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HYDRAULICALLY INFLATABLE ANCHORS

Filed Aug. 21, 1957

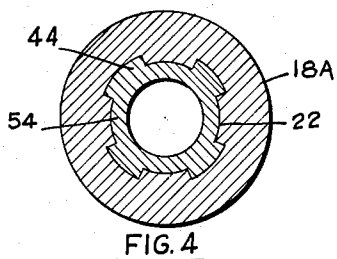

FIG. 4

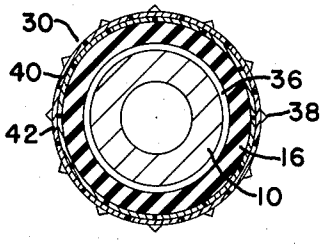

FIG.-2

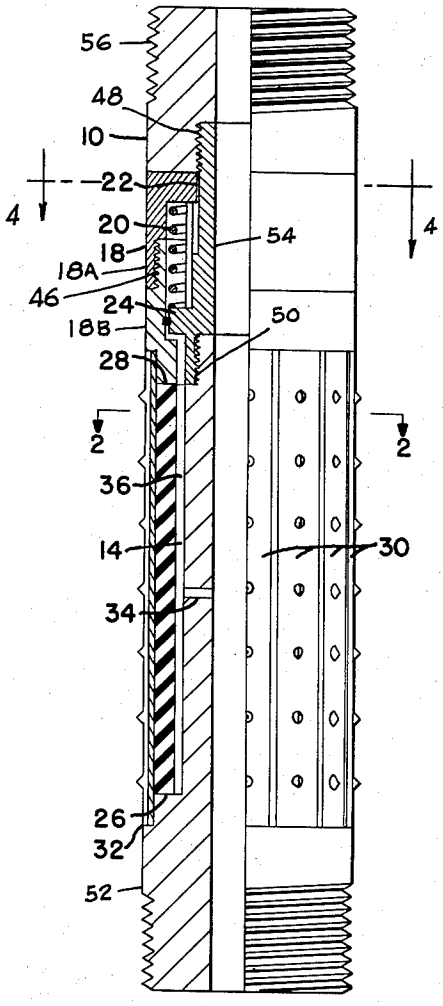

FIG.-1

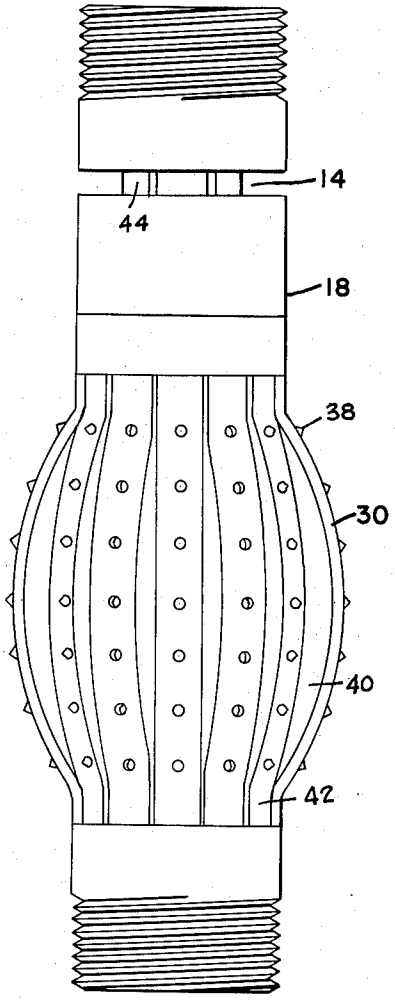

FIG.-3

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HYDRAULICALLY INFLATABLE ANCHORS

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5 Claims. (Cl. 166—212)

This invention relates to an anchor assembly unit with the assembly being expandable by the exertion of hydraulic pressure. The invention is more particularly concerned with an hydraulically inflatable anchor for use in petroleum wells to prevent a packer from moving up or down within the well bore.

In the drilling of wells, it is sometimes necessary or desirable that a packer be set in the annulus between the string of drill pipe and the bore of the well hole. The packer is usually required to isolate the annular space above the packer from the space below the packer. In some cases hydrostatic pressure of fluid above the packer tends to move the packer longitudinally within the well bore. This is especially true in the three channel drill pipe system employing the use of two drilling fluids where, in some cases, a packer unit may be required to withstand downward forces in the order of 200,000 to 300,000 lbs. In order for the packer assembly not to move longitudinally, this tremendous force must be transmitted to the formation rock. Various methods have been suggested for thus transmitting this force. Among those has been the use of conventional mechanical slip or anchor assemblies. The use of mechanical slip or anchor assemblies has not been satisfactory particularly due to the irregularities of the diameter of the hole and the limited amount of travel which mechanical anchors have. Other methods have also proved unsatisfactory.

Advantages and features of this invention will become more apparent and readily understood from the ensuing description and from the accompanying drawings, in which:

Figure 1 is a partial sectional vertical view of the hydraulically inflatable anchor unit.

Figure 2 is a cross-sectional view taken at 2—2 of Figure 1.

Figure 3 is a side view of the anchor unit in expanded position.

Figure 4 is a cross-sectional view taken at 4—4 of Figure 1.

Referring specifically to the drawing, numeral 10 designates a tubular support or mandrel having a recessed section 14 upon which the anchor assembly is mounted. Sleeve 16 is mounted in and about recessed section 14. Sleeve 16 is preferably made of a material that has good expansive characteristics, with soft rubber being the preferred material. A slidable ring or annular member 18 is mounted on and surrounds recessed section 14 of mandrel 10 above sleeve 16. A spring 20 tends to move piston 18 upward or in an opposite direction from sleeve 16. The reason for this will be seen clearly hereinafter. Lip 24 is provided in recess 14 as an anchor for spring 20. A spline section having splines 22 is provided on annular member 18 and cooperates with mating splines 44 of tubular support 10 to prevent rotational movement between annular member 18 and tubular support 10.

Various construction practices may be resorted to to place spring 20, sleeve 16, and annular member 18 over

mandrel 10 to fit into recess section 14. For example, mandrel 10 may be divided into three sections for purposes of construction, namely an upper section 56, an intermediate section 54 and a lower section 52. Lower section 52 is connected to intermediate section 54 by threads 50. Intermediate section 54 is connected to upper section 56 by threads 48. Ring member 18 can conveniently be divided into an upper section 18A and a lower section 18B and connected together by threads 46. To assemble the device, mandrel 10 is dismantled into upper section 56, intermediate section 54 and lower section 52. Ring member 18 is likewise dismantled into sections 18A and 18B. Sleeve 16 and its associated bands and lower section 18B of annular ring 18 are then slipped over lower section 52 of mandrel 10 into recess 14. Intermediate section 54 of mandrel 10 is then connected to lower section 52 by threads 50. Spring member 20 is then placed in position and upper section 18A of annular ring 18 is connected to the lower section 18B by threads 46. Upper section 56 of mandrel 10 is then connected to intermediate section 54 by threads 48.

The sleeve 16 is mounted or affixed to the mandrel at its lower end at 26, which is the bottom of recessed section 14 and the other end of sleeve 16 is mounted or affixed to the slidable ring member 18 at 28. At least two rows, an inner row 40 and an outer row 42, of flexible bands 30 are placed around the circumference of the sleeve 16 parallel to the longitudinal axis of the anchor unit. The lower ends of these bands 30 are firmly affixed to the tubular support 10 at 32, while the upper ends are firmly affixed to slidable ring member 18 which is free to move vertically but is restrained from rotating with respect to tubular support 10. Flexible bands 30 are preferably made of spring steel.

In operation, the anchor assembly unit is normally screwed to the drill string and then lowered into position with hydraulic pressure applied through ports 34 in the walls of recessed section 14. Hydraulic fluid then enters space 36 and forces sleeve 16 outwardly into an expanded position. Ring member 18 to which the upper ends of bands 30 and sleeve 16 are attached moves downwardly against the compression of restraining spring 20 allowing sufficient slack for the flexible bands 30 to move radially outwardly into contact with the formation. As the bands move outwardly the circumference about the mid-section of the bands is increased. Thus, there is lateral movement between adjacent bands. The middle portions of bands 30, for example, are no longer in contact and are moved apart as seen in Fig. 3. The flexible sleeve 16, however, is always given positive support by the overlapping bands and there is no tendency for the material of the flexible sleeve to extrude between the bands.

Serrations 38 may be provided on the outer row of bands 30 to increase the friction with the formation. However, the length of the anchor section can be made sufficiently long to support any required load. The force of the load is, of course, transmitted through the spring bands to the formation. A view of the anchor assemblies in expanded position is illustrated in Figure 3. To release the anchor, hydraulic pressure is released from the space 36 and the ring member restraining spring 20 moves ring member 18 upwardly causing the spring bands to retract against sleeve 16 and into the recessed section 14 of tubular support 10. The fluid pressure may be continuously applied to the interior of sleeve 16 to maintain the anchor in its expanded position. Additional channels of pipe may be run in the interior of mandrel 10 to conduct drilling or other type operations at the bottom of the hole.

Many advantages of the anchor unit are readily ap-

parent. For instance, spring steel slips will conform to the contour of the bore hole more effectively than would conventional mechanical slips or rigid slip segments. The spring slips permit a greater expansion in an enlarged bore hole than previous type slips. The combined thickness of the walls of the tubular support or mandrel, the elastic sleeve and the rows of bands is rather small in comparison to the thickness required of conventional slips or slip segments and would, therefore, permit the use of a larger tubular member or mandrel for a given tool for packer assembly outside diameter. The latter factor is very critical in adopting an anchor section to the 3-channel drill pipe system of drilling.

This anchor unit may be utilized in any apparatus which is used in a well bore to hold a packer or other equipment against longitudinal movement.

It is apparent that numerous modifications and variations may be made in the apparatus described without departing from the spirit and scope of the present invention and it is intended that the invention be limited only by the scope of the following claims.

What is claimed is:

1. An inflatable anchor unit for use in a well bore which comprises a tubular support having an exterior recessed section and at least one port extending through the wall of said recessed section, a slidable annular member surrounding said recessed section, an expansible sleeve surrounding said recessed section below said annular member with one end of said sleeve circumtiguously and sealingly affixed to said annular member and the other end circumtiguously and sealingly affixed to said tubular support, at least two rows of overlapping bands placed longitudinally along the periphery of said sleeve with those ends of said bands nearest said annular member affixed to said annular member and the opposite ends being affixed to said tubular support, whereby said bands are expanded outwardly upon fluid pressure being exerted in said tubular support.

2. An inflatable anchor unit for use in a well bore which comprises a tubular support having an exterior recessed section, a slidable annular member surrounding said recessed section, an expansible sleeve below said annular member and surroundng said recessed section with one end of said sleeve circumtiguously affixed to said annular member and the other end circumtiguously affixed to said tubular support, at least two rows of overlapping bands placed longitudinally along the periphery of said sleeve with those ends of said bands near said annular member affixed to said annular member and the opposite ends being affixed to said tubular support, resilient means of a character to force said annular member longitudinally along said recessed section and in an opposite direction from where said sleeve is affixed to said tubular support, and port means establishing fluid communication between the interior of said support and the interior of said sleeve.

3. An apparatus according to claim 2 in which the bands are made of flexible steel.

4. An apparatus according to claim 2 wherein said bands are provided with serrations.

5. An apparatus according to claim 2 wherein a spline section is provided for said annular member and cooperates with a mating spline section of said tubular support to prevent rotation of said anchor unit.

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