

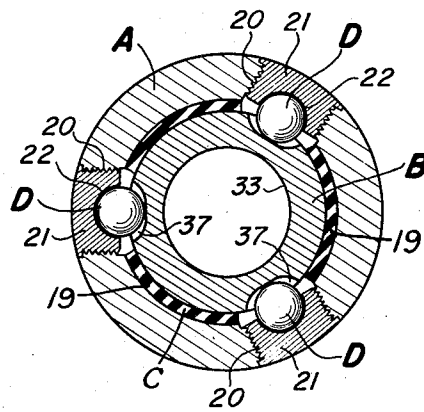
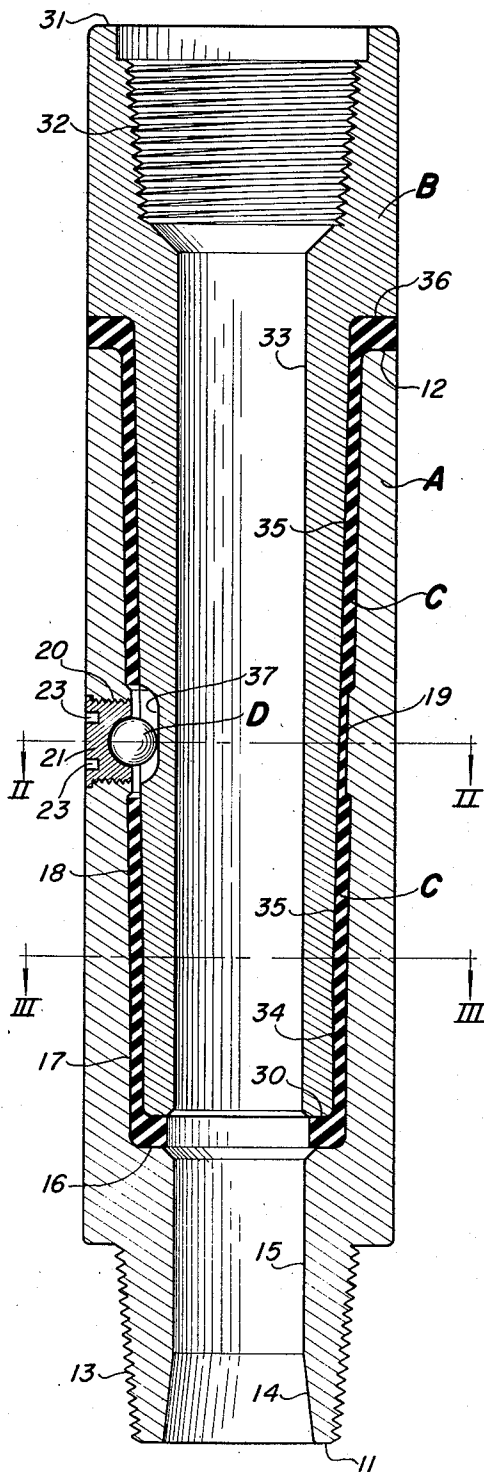
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SHOCK ABSORBING DRILL COLLAR

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SHOCK ABSORBING DRILL COLLAR

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5 Claims. (Cl. 255—28)

This application is directed to a tubular assembly for transmitting longitudinal and rotational forces. The device is particularly adapted for arrangement in a drill stem used for rotary drilling and through which a stream of drilling fluid is circulated, the assembly transmitting the weight and torque imposed through the drill stem to the drill bit in drilling operations.

The device of the present invention is particularly useful when incorporated in a string of drill pipe immediately above the drill bit. The flexibility of the device allows shocks to be absorbed and thereby increases the bearing life of a rock bit carried by the drill stem. In addition, the device may be utilized in other places. For example, the device may be placed in the drilling string above the drill collars or a plurality of devices may be used, one between each of the drill collars in the drill string.

Other objects and advantages of the present invention may be seen from the following description taken with the drawing in which

Fig. 1 is in the form of an elevation, partly in section, showing an embodiment of the present invention;

Fig. 2 is a view taken along line II—II of Fig. 1; and

Fig. 3 is a view taken along line III—III of Fig. 1.

Turning now specifically to the drawing, the device of the present invention consists of two tubular members A and B. Arranged between the two members is a rubber member C which is vulcanized to the adjacent walls of members A and B. A lost motion metal load carrying means, with the embodiment specifically shown as movable balls D, is arranged between the members A and B such that under ordinary usage the load is carried by rubber member C but when the normal stresses are exceeded the load bearing means is engaged before rubber member C is subjected to such stresses as would cause it to fail.

Taking up specifically member A, the ends are designated as 11 and 12. Adjacent end 11 is a threaded pin end 13 adapted to fit into a conventional box thread. The interior of member A is in the form of a bore or passage. Starting at the end 11, wall sections of the passage are inwardly tapering section 14, cylindrical section 15, shoulder 16, cylindrical section 17, and outwardly tapering section 18.

Approximately at the mid-point of tapering section 18 is an inwardly extending shoulder 19 which is provided with symmetrically arranged threaded openings 20. In each of said threaded openings a threaded plug 21 is arranged. The inner wall of a plug 21 is provided with an arcuate shaped opening adapted to form a recess to receive a portion of a movable ball D. The outer wall of plug 21 is provided with spaced recesses 23 which provide the means for using a wrench, not shown, for applying or for removing plug 21.

Member B has an end 30 and an end 31. Adjacent end 31 is a box thread 32 adapted to receive a conventional pin thread. The inner wall of member B consists of a cylindrical bore 33. The outer wall of member B and

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starting at end 30 consists of a cylindrical section 34 which is adjacent the cylindrical section 17 of member A. Cylindrical section 34 is joined with an outwardly tapering section 35 which terminates in shoulder 36. At approximately the mid-point of tapering section 35 and adjacent the circular shoulder 19 of member A are arranged symmetrically spaced recesses 37.

As will be seen from the showing in Figs. 1 and 2, recesses 37 of member B each form an opening which extends both longitudinally and circumferentially. The recesses 22 in each of members 21 mounted in member A are defined by surfaces having the same diameters as the movable balls D. In the embodiment shown, from the mid-position of movable balls D, members A and B may move longitudinally or arcuately together without any change in position of the movable balls D. When members A and B move arcuately or longitudinally relative to each other then balls D change position relative to slots 37 to engage with the walls thereof. For example, members A and B may move longitudinally approximately one-half the diameter of movable balls D and arcuately approximately one-eighth the diameter of the balls D before the balls D are brought into engagement with the walls of slot 37 for load carrying.

Between members A and B is arranged the rubber body C which is vulcanized to the surfaces of the elements 16, 17, 18, 19, and 12 of member A and to surfaces 30, 34, 35, and 36 of member B. In normal use when the device is incorporated in a string of drill pipe near the lower end thereof, member C is in compression. Under normal loads member C will withstand all of the force being transmitted from member B to member A or from member A to member B but when these normal stresses are exceeded, body C becomes sufficiently distorted to allow movable balls D to assume the load.

The cylindrical adjacent wall portions 17 and 34 define an annular area of constant thickness with a length appreciably greater than the maximum relative longitudinal movement which the movable balls D and slots 37 allow between members A and B. This area is always completely filled by the member C which fills and seals the area by deformation of the member C. This construction assures a constant annular area at this point when parts A and B move with respect to each other along their longitudinal axes and eliminates the possibility of leakage of drilling fluid past the rubber member C, should the vulcanized bond between member C and either member A or B fail, when the device is incorporated in a drill stem used for drilling boreholes by the rotary method.

When assembling the device, it will be found satisfactory to machine members A and B and then fabricate an annular shaped member to fit between members A and B. This rubber member is then forced into position. If the rubber member is of uniform thickness, it is extruded at shoulder 19 so that the space between the two load carrying members is completely filled by the rubber member. The structure consisting of members A and B and the rubber body is then vulcanized to produce the unitary assembly consisting of parts A, B and C. At each of the openings 20, either before or after vulcanization, a piece of the rubber body may be cut out to allow a movable ball D to be placed in position and the movable ball is then retained in position by screwing a member 21 into each of the openings 20.

The dimensions of an assembly which has been found to give satisfactory service are as follows:

Outside diameter—6¾ inches

Diameter of the passage through the device—2¾ inches

Thickness of member C between end members 36 and 12 and between end members 30 and 16—1¼ inches

Thickness of member C between wall 35 and shoulder 19— $\frac{1}{4}$ inch

Width of shoulder 19— $2\frac{1}{2}$ inches

Thickness of member C between surfaces 17 and 34— $\frac{5}{16}$ inch

Thickness of member C between surfaces 18 and 35 except at shoulder 19— $\frac{5}{16}$ inch

Diameter of movable balls—1 inch

Maximum possible longitudinal movement between members A and B—1 inch or $\frac{1}{2}$ the diameter of the movable ball from its mid position.

Maximum possible angular movement between members B and C— $\frac{1}{4}$ inch or $\frac{1}{8}$ of the diameter of the movable ball from its mid-point.

It has been found that an assembly of these dimensions may be incorporated in a string of drill pipe above a rock type drilling bit and in normal operation body C is capable of assuming the forces being applied and when excessive forces are placed on the assembly, the movable members or balls D are forced into load carrying position before member C is stressed to such a point that it shears or comes loose from members A and B.

While a specific embodiment of the present invention has been described and illustrated, it will be obvious to a workman skilled in the art that changes may be made in the sizes, shapes and proportions of the parts of the assembly without departing from the invention.

I claim:

1. A shock absorbing collar adapted to be arranged in a drill string to form a continuous passage for circulating drilling fluid which comprises an outer cylindrical sleeve having a first portion of its internal cylindrical bore defined by a vertical cylindrical wall, a second portion of its internal bore defined by an outwardly offset vertical cylindrical wall, and a third portion of its internal bore defined by a cylindrical wall tapering outwardly from the offset vertical cylindrical wall and forming a continuation thereof, an inner cylindrical sleeve arranged concentrically within said outer sleeve having a first portion of its outer surface defined by a vertical cylindrical wall and having a second portion of its outer surface defined by an outwardly tapering wall and having an inner vertical cylindrical wall co-operating with the first portion of the vertical cylindrical wall of the internal bore of the outer sleeve to form said continuous passage, said inner sleeve and said outer sleeve each having at least one recess at approximately the midpoint of the cylindrical walls and co-operating with the recess in the opposite wall, said inner sleeve being spaced away from said outer sleeve equidistantly between the cylindrical walls defined by the second and third portion of the outer sleeve and the cylindrical walls defined by the first and second portion of the inner sleeve, a rubber packing member of generally cylindrical shape having inner and outer walls conforming to the second and third portions and the first and second portions of said cylindrical walls of said outer and inner sleeves, respectively, and arranged in the space between said sleeves and vulcanized to said sleeves to form a unitary structure, said rubber member having a portion of its wall cut away in said recesses, and a spherical lost motion movable member arranged between said inner and outer sleeves in said co-operating recesses, said recess in the outer sleeve providing a hemispherical surface having the same diameter as that of the movable member and said recess in the inner sleeve providing an elongated curved surface of a length sufficient to allow limited angular and longitudinal movement between said sleeves, said movable member being forcible into a load carrying position on movement of said sleeves relative to each other before said rubber member is distorted to failure by torque imposed on said sleeves and rubber member through the drill string.

2. A shock absorbing collar in accordance with claim 1 in which the inner sleeve and the outer sleeve are provided with a plurality of co-operating recesses and the recesses are located in said inner and outer sleeves between the outwardly tapering wall and the offset vertical cylindrical wall of the outer sleeve and between the outwardly tapering wall and the outer vertical cylindrical wall of the inner sleeve, each of said co-operating recesses having a movable member therein.

3. A shock absorbing collar in accordance with claim 1 in which the hemispherical surface is formed in a releasably connected closure means arranged in an opening provided in the wall of said outer sleeve for inserting said movable member.

4. A shock absorbing collar adapted to be arranged in a drill string to form a continuous passage for circulating drilling fluid which comprises an outer cylindrical sleeve having a first portion of its internal cylindrical bore defined by a vertical cylindrical wall, a second portion of its internal bore defined by an outwardly offset vertical cylindrical wall, and a third portion of its internal bore defined by a cylindrical wall tapering outwardly from the offset vertical cylindrical wall and forming a continuation thereof, an inner cylindrical sleeve arranged concentrically within said outer sleeve having a first portion of its outer surface defined by a vertical cylindrical wall and having a second portion of its outer surface defined by an outwardly tapering wall and having an inner vertical cylindrical wall co-operating with the first portion of the vertical cylindrical wall of the internal bore of the outer sleeve to form said continuous passage, said inner sleeve and said outer sleeve each having at least one recess at approximately the midpoint of the cylindrical walls and co-operating with the recess in the opposite wall, said inner sleeve being spaced away from said outer sleeve equidistantly between the cylindrical walls defined by the second and third portion of the outer sleeve and the cylindrical walls defined by the first and second portion of the inner sleeve, a rubber packing member of generally cylindrical shape having inner and outer walls conforming to the second and third portions and the first and second portions of said cylindrical walls of said outer and inner sleeves respectively and arranged in the space between said sleeves and vulcanized to said sleeves to form a unitary structure, said rubber member having a portion of its wall cut away in said recesses, and a spherical lost motion movable member arranged between said inner and outer sleeves in said co-operating recesses, one of said recesses in said sleeves providing a hemispherical surface having the same diameter as that of the movable member and the other of said recesses providing an elongated curved surface of a length sufficient to allow limited angular and longitudinal movement between said sleeves, said movable member being forcible into a load carrying position on movement of said sleeves relative to each other before said rubber member is distorted to failure by torque imposed on said sleeves and rubber member through the drill string.

5. A shock absorbing drill collar in accordance with claim 4 in which the hemispherical surface is formed in a releasably connected closure means in an opening provided in the wall of one of said sleeves for inserting said movable member.

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