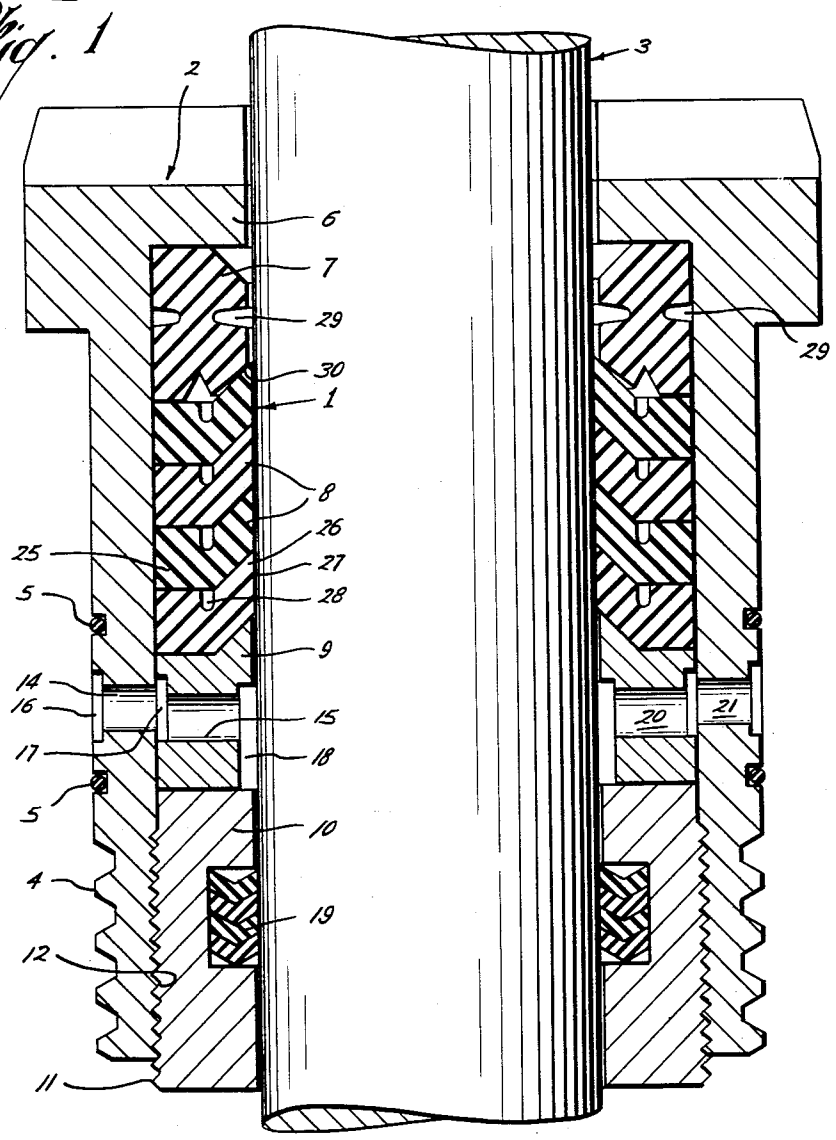
Dec. 5, 1961 J. T. TUCKER ET AL 3,011,808

PUMP PACKING

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Fig. 1



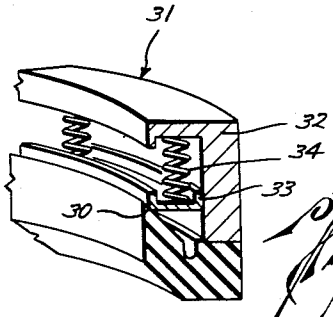


Fig. 2

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PUMP PACKING

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Our invention relates to the art of pump packing, and is particularly adapted for use in a high pressure reciprocating plunger pump of the type used for mud pumping in the drilling of oil and gas wells, and the fracturing and cementing of subterranean formations.

In single acting reciprocating pumps, often identified as plunger pumps, a plunger reciprocates within a cylinder to pull fluid thereinto on its downward or intake stroke and force fluid therefrom on its upward or discharge stroke. As one end of the plunger projects into the fluid chamber at the top of the cylinder and the other is connected to a source of power at the bottom thereof to produce reciprocation, it is common terminology, for purposes of description, to refer to the fluid end and power end of the cylinder of a plunger pump.

It is apparent that for satisfactory operation, the fluid must be confined to the fluid end of the cylinder by packing means which allow little or no leakage along the reciprocating plunger. It is equally apparent that as the pressure within the fluid chamber increases, the tendency toward leakage also increases. Recent years have seen a steady rise of the pumping pressure requirements of the oil industry, and conventional packing means have proven unequal to the task of confining high pressure fluid over a substantial period of time. Further, higher rates of reciprocation such as are characteristic of newer pumps, particularly of the type disclosed in Patent No. 2,842,060, issued July 8, 1958, require packing means superior to any hitherto available.

The art of packing around plungers or other reciprocating members to prevent leakage thereby has been an active area of research for many years, but problems created by the demand for higher pressures and larger capacities in pumps, coupled with the demand for packing of long life to eliminate too frequent replacement have outstripped the ingenuity of the inventors in this field.

Current practice involves the use of a number of annular packing rings of a suitably resilient material interposed between the cylinder and the plunger. Each ring has an inwardly extending lip which presses against the reciprocating member and the lips are conventionally biased upwardly, i.e., toward the fluid end, so that the increasing pressure of the confined liquid created by the upward stroke of the plunger will force them into a tighter embrace about the plunger. It has been thought in the past that the provision of annular spaces between adjoining lips increased the efficiency of the seal by allowing room for the lips to flex. Further, it has been the practice to make the inner diameter of the packing ring somewhat less than the outer diameter of the plunger to produce what is known as a high interference fit therebetween at the time of initial assembly. This arrangement seeks to insure proper sealing during the downward or intake stroke of the plunger when there is no pressure in the fluid chamber. A so-called packing gland or nut conventionally is employed to load the packing elements along their longitudinal axis, i.e., the direction parallel

to the direction of movement of the plunger. The packing gland is periodically adjusted in an effort to compensate for wear and keep the elements compressed to seal effectively.

It is in this general environment and upon these elements that our invention effects its primary object which is to provide an improved pump packing which will render satisfactory service for long periods of time under severe conditions of service with regard to working pressures and rates of reciprocation.

It is a further object of our invention to provide an improved pump packing which eliminates the necessity for a high interference fits between the plunger and the packing lips, thereby allowing more ready initial assembly and increased packing life.

It is also an object of our invention to provide a pump packing assembly which includes a loading member acting in cooperation with the packing rings to produce an effective and continuous seal over the entire life of the packing.

It is a further object of our invention to provide a pump packing in which the sealing lips are so designed and disposed relative to each other to readily accommodate themselves to wear on the exposed portions thereof in order to render satisfactory service far beyond the life expectancy of conventional assemblies.

The foregoing objects are accomplished by the provision of sealing rings of novel design, and a unique loading member or header ring disposed thereabove. The several rings are disposed in abutting relationship, one atop the other, and uniform bearing contact is maintained therebetween, for our experience has proven that the conventional spaces between the lips are a detriment to effective sealing and shorten the life of the packing. The loading member is so designed that its outer portion bears against the body of the sealing rings to maintain a load downwardly along the longitudinal axis thereof and its inner portion exerts a force inwardly and downwardly against the upwardly inclined sealing lips to bias them into engagement with the external periphery of the plunger. These improvements result in increased efficiency of the packing assembly and provide the means by which the long felt need for a superior packing is supplied.

The preferred embodiment and one modification of our invention are illustrated in the attached drawings in which:

FIG. 1 is a view in section through a packing housing with a reciprocating member extending therethrough showing one type of loading member, and

FIG. 2 is an enlarged view in section of an alternate loading member which utilizes coil springs to provide the lip biasing load.

Referring to FIG. 1, we have chosen to illustrate our packing in an assembly such as is employed in a new pump which recently became available. In this design, the packing **1** is contained within a removable housing **2** having a cylindrical bore therethrough for accommodation of a reciprocating plunger **3**. The housing **2** provides certain advantages with regard to removal for replacement of the packing, but our invention is equally suitable for the more conventional assemblies in which the walls of the cylinder itself serve to house the packing means.

In FIG. 1, the housing **2** is received within a cylinder

and is attached thereto by means of threads 4 about the lower portion thereof. The O rings 5 seal the housing against the cylinder wall so that it in effect becomes a part of the cylinder.

The housing 2 is counterbored from the bottom thereof and has an inwardly turned shoulder 6 at its top. Within the counterbore is the packing assembly which includes a loading member 7, a series of identical packing or sealing rings 8, a packing ring support and lubricating ring 9, and a packing gland 10. Thus the shoulder 6 at the top of the housing provides a base against which the packing is compressed when the gland 10 is moved upwardly within housing 2 by means of the threads 11 and 12 therebetween.

Experience has proven the desirability of providing some means to lubricate the packing. For this purpose, passage 14 through the housing 2 interconnects with passage 15 through the ring 9. An annular groove 16 about the housing 2 insures proper flow of lubricant into passage 14 whatever the radial alignment of the housing with regard to the lubricant passage through the cylinder, not shown. Similarly, groove 17 about ring 9 eliminates the necessity for precise radial alignment of passages 14 and 15, and groove 18 within ring 9 directs lubricant around the inner portion thereof to reach the entire circumference of the plunger 3.

One or more return passages such as 20 and 21 through the ring 9 and housing 2, respectively, opposite the passages 14 and 15, provide an avenue through which the lubricant can be recovered for recirculation.

The primary seal is effected by the rings 8 as shall be explained more fully hereinafter; however, a rubber wiper ring 19 is carried within the packing gland 10 to prevent leakage of lubricant therebelow.

The sealing rings 8 are identical, and are formed of a semi-flexible bonded corded material. A typical ring has an outer body portion 25 which is of substantially uniform thickness, and a lip portion 26 extending upwardly and inwardly therefrom. The inner face 27 of the lip portion 26 is parallel to the axis of the ring to surround and embrace the plunger 3 and make full face sealing contact therewith.

An annular groove 28 is formed in the upper side of the ring 8 along the line where the lip portion is joined to the body portion. This groove allows increased flexibility of the lip portion relative to the body portion so that the former may better perform its sealing function and readily accommodate itself to the plunger as normal wear occurs.

The loading member 7 in FIG. 1 embodiment of our invention is formed of a resilient material such as rubber. The annular grooves 29 about the center thereof increase its resiliency. Its lower side is shaped to bear against the upper side of the body portion of the uppermost sealing ring, and at a point 30 on the upper side of the lip portion near the inner edge thereof. Thus, when the packing assembly is compressed between shoulder 6 and gland 10, the loading member exerts a force along the axis of the sealing rings at the outer or body portions and an additional force downwardly and inwardly against the lip portions. As the rings are identical and the lower side of both the body and lip portions of each bears against the upper side of its companion immediately below, the loading forces are communicated downwardly through the assembly to load each ring and bias its lip into contact with the plunger 3.

It is apparent that the lips will be forced into close embrace with the plunger when the packing is compressed. As a result, it is not necessary to so dimension the inner diameter of the ring relative to the plunger diameter to produce an initial high interference fit in which the latter is forced through the former at the time of assembly, for the lips assume the proper configuration when the packing gland 10 effects the prescribed design precompression.

The upper portion of sealing ring supporting and lubricating ring 9 is shaped to accommodate the lower side of the lowermost sealing ring and provide support therefor. The ring 9 and gland 10 are preferably of a relatively rigid or inflexible material, and the loading member 7 imparts resiliency to the assembly to preload the rings and progressively compensate for wear without frequent adjustment of the packing gland.

The modified loading member 31 shown in FIG. 2 may be used in lieu of the member 7 in FIG. 1. As indicated above, the primary purpose of the loading member is to bias the sealing rings in the proper manner to effect a more efficient seal for a longer period of time. The application of the force at the point 30 is instrumental in producing this result, and the member 31 with its relatively rigid main portion 32 and spring loaded inner ring 33 will accomplish the lip biasing function in a manner similar to the resilient member 7. A series of coil springs 34 are spaced about the inside of the body portion 32 to load the inner ring 33 when the gland 10 is tightened to produce design precompression of the assembly.

It should be observed that neither the resilient member 7 nor the spring loaded member 31 contributes directly to the seal, i.e., they do not contact the plunger but only the upper sealing ring in which position they can perform their sole office of loading the primary sealing elements.

While we have chosen to describe and illustrate the presently preferred embodiment and one modification of our invention, it is to be understood that many changes will occur to one skilled in the art, and the scope of our invention is to be determined by reference to the following claims.

We claim:

1. Packing means for effecting a seal about a reciprocating member extending into a fluid chamber thereabove, said packing means comprising a plurality of annular sealing rings in axially abutting relationship and an annular loading member bearing against the uppermost of said rings, each of said rings comprising an outer body portion and a lip portion extending inwardly and upwardly from said body portion, said loading member comprising an outer element bearing against the body portion of said uppermost sealing ring and a resilient inner element bearing against the upper side of said lip portion of said uppermost sealing ring adjacent the inner edge thereof.

2. Packing means for effecting a seal about a reciprocating member extending into a fluid chamber thereabove, said packing means comprising a plurality of annular sealing rings in axially abutting relationship, and an annular loading member bearing against the uppermost of said rings, each of said rings comprising an outer body portion of substantially uniform thickness, a lip portion extending inwardly and upwardly from said body portion, and an annular groove in the upper side of said ring at the intersection of said body portion and said lip portion, said loading member comprising an outer element bearing against the body portion of said uppermost sealing ring and a resilient inner element bearing against the upper side of said lip portion of said uppermost sealing ring adjacent the inner edge thereof.

3. The combination of claim 2 in which said outer element of said loading member is relatively inflexible, and said inner element of said loading member comprises an annular ring and a series of compression springs spaced therearound.

4. Packing means for effecting a seal about a reciprocating member extending into a fluid chamber thereabove, said packing means comprising a plurality of annular sealing rings in axially abutting relationship, an annular loading member bearing against the uppermost of said rings, and a packing gland supporting the lowermost of said rings, each of said rings comprising an outer body portion of substantially uniform thickness, a lip portion extending inwardly and upwardly from said body portion, and an annular groove in the upper side of said ring at

the intersection of said body portion and said lip portion, said loading member comprising an outer element bearing against the body portion of said uppermost ring and a resilient inner element bearing against the upper side of the lip portion of said uppermost ring adjacent the inner edge thereof.

5. The combination of claim 4 in which said outer element of said loading member is relatively inflexible and said inner element of said loading member comprises

an annular ring and a series of compression springs spaced therearound.

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