June 21, 1949. H. W. McDONALD 2,473,537

ROTARY BIT OPERATING MECHANISM

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Fig. 1.

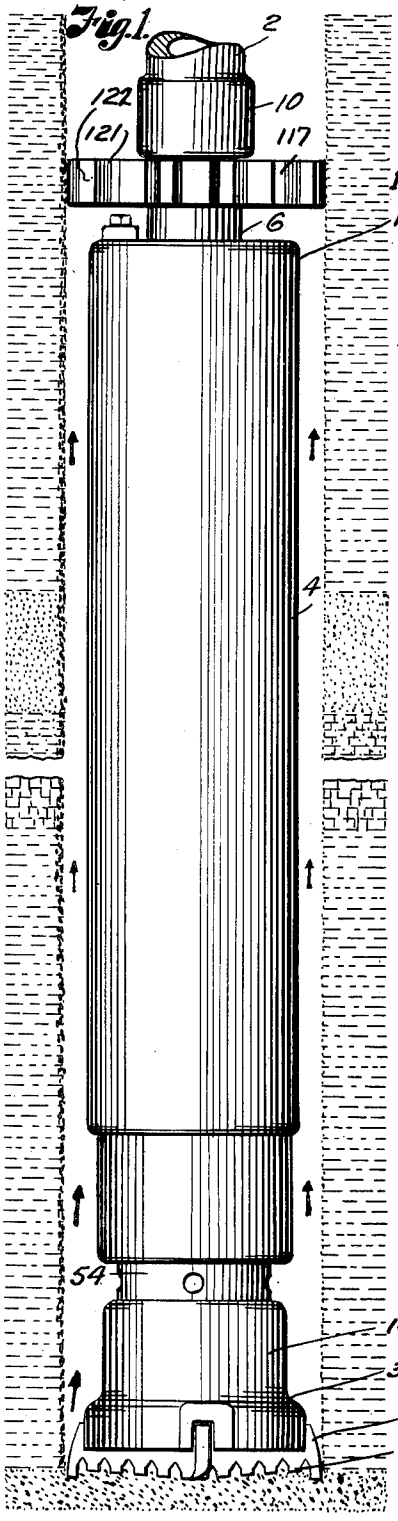
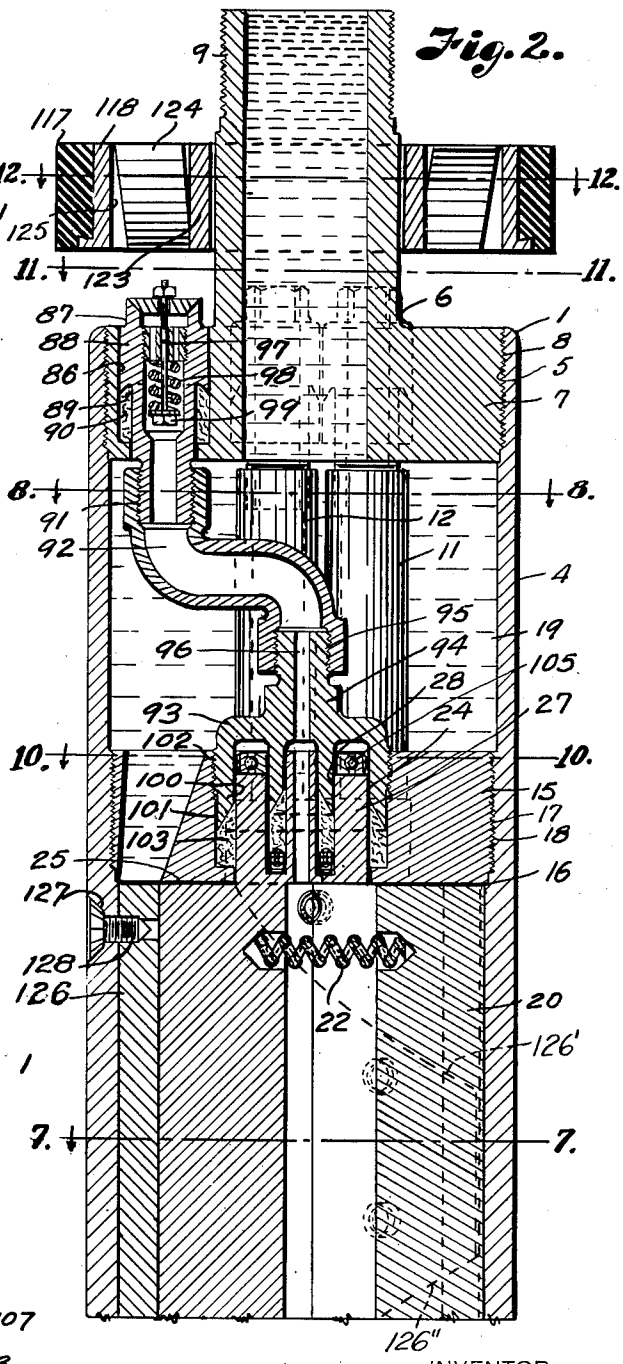


Fig. 2.



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Fig. 2A.

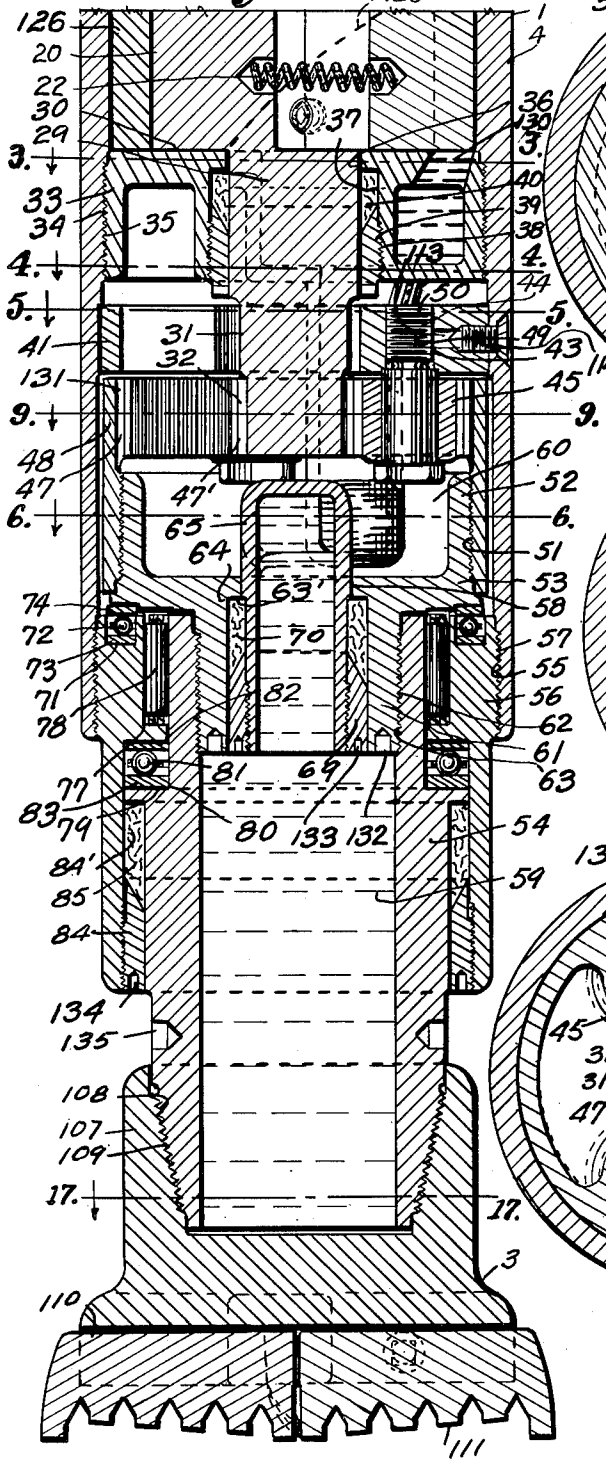


Fig. 3.

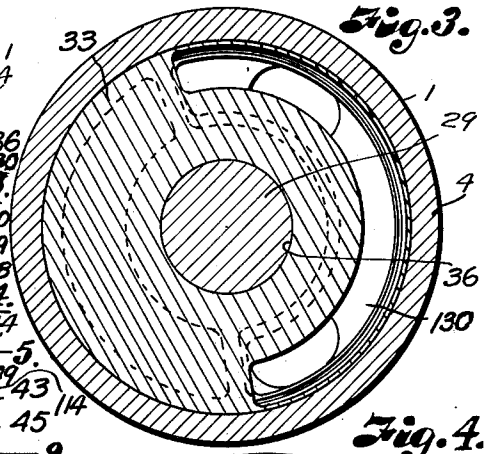


Fig. 4.

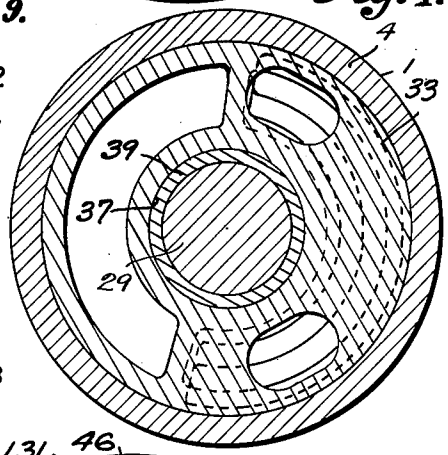
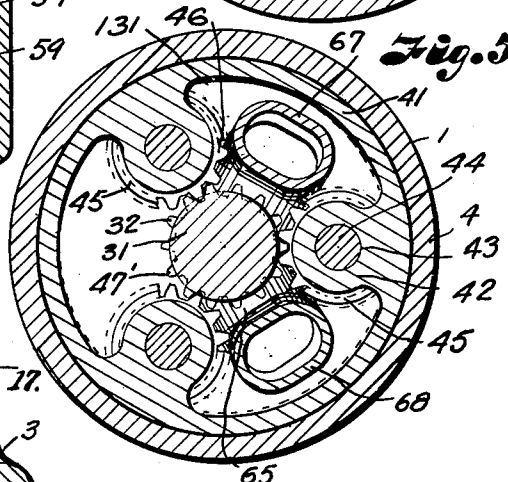


Fig. 5.



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Fig. 8.

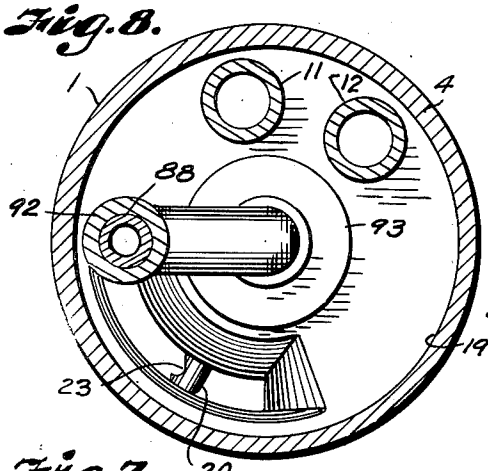


Fig. 11.

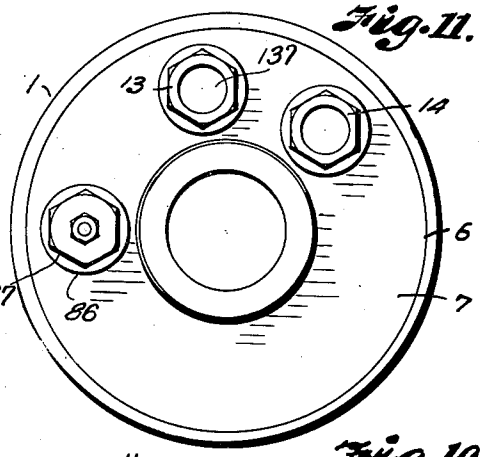


Fig. 7.

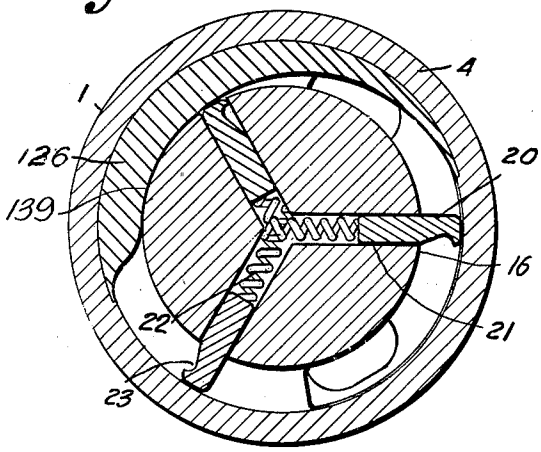


Fig. 10.

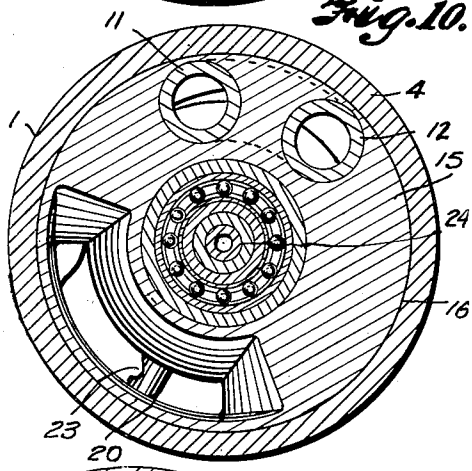


Fig. 6.

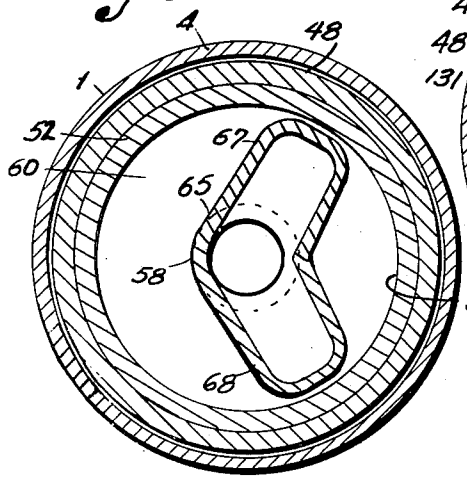
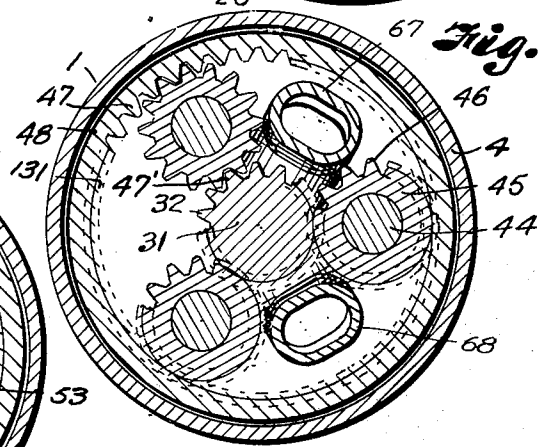


Fig. 9.



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Fig. 13.

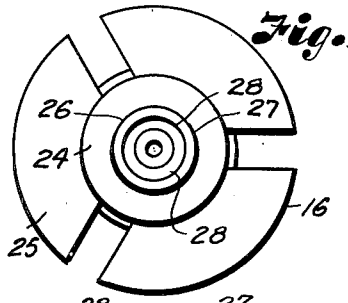


Fig. 12.

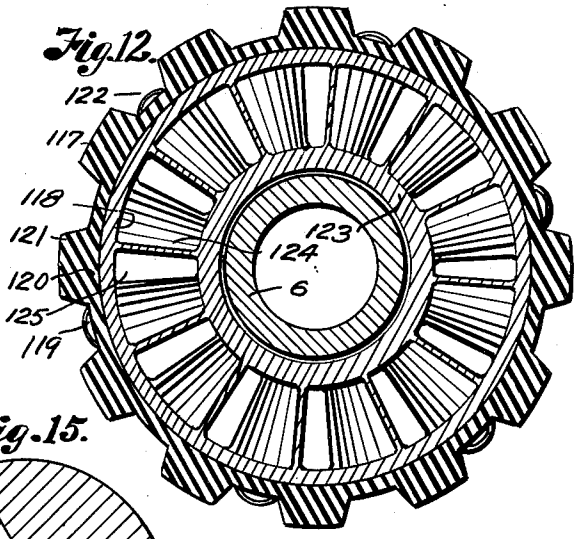


Fig. 14.

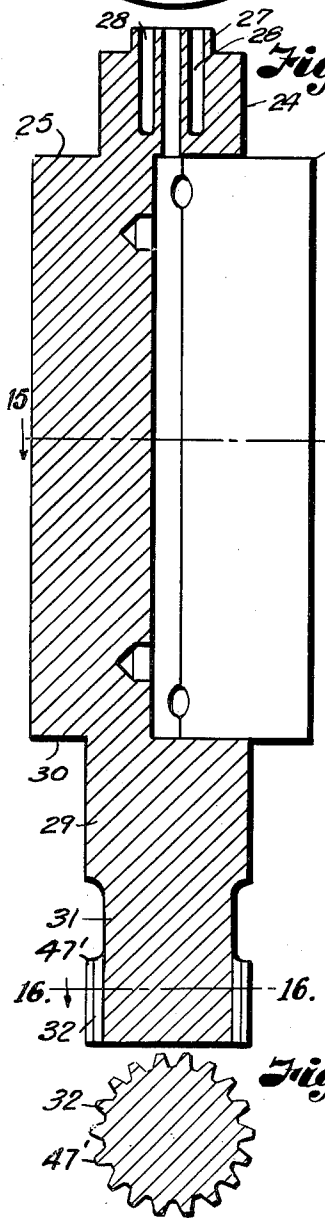


Fig. 15.

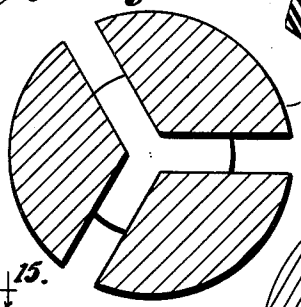


Fig. 17.

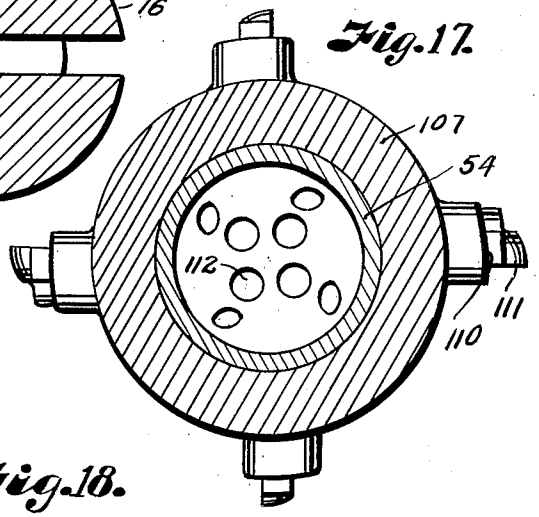


Fig. 18.

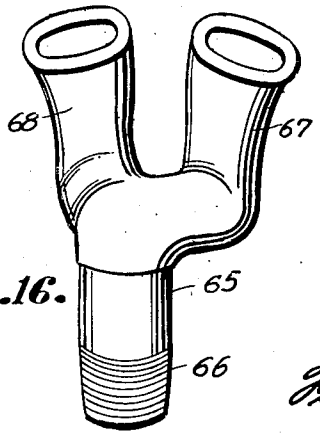


Fig. 16.

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UNITED STATES PATENT OFFICE

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ROTARY BIT OPERATING MECHANISM

Harry W. McDonald, Kansas City, Mo.

Application August 8, 1945, Serial No. 609,591

3 Claims. (Cl. 255—4)

1

This invention relates to rotary bit operating mechanism, and more particularly to mechanism including a rotary motor of the character adapted for use in connection with drill bits or other earth boring tools.

The principal objects of the present invention are to provide hydraulic means for use in connection with earth boring tools in which rotation or oscillation of the tool is accomplished by pressure of drilling fluid through the tool while the barrel remains stationary; to provide a device of this character which may be attached to drill pipe; to provide a device of this character in which the fluid pressure medium is delivered through the motor for discharge at the end of the bit and to conduct the earth formation loosened by the bit from the bore hole; to provide for introduction of water through the drill pipe and motor mechanism to the drill bit; to provide for relief of fluid pressure through the top of the barrel when such pressure is too great to flow through the drill bit; to provide means above the barrel for spacing the barrel from the walls of the bore hole so that such barrel will not contact the bore hole in a drilling operation whereby such spacing means will tend to plaster or mud up the walls of the bore hole and still allow the motor and drill bit to remain free from said wall; to provide such spacing means with fins so that the action of the drilling fluid returning from the bottom of the drill bit upwardly in the bore hole will pass therethrough at an angle to cause rotation of the spacer and thus clean the bore hole of loosened earth material, rock, etc., from the bottom of the hole; and to provide a device for this purpose simple, economical and efficient in operation.

In accomplishing these and other objects of the present invention, I have provided an improved structure, the preferred forms of which are illustrated in the accompanying drawings wherein:

Fig. 1 is an elevation of my rotary bit operating mechanism carrying a drill bit and attached to a drill pipe.

Fig. 2 is a longitudinal section of the upper part of the motor particularly illustrating the course of the water therethrough.

Fig. 2A is a longitudinal section of the lower part of the motor and drill bit.

Fig. 3 is a cross section taken on a line 3—3, Fig. 2A.

Fig. 4 is a cross section taken on a line 4—4, Fig. 2A.

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Fig. 5 is a cross section taken on a line 5—5, Fig. 2A.

Fig. 6 is a cross section taken on a line 6—6, Fig. 2A.

Fig. 7 is a cross section taken on a line 7—7, Fig. 2.

Fig. 8 is a cross section taken on a line 8—8, Fig. 2.

Fig. 9 is a cross section taken on a line 9—9, Fig. 2A.

Fig. 10 is a cross section taken on a line 10—10, Fig. 2.

Fig. 11 is a cross section taken on a line 11—11, Fig. 2.

Fig. 12 is a cross section taken on a line 12—12, Fig. 2.

Fig. 13 is a top plan view of the rotor.

Fig. 14 is a longitudinal section of the rotor.

Fig. 15 is a cross section taken on a line 15—15, Fig. 14.

Fig. 16 is a cross section taken on a line 16—16, Fig. 15, particularly illustrating the gear on the end of the rotor.

Fig. 17 is a cross section taken on a line 17—17, Fig. 2A.

Fig. 18 is a perspective view of the water course connection.

Referring more in detail to the drawings:

1 designates a rotary bit operating mechanism embodying the features of my invention attached to a drill pipe 2 and having a drill bit 3 attached to the lower end of the turbine.

The apparatus consists of a cylindrical casing member or barrel 4 having internal screw threads 5 at its upper end and adapted to receive a coupling 6 having an enlarged end forming a head 7 provided with threads 8 around the outer periphery thereof adapted to engage the threads 5 of the barrel 4 to form a closure for the barrel. The upper end of the coupling 6 is provided with threads 9 adapted to engage in an internally threaded collar 10 on the drill pipe 2 for attachment of the apparatus to the drill pipe.

Located within the casing 4 are tubes 11 and 12 having their upper ends extending through the head 7 of the barrel and fastened thereto by nuts 13 and 14. The tubes 11 and 12 are preferably located near one side of the casing 4, as best illustrated in Fig. 11, and extend downwardly to attach to a head 15 of a rotor 16 located substantially midway of the motor. The head has screw threads 17 around its outer periphery adapted to engage with an internally screw threaded shoulder 18 on the casing 4, as best illustrated in Fig. 2, forming a water chamber 19 between the head 7

and head 15. The tubes 11 and 12 are threaded into bore openings in the head 15, as shown in dotted lines (Fig. 2), or may be welded or otherwise secured to the head.

The rotor has a plurality of blades 20. While any number of blades may be used, I have here preferably shown three as best suited for my purpose. The blades are loosely engaged in slots 21 of the rotor and have their inner edges engaging springs 22 for urging the blades outwardly against the wall of the barrel for a purpose later described. One side of the outer ends of the blades is provided with grooves or the like 23 so that the blades will give to the fluid an added push or whirling action to increase the pressure thereof.

The upper end of the rotor has an upstanding stem 24 (Fig. 14) providing a shoulder 25 adapted to rest against the head 15. The stem 24 is provided with an offset shoulder 26 forming a centrally located upstanding portion 27 having an annular groove 28 extending downwardly therein for a purpose later described. The lower end of the rotor is provided with a depending stem 29 forming an offset shoulder 30 on the lower end of the rotor and the lower end of the stem is provided with a reduced portion 31 adapted to receive a pinion gear 32. The pinion gear is rigidly secured to the stem by welding or in any other suitable manner.

The rotor is held in place in the barrel by a bushing member 33 which forms a seat for the rotor, the upper side of which abuts against the shoulder 30 of the rotor. The outer periphery of the bushing is provided with screw threads 34 adapted to engage screw threads 35 on the inner circumference of the barrel 4 as best illustrated in Fig. 2A. The bushing is provided with a central bore 36. The bore is provided with an enlarged portion providing a recess 37, the lower portion of which is provided with threads 38 adapted to receive a screw threaded packing nut 39 for holding the bushing in place. The packing nut is of shorter length than the recessed portion 37 and I preferably fill such recessed portion with a packing material as indicated at 40 (Fig. 2A) which may be furnished with a lubricant if desired.

Secured to the reduced portion 31 of the stem 29 of the rotor below the bushing member 33 is a pinion gear retaining ring 41 for retaining the rotor in position in the barrel. The pinion gear retaining ring is provided with a plurality of inwardly extending lugs 42 having bores 43 forming a bearing for stud bolts 44. Mounted on the stud bolts 44 are pinions 45 having teeth 46 adapted to engage with teeth 47 on a ring gear 48. The teeth of the pinions 45 also mesh with the teeth 47' on pinion gear 32 mounted on the lower end of the stem 29 of the rotor. The stud bolts 44 have their ends screw threaded as indicated at 49 (Fig. 2A), and are adapted to engage in threads 50 of the bores 43 in the pinion gear retaining ring 41. While I have here shown three gears carried by the pinion gear retaining ring, I particularly prefer two or more, although any suitable number may be used.

The lower portion of the ring gear 48 is provided with internal screw threads 51 adapted to receive a screw threaded upstanding flange 52 of a coupling member 53 adapted to engage a hollow rotatable shaft 54 which extends below the end of the barrel 4 to which is attached a drill bit or the like 3 as later described. If desired, the ring gear 48 and coupling member 53 may be made in one piece, although I prefer the structure as illustrated.

The lower end of the barrel 4 is provided with internal screw threads 55 adapted to receive a sleeve 56 having threads 57 on its outer periphery adapted to engage the threads 55 on the barrel. The coupling member 53 has a bore 58 through substantially the center thereof which leads to a chamber 59 in the shaft 54 as best illustrated in Fig. 2A. The upstanding flange 52 of the coupling member provides a chamber 60 in which oil or other lubrication may be supplied for lubricating the device as later described.

The lower part of the coupling 53 has a depending cylindrical boss 61 provided on its outer circumference with screw threads 62 which engage with screw threads 63 on the inner circumference of the shaft 54. The bore 58 in the coupling member is provided with an offset portion 63' forming a recess 64. Located within the bore of the coupling member is a duct member 65 having its lower end provided with threads 66 and its upper ends extending into the chamber 60. The member 65 may be of any suitable form but is here illustrated as being substantially Y-shaped and the upper end has diverging branches 67 and 68 providing drilling fluid courses extending upwardly through the ring gear and pinion gear retaining ring to the bushing member or head 33, and are rigidly secured thereto by welding or other suitable means, as illustrated in Fig. 5.

The threads 66 on the lower end of the duct member are adapted to receive a bushing 69 which engages in the recess 64 formed by the depending boss of the coupling member. The bushing is of shorter length than the recess 64 which provides a space which may be filled with suitable packing material 70 between the walls thereof and the coupling member.

The shaft 54 has ball and roller bearing engagement with the sleeve 56 and with the coupling member 53 which preferably consists of a raceway 71 in the upper portion of the sleeve 56 adapted to receive ball bearings 72 between the coupling member 53 and the sleeve 56. The ball bearings are retained in place by suitable cylindrical rings 73 and 74 which provide the raceway for the ball bearings. The sleeve 56 is provided with an enlarged upper portion having a longitudinal cylindrical recessed portion 75 providing a shoulder 77 adapted to receive roller bearings 78. The shaft 54 is formed with an annular shoulder 79 providing a raceway 80 for ball bearings 81 held in place by retaining rings 82 and 83; the ball and roller bearings providing free rotatable movement between the shaft, sleeve and coupling member.

The lower end of the sleeve 56 is internally screw threaded and adapted to receive a screw threaded bushing 84 which engages in a recessed portion 84' between the shaft and sleeve to aid in retaining the shaft in the sleeve and free rotation therein. The bushing 83 is of shorter length than the recessed portion 84 and suitable packing material 85 may be placed therein and lubricated if desired, and to prevent back pressure of drilling fluid from contacting the bearings and working parts of the device.

The head 7 in the upper end of the barrel 4 is provided with a bore 86 adapted to receive a valve member 87 comprising a tube or cylindrical member 88 extending through the bore opening, the lower end being offset as indicated at 89 to provide for packing material 90 between the walls thereof and the head 7. The lower end of the

tube is provided with threads 91 which extend into the chamber 19 and is adapted to receive an internally threaded pipe or the like 92 which leads to a packing gland 93 having its lower end screw threadedly engaging the head 15 as best illustrated in Fig. 2. The upper end of the packing gland is provided with an upstanding boss 94 screw threadedly engaging the lower end of the pipe 92 as indicated at 95. The packing gland 93 is provided with a bore opening 96 leading to the head 15 and rotor 16. The tube 88 is centrally bored and adapted to receive a valve stem 97 having a spring 98 held in place by a nut 99 so that drilling fluid may pass from the rotor through the tube and valve when a pressure is built up, as will later be disclosed in describing operation of the device.

The packing gland 93 is provided at its lower end with a plurality of depending flanges 100 which engage in a cylindrical recess 101 in the head 15. The outer periphery of the packing gland is supplied with screw threads adapted to engage with internal screw threads in the grooves of the head as illustrated at 102 (Fig. 2). The lower ends of the packing gland stop short of the cylindrical grooves and the grooves are filled with packing material 103 which may be furnished with lubricating material and to aid in sealing the packing gland within the head 15. The stem 24 of the rotor 16 engages between the depending flanges of the packing gland and provides a ball race 105 for ball bearings 106 so that the rotor will rotate freely within the head 15 as will later be shown.

The drill bit 3 may be of any suitable construction, but here shown to have a shank 107 having a screw threaded bore opening 108 adapted to receive external screw threads 109 on the lower end of the rotor 54 for attaching the bit to the rotor. The bit is provided with a head 110 having teeth 111 of ordinary construction. Openings 112 are provided in the bit head to provide for passage of drilling fluid from the chamber 59 to the bit head and thence to the teeth for a purpose later described.

In order to safeguard against breaking or distortion of the pinions, ring gear and/or motor and consequently, loss of tools in the well, I preferably provide bore openings 113 in the barrel 4 of the motor registering with bore openings in the pinion gear retaining ring 41 for receiving shear pins or the like 114. The pins are screw threaded and have heads which are inset in the barrel and are adapted to engage in screw threads of the bore in the pinion gear retaining ring so that the casing of the motor will be held to the pinion gear retaining ring. This is a safety factor to prevent twisting off of the drill bit from the drill stem and thereby loss of the same in a hole which causes expensive fishing operations and consequently, loss of drilling time. The pins are made of a material which will tend to shear off before the drill bit will be lost or before causing distortion of the pinion and ring gear.

Loosely secured to the coupling member 6 so that it will rotate freely thereon is a spacer or mudder 117 of greater diameter than the barrel 4 which is adapted to engage the walls of a bore hole made by the drill bit. The spacing member is cylindrical in form and comprises a ring 118. Secured to the outer circumference of the ring 118 by rivets or the like 119 is a ring 120 made of resilient material, such as rubber or the like. The ring 120 is made irregular in the shape of outstanding lugs 121 with notches 122 therebetween

for engaging the walls of the bore hole. The spacer includes an inner ring 123 and located between the rings 118 and 123 is a plurality of blades or fins 124 spaced apart to provide openings 125 therebetween so that drilling fluid and loose material from the bottom of the bore hole passing upwardly will flow through said openings. The blades are set at an angle in the ring so that the fluid passing upwardly will cause the spacer to rotate and the rubber notched ring will engage the bore hole to mud up the same and hold the barrel of the turbine spaced therefrom. While I have here shown the rubber ring to be riveted to the ring of the spacer, it will be obvious that it may be secured thereto in any suitable manner, as by welding or otherwise. It will also be apparent that more spacers may be used as desired.

Located within the barrel 4 so that it extends approximately one-half the distance of the inner circumference of the barrel is a cam 126, against which the edges of the blades 20 of the rotor 16 will contact as the rotor is rotated in the barrel. The forward portion of the cam 126 is reduced in length longitudinally of the barrel, the upper and lower portions being cut away as at 126' and 126'', respectively, as shown in Figs. 2 and 2A to provide channels through which drilling fluid passes to the tubes 11 and 12 and duct 65. The barrel is provided with openings 127 mating with threaded openings in the cam adapted to receive set screws or the like 128 for retaining the cam in place in the barrel.

In assembling a device constructed as described, the cam 126 is first assembled in the barrel 4; the rotor 16 with its blades 20 is inserted in the slots 21 with the springs 22 inserted so as to provide an outwardly spring-urged force on the blades against the barrel and cam as will later appear. The head 15 is then inserted in the barrel and gauged therewith by the internal screw threads and so disposed as to engage the upper end of the rotor 16. The Y-shaped passageway comprising the pipe or tube 65 with the branch arms 67 and 68 is welded into the bushing member 33 so as to connect with the water passageways through the rotor, as indicated at 130 (Fig. 2A). The bushing member is then screw threadedly engaged with the barrel and the packing 40 placed in the recess 37 and the packing nut 39 attached to the bushing. The pinion ring gear 41 with its pinions 45 is then assembled. I then preferably assemble the ring gear 48 with the coupler 53. The water passageways consisting of the Y-shaped member with its arms 67 and 68 will extend through the pinion gear retaining ring and having its lower end 65 engage with the bore opening in the coupler 53. Oil or other lubricant for the working parts is then placed in the chamber 131 above the coupler in which the pinion gears are adapted to rotate to provide lubrication therefor. Packing material 70 is then placed in the recess 64 between the coupler and tube 65 and the packing nut 69 is then screw threadedly engaged with the lower end of the tube 65.

I preferably provide notches or the like 132 in the annular flange of the depending boss of the coupler in which a suitable tool may be engaged for tightening the coupler in the ring gear. I also preferably provide notches or the like 133 in the packing nut 69 to receive a tool for likewise tightening the packing nut with respect to the tube 65.

The ball bearings 72 and roller bearings 78 are then assembled and the sleeve 56 screw thread-

edly engaged with the lower end of the barrel. The ball bearings 80 with the retaining rings 79 are then assembled and the rotor 54 then screw threadedly engaged with the depending boss 61 on the coupler 53. Packing material 85 is then inserted in the recess between the rotor and sleeve and the packing nut 83 screw threadedly engaged with the sleeve. Holes or the like 134 are provided in the packing nut in which a tool may be engaged for tightening the packing nut. I also preferably provide sockets 135 around the rotor 54 also to be engaged by a tool for tightening the rotor with respect to the coupling member 53.

Packing material 103 is then placed in the grooves 101 in the head 15 and lubricant applied thereto. The ball bearings 106 are then placed in the raceways 105 and the packing gland 93 is screw threadedly engaged with the head 15. The tube 92 is then screw threadedly engaged with the upstanding boss 94 on the packing gland and the tubes 11 and 12 are also screw threadedly attached to the head 15. The head 7 of the coupler 6 is then screw threadedly engaged with the upper end of the barrel 4. The packing material 85 is then assembled with the tube 88 and inserted in the bore opening 86 in the head. The lower end of the tube 88 is then threaded into the threads 91 of the upper end of the tube 92 to complete the assembly of the valve 87. Suitable packing material (not shown) may then be placed around the tubes 11 and 12 where they extend through the head 7 and nuts 13 and 14 secured to the upper ends of said tubes. The nuts are provided with bore openings 137 for a purpose later described. The spacer 117 may then be inserted over the tubular portion of the shank 6 and the drill bit 3 attached to the lower end of the shaft 54. The complete assembled turbine may then be attached to the drill stem by connecting the screw threaded tubular portion of the coupler 6 with the collar 10 of the drill pipe.

Operation of a device constructed and assembled as described is as follows.

Drilling fluid such as water or the like, may be forced through the drill pipe 2 by a pump (not shown) and will enter the rotor through coupler 6 to chamber 19. From chamber 19 the fluid will be forced through passageway 133 in the head 15 at the top of the rotor 16 and will contact the blades 20 of the rotor. As the water contacts the blades on the rotor, the rotor will be caused to rotate, thus causing rotation of the pinion gear retaining ring and ring gear through the pinion 32 secured to the lower end of the rotor 16 and the ring gear being attached to the coupling member 53, which is in turn fastened to the shaft 54, will cause the shaft to rotate and thus rotate the drill bit 3 in the bottom of the bore hole.

As the Y-shaped passageway consisting of pipe 65 with its branches 67 and 68 extends upwardly through the ring gear and pinion gear retaining ring and connects to passageways in the bushing member or head 33, drilling fluid from the rotor will pass downwardly through said pipes and into chamber 59 in the hollow shaft 54; thence through openings 112 in the head of the drill bit to wash the earth material from the teeth of the bit. The drilling fluid will pass through the bit and will flow upwardly around the outside of the barrel as indicated by the arrows (Fig. 1), carrying the loosened earth material and debris therewith, and will flow through the openings 125 in the spacer 117 contacting the angled vanes or blades 124 to cause the spacer to rotate, giving a swirling action to the fluid to carry the material up through the bore hole to the surface.

Referring to Fig. 7, it will be noted that I provide a cam 126 along the inner wall of the barrel which engages the rotor as shown in Fig. 7 and dotted lines in Figs. 2 and 2A. When the rotor is rotated, the outer edges of the blades 20 will contact the cam member and be depressed against their springs so that only two of the blades will contact the wall of the barrel at one time. This is an important feature of applicant's invention for the reason that the blade will not allow fluid to pass between the rotor with its blades and the cam the fluid moving through the channels formed by the cut away portions of the cam. This will prevent fluid lock of the device as is a common occurrence in ordinary devices of this character. By reference to Fig. 7 it will be noted that when the rotor is rotating, a short portion of it will directly contact the cam 126, as indicated at 139, thus preventing fluid from passing this point.

The notched ends 23 of the blades are so shaped and positioned that as they rotate the fluid will be engaged so that it will be given an added push or swirl to increase the pressure thereof and, thus, greater pressure on the rotor to insure positive rotation of the drill bit by reason of the rotor and ring gear.

Back pressure of the pumping fluid from the rotor will be relieved through longitudinal bore opening 96 in the packing gland 93 through pipe 92 and valve member 87 in the head 7 of the coupling member 6. Also any excess back pressure of fluid from the motor will be relieved through the head 15 and pipes 11 and 12 through openings 135 of the nuts 13 and 14 (Fig. 11).

It will be obvious from the foregoing that I have provided an improved rotary bit operating mechanism for an earth boring device in which the boring drill will be rotated solely by fluid pressure through the device, and which is simple, economical and efficient in operation.

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

1. A rotary motor of the character described adapted to be attached at its upper end to a drill pipe and its lower end to a drill bit comprising, a barrel, a coupler having a head for attaching said barrel to the drill pipe, a rotor in said barrel having a head spaced from said first named head providing a fluid chamber therebetween, fluid medium in said chamber, a cam in said barrel the forward portion of said cam being cut away at each end and the rear portion extending the length of said rotor, said barrel having passages communicating with said cut away portions of the cam, said rotor having a plurality of grooves therein, blades in said grooves, means resiliently urging said blades against the wall of said barrel and cam to prevent locking of said rotor, a pinion gear retaining ring carried by the lower end of said rotor, a ring secured to the barrel, an intermediate gear rotatably carried by said ring and meshing with the pinion gear, a ring gear engaging said intermediate gear, a hollow rotatable shaft in the lower end of said barrel, means for attaching said shaft to said ring gear, and means for passing the fluid medium from said chamber through the rotor and shaft to said bit for causing rotation of the bit.

2. A rotary motor of the character described adapted to be attached at its upper end to a drill pipe and its lower end to a drill bit comprising, a barrel, means for attaching said barrel to the drill pipe, a rotor in said barrel having a head spaced from said barrel attaching means provid-

ing a fluid chamber therebetween, said head having a passageway for said fluid and a second passageway for relief of back pressure in said barrel, a cam in said barrel the forward portion of said cam being cut away at each end and the rear portion extending the length of said rotor, said rotor having a plurality of grooves therein, blades in said grooves, means resiliently urging said blades against the wall of said barrel and cam to prevent leakage of fluid medium past said rotor, means connected to said second passageway in said second named head and to the passageway in the first named head and communicating with the cut away portions of the cam for relief of fluid from said rotor, a pinion gear carried by the lower end of said rotor, an intermediate gear meshing with the pinion gear, means stationary relative to the barrel for rotatably mounting the intermediate gear, a ring gear engaging said intermediate gear, a hollow rotatable shaft in the lower end of said barrel, means for attaching said shaft to said ring gear, and means for passing fluid medium from said chamber through the rotor and shaft to said bit for causing rotation of the bit.

3. A rotary bit operating mechanism comprising, a drill pipe, a barrel attached at its upper end to the drill pipe, an hydraulic motor in the barrel having communication with the drill pipe for delivery of drilling fluid to said motor for actuating same, a bit rotatably mounted at the lower end of said barrel, a transmission means

within the barrel between the motor and the bit, said transmission means having operative connection with said bit, means forming an enclosing chamber for the transmission means, a shaft extending from the motor into the chamber, said shaft having operative connection with said transmission means, a duct stationary relative to the barrel extending through the chamber and communicating the motor outlet with the rotary drill for delivery of drilling fluid thereto, means for sealing the connection of the stationary duct with the bit for preventing entry of drilling fluid into the transmission chamber, and means communicating the hydraulic motor with the exterior of the barrel for relieving back pressure in said motor.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
945,209	Avery	Jan. 4, 1910
1,188,001	May	June 20, 1916
1,786,173	Scharpenberg	Dec. 23, 1930
1,790,460	Capeliuschinicoff	Jan. 27, 1931
1,850,403	Lee	Mar. 22, 1932
2,044,349	Diehl	June 16, 1936
2,166,937	Bettis	July 25, 1939