Sept. 21, 1971 G. G. BROWNING, JR 3,606,797

POLISHED ROD ALIGNMENT BEARING IN WELL PUMPING APPARATUS

Filed Sept. 9, 1969

FIG. 1

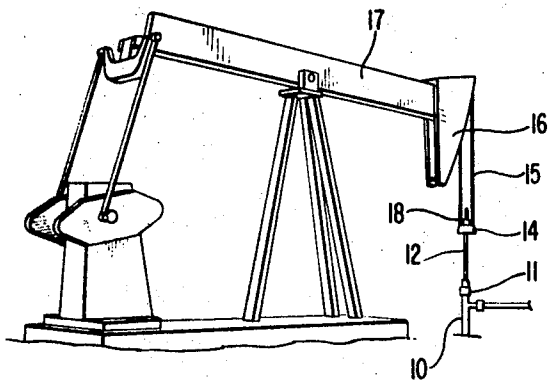


FIG. 2

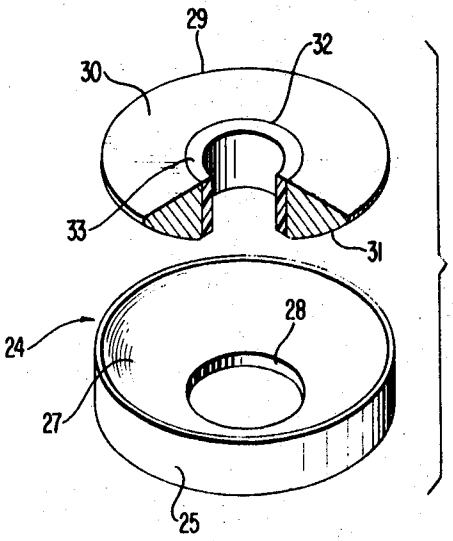


FIG. 3

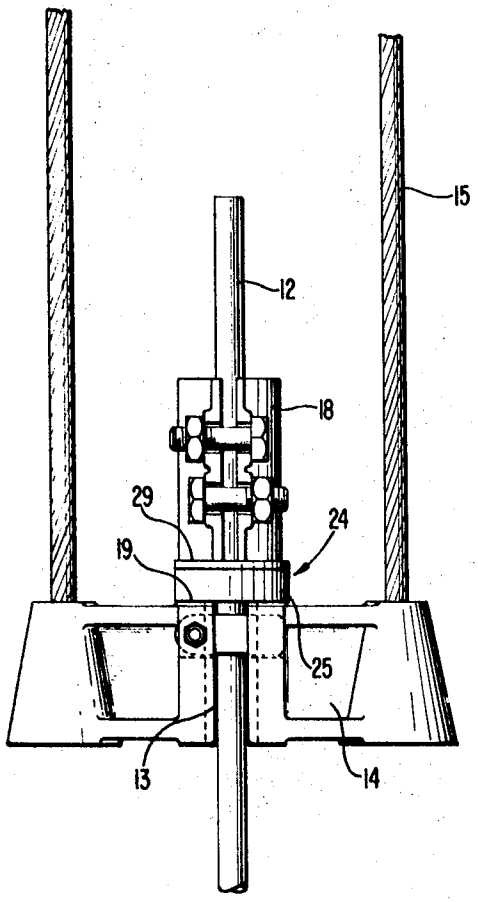
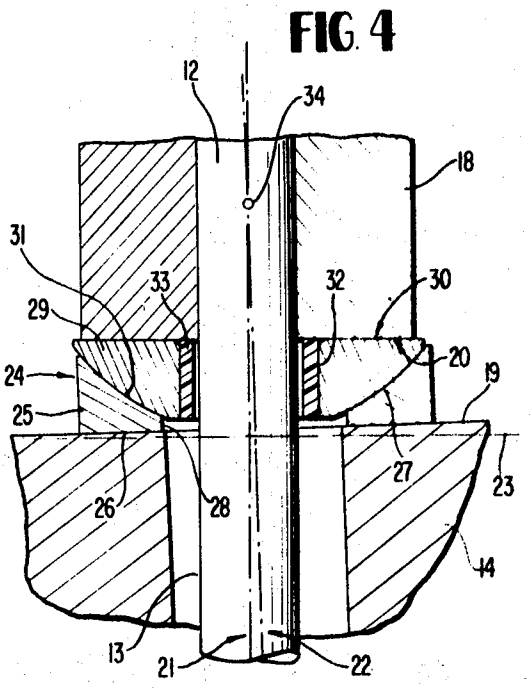


FIG. 4



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POLISHING ROD ALIGNMENT BEARING IN WELL PUMPING APPARATUS

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ABSTRACT OF THE DISCLOSURE

A two-part self-aligning thrust bearing is interposed between the top face of the carrier bar and the bottom face of the polished rod clamp in surrounding relationship to the polished rod. The arrangement relieves the polished rod of bending stresses which occur when there is misalignment of the bottom surface of the clamp or top surface of the carrier bar with respect to the axis of the polished rod.

A serious problem exists in well pumping equipment with respect to repeatedly bending and stressing the polished rod until the latter eventually breaks or fails, causing an expensive shut down of the well. The bending and over-stressing of the polished rod is caused by misalignment of either the polished rod clamp or carrier bar with respect to the vertical axis of the polished rod. This misalignment can occur in any number of vertical planes during the operation of the pumping rig. The polished rod clamp supports the complete weight of the pumping string, sucker rods and pump, plus well fluid, and allows the rod string to be raised and lowered by the pump walking beam and associated elements. The total load on the clamp can range from a few thousand pounds to as much as thirty thousand pounds, more or less, depending on well depth and pump size. Normally, the carrier bar engages directly under the bottom of the polished rod clamp and is suspended from the walking beam by a bridle or equivalent means and thus bears the heavy weight of the pumping string.

To avoid bending and over-stressing the polished rod, the heavy load thereon should be axial and there should be perfect and complete contact between the bottom surface of the polished rod clamp and the top surface of the carrier bar and these abutting surfaces should be normal to the axis of the polished rod. Such is not always the case in actual practice due to a number of variables in the pumping apparatus and the well tubing itself. Consequently, the objective of this invention is to provide means to compensate for the frequently encountered misalignment of the polished rod clamp and/or carrier bar with respect to the polished rod axis in the form of a self-aligning thrust bearing interposed directly between the bottom of the clamp and the top of the carrier bar in surrounding relation to the polished rod. The necessary alignment of parts is made possible due to the fact that the pressure applied to the top section of the alignment bearing or plate will cause this element to adjust automatically in the lower section of the bearing until the load or force is in true alignment with the axis of the string. By utilizing the self-aligning bearing between the polished rod clamp and carrier bar, the polished rod is relieved effectively of bending stresses in the critical area at the bottom of the clamp where it frequently fails.

Without the invention bearing being utilized in the apparatus, there will arise inevitably some misalignment between the top surface of the carrier bar and the bottom of the polished rod clamp and there will be only partial contact between these opposed surfaces as the heavy load carried by the clamp is transmitted to the carrier bar.

This misalignment and incomplete contact will be translated into bending of the polished rod on each pumping stroke as the two opposed misaligned surfaces make repeated contacts. Eventually, cold working of the polished rod and fatigue fracture will occur. When the invention self-aligning thrust bearing is used, even though there is the usual misalignment of the clamp and/or carrier bar with respect to the axis of the polished rod, the load on the pumping string is always transmitted along the true axis of the polished rod, thus avoiding bending thereof.

Other features and advantages of the invention will appear during the course of the following description.

BRIEF DESCRIPTION OF DRAWING FIGURES

FIG. 1 is a general perspective view of well pump apparatus having the invention incorporated therein.

FIG. 2 is an enlarged exploded perspective view, partly in section, of a self-aligning thrust bearing embodying the invention.

FIG. 3 is a fragmentary side elevational view of a polished rod, rod clamp, carrier bar and associated elements having the invention thrust bearing incorporated therein.

FIG. 4 is an enlarged fragmentary central vertical section through the bearing, clamp and carrier bar in any vertical plane of the apparatus and illustrating the misalignment of the clamp and carrier bar and the compensating effect of the bearing.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the drawings in detail, wherein like numerals designate like parts throughout the same, the numeral **10** designates an above ground portion of a well casing having a stuffing box **11** capping its upper end through which the usual reciprocatory polished rod **12** operates. The upper portion of the polished rod **12** is received detachably within a side slot **13** of a conventional carrier bar **14** suspended at its opposite ends by a bridle means **15**, connected with the "horse head" **16** at one end of a walking beam **17**. The basic construction of the pumping apparatus is entirely conventional and need not be described in further detail for a proper understanding of the invention.

Above the carrier bar **14**, a conventional polished rod clamp **18** tightly embraces the polished rod **12** and in the conventional prior art arrangement, the complete weight of the sucker rod string will be transmitted through the polished rod and clamp **18** to the top of the carrier bar **14**, as the bottom of the clamp normally abuts the top face **19** of the carrier bar. As discussed previously, the frequently encountered non-parallelism between the top face **19** and the lower face **20** of the polished rod clamp when the parts are in contact and under load results in repeated bending of the polished rod and the ultimate failure thereof. This misalignment is graphically illustrated in FIG. 4 in a somewhat exaggerated manner. The true vertical axis of the polished rod in FIG. 4 is indicated by the center line **21** while the tilted axis of the carrier bar is represented by the line **22** which diverges downwardly from the polished rod axis. The degree of non-parallelism between the faces **19** and **20** is graphically shown by the angle between the face **19** of the carrier bar and the true horizontal line **23** in FIG. 4. Again, the opposed faces **19** and **20** are normally in direct abutting contact where the invention bearing is not employed and it may be readily understood that when the non-parallel faces **19** and **20** come into contact under the extremely heavy load suspended from the clamp **18**, the polished rod **12** will be subjected to bending at the lower end of the clamp and will ultimately break off at this point.

The self-aligning thrust bearing which forms the heart of the invention is shown at **24** and is in the nature of an attachment for any conventional pumping rig having a polished rod, rod clamp and carrier bar. The bearing **24** is in two parts, as shown, including a lower base part **25** which is annular with a flat bottom surface **26** for face-to-face contact with the surface **19** and an upper concave face **27** of spherical curvature. The bearing section **25** has a central opening **28** to accommodate the polished rod **12**. A mating upper bearing section **29** is provided having an upper flat face **30** adapted to abut the lower face **20** of the clamp **18**, and a lower convex spherically curved face **31**. The convex **31** interfits slidably with the concave face **27** of the lower bearing section so that the two bearing sections may swivel in all directions in the manner of a universal joint. This renders the thrust bearing self-adjusting or self-aligning under load and assures that the heavy load transmitted through the polished rod clamp **18** will in all events be transmitted along the true axis of the polished rod **12**, without misalignment and without the consequence failure of the polished rod due to bending.

The upper bearing section **29** also has a central bore **32**. In order to allow universal orientation of the polished rod for alignment under load, it will be noted that central opening **28** is larger than central bore **32**. Central bore **32** may be the smaller of the bores as shown since this bore just has to accommodate the diameter of the polished rod. Within this bore **32** is anchored a suitable plastic liner **33** which is employed when relatively small diameter polished rods are used. Polished rods generally vary in diameter between approximately 1⅛ inches to 1½ inches. If a larger rod is encountered, the plastic liner **33** may be removed. The liner simply renders the bearing adaptable to various sizes of polished rods and establishes a more-or-less uniform clearance between the rod and bearing. The bearing sections are formed of any suitable durable bearing material and such materials are well known in the art. In essence, the bearing **24** is a two-part self-adjusting swivel type thrust bearing which is capable of universal movement under the heavy load suspended from the clamp **18** which bears directly on the bearing. Since the bearing is interposed between the clamp **18** and carrier bar **14**, it will always compensate for misalignment of these parts, as described, and transmit the ultimate load on the polished rod **12** directly along the true axis thereof so that during the pumping operation, the rod will not be subjected to repeated bending due to the misalignment of parts. The center of swivel of the thrust bearing is indicated graphically at the point **34**, which point lies directly on the true axis of polished rod **12**.

In view of the foregoing description, it is believed that the utility and the advantages of the invention will now be readily apparent to those skilled in the art.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of the invention.

I claim:

1. In a well pumping apparatus, a reciprocatory polished rod, a polished rod clamp embracing the polished rod and fixed thereto and having a bottom face, a carrier bar disposed below the polished rod clamp in opposed relation thereto, suspension means for the carrier bar leading to and connected with a walking beam, the improvement comprising a self-aligning free swiveling two-part thrust bearing attachment surrounding the polished rod comprising an upper bearing plate having a top flat face directly contacting said bottom face of the clamp and a lower bearing plate having a flat bottom face directly contacting the top face of the carrier bar and serving to transmit the weight suspended from the polished rod clamp to the carrier bar, said upper and lower bearing plates having contacting concave and convex surfaces which slidably interfit and permit adjusting automatically of the plates under said weight to cause the weight to be directed along the axis of the polished rod irrespective of the degree of parallelism between the bottom face of said clamp and the top of said carrier bar.

2. The structure of claim **1**, and said interfitting plates being annular and each having a central bore adapted to receive the polished rod therethrough.

3. The structure of claim **2**, and one of said plates having a smaller bore than the other plate, and a removable and replaceable liner within the bore of said one plate allowing the bore to accommodate a range of polished rod sizes.

4. The structure of claim **3**, and said liner formed of plastic.

5. The structure of claim **1**, and said lower bearing plate having an upper concave bearing face, and said upper bearing plate having a lower convex face engaging and having swiveled engagement with said concave face of the lower bearing plate.

6. The structure of claim **5**, and said concave and convex bearing faces being spherically formed and having a common radius centered on the true axis of said polished rod.

7. The structure of claim **6**, and said lower and upper bearing plates being annular and each having a central through bore receiving the polished rod with a clearance space.

8. The structure of claim **7**, and a plastic liner removably mounted in at least one of said through bores.

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