Sept. 10, 1968 B. WILLIAMS 3,400,938

DRILLING HEAD ASSEMBLY

Filed Sept. 16, 1966 6 Sheets-Sheet 1

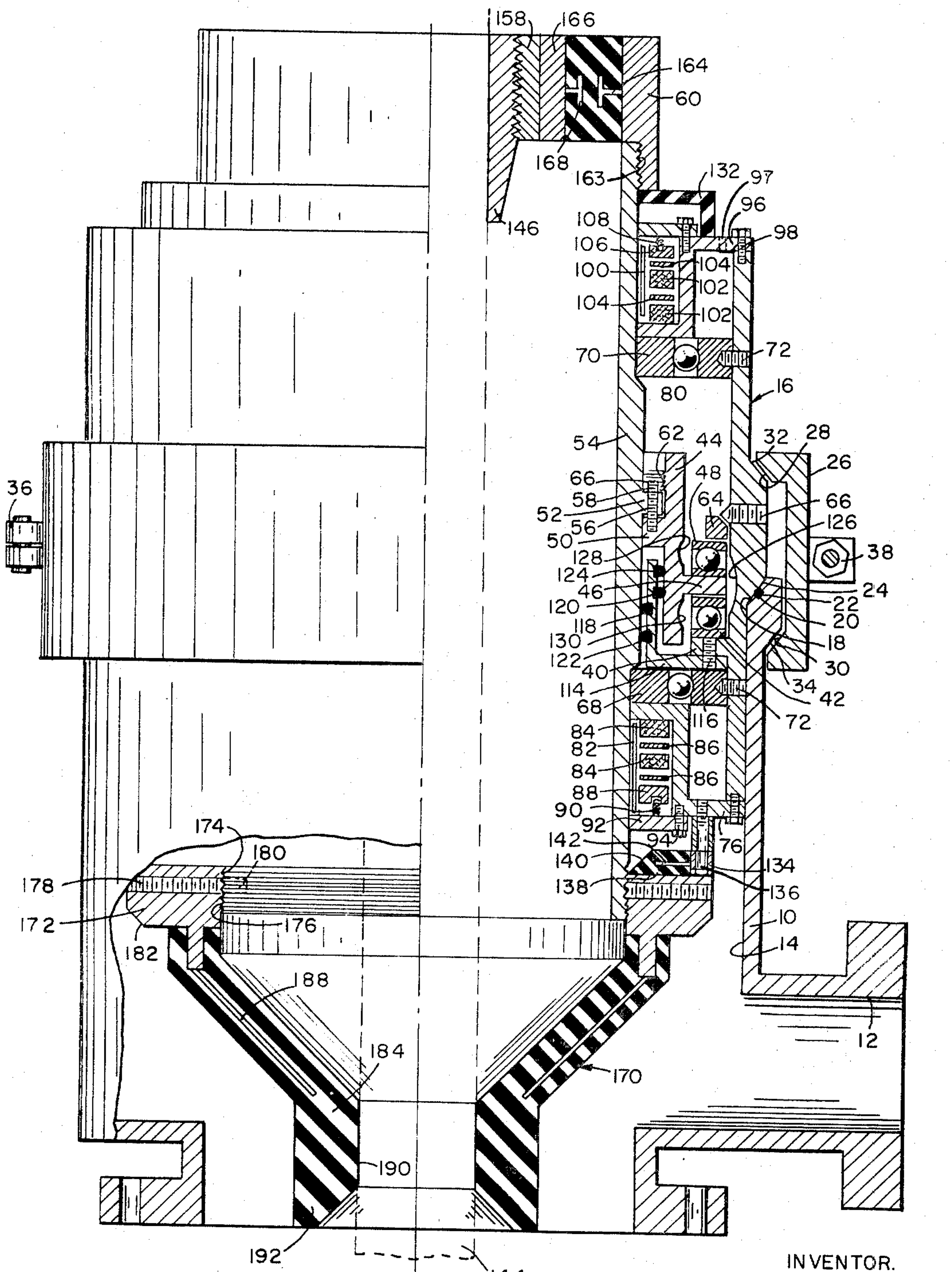

FIG. I

INVENTOR.
BOB WILLIAMS

BY *Head & Johnson*

ATTORNEYS

Sept. 10, 1968 B. WILLIAMS 3,400,938

DRILLING HEAD ASSEMBLY

Filed Sept. 16, 1966 6 Sheets-Sheet 2

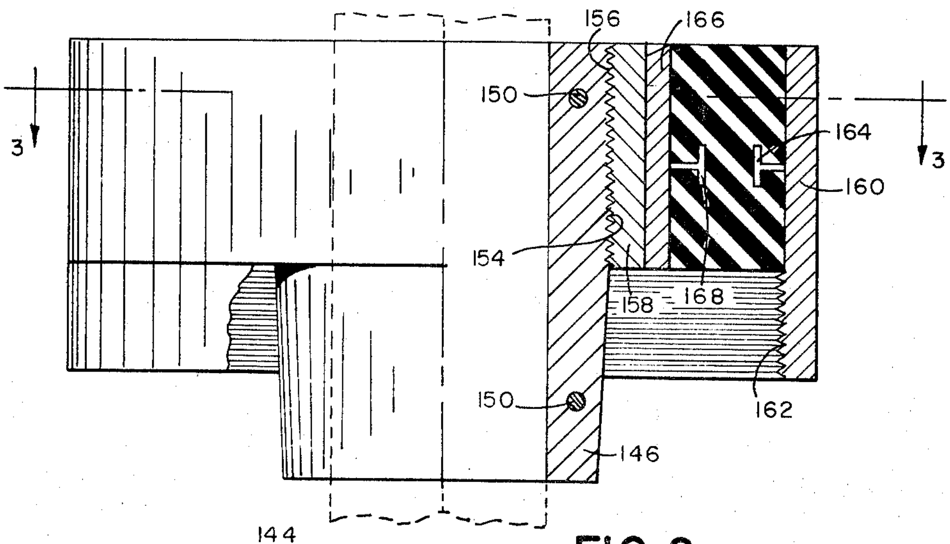

FIG. 2

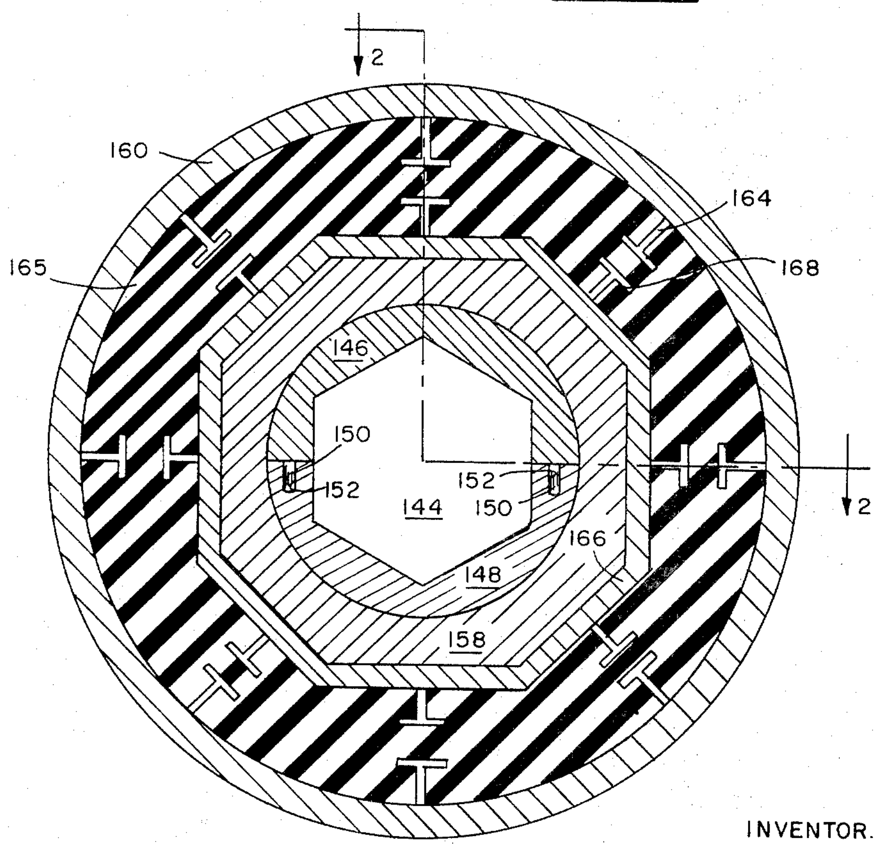

FIG. 3

INVENTOR.
BOB WILLIAMS

BY Head + Johnson

ATTORNEYS

Sept. 10, 1968 B. WILLIAMS 3,400,938

DRILLING HEAD ASSEMBLY

Filed Sept. 16, 1966 6 Sheets-Sheet 3

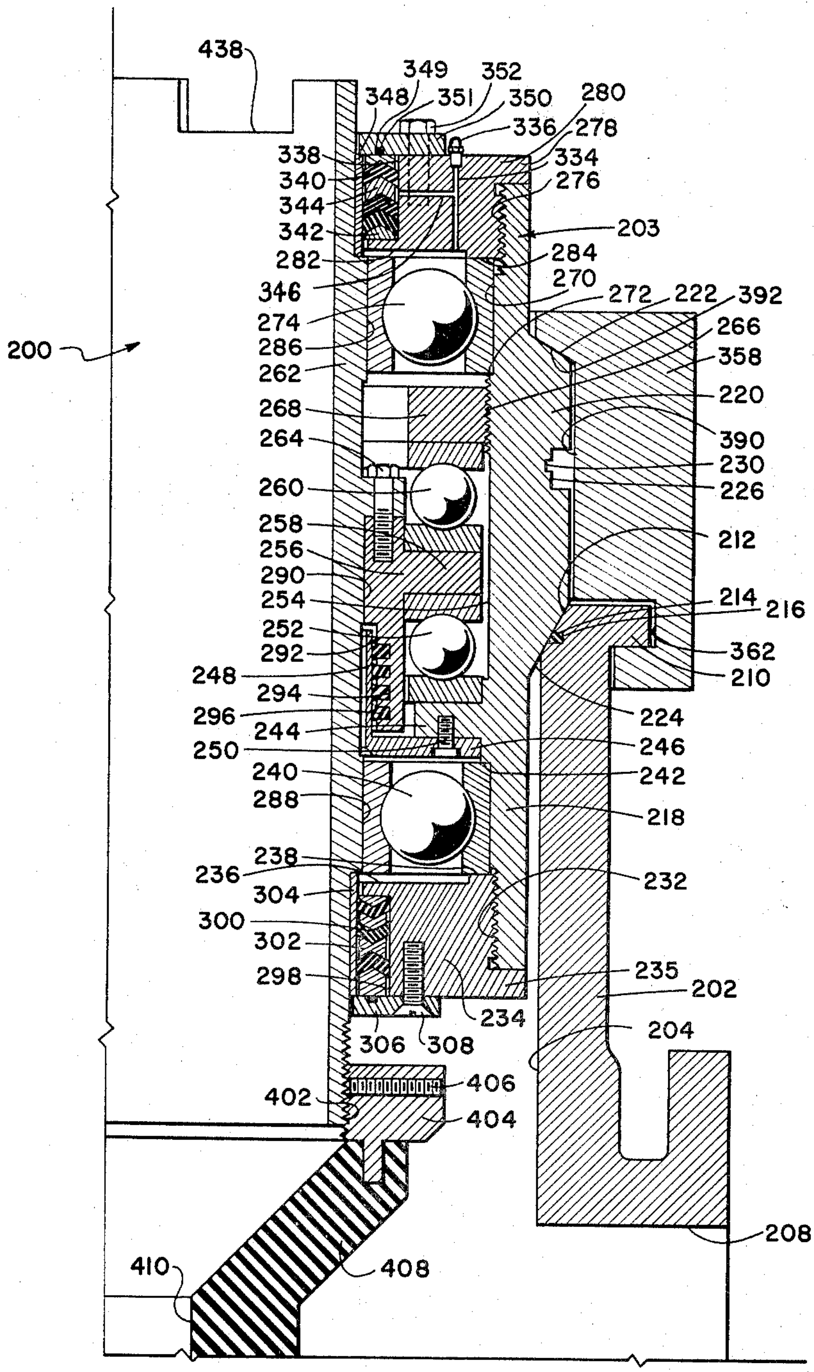

FIG. 4

INVENTOR.
Bob Williams

BY *William S. Dorman*

ATTORNEY

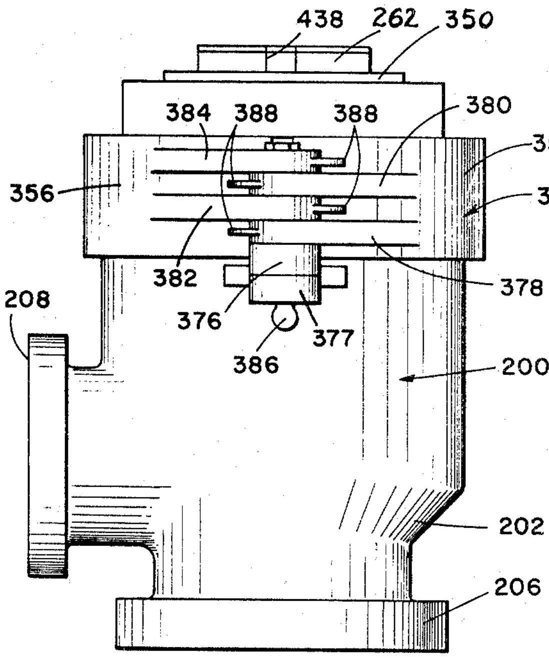

FIG. 5

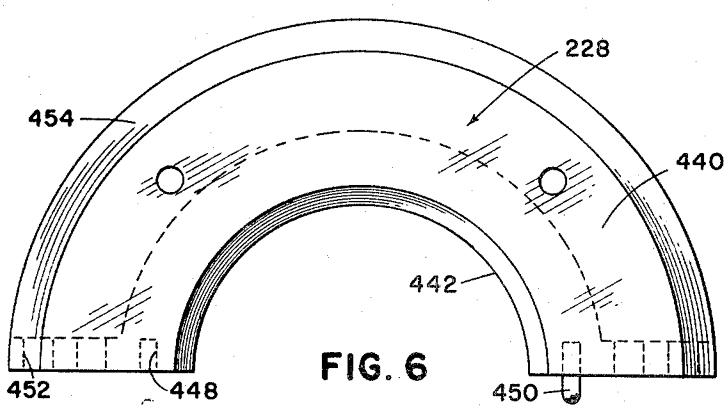

FIG. 6

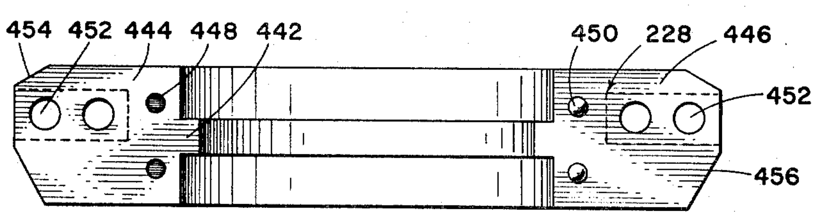

FIG. 7

INVENTOR.
Bob Williams
BY *William S. Dorman*
ATTORNEY

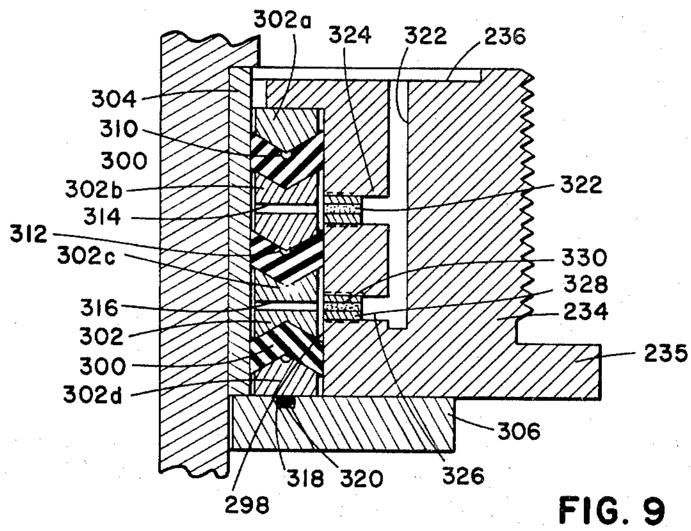

FIG. 9

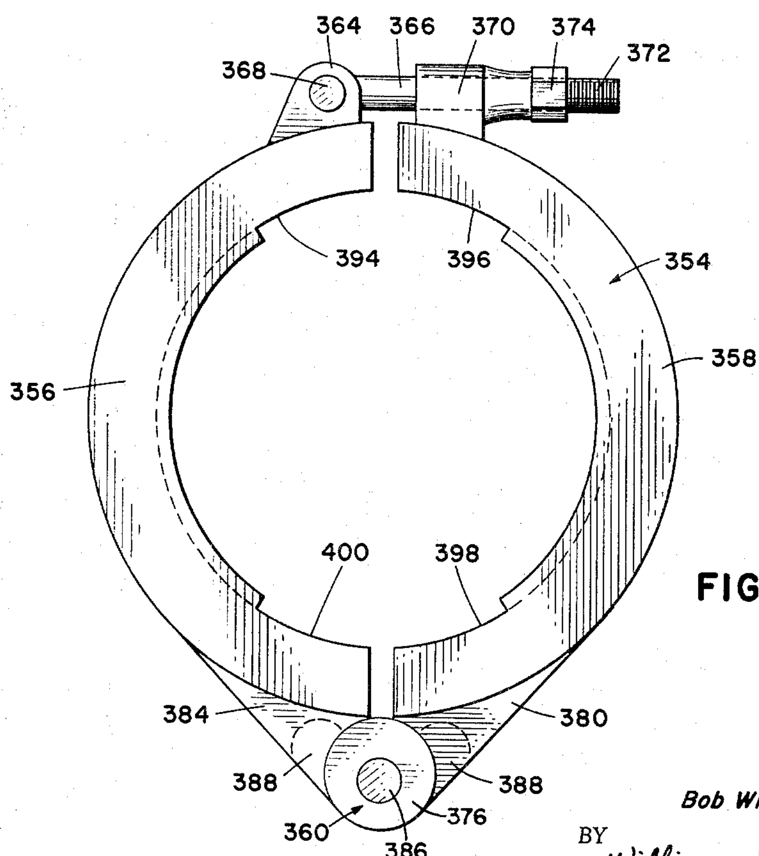

FIG. 8

INVENTOR.
Bob Williams
BY *William S. Dorman*
ATTORNEY

Sept. 10, 1968 B. WILLIAMS 3,400,938

DRILLING HEAD ASSEMBLY

Filed Sept. 16, 1966 6 Sheets-Sheet 6

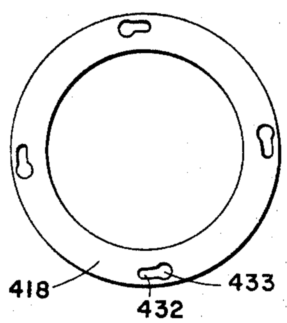

FIG. 13

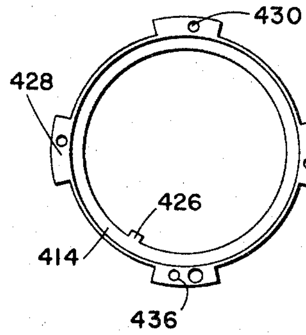

FIG. 11

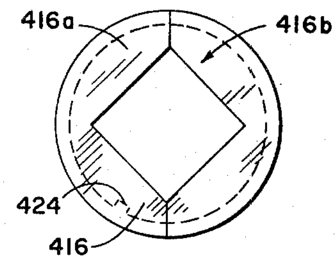

FIG. 12

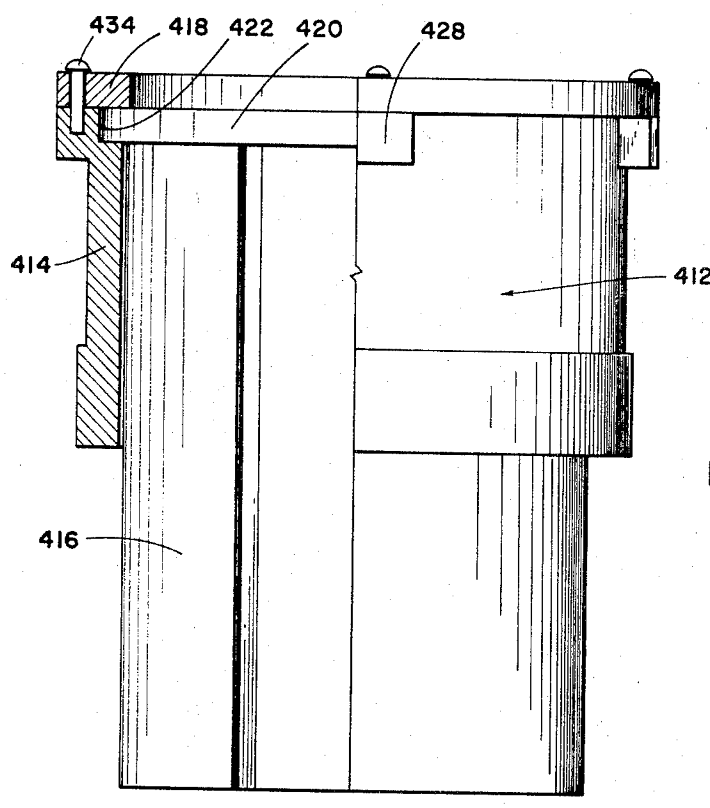

FIG. 10

INVENTOR.
Bob Williams

BY William S. Dorman

ATTORNEY

United States Patent Office 3,400,938
Patented Sept. 10, 1968

1

3,400,938
DRILLING HEAD ASSEMBLY
Bob Williams, 823 Cavanaugh Road, Fort Smith, Ark. 72901
Continuation-in-part of application Ser. No. 503,555, Oct. 23, 1965. This application Sept. 16, 1966, Ser. No. 586,912
15 Claims. (Cl. 277—31)

ABSTRACT OF THE DISCLOSURE

A rotary drilling head assembly for a well bore, comprising a stationary housing and a seal assembly supported by the stationary housing. The seal assembly comprises a rotatable sleeve member having a stationary sleeve member therearound, with a chamber provided between the sleeves for receiving a lubricating fluid. Bearing means is interposed between the two sleeves and upper and lower sealing members are provided in order to preclude leakage of fluid from the chamber, and auxiliary seal means is provided for additional protection of the bearing means. In addition, quick opening and closing clamping means is provided for facilitating the installation of the assembly at the well site.

This application is a continuation-in-part application of my co-pending application Ser. No. 503,555, filed Oct. 23, 1965 now abandoned and entitled "Drilling Head Assembly." This invention relates to a drilling head assembly useful in well drilling. More particularly, this invention relates to drilling heads for rotary drilling rigs and improved sealing means for the drilling heads.

Drilling of oil and gas wells is accomplished by means of a bit attached to the end of a hollow string of drilling pipe. The drill bit and drilling pipe receives a rotary motion from power equipment located on the surface which transmits this rotary motion to the circular drill stem through a non-circular conduit attached to the top of the drill string and known as a drill kelly. The kelly receives its rotary motion from the power equipment through a non-circular bushing located in the drilling floor through which the kelly slides as the drilling progresses. As the drill bit digs deeper into the earth additional sections of drill pipe are added by the procedure of stopping the drilling, raising the kelly and the attached drilling string, uncoupling the kelly from the string, adding a new section of drilling pipe, and then recoupling the kelly.

Below the drilling floor and on the ground surface a variety of specialized equipment is usually attached to the top of the casing where it emerges from the ground. Among these types of equipment is usually a component known as a drilling head which usually provides means for the circulation of various fluids used in the drilling and to provide means for the sealing of the interior of the well from the surface during drilling. In order to maintain a seal around the drilling kelly and drill stem while drilling is continuing and particularly when the kelly and drill stem are being removed from the bore, numerous sealing means have been developed to provide rotational and slidable sealing of the kelly within the drilling head. These generally include a spindle of some sort through which the kelly may pass and which includes a packing at its lower end to seal the circumference of the kelly from the surface.

The continual rotation of the kelly and drill stem, the frequent upward and downward movement of the kelly and drill stem during addition of drill stem sections, and the high pressures to which the drilling head is subjected, demand that the packing components in the drilling head be able to withstand the excessive wear and be capable

2

of each replacement. Also, as today's oil and gas wells go to increasingly greater depths, the need for a sturdy and well packed drilling head increases.

In addition, the increasing popularity of air drilling combined with the increasing depth of new wells demand more efficient means of sealing the drilling head from the internal pressures.

The present invention contemplates a rotary drilling head assembly particularly designed and constructed for overcoming the disadvantages of present-day devices of this type, and comprises an upper and lower housing positioned together in a manner that will permit quick disassembly and yet which are held sealably together. Within the upper housing is an inner housing or spindle which is held therein by means of an improved arrangement of bearings so that both the spindle and the entire drilling head are capable or resisting tremendous thrust forces. Secured to this inner housing is an upper shock absorbing driving connection for a drilling kelly which receives a non-circular kelly and transmits the rotative motion of the kelly to the spindle and yet is designed to provide shock absorbing protection to the spindle and housing. Secured to the lower end of the inner housing or spindle is an improved kelly seal which rotates with the drilling kelly during the drilling operations and is particularly designed to resist the great fluid pressures within the bore hole to which it might be subjected and let to provide for easy slidable motion of the kelly and drill string therethrough.

The primary object of this invention is to provide a rotary drilling head which has improved characteristics of wear and sealing, and is efficient in operation.

Another object of this invention is to provide a drilling head in which the bearing components are more efficiently designed to withstand greater stresses.

Still another object of this invention is to provide a drilling head of improved design which incorporates efficient means for protecting the drilling head components from shock and stress.

Still another object of this invention is to provide a drilling head having an improved means of sealing the drilling kelly and drilling stem within the drilling head.

A further object of this invention is to provide a novel drilling head particularly designed and constructed for sealing the bearings from the well fluids and other debris for greatly increasing the useful and efficient life thereof.

Other and further objects and advantageous features of the present invention will hereinafter more fully appear in connection with a detailed description of the drawings in which:

FIGURE 1 is a side elevational view in partial cross-section of a rotary drilling head embodying the invention.

FIGURE 2 is a side elevational view in partial cross-section of a kelly drive component which may be used in combination with the invention.

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 2.

FIGURE 4 is a broken sectional elevational view of a half section of a rotary drilling head assembly embodying modification of the invention.

FIGURE 5 is an elevational view of the modified rotary drilling assembly depicted in FIGURE 4.

FIGURE 6 is a plan view of an adapter member for the rotary drilling head assembly of the invention.

FIGURE 7 is an end elevational view of the adapter member shown in FIGURE 6.

FIGURE 8 is a plan view of a clamp assembly utilized in association with the rotary drilling head assembly of the invention.

FIGURE 9 is an enlarged sectional elevational view of a seal member utilized in the invention.

FIGURE 10 is a side elevational view, partly in section, of a kelly drive adapter housing such as may be utilized in connection with the invention.

FIGURE 11 is a plan view of the outer housing of the kelly drive adapter housing depicted in FIGURE 10.

FIGURE 12 is a plan view of the inner housing of the kelly drive adapter housing depicted in FIGURE 10.

FIGURE 13 is a plan view of the upper ring member of the kelly drive adapter housing depicted in FIGURE 10.

Referring now to the figures in detail, in FIGURE 1 the assembled relationship of the components is shown. A rotating head bowl or lower housing member **10** provides support means for the other components of this device and provides means for attachment of the device to a casing (not shown) or other oil and gas well component at the surface of the well bore. Attachment of lower housing member **10** to the well components is by conventional flange and bolt means. Besides providing communication between the interior portion of the rotating head assembly of this invention and the bore housing member **10** includes a fluid opening **12** which permits passage of drilling fluids and other bore hole fluids through housing member **10**. Lower housing member **10** has an interior bore **14** into which is slidably received an upper housing member **16**. Lower housing member **10** has an annular beveled shoulder **18** which includes a recess **20** into which is fitted a packing ring **22**. Upper housing **16** has a circumferential shoulder **24** which rests against shoulder **18** of the lower housing member when upper housing member **16** is in its proper position. When upper housing member **16** is positioned within lower housing member **10** and shoulder **24** rests against shoulder **18**, packing ring **22** provides a tight seal between the two housing members when they are in proper alignment and held securely together by means of clamp **26** which is a two section substantially cylindrical clamp. Clamp **26** has an upper beveled shoulder **28** and a lower beveled shoulder **30** which, when clamp **26** is locked in position, are secured respectively to an upper beveled shoulder **32** on housing **16** and a lower beveled shoulder **34** of housing **10**. Clamp **26** is secured in position by means of a conventional hinge **36** holding the two hinge halves together and conventional nut and bolt locking means **38** securing the two hinge halves in a locked position. Since upper housing member **16** will be securely clamped to lower housing member **10**, housing member **16** will remain stationary with housing member **10** and the other well head components to which housing member **10** has been connected.

Housing member **16** is an open ended cylindrical member and provides a support means for the rotating components and sealing components located within housing **16**. Housing **16** includes an inner annular seat **40** which provides support for the rotating components and upon which rests a lower thrust bearing **42** which will bear most of the downward thrust, particularly when the drilling string and kelly are being relocated in the bore hole. Thrust bearing **42** further supports a thrust cylinder or tubular member **44** which includes a support **46** which rotates freely between lower thrust bearing **42** and an upper thrust bearing **48**. Thrust bearings **42** and **48** are designed to withstand the tremendous pressures exerted when the kelly and attached drilling strings are moved upward or downward while they are rotating. Bearing **42** resists the downward stress of the drilling string and bearing **48** resists the upward forces. Neither the inner nor the outer race of either bearing is secured in place. Disposed interiorly of tubular member **44** is an annular shoulder **50** against which rests an exterior annular shoulder **52** of a tubular member **54**. Shoulder **52** is secured to shoulder **50** by means of a plurality of Allen head bolts **56** which are further held in position against vibration by means of a nut **58** which has threads on the outside diameter thereof and which is held securely against the top of shoulder **52** by bolts **56**. Threads **60** on the exterior of nut **58** cooperate with threads **62** on the interior of tubular member **44**. The threads on nut **58** secure Allen head bolt **56** from vibrating out of position and also help distribute the thrust load on these members. The load bearing members **42**, **46**, and **48**, are maintained in a relatively closed position by the provision of a ring member **64** which is further held in position by a beveled screw member **66** penetrating the wall of housing member **16** and securing ring member **64** in position.

Tubular member **54**, and consequently the rotating drilling components passing through tubular member **54**, is maintained in a relatively stable axial position with regard to housing **16** by the action of a lower radial bearing **68** and an upper radial bearing **70** each of which is held in its respective position partly by means of a set screw **72** which holds the outer race of each bearing stationary with respect to housing member **16**.

Lower radial bearing **68** is further held in position by resting upon a shoulder **74** of a lower annular support member **76**. Support member **76** is held in position against upper housing member **16** by means of bolts **78**. Upper radial bearing **70** is further held in its position by the resting of its interior race upon beveled shoulder **80** of tubular member **54**.

Conventional oil and grease lubricants are supplied to the bearing and moving members described above and are maintained in their proper lubricating areas by a unique arrangement of seals and packing members. The upper and lower ends of upper housing **16** are packed in an identical manner to form a seal around tubular member **54**. A thin tubular member **82** having a polished exterior surface is positioned closely around tubular member **54** and adjacent the inner perimeter of annular support member **76**. Positioned annularly between member **82** and support member **76** are a series of packing members **84** of conventional resilient packing material, which provide the sealing means for the lubricant. Disposed between each packing member **84** is a thin ring **86** which, upon proper adjustment, provides means to expand the packing members **84** and adjust their sealing ability, particularly where they have been subjected to long wear. A heavier metal ring **88** is set at the bottom of the packing assembly to provide additional pressure upon the packing members. Ring **88** has a series of recesses into which fit a number of springs **90** to transmit this pressure to the packing members. Ring **88** and spring **90** are held in their relative positions in support of the packing members by means of an annular plate **92** secured to support member **76** by a recessed screw **94**. A similar packing assembly is positioned at the upper end of housing **16** with an upper annular support member **96** retaining the upper radial bearing **70** in position. Support member **96** is furnished with a conventional lubricating fitting **97** to permit the passage of oil or grease lubricants into the interior of the drilling head. Support member **96** is secured against housing **16** by a recessed screw member **98**. An upper thin tubular member **100** is secured in position around tubular member **54** similarly to member **82**. Positioned above annular member **96** are a number of packing members **102** with thin rings interspaced to provide means for compressing the packing members and forcing them into closer sealing engagement with tubular ember **100**. Above an endwise packing member **104** is another heavy ring **106** which has a number of recessed springs **108** which are compressed between ring **106** and an annular plate **110** held in position against the upper end of housing **16** by a series of recessed screws **112**.

An additional sealing assembly is provided intermediate the upper and lower sealing assemblies just described by means of a special groove packing sleeve **114** positioned around tubular member **54** and secured by means of Allen screw **116** to the underside of annular seat **40**. Member **114** includes a plurality of interior and exterior circumferential grooves **118** and **120** into which are disposed special packing rings **122** and **124**. Besides assisting in maintaining a centered position of tubular member 54, this packing assembly provides a means of isolating the lubricant material above and below the packing assembly itself. For example, if for some reason the packing rings 84 at the lower end of housing 16 should fail, this packing assembly will assure that oil or grease sealed above packing rings 122 and 124 will not be drained off.

In addition to the sealing assemblies described above the lubrication and circulation of lubricant around the bearings and rotating members is assisted by the unique design of the housing members themselves. For example, housing member 16 has, on its interior wall somewhat adjacent bearings 42 and 48, a recessed portion 126 which permits improved circulation of lubricant around those bearings and tubular member 44 has recessed portions 128 and 130 on its exterior wall opposite bearings 42 and 48 also to provide for improved circulation of lubricant.

Other sealing means are provided at either end of housing 16 to give protection to the interior components of the rotating head from well bore pressures, dust, and water. At the upper end of housing 54 a resilient annular shield 132 is fitted tightly over housing 54 to rotate with housing 54 and cover the end portion of housing 16 and protect the interior parts. A further protective assembly is secured to support member 76 at the lower end of housing 16 to give added protection to that part of the assembly. This lower protective component is comprised of an annular steel ring 134 secured to support member 76 by a series of recessed screws 136, and a flat annular resilient member 138 secured to ring 134. Flat resilient member 138 has a beveled edge 140 and embedded within 138 is a spring member 142. The cooperation of beveled edge 140 of the resilient member and the biasing of springs 142 within the resilient member 138 tend to bias member 138 against tubular member 54 as tubular member 54 is forced through the radius of resilient seal 138.

FIGURE 1 describes in outline a drilling kelly 144 in position through the rotating drilling head assembly of this invention. As described above, drilling kelly 144 is taken to be a conventional noncircular drilling kelly which receives its rotative motion from a power device not made a part of this invention. When drilling is in progress, it is necessary that the rotative components of this invention receive their motion by transmission from the kelly 144 and that at the same time a means of sealing the kelly below the rotating head must be provided to protect the components of this invention from the pressure effects and corrosion effects of bore hole fluids and at the same time prevent the bore hole fluids from reaching the surface of the ground by passage around the kelly. Thus FIGURE 1 in conjunction with FIGURES 2 and 3 describe one particular means by which the power is transmitted from the drilling kelly 144 to the rotative components of this invention. However, there is no intention of limiting the drive means to the particular arrangement shown in FIGURES 1, 2 and 3. Although the drilling kelly 144 may be of square, hexagonal, or octagonal conformation, for the sake of simplicity FIGURE 3 describes a drilling kelly of hexagonal shape. A split bushing formed from semi-circular components 146 and 148 fit together in close position around kelly 144. Bushing half 146 includes a series of pins 150 which positioned themselves within recesses 152 of kelly bushing 148. Each bushing component 146 and 148 is externally threaded with threads 154 at the upper portion of the bushing assembly. When pins 150 are lined up properly with recesses 152 so that bushing halves 146 and 148 are assembled, threads 154 become continuous and permit the bushing assembly to be threaded into threaded portion 156 of octagonal bushing 158. Threaded portion 156 is slightly tapered so that kelly bushings 146 and 148 may be drawn closely around the drilling kelly permitting octagonal bushing 158 to be received slidably into a similar opening in an assembly secured to the rotating drilling head assembly.

Outer ring 160 has an internally threaded portion 162 adjacent its lower edge which is threadably received on the external threads 164 of tubular member 54, of the rotating head assembly. Secured at a number of places interiorly of ring 160 are a number of pins 164 facing inwardly and embedded in a resilient material 165 such as rubber or neoprene which will act as a shock absorber in reducing the rotative shocks from the drilling kelly and tend to prevent injury to the drilling head assembly. An octagonal bushing 166 is also provided with a number of pins 168. Pins 168 are also embedded in resilient material 165 so that bushing 166 is secured in a shock absorbing manner to outer ring 160. When drilling kelly 144 is provided with bushings 146 and 148 which are secured as mentioned above by octagonal bushing 158 and is lowered into the drilling head assembly, octagonal bushing 158 fits closely into bushing 166 and transmits the rotative motion from the kelly to the drilling head assembly. When the semi-circular bushing components 146 and 148 are held in position around the kelly by octagonal bushing 158, a very close but slidable fit around the kelly is provided so that the kelly will be permitted to slide through this bushing assembly as the drilling progresses and the drill bit, drill string, and kelly are progressively lowered into the bore hole. Threads 154 on semi-circular components 146 and 148 are right hand threads which are further secured during the drilling process. Then, when the kelly and drill string are to be removed, the reverse rotation of the kelly will loosen these bushing components and permit them to be quickly and easily removed from the kelly.

The interior components of the drilling head assembly are protected from the bore hole fluids by a seal cup 170 which is threadably secured to the bottom of tubular member 54. Seal cup 170 includes an upper annular ring member 172 which has internal left hand threads 174 which threadably match external left hand threads 176 adjacent the lower end of tubular member 54. Locking the annular ring member 172 into position around tubular member 54 are a series of locking screws 178 which thread into matching recesses 180 in tubular member 54 when ring 172 is properly threaded onto member 154. In its fully threaded position ring member 172 fits flush against annular resilient member 138 and provides a degree of maintaining member 138 in its position and gives some additional sealing effect to the drilling head assembly. Annular ring member 172 has a beveled shoulder 182 which helps guide the drilling head assembly into the position at the initiation of the drilling operations. Ring member 172 is secured to a resilient sealing cup 184 by means of the embedding of an annular flange portion 186 and a series of spring-like members 188 into resilient cup 184. Resilient sealing cup 184 has an upper essentially circular portion surrounding flange 186, and an intermediate frusto-conical portion into which spring-like members 188 are embedded and a lower reduced diameter neck portion adjacent the lower end of member 184. Spring-like members 188 are embedded in resilient member 184 to a longitudinal extent corresponding to the longitudinal extent of frusto-conical portion of the resilient member 184. Spring-like members 188 cooperate with the frusto-conical portion of member 184 to bias the resilient member 184 into a sealable position around a drilling kelly or a drill stem. That is, when drilling is in progress member 184 will be sealable around the drilling kelly, and when the drilling kelly and drilling string are either raised or lowered, member 184 will, for a portion of the travel of a drill string, be in sealable arrangement around the drilling string. Interior of resilient member 184 is a bore portion 190 which is essentially cylindrical in appearance and which is the part of member 184 coming into sealable engagement with the drilling kelly and drill string. Below bore 190 is an outwardly flanging surface **192** which provides means for guiding the sealing member **184** and the drilling head assembly itself onto the drilling kelly when the unit is assembled. Spring-like members **188** extend only through the frusto-conical portion of member **184** so that they will bias bore **190** around the drilling kelly and drill string and yet will permit bore **190** to expand to the limit of the resiliency of member **184** as drilling kellys of different sizes and configurations or drilling strings of different sizes pass through bore **190**. If spring-like members **188** were to extend the full length of bore **190**, resilient member **184** would be restricted in its expansive ability.

Referring now to FIGURES 4 and 5, reference character **200** generally indicates a modified rotary drilling head assembly comprising a stationary air bowl or lower housing **202** having an upper housing or sealing assembly generally indicated at **203** disposed therein and supported thereby. The housing **202** is of a substantially cylindrical configuration and is provided with a centrally disposed bore **204** extending longitudinally therethrough. One end of the bowl **202** is adapted for connection with the well casing (not shown) in any well known manner, such as by an outwardly directed circumferential flange **206** and a plurality of bolts (not shown). The bowl **202** is held stationary by virtue of the connection with the well casing, and a side opening or port **208** is preferably provided in the bowl **202** for facilitating circulation of drilling fluids during the well drilling operation, as is well known.

The opposite end of the bowl **202** may be provided with an outwardly directed circumferential flange **210** for a purpose as will be hereinafter set forth. The upper end of the bore **204**, as viewed in FIGURE 4, is tapered or beveled as shown at **212** and is provided with a substantially centrally disposed annular recess **214** extending circumferentially therearound for receiving an annular sealing ring **216** therein. The recess **214** is of a substantially rectangular cross sectional configuration with the upper and lower sides thereof extending substantially perpendicularly with respect to the longitudinal axis of the bowl **202**. The inner corner of the recess **214** terminates on the beveled surface **212** and is thus of a correspondingly beveled or tapered configuration in cross section. The sealing ring **216** is of a cross sectional configuration complementary to the recess **214** and the inner corner thereof is tapered correspondingly with the beveled surface **212** for a purpose as will be hereinafter set forth.

The upper housing or sealing assembly **203** comprises an outer sleeve **218** having an enlarged portion or outwardly extending collar portion **220** providing an upper annular shoulder **222** and a lower annular shoulder **224**. The lower shoulder **224** is tapered upwardly and outwardly complementary to the configuration of the beveled surface **212** for engagement therewith as shown in FIGURE 4 whereby the assembly **203** is supported by the beveled shoulder **212**. The upper shoulder **222** is tapered outwardly and downwardly, and the sleeve **218** is held stationary with the bowl **202** in a manner as will be hereinafter set forth in detail.

An annular groove **226** is provided around the outer periphery of the collar portion **220** and preferably substantially centrally disposed with respect to the length thereof for supporting an adapter member **228** (FIGURES 6 and 7) around the collar **220**. An annular recess **230** is provided around the inner periphery of the groove **226** for receiving a suitable sealing ring, such as an O-ring, or the like (not shown). The sealing member provides a seal between the sleeve **218** and adapter member **228** in installations wherein the adapter **228** is utilized and may either be substantially permanently disposed within the recess **230** or disposed therein at such a time when it is desirable to utilize the adapter ring **228**, as will be hereinafter set forth in detail.

The lower end of the sleeve **218**, as viewed in FIGURE 4, is internally threaded at **232** to receive a first threaded seal carrier ring **234** therein. The outer end of the ring **234** is preferably provided with an outwardly extending circumferential flange **235** for engaging the lower end of the sleeve **218** for limiting the inward or upward movement of the ring **234** with respect to the sleeve **218**. The threads **232** are preferably left hand threads for a purpose as will be hereinafter set forth. The inner end of the ring **234** is provided with a centrally disposed circular recess **236** whereby an annular shoulder **238** is formed around the outer circumference thereof. The shoulder **238** engages the outer race of a first radial bearing member **240** and securely retains the outer race of the bearing **240** against an annular shoulder **242** provided on the inner periphery of the sleeve **218**.

An inwardly directed annular flange **244** is provided on the inner periphery of the sleeve **218** and spaced from the shoulder **242** for receiving thereagainst an outwardly extending flange **246** of a separator sleeve **248**. The flange **246** may be secured adjacent the flange **244** in any suitable manner, such as by a plurality of circumferentially spaced screw members **250**. The flange **244** supports a first thrust bearing **252**, and the outer periphery of the lower race of the bearing **252** is disposed adjacent the inner periphery of the sleeve **218** as particularly shown in FIGURE 4. The inner periphery of the sleeve **218** is recessed at **254**, however, whereby the upper race of the bearing **252** is spaced slightly therefrom.

A bearing separator sleeve **256** is supported from the bearing **252** by an outwardly extending circumferential flange **258** provided on the outer periphery of the sleeve **256** and which rests on the bearing **252**. The flange **258**, in turn, supports a second thrust bearing **260**. The inner periphery of each bearing **252** and **260** is disposed adjacent the outer periphery of the sleeve **256**. The sleeve **256** is secured to a rotatable tubular member **262** in any suitable manner, such as by a plurality of bolt members **264** which extend through an outwardly extending flange **266** on the outer periphery of the tubular member **262**, and which further extend longitudinally into the bearing separator sleeve **256**. The sleeve **218** is in connection with the upper race of the bearing **260** in any well known manner. For example, as shown in FIGURE 4, the inner periphery of the sleeve **218** is threaded at **266** for receiving an annular ring **268** having complementary threads provided on the outer periphery thereof. The ring **268** rests on the upper race of the bearing **260** and it will be apparent that the inner periphery of the ring **268** is spaced from the outer periphery of the tubular member **262**. The threaded connection **266** is preferably a right hand thread connection for a purpose as will be hereinafter set forth. Of course, suitable recesses (not shown) may be provided on the exposed face of the ring **268** for receiving a suitable tool (not shown) in order to facilitate tightening and loosening or threading and unthreading of the ring **268** within the sleeve **218**, as is well known.

The inner periphery of the sleeve **218** is slightly enlarged at **270** to provide an inwardly directed shoulder **272** which receives or supports the outer race of a second radial bearing **274**. The upper end of the sleeve **218**, as viewed in FIGURE 4, is provided with an internally threaded portion **276** for receiving a second seal carrier ring **278** therein. The ring **278** is generally similar to the ring **234** and is preferably provided with an outwardly extending circumferential flange **280** at the outer end thereof for enagement with the end of the sleeve **218** for limiting the inwardly movement of the ring **278** with respect to the sleeve **218**. The inner end of the ring **278** is provided with a centrally disposed substantially circular recess **282** which forms a circumferential shoulder **284** around the outer periphery thereof. The shoulder **284** bears against the outer race of the bearing **274** for retaining the bearing **274** securely in position on the shoulder **272**. A suitable lubricating fluid (not shown) is provided between the tubular member **262** and sleeve **218** for lubrication of the bearings **240, 252, 260** and **274** and is sealed therein, all as will be hereinafter set forth in detail.

The tubular member 262 is substantially concentrically disposed with respect to the sleeve 218 and bore 204 of the bowl 202 and preferably extends slightly beyond the opposite ends of the sleeve 218. The tubular member 262 is provided with a first enlarged cylindrical portion 286 spaced below the upper end thereof as viewed in FIGURE 4 for bearing against the inner periphery of the inner race of the radial bearing 274. A second enlarged cylindrical portion 288 is provided on the outer periphery of the tubular member 262 and spaced from the lower end thereof for bearing against the inner periphery of the radial bearing 240. It will be readily apparent that any rotational movement of the tubular member 266 will be trasmitted to the inner race of the bearings 240 and 274 by virtue of the engagement therebetween. However, no rotational movement will be transmitted to the outer races of the bearings 240 and 274.

A third enlarged cylindrical portion 290 is provided on the outer periphery of the tubular member 262 for bearing against the inner periphery of the bearing separator sleeve 256. Rotational movement of the tubular member 262 will be transmitted to the sleeve 256 since the sleeve 256 is secured to the tubular member by the screws 264. It will be apparent that rotational movement of the sleeve 256 will be transmitted simultaneously to the upper race of the thrust bearing 252 and to the lower race of the thrust bearing 260 through the engagement of the flange 258 therewith. However, the rotational movement will not be transmitted to the lower race of the bearing 252 or the upper race of the bearing 260.

The inner periphery of the bearing separator sleeve 256 is enlarged at 292 whereby the separator sleeve 248 is spaced slightly from the inner periphery of the sleeve 256 and outer periphery of the tubular member 262. The sleeve 248 is retained stationary with the sleeve 218 by the engagement therewith through the screws 250 and flange 244, and consequently there is relative rotational movement between the bearing separator 256 and the separator sleeve 248. A plurality of spaced annular recesses or grooves are provided on the enlarged inner periphery 292 of the bearing separator 256 each for receiving a dynamic sealing member 294 therein. Whereas substantially any suitable sealing or packing members 294 may be utilized, it is preferable to provide ½-V inside lip packing as particularly shown in FIGURE 4. This type of packing provides an excellent dynamic sealing between the stationary sleeve 248 and rotating sleeve 256, and the upwardly extending configuration of the inner lip of the packing members permits a lubricating fluid to flow upwardly around the packings 294, but substantially precludes any reverse flow of fluid therearound, for a purpose and as will be hereinafter set forth in detail. In addition, it is preferable that the outer periphery of the sleeve 248 against which the packings 294 ride be of a hard chrome finish for improving the useful life and sealing qualities of the packing members and sleeve.

The seal carrier rings 234 and 278 are provided for sealing around the outer periphery of the tubular member 262 for substantially precluding contamination of the bearing members from any well fluids, or other foreign particles or debris. The rings 234 and 278 are generally similar and function in a generally similar, but reverse, manner. As particularly shown in FIGURE 9, the first ring 234 is provided with an enlarged central bore portion 298 for receiving a plurality of packing or sealing members 300 and spacer members 302 therein. A cylindrical sleeve 304 is disposed around the outer periphery of the tubular member 262 in substantial alignment with the ring 234 and is rotatable simultaneously therewith. The packings 300 and spacers 304 are retained within the bore 298 by a retaining ring 306 which may be secured to the seal carrier ring 234 in any well known manner, such as by a plurality of circumferentially spaced screws 308 (FIGURE 4).

The outer periphery of the sleeve 304 is preferably provided with a hard chrome finish for increasing the efficient life thereof, and the inner periphery of each of the packing members 300 rides against this hard chrome surface to provide an efficient dynamic sealing between the rotatable tubular member 262 and stationary seal carrier ring 234. The packing members 300 are preferably of the well known chevron type, and it is preferable to provide three of the packing members 300 as shown herein. The lowermost packing 300 as viewed in FIGURES 4 and 9 is inverted, or disposed in such a manner that the sides thereof are tapered in a downward and outward direction whereas the upper two packings 300 are disposed in an upright position whereby the sides thereof taper in an upward and outward direction. The downwardly tapering lower packing 300 functions to substantially preclude any upward passage of well fluid, or the like, around the outer periphery of the cylinder 304, and the upwardly tapering upper packings 300 function to substantially preclude any downward passage of lubricant, or the like, around the cylinder 304.

The spacers 302 are preferably constructed from brass, but not limited thereto, and comprise an upper annular spacer 302*a* having the lower surface thereof substantially V-shaped in cross-sectional configuration complementary to the configuration of the upper chevron packing 300. The inner periphery of the spacer 302*a* is spaced from the outer periphery of the sleeve or cylinder 304 to preclude any engagement therebetween during rotation of the sleeve 304. In addition, an annular recess or trough 310 is provided at the center of the V between the upper packing 300 and spacer 302*a* for accumulating a quantity of the lubricant therein, as will be hereinafter set forth. The second spacer 302*b* is of an annular configuration with the cross-sectional configuration of both the upper and lower surfaces thereof being V-shaped complementary to the upper packings 300. The inner periphery of the spacer 302*b* is spaced from the outer periphery of the sleeve 304, and an annular trough 312 is provided at the V of the second packing member 300 for the accumulation of a quantity of the lubricant therein. In addition, at least one transverse passageway 314 is provided in the spacer ring 302*b* for communicating the lubricant from the outer periphery of the spacer 302*b* to the inner periphery thereof, as will be hereinafter set forth. The third spacer 302*c* is an annular ring wherein the upper surface thereof is substantially V-shaped in cross-sectional configuration, and the lower surface thereof is of a substantially inverted V-shaped configuration. The inner periphery of the spacer 302*c* is spaced from the outer periphery of the sleeve 304, and at least one transversely extending passageway 316 for communicating or directing the lubricating fluid from the outer periphery of the ring 302*c* to the inner periphery thereof. The lowermost spacer ring 302*d* is substantially identical to the uppermost ring 302*a*, but reversed in position with respect thereto. Of course, the inner periphery of the lower spacer 302*d* is spaced from the outer periphery of the cylinder 304. In addition, there will be slight spacing between the outer periphery of each of the spacer rings 302 and the bore 298 for facilitating longitudinal distribution of the lubricant, as will be hereinafter set forth. This spacing is depicted in an exaggerated condition in FIGURE 9 for purposes of illustration.

An annular groove or recess 318 is provided on the upper or inwardly directed face to the retainer ring 306 for receiving a compression ring 320, such as an O-ring, or the like, therein. The compression ring 320 is concentrically arranged with respect to the spacer ring 302*d* and is preferably substantially centrally disposed between the inner and outer circumferences thereof for constantly exerting an upward pressure on the spacer ring 302*d* for maintaining a longitudinal force through the spacer members 302 and packing members 300. This assures an efficient packing between the spacers **302** and packing members **300** for increasing the overall efficiency of the packing or sealing action of the packing members **300**.

As hereinbefore set forth, the area between the tubular member **262** and sleeve **218** and between the seal carrier rings **234** and **278** is filled with a suitable lubricating fluid. The lubricant surrounds the bearings **240**, **252**, **260** and **274** for assuring an efficient lubrication thereon. A longitudinally extending passageway **322** (FIGURE 9) is provided in the seal carrier ring **234** and has one end thereof open at the recess **236** for receiving the lubricating fluid therein. A pair of spaced radially inwardly extending passageways **324** and **326** extend from the passageway **322** to the bore **298** for directing a portion of the lubricant to the outer periphery of the spacers **302**, and particularly to the spacers **302***b* and **302***c*. The slight clearance between the spacers **302** and the bore **298** will permit the lubricant to adequately lubricate the packing members **300** disposed against the bore **298**, and the passageways **314** and **316** will direct a portion of the lubricant to the inner periphery of the spacers **302***b* and **302***c* whereby the lubricant will be distributed to the inner periphery of the packing members **300** which bear against the sleeve **304**. A portion of the lubricant will work its way into the troughs **310** and **314** for further facilitating and improving the lubrication of the packing members **300** and spacers **302**.

It has been found that a relatively small amount of the lubricating fluid is required to adequately lubricate the packing members **300**, and as a result, it is desirable to provide a cylindrical choke member **328** for each bore **324** and **326**. The bores **324** and **326** may be internally threaded at the ends thereof which terminate in the bore **298** whereby the choke members **328** may be threadedly inserted therein and in such a position that the choke members do not extend or protrude into the bore **298**. In addition, the internal bores **330** may be filled with a suitable fibrous or fabric material, such as cotton, or like, as shown at **332**, for further control of the quantity of lubricant which is allowed to drip or otherwise slowly flow into the bores **314** and **316**.

As hereinbefore set forth, the seal carrier is generally similar to the seal carrier **234**, and as shown in FIGURE 4, a longitudinally extending bore or passageway **334** extends therethrough for directing the lubricant into the annular space between the tubular member **262** and sleeve **218**. A zerk fitting **336**, or the like, may be provided at the outer end of the bore **334** for facilitating the injection of the lubricant into the bore **334**, as is well known. In addition, an enlarged central bore **338** is provided in the ring **278** for receiving a plurality of packing members **340** and spacers **342** which are similar to the packing members **300** and spacers **302**. The packing members **340** are preferably of the well known chevron type, and there are preferably three of these chevron packings provided in an inverted position whereby the lips or sidewalls thereof are tapered outwardly and downwardly. The lowermost two of the packing members **340** are preferably disposed in abutting relationship and the third packing member **340** is preferably spaced thereabove, as viewed in FIGURE 4. The spacer rings **342** are preferably constructed from brass, or the like, but not limited thereto, and are of cross-sectional configurations generally similar to the respective spacer members **302**. In addition, the centermost spacer member **342** is provided with at least one transversely extending bore **344** for providing communication between the inner and outer peripheries of the spacers **342**. A radially extending bore or passageway **346** is provided in the seal carrier ring **278** for directing a portion of the lubricant from the bore **334** to the bore **338** whereby, a portion of the lubricant will be distributed to the packing members **340** in a similar manner as hereinbefore set forth with respect to the packing members **300**. It is preferably to utilize a choke member (not shown) similar to the choke **328** in the bore **344** for controlling the flow of lubricant into the bore **334**. Of course, a suitable cylinder or sleeve **348** similar to the sleeve **304** is disposed around the outer periphery of the tubular member **262** in substantially alignment with the seal carrier ring **278** and is provided with a hard chrome outer periphery for receiving the inner periphery of the packing members **340** thereagainst. The sleeve **348** rotates simultaneously with the tubular member **262**, and the packing members **340** provide an efficient dynamic sealing between the rotating cylinder **348** and the stationary seal carrier ring **278**. Of course, a suitable retainer ring **350** may be removably secured to the outer surface of the seal carrier ring **278** in any suitable manner, such as by a plurality of circumferentially spaced studs or screws **352** for retaining the packing members **340** and spacer members **342** within the bore **338**. In addition, an annular groove **349** is provided on the inner face of the ring **350** for receiving an O-ring **351**, or the like, which is a compression seal for constantly exerting a downward force on the uppermost spacer **342** whereby an efficient sealing engagement is provided between the spacers **342** and packing **340**.

The sleeve **218** is held or retained in stationary relationship with respect to the bowl **202** by means of a sectional clamping device generally indicated at **354**, and particularly shown in FIGURES 4, 5 and 8. The clamping device **354** comprises a pair of arcuate half sections or jaws **356** and **358** hingedly secured together and to the bowl **202** at **360**, as will be hereinafter set forth. The jaws **356** and **358** are substantially identical in construction, and each is provided with an annular recess **362** (FIGURE 4) whereby each jaw receives substantially one-half of the flange **210** provided on the upper end of the bowl **202** when the jaws are in the closed or clamping position.

The free or outer end of one jaw, such as the jaw **356** as depicted herein, is provided with a pair of spaced outwardly extending apertured boss of flange members **364** (only one of which is shown in FIGURE 8) for receiving one end of a latch arm **366** therebetween. The arm **366** is pivotally secured to the flanges **364** by a suitable pivot pin **368**, as is well known. The outer end of the other jaw, such as the jaw **358**, is provided with an outwardly extending latch receiving member **370** having an open sided slot (not shown) extending along the length thereof for removably receiving the latch arm **366** therein. The outer end of the latch arm **366** is preferably threaded as shown at **372** in FIGURE 8 for receiving a threaded locking nut **374** thereon whereby the nut **374** may be tightened into a locking engagement with the latch receiving member **370** in the closed or latched position of the arm **366**.

Of course, when it is desired to open the jaws **356** and **358**, the nut **374** may be backed off, and the latch arm **366** may be quickly and easily manually pivoted about the pin **368** for releasing the locking engagement between the jaws. Conversely, when it is desired to clamp or lock the jaws **356** and **358** around the bowl **202**, the latch arm **366** may be quickly and easily pivoted about the pin **368** in a reverse position for disposition in the latch receiving member **370**, and the lock nut **374** may be locked against the member **370** for securely latching the jaws **356** and **358** in the closed position. Whereas the particular latch arm or swing bolt depicted herein is very efficient and durable in operation, it is to be understood that substantially any desired latching mechanism may be utilized in lieu thereof, such as a hydraulic double-action cylinder, or the like, as is well known.

As particularly shown in FIGURE 5, a cylindrical hinge member **376** is secured to the outer periphery of the bowl **202** in any suitable manner, such as by a flange **377** which may be welded to the bowl, or otherwise secured between the bowl and member **376**. A pair of longitudinally spaced outwardly extending apertured flanges **378** and **380** are provided on the outer periphery of the jaw **358** whereby the flange **378** is disposed adjacent the upper end of the cylindrical member 376. A pair of similar spaced outwardly extending apertured flanges 382 and 384 are provided on the outer periphery of the jaw 356 whereby the flange 382 is interposed between the flanges 378 and 380, and the flange 384 is disposed adjacent the upper surface of the flange 380. A suitable hinge pin 386 extends through the apertures of the flanges and through the cylindrical member to provide the pivotal or hinged connected between the jaws 356 and 358 and bowl 202.

Suitable stop members 388 are provided on each flange 378, 380, 382 and 384 for limiting the opening pivotal movement of the jaws 356 and 358 for precluding accidental complete disengagement of the jaws with the upper end of the bowl 202 during the opening of the clamping device 354. Furthermore, it will be noted in FIGURE 8 that the axis of the hinge pin 386 is offset with respect to the axis of the cylindrical member 376 and corresponding configuration formed by the flanges 378, 380, 382 and 384 whereby the path of the outer ends of the jaws will be such that the free ends of the jaws will always be in engagement with the upper end of the bowl 202 during the opening and closing of the clamp 354. This facilitates the overall operation of the device, and is a practical advantage of the structure.

Referring again to FIGURE 4, it is to be noted that the inner periphery 390 of the jaws 356 and 358 is slightly spaced from the outer periphery of the collar 220. In addition, an inwardly directed, upwardly tapered shoulder 392 is provided on the inner periphery of each clamp jaw 356 and 358 which is of a taper complementary to the tapered shoulder 222, and is in engagement therewith in the closed or clamped position of the clamping mechanism 354. The tapered configuration of the shoulders 392 and 222 in combination with the tapered configuration of the shoulders 212 and 224 provides a self-centering action as the upper housing or sealing assembly 203 is clamped in position within the bowl 202. The shoulder 392 is cutaway at the opposite ends of each jaw member 356 and 358, as shown at 394, 396, 398 and 400 in FIGURE 8, to provide clearance for facilitating disposition of the assembly 203 in the bowl 202 with a minium of arcuately outward movement of the clamp jaws 356 and 358 in the open position thereof.

The lower end of the tubular member 262, as viewed in FIGURE 4, is externally threaded at 402 for receiving an internally threaded stripper holder ring 404 thereon. The ring 404 may be secured in the desired position on the threaded end 402 in any well known manner, such as by a set screw 406, or the like. A stripper rubber 408 generally similar to the frusto-conical member 184 depicted in FIGURE 1 is bonded or otherwise secured to the ring 404 and is provided with an internal bore 410 adapted to engage the outer periphery of a drill string (not shown in FIGURE 4) in the manner generally as set forth in the first embodiment of the invention, and as is well known.

As hereinbefore set forth, the drill string is rotated by the kelly, and any suitable means may be utilized for transmitting rotation of the kelly to the tubular member 262. For example, as shown in FIGURES 10 through 13, a drive assembly generally indicated at 412 is depicted which comprises an outer housing or sleeve 414 having an inner housing 416 disposed therein and a retaining ring 418 for retaining the inner housing 416 within the outer housing 414. The inner housing 416 is preferably sectional as shown in FIGURE 12 and comprises a pair of substantially identical half sections 416*a* and 416*b* for facilitating disposition thereof around the outer periphery of the kelly. The inner periphery of the housing 416 is square or of any other configuration corresponding to the kelly whereby the rotation of the kelly is transmitted to the housing 416 by the engagement therebetween. The upper end of the housing 416 is provided with an outwardly extending circumferential flange 420 for engagement with or disposition in an annular groove 422 provided on the inner periphery of the outer housing 414. In addition, at least one longitudinally extending recess or spline groove 424 is provided on the outer periphery of the housing 416 for receiving an inwardly directed lug 426 provided on the inner periphery of the outer housing 414, thus providing a drive connection therebetween.

A plurality of circumferentially spaced outwardly directed lugs 428 are provided around the upper end of the housing 414, as viewed in FIGURE 10, and each of the lugs 428 is provided with at least one aperture 430 extending therethrough. The ring 418 is provided with a plurality of circumferentially spaced elongated apertures 432 each having an enlarged portion 433 which will register or be in substantially alignment with each of the apertures 430 when the ring 418 is disposed on the upper end of the housing 414. A pin member 434 may be disposed through each of the aligned apertures 430 and 432, and the ring 418 may be rotated in a direction for moving the enlarged portion 433 of each aperture 432 away from the respective pin 432. At least one of the flanges 428 is provided with a second apertures 436 which will be in alignment with the open portion of the respective aperture 432 upon the revolved position of the ring 418 whereby a suitable locking pin may be inserted through the apertures 436 and 432 for locking the ring 418 in the revolved or orientated position, thus retaining the inner housing 416 securely within the outer housing 414.

The entire drive assembly 412 is adapted for disposition within the upper end of the tubular member 262 for transmitting rotation thereto. The lugs or flanges 428 may be disposed in complementary recesses provided in the upper end of the tubular member 262. Rotation of the drive assembly 412 is transmitted to the tubular member 262 through the engagement between the lugs 428 and recesses 438. Of course, the rotational movement of the tubular member 262 is absorbed by the bearings 240, 252, 260 and 274 and the sleeve 218 and bowl 202 remain stationary.

It will be apparent that it may be desirable to provide air bowls 202 in variety of sizes. When the bowl 202 is larger than the assembly 203, the adapter member may be utilized. The adapter 228 comprises a pair of substantially identical semi-circular half sections 440, only one of which is shown in FIGURES 6 and 7, for encircling the collar portion 220 of the sleeve 218. Each half section 440 is provided with an inwardly directed flange member 442 extending around the inner periphery thereof for engagement with the annular recess 226 provided on the outer periphery of the collar 220. The opposite ends 444 and 446 of the half section 440 are provided with complementary bores 448 and pins 450 whereby the pins 450 of one half section will engage the bores 448 of the other half section for facilitating retaining of the half sections 440 in position around the collar 220. In addition, each end member 444 and 446 is provided with spaced apertures 452 for receiving bolts (not shown), or the like, therethrough in order to securely lock or clamp the half-sections 440 around the collar 220.

The upper end of the other periphery of the half section 440 as viewed in FIGURE 7 is bevelled at 454 at a taper complementary with the shoulder 392 of the clamp 354, and the lower end of the outer periphery of the half section 440 is beveled at 456 at a taper complementary to the shoulder 212 for seating thereon in the same manner as the collar 220. Thus, the adapter member 228 will be engaged by the bowl 202 and clamp 354 in the same manner as the collar 220 whereby the assembly 203 may be securely retained around the drill pipe and within the bowl 202 by selecting an adapter 228 of the proper diametric size. Thus, a single assembly 203 may be utilized for bowls which are of substantially any larger size than the assembly 203.

In the event the bowl 202 is smaller than that depicted in FIGURE 4, a different adapter may be utilized. In this instance, a flange type fitting (not shown) may be utilized which comprises a lower flange of a size complementary to the size of the upper flange **210** of the smaller bowl **202**, and which may be bolted or otherwise secured thereto in any well known manner. An upper flange may be provided for the adapter which is of a size corresponding to the flange **210** of the bowl **202** as shown in FIGURE 4. The adapter may be provided with hinge connection members similar to that provided on the bowl **202** and the clamp **354** may be hingedly secured to the adapter as hereinbefore set forth. Of course, the inner periphery of the upper flange of the adapter will be beveled or tapered similar to the taper **212** for receiving the collar **220** thereagainst, and the clamp **354** may be utilized in the manner as hereinbefore set forth for clamping the assembly **203** to the adapter, which in turn is rigidly secured to the smaller bowl **202**.

Of course, it will be apparent that the stripper **408** may be provided in a variety of sizes for use with substantially any size drill pipe. The stripper rubber **408** may be readily removed and replaced, as required, either because of wear, or due to need for another size, by unthreading the ring **406** from the end of the tubular member **262**, and threading the ring **406** of the new stripper on the tubular member **262** in lieu thereof.

In use, the assembly **203** may be quickly and easily installed on the bowl **202** by releasing the latch arm **366** and opening the clamp jaws **356** and **358**. The opening of the jaws will be limited by the stop members **388**, thus assuring that the outer ends of the jaws will remain in contact with the upper end of the bowl **202** at all times. This facilitates the reclamping of the jaws around the assembly **203**.

The assembly **203** may then be disposed in the bowl **202** with the lower tapered shoulder **224** of the collar **220** disposed on the shoulder **212**. The complementary tapers **212** and **224** will provide a self-centering action for facilitating the disposition of the assembly **203** in the bowl **202**. The jaws **356** and **358** may then be rotated into a closed position around the collar **220** for bringing the tapered shoulder **392** into engagement with the tapered shoulder **222**. This action further facilitates the centering of the assembly **203** within the bowl. The entire device **200** may then be secured to the well casing, as hereinbefore set forth.

Of course, the drive assembly **412** may be installed around the kelly prior to disposition of the assembly **412** within the tubular member **262**, or may be disposed within the tubular member **262**, and then the kelly may be inserted therethrough, as desired. The engagement of the inner periphery of the housing **416** with the outer periphery of the kelly will transmit rotation to the drive assembly **412**, and the engagement of the lugs **428** of the drive assembly with the recesses **438** of the tubular member will transmit rotation to the tubular member.

The space between the tubular member **262** and the sleeve **218** is filled with a lubricant, as hereinbefore set forth. A portion of this lubricant is directed to the packing members **340** and another portion of the lubricant is directed to the packing members **300**. It has been found that this provides an exceptionally efficient lubrication of the packing members and greatly prolongs the useful life thereof. The packing members **340**, having the sidewalls thereof tapering downwardly, substantially precludes any upward leakage of the lubricant from the annular space surrounding the tubular member **262**, and the upwardly tapering sidewalls of the uppermost packing members **300** substantially precludes any downward leakage of the lubricant from the annular space surrounding the tubular member **262**. The downwardly tapering sidewalls of the lowermost packing member **300** substantially precludes any leakage of well fluids into the annular space surrounding the tubular member **262**. In addition, the packing members **248** which are provided with upwardly tapering sealing lips, permit the lubricant to flow upwardly around the sleeve **348** for assuring an adequate supply of the lubricant to the lower bearing **240**, but substantially preclude any downward passage of fluid around the sleeve **348**, thus providing a double assurance that no well fluids will leak around the tubular member **262** for contamination of the bearings **252, 260** and **274**.

As hereinbefore set forth, the threads **232** are preferably left-hand threads whereas the threads **266** and **276** are preferably right-hand threads. This is to facilitate the assembly of the seal assembly **203** whereby the threaded connection of the ring **268** and seal carrier **278** with the sleeve **218** will not unthread the seal carrier ring **234**. Of course, suitable tool receiving recesses (not shown) may be provided in the exposed surfaces of the seal carriers **234** and **278** and the ring **268** for receiving suitable tools (not shown) for facilitating the assembly of the device **203**.

The novel rotary drilling head assembly **200** is particularly designed and constructed for ease of assembly; to assure an adequate lubrication of the packing members; to assure an efficient sealing of the bearing members from contamination by well fluids, and the like; and to assure an adequate lubrication of the bearing members whereby the assembly will function efficiently for a maximum of operating time without the necessity of replacement of parts, or other repair thereto. The novel device is simple and efficient in operation and economical and durable in construction.

Changes may be made in the combination and arrangement of parts as heretobefore set forth in the specification and shown in the drawings, it being understood that any modification in the precise embodiment of the invention may be made within the scope of the following claims, without departing from the spirit of the invention.

What is claimed is:

1. A rotary drilling head assembly for a well bore comprising a stationary housing, a seal assembly supported by the stationary housing, said seal assembly comprising a rotatable sleeve member, a stationary sleeve member surrounding the rotatable sleeve, a chamber provided between the stationary sleeve and rotatable sleeve for receiving a lubricating fluid, bearing means interposed between the stationary sleeve and rotatable sleeve and disposed within the chamber, upper and lower sealing means carried by the stationary sleeve and providing a seal for the chamber to substantially preclude leakage of fluid out of or into the chamber, and auxiliary seal means interposed between the upper and lower sealing means for further precluding leakage of fluid into the chamber for additional protection of the bearing means, and means being provided for directing a portion of the lubricant to the upper and lower sealing means for lubrication thereof.

2. A rotary drilling head assembly as set forth in claim 1 and including means for transmitting rotation to the rotatable sleeve member.

3. A rotary drilling head assembly as set forth in claim 1 and including adapter means for adapting the seal assembly for support by substantially any size stationary housing.

4. A rotary drilling head assembly as set forth in claim 1 wherein the stationary housing is provided with clamping means for removably securing the seal assembly thereto.

5. A rotary drilling head assembly as set forth in claim 1 wherein stripper means is removably secured to the rotatable sleeve member.

6. A rotary drilling head assembly as set forth in claim 5 wherein the stripper means comprises a ring member threadedly secured to the rotatable sleeve member, and a substantially conical stripper rubber carried by the said ring member.

7. A rotary drilling head assembly for a well bore comprising a stationary housing, a seal assembly supported by the stationary housing, said seal assembly comprising a rotatable sleeve member, a stationary sleeve member surrounding the rotatable sleeve, a chamber provided between the stationary sleeve and rotatable sleeve for receiving a lubricating fluid, bearing means interposed between the stationary sleeve and rotatable sleeve and disposed within the chamber, upper and lower sealing means carried by the stationary sleeve and providing a seal for the chamber to substantially preclude leakage of fluid out of or into the chamber, and auxiliary seal means interposed between the upper and lower sealing means for further precluding leakage of fluid into the chamber for additional protection of the bearing means, said upper and lower sealing means each including a plurality of annular packing members, a plurality of spacer members, and compression means for maintaining a longitudinal pressure between the packing members and spacer members.

8. A rotary drilling head assembly for a well bore comprising a stationary housing, a seal assembly supported by the stationary housing, said seal assembly comprising a rotatable sleeve member, a stationary sleeve member surrounding the rotatable sleeve, a chamber provided between the stationary sleeve and rotatable sleeve for receiving a lubricating fluid, bearing means interposed between the stationary sleeve and rotatable sleeve and disposed within the chamber, upper and lower sealing means carried by the stationary sleeve and providing a seal for the chamber to substantially preclude leakage of fluid out of or into the chamber, and auxiliary seal means interposed between the upper and lower sealing means for further precluding leakage of fluid into the chamber for additional protection of the bearing means, and clamping means provided for cooperating with the stationary housing and seal assembly to removably secure the seal assembly to the stationary housing, said clamping means including a pair of hinged jaw members for alternate opening and closing, stop means for limiting the movement of the jaws in the opening direction, and latch means for securing the jaws in the closed position thereof.

9. A rotary drilling head assembly as set forth in claim **8** wherein means is provided for cooperating between the clamping means and stationary housing and seal assembly for a self-centering of the seal assembly with respect to the stationary housing upon clamping of the seal assembly to the stationary housing.

10. A rotary drilling head assembly for a well bore comprising a stationary housing, a seal assembly supported by the stationary housing, said seal assembly comprising a rotatable sleeve member, a stationary sleeve member surrounding the rotatable sleeve, a chamber provided between the stationary sleeve and rotatable sleeve for receiving a lubricating fluid, bearing means interposed between the stationary sleeve and rotatable sleeve and disposed within the chamber, upper and lower sealing means carried by the stationary sleeve and providing a seal for the chamber to substantially preclude leakage of fluid out of or into the chamber, and auxiliary seal means interposed between the upper and lower sealing means for further precluding leakage of fluid into the chamber for additional protection of the bearing means, said bearings means including a pair of spaced radial bearings disposed between the rotatable sleeve member and stationary sleeve member, a pair of spaced thrust bearings interposed between the stationary sleeve member and rotatable sleeve member and disposed between the radial bearings, and said auxiliary seal means being interposed between the thrust bearings and one of said radial bearings.

11. A rotary drilling head assembly for a well bore comprising a stationary housing, a seal assembly supported by the stationary housing, said seal assembly comprising a rotatable sleeve member, a stationary sleeve member surrounding the rotatable sleeve, a chamber provided between the stationary sleeve and rotatable sleeve for receiving a lubricating fluid, bearing means interposed between the stationary sleeve and rotatable sleeve and disposed within the chamber, upper and lower sealing means carried by the stationary sleeve and providing a seal for the chamber to substantially preclude leakage of fluid out of or into the chamber, and auxiliary seal means interposed between the upper and lower sealing means for further precluding leakage of fluid into the chamber for additional protection of the bearing means, said upper sealing means being provided with a plurality of annular packing members having the sealing lips thereof tapered outwardly and downwardly, the lower sealing means being provided with a plurality of annular packing members having the sealing lips thereof tapered upwardly and outwardly and at least one annular packing member having the sealing lips thereof tapered outwardly and downwardly, and the auxiliary seal means being provided with a plurality of spaced annular packing members having the inner sealing lips thereof tapered upwardly.

12. A rotary drilling head assembly comprising a stationary housing having an inwardly and downwardly tapered shoulder provided at one end thereof, a seal assembly supported by the stationary housing and comprising an outer stationary sleeve member having a tapered shoulder on the outer periphery thereof for engagement with the tapered shoulder of the stationary housing, a rotatable sleeve member concentrically disposed within the stationary sleeve, an annular chamber provided between the rotatable sleeve and the stationary sleeve for receiving a lubricant therein, upper and lower sealing means carried by the stationary sleeve for sealing the chamber, upper and lower radial bearings disposed in the chamber and supported by the stationary sleeve and engageable with the outer periphery of the rotatable sleeve, a pair of thrust bearings disposed in the chamber between the radial bearings and interposed between the rotatable and stationary sleeves, auxiliary packing means carried by the rotatable sleeve and interposed between the thrust bearings and the lower radial bearing, passageway means provided in the upper sealing means for directing the lubricant into the chamber, passageway means provided in both the upper and lower sealing means for directing a portion of the lubricant to the inner peripheries thereof for lubrication thereof, and clamping means carried by the stationary housing and cooperating with the stationary sleeve for removably securing the seal assembly to the stationary housing.

13. A rotary drilling head assembly as set forth in claim **12** and including stripper means removably secured to the rotatable sleeve.

14. A rotary drilling head assembly as set forth in claim **12** and including means for transmitting rotation to the rotatable sleeve member.

15. A rotary drilling head assembly as set forth in claim **12** and including adapter means for adapting the seal assembly for support by substantially any size stationary housing.

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JAMES A. LEPPINK, *Primary Examiner.*