June 30, 1959 J. E. COLLINS 2,892,644

PACKING MEANS FOR PLUNGER VALVES

Filed June 18, 1954 3 Sheets-Sheet 1

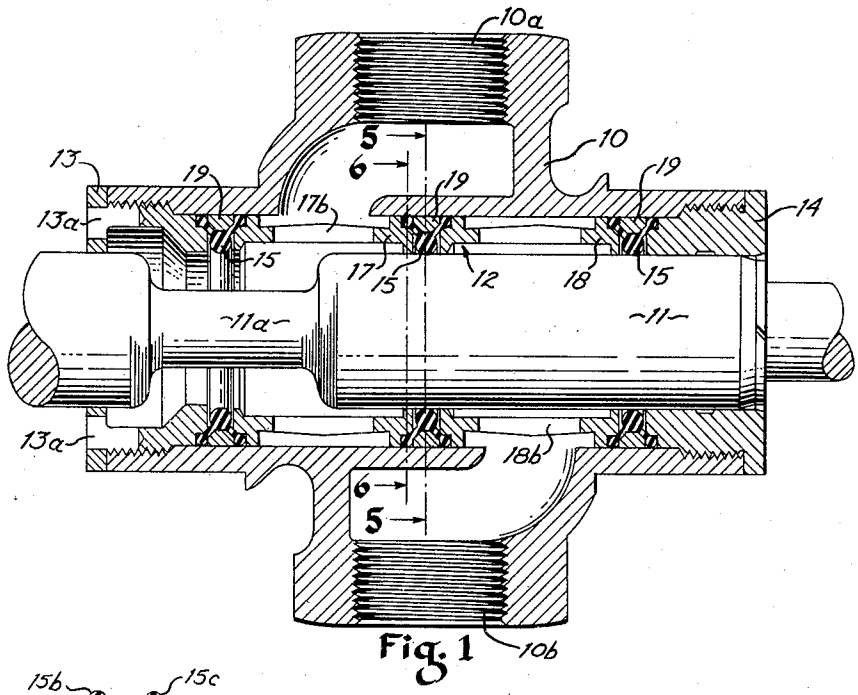

Fig. 1

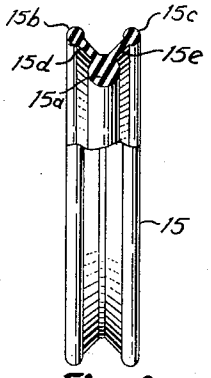

Fig. 2

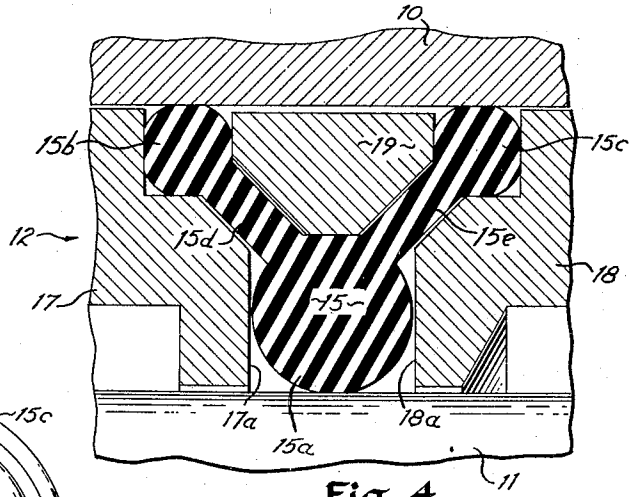

Fig. 4

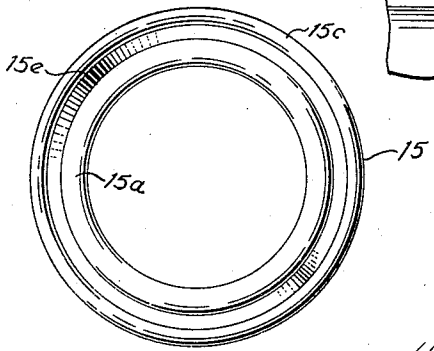

Fig. 3

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PACKING MEANS FOR PLUNGER VALVES

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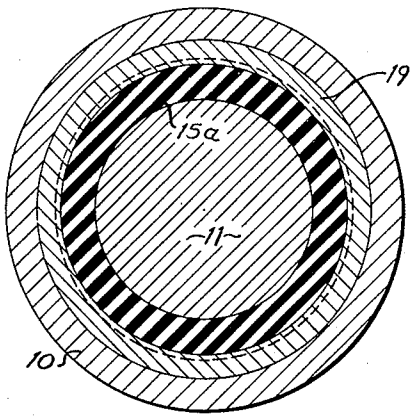

Fig. 5

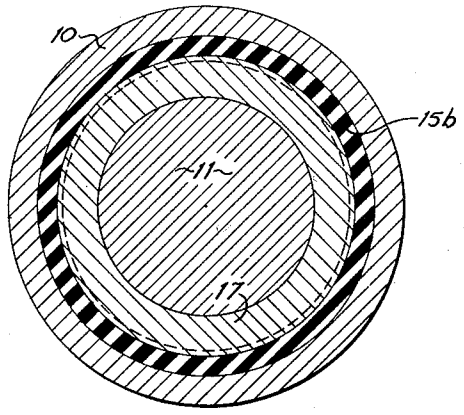

Fig. 6

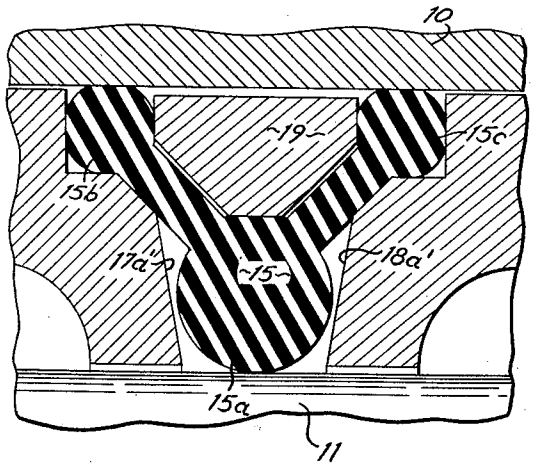

Fig. 7

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PACKING MEANS FOR PLUNGER VALVES

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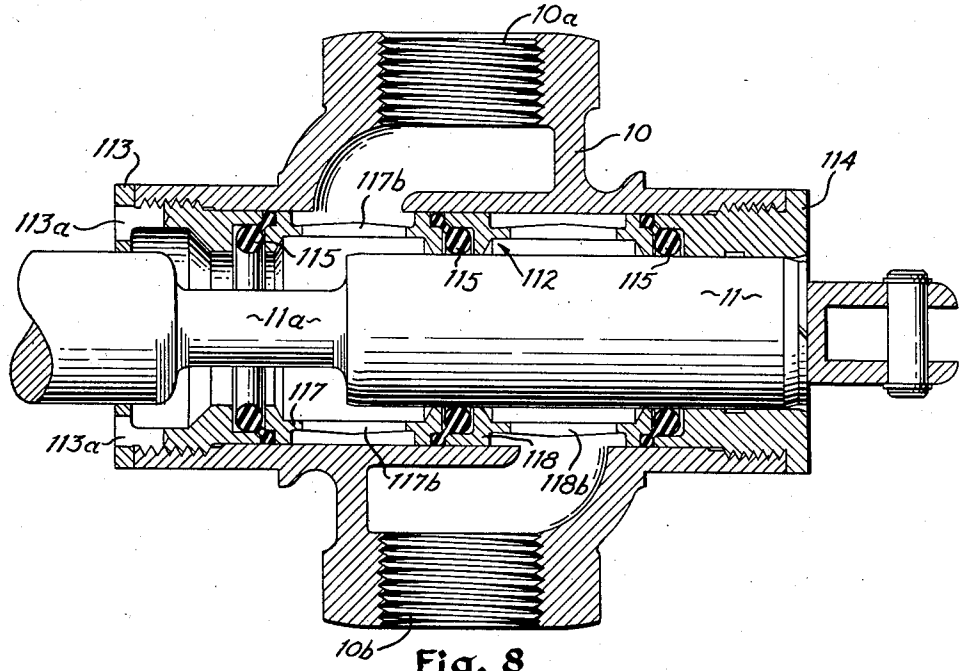

Fig. 8

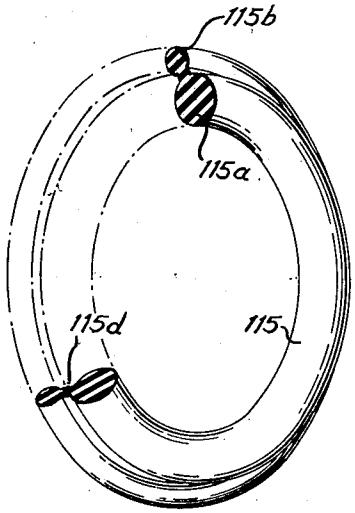

Fig. 10

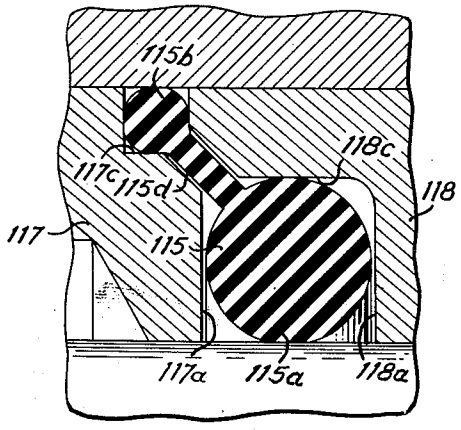

Fig. 9

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United States Patent Office 2,892,644 Patented June 30, 1959

2,892,644

PACKING MEANS FOR PLUNGER VALVES

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Application June 18, 1954, Serial No. 437,818

10 Claims. (Cl. 286—26)

This invention relates to improvements in a packer or packing means and more particularly to that found in a packing assembly for a plunger valve.

One of the objects of the present invention is to provide a packing assembly for location in the space between two relatively movable members wherein said packing assembly includes a packer mechanically locked therein so that the packer may be of relatively soft material to provide a long wear life without danger of being blown from the packing assembly.

A further object of the present invention is to provide a packing assembly for a plunger valve wherein said packing assembly has a packer shaped to effect a mechanical lock with the packing assembly to make it impossible to pull the packer loose from its lodging therein while still permitting the flexing action desirable in a packer.

A further object of the present invention is to provide a packing assembly having a packer therein and located between two relatively movable members with said packing assembly mounting said packer so that high pressure use will tend to pull the packer away from the member movable relative thereto so as to decrease wear therebetween.

A further object of the present invention is to provide a plunger valve that can be economically manufactured on a mass-production basis with valve parts which can be readily assembled or disassembled to permit repair, replacement or interchange of the parts.

A further object of the present invention is to provide a plunger valve design wherein the packer for sealing is maintained under stress and wherein wear and tear thereon is eliminated or reduced to a minimum.

A further object of the present invention is to provide a packing assembly having a packer therein and being characterized by its structural simplicity, inexpensive manufacturing costs, ease of assembly operating efficiency, and strong and sturdy nature under all operating conditions.

Other features of this invention reside in the arrangement and design of the parts for carrying out their appropriate functions.

Other objects and advantages of this invention will be apparent from the accompanying drawings and description and the essential features will be set forth in the appended claims.

In the drawings,

Fig. 1 is a longitudinal sectional view through a plunger valve having a packing assembly with one of the packers of the present invention;

Fig. 2 is a side elevational view, partially in section, of the packer in Fig. 1;

Fig. 3 is an elevational view taken in the axial direction of the packer in Figs. 1 and 2;

Fig. 4 is an enlarged longitudinal sectional view of the structure surrounding the packer in a portion of Fig. 1;

Fig. 5 is an enlarged transverse sectional view through the plunger valve and packer taken along the line 5—5 in Fig. 1;

Fig. 6 is an enlarged transverse sectional view through the packer and plunger valve taken along line 6—6 in Fig. 1;

Fig. 7 is an enlarged longitudinal sectional view, similar to Fig. 4, of a modified construction of the packing assembly elements abutting axially against opposite sides of the packer in Fig. 1;

Fig. 8 is a longitudinal sectional view through a plunger valve, similar to Fig. 1; having a packing assembly with another form of packer of the present invention;

Fig. 9 is an enlarged longitudinal sectional view of the structure surrounding the packer in a portion of Fig. 8; while

Fig. 10 is a perspective view, partially in section, of the packer in Fig. 8.

Those familiar with the state of development of this art will recognize that the present invention might be adapted to various uses, but I have chosen to show the same used with a three-way, exhausting type, plunger valve with an open end exhaust.

The plunger valves in Figs. 1 and 8 each include an outer valve body member **10** having ports **10***a* and **10***b* formed therein and in fluid communication with the bore of the body member wherein a valve stem member or plunger **11** is mounted for endwise movement between a shut-off and exhausting position and a fluid flow position between the ports **10***a*, **10***b*. A packing assembly **12** in Fig. 1 and **112** in Fig. 8 is located in the space between the relatively movable valve members **10** and **11** with this packing assembly generally fixed against axial movement with respect to the valve body member **10** by means of having screw-type end plugs **13**, **14** or **113**, **114** screwed into opposite ends of the through bore in the valve body member **10**.

The valves in Figs. 1 and 8 are three-way, exhausting type valves of the open end exhausting type shown in their exhausting positions. Each valve in its illustrated exhausting position permits its port **10***a* to exhaust through the exhaust ports **13***a* or **113***a* respectively in the end plug **13** or **113** while cutting off flow from the high pressure port **10***b*. Both end plugs for any one valve are identical except for the addition of exhaust ports **13***a* or **113***a* in one.

It should be understood that in its broader aspects this invention includes the placement of this packing assembly **12** or **112**, or similar structure, between any two relatively movable members with these members not necessarily taking the form of the valve body member **10** and the valve stem member **11** of a plunger type valve.

Since many features of the Figs. 1, 4, 7 and 8 constructions are identical, all the common or similar features will be described at the same time. The packing assemblies **12** in Fig. 1 and **112** in Fig. 8 include respectively an annular packer **15** of generally V-shape in cross section with this V-shape approaching a Y-shape because of the enlargement at the junction of the legs of the V and an annular packer **115** of generally I-shape in cross section. The packers **15** and **115** have respectively O-ring or annular portions **15***a*, **15***b*, **15***c* and **115***a*, **115***b* providing sealing portions between the valve members **10** and **11**. These O-ring portions are respectively located at the opposite ends of connecting legs or webs **15***d*, **15***e*, and **115***d* and integrally cast or otherwise formed therewith. The cross sectional diameter of each O-ring portion is greater than the width of its respective connecting leg **15***d*, **15***e* or **115***d*, and these legs are solid, annular members so that no leakage can occur axially of the packer **15** or **115** between annular portions **15***a*, **15***b*, **15***c* or **115***a*, **115***b*. The packers **15** and **115** are molded

or otherwise formed as a one-piece member of rubber, rubber-like, or other similar resilient sealing material.

The packing assemblies 12 and 112 respectively also include annular elements 17, 18 and 19 in Fig. 4 and 117, 118 in Fig. 8 to urge the O-ring portions 15*a*, 15*b*, 15*c* and 115*a*, 115*b* into sealing contact with the members 10 and 11 and to mechanically lock the packers 15 and 115 in the packing assemblies. The resiliency of the packers 15 and 115 permit limited axial relative movement of the elements with respect thereto during tightening of the screw type end plugs 13, 14 and 113, 114 so that a good sealing contact will be provided. The annular elements positively locate and lock the packers 15 and 115 in proper position while assuring proper sealing contact with the relatively movable members 10 and 11. The two annular sleeve spacer elements 17, 18 and 117, 118 abut against opposite sides of, straddle, and are axially aligned with the annular packers 15 and 115 located therebetween while the annular wedge or spreader element 19 in Fig. 4 is located between the diverging legs of the V-shape in radial alignment with the inner O-ring portion 15*a*. In the cross section of Fig. 9, the I-shape annular packer 115 has the lengthwise extending center line of the connecting web coinciding with the line connecting the centers of the O-ring portions 115*a*, 115*b*. This line is inclined upwardly to the left at about a 45° angle in Fig. 9 with respect to the central axis of said packer extending horizontally in Figs. 8 and 9. In Fig. 9, this inclination permits annular element 117 to have a cylindrical portion 117*c* to be located radially inwardly from O-ring portion 115*b* and permits annular element 118 to have a cylindrical portion 118*c* to be located radially outwardly from O-ring portion 115*a*. These elements coact together in both Figs. 4 and 8 to lock the packers 15 and 115 by the O-ring portions 15*a*, 15*b*, 15*c* and 115*a*, 115*b* and the connecting legs 15*d*, 15*e* and 115*d* in the packing assemblies 12 and 112.

In Figs. 4 and 9, surfaces 17*a*, 18*a* and 117*a*, 118*a* on the respective sleeve elements 17, 18 and 117, 118 straddle the O-ring portions 15*a* and 115*a* and extend generally parallel to each other and transversely to the central axis of the valve stem 11 in contrast with the corresponding surfaces in Fig. 7 to be later described.

It should be noted that the seals between the O-ring portions 15*a* and 115*a* and the valve stem members 11 are dynamic seals since the valve stem members 11 are movable endwise relative to the packing assemblies 12 and 112, while static seals exist between O-ring portions 15*b*, 15*c* and 115*d* and the bore of the valve body members 12. These sealing surfaces prevent endwise leakage between these valve members.

The valve constructions in Figs. 1 and 8 respectively include three packers 15 and 115, and two annular sleeve elements 17, 18 and 117, 118. The Fig. 1 construction also includes three annular wedge elements 19. The inner noses of the screw type end plugs 13, 14 and 113, 114 provide surfaces corresponding to those found on the ends of the annular sleeve elements 17, 18 and 117, 118 to complete the packing assemblies 12, 112 located in the space between the valve members 10 and 11. The centrally located packers 15, and 115 in Figs. 1 and 8 are straddled by and located axially between the valve ports 10*a* and 10*b* where they communicate with the bore of the valve bodies 10 through ports 17*b*, 18*b* and 117*b*, 118*b* in the sleeve elements 17, 18 and 117, 118 respectively.

The operation of each valve is basically the same and should be readily apparent. When the valve stem member 11 is in the Fig. 1 or 8 position, flow between the valve ports 10*a* and 10*b* is cut off but valve port 10*a* may exhaust through the exhaust ports 13*a* or 113*a* in the end plug 13 or 113. However, when the valve stem member 11 is moved toward the right in Fig. 1 so that the necked-down portion 11*a* thereon straddles the centrally located packer 15 or 115, flow may take place from the valve body port 10*a* to the valve body port 10*b* through ports 17*b*, 18*b*, or 117*b*, 118*b* and along the necked-down portion 11*a* of the valve stem. Then, exhaust flow out ports 13*a* or 113*a* has been cut off. Annular grooves are provided in the periphery and in the bore of each sleeve element 17, 18 or 117, 118 so that flow may take place through one or more of the plurality of the circumferentially spaced ports 17*b*, 18*b* or 117*b*, 118*b* in the annular walls of the sleeve elements.

The ease of assembly and disassembly should now be apparent. The valve parts and the parts of the packing assemblies 12 and 112 may be easily assembled, replaced for repair and interchanged with other identically shaped parts in the valve assemblies. This construction makes it possible to manufacture valves on a mass-production basis, to thus increase uniformity of valve operation, and to decrease manufacturing cost. The packers 15 and 115 are maintained under compression with wear and tear thereon eliminated or reduced to a minimum. In the Fig. 1 construction, annular elements 17 and 18 are identical so that not only they may be interchanged with each other, but also one or both may be turned end for end to position them properly for assembly. In the Fig. 8 construction, the lack of symmetry in packer 115 about a vertical transverse central plane requires variations in design of the surfaces engaged therewith. In the illustrated construction, the noses of end plugs 113 and 114 are identical so that the packing assembly elements 117, 118 and the packers 115 can be turned end for end as a unit and the valve will still operate properly. Hence, the elements 117 and 118 must be assembled with both facing the same way; it is impossible to get them in the wrong way if packers 115 are to be properly used.

Additional types of multiple way valves can be formed from the component parts disclosed. First, if exhaust ports 13*a* and 113*a* are closed, the Fig. 1 and Fig. 8 valves become two-way valves. Second, if either another annular element 17 or 18 and annular element 19 and packer 15 is added to Fig. 1 or if another annular element 118 and packer 115 is added to Fig. 8, another type valve will be formed if the valve body 10 has another port correspondingly added thereto in fluid communication with the added annular element. The valve type will be either a four-way open end exhaust or a three-way-piped-exhaust with the latter having exhaust ports 13*a* and 113*a* blocked. Third, a four-way-piped-exhaust valve may be formed by duplicating the element and packer set mentioned in the immediately foreging second illustration and providing a suitable number of ports in the valve body.

The packing assemblies 12 and 112 as well as packers 15 and 115 therein have several advantages, and these are especially apparent when each packing assembly is mounted in a valve in the manner shown in Fig. 1 or 8. First, the packer 15 or 115 has greater stability with respect to blow-out and dislodging from its mounting because a mechanical lock coacts with its V-shape or I-shape to hold the packer in proper location. Blow-out tends to occur, for example, when the valve stem member 11 is suddenly shifted to the right from its Fig. 1 or 8 position to permit flow between the valve body ports 10*a* and 10*b*. This action will produce a sudden pressure change on the centrally located packer 15 or 115 and also remove the support from around the bore thereof. When the pressure change is sufficiently great and sufficiently sudden, it will tend to squeeze out or blow out the packer 15 or 115 from its mounting in the packing assembly. Blow-out is especially prevalent when a conventional O-ring is used. However, in the present construction, the annular elements 17, 18, 19 or 117, 118 respectively coact with the shape of the packer 15 or 115 to mechanically lock it in position so that it is impossible to pull the packer loose by this differential pressure.

Second, the packers 15 and 115 present all of the advantages of an O-ring since each of the O-ring portions 15*a*, 15*b*, 15*c* and 115*a*, 115*b* are shaped like an O-ring where they make sealing contact with the valve members 10 and 11. The flexible connecting webs 15*d*, 15*e* and

115*d* also permit the flexing action obtained from the ordinary O-ring.

Third, a softer (durometer rating) packer 15 or 115 may be used since its hardness is not a factor in maintaining its position against blow-out because a mechanical lock firmly holds it in position. This softer packer ring will have a longer wear life and provide better sealing.

Fourth, the ease of assembly and the interchangeability of the parts combine with the simplicity of the valve design so that the mechanical lock of the packer 15 or 115 can be effected with ease and simplicity.

Fifth, the shape of packer 15 or 115 and annular elements 17, 18, 19 or 117, 118 coact together to prevent any increase in end thrust thereon to increase friction at the dynamic seal formed by O-ring portion 15*a* or 115*a* and the movable plunger 11. Any increase in end thrust, whether caused by differential fluid pressures along the bore of the valve or by tightening of one of the end plugs 13, 14, 113 or 114, will be transmitted in Figs. 4, 7 and 8 through the smaller, outer O-ring portions 15*b*, 15*c* or 115*b* to increase the static seal in the valve body bore instead of through O-ring portion 15*a* or 115*a*. Hence, O-ring portion 15*a* or 115*a* is not squeezed by end thrust and therefore the friction on plunger 11 is not increased at the dynamic seal. Note, for example, the clearance between O-ring portion 15*a* and surfaces 17*a*, 18*a* in Fig. 4. These advantages are not obtained when an ordinary O-ring is located between adjacent sleeve elements, corresponding, for example, to sleeves 17 and 18.

Fig. 7 discloses another form of the invention especially adapted for high pressure use (over 200 p.s.i.). This construction is exactly identical to that shown in Fig. 4 except that the parallel and annular surfaces 17*a* and 18*a* in Fig. 4 straddling the O-ring portion 15*a* have been changed to tapered annular surfaces 17*a'* and 18*a'* in Fig. 7. It has been noted that under high pressure conditions the O-ring portion 15*a* forming the dynamic seal has a relatively short wear life in some installations. Under high pressure conditions, the shape of surfaces 17*a'* and 18*a'*, diverging in the outward direction away from the dynamic sealing surface with the relatively movable inner member 11, cause the O-ring portion 15*a* to have a tendency to climb up these diverging surfaces 17*a'* and 18*a'* and thus to lessen the squeeze on the valve stem 11 and to reduce the wear on the packer 15.

It is contemplated that the present invention will include within its scope modifications of the present construction. For example, the V-shape of packer 15 may be inverted with the diverging legs diverging inwardly instead of outwardly as the latter is shown in the present construction. Then, the annular wedge element 19 would be located radially inwardly from the O-ring portion 15*a* instead of radially outwardly therefrom. However, the illustrated construction is the preferred construction and the larger O-ring portion 15*a* provides a longer wear life at the dynamic sealing surface.

Various changes in details and arrangement of parts can be made by one skilled in the art without departing from either the spirit of this invention or the scope of the appended claims.

What I claim is:

1. A packing assembly for placement in a space between relatively movable members comprising, an annular packer with annular portions at the opposite ends of a connecting web, and annular elements abutting against said packer to expand the same radially and urge one of said annular portions into sealing contact with one of said members and urge the other of said annular portions into sealing contact with the other of said members said elements having surfaces straddling but spaced axially from one of said annular portions.

2. A packing assembly according to claim 1 in which said straddling surfaces mutually converge toward the location where the annular portion straddled by said surfaces engages its respective relatively movable member.

3. A packing assembly for placement in a space between relatively movable inner and outer members comprising, an annular packer with O-ring portions at the opposite ends of a connecting web and with the cross sectional diameter of each O-ring portion being greater than the width of its connecting web, and annular elements abutting against said packer to expand the same radially and urge one of said O-ring portions into sealing contact with the inner member and urge the other O-ring portion into sealing contact with the outer member and to lock said web and O-ring portions in said packing assembly, said elements having surfaces straddling but spaced axially from one of said O-ring portions.

4. A packer assembly according to claim 3 wherein said O-ring portions are radially and axially offset from each other relative to the central axis about which the packer is annular.

5. A packing assembly for placement in a space between relatively movable inner and outer members comprising, an annular packer of generally V-shape in cross section with O-ring portions at the opposite ends of each leg and with the cross sectional diameter of each O-ring portion being greater than the width of its connecting leg, and annular elements abutting against said packer to expand the same and urge one O-ring portion into sealing contact with the inner member and urge the other O-ring portions into sealing contact with the outer member, said annular elements including at least two sleeve elements abutting against opposite sides of and axially aligned with said packer and including a spreader element disposed between the diverging legs of said V-shape to lock said legs and O-ring portions in said packing assembly.

6. A packing assembly for placement in a space between an outer valve body member and an inner valve stem member which is endwise movable within the outer member comprising, an annular packer of generally V-shape in cross section with O-ring portions at the opposite ends of each leg and with the cross sectional diameter of each O-ring portion being greater than the width of its connecting leg, and annular elements abutting against said packer to expand the same radially and urge one O-ring portion into sealing contact with the inner member and urge the other O-ring portions into sealing contact with the outer member, said annular elements including at least two sleeve elements abutting against opposite sides of and axially aligned with said packer and including a spreader element disposed between the diverging legs of said V-shape in radial alignment with said one O-ring portion to lock said legs and O-ring portions in said packing assembly.

7. A packing assembly for placement in a space between relatively movable inner and outer members comprising, an annular packer with O-ring portions at the opposite ends of a connecting web and with the cross sectional diameter of each O-ring portion being greater than the width of its connecting web, and annular elements abutting against said packer to expand the same and urge one of said O-ring portions into sealing contact with the inner member and urge the other of said O-ring portions into sealing contact with the outer member and to lock said web and O-ring portions in said packing assembly, said elements having surfaces straddling and spaced from said one O-ring portion and having other surfaces straddling and contacting said other O-ring portion when the packing assembly is in assembled position.

8. A packing assembly for placement in a space between relatively movable inner and outer members comprising, an annular packer of generally V-shape in cross section with O-ring portions at the opposite ends of each leg and with the cross sectional diameter of each O-ring portion being greater than the width of its connecting leg, and annular elements abutting against said packer to expand the same radially and urge one O-ring portion into sealing contact with the inner member and urge the other O-ring portions into sealing contact with the outer mem-

ber, said annular elements including at least two sleeve elements abutting against opposite sides of and axially aligned with said packer and including a spreader element disposed between the diverging legs of said V-shape to lock said legs and O-ring portions in said packing assembly, said sleeve elements having surfaces which diverge outward with respect to the cross sectional center of said packer and which straddle and are spaced from said one O-ring portion and having other surfaces straddling and contacting said other O-ring portions when the packing assembly is in assembled position.

9. A packing assembly for placement in a space between the longitudinal wall of a bore in an outer valve body member and an inner valve stem member which is endwise movable within the bore of the outer member comprising, an annular packer of generally V-shape in cross section with O-ring portions at the opposite ends of each leg and with the cross sectional diameter of each O-ring portion being greater than the width of its connecting leg, annular elements abutting against said packer to expand the same radially and urge one O-ring portion into sealing contact with the inner member and urge the other O-ring portions into sealing contact with the longitudinal wall of the outer member, said annular elements including at least two sleeve elements abutting against opposite sides of and axially aligned with said packer and including a spreader element disposed between the diverging legs of said V-shape such that the packer and the spreader element are disposed between said annular elements with a tight fit to lock said legs and O-ring portions in said packing assembly, and means for securing the packing assembly in position in the bore against axial movement therein.

10. A packing assembly constructed in accordance with claim 9 wherein said means comprises end plugs disposed in each end of the bore in the outer valve body member.

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