FIG. 1

FIG. 2

FIG. 3

FIG. 4

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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 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 opposed surfaces should be coaxial with respect 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 a 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 end from a bridle or equivalent 15. The 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 formed by 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 1/4 inches to 1/2 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.

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