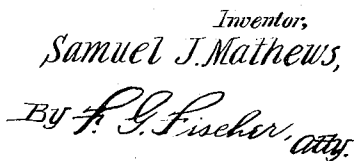


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6 SHEETS—SHEET 1.

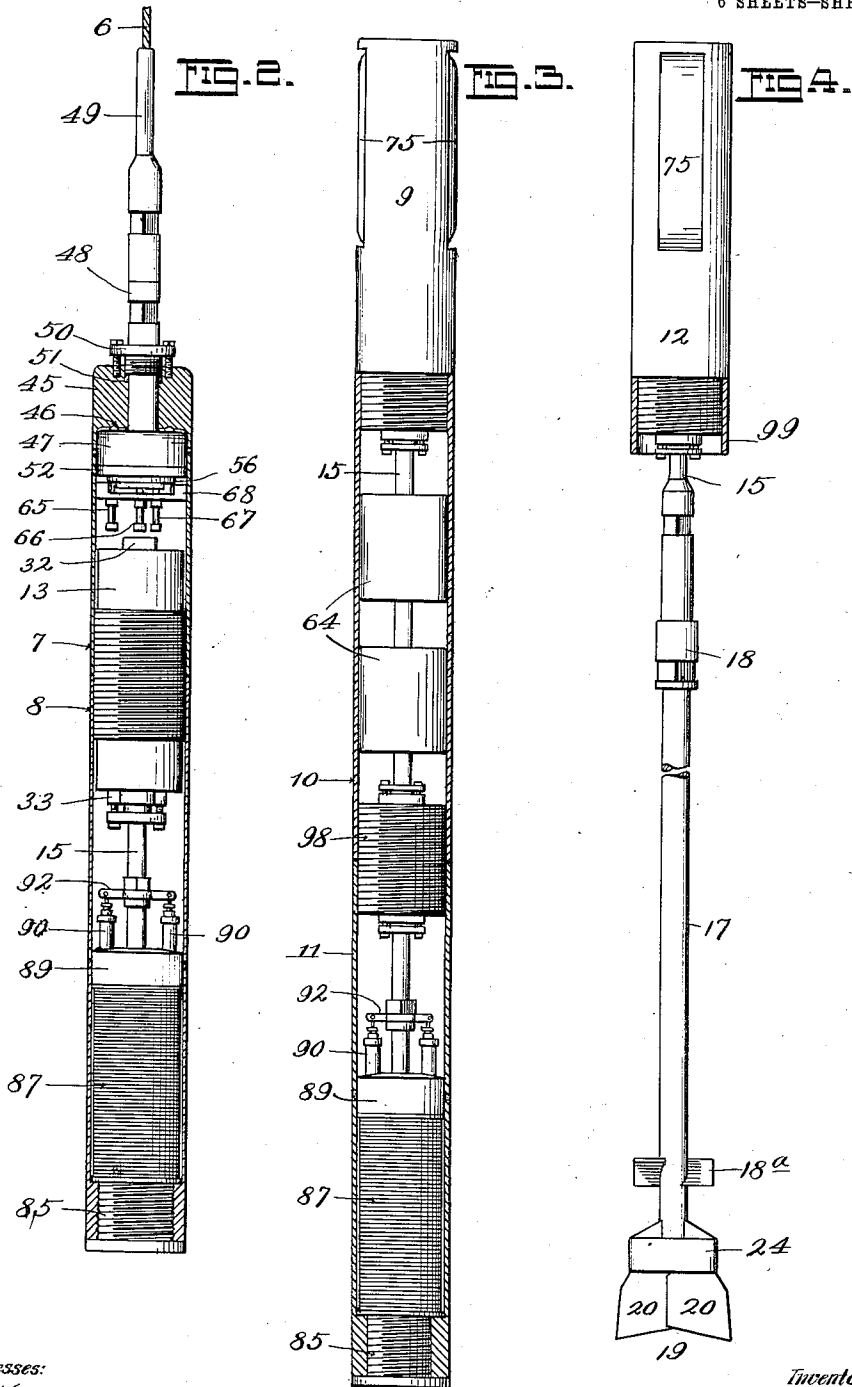


S. J. MATHEWS.
WELL DRILLING GEAR.
APPLICATION FILED JUNE 20, 1912.

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Patented Nov. 4, 1913.

6 SHEETS—SHEET 2.



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6 SHEETS—SHEET 3.

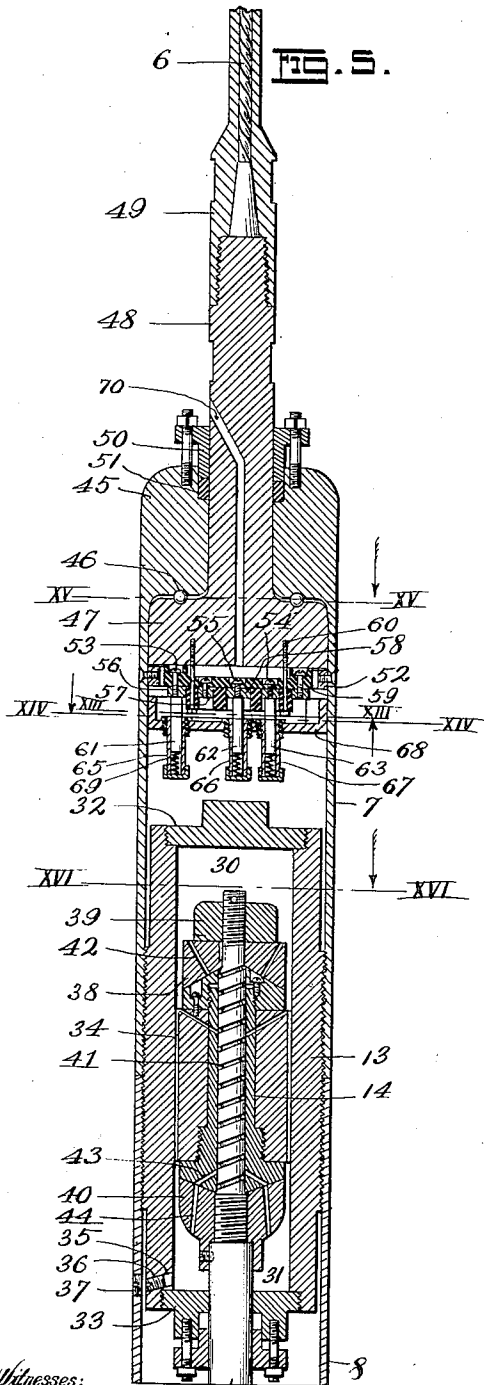


FIG. 15.

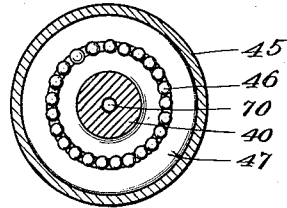


FIG. 16.

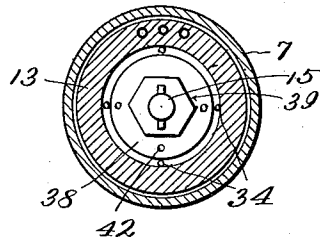
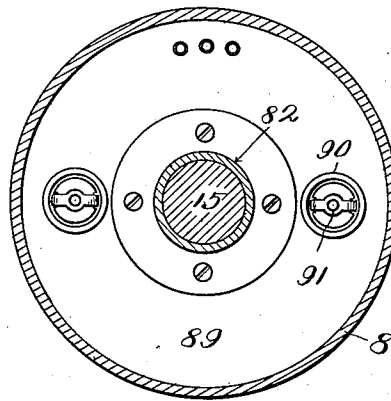


FIG. 17.



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6 SHEETS—SHEET 4.



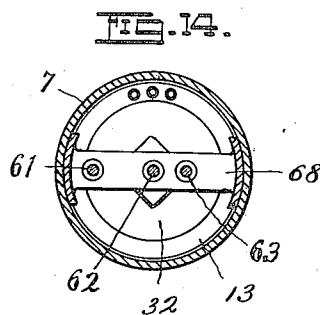
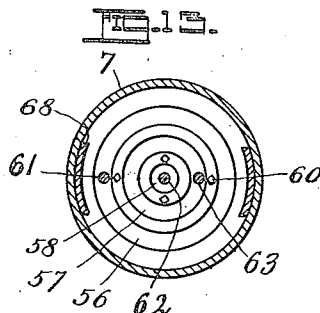
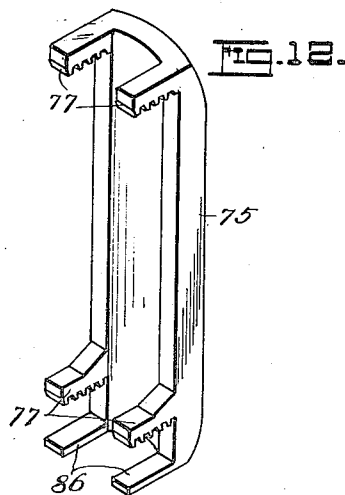
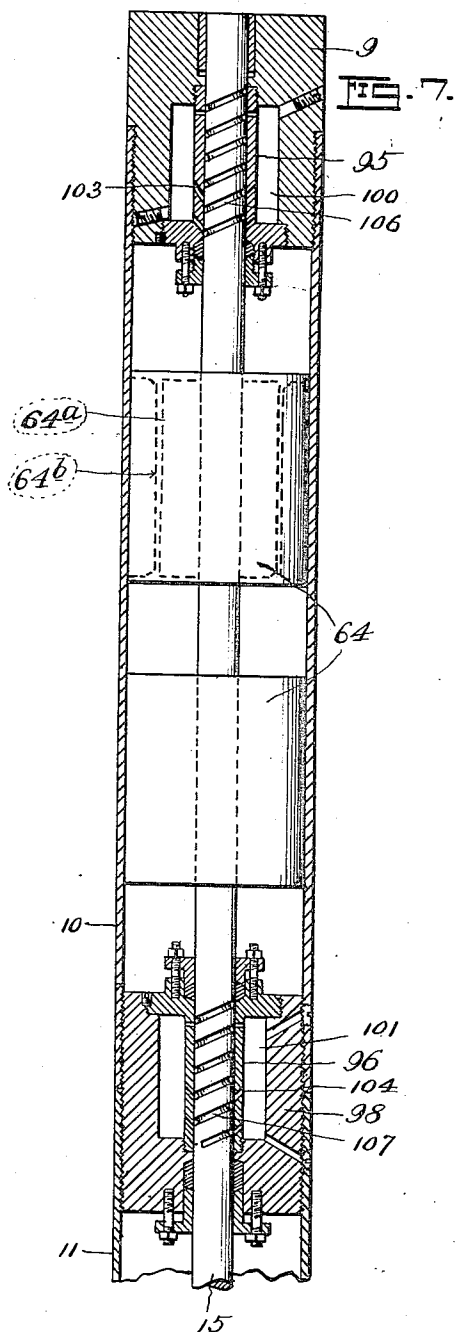
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6 SHEETS—SHEET 5.



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6 SHEETS—SHEET 6.

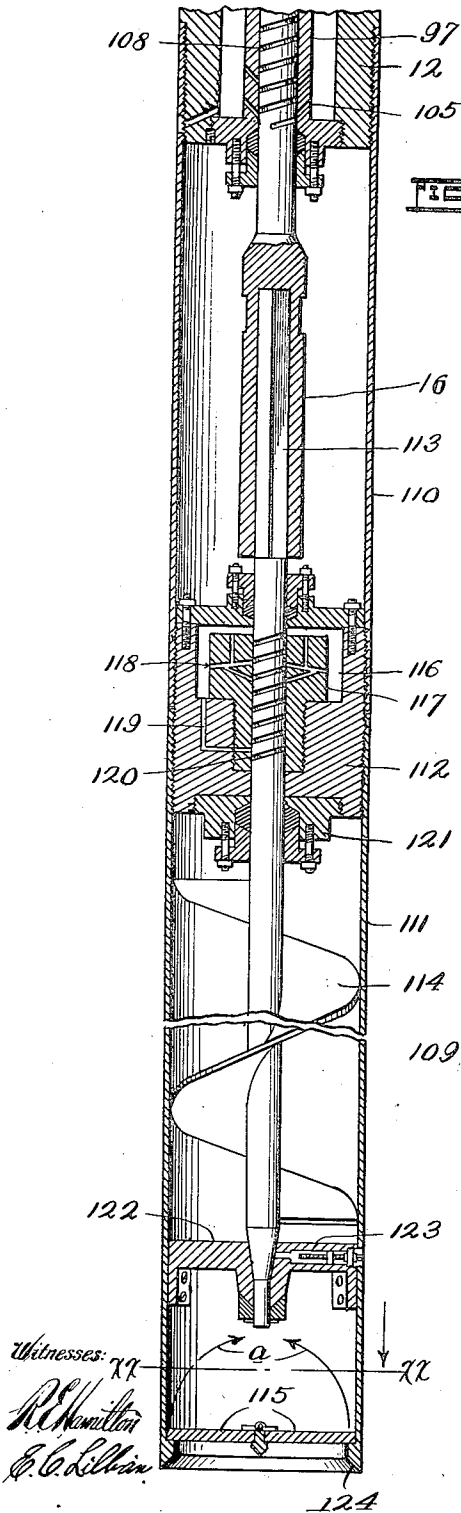


Fig. 19.

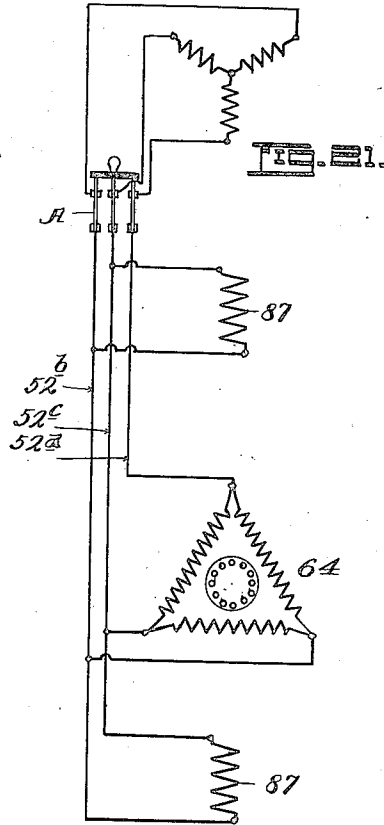
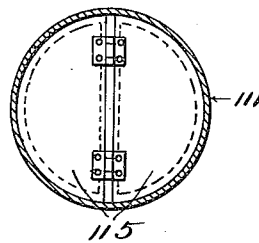


Fig. 21.

Fig. 20.



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UNITED STATES PATENT OFFICE.

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WELL-DRILLING GEAR.

1,077,620.

Specification of Letters Patent.

Patented Nov. 4, 1913.

Application filed June 20, 1912. Serial No. 704,809.

To all whom it may concern:

Be it known that I, SAMUEL J. MATHEWS, a citizen of the United States, residing at Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Well-Drilling Gear, of which the following is a specification.

My invention relates to improvements in well-drilling gear, and the important objects of the invention are: first, to provide a new and useful gear of this character which can be driven at a greater cutting speed with less power than heretofore; second, to apply the power to the gear in such manner as to reduce torsional strain to a minimum; third, to materially reduce the time ordinarily consumed in removing the gear from and replacing it in the well; and fourth, to use less casing in lining the well bore than heretofore.

Other objects of the invention will hereinafter appear, and in order that said invention may be fully understood, reference will now be made to the accompanying drawings, in which:

Figure 1 is a side elevation showing the gear in operative position. Fig. 2 is a side elevation partly in section of the upper portion of the gear. Fig. 3 is a side elevation partly in section of a continuation of the part disclosed by Fig. 2. Fig. 4 is a side elevation partly in section of a continuation of the part disclosed by Fig. 3. Fig. 5 is a central vertical section of the upper portion of the gear. Fig. 6 is a central vertical section of a continuation of the part disclosed by Fig. 5. Fig. 7 is a vertical central section of a continuation of the part disclosed by Fig. 6. Fig. 8 is a vertical central section of the lower portion of the gear. Fig. 9 is a broken, vertical, central section of a dash-pot, employed in carrying out the invention. Fig. 10 is an enlarged cross section on line X—X of Fig. 6, showing a pair of shoes employed to hold the gear from rotation in the well bore with the bit. Fig. 11 is a vertical section on line XI—XI of Fig. 6. Fig. 12 is a detail perspective of one of the shoes disclosed by Fig. 10. Fig. 13 is a cross section on line XIII—XIII of Fig. 5, showing part of a self-adjusting contact employed in carrying out the invention. Fig. 14 is a cross section on line XIV—XIV of Fig. 5. Fig. 15 is a cross section of a ball-

bearing on line XV—XV of Fig. 5. Fig. 16 is a cross section on line XVI—XVI of Fig. 5, showing a tubular section and a coupling member therefor. Fig. 17 is a cross section on line XVII—XVII of Fig. 6, showing a pair of dash-pots employed in carrying out the invention. Fig. 18 is a cross section of the bit, on line XVIII—XVIII of Fig. 8. Fig. 19 is a central, vertical section of a bailer, employed in carrying out the invention. Fig. 20 is a cross section on line XX—XX of Fig. 19. Fig. 21 is a diagram of a motor and solenoid circuit, employed in carrying out the invention.

Referring to Fig. 1 of the drawings, 1 designates the customary rigging for handling the drilling gear, said rigging consisting of a derrick 2, a crown-sheave 3, mounted upon said derrick, a combined engine and electric generator 4, a drum 5 driven by the engine, and a cable 6 running over the crown-sheave 3 and attached at its ends to drum 5 and the upper end of the drilling gear.

For convenience in gaining access to and assembling the several parts constituting my improved drilling gear, I connect the same by sections of tubing 7, 8, 9, 10, 11 and 12, see Figs. 1, 5, 6, 7 and 8. Sections 7 and 8 are united by an internal coupling member 13, containing a bearing 14 in which the upper end of a stem 15 is journaled. Said stem extends partway through section 7 and through sections 8 to 12, inclusive, and terminates at its lower end in a chuck 16 to receive the rectangular upper terminal of the bit-shank 17, which is removably-held in the chuck by a coupling 18. Shank 17 (Fig. 8) is provided with a pair of oppositely-inclined blades 18^a, to elevate the cuttings when the bit 19 is driven in cutting direction, and to assist in raising the gear when the bit is driven in a reverse direction, by bearing against the cuttings. Said blades 18^a also agitate any mud which may be encountered in the well bore and thus prevent said mud from unduly accumulating on the shank and thus interfering with the operation of the bit.

Bit 19 consists of a pair of blades 20, removably-secured at their upper ends in a pair of holders 21 by pins 22, said holders being pivotally-secured by pins 23 to a hollow base 24 at the lower end of shank 17. Bit 19 is preferably in the form of a reamer

to cut the bore of the well large enough to receive a casing 25 of uniform diameter, and each blade 20 has a beveled upper portion 26 to contact with the lower end of said casing 25, to swing the lower outer corners of the blades toward each other so that they will readily enter the casing when withdrawing the drilling gear from the well bore. When the bit 19 is below the casing 25, its blades 20 are ordinarily spread apart by a presser-foot 27, yieldingly-held in engagement with the adjacent ends of holders 21 by an expansion spring 28, which, together with the presser-foot is operably-mounted in a socket 29 in the lower portion of the shank 17. The casing 25 is held from rotating with the drilling gear by a clamp 25^a, mounted upon the platform of the derrick 2.

Referring back to the coupling-member 13, (Fig. 5) it will be seen that the same has upper and lower oil-chambers 30 and 31, closed at their outer ends by screw-plugs 32 and 33, respectively, and communicating at their inner ends through vertical ducts 34. Said oil-chambers are provided with oil for the purpose of lubricating bearing 14 and that part of stem 15 journaled therein. The oil-chamber 31 has an outlet 35 at its lower end normally-closed by a threaded plug 36, to which access may be had through an aperture in the tubular section 8, said aperture being normally closed by a screw-plug 37.

Stem 15 is provided with a thrust-bearing 38, mounted on the upper end of bearing 14 to carry the weight of stem 15 and all the parts carried thereby when the drilling gear is being lowered into or raised from the well bore. In addition to the thrust-bearing 38 being keyed to the upper end of stem 15, it is further secured thereon by a lock-nut 39. Stem 15 is also provided with a thrust-bearing 40, operably-engaging the lower end of bearing 14 to receive the end thrust of the stem while the bit 19 is cutting. That portion of stem 15 journaled in bearing 14 has a spiral duct 41, communicating with ducts 42 and 43 in thrust-bearing 38 and the lower portion of bearing 14, respectively, the ducts 43 communicating at their lower ends with ducts 44 in thrust-bearing 40. With the foregoing arrangement of ducts, bearing 14 is constantly lubricated during the drilling operation by oil carried upward from the oil-chamber 31 by the spiral duct 41, said oil-chamber 31 being replenished from the upper oil-chamber 30 through the vertical ducts 34.

The tubular section 7 is provided at its upper end with a thrust-bearing 45, which rests upon ball-bearings 46, carried by the enlarged base 47 of a shank 48 attached to cable 6 by a coupling 49. Bearing 45 is provided at its upper end with a gland 50 and packing 51 to exclude foreign matter

from the ball-bearings 46. Shank 48 is prevented from moving downward independently of section 7 by an annulus 52 secured to the tubular section and abutting against the base 47.

By swiveling the tubular section 7 on shank 48, as described, the gear is free to turn independently of said shank while being raised or lowered without twisting the cable 6 and an electric cable 52^a containing a plurality of wires 52^b, 52^c and 52^d, communicating at one end with the electric generator and at their opposite end with one or more motors 64. In order to prevent the wires 52^b, 52^c and 52^d from becoming twisted in their passage from shank 48 to the motors 64, I provide a self-adjusting contact comprising binding-posts 53, 54 and 55, three annular conductors 56, 57 and 58, an insulating plate 59 to which the annular conductors are secured by said binding-posts, and three brushes 61, 62 and 63, which bear against the end of conductors 56, 57 and 58, respectively. The insulating plate 59 is secured to base 47 by screws 60. The circuit through the wires 52^b, 52^c and 52^d is controlled by a switch A, Fig. 21. Brushes 61, 62 and 63 are operably-mounted in brush holders 65, 66 and 67, respectively, secured to a plate 68 in the tubular section 7 (Fig. 5), and in order to obtain good contacts between the brushes and their respective annular conductors, which they slidably engage, I interpose springs 69 between the lower ends of said brushes and their respective holders.

The wires constituting the electric cable 52^a, extend outward from their respective binding posts through a central duct 70 in shank 48, and in their passage to drum 5 run around pulleys 71 and 72 at the upper portion of the derrick, and a traveling pulley 73 carrying a counterweight 74 to keep the wires taut and at the same time allow them to pay out so that they will at no time carry the weight of the drilling gear.

The rotors 64^a of the motors 64 are keyed or otherwise fixedly-mounted upon stem 15, while the stators 64^b of said motors are fixed in the tubular section 10 to prevent them from rotating with the stem.

When the drilling gear is in operation in the bore of a well, tubular sections 7 to 12, inclusive, are prevented from rotating with stem 15 and the drill bit, by two sets of shoes 75 and 76, set at right angles to each other and operably-mounted in the sections 9 and 12, respectively, (Figs. 1 and 6). Shoes 75 and 76 are adapted to frictionally-engage either the casing 25 or the sides of the well bore, and since each set of shoes and its actuating mechanism, is a duplicate of the other, I will proceed to describe but one set.

Each shoe 75 is provided at its upper and

lower portion with a pair of inwardly-extending rack-bars 77, each of which intermeshes with a pinion 78, fixedly-mounted upon each end of a short shaft 79 provided with a centrally disposed fixedly-mounted pinion 80, intermeshing with a rack 81, integral with a sleeve 82 reciprocally-mounted on stem 15 (Fig. 6). Each shaft 79 is journaled in a pair of bearings 83 secured to a dove-tail plate 84, (Figs. 6, 10 and 11) removably-mounted in its respective section, the upper reduced end 85 of which is screwed into the lower end of the adjacent section. Each shoe is held from independent upward movement by its uppermost rack-bars 77 slidably-engaging the underside of the adjacent plate 84, and from independent downward movement by a pair of inwardly-extending arms 86, slidably-engaging the upper surface of the adjacent plate 84. Sleeve 82 is drawn upward to throw the shoes outward into engagement with the walls of the bore by one or more solenoids 87, each having a movable core 88 fixed to said sleeve to raise the same when the solenoids are energized.

The solenoids are carried in the tubular sections 8 and 11, and each is provided at its upper end with a hollow head 89 carrying a pair of oppositely-disposed dash-pots 90, the plungers 91 of which are connected at their upper ends to a yoke 92, secured to the upper end of sleeve 82 to prevent the same from being drawn upward too rapidly by the solenoid and imparting shock to the shoes. Each dash-pot is preferably filled with oil or other fluid to retard the upward movement of its respective plunger 91, the lower annular end of which has a port 93 almost entirely closed by a valve 94, which uncovers the port and permits the plunger to readily pass downward through the fluid when the solenoid is deenergized. The solenoids may have an independent circuit or may be in the motor circuit as shown on Fig. 21.

In addition to bearing 14, stem 15 is journaled in bearings 95, 96 and 97. Bearing 95 is removably-secured in the lower end of section 9, which screws into the upper end of the section 10. Bearing 96 is removably-arranged in a coupling-member 98 connecting the adjacent ends of sections 10 and 11, and bearing 97 is removably-arranged in the lower end of section 12, which lower end is exteriorly-threaded to receive other attachments, for instance, like that disclosed by Fig. 19. When the type of bit disclosed by Fig. 8 is employed, the exterior threads on the lower end of section 12 are protected by an annular internally-threaded shield 99. The bearings 95, 96 and 97 extend through lubricant-chambers 100, 101, and 102, (Figs. 7 and 8) and have ports 103, 104 and 105 through which oil may flow to spiral ducts

106, 107 and 108, respectively, in stem 15. Said spiral ducts conduct the oil upward the full length of the bearings to keep the same and those portions of the stem 15 journaled therein thoroughly lubricated.

As the drilling proceeds and the cuttings accumulate between bit 19 and section 12, the gear is withdrawn from the bore and a bailer 109 is substituted for the bit to remove the cuttings when the gear is again replaced in the bore. Bailer 109 consists of a tubular section 110 adapted to be screwed upon the lower end of section 12, a tubular section 111 connected to the lower end of section 110 by a coupling 112, a shank 113 adapted to enter the chuck 16 and provided at its lower portion with a spiral conveyer 114, and a pair of inwardly-opening valves 115, which admit the cuttings to section 111 and retain them therein until the drilling gear is hoisted to the top of the well, when said valves may be readily opened in the direction of arrow *a*, Fig. 19, to empty the cuttings. Coupling 112 has an oil-chamber 116 to lubricate a bearing 117 and that portion of the bailer shank journaled therein. Bearing 117 is screwed into coupling 112 and has oil ducts 118 and 119 communicating with chamber 116 and a spiral duct 120, whereby oil is carried from the lower portion of the bearing 117 to the upper end thereof when the shank 113 is rotated. Oil is prevented from following the bailer shank down through the coupling 112 by a stuffing-box 121 at the lower portion of said coupling member. The lower end of shank 113 is mounted in a thrust-bearing 122 secured in the lower portion of the tubular section 111 and provided with an oil-chamber 123, to lubricate said bearing and that portion of the shank journaled therein. The lower terminal of tubular section 111 is beveled to a sharp edge 124 to facilitate its passage through the cuttings.

The operation briefly stated is as follows: When the electric circuits are closed, motors 64 are energized and rotate the stem 15 and the boring tool coupled to the lower end thereof. As the boring tool cuts its way into the earth, it is followed by the rest of the drilling gear, which is held from rotating by any suitable means until the shoes 75 and 76 enter the bore, the walls of which they frictionally-engage to prevent the rest of the gear from rotating with the boring tool and the stem 15. As the cuttings in the bore accumulate and fill the space between the tool 19 and section 12 of the gear, said gear is withdrawn from the bore and the bailer is substituted for the tool 19, after which the gear is inserted in the bore to remove the cuttings. After the cuttings have been gathered by the bailer, the gear is again withdrawn from the bore to empty the cuttings and the tool 19 is substituted for

the bailer. These operations are continued until a well of the desired depth has been drilled.

Should the walls of the bore require re-inforcing, this may be readily accomplished by permitting the casing 25 to follow bit 19.

Having thus described my invention what I claim and desire to secure by Letters Patent, is:

10 1. In a drilling gear of the character described, a suitable tool, a motor having a stationary part and a rotary part which latter is operably-connected to the tool to actuate the same, and electrically-controlled means adapted to coast with the walls of a well bore in preventing the stationary part of the motor from rotating with the tool.

2. In a drilling gear of the character described, a suitable tool, a motor having a stationary part and a rotary part which latter is operably-connected to the tool to actuate the same, and electrically-controlled frictional means adapted to coast with the walls of a well bore in preventing the stationary part of said motor from rotating with the tool.

3. In a drilling gear of the character described, a tool, a motor having a stationary part and a rotary part which latter is operably-connected to said tool to actuate the same, and electrically-controlled shoes to engage the walls of a well bore to prevent the stationary part of said motor from rotating.

4. In a drilling gear of the character described, a tool, a motor having a stationary part and a rotary part which latter is operably-connected to said tool to actuate the same, shoes operably-connected to the stationary part of said motor and adapted to engage the walls of a well bore to prevent said stationary part from rotating with the tool, integral racks on said shoes to actuate the same, pinions to actuate said racks, and means for actuating said pinions.

5. In a drilling gear of the character described, a tool, a motor having a stationary part and a rotary part which latter is operably-connected to said tool to actuate the same, shoes operably-connected to the stationary part of said motor and adapted to engage the walls of a well bore to prevent said stationary part from rotating with the tool, and a solenoid for actuating said shoes.

6. In a drilling gear of the character described, a tool, a motor having a stationary part and a rotary part which latter is operably-connected to said tool to actuate the same, shoes operably-connected to the stationary part of said motor and adapted to engage the walls of a well bore to prevent said stationary part from rotating with the tool, a solenoid for actuating said shoes, and means to retard the action of said solenoid.

7. In a drilling gear of the character described, a tool, a motor having a stationary

part and a rotary part which latter is operably-connected to said tool to actuate the same, shoes operably-connected to the stationary part of said motor and adapted to engage the walls of a well bore to prevent said stationary part from rotating with the tool, a solenoid for actuating said shoes, and a dash-pot to retard the action of said solenoid.

8. In a drilling gear of the character described, a tool, a motor having a stationary part and a rotary part which latter is operably-connected to said tool to actuate the same, shoes operably-connected to the stationary part of said motor and adapted to engage the walls of a well bore to prevent said stationary part from rotating with the tool, racks on said shoes to actuate the same, pinions intermeshing with said racks to actuate the same, other pinions to actuate the first-mentioned pinions, racks to actuate the last-mentioned pinions, a member carrying the last-mentioned racks, a solenoid for actuating said member, and dash-pots operably-connected to said member to retard the movement thereof.

9. In a drilling gear of the character described, a tool, a rotatable stem carrying said tool, tubular means in which said stem is journaled, electrically-controlled means to secure said tubular means from rotation, and a motor inclosed in said tubular means and connected to the stem to rotate the same.

10. In a drilling gear of the character described, a tool, a rotatable stem carrying said tool, tubular means in which said stem is journaled, frictional means to secure said tubular means from rotation, an electric motor inclosed in said tubular means and connected to the stem to rotate the same, a shank swiveled to said tubular means and having a duct, a self-adjusting contact having one part connected to said shank and another part to the tubular means, and electric conductors leading from a source of supply and through the duct to said motor, said conductors being connected to the self-adjusting contact.

11. In a drilling gear of the character described, a tool, a rotatable stem carrying said tool, tubular means in which said stem is journaled, a motor inclosed in said tubular means and operably-connected to the stem to rotate the same, a shank swiveled to the upper end of said tubular means, and a cable connected to said shank to raise and lower the same and the parts connected thereto.

12. In a drilling gear of the character described, a tool, a rotatable stem carrying said tool, a plurality of coupling-members in which said stem is journaled, a motor in one section and operably-connected to said stem to rotate the same, shoes operably-mounted in another section and adapted to engage the

walls of a well bore to keep the sections from rotating with the stem, and electrically-controlled means in another section to operate said shoes.

5 13. In a drilling gear of the character described, a tool, an electric motor operably-
connected to said tool to actuate the same,
tubular-means containing said electric motor,
a shank provided with a duct and
10 loosely connected to said tubular member to
allow the same to turn independently thereof,
a self-adjusting contact having one part
connected to said shank and another part
to the tubular member, and electric conduc-
15 tors leading from a source of supply and
through the duct to the motor, said conductors
being connected to the self-adjusting
contact.

14. In a drilling gear of the character de-
20 scribed, a tool, an electric motor operably-
connected to said tool to actuate the same,
tubular-means containing said electric motor,
a shank provided with a duct and
loosely connected to said tubular member to
25 allow the same to turn independently thereof,
a self-adjusting contact having one part

connected to said shank and another part
to the tubular member, electric conductors
leading from a source of supply and through
the duct to the motor, said conductors being 30
connected to the self-adjusting contact,
means for paying out or taking up said conductors,
and means for automatically taking
up slack in said conductors.

15. In a drill gear of the character de- 35
scribed, a casing held from rotation, an under-
cutting tool to cut in advance of said casing,
tubular means in which said tool is
 journaled, said tubular means being capable
of vertical movement in the casing to permit 40
the tool to cut in advance of said casing,
electrically controlled means adapted to engage
said casing to secure the tubular-means
from rotation with the undercutting tool,
and means for rotating the undercutting 45
tool.

In testimony whereof I affix my signature,
in the presence of two witnesses.

SAMUEL J. MATHEWS.

Witnesses:

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F. G. FISCHER.