

Dec. 26, 1933.

H. C. JOHANSEN

1,940,800

DRILLING APPARATUS

Filed June 3, 1929

5 Sheets-Sheet 1

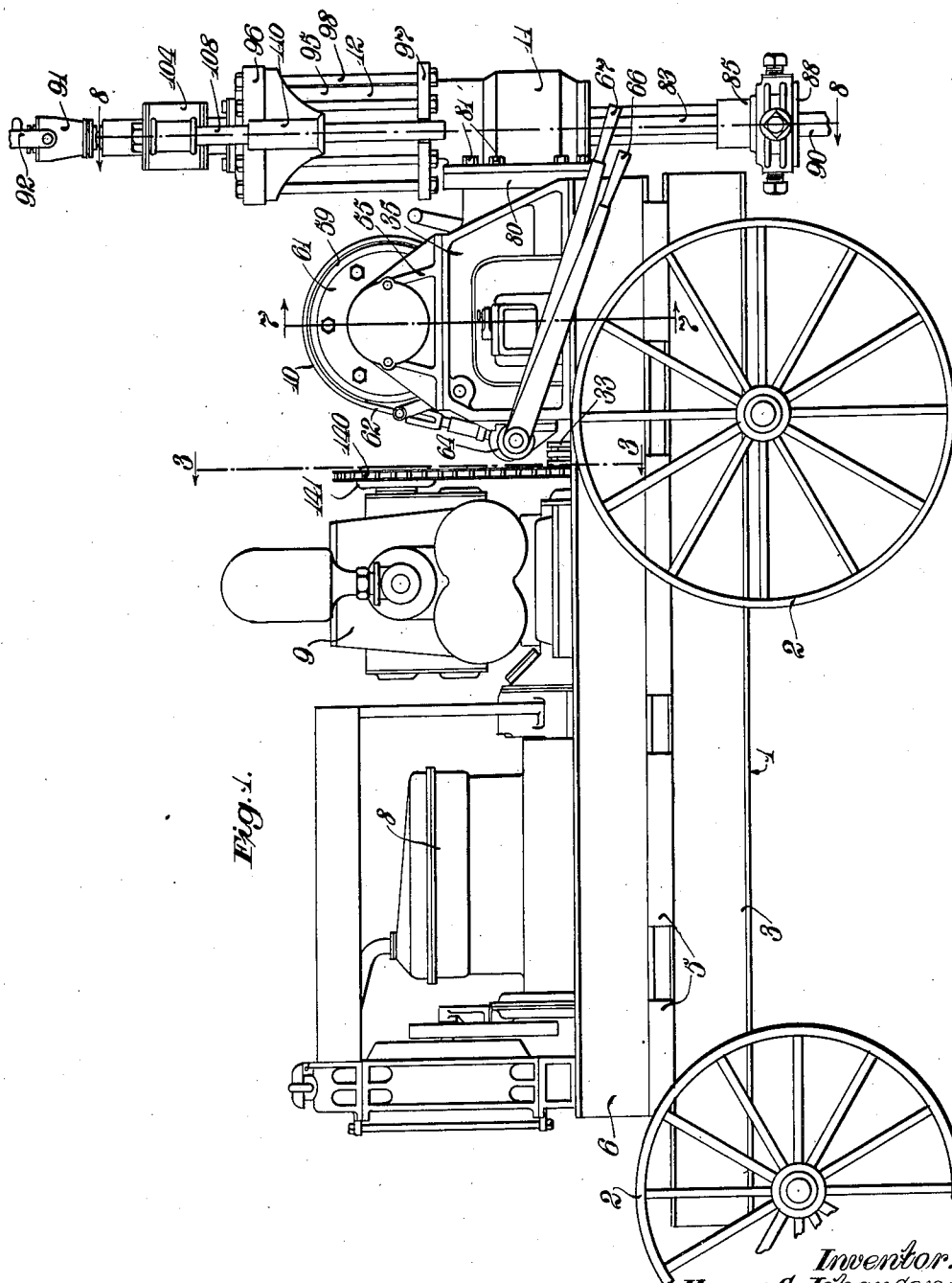


Fig. 1.

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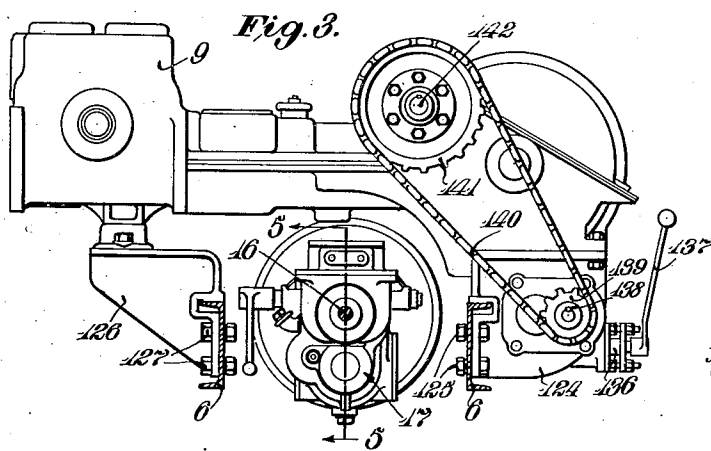
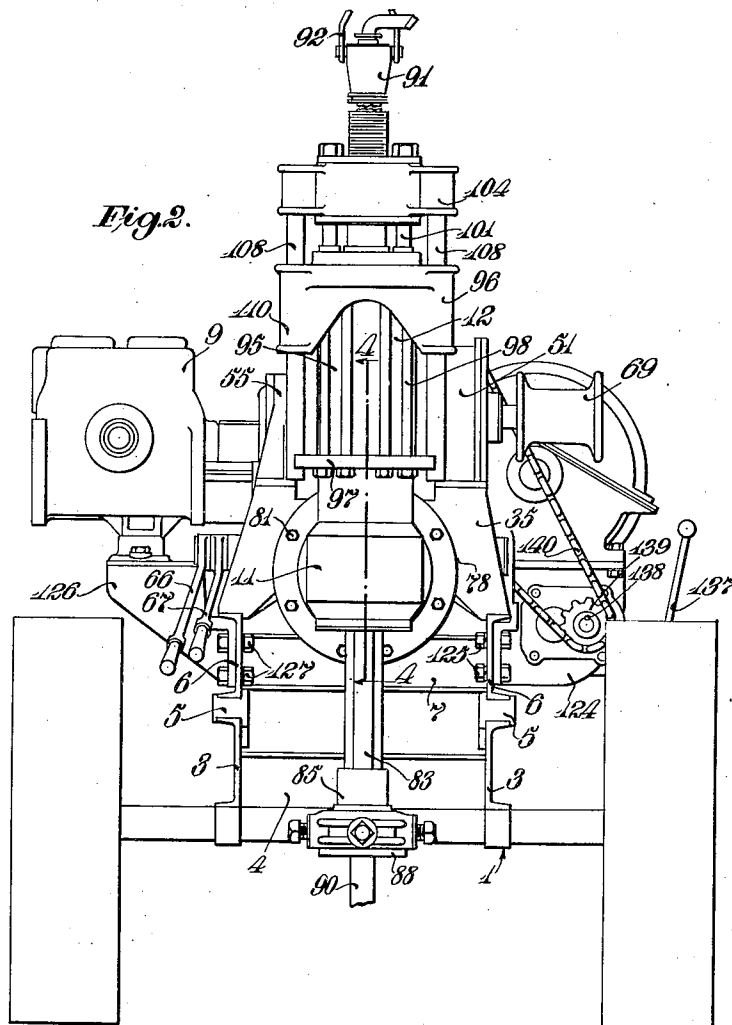
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5 Sheets-Sheet 2



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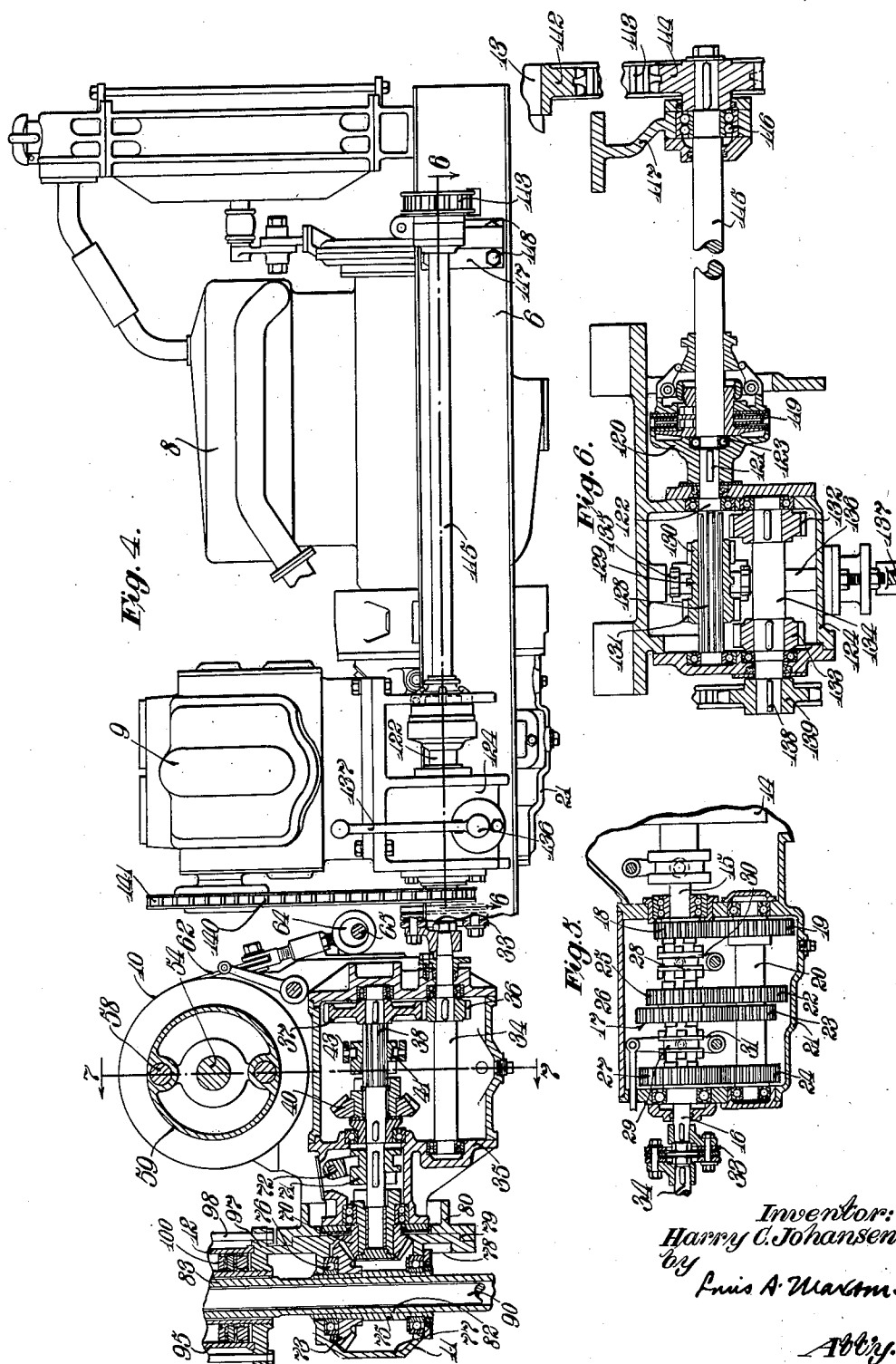
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DRILLING APPARATUS

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5 Sheets-Sheet 3



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DRILLING APPARATUS

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5 Sheets-Sheet 4

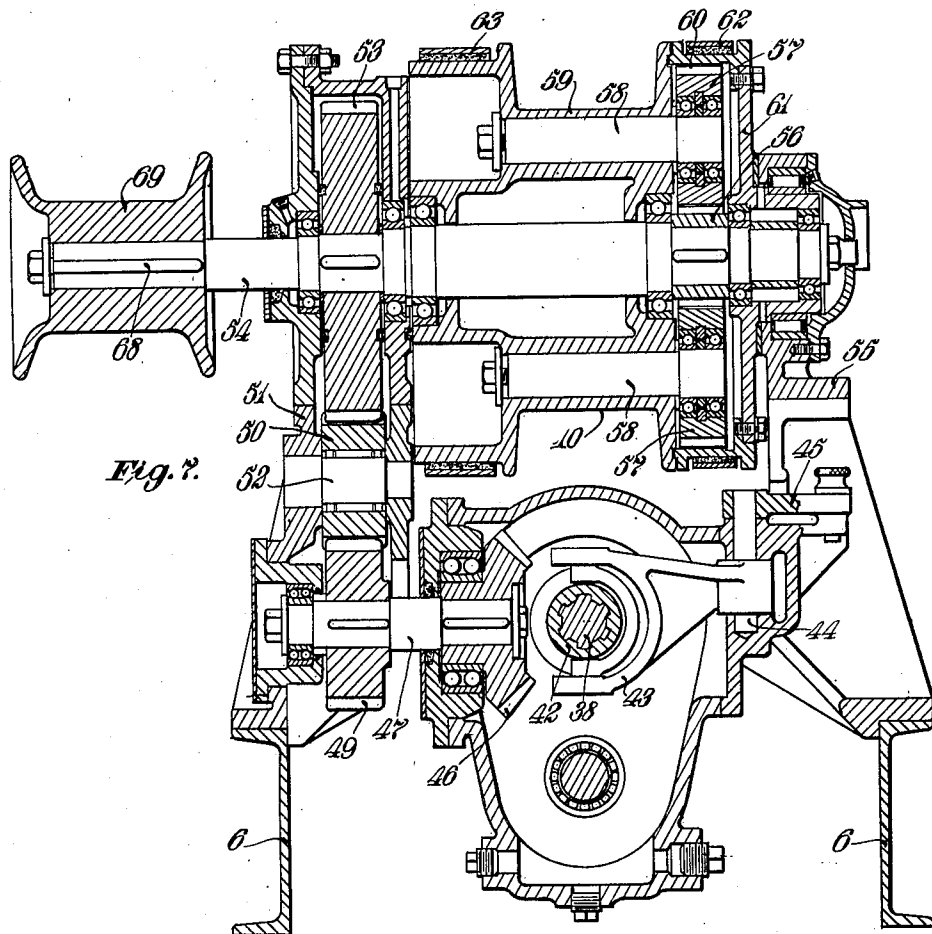


Fig. 7.

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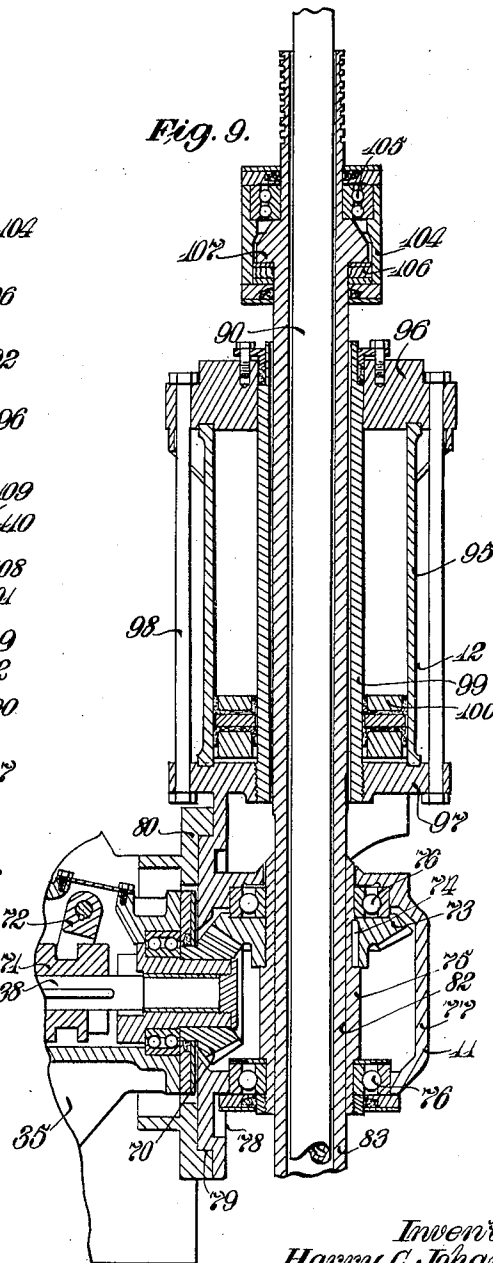
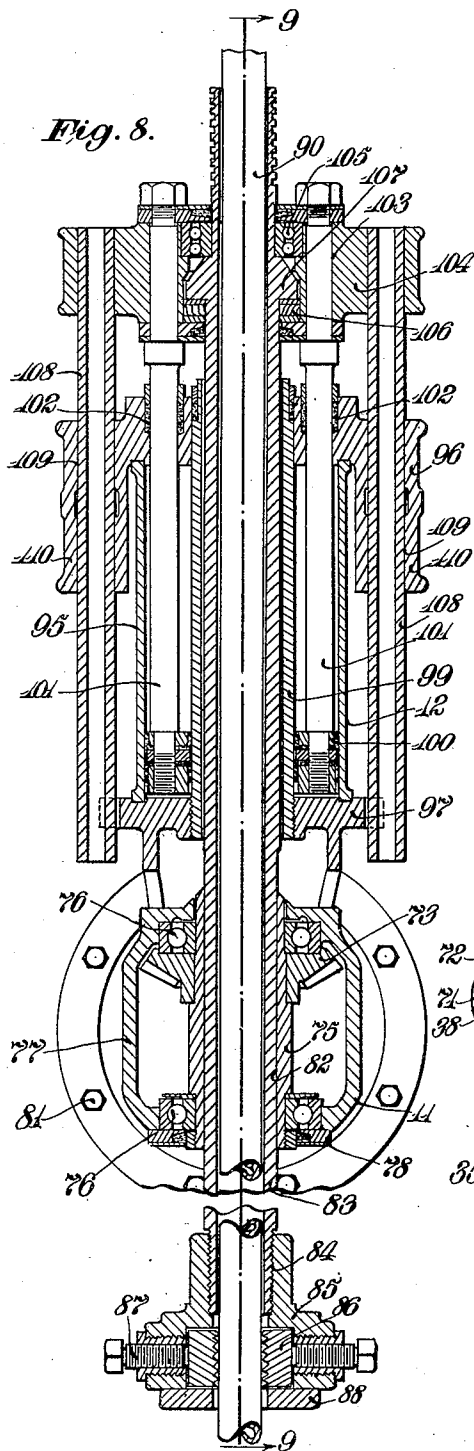
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DRILLING APPARATUS

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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DRILLING APPARATUS

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Application June 3, 1929. Serial No. 368,111

20 Claims. (Cl. 255—19)

This invention relates to drilling apparatus and more particularly, but not exclusively, pertains to a drilling apparatus of the portable, oil and gas well type.

5 An object of this invention is to provide an improved drilling apparatus. Another object is to provide an improved portable core drilling apparatus especially adapted to use in oil and gas well drilling. A further object is to provide a
10 drilling apparatus mounted on a wheeled truck and having an improved arrangement of the drill, hoisting mechanism, pump and engine mounted thereon, and improved driving connections therefor. Yet another object is to provide an improved plural speed drive for the pump. A still further object is to provide an improved gasoline driven drilling apparatus having its engine operatively connected respectively at its opposite ends to the hoisting and drill rotation mechanisms and the pump, the pump being driven from the front end of the engine shaft through a separate transmission mechanism. Yet another object is to provide an improved core drilling apparatus having improved hydraulic
25 feeding mechanism and improved drill rotation means. Still another object is to provide an improved drilling apparatus having a plural predetermined speed transmission mechanism through which the hoisting and drill rotation mechanisms are driven and a separate plural predetermined speed transmission mechanism for the pump. A further object of this invention is to provide an improved drilling apparatus having an improved general arrangement of parts. These
35 and other objects and advantages of this invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

40 In these drawings,—

Fig. 1 is a side elevational view of an illustrative embodiment of the improved drilling apparatus.

45 Fig. 2 is an end elevational view of the apparatus shown in Fig. 1.

Fig. 3 is a transverse sectional view, with parts shown in elevation, taken substantially on line 3—3 of Fig. 1.

50 Fig. 4 is a central, longitudinally extending, vertical sectional view, partially in elevation, taken substantially on line 4—4 of Fig. 2, certain parts being omitted to facilitate illustration.

55 Fig. 5 is a longitudinally extending, vertical sectional view taken substantially on line 5—5 of Fig. 3 and illustrating the plural speed engine transmission.

Fig. 6 is a detail sectional view taken substantially on line 6—6 of Fig. 4, parts being omitted to facilitate illustration.

60 Fig. 7 is a transverse vertical sectional view

taken substantially on line 7—7 of Figs. 1 and 4.

Fig. 8 is a vertical sectional view taken substantially on line 8—8 of Fig. 1.

Fig. 9 is a vertical sectional view taken on line 9—9 of Fig. 8, with parts omitted.

In this illustrative construction there is shown a core drilling apparatus of the gasoline driven portable type generally comprising a truck frame 1 mounted on wheels 2. As shown in the drawings, the truck frame 1 includes parallel side frames 3 rigidly connected together by transverse frame members 4. Slidably mounted on these side members 3 are shoes 5 supporting parallel frame members 6 similar to the frame members 3 and similarly connected together by transverse frame members 7. The upper frame members 6 of the truck have mounted thereon a gasoline engine 8 of a usual design, a pump 9, a hoisting mechanism 10, drill rotation mechanism 11, and a hydraulic drill feeding mechanism 12; the pump, rotation and hoisting mechanisms being driven through improved transmission mechanisms hereinafter described, by the engine 8. As illustrated, the engine 8 is mounted at the forward end of the sliding frame and is disposed with its power shaft 13 horizontally disposed and extending longitudinally of the apparatus. As will later be described, the drill rotation and hoisting mechanisms are driven from one end of the engine power shaft 13 while the pump 9 is driven in an improved manner from the other end thereof.

Now referring to the plural speed engine transmission, it will be observed that the rear end of the engine power shaft 13 is connectible by a usual friction engine clutch 14 (see Fig. 5) to a horizontal longitudinally extending transmission shaft 15 arranged in axial alignment with the engine shaft. This shaft 15 in turn drives a shaft 16 through a plural speed selective transmission, generally designated 17, herein preferably a four speed transmission, whereby a plural predetermined speed drive for the drill rotation and hoisting mechanisms is obtained. This plural speed transmission mechanism specifically comprises a pinion 18 fixed to the shaft 15 and meshing with a spur gear 19 fixed to a horizontal shaft 20 arranged parallel with and below the shaft 15 and suitably journaled in anti-friction bearings carried by the transmission housing 21. The shaft 20 has also fixed thereto spur gears 22, 23 and 24 of different size which mesh respectively with spur gears 25, 26 and 27 rotatably mounted on the shaft 16. Jaw clutches 28 and 29 are employed for selectively connecting the gears 25, 26 and 27 to the shaft 16 and for connecting the shafts 15 and 16 together. These clutches are adapted to be actuated by means of shipper yokes 30 and 31, respectively, fixed to horizontal shafts rotatably mounted within the

transmission housing, and these shafts are connected through usual pull rods to a suitable operator-controlled selective gear shift mechanism (not shown). From the foregoing description it is evident that the shaft 15 is adapted to drive the shaft 16 at a plurality of speeds, herein four predetermined speeds, through the gearing described above, and as a result the drill rotation and hoisting mechanisms may be driven at a plurality of predetermined speeds. As shown in Figs. 4 and 5, the shaft 16 is connected by a flexible coupling 33 of a usual design to a horizontal shaft 34 aligned with the shaft 16 and suitably journaled in anti-friction bearings supported within a base frame 35 by which the drill rotation, hoisting, and feeding mechanisms are supported. Keyed to the shaft 34 is a spur pinion 36 meshing with a spur gear 37 keyed to a horizontal, longitudinally extending shaft 38 arranged parallel with and above the shaft 34 and likewise suitably journaled within the base frame 35.

The improved hoisting mechanism comprises a bevel gear 40 journaled on the shaft 38 and connectable to the shaft by a jaw clutch 41. This jaw clutch comprises a shiftable clutch member 42 splined to the shaft 38 and having engageable therewith a pivoted shipper member 43 secured to a vertical shaft 44 (see Fig. 7) rotatably mounted within the base frame 35. Secured to the upper end of this shaft is an operating lever 45. Meshing with the bevel gear 40 is a bevel gear 46 keyed to a horizontal shaft 47 extending transversely of the base frame and arranged with its axis perpendicular to the axis of the shaft 38 and in the same horizontal plane. This shaft is suitably journaled in anti-friction bearings on the base frame and has keyed thereto a spur pinion 49 meshing with a spur gear 50 arranged within a hollow standard 51 disposed at one side of the base frame. This spur gear is suitably journaled on a horizontal stub shaft 52 arranged parallel with and above the shaft 47 and supported by the standard. The gear 50 meshes with a spur gear 53 also housed within the standard and keyed to a horizontal shaft 54 journaled adjacent one end in anti-friction bearings supported by the standard 51. The other end of this shaft is journaled in anti-friction bearings supported by a standard 55 disposed at the other side of the base frame. As clearly shown in Fig. 7, the shaft 54 has keyed thereto a spur pinion 56 meshing with spur planet gears 57 journaled on horizontal stub shafts 58 supported by a hoisting drum 59. These gears 57 mesh with an internal gear 60 secured to a rotatable reaction member 61 suitably journaled within the standard 55. This reaction member 61 is grooved on its outer periphery and a brake band 62 is arranged in this groove and is provided with a suitable operating mechanism. The hoisting drum 59 is arranged on a transverse axis between the hydraulic feeding mechanism 12 and the pump 9 directly above the longitudinal shaft 38 and is suitably journaled on anti-friction bearings supported by the shaft 54 and has cooperating therewith a brake band 63 similar to the brake band 62. The operating mechanism for the brake band 62 comprises an eccentric member 64 carried on a transverse shaft 65 and to which one end of the brake band is connected. This shaft has secured thereto at one side of the base frame an operating lever 66. Similar operating mechanism including an operating lever 67 is employed for the brake band 63. Also secured to the shaft 54 at one end thereof as by

a key 68 is a capstan or "cat-head" 69. It will thus be seen that when the bevel gear 40 is connected to the shaft 38 by the clutch 41, and the shaft 38 is suitably connected to the engine, and the reaction member 61 is held stationary by the brake band 62, the hoisting drum 59 may be driven through bevel gearing 40, 46, spur gearing 49, 50 and 53, the shaft 54, spur pinion 56, and planet gears 57 meshing with the stationary internal gear 60, the gears 57 rolling around the stationary internal gear 60 as a trackway during drum rotation. The capstan 69 is also simultaneously driven directly by the shaft 54. Upon release of the brake band 62, the drum 59 may rotate freely; the brake band 63 being provided to hold the hoisting drum stationary when desired.

As shown in the drawings, the improved drill rotation mechanism 11 comprises a bevel pinion 70 arranged coaxially with the shaft 38 and journaled within anti-friction bearings carried by the base frame 35. This bevel pinion is connectible to the shaft 38 by means of a jaw clutch member 71 splined to the shaft and having suitable shipper mechanism 72. This bevel pinion 70 meshes with a bevel gear 73 keyed at 74 to a rotation member 75. The rotation member 75 is journaled at its opposite ends within anti-friction bearings 76 supported by the frame 77 of the swiveled drill head 78. As shown in Fig. 9, the frame 77 has a cylindrical bearing portion 79 journaled on a swivel plate 80 suitably rigidly secured to the drill frame 35. The drill head 78 is adapted to be swiveled relative to the base about the axis of the shaft 38 and is adapted to be held in any of its angular positions by means of suitable clamping bolts 81 (see Fig. 1). Extending through the rotation member 75 is a central polygonal opening 82 which is adapted to engage and drive a hollow drive rod 83 of polygonal cross section. This drive rod 83 has threadedly connected thereto at 84 at its lower end a usual jaw clutch or chuck 85 having clutch jaws 86 operated by set screws 87 threadedly connected within the chuck casing. The chuck jaws 86 are held in position within the chuck casing by means of an axially perforated plate 88 secured to the chuck casing. Extending through the hollow drive rod 83 and chuck is a usual hollow drill stem 90 which is connectible to the drive rod 83 by the chuck 85. The lower end of this drill stem is connectible in a usual manner to the drill rod line and carries at its upper end a usual water swivel 91 and lifting bail 92.

Now referring to the improved hydraulic feeding mechanism shown in Figs. 8 and 9, it will be observed that carried by the swiveled drill frame 78 is a hydraulic feed cylinder comprising a cylinder member 95 having upper and lower heads 96 and 97. The cylinder member 95 and heads 96 and 97 are held in assembled relation by tie rods 98. Secured to the top cylinder head and extending axially through the cylinder is a hollow sleeve 99 through which the drive rod 83 extends, the cylinder member and this sleeve forming an annular piston chamber. Reciprocally mounted within this piston chamber is an annular feed piston 100 having secured thereto parallel piston rods 101 extending upwardly through suitable stuffing boxes 102 carried by the top cylinder head 96. These piston rods are secured at their upper ends at 103 to a transverse thrust head frame 104. This thrust head frame carries anti-friction bearings 105 and 106 having interposed therebetween a thrust collar 107 herein formed integral with

the drive rod 83, and these anti-friction bearings receive the axial thrust of the drive rod in opposite directions. Secured to the opposite sides of the thrust head frame are guide rods 108 which slide through bores 109 formed within projecting lugs 110, herein formed integral with the top cylinder head 96. Pressure fluid, herein water under pressure, is adapted to be supplied to the opposite ends of the feed cylinder at the opposite sides of the feed piston through any suitable operator-controlled fluid connections from any suitable source, for instance, from the pump 9. It will thus be seen that as the drive rod 83 is rotated by the rotation member 75 it may also be fed axially through the rotation member by the hydraulic feeding mechanism, the weight of the rotatable drive rod together with the drill stem and rod line carried thereby being supported by the thrust head of the hydraulic.

The pump 9 is arranged with its longitudinal axis extending transversely of the truck frame and is disposed between the hoisting mechanism 10 and the driving engine 8 directly above the plural speed engine transmission, as clearly shown in Fig. 3. The plural speed transmission mechanism for driving this pump comprises a chain sprocket 112 keyed to the forward end of the engine shaft 13 (see Fig. 6). This chain sprocket 112 is connected by an endless chain connection 113 to a chain sprocket 114 keyed to a horizontal shaft 115 extending longitudinally of the apparatus along one side of the truck frame. The forward end of the shaft 115 is journaled within anti-friction bearings 116 supported by a bearing bracket 117 secured by screws 118 to one of the frame members 6. This shaft 115 is connectable by an operator-controlled friction clutch 119 including a clutch housing 120 keyed at 121 to a horizontal shaft 122 aligned with the shaft 115 and disposed at the rear thereof. The clutch housing 120 carries anti-friction bearings 123 within which the rear end of the shaft 115 is journaled. The shaft 122 is suitably journaled within anti-friction bearings supported by a transmission housing 124 disposed beneath the pump 9 and suitably secured by screws 125 to one of the frame members 6 (see Fig. 2), this transmission housing also forming a support for the adjacent end of the pump. The other end of the pump is supported by a bracket 126 secured by screws 127 to the other frame member 6 at the opposite side of the truck. Splined at 128 to the shaft 122 and axially movable relative thereto is a hollow shaft 129. This shaft has integrally connected therewith gears 130 and 131 of different size and which are selectively connectible to gears 132 and 133 of different size keyed to a shaft 134 suitably journaled within the transmission housing. It will thus be evident that when the gears 131 and 133 are in meshing engagement, the shaft 134 will be driven at a relatively high speed, and that when the gears 130 and 132 are connected the shaft will be driven at a relatively low speed. Operator-controlled means is employed for shifting the gears 130 and 131 and herein comprises a shipper yoke 135 suitably secured to a transversely extending operating shaft 136. Secured to the outer end of the shaft 136 is an operating member 137 disposed at the side of the pump. As clearly shown in Fig. 6, the rear end of the shaft 134 has keyed thereto at 138 a chain sprocket 139 connected by an endless chain connection 140 to a chain sprocket 141 suitably secured to the pump driving shaft 142. It will thus be seen that

the pump 9 may be independently driven from the engine 8 at either a relatively high predetermined speed or a relatively low predetermined speed through a plural speed transmission mechanism entirely separate from the plural speed engine transmission 17.

The operation of the improved drilling apparatus is as follows: After the apparatus has been transported to the working place and has been suitably set up beneath the well derrick, the hoisting cable on the hoist drum 59 is extended upwardly around the pulley blocks carried at the top of the well derrick and the "drop line" of the hoisting tackle is connected to the lifting bail 92 at the top of the drill stem 90. The drill stem 90 is then lowered downwardly through the hollow drive rod 83 and is connected to the upper end of the drill rod line in a well known manner. Water under pressure is then admitted to the lower end of the feed cylinder 95 at the lower side of the feed piston 100 (see Fig. 8) and the feed piston is moved upwardly to the upper end of the feed cylinder, thereby moving the drive rod 83 in its uppermost position. The operator then adjusts the set screws 87 of the chuck 85, to connect the drill stem 90 to the drive rod 83. The operator then manipulates the gear shift mechanism for the plural speed engine transmission 17 to select the desired speed. The pinion 70 is then connected to the shaft 38 by the jaw clutch 71 and upon application of the engine clutch 14 the rotation member 75 may be rotated by the engine 8, thereby rotating the drive rod 83. Water under pressure is then supplied to the upper end of the feed cylinder 95 at the upper side of the feed piston 100 and the drive rod 83 is then fed downwardly through the rotation member 75 as it is rotated thereby and as a result the drill stem 90 and the drill rod line are fed toward the work. It is obvious that the rate of rotation of the drive rod 83 may be controlled by the plural speed engine transmission 17, it being possible to rotate the drive rod at any of four predetermined speeds through the different sets of gears 24, 27, 23, 26, 22, 25, or through direct connection of shafts 15 and 16. It is also evident that the hoisting drum 59 may be rotated at speeds proportional to any of these speeds simply by throwing the clutch member 41 into engagement with the bevel gear 40 connecting the latter to the drive shaft 38. Drum rotation may be controlled by the brake band 62 controlling rotation of the reaction member 61. It will also be noted that the drum 59 may be braked simply by applying the brake band 63. It will further be seen that the capstan or "cat-head" 69 also may be rotated at a plurality of speeds through the plural speed engine transmission, this capstan being used for various auxiliary hoisting purposes and for "breaking and making" rod line joints and under certain conditions acting as a pressure controlling device for the rod line. The "cat line" on this cat-head is also used for sliding the frame 5 together with the drilling mechanism thereon relative to the truck frame 3 to move the hydraulic and rotation mechanisms laterally relative to the drill hole in a well known manner. The pump 9 may be driven from the engine at either a fast speed or a slow speed and may be connected through suitable connections (not shown) to the water swivel 91 to supply water under pressure through the hollow drill stem 90 and through the rod line in a well known manner. The pump 9 may also be connected through connections (not shown) to the supply

connections for the hydraulic feeding mechanism. After the feeding limit of the feed cylinder is reached, the drill stem may be held in a usual manner by the hoisting mechanism 10 and the feed piston again moved to its initial position at the upper end of the feed cylinder and again connected to the drill stem by the chuck 85, this operation being repeated until a hole of a depth substantially equal to the length of the stem is obtained. When it is desired to hoist the rod line from the hole, the hoisting tackle is connected to the lifting bail 92 at the top of the drill stem 90 and the hoisting cable is wound in at the desired speed by the hoisting drum 59. It will also be evident that by simply releasing the clamping bolts 81 it is possible to swing the drill head 78 about the axis of the shaft 38 to vary the angular position of the drive rod 83, it being possible to drill at any angle about the swivel head axis. The engine clutch 14 is used only when starting the engine, changing gears, or to throw out both the hoisting and rotation mechanisms.

As a result of this invention it will be noted that an improved portable oil and gas well drilling apparatus is provided especially adapted to use in oil and gas well drilling, the various elements of the drill being arranged in a novel manner on a wheeled truck frame. It will also be noted that an improved portable core drilling apparatus is provided with extremely rugged construction especially adapted to the severe demands of service encountered in the oil fields, and furthermore, by arranging the various elements of the apparatus in the novel manner described, the drill is rendered exceedingly compact. It will further be noted that improved driving connections are employed for the hoisting and rotation mechanisms and the pump, the hoisting and rotation mechanisms being driven through the plural speed engine transmission mechanism from one end of the engine power shaft while the pump is driven by a separate plural speed transmission mechanism operatively connected to the other end of the engine shaft. These and other uses and advantages of the improved drilling apparatus will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which my invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration 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. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a hoisting mechanism on said base immediately adjacent said rotation and feeding mechanism, a feed pump on said base between said engine and hoisting mechanism for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said engine and said rotation and hoisting mechanisms, and driving connections between the other end of said engine and said pump.

2. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at

the other end thereof, a hoisting mechanism on said base including a hoisting drum disposed on a transverse axis immediately adjacent said rotation and feeding mechanism, a feed pump on said base between said engine and hoisting mechanism for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said engine and said rotation and hoisting mechanisms, and driving connections between the other end of said engine and said pump.

3. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a hoisting mechanism on said base immediately adjacent said rotation and feeding mechanism, a feed pump on said base between said engine and hoisting mechanism for supplying fluid under pressure to said feeding mechanism and having its longitudinal axis arranged transversely of said base, driving connections between one end of said engine and said rotation and hoisting mechanisms, and driving connections between the other end of said engine and said pump.

4. In a drilling apparatus, a portable base, an engine thereon, drill rotation and feeding mechanisms on said base, a hoisting mechanism on said base including a hoisting drum arranged on a transverse axis immediately adjacent said rotation and feeding mechanism, and driving connections between said engine and said rotation and hoisting mechanisms including a plural speed transmission mechanism having a horizontal shaft extending longitudinally of said base, a second shaft aligned with said first shaft, connections between said shafts, a third shaft arranged parallel with said shafts and extending longitudinally of said base beneath said hoisting drum, connections between said second and third shafts, and separate clutch controlled connections between said third shaft and said rotation and hoisting mechanisms.

5. In a drilling apparatus, a portable base, an engine on said base at one end thereof and having its power shaft extending longitudinally of said base, a drill rotation mechanism on said base at the other end thereof, a drill hoisting mechanism on said base, a hydraulic drill feeding mechanism on said base, a pump on said base for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation and hoisting mechanisms including a horizontal longitudinally extending transmission shaft, separate clutch controlled connections between said transmission shaft and said rotation and hoisting mechanisms, a plural speed transmission mechanism between said transmission shaft and said engine shaft, and driving connections between the other end of said engine shaft and said pump including a second horizontal longitudinally extending transmission shaft arranged at one side of the base, connections between said engine and said second transmission shaft, and a plural speed transmission mechanism between said second transmission shaft and said pump.

6. In a drilling apparatus, a portable base, an engine on said base at one end thereof and having its power shaft extending longitudinally of said base, a drill rotation mechanism on said base at the other end thereof, a drill hoisting mechanism on said base, a hydraulic drill feeding mechanism on said base, a pump on said base

for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation and hoisting mechanisms including a horizontal longitudinally extending transmission shaft, separate clutch controlled connections between said transmission shaft and said rotation and hoisting mechanisms, a plural speed transmission mechanism between said transmission shaft and said engine shaft, and driving connections between the other end of said engine shaft and said pump including a second horizontal longitudinally extending transmission shaft arranged at one side of the base, connections between said engine and said second transmission shaft including an operator controlled clutch, and a plural speed transmission mechanism between said second transmission shaft and said pump.

7. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism on said base, said rotation and feeding mechanisms being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and driven by the latter, and a plural speed transmission mechanism between said parallel shaft and said pump.

8. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism on said base, said rotation and feeding mechanisms being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and operatively connected to the latter at one end thereof, said transmission shaft extending longitudinally of said base in adjacency to said pump, and a plural speed transmission mechanism between the opposite end of said parallel shaft and said pump.

9. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism on said base, said rotation and feeding mechanisms being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism including a plural speed transmission mechanism having its elements arranged generally on an axis extending longitudinally of said base, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and driven by the latter, and a plural speed transmission mechanism between said parallel shaft and said pump.

erally on an axis extending longitudinally of said base, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and driven by the latter, and a plural speed transmission mechanism between said parallel shaft and said pump.

10. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism including a plural speed transmission mechanism having its elements arranged generally on an axis extending longitudinally of said base, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and operatively connected to the latter at one end thereof, said transmission shaft extending longitudinally of said base in adjacency to said pump, and a plural speed transmission mechanism between the opposite end of said parallel shaft and said pump.

11. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism on said base, said rotation and feeding mechanisms being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism including a plural speed transmission mechanism having its elements arranged generally on an axis extending longitudinally of said base and arranged beneath said pump, said pump extending transversely of said base above said transmission mechanism, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and driven by the latter, and a plural speed transmission mechanism between said parallel shaft and said pump.

12. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism including a plural speed transmission mechanism having its elements arranged generally on an axis extending longitudinally of said base and arranged beneath said pump, said pump extending transversely of said base above said

transmission mechanism, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and operatively connected to the latter at one end thereof, said transmission shaft extending longitudinally of said base in adjacency to said pump, and a plural speed transmission mechanism between the opposite end of said parallel shaft and said pump.

13. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism on said base, said rotation and feeding mechanisms being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and driven by the latter, a plural speed transmission mechanism between said parallel shaft and said pump, and a clutch between said parallel shaft and said transmission mechanism for interrupting the drive of said pump at will.

14. In a drilling apparatus, a portable base, a prime mover mounted on said base at one end thereof and having its power shaft extending longitudinally of said base, drill rod rotation mechanism on said base, hydraulic drill rod feeding mechanism on said base, said rotation and feeding mechanisms being mounted on said base at the opposite end thereof, a pump on said base between said prime mover and said mechanisms for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said power shaft and said rotation mechanism including a plural speed transmission mechanism having its elements arranged generally on an axis extending longitudinally of said base and driving connections between said transmission mechanism and said rotation mechanism including a clutch for interrupting the drive for said rotation mechanism at will, and driving connections between the opposite end of said power shaft and said pump including a shaft arranged parallel with said power shaft and extending longitudinally of said base at one side thereof along the side of said prime mover and driven by the latter, and a plural speed transmission mechanism between said parallel shaft and said pump.

15. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a feed pump on said base between said engine and said rotation and feeding mechanism for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said engine power shaft

and said rotation mechanism, and driving connections between the other end of said engine power shaft and said pump.

16. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a feed pump on said base between said engine and said rotation and feeding mechanism for supplying fluid under pressure to said feeding mechanism, said pump having its longitudinal axis arranged transversely of said base, driving connections between one end of said engine power shaft and said rotation mechanism, and driving connections between the other end of said engine power shaft and said pump.

17. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a feed pump on said base between said engine and said rotation and feeding mechanism for supplying fluid under pressure to said feeding mechanism, driving connections between one end of said engine power shaft and said rotation mechanism, and plural speed driving connections between the other end of said engine power shaft and said pump.

18. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a feed pump on said base between said engine and said rotation and feeding mechanism for supplying fluid under pressure to said feeding mechanism, said pump having its longitudinal axis arranged transversely of said base, driving connections between one end of said engine power shaft and said rotation mechanism, and plural speed driving connections between the other end of said engine power shaft and said pump.

19. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a feed pump on said base between said engine and said rotation and feeding mechanism for supplying fluid under pressure to said feeding mechanism, plural speed driving connections between one end of said engine power shaft and said rotation mechanism, and separate plural speed driving connections between the other end of said engine power shaft and said pump.

20. In a drilling apparatus, a base, an engine thereon at one end thereof and having its power shaft extending longitudinally of said base, drill rotation and feeding mechanism on said base at the other end thereof, a feed pump on said base between said engine and said rotation and feeding mechanism for supplying fluid under pressure to said feeding mechanism, said pump having its longitudinal axis arranged transversely of said base, plural speed driving connections between one end of said engine power shaft and said rotation mechanism, and separate plural speed driving connections between the other end of said engine power shaft and said pump.

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