March 4, 1958 E. B. SUTHERLAND 2,825,590

PACKING SEAL CONSTRUCTION

Filed Oct. 14, 1953 4 Sheets-Sheet 1

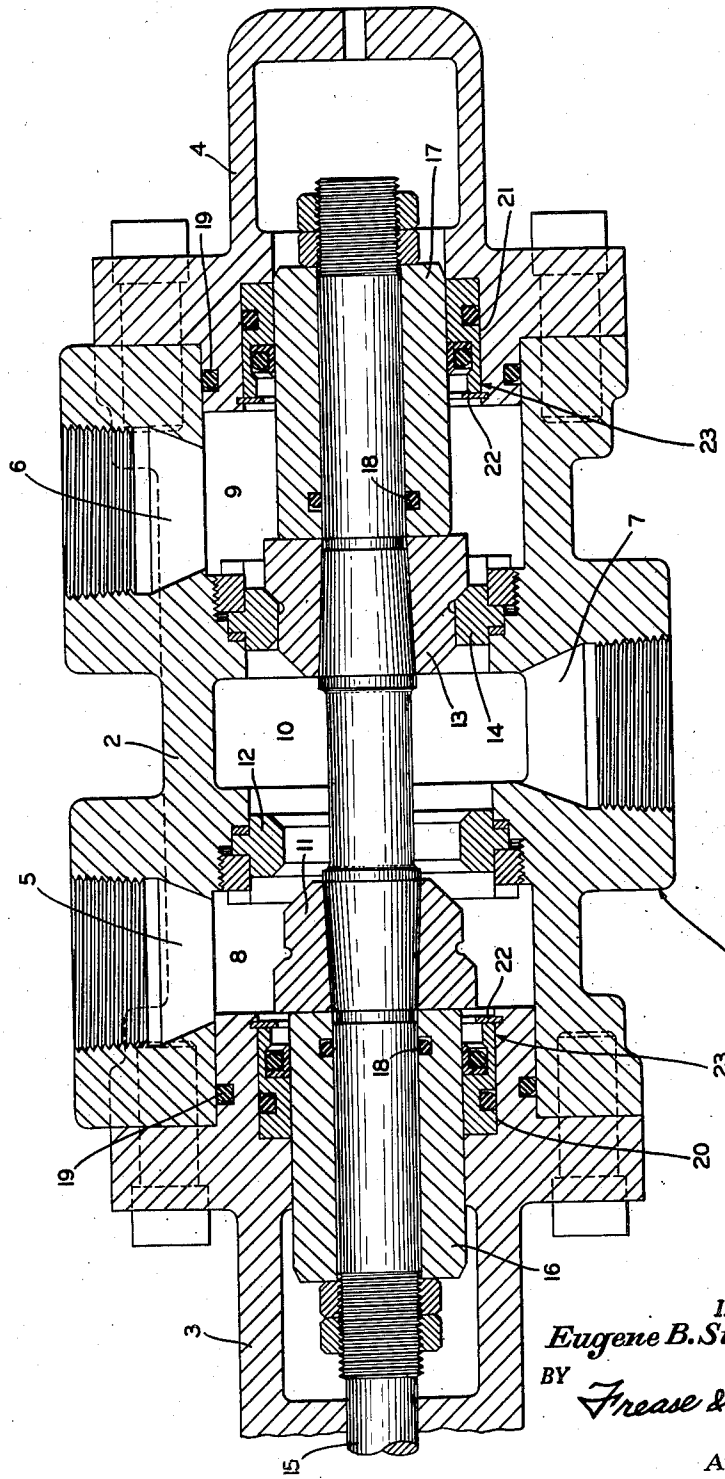

Fig. 1

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Fig. 2

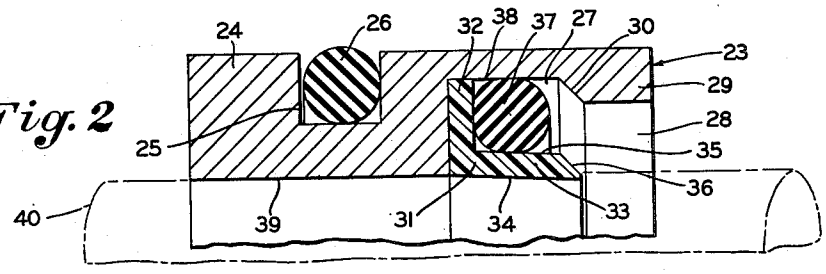
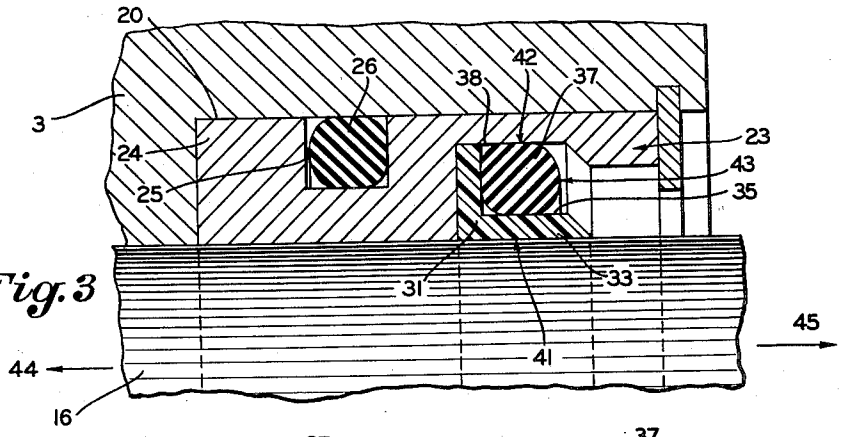


Fig. 3



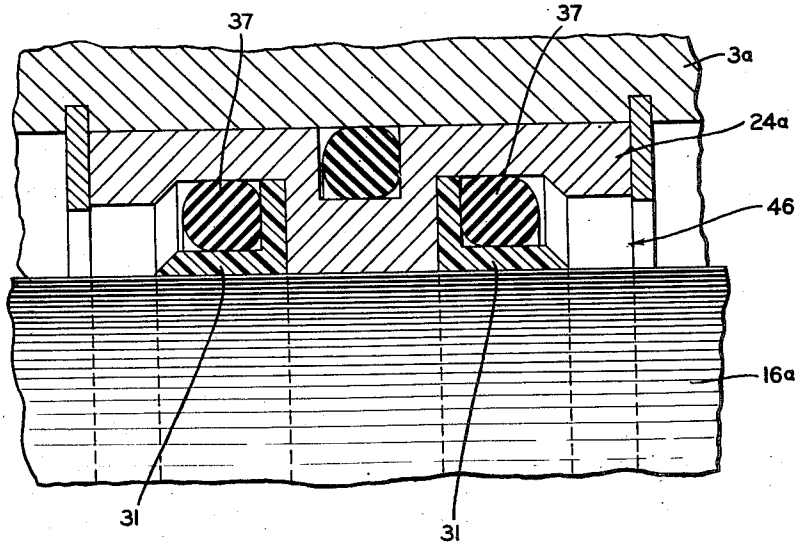


Fig. 4

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PACKING SEAL CONSTRUCTION

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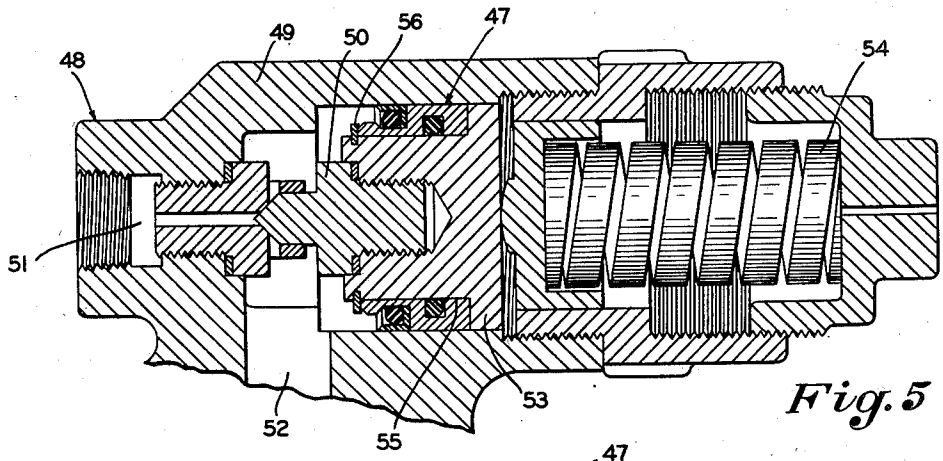

Fig. 5

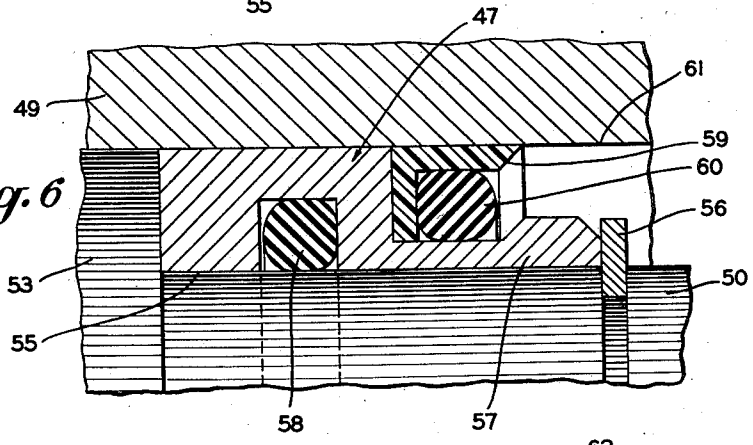

Fig. 6

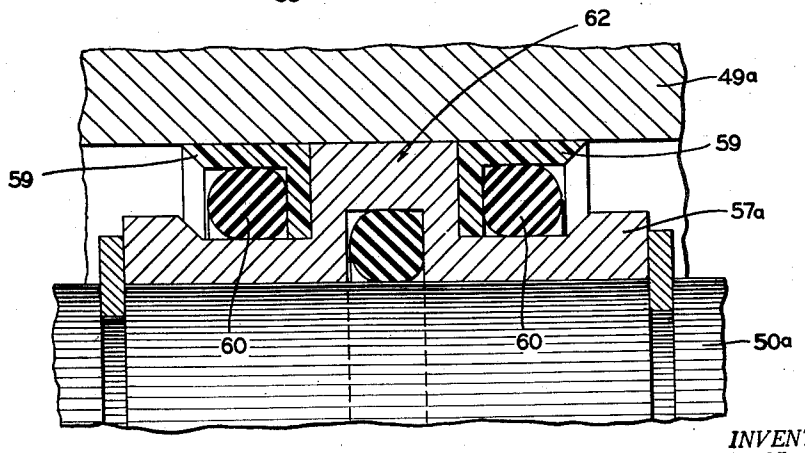

Fig. 7

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PACKING SEAL CONSTRUCTION

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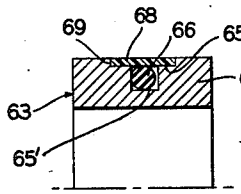

Fig. 8

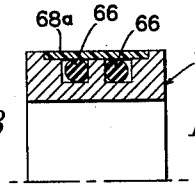

Fig. 10

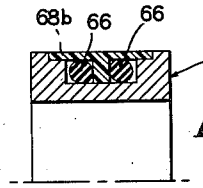

Fig. 12

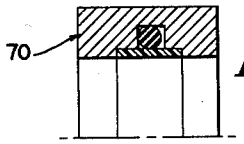

Fig. 9

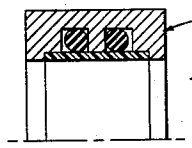

Fig. 11

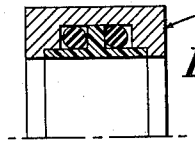

Fig. 13

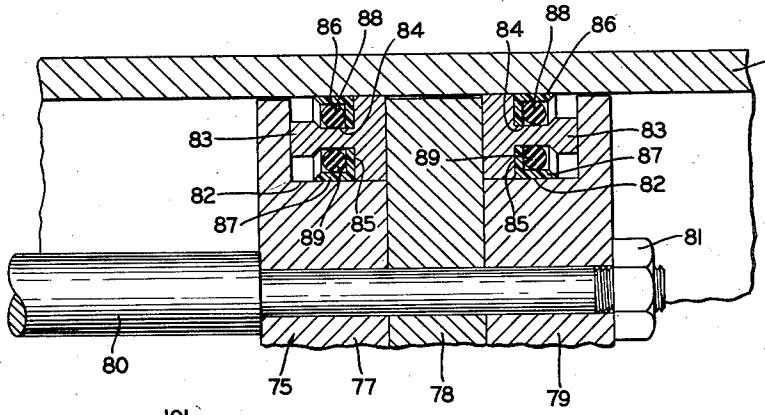

Fig. 14

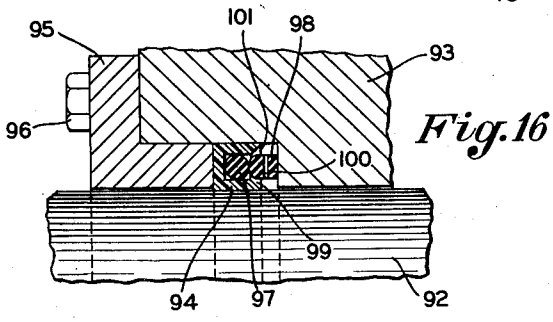

Fig. 16

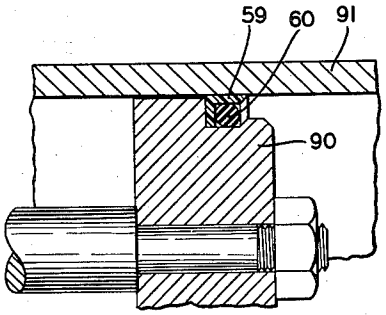

Fig. 15

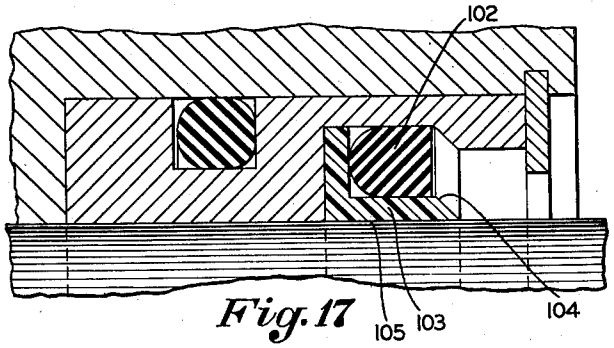

Fig. 17

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PACKING SEAL CONSTRUCTION

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Application October 14, 1953, Serial No. 386,063

3 Claims. (Cl. 286—26)

The invention relates to a packing seal construction for providing an effective seal between relatively axially movable parts, and more particularly to a packing seal construction particularly suitable for high pressure hydraulic use to seal a joint against fluid pressure leakage, for example a joint between an opening in a pressure containing housing or valve body and a rod or shaft slidably movable in said housing or valve body.

There are innumerable devices in hydraulic or pressure systems where packing means are required to seal a joint against fluid leakage between piston-like components such as in hydraulic valves or hydraulic devices operated by the pressure in an hydraulic system, for example, where a longitudinally movable valve actuating shaft moves axially back and forth to close or open ports located along the length of the shaft and communicating with various parts of the system. Such a shaft must be sealed against leakage through the opening through which the shaft moves back and forth, which leakage can occur, unless proper sealing means is provided, from the pressure contained by the valve body and controlled by the ports opened or closed by movement of the valve actuating shaft.

Heretofore, usual packing sealing means has commonly been the so-called "chevron" type of packing in which rings of packing material, of somewhat V-shaped cross-section, are compressed in a recess in a valve body surrounding and pressing against the slidable shaft movable therethrough. As the contained pressure increases, it is sometimes necessary to increase the compression upon the "chevron" packing rings in order to maintain the joint leak-proof.

A large amount of friction is thus developed between the "chevron" packing and the shaft movable to and fro therethrough. Not only is there a large power requirement to overcome such friction, but frequent adjustment of the packing compressing means may be necessary and ultimately leaks develop requiring replacement of the packing at frequent intervals particularly when high pressure work is involved.

Moreover, scoring and ultimate damage to one of the components may result not only from the pressure of the packing material but from foreign material which may accumulate on the relatively movable parts and be dragged back and forth either across the packing material or the surface contacted thereby.

As a result, packing maintenance and replacement costs in certain industrial applications are extremely high, and in some instances where high pressures or unusual circumstances are involved, packing replacements may have to be made of "chevron" type packings at very short intervals. Even though the replacement costs of the packing itself may be small, standby charges for the equipment out of service during the time required for making the replacement may be very high.

In recent years O-rings have been used extensively for efficiently sealing joints in certain applications in hydraulic systems but an O-ring packing does not answer the problem indicated. A further difficulty encountered with O-rings is that when a shaft sealed by an O-ring moves axially through a cylindrical opening in a valve body, the material in the O-ring under the contained pressure tends to extrude along the shaft in the direction of shaft movement and to be pinched between the shaft and the cylindrical opening through which the shaft moves. This pinching of the O-ring material ultimately causes failure of the O-ring, requiring replacement thereof.

Accordingly, it is a general object of the present invention to provide a new packing construction for relatively slidably movable parts particularly in high pressure hydraulic devices in which friction losses during relative movement of the parts sealed by the packing are substantially reduced.

Furthermore, it is an object of the present invention to provide a new packing construction for hydraulic devices in which O-rings are used to exert the pressure to maintain the sealing material in sealing contact with the relatively movable component without subjecting the O-ring to damage by such movement.

Furtherfore, it is an object of the present invention to provide a new packing seal construction in which a plastic packing material such as "Teflon," nylon or "Kel 'F' " is used to make the sliding sealing contact, which packing material is preloaded by an O-ring out of contact with the movable component being sealed thereby maintaining the desired sealing pressure while providing for minimum friction between the sliding part and the plastic packing material.

The plastic materials referred to may be machined or molded and have an extremely low coefficient of friction. They may be subjected to pressure but have very little pressure exerting qualities in themselves. They have the characteristics of resisting permanent distortion or of taking a set from pressure continually exerted thereon. They are known as "memory" plastics and tend to return to their original shape after distortion but such return is very slow and accompanied by a time lag. Thus these plastics cannot be properly described as having resilience even though distortion thereof from pressure is not permanent but is overcome slowly after a time interval by a return of the plastic body to initial shape.

Also it is an object of the present invention to provide a new packing seal construction for high pressure hydraulic devices which eliminates the heavy friction losses developed in and the high power requirements for operating devices packed by chevron packing material.

Furthermore, it is an object of the present invention to provide a new packing seal construction for high pressure hydraulic devices utilizing O-rings for the packing sealing pressure but avoiding the O-ring pinch-off-damage characteristics of prior O-ring seals between relatively slidably movable hydraulic device components or parts.

Also, it is an object of the present invention to provide a new packing seal construction for hydraulic devices which may be readily fabricated as a replacement unit or cartridge to replace typical chevron packing in use by substitution of the unit or cartridge in the annular hydraulic device cavity in which the chevron packing material is located.

Likewise, it is an object of the present invention to provide a new packing seal construction for hydraulic devices in which no adjustments are required from time to time in order to provide efficient packing during continued use of the device packed.

Also it is an object of the present invention to provide a new packing seal construction for hydraulic devices in which the sealing pressure is automatically established by predetermined preloading, and the preload sealing pres-

sure is increased by the contained pressure in the hydraulic system.

Moreover, it is an object of the present invention to provide a new packing seal construction for hydraulic devices utilizing O-rings for preloading and a slippery "memory" plastic packing material, such as "Teflon," nylon or "Kel 'F'," loaded by the O-ring for sealing, and in sliding contact with the relatively movable part being sealed, wherein the low coefficient of friction of the plastic material and slipperiness thereof substantially eliminates wear and minimizes power requirements for moving the relatively movable parts, for instance in the packing for pump piston rods or pistons.

Likewise, it is an object of the present invention to provide a new packing seal construction which is effective and efficient in sealing contained pressures over a wide range from substantially zero to as high as say ten to twenty thousand pounds per square inch in hydraulic devices such as valves; and which is equally effective in sealing low pressure devices such as in low air pressure systems involving pressures as low as say thirty pounds per square inch.

Finally, it is an object of the present invention to solve problems existing in the art, to eliminate prior art difficulties in the failure of prior packing constructions, to generally improve the construction and use of packing seals for hydraulic devices, to provide a packing construction which is simple in construction, inexpensive to manufacture, and easy to install and use as a component of hydraulic devices or as a replacement unit for prior packing seals, and to obtain the foregoing advantages and desiderata in a simple and effective manner.

These and other objects and advantages apparent to those skilled in the art from the following description and claims may be obtained, the stated results achieved, and the described difficulties overcome, by the constructions, combinations, subcombinations, parts, elements, devices and arrangements, which comprise the present invention, the nature of which is set forth in the following general statement, preferred embodiments of which—illustrative of the best mode in which applicant has contemplated applying the principles—are set forth in the following description and shown in the drawings; and which are particularly and distinctly pointed out and set forth in the appended claims forming part hereof.

The nature of the improvements in packing seal construction of the present invention may be stated in general terms as including a housing member having annular recess means therein, an annular "memory" plastic packing sealing member mounted in said housing recess and having an annular sealing surface and an opposed annular bearing surface, a rubber O-ring in said housing recess in annular contact with said sealing member bearing surface and exerting pressure between a wall of said housing and said sealing member bearing surface, and retaining means maintaining the plastic sealing member and O-ring assembled in said housing recess, whereby when the packing construction is assembled for packing a joint between two relatively movable parts, and is fixed with respect to one of the parts, the plastic sealing member is in sliding contact with the other relatively movable part and is pressed in sealing relation annularly against said other part by the rubber O-ring.

By way of example, several embodiments of the improved packing seal construction of the present invention are shown in the accompanying drawings forming part hereof, wherein:

Figure 1 is a longitudinal sectional view of a typical three-way valve equipped with one form of improved packing construction;

Fig. 2 is an enlarged fragmentary sectional view of the improved packing seal construction shown in Fig. 1, detached, and prior to assembly in the valve of Fig. 1;

Fig. 3 is an enlarged view similar to Fig. 2 but showing the packing construction in assembled or operative position;

Fig. 4 is a view similar to Fig. 3 of a slightly modified form of construction;

Fig. 5 is a fragmentary longitudinal sectional view of a hydraulic device including another modified form of improved packing seal construction in which the packing unit is mounted on the movable part;

Fig. 6 is an enlarged view, similar to Fig. 3, of the packing construction shown in Fig. 5;

Fig. 7 is a view similar to Fig. 6 of a slightly modified form of construction;

Figs. 8, 9, 10, 11, 12 and 13 are fragmentary sectional views of further modified forms of improved packing construction;

Fig. 14 is a fragmentary sectional view illustrating the improved packing seal construction used for sealing a double acting piston;

Fig. 15 is a view similar to Fig. 14 showing a further modified form of piston packing seal construction;

Fig. 16 is a sectional view of the improved packing seal construction used for packing a piston rod; and

Fig. 17 is a sectional view similar to Fig. 3, showing a modified form of O-ring.

Similar numerals refer to similar parts throughout the several figures of the drawings.

The improved packing seal construction of the present invention may be used in many kinds and sizes of hydraulic devices, as by being mounted on the fixed or body member of the device for packing a point between the body and a member slidably movable therein; or the improved packing construction may be fixed to the movable member of an hydraulic device and used to pack a joint between the movable member and a fixed body member in which the movable member is slidably movable.

Also, the improved packing seal construction may comprise a separate cartridge or unit as an interchangeable unit for replacing typical chevron packing means in use, or may be mounted as a unit or cartridge in the same type or character of the recess normally formed in hydraulic devices for receiving the packing means, or may be formed as a part of the construction or device to be packed without being fabricated as a separate cartridge or unit.

Referring first to Figs. 1, 2 and 3, a typical three-way hydraulic valve is indicated generally at 1 including assembled valve body parts 2, 3 and 4 having a series of passages 5, 6 and 7 communicating, respectively, with chambers 8, 9 and 10. A valve 11 and valve seat 12 control communication between chambers 8 and 10 while the valve 13 and valve seat 14 control communication between chambers 9 and 10. The valves 11 and 13 are mounted in a usual manner on a valve operating shaft or rod 15 so that upon reciprocation of shaft 15 in one direction or the other, the valves 11 and 13 may be selectively closed. Sleeves 16 and 17 are mounted on shaft 15 beyond valves 11 and 13, respectively, and are sealed with respect to the shaft 15 by typical O-rings 18. Similarly, typical O-rings 19 may seal the joints between valve body members 2, 3 and 4.

In the construction shown, a chevron packing has normally been mounted in the annular recesses 20 and 21, respectively, in valve body members 3 and 4, the chevron packing being retained by split snap rings 22 to seal the joints between valve body members 3 and 4 and shaft sleeves 16 and 17, which are slidably moved or reciprocated within the valve body members 2, 3 and 4. Fluid under high pressure may be present within the chambers 8, 9 and 10 and it is necessary to prevent leakage at the packed joints while permitting slidable movement of shaft 15 and sleeves 16 and 17 thereon.

Thus far the construction of the three-way valve illustrated forms no part of the present invention but is illustrative of an hydraulic device which may be packed by the improved packing seal construction.

In accordance with the present invention packing seal units generally indicated at 23 are interchangeably substituted for the prior art chevron packing in recesses 20 and 21 and are held assembled by the abutment means in the form of split snap rings 22.

Referring to Figs. 2 and 3, the packing seal unit or cartridge 23 comprises a housing member 24 generally in the form of an annular ring or sleeve having an external annular groove 25 intermediate its ends receiving a typical rubber O-ring 26. The housing member 24 is provided with an internal annular recess 27 communicating with one end of the member 24 through a reduced opening 28 formed by re-entrant flange portion 29 preferably having a tapered surface 30.

An annular packing or sealing ring 31, preferably L-shaped in cross-section, is mounted within recess 27 having an annular radially extending leg portion 32 and an axially extending leg portion 33. The axially extending leg portion 33 is formed with an extended inner annular sealing surface 34 and an opposed annular bearing surface 35, and the free end of the leg portion 33 is preferably tapered as shown at 36.

In accordance with the present invention, the annular ring 31 is formed of a "memory" plastic, such as "Teflon," "nylon" or "Kel 'F'," which plastics have a very low coefficient of friction and a characteristic slipperiness at the surfaces thereof, whether molded, machined, ground or otherwise formed.

A rubber O-ring 37 is also mounted within the housing recess 27, and the O-ring 37 exerts pressure between the recess surface 38 and the bearing surface 35 of the axially extending leg 33 of L-shaped packing member 31 so that the leg 33 of packing member 31 is distorted out of normal position when the packing seal unit 23 is not assembled in packing relation in an hydraulic device, as illustrated in Fig. 2. Thus, referring to Fig. 2 the sealing surface 34 of packing member leg 33 is angled with respect to the cylindrical opening 39 of housing member 24, or with respect to a sleeve or shaft indicated by dot-dash lines 40 in Fig. 2, against which the packing member 31 is intended to seal.

When the packing unit 23 is assembled in an hydraulic device as shown in Fig. 1, the various parts thereof assume the positions shown in Fig. 3 wherein the O-rings 26 and 37 are compressed and distorted. The O-ring 26 performs its usual or typical sealing function between housing member 24 and valve body member 3, said members 3 and 24 being fixed with respect to one another. The O-ring 37 is likewise compressed, as shown in Fig. 3, and thereby exerts pressure between the housing member recess surface 38 and the bearing surface 35 of sealing member 31 to a predetermined preloaded extent, the preload being determined by the relative sizes of the parts and particularly the cross sectional diameter of the O-ring 37.

This preloading of the plastic sealing member 31 urging the leg 33 thereof toward the surface of sleeve member 16 being sealed, establishes a pinch-off seal at the zone 41 below the center line of the annulus of O-ring 37 at the sealing face 34 of the sealing member 31 against the relatively slidable surface of sleeve member 16; and at the same time, the compressed O-ring 37 establishes a static pinch-off seal 42 at the annular zone of contact between the periphery of the O-ring 37 and the annular recess surface 38.

These preloaded pinch-off seals 41 and 42 are augmented during the operation of the valve 1 by the contained pressure within chambers 8, 9 and 10 which communicate through opening 28 with the free surface 43 of the O-ring 37, tending to further distort the O-ring and increase the pinch-off pressures 41 and 42.

By forming the L-shaped sealing member 31 of a "memory" plastic of the character described, the low coefficient of friction thereof, or in other words the extreme slipperiness of its surfaces reduces to a minimum the friction that must be overcome in moving the sleeve 16 back and forth across the plastic ring sealing surface 34. Furthermore, because of the slipperiness and low friction characteristics, wear on the relatively movable parts becomes practically non-existent and the hydraulic device may be operated over long periods of time without maintenance or replacement of the packing or parts contacted thereby and with minimum power consumption in moving the relatively movable parts.

Furthermore, the improved packing seal construction utilizes all of the improved characteristics and advantages of a typical O-ring seal without subjecting the O-ring itself to sliding contact with a movable part.

The improved packing seal construction may be readily assembled to form the cartridge or unit 23 as shown in Fig. 2 by distorting the plastic packing member 31 and inserting it into recess 27 through opening 28. The "memory" plastics have the property of being capable of being distorted out of shape but of returning slowly with a time lag to original shape. After insertion of the packing ring 31 in recess 27, rubber O-ring 37 may likewise be pushed into the recess to the assembled position shown in Fig. 2.

Referring to Fig. 3, there is no tendency to disturb the proper assembled relation of the parts of the packing unit 23 when sleeve 16 moves relatively to the packing unit in the direction of the arrow 44. However, when the sleeve 16 moves in the other direction as indicated by the arrow 45, the tendency is to carry the packing member 31 pressed against sleeve 16 by O-ring 37 with sleeve 16. Such movement of the packing member 31, if occurring, would ultimately result in disassembly of the packing unit 23. For the purpose of preventing any such disassembly, the re-entrant shoulder or flange 29 is provided for holding or retaining the packing unit elements in proper assembled relation, and thus flange 29 provides a retainer means for the packing.

The various O-rings described have been indicated as being formed of rubber, but it is understood that they may be formed of any of the usual materials used in the manufacture of O-rings, all of which are rubber like materials, and may include synthetic rubber, neoprene, and the like.

The "memory" plastics referred to from which the sealing ring 31 is formed, have other characteristics which provide the new results of the present invention. These plastics are non-porous and normally are not attacked or affected by atmospheric conditions or chemicals or other substances which may come in contact with the sealing ring during use in hydraulic devices. Also, they are extremely heat resistant. Moreover, they have sufficient body or substance to maintain the shape to which they are originally formed by molding, machining or other forming operation. Likewise, they have extreme toughness and yet are soft, pliable and flexible. While they have no appreciable resilience, yet the material can be compressed somewhat and has sufficient flexibility that the sealing rings 31 may be moved or distorted to change their initially formed shapes temporarily, as when a ring 31 is inserted into the housing recess through opening 28, or as when the leg 33 is moved to the position shown in Fig. 2 by the pressure of the O-ring 37.

Of the "memory" plastics referred to, "Teflon" is the preferred plastic, the same being a polymerized tetrafluoro-ethylene plastic made by the E. I. du Pont Company, the exact degree of polymerization being unknown.

A slightly modified form of construction is shown in Fig. 4, generally similar to the construction shown in Figs. 1, 2 and 3 except that the packing seal unit generally indicated at 46 has two plastic sealing rings 31 pressed in sealing contact by O-rings 37 and assembled within double-ended housing member 24*a* to seal the joint between the member 3*a* of an hydraulic device and

a shaft or sleeve 16*a* movable axially in either direction. The unit 46 thus provides for sealing in either direction the joint between the relatively movable members 3*a* and 16*a*.

Another modified form of construction is shown in Figs. 5 and 6 wherein the improved packing sealing unit generally indicated at 47 is mounted on the movable member and is moved in outside sliding contact with a stationary or fixed member of an hydraulic device. In Fig. 5, a typical hydraulic device is indicated generally at 48 including a body 49 within which valve member 50 moves to control the passage of fluid under pressure through passages 51 and 52. The valve member 50 is attached to a pistonlike housing member 55 movable axially against the pressure of spring 54. The housing member 53 is formed with an annular recess 55 in which, in accordance with prior practice a "chevron" packing was located, held assembled by split snap ring 56. In accordance with the present invention, the "chevron" packing is replaced by an improved packing seal unit 47 constructed in the same manner as the packing unit 23 of Fig. 3 excepting that the various parts thereof are transposed from inside to outside, as shown.

Thus, packing unit 47 has a housing member 57, a static sealing O-ring 58, an annular L-shaped plastic sealing member 59, and an O-ring 60 pressing the axially extending annular leg of plastic sealing ring 59 against the cylindrical surface 61 of body member 49 along which the packing seal unit 47 slides upon movement of valve member 50. The various elements of the packing seal unit 47 operate and function in the same manner as the similar elements of packing unit 23.

A slightly modified form of construction is shown in Fig. 7, generally similar to the construction shown in Figs. 5 and 6, except that the packing seal unit generally indicated at 62 has two plastic sealing rings 59 pressed in sealing contact by O-rings 60 and assembled within double-ended housing member 57*a* to seal the joint between the member 50*a* of an hydraulic device and a cylinder 49*a* within which member 50*a* moves axially in either direction. The unit 62 thus provides for sealing in either direction the joint between the relative movable members 49*a* and 50*a*.

Other modified forms of improved packing seal construction of the present invention are shown in Figs. 8, 9, 10, 11, 12 and 13; Figs. 8, 10 and 12 illustrating outside sealing units or cartridges, and Figs. 9, 11 and 13 illustrating inside sealing units or cartridges of equivalent construction.

In Fig. 8, the unit 63 can be substituted for a "chevron" type packing having a similar size and cross-sectional configuration. The unit 63 includes a housing member 64 having an annular recess 65 with a deeper portion 65'. An O-ring 66 is located in recess portion 65' pressing a cylindrical plastic sleeve sealing member 68 outwardly into sealing contact with the member in which sealing unit 63 is relatively slidably mounted. The shoulder 69 axially at each end of recess 65 forms retaining means holding the sealing unit parts assembled.

The modified form of device shown in Fig. 9 at 70 is an inside sealing unit counterpart of the sealing unit 63.

The sealing unit 71 illustrated in Fig. 10 is similar to the constructon of Fig. 8 excepting that two rubber O-rings 66 are used for increased sealing pressure against the plastic sealing sleeve member 68*a*; and the construction of the unit 72 in Fig. 11 is the inside sealing counterpart of the sealing unit 71.

The sealing unit 73 illustrated in Fig. 12 is similar to the construction shown in Fig. 10 and includes two rubber O-rings 65 pressing a T-shaped plastic sealing ring 68*b* in sealing contact with the part sealed; while the sealing unit 74 illustrated in Fig. 13 is an inside sealing counterpart of the construction shown in Fig. 12.

The improved packing seal construction of the present invention may also be incorporated in a piston and cylinder construction as illustrated in Fig. 14 wherein a double acting piston generally indicated at 75 may move back and forth within cylinder 76. The piston 75 may comprise piston members 77, 78 and 79 assembled to piston rod 80 by nut 81 and providing annular piston grooves or recesses 82 in which are located packing housing members 83 having annular recesses 84 and 85 formed therein. Outside and inside plastic sealing rings 86 and 87 are located in recesses 84 and 85 and are held in sealing contact with the surfaces to be sealed by O-rings 88 and 89.

A simplified form of sealing construction for a piston and cylinder is illustrated in Fig. 15, similar to the construction shown in Fig. 6, in which the packing unit housing is formed integrally with the piston 90 movable in cylinder 91 and sealed by an annular plastic sealing ring 59 and O-ring 60.

Fig. 16 shows a form of the improved packing seal construction of the present invention used for packing a piston rod 92 which slidably moves in a cylinder body 93. The packing seal member 94, in this case is U-shaped in cross section and is contained in an annular recess in the cylinder body by a gland follower 95 and cap screws 96. An O-ring 97 is located in the recess formed by the U-shape of the packing seal member 94 and is held therein by an abutting locating spacer ring 98. Thus, two opposing annular bearing surfaces and two annular sealing surfaces are formed on the U-shaped packing seal member.

In this form of packing seal construction, the contained hydraulic pressure within the cylinder can work against the packing seal member 94 by the hydraulic fluid entering the space 99 between the lower portion of the locating spacer ring 98 and the lower annular bearing surface of the packing seal member 94, and also by passing through holes 100 into the space 101 between the top bearing surface of the packing seal member 94 and the outside portion of the locating spacer ring 98.

Fig. 17 illustrates the packing seal construction of the present invention in the identical use and form shown in Fig. 3 with the exception that the O-ring 102 pressing against annular L-shaped sealing member 103 is generally D-shaped in cross section. When a D-shaped O-ring is used, it bear against a greater area of the bearing surface 104 of the sealing member 103, and therefore, rather than having a substantially annular line contact pinch-off seal, there is produced a pinch-off seal over a wide annular area of the sealing surface 105 of the packing seal member 103.

Accordingly, the present invention provides a new packing seal construction which forms a most effective and efficient seal between relatively slidably movable parts; which is particularly suitable for high pressure hydraulic use such as in hydraulic devices where the working pressures may be as high as say ten to twenty thousand pounds per square inch; which is also equally effective as a packing sealing means in low pressure devices; which may be used as a cartridge or unit to replace chevron packing in existing devices; which exert little if any frictional resistance to the relative movement of the parts packed thereby; which avoid wear, scoring, injury or damage to a highly polished surface which may constitute one of the packed surfaces; which is preloaded in use and does not require adjustment for maintaining an efficient leak-proof joint; which incorporates the advantages of an O-ring seal without the disadvantages thereof; in which an O-ring is used to exert the sealing pressure without sliding contact of a relatively movable part with the O-ring thereby avoiding O-ring pinch-off-damage; and which overcomes prior art difficulties, solves long standing problems, and obtains the new results described.

In the foregoing description, certain terms have been

used for brevity, clearness and understanding; but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such terms are utilized for descriptive purposes herein and not for the purpose of limitation, and are intended to be broadly construed. When the term "O-ring" is used herein and in the claims, it is not intended to limit the same to a ring having a circular cross-section but the term includes rings having other than circular cross-section such as the D-shaped ring illustrated.

Moreover, the description of the improvements is by way of example, and the scope of the present invention is not limited to the exact details illustrated or to the specific sizes and shapes shown.

Having now described the features, discoveries and principles of the present invention, the manufacture, assembly, use, properties and characteristics of the improved packing seal construction and elements thereof, and the advantageous, new and useful results obtained thereby; the new and useful constructions, combinations, subcombinations, parts, elements, devices, arrangements, discoveries and principles, and mechanical equivalents thereof obvious to those skilled in the art are set forth in the appended claims.

I claim:

1. In a packing seal construction for hydraulic devices, a housing member subject to contained pressures and having axially and radially extending surfaces forming an annular recess therein; an L-shaped cross section annular, tough, slippery, low-friction, pliable memory plastic sealing member assembled in said recess and having a radial leg and an axial leg; the axial leg of said sealing member having an axially extending sealing surface and an opposed annular axially extending bearing surface; the radial leg of said sealing member abutting the radial surface of said housing member recess; a resilient material O-ring assembled in said housing member recess in annular contact with and precompressed radially between the bearing surface of said sealing member and the axially extending surface of said housing member recess; said precompression of said O-ring distorting the O-ring section to less radial dimension than prior to assembly; said precompressed O-ring when assembled exerting radial pressure between the bearing surface of said sealing member and the axially extending surface of said housing member recess independent of any axial pressure on said O-ring and sealing member; said precompressed O-ring abutting the radial leg of said sealing member and being subject to at least part of the contained pressures to which the housing member is subject; said precompressed O-ring having arcuate outer surfaces spaced from portions of the sealing member at least prior to the subjection of said O-ring to said contained pressures and said radial pressure exerted by said O-ring increasing as said contained pressures increase; and shoulder retaining means operably connected with the axial surface of said housing member recess maintaining the sealing member and O-ring assembled in said recess as a unit; whereby when the packing seal construction is assembled for packing a joint between two relatively movable parts, and is fixed with respect to one of the parts, the sealing surface of said sealing member is in a low-friction sliding contact with the other relatively movable part, is pressed in sealing relation annularly against said other part by the precompressed and distorted O-ring prior to the subjection to contained pressures, and is pressed more tightly against said other part when the O-ring is subjected to contained pressures.

2. Packing seal construction as set forth in claim 1 in which the precompressed O-ring assembled in the housing member recess is normally spaced from the shoulder retaining means so that the precompressed O-ring is normally free of axial compression between the shoulder retaining means and the axially opposed radial leg of said sealing member when assembled.

3. In a packing seal construction for hydraulic devices, a housing member subject to contained pressures and having axially and radially extending surfaces forming an annular recess therein; an annular, tough, slippery, low-friction, pliable memory plastic sealing member assembled in said recess and in cross section having a series of legs connected at generally right angles including a radial leg and at least one axial leg; said one axial leg of said member having an annular axially extending sealing surface and an opposed annular axially extending bearing surface; the sealing member abutting at least certain of the surfaces of said housing member recess; said one axial leg of said sealing member being spaced radially from the axially extending surface of said housing member recess; a resilient material O-ring assembled in radial precompression in said housing member recess in annular contact with the bearing surface of the one axial leg of said sealing member and in association with said axially extending surface of said housing member recess; said precompression of said O-ring distorting the O-ring section to less radial dimension than prior to assembly; said precompressed O-ring when assembled exerting radial pressure on the bearing surface of the one axial leg of said sealing member independent of any axial pressure on said O-ring and sealing member; said precompressed O-ring abutting the radial leg of said sealing member and being subject to at least a part of the contained pressures to which the housing member is subject; said precompressed O-ring having arcuate outer surfaces spaced from portions of the sealing member at least prior to the subjection of said O-ring to said contained pressures and said radial pressure exerted by said O-ring increasing as said contained pressures increase; and radially extending retaining means operably connected with the housing member maintaining the sealing member and O-ring assembled in said housing member recess as a unit; whereby when the packing seal construction is assembled for packing a joint between two relatively movable parts, and is fixed with respect to one of the parts, the sealing surface of the one axial leg of said sealing member is in low-friction, sliding contact with the other of the relatively movable parts, is pressed in sealing relation annularly against said other part by the precompressed and distorted O-ring prior to the subjection to contained pressures, and is pressed more tightly against said other part when the O-ring is subjected to contained pressures.

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