METHOD AND DEVICE FOR REDUCING FRICTION BETWEEN HELICAL MEMBERS OF A DOWNHOLE DAMPER

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ABSTRACT

A method for reducing friction between interconnected outer and inner helical members of a downhole damper where the damper includes an outer damper body and an inner damper body, and where the outer and inner damper bodies are telescopically movable relative each other, the outer and inner damper bodies being biased in the extending direction, and where one of the outer and inner damper bodies is connected to a drill bit workable at a borehole face, and where the other of the outer and inner damper bodies is connected to a torque and force transmitting member, and where the outer and inner helical parts are arranged so as to retract the bit from the face when torque applied by the torque and force transmitting member exceeds a preset value, wherein the method includes letting a relative movement between the inner and outer body force lubricant to flow between the helical members.
METHOD AND DEVICE FOR REDUCING FRICTION BETWEEN HELICAL MEMBERS OF A DOWHOLE DAMPER

BACKGROUND

[0001] There is provided a method for reducing friction between helical members of a downhole damper. More precisely there is provided a method for reducing friction between interconnected outer and inner helical members of a downhole damper where the damper includes an outer damper body and an inner damper body, and where the outer and inner damper bodies are successively movable relative each other, the outer and inner damper bodies being biased in the extending direction, and where one of the outer and inner damper bodies, possibly via intermediate items, are connected to a drill bit workable at a borehole face, and where the other of the outer and inner damper bodies is connected to a torque and force transmitting member, and where the outer and inner helical parts are arranged so as to retract the bit from the face when torque applied by the torque and force transmitting member exceeds a preset value. The invention also includes a device for practising the method.

[0002] When drilling in the ground it is normal, at least in some types of formations, to use a torsion damper in order to damp the varying force from a drill bit that acts on a torque and force transmitting member. Typically the torque and force transmitting member is in the form of a drill string. The damping element in the damper may include rubber or spring elements.


[0004] The operating principle of this damper is that when the torque from the bit exceed a preset value, the bit is somewhat retracted from the face. Thus the torque is reduced and the bit is again forced against the face.

[0005] In order to maintain a stable rate of penetration, it is of utmost importance to keep the friction between the helical members of the damper as low as possible. A low friction reduces the hysteresis of the damper and promotes an even cutting depth.

[0006] According to the above US-patent the helical members are enclosed in lubricant, but the friction is still higher than preferred.

SUMMARY

[0007] The purpose of the invention is to overcome or reduce at least one of the disadvantages of the prior art.

[0008] The purpose is achieved according to the invention by the features as disclosed in the description below and in the following patent claims.

[0009] There is provided a method for reducing friction between interconnected outer and inner helical members of a downhole damper where the damper includes an outer damper body and an inner damper body, and where the outer and inner damper bodies are successively movable relative each other, the outer and inner damper bodies being biased in the extending direction, and where one of the outer and inner damper bodies is connected to a drill bit workable at a borehole face, and where the other of the outer and inner damper bodies is connected to a torque and force transmitting member, and where the outer and inner helical parts are arranged so as to retract the bit from the face when torque applied by the torque and force transmitting member exceeds a preset value, wherein the method includes:

[0010] letting a relative movement between the inner and outer bodies force lubricant to flow between the helical members.

[0011] Intermediate items known to a skilled person may be present at least between the damper and the drill bit or between the damper and the torque and force transmitting member.

[0012] By letting the relative movement between the inner and outer bodies force lubricant to flow between the helical members, a much improved lubrication is achieved compared to a normal lubricant-filled systems where lubricant just follow the movement of surfaces.

[0013] A continues exchange of lubricant between the helical members proportional to the relative movement of the helical members is achieved. This renders it possible to increase the length of contact between the helical members and thus reduce the contact pressure between them.

[0014] As the contact pressure is reduced, higher load may be applied to the damper and improved working life may be achieved.

[0015] The method may further include:

[0016] arranging a closed first cavity filled with lubricant at a first end party of the helical members;

[0017] arranging a closed second cavity filled with lubricant at a second end party of the helical members;

[0018] shrinking the closed first cavity of lubricant and expanding the closed second cavity of lubricant when the inner helical member is moved toward the first cavity of lubricant.

[0019] Such a method provides a simple and operationally reliable way of achieving the purpose of the invention.

[0020] The method may be practiced by the use of a downhole damper where the damper includes an outer damper body having an outer helical member, and an inner damper body having an inner helical member operable interconnected with the outer helical member, and where the outer and inner damper bodies are successively movable relative each other, the outer and inner damper bodies being biased in the extending direction, and where one of the outer and inner damper bodies is connected to a drill bit workable at a face, and where the other of the outer and inner damper bodies are connected to a torque and force transmitting member, and where the outer and inner helical parts are arranged so as to retract the bit from the face when torque applied by the torque and force transmitting member exceeds a preset value, wherein a closed first cavity is defined by the inner damper body, a first bore in the outer damper body, the outer helical member and a first cylindrical part of the inner damper body, and where a closed second cavity is defined by the inner damper body, a second bore in the outer damper body, the outer helical member and a second cylindrical part of the inner damper body, and where the first and second cavity are positioned at opposite ends of the outer helical member.

[0021] The downhole damper may include an inner helical member including helical splines with at least a first or a second contact area wherein at least one of the contact areas have pockets.

[0022] The pockets may be in the form of voids or cavities in the contact areas. The purpose of the pockets is to hold lubricant for the nearby parts of the contact areas.

[0023] As the contact areas, when no pockets are present, is relatively long, flow of lubrication may be insufficient, par-
ticularly when short movements between the helical members are encountered. The pockets relieve this problem as the distance between pockets may be relatively short.

[0024] The cross section areas of the first and second cavities are substantially equal. The need for a volume compensator is thus eliminated.

[0025] In some applications, when the cross section areas of the first and second cavities may be unequal, a volume compensator may be present, but designed to retain the forced lubrication of the invention. The compensator may be in the form of a gas driven lubricant-filled compensator. If such a compensator is connected to the first cavity, the pressure in the first cavity will be governed by the pressure in the compensator, also when the inner damper body is moved in the direction towards the second cavity.

[0026] To compensate for lubricant leakage, a device for continuous or intermittent refilling of the first and second cavities may be present, for instance in the form of a lubricant-filled compensator having a one way valve on its supply line.

[0027] The method and device according to the invention render it possible to overcome weaknesses of prior art compensators in that improved lubrication reduces hysteresis and improves working life of the compensator as well as improves its load bearing capacity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] Below, an example of a preferred method and damper is explained under reference to the enclosed drawings, where:

[0029] FIG. 1 shows a damper according to the invention positioned in a borehole in the ground;

[0030] FIG. 2 shows a section of the damper where an inner damper body is in a middle position in an outer damper body;

[0031] FIG. 3 shows the same as in FIG. 2, but where the inner damper body is moved somewhat into the outer damper body;

[0032] FIG. 4 shows the same as in FIG. 2 in an alternative embodiment.

DETAILED DESCRIPTION OF THE DRAWINGS

[0033] On the drawings the reference number 1 denotes a damper that is positioned between a drill bit 2 and a torque and force transmitting member 4, here in the form of a drill string, in a borehole 6 in the ground 8. The bit 2 is working on a face 10 of the borehole.

[0034] The damper 1 includes an outer damper body 12 and an inner damper body 14 where the inner damper body 14 is telescopically movable relative the outer damper body 12.

[0035] In FIGS. 2 and 3 the outer damper body 12 is shown sectioned, while the inner damper body 14 is shown solid.

[0036] The outer damper body 14 includes an outer helical member 16 that is operable interconnected with an inner helical member 18.

[0037] In this preferred embodiment the outer and inner helical members 16, 18 are formed as trapezoidal helical splines 20.

[0038] At a first end party 22 of the helical members 16, 18, extending from the outer helical member 16, the outer damper body 12 has a first bore 24. At a second end party 26 of the helical members 16, 18, extending from the outer helical member 16, the outer damper body 12 has a second bore 28.

The first and second bores 24, 28 have substantially equal diameters that are larger than an inner diameter of the outer helical member 16.

[0039] A closable port 30 is provided in the outer damper body 12 at the first bore 24.

[0040] The inner damper body 14 has a first flange 32 at the first end party 22. The outer diameter of the first flange 32 corresponds to the diameter of the first bore 24 and is movable in the first bore 24. A first seal 34 prevents fluid from flowing between the first bore 24 and the first flange 32.

[0041] At the second end party 26, the inner damper body 14 has a second flange 36. The outer diameter of the second flange 36 corresponds to the diameter of the second bore 28 and is movable in the second bore 28. A second seal 38 prevents fluid from flowing between the second bore 28 and the second flange 36.

[0042] A compression spring 40 is biasing the inner damper body 14 in the extending direction of the damper 1 that is downwards in FIG. 2.

[0043] A closed first cavity 42 for lubricant is thus formed as an annulus between the first bore 24 and the inner damper body 14. The first cavity 42 is limited in the axial direction by the outer helical member 16 and the first flange 32.

[0044] A closed second cavity 44 for lubricant is formed as an annulus between the second bore 28 and the inner damper body 14. The second cavity 44 is limited in the axial direction by the outer helical member 16 and the second flange 36.

[0045] A clearance 46 exists between the outer helical member 16 and the inner helical member 18. A first contact area 48 is present on the side facing the first cavity 42 of the helical splines 20, while a second contact area 50 is present on the opposite side of the helical splines 20.

[0046] After lubricant is filled through the port 30 into the first and second cavities 42, 44, and the clearance 46, the port 30 is closed.

[0047] When the combined torque and axial force exerted on the damper 1 exceed the biasing force of the spring 40, see FIG. 3, the inner damper body 14 is moving into the outer damper body 12 under relative rotation, thus retracting the bit 2 from a face 46 of the bore hole 6.

[0048] As the inner damper body 14 is moving into the outer damper body 12, the second flange 36 is moved into the second cavity 44. The volume of the second cavity 44 is reduced and the surplus lubricant present in the second cavity 44 forced to flow through the clearance 46. The lubricant is thus lubricating contact areas 48, 50 between the outer helical member 16 and the inner helical member 18, as well as cleaning the clearance 46.

[0049] The lubricant may flow into the closed first cavity 42 as the volume of this first cavity is expanding due to the first flange 32 moving away from the first cavity 42. The volume of the first cavity 42 is expanding at substantially the same rate as the volume of second cavity 44 is reduced.

[0050] When the bit 2 is withdrawn sufficiently from the face 46, the torque and axial force acting on the damper 1 is reduced. The spring 40 will then force to move the inner damper body 14 for the damper 1 to be extended.

[0051] The lubricant will then flow through the clearance 46 in the opposite direction from the first cavity 42 and into the second cavity 44.

[0052] In an alternative embodiment, see FIG. 4, the trapezoidal helical splines 20 are provided with a number of pockets 52 in the form of voids in the first and second contact areas 48, 50.
FIG. 4 also shows a compensator 54 that is connected to the first cavity 42 by a supply line 56. If the supply line 56 is equipped with a one way valve 58, the compensator 54 acts as refill device.

When the inner damper body 14 is moved into the outer damper body 12, the value of the clearance 46 at the first contact area 48 is probably different from the value of the clearance 46 at the second contact area 50.

A larger portion of the lubricant flow will direct itself to the contact area 48, 50 having the largest clearance 46. As the contact area 48, 50 receiving least flow has pockets 52 filled with lubricant, sufficient lubricant is available to secure proper lubrication at all times.

The lubricant present in the pockets 52 of the contact area 48, 50 having the largest clearance, will be exchanged by the flow through the clearance 46.

What is claimed is:

1. A method for reducing friction between interconnected outer and inner helical members of a downhole damper where the damper includes an outer damper body and an inner damper body, and where the outer and inner damper bodies are telescopically movable relative each other, and an outer and inner damper bodies being biased in the extending direction, and where one of the outer and inner damper bodies is connected to a drill bit workable at a borehole face, and where the other of the outer and inner damper bodies is connected to a torque and force transmitting member, and where the outer and inner helical parts are arranged so as to retract the bit from the face when torque applied by the torque and force transmitting member exceeds a preset value, wherein the method includes:

   letting a relative movement between the inner and outer body force lubricant to flow between the helical members.

2. A method according to claim 1, wherein the method further includes:

   arranging a closed first cavity filled with lubricant at a first end party of the helical members;

   arranging a closed second cavity filled with lubricant at a second end party of the helical members;

   shrinking the closed first cavity of lubricant and expanding the closed second cavity of lubricant when the inner helical member is moved towards the first cavity of lubricant.

3. A downhole damper where the damper includes an outer damper body having an outer helical member, and an inner damper body having an inner helical member operable interconnected with the outer helical member, and where the outer and inner damper bodies are telescopically movable relative each other, the outer and inner damper bodies being biased in the extending direction, and where one of the outer and inner damper bodies is connected to a drill bit workable at a face, and where the other of the outer and inner damper bodies is connected to a torque and force transmitting member, and where the outer and inner helical parts are arranged so as to retract the bit from the face when torque applied by the torque and force transmitting member exceeds a preset value, wherein a closed first cavity is defined by the inner damper body, a first bore in the outer damper body, the outer helical member and a first cylindrical part of the inner damper body, and where closed second cavity is defined by the inner damper body, a second bore in the outer damper body, the outer helical member and a second cylindrical part of the inner damper body, and where the first and second cavity are positioned at opposite ends of the outer helical member.

4. A downhole damper according to claim 1, wherein the inner helical member includes helical splines with at least a first or a second contact area.

5. A device according to claim 1, wherein at least one of the contact areas have pockets.

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