ABSTRACT: A bumper sub and closed fluid circulation assembly wherein the assembly is adapted to be connected in a pipe string having means for closed fluid circulation to provide for limited telescoping movement within the pipe string, and for bumping action as desired.
BUMPER SUB AND CLOSED FLUID CIRCULATION ASSEMBLY

BACKGROUND OF THE INVENTION

The field of this invention is well apparatus for closed fluid circulation. Under some well conditions, it has been desirable or necessary to utilize closed fluid circulation which involves a drilling pipe with an inner pipe so that fluid is circulated downwardly in the annulus of the drill pipe and upwardly through the inner pipe, or vice versa, so that circulation in the open well bore is avoided. Suitable apparatus for such closed fluid circulation is disclosed in U.S. Pat. No. 3,208,539.

However, under certain circumstances, such prior apparatus is unsuitable. For example, in offshore drilling, as the ship or floating drilling platform goes up and down due to wave action, the length of the drill string varies so that with such prior apparatus, the weight on the drill bit fluctuates or the drill bit may even be vertically moved off of the bottom of the hole being drilled. In other instances, in both offshore and onshore drilling, it is desirable to provide a bumping action to free the pipe string or the bit from a stuck condition in the well bore, and without pulling the pipe string from the well bore.

SUMMARY OF THE INVENTION

This invention relates to a bumper sub and closed fluid circulation assembly which is adapted to be connected in a pipe string having means for closed fluid circulation. With the assembly of this invention, limited vertical movement within the pipe string itself may occur without changing the weight on the drill bit. Therefore, drilling operations are substantially unaffected by wave action offshore within the limits of the vertical movement of the assembly. Also, in coring operations where it is important to maintain substantially constant weight on the coring bit, the assembly of this invention makes this possible. Bumping can also be accomplished with this invention by removing the pipe string from the well bore. In addition, the assembly may be utilized in any situation wherein it is desirable or necessary to provide vertical movement or bumping within the pipe string itself.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical sectional view, illustrating the apparatus of this invention in a telescoped position; FIG. 2 is a view similar to FIG. 1, and showing a portion thereof in the extended or bumping position; and FIGS. 3A, 3B, 3C and 3D are vertical sectional views of one-half of the apparatus of this invention, with the parts in the telescoped position corresponding to FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the letter A designates generally the apparatus or assembly of this invention. Briefly, the bumper sub and closed fluid circulation assembly A includes a pair of outer tubular body members 10 and 11 which are disposed in longitudinally telescoping relationship to each other. Such apparatus A is adapted to be connected in a pipe string at any suitable point, the location of which depends upon the use thereof. For this purpose, the upper end 10a of one of the body members 10 is provided with threads or other means for connecting to the lower portion of the pipe string, a portion of which is shown at P in FIG. 1. The lower end of the outer tubular body member 11 has threads or other means 11a for connecting to the upper end of the lower portion of the pipe string P' therebelow. A pair of inner pipes 14 and 15 are disposed in longitudinally telescoping relationship to each other within the outer tubular body members 10 and 11, with an annulus 16 formed between the lower end of the pipe string, a portion of which is shown at A in FIG. 1. The inner pipe 14 is connected to the outer tubular body member 10 by any suitable connection such as connectors 20, the construction of which will be described hereinafter. The other inner pipe 15 is connected to the outer body member 11 by a similar connector means 22. The upper end of the inner pipe 14 is adapted to be connected with a pipe 60 extending thereabove which forms an extension thereof within the pipe string P, and the lower end of the inner pipe 15 is adapted to be similarly connected to a pipe 61 extending therebelow for forming a continuation of such pipe 15 downwardly in the portion of the pipe string P' below the assembly A. Various uses of the assembly A are possible, and some of such uses will be described hereinafter.

Considering the invention more in detail, the outer tubular body member or mandrel 10 is preferably formed of a plurality of parts which are threaded or are otherwise connected together as illustrated in FIGS. 3A, 3B and 3C. Similarly, the outer tubular body member or mandrel body 11 is preferably formed of a plurality of sections which are threaded or are otherwise suitably connected together. The mandrel 10 is provided with a removable mandrel ring 10b having a wearing surface 10c which is contacted by the upper end 11d of the mandrel body 11 when the members 10 and 11 are fully telescoped (FIG. 3A). Splines 10d and 11b (FIG. 3B) interconnect the members 10 and 11 to prevent relative rotational movement therebetween while permitting relative longitudinal movement therebetween.

An annular knocker or hammer 10e is formed on the member or mandrel 10 at an intermediate point and it is adapted to be moved longitudinally into contact with a hammerer or other contact surface 11e which is also annular and is a part of the member or mandrel body 11. Such contact is illustrated in FIG. 2 of the drawings. When such contact occurs upon a rapid upward movement of the mandrel 10 relative to the mandrel body 11, a bumping action occurs which is transmitted to the entire pipe string P, and particularly the portion P' below the assembly A.

To facilitate the relative longitudinal movement of the mandrel 10 and the mandrel body 11, an annular portion is sealed off between the members 10 and 11 by suitable seals rings 30 at the upper end of the member 11, and lower seal rings 31 at the lower end of the member 11. A lubricant such as oil is disposed between such seals 30 and 31 and is normally introduced by removing plugs 32 and 33. The lubricant may be introduced through the opening provided in the member 11 when the plug 33 is removed, and with the plug 32 removed. In that way, when the lubricant discharges from the opening provided when the plug 32 is removed, it is known that the space is substantially filled with lubricant, and the plugs 32 and 33 may be reinserted.

The fixed connection means 20 for connecting the upper inner pipe or tube 14 to the mandrel 10 includes a ring 35 which is annularly spaced from the external surface of the pipe 14 and is connected thereto by a plurality of radial connectors 36. The connection is preferably by welds 35a and 36a. The upper section of the mandrel 10 is provided with an annular recess 10r (FIG. 3A) which is of a diameter to receive the ring 35 therein. The lower end 40 of the pipe string P is disposed above the ring 35 so as to confine the ring 35 within the recess 10r, whereby the ring 35 is locked relative to the mandrel 10.

Due to the connection of the ring 35 to the inner pipe 14 through the radial ribs 36, the pipe 14 is fixed with respect to the mandrel 10. Since only three of such ribs 36 are required to hold the pipe 14 in the fixed relationship, they do not restrict the flow of fluid in the annulus or annular space 16 between the inner pipes 14, 15 and the outer member 10, 11.

To assist in holding the inner pipe 14 centrally within the mandrel 10, a plurality of laterally or radially disposed ribs or spacers 50 are preferably welded or are otherwise secured to the external surface of the pipe 14 (FIG. 3A). As shown in FIG. 3A, an additional ring 50a is used to support such ribs 50, and the ring 50a is welded to the pipe 14, with the ribs 50 being spaced at an angle of about 120°. Such spacers or ribs 50 may be located at different elevations (FIGS. 3A and 3C) on the pipe 14, depending upon the length of the pipe 14.

The connector 22 (FIGS. 1 and 3D) is preferably the same as the connector 20, except that it is used for securing the
inner pipe 15 to the mandrel body 11. Thus, the connector 22 has a ring 135, and a plurality of radial ribs or connectors 136 which are welded at 136a and 135a. The mandrel body or member 11 has an annular recess 11e by means of an adapter section 111 having an annular shoulder 111e (FIG. 3D).

A fluid seal is provided between the pipes 14 and 15 by any suitable means such as seal rings 55 formed of rubber or other suitable material. Such rings 55 are shown as being on the internal surface of the pipe 15 and in sealing engagement with the external surface of the pipe 14. Such seal is maintained at all times, even when there is relative longitudinal movement between the pipes 14 and 15.

The upper end of the pipe 14 is connected to a pipe 60 (a portion of which is shown in FIG. 3A) which extends upwardly in the pipe string P, normally to the surface so that the annulus 16 continues all of the way to the top of the well and is separated from the interior of the pipe 60 and the pipes 14 and 15.

Similarly, the lower end of the pipe 15 may be connected to a pipe 61 which extends downwardly into the lower portion P' of the pipe string and normally, such lower pipe or pipes 61 will extend downwardly to substantially the same point as the lower end of the pipe string P'. Usually, the inner pipe 61 and the pipe string portion P' terminate with suitable connectors at a drilling bit or a coring bit. Closed fluid circulation may thus be maintained throughout the entire pipe string by the flow of fluid either downwardly or upwardly in the annulus 16 and then in the opposite direction within the bore of the pipes 61, 15, 14 and 60. Thus, the closed fluid circulation may be in either direction so that circulation of fluid externally of the pipe string is avoided, whereby the danger of losing the fluid in porous formations is avoided.

In the operation or use of the assembly A of this invention, such assembly A is disposed in a pipe string, usually with drill collars (shown) above or below the assembly A. In a typical use of the assembly A, such assembly A is located in a pipe string which is used for offshore drilling where the drill string moves up and down as the drilling ship or drilling platform moves up and down due to wave action. With the present invention, as the ship or drilling platform moves up and down, the outer tubular members 10 and 11 may move up and down relative to each other within the limits of travel provided by the assembly A, and during such movement, the inner pipes 14 and 15 will likewise move upwardly and downwardly relative to each other. If the vertical movements in the pipe string are more than can be realized by a single assembly A, a plurality of such assemblies A may be incorporated in the same pipe string so that the drilling bit remains on the bottom and continues to drill even though the length of the pipe string is actually varying due to the movements of the ship or drilling platform.

In another example of the use of the apparatus of this invention, the lower end of the pipe string may have a diamond bit or other coring bit thereon which needs a constant weight on the bit to properly perform its coring operation. Drill collars are then disposed in the pipe string portion P' below the assembly A to place a predetermined load on the coring bit. The assembly A is in its telescoped position shown in FIG. 1 at the start of the drilling so that as drilling proceeds, the drill collars maintain a constant load on the coring bit while the assembly A is being extended from its telescoped position of FIG. 1 to the extended position of FIG. 2. When the assembly A reaches the position of FIG. 2, the weight on the drill string will immediately increase due to the drill collars then being supported by the pipe string from the surface, and the operator will then know that he will have to slack off on the pipe string to again telescope or collapse the assembly A to the position shown in FIG. 1. Thereafter, continued drilling with a constant load from the drill collars may be accomplished.

Should the pipe string P become stuck during drilling operations, the assembly A may be used for imparting a bump by pulling upwardly on the pipe string P to bring the surfaces 10e and 11c together with a bumping action.

During all of the various motions and uses of the apparatus A, closed fluid circulation is maintained within the interior of the pipes 14 and 15 and the annulus 16. Thus, the assembly A provides a bumper sub with the means for maintaining the closed fluid circulation in the rest of the pipe string.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

We claim:
1. A bumper sub and closed fluid circulation assembly adapted to be connected in a pipe string, comprising:
a pair of outer tubular body members disposed in longitudinally telescoping relationship to each other;
means for connecting said body members in a pipe string including means on the upper end of one of said body members for connecting the pipe string and means on the lower end of the other of said body members for connecting in a pipe string;
a pair of inner pipes disposed in longitudinally telescoping relationship to each other in said outer tubular body members with an annulus extending longitudinally between said pair of inner pipes and said outer tubular body members from the upper end to the lower end of said body members for the flow of fluid therethrough;
a first connector means having longitudinal flow passages therethrough securing one of said inner pipes to one of said outer tubular body members and a second connector means having longitudinal flow passages therethrough securing the other of said inner pipes to the other of said outer tubular body members for causing said inner pipes to telescope and extend relative to each other as said outer tubular body members telescope and extend relative to each other.

2. The structure set forth in claim 1, including:
coating surfaces on said tubular body members for limiting the extent of telescoping of said members and adapted to be engaged with each other for producing a bump in the pipe string.

3. The structure set forth in claim 1, including:
a movable seal means between said inner pipes for preventing fluid leakage therethrough when said pipes are moved longitudinally relative to each other and when said pipes are stationary relative to each other.

4. The structure set forth in claim 3, including:
coating surfaces on said tubular body members for limiting the extent of telescoping of said members and adapted to be engaged with each other for producing a bump in the pipe string.

5. The structure set forth in claim 1, wherein said means securing each of said inner pipes to one of said outer tubular body members includes:
a ring spaced radially from the externally surface of each of said inner pipes;
an annular recess in one of said body members for receiving said ring; and
a plurality of radial spacer and connector ribs secured to the internal surface of said ring and to the external surface of one of said inner pipes.

6. The structure set forth in claim 1, including:
means on said outer tubular body members permitting longitudinal relative movement therethrough but preventing relative rotational movement therethrough.

7. The structure set forth in claim 2, including:
longitudinally spaced seal means between said tubular body members and disposed above and below said coating surfaces for providing a lubricating chamber therethrough in which lubricant is disposed to facilitate the telescoping and extension of said body members relative to each other.

8. The structure set forth in claim 1, including:
centralizer ribs secured on the external surface of each of said inner pipes and extending radially into sliding engagement with the inside surface of one of said tubular members to facilitate telescoping and extending of said inner pipes while maintaining said annulus open for fluid circulation.

9. The structure set forth in claim 1, including: means for connecting the upper end of the upper one of said inner pipes to an inner pipe in the portion of the pipe string thereabove.

10. The structure set forth in claim 1, including: means for connecting the upper end of the upper one of said inner pipes to an inner pipe in the portion of the pipe string thereabove; and means for connecting the lower end of the lower one of said inner pipes to another inner pipe in the portion of the pipe string therebelow.