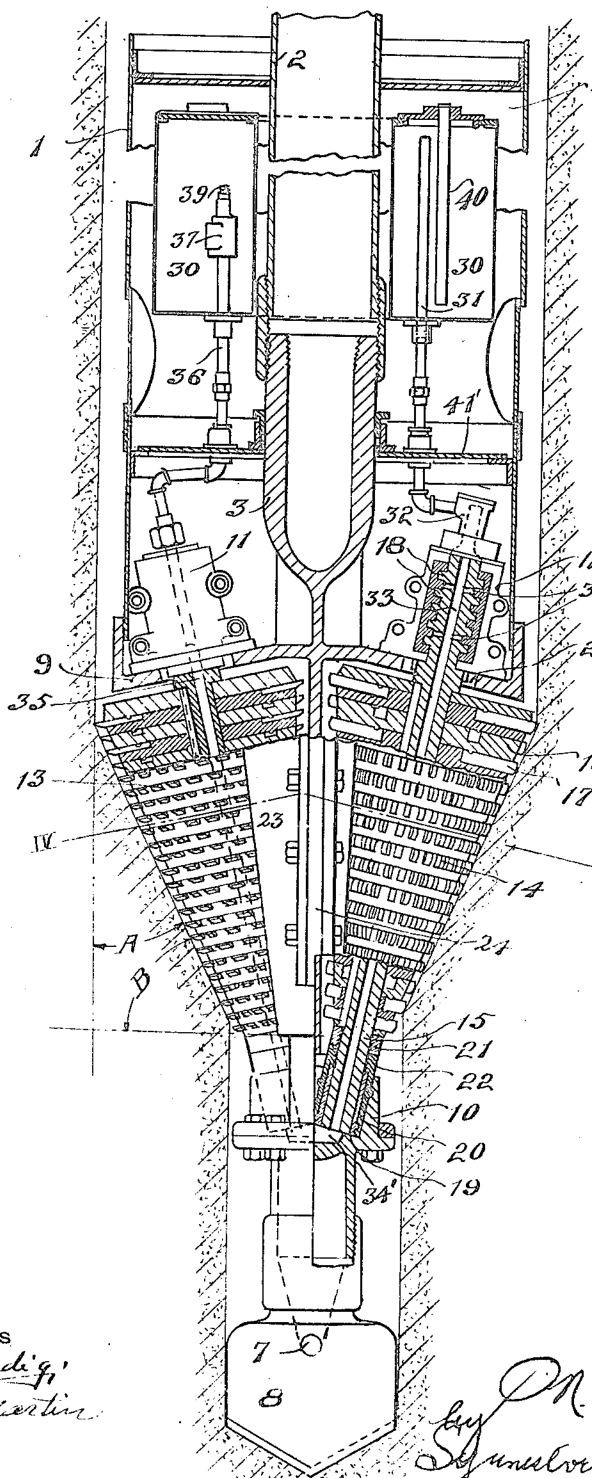
M. E. LAYNE.
DRILLING APPARATUS.
APPLICATION FILED DEC. 1, 1913.

1,302,058.

Patented Apr. 29, 1919.

3 SHEETS—SHEET 1.

Fig. 1



WITNESSES
Julian H. Kendig,
Archworth Martin

INVENTOR
M. E. Layne
By Wm. H. Bradley
Att'ys.

M. E. LAYNE.

DRILLING APPARATUS.

APPLICATION FILED DEC. 1, 1913.

1,302,058.

Patented Apr. 29, 1919.

3 SHEETS—SHEET 2.

Fig. 8

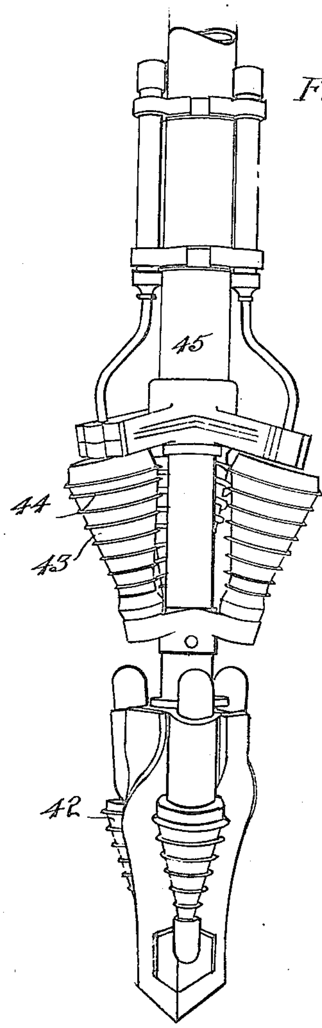


Fig. 2

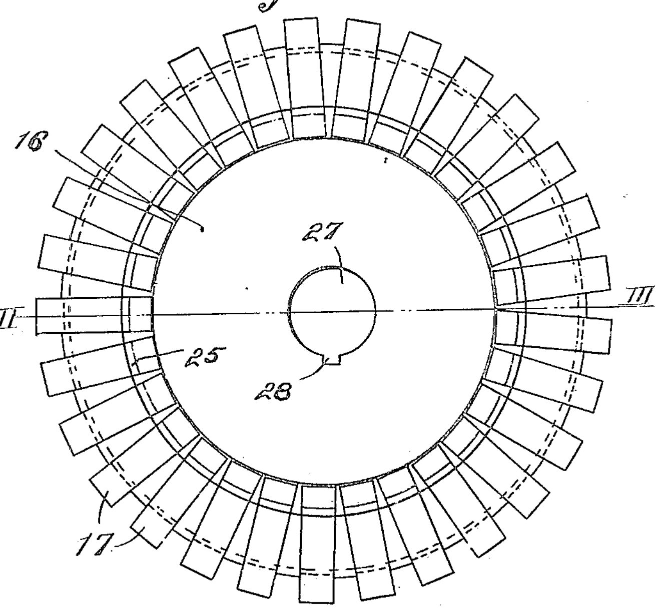


Fig. 3

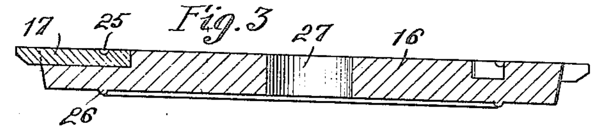
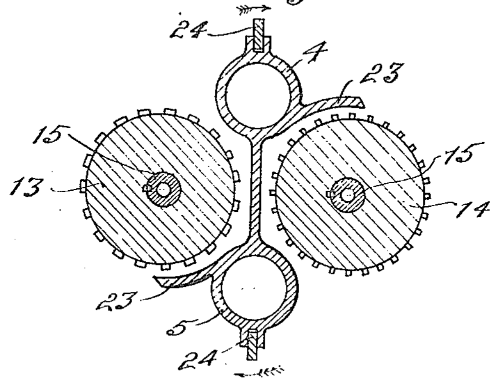


Fig. 4



WITNESSES

Julian H. Kendig,

Archworth Martin

INVENTOR

M. E. Layne

by Symmetner & Bradley

Att'ys.

M. E. LAYNE.

DRILLING APPARATUS.

APPLICATION FILED DEC. 1, 1913.

1,302,058. Patented Apr. 29, 1919.

3 SHEETS—SHEET 3.

Fig. 5

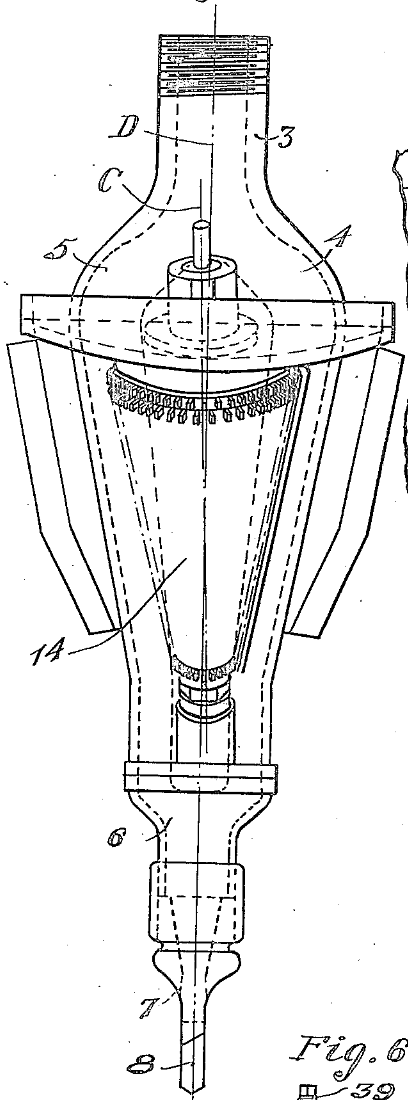


Fig. 7

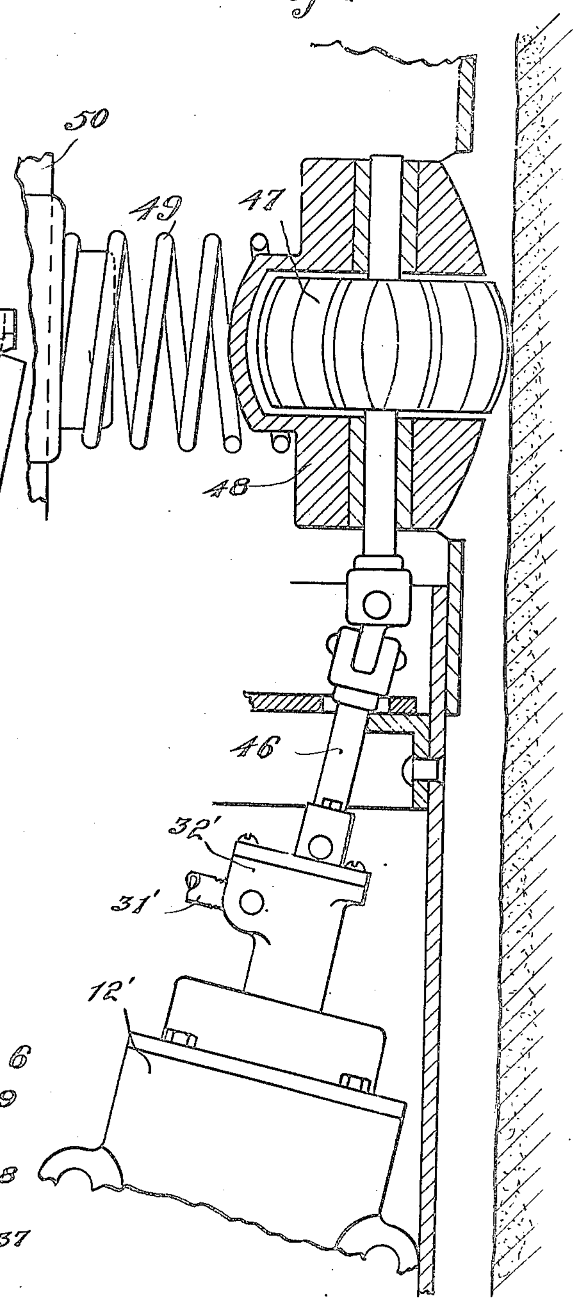
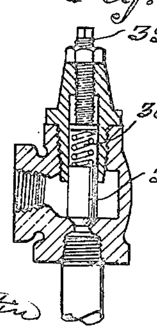


Fig. 6



WITNESSES

Julian H Kendig, Jr.

Archworth Martin

INVENTOR

M. E. Layne

by Synnestvedt & Bradley

Att'ys.

UNITED STATES PATENT OFFICE.

MAHLON E. LAYNE, OF HOUSTON, TEXAS.

DRILLING APPARATUS.

1,302,058. Specification of Letters Patent. Patented Apr. 29, 1919.

Application filed December 1, 1913. Serial No. 803,868.

To all whom it may concern:

Be it known that I, MAHLON E. LAYNE, a citizen of the United States, residing at Houston, Harris county, Texas, have invented certain new and useful Improvements in Drilling Apparatus, of which the following is a specification.

The invention relates to drilling apparatus for use primarily in the boring of wells, although it will be understood that holes for any purpose and extending in any direction may be bored or drilled by the use of this apparatus. The invention has for its principal objects: the provision of an apparatus wherein a boring and reaming action may be advantageously carried on simultaneously; the provision of an apparatus wherein the wear upon the individual cutters is reduced to a minimum and the distance which it is possible to penetrate with the apparatus without renewal of the cutters correspondingly increased; the provision of means arranged so that a screwing action by the reamers is secured combined with a wedging action, thus increasing the rapidity of the drilling operation; the provision of an arrangement wherein the action of all of the cutters is a crushing one and wherein the wear is equalized between the various cutters; the provision of an arrangement of cutters whereby the downward advance thereof is made in a series of steps with more or less jolting action, thus increasing the crushing effect of the cutters and adding to the rapidity of the eroding action as compared with apparatus having a smooth uniform advance of the cutting mechanism; the provision whereby the stalling of the rotary cutting means is avoided; and the provision of improved means for securing a lubrication of the various bearings employed with the rotary cutting or crushing means. Certain embodiments of the invention are illustrated in the accompanying drawings, wherein—

Figure 1 is a longitudinal section through the lower part of the apparatus, Fig. 2 is a plan view on an enlarged scale, of one of the cone disks with the cutters in position in the various cutter grooves, Fig. 3 is a section on the line III—III of Fig. 2, Fig. 4 is a section on the line IV—IV of Fig. 1, Fig. 5 is a side elevation of the apparatus of Fig. 1, Fig. 6 is a section on an enlarged scale through the check valve in the oil reservoir, Fig. 7 is a side elevation partly in section of a modification of the lubricating mechanism, and Fig. 8 is a side elevation of another modified form of apparatus.

Referring first to Figs. 1 and 5, the framework of the apparatus, which may be constructed in a variety of ways, preferably consists of the cylindrical portions 1 and 2 and the casting 3 all rigidly secured together and rotatable from above by mechanism which may be of any approved type and which constitutes no part of my present invention. The tubular portions 2 and 3 are designed to constitute a passageway for the supply of water to the lower end of the apparatus, and by reference to Fig. 5 it will be seen that the member 3 is formed into two diverging branches 4 and 5 which converge at their lower ends into the single passage 6 from which there is an outlet opening 7 adjacent the extreme lower end of the cavity being formed.

The extreme lower end of the frame is provided with a diamond pointed drilling member 8 which may be of any approved type and is designed to form a cavity of relatively small diameter in advance of the drum cutting means to be later described, which acts as a reamer to enlarge the cavity formed by the drilling member 8. This arrangement does away with the necessity of boring a relatively small starting hole, as has heretofore been the practice, since with my apparatus the starting cavity and the enlargement thereof can be formed at the one operation, thus effecting economy of time and effort. Even though the starting cavity should be separately formed, the use of the drill 8 in connection with the reaming devices is advantageous, since the operation of the reaming devices tends to fill up the preliminarily formed guide bore, and it will in such cases free the passage of the accumulation of dirt and stones. The drill 8 also serves as a guide or steady means for the lower end of the apparatus, insuring a straighter bore than would be the case if the device were not employed.

The casting 3 is also provided with a flanged portion 9 and an enlargement 10. The flange 9 serves as a support for the two bearings 11 and 12, while the enlargement 10 is provided with a pair of recesses for carrying the journals of the conical reaming drums 13, 14. Two of these drums are illustrated, although any desired number may be employed.

The drums 13—14 are similar, and each comprises a hollow shaft 15, a plurality of flat disks 16 each keyed to the shaft so that they all rotate together, and a plurality of cutters 17 clamped between the various disks. The upper end of each shaft is provided with a plurality of ribs 18 which are engaged by the thrust bearings 11 and 12, so that the thrust in both directions is taken at these bearings. The lower end of the shaft is provided with a brass 19 rotating in the babbitt 20, and a clamping action upon the disks carried by the shaft is secured by means of the nut 21 threaded upon the shaft and locked in position by means of the lock nut 22.

The axes of the drums are inclined at a relatively small angle with respect to the axis of rotation of the frame, and the angle of divergence between the sides of the cones is also made relatively small in order that the angle A (Fig. 1) which the side of the cone makes with the vertical is less than the angle B which the side makes with the horizontal. By making the angle A less than the angle B a pronounced wedging action of the drums in the earth being cut is secured, so that a much more vigorous abrading or cutting action is secured than is the case where the line of inclination of the outside of the cone approaches the horizontal, as in prior constructions. Another advantage incident to this arrangement results from the fact that more cutters can be used, due to the length of the cones. Where a larger number of cutters are employed the wear upon each cutter is reduced, and as a result the apparatus can be made to penerate a much greater distance into the earth without removal for replacement of the cutters than is the case where the sides of the cones approach the horizontal and work at substantially the bottom of the cavity being cut instead of upon the side thereof. The cutting drum of conical form also has the further advantage over a drum of cylindrical form, in that the cutters wear more uniformly. With drums of cylindrical form, there is a tendency of the teeth upon certain portions of the drums to drag through the material, while with a conical drum the amount of material passed over by each part of the drum is proportional to its speed of rotation, so that the action of all the teeth is purely a crushing or rolling action instead of a shearing action. By reference to Fig. 1, it will be noted that the plane of the cutters of the drum 13 is different from that of the cutters of the drum 14, which arrangement tends to secure a more effective abrasion of the surface upon which the cutters act than is the case where all of the cutters lie in the same position.

In order to prevent a wedging or clogging action of the material cut by the drums, with respect to the framework of the machine, the guards or shields 23 shown in Fig. 4 are employed. These shields follow the curvature of the drums and prevent material from wedging between the drums and the framework, which action would tend to stall the machine. The shields are placed relatively close to the drums so that any particles of material which pass between the drums and the shields can be carried clear around by the drums without clogging. In order to steady the lower portion of the machine against lateral movement the projecting members 24 also shown in Fig. 4 are provided. These members project out to a point about the same distance from the center of rotation of the frame as the outer sections of the drums, so that the framework is held against movement in all directions. The necessity for members of this kind is of course reduced where the number drums is increased.

The construction of the disks 16 and cutters 17 will be readily understood by reference to Figs. 2 and 3. The face of the disk 16 is provided with a plurality of radial recesses in which the cutters 17 fit. The faces of the cutters are provided with transverse grooves 25, and when the cutters are in position these grooves are all in alinement and adapted to be engaged by a rib on the face of the next disk, such rib corresponding to the rib 26 on the under face of the disk shown in Fig. 3. The cutters are thus held securely against movement in all directions, without the use of screws or additional fastening means, and cannot be removed until the drums are disassembled. I have found that separate teeth or cutters of this kind give a better abrading action than is the case where continuous circular cutting disks are employed, and also that the surface acted upon is more uniformly and smoothly cut down, as the employment of continuous cutting disks such for instance as illustrated in Fig. 8 tend to cut steps or grooves in the face of the material, thus giving an uneven surface. Cutters which become worn and too short for use in the upper portions of the drum may be advantageously used when placed a step lower down in the drum.

As indicated in Fig. 2, the opening 27 through the disk is provided with a key way 28 so that the disks will turn with the shaft upon which they are mounted, and it will be further noted that the opening 27 is eccentric with respect to the outer edge of the disk. When the disks are assembled a drum is secured which is eccentric with respect to the axis of rotation. This arrangement gives a more rapid reducing action than is the case where the axis of rotation is concentric with the outer surface of the drum. The eccentricity of the drums secures a somewhat uneven cutting of the material in which the apparatus is working, and as a result the apparatus moves down from time to time with a jolt, so that in effect a downward blow is struck at intervals increasing the crushing effect of the cutters.

Another feature of my construction, tending to increase its efficiency, will be understood by reference to Fig. 5, from which it will be seen that the axis of rotation C of the drum 14 is inclined laterally with respect to the axis of rotation D of the frame. The effect of this inclination is to give the drums somewhat of a screwing action tending to pull the apparatus downward, it being understood that the drums are all tilted laterally in the same circumferential direction. This increases the downward feed of the device, and assists in forcing the drill 8 downward, so that it is feasible to accomplish both the drilling and the reaming at the one operation. A slight adjustment of the upper end of the shaft 15 is made possible by providing a clearance space 29 in the flange 9 (Fig. 1) at the upper end of each of said shafts. The bearings 11 and 12 are secured to the flange by means of cap screws (not shown), and by shifting the cap screws the bearings 11 and 12 can be adjusted to vary the inclination of the shafts 15.

The bearings at the upper and lower ends of the shafts 15 are oiled automatically from an annular reservoir 30 which surrounds the pipe 2. Extending downward from the upper portion of the reservoir is a pipe 31, such pipe communicating with a pump 32 carried on the top of the bearing 12. This pump 32 may be of any of the well known rotary types, and is operated by the end of the shaft 15 which extends up inside the pump as indicated in dotted lines. The rotation of the shaft 15 operates the pump and forces a supply of oil down through the passage 33 in the shaft 15. This shaft 15 is provided at its upper end with transverse passages 34 by means of which the lubricant secures access to the bearing 12. The oil is then forced to the lower end of the shaft to the chamber 34′ from which point it is forced up into the bearings at the lower ends of the shafts. The chamber 34′ communicates with the passage 35 through the shaft of the drum or roller 13, so that the oil is forced up through this passage and oils the bearing 11 which is similar in construction to the bearing 12. The oil which passes this bearing 11 is then forced up through the passage 36 and discharges into the reservoir 30 from which it started. The upper end of the pipe 36 is preferably provided with the check valve 37 shown in enlarged detail in Fig. 6, such check valve preventing a back flow of oil through the pipe. This check valve is held in closed position by means of a spring 38 regulated by the screw 39. Extending into the top of the reservoir 30 is a pipe 40 in communication at its upper end with the space 41. During the drilling operation this space 41 is flooded with the water supplied from the outlet 7, and as a result, the reservoir 30 fills with water as the oil is pumped therefrom. The oil being lighter than water floats upon the top of the water, so that all of the oil is discharged into the pipe 31 before any water can gain access to such pipe 31. The reservoir 30 is of course supplied with sufficient oil to last during the drilling operation, so that ordinarily no water is allowed to pass through the pipe 31. The arrangement is a desirable one, inasmuch as any dirt which may be in the oil or in the water settles to the bottom of the reservoir, leaving a clean supply of oil in the upper portion of the reservoir for discharge to the pipe 31. Other advantages incident to this lubricating arrangement will be readily apparent to those skilled in the art, one of the most apparent of such advantages being the economy incident to the positive circulation of the oil and the return to the reservoir of the unused portions thereof. A partition 41′ closes off the space which contains the bearings 11 and 12.

A modification of the arrangement of the drums is illustrated in Fig. 8 wherein two sets of inclined conical drums 42 and 43 are employed, the lower set of drums being of smaller diameter than the upper set. The drums in this case are of a slightly modified form in that continuous cutting disks 44 are employed instead of the spaced teeth of the construction of Fig. 1. This construction is cheaper than that of Fig. 1, but is not so effective, and as heretofore pointed out, the continuous cutters tend to form rings or ridges in the surface of the material being cut. This is obviated somewhat by staggering the cutters on adjacent drums, and by inclining the axes of the drums laterally, but the tendency to leave the ridges still remains to a greater or less extent. The framework 45 in this type of construction is also of a somewhat different form.

A modified arrangement for securing the operation of the oil pump 32′ is indicated in Fig. 7, the oil pump being mounted in this case upon the top of the bearing 12′ as in the other type of construction, but the operation of the pump being secured from the rod 46 instead of from the shaft of the cutting drum. This shaft 46 is rotated from the toothed wheel 47 which bears against the stratum of material being cut, and is rotated by this contact. The toothed wheel 47 is carried in a bearing 48 which is yieldingly held outward by means of a spring 49 which bears against a fixed portion 50 of the framework. Oil is supplied to the pump 32′ by means of a pipe 31′ in the same manner as illustrated in Fig. 1.

What I claim is—

1. In combination in apparatus for boring holes in the ground, a rotatable framework, and a plurality of rotatable conical members carried by the framework with their axes converging and also tilted laterally in the same circumferential direction with respect to the center line of the framework, and provided with cutting means at their surfaces, the angle of inclination of the surfaces of the members to the vertical at the sides thereof remote from the center line of the framework being less than the angle of inclination of such surfaces to the horizontal.

2. In combination in apparatus for boring holes in the ground, a rotatable framework and a plurality of rotatable drums carried by the framework, with their axes converging and with cutting means at their surfaces, the axes of the said drums being eccentric with respect to the surfaces thereof.

3. In combination in apparatus for boring holes in the ground, a rotatable framework, and a plurality of rotatable conical drums carried by the framework, with their axes converging and with cutting means at their surfaces, the axes of the said drums being eccentric with respect to the surfaces thereof.

4. In combination in apparatus for boring holes in the ground, a rotatable framework and a plurality of rotatable drums carried by the framework, with their axes converging and with cutting means at their surfaces, the axes of the said drums being eccentric with respect to the surfaces thereof, and being inclined laterally with respect to the center line of the framework.

5. In combination in apparatus for boring holes in the ground, a rotatable framework, and a plurality of rotatable conical drums carried by the framework with their axes converging and each comprising a rotatable shaft, a plurality of flat disks keyed to the shaft and provided with cutter slots, and cutters clamped in the slots between the disks.

6. In combination in apparatus for boring holes in the ground, a rotatable framework and a plurality of rotatable drums carried by the framework, having their axes converging toward the axis of the framework, the said drums comprising a plurality of flat disks and flat spaced cutter bars clamped between the disks, the faces of the cutters on one drum being at substantially right angles to the faces of the cutters on another drum.

7. In combination in apparatus for boring holes in the ground, a rotatable framework and a plurality of rotatable drums carried by the framework, the said drums comprising a plurality of flat disks, a shaft extending through the disks, spaced cutters clamped between the disks, and interlocking means between the faces of the disks and the cutters, adapted to prevent endwise movement of the cutters.

8. In combination in apparatus for boring holes in the ground, a rotatable framework, a plurality of inclined shafts carried by the framework, drums with cutting surfaces keyed to the shafts, and thrust bearings for the upper ends of the shaft, such bearings being formed to take the thrust of the shaft in both directions.

9. In combination in apparatus for boring holes in the ground, a rotatable framework, a plurality of inclined shafts carried by the framework, drums with cutting surfaces keyed to the shafts, bearings for the lower ends of the shafts, and thrust bearings for the upper end of the shafts, such thrust bearings being adjustable laterally to vary the inclination of the shafts.

10. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of rotatable cutting drums carried by the frame with their axes converging, and shields carried by the frame and extending around portions of the drums in proximity thereto and adapted to prevent the wedging of material between the frame and the drums.

11. In combination in apparatus for drilling holes in the ground, a rotatable frame comprising a tubular member provided at its end with two branches which diverge and then converge at the lower end of the machine and have an outlet at such lower end for the passage of water, a plurality of inclined rotatable cutting drums opposite the said branches of the frame, and a drilling member below the said drums.

12. In combination in apparatus for drilling holes in the ground, a rotatable frame comprising a tubular member provided at its end with two branches which diverge and then converge at the lower end of the machine and have an outlet at such lower end for the passage of water, a web connecting the two branches, and a plurality of inclined rotatable cutting drums carried by the frame.

13. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of inclined rotary cutting drums carried thereby, and guide means carried by the frame intermediate the drums and adapted to engage the walls of the cavity being bored.

14. In combination in apparatus for drilling holes in the ground, a rotatable frame and a drilling member carried by the frame in advance of the drums and adapted to drill a hole of less diameter than that cut by the drums, the said drums being inclined so as

to cut a conical cavity with the sides thereof at an angle less than 45 degrees to the axis of rotation of the frame, and the surfaces of the drums being eccentric with relation to their axis of rotation.

15. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of inclined rotating drums carried by the frame, bearings for the drums, lubricating passages for the bearings extending longitudinally of the drums and communicating at the bottoms of the drums, and means for forcing oil down through the passage in one drum and up through the passage in another.

16. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of inclined rotating drums carried by the frame, bearings for the drums, lubricating passages for the bearings extending longitudinally of the drums and communicating at the bottoms of the drums, a reservoir of oil above the drums, and means for circulating oil from the reservoir down through the passage in one drum and up through the passage in another drum and into the reservoir.

17. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of inclined rotating drums carried by the frame, bearings for the drums, lubricating passages for the bearings extending longitudinally of the drums and communicating at the bottoms of the drums, a reservoir of oil above the drums, and means operated by the rotation of the frame for forcing oil from the reservoir down through the passage in one drum and up through the passage in another drum and into the reservoir.

18. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of inclined rotating drums carried by the frame, bearings for the drums, lubricating passages for the bearings extending longitudinally of the drums and communicating at the bottoms of the drums, a reservoir of oil above the drums, a pump operated by the rotation of one of the drums, and connections from the passages in the drums to the reservoir and pump whereby oil is pumped from the reservoir down through the passage in one drum, then up through the passage in another drum and then back into the reservoir.

19. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of inclined rotating drums carried by the frame, bearings for the drums, lubricating passages for the bearings extending longitudinally of the drum and communicating at the bottoms of the drums, a reservoir of oil above the drums, a pump operated by the rotation of one of the drums, and connections from the passages in the drums to the reservoir and pump whereby oil is pumped from the reservoir down through the passage in one drum, then up through the passage in another drum and then back into the reservoir, a check valve being provided for preventing a reverse flow of oil.

20. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of inclined rotating drums carried by the frame, bearings for the drums, lubricating passages for the bearings extending longitudinally of the drums and communicating at the bottoms of the drums, a reservoir of oil above the drums, an outlet pipe extending from a point adjacent the upper part of the reservoir to the upper end of one of said passages through a drum, means for circulating oil down such last passage and up through the passage through another drum and into the reservoir again, and a water pipe leading into the oil reservoir from the upper portion thereof and extending to a point adjacent the bottom thereof.

21. In combination in boring apparatus, a rotatable framework and a plurality of rotatable drums carried by the framework, the said drums being provided with a plurality of circumferential rows of flat cutter bars, the flat faces of the cutters on one drum being at substantial right angles to the flat faces of the cutter bars on another drum.

22. In combination in apparatus for drilling holes in the ground, a rotatable framework, a plurality of rotatable conical drums carried thereby and provided with cutting means at their surfaces, the angle of inclination of the surfaces of the members to the vertical at the sides thereof remote from the center line of the framework being less than the angle of inclination of such surfaces to the horizontal, and a drilling member carried by the frame in advance of the drums and adapted to drill a hole of less diameter than that cut by the drums, the said drums being also inclined laterally in the same circumferential direction to secure a screw effect tending to force the drilling member into the ground.

23. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of rotatable conical drums carried thereby, and a drilling member with a cutting point carried by the frame in advance of the drums and adapted to drill a hole of a diameter less than that cut by the upper ends of the drums and greater than that cut by the lower ends of the drums.

24. In combination in apparatus for drilling holes in the ground, a rotatable frame, a plurality of rotatable drums carried thereby, and a drilling member with a cutting point carried by the frame in advance of the drums and adapted to drill a hole of a diameter less than that cut by the upper ends of the drums and greater than that cut by the

lower ends of the drums, said drums being provided with cutting elements adapted to advance the apparatus through the work.

25. In combination in apparatus for drilling holes in the ground, a rotatable frame, a reaming element adapted to cut a conical hole, and a drilling member with a cutting point carried by the frame in advance of the reaming element and adapted to drill a hole of a diameter greater than that cut by the lower end of the reaming element and less than that cut by the upper end of the reaming element, said reaming element being provided with cutting means adapted to advance the apparatus through the work.

In testimony whereof I have hereunto signed my name in the presence of the two subscribed witnesses.

MAHLON E. LAYNE.

Witnesses:
R. H. Kelley,
Urebert Davis.