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SEAL ASSEMBLY

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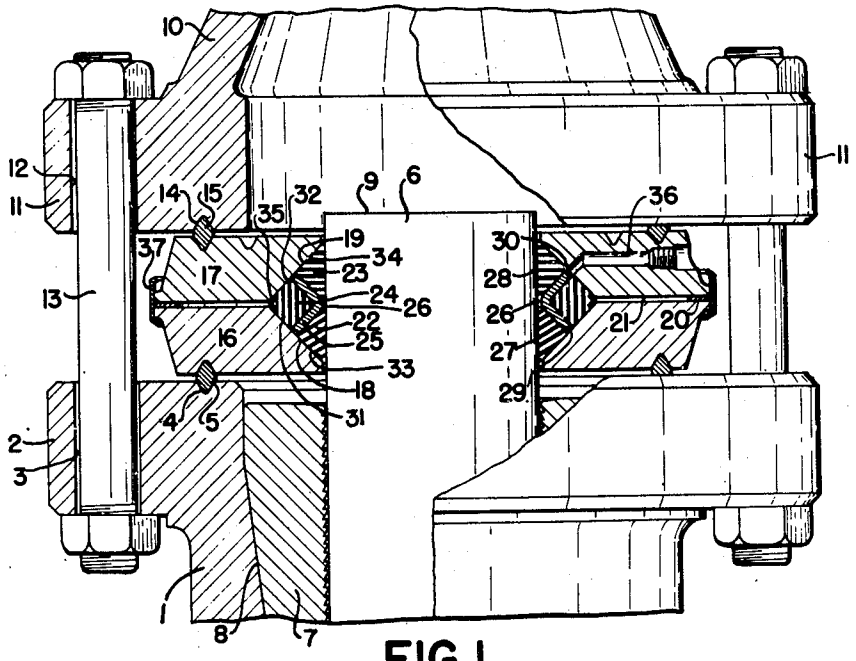


FIG. 1

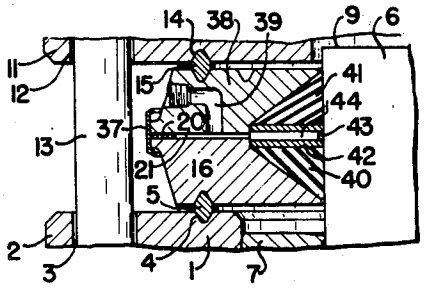


FIG. 3

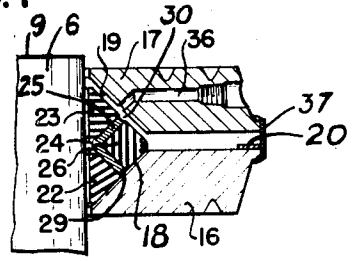


FIG. 2

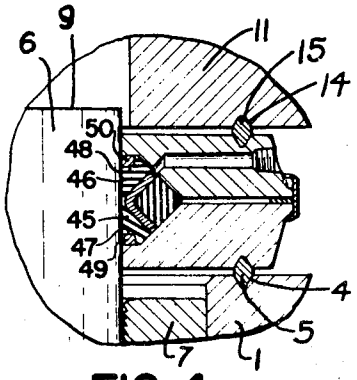


FIG. 4

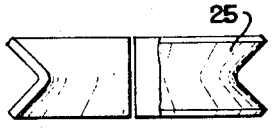


FIG. 5

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SEAL ASSEMBLY

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19 Claims. (Cl. 285—22)

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This invention relates to seal assemblies and has for its general object the provision of an assembly to be placed about another member and to be caused to effect a seal with regard to the outer surface of such other member.

More specifically this invention has for its object the provision of a seal assembly which may be placed about a pipe such as the casing or tubing of a well and caused to form a seal with the exterior surface of such pipe. Such an assembly is particularly useful in forming a seal between a well casing and casing head, being placed about the well casing adjacent to or within the casing head, caused to effect a seal with respect to the casing, and clamped or joined to the well head to effect a seal with regard to the well head.

More specifically it is an object of this invention to provide a structure of the type referred to in which the seal will be effected by means of a resilient pressure applied to a packing material which is flowable under pressure.

Another object is to provide such a device in which the pressure may be applied by the same act by which the assembly is sealed to the well head.

Yet another object of this invention is to provide such an assembly in which the seal effected thereby about a casing or other member may be tested after it is formed.

Yet another object is to provide such an assembly in which the testing operation will provide a test not only of the seal effected between the packing and the pipe or other member but also of the seal effected between the packing and the remainder of the seal assembly.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain specific embodiments of the invention.

In the drawing:

Fig. 1 is a view partly in longitudinal cross section illustrating a seal assembly constructed in accordance with this invention in combination with a casing, casing head, etc., of a well.

Fig. 2 is a view showing a portion of the structure illustrated in Fig. 1 and showing the positions occupied by the respective parts of the assembly prior to the distortion of the packing to form a seal.

Fig. 3 is a view similar to one side of Fig. 1 but illustrating a slightly modified form of the invention.

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Fig. 4 is a view similar to Fig. 3 but illustrating a still further modified form of the invention.

Fig. 5 is a side elevation of the segmental packing ring supporting and spacing means employed in connection with the forms shown in Figs. 1 and 4, a portion thereof being broken away to show the inside elevation of the ring.

As is customary, the casing head 1 illustrated in Fig. 1 is mounted in any suitable manner as upon the upper end of a string of surface casing (not shown) and at its upper end is provided with an outwardly extending flange 2 having bolt holes 3 therethrough. The upper surface of the flange 2 is provided in the customary manner with a groove 4 for the reception of a metal sealing ring 5.

The customary well casing 6 extends upwardly from within the well and is supported in the usual manner by means of slips 7 disposed within the tapered bowl portion 8 of the casing head.

The casing 6 extends above the upper end of the casing head 1 by an amount sufficient to enable it to project through the seal assembly presently to be described and is cut off at a suitable height as indicated by the numeral 9. Above the seal assembly any suitable additional equipment such as a tubing head or bonnet 10 having a flange 11 thereon may be employed. This flange 11 has holes 12 therethrough for the reception of studs 13 that extend through both the holes 12 in the flange 11 and the holes 3 in the flange 2 so that the flanges 2 and 11 may be drawn tightly toward each other by means of these studs and the nuts thereon. The lower surface of the flange 11 is provided with a groove 14 for receiving a metal seal ring 15 preferably corresponding in size to the metal seal ring 5.

Interposed between the flanges 2 and 11 is the seal assembly constructed in accordance with this invention. The body of this seal assembly is made up of two parts 16 and 17 which are of relatively hard stiff material though slightly resilient in nature, such as for example steel plates. Each of these parts is provided with a central opening through which the casing 6 extends, the openings being in alignment with each other for this purpose. The adjacent edges of these openings are cut away or beveled as shown at 18 and 19 respectively so that the body parts 16 and 17 when placed together will form between them by virtue of these beveled cut away portions a groove which opens radially inwardly toward the casing 6. Between these body parts 16 and 17 adjacent their outer edges there is provided an annular gasket 20 which is preferably of copper or some soft

metal capable not only of forming a seal or partial seal between the parts around their outer edges, but primarily capable of providing a limit stop limiting the extent to which the outer edges of the parts 16 and 17 may be moved toward each other so that there will always be a space between these parts radially inwardly from the gasket 20 as shown at 21.

Disposed within the groove formed by the two cut away portions or bevels 18 and 19 is a packing which in the form illustrated in Fig. 1 is made up of two identical packing rings 22 and 23 of substantially triangular cross section, a third packing ring 24 of substantially rectangular cross section, and a segmental spacer and support 25 which extends between the three packing rings and spaces them apart. The segmental support 25 spaces the rings 22 and 23 apart to provide an inwardly opening groove 26 which divides and spaces apart the inner faces 27 and 28 of the packing provided respectively by the rings 22 and 23. At the same time the segmental support and spacer 25 spaces each of the rings 22 and 23 from the ring 24 and provides a groove in each of the outer faces of the composite packing, which groove opens into the groove in the body and divides the outer faces of the composite packing edge into two spaced parts or zones. These grooves are designated 29 and 30. One of each of these parts or zones is provided by the ring 24 as shown at 31 and 32 respectively, and the other by the ring 22 at 33 or the ring 23 at 34 as the case may be. The segmental support and spacer 25 also provides, intermediate its segments, passageways which interconnect the various grooves in the inner and outer faces of the composite packing, all for a purpose presently to be described.

In order to oppose extrusion of the packing into the space between the body parts, the entrance to this space at the bottom of the groove may be bridged by a relatively thin ring of metal or other suitable material as shown at 35.

One of the body parts 17 is provided with a passageway 36, which extends from the outer margin of the part 17 and communicates at its inner end with the groove 30. It will be apparent that pressure fluid may be injected through this passageway 36 and that such fluid under pressure will be transmitted to the groove 26 along the mid-portion of the inner face of the packing and also to each of the grooves 29 and 30 along the mid-portion of each of the outer faces of the packing to test the seal provided by each face of the packing on each side of each groove.

Prior to its distortion under pressure, the composite packing is preferably of such size that it will substantially space apart the body parts 16 and 17 as illustrated in Fig. 2 of the drawing. In order that the seal assembly including the parts 16 and 17 and the parts that go to make up the composite packing may be handled and shipped as a unit without coming apart, a retaining hoop with inturned upper and lower edges is provided as shown at 37 extending about and embracing the marginal portions of the parts 16 and 17 and limiting their movement away from each other. In operation, after the casing 6 has been run in a well the seal assembly in its uncompressed state as illustrated in Fig. 2 will be placed over the upper end of the casing with a seal ring 5 between it and the casing head. The casing at this time will preferably be severed at a level just above the upper face of the seal assembly. Then a second seal ring will be placed on top of the assembly as shown at 15 and a tubing head, valve, or other

desired apparatus 10 will be placed on top of the second seal ring and the studs 13 will be put in place and tightened.

Tightening of the studs 13 will put end-wise pressure upon the parts 16 and 17 of the seal assembly body and urge these parts toward each other. As they move toward each other they will put pressure upon the material of the packing, which is flowable under pressure, and will cause this material to flow radially inwardly toward and into sealing engagement with the casing. The seal rings 5 and 15, located as they are adjacent the outer marginal portions of the body parts 16 and 17, but still inwardly from the gasket 20, will tend to flex the parts 16 and 17 and bring their outer edges together first. Contact between these parts and the gasket 20 will limit the movement of the outer edges toward each other whereupon the pressure exerted through the seal rings 5 and 15 will act as through a double cantilever upon the composite packing around the casing and the resiliency of the parts 16 and 17 will provide a resilient pressure upon this packing.

When a sufficient pressure has been brought to bear upon the packing by tightening the studs 13 a fluid under testing pressure may then be injected through the passageway 36 into the grooves 26, 29 and 30. This pressure will tend to escape in each direction from each of these grooves and any loss of pressure injected through the passageway 36 will indicate that the seal is insufficient along one or more faces of the packing. If it is insufficient, greater pressure can be applied by tightening further the studs 13 until the leakage stops. The parts 16 and 17, being resilient and flexed, will tend to follow the packing in the event of shrinkage or other action which would tend to reduce the sealing pressure, and thus maintain the sealing pressure within reasonable limits without additional taking up of the studs 13.

Referring now to Fig. 3, the body part 16 of this modification is in substance the same as that shown in Fig. 1 and this is also true of the hoop 37 which holds the parts in assembled relation while not under pressure, and of the gasket 20 which is located between the parts. The body part 38 is of very similar construction to the body part 17 but differs therefrom in that the passageway 39 through which test fluid under pressure is injected, instead of communicating with one of the beveled edges that receives the packing, communicates with the open space 21 between the two body parts inwardly of the gasket 20.

The packing in this instance consists of two separate packing rings 40 and 41 having a spacing ring 42 interposed between them. This spacing ring 42 has a circumferential groove 43 opening inwardly about its inner edge thus providing a groove which divides the inwardly facing surfaces of the packing. This spacer and support ring also has a passageway 44 extending radially from the groove 43 and communicating with the space 21 between the body parts.

It will be clear that the operation of this structure is quite similar to that described in connection with Figs. 1 and 2, but since in this instance the spacer ring 42 bridges the gap 21, it is unnecessary to employ the ring 35 shown in Fig. 1. The packing will be expanded into contact with the casing in the same manner as described in connection with Fig. 1, whereupon test pressure may be injected through the passageway 39 into the space 21 and thence through the passageway 44 into the groove 43. This test fluid will tend

to flow along the surfaces between the packing rings 40 and 41 respectively and the body parts 16 and 38, from the space 21, and along the inwardly facing surfaces of these two packing rings from the groove 43. As before, any leakage will be shown immediately by loss of pressure fluid and if necessary further tightening of the packing may be effected by further tightening of the studs 13.

With reference to the form illustrated in Fig. 4, this is in all respects the same as that shown in Fig. 1 except that instead of the packing rings 22 and 23 there are employed packing rings 45 and 46, each of which has a countersink as shown at 47 and 48 respectively for the reception of relatively rigid collapsible rings 49 and 50. In operation, the action is much the same as described in connection with Fig. 1 except that when pressure is placed upon the packing the rings 49 and 50 will be collapsed inwardly into contact with the casing so as to oppose extrusion of the packing rings 45 and 46 as the pressure on these rings increases.

From the foregoing it will be seen that a means has been provided whereby all of the objects and advantages sought by this invention may be accomplished. It is to be understood that the seal assembly provided by this invention, though specially adapted for use as a seal about the pipe used in a well, is not limited to such use but may be used in any situation in which it is desired to provide an assembly of the type herein claimed for sealing about the exterior of any member passing therethrough. The invention therefore is to be limited in its scope only by the prior art and by the terms of the appended claims.

Having described my invention, I claim:

1. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, support means having a portion extending about the inner periphery of said packing and providing a permanent inwardly opening groove dividing the inner face of said packing intermediate its ends, one of said parts and said packing having connected passageways therethrough which together provide communication between the outside of the assembly and said permanent groove.

2. A seal assembly having an opening therethrough adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering

with the openings in said parts and dimensions such as to space said parts from each other, a relatively rigid support means having a portion extending about the inner periphery of said packing and providing a permanent inwardly opening groove dividing the inner face of said packing intermediate its ends, one of said parts and said packing having directly connected passageways therethrough providing communication entirely within said one part and said packing between the outside of the assembly and said permanent groove.

3. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly having a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive said member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, and means adjacent the outer extremities of said parts for limiting movement of the outer extremities of said parts toward each other to such a degree as to provide at all times a space between said parts at their inner extremities adjacent said groove.

4. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, and means engaging about outer marginal portions of said parts to limit movement of said parts away from each other and retain said parts and packing in assembly when the assembly is not in use.

5. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, and a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, said parts being somewhat resilient and adapted to have their outer edges forced toward each other to resiliently urge the walls of the groove formed by the cut-away edges of said parts

against the packing, and to provide for take up of shrinkage or the like of the packing.

6. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, said parts being somewhat resilient and adapted to have their outer edges forced toward each other to resiliently urge the walls of the groove formed by the cut-away edges of said parts against the packing to place it under sealing pressure and to provide for take up of shrinkage or the like of the packing, and means for limiting the movement of the outer extremities of said parts toward each other to such a degree as to leave, at all times, a space between the inner extremities of said parts adjacent said groove.

7. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, said packing having a counter-sink formed therein at each end of the packing about the opening through the packing, and a rigid packing retaining element in each counter-sink movable under pressure from said parts radially inwardly to oppose extrusion of the packing end-wise into the openings through said parts.

8. A seal assembly having an opening therethrough adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a body of relatively rigid material having an opening therethrough to receive such member, said body having an inwardly facing groove about its inner periphery, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the opening through said body, support means providing a permanent inwardly opening groove dividing the inner face of said packing intermediate its ends, said body and packing having connected passageways therethrough which together provide communication between the outside of the assembly and said permanent groove, and said body including means having a resilient laterally extending portion and a portion forming one side of said groove, said means being movable by pressure on said laterally extending portion to apply pressure to said packing.

9. An assembly as set forth in claim 8, said packing having a countersink formed therein at each end of the packing about the opening through the packing, and a rigid element in each countersink movable under pressure from said pressure applying means radially inwardly to oppose extrusion of the packing endwise into the openings through said parts.

10. A seal assembly having an opening therethrough adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a body of relatively rigid material having an opening therethrough to receive such member, said body having an inwardly facing groove about its inner periphery, a packing comprising a relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the opening through said body, support means providing a permanent inwardly opening groove dividing the inner face of said packing intermediate its ends and a permanent outwardly opening groove facing into said groove in the body and dividing the outer face of said packing intermediate its ends, said body and packing having connected passageways which together provide communication between the outside of the assembly and said permanent grooves, and said body including means having a resilient laterally extending portion and a portion forming one side of said groove, said means being movable by pressure on said laterally extending portion to apply pressure to said packing.

11. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, and a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, said packing including two axially spaced rings of packing material of substantially the same inner diameter and support means between said rings for holding them apart and providing a groove dividing their inner faces.

12. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, and a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, said packing including a pair of spaced apart rings of packing material of substantially the same inner diameter and a third ring of packing material exteriorally of and overlapping in part the exteriors of said

first two rings and fitting partly between them to assist in spacing them apart.

13. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, and a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, said packing including a pair of spaced-apart rings of packing material of substantially the same inner diameter and a third ring of packing material exteriorly of and overlapping in part the exteriors of said first two rings and fitting partly between them to assist in spacing them apart, said three rings of packing material nesting together to form a composite packing substantially triangular in cross section.

14. A seal assembly having an opening therethrough and adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a pair of opposed relatively hard and rigid body parts having registering openings therethrough to receive such member, said parts having their adjacent edges surrounding said openings cut away whereby the adjacent cut-away edges of said parts together form a groove facing toward and surrounding said opening, and a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the openings in said parts and dimensions such as to space said parts from each other, said packing including a pair of spaced apart rings of packing material of substantially the same inner diameter and a third ring of packing material exteriorly of and overlapping in part the exteriors of said first two rings and fitting partly between them to assist in spacing them apart, said three rings of packing material nesting together to form a composite packing substantially triangular in cross section, and segmental support means interposed between said rings and spacing them apart to provide an inwardly opening groove dividing the inner face of the composite packing intermediate its ends and an outwardly opening groove opening into the groove in the body dividing the outer face of the composite packing intermediate its ends.

15. An assembly as set forth in claim 8 in which the packing includes two axially spaced rings of packing material of substantially the same inner diameter and the support means fits partly between said rings to provide a composite packing and divide the inner face of said composite packing intermediate its ends.

16. An assembly as set forth in claim 8 in which the packing includes a pair of spaced apart rings of packing material of substantially the same inner diameter and a third ring of packing material exteriorly of and overlapping in part the exteriors of said first two rings and fitting partly between them to assist in spacing them apart, and the support means extends between the said three rings to space them apart and provide a composite packing with an inwardly opening groove dividing the inner faces of said pair of packing rings.

17. An assembly as set forth in claim 8 in which the support means also extends laterally through said packing in a direction generally away from the axis thereof and provides a passageway leading from the inwardly opening groove to the outer surface of said packing.

18. A seal assembly having an opening therethrough adapted to provide a sealed engagement about a member passing through said opening, said assembly comprising a body of relatively rigid material having an opening therethrough to receive such member, said body having an inwardly facing groove about its inner periphery, a packing comprising relatively soft material flowable under pressure disposed in and conforming to said groove and, prior to distortion, having an opening substantially registering with the opening through said body, and said body including means having a resilient laterally extending portion and a portion forming one side of said groove, said means being movable by pressure on said laterally extending portion to apply pressure to said packing.

19. As a subcombination, a composite packing comprising a plurality of packing rings nested with each other to provide a composite assembly of substantially triangular cross section, two of said rings having substantially the same inner diameter and support means extending between said rings and providing a groove dividing the inner faces of said two rings and also providing a passageway from said groove to the outer face of the composite packing.

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