Hydrodynamic Journal Bearing Flow Control Bushing for a Rotating Control Device

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Patent Application Serial No. 61/579,134, titled Hydrodynamic Journal Bearing Flow Control Bushing for a Rotating Control Device, which was filed December 22, 2011. This priority application is hereby incorporated by reference in its entirety into the present application, to the extent that it is not inconsistent with the present application.

BACKGROUND

[0002] This disclosure relates generally to methods and apparatus for controlling wellbore pressure during drilling processes. More specifically, this disclosure relates to rotating control devices for use in hydrocarbon recovery operations that can withstand high wellbore pressures while maintaining sealed engagement with a rotating tubular.

[0003] Rotating control devices generally include an annular sealing member that is supported within a rotating inner body and a stationary outer body. Hydraulic pressure is applied to the annular sealing member to effectuate a seal against a wellbore tubular that is disposed within the rotating control device. The sealing member and the inner body, which is rotatably supported on bearings coupled to the outer body, rotate with the wellbore tubular. In this manner, rotating control devices allow for elevated wellbore pressure to be maintained while the wellbore tubular is rotated, enabling activities such as underbalanced drilling.

[0004] Under their normal operating conditions, rotating control devices are often subjected to high pressure and rotational speeds during operation. Therefore, the rotating components and the bearings that support the components have to be designed to handle these loads. As components begin to wear or are damaged, operation of the rotating control device will be effected and drilling operations will eventually have to be suspended to allow for maintenance or replacement of worn components.

[0005] Thus, there is a continuing need in the art for rotating control devices that overcome these and other limitations of the prior art.

BRIEF SUMMARY OF THE DISCLOSURE

[0006] ~~In certain embodiments~~According to a first aspect of the present invention, there is provided a rotating control device ~~comprises~~ comprising an outer housing having a bore for receiving a tubular member.; ~~An~~ an inner housing and a piston assembly are rotatably

disposed within the outer housing~~.~~; ~~An~~ an annular sealing assembly ~~is~~ disposed between the piston assembly and the inner housing so that axial movement of the piston assembly moves the annular sealing assembly into sealing engagement with the inner housing and the tubular member~~.~~; ~~A plurality of bearings is disposed between the inner housing and the outer housing. At least one of the plurality of bearings is~~ a hydrodynamic journal bearing that is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing~~.~~; and means for urging the flow bushing into an eccentric position relative to the inner housing.

[0006a] According to a second aspect of the present invention, there is provided a rotating control device comprising: an outer housing defining a bore therein for receiving a tubular member; an inner housing rotatably disposed within the outer housing; an annular sealing assembly supported within the inner housing for sealed engagement with the tubular member; a rotatable piston axially movable within the outer housing, wherein axial movement of the rotatable piston causes radially inward movement of the annular sealing assembly; and a hydrodynamic journal bearing that is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing.; and means for urging the flow bushing into an eccentric position relative to the inner housing.

[0006b] According to a third aspect of the present invention, there is provided a method for operating a rotating control device comprising: disposing an inner housing, a piston assembly, and an annular sealing assembly within an outer housing, wherein the inner housing, piston assembly, and the annular sealing assembly are supported by a plurality of bearings disposed between the inner housing and the outer housing that allow the inner housing, piston assembly, and the annular sealing assembly to rotate relative to the outer housing, and wherein at least one of the plurality of bearings is a hydrodynamic journal bearing that is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing, wherein the rotating control device also includes means for urging the flow bushing into an eccentric position relative to the inner housing; and providing a pressurized fluid to the hydrodynamic journal bearing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] For a more detailed description of the embodiments of the present disclosure, reference will now be made to the accompanying drawings.

[0008] Figure 1 is a partial sectional view of a rotating control device.

[0009] Figure 2 is a sectional view of a portion of the rotating control device of Figure 1.

[0010] Figure 3 is a partial sectional schematic view of a portion of the rotating control device of Figure 1.

DETAILED DESCRIPTION

[0011] It is to be understood that the following disclosure describes several exemplary embodiments for implementing different features, structures, or functions of the invention. Exemplary embodiments of components, arrangements, and configurations are described below to simplify the present disclosure; however, these exemplary embodiments are provided merely as examples and are not intended to limit the scope of the invention. Additionally, the present disclosure may repeat reference numerals and/or letters in the various exemplary embodiments and across the Figures provided herein. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various exemplary embodiments and/or configurations discussed in the various Figures. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact. Finally, the exemplary embodiments presented below may be combined in any combination of ways, i.e., any element from one exemplary embodiment may be used in any other exemplary embodiment, without departing from the scope of the disclosure.

[0012] Additionally, certain terms are used throughout the following description and claims to refer to particular components. As one skilled in the art will appreciate, various entities may refer to the same component by different names, and as such, the naming convention for the

What is claimed is:

1. A rotating control device comprising:

an outer housing defining a bore therein for receiving a tubular member;

an inner housing rotatably disposed within the outer housing;

a piston assembly rotatably disposed within the outer housing;

an annular sealing assembly disposed between the piston assembly and the inner housing, wherein axial movement of the piston assembly moves the annular sealing assembly into sealing engagement with the inner housing and the tubular member; ~~and~~

~~a plurality of bearings disposed between the inner housing and the outer housing, wherein at least one of the plurality of bearings is~~ a hydrodynamic journal bearing that is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing~~.~~; and

means for urging the flow bushing into an eccentric position relative to the inner housing.

~~2. The rotating control device of claim 1, wherein the hydrodynamic journal bearing is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing.~~

32. The rotating control device of claim 21, ~~further comprising~~wherein the means for urging the flow bushing into an eccentric position relative to the inner housing comprises a bushing spring disposed between the outer housing and the flow bushing.

43. The rotating control device of ~~any preceding~~ claim 1, wherein an outer surface of the inner housing sleeve is coated with a soft metal bearing material.

54. The rotating control device of claim ~~2 or 3~~1, wherein an inner surface of the flow bushing is hardened.

65. The rotating control device of ~~any preceding~~ claim 1, further comprising a fluid input port and a fluid output port disposed through the outer housing and in fluid communication with each other and with the hydrodynamic journal bearing.

76. The rotating control device of ~~any preceding~~ claim 5, further comprising a closing chamber defined by the piston and the outer housing, wherein the closing chamber is in fluid communication with the hydrodynamic journal bearing.

87. A rotating control device comprising:

an outer housing defining a bore therein for receiving a tubular member;

an inner housing rotatably disposed within the outer housing;

an annular sealing assembly supported within the inner housing for sealed engagement with the tubular member;

a rotatable piston axially movable within the outer housing, wherein axial movement of the rotatable piston causes radially inward movement of the annular sealing assembly; and

~~a plurality of bearings disposed between the inner housing and the outer housing, wherein at least one of the plurality of bearings is~~ a hydrodynamic journal bearing that is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing~~.~~; and

means for urging the flow bushing into an eccentric position relative to the inner housing.

~~9. The rotating control device of claim 8, wherein the hydrodynamic journal bearing is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing.~~

~~10~~8. The rotating control device of claim ~~9~~7, ~~further comprising~~wherein the means for urging the flow bushing into an eccentric position relative to the inner housing comprises a bushing spring disposed between the outer housing and the flow bushing.

~~11~~9. The rotating control device of claim ~~8, 9 or 10~~7, wherein an outer surface of the inner housing sleeve is coated with a soft metal bearing material.

~~12~~10. The rotating control device of claim ~~9 or 10~~7, wherein an inner surface of the flow bushing is hardened.

~~13~~11. The rotating control device of ~~any one of claims 8 to 12~~claim 7, further comprising a fluid input port and a fluid output port disposed through the outer housing and in fluid communication with each other and with the hydrodynamic journal bearing.

~~14~~12. The rotating control device of ~~any one of claims 8 to 13~~claim 11, further comprising a closing chamber defined by the piston and the outer housing, wherein the closing chamber is in fluid communication with the hydrodynamic journal bearing.

~~15~~13. A method for operating a rotating control device comprising:

disposing an inner housing, a piston assembly, and an annular sealing assembly within an outer housing, wherein the inner housing, piston assembly, and the annular sealing assembly are supported by a plurality of bearings disposed between the inner housing and the outer housing that allow the inner housing, piston assembly, and the annular sealing assembly to

rotate relative to the outer housing, and wherein ~~at least~~ one of the plurality of bearings is a hydrodynamic journal bearing that is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing, wherein the rotating control device also includes means for urging the flow bushing into an eccentric position relative to the inner housing; and

providing a pressurized fluid to the hydrodynamic journal bearing.

~~16~~14. The method of claim ~~15~~13, further comprising providing a pressurized fluid to a closing chamber defined by the piston and the outer housing so as to move the piston axially relative to the outer housing.

~~17~~15. The method of claim ~~16~~ 14 wherein the closing chamber is in fluid communication with the hydrodynamic journal bearing.

~~18. The method of any one of claims 15 to 17, wherein the hydrodynamic journal bearing is formed between an inner housing sleeve that is coupled to the inner housing and a flow bushing that is coupled to the outer housing.~~

~~19~~16. The method of claim ~~18~~13, further comprising a bushing spring disposed between the outer housing and the flow bushing.

~~20~~17. The method of claim ~~18 or 19~~13, wherein an outer surface of the inner housing sleeve is coated with a soft metal bearing material and an inner surface of the flow bushing is hardened.