

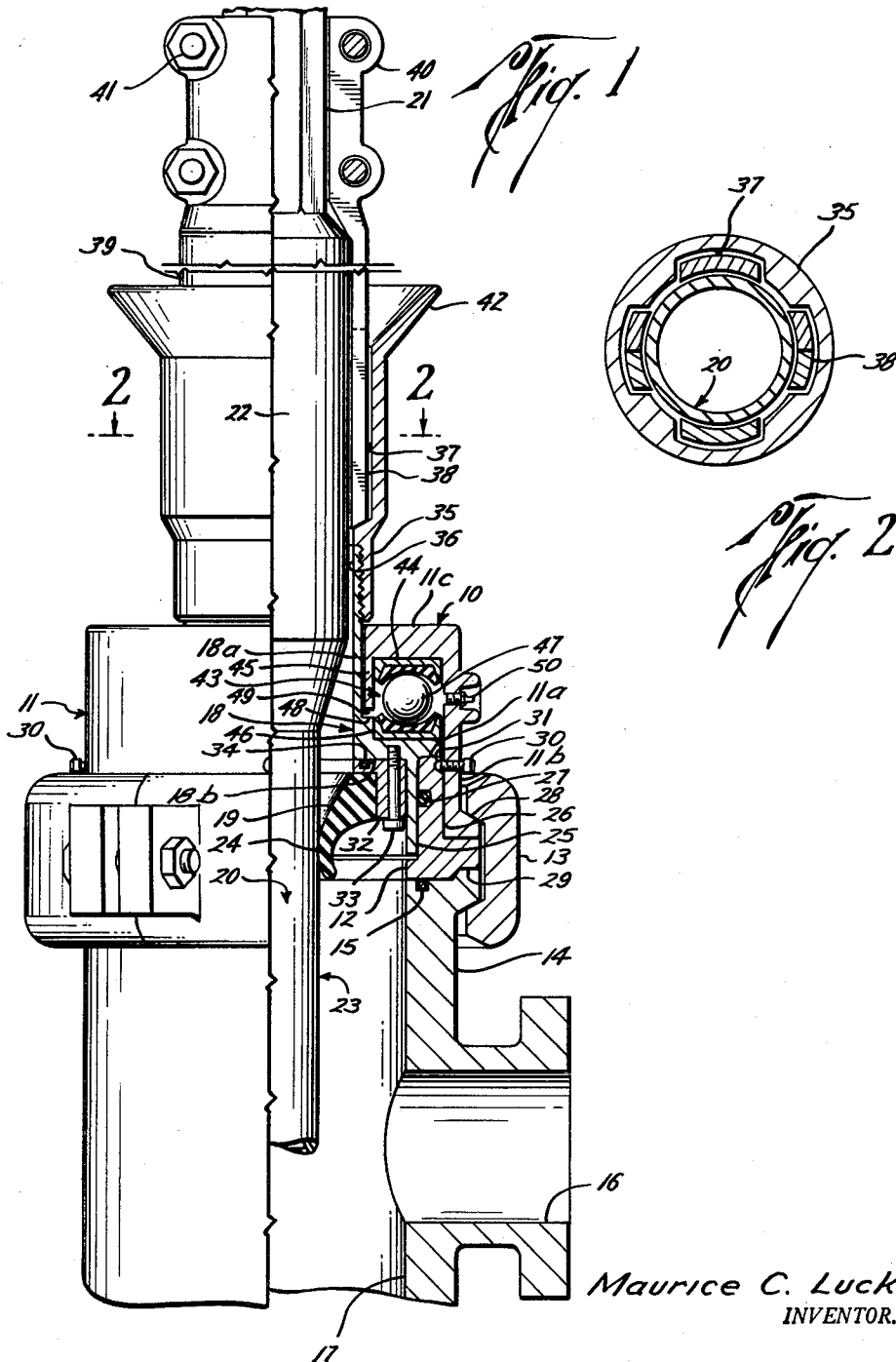
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DRILLING HEAD

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DRILLING HEAD

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This invention relates generally to well drilling heads; and, more particularly, to an improved head particularly well suited for use in rotary air or gas drilling.

In this type of well drilling, air or gas is pumped downwardly through the drill string for washing cuttings upwardly through the annulus about the string and out a port in the side of the wellhead. Alternatively, the air or gas may be admitted through the side port and pumped downwardly through the annulus for washing the cuttings up and out of the drill string. In either case, the air in the annulus is contained by means of a "stripper rubber" which closes about tool joints and portions of the Kelly as well as the drill pipe above the side port as they are "stripped" or run through it under pressure. In addition to containing the drilling fluid, the stripper rubber also aids in containing well fluid under pressure.

This stripper rubber comprises a radially flexible annulus which is mounted on a housing of a drilling head which is connected above a blowout preventer or other wellhead member. Preferably, it is carried from the housing for rotation with the pipe during drilling so as to keep wear on the rubber to a minimum.

In a rotating drilling head of this general type, well pressure may subject the carrier for the rubber to a rather substantial axial thrust. One serious problem which has been encountered is the cutting and scoring of the conventional thrust bearing disposed between the carrier and housing for this purpose, because grit and other fine particles find their way between its moving metal parts. Although proposals have been made in other fields to use resilient rolling parts which permit gritty particles to be pressed into them without scoring the metal races, such bearings would be irreparably damaged by the axial thrust encountered in the drilling of wells.

An object of this invention is to provide a drilling head having a thrust bearing which will enable low friction rotation of the stripper rubber during air or gas drilling without, at the same time becoming cut, scored or otherwise damaged in the event well pressure becomes excessive.

This and other objects are accomplished, in accordance with the illustrated embodiment of this invention, by a rotating drilling head having an axial thrust bearing between the housing and the carrier for the stripper rubber which, as distinguished from the conventional bearing, has races of rubber-like material and metal balls or rollers therebetween. Although the thrust on the carrier due to well pressures would ordinarily distort the races to such an extent as to damage them beyond repair, axial movement of the carrier toward the housing is limited by a part on the carrier which moves into engagement with a part on the housing before the well pressure exceeds a certain value. Although such interengagement of the carrier and housing will have a substantial braking effect on the stripper rubber, this is of no concern since the pressure sufficient to cause interengagement is higher than that at which air drilling will be continued in any event. That is, air or gas drilling is normally carried on only at relatively low well pressures so that the axial force on the bearing is so small that there is virtually no distortion of

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the races. By the time the well pressure reaches a point at which its thrust would unduly distort the bearing races, air drilling would be stopped so that the rotating bearing would no longer be required.

In the drawings, wherein like reference characters are used throughout to designate like parts:

FIG. 1 is a view of a rotating drilling head constructed in accordance with the present invention, with one side thereof in section and the stripper rubber closed about a drill pipe received therein; and

FIG. 2 is a cross-sectional view of the head, as seen along broken line 2-2 of FIG. 1.

Turning now to a detailed description of the drawings, and particularly FIG. 1 thereof, the rotating drilling head, which is designated in its entirety by reference character 10, includes a housing 11 having a bore 12 therethrough and connected by a conventional clamp 13 or other suitable means to the upper end of a wellhead member 14, which may be a blowout preventer. The oppositely facing ends of the housing 11 and wellhead member 14 are sealed with respect to one another by means of an O-ring 15 carried by one of them, and the wellhead member has a port 16 in its side communicating with the bore 12 therethrough which forms a continuation of the bore 12 through the housing 11. Obviously, this side port may be formed in the housing of the drilling head.

The drilling head also includes a carrier 18 which is received within and mounted on the housing 11 for rotation and axial movement with respect thereto, in a manner to be described hereinafter. This carrier mounts a stripper rubber 19 which, as previously noted, comprises an annulus of resilient material for closing about a drill string 20 received therein above the side port 16. As shown, this drill string includes an out-of-round Kelly 21 at its upper end which is connected by means of a tool joint 22 to a section 23 of drill pipe. As well known in this art, the Kelly extends upwardly to suitable apparatus which includes a drive bushing for imparting rotation to the string as well as hoists for raising and lowering the string during drilling of the well.

As the string is moved vertically, its differently contoured and sized components will pass successively through the stripper rubber 19. In order to maintain a closure about each of these components, the stripper rubber is radially flexible and includes a downwardly directed lip 24 for containing well pressure in the annulus between the drill string and the bore through the wellhead member 14. Thus, as fluid is pumped either downwardly through the drill string or downwardly through the annulus, it is contained for passage into the side port 16 or into the lower end of the drill string.

The carrier 18 includes a tubular body 18a having an outwardly extending flange 18b, the outer periphery of which seats upon an inner shoulder 11a of a packing assembly 26, which forms part of the housing 11, to support the carrier against downward movement with respect to the housing. A sleeve 25 depending from an intermediate portion of the flange 18b extends closely within a surrounding counterbored portion of the packing assembly 26 of the housing to provide a radial guide for the carrier. An O-ring 27 or other seal means is carried in the counterbored portion of the packing assembly for sealing engagement with the sleeve during rotation and axial movement of the carrier with respect to the housing.

The lower end of a tubular body portion 11b of the housing is closely fittable about the packing assembly 26 and has an outwardly extending lower flange 28 which

bears upon an outer flange 29 of the assembly when the clamp 13 is in place. Upon disconnection of the clamp and removal of the drilling head from the wellhead member 14, the packing assembly is removable from the housing body portion by means of bolts 30 on such portion which have inner ends removably received within a groove 31 about the packing assembly. The stripper rubber 19 is molded to a ring 32 of the carrier which is removably connected by cap screws 33 to the carrier flange 18b within the sleeve 25 to permit replacement of the stripper rubber separately from the remainder of the head upon removal of the head from the well. This ring is also sealed with respect to the flange by means of an O-ring 34 to prevent well fluid from passing between the ring and flange.

The tubular body 18a of the carrier above the flange 18b provides a bore 36 for receiving the drill string above the stripper rubber, and an upwardly extending sleeve 35 providing a continuation of the bore is threaded to the body to enable separation of the carrier and housing. As best shown in FIG. 2, slots 37 on the interior of sleeve 35 receive fingers 38 at the lower end of a split drive sleeve 39 removably received within and seated upon the sleeve 35. With reference to FIG. 1, the upper end 40 of the drive sleeve has an out-of-round interior for rotatable driving engagement with the Kelly 21 of the drill string as the Kelly moves vertically therethrough. This split housing is removably secured about the Kelly by means of bolts 41 and, when so disposed, may be lowered into the driving engagement with the carrier sleeve 35. In this manner, the rotation of the Kelly is imparted to the carrier through the drive sleeve 39 so as to rotate the stripper rubber with the drill string for the reason previously mentioned. As shown in FIG. 1, the upper end of sleeve 35 has a bell 42 for guiding the lower end of the string into the bore of the drilling head.

As will be understood from the foregoing description, well pressure within the annulus between the drill string and wellhead member 14 will urge the carrier 18 axially upwardly with respect to the housing 11 which is fixed to the wellhead member. The bearing for taking this thrust, and indicated in its entirety by reference character 43, is contained between the upper side of the flange 18b of the carrier and the lower side of an inwardly extending radial flange 11c on the upper end of the tubular body portion 11b of the housing. It comprises an upper race 44 on the flange 11c and a lower race 46 on the flange 18b, each race comprising a resilient ring of rubber or rubber-like material molded to an annular metal cup. As shown in FIG. 1, the cups for the races are received within annular channels formed between the inside of the tubular body portion 11b and a rim 45 on flange 11c and an abutment on the inner end of the flange 18b.

In the particular embodiment if the bearing shown in the drawings, the inner faces of the resilient races are dished out to contain the opposite sides of metal balls 47 received therebetween. As in the case of conventional thrust bearings, these balls roll between the races as the races are rotated with respect to one another—that is, as the carrier 18 rotates with respect to the housing 11. As previously noted, the gritty substances which enter the bearing and get between the contacting surfaces of the balls 47 and the races are pressed into the resilient material of the races so that they do not score the metal balls. A grease fitting 50 in the housing body portion 11b enables lubrication of the bearing.

As previously described, the upward movement of the carrier with respect to the housing will distort the resilient material of the races 44 and 46 to a certain amount. However, in accordance with the present invention, this distortion is limited by the engagement of a shoulder 48 on the abutment on the carrier flange 18b with an oppositely facing surface 49 on the rim 45 of the housing before this distortion has reached a point that it renders the bearing inoperable. As also mentioned heretofore, air drilling is ordinarily stopped when well pressure rises,

so that this bearing will enable the carrier to rotate with a minimum of friction during the drilling operation. Then, when the well pressure rises and the drilling is discontinued, the shoulder 48 will move into engagement with the shoulder 49 to transfer the thrust of the carrier directly to the housing and limit further distortion of the bearing races.

Reviewing now the over-all operation of the apparatus of this invention, a drill string 20 is rotated by suitable apparatus (not shown) as it is lowered through the drilling head 10. At the same time, air or gas is either pumped downwardly through the drill string and out the side port 16 in the wellhead member or, in the alternative, downwardly through the annulus and up and out of the drill string, so as to wash away the cuttings at the lower end of the well. In either case, this fluid medium is contained within the annulus between the drill string and the wellhead member 14 by means of the stripper rubber 19 which is rotated with the drill string to reduce its wear to a minimum.

During this drilling operation, the carrier 18 for the rubber 19 rotates with respect to the housing 11 with very low friction due to the thrust bearing 43. Inasmuch as the races 44 and 46 of this bearing are of resilient material, the gritty substances which may find their way between the races and the metal balls or other rolling elements 47 do not score the metal, but instead are pressed into the races as the carrier moves upwardly due to the axial thrust of well pressure within the annulus. Although the races will thereby be distorted somewhat, when this pressure reaches a point at which air drilling must be discontinued, the shoulder 48 moves into engagement with the shoulder 49 to limit further axial movement of the carrier and transfer the load of the carrier directly to the housing. Thus, the resilient races are not distorted to such an extent as to be damaged and the bearing may be used again without replacement.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A drilling head, comprising a housing for connection above a wellhead member, a carrier received within the housing for rotative and axial movement with respect thereto, means sealing between the carrier and housing during such movement, an annulus of resilient material on the carrier for closing about a pipe received therein to contain fluid in the annular space between the pipe and wellhead member, a bearing between the carrier and housing to receive the thrust in one axial direction due to the pressure of the contained fluid, said bearing comprising first and second races of resilient material on the carrier and housing, respectively, and a plurality of relatively rigid parts for rolling therebetween upon rotation of said carrier with respect to the housing, and means to prevent undue distortion of the bearing races by limiting axial movement of said carrier in said one direction with respect to said housing.

2. A drilling head, comprising a housing, means on the housing for connecting it above a wellhead member, a carrier sealably mounted within the housing for rotation and axial movement with respect thereto, an annulus of resilient material mounted on the carrier and having a downwardly directed lip for sealably closing about a pipe within the carrier, a thrust bearing between the carrier and

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housing including oppositely facing annular races of resilient material having a plurality of relatively rigid, rolling elements therebetween, and stop parts on the carrier and housing engageable with one another upon predetermined upward axial movement of the carrier with respect to the housing. 5

3. A drilling head of the character defined in claim 2, wherein said housing and carrier comprise tubular bodies having inwardly and outwardly extending flanges, respectively, for containing the bearing races therebetween, and 10

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said parts comprise oppositely facing shoulders on said housing and carrier flanges.

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