

Aug. 8, 1944.

C. W. VAN WORMER

2,355,342

DRILLING APPARATUS

Filed June 13, 1942

3 Sheets-Sheet 1

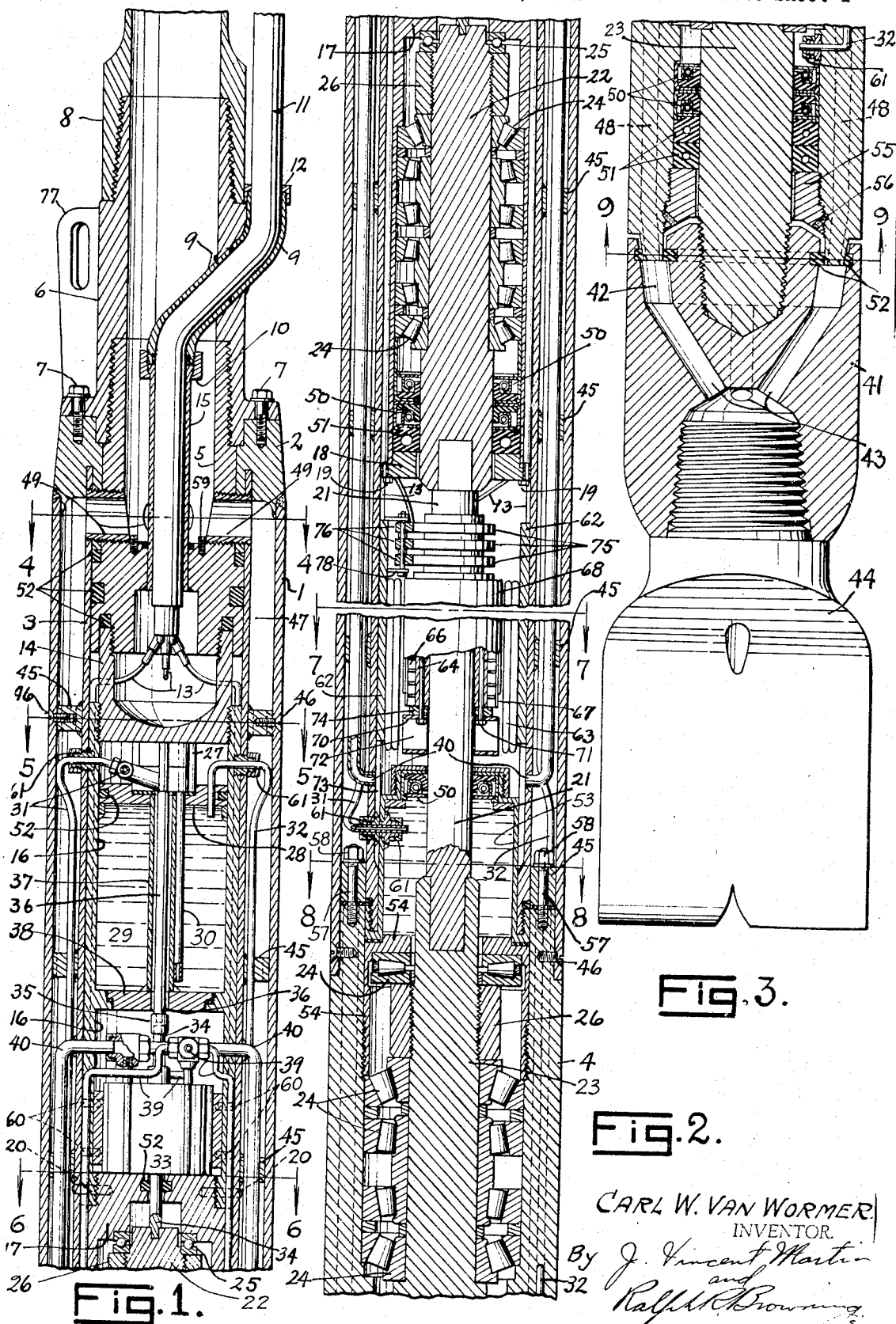


Fig. 3.

Fig. 2.

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3 Sheets-Sheet 2

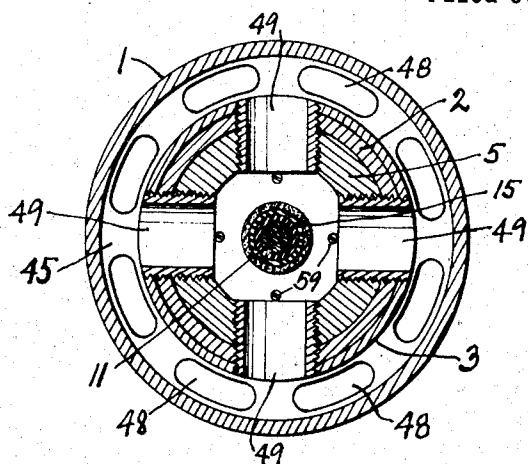


Fig. 4.

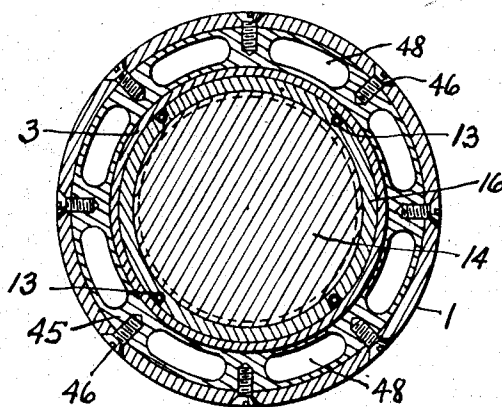


Fig. 5.

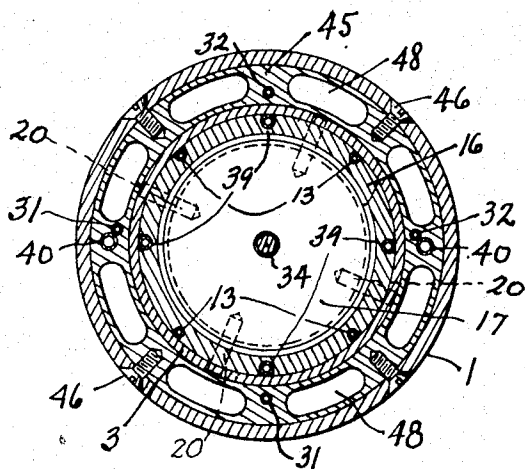


Fig. 6.

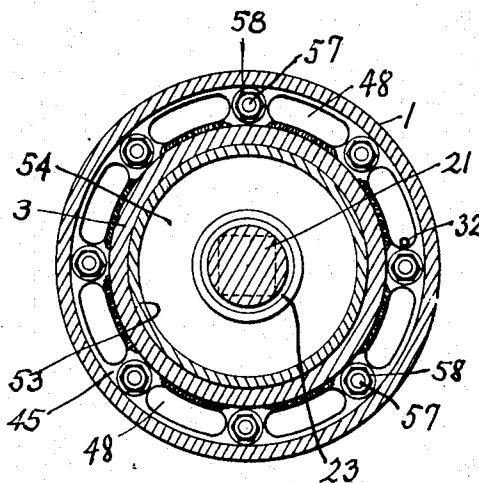


Fig. 8.

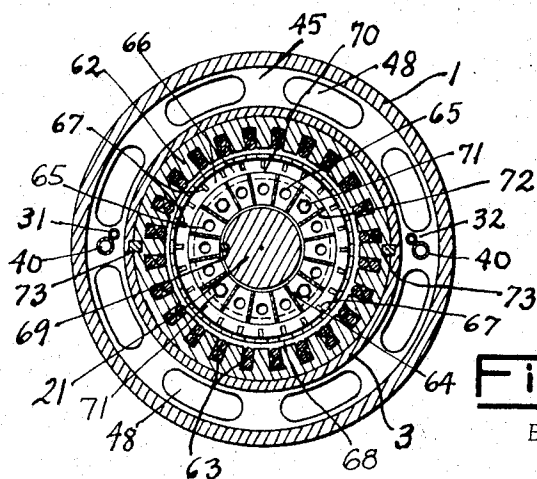


Fig. 7.

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3 Sheets-Sheet 3

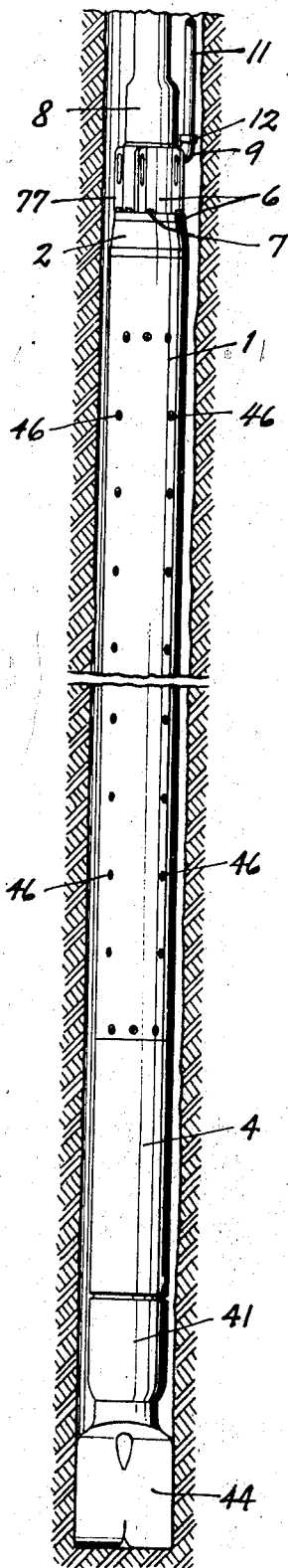


FIG. 10.

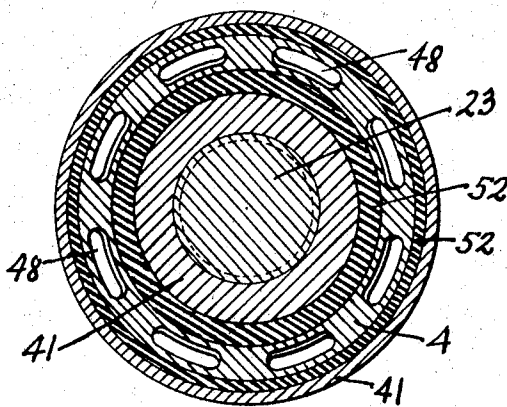


FIG. 9.

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2,355,342

DRILLING APPARATUS

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Application June 13, 1942, Serial No. 446,856

13 Claims. (Cl. 255-4.8)

This invention relates to drilling equipment for drilling wells and the like and has for its general object the provision of a drilling equipment constituting an improvement over the presently known rotary equipment for drilling wells.

In the most widely used rotary drilling equipment, power is transmitted through a rotating drill stem, or long pipe from the surface of the earth, and the cuttings from the drill are washed out of the hole by slush circulated through and around the drill stem. Many difficulties and objections arise in connection with such equipment, due principally to the use of such a long drive shaft.

It has been proposed to operate a rotary drill bit by means of a motor located in the well adjacent the bit, but previous attempts to do this have not resulted in wide spread use because of such difficulties as getting a motor of sufficient power and proper operating characteristics in the limited space available, supplying power thereto, dissipating heat therefrom in the presence of high temperatures in the surrounding earth, providing proper lubrication and arranging for proper bearings in the limited space.

It is a more specific object of this invention to provide a drilling apparatus of the type last mentioned, in which the defects and difficulties referred to will not be present.

It is a further object to provide such an apparatus which will be lighter, less expensive, more easily portable, more durable and trouble free, and require less amount of critical materials than drilling equipment of similar capacity heretofore produced.

A further object is to provide an apparatus which will make it possible to drill wells deeper, more accurately, and with greater safety.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein is illustrated by way of example one embodiment of the invention.

In the drawings:

Fig. 1 is a longitudinal cross section through the upper end portion of a drilling mechanism constructed in accordance with this invention.

Fig. 2 shows a continuation of the lower portion of Fig. 1.

Fig. 3 shows a continuation of the lower portion of Fig. 2.

Fig. 4 is a horizontal cross section taken along the line 4-4 of Fig. 1.

Fig. 5 is a horizontal cross section taken along the line 5-5 of Fig. 1.

Fig. 6 is a horizontal cross section taken along the line 6-6 of Fig. 1.

Fig. 7 is a horizontal cross section taken along the line 7-7 of Fig. 2.

Fig. 8 is a horizontal cross section taken along the line 8-8 of Fig. 2.

Fig. 9 is a horizontal cross section taken along the line 9-9 of Fig. 3.

Fig. 10 shows a longitudinal cross section through a well bore being drilled by a mechanism constructed in accordance with this invention, such mechanism in this instance being illustrated on a reduced scale and shown in side elevation.

Referring now more in detail to the drawings, it will be seen that the major portion of the device is enclosed within an outer housing 1 having an outer head 2 welded or otherwise secured to its upper end. Within this outer housing and arranged in concentric spaced relation with respect thereto is the inner housing 3. Secured in a manner hereinafter to be described to the lower ends of the outer and inner housings 1 and 3 is a lower bearing housing 4 which extends downwardly a considerable distance below the inner and outer housings 1 and 3. The outer head 2 also has a part extending over the upper end of and down within the inner housing 3 as clearly illustrated in Fig. 1.

Disposed within the outer head 2 and extending downwardly within the inner housing 3 is the inner head 5, the upper end of which projects upwardly beyond the outer head 2 and is threaded to receive the lug coupling 6. The lug coupling 6 is secured to the outer head 2 by means of cap screws 7 which extend through a flange in the lug coupling 6 and are threaded into the outer head 2. The lug coupling 6 on its upper end is threaded to receive the lower end of a section of drill pipe 8.

An offset electrical conduit pipe section 9 of substantially S-shape extends through an opening provided therefor in one side of the lug coupling 6 and is welded to the lug coupling 6 about said opening so as to provide a seal with respect thereto. At its lower end this pipe section 9 is provided with a coupling 10 for a purpose presently to be stated. This pipe is for the purpose of passing an electrical conduit or cable 11 from the exterior of the lug coupling 6 to the interior thereof. A seal between the cable and the outer end of the pipe is provided by means of a conduit coupling 12 threaded on to the outer end of the pipe and serving to bind the pipe tightly around the electrical cable.

The lower end of the electrical cable is separated into the various wires which extend there-through and these wires as individual conductors 13 are spread apart and caused to extend through circumferentially spaced openings in the electrical distribution housing 14. The lower portion of the electrical cable 11 below the pipe section 9 extends through a lower electrical conduit pipe 15 which is coupled to the lower end of

the pipe 9 by means of the coupling 10. This conduit section 15 extends from the pipe 9 substantially to the lower end of the cable as a unit.

Threaded to the lower end of the electrical distribution housing 14 is a circulator housing 16 having grooves formed in its outer surfaces which are of a size to receive the various electrical conductors 13. These grooves extend longitudinally of the outer surface of the circulator housing 16 and serve to carry these electrical conductors 13 downwardly toward the motor in a manner which will be presently described more in detail.

Threaded into the lower end of the circulator housing 16 is the upper end of the upper bearing housing 17. The lower end of this bearing housing is adapted to be closed by means of an annular plug 18 which in turn is held in place with respect to the housing 17 by means of cap screws 19.

The circulator housing 16 and the upper bearing housing 17 as above stated are threaded to each other and are secured firmly in threaded engagement by means of set screws 20 provided for the purpose.

The motor which is located below the upper bearing housing has its rotor carried on a motor shaft 21. The upper end of this shaft 21 is formed with a square or other non-circular cross section adapted to fit into a socket of corresponding shape in the lower end of the upper bearing shaft 22. This upper bearing shaft as compared with the motor shaft 21 is of relatively larger diameter so that it will accommodate adequate bearings. The lower end of the motor shaft 21 is likewise formed with a square or other non-circular cross section for the purpose of fitting within a socket in the upper end of the lower bearing shaft 23. The lower bearing shaft 23 like the upper bearing shaft 22 is of relatively larger diameter than the motor shaft 21 in order that adequate bearings may be provided for the support of these three shafts. These bearings are indicated generally by means of the numeral 24 and may substantially all be formed as conical roller bearings. In addition to these bearings there is also shown at the upper end of the shaft 22 a ball thrust bearing 25, the upward thrust from the shaft 22 being conducted to the bearing 25 through a nut 26 which provides a shoulder on which the lower bearing race may rest.

Referring now again to the circulator housing 16, it will be seen that there is mounted within the upper end of this housing just below the lower end of the electrical distributor housing an oil pump or circulator 27 for a purpose now to be explained. This oil pump or circulator is mounted upon a base plate 28 suitably secured within the housing 16 and forming the upper end of an oil reservoir 29. This oil pump or circulator 27 is adapted to draw oil from the reservoir 29 through the oil suction pipe 30 and to discharge the same through the oil discharge lines 31 which extend through the housing 16 and the housing 3 in a radial direction into the annular space between the outer and inner housings 1 and 3 and thence downwardly through this space. As will be seen clearly in Fig. 6, there are two such downwardly extending discharge lines from the oil circulator 27, one of these extending downwardly and emptying into the upper end portion of the upper bearing housing 17 and the other extending downwardly and emptying into the upper end portion of the housing for the lower bearings 24. Leading upwardly from the lower ends of each of such bearing housings are oil return

lines 32 of which there are two as will be clearly illustrated in Fig. 6. These oil return lines likewise extend upwardly through the space between the outer and inner housings 1 and 2 and conduct the oil from the bearings back into the oil reservoir 29.

Mounted within the lower end of the circulator housing 16 is the air circulator 33. This circulator 33 is carried on the air circulator shaft 34, the upper end of which is provided with a coupling 35 by means of which this air circulator shaft 34 is joined to the oil circulator shaft 36 that extends upwardly to operate the oil circulator. This shaft extends upwardly through the tubular conduit 37 which is disposed centrally within the oil reservoir 29, making the oil reservoir of annular cross section. This tubular member 37 is preferably welded or otherwise securely sealed at its lower end to the oil plug of disk 38 which closes the lower end of the oil reservoir. The outer edges of this disk or plug 38 are sealed with respect to the inside of the circulator housing 16 so as to provide a closed oil reservoir 29.

The air circulator 33 is adapted to take air in through the air intake pipes 39 and to discharge it through air discharge pipes 40 which extend radially from the air circulator out through the circulator housing 16 and the inner housing 3 into the annular space between the outer and inner housings 1 and 3. The pipes 40 then extend downwardly through this annular space to a point adjacent the lower end of the motor where the air is discharged into the motor housing and passes upwardly through the motor to the upper end of the motor housing where it enters the inlet pipes 39 to be conducted back to the air circulator.

Carried on the lower end of the lower bearing shaft 23 and threadedly secured thereto is the drill bit coupling 41. This drill bit coupling is provided with an annular slush groove 42 which is open upwardly and which communicates with downwardly and inwardly extending slush passageways 43. The drill bit coupling 41 is provided with a threaded socket at its lower end adapted to receive the pin on a drilling bit 44 which may be of any desirable type.

The inner and outer housings 3 and 1 are held in accurately spaced relation by means of spacer rings or flanges 45 placed therebetween at spaced intervals along the length of the device. These rings 45 may be welded or otherwise secured to the inner housing 3 if desired. They are illustrated as being secured to the outer housing 1 by means of the spacer flange screws 46. The space thus provided by these spacer rings provides a water jacket 47 between the outer and inner housings. It will be readily appreciated by observing the various Figs. 4 to 8 inclusive that these spacer rings or flanges 45 are provided with openings therethrough as shown at 48 so that slush may pass downwardly from top to bottom through the water jacket or slush jacket 47. Slush is of course pumped downwardly through the drill stem 8 in the usual manner and thence through the lug coupling 6 into the inner head 5. Extending from the inner head 5 in various radial directions are the slush nipples 49 which conduct the slush from the interior of the inner head 5 in a radially outward direction into the interior of the water or slush jacket 47.

The lower end of the lower bearing housing is closed against the leakage of lubricant therefrom by means of the oil seal rings 50 and the compo-

sition packing rings 51 which are disposed within the housing 4 and about the lower end of the shaft 23.

The housing 4 has longitudinal passageways through its wall as shown at 48 which correspond to the openings 48 in the spacer flanges 45. These passageways conduct the slush downwardly from the slush jacket 47 to the lower end of the housing 4. This lower end of the housing 4 is slightly reduced in its radial cross section so as to fit within the annular groove 42 in the upper end of the drill bit coupling 41. The drill bit coupling 41 is intended to rotate with respect to the body 4 but the leakage of slush from the joint between these two parts is prevented by means of the inner and outer sealing rings 52 which may be of rubber or some suitable composition and which are illustrated as being located in grooves provided for the purpose in the opposite walls of the annular slush passage 42. Thus it will be seen that even while the drilling bit collar 41 is being rotated during the process of drilling, slush may be pumped downwardly through the slush jacket 47, through the openings 48 and into the annular slush passage 42 in the drill collar and thence into the drilling bit, without being permitted to leak out between the body 4 and the drilling collar 41.

Hooked over the lower end of the inner housing 3 and having a part disposed within the lower end of this inner housing and the inner upper end of the housing 4 is an inverted cup shaped lubricant retainer 53. This retainer has in its upper end an oil seal ring 50 similar to those heretofore mentioned which provides a seal about the lower portion of the motor shaft 21 to prevent the leakage of lubricant upwardly along this shaft.

Against the lower end of this lubricant retainer there is disposed a thrust bearing sleeve 54 having an inwardly extending flange at its upper end adapted to receive the upper bearing race of the major thrust roller bearing. This bearing like the thrust bearing heretofore referred to has its lower race carried on a nut 26 on the shaft 23 so that a thrust load is transmitted from the shaft 23 through the nut 26 to the lower bearing race and thence through the rollers to the upper bearing race and to the thrust bearing sleeve flange 54.

The packing rings 50 and 51 adjacent the lower end of the body 4 are held in place therein by means of an annular packing retaining plug 55 threaded into the body 4. This plug is in turn locked in its threaded engagement with respect to the body 4 by means of set screws 56.

The inner housing 3 is anchored to the body 4 by means of one of the spacer flanges 45 which is welded to the body 3 adjacent its lower end and which has openings therein for the purpose of receiving the studs 57 having nuts 58 on their upper end. These studs 57 are in threaded engagement with the upper end of the body 4 so that when the nuts 58 are tightened the inner housing 3 will be tightened against the upper end of the body 4.

It will be noted that the set screws 59 are employed within the inner head 5 for the purpose of retaining the slush nipples 49 in place therein. It will further be seen that set screws 60 are extended through the wall of the circulator housing 16 to secure the air circulator 33 in place therein.

The oil discharge lines and oil return lines 31 and 32 respectively are passed through the inner housing 3 and a seal is formed about them with-

in the openings through the inner housing by means of bushings and nuts 61.

Carried within the inner housing 3 below the circulator housing and below the upper bearing housing 17 is the motor stator frame 62. This motor stator frame 62 as illustrated more in detail in Fig. 7 is provided with slots along its inner surface thereby forming tongues on which the stator winding 63 is carried.

Carried on the motor shaft 21 within the stator winding is the rotor frame or spider 64. This spider has circulation holes 65 extending longitudinally therethrough so as to permit the circulation of air or other inert gas for a purpose presently to be set forth. Surrounding the spider 64 is the armature core 66 in which are formed grooves 67, the armature bars 68 being laid in these grooves. The armature frame or spider is preferably keyed to the shaft 21 by means of a key 69.

It will be understood that while reference is being made to armature parts, this term is to be understood as covering any type of rotor for an electric motor depending on which type of electric motor is to be employed. It is not intended that this invention shall be limited to any one particular type of electric motor although one type is hereinafter mentioned as preferable.

On the lower end of the rotor is a so-called end frame 70 held in place on the end of the rotor by means of bolts 71, these bolts extending through certain of the holes 64 in the armature frame. On the end frame 70 are radially extending rotor vanes 72.

The stator is held nonrotatably within the inner housing by means of keys 73 inserted between the stator frame and the inner housing 3.

It will be appreciated that the armature end plates 74 which are located above the end frames 70 on which the rotor vanes 72 are carried, serve to hold the armature core 66 on the armature frame or spider and prevent it from sliding off of the lower end of this frame or spider.

In the instance illustrated the motor is considered to be of the induction type with a wound rotor. The leads from this wound rotor are connected to the collector rings 75 which rings are adapted to receive the brushes 76 to which certain of the cable leads 13 heretofore referred to are connected. By this means, if it be desired to change the resistance of the rotor windings, any resistance desired may be connected between the conductors 13 leading from the brushes 76, and this resistance may be provided at the surface of the ground where it will not tend to heat up the mechanism actually supplying the power to the drilling bit.

More specifically, if it be considered that the motor is of a three phase induction type, then the electrical cable 11 should be provided with six conductors therein. Three of these conductors would, of course, be connected to suitable portions of the stator windings and the other three to the brushes 76 which engage the collector rings 75.

The power supply would be connected to the three conductors of the electrical cable 11 which are connected to the stator. Those three conductors which lead from the brushes 76 would be connected to suitable variable resistances so that by variation of the resistances located at the surface of the ground, the resistance factor of the rotor of this motor could be changed thereby changing its torque characteristics. The

brushes it will be noted are mounted on the brush holding frame 78.

It is thought that the operation of the device herein described will be clear from the foregoing description, but by way of further explanation of the operation thereof it may be stated that the mechanism described is lowered into the earth as the drilling continues, being suspended by means of the drill pipe 8 or other suitable tubular member. During this time the motor is operated to rotate the drill bit 44 but the drill pipe or tubular member 8 is not rotated and merely serves to take the reaction torque from the drilling operation. During the drilling operation the circulator 27 serves to cause a lubricant flow from the reservoir 29 through the conduits 31 to the bearings 24 and to flow back to the reservoir 29 through the conduits 32. At the same time the circulator 33 will cause a flow of air or some inert gas through the conduits 39 to the upper end of the motor housing, through the motor itself and especially through the openings in the armature thereof and upwardly through the conduits 40 back to the circulator. During this time slush will be pumped downwardly through the drill stem and will pass down through the jacket 47 in which the conduits 31, 32 and 40 are located. The lubricant and the gas just referred to will serve to remove excess heat from the bearings and the motor and in passing upwardly through the jacket in which the slush from the surface of the ground is flowing toward the surface of the bit, these fluids will give up their heat thus acquired to the slush. The slush in turn will carry the heat away as it flows out through the drill bit and will retain the heat as it flows back to the surface of the ground around the outside of the drill pipe 8. The slush will thus serve the double purpose of cooling the motor and bearings therefor and of washing the cuttings from the drill bit to the surface of the ground. In addition, it will also serve all the other functions that slush is called upon to perform in ordinary rotary drilling.

In order to control the torque characteristics of the motor, a suitable resistance will be placed between the conductors from the brushes 76, such resistance, however, being located above the surface of the ground so that it can dissipate its heat to the atmosphere and so that it can be varied readily by the operator.

During the operation of the device the radial and thrust load from the drill bit will be taken by the relatively large and rugged bearings 24 located on the large drive shaft 23. The upper end of the motor shaft 21 will be supported by the upper relatively large shaft 22 carried by the upper set of bearings 24. The motor shaft will thus be called upon to withstand only the torque stresses resulting from the operation of the motor and will be supported at both ends by the relatively large shafts 22 and 23 and the bearings in which these shafts operate. This makes for conservation of weight in the motor shaft and makes it possible for the motor shaft to be small enough in diameter so that an adequate motor structure may be mounted thereon. At the same time it does not limit the bearing support for the driving shaft.

In the event a well is to be drilled with the device just described which well is to be of exceedingly great depth such that the drill pipe 8 would be insufficient to support the weight, or if it be desired to use a lighter pipe which would

not be capable of supporting the weight but which would be capable of taking the reaction torque from the drilling equipment, then a cable or the like may be secured to one or more of the lugs 77 provided for that purpose on the lug coupling 6 at the upper end of the device. It will be appreciated that inasmuch as the reaction torque necessary to be taken by the tubing on which the device is carried is relatively very small compared to that which would be necessary to take on a drill stem of an ordinary drilling rig, this tubing may be made very much lighter than the usual drill stem, and the necessary support for the apparatus could be provided by a relatively light and easily handled cable secured to one of the lugs 77. In this manner a great deal of the necessary weight of the drilling equipment could be dispensed with with the consequent possibility of drilling a hole very much deeper than has heretofore been possible.

Furthermore, it will be appreciated that inasmuch as it is not necessary to transmit mechanical motion all the way from the surface of the ground through a long drill stem which does not have any intermediate support, it will be possible to run the drilling bit at a much higher speed than has heretofore been possible with the consequence that the reaction torque upon the suspending tubing or drill pipe will be relatively very much less than in the usual rotary drilling equipment.

It will, of course, be understood that while this device has been described as being suspended upon a drill pipe or tubing, it might be carried upon any suitable form of tubular member or pipe or even upon a substantially solid rod, the only requirement being that the element upon which it is carried be capable of taking the reaction torque from the drilling equipment and of supplying drilling fluid thereto.

It will further be appreciated that while the electrical conduit 11 has been described as extending up the outside of the drill pipe or tubing, it may extend up the inside or certain suitable conductors may be incorporated within the tubing or pipe itself. Also, this conductor need not necessarily be all in one long piece but may be provided with detachable connectors for connecting together a number of individual pieces.

By the use of the invention as hereinbefore described, it is possible to drill a well using much higher drilling speeds because of the smaller amount of weight that is actually being rotated, and this higher drilling speed makes it possible to use less weight on the drill bit without reducing the rate of penetration of the formation. This reduction of the weight on the drill bit not only reduces the wear and tear on the bit itself but tends to produce a straighter hole with less variation from the vertical. Furthermore, in the event a cave-in should occur at some point above the drill bit, a twist-off would not be caused because the drill stem itself would not be rotating and hence if the application of power was not immediately stopped, there would be no danger of twisting off the drill stem.

A much lighter drilling equipment has been provided which makes for a tremendous saving in the amount of steel and other critical materials that are ordinarily necessary to form a complete drilling outfit. It is estimated that for equipment for drilling a well of between nine thousand and twelve thousand feet deep, a drilling device constructed in accordance with the present invention would weigh somewhat less than

half of the usual rotary drilling device with its necessary equipment.

It will further be appreciated that while this invention has been described as involving the use of a drilling device carried on the lower end of a drill pipe or tubing, it could be carried on the lower end of any type of pipe located in the well and might be secured to that pipe in any desired manner. Therefore, it is not intended that this invention shall be limited to the use of a drilling device of the type set forth on any particular type of pipe.

From the foregoing description it is furthermore apparent that a means has been provided whereby power may be supplied to a drill bit at a point adjacent the bit itself without the necessity for transmitting mechanical power from the top of the well to the bottom thereof, and that such a means as has been provided will not become excessively heated both because of the fact that no excess heat is generated and because of the fact that such heat as is necessarily generated will be carried off by the drilling fluid. In this connection it will be seen that novel and highly satisfactory means for carrying away this heat both from the motor and from the bearings therefor has been provided, while at the same time means has been provided for conducting drilling fluid from the surface of the well to the drilling bit so that it might pick up cuttings therefrom and convey them back to the surface of the ground.

All of the other objects and advantages of this invention will be found to be attained by the structure which has been described. It will be understood, however, that the structure described is by way of illustration and example only and is not intended to be by way of limitation of this invention. This invention is to be limited only by the prior art and by the terms of the appended claims.

Having described my invention, I claim:

1. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive a drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto.

2. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom, a head on the lower end of said drive shaft adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive a drilling fluid therefrom, the head on said shaft having a passageway there-through for conducting drilling fluid from said jacket to a drill bit secured to said head, and having its passageways in communication with the lower end of said jacket, and means forming a rotating seal between said head and said body both interiorly and exteriorly of said jacket whereby said head may be rotated with respect

to said body while fluid is simultaneously flowing from said jacket into said head.

3. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, means to supply fluid to said jacket, and means on said shaft adapted to receive a drilling bit and to take fluid from said jacket and conduct it into said bit.

4. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, bearing means for said shaft for rotatably mounting it within said body, said bearing means including an anti-friction thrust bearing adapted to transmit upward thrust from said shaft to said body, said thrust bearing being located below said motor, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto.

5. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, bearings for mounting said shaft for rotation within said body, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto, and means for circulating a lubricant and a cooling fluid through said bearings.

6. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, bearing means for rotatably supporting said shaft within said body, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive drilling fluid therefrom and the lower end in communication with the interior of the drill bit secured to said shaft to deliver drilling fluid thereto, and means for circulating a lubricant through said bearing means to lubricate and cool the same, said last mentioned means having a portion of its circuit extending through said cooling fluid jacket to cool the fluid circulated through said bearings.

7. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end

adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive a drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto, and means for circulating an inert gas through said motor during its operation to dissipate any heat generated therein.

8. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive a drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto, means for circulating an inert gas through said motor during its operation, and means for circulating said gas through conductors located in said cooling fluid jacket, whereby heat generated in said motor will be dissipated into the cooling fluid passing through said jacket.

9. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive a drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto, bearing means for rotatably mounting said shaft within said body, means for circulating a lubricating and cooling fluid through said bearing means during operation of the device, means for circulating an inert gas through said motor during the operation thereof, and means for causing both said lubricating and cooling fluid and said inert gas to be brought into intimate contact with the drilling fluid circulating through said jacket, whereby heat generated in said motor and said bearings will be dissipated into the drilling fluid.

10. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto, bearing means within said body for rotatably mounting said shaft within said body, means forming a seal within said body above and below said bearing means and about said shaft to form a sealed enclosure about said bearing means, and means

for circulating a lubricating and cooling medium through said sealed enclosure about the bearing means during the operation of the device, whereby the bearing means may be lubricated and kept from overheating.

11. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom and having its lower end adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive drilling fluid therefrom and the lower end in communication with the interior of a drill bit secured to said shaft to deliver drilling fluid thereto, means forming a seal within said body above and below said motor to form a sealed enclosure within which said motor is located, and means for circulating a cooling medium through said sealed enclosure and through said motor during the operation thereof to prevent said motor from overheating.

12. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom, a head on said drive shaft having its lower end adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive drilling fluid therefrom, the lower end of said body and the upper portion of said head having telescoping relatively rotatable annular parts in engagement with each other, the annular part on the body having an opening therethrough communicating with said jacket, and the part on said head having an opening therethrough adapted to communicate with a bit carried thereby, whereby drilling fluid will be circulated first through said jacket and then transmitted to said drilling bit.

13. In a drilling mechanism adapted to be secured to the lower end of a nonrotating drill string, a body, means for securing the upper end of said body to a drill string, a motor carried by said body and having a drive shaft extending downwardly therefrom, a head on said drive shaft having a part adapted to receive a drill bit, a cooling fluid jacket around said motor within said body, the upper end of said jacket being in communication with the interior of said drill string to receive drilling fluid therefrom, said body and said head having telescoping relatively rotatable annular parts in engagement with each other, the part on said body having an opening therethrough in communication with said jacket and the part on said head having an opening therethrough in communication with a drill bit adapted to be secured thereto, and sealing rings of annular formation between said parts exteriorly of and interiorly of said openings respectively whereby fluid may pass from said jacket into said head during rotation of said head without flowing out through the joint between said body and said head, and whereby said drilling fluid may then be conducted to said drill bit.

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