

Description

This invention relates to a packing for a stuffing box.

A wide variety of packings for stuffing boxes for all types of piston rods, valve stems, shafts and the like are well-known. For example, graphite tape (such as that sold under the trademark GRAPH-LOCK by Garlock Inc) and braided graphite rings (such as that sold under the trademark GARLOCK STYLE #98 sold by Garlock Inc) have been very effective packings in most applications. However, when installed into petro-chemical industry valves, due to excessive stuffing box-to-stem dimensional tolerances, some leakage has been recorded. GRAPH-LOCK tape, when re-formed under the amount of load that can be applied in ordinary valve housings in the petrochemical industry, will not cold flow sufficiently to provide effective sealing of up to 0.79 mm (1/32") clearances when supplied in its standard density of 1.4 g/cm³. GARLOCK STYLE #98, being a soft braided packing, allows slight leakage under most high-pressure applications. US-A-883,534, US-A-3,227,464, NL-C-7001682 and FR-A-1376755 show examples of prior art packings. Also FR-A-1213840 shows a packing with adjacent rings respectively of hard and soft plastics material with facing surfaces at the same acute angle to the packing axis, so that axial pressure effects deformation of the soft plastics ring to obtain a seal.

To date, pump and valve stem packings required leakage to lubricate wearing surfaces. When utilizing a carbon-graphite system in such valve stem packings, further lubrication after installation is unnecessary. Most petro-chemical industries schedule a routine preventative maintenance tear down inspection, where valves and pumps are reconditioned, thus extending overall service life. It is not uncommon to remachine a valve stem 0.79 mm to 1.58 mm (1/32" to 1/16") overall to renew the sealing surfaces. During disassembly, the gland is cleaned to remove corrosion and system deposits. Both of these operations alter the sealing surfaces resulting in a leakage path upon reassembly using standard packing materials. Use of conventional packing such as braided constructions, twisted rope, and flexible graphite all have limitations. Braided and twisted constructions are porous and dimensionally unstable. Flexible graphite can be made impervious by compression moulding causing severe limitations in material flow and excessive sealing stress.

The present invention therefore provides a packing for a stuffing box comprising:

- (a) a low density preform ring that is compressible and reformable during packing installation to form a seal, said ring including means

for maintaining the structural integrity thereof,

- (b) an adapter ring having one end thereof adjacent one end of said preform ring, and adapted, when axial compressive force is applied to said packing, to force the material of said preform ring adjacent one radial edge of said one end thereof to move axially and radially in the direction away from said preform ring, and to further compress said material of said preform ring into an impervious and effective seal, and
- (c) said preform and adapter rings having facing surfaces each at an acute angle to the longitudinal axis of said packing,

characterised in that:

- (d) said preform ring has a density in the range of from about .5 to 1.4 g/cm³,
- (e) said adapter ring is made of a deformable compression sealing material having a density in the range of from about 1.4 to 1.7 g/cm³, and
- (f) said angles of said preform and adapter ring facing surfaces are different and such that said one end of said preform ring is adapted to form an outer diameter seal. (O.D. seal).

Instead, the preform ring can be arranged to form an inner diameter seal (I.D. seal), or the packing can include pairs of preform and adapter rings to provide each of I.D. and O.D. seals. Alternatively, both the I.D. and O.D. seals can be provided using an assembly including only three rings, that is, one preform ring in-between two adapter rings. The preform and/or adapter ring or rings can be of graphite.

The packing may also include one or more compressible packing rings, preferably a braided carbon fibre wiper ring, and also impervious pressure barrier washers or spacer rings. The washers are preferably a filled polytetrafluoroethylene ring (such as that sold under the trademark GYLON by Garlock Inc) when used with temperatures below 232°C (450°F). Metal washers, preferably of aluminum, are preferably used above 232°C (450°F).

The facing surface of the adapter ring is preferably about 60° to the longitudinal axis of the packing and the facing surface of the preform ring is preferably about 45° to this longitudinal axis, thus providing a difference in angles of about 15°. The difference in angles provides for the deformation or re-forming of the lower density flexible material preform ring so as to ensure the formation of the I.D. or O.D. seal. Other acute angles and other differences in angles can be used. The flexible of the preform ring or rings moves into the annular space between the packing and either the stem or the stuffing box.

The present invention thus provides an extremely flexible, effective, and economical packing system, by virtue of selected density ranges

for the adapter and preform rings and by different angles for the facing surfaces.

Brief description of the drawings

The present invention will be more fully understood by reference to the following detailed description thereof, when read in conjunction with the attached drawings, wherein like reference numerals refer to like elements and wherein:

Fig. 1 is a cross-sectional view through a stuffing box, stem and packing of the present invention prior to tightening of the gland;

Fig. 2 is a partial cross-sectional view showing the packing of Fig. 1 after a partial tightening of the gland; and

Figs. 3 and 4 are each partial cross-sectional views of other packings according to the present invention shown prior to tightening of the gland.

Detailed description of the invention

With reference now to the drawings, Figs. 1 and 2, show a preferred embodiment of the present invention, for use as an emissionless valve stem packing in the petrochemical industry. It should be noted that the degree of radial movement required of the packing in Figs. 1 and 2 to provide effective sealing, has been exaggerated in the drawing.

Figs. 1 and 2 show a preferred packing 10 according to the present invention, for use in a stuffing box 12 for sealing a stem 14 of a valve (not shown) controlling fluid flow through a conduit (not shown). Fig. 1 also shows a portion of a packing gland 16, which when tightened will move downwardly as shown in Fig. 2 so as to compress the packing 10. The operation of such valve and stuffing boxes are well-known and need not be described in detail here.

Referring to Fig. 1 the packing 10 comprises the following elements, from top to bottom (the term "top to bottom" is hereby defined to mean from outside to inside) of the packing: a first rigid, impervious spacer ring 18, a first sealing assembly 20, a second rigid, impervious spacer ring 22, a second sealing assembly 24, a third rigid, impervious spacer ring 26, and three compressible packing rings 28.

The first sealing assembly 20 provides an O.D. seal and the second sealing assembly 24 provides an I.D. seal, when the gland 16 is tightened. Each of the sealing assemblies 20 and 24 preferably includes a low density, flexible graphite ring which re-forms during packing installation (tightening of the packing gland 16) to provide one of the O.D. and I.D. seals. When the gland 16 is tightened, the low density material is deformed against the stuffing box or the stem as will be described below.

The first sealing assembly 20 comprises a low density graphite preform ring 30 and a higher density graphite die-formed adapter ring 32. The preform preferably has a density of

about 0.7 g/cm³ and the adapter preferably has a density of about 1.4 g/cm³. The rings 30 and 32 are adjacent to each other and have facing surfaces 34 and 36, respectively. Both surfaces 34 and 36 are at an acute angle to the longitudinal axis 38 of the packing 10, in the axially inner direction. The angle of the surface 34 is preferably about 45° and the angle of the surface 36 is preferably about 60°. The densities and angles will be discussed further below regarding the tightening of the gland 16 to further compress the preform as shown in Fig. 2.

The second sealing assembly 24 is very similar to the sealing assembly 20 except for the direction of the angles of the facing surfaces 40 and 42. The sealing assembly 24 comprises a low density graphite preform ring 44 and a higher density graphite adapter ring 46. The preform ring 44 has a density of about 0.7 g/cm³ and the adapter ring 46 has a density of about 1.4 g/cm³. The facing surfaces 40 and 42 of the rings 44 and 46, respectively, are each at an acute angle to the longitudinal axis 38 of the packing 10, in the axially outer direction. The angle of surface 40 is preferably about 45° and the angle of the surface 42 is preferably about 60°.

The spacer rings 18, 22, and 26 are preferably flat, rigid, impervious, and all identical and are preferably made of a filled polytetrafluoroethylene (such as that sold under the trademark GYLON by Garlock Inc) for applications below 232°C (450°F) and are preferably made of metal, such as aluminum, for applications above 232°C (450°F). These spacer rings (or washers) provide:

- (1) a pressure block for emission particulates diverting the leakage path toward the diametrical surfaces where the flexible graphite preform rings are most effective seals,
- (2) a load distribution surface so that uniform compression of the flexible graphite rings is assured, and
- (3) the aluminum being less noble than either graphite or the valve components will act as a sacrificial element to eliminate or reduce electrolytic action between the valve components and the graphite packing.

The spacer rings are preferably provided with a pair of radially opposed holes to facilitate removal.

The compressible packing rings 28 are preferably made of braided carbon fibers and serve as wipers to eliminate the tendency of any of the material from the preform or adapter rings to adhere to the stem or rod 14. The rings 28 are preferably a soft carbon fiber braided packing. Initially, due to the stress resulting from compression some graphite particles adhere to the stem when the valve is activated. The braided rings 28 act as wipers to strip the graphite particles from the stem and absorb

them into the braid, thus restricting leakage paths by filling voids in the braid. The fine graphite particles provide a self-lubrication extending the service life of the emissionless valve stem packing system.

Fig. 2 shows the packing 10 of Fig. 1 after the packing gland 16 has been at least partially tightened. As shown in Fig. 2, the low density preform rings 30 and 44 are forced to move, flow, or re-form into the remaining open area and to be further compressed to provide an impervious and effective O.D. seal 47 and an I.D. seal 49, respectively. Both Figs. 1 and 2 show portions of the packing assembly exaggeratedly spaced away from the stuffing box and stem in order to better illustrate the manner in which the preform rings 30 and 44 are forced to move and form I.D. and O.D. seals. In addition, Fig. 2 shows the packing 10 after it has been about half way compressed. When the packing 10 is fully compressed, the portions of the preforms 30 and 44 represented by the seals 47 and 49, respectively, will actually have moved further down (in Fig. 2) to and past the spacer rings 22 and 26, respectively. The preform rings 30 and 44, the adapter rings 32 and 46, and the braided rings 28 will actually be in contact with both the stem 14 and the stuffing box 12, as will be understood by those skilled in the art. Further, the distances between the spacer rings and the stuffing box and stem are not drawn to scale; the spacer rings would be dimensioned for use in this invention in the same way as they are used with known packings in the prior art.

Figs. 1 and 2 show the normally preferred arrangement wherein two sealing assemblies 20 and 24 are used, one for the outside diametrical leakage and one for the inside diametrical leakage. However, other arrangements can be used, such as a single preform for both leakage paths for use with smaller size packings (as shown in Fig. 4). Other arrangements can also be used with respect to the locations of the braided packing rings 28 (one other such arrangement is shown in Fig. 3).

At present, most prior art die-formed graphite stem seals are compressed to a density of between 1.3 and 1.8 g/cm³. Previously, if seals were made to less than 1.1 g/cm³, flexibility and integrity were sacrificed. The adapter rings 32 and 46 are die-formed to a predetermined density (normally from about 1.4 to 1.7 g/cm³). The preform rings 30 and 44 are flexible graphite rings of significantly lesser density (approximately 0.5 to 1.4 g/cm³). Upon compression (as shown in Fig. 2), the lower density preform rings are further compressed into the remaining open area providing impervious and effective seals.

The difference in angles between the high-density adapter rings and the low-density preform rings provides a predictable stress, causing material flow. Under low to moderate stress, the difference in angle will provide com-

pression of the preform toward the designed sealing surface. Further compression will compress the flexible graphite in the preform ring to a previously calculated sealing density. The initial material flow will fill the gap caused by design, wear, stem refurbishment, and gland distortion.

It will thus be seen that the packing 10 of the present invention includes a low density preform ring that is compressible and re-formable, and means, when axial compressive force is applied to the packing, for forcing the material adjacent one radial edge of one end of the preform ring, to move axially and to move radially in the direction away from the preform ring, and for further compressing the material that has moved or is moving into an impervious and effective seal. The material adjacent the radially outer edge of preform ring 30 moves radially outwardly to form an O.D. seal and the material adjacent the radially inner edge of preform ring 44 moves radially inwardly to form an I.D. seal.

Fig. 3 shows a preferred packing 50 (in its condition prior to tightening the packing gland) for use in a stuffing box as shown in Fig. 1.

The packing 50 is identical to the packing 10 with a few exceptions; the identical elements have the same reference numerals as in Figs. 1 and 2. The packing 50 includes certain elements in addition to those in the packing 10 of Fig. 1, namely, a braided packing ring 52 on top of the first rigid, impervious spacer ring 18 and a braided packing ring 54 (plus another spacer ring 56) between the two sealing assemblies 20 and 24. When the packing gland is tightened, the two low density preforms 30 and 44 undergo a controlled material flow as shown in Fig. 2.

Fig. 4 shows a packing 60 (in its condition prior to tightening the packing gland) for use in a stuffing box as shown in Fig. 1. The packing 60 is especially useful in applications requiring a smaller size packing. The packing 60 includes in order from top to bottom: a first braided packing ring 62, a first rigid impervious spacer ring 64, a sealing assembly 66, a second rigid, impervious spacer ring 68, and a second braided packing ring 70. The sealing assembly 66 includes a first adapter 72, a preform 74, and a second adapter 76. The first adapter 72 and the upper (axially outer) end of the preform 74 have facing surfaces 78 and 80, at an acute angle to the longitudinal axis of the packing, in the axially outer direction. The angle of the surface 78 is preferably about 60° and the angle of the surface 80 is preferably about 45°. The second adapter 76 and the bottom end of the preform 74 having facing surfaces 82 and 84, at an acute angle to the longitudinal axis of the packing, also in the axially outer direction. The angle of the surface 82 is preferably about 45° and the angle of the surface 84 is preferably about 60°.

By tightening the packing gland of the stuffing box in which the packing 60 is installed,

the preform 74 is further compressed and its upper and lower ends re-form to provide O.D. and I.D. seals respectively, similar to those shown in Fig. 2.

The seal 50 shown in Fig. 3 underwent an extensive (50,000 cycle) stem cycling test conducted at moderate pressure using a 20.3 cm (8") globe valve. The test was to evaluate the durability and sealing effectiveness of the packing of the present invention against a liquid petroleum medium (kerosene) and a short hydrocarbon vapor (propane) test to assess packing sealability after extensive stem cycling. The packing system of the present invention demonstrated low (<25 ppm) hydrocarbon emission rates for kerosene at 3,102.3 KNm⁻² (450 psig) pressure until approximately 35,000 stem cycles, when visible kerosene leakage was observed. A single readjustment of the gland flange bolting torque to its initial level of 67.75 Nm (50 ft-lb) effectively curtailed the leakage and enabled completion of the 50,000 cycle test with continued low emissions. A subsequent propane emission test resulted in a relatively low (<60 ppm) vapor leakage over a limited number of stem strokes. Stem stroke was a vertical reciprocating motion through the valve stuffing box of 12.7(5") cm with no rotation about the stem axis. The emissionless packing system used braided carbon fiber packing, for the rings 52, 54 and 28, graphitic tape-wound rings for the adapter and preform rings 30, 32, 44, and 46 and aluminum spacers. Nominal packing dimensions were 5.72 cm x 3.81 cm x 8.89 cm (2 1/4" x 1 1/2" x 3 1/2"). Minimum gland pressure required to effect a seal was employed at startup and throughout the test. The fully assembled valve was operated during normal day shift working hours only (7:30—16:00). The valve assembly was visually inspected for general operability and leakage at least three times per day. Gland flange bolting torque, initially set at 54.2 Nm (40 ft-lb) for the start of the kerosene test, was increased to 67.75 Nm (50 ft-lb) early into the cycling test to maintain adequate sealing. No increase in bolt torque above the 67.75 Nm (50 ft-lb) level was required for the remainder of the test. Upon completion of the test and inspection, it was seen that the packing had not yet been compressed to its maximum possible density (i.e. there was room for additional compression).

The invention has been described in detail with particular reference to the preferred embodiments thereof, but it will be understood that variations and modifications can be affected within the scope of the invention. For example, other densities and materials can be used for the preform and for the adapter. In fact, the adapter can be a rigid metal ring. The preform need not be graphite; other low density, compressible, re-formable sealing materials can be such as various plastics, urethane resins, composite rubber materials, etc. Other angles can also be used for the angles of the facings

surfaces of the preform and adapter rings, and in fact the one or both of the facing surfaces can be normal (90°) to the longitudinal axis of the packing. The graphite adapter and preform rings can be either tape wound (also known as spiral wrapped) or laminated (meaning "sandwiched" using flat layers of graphite). Other materials can also be used for the compressible packing rings in place of the braided carbon fiber packing, which is compatible with the graphite preform and adapter rings. For example, when using a plastic preform, a compressible packing compatible therewith would be used. These packing rings can be evenly located throughout the packing, or in a high pressure application additional ones can be added at the bottom. The term "stem" as used in the present specification and claims includes piston rods, valve stems, reciprocating and/or rotating shafts, etc. The preform can have uniform density or not, as long as the end thereof has a low density such that it will flow radially and axially into the open area and against and into contact with either the stem or stuffing box and will then compress into an impervious and effective seal. The higher density adapter ring is preferably positioned between the preform and the fluid under pressure. The term "packing installation" means during the period that packing gland is initially tightened. In addition, a separate adapter ring can be eliminated by using the spacer ring to do the job of the adapter ring in forcing the preform ring in the desired fashion. The spacer ring can be formed with its surface facing the preform ring at an angle of preferably 60°. In this case, the spacer ring would also be the "adapter ring".

The preform and adapter rings are preferably made from the same graphite tape having a density of about 1.1 g/cm³. The preform ring as made preferably has a density of about 0.7 g/cm³ and the adapter ring preferably has a density of about 1.4 g/cm³. The term "low density" with a reference to the preform ring is hereby defined to mean a density in the range of from about 0.5 to 1.4 g/cm³. The "higher density" adapter simply has a higher density than that of the preform, and when the adapter is made of graphite, is in the range of from about 1.4 to 1.7 g/cm³. Further, while the adapter is preferably always located toward the pressure, this is not essential and the preform can be located toward the pressure. The preferred packing according to the present invention employs at least one sealing assembly to form each of an I.D. and an O.D. seal, however, a packing can employ only one sealing assembly for either an I.D. or an O.D. seal, or several sealing assemblies all providing an I.D. seal or all providing an O.D. seal, if desired, and still obtain benefits from the present invention.

The low density preform rings of this invention, when formed of tape wound graphite, are preferably held together during formation,

handling, and installation by the use of a minimum amount of adhesive, preferably a rubber based adhesive, under the innermost and outermost plies. For laminated graphite preform rings, adhesive would preferably be used on every layer. Other means can be used for maintaining the structural integrity of the preform rings including, for example, mechanical means such as zinc staples.

Claims

1. A packing for a stuffing box comprising:

- (a) a low density preform ring (30;44;74) that is compressible and re-formable during packing installation to form a seal, said ring including means for maintaining the structural integrity thereof,
- (b) an adapter ring (32;46;72;76) having one end thereof adjacent one end of said preform ring, and adapted, when axial compressive force is applied to said packing, to force the material of said preform ring adjacent one radial edge of said one end thereof to move axially and radially in the direction away from said preform ring, and to further compress said material of said preform ring into an impervious and effective seal, and
- (c) said preform and adapter rings having facing surfaces each at an acute angle to the longitudinal axis of said packing,

characterised in that:

- (d) said preform ring (30;44;74) has a density in the range of from about .5 to 1.4 g/cm³,
- (e) said adapter ring (32;46;72;76) is made of a deformable, compression sealing material having a density in the range of from about 1.4 to 1.7 g/cm³, and
- (f) said angles of said preform and adapter ring facing surfaces are different and such that said one end of said preform ring is adapted for form an outer diameter seal (O.D. seal).

2. A packing as claimed in claim 1 modified in that said different angles of said preform and adapter ring facing surfaces are such that said one end of said preform ring is adapted to form an inner diameter seal (I.D. seal).

3. A packing as claimed in claim 1 or 2, having: outwardly of said preform ring (30)

- (a) a first compressible packing ring (52),
- (b) a first, rigid, flat, impervious spacer ring (18), and

inwardly of said adapter ring (32)

- (c) a second, rigid, flat, impervious spacer ring (22),
- (d) a second compressible packing ring (54),
- (e) a third, rigid, flat impervious spacer ring (56),
- (f) a second like preform ring (44),

- (g) a second like adapter ring (46) in relationship with said second preform ring, to form either an O.D. or an I.D. seal, corresponding to the relationship of said first-mentioned adapter ring (32) to said first-mentioned preform ring (30),
- (h) a fourth, rigid, flat, impervious spacer ring (26) and
- (i) a third compressible packing ring (28).

4. A packing as claimed in claim 1, 2 or 3, wherein said acute angles of said preform and adapter rings are approximately 45° and 60° respectively.

5. A packing as claimed in any preceding claim wherein the or each preform ring has a density of about 0.7 g/cm³.

6. A packing as claimed in any preceding claim wherein the or each adapter ring has a density of about 1.4 g/cm³.

7. A packing as claimed in any preceding claim wherein the or each preform ring is of graphite.

8. A packing as claimed in any preceding claim wherein the or each adapter ring is of graphite.

9. A packing as claimed in any preceding claim received in a stuffing box (12) having a stem (14) extending therethrough.

Patentansprüche

1. Packung für eine Stopfbuchse, bestehend aus

- (a) einem Knetmassenring (30;44;74) von niedriger Dichte, der während der Packungsmontage zur Bildung einer Dichtung zusammendrückbar sowie umformbar ist und Mittel zur Aufrechterhaltung seiner strukturellen Unversehrtheit aufweist,
- (b) einem Formring (32;46;72;76), der mit einer seiner Stirnseiten neben einer Stirnseite des Knetmassenringes liegt und bei Ausübung einer axialen Druckkraft auf die Packung zur Verlagerung des Materiales des Knetmassenringes im Bereich eines radialen Randes seiner einen Stirnseite in vom Knetmassenring wegweisender Axial—sowie Radialrichtung und weiters zum Zusammendrücken des Materiales des Knetmassenringes zu einer undurchlässigen und wirksamen Dichtung ausgebildet ist, wobei
- (c) der Knetmassen- und der Formring einander zugekehrte Flächen aufweisen, die jeweils unter einem spitzen Winkel bezüglich der Packungslängsachse verlaufen, dadurch gekennzeichnet, daß
- (d) der Knetmassenring (30;44;74) eine Dichte im Bereich von etwa 0,5 bis 1,4 g/cm³ aufweist,
- (e) der Formring (32;46;72;76) aus einem verformbaren Druckdichtungsmaterial von einer Dichte im Bereich von etwa 1,4 bis 1,7 g/cm³ besteht und

(16)

handling, and installation by the use of a minimum amount of adhesive, preferably a rubber based adhesive, under the innermost and outermost plies. For laminated graphite preform rings, adhesive would preferably be used on every layer. Other means can be used for maintaining the structural integrity of the preform rings including, for example, mechanical means such as zinc staples.

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- (c) said preform and adapter rings having facing surfaces each at an acute angle to the longitudinal axis of said packing,

characterised in that:

- (d) said preform ring (30;44;74) has a density in the range of from about .5 to 1.4 g/cm³,
- (e) said adapter ring (32;46;72;76) is made of a deformable, compression sealing material having a density in the range of from about 1.4 to 1.7 g/cm³, and
- (f) said angles of said preform and adapter ring facing surfaces are different and such that said one end of said preform ring is adapted for form an outer diameter seal (O.D. seal).

2. A packing as claimed in claim 1 modified in that said different angles of said preform and adapter ring facing surfaces are such that said one end of said preform ring is adapted to form an inner diameter seal (I.D. seal).

3. A packing as claimed in claim 1 or 2, having: outwardly of said preform ring (30)

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- (c) a second, rigid, flat, impervious spacer ring (22),
- (d) a second compressible packing ring (54),
- (e) a third, rigid, flat impervious spacer ring (56),
- (f) a second like preform ring (44),

- (g) a second like adapter ring (46) in relationship with said second preform ring, to form either an O.D. or an I.D. seal, corresponding to the relationship of said first-mentioned adapter ring (32) to said first-mentioned preform ring (30),
- (h) a fourth, rigid, flat, impervious spacer ring (26) and
- (i) a third compressible packing ring (28).

4. A packing as claimed in claim 1, 2 or 3, wherein said acute angles of said preform and adapter rings are approximately 45° and 60° respectively.

5. A packing as claimed in any preceding claim wherein the or each preform ring has a density of about 0.7 g/cm³.

6. A packing as claimed in any preceding claim wherein the or each adapter ring has a density of about 1.4 g/cm³.

7. A packing as claimed in any preceding claim wherein the or each preform ring is of graphite.

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Patentansprüche

1. Packung für eine Stopfbuchse, bestehend aus

- (a) einem Knetmassenring (30;44;74) von niedriger Dichte, der während der Packungsmontage zur Bildung einer Dichtung zusammendrückbar sowie umformbar ist und Mittel zur Aufrechterhaltung seiner strukturellen Unversehrtheit aufweist,
- (b) einem Formring (32;46;72;76), der mit einer seiner Stirnseiten neben einer Stirnseite des Knetmassenringes liegt und bei Ausübung einer axialen Druckkraft auf die Packung zur Verlagerung des Materiales des Knetmassenringes im Bereich eines radialen Randes seiner einen Stirnseite in vom Knetmassenring wegweisender Axial—sowie Radialrichtung und weiters zum Zusammendrücken des Materiales des Knetmassenringes zu einer undurchlässigen und wirksamen Dichtung ausgebildet ist, wobei
- (c) der Knetmassen- und der Formring einander zugekehrte Flächen aufweisen, die jeweils unter einem spitzen Winkel bezüglich der Packungslängsachse verlaufen, dadurch gekennzeichnet, daß
- (d) der Knetmassenring (30;44;74) eine Dichte im Bereich von etwa 0,5 bis 1,4 g/cm³ aufweist,
- (e) der Formring (32;46;72;76) aus einem verformbaren Druckdichtungsmaterial von einer Dichte im Bereich von etwa 1,4 bis 1,7 g/cm³ besteht und



(f) die Winkel der einander zugekehrten Flächen des Knetmassen- und des Formringes unterschiedlich und derart bemessen sind, daß die eine Stirnseite des Knetmassenringes eine Dichtung am Packungsaußendurchmesser (A.D.-Dichtung) bildet.

2. Packung nach Anspruch 1, dadurch gekennzeichnet, daß die Packung derart abgewandelt ist, daß die unterschiedlichen Winkel der einander zugekehrten Flächen des Knetmassen- und des Formringes derart bemessen sind, daß die eine Stirnseite des Knetmassenringes eine Dichtung am Packungsinwenddurchmesser (I.D.-Dichtung) bildet.

3. Packung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß an der Außenseite des Knetmassenringes (30)

- (a) ein erster zusammendrückbarer Packungsring (52),
- (b) ein erster, starrer, flacher, undurchlässiger Zwischenring (18) und an der Innenseite des Formringes (32)
- (c) ein zweiter starrer, flacher, undurchlässiger Zwischenring (22),
- (d) ein zweiter zusammendrückbarer Packungsring (54),
- (e) ein dritter, starrer, flacher, undurchlässiger Zwischenring (56),
- (f) ein zweiter gleicher Knetmassenring (44),
- (g) ein diesen zweiten Knetmassenring zugeordneter zweiter gleicher Formring (46) zur Bildung entweder einer A.D.- oder einer I.D.-Dichtung entsprechend der Zuordnung des erstgenannten Formringes (32) zum erstgenannten Knetmassenring (30),
- (h) ein vierter starrer, flacher, undurchlässiger Zwischenring (26) und
- (i) ein dritter zusammendrückbarer Packungsring (28) vorgesehen sind.

4. Packung nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die spitzen Winkel des Knetmassen- und des Formringes annähernd 45° bzw. 60° betragen.

5. Packung nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß der bzw. jeder Knetmassenring eine Dichte von etwa $0,7 \text{ g/cm}^3$ hat.

6. Packung nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß der bzw. jeder Formring eine Dichte von etwa $1,4 \text{ g/cm}^3$ hat.

7. Packung nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß der bzw. jeder Knetmassenring aus Graphit besteht.

8. Packung nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß der bzw. jeder Formring aus Graphit besteht.

9. Packung nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß sie in eine Stopfbuchse (12) eingesetzt ist, durch die sich eine Stange (14) erstreckt.

Revendications

1. Garniture pour presse-étoupe comprenant:

- (a) un anneau préformé (30;44;74) de faible densité qui est compressible et remodelable pendant l'installation de la garniture de manière à constituer une étanchéité, cet anneau comportant des moyens de maintien de son intégrité structurelle,
- (b) un anneau d'adaptation (32;46; 72;76) dont une extrémité est adjacente à une extrémité de l'anneau préformé et qui peut, lorsqu'une force de compression axiale est appliquée à la garniture, forcer la matière de l'anneau préformé, adjacente à un bord radial de sa dite extrémité à se déplacer axialement et radialement dans la direction d'éloignement de l'anneau préformé, et comprimer davantage cette matière de l'anneau préformé, en une étanchéité imperméable et effective, et
- (c) les anneaux préformés et d'adaptation comportant des surfaces en vis-à-vis inclinées chacune suivant un angle aigu par rapport à l'axe longitudinal de la garniture, caractérisée en ce que:
- (d) l'anneau préformé (30,44,74) a une densité comprise dans la plage de $0,5$ à $1,4 \text{ g/cm}^3$ environ, et
- (e) l'anneau d'adaptation (32;46;72;76) est réalisé en une matière déformable d'étanchéité par compression ayant une densité comprise dans la plage de $1,4$ à $1,7 \text{ g/cm}^3$ environ, et
- (f) les angles des surfaces en vis-à-vis des anneaux préformés et d'adaptation sont différents et tels que la dite extrémité de l'anneau préformé est propre à constituer une étanchéité de diamètre extérieur.

2. Garniture suivant la revendication 1, modifiée en ce que les dits angles différents des surfaces en vis-à-vis de l'anneau préformé et de l'anneau d'adaptation sont tels que la dite extrémité de l'anneau préformé est propre à constituer une étanchéité de diamètre intérieur.

3. Garniture suivant la revendication 1 ou 2, comprenant, vers l'extérieur de l'anneau préformé (30)

- (a) un premier anneau de garniture compressible (52),
- (b) un premier anneau d'espacement (18) rigide, plat et imperméable, et vers l'intérieur de l'anneau d'adaptation (32)
- (c) un deuxième anneau d'espacement (22) rigide, plat et imperméable,
- (d) un deuxième anneau de garniture compressible (54),
- (e) un troisième anneau d'espacement (56) rigide, plat et imperméable,
- (f) un deuxième anneau préformé semblable (44),
- (g) un deuxième anneau d'adaptation semblable



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(46) associé au deuxième anneau préformé, pour constituer une étanchéité de diamètre extérieur ou une étanchéité de diamètre intérieur, correspondant à l'association de l'anneau d'adaptation (32) cité en premier avec l'anneau préformé (30) cité en premier, (h) un quatrième anneau d'espacement (26) rigide, plat et impénétrable, et (i) un troisième anneau de garniture compressible (28).

4. Garniture suivant la revendication 1, 2 ou 3, dans laquelle les angles aigus des anneaux préformés et d'adaptation sont approximativement de 45° et 60° respectivement.

5. Garniture suivant l'une quelconque des revendications précédentes, dans laquelle l'anneau préformé, ou chaque anneau préformé, a une densité de l'ordre de 0,7 g/cm³.

6. Garniture suivant l'une quelconque des revendications précédentes, dans laquelle l'anneau d'adaptation, ou chaque anneau d'adaptation, a une densité de l'ordre de 1,4 g/cm³.

7. Garniture suivant l'une quelconque des revendications précédentes, dans laquelle l'anneau préformé, ou chaque anneau préformé, est en graphite.

8. Garniture suivant l'une quelconque des revendications précédentes, dans laquelle l'anneau d'adaptation, ou chaque anneau d'adaptation, est en graphite.

9. Garniture suivant l'une quelconque des revendications précédentes, logée dans une boîte de presse-étoupe (12) à travers laquelle passe une tige (14).

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