

March 18, 1941.

I. L. DUNN ET AL

2,235,289

STUFFING BOX

Filed July 26, 1937

3 Sheets-Sheet 1

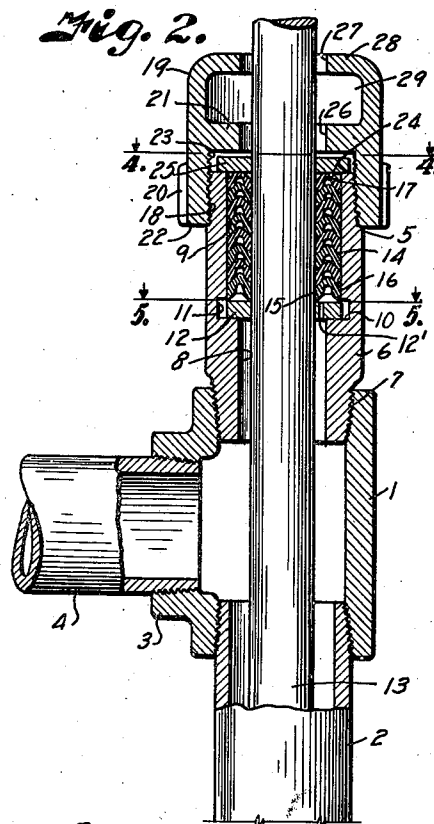
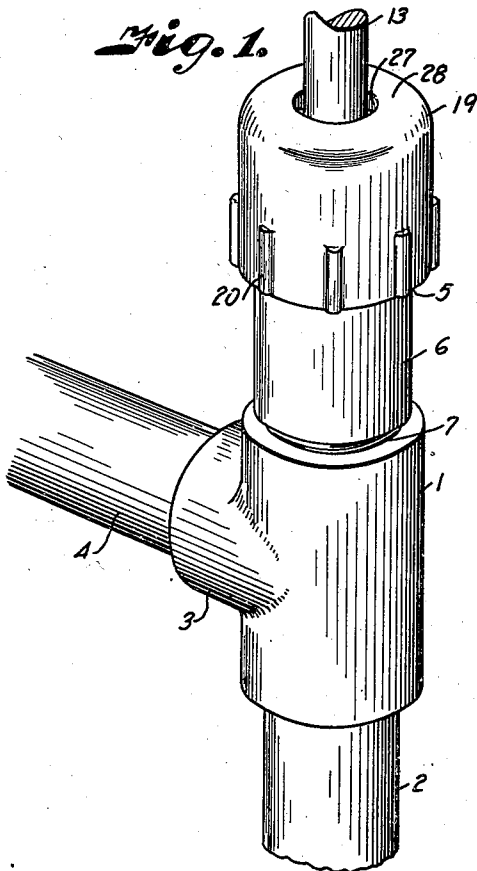


Fig. 3.

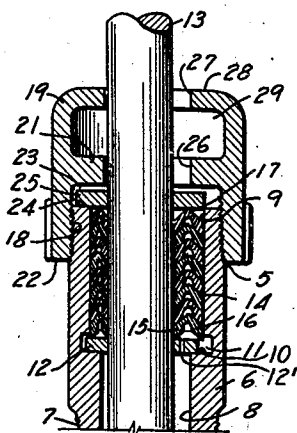


Fig. 4.

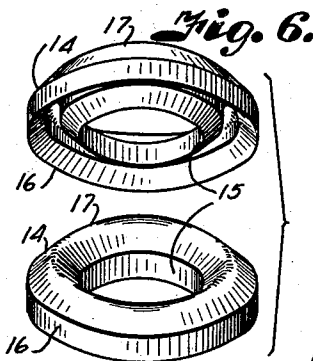
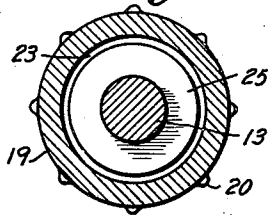
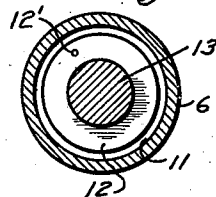


Fig. 5.



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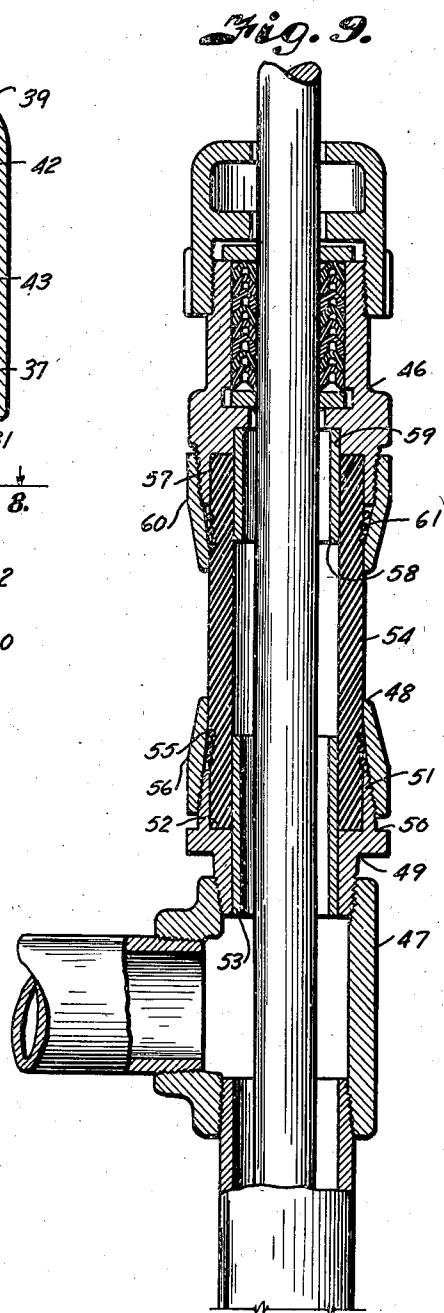
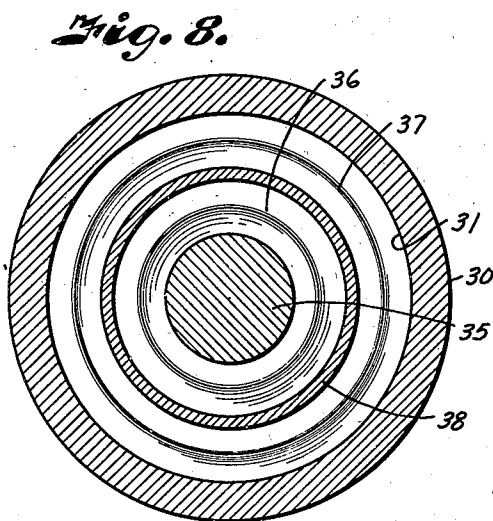
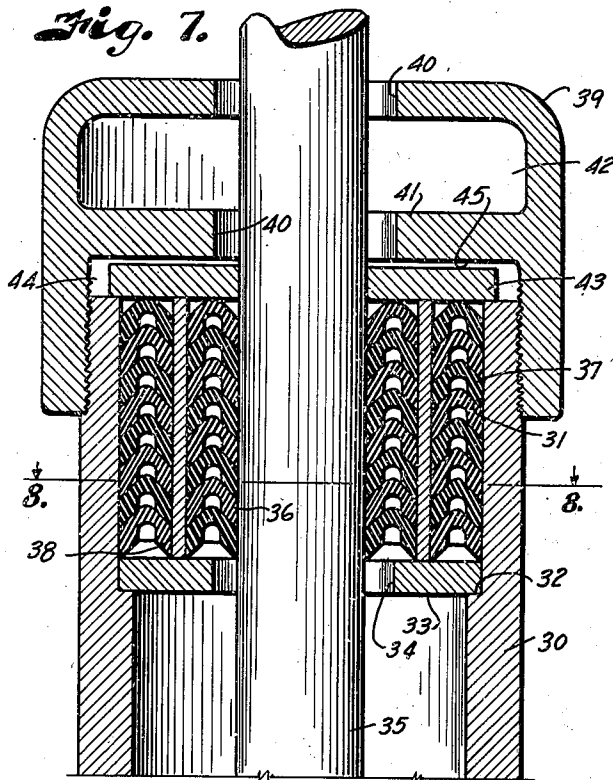
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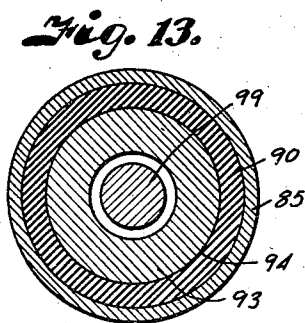
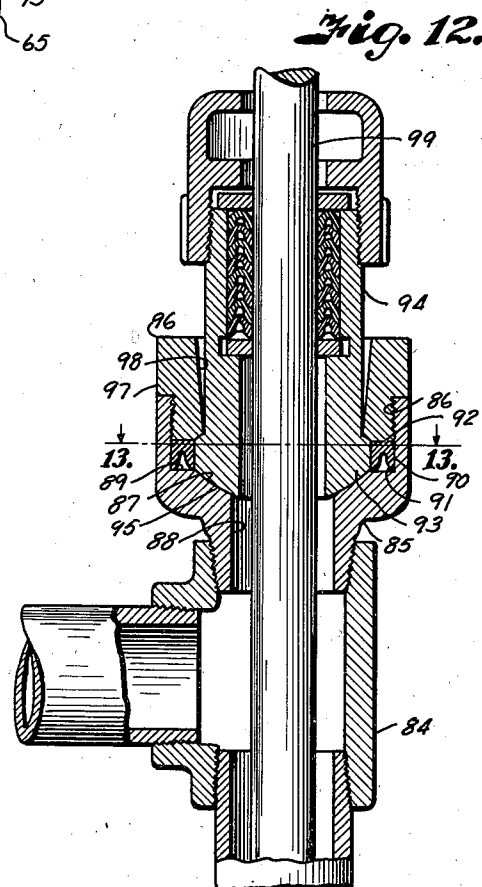
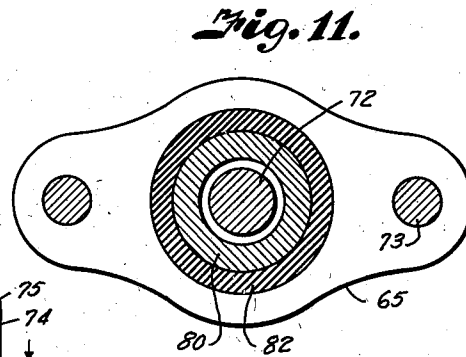
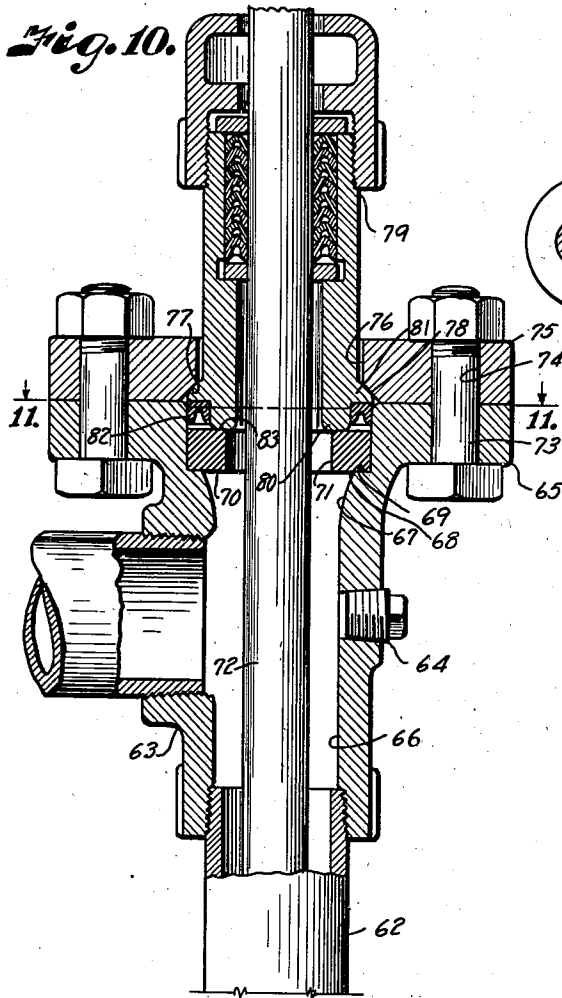
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STUFFING BOX

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Application July 26, 1937, Serial No. 155,640

1 Claim. (Cl. 286—34)

This invention relates to stuffing boxes for the pumping rods of oil and like wells, and more particularly to a stuffing box capable of flexibly sealing off the upper working end of the well pumping rods from the well.

In pumping oil wells, it is the usual practice to provide a pump element near the bottom of the well hole and to actuate the pump element through a string of rods, the upper end of which is ordinarily provided with a polish rod passing through a stuffing box above the head of the well for sealing off the oil or other fluids, which are being pumped from the well. The polish rod is usually operated by a walking beam, pumping jack, or other apparatus suitable for reciprocating the rods in the well for withdrawing well fluids from the well by the pump element during such reciprocation of the rods. The polish rod has imparted to it an arcuate motion due to the customary arcuate reciprocatory motion of the rod reciprocating mechanism. The result of this arcuate motion is that the polish rod moves out of axial alignment with the well hole and packing, which ordinarily is engaged about the polish rod to seal off the well, is distorted and subjected to disproportionate and uneven wear and stresses to thereby decrease its efficiency and useful life. Further, the pumping mechanism is frequently not aligned with the tubing, or the polish rod is bent. Under such conditions, it is necessary to use considerable pressure on the packing, causing it to be subjected to a great deal of friction. When the well is being pumped without lubrication by the well fluids, as for example, when the gas pressure in the well causes the oil, which has been pumped into the tubing, to flow from and empty the tubing, the packing can receive no additional lubrication until the pump has raised oil to the top of the well. This is also true when an old well is being periodically pumped and before the well tubing can be filled with well fluids to lubricate the stuffing box. This makes the rods more difficult to operate, slows the drop on the return stroke, causes burning out of the packing in the stuffing box and necessitates relining the stuffing box with fresh packing with the consequent expense of the packing, together with the loss of time in reinstalling the packing and stuffing box.

It is, therefore, the principal object of the present invention to provide a stuffing box, which will permit the polish rod to have appreciable lateral movements imparted to it and automatically adjust the sealing packing of the stuffing box to the misalignment of the polish rod with

the axis of the well without increase of the packing pressure on the rods, and which operates efficiently under such eccentric conditions of the polish rod relative to the axis of the well.

Other important objects of the present invention are to provide a stuffing box with a resilient packing having no initial pressure and that is self-packing under the well pressure, that relieves the pressure on the rods on their return stroke to permit easy dropping of the rods, that reduces friction between the polish rod and stuffing box to a minimum, that will not burn out when operating with fluid flowing from the well, and which, because of these features, materially reduces the cost of pumping a well.

It is a further object of our invention to provide a stuffing box which flexes in conformity to the normal arcuate movement of the polish rod operating therethrough to thereby reduce the tendency of the packing in the stuffing box to wear out and become loosened.

In accomplishing these and other objects of the present invention, we have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is an outside perspective view of a stuffing box embodying the features of the present invention, the stuffing box being shown in assembled condition on the head of a well tubing.

Fig. 2 is a vertical cross-section through our preferred form of stuffing box illustrating its novel features and showing its application to the head of a well.

Fig. 3 is a vertical cross-section through our preferred form of stuffing box illustrating the polish rod in eccentric or misaligned condition relative to the axis of the well and the corresponding position of the stuffing box elements under such conditions.

Fig. 4 is a horizontal cross-section on the line 4—4, Fig. 2.

Fig. 5 is a horizontal cross-section on the line 5—5, Fig. 2.

Fig. 6 is a perspective view of the preferred form of packing used in the stuffing box.

Fig. 7 is a vertical cross-section through a modified form of stuffing box, illustrating concentric sets of packing.

Fig. 8 is a horizontal cross-section on the line 8—8, Fig. 7.

Fig. 9 is a vertical cross-section through our preferred form of stuffing box, illustrating its application to the head of a well by a flexible jointure embodying features of the present invention.

Fig. 10 is a vertical cross-section through a modified form of box embodying the features of our invention and illustrating a modified form of flexible jointure therefor with the head of a well.

Fig. 11 is a horizontal cross-section on the line 11—11, Fig. 10.

Fig. 12 is a vertical cross-section through a stuffing box and head of a well, illustrating a flexible ball and socket jointure therebetween.

Fig. 13 is a horizontal section on the line 13—13, Fig. 12.

Referring more in detail to the drawings:

In Figs. 1 to 6, inclusive, we have shown the preferred form of stuffing box which, as in ordinary practice, is mounted at the upper end of a T-fitting 1, which is suitably mounted at the upper extremity of tubing 2 leading from an oil well or the like (not shown) and which is provided in its side opening 3 with a well fluid lead line 4 for dissipating fluids pumped from the well.

The stuffing box is generally designated 5 and consists of a cylindrical body member 6 having threaded engagement 7 at its lower outer end with the upper opening of the T-fitting 1. The body member 6 is provided with an axial bore 8, the upper portion of which bore is counter-bored, as at 9, to provide an annular shoulder 10. An annular recess 11 is also provided at the shoulder, which is of larger diameter than the counter-bore 9. Seated on the shoulder 10 is a preferably metallic retaining ring 12, having an outer diameter less than the diameter of the counter-bore 9, so it is insertable into the body through said bore. However, the ring 12 is of greater diameter than the axial-bore 8, and is thus adapted for seating engagement on the shoulder 10 and for limited lateral reciprocation in the recess in response to the customary arcuate movement of a polish rod 13 which, as in customary practice, is mounted on the pumping rods in the tubing 2 and extends therefrom upwardly and outwardly for suitable connection with a walking beam (not shown) or other suitable apparatus for reciprocating the rods in the tubing to pump the well with a pumping element (not shown) on the lower end of pump rods in the usual manner.

Mounted in the counter-bore 9 and seating on the retaining ring 12 is a plurality of inverted U-shaped flexible packing rings 14, as particularly shown in Fig. 6. The packing rings 14 are formed of a suitable tough resilient composition and have inner and outer oppositely outwardly tapered downwardly extending walls 15 and 16, each of which are joined at their upper ends by a substantially bevelled top wall 17, the top walls 17 of the packing rings being respectively engageable between the walls of superimposed packing rings, as shown in Figs. 2 and 3, in such a manner that a compact packing is provided in the stuffing box of any desirable length or thickness. The packing rings are preferably of a collective thickness less than the distance between the retaining rings when in lowered position, so that a floating or "fish gill" motion is imparted thereto in response to pumping of the well. The bottom retaining ring is also provided with a hole 12' for the passage of well fluids to expand the bottom packing ring and in turn the rings above in such a manner that all the packing rings are expanded on the pumping stroke, it being apparent that on the down stroke when pressure is reduced, sometimes below at-

mosphere, the packing rings collapse and friction is thus reduced.

The upper end of the stuffing box body member 6 is provided with external threads for receiving the lower internally threaded end 18 of a cap member 19, the cap member 19 being provided with ribs or the like 20 to facilitate its application to the body member 6 and also being provided with an internal horizontal dividing wall 21, the lower face of which is spaced from the lower end 22 of the cap a sufficient distance to provide a pocket or space 23 between said lower face and the upper horizontal end 24 of the body member 6. A retaining ring 25 is mounted on the polish rod 13 within the pocket 23, the ring 25 having a smaller outer diameter than the inner diameter of the threaded lower end of the cap member and the ring 25 is of less thickness than the depth of the pocket, lateral and vertical movements of the ring thus being permitted within the pocket when lateral thrusts are imparted to the polish rod during its reciprocation. The retaining ring 25 is adapted to rest on the upper end 24 of the body member 6. Axial bores 26 and 27 are provided in the horizontal wall 21 and upper cap end 28 of the cap member which are of larger diameter than the diameter of the polish rod, so that lateral play of the polish rod will not bind or strike the end and dividing walls of the cap member. The space 29 between the wall 21 and end 28 of the cap member provides a reservoir at the upper end of the cap member, which is suitable for the reception of oil or other lubricating medium to maintain the packing rings and polish rod in lubricated condition for facilitating operation of the well when no fluids are flowing from the well itself to lubricate the stuffing box and polish rod.

In the operation of a well provided with a stuffing box embodying the features of the present invention, well pressure ordinarily causes fluid from the well to be forced upwardly past the bottom retaining ring of the stuffing box to expand the flexible walls of the packing members for effecting a seal between the stuffing box and the polish rod. The limited space between the upper retaining ring and the inner wall of the cap permits the packing and retaining rings to, in effect, float, which has the advantage of reducing the bind and wear ordinarily encountered in stuffing boxes.

As the polish rod is reciprocated by means of a walking beam, for example, lateral play is ordinarily imparted to it which, when transmitted to the packing, has no deleterious effects on the stuffing box due to the fact that the retaining rings may follow or correspond to the play of the polish rod in the counter-bore and space 23 and, further, due to the fact, as particularly shown in Fig. 3, that the packing rings are either compressed or expanded at opposite sides thereof, depending upon the direction of lateral play of the polish rod, the packing rings always maintaining a seal between the stuffing box and polish rod to thus effectively prevent escape of well fluids from the well.

Even should pressure in the well be insufficient to lubricate the stuffing box and polish rod with well fluid, lubricating medium may be deposited in the reservoir 29 for gravitational application to the packing rings. It sometimes happens that small quantities of lubricant are extruded through the packing rings into the reservoir, in which event such fluid will gravitate

back down over the packing rings to maintain them in lubricated condition, when the well is pumping dry.

In the event that the well is operating in a dry state, the resiliency of the packing members and the lateral play permitted by the retaining rings reduces the bind between the stuffing box and the polish rod and the packing members will, therefore, not burn out, since there is not an excess of friction.

In Figs. 7 and 8, we have shown a modified form of packing, wherein the cylindrical body member 30 of a stuffing box is provided with a counter-bore 31 to provide a shoulder 32 in the interior of the member 30 for seating a retaining ring 33, the retaining ring 33 having an axial-bore 34 of substantially larger diameter than a polish rod 35 reciprocable in the stuffing box and about which the retaining ring is mounted, so that the polish rod may have lateral thrusts imparted thereto without coming into harmful frictional contact with the retaining ring.

A multiple series of packing rings 36 and 37 is provided in the counter-bore of the member 30. The packing rings are of a construction similar to the rings 18, previously discussed, and each series of rings has inner and outer diameters of differential size. The series of superimposed packing rings 36 have inner diameters of substantially the same diameter as the polish rod, which adapts them for engagement therewith and the outer series of packing rings 37 have an outer diameter substantially the same as the counter-bore 31. The series of rings are separated by a cylindrical sleeve 38 mounted therebetween and seated on the retaining ring 33, it being apparent that the amount of lateral play between the polish rod 35 and the stuffing box body member 30 is substantially doubled over that provided in our preferred form of invention, which is due to the greater amount of flex inherent in the multiple series of packing rings.

The upper end of the member 30 is provided with external threads for receiving the internal threads at the lower end of the cap member 39, the cap member being of substantially the same construction as the cap member 19, previously described, and having bores 40 in the horizontal walls 41 thereof for permitting lateral play of the polish rod 35, an oil or lubricant reservoir 42 also being provided in the cap member, which is bounded by the walls 41 of the cap member.

A retaining ring 43 is also provided, which has an axial-bore of approximately the diameter of the polish rod and an outer diameter less than the inner diameter of the end of the cap member, but of greater diameter than the counter-bore 31, thus adapting the retaining ring 43 for seating on the upper end of the member 30 and on the upper end of the cylindrical sleeve 38, when in normal condition. The ring 43 is of less thickness, however, than the space 44 between the upper end of the member 30 and the lower face 45 of the dividing walls 41, so that a floating action is permitted when the polish rod is reciprocated in the stuffing box.

In this construction, it is apparent that when the well is being pumped, well fluids are forced to the upper end of the well for transmission through the space between the retaining ring 33 and the polish rod for expanding the packing rings to seal off the top of the well. It is also apparent that lateral thrusts may be imparted to the polish rod, in which event the polish rod is not bound by the ring 33, due to the space there-

between, nor is it bound by the upper end of the cap member due to the play permitted by the retaining ring 43 in the space 44. Downward movement of the polish rod compresses the packing rings to increase their respective inner diameters, in such a manner that friction is reduced therebetween and burning out of the packing rings is precluded. Further, since a multiple series of packing rings is provided, the possible expansion and contraction of the stuffing box packing is substantially doubled over that of a single series of rings and flexibility of the stuffing box is, therefore, materially enhanced.

In pumping wells with a long stroke, the arcuate and lateral motions of the rods are more pronounced. It is, therefore, sometimes necessary to provide greater flexibility of the stuffing box relative to the rods and, in Fig. 9, we have shown a modified form of the invention, wherein a stuffing box 46, embodying the features of the preferred form of invention, is mounted on the usual T-fitting 47 at the upper end of a well, but which is interconnected therewith by a flexible coupling 48 to compensate for such deflection of the rods from the axis of the well.

The flexible coupling consists of a nipple 49, having its lower end externally threaded for engagement in the T-fitting 47 and having an annular flange 50 provided with an upwardly, externally threaded end 51, which is counterbored to provide an inner, annular shoulder 52. A retaining sleeve 53 is suitably secured to the inner wall of the nipple 49 to provide, with the end 51, a seat for a flexible hose-like body member 54, which is formed of a material resistant to well fluids. Wires or the like 55 are provided on the outer surface adjacent the ends of the body member 54 for enhancing the binding action of the body member between a threaded coupling 56 secured thereon and the end 51 of the nipple when it is screw-threadedly engaged with the nipple. The upper end 57 of the flexible member 54 is of a construction substantially similar to its opposite end, just described, with the exception that the retaining sleeve 58 thereof is spot welded, or otherwise suitably secured, to the lower, inner end of the axial-bore 59 of the stuffing box, the attachment of the member 54 to the stuffing box being had through threaded engagement of the lower end of the stuffing box with the coupling 60 mounted on the member 54, as shown at 61.

In operating a well by pumping rods having their upper end extending through a stuffing box and flexible coupling of the character just described, it is apparent that lateral play of the polish rod is compensated for by the stuffing box as pointed out in connection with the preferred form of invention, and that such lateral play is further absorbed by the coupling, since it has a tendency to bend in the direction of thrust of the polish rod. Flexibility of the well head connection and seal is thus greatly enhanced, which prolongs the life of both the stuffing box and pumping equipment and also increases the output of the well by reducing the necessity for shut-downs.

In Fig. 10 is illustrated the upper end of a well tubing 62, having a T-fitting 63 mounted thereon provided with an outlet 64 in a wall thereof for testing the well, the T-fitting being provided at its upper end with a laterally extending flange 65. The bore 66 of the T-fitting is flared outwardly at its upper end, as shown at 67, and offset as at 68 to provide a shoulder 69 for seating a flexible ring 70 having a central bore 71 of substantially larger diameter than the diameter of

the polish rod 72, which is reciprocable there-through. The ends of the flange 65 are provided with bores for receiving suitable fastening devices 73, which are insertable therethrough and through 5 corresponding aligned bores 74 of a clamping member 75, which is adapted to seat on the flange 65. The clamping member 75 is provided with a central opening 76, the lower end of which is bevelled outwardly, as shown at 77, to form a seat 10 for the rounded lower end 78 of a stuffing box 79. The stuffing box 79 is provided with an extended lower end 80, the outer periphery of which is provided with an annular flange 81 which forms 15 a shoulder for seating an inverted U-shaped flexible packing ring 82, said shoulder forming one side of the flange and the rounded upper end 78 which seats in the curved bore 77 of the clamping member forming the other side of the flange. The packing ring 82 is of less thickness than the 20 distance between the flange 81 and the upper face 83 of the resilient ring 70, whereby well fluids issuing from the well, when it is in operation, are transmitted to the under face thereof under pressure for expanding same to create a seal for 25 packing off the well at the head thereof.

In the operation of a well to which the present form of invention has been applied, it is apparent that lateral thrusts on the polish rod will not only be absorbed by the stuffing box 79, but play is 30 also permitted between the lower end of the stuffing box and the flanges at the upper end of the T-fitting, thus materially reducing wear and tear both on the polish rod and well equipment and at the same time maintaining an effective 35 seal for packing off well fluids.

In Fig. 12 we have provided a further modified form of invention wherein the usual T-fitting 84 has mounted therein, at its upper end, a nipple 85. The upper end of the nipple is provided with 40 internal threads 86 and an inset portion 87 having curved surfaces which join the axial-bore 88 of the nipple with a shoulder 89 formed by the different bores of the nipple. A sealing ring 90 of flexible character and of inverted U-shape has 45 its ends 91 seated on the shoulder and respectively engageable with the nipple and with the

side face 92 of the flanged lower end 93 of the stuffing box body member 94. The flanged end 93 of the stuffing box is curved on its lower end, as at 95, for seating engagement on the curved 5 inset surface 87 of the nipple. Mounted in the upper end of the nipple and adapted for threaded interengagement therewith is a retaining member 96 having its upper, outer face 97 in alignment with the side face of the nipple and having a tapered central bore 98, the taper thereof being 10 in an upward, outward direction.

The principal advantages in the forms of invention embodying our improved features are that the cost of maintenance of an oil well is appreciably reduced, due to the fact that the 15 packing rings are protected from an excess of friction, which precludes their burning out and avoids the consequent necessity of stopping the well to replace the packing and also saves the cost of the packing. Further, since there is no 20 bind between the polish rod and the well head, power required to operate the well is decreased and the life of the equipment prolonged, due to the lack of wear on the stuffing box, well head and rods. An effective seal is, further, provided 25 for maintaining sealing contact between the stuffing box and polish rod, which prevents loss of well fluids, whether the stuffing box be in a wet or dry condition.

What we claim and desire to secure by Letters 30 Patent is:

A stuffing box including a hollow body member having an offset bore, and a counter-bore, packing rings mounted in said offset bore engageable 35 with a member reciprocably mounted in the body member, a retaining ring movably mounted in the counter-bore and adapted to seat said packing rings, and a retaining ring movably mounted in the body member in spaced relation to the first 40 named retaining ring and in engagement with the uppermost packing ring for limiting movement of the packing rings in one direction.

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