Aug. 31, 1943. L. L. HAZEN 2,328,274

EARTH DRILLING MECHANISM

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FIG. 1

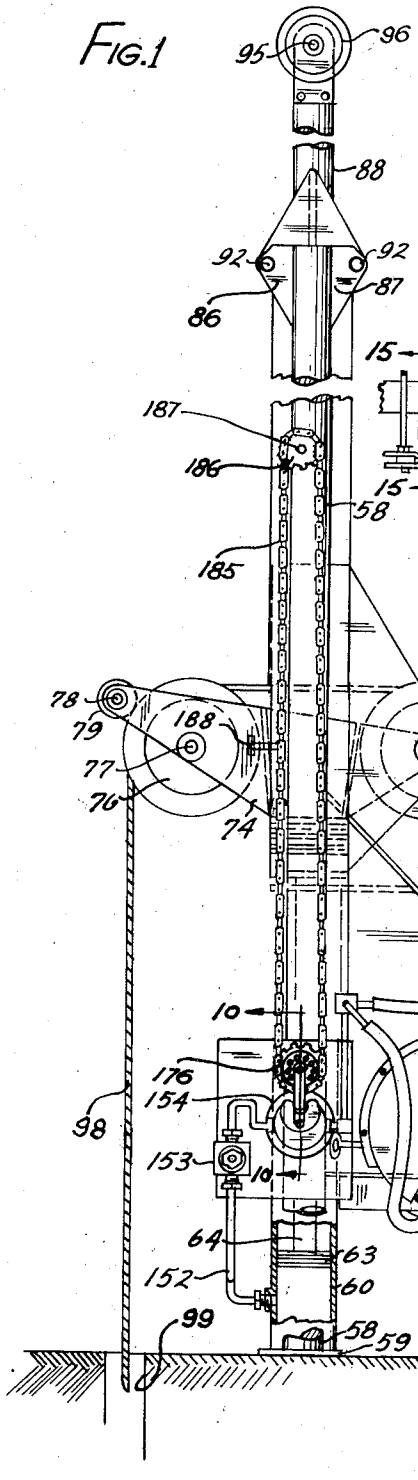


FIG. 6

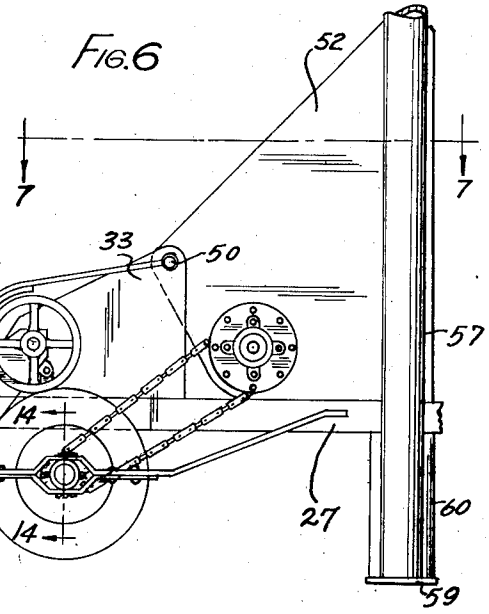
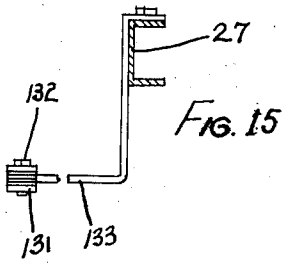


FIG. 15



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FIG. 2

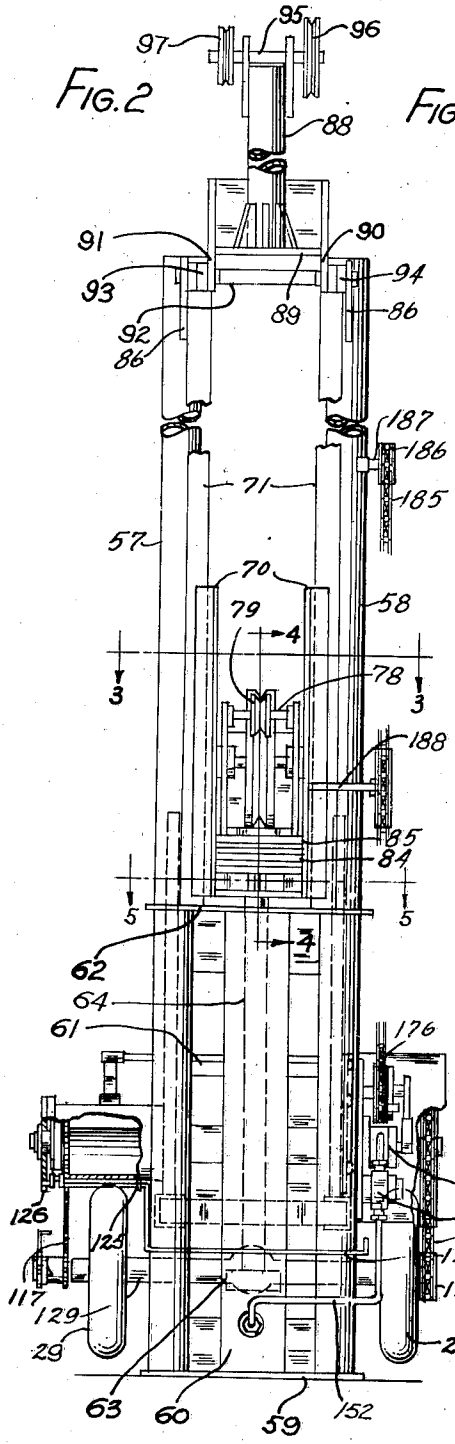


FIG. 3

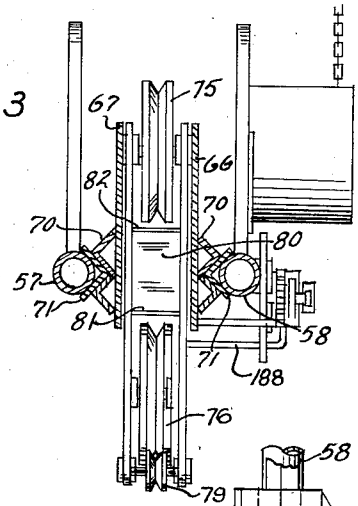


FIG. 4

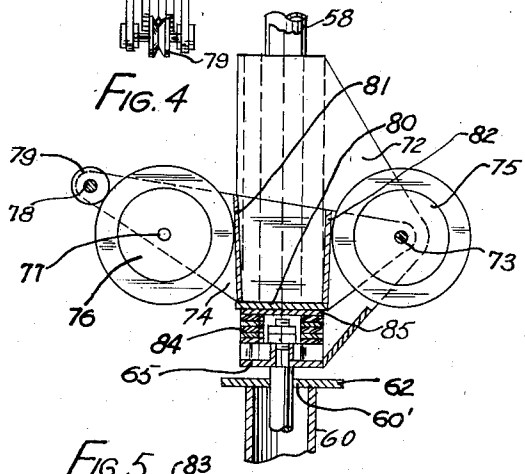
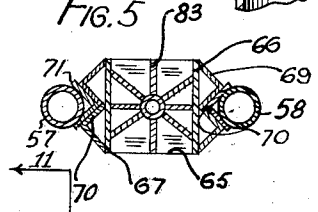


FIG. 5



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EARTH DRILLING MECHANISM

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FIG. 7

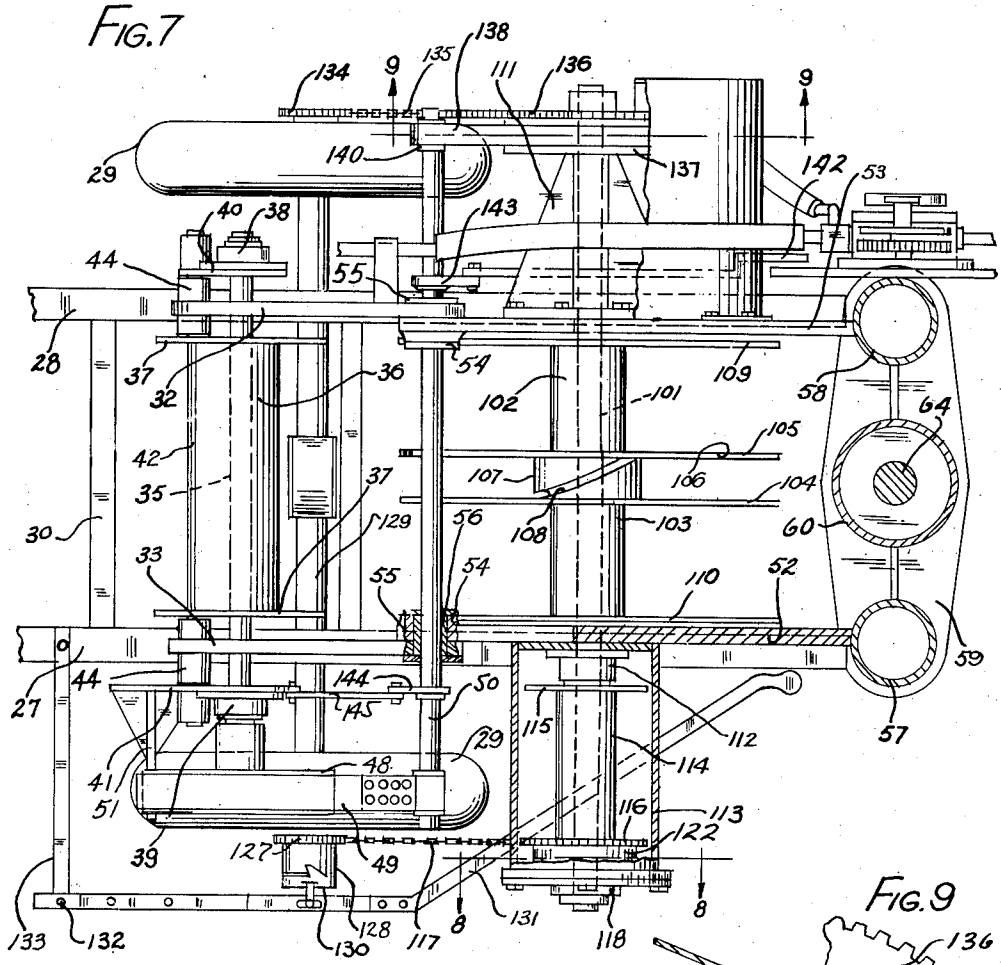


FIG. 8

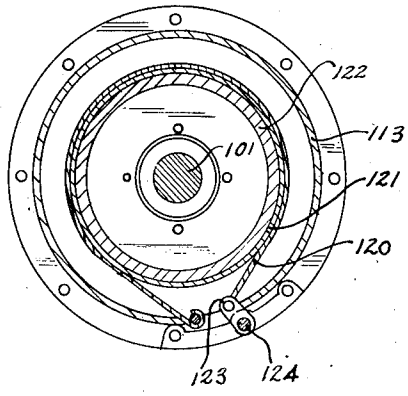
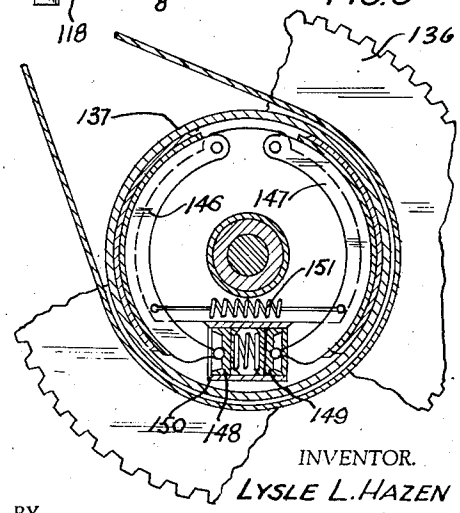


FIG. 9



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FIG. 10

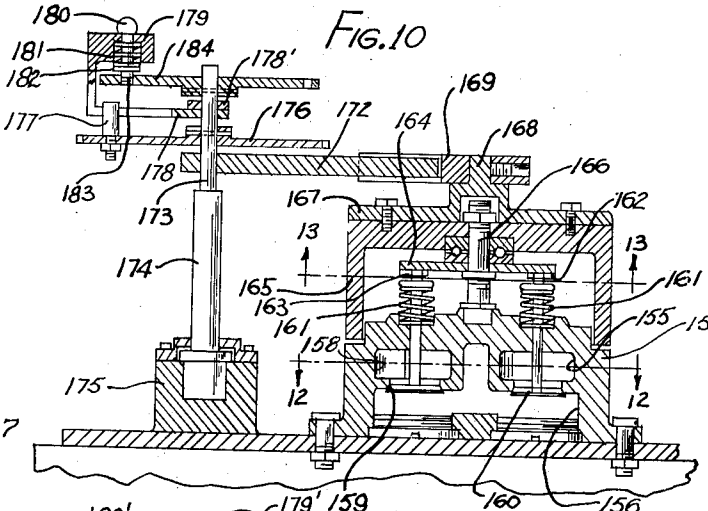


FIG. 12

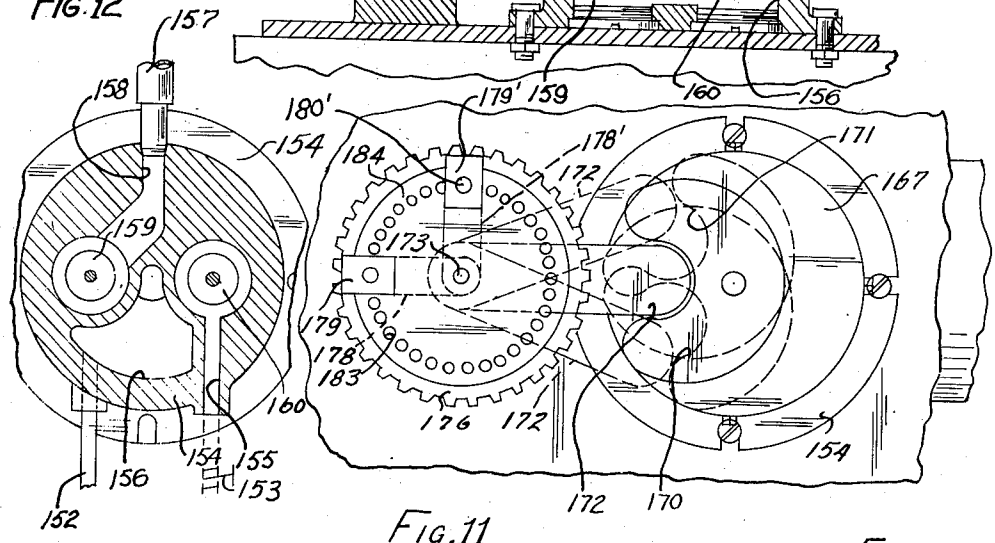


FIG. 11

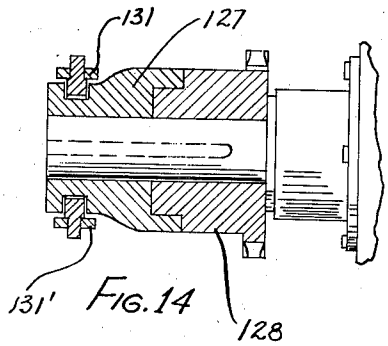
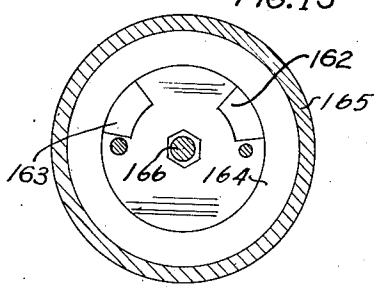


FIG. 14

FIG. 13



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Patented Aug. 31, 1943

2,328,274

UNITED STATES PATENT OFFICE

2,328,274

EARTH DRILLING MECHANISM

Lysle L. Hazen, Detroit, Mich.

Application June 10, 1940, Serial No. 339,721

2 Claims. (Cl. 254—189)

My invention relates to a new and useful improvement in an earth drilling mechanism adapted for use in drilling oil wells, water wells, mineral-prospecting holes, blast holes, etc.

A common type of drilling mechanism for these purposes is a structure which is known as the percussion or gravity type in which a string of tools suspended from the end of a cable is raised and then permitted to impact against the material being drilled by force of gravity. To raise the drilling tools a mechanism is provided and a common type now used is that structure which is known as the beam type. In some structures a crank mechanism is also used.

In the use of a percussion type drill, it is desirable that all of the cuttings be pulverized and that no large pieces or chunks be broken away by the drilling tools. The reason for this is that it is desirable that the cuttings be suspended in the liquid (generally water) which extends above the cutting tool and in which the cutting tool reciprocates. In this manner the bottom of the hole is kept clear of cuttings. Consequently, it is apparent that an efficient drilling mechanism is one which will constantly deliver to the surface to be pulverized a blow of a definite force and, since the mechanism is operating by gravity, it is therefore desirable that the mechanism be so arranged and constructed that the drilling tools shall be raised at each stroke a predetermined amount so that the drop will always be the same. This, of course, as the drilling operation proceeds, requires that an amount of cable corresponding to the amount of material pulverized at the preceding stroke be fed into the well and it is an object of the present invention to provide a mechanism in which this may be accomplished.

In drilling operations these tools are of considerable weight sometimes weighing between one thousand and eight thousand pounds and, under certain circumstances, weighing considerably more. When the tools are dropped and strike a solid body such as is encountered when drilling through rock or the like, there is, of course, under certain conditions, a considerable rebound. With drilling mechanisms as now constructed, the rebound is considerably in advance of the lifting stroke of the cable with the result that the tools when engaged by the cable in its lifting movement are again moving downwardly. It is believed obvious that if, in a drilling mechanism, the tools should be engaged by the cable on its lifting stroke just as the tools reach the upward maximum movement resulting from the rebound, a considerable saving in operation and an increased efficiency in operation would be obtained as, under such circumstances, the lifting mechanism would have to lift the tools a less distance. It is an object of the present invention to provide a drilling mechanism in which this becomes possible.

The stroke of the drilling tools may, of course, be varied under different conditions depending upon the type of tools used and, particularly, depending upon the nature of the earth through which the drilling is being effected. When going through earth or soft rock, a longer stroke would be advisable than when going through hard rock. Consequently, a drilling mechanism to be efficient should be provided with means whereby the length of the stroke may be quickly and easily adjusted within the limits of the mechanism and it is an object of the present invention to provide a mechanism in which this may be accomplished without interrupting the drilling operation.

Another advantageous feature which an efficient drilling mechanism should possess would be a mechanism whereby a maximum stroke may be obtained. It is an object of the present invention to provide a mechanism so arranged and constructed that a maximum stroke in a drilling operation may be obtained.

Another object of the invention is the provision of a drilling mechanism whereby a maximum footage of drilling per hour may be obtained while, at the same time, accurate control of the stroke for operations other than drilling operations such as "fishing," "percussion core drilling," "under-reaming," etc., may be present.

Another object of the invention is the provision of a drilling mechanism so arranged and constructed that an adjustable length of stroke may be effected while the machine is in operation.

Another object of the invention is the provision of a mechanism whereby the length of the stroke may be varied, the speed of the stroke may be varied and the tools may be lifted and allowed to drop free or lifted and allowed to drop under control.

Another object of the invention is the provision of a drilling mechanism whereby the length of the stroke may be varied and its speed varied so that at different stroke lengths a variation in speed may be obtained within the maximum speed of movement of the mechanism. In a drilling mechanism where the tools are not permitted to rest idly upon the bottom between strokes, the length of the stroke is determined by the distance of rocking of the end of the beam and the frequency of the stroke is also determined by the frequency of the rocking of the beam. In such a

type of mechanism, the stroke may be shortened by feeding in additional cable under which circumstances the tools will lie idly upon the bottom between strokes. But, it will be noted, that regardless of the length of the stroke in such a mechanism, the number of strokes per minute remains the same and at each stroke there is a violet jerk transmitted to the drilling tools with a consequent wearing particularly on the drilling jars. The present mechanism avoids this jerking of the tools and makes it possible, upon a shortening of the stroke, to increase the speed of the stroke with a resultant increased number of strokes per minute and a consequent increased efficiency in the drilling operation.

Another feature of the invention is the fact that the stroke may be lowered as the drilling proceeds even with a shortened speeded-up stroke without in any manner interfering with the operation of the mechanism.

Another object of the invention is the provision of a mechanism whereby the speed of the raising or the lowering of the tools may be regulated to fine adjustment. This is particularly desirable when "fishing" and avoids the breaking of the hold on the tools "fished" for, because of a down stroke which is of greater length than it should be.

Another object of the invention is the provision of a drilling mechanism in which maximum efficiency may be maintained regardless of the type of material in which the drill is proceeding, it being possible to regulate the stroke and speed thereof in accordance with the density or nature of the material drilled.

Another object of the invention is the provision of a drilling mechanism in which the spudding sheaves are mounted well below the top of the mast so that the length of cable between the point of anchorage and the point of entry in the hole is reduced to a minimum thus avoiding the various disadvantages and dangers and loss of efficiency resulting from whipping, buckling, etc.

Other objects will appear hereinafter.

It is recognized that various changes and modifications may be made in the present invention without departing from the spirit thereof and it is intended that such variations and modifications of the detail of structure illustrated shall be embraced in the claims attached hereto.

Forming a part of this application are drawings, in which,

Fig. 1 is a side elevational view of the invention showing parts broken away,

Fig. 2 is a front elevational view of the invention,

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2,

Fig. 4 is a sectional view taken on line 4—4 of Fig. 2,

Fig. 5 is a sectional view taken on line 5—5 of Fig. 2,

Fig. 6 is a fragmentary side elevational view of the invention from the side opposite to Fig. 1,

Fig. 7 is a view taken on line 7—7 of Fig. 6 slightly enlarged,

Fig 8 is a sectional view slightly enlarged taken on line 8—8 of Fig. 7,

Fig. 9 is a fragmentary sectional view taken on line 9—9 of Fig. 7,

Fig. 10 is a sectional view slightly enlarged taken on line 10—10 of Fig. 1,

Fig. 11 is a fragmentary side elevational view taken on line 11—11 of Fig. 2,

Fig. 12 is a sectional view taken on line 12—12 of Fig. 10,

Fig. 13 is a sectional view taken on line 13—13 of Fig. 10,

Fig. 14 is a fragmentary sectional view slightly enlarged taken on line 14—14 of Fig. 6,

Fig. 15 is a fragmentary sectional view taken on line 15—15 of Fig. 6.

In the drawings I have illustrated the invention mounted on a vehicle, such as a truck or the like, having oppositely disposed chassis rails or supporting bars 27 and 28 which project rearwardly of the rear wheels 29 of the truck. These chassis rails are connected by suitable cross bars 30 to provide a suitable framework on which the mechanism is mounted. Mounted on and projecting upwardly from these chassis rails 27 and 28 are the supporting plates 32 and 33. Positioned between the plates 32 and 33 and fixedly mounted on the shaft 35 is a sand reel 36 having the end flanges 37. The shaft 35 projects through the plates 32 and 33 and is journalled at its opposite ends in bearings 38 and 39 which are carried by the arms 40 and 41, respectively, which are secured at one of their ends to the shaft 42 and projected upwardly therefrom diagonally. The arms 40 and 41 are keyed to the shaft 42, this shaft 42 projecting through bearings 44 which are mounted on the plates 32 and 33, the shaft 42 being rockable in its bearings. The plates 32 and 33 are provided with elongated slots 45 through which the shaft 35 projects so that when the shaft 42 is rocked on its axis the sand reel 36 may be swung on an arc. Fixedly mounted on one end of the shaft 35 is a pulley 47 so arranged that when the shaft 42 is rocked in one direction so as to swing the sand rail downwardly, the pulley 47 will engage the periphery of the truck wheel 29 and when swung in the opposite direction, the pulley 47 would engage, at its periphery, a brake band 48 supported by the arm 49. This arm 49 is secured at one of its ends to the shaft 50 and at its opposite end to a stud 51 projecting outwardly from one end of the arm 41.

Mounted on the rails 27 and 28 and projecting upwardly therefrom are the spaced plates 52 and 53 which may be termed the mast supporting plates.

These plates 52 and 53 are provided at one of their edges with a boss 54 which aligns with a similar boss 55 on the plates 32 and 33 and projected through these bosses 54 and 55 is a bushing 56 whereby the plates 52 and 53 are swingably mounted on the plates 32 and 33, the shaft 50 projecting through the bushings 56. Secured to these plates 52 and 53 are the tubular members 57 and 58 which form a mast frame and which are provided at their lower ends with the connecting plate 59 which serves as a base and which, when the structure is in operative position, rests upon the ground and serves to support the structure raising the wheels 29 of the truck free of the ground as shown in Fig. 2 and in Fig. 5. The pipes 57 and 58 also project through a connecting plate 61 which is welded or otherwise suitably attached to these pipes. A cylinder 60 also projects through the plate 61 which is secured to the upper end of the cylinder 60. A plate 62 through which the pipes 57 and 58 project and to which they are welded or otherwise suitably secured is also attached to the upper end of the cylinder 60.

Slidably mounted in the cylinder 60 is a piston 63 connected to which is a piston rod 64 which

projects through the end 60' of the cylinder. The piston rod projects through the bottom plate 65 of a spudding carriage which is provided with the side walls 66 and 67 connected to the guide slide plate 69 which is provided with the W shaped plate 70 adapted for the reception of the angle iron or V-shaped guide rib 71 which is fixedly mounted on the inner surface of the pipes 57 and 58. The walls 66 and 67 are extended outwardly as at 72 to provide a spaced apart supporting structure through which is extended the shaft 73 on which is pivotally mounted at one end the sheave supporting plates 74. The shaft 73 also serves as a pivot for the sheave wheel 75 and the sheave wheel 76 is rotatably mounted on the shaft 77, the pulleys 75 and 76 being positioned between the sheave plates 74. Carried on the outer end of the sheave plates 74 by means of the shaft 78 is an idler pulley 79. The sheave plates 74 are connected together by the U-shaped structure embodying the base 80 and the side walls 81 and 82.

The base 65 is reinforced by the reinforcing ribs 83 and resting upon these ribs is a layer 84 of rubber of other suitable yieldable material which serves as a shock absorber. A plate 85 rests upon the rubber and serves as a contact member against which the plate 80 may engage.

The construction is such that upon an upward movement of the piston 63, the carriage carrying the sheave wheels 75 and 76 slides upwardly. Upon a downward movement of the piston, this carriage slides downwardly in response to gravity.

Mounted on the pipe sections 57 and 58, adjacent the upper ends thereof, are the mast supporting plates 86 and 87. A mast 88 is provided with a base 89 having the depending plates 90 and 91. These plates 90 and 91 are connected to the plates 86 and 87 by means of rods 92 which are projected therethrough and also through spacing collars 93 and 94. The construction is such that upon removing one of the rods 92, the mast 88 may be swung on the remaining rod 92 as a pivot and brought into a position to extend parallel to and substantially in engagement with the structure embodying the pipes 57 and 58. Carried on the upper end of the mast 88 is a shaft 95 on which is rotatably mounted the sand line sheave 96 and a casing line sheave 97. The drill cable 98 extends into the well opening 99 first passing over the sheaves 75 and 76, the cable being led over the sheave 75 from the drilling cable reel which is fixedly mounted on the shaft 101. This reel comprises a winding drum having the winding sections 102 and 103 spaced apart by the dividing discs 104 and 105, the latter of which is provided with the notch 106 extending inwardly from its periphery. These dividing discs 104 and 105 are spaced apart by the collar 107 which has the spiral groove 108 formed in its periphery. The reel is provided with the end flanges 109 and 110.

The shaft 101 is journalled in the bearings 111 and 112 which are secured to the plates 52 and 53. The bearing 112 is enclosed in the housing 113 which serves as a housing for the casing reel 114. This casing reel 114 is provided with the end flanges 115 and 116, the flange 116 being provided on its periphery with teeth to provide a sprocket wheel over which rides the sprocket chain 117. The cable which passes over the casing sheave 97 is wound upon the casing reel 114. The shaft 101 passes through the reel 114 which is loosely mounted thereon, the shaft 101 being also journalled in the bearing 118 which is mounted on the end of the housing 113. The housing 113 carries on its outer face a braking mechanism embodying the brake shoe 120 (see Fig. 8), having brake lining 121 mounted thereon adapted for engaging the periphery of a brake drum 122 which is formed integral with the sprocket 116.

This brake is rocked to operative and inoperative position by rocking the crank 123 which extends angularly to the rod 124 of which it is a part, this rod 124 being journalled at 125 and 126 (see Fig. 2). The sprocket chain 117 is driven by sprocket gear 127 which is mounted upon a clutch section 128 which is loosely mounted on the shaft 129, this shaft 129 being the driven shaft of the truck or other vehicle. Mounted fixedly on the projecting end of the shaft 129 is the cooperating clutch section 130 (see Fig. 7), which may be shifted axially of the shaft 129 into operative and inoperative position by means of the rockable lever 131, this lever being connected by the pivot 132 to the arm 133 which projects outwardly from the chassis rail 27.

The shaft 129 is provided on its opposite end with a sprocket wheel 134 which serves to drive the sprocket chain 135 passing around the sprocket wheel 136 which is fixedly mounted on the end of the shaft 101.

Mounted on and rotatable in unison with the shaft 101 is a brake drum 137 around which passes the brake band 138. This brake band 138 passes around a crank 139 carried by a bushing 140 which is rotatably mounted on the shaft 50 and provided with a rocker arm 141 whereby the crank may be rocked to bring the brake band 138 into frictional engagement with the brake drum 137.

The shaft 50 may be rocked by means of the lever 142 which is connected to a crank 143 projecting outwardly from the shaft 50. This shaft is also provided with a crank 144 connected by the link 145 to the arm 41 whereby a sand reel may be rocked as previously described.

In addition to the brake band 138, there is also provided an internal brake mechanism for controlling the rotation of the cable reel. This internal brake mechanism consists of a pair of brake shoes 146 and 147 within the brake drum 137, pistons 148 and 149 sliding in a cylinder 150 which is in communication with a suitable source of fluid under pressure and provided for rocking the shoes into braking position, the spring 151 moving the shoe to non-braking position.

In the operation of the mechanism, the piston 63 is driven upwardly by fluid pressure which may be compressed air or liquid under pressure so that the device may be either hydraulically or pneumatically operated. In the drawings I have shown a pipe 152 communicating with the cylinder 60 adjacent the bottom thereof. The upper end of the cylinder, while closed, is not air tight so that air may bleed therefrom. The pipe 152 leads through a speed control valve 153 to a valve housing 154. This valve housing has an exhaust opening 155 formed therein. Where the device is pneumatically operated, this passage 155 would communicate with the atmosphere and where it is hydraulically operated, a suitable piping would lead from the passage 155. The pipe 152 communicates with the chamber 156 which may be termed a common chamber inasmuch as the exhaust is led into this chamber and, likewise, the fluid under pressure is led into this chamber. A delivery pipe 157 communicates with a passage 158 formed in the housing 154. The passage 158

is provided with a control valve 159 which controls its communication with the common chamber 156. The communication of the exhaust passage 155 with the common chamber 156 is also controlled by a control valve 160. These valves are of the poppet type and are normally held in closing position by the springs 161. The valves are operated by cams 162 and 163 which are carried by and project from the under face of a disc 164 rotatable in unison with the cover housing 165, this cover housing rotating about a shaft 166 as an axis. The cover housing is provided with a plate 167 projecting upwardly from which is a flat faced boss 168 on which is positioned a cam disc 169 having a notch or recess, the walls of which define the cam surfaces 170 and 171 adapted for engagement with opposite sides of the rocker arm 172. The drawings show in dotted lines the different positions in which the disc 169 is moved by the rocker arm 172. This rocker arm is secured at one end to a shaft 173 which is journalled in a sleeve 174 projecting outwardly from the supporting block 175. Rotatably mounted on the shaft 173 is a sprocket wheel 176 projecting outwardly from one face of which, adjacent the periphery thereof, is an engagement pin 177 which is adapted upon rotation of the wheel 176 for engaging an arm 178 which is rotatably mounted at one of its ends on the shaft 173 and which is angularly turned at the opposite end and doubled upon itself to provide the retaining portion 179 in which is mounted the slidable plunger 180 normally held by the spring 181 which bears against the collar 182 pressed downwardly so as to project through an opening 183 formed in the disc 184, this disc 184 being fixedly mounted on the shaft 173.

This disc 184 is provided with a peripheral row of openings 133 which are in spaced relation to each other. An arm 178' which is formed similar to the arm 178 is also rotatably mounted on the shaft 173 and provided with a plunger 180' in the supporting angularly turned portion 179'. The sprocket wheel 176 is driven by a sprocket chain 185 (see Fig. 1), which passes around a sprocket 186 rotatably mounted on a stud 187 projecting outwardly from the pipe 53. Projecting outwardly from the wall 66 of the carriage is a stud 188 which is connected to the sprocket chain 185 so that as the carriage moves upwardly and downwardly, one side of the sprocket chain is carried with it causing the idler sprocket 186 to rotate and also effect a rotation of the sprocket 176.

The construction is such that when the piston is moved upwardly and the carriage is moved upwardly, the sprocket chain will be forced to travel so as to move the idler sprocket 186 clockwise as in the view shown in Fig. 1. This will move the sprocket wheel 176 clockwise and when the stud 177 engages the arm 178, the disc 184 will cause the shaft 173 to rotate. The arm 172 will cause the cam disc 169 to rotate so that the cam 163 on the disc 164 will move out of engagement with the stem of the valve 159 and permit it to close while at the same time the cam 162 will move into engagement with the stem of the valve 160 and force it into open position thus permitting the fluid to exhaust from the cylinder. When this fluid is exhausting from the cylinder, the carriage and piston will slide downwardly causing the sprocket wheels 186 and 176 to rotate counter-clockwise. When the movement has continued sufficiently, since the sprocket wheel 176 is rotating reversely, the stud 177 will be brought into engagement with the arm 178', consequently, the shaft 173 will be reversely rotated and effect a reverse rotation of the disc 164 on which the cams are mounted. Upon a rotation of the disc 164, the exhaust valve will be permitted to move to closed position and the delivery valve will be opened.

By adjusting the arms 178 and 178' rotatively about their axis, the length of stroke of the piston may be regulated. For instance, if the arms 178 and 178' are moved into a position where they are substantially in engagement with each other so that the stud 177, in traveling out of engagement with the arm 178 into engagement with the arm 178', would have to almost complete a revolution, it is obvious that the maximum stroke is thus provided. By rotating the arm 178' so as to cause the stud 177 to engage it when it has completed but a part of a revolution on the reverse movement, the distance that the piston would have moved downwardly in response to gravity would be considerably less than when a larger revolution would be necessary for this engagement. The downward travel of the piston, under such circumstances, would be one-half of the downward movement of the tools so that there is thus a means for regulating the length of stroke of the tools. Similarly, the upward travel of the piston is one-half the upward travel of the tools and by adjusting the relative position of the arm 178 about its axis, the upward travel may be controlled.

It is believed obvious that while the mechanism is in operation the plungers 180 or 180' may be drawn outwardly and the arms 178 or 178' rotated about their axis to a new position relatively to the disc 184. Thus, it becomes possible to vary the length of the stroke and the speed of the reciprocation while the mechanism is in operation. The distance between the arms 178 and 178' will determine the length of the stroke and, consequently, the speed of the stroke. The position of the arms 178 and 178' relatively to the disc 184 will determine the position of the stroke, that is, that part of the cylinder in which the piston will reciprocate with such an adjustment.

The speed of travel of the piston under the power stroke is, of course, determined by the volume or flow of fluid under pressure into the cylinder. The speed of travel of the piston on the reverse stroke is determined largely by the volume of flow of the exhaust from the cylinder. This is regulated manually by the operator, as desired, by manual operation of the valve 153 as shown diagrammatically in Fig. 12. In operation, the adjustment of the arms 178 and 178' is so made that when the tools strike the bottom, the exhaust valve is closed and the delivery valve opened so that as the tools start up on the rebound the piston itself is starting up. In this manner, the rebound of the tools is not checked by the raising mechanism but the tools are carried farther upwardly, the rebound constituting the first step of the upward movement of the tools. Thus, by taking advantage of the rebound, the sudden loading of the mechanism is prevented and no dead load is encountered.

What I claim as new is:

1. In a mechanism of the class described, a pair of stationary spaced apart standards; guide members carried by said standards; an elevating carriage slidably mounted between said guide members; a vertically directed cylinder extending between said standards; a piston slidably mounted in said cylinder; a piston rod project-

ing upwardly from said piston and outwardly of said cylinder; means for connecting said piston rod to said carriage; means for delivering fluid under pressure into said cylinder below said piston for moving the same upwardly in said cylinder; a control valve for controlling the delivery of fluid into said cylinder and draining of the same therefrom and movable to delivery position and to drain position; a sprocket mechanism for operating said control valve to either position; and means movable in unison with said carriage for actuating said sprocket mechanism.

2. In a well drilling mechanism of the class described, a vertically extending cylinder; a piston slidably mounted in said cylinder; a piston rod connected to said piston and projected upwardly outwardly from said cylinder; a pair of spaced apart, vertically directed standards; an elevating carriage slidably mounted between said standards; means for connecting said carriage to said piston rod; a pair of spaced apart sheave wheels carried by said carriage; a stationary member; a cable secured at one end to said stationary member and passed over said sheave wheels; a control valve for controlling the delivery of fluid into said cylinder and draining of fluid therefrom, and movable to delivery position and drain position; a rotatable cam mechanism for operating said control valve; means for rotating said cam mechanism; and means associated with said carriage for actuating said rotating means.

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