

Sept. 2, 1924.

1,507,294

H. H. MERCER

DRILLING MACHINERY

Filed May 20, 1919

5 Sheets-Sheet 1

Fig. 1.

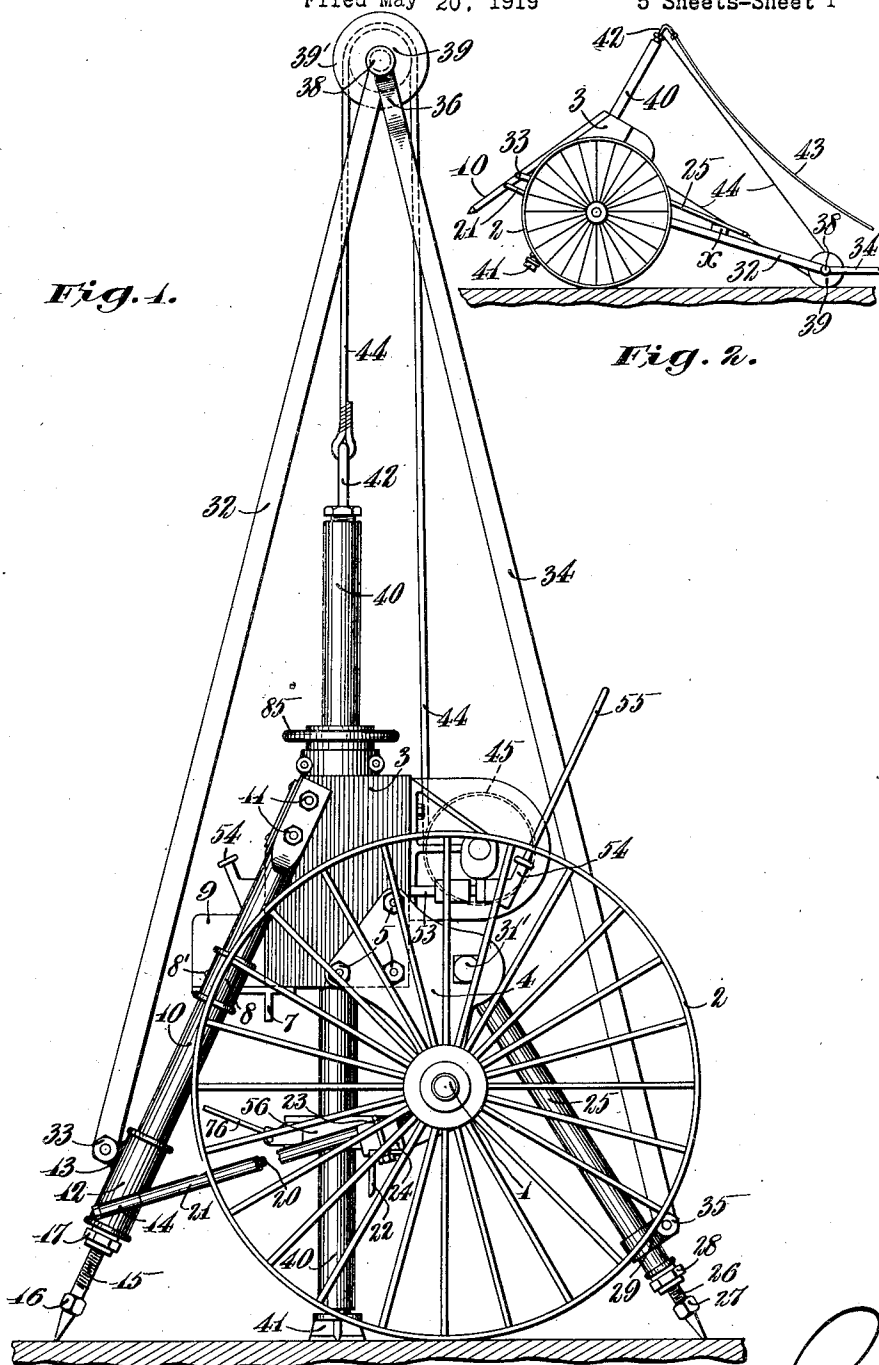
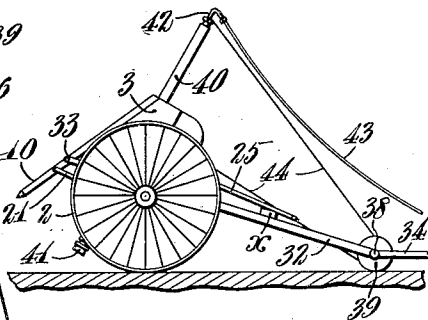


Fig. 2.



Inventor
Henry H. Mercer
By
[Signature]
Att'y.

Sept. 2, 1924.

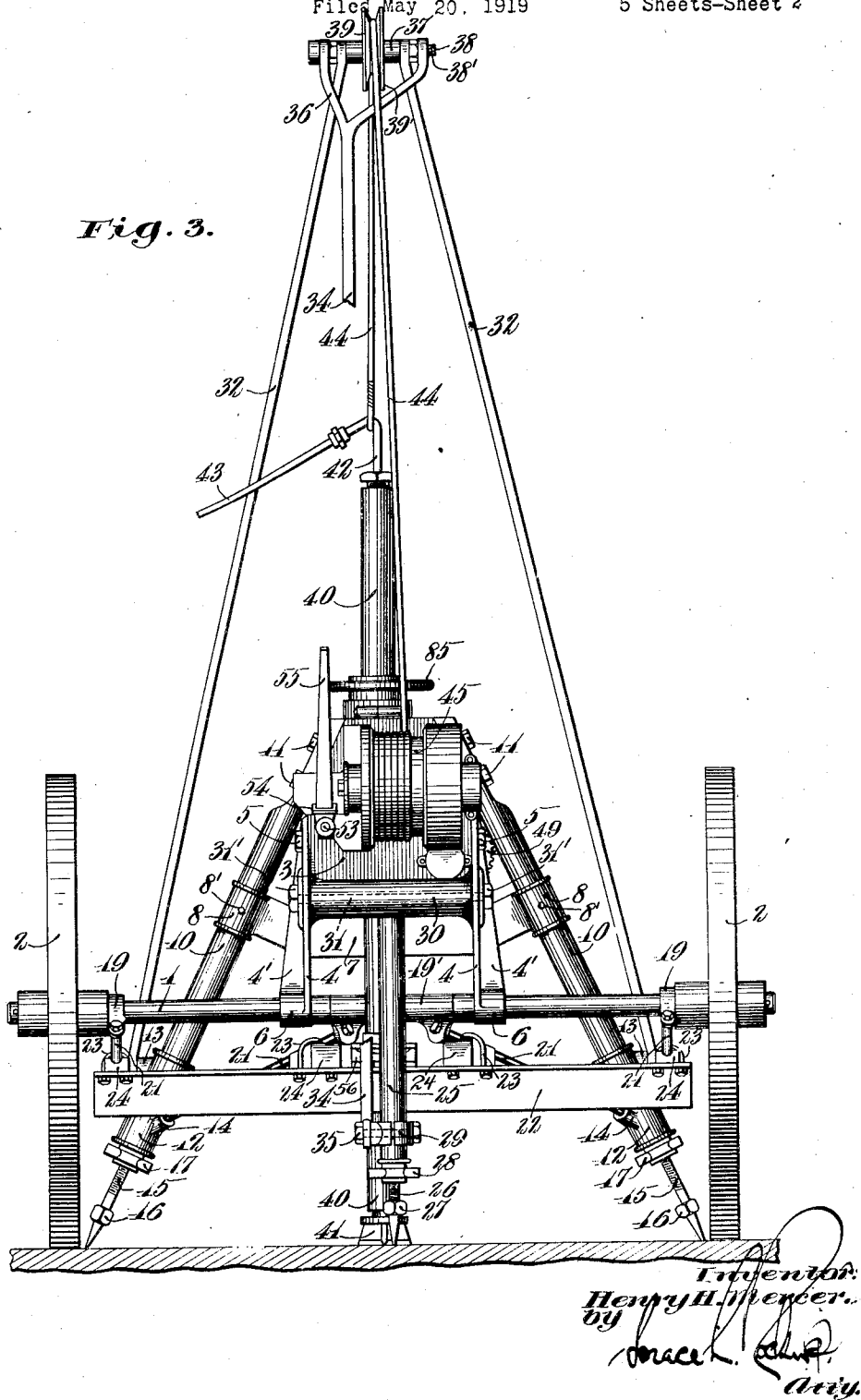
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5 Sheets-Sheet 2

Fig. 3.



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5 Sheets-Sheet 3

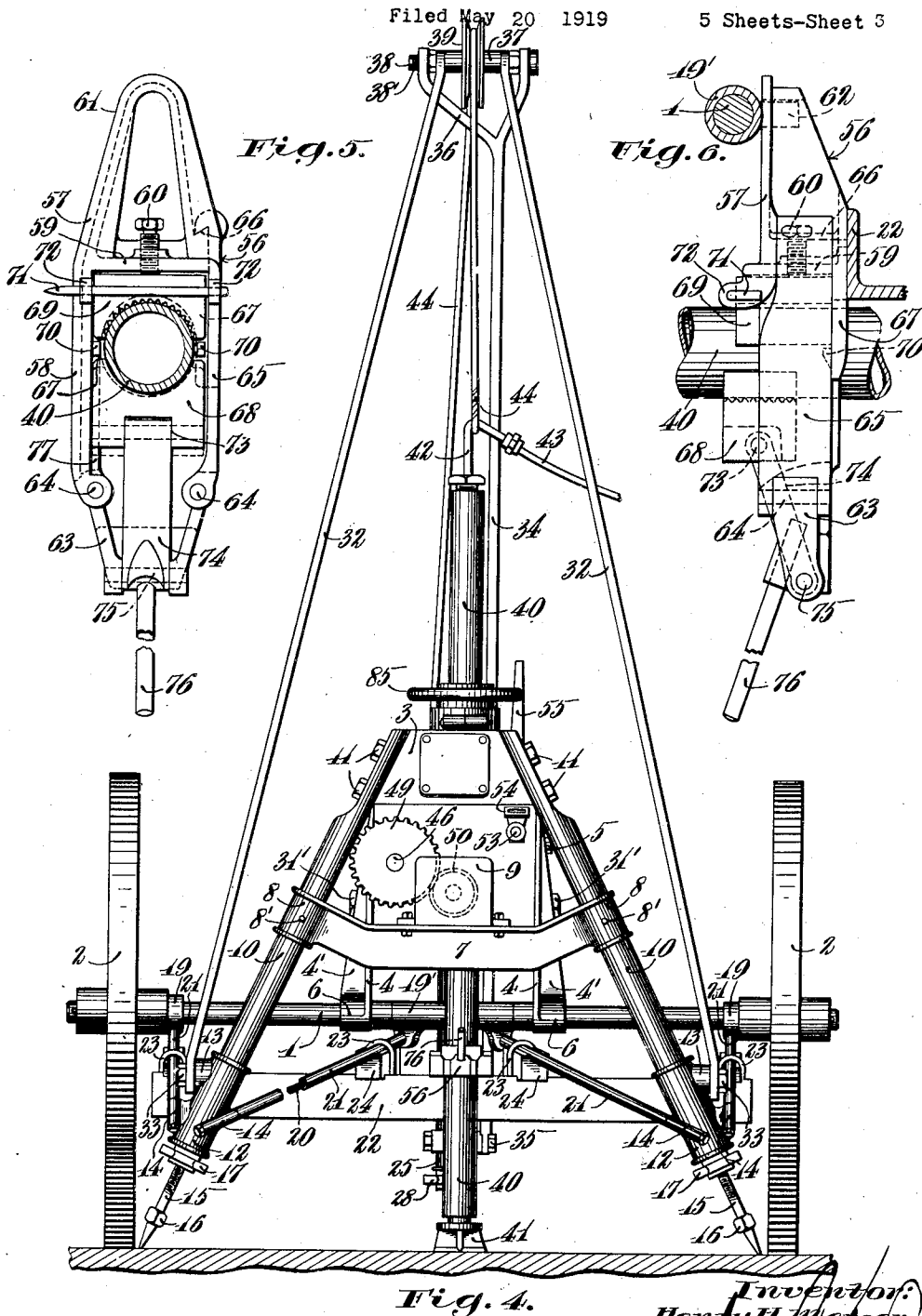


Fig. 4.

Inventor:
Henry H. Mercer.
by
[Signature]
[Signature]

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5 Sheets-Sheet 4

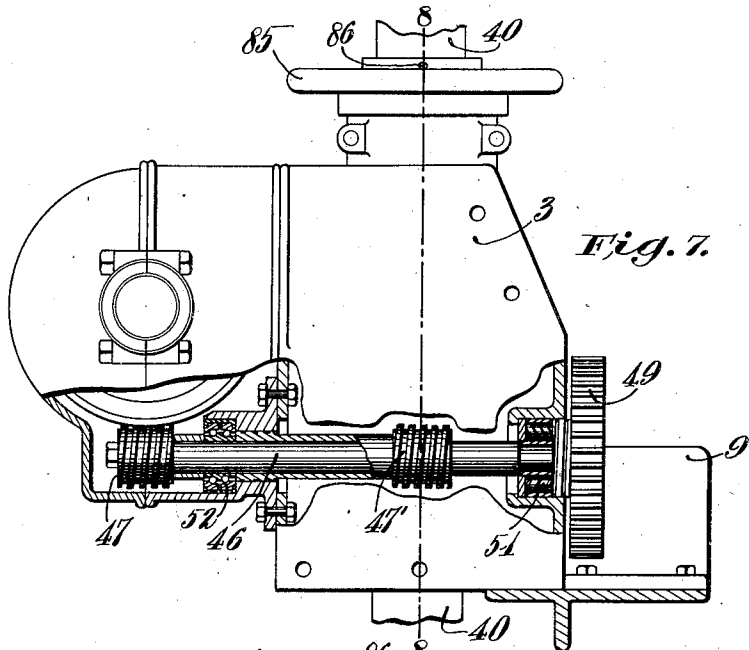


Fig. 7.

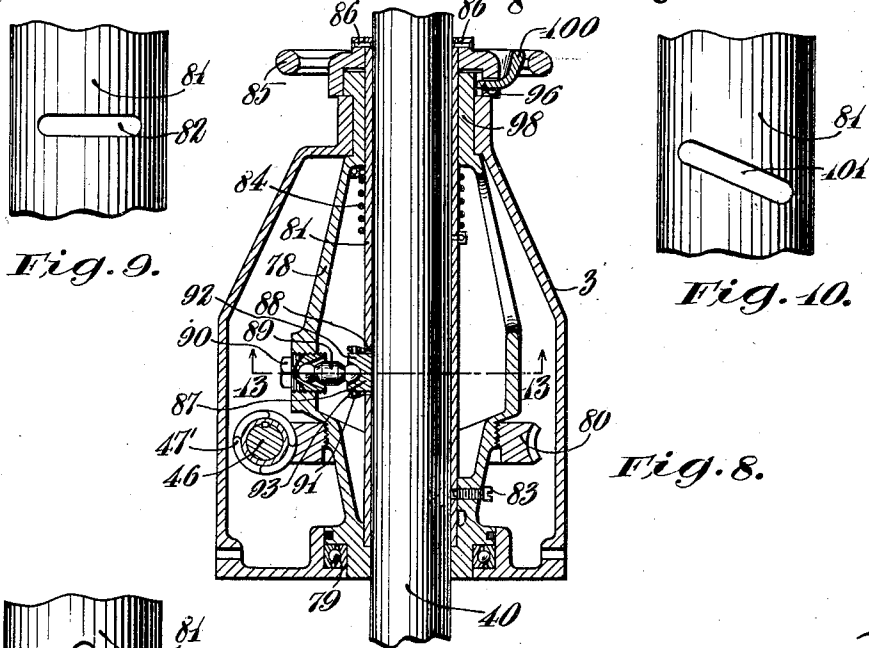
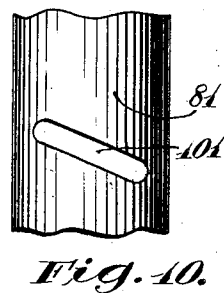
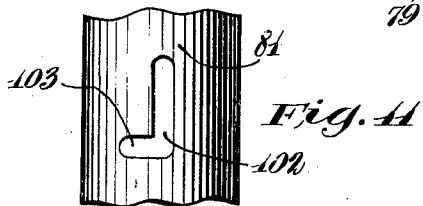


Fig. 8.



Inventor:
Henry H. Mercer.
by
[Signature]
Att'y.

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H. H. MERCER
DRILLING MACHINERY
Filed May 20, 1919

5 Sheets-Sheet 5

Fig. 12.

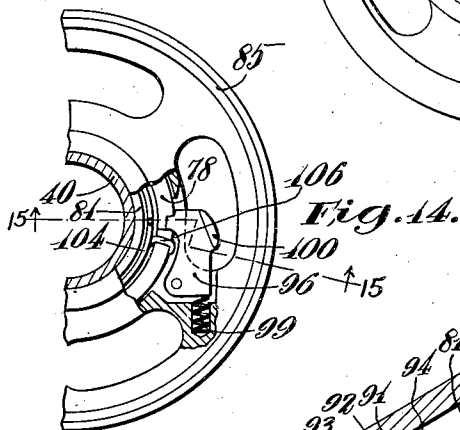
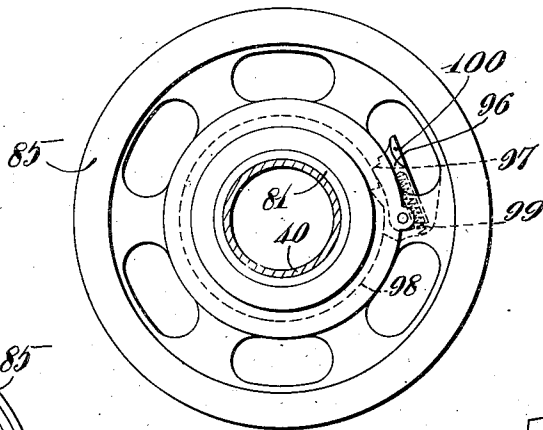


Fig. 15.

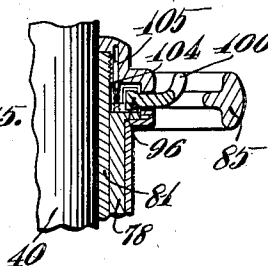


Fig. 16.

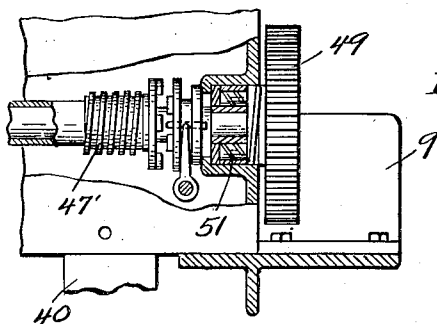


Fig. 13.

Inventor:
Henry H. Mercer.
By *[Signature]*
att'y.

Patented Sept. 2, 1924.

1,507,294

UNITED STATES PATENT OFFICE.

HENRY H. MERCER, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

DRILLING MACHINERY.

Application filed May 20, 1919. Serial No. 298,488.

To all whom it may concern:

Be it known that I, HENRY H. MERCER, a citizen of the United States, residing at Claremont, in the county of Sullivan and State of New Hampshire, have invented certain new and useful Improvements in Drilling Machinery, of which the following is a full, clear, and exact specification.

This invention relates to drilling machinery, and more especially to a type to be used in mines or quarries for drilling large blasting holes.

In rock quarries, such as limestone quarries, it is common practice to drill large blasting holes, usually three inches or more in diameter, several feet apart around the edge of a pit, the depth of the holes varying usually from ten to forty feet. Powder charges are inserted in these holes and the series of charges are set off simultaneously, usually by electrical means, to blow a large quantity of rock into the pit. The apparatus now commonly used for this purpose consists of two distinct parts, the drilling mechanism, comprising a churn drill and a tripod for supporting a sheave over which a rope or cable runs for operating the churn drill, and a steam driven drum for actuating the cable. These separate units are usually mounted upon skids and are moved from place to place to drill different holes by forcing the units along timbers laid on the ground, it being necessary before drilling each hole to level the churn drilling unit with the aid of blocks and jacks. The churn drill is operated by alternately raising and lowering the drill in such a manner that the striking force of the falling parts drives the bit into the rock. As the hole deepens, the size of the drill pipe is increased by lengthening it, with the result that the weight to be raised is very large, and that a comparatively strong steam unit is necessary to operate the churn drill.

One object of the present invention is to provide an improved drilling apparatus. Another object is to provide an improved drilling unit having all the necessary tools mounted in such a manner that the unit may easily be transported from place to place and may easily be set up and operated. Still other objects are to provide an improved controlling means, an improved tool rotating means, and an improved means for holding the parts in adjusted positions. These

and other objects and advantages of my improved construction will, however, herein-after more fully appear.

In the accompanying drawings, I have shown for purposes of illustration one embodiment which my invention may assume in practice.

In these drawings:

Fig. 1 is a side elevation of my improved apparatus in drilling position.

Fig. 2 is a side elevation of the same ready for transportation.

Fig. 3 is a rear elevation of the apparatus as illustrated in Fig. 1.

Fig. 4 is a front elevation thereof.

Fig. 5 is a plan view of a safety clamp.

Fig. 6 is a side elevation thereof.

Fig. 7 is a side elevation of the gear box, a part thereof being broken away to show the driving shaft.

Fig. 8 is a longitudinal sectional view taken on the line 8-8, Fig. 7.

Fig. 9 is a side elevation of a part of the operating tube.

Figs. 10 and 11 show modifications thereof.

Fig. 12 is a plan view of the hand wheel.

Fig. 13 is a sectional plan view on the line 13-13, Fig. 8.

Fig. 14 shows a modified form of hand wheel controlling means.

Fig. 15 is a sectional view on the line 15-15, Fig. 14.

Fig. 16 is a view similar to Fig. 7 showing a modification.

Referring to the drawings and to the machine shown therein, while the invention may be embodied in machines and devices other than the specific type herein shown, for illustrative purposes I have shown a drilling apparatus having an axle 1 which, during transportation, is carried by wheels 2, but which, when the machine is set up in drilling position, supports these wheels.

As shown, a gear box 3 is supported on the axle 1 by means of side supports or brackets 4 which are bolted to the gear box by bolts 5, the brackets carrying journals 6 through which the axle 1 passes. Reinforcing webs 4' are cast integral with the bracket members and the journals, as is clearly shown in Fig. 3. The front end of the gear box is mounted on and preferably bolted to an offset angle iron 7 (note Fig. 4). The ends of the angle iron carry sleeve members 8

which may be securely fastened on supporting legs, as by a driving fit therewith or by means of pins 8' passing through the sleeves and legs. A motor 9 is also mounted on this angle iron adjacent the gear box and is bolted to the angle iron and gear box so that the three are held in fixed relation.

When the apparatus is set up in drilling position, the whole is supported on three legs, two of which pass through the sleeves 8 and are rigidly secured by means of bolts 11 to the gear box. These two legs 10, which I prefer to term the stationary or fixed legs, because they do not have an independent movement relative to the drilling apparatus, carry on their lower ends relatively large sleeves 12 which preferably have a driving fit on these legs. A boss 13 is cast integral with each sleeve near the top thereof, and two sleeves 14 are also cast integral with each of the large sleeves 12 and at an angle thereto. Bolts 15 having pointed ends, as shown, are threaded into the lower ends of legs 10, squared heads 16 being formed near the pointed ends to facilitate the turning of these bolts in the ends of the legs in order to adjust the length of the legs, there also being provided lock nuts 17 to hold the bolts in adjusted position relative to members 12.

In my improved construction, I have also provided three split sleeves or clamps 19, 19' mounted on the axle, two of these clamps 19 being mounted adjacent the wheels, while the third and larger clamp 19' is mounted substantially centrally on the axle between the journals 6. Rods 20 threaded on both ends to receive suitable nuts are passed through the sleeves 14 and holes formed in ears on the clamps 19, 19'. These rods 20 preferably pass centrally through spacing pipe members 21 which abut against the sleeves 14 and the ears on the clamps in such a manner as to hold the lower end of the legs and the sleeves in a fixed spaced relation. By turning either of the nuts on the ends of each rod 20, the clamps 19, 19' may be tightened on the axle, thereby causing the structure comprising the axle member, the clamps, the sleeves 12 and legs 10 to form a rigid unit. I have made use of the very simple and inexpensive means comprising the rods and pipes just described, for holding the sleeves and clamps in spaced relation in preference to a single rod having shoulders formed thereon, in order to cheapen the manufacture of the parts and to render the mechanism more easily adjustable in the field, for which the tools at hand in mines or quarries it is easier to cut off the pipes 21 or to insert washers on the ends thereof to change the spacing between the clamps and sleeves, than it is to change the distance between shoulders formed integrally on the iron rods 20.

I have also provided in my improved construction a supporting and bracing member, herein shown as an angle iron 22, which preferably passes substantially from wheel to wheel beneath the pipe members 21 and is held in spaced relation to these pipe members by clevises or U-shaped bolts 23 and blocks 24, the latter being preferably constructed of iron and being formed to fit the angle iron and the pipes 21. This angle iron helps to hold the pipes in a fixed spaced relation, and further acts as a support for a safety clamp, to be hereinafter more fully described.

A third leg 25, which I preferably term the back leg, carries a bolt 26, similar to the bolts 15, having a squared head 27, and a lock nut 28 thereon to facilitate the adjustment of the length of the leg. A split sleeve or clamp 29 is mounted on this back leg to support a tripod member in adjustable position relative to this leg, as will hereinafter more clearly appear. The T-head 30 of the back leg is mounted between the flanges of the supporting brackets 4 and is held thereto by a rod 31 which passes through the T-head, and supports and carries nuts 31' on the ends thereof by means of which the flanges on the support 4 may be drawn toward each other against the ends of the T-head and be made to engage these ends frictionally to hold the back leg in adjusted position relative to the gear box and the two stationary legs.

By my improved construction it is thus seen that I have mounted a gear box rigidly on two fixed legs whose length may be adjusted, and a third leg whose length may also be adjusted, in such a manner that a gear box may be leveled by adjusting the position of the back leg relative to the front or stationary legs, and by adjusting the length of the three legs. It is further seen that by increasing the length of these three legs the gear box may be raised from the ground so that the apparatus rests on the three legs and not on the wheels with the result that the wheels do not support the drilling apparatus during the drilling operation. It is also evident that by this construction I have devised means whereby the apparatus may be easily and quickly changed from drilling position, wherein it is supported by the three legs, to a position in which it rests entirely on the axle and wheels and may be easily moved from place to place. In my improved construction it should be noted that I have offset the gear box relative to the axle so that should the back leg slip or should it be shortened, the weight of the gear box will be thrown on the two fixed legs and the wheels, the position of which is always the same relative to the box. For moving the apparatus short distances, it is only necessary to shorten the

back leg and to turn the large supporting wheels in a right hand direction (see Fig. 1), it being evident that the front or fixed legs will drag over the ground.

Two forward tripod legs 32 are preferably attached to the bosses 13 on the sleeves 12 by bolts 33 in such a manner that these tripod members or rods may be swung on these bolts as pivots. A rear tripod leg 34 is attached to the clamp or split sleeve 29 on the back leg 25 by a bolt 35 which passes through the lower end of this rear tripod leg and ears on the clamp, in such a manner that when the nut on this bolt is tightened the clamp grips the rear leg, the clamp permitting an adjustment of the one leg on the other. A yoke 36 (Figs. 3 and 4) is preferably formed on the upper end of the rear tripod leg 34. By reference to the drawing it is clearly seen that the ends of this yoke and the ends of the front tripod legs 32 are fastened together in spaced relationship by a sleeve 37 and a bolt 38 passing through these members, and that the sleeve 37 may be held in fixed relation to the axle and preferably parallel thereto to support a sheave block 39 rotatably mounted on the sleeve 37. A cotter pin 38' is passed through a hole in the end of the bolt in such a manner that the cotter pin may be easily removed and the bolt withdrawn to permit a separation of the tripod legs.

The sheave block 39 has relatively long flanges 39' formed thereon which perform a double function. During the raising and lowering of the drill pipe, the cable attached thereto and passed over the sheave 39 is liable to jump clear of the block, and the long flanges tend to prevent this. Also, as will hereinafter more fully appear, when the apparatus is set up in position for transportation (Fig. 2) the sheave 39 rests on the ground and these large flanges 39' increase the radius of the sheave so that it forms a wheel of considerable diameter on which the apparatus may rest during transportation, and which supports the cable clear of the ground during the operation of moving the apparatus from place to place so that the cable is not worn by contact with a rough surface. If desired, the leg 34 may be used as a tongue to guide the unit, or a whiffletree may be attached in place of this leg so that the apparatus may be drawn by a horse.

It should also be noted that when the leg 34 is disconnected, the legs 32 may be swung about their pivots 33 onto the axle, in which position the legs 32 may be used as a lever to lift the shorter tripod legs 10 free from the ground. The weight of gear box and associated parts may thus be brought substantially into the vertical plane of the axle, thus relieving the operator of the greater part of this weight and permitting the easy transportation of the drilling unit, the legs

32 serving also as a long guiding tongue for guiding the unit over the rough ground usually found around quarries. In either case, that is, whether the apparatus is transported on two wheels or on three wheels, the long tripod legs 32 are preferably rigidly fastened to the axle, as by putting a timber X between the legs 32 and the back leg 25 and clamping these members in position, as by tightening one of the nuts 31', to cause the flanges or webs 4 to frictionally engage the ends of the T-head of the back leg. When transporting the unit from place to place and especially when it is necessary to take it uphill, the cable carried by the drum may be fastened to some fixed object, as a tree or post, and the drum may be operated to provide the required tractive force.

The drilling is performed by a drive rod 40 which carries on its lower end a bit 41, the latter being preferably actuated by a pneumatic tool carried in the drive rod and operated by compressed air fed to the hollow drive rod through an air intake pipe 42 and air hose 43. Inasmuch as this pneumatic tool forms no part of the present invention, and inasmuch as a tool which may be used for this purpose has been clearly disclosed in Patent No. 1,250,103, patented December 11, 1917, it is not thought necessary to illustrate the same in the present application. The air pipe 42 is substantially V-shaped and functions not only as an air pipe but as a lifting bail, a loop in a cable 44 being attached to this bail and passed over the sheave block 39 for this purpose. This lifting bail has a swivel connection (not necessary to show herein) with the drive rod to permit a rotation of the latter during the drilling operation.

In my improved construction a winding drum 45 is preferably mounted on the gear box to carry the cable 44 which is used for raising and lowering the driving rod to permit an inspection of the drill bit or the pneumatic tool, or to change the length of the driving rod or to ease the tool on the work when the drilling is hard and the pneumatic bit driving tool slows down.

As is clearly shown in Figs. 1 and 7, the motor, gear box and drum are mounted in fixed relation to each other in such a manner that a single driving shaft 46 may be passed through the gear box and be made to operate, as through worm gears 47 and 47', the winding drum or the driving tube. The shaft carries a large driving wheel 49 which meshes with a driving pinion 50 on the motor. The driving shaft is rotatably mounted in roller bearings 51 and a ball thrust and radial bearing 52 which receives the thrust from both worms, which, it will be noted, drive in the same direction.

In so far as concerns the apparatus herein disclosed, any form of drum or drum op-

erating mechanism may be used, and for controlling the same, I have shown a controlling rod 53 passing through the gear box and having sockets 54 formed on each end thereof and preferably at an angle thereto to receive a handle or handles 55, in such a manner that the drum may be easily controlled from either or both sides of the machine.

In the drilling of holes for blasting purposes, the drilling operation is started with a short driving rod, and as the hole is deepened new driving rod sections are added so that the large driving rod always projects above the surface of the ground. This is essential to the proper operation of the drilling apparatus, for usually a part of the compressed air admitted through the hose and passed centrally down through the drive rod is used to force the cuttings from the bottom of the hole up between the drive rod and the wall of the hole to the surface. The diameter of the drive rod is carefully chosen so that the space between the drive rod and the wall of the hole is within certain limits within which the velocity of the air passing upward about the drive rod will be maintained sufficient to force out the cuttings. If the top of the drive rod should be permitted to pass below the surface of the ground, the velocity of the air as it passes over the top of the drive rod would fall so rapidly that the cuttings would be dropped and would not be brought to the surface, and the drilling operation would soon be stopped. To rigidly hold the drive rod when adding a new section thereto, or to hold the drive rod in an elevated position to inspect or change the bit, or when transporting the apparatus, or when for various other reasons it is necessary to hold the drive rod immovable, there is preferably provided a safety clamp 56, which is here shown as mounted below the gear box.

The body of this clamp is preferably formed of a casting 57 having a projecting arm 58, a back flange or back head 59 carrying a set screw 60, and a hollow projecting and supporting arm 61 adapted to receive a pin 62 secured to the clamp 19'. The end of the arm 61 projects under and rests against the clamp 19' in such a manner that the vise 56 may be pivoted on the pin 62 and slid along the angle iron 22 into any desired position relative to the drive rod. A head block 63 is pivotally connected to the arm 58 by one of the pivots 64, and carries on a second pivot 64 a connecting link or hook 65 adapted to be caught, as shown at 66, onto a suitable shoulder formed on the casting 57 adjacent the back flange or back head 59. The member 58 and back head 59 are preferably formed with a bottom plate 67 to support a vise jaw 69, stops 70 also being formed on the opposite sides of this plate to normally retain the jaw 69 adjacent the back

head 59. This vise jaw is preferably held against vertical movement by the plate 67 and a pin 71 detachably secured in suitable ears 72. The other vise jaw 68 is preferably pivotally connected, as shown at 73, to a link 74, the latter being in turn pivoted to the front head by a pivot 75. If desired, a handle 76 may be used to rotate the link about its pivot to retract the vise jaw 68, or force the latter toward the cooperating vise jaw 75 to securely clamp the drive rod in adjusted position. The relative positions of the two vise jaws may be adjusted by the set screw 60. If desired, the vise jaws may be provided with similar teeth, but I preferably provide the jaw 68 with horizontal teeth and the jaw 69 with vertical teeth. From the foregoing it is clear that the link 65 may be freed from the casting 67 and the vise slid along the angle iron 22 about the pivot 62, or the vise may be easily set up as shown in Figs. 5 and 6 and the vise jaws operated to securely clamp the drive tube between them by manipulation of the lever and set screw. Should the link be depressed when it is not in position to clamp the tube, the jaw will be supported by a flange 77 carried by the arm 58.

In the drilling of large holes, the drill bits, such as shown at 41, are quite large and heavy, necessitating the use of a powerful tool to reciprocate the bit. In the present form of my invention, the bit is reciprocated by a pneumatic tool, such as shown in the Gilman patent referred to above, the tool being mounted in the drive rod adjacent the bit. This type of tool is termed, in the field, a "ground hog" tool because it digs its hole and crawls in as it digs. If desired, a tool reciprocating means such as is commonly used in rock drills, may be used to rotate the bit during the drilling operation, but since these rotating mechanisms add to the weight of the parts which are adjustably supported in the hole being drilled, and usually cut down the power of the tool because the diameter of the piston must be cut down to provide space for the rotating mechanism, I preferably provide means for rotating the ground hog drill and the bit carried thereby, by rotating the driving tube which carries the ground hog drill.

In the preferred form of my invention, I have provided a rotating means adapted to encircle the driving rod and to have a detachable driving connection therewith, the rotating means being driven by the worm 47'. This mechanism has a rotator 78 mounted on a ball thrust and radial bearing 79, the latter being supported by the bottom plate of the gear box, as is clearly shown in Fig. 8. The operative connection between the rotator and the shaft consists of a worm 47' and a worm gear 80, the latter being preferably removably mounted on the

rotator, as by means of a threaded connection, as is shown. Mounted concentrically in the rotator, and preferably carried thereby, is an operating tube 81 provided near its lower end with a horizontal slot 82 (Fig. 9) passing partially around the operating tube and being adapted to receive one end of a set screw 83 threaded into the rotator nearest the lower end thereof. This slot and set screw hold the operating tube against longitudinal displacement relative to the rotator during the drilling operation. A coiled spring 84 encircles the operating tube, one end of this spring being attached to the tube and the other to the rotator, as is clearly shown in Fig. 8. This operating tube is attached to a hand wheel 85 by any suitable means, such as rivets 86, in order that its position relative to the rotator may be adjusted by the hand wheel.

Since the rotator is positively driven by the shaft 46 in such a manner that the rotator is constantly turned while the motor is in operation, the hand wheel and operating tube must also be constantly rotated because of the connection between the operating tube and the rotator through the slot and set screw and spring connections therebetween. If desired, a clutch drive may be used to drive the rotator from the shaft, as shown in Fig. 16. In this case, however, for reasons which will hereinafter more fully appear, I preferably use a clutch driving connection between the rotator and the drive rod. For this purpose I preferably provide a series of jaws 87 passing through slots 88 in the operating tube, the inner surfaces of the jaws being preferably serrated to insure a positive connection between the jaws and the driving rod. The jaws are forced into positive connection with the driving rod through a plurality of toggle mechanisms each of which is shown herein as having a toggle link 89, one end of which rests in a socket in a jaw 87 and the other in an adjusting plug 90 preferably threaded into a boss formed on the rotator. Stud 91 project in opposite directions from ears or flanges 92 formed on the jaw, and carry coiled springs 93 the ends 94 of which rest on the operating tube and tend to force the end of the toggle link and the jaw connected therewith away from the driving rod. As is clearly shown in Fig. 13, if the operating tube be rotated a trifle in a counter-clockwise direction relative to the rotator 78, the jaws will be forced into gripping relation with the driving rod through the action of the toggle links.

The spring 84, due to its connections with the operating tube and the rotator, and due to its tendency to unwind in a counter-clockwise direction, normally retains the clutch mechanism, that is, the jaws 87 and the toggle links connecting them to the rotor, in

operative position to drive the tube 40 through rotation of the rotor as hereinbefore described. The operating tube 81, because of its connection with the hand wheel 85, may be rotated by the latter in a clockwise direction to loosen the toggle mechanism and permit the springs 93 to raise the jaws 87 out of contact with the drilling tube. The hand wheel may be rotated sufficiently to permit a pawl 96 carried by the hand wheel to drop into a depression 97 in the upper end of the bearing 98 of the rotator, a pawl spring 99 holding this pawl in locking position in the depression to keep the parts in inoperative position and prevent the coiled spring 84 from returning the tube to its former relative position with respect to the rotator when the hand wheel is released. During operation, the rotator and the hand wheel are rotating but very slowly so that the operator can easily grasp the hand wheel and advance it and the operating tube ahead of the rotator. When it is desired to again set the rotating mechanism into operation, the operator grasps the wheel, advances it a trifle ahead of the rotator, and releases the pawl by an outward pressure on an upwardly projecting thumb piece 100 formed integrally with the pawl.

If desired, the sleeve 81 may be provided with a spiral groove 101 (Fig. 10) in preference to the horizontal groove 82, so that when the operating tube is given a slight rotation in advance of the rotator by means of the hand wheel 85, the set screw 83 will cause the operating tube to move vertically a sufficient distance to release the clutch jaws 87 from the driving tube 40, or, if desired, this movement may be just sufficient to cause the jaws to lightly grip the tube and rotate it slowly due to the partial slipping of the jaws over the surface of the tube.

If desired, the opening in the operating tube in which the end of the set screw 83 works may be still further modified and formed L-shaped, as shown at 102 in Fig. 11, so that the operator may raise the operating tube by pushing upward on the controlling wheel 85 and then, by rotating the tube into the short leg 103 of the slot, hold the tube in an elevated position and the jaws out of contact with the driven element.

While I have shown in my preferred embodiment a coiled spring 84 encircling the operating tube within the rotator, various means may be used for normally holding the clutch mechanism in operative position, such as a coiled spring 104 (see Figs. 14 and 15) mounted within the hub of the controlling wheel 85, one end of this spring being fastened to the hub, as shown at 105, and the other end to the rotator, as shown at 106.

In the operation of my improved drilling mechanism, after the drilling unit has been set up on the shorter tripod and the cable 44

has been attached to the drilling tube 40, the compressed air or other operating fluid may be admitted to the ground hog drill and the hole may be drilled by the bit 41 through the reciprocatory movement given to this bit by the tool carried in the drilling tube, without rotating the tool or the bit, this tool functioning in the same manner as does the ordinary churn drill but cutting more rapidly and without the necessity of reciprocating the drilling tube to procure the cutting action of the bit. During the cutting operation, if the tool tends to bind or to slow down, the position of the cutting bit relative to the bottom of the hole may be varied by putting a tension on the cable and raising the bit a trifle from the bottom of the hole. In drilling operations, it is preferable, however, to rotate the bit so that the hole is maintained round and so that the cutting edges of the bit do not work in grooves in the bottom of the hole. The necessary rotation of the bit may be obtained by releasing the pawl 96 and permitting the clutch mechanism to connect the rotator to the drilling tube so that the latter together with the bit driven thereby is rotated. During this rotation, the jaws will grip the tube 40, but the jar of the tube due to the action of the percussive tool in the end of the drive tube will be sufficient to feed the tube past the jaws and permit the tube to advance as the hole is advanced. The clutching mechanism may be released in a variety of ways according to the action of the pneumatic tool and the quality of rock being cut. If desired, the drum may be operated to raise the drilling tube, which thereby carries upward the jaws 87, the slots 88 being large enough to permit the jaws to move upward with respect to the operating tube until the springs 93 raise the jaws from the tube. Or, if desired, the operator may elevate the handle 85 and with it the operating tube and the jaws, until the latter will be released from the tube by the springs 93. If the operating tube 81 is provided with a slot, as shown at 101 in Fig. 10, the jaws may be released from the driving tube 40 by partially rotating the outer tube with respect to the rotator as above described. Or the clutching mechanism may be thrown out of operation by rotating the handle 85 a sufficient distance in advance of the rotator to permit the pawl 96 to fall into the depression 97 formed in the rotator bearing, and thereby render the connection between the rotating device and the pneumatic tool inoperative.

It will thus be seen that I have provided an improved drilling mechanism which is mounted for transportation, or for operation as a single unit, that the controlling mechanism for the different parts of the unit may easily be manipulated from nearly any

point about the apparatus, and that the drilling apparatus may be operated in an efficient manner to reciprocate a bit, or to reciprocate and rotate a bit to drill a hole. It will further be noted that by the improved clutching mechanism and clutch controlling means, the rotating mechanism and its connection with the drilling tool may be controlled in a variety of ways to give any desired drilling action according to the drilling operation required for the particular work to be done. It will further be noted that the drill rotating means is very compactly built and forms a single unit which may be supported by a tripod during drilling operation or mounted on a wheel support during transportation. An important feature of my improved device is the use of a ground hog drill which is compactly placed in the drilling tube to follow the tool into the hole so that this drilling tool does not take up any appreciable space and increase the size and weight of the parts carried by the tripod during a drilling operation, and the placing of the rotating means where it does not affect the size of the reciprocating tool. Still another feature is the improved means whereby the drilling unit may be transported from place to place on two wheels or on three wheels, and whereby, by adjusting different parts of the apparatus, a very strong and efficient tongue is provided for guiding the apparatus during transportation.

While I have in this application specifically described several embodiments which my invention may assume in practice, it is to be understood that these forms are used for illustrative purposes only and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. The combination with a tool, of a support therefor comprising a plurality of superimposed tripods, the feet of each secured to the other to form a unitary structure.
2. The combination with a tool, of a support therefor comprising a plurality of tripods, the feet of each secured to the other to form a unitary structure and so disposed that a vertical line let fall from the top of one of said tripods would pass within a circle drawn through the feet of the other.
3. The combination with a tool, of a support therefor comprising a plurality of tripods, the feet of each secured to the other to form a unitary structure and so disposed that vertical lines drawn through the tops of either of said tripods would pass through a circle drawn through the extremities of the legs of the other.
4. The combination with a tool, of a sup-

port therefor comprising a tripod and means carried at the apex of said tripod for rotating said tool and for supporting it during rotation, said tool being free to rotate on its support when said rotating means is inactive.

5 5. A drilling apparatus comprising a tripod, a second tripod having legs mounted on the legs of the first tripod, tool actuating means carried by said first named tripod, and a tool supporting means carried by the second tripod.

10 6. A drilling apparatus comprising a plurality of tripods forming a unitary structure, a tool mounted on one of said tripods and movable relative thereto, means whereby said tool may be advanced toward the work, and means operatively connected to the other of said tripods for holding said tool in a fixed position.

20 7. A drilling apparatus comprising a plurality of tripods forming a unitary structure, a tool mounted on one of said tripods and movable relative thereto, means operatively connected to another of said tripods whereby said tool may be advanced toward the work, and means carried by one of said tripods for holding said tool in a fixed position irrespective of its position relative to said tripod.

30 8. A drilling apparatus comprising a plurality of tripods forming a unitary structure, a tool mounted on one of said tripods and movable relative thereto, means operatively connected to another of said tripods whereby said tool may be advanced toward the work, and a vise for holding said tool in a fixed position and operable to grip the same at all times at the will of the operator.

40 9. In a drilling apparatus, a tool, a wheeled support, supporting means carried thereby for supporting said tool during drilling operation and including a wheel spaced from the ground during drilling, said mechanism being adjustable so that said tool may be supported by said wheeled support and said wheel during transportation.

50 10. In a drilling apparatus, a tool, a two-wheeled support, supporting means carried thereby for supporting a tool during a drilling operation and including a third wheel spaced from the ground during drilling, said mechanism being adjustable so that said tool may be supported by said wheeled support and said wheel during transportation.

55 11. In a drilling apparatus, a tool, a wheeled support, supporting means carried thereby for supporting a tool during a drilling operation and including a sheave adapted to receive a cable, and means permitting adjustment of said sheave whereby said tool supporting means may be supported by said wheeled support and said sheave for transportation.

60 12. In a drilling apparatus, a tool sup-

porting means comprising an axle, wheels thereon, means for supporting the apparatus during operation thereof, said means having a pivoted leg which may be swung out of engagement with a quarry floor to permit a tilting of the apparatus, a standard carried by said axle, and means for rigidly securing said standard to said axle whereby said standard may be used as a tongue to guide the apparatus during transportation.

75 13. In a drilling apparatus, a tool supporting means comprising an axle, wheels thereon, a tripod for supporting the apparatus during operation thereof, said tripod having a pivoted leg which may be swung out of engagement with a quarry floor to permit a tilting of the apparatus, a pivoted standard carried by said axle, and means for rigidly securing said standard to said axle whereby said standard may be used as a tongue to guide the apparatus during transportation.

80 14. In a drilling apparatus, a tool supporting means comprising an axle, wheels thereon for supporting the apparatus during transportation, means for supporting the apparatus during operation thereof, a sheave, means for supporting said sheave, relative to said tool supporting means and means for securing a portion of said sheave supporting means against movement relative to said axle whereby said last named means may serve as a handle for guiding the apparatus during transportation.

90 15. In a drilling apparatus, a tool supporting means comprising an axle, wheels thereon for supporting the apparatus during transportation, means for supporting the apparatus during operation thereof, a second supporting means, a sheave thereon, and means for securing said last named means against movement relative to said axle whereby said apparatus may be supported by said wheels and said sheave during transportation.

100 16. In a drilling apparatus, a wheeled support, a plurality of tripods thereon, and means for interlocking the legs of said tripods whereby certain of the legs of one tripod may serve as a guiding handle during transportation.

105 17. In a drilling apparatus including a rotatably movable support and a stationary support adapted to cooperate therewith and used during drilling operation, a ground hog tool, means on the stationary support for rotating the same, and means having operative connection with said stationary support for changing the position of the tool relative to the work.

120 18. In a drilling apparatus including a stationary and rotatably movable support adapted to cooperate therewith, a ground hog tool mounted on said stationary support, and means detachably secured thereto for

holding said tool in a fixed position during any stationary or rotated position thereof.

19. In a drilling apparatus, a ground hog tool, means for continuously rotating the same, including a guide and engaging members radially slidable therein and controlled by relative movement between said means and tool, means for changing the position of the tool relative to the work during the drilling operation, and means for holding said tool in a fixed position at any position thereof.

20. In a drilling apparatus, a ground hog tool, means for continuously rotating the same, including a guide and engaging members radially slidable therein and controlled by relative movement between said means and tool, means for changing the position of the tool relative to the work, and means for holding said tool in a fixed position at any position thereof.

21. In a drilling apparatus, a ground hog drill comprising a drill bit and means for actuating the same, including a guide and engaging members radially slidable therein and controlled by relative movement between said means and tool, means for rotating said drill, and means including a drum and a cable actuated thereby for varying the position of said drill relative to the work.

22. In a drilling apparatus, a plurality of tripods a ground hog drill comprising a drill bit and means for actuating the same carried by the apex of one of said tripods, means for rotating said drill, means including a drum mounted on said tripod and a cable having operative connection with the other tripod and actuated thereby for varying the position of said drill relative to the work, and a single actuator for said rotating means and drum.

23. In a drilling apparatus, a tripod, a ground hog drill, means for rotating said drill forming the apex of said tripod, means including a drum and a cable actuated thereby for varying the position of said drill relative to the work, and a vise for securing said drill in a predetermined position for transportation.

24. In a drilling apparatus including superimposed tripods, a ground hog drill, comprising a drill bit and means for actuating the same, means for rotating said drill carried at the apex of one of said tripods, and means including a drum, a cable actuated thereby, and a sheave mounted on the other of said tripods above said drill for varying the position of said drill relative to the work.

25. In a drilling apparatus, a plurality of tripods, a ground hog drill comprising a drill bit and means for actuating the same, means for rotating said drill carried at the apex of one tripod, and means including a drum, a cable actuated thereby and op-

eratively connected to the other tripod, a support, and a sheave mounted above said drill on said support for varying the position of said drill relative to the work.

26. In a drilling apparatus, a tripod, a ground hog drill carried thereby, means located at the apex of said tripod for rotating said drill, and means including a drum and a cable actuated thereby for varying the position of said drill relative to the work.

27. In a drilling apparatus, a tripod, a ground hog drill, means for rotating said drill, and means including a drum, a cable actuated thereby, a second tripod carried by said first named tripod, and a sheave mounted above said drill on the last named tripod for varying the position of said drill relative to the work.

28. In a drilling apparatus, a ground hog drill having a drilling tube, and means including a guide having engaging members radially slidable therein and engageable with said tube to continuously rotate the drill.

29. In a drilling apparatus, a ground hog drill having a drilling tube, and means constantly rotating in one direction and engageable in only said direction of rotation with said tube to rotate the drill.

30. In a drilling apparatus, a ground hog drill having a drilling tube, means engageable with said tube to rotate the drill, and means coaxially rotatable with and relative to said tube for controlling only rotative engagement of said rotating means with said tube.

31. In a drilling apparatus, a ground hog drill having a drill tube, means engageable with said tube to rotate the drill, and means normally rotating with said rotating means and coaxially rotatable with and relative to said tube for controlling only rotative engagement of said rotating means with said tube.

32. In a drilling apparatus, a ground hog drill having a drilling tube, means engageable with said tube to continuously rotate the drill, said last named means comprising a clutch adapted to grip the outside of said tube operable by relative movement between said clutch and rotating means, and resilient means adapted to keep said clutch out of engagement with said tube.

33. In a drilling apparatus, a ground hog drill having a drilling tube, and means engageable with said tube to continuously rotate the drill, said last named means comprising a clutch adapted to grip in only one direction of rotation, the outside of said tube to rotate the latter while permitting said tube to be advanced against the work.

34. In a ground hog drilling apparatus, a drill tube, a rotator mounted coaxially therewith, clutch engaging members between said

tube and rotator, and means movable with said engaging members to actuate the same and coaxially rotatable with and relative to said tube.

35. In a ground hog drilling apparatus, a drill tube, a rotator mounted coaxially therewith, clutch mechanism between said tube and rotator, and a single actuating means rotatable coaxially with said clutch mechanism for controlling only rotative movement.

36. In a ground hog drilling apparatus, a drill tube, a rotator mounted coaxially therewith, clutch mechanism between said tube and rotator, and longitudinally movable means operable during rotation carried by said rotator for controlling said clutch mechanism.

37. In a ground hog drilling apparatus, a drill tube, a rotator mounted coaxially therewith, clutch mechanism between said tube and rotator, and longitudinally movable means carried by said rotator and movable therewith for controlling said clutch mechanism at the will of the operator.

38. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, a rotator mounted coaxially with said drill tube, and means for varying the relative angular positions of said operating tube and rotator to control said rotator.

39. In a drilling apparatus, a ground hog drill having a drilling tube, means engageable with said tube to rotate the drill, and means longitudinally operable during rotation of the tube for controlling only rotative engagement of said rotating means with said tube at the will of the operator.

40. In a drilling apparatus, a ground hog drill having a drill tube, means engageable with said tube to rotate the drill, and means rotatable coaxially with said tube and normally rotating with said rotating means for controlling only rotative engagement of said rotating means with said tube, said last mentioned means being operable to effect such control during rotation thereof.

41. In a drilling apparatus, a ground hog drill, a drill tube, a rotator mounted coaxially therewith, clutch mechanism for effecting only rotation between said tube and rotator, and longitudinally movable means for controlling said clutch mechanism operable during rotation of said rotator and at the will of the operator.

42. In a ground hog drilling apparatus, a drill tube, a rotator mounted coaxially therewith, clutch mechanism for varying only rotative engagement between said tube and rotator, and means carried by and operable during rotation of said rotator for controlling said clutch mechanism.

43. In a drilling apparatus, a drill stem, engaging means therefor, and resilient means for operatively connecting and disconnecting said engaging means with said

stem, said resilient means being necessarily completely yielding during both of said operations.

44. In a ground hog drilling apparatus, a drill tube, and rotating means therefor comprising an operating tube mounted coaxially therewith, a rotator mounted coaxially therewith and means for varying the relative longitudinal positions of said operating tube and rotator to control said rotator.

45. In a ground hog drilling apparatus, a drill tube, and rotating means therefor comprising an operating tube mounted coaxially with said drill tube, a rotator also mounted coaxially with said drill tube, and means for varying the relative angular and longitudinal positions of said operating tube and rotator to control said rotator.

46. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, and a rotator mounted coaxially with said drill tube and having clutch mechanism adapted to rotate said drill tube and controlled by the relative positions of said operating tube and rotator.

47. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith and a rotator mounted coaxially with said drill tube and provided with clutch mechanism adapted to rotate said drill tube and controlled by the relative angular positions of said operating tube and rotator.

48. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, and a rotator mounted coaxially with said drill tube and provided with clutch mechanism adapted to rotate said drill tube and controlled by the relative longitudinal positions of said operating tube and rotator.

49. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith and a rotator mounted coaxially with said drill tube and provided with clutch mechanism adapted to rotate said drill tube and controlled by the relative angular and longitudinal positions of said operating tube and rotator.

50. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, a rotator mounted coaxially with said drill tube and provided with clutch mechanism adapted to rotate said drill tube and controlled by the relative positions of said operating tube and rotator, and means for controlling the positions of said operating tube and rotator.

51. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, a rotator mounted coaxially with said drill tube, clutch mechanism carried by said rotator and adapted to rotate said drill tube and controlled by the relative angular positions of said operating tube and

rotator, and means for controlling the positions of said operating tube and rotator.

52. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, a rotator mounted coaxially with said drill tube, clutch mechanism carried by said rotator and adapted to rotate said drill tube and controlled by the relative longitudinal positions of said operating tube and rotator, and means for controlling the positions of said operating tube and rotator.

53. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, a rotator mounted coaxially with said drill tube, clutch mechanism carried directly by said rotator and adapted to rotate said drill tube and controlled by the relative angular and longitudinal positions of said operating tube and rotator, and means for controlling the positions of said operating tube and rotator.

54. In a ground hog drilling apparatus, a continuously rotating rotator, a drill tube, clutch mechanism therebetween adapted to disengage said member and which is controlled by relative movement of said tube and rotator, and resilient means for retaining the engaging portions of said clutch inoperative.

55. In a ground hog drilling apparatus, a unidirectionally moving rotator, a drill tube, clutch mechanism therebetween adapted to disengage said member and which is controlled by relative movement of said tube and rotator, and means including resilient members for retaining said clutch inoperative.

56. In a ground hog drilling apparatus, a unidirectionally moving rotator, a drill tube, clutch mechanism therebetween including a guide and engaging members radially slidable therein controlled by relative movement of said tube and rotator, and means including a hoisting apparatus for controlling the relative position of said tube and rotator.

57. In a ground hog drilling apparatus, including a plurality of superimposed tripods forming a unitary structure, a rotator carried by one of said tripods, a drill tube, clutch mechanism therebetween controlled by relative movement of said tube and rotator, means including a hoisting apparatus operatively connected to the other tripod for moving said tube relative to said rotator, and means for holding said tube in a predetermined position relative to said rotator.

58. In a ground hog drilling apparatus, a rotator, a drill tube, clutch mechanism therebetween including a guide and engaging members radially slidable therein and controlled by relative movement of said tube and rotator, means including a hoisting apparatus for controlling the relative positions of said tube and rotator, and means for ac-

tuating said rotator and said last named means simultaneously.

59. In a ground hog drilling apparatus, a rotator, a drill tube, clutch mechanism therebetween including engaging members having resilient means to hold the same out of contact with said drill tube controlled by relative movement of said tube and rotator, means for moving said rotator relative to said tube, means including a hoisting apparatus for controlling the relative positions of said tube and rotator, and a single means for actuating said rotator and said last named means.

60. In a drilling apparatus, a ground hog drill, means for rotating said drill, means for connecting said drill and rotating means, means for controlling said connecting means, including resilient means to hold said connecting means out of contact with said tube, said resilient means being necessarily yielding whenever said disconnection is made, and means simultaneously operable with said rotating means for varying the relative position of said drill to the work.

61. In a drilling apparatus, a ground hog drill, means for rotating said drill, radially slidable means for connecting said drill and rotating means, means for controlling said connecting means, means for varying the relative position of said drill to the work, and means for actuating said rotating means and said varying means simultaneously or independently.

62. In a drilling apparatus, a drill rotating mechanism, a tube operated thereby, clutch mechanism for connecting said rotating mechanism and tube, means for controlling the position of said tube relative to the work, and means arranged at opposite sides of said apparatus for controlling said last named means.

63. In a drilling apparatus, a drill rotating mechanism, a tube operated thereby, clutch mechanism for connecting said rotating mechanism and tube, means for controlling the position of said tube relative to the work, and means arranged at opposite sides of said apparatus for controlling said clutch mechanism.

64. In a ground hog drilling apparatus, a drill tube and rotating means therefor comprising an operating tube mounted coaxially therewith, engaging means cooperating with said drill and operating tube, and means for controlling the longitudinal position of said operating tube to control said engaging means.

65. In a ground hog drilling apparatus, a rotator, a drill tube, clutch mechanism therebetween including radially slidable engaging members controlled by relative movement of said tube and rotator, means including a hoisting apparatus for moving said tube relative to said rotator, and

means for holding said tube in a predetermined position relative to said rotator, said last named means comprising a releasable vise adapted to engage said tube, and to be moved pivotally out of engaging position.

66. In a drilling apparatus, an actuator, an operating tube adjustable relative thereto and controlling the operation thereof, and means for limiting the relative movement of said actuator and tube.

67. In a drilling apparatus, an actuator, an operating tube adjustable relative thereto and controlling the operation thereof, and means for normally retaining said tube in a predetermined position relative to said actuator.

68. In a drilling apparatus, a rotator, an operating tube adjustable relative thereto, and resilient means for normally retaining said tube in a predetermined position relative to said rotator.

69. In a ground hog drilling apparatus, a drill tube, an operating tube mounted coaxially therewith, a rotator mounted coaxially with said drill tube and provided with clutch mechanism adapted to rotate said drill tube and controlled by the relative positions of said operating tube and rotator, and means for adjusting said clutch mechanism.

70. In a drilling mechanism, a drill tube, and means for rotating the same including a member rotating coaxially with the drill tube, jaws adapted to engage said drill tube and pivotally connected to said rotating member, and means movable relative to said jaws whereby said jaws may be caused to engage and disengage from said tube at the will of the operator.

71. In a drilling mechanism, a drill tube, means for rotating the same including a member rotating coaxially with said drill tube, jaws adapted to engage said drill tube and pivotally connected to said rotating member, means automatically tending to cause said jaws to engage said drill tube, and means movable relative to said jaws whereby said jaws may be caused to engage or disengage from said tube at the will of the operator.

72. In a drilling mechanism, a drill tube, means for rotating the same including a member rotating coaxially with said drill tube, jaws adapted to engage said drill tube and pivotally connected to said rotating member, rotatable means automatically tending to cause said jaws to engage said

drill tube, and means whereby said jaws may be caused during operation to engage or disengage from said tube at the will of the operator.

73. In a drilling mechanism, a drill tube, means for rotating the same including a member rotating coaxially with said drill tube, jaws adapted to engage said drill tube and pivotally connected to said rotating member, means automatically operative to cause said jaws to engage said drill tube, and means movable relative to the jaws and the rotating member whereby said jaws may be caused during operation to engage or disengage from said tube at the will of the operator.

74. In a rotary drilling mechanism, a member having a vertical work receiving opening, a plurality of lateral openings therein, work gripping members mounted in said openings and projectable therethrough to grip the work, stems engaging said work gripping members for moving the same, a member engaging said stems to move the latter, and means for changing the relative position of said first and last mentioned members to cause said work gripping members to grip or release the work.

75. In a rotary drilling mechanism, a member having a vertical work receiving opening, a plurality of lateral openings therein, work gripping members mounted in said openings and projectable therethrough to grip the work, stems engaging said work gripping members for moving the same, a member coaxial with said first mentioned member and engaging said stems to move the latter, and means for changing the relative position of said first and last mentioned members to cause said work gripping members to grip or release the work.

76. In a rotary drilling mechanism, a member having a vertical work receiving opening, a plurality of lateral openings therein, work gripping members mounted in said openings and projectable therethrough to grip the work, stems engaging said work gripping members for moving the same, a power operated rotating member coaxial with said first mentioned member and engaging said stems to move the latter, and means for changing the relative position of said first and last mentioned members to cause said work gripping members to grip or release the work.

In testimony whereof I affix my signature.

HENRY H. MERCER.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,507,294, granted September 2, 1924, upon the application of Henry H. Mercer, of Claremont, New Hampshire, for an improvement in "Drilling Machinery," errors appear in the printed specification requiring correction as follows: Page 2, line 59, for the word "which" read *with*; same page, line 104, for the article "a," second occurrence, read *the*; page 6, line 114, claim 1, for the word "the" read *each*; page 7, line 16, claim 6, after the word "means" insert the words *operatively connected to the other of said tripods*; same page and claim, lines 18 and 19, strike out the words "operatively connected to the other of said tripods"; same page, line 93, claim 14, strike out the comma after "sheave" and insert the same to follow the word "means," first occurrence, in line 94; page 8, lines 5, 15, and 24, claims 19, 20, and 21, after the word "same" strike out the comma; same page, line 32, claim 22, after the word "tripods" insert a comma, and in line 51, claim 24, strike out the comma after the word "drill"; same page, line 125, claim 33, strike out the comma after the word "rotation"; page 9, line 73, claim 44, after the word "with," line 93, claim 47, and line 109, claim 49, after the word "therewith," insert a comma; page 10, line 47, claim 57, after the word "apparatus," and line 84, claim 60, after the word "means," first occurrence, strike out the comma; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of November, A. D. 1924.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.