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Biffle

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[54] **DRILL HEAD AND SEALING APPARATUS THEREFORE**

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[51] **Int. Cl.**.....**F16j 15/16**, E21b 33/00

[58] **Field of Search**.....277/31, 71, 3, 4

[56] **References Cited**

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[57] **ABSTRACT**

A drill head assembly for use in oil drilling operations in which there is provided a rotatable packing means for preventing abrasive well fluids or vapors from contacting the bearing surfaces of the rotatable portion of the drilling head and for preventing the escape of well fluids or vapors into the atmosphere. The packing means is constructed such that packing becomes tighter as the well pressure increases, thereby performing the function of a final control in the event of a blowout and is also constructed such that repacking may be performed externally to the drilling head without disassembly of the drill head or any of the rotatable parts therein.

17 Claims, 3 Drawing Figures

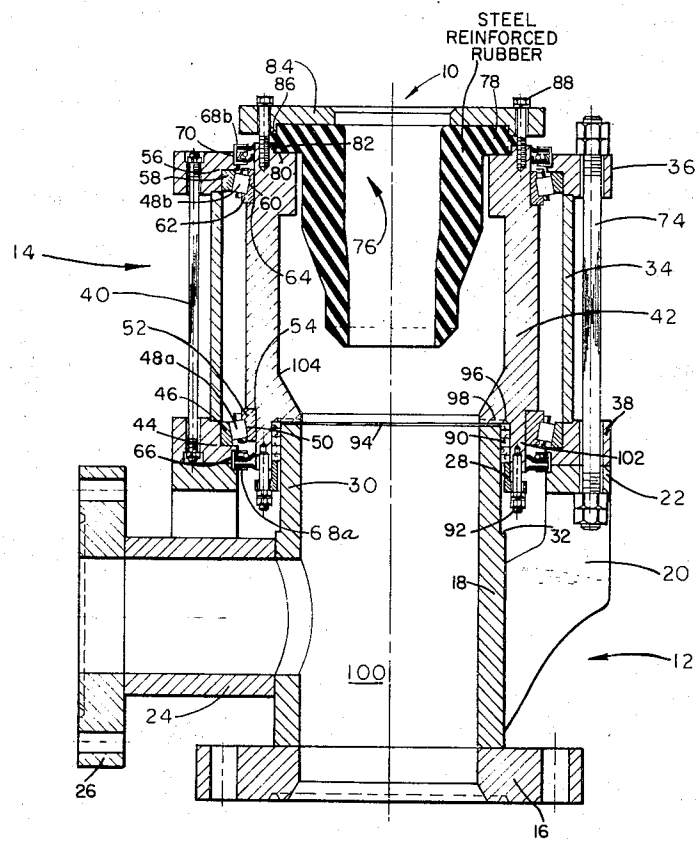
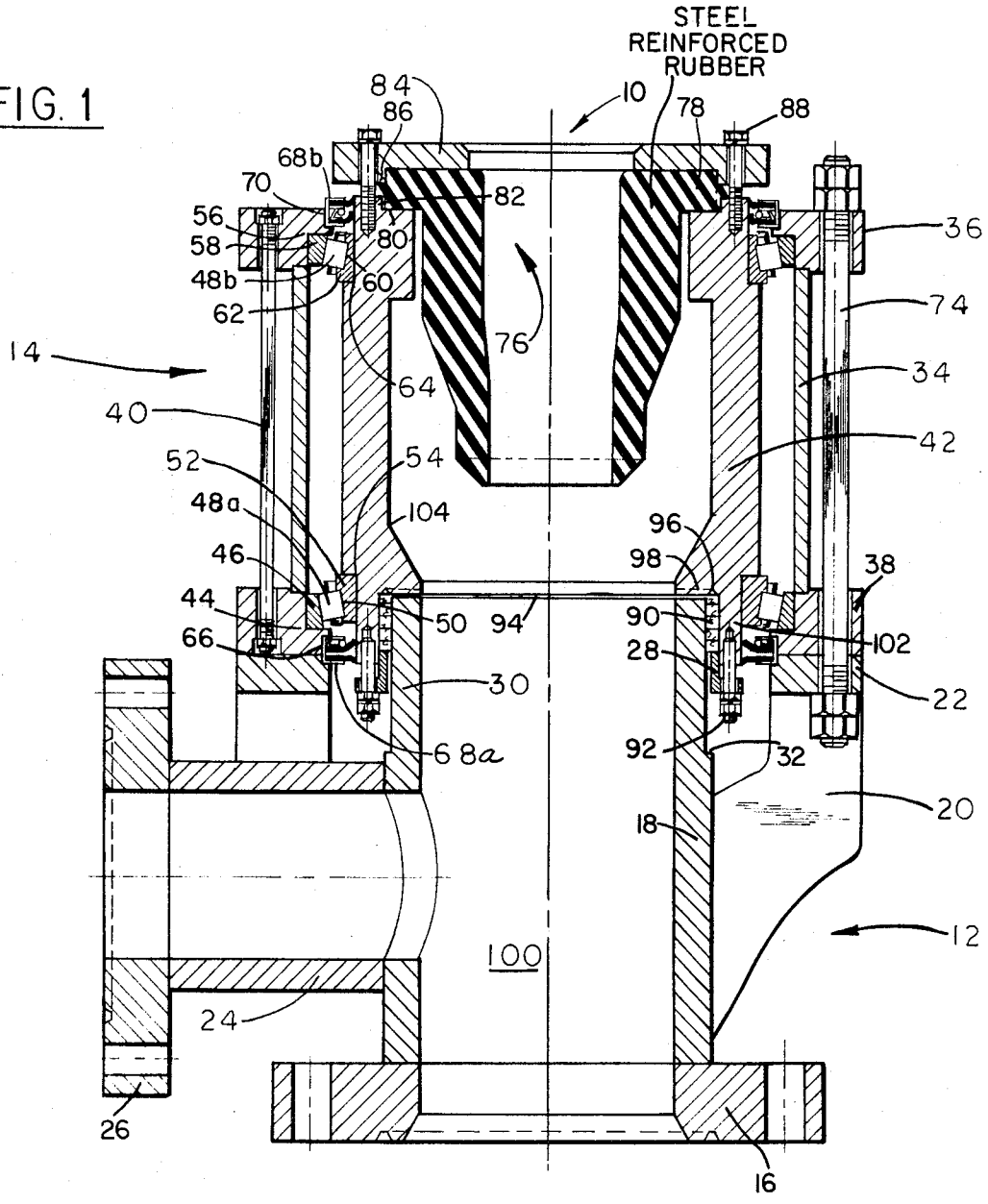


FIG. 1



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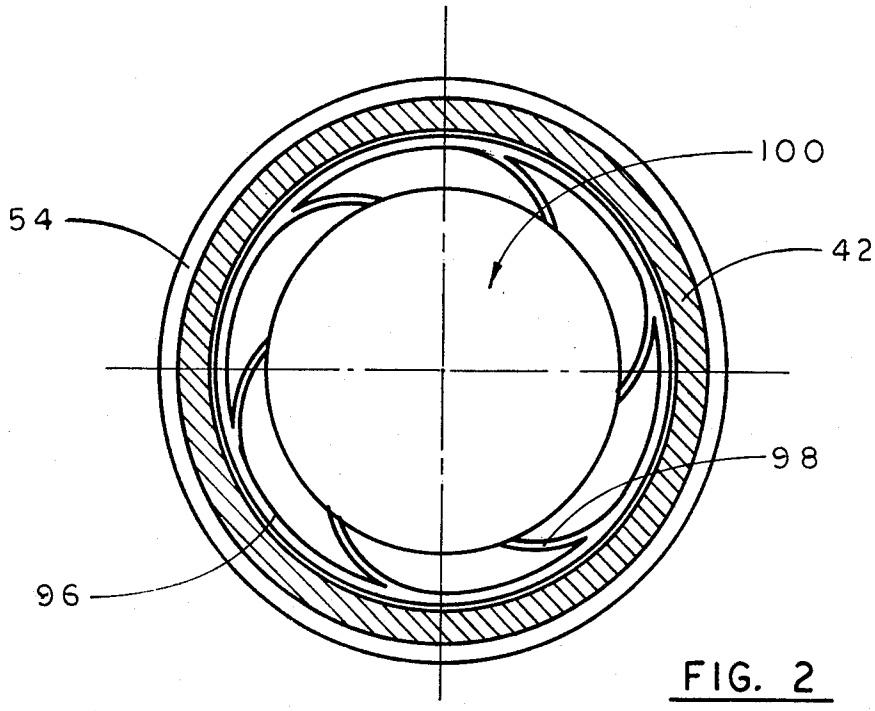


FIG. 2

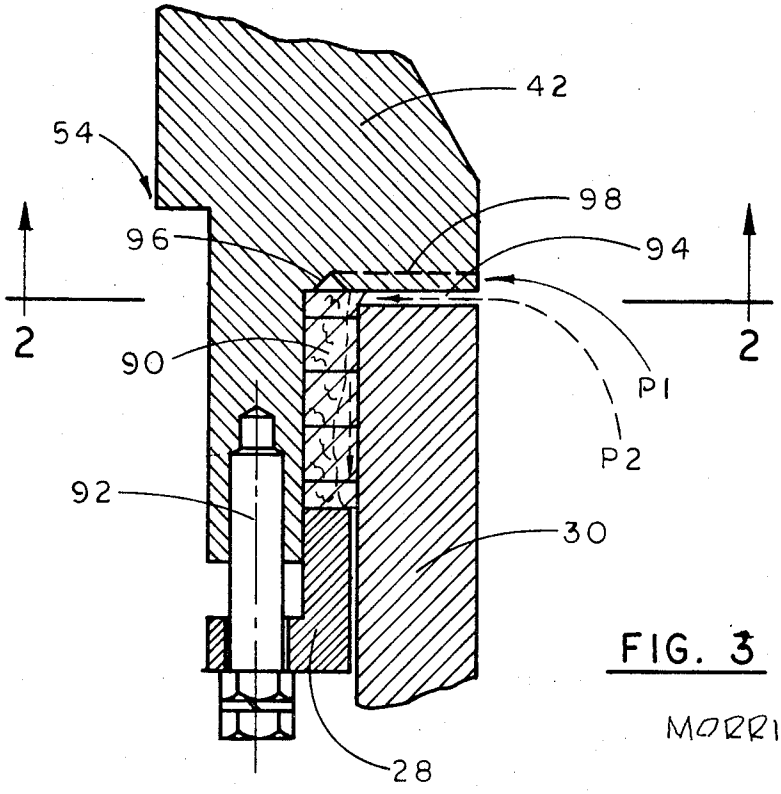


FIG. 3

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DRILL HEAD AND SEALING APPARATUS THEREFORE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a drill head with rotatable packing means contained therein for forming a tight packing between the rotatable and non-rotatable sections of the drill head, this apparatus is particularly useful for use with a rotary table of the type used in oil well drilling operations.

2. Description of the Prior Art

Drill heads for use in oil well drilling operations are well known. Generally, oil well drilling is presently accomplished by rotary drilling. This includes a rotary table for driving a rotatable member referred to as a kelley via well known driving means such as a non-circular bushing referred to in the industry as a kelley bushing. Attached to one end of the kelley is a drill pipe section which is lowered into the earth by the kelley and rotated by the kelley bushing during the drilling. At a time when drilling has progressed as far as the kelley permits, the drill pipe section is raised and another drill pipe section is attached to the previously attached drill pipe forming what is commonly referred to as a drill string. The drill string in turn is reattached to the kelley whereupon drilling may be resumed.

One inherent disadvantage in this type of drilling is the problem of keeping the abrasive well fluids for contacting the rotating portions of the drilling apparatus. This problem is further compounded by the internal pressures of the well fluid, which can be great, particularly when a blowout occurs. The forces generated by the internal well pressures tend to find an exit which provides the path of least resistance. Hence, it is very necessary to prevent the fluids which are sometimes at tremendous pressures from contacting the oil and grease seals and bearings.

There has been much activity in the designing of apparatus which minimizes the aforementioned problem. One such patent, U.S. Pat. No. 2,303,090, issued to Pranger, takes the problem into consideration. However, the structure described in that patent appears to be a rather complicated mechanical structure which would inherently add to the initial cost and would also add to the maintenance costs, a serious consideration which must be borne by those in the field. The need which exists in the industry is for apparatus which is mechanically simple and relatively inexpensive to maintain. Such apparatus is what the instant invention is concerned with.

Other patents which are representative of apparatus designed to prevent or minimize the aforementioned problem are U.S. Pat. Nos. 2,853,274 issued to Collins, 2,904,357 issued to Knox, 3,387,851 issued to Cugini, 3,400,938 issued to Williams. One feature which is common to all of the above identified patents is their relative complexity. In none of these patents is there a design wherein the new packing may be placed in the sealing chamber externally, thus obviating a major disassembly, nor can packing be replaced without removing the entire string of drill tools from hole, nor does the prior art disclose a design wherein the bearing and sleeve assembly can be removed from the body of the drilling head to provide access to the packing assembly without having to disassemble the bearing assembly.

e.g., in Knox, it is necessary to pull both the bearing assembly and the lower seal together out of the drilling head in order to obtain access to the lower seal.

Applicant not only provides such an apparatus, but also provides an apparatus in which this may be accomplished external to the drilling head. Applicant further provides an apparatus which is mechanically simple, easy to maintain yet producing superior results in preventing abrasive well fluids from contacting any rotatable parts.

SUMMARY OF THE INVENTION

The present invention relates to a drill head for use in rotary drilling operations.

The applicant having taken into account the problems which have been encountered in the past, has designed a packing which is positioned between the rotating and stationary members of the drill head and which will prevent debris, abrasive well fluid from contacting any of the rotatable mechanical sections of the drill head. The instant invention is one solution to the problem. The design of the drill head along with the packing means prevents any debris, whether it be fluid, vapor or dry, airborne or whatever, from passing through the grease seals and contacting the rotating sections. Further, because of the inherent design of the instant invention, any debris which might be blown out would be directed out into the atmosphere away from the grease seals, bearings, ect. The packing means utilized herein are self energizing, i.e., if the internal well pressure increases, the packing means gets proportionally tighter by utilizing the forces generated by the well pressures.

The drill head consists basically of a lower assembly and an upper assembly. The lower assembly is stationery and is usually mounted on a blowout preventer or well casing. It further provides a side outlet for the egress of debris formed by the cuttings and the various drilling muds and lubricants used in the drilling operation. The lower assembly also has formed therein a tubular projection finished in a smooth hard chrome finish, usually referred to as a wash pipe. This tubular projection may or may not be made integral to the lower assembly. For purposes of this specification, it is assumed to be integral to the lower housing, although it would just as easily be a separate unit and threadedly affixed thereto. A gland is positioned over the wash pipe and is capable of longitudinal movement thereon.

The upper housing includes a housing in which is positioned a rotating sleeve, which is also referred to in the trade as a rotating bowl. Interposed between the housing and sleeve are the necessary bearings and lubricating means. The upper housing is positioned on the lower housing and because of the inherent design of the apparatus, an annular space is formed between the outside surface of the projecting wash pipe and the inside surface of the rotating sleeve. Into this annular space is positioned the packing material which is used for the sealing means. Pressure is applied on the packing by the longitudinal drawing of the gland into the annular space. Means are provided on the bottom of the rotating sleeve for retaining the gland in fixed relation thereto such that the gland rotates with the rotating sleeve. A seal is formed when enough pressure is applied on the packing means by the adjustable

gland. This seal becomes a rotatable seal when the sleeve is given rotation by some driver.

Also provided in this invention are means for further securing a seal, particularly in the event of a blowout. There is provided on the bottom edge of the sleeve an annular groove connected to the well opening by a plurality of inlets. The annular groove opens up directly above the packing material. Thus any pressures existing in the well will be directed immediately on top of the packing material via the inlets and annular groove. This direction is in direct opposition to the pressure directed by the gland resulting in the horizontal expansion of the packing material thereby further increasing the seal. Naturally, in the event of a blowout, rotation of the sleeve should be halted because of the increased pressure being applied to the packing means, thereby increasing the friction between the packing and the wash pipe, otherwise the packing material would quickly be destroyed by the combined friction and heat caused by rotation.

It will on occasion be necessary to replace the packing material because of wear and tear. This presents no problem since all that is required with this invention is dropping, i.e., lowering, the gland and inserting the new packing. It is not necessary to disassemble the drill head nor is it necessary to pull out the drill string. Another important feature is the fact that the insertion of new packing may be done externally to the drill head.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of the drill head shown in cross section.

FIG. 2 is an enlarged crossectional view taken of the upper drill head assembly.

FIG. 3 is an enlarged crossectional view taken of one portion of the wash pipe and packing gland follower.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a drill head **10** comprising a lower assembly **12** and an upper assembly **14**, which is the subject of the present invention. The drill head **10**, in operation, is mounted to the upper end of a well casing (not shown) or mechanical blowout preventers by conventional means such as a mounting flange **16**. In the operation of the invention, a kelley (not shown) is passed downwardly through the drill head **10**, the drill string being attached to the kelley. Attached to the mounting flange **16** is a lower housing **18** which may be attached to the mounting flange **16** by means such as welding. The lower housing **18** is provided on its exterior walls, for reinforcement, with a plurality of mounting struts **20** which are attached to a flange **22**. The flange **22** contains a plurality of holes bored therethrough. The inside diameter of the mounting flange **22** is greater than the outside diameter of the lower housing **18** such that an annular space is formed between the outside wall surface of the lower housing **18** and the inside wall surface of the mounting flange **22**. A packing gland follower ring **28** is adapted to fit in the annular space formed by the housing **18** and the mounting flange **22**. Integral to the interior of the housing **18** is a wash pipe **30** which may be machined from the metal forming the housing **18** down to a hard smooth chrome finish. The wash pipe section begins at the shoulder **32** machined on the lower housing **18**. If desired the wash pipe **30** could be a separable member and attached to the housing **18** by conventional thread means. The outside diameter of the wash pipe **30** is smaller than the inside diameter of the packing gland follower **28** such that the packing gland **28** can be easily moved longitudinally up and down the wash pipe **30**. The housing **18** is further provided with a side outlet tube **24** mounted thereon by conventional means such as welding. On the extreme end of the side outlet tube **24** is a side outlet flange **26**. In the operation of the drill head **10**, the cuttings, debris and fluids are exited from the well via the side outlet tube **24**.

Mounted on the upper mounting flange **22** of the lower assembly **12** is the upper assembly **14** of the drill head **10**. The upper assembly **14** includes the rotating parts of the drill head **10** and may be assembled separately prior to being mounted on the upper mounting flange **22**. The upper assembly **14** includes a bearing housing spacer tube **34**. Attached to the upper and lower ends of the bearing housing tube **34** are flanges **36** and **38** respectively which are held in place by a plurality of upper assembly retaining bolts **40**. The retaining bolts **40** are placed in position only after the complete assembly of the upper assembly **14**.

A rotating sleeve **42**, sometimes referred to as a rotating bowl, is mounted within the annulus formed by the interior of the bearing housing spacer **34**. The opening formed within the rotating sleeve **42** narrows at **104**, which is located towards the bottom of the sleeve **42**. A projection **102** is formed at the bottom edge of the sleeve **42**. Means for receiving threaded bolts are provided on both the upper and lower edges of the sleeve **42**. The lower flange **38** is provided with a shoulder **44** on its interior surface in which rests an outer race member **46** which acts as a track for bearings **48***a*. The bearings **48***a* are received within a seat **50** of an inner race member **52** which engages a shoulder **54** formed on the lower exterior surface of the sleeve **42**. The bearings used in the preferred embodiment are preferably of the roller tapered type having both thrust and radial capabilities.

A similar configuration also occurs at the upper end of the bearing housing spacer **34**. The upper flange **36** is provided with a shoulder **56** on its interior surface in which rests an outer race member **58** which acts as a track for bearings **48***b* which are received within a seat **60** of an inner race member **62** which engages a shoulder **64** formed at the upper exterior surface of the rotating sleeve **42**.

Interposed between the lower flange **38** and the lower end of the sleeve **42** are conventional grease seals and dust keepers **68***a* which are held in position by conventional means in a groove **66** formed in the lower flange **38** and the flange **22**.

Similarly, interposed between the upper flange **36** and the upper end of the sleeve **42** are conventional grease seals and dust keepers **68***b* which rest in a shoulder **70** formed in the flange **36**, said grease seals **68***b* being conventionally held in place.

The upper assembly **14** is held together by the upper assembly retaining bolts **40**. These bolts merely serve to hold the upper assembly **14** together should it be necessary to remove the upper assembly **14** from the lower assembly **12**.

The annular space formed by the inside wall of the bearing housing spacer **34** and the outside wall of the sleeve **42** is filled with some form of lubricant via conventional grease fittings or circulating coolant and or lubricant circulated by external mechanical means. (not shown)

The flanges **36**, **38**, and **22** are provided with a plurality of holes for receiving hold down bolts **74** when the holes are in alignment, these bolts should be fabricated from a hard tempered steel and are utilized to hold the upper assembly **14** to the lower assembly. Great strength is a characteristic necessary for the hold down bolts **74**, for they are utilized to transfer any thrust generated against the rotating sleeve **42** down to the well head via the struts **20**.

A resilient mass **76** having a cap **78** at one end and an elongated taper at the other end and an opening formed through the longitudinal axis of the mass **76** forms what is commonly referred to as drilling rubber, this usually is a steel reinforced rubber. The cap **78** is adapted to rest on a shoulder **80** within the opening formed by an annular lip **82** on the upper interior wall of the sleeve **42**. A metallic collar **84** having an annular recess formed by a shoulder **86** is designed to be placed over the drilling rubber **76** when seated on the shoulder **80** and is fixed to the rotating sleeve **42** by bolt means **88**, thereby also compressively holding the drilling rubber to the rotating sleeve **42**. In operation, the drill head **10** has a kelley, passed downwardly through the drilling rubber **76** into the well casing which is of course rigid. The drilling rubber **76** provides a tight fit for the kelley thereby sealing the well pressure from the atmosphere. Because of the inherent design of the drilling rubber **76**, the greater the interior well pressure, the greater the seal becomes between the drilling rubber **76** and the kelley.

The upper assembly **14** is mounted on the lower assembly by the mounting bolts **74**. There is thus formed an annular void between the shoulder **102** formed on the bottom of sleeve **42** and the outside surface at the upper extremity of the wash pipe **30**. Into this void is packed a packing material **90** such as braided Teflon. The packing gland follower **28** is adapted to fit into the void for the application of compression on the packing material **90** and is held in place by adjusting bolts **92** which are threadedly fixed into the bottom of the sleeve **42**. The tighter that the bolts **92** are made, the greater the compression, therefore the greater the seal which exists between the sleeve **42** and the wash pipe **30**. However, it is to be noted that if too much force is applied initially to the bolts **92**, the packing **90** will wear out that much more rapidly. It can be seen that it is no major task to repack the packing **90** since this may be accomplished simply by dropping the packing gland follower **28** and inserting the new packing material.

There is a gap **94** formed between the lower end of the sleeve **42** and the upper end of the wash pipe **30**. The size for the gap is determined by the upper assembly **14** and is of a size approximating 0.004 inch, if necessary, conventional shims may be used in order to provide a gap. There is also a machined groove **96** formed on the bottom end of the rotating sleeve **42** which functions to direct any well pressures down to the top of the packing means **90**. The greater the well pressure, the greater the seal which exists between the sleeve **42** and the wash pipe **30**. This occurs because the well pressure is applied to the top of the packing **90**, but since the packing **90** is held in place by the packing gland follower **28**, the packing **90** must of necessity expand horizontally which thus results in a tighter seal between the sleeve **42** and the wash pipe **30**. However, if a seal leak is caused to be made by intense well pressure, such as that generated by a blowout, any debris which is exited will be directed down through the void containing the packing material **90**, and out, leaving the grease seals **68***a* intact. This very important feature will be further amplified.

In operation, the sleeve **42** is caused to be rotated by the kelley. The packing gland follower **28** is constrained to rotate with the sleeve by the bolts **92**. This results in the packing **90** to also rotate about the stationery wash pipe **30**. This necessitates after a period of time, because of wear and tear caused by heat and friction; the adjusting of the packing **90**, which is no major undertaking since with the instant invention it is down simply by raising the packing gland follower **28** by tightening the bolts **92**, thereby, applying further compression on the packing material **90**. In the event it is necessary to insert new packing material, this is accomplished by simply lowering the packing gland follower **28** and inserting new packing material.

Reference is now made to FIGS. **2** and **3** for a better understanding as to how the self energizing feature of the packing means operates. FIG. **2** illustrates the groove **96** connected to a plurality of what are referred to as pressure inlets **98**. The pressure inlets **98** originate from the interior of the annulus **100**, in other words, the pressure inlets **98** are in communication with whatever exists in the annulus **100**, which in turn is in communication with the well. Initially, because of pressure applied by the packing gland follower **28**, some of the packing **90** will flow into the gap **94** (FIG. **3**). It can be seen, that upon the existence of any well pressure, the well pressure, **P1**, will be directed into the pressure inlets **98** and into the groove **96** which thus provides direction means for applying the forces generated by the internal well pressures directly on top of the packing **90**. This in turn, necessarily, because of the increased compression results in the tightening of the seal between the rotating sleeve **42** and the stationery wash pipe **30**. Obviously, if a blowout were to occur, it would be necessary to stop the rotation of the kelley, since any rotation would quickly enhance the destruction of the packing material **90**.

However, if the pressure inlets **98** and the groove **96** were to be absent, the forces generated by the well pressure, shown as dotted arrows **P2**, would result in the packing **90** being compressed sideways, thus eventually resulting in a gap being formed alongside the wash pipe **30**, as shown by the dotted lines in FIG. **3**. Thus it can be seen, that without the inlets **98** and groove **96**, the seal would be lost much more readily.

What is claimed is:

1. A drill head having an annular chamber formed therethrough for the reception of a rotating driving member used in the drilling of wells, comprising:

an annular sleeve;

a first annular housing adapted to concentrically receive said annular sleeve, thereby forming a chamber between said annular sleeve and said first annular housing;

bearing means disposed within said chamber such that said annular sleeve is rotatable;

a second housing adapted to receive said first annular housing and said annular sleeve in a manner such that an annulus is formed between said annular sleeve and said second housing;

packing means adapted to be positioned in said annulus;

means for applying pressure on said packing means in a first direction thereby forming a rotating hermetic seal between said annular sleeve and said second housing;

means for capping the upper extremity of said drill head, said means adapted to receive said driving member and further providing a seal preventing the egress of any existing well fluids via the upper extremity;

means for directing any internal forces generated by said well onto said packing means in a second direction further insuring a hermetic seal to exist between said annular sleeve and said second housing;

2. A drill head according to claim **1** wherein said annular sleeve and said second housing have a clearance formed therebetween such that said annular sleeve is rotatable independently of said second housing.

3. A drill head according to claim **2** wherein said first annular housing and said second housing are stationery.

4. A drill head according to claim **3** wherein said clearance is formed between the lower extremity of said annular sleeve and the upper extremity of said second housing.

5. A drill head according to claim **4** wherein said second housing includes a wash pipe such that when said second housing receives said first annular housing, the outside wall of said wash pipe and the inside wall of said annular sleeve define said annulus.

6. A drill head according to claim **1** in which said first annular housing comprises an annular tube terminated at each end with a flange.

7. A drill head according to claim **6** in which said bearing means comprise tapered roller bearings having both radial and thrust capabilities.

8. A drill head according to claim **1** wherein said means for directing any generated internal forces onto said packing means comprises an annular groove formed on the bottom end of the annular sleeve, said annular groove being connected to a plurality of inlets, said inlets being in communication with the annular chamber formed through said drill head.

9. A drill head according to claim **1** wherein said packing means comprises an annular gland, wherein said annular gland has an inside diameter greater than the outside diameter of said wash pipe and positioned such that it encircles a portion of said second housing at the upper extremity thereof and is capable of longitudinal movement about said wash pipe.

10. A drill head according to claim **9** wherein said means for applying pressure on said packing means is provided by said annular gland having a shoulder formed thereon, said shoulder being of a dimension and size such that said annulus formed between said annular sleeve and said second housing being adapted to receive said shoulder.

11. A drill head according to claim **10** wherein said annular gland is threadedly affixed to the lower extremity of said annular sleeve.

12. A drill head according to claim **1** wherein said means for capping comprises an elongated resilient steel reinforced mass having an opening therethrough along the longitudinal axis thereof for the reception of said rotating driving member, the exterior of said resilient mass being tapered inwardly in a downwardly direction, said means for capping thereby providing a constrictive seal about said driving member extending therethrough and insuring a tighter seal upon the application of any pressurized fluids thereto, said mass retained on said annular sleeve by compression means.

13. A drill head according to claim **1** wherein said second housing further includes a side outlet tube for the egress of well fluids, cuttings and the like.

14. A drill head having an annular chamber formed therethrough for the reception of a rotatable driver member, such as a kelley, for use in conventional and pressure well drilling, comprising:

a first stationery housing including a tubular projection at the upper extremity thereof and also including an outlet tube for the egress of well fluids, cuttings and the like, said stationery housing having means for affixing same to a well casing;

a second stationery housing, adapted for mounting on said first stationary housing;

a rotatable sleeve member concentrically disposed within said second stationery housing, said second stationery housing adapted for mounting on said first stationery housing thereby forming an annulus between said sleeve member and said tubular projection;

bearing means interposed between said rotatable sleeve and said second stationery housing;

means for lubricating said bearing means;

packing means positioned in said annulus;

an adjustable gland to regulate the compression of said packing means in a first direction thereby forming a rotating hermetic seal between said rotating sleeve and said tubular projection, said adjustable gland being in fixed relationship with said rotatable sleeve;

capping means for the upper extremity of said rotating sleeve member, said capping means adapted to receive a driving member and further providing a seal between said drill head and said driving member;

means for compressively holding said capping means with said rotatable sleeve, and

means for directing any internal well pressures onto said packing means in a direction opposing said first direction thereby resulting in the expansion of said packing means, further tightening said hermetic seal.

15. A drill head according to claim **14** wherein said means for directing any internal well pressures onto said packing means comprises an annular groove formed on the bottom edge of said rotatable sleeve, said annular groove positioned immediately adjacent the upper portion of said packing means and said annular groove being further connected to a plurality of inlets, said inlets being in communication with any generated well pressures.

16. A drill head according to claim 15 wherein said adjustable gland has an inside diameter greater than the outside diameter of said tubular projection and positioned such that said gland encircles said tubular projection and is adjustably affixed to said rotating sleeve and is rotatable therewith.

17. A drill head having an annular chamber formed therethrough in communication with any existing well pressures, said annular chamber adapted to receive a rotatable driver member for use in conventional and well drilling operations, comprising:

a first stationery housing including a hard smooth tubular projection at the upper extremity thereof, said first stationery housing further including an outlet for the egress of internal well wastes and also including means for affixing said stationery housing to a well casing;

a second stationary housing adapted for mounting on said first stationary housing;

a sleeve member rotatable disposed within said second stationery housing wherein an annulus is formed between the inside surface of a shoulder formed on the lower extremity of said sleeve member and the outside surface of said tubular projection when said second stationery housing is mounted on said first stationery housing;

packing means concentrically positioned in said annulus;

an adjustable gland to regulate the compression of said packing means in a first direction thereby forming a rotating hermetic seal between said rotating sleeve member and said tubular projection, said adjustable gland being in fixed relationship with said rotatable sleeve and having an inside diameter greater than the outside diameter of said tubular projection and positioned such that said gland encircles said tubular projection and is adjustably affixed to said rotating sleeve;

capping means for the upper extremity of said rotating sleeve member, said capping means adapted to receive a driving member and further providing a seal between said drill head and said driving member;

means for holding said capping means in compression with said rotatable sleeve member, and

an annular groove and a plurality of inlets formed on the bottom edge of said sleeve member, said annular groove being connected to said inlets, said inlets being in communication with the well chamber whereby any generated forces are directed through said inlets to said groove and applied directly to said packing means by said groove, said forces being directed onto said packing means in a direction opposing said first direction.

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