April 14, 1964 L. S. AUER 3,128,614

DRILLING HEAD

Filed Oct. 27, 1961 2 Sheets-Sheet 1

FIG. 2.

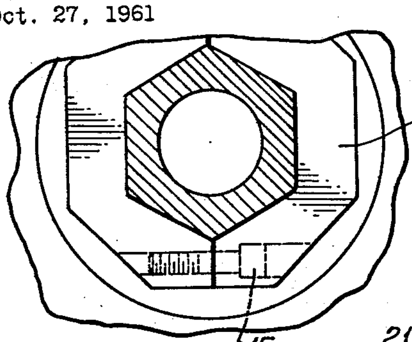
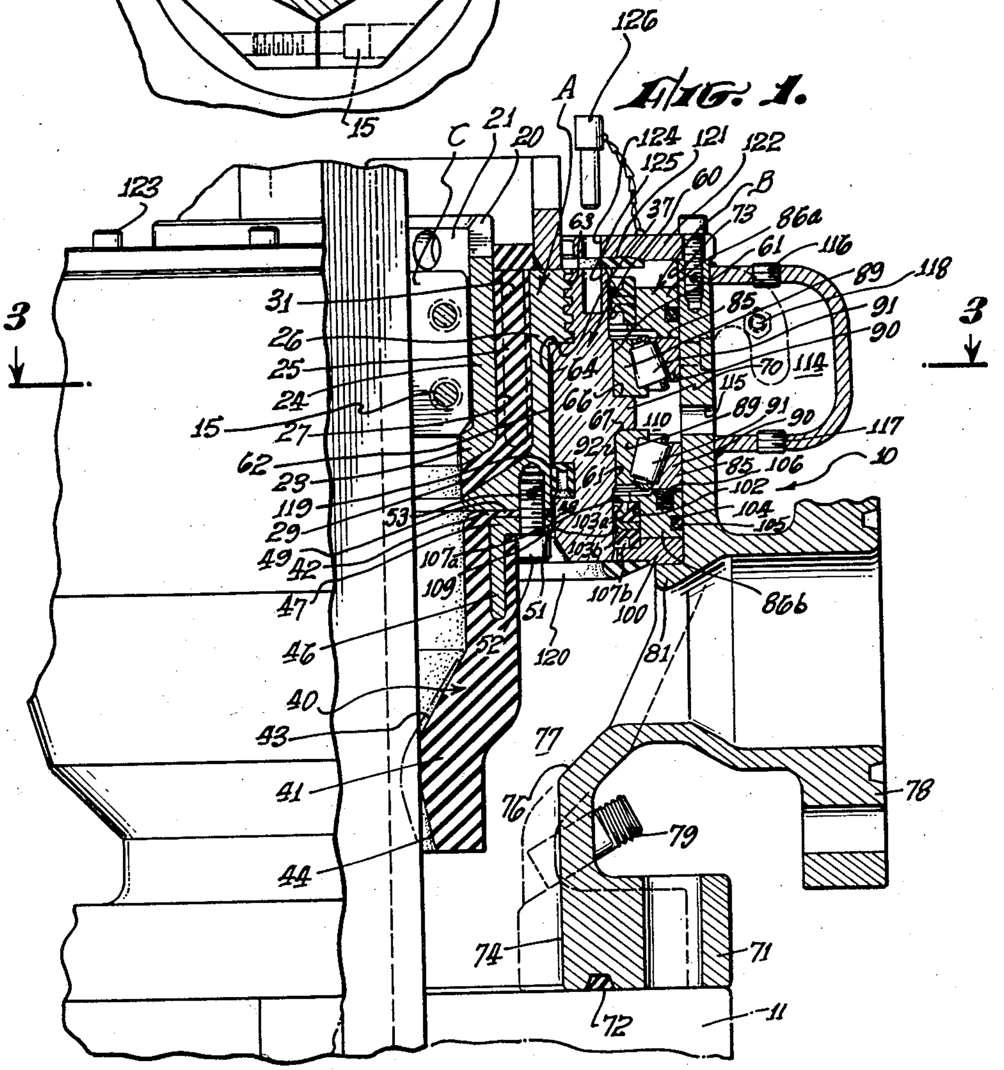


FIG. 1.



LELAND S. AUER,
INVENTOR.

BY HIS ATTORNEYS.

Spensley & Horn.

April 14, 1964 L. S. AUER 3,128,614

DRILLING HEAD

Filed Oct. 27, 1961 2 Sheets-Sheet 2

FIG. 3.

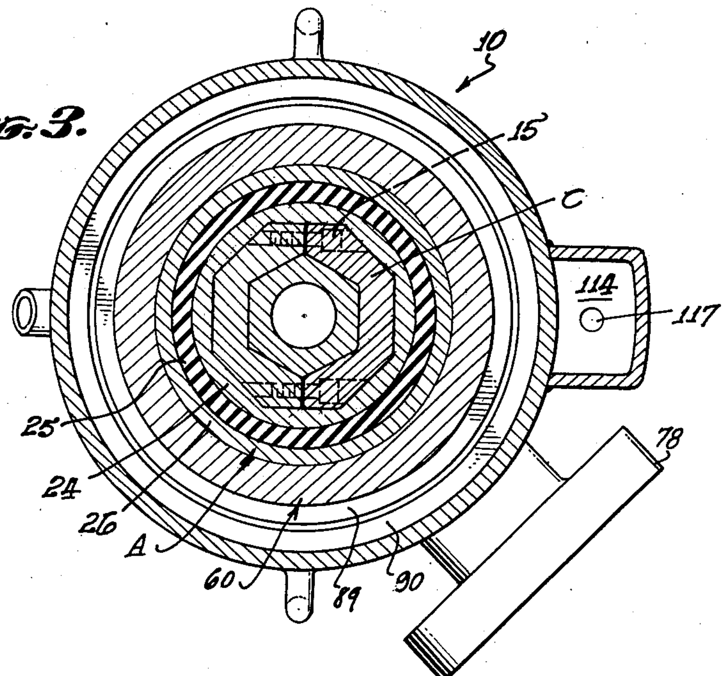


FIG. 4.

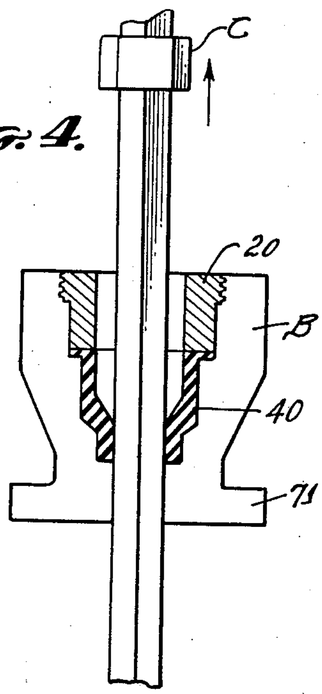
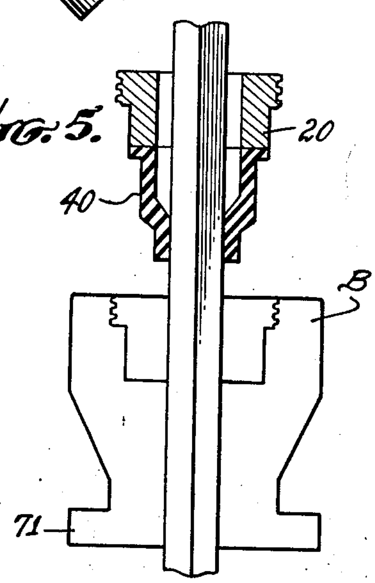


FIG. 5.



LELAND S. AUER,
INVENTOR.

BY HIS ATTORNEYS
Spensley & Horn.

United States Patent Office

3,128,614

Patented Apr. 14, 1964

3,128,614

DRILLING HEAD

Leland S. Auer, Sherman Oaks, Calif., assignor to Grant Oil Tool Company, Los Angeles, Calif., a corporation of California

Filed Oct. 27, 1961, Ser. No. 148,091
4 Claims. (Cl. 64—23.5)

This invention relates to well drilling apparatus and more particularly to an improved well drilling head.

In rotary well drilling operations, a rotary table mechanism is employed, which includes a rotatably supported driving element having a non-circular opening therethrough through which a kelly of similar non-circular cross-sectional configuration is slidably extended whereby the kelly can be turned and is capable of vertical movement relative to the table during such rotation. The kelly is attached at its lower end to the upper end of a section of drill pipe which is lowered into the well and rotated during the drilling operation. When the drilling operation has proceeded until the kelly has been lowered as far as possible, the kelly and drill string are raised to connect another section of drill pipe into the string whereupon the kelly is reconnected to the new section and the drilling operation is resumed. In the more commonly used forward circulation drilling operation, the drilling fluid is pumped downwardly through the interior of the drill string, out the bottom thereof at the bottom of the well bore and upwardly through the annulus surrounding the drill string and between the exterior of the drill string and the interior surface of the well bore. The well fluid moving upwardly through the annulus entrains the cuttings and debris at the bottom of the hole and carries it to the surface of the well. In reverse circulation, the drilling fluid is pumped down the annulus between the drill string and the well casing or well bore, through the drill bit and upward through the drill string. Reverse circulation is advantageous because the well fluid has a higher velocity of movement upward through the smaller cross-sectional area at the interior of the drill string and more quickly carries away the cuttings and debris from the bottom of the hole. Reverse circulation type drilling has been hindered in the prior art due to the absence of a satisfactory means for sealing around the kelly and the drill stem within the drilling head spindle.

Recently, gas or air drilling has become more widely employed. In this drilling operation, compressed gas or air acts as the drilling fluid and is injected through the drill stem and drill bit and forced upward through the annulus as the medium for removing the bit cuttings from the well and also to provide a cooling medium for the frictionally heated drill bit.

In drilling operations involving the above-described type of drilling, a drilling head is customarily attached to the top of the well casing below the derrick floor upon which the rotary table to rotate the kelly is mounted. In the prior art, in the most generally used types of drilling heads, such drilling heads usually include an outer casing and a rotatable spindle carried therein. The rotatable spindle is matable with the kelly and rotates with the kelly during the rotary drilling operation. The kelly and drill stem are slidable through the spindle and the kelly rotates with the spindle during the drilling operation. Sealing means are provided in the drilling head between the spindle and the kelly or the sections of drill stem, whichever is passing through the spindle. The packing is customarily provided about the kelly and drill stem and arranged between these conduits and the rotating spindle. These conventional packings are provided in an attempt to confine the pressures in the well and to prevent the drilling fluid, whether liquid or gas, from escaping

between the spindle and the slidable members of the drill string. It can be seen that in reverse circulation drilling operations and gas drilling operations, the efficiency of the seal is important and in these two types of drilling operations particularly an unusually good seal is required between the drill stem or string and the drilling head, since the fluid in the annulus surrounding the drill string is under greater pressure at the drilling head than that which is encountered in forward circulation operation.

The kelly must be progressively lowered vertically through the packing or sealing means contained within the drilling head spindle while drilling is in progress. Additionally, the kelly and drill stem must be periodically moved upward vertically through the sealing means through the drilling head spindle. This is necessary in order to detach the kelly from the drill stem so that an additional section of drill stem may be incorporated in the drill string. Since the kelly is square or hexagonal in configuration, while the drill stem is circular, there is a change of configuration in the members being pulled through the seal and it is necessary that the seal be so constructed as to act on both the circular cross section and the non-circular cross section. In the prior state of the art, drilling heads are large in size, particularly in height, and are cumbersome and inefficient in operation. Due to such height, elevated structures are required above the well head. It has been difficult with drilling heads of the prior art to obtain good lubrication for the parts which are rotated within the head and such parts are exposed to damage when the spindle assembly is removed to change bits, or perform a like operation.

Accordingly, it is an object of the present invention to provide an improved rotary drilling head which is economical to construct and efficient in operation with a long life and with a minimum of repairs due to isolation of various elements such as oil, dust and sand from those portions of the drilling head to which such elements would be harmful.

It is another object of the present invention to provide a rotary drilling head which incorporates a kelly wiper of improved design over those heretofore utilized and which is easily replaced within the drilling head.

It is a further object of the present invention to provide an improved drilling head which is of lesser elevation than those drilling heads presently available.

It is a primary object of the present invention to provide an improved drilling head assembly for rotary well drilling operations in which the drive unit and wiper for the assembly are removed only when components of increased diameter such as reamers or drill bits are added to the drill string.

It is a further object of the present invention to provide an improved drilling head assembly which makes possible the easy addition of drill stem to the drill string without removal of components of the drilling head and their subsequent exposure to harmful elements.

It is yet another object of the present invention to provide an improved drilling head which includes the means for lubricating the various elements within the head which are subject to friction, which lubricating means insures a non-contaminated source of lubricant to the various bearings and frictionally engaged surfaces of the drilling head. The lubricating device retains oil within the required areas at positive pressure relative to the drilling fluid.

It is an object of the present invention to provide a drilling head assembly which is particularly adapted to relatively low pressure operations and is therefore particularly suitable for air or gas drilling operations.

Yet another object of the present invention is to provide a drilling head assembly in which the unlocking of the spindle portion of the assembly for a change of drill bit or the like is semiautomatic, but in which the spindle can be locked or unlocked by manual means.

It is a principal object of the present invention to provide a drilling head assembly in which the bearing and packing means of the assembly remain in the head during all drilling operations.

Yet a further object of the present invention is to provide a drilling head assembly which includes shock absorber means for isolating the shock and vibration of the drill string from the components of the drilling head which might be injured by such shock and vibration.

A still further object of the present invention is to provide a drilling head which includes preloaded bearings that compensate for wear to the apparatus during the drilling operation.

The novel features which are believed to be characteristic of the invention both as to its organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawing in which a presently preferred embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only and is not intended as a definition of the limits of the invention.

In the drawings:

FIGURE 1 is a view in elevation and partly in section of the presently preferred embodiment of a rotary drilling head in accordance with the present invention;

FIGURE 2 is a sectional plan view taken along line **2—2** of FIGURE 1;

FIGURE 3 is a sectional plan view taken along line **3—3** of FIGURE 1;

FIGURE 4 is a partially schematic view of the drilling head in operation in the condition assumed when drill pipe is added to the string; and

FIGURE 5 is a view corresponding to FIGURE 4 when the spindle assembly is removed to change bits or perform a like operation.

As an illustration of the manner and use of the present invention, a well bore is extended vertically into the earth strata with a well casing disposed in the bore. The drilling fluid may be either circulated down the annulus between the drill stem and the casing or wall of the well and upwardly through the drill stem, or it may be circulated downwardly through the drill stem and upwardly through the annulus. The purpose of the circulation of the fluid through the well flow circuit is to take away the cuttings of the drill bit and to provide a cooling medium for the drill bit while drilling is in progress. The present invention is adaptable to both the drilling fluid circuits, one of which is known as reverse circulation while the other is positive or forward circulation. The present invention is particularly adapted to positive circulation using gas or air as the drilling or circulating fluid.

The drilling head of the present invention is indicated generally as **10** and is illustrated in its presently preferred form as attached to the upper end of the well casing by means of a flange **11** thereon. A derrick floor is disposed above the drilling head **10** with a rotary table of conventional construction (not shown) on the upper side of the derrick floor. The rotary table includes a bushing through which a hexagonally, or non-circular, shaped hollow kelly extends. The table includes means for being rotated by suitable power and power transmitting mechanism whereby the kelly with the drilling string attached thereto may be rotated. The drilling string comprises in general a series of drill stems connected one to the other with the kelly connected to the uppermost drill stem. The drill stem, kelly and the drilling tools attached thereto are referred to as the drilling string. The drilling head of the present invention includes in general a spindle assembly A which is rotatable within the casing and bearing assembly B. A kelly bushing C is affixed to the kelly and is non-circular in both inside and outside configuration, being matable with the configuration of the kelly on its interior surface as shown particularly in FIGURES 1 and 3. The kelly bushing is attached to the kelly by bolts **15** such that it is vertically slidable along the kelly, but is non-rotatable with respect thereto. The spindle includes a drive bushing **20** which is generally cylindrical in configuration with an interior wall **21** extending from the upper end thereof, which wall is similar in configuration to the exterior configuration of the kelly bushing C and is thus matable with the kelly bushing. That is, as shown particularly in FIGURE 1, the interior surface of the drive bushing extending downwardly from the upper end thereof is indicated as **21** and has a configuration which is generally octagonal such that the kelly bushing is insertable therein and when engaged therewith will be rotated by the kelly and will in turn rotate the drive bushing. The drive bushing proximate its lower end, is decreased in diameter to a diameter which is less than that of the kelly bushing to thereby serve as a stop for the kelly bushing and limit the downward movement therein. Thus, as shown in FIGURE 1, at a depth substantially greater than the height of the kelly bushing C, there is an inward protrusion **23** on the drive bushing to a diameter which is substantially less than the diameter of the kelly bushing C. The drive bushing is made up of three components, namely an interior drive bushing member **24**, intermediate shock absorber member **25** and an outer drive bushing member **26**. The outer surface **27** of the inner drive bushing member **24** is matable with and bonded to the intermediate shock absorber member **25** which is formed of elastomeric material and which completely separates the inner drive bushing member from the outer drive bushing member **26**. Thus, the three members each are generally cylindrical in configuration and taper inwardly proximate their lower end in the orientation of the figures such that the lower end of the outer drive bushing member forms the lower end **29** of the drive bushing. The elastomeric material of the intermediate member has formed therein a circumferentially spaced series of holes **31** which allow increased flexibility of the elastomeric material. Thus, the inner drive bushing member **24** is isolated from the outer drive bushing member **26** by the elastomeric intermediate member **25** to serve as a shock and vibration isolation component. The exterior surface of the outer drive bushing member is of circular cylindrical configuration with an upper end portion having an increased diameter. The upper portion is male threaded downwardly from the upper end thereof and terminates in a horizontal shoulder **37**. Thus, the drive bushing comprises in general a cylindrical bushing member with an interior surface that defines an octagon matable with the kelly bushing and having an inwardly protruding shoulder thereon which acts as a downward limit for movement of the kelly bushing into the drive bushing. The exterior drive bushing member defines an exterior surface which is of circular cylindrical configuration with male threads **38** protruding outwardly proximate the upper end thereof and defining a horizontally extending downwardly facing shoulder **37** which acts as a limit shoulder for engagement with the spindle drive member as discussed more fully hereinafter. The two members are separated and isolated one from the other by the elastomeric isolating member positioned therebetween. Extending downwardly from the lower end **29** of the drive bushing, there is affixed to the drive bushing the wiper member **40** which is formed of elastomeric material and which is adapted to engage the kelly **12** or the drill stem passing through the sealing member in fluid sealing engagement. The sealing member is designated generally as **40** and includes a downwardly extending elastomeric member **41** which is generally cylindrical proximate its upper end and tapers inwardly to a diameter less than the minimum diameter of the drill stem or kelly. The wiper member thus has a horizontal upper surface 42 which is approximately equal in annular cross-sectional area to the lower surface of the drive bushing such that the wiper member is matable with the bushing. The wiper member is of uniform cylindrical configuration throughout approximately half its height extending downwardly therefrom at which point it tapers inwardly along the surface 43 which serves as the wiping surface for the kelly or drill string. At its innermost sealing diameter, the sealing member is then tapered outwardly to an inner diameter 44 which is somewhat greater than the diameter of the kelly or drill stem to be encountered to allow small enlargements such as drill collars to pass therethrough. Referring particularly to FIGURE 1, it can be seen that the lowermost part of the wiper member is normally urged inwardly into sealing engagement with the drill string, but is flexible outwardly therefrom to allow lateral movement of the drill string. A stiffener finger 46 is bonded into the generally cylindrical upper portion of the wiper member. The stiffener 46 is generally cylindrical with a horizontal flange 47 extending outwardly therefrom such that the stiffener member extends downwardly into the body of the wiper member throughout a portion of its cylindrical segment and then passes outwardly to the outer diameter of the drive bushing. As shown in FIGURE 1, the height of the stiffener at the flange is less than the thickness of the flange 48 of the wiper member such that a layer 49 of the elastomeric material of the wiper member is present between the stiffener flange 47 and the lower surface 29 of the drive bushing to act as a gasket therefor. The lower surface 51 of the stiffener flange, however, from the lower surface of the wiper member flange such that a lock bolt 52 can be utilized to affix the wiper member to the drive bushing. The lock bolts in the presently preferred embodiment includes a Nyloc pin 53 which serves as a lock means to retain the bolts in place and thus to retain the wiper member in engagement with the drive bushing.

Outwardly from the drive bushing, there is provided a spindle drive member designated generally as 60, which member is generally cylindrical in configuration with a circular cylindrical exterior 61 and interior 62 surface. On the interior surface of the spindle member 60 extending downwardly from the upper end thereof, there is a female threaded indentation 63 matable with the male threads of the drive bushing. The male threads are at a diameter substantially greater than the interior wall 62 of the spindle drive member 60 such that a shoulder 64 is provided at the lower end of the threaded portion, which shoulder 64 is tapered to serve as a stop surface for the downward movement of the drive bushing into the spindle drive member. That is, the interior surface 62 of the spindle drive member is matable with the exterior surface of the drive bushing. Thus, the drive bushing and wiper member can pass downwardly through the spindle drive member by rotation and engagement of the threads. The downward travel of the drive bushing within the spindle drive member is limited by engagement of the horizontal shoulder of the drive bushing with the upwardly facing shoulder of the spindle drive member. At the exterior surface 61 of the spindle drive member, there is provided a protrusion 70 at approximately the midpoint of the spindle drive member. Thus, the spindle drive ring 60 is generally cylindrical in configuration with an outer vertical wall 61 having a protruding retaining shoulder 70 approximately at the midpoint of the wall 61. As more fully described hereinafter, the spindle drive ring 60 rotates with the spindle assembly, but remains in place in the drilling head when the drive bushing and wiper member are removed from the drilling head in order to replace components of relatively large diameter in the drill string.

The housing and bearing assembly designated generally as B includes an outer housing member having a flange 71 at the lower end thereof which is affixed in sealing engagement with the flange 11 at the upper end of the well casing. Sealing means such as a sealing gasket 72 are provided at the mating surface of the flange and the well casing to retain fluid pressure within the well casing. The housing B is again generally cylindrical in configuration with an upper portion of enlarged diameter 73 which tapers to a lower portion of decreased diameter 74. A fluid path is provided between the interior wall 76 of the housing at its lower end and the wiper member which extends therein. A fluid outlet 77 is formed in fluid communication with the interior of the drilling head such that fluid can flow as shown upwardly through the well casing through the drilling head housing past the outer surface of the sealing member and outwardly through the fluid opening 77. A flange 78 is provided for attachment of a suitable fluid conduit to the drilling head housing in order to conduct fluid to or from the well casing and thus from the annulus surrounding the drill string passing through the drilling head. A water nozzle 79 is provided through the lower portion of the drilling head housing to allow the insertion of water or other fluid when such is necessary or desirable. The nozzle or inlet 79 can also be utilized for sampling, injection, instrumentation and the like. Positioned above the fluid outlet is the bearing assembly of the drilling head. The interior wall 76 of the drilling head housing at the upper portion thereof is cylindrical with a vertical wall. The vertical wall 76 is of substantially greater diameter than the outermost diameter of the protrusion 70 on the spindle drive ring. Thus, when the spindle drive ring is contained within the drilling head, the outermost diameter thereof is spaced a substantial distance from the inner wall of the housing assembly. Positioned between the vertical wall 61 of the spindle drive ring and the interior vertical wall of the housing assembly are a plurality of bearing assemblies 85 and fluid sealing assemblies 86*a* and 86*b*. The spindle is thus journaled within the housing by a bearing assembly which includes an upper 86*a* and lower 86*b* combination radial and thrust bearing assembly. Each of the bearing assemblies includes an inner race 89 and an outer race 90 with tapered roller bearings 91 positioned therebetween. The inner surface 92 of the bearing races is in bearing contact with the outer vertical wall 61 of the spindle drive member while the outer surface of the outer races 90 is in bearing contact with the interior wall 76 of the housing member. The lower surface of the upper inner race 89 is in bearing contact with the upwardly facing shoulder 66 of the spindle drive ring protrusion 70 while the upper inner surface of the lower bearing race 89 is in contact with the downwardly facing shoulder 67 of the spindle drive ring protrusion. Thus, the bearing assemblies are retained in position, and in turn act to limit both the horizontal and vertical movement of the spindle drive ring member which is rotatable with respect to the drilling head housing.

The lower bearing assembly 86*b* is retained in its vertical position by a retaining ring 100 which is annular in configuration and which is seated upon the horizontally extending shoulder 81 of the bearing housing. The retaining ring is formed into separable parts for insertion of the sealing ring as described hereinafter. Considered as a whole, however, the lower retaining ring has an inner diameter approximately equal to but greater than the outer diameter of the spindle drive member and an outer diameter approximately equal to the inner diameter of the interior wall 76 of the housing at its cylindrical portion. An annular indentation 102 is provided in the retaining ring for positioning the sealing gasket 103 which acts as a fluid seal against the exterior wall 61 of the spindle drive ring 60 during rotation thereof. An annular recess 104 is provided in the exterior wall of the retainer ring with an O-ring seal 105 positioned therein. A series of circumferentially spaced recesses 106 extending downwardly from the upper surface of the retaining ring are provided to position a plurality of springs 106 which urge the outer race of the bearing assembly upwardly against the tapered bearings such that a preload is continuously provided on the bearings to compensate for wear thereof. The bearing race is thus preloaded such that the races are constantly urged into bearing engagement with the roller bearings when wear occurs during operation.

Positioned within the recesses of the retainer rings are sealing gaskets **103** which are similar in configuration. Referring particularly to FIGURE 1, each of the sealing gaskets includes an upper and lower sealing member **103***a* and **103***b* which is formed as shown in the figure with a normally outwardly urged lip which is urged into engagement with the wall of the spindle drive member. As shown in the figure, the two portions of the sealing gasket are inverted relative one to the other such that a recess **107***a* or **107***b* is defined in each member where fluid in the recess increases the outward force on the lip. Thus, if fluid is able to flow into the recess **107***a* or **107***b* it pushes the lip outward more firmly into sealing engagement with the wall of the spindle drive member. A generally T-shaped annular back-up ring **109** is positioned between the two members and extends to an inside diameter approximately equal to but greater than the outside diameter of the vertical wall of the spindle drive member. The generally T-shaped back-up ring **109** has a slope at the inner surface of the T which is generally mateable with the angle of the surface of the sealing members **103***a* and **103***b* to keep the lips of the sealing rings from collapsing. Thus, it may be seen that in both the upper and lower sealing ring assemblies the lips are urged into sealing engagement with the wall and the engagement is increased when pressure is formed in the cavity **107***a* proximate the upper lip and in the cavity **107***b* proximate the lower lip. The lips therefore prevent the passage of fluid in either direction along the wall of the retainer member or along the wall of the spindle drive member.

As can thus be seen in FIGURES 1 and 3, a cavity **110** which is annular in configuration is formed between the bearing races and the housing, which cavity is kept filled with oil as described hereinafter, with the oil maintained under a pressure somewhat greater than atmospheric. The oil serves to lubricate the bearings and is retained within the bearing assembly section by the double sealing rings described hereinbefore. Thus, oil under pressure which seeks to pass outwardly from the cavity along the wall of the spindle drive member enters the recess of the sealing ring and forces the lip into sealing engagement with the spindle drive member. Conversely, when well fluid passes upward along the wall **61** to the lower lip **103***b* it fills the recess **107***b* and forces the lip into further engagement with the wall **61**. The oil within the cavity which serves to lubricate the bearings is retained therein by the double sealing rings while foreign material and drilling fluid is kept from entering the oil reservoir by the outer lips of the sealing rings. An oil reservoir **114** is formed upon the outer wall of the drilling head housing with an opening **115** through the wall of the housing into the annular cavity **110** between the bearing assemblies. The oil reservoir is provided with an oil inlet cock **116** and an oil outlet cock **117**. Additionally, an air fitting **118** is provided through the wall of the oil reservoir in order that an air line can be connected to the reservoir to maintain a pressure somewhat above atmospheric within the oil reservoir. In the presently preferred embodiment a pressure is maintained which is approximately 2 p.s.i. greater than the annular pressure in the well to insure that oil is circulated to the bearings under positive pressure and that the pressure upon the sealing rings is greater in the oil reservoir than on the exterior of the oil reservoir to assure the prevention of entry of any material from the annulus to the reservoir through the port **115**. In addition to the double acting sealing rings, additional seals are provided by means of a sealing gasket **120** which is annular in configuration and spans the lower retaining ring and the outer wall of the spindle drive member. A similar sealing gasket **121** is provided at the upper surface of the upper retaining ring and spans the opening between the drive member. A drive bushing seal **119** is provided in an annular recess in the inner wall of the spindle drive member and drive bushing to furnish a fluid seal therebetween.

An annular top plate **122** is affixed to the wall of the housing and extends inwardly to an inside diameter approximately equal to but greater than the maximum diameter of the threads of the drive bushing. The top plate is retained in position by a plurality of circumferentially spaced bolts **123** with a Nyloc retainer pin to lock the bolts in position. Thus, the spindle drive member cannot be removed from the housing, nor can the retainer rings or bearing assemblies, without removal of the top plate **122** of the drilling head. The drive bushing and the wiper member affixed thereto can, however, be removed through the central opening of the top plate. An opening **124** is provided through the top plate coextensive with a hole **125** in the top surface of the spindle drive member such that a pin **126** can be inserted through the top plate and into the spindle drive member to prevent rotation thereof. Thus, when it is desired to remove the inner portions; that is the drive bushing and sealing member, from the drilling head assembly, it is necessary only to insert the pin into position thereby locking the spindle drive member and housing together, after which rotation of the kelly will rotate the drive bushing from the spindle drive member and allow it to be removed from the drilling head.

Thus, referring to FIGURES 4 and 5, in operation when the drill stem is being added to the drill string the complete operation takes place without removal of any of the components from the drilling head. That is, as shown in FIGURE 4, the kelly with the kelly bushing C attached thereto is raised from the drilling head such that the kelly bushing is removed from the recess in the drilling head with which it is mated during the drilling rotation. The kelly can then be moved vertically upward through the drilling head until the drill stem is exposed and another length of drill stem is inserted in the string. When, however, it is necessary to insert a component in the drill string such as a bit or reamer which cannot pass through the normal openings in the drilling head, the drive bushing **20** and wiper **40** assembly are removed by locking the spindle drive member into engagement with the housing, after which the kelly bushing is rotated while in the engaged position with the drilling head, causing the threads between the drive bushing and spindle drive member to become disengaged so that the drive member and wiper member can be removed vertically from the drilling head as shown in FIGURE 5. It is to be noted that when these components are removed, none of the bearings or critical components of the drilling head are exposed.

What is claimed is:

1. A well drilling head for confining fluid within a well by surrounding and sealing against a rotatable drill string including a kelly of non-circular cross-sectional configuration: a kelly bushing adapted to engage the kelly in longitudinally sliding engagement for rotation therewith; a spindle assembly non-rotatably mated with said kelly bushing for rotation thereby, said spindle assembly including a drive bushing member, a wiper affixed to said drive bushing member and depended therefrom and adapted for sealing contact with the drill string, and a spindle drive member; a bearing assembly, said bearing assembly rotatably mounting said spindle drive member for rotation of said spindle assembly about the axis of the drill string; a housing enclosing said bearing assembly, said housing having an axial opening therethrough for the passage of said drill string and for engagement of said kelly into said kelly bushing, sealing means within said housing enclosing a cavity surrounding said bearings, means sup-

plying lubricant to said cavity, and means for mounting said drive bushing and wiper assembly within said spindle drive member for selective removal therefrom with said kelly bushing, said spindle drive member having an inside diameter greater than said drill string.

2. A well drilling head for confining fluid within a well by surrounding and sealing against a rotatable drill string including a kelly of non-circular cross-sectional configuration: a kelly bushing adapted to engage the kelly in longitudinally sliding engagement for rotation therewith; a spindle assembly non-rotatably mated with said kelly bushing for rotation thereby, said spindle assembly including a drive bushing member, a wiper affixed to said drive bushing member and depended therefrom and adapted for sealing contact with the drill string, and a spindle drive member; a bearing assembly, said bearing assembly rotatably mounting said spindle drive member for rotation of said spindle assembly about the axis of the drill string; a housing enclosing said bearing assembly, said housing having an axial opening therethrough for the passage of said drill string and for engagement of said kelly into said kelly bushing; said housing defining an annular closed cavity, said bearing assembly positioned within said annular cavity; means for supplying lubricant to said cavity at a pressure above the pressure within said housing exteriorly of said cavity, and means for mounting said drive bushing and wiper assembly within said spindle drive member for selective removal therefrom with said kelly bushing, said spindle drive member having an inside diameter greater than said drill string.

3. A well drilling head for confining fluid within a well by surrounding and sealing against a rotatable drill string including a kelly of non-circular cross-sectional configuration: a kelly bushing adapted to engage the kelly in longitudinally sliding engagement fo r rotation therewith; a spindle assembly non-rotatably mated with said kelly bushing for rotation thereby, said spindle assembly including a drive bushing member, a wiper affixed to said drive bushing member and depended therefrom and adapted for sealing contact with the drill string, and a spindle drive member; said spindle drive member having a generally cylindrical exterior surface, a circumferential protrusion extending radially from said exterior surface to said spindle drive member; a bearing assembly, said bearing assembly rotatably mounting said spindle drive member for rotation of said spindle assembly about the axis of the drill string, said bearing assembly being in radial bearing contact with said exterior cylindrical wall of said spindle and in longitudinal bearing contact with said circumferential protrusion; a housing assembly enclosing said bearing assembly, said housing having an axial opening therethrough for the passage of said drill string and for engagement of said kelly into said kelly bushing; sealing means within said housing enclosing a cavity surrounding said bearing, means supplying lubricant to said cavity, and means for mounting said drive bushing and wiper assembly within said spindle drive member for selective removal therefrom with said kelly bushing, said spindle drive member having an inside diameter greater than said drill string.

4. A well drilling head for confining fluid within a well by surrounding and sealing against a rotatable drill string including a kelly of non-circular cross-sectional configuration: a kelly bushing adapted to engage the kelly in longitudinally sliding engagement for rotation therewith; a spindle assembly non-rotatably mated with said kelly bushing for rotation thereby, said spindle assembly including a drive bushing member, a wiper affixed to said drive bushing member and depended therefrom and adapted for sealing contact with the drill string, and a spindle drive member; said spindle drive member having a generally cylindrical exterior surface, a circumferential protrusion extending radially from said exterior surface of said spindle drive member; a bearing assembly, said bearing assembly rotatably mounting said spindle drive member for rotation of said spindle assembly about the axis of the drill string, said bearing assembly being in radial bearing contact with said exterior cylindrical wall of said spindle and in longitudinal bearing contact with said circumferential protrusion; a housing assembly enclosing said bearing assembly, said housing having an axial opening therethrough for the passage of said drill string and for engagement of said kelly into said kelly bushing; said housing defining an annular closed cavity, said bearing assembly positioned within said annular cavity; means for supplying lubricant to said cavity at a pressure above the pressure within said housing exteriorly of said cavity, and means for mounting said drive bushing and wiper assembly within said spindle drive member for selective removal therefrom with said kelly bushing, said spindle drive member having an inside diameter greater than said drill string.

References Cited in the file of this patent

UNITED STATES PATENTS

2,170,916	Schweitzer et al.	Aug. 29, 1939
2,795,398	Ragland	June 11, 1957
2,846,247	Davis	Aug. 5, 1958
2,865,218	Bishop	Dec. 23, 1958
2,995,196	Gibson et al.	Aug. 8, 1961
3,052,300	Hampton	Sept. 4, 1962