

July 12, 1932.

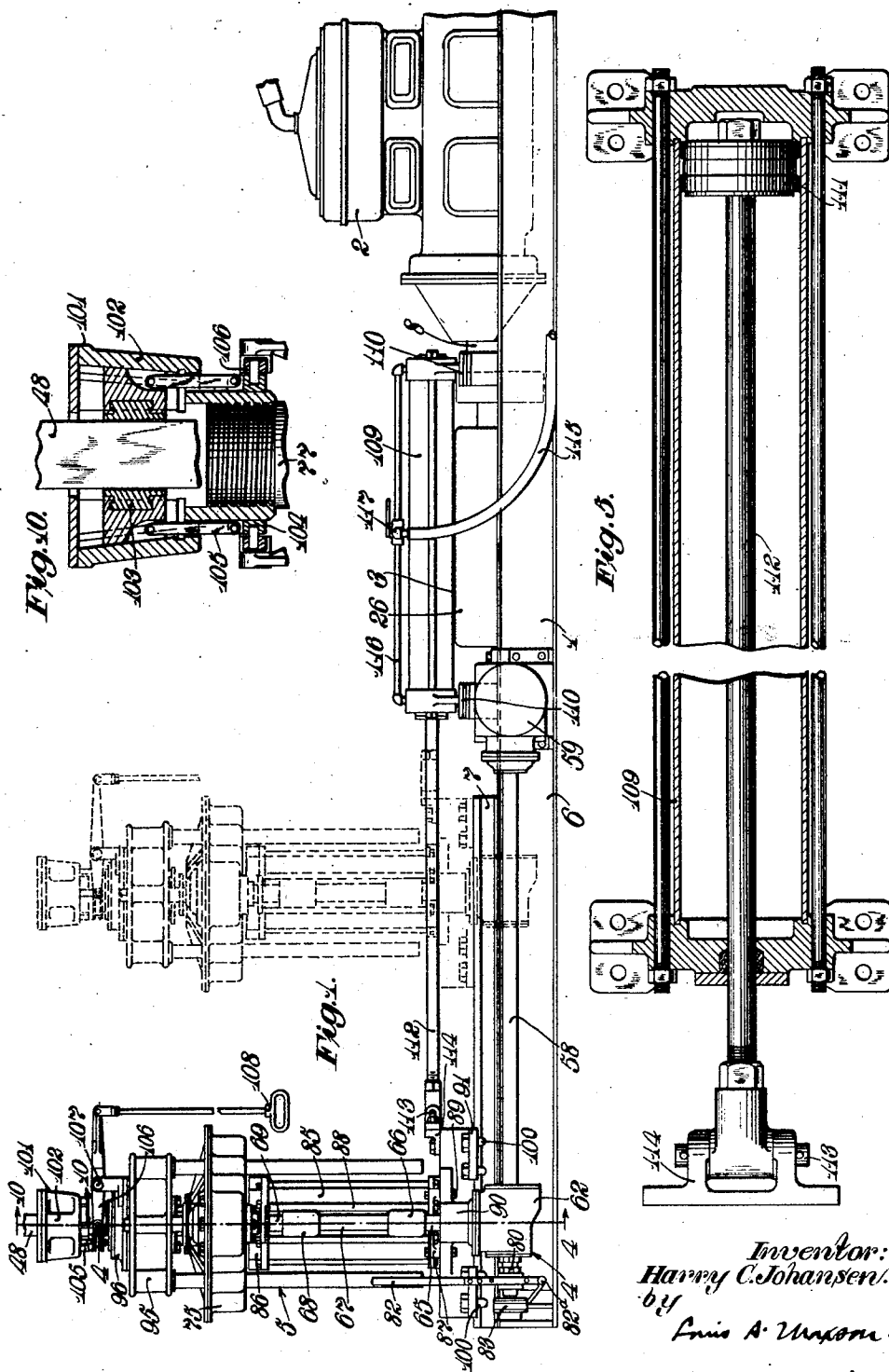
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1,866,934

DRILLING APPARATUS

Filed Oct. 29, 1930

4 Sheets-Sheet 1



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July 12, 1932.

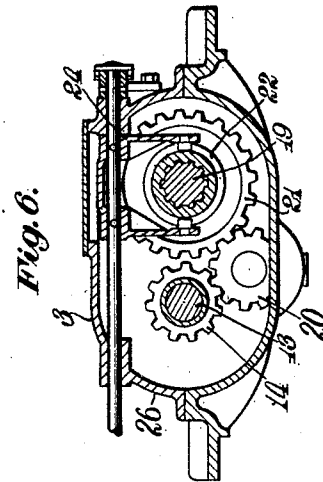
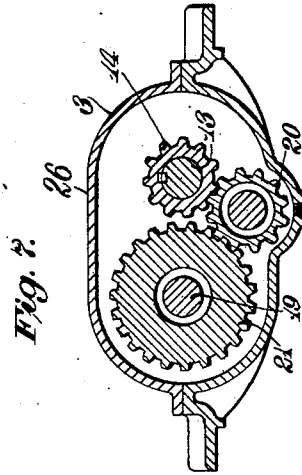
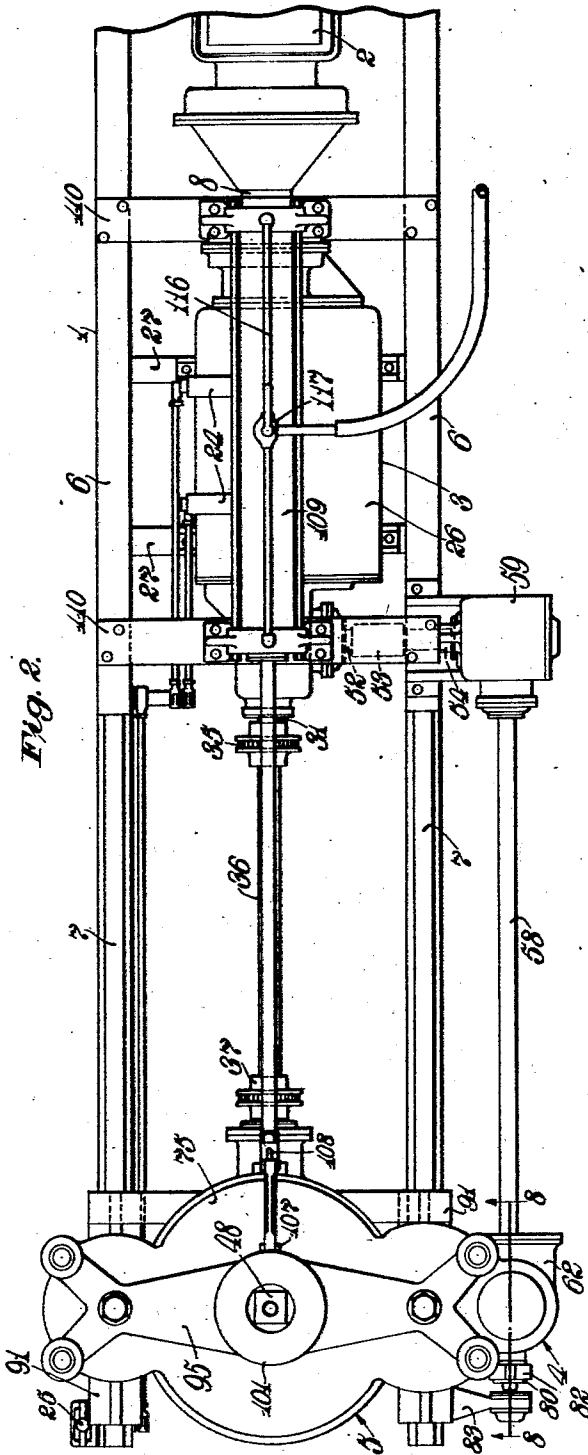
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DRILLING APPARATUS

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4 Sheets-Sheet 2



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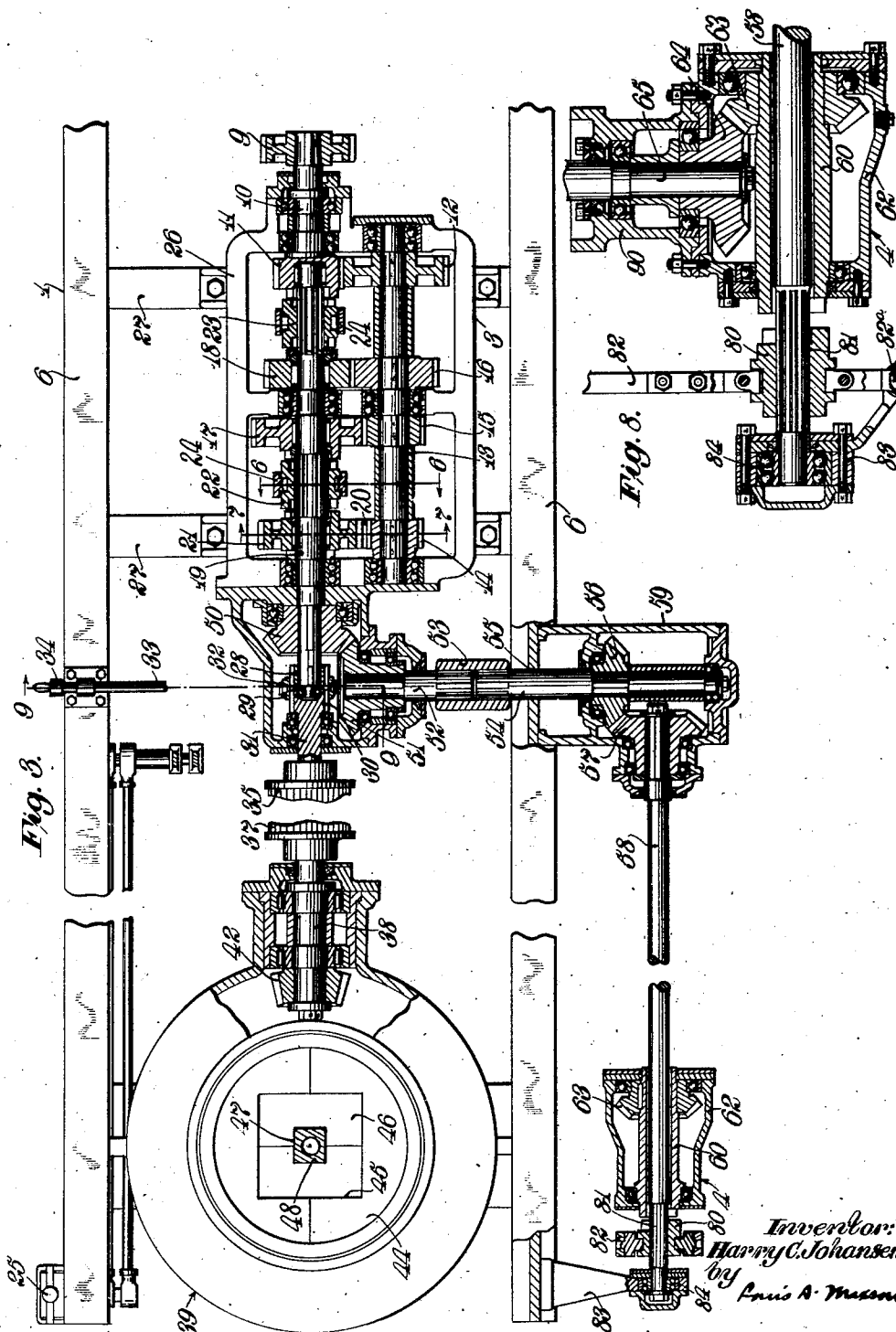
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DRILLING APPARATUS

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4 Sheets-Sheet 3



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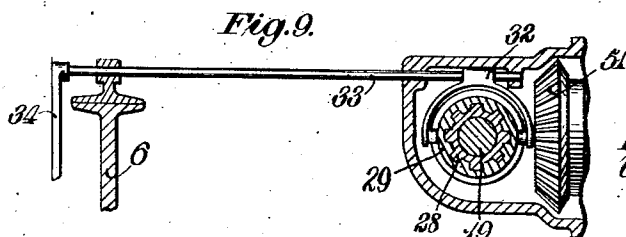
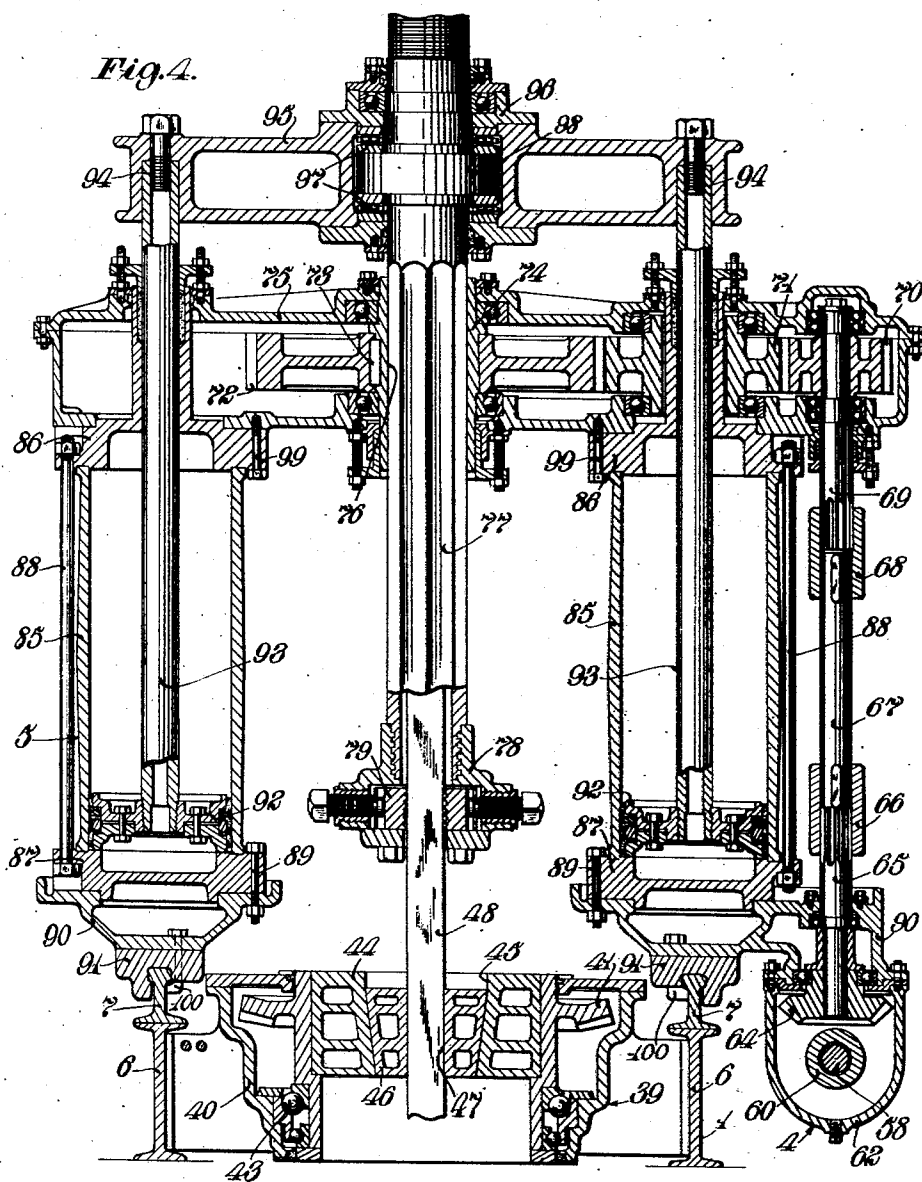
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DRILLING APPARATUS

Filed Oct. 29, 1930

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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DRILLING APPARATUS

Application filed October 29, 1930. Serial No. 491,978.

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

5 An object of this invention is to provide an improved drilling apparatus. Another object is to provide an improved drilling apparatus of the rotary type especially adapted to use in oil and gas well drilling. A further
10 object is to provide an improved rotary drill wherein the rotary table is driven through an improved mechanism and having associated therewith improved power operated feeding means whereby the grief stem may be
15 fed positively through the table. Yet another object is to provide an improved rotary drill having improved hydraulic feeding means for feeding the grief stem positively through the rotary table and wherein the
20 feeding means to be shifted laterally relative to the rotary table to clear the latter for the usual rotary drilling operations. A further object is to provide an improved oil and gas well drilling apparatus of the combined rotary and core drill type wherein separate driving mechanisms are employed for
25 rotating the grief stem during the rotary and core drilling operations. A still further object of this invention is to provide an improved drilling apparatus of the rotary type having improved rotation means whereby
30 the drill stem may be rotated at a plurality of predetermined speeds. A still further object of this invention is to provide an improved drilling apparatus of the combined rotary and core drill type having separate driving means for the drive rod and rotary
35 table whereby the rotary table and drive rod may be independently rotated. These and other objects 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.

45 In these drawings,—

Fig. 1 is a side elevational view of an illustrative embodiment of the improved drilling apparatus, the hydraulic feeding mechanism being shown in a plurality of positions;
50

Fig. 2 is an enlarged plan view of the apparatus shown in Fig. 1;

Fig. 3 is an enlarged horizontal sectional view illustrating the improved rotation
55 mechanism;

Fig. 4 is a transverse vertical sectional view taken substantially on line 4—4 of Fig. 1;

Fig. 5 is a detail sectional view illustrating the hydraulic transfer mechanism for the feeding mechanism;
60

Figs. 6 and 7 are transverse vertical sectional views taken substantially on lines 6—6 and 7—7 respectively, of Fig. 3;

Fig. 8 is a detail sectional view taken substantially on line 8—8 of Fig. 2;
65

Fig. 9 is a detail sectional view taken substantially on line 9—9 of Fig. 3; and

Fig. 10 is a detail sectional view taken substantially on line 10—10 of Fig. 1.

In this illustrative embodiment of the invention there is shown a drilling apparatus
70 of the oil and gas well type generally comprising a base 1, a prime mover 2, transmission mechanism 3, rotation mechanism 4, and hydraulic feeding mechanism generally designated 5. The drill base 1 herein comprises
75 parallel I-beams 6 suitably transversely braced and having mounted thereon at their forward ends parallel horizontal guide rails or tracks 7 on which the feeding mechanism
80 5 is slidably mounted as will later be described.

Now referring to the improved driving mechanism for the rotation mechanism 4 it will be noted that the power shaft 8 of the prime mover 2 extends longitudinally of and
85 midway between the I-beams 6 of the drill base and is connected through spur gearing 9 to a horizontal longitudinally extending shaft 10 of a plural speed transmission
90 mechanism indicated generally at 3. Secured to this shaft is a spur gear 11 meshing with a spur gear 12 fixed to a parallel counter-shaft 13. Also keyed to the shaft 13 are
95 three gears 14, 15 and 16 of different tooth ratio, the gears 15 and 16 meshing with spur gears 17 and 18 respectively, journaled on a horizontal shaft 19 alined with the shaft 10. The pinion 14 meshes, as shown in Fig. 7, with
100 an intermediate or idler gear 20 which in

turn meshes with a spur gear 21 likewise journaled on the shaft 19. For selectively connecting the gears 21 and 17 to the shaft 19 there is provided a double ended jaw clutch 22 splined to the shaft 19 and connectible with clutch teeth carried by the gears respectively. A similar double ended clutch element 23 is splined to the shaft 19 for connecting the gear 18 thereto or for connecting the shafts 10 and 19 directly together. The sliding clutch elements 22, 23 are provided with usual shipper mechanism 24, as shown in Fig. 6, and this shipper mechanism is operated through usual connections by a selective gear shift lever 25 (Figs. 2 and 3). It will thus be seen that when the shafts 10 and 19 are connected directly together the latter is driven at a relatively high speed, while upon connection of the gears 17 and 18 to the shaft the latter is driven selectively at different relatively slower speeds. Upon connection of the gear 21 to the shaft 19 reverse rotation of the shaft is effected. This transmission mechanism is of a usual design and the gears thereof are housed within a casing 26 supported by transverse frame members 27 secured at their ends to the I-beams 6 of the drill base. In the present construction, fixed to the forward end of the shaft 19 is a clutch element 28 which is connectible by a sliding clutch element 29 to a clutch element 30 secured to a shaft 31 aligned with the shaft 19 and likewise journaled in the transmission housing. The means for shifting the clutch element 29 comprises, as shown in Fig. 9, a shipper yoke 32 fixed to a transversely arranged operating rod 33 having a usual operating handle 34. The shaft 31 is connected by a flexible coupling or universal joint 35 to a shaft 36 in turn connected through a flexible coupling or universal joint 37 to a shaft 38. A rotary table generally designated 39 is arranged at a low level between the sides of the drill base and herein comprises a base frame 40 secured to the I-beams 6 of the drill base. Rotatably mounted within this base frame is a large bevel gear or rotary table 41 and the shaft 38 has fixed thereto a bevel pinion 42 meshed with and driving the bevel gear 41. This rotary table is horizontally disposed and journaled on ball thrust bearings 43 suitably supported within the base frame. Supported within and secured to the rotary table is a member 44 herein in the form of a two-part or split bushing having a central square tapered opening 45 which receives wedge shaped drive members or slips 46. As clearly shown in Fig. 3 the slips 46 cooperate to form a central square opening 47 through which the usual square grief or drill stem 48 extends, the slips 46 engaging, and upon rotation of the table, driving the grief stem 48 as will later be described. It is obvious that the wedge shaped slips 46 carried within the rotary table may

be of any desired form and that wedge shaped jaws with teeth or any suitable devices may be substituted for those disclosed, for instance jaws of the type adapted to grip the stem and prevent sliding movement thereof through the table. It is also evident that grief stems of differently shaped cross sections and slips cooperating to form differently shaped openings may be readily substituted for those disclosed.

Now referring to the mechanism for effecting rotation of the grief stem when the rotary table is disconnected from its drive, attention is directed to the fact that secured to the shaft 19 at the rear of the clutch element 28 (see Fig. 3) is a bevel gear 50 meshing with a bevel gear 51 keyed to a horizontal transversely extending shaft 52. This shaft is connected by a coupling 53 to an aligned shaft 54 extending laterally through an aperture 55 in the side of the drill base. This shaft has keyed thereto a bevel gear 56 meshing with a bevel gear 57 in turn keyed to a horizontal shaft 58 extending longitudinally along one side of the drill base. The adjacent ends of the shafts 54 and 58 are journaled within a housing 59 secured to the drill base and in which the bevel gears 56 and 57 are enclosed. Surrounding the shaft 58 is a hollow shaft 60 suitably journaled within a housing 62 secured as shown in Fig. 4, to an element of the feeding mechanism as hereinafter described. Keyed to this hollow shaft 60 is a bevel gear 63 meshing with a bevel gear 64 fixed to a vertical shaft 65. It will herein be noted that the shaft 60 is free to move relative to the shaft 58 so that when the feeding mechanism is shifted laterally on its guides the gears 63 and 64 are maintained always in mesh. This shaft is connected by a coupling 66 to a shaft 67 in turn connected by a coupling 68 to an aligned shaft 69. Fixed to the shaft 69 at the upper end thereof is a spur pinion 70 driving through an intermediate gear 71, a large spur gear 72 keyed at 73 to a tubular shaft 74 suitably journaled in anti-friction bearings carried by a gear housing 75. This tubular shaft 74 constitutes the drive rod rotation member and is herein formed with a central polygonal opening 76 through which a correspondingly shaped drive rod 77 extends. Carried at the lower end of the drive rod 77 is a usual bottom drill chuck 78 of the jaw type having usual chuck jaws 79 adapted to grip the grief stem 48 to connect positively the latter to the drive rod 77. As shown in Fig. 8 the hollow shaft 60 is connectible in driving relation with the shaft 58 by means of a sliding jaw clutch 80 splined at 81 to the shaft 58 and having clutch teeth connectible to the clutch teeth formed on the shaft 60. The sliding clutch member 80 is provided with a usual pivoted shipper lever 82 pivotally mounted at 82a on a bracket 83 attached to the drill

base. Carried within this bracket is an anti-friction bearing 84 in which the forward end of the shaft 58 is journaled. It will thus be seen that when the clutch 29 is disconnected and the shafts 58 and 60 are connected in driving relation by the clutch 80 the grief stem 48 may be rotated independently of the rotary table 39.

The improved feeding mechanism 5 comprises parallel vertically disposed cylinders 85 disposed, when in the position shown in Fig. 4, at opposite sides of the rotary table 39. The cylinders 85 are provided with upper and lower heads 86 and 87 and the cylinder parts are maintained in assembled relation by means of tie bolts 88. Secured by bolts 89 to the lower cylinder heads 87 is a transverse frame member 90 supported by sliding shoes 91 engaging the guideways or tracks 7. The housing 62, above referred to, is secured to the frame 90. Disposed within each of the cylinders 85 is a feed piston 92 secured to parallel piston rods 93. These pistons rods extend upwardly through suitable stuffing boxes carried by the top cylinder heads and are secured at 94 to a cross arm 95 extending transversely across the tops of the feed cylinders and supporting a usual thrust head 96. This thrust head comprises anti-friction bearings 97 rotatably supporting a flange 98 secured to the drive rod 77. As shown in Fig. 4 the gear housing 75 is secured by screws 99 to the top heads 86 of the feed cylinders. Fluid under pressure may be admitted in any suitable manner to the feed cylinders 85 to effect movement of the feed pistons. It will thus be seen that as the drive rod 77 is rotated it may at the same time be fed axially by the hydraulic feeding mechanism. The feeding mechanism may be locked to the guide rails by means of clamping bolts 100 carried by the sliding shoes 91 and having hook shaped lower ends underlying the treads of the rails. When these bolts are tightened the sliding shoes are clamped in position to the rails.

To facilitate control of the grief stem there is provided at the upper end of the drive rod 77 a top chuck 101 comprising a casing 102 carrying wedge shaped chuck jaws 103 adapted to connect the grief stem 48. The means for actuating these chuck jaws comprises an annular member 104 connected through links 105 to the chuck jaws. Cooperating with the grooved periphery of the member 104 is a shipper lever 106 pivoted at 107 on a screw to the top of the cross arm 95 and this shipper lever is provided with a usual operating handle 108.

The means for shifting the feeding mechanism 5 along the guideways 7 to clear the rotary table 39 for the usual rotary drilling operations comprises a horizontal cylinder 109 supported by transverse frames 110 attached at their ends to the I-beams 6 of the

drill base. In the present construction the cylinder 109 extends longitudinally above the transmission mechanism 3 although it is evident that the cylinder may be arranged in various positions as desired. Reciprocally mounted in this cylinder as shown in Fig. 5 is a piston 111 having a piston rod 112 pivotally connected at 113 to a transverse member 114 in turn attached in a suitable manner to the sliding shoes 91 on which the feeding mechanism is mounted. Fluid under pressure may be supplied to the cylinder 109 through a supply hose 115 and pipe connections 116 under the control of a usual four-way valve 117.

When it is desired to operate the apparatus as a rotary drill using the rotary table as the means for rotating the grief stem 48, the clutch 80 is disconnected, thereby disconnecting the drive rod 77 from its driving mechanism. The clutch 29 is then connected and the rotary table 39 driven at any desired speed through the plural speed transmission mechanism 3 by the prime mover 2. The grief stem 48 is fed through the table in the usual manner by the hoisting mechanism or draw works of the drilling apparatus in accordance with the usual rotary practice. During starting of the hole or when it is desired to feed the grief stem at a controlled speed the feeding mechanism 5 is shifted from the dotted line position shown in Fig. 1 to the full line position in that figure wherein it overlies the rotary table. The bottom chuck 78 is then set, connecting the grief stem 48 to the hydraulic. Upon admission of fluid under pressure to the cylinders 85 of the feeding mechanism the grief stem 48 may be fed upwardly and downwardly through the rotary table as desired. If it is desired to clear the table for the usual rotary drilling operations, the feeding mechanism is again shifted to the dotted line position shown in Fig. 1. When it is desired to operate the drilling apparatus as a standard core drill, the clutch 29 is released, disconnecting the rotary table 39 from its drive. The clutch 80 is then connected, connecting the shafts 58, 60 in driving relation, thereby connecting the drive rod 77 to the prime mover through the plural speed transmission mechanism 3 and the gear train including the large spur gear 72 fixed to the drive rod rotation member 74. The bottom chuck 78 is then set to connect the grief stem 48 to the drive rod 77 and the grief stem is fed upwardly and downwardly as it is rotated by the member 74 at a controlled rate by the hydraulic. The top chuck 101 is operated to hold the grief stem 48 during adjustment thereof, and when the bottom chuck 78 is released, and under certain conditions, cooperates with the bottom chuck in the drive of the grief stem in a manner well understood in the art. The thrust head 96 supports the weight of the drill stem

during rotation thereof in accordance with either the rotary or core drill method of drilling, that is when the grief stem is rotated by either of its rotation mechanisms.

5 It will be noted that if desired the rotation member 74 and the rotary table 39 rotate at the same angular speed in the same direction and may if desired be connected simultaneously to the prime mover to act simultaneously as the rotation means for the grief stem 48, this being highly desirable when difficult drilling conditions are encountered and a powerful rotation is necessary.

10 As a result of this invention it will be noted that an improved rotary drilling apparatus is provided having improved positive feeding means whereby an extremely sensitive feed may be obtained, thereby enabling the rotary drill to be used with a standard diamond 20 core bit. It will further be noted that an improved hydraulic feeding mechanism is provided especially adapted to use with a standard rotary drill. It will further be noted that by the provision of the separate 25 rotation mechanisms for the grief stem it is possible for the drilling apparatus to operate either as a standard rotary or a standard core drill, the rotation mechanisms being operable wholly independently of each other, 30 although if desired may be operated simultaneously to obtain a more powerful rotation under difficult drilling conditions. It will still further be noted that by the provision of a guideway on which the hydraulic feeding 35 mechanism is mounted it is possible to shift the feeding mechanism laterally to clear the rotary table for the usual rotary drilling operations. These and other uses and advantages of the improved drilling apparatus 40 will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which this invention may assume in practice, it will be understood 45 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.

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

1. In a drilling apparatus, a grief stem, a plurality of rotation mechanisms for said grief stem for rotating the latter in the same 55 direction at a drilling speed during drilling, a prime mover, and means for independently connecting said rotation mechanisms to said prime mover.

60 2. In a drilling apparatus, a grief stem, a plurality of rotation mechanisms for said grief stem for rotating the latter at a drilling speed during drilling, a prime mover, and means for independently or simultaneously 65 connecting said rotation mechanisms to said prime mover.

3. In a drilling apparatus, a rotary table, a grief stem rotated thereby, a prime mover, a supplemental rotation means for said grief stem for rotating the latter at a drilling speed during drilling, and means for independently 70 connecting said rotary table and supplemental rotation means to said prime mover.

4. In a drilling apparatus, a rotary table, a grief stem rotated thereby, hydraulic feeding means for the grief stem, means independent of said rotary table for rotating said 75 grief stem at a drilling speed during drilling, a prime mover, and means for connecting said rotary table and said separate rotation means to said prime mover.

5. In a drilling apparatus, a rotary table, a grief stem rotated thereby, and mechanism independent of said table for rotating said 80 grief stem at a drilling speed during drilling.

6. In a drilling apparatus, a rotary table, 85 power devices for rotating said table at different predetermined drilling speeds during drilling, a grief stem rotated by said table, and devices separate from said table and operable independently of the latter for rotating 90 said grief stem at similar speeds during drilling.

7. In a drilling apparatus, a rotary table, a prime mover, a plural predetermined speed transmission mechanism driven thereby, a rotation member connected to said grief stem 95 for rotating the latter during drilling independently of said rotary table, and means for independently connecting said rotary table and said rotation member in driving relation with said transmission mechanism. 100

8. In a drilling apparatus, a grief stem, hydraulic feeding means for said grief stem, and mechanism for rotating said grief stem including a rotation member disposed relative to said grief stem above the point of connection thereof with said feeding mechanism and through which said grief stem extends 105 and a rotary table disposed below said rotation member. 110

9. In a drilling apparatus, a grief stem, rotation means therefor including a drive rod, drive rod rotation means, and a chuck carried by said drive rod for connecting the grief stem thereto, hydraulic feeding mechanism by which said drive rod is rotatably 115 supported, and means for rotating said grief stem at a drilling speed when said chuck is released.

10. In a drilling apparatus, a grief stem, rotation means therefor including a drive rod, drive rod rotation means, and a chuck carried by said drive rod for connecting the grief stem thereto, a rotary table for rotating 120 said grief stem, and hydraulic feeding mechanism by which said drive rod is rotatably supported for feeding the grief stem during rotation thereof by either said drive rod or said table and including parallel feed- 125 130

ing devices between which said drive rod extends.

11. In a drilling apparatus, a drill base presenting a guideway, a rotary table on said base, hydraulic feeding means movable along said guideway relative to said table, a grief stem, means for connecting said grief stem to said hydraulic feeding means, and separate means for rotating said grief stem including a rotation member carried by said feeding means.

12. In a drilling apparatus, a drill base presenting a guideway, a rotary table on said base, hydraulic feeding means movable along said guideway relative to said table, a grief stem, means for connecting said grief stem to said hydraulic feeding means, and means for rotating said grief stem including a prime mover carried by said drill base, a rotation member carried by said feeding means, and driving connections between said prime mover and said table and rotation member.

13. In a drilling apparatus, a rotary table, a drill stem rotated thereby, hydraulic feeding means for the stem including parallel feed cylinders and pistons contained in said cylinders, a housing supported by said cylinders at the upper ends thereof, and means separate from said table for rotating said drill stem including a rotation member journaled within said housing and through which the drill stem extends.

14. In a drilling apparatus, a rotary table, a drill stem rotated thereby, hydraulic feeding means for the stem including parallel feed cylinders and pistons contained in said cylinders, a housing supported by said cylinders at the upper ends thereof, means separate from said table for rotating said drill stem including a rotation member journaled within said housing and through which the drill stem extends, and power devices for rotating said member including a vertical shaft arranged parallel with said feed cylinders.

15. In a drilling apparatus, a rotary table, a drill stem rotated thereby, hydraulic feeding means for the stem including parallel feed cylinders and pistons contained in said cylinders, a housing supported by said cylinders at the upper ends thereof, means separate from said table for rotating said drill stem including a rotation member journaled within said housing and through which the drill stem extends, and power devices for rotating said member including a vertical shaft arranged parallel with said feed cylinders, a shaft extending longitudinally of said apparatus, and gearing connecting said shafts.

16. In a drilling apparatus, a rotary table, a grief stem rotated thereby, means independent of said rotary table for rotating the grief stem at a drilling speed during drilling, hydraulic feeding mechanism for the stem including a hydraulic feeding device arranged adjacent one side of said rotary table

and connections extending from said feeding device over the table for connecting the grief stem to the hydraulic, and means whereby said hydraulic feeding device may be shifted bodily laterally relative to the rotary table to clear the latter for the usual rotary drilling operations.

17. In a drilling apparatus, a rotary table, a grief stem rotated thereby, means independent of said rotary table for rotating the grief stem at a drilling speed during drilling, hydraulic feeding mechanism for the stem including a hydraulic feeding device arranged adjacent one side of said rotary table and connections extending from said feeding device over the table for connecting the grief stem to the hydraulic, and means whereby said hydraulic feeding device and said independent grief stem rotation means may be shifted bodily laterally relative to the rotary table to clear the latter for the usual rotary drilling operations.

18. In a drilling apparatus, a rotary table, a grief stem rotated thereby, means independent of the rotary table for rotating the grief stem at a drilling speed during drilling, positive feeding mechanism for the grief stem including power feeding devices disposed above the derrick floor at opposite sides of the rotary table and between which the grief stem extends, said feeding devices arranged along the sides of the table and closely adjacent thereto, and horizontal guideways at the sides of the rotary table on which said power feeding devices and said independent grief stem rotation means are slidably mounted for movement bodily laterally relative to the rotary table to clear the latter for the usual rotary drilling operations.

19. In a drilling apparatus, a rotary table, a grief stem rotated thereby, means independent of the rotary table for rotating the grief stem at a drilling speed during drilling, hydraulic feeding mechanism for the grief stem including hydraulic feeding devices disposed above the derrick floor at opposite sides of the rotary table and between which the grief stem extends, said hydraulic feeding devices extending adjacent the sides of the table, and horizontal guideways at the sides of the rotary table on which said hydraulic feeding devices and said independent grief stem rotation means are slidably mounted for movement bodily laterally relative to the rotary table to clear the latter for the usual rotary drilling operations.

20. In a drilling apparatus, a rotary table, a grief stem rotated thereby, means independent of the table for rotating the grief stem at a drilling speed during drilling, a hydraulic feeding mechanism for the grief stem comprising parallel power feeding devices arranged above the derrick floor at opposite sides of the rotary table immediately adjacent the latter and connectible to the

grief stem, and horizontal guideways arranged at the sides of the rotary table on which said power feeding devices of the feeding mechanism are slidably mounted, said power feeding devices being shiftable bodily laterally along said guideways to one side of the rotary table to clear the latter for the usual rotary drilling operations.

21. In a drilling apparatus, a rotary table, 10 a grief stem rotated thereby, means independent of the table for rotating the grief stem at a drilling speed during drilling, a hydraulic feeding mechanism including a feed cylinder arranged above the derrick 15 floor at one side of the rotary table adjacent the table, a piston reciprocable in said cylinder, devices for connecting said piston to the grief stem, and a guideway adjacent said table for sliding said hydraulic feeding mechanism and said independent grief stem rotation means bodily laterally to one side of the 20 table to clear the latter for the usual rotary drilling operations.

22. In a drilling apparatus, a rotary table, 25 a grief stem rotated thereby, means independent of the table for rotating the grief stem at a drilling speed during drilling, a hydraulic feeding mechanism for the stem comprising hydraulic feeding devices arranged above the derrick floor at the opposite 30 sides of the rotary table and connectible to the grief stem, the lower ends of said hydraulic devices arranged adjacent the top surface of the table, and horizontal guideways on which said hydraulic feeding devices and said independent grief stem rotation means are slidably mounted.

In testimony whereof I affix my signature.

HARRY C. JOHANSEN.