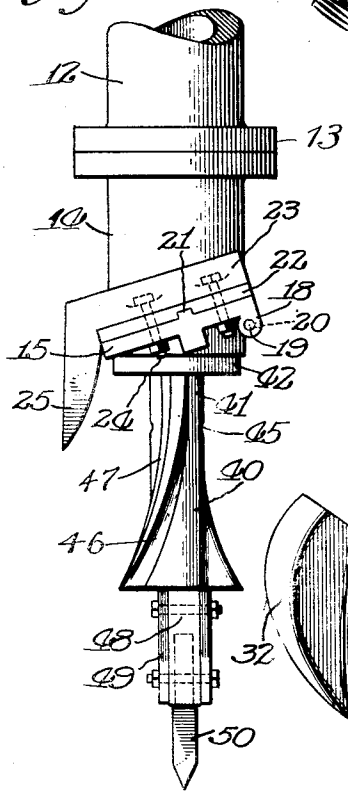


Fig. 3.



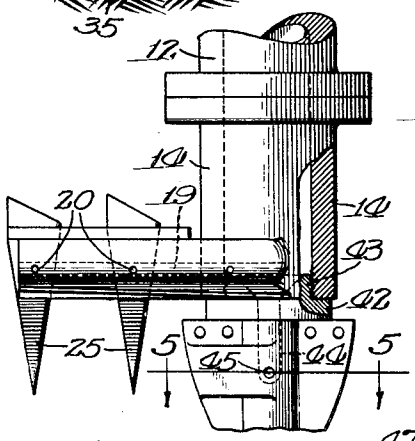


Fig. 4.

Fig. 5.

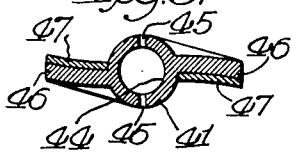


Fig. 6.

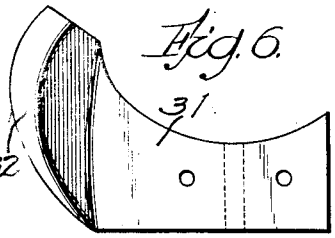
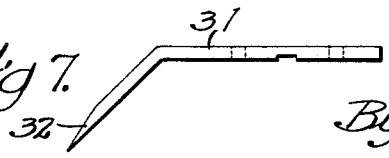


Fig 7.



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Patented Oct. 6, 1931

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UNITED STATES PATENT OFFICE

WILLIAM J. NEWMAN, OF CHICAGO, ILLINOIS

APPARATUS FOR DRILLING WELLS

Application filed March 19, 1928. Serial No. 262,802.

In digging wells for foundations, it is the common practice to do the excavating by hand and remove the excavated material as the digging progresses. These foundation wells are of various sizes but frequently run five or six feet in diameter and up to a hundred feet or more in depth. As the digging progresses, lagging is put in place to prevent caving of the walls. In accordance with the present invention, I provide power driven excavating or drilling apparatus which will drill holes of the proper size, and instead of removing the earth as the work progresses, preferably keep the hole filled with water and leave the excavated and loosened earth mixed with water in the hole as the work progresses. Water is used in connection with the digging apparatus, but this water is preferably pumped from the top of the well down through the piping to the cutter head and used over and over again. After the well has been dug to the desired depth, the digging apparatus is removed, a suitable casing preferably formed of steel is inserted the full depth of the hole, the water and earth are then removed from the hole and in order to complete the foundation concrete is placed in position in the bottom of the hole and the casing is gradually withdrawn as the filling takes place.

The objects of this invention are to provide a new method of drilling wells or the like which will be rapid and economical; to provide an improved cutter head or cutting apparatus for drilling relatively large wells or holes in the earth; to provide an improved well drilling apparatus which will be comparatively simple in construction and durable and efficient in operation; to provide means for excavating large holes whereby the cutting or excavating progresses gradually from a small diameter to a relatively large diameter in a step-by-step or gradually increasing radius; and to provide such other novel steps of procedure and features of construction as will be described more fully hereinafter.

In the accompanying drawings illustrating this invention,

Figure 1 is a sectional view of a well showing my improved apparatus in operative position;

Figure 2 is an enlarged sectional plan view taken on the line 2—2 of Figure 1;

Figure 3 is an enlarged side view showing a portion of the digging apparatus;

Figure 4 is a view taken at approximately right angles, showing the parts illustrated in Figure 3;

Figure 5 is a sectional view taken on the line 5—5 of Figure 4;

Figures 6 and 7 are details of some of the cutting and elevating devices;

Figure 8 is a view similar to Figure 3, showing another of the cutter arms;

Figure 9 is a sectional view taken on the line 9—9 of Figure 1; and

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

In the particular form of the invention as shown in these drawings, a drill pipe 12 is provided which is preferably arranged with end flanges 13 so that the pipe may be increased in length by adding sections at the top as the work progresses. Any suitable means (not shown) may be used for turning or rotating the pipe 12. The earth or material to be excavated may be, and usually is, of various kinds such as clay, gravel and occasionally rocks or boulders may be encountered, but the device is not intended for cutting through solid rock formation.

It has heretofore been proposed to drill wells by means of apparatus having cutter members in which the principal cutting operation is done in a single horizontal plane, but I have found that with apparatus of this character, particularly when stones are encountered, there is a tendency for the cutter head to rotate on the top of the stones; consequently the cutters are dulled without making any substantial progress.

In accordance with the present invention I provide a cutter head having drilling instrumentalities with gradually increasing radius and means for holding the excavated material in raised or elevated position above the cutter head. A hollow cylinder or head 14 is bolted or otherwise secured to the lower end of the pipe 12 and is provided with one or

more radially arranged arms such as shown at 15, 16, and 17. These arms are preferably formed integrally with the cylinder 14 and are arranged diagonally or at an angle to the horizontal plane. These arms have tubular projections 18 which are preferably formed integrally therewith and are provided with outlet holes 19 at the ends and other outlet holes 20 in the sides thereof to permit water to flow outwardly from the cylinder 14.

Each of the arms is preferably provided with different types or differently arranged cutting and excavating members, for instance the first arm 15 has a longitudinal key or rib 21, and its upper surface is provided with a plate 22 which is preferably formed of steel and provided with a groove for receiving the rib 21. One or more rooter teeth or earth loosening members 23 are secured to the arm 15 by means of bolts 24 and have forwardly and downwardly projecting portions 25 which have approximately V-shaped cutting portions for engagement with the earth. These teeth are intended to cut into and loosen the material, and in the event of encountering rocks or boulders will tend to dislodge the same.

The second arm 16 is also provided with a rib 26 and has a plate or blade 27 on its upper surface, this plate being provided at its forward edge with a downwardly and forwardly extending cutting and elevating lip or projection 28, as shown particularly in Figure 8. This arm also has two plow teeth or excavating devices 29 and 30 which are secured thereto by means of bolts. The forward end of the outer tooth 29 is curved and is positioned so that it cuts approximately the full diameter of the well, while the inner tooth 30 is somewhat shorter and its forward end is preferably positioned so that it will cut intermediate of the rooter teeth 23. These plow teeth are preferably tapered in cross section or somewhat thicker at the outer edge than at the inner edge so that they will have a tendency to throw the material inwardly. The arm 16 also has an excavating and elevating leaf blade 31 secured thereto with its forwardly and downwardly projecting excavating edge 32 arranged to engage with material adjacent to the cylinder or head 14. The operating members on the arm 16 are preferably arranged to excavate and also to elevate some of the material which will have a tendency to fall over back of the arm.

The third arm 17 is also provided with a steel plate 33 which is similar to the plate or blade 27 but which has a projecting cutting edge 34 that extends downwardly below the cutting edge 28. This arm is also provided with plow teeth 35 and 36 which are similar to the teeth 29 and 30 but arranged to cut at slightly different distances from the axis of rotation. This arm is also provided with an inner leaf blade 37 which is similar to the blade 31. The devices on the arm 17 are intended to do the final outer cutting and also to elevate the material which passes up over the arm onto a spiral elevator or conveyor 38. This spiral conveyor or elevator encircles the central pipe and extends out to approximately the outer diameter of the drill and is of sufficient length so that the material which is forced or carried upwardly on the same will be held in raised position or off from the bottom of the drill hole, as will be explained more fully hereinafter. This conveyor may be made of any suitable material such as sheet steel or the like and is preferably provided with an upwardly extending flange 39 around its outer periphery.

Below the cylinder or head 14 is arranged another cutting device 40 which is somewhat on the order of a twist drill or auger and which is of less diameter than the above described cutting mechanism. This cutting device comprises a central shaft 41 having an outwardly extending flange 42 at its upper end and provided with a threaded extension 43 which engages with the threaded lower end of the cylinder 14. The shaft 41 has a hole 44 which extends downwardly from the upper end and has outlet holes 45 to provide jets on either side thereof. The shaft 41 has integrally formed spirally arranged blades or wings 46 which are provided on their front faces with fish-tail cutter blades 47 which are preferably formed of steel or other suitable cutting material. These cutting blades preferably extend out somewhat beyond the flange 42 and cylinder 14 so that the material which is excavated and raised thereby will be discharged in position to be acted upon by the inner cutting and elevating blades 31 and 37.

The shaft 41 has a downwardly extending projection 48 which is flattened to receive two steel plates 49 which are secured to either side thereof and which are preferably tempered and provided with ground edges so that they not only protect the shaft but also serve for cutting purposes. A drill point 50 is secured in the lower end of the extension 48 and is preferably made of suitable drilling material or steel so that it will cut through all materials which are likely to be encountered and will serve as a guide for the entire drilling apparatus.

It will be noted that as the drilling proceeds and the drill reaches a considerable depth, the buoyancy of the water tends to reduce the effective weight or pressure upon the drill which is usually depended upon for forcing the drill into the material or expediting its cutting. In order to counteract such tendency and to provide for additional pressure, I provide a cylindrical weight 51 which is split so that it will fit over one of the lower sections of the pipe, as shown

in Figure 1, and is provided with grooves for retaining bands or rings 52 which hold the two halves in position on the pipe. With a drill adapted for cutting a well of approximately four feet in diameter and one hundred feet deep, I provide weights such as shown which are of sufficient size to weigh approximately four thousand pounds.

When a well is to be drilled, the drilling machine is arranged in position with the drill point 50 positioned at the center of the hole and the drill is then rotated which causes the drill point to make a drift hole and thereby guide the succeeding cutting devices. As the point 50 moves downwardly it is followed by the plates 49 which may do some cutting and then by the auger or twist drill cutting device 40 which enlarges the hole and further serves to center and guide the drill. Water being forced downwardly through the pipes 12 and 14 passes out through the holes 45 and the jets thus formed serve to soften and loosen the material which is being acted upon by the auger 40. This is followed by the action of the first rooter teeth 23 on the arm 15 which stir up and loosen the material in wider circles, and if any stones or boulders are encountered they tend to dislodge the same and eventually move them into position to be engaged by the succeeding digging and elevating mechanisms. These rooter teeth are succeeded or followed by the cutting plate 27 and the plow teeth 29 and 30 and the blade 31 on the arm 16 which further enlarge the drill hole or well and also tend to raise or elevate the material which passes upwardly over the same and drops down at the rear of the arm. The cutting and elevating devices on the next arm 17 complete the forming of the diameter of the well, and the material which is gathered thereon is forced backwardly over the arm and up onto the spiral conveyor 38.

It will be understood that in the mean time water is also pouring out through the pipes or outlets of the several arms, thereby tending to soften and loosen the material which is churned into more or less of a muck or sludge before it passes up onto the conveyor. This water is preferably pumped from the top of the well back down through the pipe, being used repeatedly so that practically all of the loosened earth remains in suspension in the well and the weight of this mud or sludge tends to support the walls of the hole during the drilling operation.

The conveyor 38 holds such material in somewhat elevated position or so that it does not fall back onto the bottom of the well. In some kinds of earth or dirt such conveyor may not be essential; but if gravel or stones or other similar heavy material is encountered, such material will ordinarily fall or remain on the bottom of the well where it will be encountered again and again by the drilling devices, thereby tending to rapidly dull or wear the same without permitting any substantial progress to be made. The weight 51 may be applied as the drilling starts or if desired may be applied later after the well has reached considerable depth.

If the well is to be filled with concrete, as for foundation purposes, a casing may be introduced, as shown at 53, which is usually done after the drill has been removed, although if the hole is somewhat larger than the drill this casing may be of sufficient diameter to pass over the drill before it is removed.

After the drill has been removed the mud or earth and water filling the hole is then taken out and concrete is poured in. As the concrete gradually rises in the bottom of the hole the casing is withdrawn so that there is finally a solid column of concrete with its outer surface in intimate engagement with the walls of the hole.

From this description it will be seen that I provide a novel method of drilling in that the excavated material is held off from the bottom of the hole while at the same time being retained in the hole, the buoyant action of the water being of considerable assistance in this connection. Furthermore I provide means whereby there is a gradual increase in the diameter of the hole due to the different cutting or drilling instrumentalities whereby the material to be drilled is attacked in the most advantageous manner in order to loosen and elevate the same without undue wear and strain on the drill.

It will be noted that changes may be made in the details of construction, arrangement of the parts and method of operation without departing from the comprehensive features of this invention which I do not wish to limit to the exact forms herein discussed, except as specified in the following claims in which I claim:

1. The combination with a pipe which is adapted to be rotated, of a cylindrical head secured to the lower end of the pipe and having a plurality of radially arranged flat arms with their upper surfaces at an angle to the direction of rotation, conduits leading from the cylindrical head and formed integrally with said arms and having outlet holes, one or more teeth secured to one of said arms, cutter blades and plates secured to the other arms, a spiral conveyor coacting with one of the arms and adapted to convey the material upwardly for a predetermined distance, and advance drilling members carried by said cylindrical head and adapted to guide the cylinder head with its excavating devices.

2. In a drilling apparatus, the combination of a pipe which is adapted to be rotated, a cylindrical head secured to the lower end of said pipe, a plurality of radially arranged flat arms carried by said head with their up-

per surfaces at an angle to the horizontal, earth loosening and cutting devices carried by said arms, a spiral conveyor extending rearwardly and upwardly from one of said arms, a shaft secured to the lower end of the cylinder, a plurality of spiral cutting blades carried by said shaft, a passageway through the shaft and passageways formed integrally with said arms which communicate with the passageway through the shaft having outlets through which water may be forced from the pipe, and a drill point secured to the lower end of the shaft.

3. A power driven drilling apparatus for drilling relatively large holes such as foundation holes of approximately four feet or more in diameter, comprising a tubular shaft through which water may be passed, a central drill point at the lower end of the shaft adapted to drill a guide hole and serving as a bearing for the shaft and other drilling members, a spiral auger of greater diameter than the drill point arranged above the point, outwardly projecting arms carried by the pipe and arranged above the auger and excavating devices carried by the arms for cutting a larger diameter than the auger and completing the full diameter of the hole.

WILLIAM J. NEWMAN.