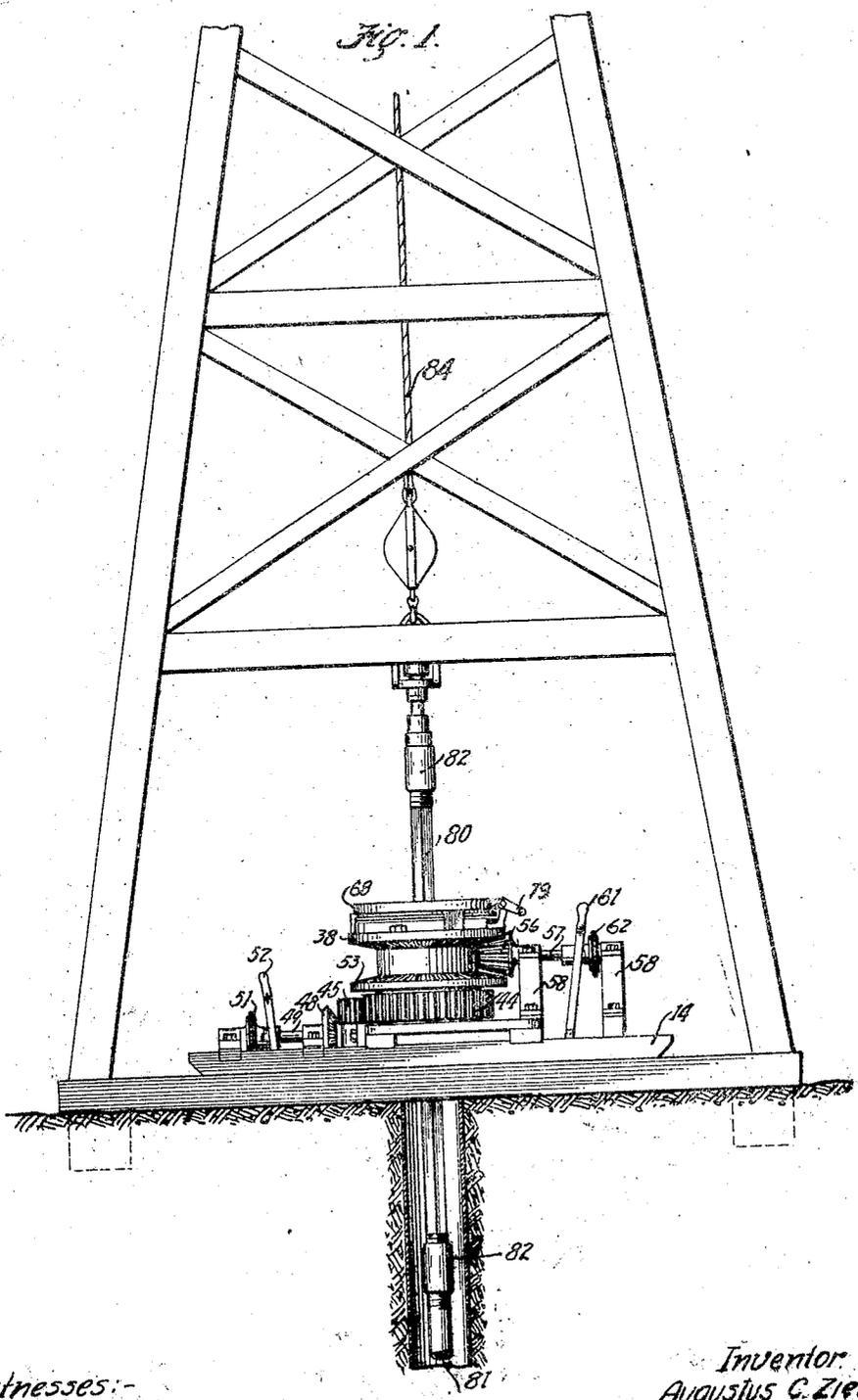


A. C. ZIERATH.  
ROTARY DRILLING MACHINE.  
APPLICATION FILED JAN. 26, 1914.

Patented Feb. 22, 1916.  
5 SHEETS—SHEET 1.

1,173,138.



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Bernd. Hockett

By

Inventor  
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Harold Thomas  
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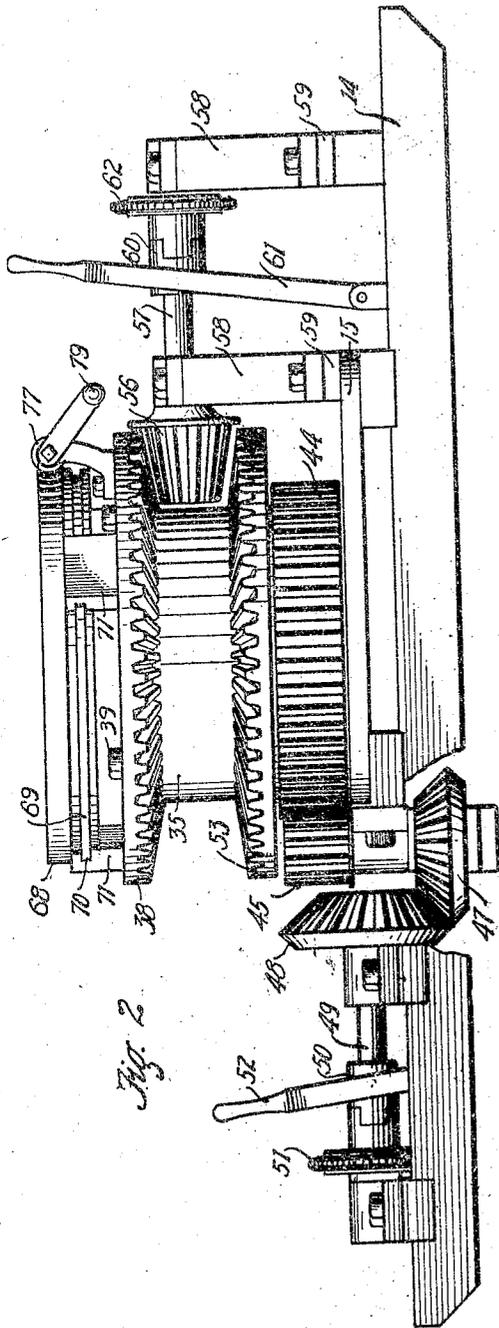


Fig. 2

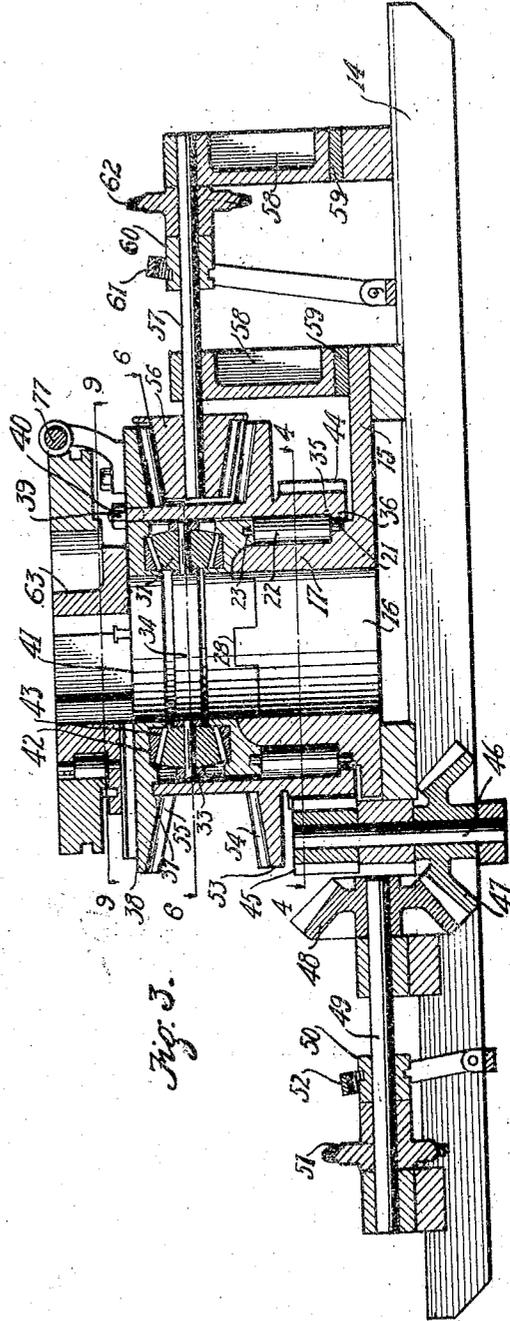


Fig. 3.

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1,173,138.

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5 SHEETS—SHEET 3.

Fig. 4.

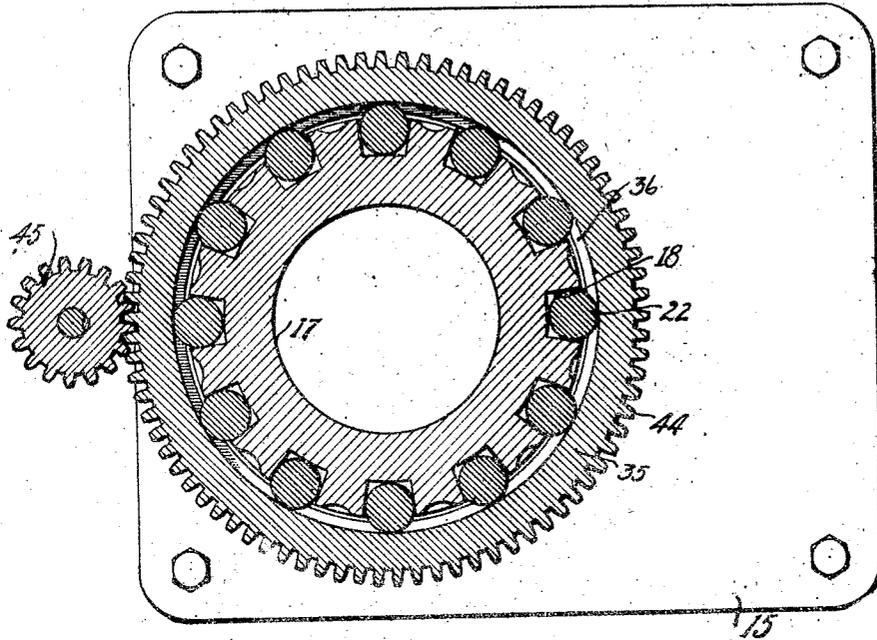
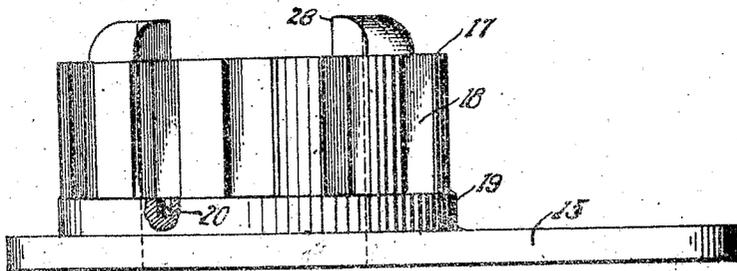


Fig. 5.



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1,173,138.

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5 SHEETS—SHEET 4.

Fig. 6.

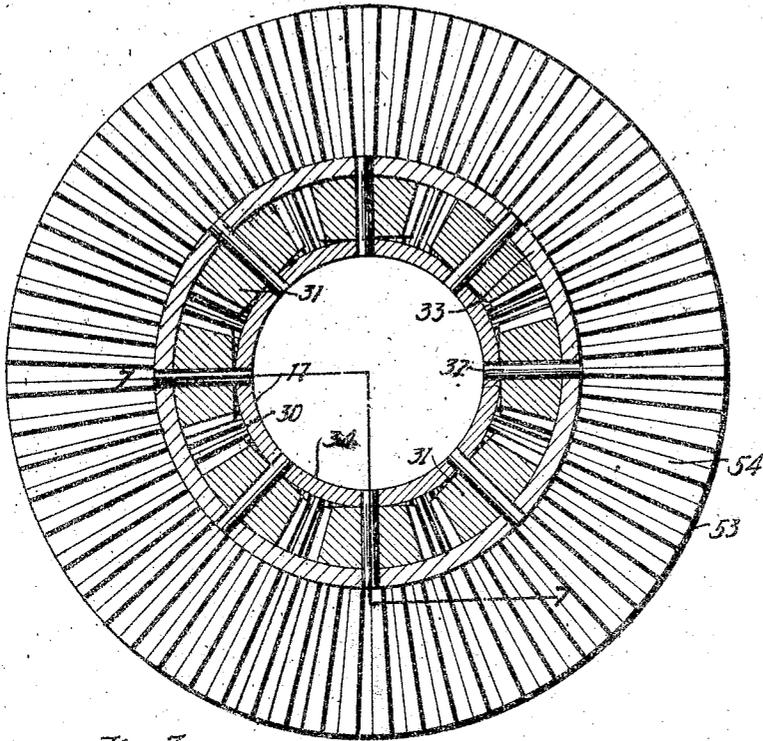
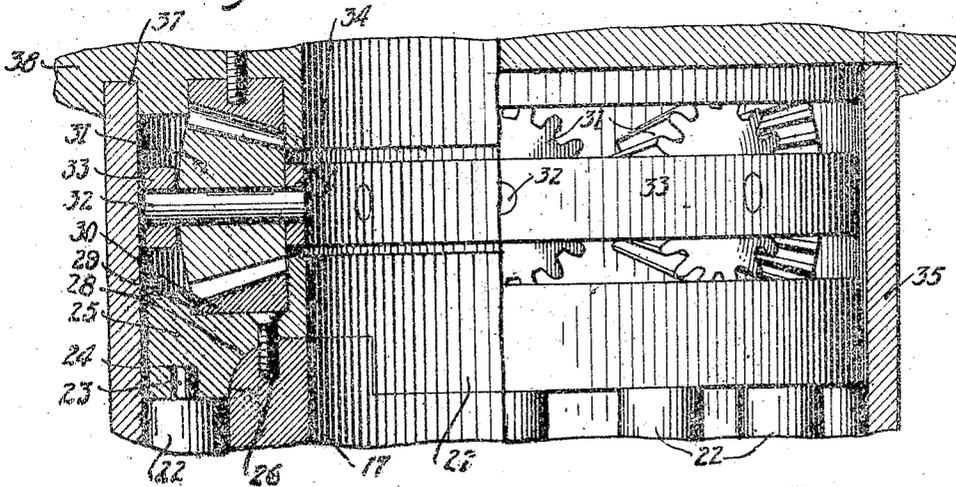


Fig. 7.



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1,173,138.

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5 SHEETS—SHEET 5.

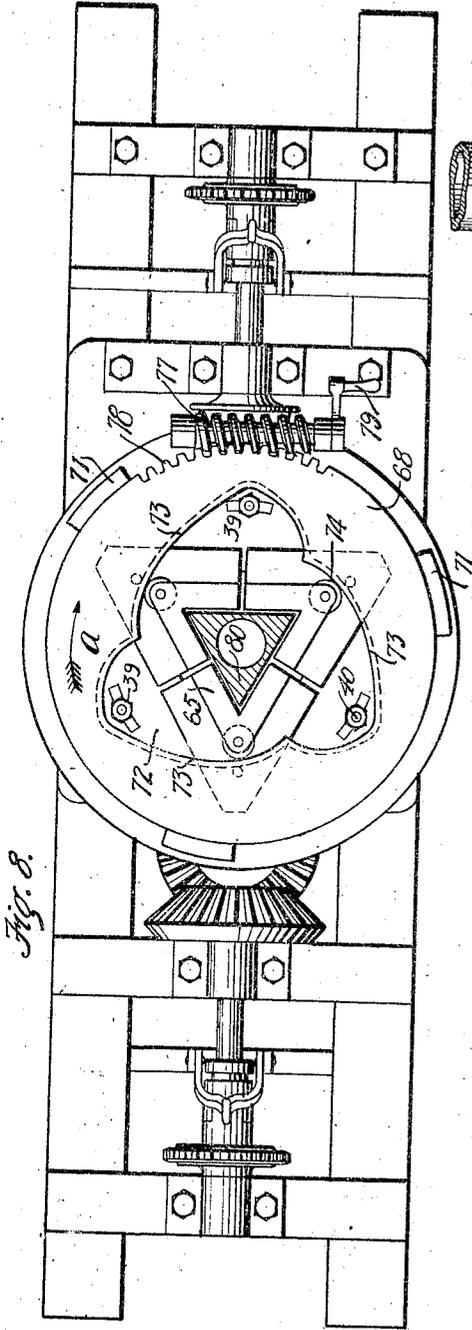


Fig. 8.

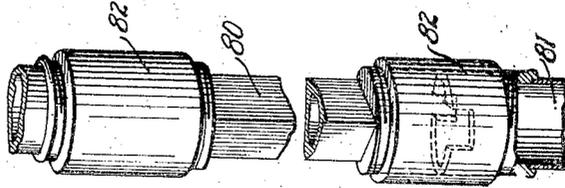


Fig. 11.

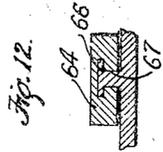


Fig. 12.

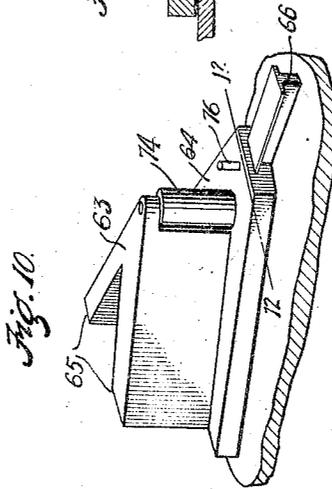


Fig. 10.

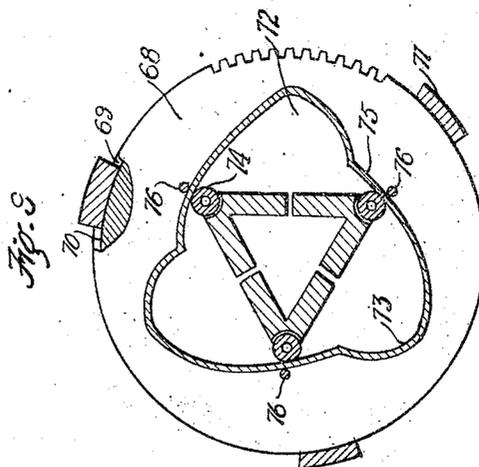


Fig. 9.

Witnesses:

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Inventor  
 Augustus C. Zierath

James Strauss

Att'y

# UNITED STATES PATENT OFFICE.

AUGUSTUS C. ZIERATH, OF LOS ANGELES, CALIFORNIA.

## ROTARY DRILLING-MACHINE.

1,173,138.

Specification of Letters Patent. Patented Feb. 22, 1916.

Application filed January 26, 1914. Serial No. 814,560.

*To all whom it may concern:*

Be it known that I, AUGUSTUS C. ZIERATH, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented new and useful Improvements in Rotary Drilling-Machines, of which the following is a specification.

This invention relates to a rotary drilling machine, and particularly pertains to a mechanism for drilling wells.

In the drilling of wells, particularly oil wells, where the drilling operations are carried on at a great depth, difficulty is met in providing a durable bearing for the drill-pipe-rotating-mechanism on account of its weight and the strains imposed thereon in rotating the drill-pipe and at the same time guard against wreckage of the rotary due to leverage strains exerted thereon by the drill-pipe.

It is the object of this invention to overcome the above difficulties by providing a substantial bearing on which the rotary revolves in rotating the drill-pipe and providing a separate anti-friction bearing for preventing binding and damage to the rotary due to lateral strains thereon.

Another object is to provide a duplex driving means for a rotary, whereby the driving strains in drilling operations will be delivered to opposite sides of the rotary and thereby distributed so as not to impose the driving strains at one point, and whereby smooth and steady running of the rotary is effected.

Another object is to provide a driving means by which the direction of rotation of the rotary can be reversed without reversing the engine when it is desired to ream the bore.

A further object is to provide a means for connecting the drill-pipe to the rotary which will permit of vertical movement of the drill-pipe in relation to the rotary without tending to unseat the rotary, and in which binding of the drill-pipe in the rotary is largely obviated.

Another object is to provide a rotary which can be readily assembled or taken apart for repair or renewal of worn or damaged parts, and which is so constructed that it need not be removed during the insertion or removal of the well-casing.

Further objects will appear hereinafter.

The invention primarily resides in a revolvable vertically disposed cylinder supported upon horizontally disposed toothed bearings and having anti-friction bearings to oppose lateral thrusts thereon, gear means for rotating said cylinder from opposite sides thereof, and means for slidably connecting a drill-pipe to said cylinder.

The invention is illustrated in the accompanying drawings, in which:

Figure 1 is a side elevation showing the invention as applied. Fig. 2 is a detail side elevation of the rotary, with parts broken away. Fig. 3 is a vertical longitudinal section thereof partly in elevation. Fig. 4 is an enlarged horizontal section on the line 4-4 of Fig. 3, showing the construction and arrangement of the lateral bearings. Fig. 5 is a detail in side elevation of the base-plate with the cylinder and lateral anti-friction rollers removed. Fig. 6 is a detail horizontal section on the line 6-6 of Fig. 3 with the driving pinion removed. Fig. 7 is an enlarged section and elevation on the line 7-7 of Fig. 6, showing the horizontal floating toothed bearing, the racks being shown removed in elevation. Fig. 8 is a plan view of the rotary showing the chuck for engaging the drill-pipe. Fig. 9 is a detail horizontal section on the line 9-9 of Fig. 3 as seen in the direction indicated by the arrows. Fig. 10 is a detail in perspective of one of the chuck members. Fig. 11 is a perspective view, with portions broken away, of the connection to the drill-pipe, whereby the latter is slidably engaged by the chuck. Fig. 12 is a detail section on the line 12-12 of Fig. 10.

In the drawings, 14 indicates the timber bed-frame of the rotary, which may be of any suitable construction. Rigidly mounted on the bed-frame 14 is a base-plate 15 having a circular opening 16 therein on the marginal edge of which is formed an upwardly extending continuous flange forming a cylinder 17 projecting upwardly from the upper face of the base-plate 15. The outer vertical wall of the cylinder 17 is formed with a series of channels 18 which open at the upper end of the cylinder and terminate at their lower ends in a shoulder 19. The lower ends of the channels 18 are formed with sockets 20 for the reception of trunnions 21 on the lower ends of anti-friction rollers 22 which are adapted to be positioned

in the channels 18, as illustrated in Fig. 4, with their vertical faces extending beyond the outer face of the cylinder 17. The upper ends of the rollers 22 are formed with trunnions 23 adapted to extend into sockets 24 formed on the underside of a ring 25 removably and rigidly mounted on the upper end of the cylinder 17; the rollers 22 being held in place on the cylinder 17 by the ring 25 which is secured to the cylinder against upward movement by means of screws or bolts 26.

As a means for more securely attaching the ring 25 to the cylinder 17 to insure it against turning thereon and shearing the bolts 26 and the trunnions 23, the underside of the ring 25 is formed with lugs 27 adapted to snugly fit spaces between parallel projecting lugs 28 on the upper end of the cylinder 17 to form a substantial interlocking engagement between the ring and the cylinder. To further secure the ring against horizontal movement in relation to the cylinder its outer edge is extended downwardly to overlap the upper end of the cylinder, as particularly shown in Fig. 7.

Formed upon the upper face of the ring 25 and concentric therewith is an annular channel 29 in which is mounted a circular toothed rack 30. Engaging with the rack 30 is a series of corresponding tapered pinions 31 revolvably mounted on radially extending studs 32 carried by a pair of concentric floating rings 33 and 34; the pinions 31 being positioned between the rings 33 and 34, and cooperating with the latter to form a toothed floating bearing.

Surrounding the stationary cylinder 17 is a revoluble cylinder 35, the inner periphery of which revolvably contacts the rollers 22. The lower end of the cylinder 35 is formed with an inturned flange 36 which extends beneath the lower ends of the rollers 22 and forms an engagement with the latter to prevent upward movement of the cylinder 35; the cylinder 35 being placed in position around the stationary cylinder 17 in assembling the structure before the rollers 22, ring 25, and the floating rings and pinions are put in place. The upper end of the cylinder 35 terminates adjacent the plane of the upper faces of the pinions 31 and extends into an annular channel 37 formed on the underside of a circular plate 38 and secured to the latter by means of nuts 39 which are screwed on threaded studs 40 on the end of the cylinder 35 and extending through perforations in the plate 38.

The plate 38 is formed with a circular opening 41, which opening and the interior peripheries of the inner floating ring 34, ring 25 and cylinder 17 correspond, and formed on the underside of the plate 38 concentric with the opening 41 and opposite the channel 29 and the ring 25 is an annular

channel 42 in which a circular toothed rack 43 is mounted, which rack meshes with the pinions 31 and cooperates with the latter and the rack 30 to form a horizontal revoluble toothed bearing for the plate 38 and cylinder 35 and the structures carried thereby.

The side walls of the channels 29 and 42 project upwardly and downwardly a sufficient distance to extend adjacent the ends of the teeth of the pinions 31 to retain the floating rings and pinions against diametrical displacement. The toothed racks 30 and 43 are detachably mounted in the channels 29 and 42 so as to permit of their removal and renewal when occasion requires.

Formed on the outer periphery of the cylinder 35 at its lower end are spur teeth 44 which mesh with a driving pinion 45 on a stud shaft 46 carried in suitable bearings on the bed-frame 14 and adapted to be rotated from any suitable source of power through a beveled pinion 47 thereon meshing with a corresponding pinion 48 on a shaft 49 carrying a clutch 50 adapted to be engaged with a sprocket wheel 51 to which a motive power is applied. The sprocket 51 is loose on the shaft 49 and clutch member 50 is keyed on the shaft; the clutch member being movable in and out of engagement with the sprocket 51 by means of a hand lever 52.

Formed on the cylinder 35 above the spur teeth 44 is a horizontally extending flange 53 on the upper face of which spur teeth 54 are formed, and formed on the underside of the plate 38 at its outer edge, which projects over the flange 53, are corresponding spur teeth 55. Interposed between the flange 53 and the plate 38 and arranged in constant mesh with the spur teeth 55 is a pinion 56 which is disposed on the side of the cylinder 35 diametrically opposite the pinion 45 and is designed to cooperate with the latter to rotate the cylinder 35 in one direction and to rotate the cylinder independent of the pinion 45 in the opposite direction when moved into engagement with the teeth 54.

The pinion 56 is mounted on a shaft 57 carrying suitable bearings or standards 58 normally supported on shim-blocks 59 on the bed-frame 14 and base-plate 15. When it is desired to position the pinion 56 into engagement with the teeth 54 the shim-blocks 59 are removed so as to position the shaft 57 on a lower plane. The shaft 57 is designed to be rotated through the medium of a clutch member 60, controlled by a hand-lever 61, and a sprocket-wheel 62 loose on the shaft 57 and adapted to be connected thereto through the clutch 60, to which sprocket power is applied from any suitable source.

Mounted on the plate 38 is a chuck for slidably engaging the drill-pipe. This chuck is of peculiar construction to facilitate

tate its loose engagement with and disconnection from, the drill-pipe, and is of such design as to permit the drill-pipe being removed during the operation of the rotary without loosening the chuck. This chuck is particularly shown in Figs. 2, 3, 8, 9 and 10 and embodies a series of three jaws 63 mounted to reciprocate horizontally on the plate 38 and adapted to be positively advanced and retracted simultaneously in relation to each other and to the center of the opening 41. Each jaw 63 comprises a horizontally disposed V-shaped plate 64 on the inner marginal edges of which intersecting upwardly extending flanges 65 are mounted; the inner faces of the flanges 65 and the plate 64 being aligned and extending toward the center of the opening 41 constitute the drill-stem engaging faces of the jaws.

The plates 64 are slidably mounted and guided upon guide rails 66, here shown as T-shaped in cross section, and engaging with corresponding shaped channels 67 formed on the underside of the plate 64 and extending centrally thereof. The guide rails 66 are rigidly mounted on the plate 38 and extend in radial relation to the center of the opening 41 on radii arranged at equal angles in relation to each other so that when the jaws 63 are moved simultaneously longitudinally of the guide rails 66 they will assume corresponding positions in relation to each other and to the center of the opening 41, irrespective of their distance from each other.

The means for advancing and retracting the jaws 63 includes a disk 68 formed with a continuous flange 69 on its outer periphery which is slidably engaged by grooves 70 formed in standards 71 on the plate 38; the disk 68 thus extending parallel with the plate 38 and revoluble in relation thereof. Formed in the disk 68 is an opening 72, the vertical walls of which are arranged in three corresponding arcs struck from three different points to form cam faces 73 disposed to contacts rollers 74 mounted at the intersection of the vertical flanges 65 on the jaw members 63 in such manner that when the disk 68 is rotated in the direction indicated by the arrow —a— in Fig. 8, the jaws 63 will be caused to advance toward each other by the action of the cam faces 73. Formed on the underside of the disk 68 on the marginal edge of the opening 72 is a flange 75, the outer face of which conforms to the curvature of the cam faces 73 and are adapted to engage upwardly extending pins or projections 76 on the plates 64 adjacent the rollers 74, in such manner that when the disk 68 is rotated in the direction opposite that indicated by the arrow —a— in Fig. 8, the jaws 63 will be caused to be simultaneously retracted in relation to each other. The disk 68 is designed to be rotated a par-

tial revolution sufficient to effect the proper range of movement of the jaws 63. This movement of the disk 68 is accomplished by means of a worm shaft 77 revolubly mounted in suitable bearings on the plate 38, which worm shaft meshes with teeth 78 formed on the outer edge of the disk 68. The worm shaft 77 is provided with a hand-crank 79 by which it can be manually rotated to actuate the disk 68.

In the application of the invention the bed-frame 14 is positioned in suitable relation to the well to be drilled and to the derrick as is customary in well drilling operations and the chuck jaws 63 are moved into slidable engagement with a three-sided tubular stem 80, which is connected at its lower end to the drill-pipe 81 and at its upper end to a cap 82. The cap 82 is connected to the drill-pipe raising and lowering mechanism through a cable 84 in the usual manner and is also connected to a suitable source of liquid supply in the customary manner. The stem 80, being slidably engaged by the chuck jaws 63, permits of its being raised and lowered to reciprocate the drill-pipe vertically simultaneously with or independently of its rotary movement, which rotary movement is effected by means of the rotary comprising the present invention.

In the operation of the invention the cylinder 35 is rotated in one direction by the action of the pinions 45 and 56, which are rotated from any suitable source of power through the sprockets 51 and 62. The rotation of the cylinder 35 carries the disk 38 and the chuck jaws 63 therewith so as to cause the stem 80 and the drill-pipe 81 to rotate; the cylinder 35 revolving on the tapered pinions 31 interpolated between the racks 30 and 43. The pinions 31 thus form a toothed bearing for the cylinder 35 and will act when the driving power is shut off from the driving pinions 45 and 56 to prevent spinning or racing of the cylinder 35 and cause it to come to a quick stop by reason of the engagement of the teeth of the bearing pinions on its opposite sides with the racks 30 and 43. By the provision of the vertical rollers 22 between the rotary cylinder 35 and stationary cylinder 17 an effective anti-friction bearing is provided to facilitate rotation of the cylinder 35 under such transverse strains as may be imposed thereon by lateral deflection of the drill-pipe or other causes. When it is desired to reverse the direction of rotation of the rotary cylinder 35 the shim-blocks 59 are removed and the standards 58 disposed and secured in a lower position to arrange the pinion 56 in engagement with the teeth 54. The clutch 50 is then thrown out to disconnect the pinion 45 with the source of power and the shaft 57 and pinion 56 are

rotated to revolve the pinion 56 in its usual direction and thereby operate to reverse the direction of rotation of the cylinder 35. This enables the reversing of the drill when it is desired to ream the bore.

What I claim is:

1. In a well drilling machine, the combination of a stationary cylinder, a rotary cylinder provided with means for engaging a drill pipe disposed about said first cylinder, a series of anti-friction rollers interposed between said cylinders to form a lateral bearing, and a series of connected floating rollers mounted between the upper surface of the stationary cylinder and an inwardly extending portion on said rotary cylinder to form a vertical bearing.
2. In a well drilling mechanism having a rotary cylinder carrying drill-pipe engaging means, a stationary cylinder extending into said rotary cylinder, a series of anti-friction rollers interposed between said cylinders to form a lateral bearing, a circular toothed rack carried by the stationary cylinder, a series of connected floating pinions on said circular rack, and a complementary circular rack carried by the rotary cylinder engaging and supported upon said pinions.
3. In a well drilling machine having a rotary cylinder and drill-pipe engaging means thereon, a stationary cylinder extending into said rotary cylinder, a detachable ring secured to the stationary cylinder, a series of anti-friction rollers interposed between said cylinders and carried by the stationary cylinder and said ring, an annular toothed rack on said ring, a pair of concentric floating rings, a series of pinions revolvably mounted between said rings and supported upon the annular toothed rack, a circular toothed rack carried by the rotary cylinder meshing with said pinions through which the rotary cylinder is supported on the pinions, and means for rotating the rotary cylinder.
4. In a well drilling machine the construction comprising a rotary cylinder, toothed rollers forming a horizontal bearing for said cylinder, vertical anti-friction rollers forming lateral bearings for said cylinder, spur teeth on the lower end of said cylinder, a driving pinion meshing therewith, spur teeth on the upper portion of said cylinder, a pinion meshing with said last named spur teeth arranged diametrically opposite the first named pinion, and means for rotating said pinions in unison to effect the

rotation of said cylinder on the toothed rollers.

5. In a well drilling machine, the combination with a rotary member, of a drill pipe engaging means comprising a plurality of jaw members, radial guide rails mounted on said rotary member on which said jaw members are slidably mounted, a disk carried by said rotary member having a central opening, the walls of which form a cam and are engaged with the jaw members, and means for manually rotating said disk to advance or retract the jaw members in relation to each other.

6. In a well drilling machine the combination with a rotary member, a plurality of radially extending rails on said member, V-shaped jaw members slidably mounted on and guided by said rails, a disk having a central opening, the side walls of which form cam faces arranged to engage said jaw members to advance the jaw members toward each other when the disk is rotated in one direction, and means on the disk for retracting the jaw members when it is rotated in the opposite direction.

7. In a well drilling machine the combination with a rotary member, a plurality of radially extending rails on said member, V-shaped jaw members slidably mounted on and guided by said rails, a disk having a central opening, the side walls of which form cam faces arranged to engage said jaw members to advance the jaw members toward each other when the disk is rotated in one direction, a flange on said disk paralleling the cam faces of the opening therein, and projections on the jaw members adapted to be engaged by said flange to retract the jaw members when the disk is rotated in a reverse direction.

8. In a well drilling machine the combination with a stationary cylinder, a rotary cylinder, a series of anti-friction rollers interposed between said cylinders, a flange on said cylinder overlapping the lower ends of said rollers to prevent upward movement of the cylinder, and a roller bearing on said stationary cylinder forming a horizontal bearing for the rotary cylinder.

In witness that I claim the foregoing I have hereunto subscribed my name this 9th day of January, 1914.

AUGUSTUS C. ZIERATH.

Witnesses:

MARGUERITE BATES,  
MARIE BATTEY.