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SLUSH PUMP PISTON AND PISTON ROD

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Fig. 1

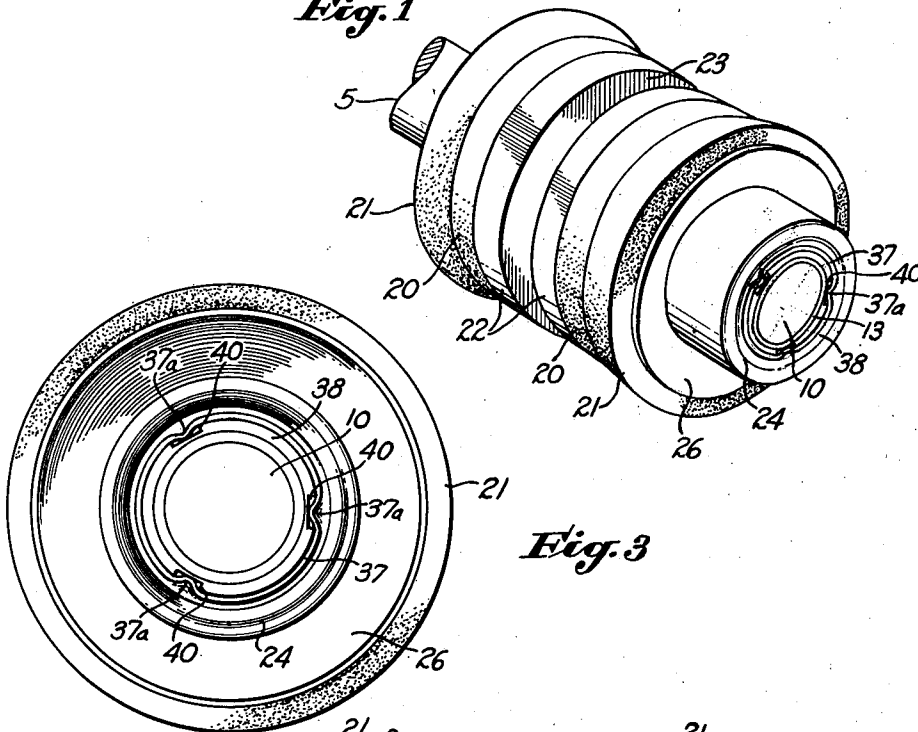


Fig. 3

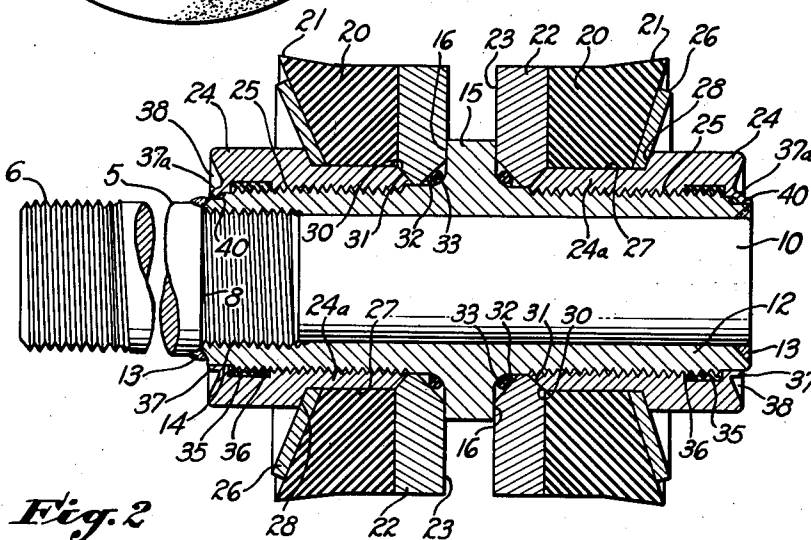


Fig. 2

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SLUSH PUMP PISTON AND PISTON ROD

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20 Claims. (Cl. 309-4)

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This invention relates to pumps, particularly to those known as slush pumps, and more especially to piston and piston rod constructions therefor.

Slush pumps of the indicated character are commonly employed in the pumping of so-called drilling mud used in the drilling of deep wells, such as oil wells. As modern drilling practices have developed oil and gas wells have become deeper and deeper, and the loads imposed upon slush pumps in circulating drilling mud under steadily increasing hydraulic heads have become greater and greater. As a consequence, it has become impossible in a great many instances to retain the pistons on the piston rods by the means and methods conventionally employed, as illustrated by threaded retaining nuts mounted upon the ends of the piston rods. Such piston rod ends are commonly slender and permit stretch. In addition, the shock loads which are applied during reciprocating operation to the threads by which the nuts are affixed cause loosening by wear at the threads and at the engaging faces between the nuts and the pistons. The severity of these loads is apparent when it is realized that in the drilling of deep wells steam pressures in the order of 350 to 500 pounds are now common as against earlier requirements of 100 pounds and less. Also, pump diameters have been increased from about 12 inches to about 20 inches, thus further greatly increasing total loads imposed, which may run up to a possible maximum of 120,000 pounds.

Another factor involved in the circulating of drilling mud in deep well drilling is found in the fact that as greater depths are reached in the drilling of the well, more circulating power is required. Since the power of the prime mover cannot ordinarily be appreciably increased, the cross sectional area of the pistons is decreased, and liners of smaller internal diameter are successively employed to replace liners of larger internal diameters. Such liner substitutions require correspondingly smaller piston diameters.

In view of the difficulties above outlined, it is one object of this invention to provide a piston and piston rod construction capable of withstanding the increasing shock loads currently imposed upon slush pump pistons and their rods, an incidental object being to avoid loosening of the pistons on their rods and to avoid detachment of the pistons from their rods because of thread wear or stripping.

Another object of the invention is to provide a piston and piston rod construction wherein a piston rod of adequate size and strength is substan-

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tially integrally bound to piston means which carry the usual sealing ring assembly comprising heavy rubber packing rings.

Still another object of the invention is to provide a slush pump piston construction such that effective piston diameters may be easily increased or decreased according to pumping requirements, and a kindred object of the invention is to provide a piston construction which may be easily assembled and disassembled as may be required either for the purpose of change in piston size or for the purpose of replacing worn parts.

Other objects and various features of the invention will become apparent to those skilled in this art upon reference to the accompanying drawing and the following specification wherein one embodiment of the invention is presented by way of illustration.

In the drawing:

Fig. 1 is a perspective view of a piston constructed and mounted upon a piston rod in accordance with this invention;

Fig. 2 is a longitudinal section through the piston and piston rod assembly shown in Fig. 1; and Fig. 3 is an end view of the assembly.

As best seen in Fig. 2, an elongated piston rod 5 carries at one end threads 6 for attachment to power means by which the rod and its piston are reciprocated. The piston-carrying end of the rod is reduced somewhat to provide an annular shoulder 8 and to yield a reduced cylindrical piston-carrying portion 10 upon which there is rigidly and permanently secured a sleeve 12 of somewhat larger diameter than that of the main length of the piston rod 5. The securing of the sleeve 12 is accomplished by shrinking the same upon the reduced rod portion 10 in a manner well known in the metal working industry. For some uses it is additionally important that a positive and permanent joint between the rod and the sleeve 12 be further assured, and this may be accomplished by weldings 13 adjacent the shoulder 8 and at the outer end of the rod portion 10 as illustrated. Preferably, however, the inner end of the rod portion 10 and the corresponding end of the sleeve 12 are provided with cooperating threads 14 for a short distance, such as about ten to twenty percent of their length or for a distance of about one to one and one-half inches of an eight inch rod portion 10. With such short threads 14, the expanded hot sleeve 12, when being applied, may be readily threaded into place before the shrinkage required by the operation occurs. When such threads 14 are employed, the weldings 13 are seldom used. By means of such shrink fit the

sleeve 12 becomes in effect a substantially integral portion of the piston rod 5 and its end portion 10, so that, regardless of strains applied, the sleeve 12 will not become loose upon or be separated from the end portion 10 of the rod. Thus the rod 5, the end portion 10, and the sleeve 12 constitute effectively a one-piece piston rod structure which carries the piston parts next to be described.

The sleeve 12 is provided at its middle with an annular integral hub 15 whose diameter is substantially the diameter of the smallest pump liner in which the piston will be used. This hub 15 constitutes a thrust-receiving flange or annular rib, and it provides on its opposite sides annular radially extending walls 16 against which are received two opposed sealing ring assemblies, spaced as illustrated, by the hub 15. Thus, the sleeve 12 and the hub 15 provide a piston body to carry the sealing assemblies. Each assembly comprises a heavy rubber sealing ring or piston ring 20 of a general configuration commonly employed on slush pump pistons and more generally known in the trade assembly as a "rubber." Each ring 20 is provided with a conventionally flared annular rim 21 on its working face, such rim 21 being compressible within the pump cylinder or liner to produce the required pumping seal. According to the present construction, each piston ring 20 bears against a backing plate 22 apertured to pass over the sleeve 12 and providing a wall 23 whose inward annular portion is rigidly bound against the corresponding radial wall 16 of the hub 15. Each piston ring 20 and its backing plate 22 are bound in the operative position illustrated by means of an elongated anchoring nut 24 which is mounted upon the sleeve 12 through the medium of threads 25, the respective packing ring 20 having its face opposite from the backing plate 22 engaged by a concave retainer plate 26 of sufficiently smaller diameter not to interfere with the functioning of the rim 21 of the respective piston ring 20. As illustrated, the internal diameter of each backing plate 22 is substantially the external diameter of the sleeve 12 at the ends of the respective threads 25, whereas the inner diameter of each piston ring 20 is somewhat greater in order to receive a reduced diameter extension 24a of its anchoring nut 24. The extension 24a thus provides an outer cylindrical surface 27 which receives the inner cylindrical wall of the adjacent rubber piston ring 20 and also receives the innermost edge of the respective retainer plate 26. The retainer plate 26 is in each instance bound against the piston ring 20 by a sloping shoulder 28 formed by the portion of greatest diameter of the anchoring nut 24. The angularity of the shoulder 28 is commonly in the order of 20 to 25 degrees with respect to the corresponding radius.

For the purpose of positively binding each backing plate 22, the inner end of the extension 24a of the respective nut 24 is beveled at an angle of about 45 degrees to provide a beveled thrust shoulder 30 which binds against a correspondingly pitched face 31 formed on the adjacent portion of the backing plate 22. If deemed desirable, such backing plate may be packed against passage of fluid between it and the hub 15, this being accomplished, for example, by beveling its inner portion opposite the face 31 so as to provide a small annular pocket 32 in which is located a circular rubber packing ring 33 which may be of circular cross section and is compressed into packing form as the plate 22 is forced into

the operative position illustrated. At the same time, sand which is contained in the fluid being pumped and which works past the piston rings 20 is successfully trapped in the annular space provided between the backing plates 22 and lying radially outside the hub 15, in all instances where the plates 22 are of larger operating diameter than the diameter of the hub 15. Thus, it is desirable in all slush pump installations to employ backing plates 22 and piston rings 20 of materially greater diameter than the diameter of the hub 15 whereby to establish such annular sand-collecting space. It has been found that the functioning of this annular space to trap the sand which works past the piston rings 20 very greatly reduces wear upon the piston rings 20, the backing plates 22 and the walls of the cylinder in which the piston operates, thereby very greatly prolonging the life of these portions of the equipment.

For the purpose of locating the anchoring nuts 24 in operative position, each may be provided with a fiber locking ring 35 seated in an internal annular groove 36 adjacent the outer end of the nut 24, whereby threads will be cut in the fiber ring 35 as it is turned into operative position. In order to insure further against loosening of the anchoring nuts 24 during use, each is provided with an annular, thin integral rim 37 adjacent the outermost end portion of the sleeve 12, this rim being formed by cutting an annular groove 38 in the end of the respective nut 24. To cooperate with portions of the rim 37, adjacent portions of the end of the sleeve 12 are provided with notches 40 in each of which, when the respective nut 24 is screwed into its operative position, a detent 37a is formed by striking the adjacent portion of the rim 37 with a punch, the metal thus being depressed as illustrated. Such detents may provide at only one position or at a plurality of positions as required. By lifting the detent 37a with a tool when it is desired to remove the nut 24, the respective notch 40 will be freed. This form of locating means has the advantage of being formed with the nut turned up in its tightest position, regardless of the location of any portion of the rim 37 and any particular notch 40.

In employing the piston and piston rod construction of the present invention, as will be apparent, a piston assembly may be built up of any required diameter greater than the minimum diameter defined by the hub 15. Such piston diameter will be determined by the diameter of the backing plates 22 and the rubber piston rings 20. When the parts 20, 22 and 26 are positioned upon the respective end of the sleeve 12, the respective backing plate being against the hub 15, an anchoring nut 24 is readily turned up so that its beveled thrust shoulder 30 engages the beveled face 31 on the respective backing plate 22 and binds the latter against the adjacent radial wall 16 of the hub 15. The beveled thrust shoulder 30 serves positively to center the respective backing plate 22, even though the diameter of the opening in the respective plate 22 might be slightly greater than the diameter of the sleeve 12 at this location. During the same operation the beveled shoulder 28 engages the respective retainer plate 26 so that it compresses to any required extent the rubber retaining ring 20. A detent 37a is then projected into one of the notches 40 through the application of a punch or similar offsetting tool to the adjacent portion of the rim 40. The same operations are per-

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formed at both ends of the piston. By reason of the described type of construction, the rubber piston rings 20, the backing plates 22 and the concave retainer plates 26 are readily renewed or replaced with parts of different diameters, as has previously been indicated, the diameter of the hub 15 being no larger than the diameter of the smallest piston to be employed. The two sealing ring assemblies arranged as shown provide for normal reciprocating pump operations, the leading flared rim 21 in each instance hugging the cylinder or liner walls of the pump according to conventional practice.

It is to be particularly noted that all thrust occasioned by movement of the pump rod in both directions of reciprocation is taken by the hub 15, and transmitted thence to the sleeve 12, such thrust having been received by the hub 15 from the backing plates 22. Thus, the threads 25 are never required to take any great strain, inasmuch as they have to resist only the trailing forces, and these are inconsequential as compared with the pumping loads and strains. The shrinking of the sleeve 12 upon the reduced piston-carrying portion of the rod, together with the weldings 13 or threads 14, positively prevent any dislodgment of the sleeve 12 with respect to the piston rod 5 and its end portion 10. Thus, the joint between the piston assembly and the piston rod 5 is permanent and not subject to wear, no difficulties being encountered under loads within the capacity of the rod 5 and its attachment by the threads 6 to the prime mover.

Further, in view of the increased diameter of the sleeve 12 where the threads 25 are provided, and also in view of the elongation of the anchoring nuts 24, wear and loosening of the nuts 24 at the threads 25 may be entirely eliminated. The fiber locking rings 35 and the detents 37a thoroughly insure against backing up of the nuts 24. Wear of the rubber sealing rings and the backing plate 22 is cured by easy replacement of the parts as heretofore described.

Since variations of the invention herein disclosed will, no doubt, occur to others skilled in this art, it is intended to cover all modifications which fall within the scope of the claims.

I claim as my invention:

1. In combination in a piston rod and piston structure: a relatively elongated piston rod; a body member rigidly and permanently secured to and directly upon one end of said rod substantially throughout the entire length of said body member by means of a welded, threaded, shrunk fit; and an annular hub rigidly and permanently secured to said body member and adapted to receive piston forming means against said hub.

2. In combination in a piston structure: a piston sleeve adapted to be secured to one end of a piston rod; an annular flange rigidly and permanently secured to said piston sleeve; a backing plate adapted to be positioned against said flange; sealing means adapted to be disposed against said plate and to seal said piston in a cylinder; and means for removably binding said plate and sealing means against said flange, whereby thrust upon said sealing means and plate is received by said flange and transmitted thereby to said sleeve and rod, said sleeve being provided with threads, and said binding means including a nut threaded on the threads of said sleeve, the outer end of said nut being provided with a thin rim adjacent said sleeve, and the adjacent outer end of said sleeve being provided with a notch into which a portion of said thin rim may be de-

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pressed to lock said nut against rotation on said sleeve.

3. In combination in a piston rod and piston structure: a piston rod; a piston sleeve rigidly and permanently secured to one end of said rod; an annular radially extending rib rigidly and permanently attached to an intermediate portion of said sleeve member and providing annular seats at its opposite side; rigid backing plates respectively positioned against said seats; sealing means respectively positioned against said backing plates and adapted to seal the piston in a cylinder during reciprocation therein, said backing plates and sealing means having greater external diameters than the external diameter of said annular rib, and providing a trap space around said rib and between said rigid backing plates; and means for removably binding said plates and sealing means in said seats, whereby thrust upon said sealing means and backing plates is received by said annular rib upon reciprocation in either direction and such thrust is transmitted through said sleeve and rod, each of said means for binding said plates and sealing means against their seats being an elongated nut having a reduced portion passing centrally through said sealing means, the inner reduced end of each of said nuts bearing against the respective backing plate to bind the latter against said annular rib.

4. A combination as in claim 3 wherein the outer end of each nut is headed and provides a shoulder for binding its sealing means in operative position against the respective backing plate, a retainer plate being disposed about the reduced portion of each nut and held by the respective nut head against the respective sealing means.

5. In combination in a piston and piston rod structure: a piston rod; a sleeve member rigidly and permanently secured upon the end of said rod, the other end of said rod being adapted to be attached to means for reciprocating said structure; an annular rib rigidly and permanently connected to said sleeve member and providing at one side a seat; a rigid backing plate positioned against said seat; sealing means positioned against said backing plate and adapted to seal the piston in a cylinder; and means removably binding said backing plate and sealing means in said seat whereby thrust upon said sealing means and said plate is received by said rib, said backing plate and sealing means having greater external diameter than the external diameter of said annular rib, said rib accommodating backing plates and sealing means of varying diameters for use in cylinders of varying diameters, said binding means including elongated nut means carried by said sleeve member and having a reduced portion projecting axially within and through said sealing means and bearing against said backing plate, thereby binding said backing plate upon said seat of said annular rib.

6. In combination in a piston structure: a sleeve member adapted to be secured upon one end of a piston rod; an annular rib rigidly and permanently connected to a middle portion of said sleeve member and providing at each side a seat; a rigid backing plate positioned against each seat; annular sealing means positioned against each backing plate, such backing plates and sealing means having substantially greater external diameters than said rib and thereby providing an annular space between said plates, and said backing plates supporting the annular portions of said sealing means extending beyond

said rib, the portions of said sleeve member beyond said seats being threaded externally and having smaller external diameters than the internal diameters of said annular sealing means; and elongated nuts threadedly mounted upon said externally threaded portions of said sleeve member and having outer surfaces extending within and frictionally engaging the inner cylindrical walls of said annular sealing means, said nuts being provided with headed portions whose external diameters are less than the diameters of said backing plates and sealing means.

7. A combination as in claim 6 including retainer plates held by the headed portions of the respective nuts against the adjacent ends of the respective annular sealing means, said retainer plates being disposed around said outer surfaces of said nuts, and said retainer plates having external diameters greater than the external diameter of said rib and somewhat less than the external diameter of the respective sealing means.

8. A combination as in claim 6 wherein the inner ends of said nuts and the innermost walls of said backing plates are concentrically beveled to center said backing plates and to force them against their seats on said annular rib.

9. A combination as in claim 6 including packing means disposed between beveled innermost portions of said backing plates and the joints between said rib and sleeve member.

10. In combination: a piston rod structure; an annular rib rigidly and permanently connected to said piston rod structure and providing at one side a seat; a rigid backing plate positioned against said seat; annular sealing means positioned against said backing plate and supported by said backing plate, a portion of said rod structure beyond said seat being threaded externally and having a smaller external diameter than the internal diameter of said annular sealing means; and an elongated nut threadedly mounted upon said externally threaded portion of said rod structure and extending through said sealing means in engagement with the internal annular wall thereof, said nut being provided with means for retention of said sealing means.

11. A combination as in claim 10 wherein said elongated nut extends into engagement with said rigid backing plate and binds said backing plate upon said seat against said annular rib.

12. A combination as in claim 10 wherein the engaging portions of said backing plate and elongated nut are relatively inclined to center said backing plate.

13. A combination as in claim 10 including packing means disposed between spaced innermost portions of said backing plate and rib to seal the joint therebetween.

14. In combination: a piston rod structure; an annular flange rigidly and permanently secured to said rod structure; a backing plate adapted to be positioned against said flange; sealing means adapted to be disposed against said plate and to engage the walls of a cylinder; and means for removably binding said plate and sealing means against said flange, whereby thrust upon said sealing means and plate is received by said flange and transmitted thereby to said rod structure, said rod structure being provided with threads, and said binding means including a nut threaded on the threads of said rod structure, the outer end of said nut being provided with a thin rim adjacent said rod structure, and the adjacent outer end of said rod structure being provided with a notch into which a portion of said thin

rim may be depressed to lock said nut against rotation on said rod structure.

15. In combination: a piston rod structure; an annular rib rigidly and permanently connected to said rod structure and providing at one side a seat; a rigid backing plate positioned against said seat; sealing means positioned against said backing plate and adapted to engage cylinder walls; and means removably binding said backing plate and sealing means in said seat, whereby thrust upon said sealing means and said plate is received by said rib, said backing plate and sealing means having greater external diameters than the external diameter of said annular rib, said rib accommodating backing plates and sealing means of varying diameters for use in cylinders of varying diameters, said binding means including elongated nut means carried by said structure and having a reduced portion projecting axially within and through said sealing means and bearing against said backing plate, thereby binding said backing plate upon said seat of said annular rib.

16. In combination: a piston rod structure; an annular radially extending rib rigidly and permanently attached to an intermediate portion of said rod structure and providing annular seats at its opposite sides; rigid backing plates respectively positioned against said seats; sealing means respectively positioned against backing plates and adapted to seal the piston in a cylinder during reciprocation therein; said backing plates and sealing means having greater external diameters than the external diameter of said annular rib, and providing a trap space around said rib and between said rigid backing plates; and means for removably binding said plates and sealing means in said seats, whereby thrust upon said sealing means and backing plates is received by said annular rib upon reciprocation in either direction and such thrust is transmitted through said rod structure, each means for binding said plates and sealing means against their seats being an elongated nut having a reduced portion passing centrally through said sealing means, the inner reduced end of said nut bearing against the respective backing plate to bind the latter against said annular rib.

17. A combination as in claim 16 wherein the outer end of each nut is headed and provides a shoulder for binding its sealing means in operative position against the respective backing plate, a retainer plate being disposed about the reduced portion of each nut and held by the respective nut head against the respective sealing means.

18. In combination: a piston rod structure; an annular rib rigidly and permanently connected to a middle portion of said piston rod structure and providing at each side a seat; a rigid backing plate positioned against each seat; annular sealing means positioned against each backing plate, such backing plates and sealing means having substantially greater external diameters than said rib, and thereby providing an annular space between said plates, and said backing plates supporting the annular portions of said sealing means extending beyond said rib, the portions of said rod structure beyond said seats being threaded externally and having smaller external diameters than the internal diameters of said annular sealing means; elongated nuts threadedly mounted upon said externally threaded portions of said rod structure, and having outer surfaces extending within and frictionally engaging the inner cylindrical walls of said annular

sealing means, said nuts being provided with headed portions whose external diameters are less than the diameters of said backing plates and sealing means; and retainer plates held by the headed portions of the respective nuts against the adjacent ends of the respective annular sealing means, said retainer plates being disposed around said outer surfaces of said nuts, and said retainer plates having external diameters greater than the external diameter of said rib and somewhat less than the external diameter of the respective sealing means.

19. In combination: a piston rod structure; an annular rib rigidly and permanently connected to a middle portion of said piston rod structure and providing at each side a seat; a rigid backing plate positioned against each seat; annular sealing means positioned against each backing plate, such backing plates and sealing means having substantially greater external diameters than said rib and thereby providing an annular space between said plates, and said backing plates supporting the annular portions of said sealing means extending beyond said rib, the portions of said rod structure beyond said seats being threaded externally and having smaller external diameters than the internal diameters of said annular sealing means; and elongated nuts threadedly mounted upon said externally threaded portions of said rod structure, and having outer surfaces extending within and frictionally engaging the inner cylindrical walls of said annular sealing means, said nuts being provided with headed portions whose external diameters are less than the diameters of said backing plates and sealing means, the inner ends of said nuts and the innermost walls of said backing plates being concentrically beveled to center said backing plates and to force them against their seats on said annular rib.

20. In combination: a piston rod structure; an annular rib rigidly and permanently connected

to a middle portion of said piston rod structure and providing at each side a seat; a rigid backing plate positioned against each seat; annular sealing means positioned against each backing plate, such backing plates and sealing means having substantially greater external diameters than said rib and thereby providing an annular space between said plates, and said backing plates supporting the annular portions of said sealing means extending beyond said rib, the portions of said rod structure beyond said seats being threaded externally and having smaller external diameters than the internal diameters of said annular sealing means; elongated nuts threadedly mounted upon said externally threaded portions of said rod structure, and having outer surfaces extending within and frictionally engaging the inner cylindrical walls of said annular sealing means, said nuts being provided with headed portions whose external diameters are less than the diameters of said backing plates and sealing means; and packing means disposed between beveled innermost portions of said backing plates and the joints between said rib and rod structure.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,216,218	Eddowes	Feb. 13, 1917
1,796,415	Tyler	Mar. 17, 1931
1,817,808	Eaton	Aug. 4, 1931
1,955,157	Wayne	Apr. 17, 1934
2,216,577	Stillwagon	Oct. 1, 1940
2,315,012	Park	Mar. 30, 1943
2,321,160	Schnitzer	June 8, 1943
2,443,110	MacClatchie	June 8, 1948