Dec. 23, 1941. G. H. WILLIAMS 2,267,183

STUFFING BOX

Filed July 17, 1939 2 Sheets-Sheet 1

FIG. 1.

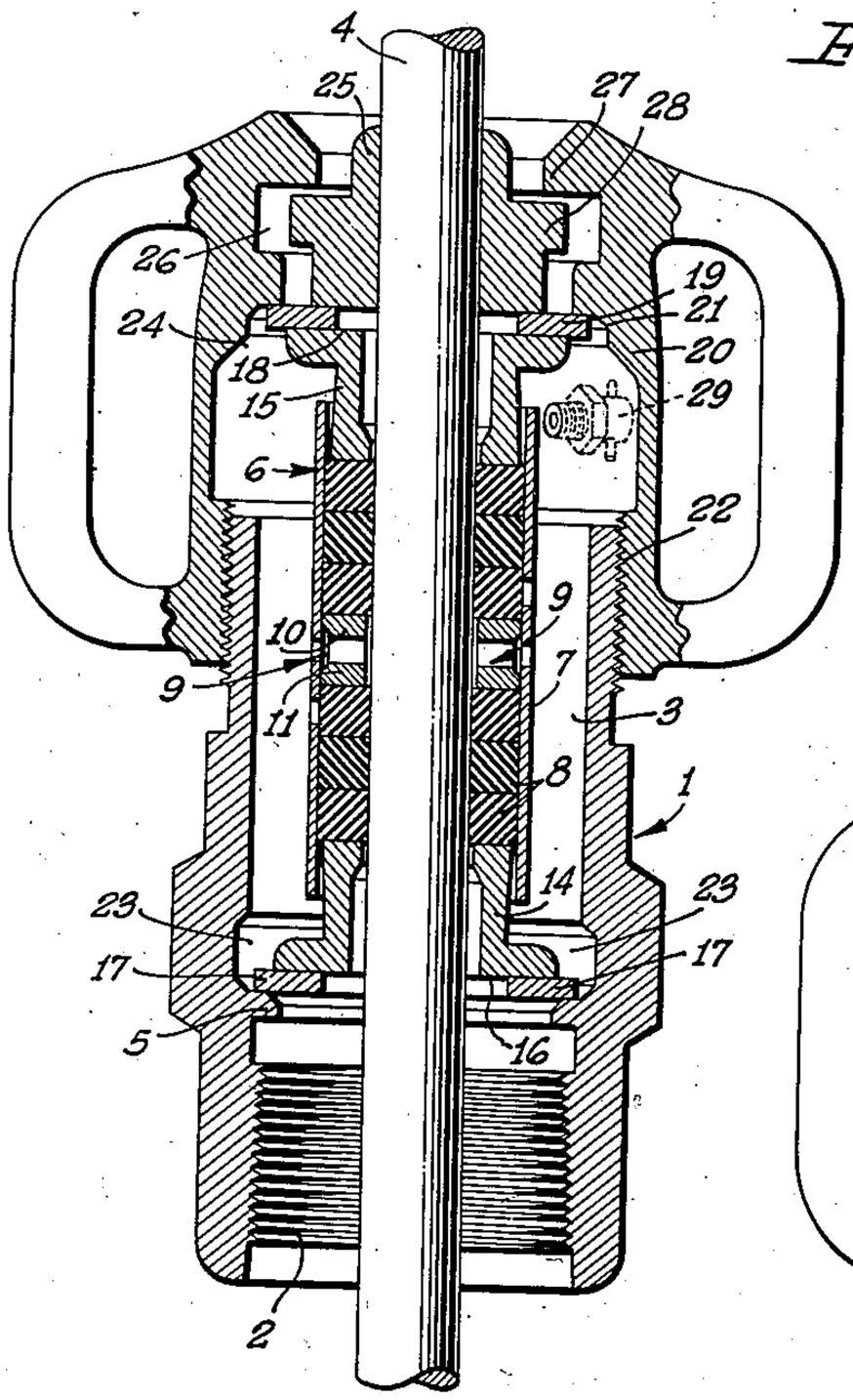


FIG. 2.

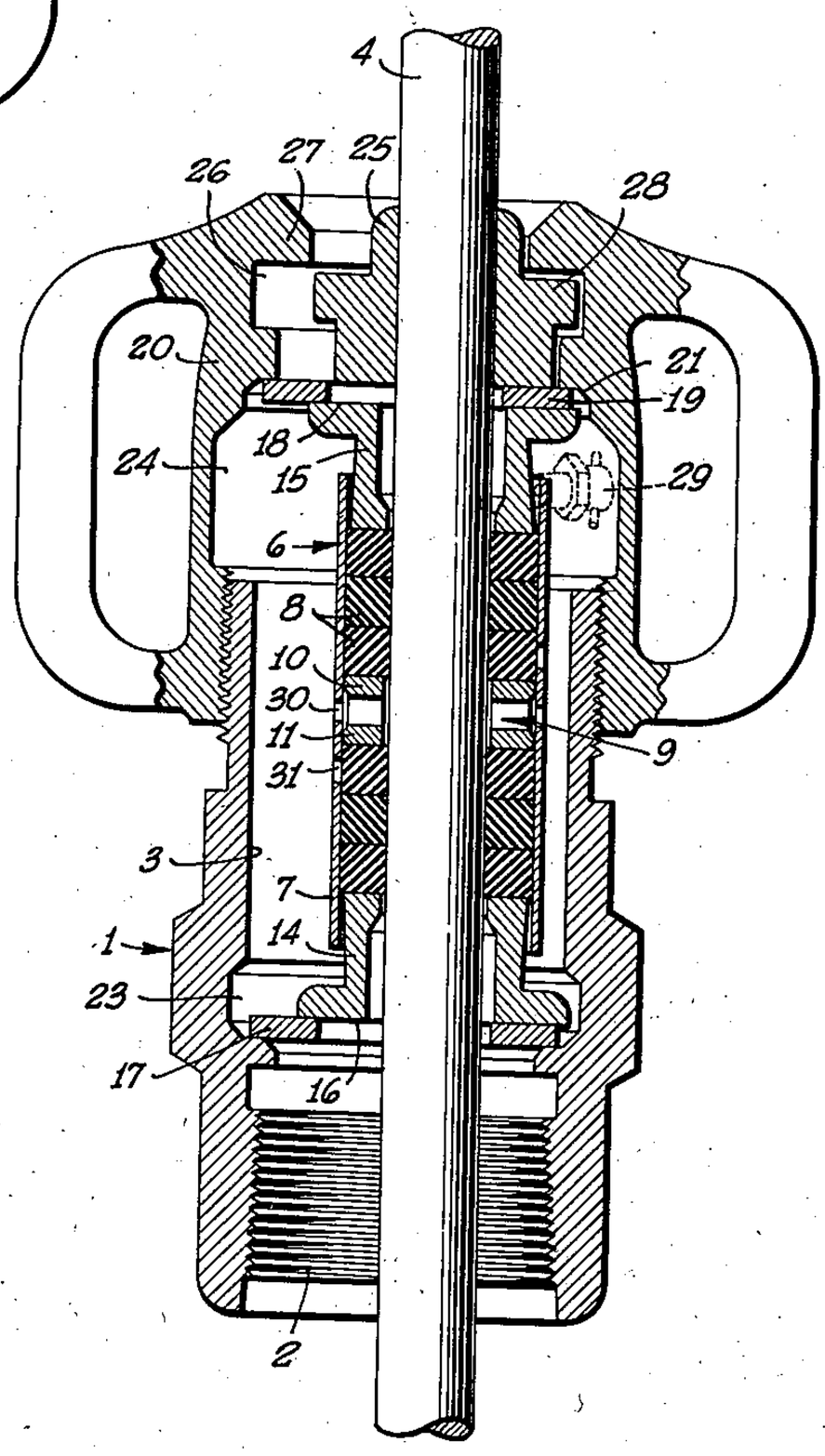
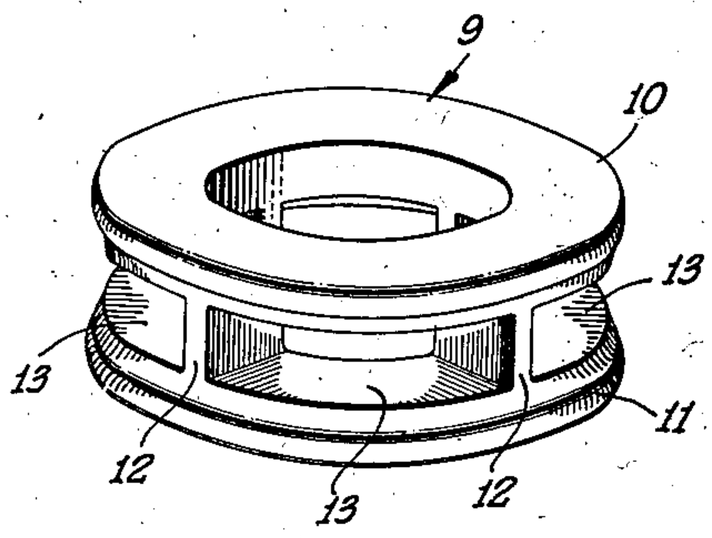


FIG. 6.



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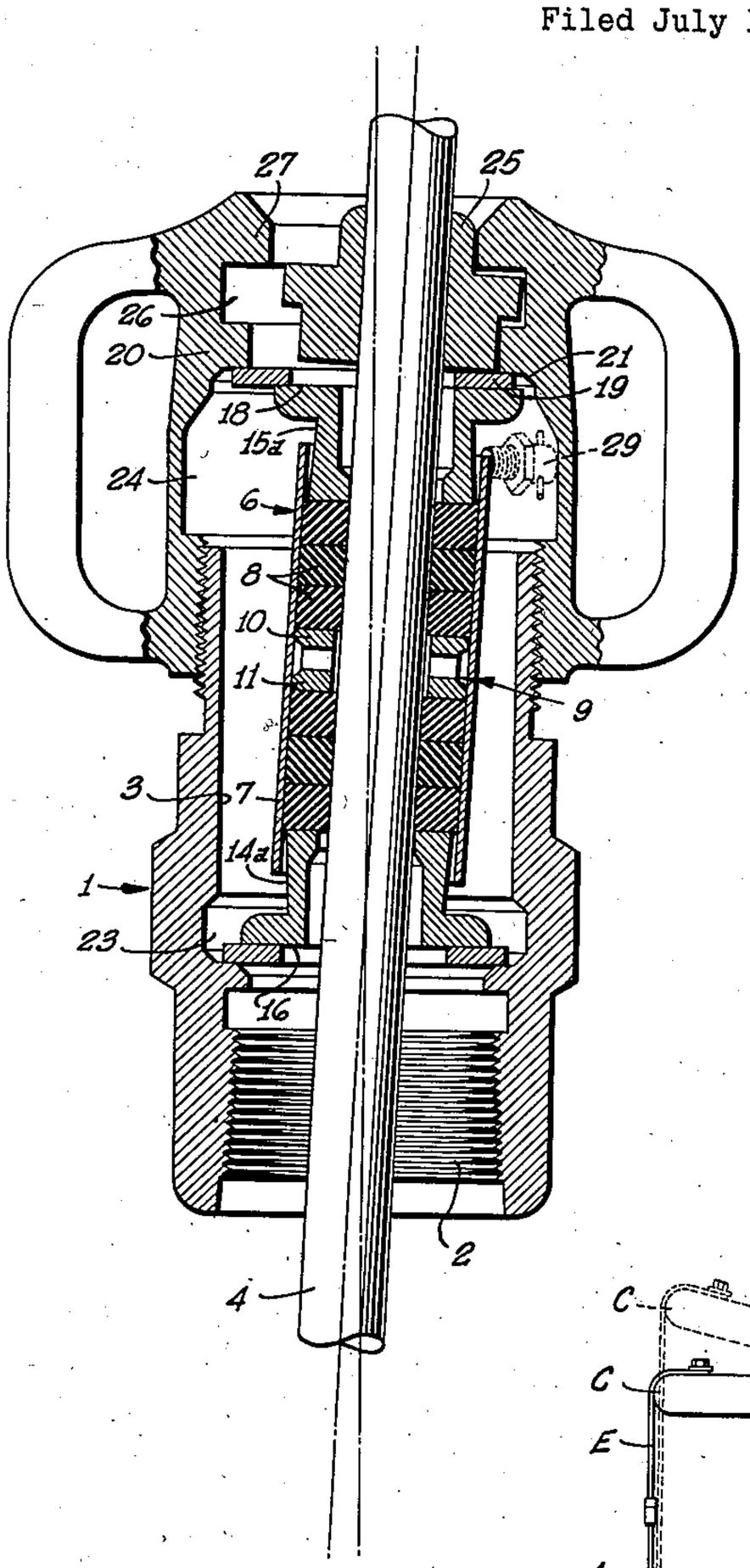


FIG. 3.

FIG. 4.

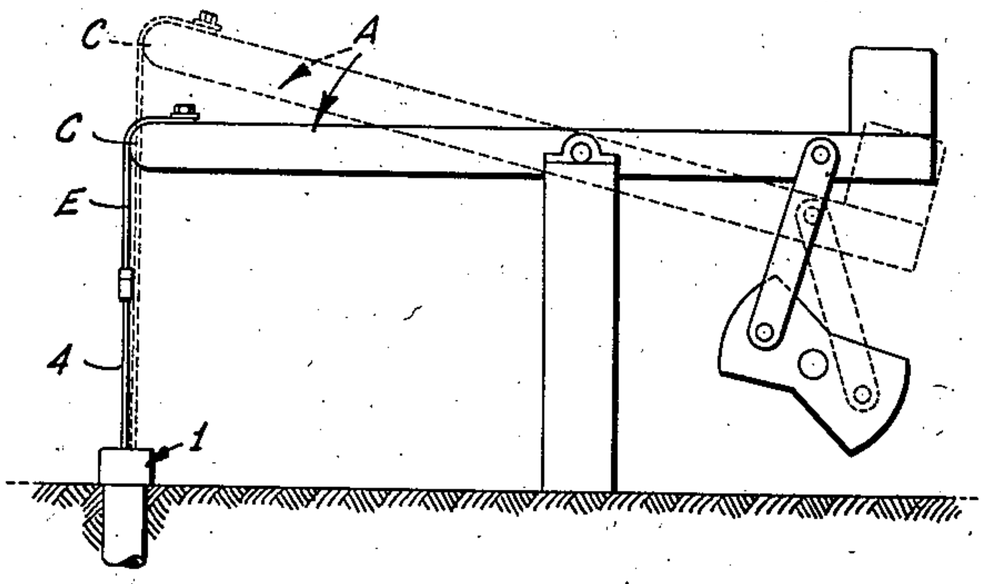
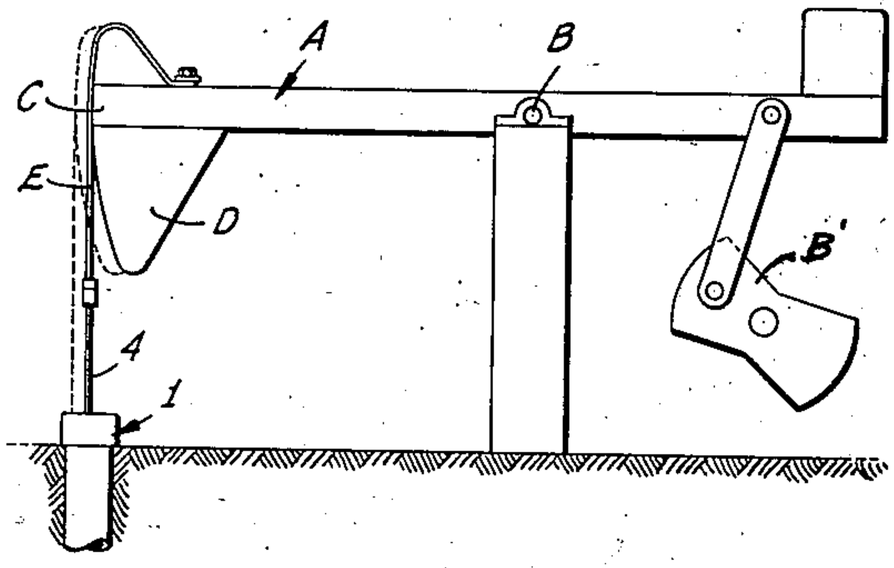


FIG. 5.



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2,267,183

STUFFING BOX

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Application July 17, 1939, Serial No. 284,842

2 Claims. (Cl. 286—15)

My invention relates to stuffing boxes and has particular reference to an improved stuffing box for packing off around a reciprocating rod such as the "polished rod" of an oil well pump.

In the pumping of oil wells it is the common practice to employ a plunger and barrel type of pump located deep within the well, from which a string of sucker rods extends to the ground surface for connection to a reciprocating pumping jack or other power mechanism by which the sucker rods and plunger are reciprocated.

The upper end section of the sucker rod string is usually formed as a "polished rod" which passes through a stuffing box at the well head which will prevent leakage of oil around the polished rod while permitting free reciprocatory movement thereof. While the ideal condition for maintaining the sealing action of the stuffing box over prolonged periods of operation is that of reciprocating the polished rod through the stuffing box in a vertical line coincident with the axis of the tubing within which it operates, it is found that this ideal condition is seldom encountered. The polished rod may be shifted from such axial relation even though its path of movement may be in a direct vertical line or the polished rod may shift laterally during each cycle of its movement so that in stuffing boxes in which the packing is rigidly mounted such packing becomes rapidly worn.

The pumping apparatus which is most commonly employed for reciprocating the sucker rod string is of the walking beam type in which a walking beam is pivoted to reciprocate in a vertical plane with one of its ends disposed immediately above the well head and to which a cable or other connecting device is secured and coupled to the polished rod. It follows that, though the polished rod will be reciprocated in a substantially vertical direction, the arcuate path described by the outer end of the walking beam will produce a lateral shifting of the upper end of the polished rod during each stroke. Thus the polished rod will be forced laterally first against one side and then the other of the packing employed in the stuffing box, rapidly wearing such packing so that it no longer makes a sealing fit with the polished rod. Even though devices such as "horse heads" are used on the walking beam, to minimize such lateral shifting of the polished rod, an appreciable shifting frequently occurs with the attendant rapid wearing out of the packing and loss of seal.

It is therefore an object of my invention to provide a stuffing box of the character described, in which the packing surrounding the polished rod may shift laterally in all directions to compensate for misalignment of the power apparatus and may also assume different angular positions coincident with the tilt of the axis of the polished rod.

Another object of my invention is to provide a stuffing box of the character described, wherein the packing surrounding the polished rod is contained within the packing unit extending along the rod and in which the packing unit is so mounted within a housing as to permit the entire unit to shift bodily in all lateral directions as well as to permit either end of the packing unit to be shifted laterally different amounts and in different directions.

Another object of my invention is to provide a device of the character set forth wherein slide bearings are provided for each end of the packing unit upon which the packing unit may float freely in all lateral directions and in which the slide bearings will permit constant shifting without undue wear.

Another object of my invention is to provide a device of the character set forth in the preceding paragraph wherein the bearings are constructed of readily replaceable parts.

Other objects and advantages of my invention will be apparent from a study of the following specifications, read in connection with the accompanying drawings, wherein

Fig. 1 is a vertical sectional view taken through a stuffing box construction embodying the principles of my invention and illustrating the position of the parts when the polished rod is operating along a direct vertical line axially aligned with the housing;

Fig. 2 is a view similar to Fig. 1 but illustrating the position of the parts when the motion of the polished rod is along a direct vertical line but is offset laterally from the axial alignment with the housing;

Fig. 3 is a view similar to Fig. 1 and illustrating the position of the parts when the polished rod is moved along a path which is disposed by an angle to the vertical or to a changing angle during different parts of the cycle of movement of the polished rod;

Fig. 4 is a diagrammatic view of an oil well pumping apparatus illustrating the circumstances of mis-alignment of the pumping apparatus with the axis of the well, causing the conditions depicted in Fig. 2;

Fig. 5 is a diagrammatic view similar to Fig. 4 and illustrating the circumstances which cause a bending of the polished rod and the conditions depicted in Fig. 3; and

Fig. 6 is a detail perspective view of a spacing ring which may be employed as a part of my packing unit.

Referring to the drawings, I have illustrated in Fig. 1 a stuffing box housing comprising a body portion 1 which is adapted to be secured upon the upper end of the well tubing (not shown) by means of a suitable threaded connection 2. The housing 1 provides a relatively large diameter chamber 3 through which the polished rod 4

extends, the housing being provided at the lower end of this chamber with an inwardly extending radial flange 5 upon which the lower end of a packing unit 6 may bear. The packing unit comprises an elongated tube or sleeve 7 which constitutes a casing within which is disposed a plurality of packing ring 8 formed of suitable packing material. I prefer to arrange the packing rings as relatively narrow rings stacked one upon the other in two groups, an upper group including a plurality of these rings and a lower group including a plurality of these rings, the two groups being spaced apart by means of a spacing ring 9 illustrated particularly in Fig. 6.

The spacing ring 9 may be readily formed as a casting including an upper ring element 10 and a lower ring element 11 spaced from each other by a plurality of narrow webs 12 so as to provide therebetween a plurality of relatively large radially extending openings 13 through which lubricant may readily pass to the surface of the polished rod enclosed within the packing rings and spacer rings.

The tubing 7 is preferably somewhat longer than is required to house the assembled packing and spacing rings so as to provide spaces on each end of the assembled rings into which glands 14 and 15 (constituting parts of the packing unit 6) may project, the external diameter of that portion of the glands 14 and 15 which extends into the tube 7 being preferably somewhat less than the internal diameter of the tube 7 so that while the inner ends of the glands 14 and 15 may bear directly upon the outermost packing rings there will be substantially no metallic contact between the glands and the tube 7.

The outer or lower end of the packing gland 14 is preferably machined or ground to a horizontal surface 16 which constitutes a bearing surface adapted to rest upon and slide laterally on a wear ring 17 which may be formed of relatively hard steel. In order to insure a tight and substantially liquid-proof seal between the gland 14 and the wear ring 17, the interengaging surfaces may be lapped together.

A similar construction is provided for the gland 15, its upper surface 18 being lapped upon the lower surface of an upper steel wear ring 19. Pressure is applied to the upper gland 15 by means of a cap portion 20 of the housing which has a radially inwardly extending shoulder 21 engaging the wear ring 19, the cap 20 being threadely secured upon the body portion 1 of the housing as indicated at 22, so that by screwing down upon the cap 20 any desired pressure may be exerted upon the packing rings 8.

It will be observed that the housing 1 is provided immediately adjacent the lower end of the gland 15 with an enlargement 23 of its internal bore while the cap member 20 is provided with an internal bore 24 immediately adjacent the upper gland 15 of considerably greater diameter than the greatest diameter of the gland 15. Thus the entire packing unit 6 (including the packing rings 8, tubing 7 and glands 14 and 15) are allowed considerable latitude of lateral movement within the housing and cap so that the packing unit is freely floating in all lateral directions within the housing.

Moreover, one end of the packing unit 6 is free to float or move laterally independent of the other end of the unit so that either end of the packing unit may shift laterally different amounts and in different directions in order to maintain the axis of the packing unit aligned with a tilted or angular disposition of the polished rod 4.

In Fig. 4 I have illustrated a typical walking beam pumping apparatus as coupled to the polished rod 4 and which comprises a walking beam A arranged to be oscillated about a pivot B by means of a conventional pitman B'. When properly installed, such walking beam A has its outer end C disposed immediately in alignment with the axis of the well bore so that upon oscillation of the walking beam A the polished rod 4 should reciprocate along a direct vertical line which is in turn axially aligned with the housing 1 of the stuffing box. In order that the arcuate path described by the outer end C of the walking beam will not cause appreciable lateral movement away from this direct vertical line, a horse head D may be provided, over which the cable E coupled to the upper end of the polished rod 4 may pass. Under these circumstances the polished rod 4 will be reciprocated along a direct vertical line which will be aligned with the axis of the housing 1 and the position of the packing unit 6 will be such as is illustrated in Fig. 1. If, however, due to inaccuracy in the construction of the horse head D there is some deviation from the direct vertical movement, the entire packing unit 6 may bodily shift laterally in the housing without imposing any lateral strain upon the packing and the wear on the packing surface will be uniform throughout its circumference.

However, if there has been any misalignment of the outer end C of the walking beam with the axis of the well bore, the path described by the polished rod 4 will be along a direct vertical line but this line will have been shifted or offset laterally from the axis of the housing 1, as is illustrated in dotted lines in Fig. 4. When this condition obtains, the entire packing unit 6 will shift to the position shown in Fig. 2, the packing unit being freely floating within the housing 1 so that it will assume the offset position and again there will be no lateral load upon the packing rings.

In many wells the actual motion of the polished rod 4 does not follow a true vertical line as depicted in Fig. 4 but describes a path which is disposed at an angle to the vertical or which may include a bending or tilting of the polished rod at different portions of its cycle of movement. For example, as illustrated in Fig. 5, the cable E may be connected directly to the outer end C of the walking beam A without employing the horse head D. The arcuate path described by the outer end C of the walking beam will therefore cause the polished rod 4 to assume different angular positions during different portions of its cycle of operations so that within the stuffing box the polished rod is reciprocated along a path of constantly changing angle to the vertical. By employing my stuffing box with the packing unit freely floating at each of its ends, the packing unit may assume constantly changing angular positions, maintaining the packing unit in alignment with the axis of the polished rod, as shown in Fig. 3. To facilitate this angular disposition of the packing unit, I prefer that the packing glands 15 and 16 be formed with tapering side walls as indicated at 14*a* and 15*a*, respectively, which will permit the sleeve 7 to assume the necessary angular position without requiring tilting of the glands 14 and 15. Under such conditions it will be apparent that the glands 14 and 15 will each slide laterally to whatever extent is required to maintain the packing unit in axial

alignment with the polished rod 4 and no lateral load will be imposed upon the packing rings 8.

It will be observed, from an inspection of Figs. 1, 2 and 3, that a wear bushing 25 is provided to encircle the polished rod 4 immediately above the steel wear ring 19, the wear bushing 25 being received within a chamber 26 formed in the upper end of the cap or cover member 20. The shape of the chamber 26 is such that it provides a radially inwardly extending flange or shoulder 27, overlying a radially extending flange 28 formed upon the wear bushing 25, but the shape of the chamber 26 is such that all of its lateral diameters considerably exceed the corresponding diameters of all portions of the wear bushing 25. The lateral space which is therefore provided through which the wear bushing 25 (and the polished rod 4) may shift are maintained, however, slightly less than the lateral space provided in the chamber 3 through which the packing unit 6 may shift. Hence where mis-alignment exceeds the amount which may be compensated for by the shifting of the packing unit, the wear bushing will engage and bear upon the cap 20 so that any wear which occurs, occurs immediately between the wear bushing 25 and the polished rod 4 where it may be readily noticed and suitable correction in alignment may be made. By forming the wear bushing 25 of cast iron or similar material softer than the polished rod 4, all of the wear which occurs prior to correction will occur on the wear bushing 25, which bushing is readily replaceable. However, even though such wear does occur, there will be no lateral strains imposed between the packing unit 6 and the polished rod 4 and there will be no loss of seal between these members.

By providing the packing rings 8 freely floating within the shell or tube 7, any bending which may occur in the polished rod during its normal reciprocating motion may be compensated for by the relative lateral shifting of the several packing rings to conform with the bend produced in the polished rod 4.

Lubrication of the entire stuffing box may be readily accomplished by filling the chamber 3 with suitable oil, grease or other lubricant, which may be introduced through a suitable grease fitting 29 extending into the cover 20. Adequate lubrication of the polished rod may be likewise accomplished by providing a plurality of holes or apertures 30 through the shell 7 which are alignable with the space between the upper and lower flanges of the spacing ring 9 so that lubricant may pass from the chamber 3 through the openings in the shell 7 and through the apertures 13 provided in the spacing ring 9 to the surface of the polished rod 4.

It will be observed that the bore 31 through the ring 9 is somewhat larger than the diameter of the polished rod 4 so that the interior of the ring 9 forms a lubricant chamber immediately adjacent the surface of the polished rod.

Since the shell 7 is not secured either to the glands 14 and 15 or the packing rings 8 and therefore may assume various vertical positions relative to the spacing ring 9, I prefer to provide a plurality of sets of holes or apertures 30 in the shell 7 arranged in staggered relation above and below the central set of such apertures so that regardless of vertical shifting of the shell 7 at least a number of holes will be disposed adjacent the apertures 13 in the spacing ring 9.

It will be apparent that the stuffing box constructed in accordance with the description herein may be readily and economically manufactured since the glands 14 and 15 may be constructed as duplicates of each other and the steel bearing rings 17 and 19 may be constructed as duplicates. Moreover, it will be noted that the entire packing unit may be readily removed and replaced merely by removing the cover portion 20 of the housing, all of the parts of the packing unit and their associated wear rings being readily removable through the upper end of the chamber 3.

It will therefore be observed that I have provided a stuffing box for polished rods which will automatically compensate for any of the lateral displacements commonly found in oil well pumping apparatus and that, by providing the freely floating packing unit, I insure an adequate packing seal regardless of the cause, character or degree of such lateral displacement.

While I have shown and described the preferred embodiment of my invention, I do not desire to be limited to any of the details of construction shown or described herein, except as defined in the appended claims.

I claim:

1. A stuffing box comprising a housing through which a reciprocating rod extends, a packing unit surrounding said rod and extending longitudinally along said rod, plane bearing surfaces formed at either end of said packing unit and disposed transversely of the axis of said rod, a chamber formed in said housing having lateral dimensions in excess of the lateral dimensions of said packing unit, plane bearing surfaces formed upon said housing at opposite ends of said chamber to engage and mount said packing unit for free bodily lateral movement within said chamber, a wear bushing surrounding said rod, and a second chamber in said housing for receiving said wear bushing having lateral dimensions exceeding the lateral dimensions of said bushing by an amount less than the dimensions of the first chamber exceeds the dimensions of the packing unit.

2. A stuffing box comprising a housing defining a chamber through which a reciprocating rod extends in the general direction of the longitudinal axis of the chamber; a packing unit surrounding said rod including a pair of glands spaced free of each other along said rod, a plurality of separate packing rings surrounding said rod and interposed between said glands, each of said glands comprising a bushing having an inner end engageable with said packing rings and an enlarged outer end, a longitudinal rod receiving bore extending through said gland and having a plurality of diameters all in excess of the diameter of said rod, progressively increasing from the inner end to the outer end of said gland, the outer end of said gland having a plane bearing surface formed thereon and disposed in a plane perpendicular to the axis of said bore, a sleeve surrounding said packing rings and of greater length than said packing rings to overlie the inner ends of said glands, said glands having an outer surface tapering inwardly as it approaches the outer end of said gland to permit axial misalignment of said sleeve with said gland, and plane bearing surfaces on said housing disposed adjacent each end of said chamber and extending in a plane perpendicular to the axis of said chamber for slidably mounting said glands for free lateral movement independent of each other.

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