Jan. 4, 1944. W. T. CALDWELL 2,338,093

KELLY ROD AND DRIVE BUSHING THEREFOR

Filed June 28, 1941 2 Sheets-Sheet 1

Fig. 1.

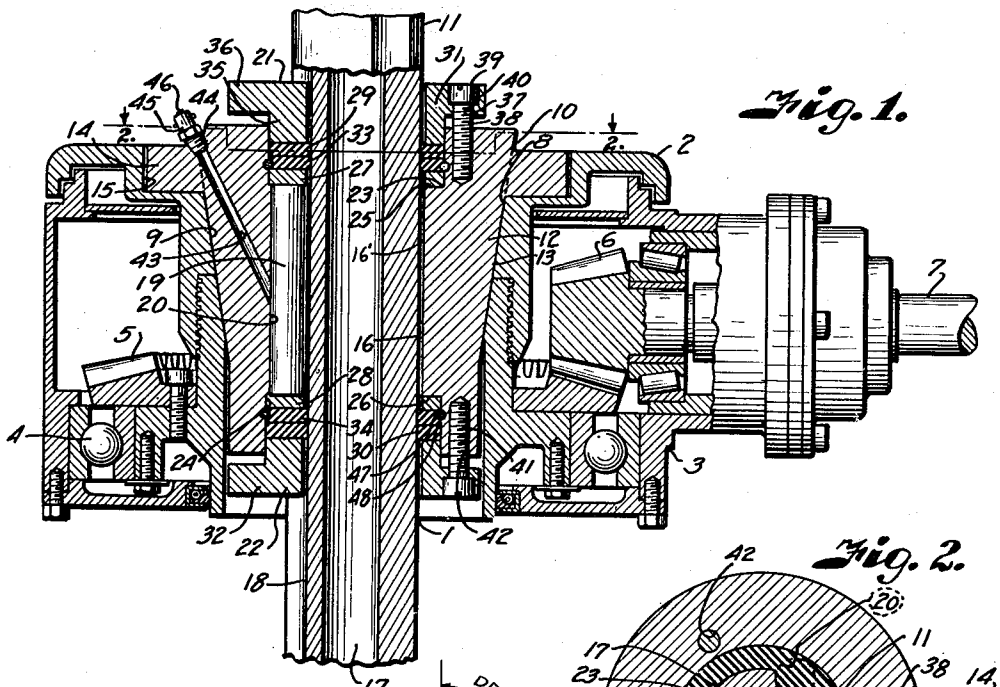


Fig. 2.

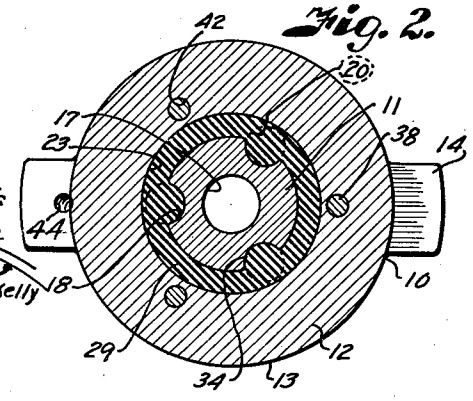


Fig. 5.

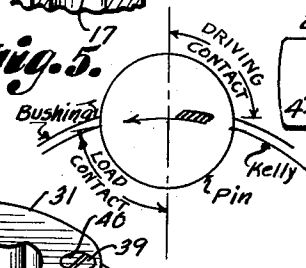


Fig. 3.

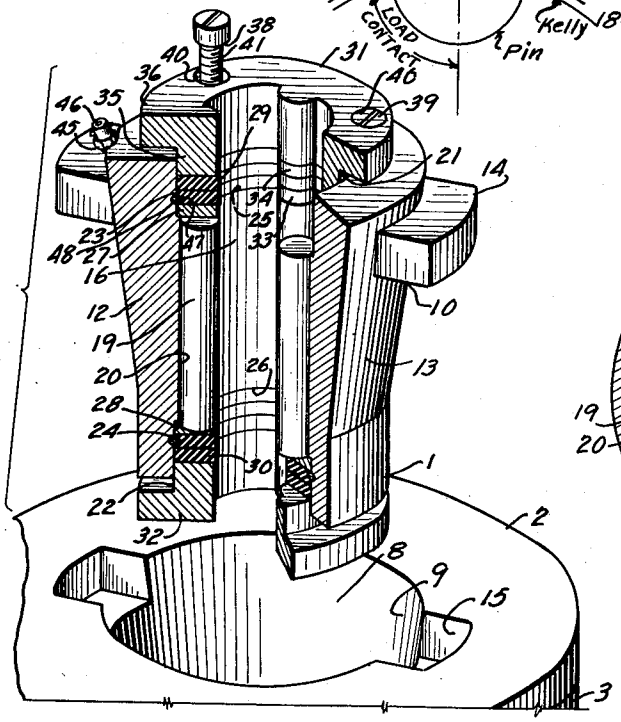
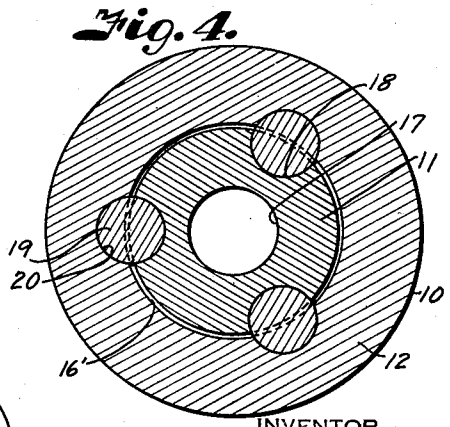


Fig. 4.



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Fig. 6.

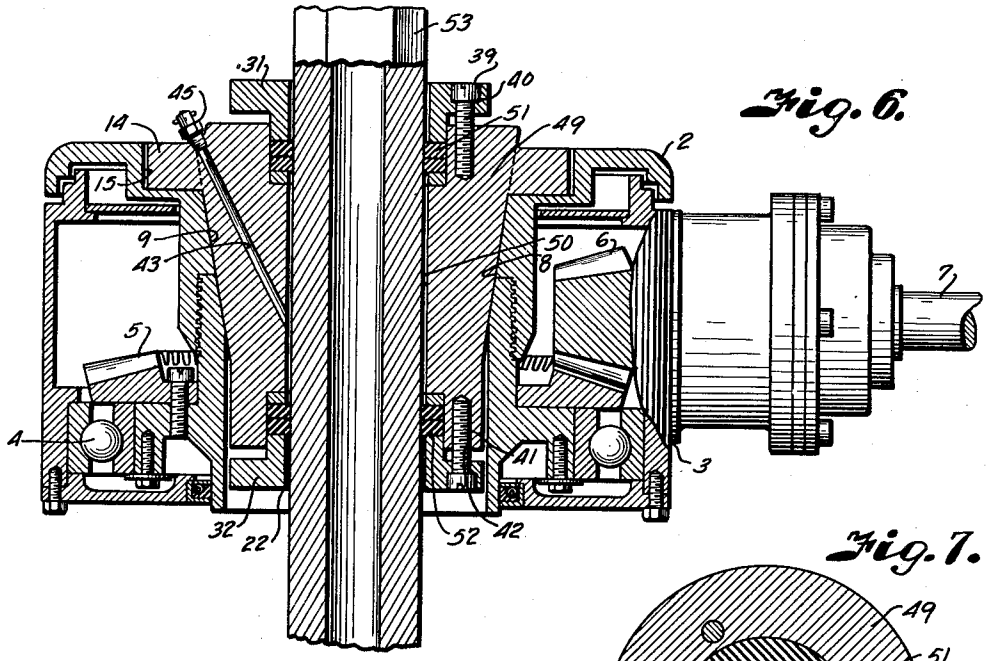


Fig. 7.

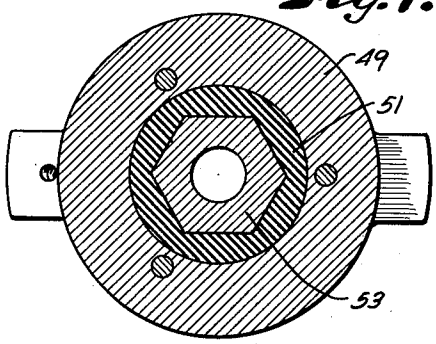


Fig. 8.

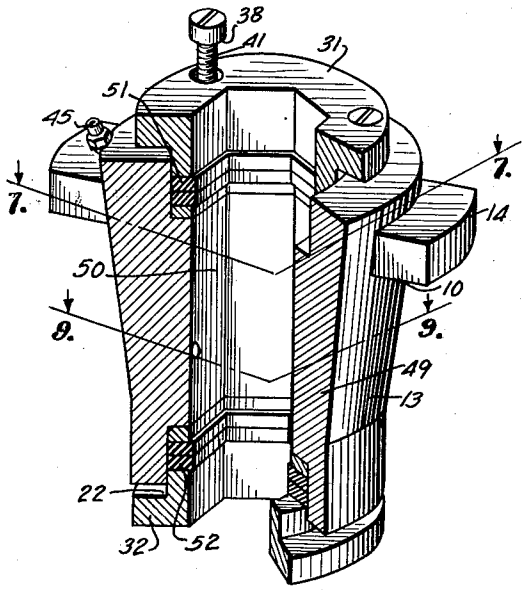
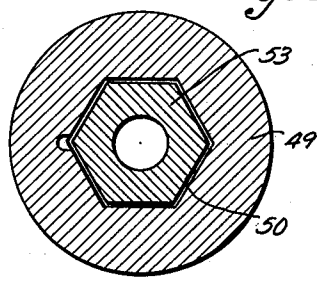


Fig. 9.



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2,338,093

KELLY ROD AND DRIVE BUSHING THEREFOR

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Application June 28, 1941, Serial No. 400,322

12 Claims. (Cl. 255—23)

This invention relates to rotary drilling apparatus, and more particularly to a Kelly rod and drive bushing therefor, the application for patent for the present invention being a continuation in part of a copending application for patent on "Kelly rod and drive bushing therefor" filed January 20, 1939, Serial No. 251,966, now abandoned.

When a drill feeding mechanism is used in conjunction with a drill rotating mechanism it is difficult to grip a conventional Kelly rod with the feed chuck of the feeding mechanism due to the cross-sectional shape thereof, and any deformity in the Kelly rod produced by the gripping chuck interferes with movement of the Kelly rod through the drive bushing. Consequently the Kelly rods are constructed to provide considerable looseness between the rods and bushings. This looseness produces considerable back-lash and wear due to battering caused by resistance of bit rotation under power of the rotary.

I therefore provide a Kelly rod of circular cross-section which can be gripped by the chuck and slide freely through a circular bore in the drive bushing of the rotary mechanism and provide the bushing with relatively close fitting drive keys operable in longitudinal grooves of the Kelly rod.

I am aware that it has been suggested to drive Kelly rods with keys, but such keys have not proved satisfactory because the keys tend to bind the kelly within the drive bushing and prevent free sliding movement of the Kelly rod through the bushing.

It is an object of the invention to overcome this difficulty by providing cylindrical rod-like keys which are positioned in grooves of the kelly and bushing in such a manner that driving contact area between the bushing and keys is substantially equal to the driving contact between the keys and Kelly rod with the resultant forces of the driving connection acting diametrically through the axes of the keys.

Another difficulty in rotary drilling mechanisms is that the Kelly rod moves through the drive bushing as the drilling progresses and enters the bore-hole below the drilling table so that it is coated with drilling fluid and mud when it is retracted through the table to add another section of drill pipe. Since there is clearance space between the drive bushing and Kelly rod, the drilling fluid and mud are carried into the bore of the drive bushing, and being of abrasive character are apt to cause rapid wear of the kelly, drive bushing, and the rod-like or cylindrical keys. A lack of adequate lubrication aggravates the wearing action.

Therefore, further objects of the present invention are to provide the Kelly rod bushing with means for wiping the drilling fluid from the Kelly rod when the Kelly rod is moved therethrough; and to provide for pressure lubrication of the driving faces to resist wear and entrance of the drilling fluid into the bushing.

In accomplishing these and other objects of the invention, as hereinafter pointed out, I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a vertical section through a drill rotating mechanism equipped with a kelly and drive bushing embodying the features of the present invention.

Fig. 2 is a horizontal section through the drive bushing and kelly on the line 2—2 of Fig. 1.

Fig. 3 is a perspective sectional view of the Kelly drive bushing removed from its seat in the turntable of the rotary mechanism.

Fig. 4 is an enlarged horizontal section on the line 4—4 of Fig. 1, particularly illustrating the keying elements and the clearance space between the bushing and Kelly rod.

Fig. 5 is a diagrammatic view showing the drive contact areas between the Kelly rod, drive bushing and rod-like keys whereby the thrusts acting on the keys are substantially equal.

Fig. 6 is a section through a drill rotating mechanism for actuating a conventional Kelly rod of polygonal cross-section, and equipped with a modified form of drive bushing to accommodate the conventional Kelly rod.

Fig. 7 is a horizontal section through the drive bushing and kelly on the line 7—7 of Fig. 5.

Fig. 8 is a perspective sectional view of the modified form of drive bushing.

Fig. 9 is a horizontal section through the drive bushing and kelly on the line 9—9 of Fig. 8.

Referring more in detail to the drawings:

1 designates a rotary mechanism such as used in connection with conventional drilling rigs for rotating the drilling string. The rotary mechanism includes a turntable 2 that is mounted on a gear housing 3, which is adapted to be secured to the platform of the drilling rig (not shown). The rotary table 2 is preferably mounted on anti-friction bearings 4 and carries a ring gear 5 meshing with a pinion gear 6. The pinion gear 6 is fixed on a drive shaft 7 that is connected with a prime mover (not shown), usually forming a part of the drilling rig. The turntable 2 has a

central opening 8 forming a conical seat 9 for a drive bushing 10 slidably keyed relatively to a Kelly rod 11 which extends therethrough. The drive bushing includes a substantially conical-shaped body 12 having a tapered exterior 13 engaging the seat 9, whereby the bushing is wedged within the turntable to rotate therewith. The drive bushing also includes laterally extending lugs 14 that engage in sockets 15 formed in the turntable to provide a positive driven connection therewith. The Kelly rod 11 is of circular cross-section and smaller in diameter than the bore 16 of the drive bushing to provide clearance space 16' therebetween whereby the Kelly rod is freely slidably through the drive bushing while the parts are under load incidental to rotation of the bushing and resistance offered by the drill bit.

The Kelly rod illustrated in Figs. 1 and 2 is formed of tubular stock to provide a channel 17 through which a drilling fluid is delivered to the drill pipe by way of a swivel head (not shown), which is attached to the upper end of the Kelly rod. The circular periphery of the Kelly rod is provided with a plurality of longitudinal grooves or flutes 18 of semicircular cross-section and shown as three in number, to engage driving keys 19 seated in registering semicircular grooves 20 formed in the face of the bore 16. The drive members or keys are of cylinder or rod-like shape having substantially close but sliding fit within the substantially semicircular grooves. The keys have less length than the bushing to accommodate sealing elements 21 and 22, later described. Due to the clearance space 16', and the relatively close fit of the keys, the grooves are slightly less than semicircular but they are of substantially equal depth in both the Kelly rod and bushing so that the driving contacts of the keys with the bushing and with the Kelly rod are substantially equal, as shown in Fig. 5. The axial centers of the keys therefore are in the space 16' and the driving connection between the bushing and the Kelly rod is through the diameter of the keys to equalize the pressure thereof against the walls of the respective grooves so they will not interfere with free sliding movement of the Kelly rod when under driving load. The keys have relatively close fit within the grooves so as to prevent radial play between the Kelly rod and drive bushing, thereby avoiding wear incidental to looseness. The shape of the keys permits free sliding movement of the Kelly rod through the bushing while they are retained therein from axial movement by means of the sealing elements now to be described. The driving pressures being equal, the keys maintain the Kelly rod concentric with the bore of the drive bushing.

Formed in the upper and lower ends of the drive bushing are counterbores 23 and 24, forming shoulders 25 and 26 substantially in registry with the ends of the keys as clearly shown in Fig. 1. Inserted within the counterbores, and engaging the shoulders, are rings 27 and 28 to engage the ends of the keys. Also inserted in the bores are packing rings 29 and 30, which are engaged by packing glands or followers 31 and 32. The rings 27 and 28 preferably have tongues 33 projecting from their inner periphery to closely engage in the grooves 18 of the Kelly rod to support similarly shaped tongues 34 of the packing rings, which also enter and seal the grooves of the kelly. The packing followers include collars 35 of suitable diameter to pass over the kelly and into the counterbores. The collars have radially extending flanges 36, provided with openings 37 for passing screws 38 having fillister heads 39 engaged in counterbores 40 of the flange openings, the shanks 41 of the screws being threaded in sockets 42 in the respective ends of the bushing, as shown in Fig. 1.

It is thus obvious that when the screws 38 are tightened, the followers 31 and 32 are moved into compressing relation with the packing rings 29 and 30, and the packing rings are forced into sealing contact with the circumferential face of the Kelly rod so as to effect a seal therebetween. The packing rings also form wipers for removing drilling fluid from the face and grooves of the rod before they pass into the bushing, so that the portions of the Kelly rod engaged by the inner bore of the bushing and the driving keys are free of drilling fluid. Since the drilling fluid is excluded from the bushing, it is, therefore, possible to lubricate the keys and bore of the bushing so as to further reduce wear and promote smoother driving action between the bushing and Kelly rod.

In order to supply the lubricant, the bushing 10 is provided with a channel 43 which extends downwardly from the upper end of the bushing and terminates substantially in the center thereof, as shown in Fig. 1. The outer end of the channel is counterbored and threaded, as at 44, to accommodate a pressure fitting 45 having a check valve 46 therein for closing the channel. It is thus obvious that by applying a pressure grease gun to the fitting, the lubricant or grease may be forced into the interior of the bushing and retained by the packings under pressure. Therefore the clearance space 16' between the kelly and drive bushing, as well as those surrounding the driving keys, is filled with lubricant under sufficient pressure to exclude further the possibility of drilling fluid entering the driving portion of the bushing. If desired, the washers 27 and 28 may be retained against the shoulders 25 and 26 by means of spring rings 47 engaged within grooves 48 in the walls of the bores and having portions projecting over the washers.

The drive bushing 49, illustrated in Figs. 6 to 9 inclusive, is substantially the same construction as that shown in Figs. 1, 2 and 3, with the exception that it is provided with a polygonal bore 50 and is equipped with similar packing elements 49, 51 and 52 at the respective ends thereof. The packing rings, however, conform in shape to the cross-sectional shape of the Kelly rod 53, the illustrated instance being a Kelly rod of hexagonal section. However, it is obvious that a similar bushing may be provided for any conventional shaped Kelly rod without departing from the spirit of the invention.

From the foregoing it is obvious that I have provided a Kelly rod and drive bushing assembly constructed to provide free sliding movement of the Kelly rod in the bushing, and have provided means to exclude the drilling fluid from the driving connection. I have also provided the bushing with a lubricant supply so that closer tolerances may be effected between the driving faces of the bushing and Kelly rod.

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

1. In a drill rotating mechanism, a Kelly rod of circular cross-section and having longitudinal grooves of substantially semicircular cross-section, a driving bushing having a cylindrical bore of slightly larger diameter than the diam-

eter of the Kelly rod to provide a clearance space therebetween for free sliding movement of the Kelly rod through the bushing, said bushing having grooves of substantially semicircular cross-section registering with the grooves in the Kelly rod and cooperating therewith to provide recesses of circular cross-section, cylindrical keys closely fitting within said recesses and having driven contact with the bushing substantially equal in area to driving contact with the Kelly rod, and means at the ends of the bushing engagingly retaining said cylindrical keys to prevent longitudinal movement of the keys in the bushing.

2. In a drill rotating mechanism, a Kelly rod of circular cross-section and having longitudinal grooves of substantially semicircular cross-section, a driving bushing having a cylindrical bore of slightly larger diameter than the diameter of the Kelly rod to provide a clearance space therebetween for free sliding movement of the Kelly rod through the bushing, said bushing having grooves of substantially semicircular cross-section registering with the grooves in the Kelly rod and cooperating therewith to provide recesses of circular cross-section, cylindrical keys closely fitting within said recesses and having driven contact with the bushing substantially equal in area to driving contact with the Kelly rod, said driving and driven contact areas being located on diametrically opposite sides of said keys, and means at the ends of the bushing engagingly retaining said cylindrical keys to prevent longitudinal movement of the keys in the bushing.

3. In a drill rotating mechanism, a Kelly rod of circular cross-section and having longitudinal grooves of substantially semicircular cross-section, a driving bushing having a cylindrical bore of slightly larger diameter than the diameter of the Kelly rod to provide a clearance space therebetween for free sliding movement of the Kelly rod through the bushing, said bushing having grooves of substantially semicircular cross-section registering with the grooves in the Kelly rod and cooperating therewith to provide recesses of circular cross-section, cylindrical keys closely fitting within said recesses and having driven contact with the bushing substantially equal in area to driving contact with the Kelly rod, and sealing means at the respective ends of the bushing to retain said cylindrical keys.

4. In a drill rotating mechanism, a Kelly rod of circular cross-section and having longitudinal grooves of substantially semicircular cross-section, a driving bushing having a cylindrical bore of slightly larger diameter than the diameter of the Kelly rod to provide a clearance space therebetween for free sliding movement of the Kelly rod through the bushing, said bushing having grooves of substantially semicircular cross-section registering with the grooves in the Kelly rod and cooperating therewith to provide recesses of circular cross-section, cylindrical keys closely fitting within said recesses and having driven contact with the bushing substantially equal in area to driving contact with the Kelly rod, said driving and driven contact areas being located on diametrically opposite sides of said keys, means at the ends of the bushing engagingly retaining said cylindrical keys to prevent longitudinal movement of the keys in the bushing, sealing means at the respective ends of the bushing to retain said cylindrical keys, and means connected with the bushing for injecting a lubricant between said sealing means to fill the clearance space and provide lubricant for the cylindrical keys.

5. In a drill rotating mechanism, a Kelly rod of circular cross-section and having longitudinal grooves of substantially semicylindrical cross-section, a drive bushing for the Kelly rod having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves and of substantially semicylindrical cross-section, driving keys in said registering grooves of substantially cylindrical cross-section, and packing means at the respective ends of said bore to seal the bushing with the Kelly rod including means for retaining said keys from longitudinal movement in the grooves of the drive bushing.

6. In a drill rotating mechanism, a Kelly rod of circular cross-section and having longitudinal grooves of substantially semicylindrical cross-section, a drive bushing for the Kelly rod having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves and of substantially semicylindrical cross-section, driving keys in said registering grooves of substantially cylindrical cross-section, packing means at the respective ends of said bore to seal the bushing with the Kelly rod including means for retaining said keys from longitudinal movement in the grooves of the drive bushing, and means connected with the drive bushing for injecting a lubricant between said packing means for lubricating the keys in said grooves.

7. In a drill rotating mechanism, a Kelly rod having longitudinal grooves, a drive bushing having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves, driving keys in said grooves, and packing means at the respective ends of said bore to seal the bushing with the Kelly rod including means for retaining said keys from longitudinal movement in the grooves of the drive bushing.

8. In a drill rotating mechanism, a Kelly rod having longitudinal grooves, a drive bushing having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves, driving keys in said grooves, packing means at the respective ends of said bore to seal the bushing with the Kelly rod including means for retaining said keys from longitudinal movement in the grooves of the drive bushing, and means for injecting a pressure medium into the bore of the drive bushing.

9. In a drill rotating mechanism, a Kelly rod having longitudinal grooves, a drive bushing having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves, driving keys in said grooves, said bushing having counterbores at the upper and lower ends thereof, and packing means in said counterbores to seal the bushing with the Kelly rod including means for retaining said keys from longitudinal movement in the grooves of the drive bushing.

10. In a drill rotating mechanism, a Kelly rod having longitudinal grooves, a drive bushing having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves, driving keys in said grooves, said bushing having counterbores at the upper and lower ends thereof, washers in the bottoms of said bores and having tongues extending into said Kelly rod grooves, packing supported by said

washers and having flexible tongues supported on said tongues of the washers, and glands for retaining said packing.

11. In a drill rotating mechanism, a Kelly rod having longitudinal grooves, a drive bushing having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves, driving keys in said grooves, said bushing having counterbores at the upper and lower ends thereof, washers in the bottoms of said bores and having tongues extending into said Kelly rod grooves, packing supported by said washers and having flexible tongues supported on said tongues of the washers, and glands for retaining said packing, said glands having tongues extending into the Kelly rod grooves to cooperate with the washer tongues in supporting the packing in sealing contact with said grooves.

12. In a drill rotating mechanism, a Kelly rod having longitudinal grooves, a drive bushing having a bore passing the Kelly rod therethrough and provided with grooves registering with the Kelly rod grooves, driving keys in said grooves, said bushing having counterbores at the upper and lower ends thereof, washers in the bottoms of said bores and having tongues extending into said Kelly rod grooves, packing supported by said washers and having flexible tongues supported on said tongues of the washers, glands for retaining said packing, and means for retaining said washers in the bottoms of said bores.

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