

Description

The present invention relates to mechanical face seals.

FR-E 57 100 discloses a seal in which an intermediate seal face member rotatably engages sealing faces of a first seal face member which is mounted in fixed axial and rotational relationship with a first component and a second seal face member which is mounted in fixed rotational relationship with a second component, the second seal face member being movable axially and being urged towards the first seal face member to maintain sealing engagement between the third seal face member and the first and second seal face members. DE-A 2 017 809 discloses a double seal in which each seal assembly comprises a first seal face member mounted in fixed axial and rotational relationship with respect to one of a pair of relatively rotatable components and a second seal face member mounted in fixed rotational relationship but movable axially of a second component. The first seal face members of the two seal assemblies are however mounted with respect to different components and the sealing faces are radial.

According to one aspect of the present invention a mechanical face seal for providing a fluid tight seal between a pair of relatively rotatable components includes a pair of coaxial seal assemblies, each seal assembly comprises; a first annular seal face member mounted in fixed rotational relationship and sealed with respect to one of said components; and second annular seal face member mounted in fixed rotational relationship and sealed with respect to said other of said components, said second seal face member being moveable axially with respect to the two components; said first and second seal face members having oppositely inclined sealing faces, a third annular seal face member disposed between and free to rotate relative to the first and second seal face members; and spring means associated with the second seal face member to urge it axially towards the first seal face member, so as to maintain opposed sealing faces of the third seal face member in sealing engagement with sealing faces of the first and second seal face members respectively, characterised in that a first seal face assembly is mounted on one component and defines a pair of radially spaced sealing faces, said sealing faces being inclined to the axis of the first seal face assembly and a pair of annular second seal face members are mounted in radially spaced relationship on the other component, said second seal face members being fixed rotationally but movable independently axially of said other component.

The inclined sealing faces of the first and second seal face members will thus exert radial forces on the third seal face members, which will centralise the third seal face members and provide radial stability. Preferably the inclined sealing faces of the first seal face members will be oppositely inclined.

The inner and outer first seal face members may be defined by a single annular component. However, each pair of second seal face members and each pair of third seal face members are defined by separate annular components. Separate spring

means may be provided to urge each of the second seal face members towards the opposed sealing faces of the first seal face members.

With the double seal assembly disclosed above, a chamber is defined between the pair of the third seal face members, one or more passages passing between the concentric sealing faces of the first or second seal face members may be provided to this chamber, so that fluid leaking past the sealing faces may be drained from the chamber, or fluid may be introduced into the chamber to provide a barrier and/or for lubricating and/or cooling purposes.

The invention is now described, by way of example only, with reference to the accompanying drawing, which shows in sectional elevation a mechanical face seal formed in accordance with the present invention.

In the double seal illustrated, a first annular seal face assembly or seat 112, is bolted to a radially extending flange 113 on the shaft 111, by means of a plurality of angularly spaced bolts 114. The seat 112 is sealed to the flange 113 by means of an elastomeric O-ring 115 or by other conventional methods. The seat 112 defines a pair of oppositely inclined frustoconical sealing faces 116 and 117.

A tubular support member 120 is bolted to the housing 110 by means of a plurality of angularly spaced bolts 121 passing through a flange portion 122, so that the tubular portion of support member 120 extends coaxially of the shaft 111 towards the seat 112. The flange portion 122 of support member 120 is sealed with respect to the housing 110, by means of an elastomeric O-ring 123. A pair of coaxial sealing rings 124 and 125 are slidably mounted on the internal and external surfaces respectively, of the tubular portion of support member 120. The rings 124 and 125 are sealed with respect to the support member 120 by means of elastomeric O-rings 126. Keys 127 mounted on the support member 120 engage in axially extending key-ways 128 in the sealing rings 124 and 125, so as to permit axial but prevent rotational movement of the rings 124 and 125 relative to the support member 120.

A plurality of angularly spaced axially extending grooves 130 and 131 of part circular cross section, are provided in the outer surface of ring 124 and the inner surface of ring 125, so that when aligned, the grooves 130 and 131 will provide locations for a plurality of helical compression springs 132. The grooves 130 and 131 open to the surface of the rings 124 and 125 that engage the support member 120 and are closed at their other end, so that the springs 132 may act between the end of support member 120 and the closed end of the grooves 130 and 131, to urge the rings 124 and 125 axially towards the seat 112. Alternate grooves 130 in ring 124 and alternate grooves 131 in ring 125 are of increased length relative to the intermediate grooves, and the shorter grooves 130 on ring 124 are aligned with the longer grooves 131 on ring 125, so that adjacent springs 132 will act between the support member 120 and either the end of groove 130 in ring 124 or the end of groove 131 in ring 125. In this manner, rings 124 and 125 will be independently loaded towards the seat 112. Oppositely inclined frustoconical sealing faces

135 and 136 are provided on the ends of rings 124 and 125 respectively, sealing face 135 being axially aligned and of opposite inclination to the sealing face 116 on seat 112, and sealing face 136 being axially aligned and of opposite inclination to sealing face 117 on seat 112.

A pair of third seal face members 140 and 141 are positioned between the sealing faces of seat 112 and rings 124 and 125, seal face member 140 having a pair of frustoconical sealing faces 142 and 143 corresponding to and engaging sealing face 116 of seat 112 and sealing face 135 of ring 124, respectively. Similarly the seal face member 141 has a pair of frustoconical sealing faces 144 and 145 corresponding to and engaging sealing face 117 of seat 112 and sealing face 136 of ring 125, respectively. The sealing faces 116 and 142, 143 and 135, 117 and 144, and 145 and 136 are maintained in sealing engagement by means of the axial force exerted by springs 132. The frustoconical surfaces 116 and 135, and 117 and 136 also exert radial loads on the seal face members 140 and 141 respectively to centre these with respect to said frustoconical surfaces.

In the seal arrangement described above, the third seal face members 140 and 141 float between the seat 112 and rings 124 and 125 of the second seal face assembly and are not constrained rotationally with respect to either the shaft 111 or housing 110, thus avoiding the excessive wear when one pair of faces is subjected to high friction running conditions.

An annular chamber 150 is defined between the seal face members 140 and 141. One or more passages 151 may be provided through the tubular portion of support member 120 and through the housing 110, to communicate with this chamber 150. Where, for example, the seal is to be used to separate one service on the outside of ring 125 and member 141 from another service on the inside of ring 124 and member 140, the passage 151 may serve to remove any fluid which leaks past sealing faces 116 and 142, 143 and 135, 117 and 144 or 145 and 136, so that the fluid in one service will not be contaminated by the fluid in the other service, even if some leakage does occur across the sealing faces. Alternatively, if for example the seal is to be used to seal a potentially hazardous gas or vapour from atmosphere, the chamber 150 may be filled with a barrier liquid, which will also serve to lubricate and cool the sealing faces.

The materials used to produce the members 112, 124, 125, 140 and 141 may be selected for their wear properties or may be provided with wear inserts. For example the third seal face members 140, 141 may constitute wear elements and would be made of a softer material than the seat 112 and second seal face members 124, 125. With such a seal, the third seal face members 140, 141 would typically be made from graphite, carbon or plastics material while the seat 112 and second seal face members 124, 125 are made from metal or a sintered refractory material, for example alumina. The third seal face members 140, 141 may however be made of a similar or harder material than the seat 112 and second seal face members 124, 125. Alternatively wear inserts may be

provided on the seat 112 to define sealing faces 116, 117 and/or members 124, 125 to define sealing faces 135, 136. The various annular members may be of split configuration to facilitate removal and replacement and the sealing faces may be of semi-spherical rather than frustoconical configuration.

Various modifications may be made, without departing from the present invention. For example the seat 112 may be mounted with respect to the housing 110 and the members 124 and 125 mounted with respect to the shaft 111. Moreover the member 112 may also be moveable axially with respect to the components.

Furthermore, the sealing faces 116 and 117 of the seat 112 may be formed on separate rings. While in the embodiment illustrated rings 124 and 125 are of similar configuration, the configuration of these rings may be varied to adjust their pressure balance and hence the effect of the pressure of fluid on the inner and outer seals, so that differential loading of the inner and outer seal face members may be achieved or to compensate for pressure differentials across the seal. Also the spring rates of the springs 132 acting on the rings 124 and 125 may differ to vary the axial loads applied to the inner and outer seal face members 140 and 141.

An emergency sealing face may be provided on the second seal face member 124 or 125 so that when wear of the third seal face member 140, 141 reaches a certain limit or the third seal face member 140, 141 collapses, for example as a result of accidental damage, the emergency sealing face 26 will engage the seat 112 to provide an emergency seal.

Claims

1. A mechanical face seal for providing a fluid tight seal between a pair of relatively rotatable components includes a pair of coaxial seal assemblies (112, 140, 124, 132; 112, 141, 125, 130) each seal assembly comprising; a first annular seal face member (112) mounted in fixed rotational relationship and sealed with respect to one of said components (110, 111); a second annular seal face member (124, 125) mounted in fixed rotational relationship and sealed with respect to said other of said components (110, 111), said second seal face member (124, 125) being moveable axially with respect to the two components, (110, 111); said first and second seal face members (112, 124, 125) having oppositely inclined sealing faces (116, 135, 117, 136), a third annular seal face member (140, 141) disposed between and free to rotate relative to the first and second seal face members (112, 124, 125); and spring means (132) associated with the second seal face member (124, 125) to urge it axially towards the first seal face member (112), so as to maintain opposed sealing faces (142, 143, 144, 145) of the third seal face member (140, 141) in sealing engagement with sealing faces (116, 117, 135, 136) of the first and second seal face members (112, 124, 125) respectively, characterised in that a first seal face assembly (112) is mounted on one component (111) and defines a pair of radially spaced sealing faces (116, 117), said seal-

135 and 136 are provided on the ends of rings 124 and 125 respectively, sealing face 135 being axially aligned and of opposite inclination to the sealing face 116 on seat 112, and sealing face 136 being axially aligned and of opposite inclination to sealing face 117 on seat 112.

A pair of third seal face members 140 and 141 are positioned between the sealing faces of seat 112 and rings 124 and 125, seal face member 140 having a pair of frustoconical sealing faces 142 and 143 corresponding to and engaging sealing face 116 of seat 112 and sealing face 135 of ring 124, respectively. Similarly the seal face member 141 has a pair of frustoconical sealing faces 144 and 145 corresponding to and engaging sealing face 117 of seat 112 and sealing face 136 of ring 125, respectively. The sealing faces 116 and 142, 143 and 135, 117 and 144, and 145 and 136 are maintained in sealing engagement by means of the axial force exerted by springs 132. The frustoconical surfaces 116 and 135, and 117 and 136 also exert radial loads on the seal face members 140 and 141 respectively to centre these with respect to said frustoconical surfaces.

In the seal arrangement described above, the third seal face members 140 and 141 float between the seat 112 and rings 124 and 125 of the second seal face assembly and are not constrained rotationally with respect to either the shaft 111 or housing 110, thus avoiding the excessive wear when one pair of faces is subjected to high friction running conditions.

An annular chamber 150 is defined between the seal face members 140 and 141. One or more passages 151 may be provided through the tubular portion of support member 120 and through the housing 110, to communicate with this chamber 150. Where, for example, the seal is to be used to separate one service on the outside of ring 125 and member 141 from another service on the inside of ring 124 and member 140, the passage 151 may serve to remove any fluid which leaks past sealing faces 116 and 142, 143 and 135, 117 and 144 or 145 and 136, so that the fluid in one service will not be contaminated by the fluid in the other service, even if some leakage does occur across the sealing faces. Alternatively, if for example the seal is to be used to seal a potentially hazardous gas or vapour from atmosphere, the chamber 150 may be filled with a barrier liquid, which will also serve to lubricate and cool the sealing faces.

The materials used to produce the members 112, 124, 125, 140 and 141 may be selected for their wear properties or may be provided with wear inserts. For example the third seal face members 140, 141 may constitute wear elements and would be made of a softer material than the seat 112 and second seal face members 124, 125. With such a seal, the third seal face members 140, 141 would typically be made from graphite, carbon or plastics material while the seat 112 and second seal face members 124, 125 are made from metal or a sintered refractory material, for example alumina. The third seal face members 140, 141 may however be made of a similar or harder material than the seat 112 and second seal face members 124, 125. Alternatively wear inserts may be

provided on the seat 112 to define sealing faces 116, 117 and/or members 124, 125 to define sealing faces 135, 136. The various annular members may be of split configuration to facilitate removal and replacement and the sealing faces may be of semi-spherical rather than frustoconical configuration.

Various modifications may be made, without departing from the present invention. For example the seat 112 may be mounted with respect to the housing 110 and the members 124 and 125 mounted with respect to the shaft 111. Moreover the member 112 may also be moveable axially with respect to the components.

Furthermore, the sealing faces 116 and 117 of the seat 112 may be formed on separate rings. While in the embodiment illustrated rings 124 and 125 are of similar configuration, the configuration of these rings may be varied to adjust their pressure balance and hence the effect of the pressure of fluid on the inner and outer seals, so that differential loading of the inner and outer seal face members may be achieved or to compensate for pressure differentials across the seal. Also the spring rates of the springs 132 acting on the rings 124 and 125 may differ to vary the axial loads applied to the inner and outer seal face members 140 and 141.

An emergency sealing face may be provided on the second seal face member 124 or 125 so that when wear of the third seal face member 140, 141 reaches a certain limit or the third seal face member 140, 141 collapses, for example as a result of accidental damage, the emergency sealing face 26 will engage the seat 112 to provide an emergency seal.

Claims

1. A mechanical face seal for providing a fluid tight seal between a pair of relatively rotatable components includes a pair of coaxial seal assemblies (112, 140, 124, 132; 112, 141, 125, 130) each seal assembly comprising; a first annular seal face member (112) mounted in fixed rotational relationship and sealed with respect to one of said components (110, 111); a second annular seal face member (124, 125) mounted in fixed rotational relationship and sealed with respect to said other of said components (110, 111), said second seal face member (124, 125) being moveable axially with respect to the two components, (110, 111); said first and second seal face members (112, 124, 125) having oppositely inclined sealing faces (116, 135, 117, 136), a third annular seal face member (140, 141) disposed between and free to rotate relative to the first and second seal face members (112, 124, 125); and spring means (132) associated with the second seal face member (124, 125) to urge it axially towards the first seal face member (112), so as to maintain opposed sealing faces (142, 143, 144, 145) of the third seal face member (140, 141) in sealing engagement with sealing faces (116, 117, 135, 136) of the first and second seal face members (112, 124, 125) respectively, characterised in that a first seal face assembly (112) is mounted on one component (111) and defines a pair of radially spaced sealing faces (116, 117), said seal-





ing faces (116, 117) being inclined to the axis of the first seal face assembly (112) and a pair of annular second seal face members (124, 125) are mounted in radially spaced relationship on the other component (110), said second seal face members (124, 125) being fixed rotationally but movable independently axially of said other component (110).

2. A mechanical face seal according to Claim 1 characterised in that the sealing faces (116, 117) of the first seal face assembly (112) are oppositely inclined.

3. A mechanical face seal according to Claim 1 or 2 characterised in that the first seal face assembly (112) comprises a ring having a pair of inclined concentric annular sealing faces (116, 117).

4. A mechanical face seal according to any one of Claims 1 to 3 characterised in that the second seal face members (124, 125) are slidingly mounted and sealed with respect to the internal and external diameters of a tubular support member (120) mounted on said other component (110).

5. A mechanical face seal according to Claim 4 characterised in that keys (127) mounted on the tubular support member (120) engage in axially extending key-ways (128) in the second seal face members (124, 125) to prevent rotation of said seal face members (124, 125) relative to the support member (120) while permitting axial movement of the seal face members (124, 125).

6. A mechanical face seal according to Claim 4 or 5 characterised in that separate spring means (132) are provided to urge the second seal face members (124, 125) independently towards the first seal face assembly (112).

7. A mechanical face seal according to Claim 6 characterised in that a plurality of angularly spaced axially extending grooves (130, 131) are provided in the outer surface of the inner second seal face member (124) and the inner surface of the outer second seal face member (125), so that when aligned, the grooves (130, 131) will provide locations for a plurality of angularly spaced compression springs (132) which will act between the end of the tubular support member (120) and the closed end of the axially extending grooves (130, 131), to urge the second seal face members (124, 125) towards the first seal face assembly (112).

8. A mechanical face seal according to Claim 7 characterised in that alternate axially extending grooves (131) in the outer second seal face member (125) and alternate axially extending grooves (130) in the inner second seal face member (124) are of increased length relative to the intermediate grooves, the shorter grooves (131) on the outer second seal face member (125) being aligned with the longer grooves (130) on the inner second seal face member (124) so that adjacent springs (132) will act between the support member (120) and the end of the shorter groove (131) in the outer second seal face member (125) or the shorter groove (130) in the inner second seal face member (124).

9. A mechanical face seal according to any one of Claims 6 to 8 characterised in that the spring rate of the spring means (132) acting upon the inner and outer second seal face members (124, 125) differ.

10. A mechanical face seal according to any one of Claims 1 to 9 characterised in that the dimensions of the second seal face members (124, 125) differ, so that the pressure balance of the second seal face members differ (124, 125).

11. A mechanical face seal according to any one of Claims 1 to 10 characterised in that an annular chamber (150) is defined between the third seal face members (140, 141), a passage (151) being provided to said annular chamber between the sealing faces (116, 117 or 135, 136) of the first or second seal face members (112, 124, 125) by means of which fluid may be removed from or introduced into the annular chamber (150).

12. A mechanical face seal according to any one of the preceding claims characterised in that the or each third seal face member (140, 141) is made of material which is softer than the materials used to define the sealing faces of the first and second seal face members (112, 124, 125).

13. A mechanical face seal according to Claim 12 characterised in that the or each third seal face member (140, 141) is made from graphite, carbon or a plastics material and the first and second seal face members (112, 124, 125) are made from metal or a sintered refractory material.

14. A mechanical face seal according to any one of the preceding claims characterised in that the sealing faces (116, 117, 135, 136) of the first and second seal face members (112, 124, 125) are defined by replaceable inserts.

15. A mechanical face seal according to any one of the preceding claims characterised in that one or more of the annular members (112, 124, 125, 140, 141) are split axially into a plurality of arcuate portions.

16. A mechanical face seal according to any one of the preceding claims characterised in that the sealing faces (116, 117, 135, 136, 142, 143, 144, 145) of the seal face members (112, 124, 125, 140, 141) are of frustoconical configuration.

17. A mechanical face seal according to any one of Claims 1 to 15 in which the sealing faces (116, 117, 135, 136, 142, 143, 144, 145) of the seal face members (112, 124, 125, 140, 141) are of semi-spherical configuration.

18. A mechanical face seal according to any one of the preceding claims in which an emergency sealing face is provided on the second seal face member (124, 125) for engagement with the first seal face member (112) when wear on the third seal face member (140, 141) reaches a certain limit or the third seal face member (140, 141) collapses.

Patentansprüche

1. Mechanische Flächendichtung zum Schaffen einer fluiddichten Dichtung zwischen zwei relativ zueinander drehbaren Bauteilen, mit einem Paar koaxialer Dichtungsanordnungen (112, 140, 124, 132; 112, 141, 125, 130), wobei jede Dichtungsanordnung folgendes aufweist: ein erstes ringförmiges Dichtflächenteil (112), das drehfest und abgedichtet in bezug auf eines der Bauteile (110, 111) angeordnet ist, ein zweites ringförmiges Dichtflächenteil (124, 125), das drehfest und abgedichtet in bezug auf das an-



... Bauteil (110, 111) angeordnet ist, wobei das zweite Dichtflächenteil (124, 125) bezüglich der beiden Bauteile (110, 111) axial beweglich ist; wobei das erste und zweite Dichtflächenteil (112, 124, 125) entgegengesetzt geneigte Dichtflächen (116, 135, 117, 136) hat, wobei ein drittes ringförmiges Dichtflächenteil (140, 141) zwischen dem ersten und dem zweiten Dichtflächenteil (112, 124, 125) angeordnet ist und sich bezüglich des ersten und zweiten Dichtflächenteiles (112, 124, 125) frei drehen kann; und eine Federeinrichtung (132), die dem zweiten Dichtflächenteil (124, 125) zugeordnet ist, um es axial gegen das erste Dichtflächenteil (112) zu drängen, um entgegengesetzte Dichtflächen (142, 143, 144, 145) des dritten Dichtflächenteiles (140, 141) in Dichtungsanlage mit den Dichtflächen (116, 117, 135, 136) des ersten und zweiten Dichtflächenteiles (112, 124, 125) jeweils zu halten, dadurch gekennzeichnet, daß eine erste Dichtflächenanordnung (112) an einem Bauteil (111) angeordnet ist und ein Paar radialer, voneinander beabstandeter Dichtflächen (116, 117) bildet, wobei die Dichtflächen (116, 117) gegen die Achse der ersten Dichtflächenanordnung (112) geneigt ist, und ein Paar ringförmiger zweiter Dichtflächenteile (124, 125) im radialen gegenseitigen Abstand an dem anderen Bauteil (110) angeordnet sind, wobei die zweiten Dichtflächenteile (124, 125) drehfest aber in bezug auf das andere Bauteil (110) axial unabhängig beweglich sind.

2. Mechanische Flächendichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Dichtflächen (116, 117) der ersten Dichtflächenanordnung (112) entgegengesetzt geneigt sind.

3. Mechanische Flächendichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die erste Dichtflächenanordnung (112) einen Ring aufweist, der ein Paar geneigter konzentrischer ringförmiger Dichtflächen (116, 117) hat.

4. Mechanische Flächendichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die zweiten Dichtflächenteile (124, 125) bezüglich der inneren und äußeren Durchmesser eines an dem anderen Bauteil (110) angeordneten rohrförmigen Stütztes (120) verschiebbar angeordnet und abgedichtet sind.

5. Mechanische Flächendichtung nach Anspruch 4, dadurch gekennzeichnet, daß Keile (127), die an dem rohrförmigen Stützteil (120) angeordnet sind, in axial verlaufende Keilnuten (128) in den zweiten Dichtflächenteilen (124, 125) eingreifen, um eine Drehung der zweiten Dichtflächenteile (124, 125) relativ zu dem Stützteil (120) zu verhindern und gleichzeitig eine Axialbewegung der Dichtflächenteile (124, 125) zuzulassen.

6. Mechanische Flächendichtung nach Anspruch 4 oder 5, dadurch gekennzeichnet, daß voneinander getrennte Federeinrichtungen (132) vorgesehen sind, um die zweiten Dichtflächenteile (124, 125) unabhängig voneinander gegen die erste Dichtflächenanordnung (112) zu drängen.

7. Mechanische Flächendichtung nach Anspruch 6, dadurch gekennzeichnet, daß eine Vielzahl von winklig voneinander beabstandeten, axial verlaufenden Nuten (130, 131) in der äußeren Oberfläche des inneren zweiten Dichtflächenteiles (124) und

der inneren Oberfläche des äußeren zweiten Dichtflächenteiles (125) vorgesehen ist, so daß die Nuten (130, 131), wenn sie ausgerichtet sind, Sitze für eine Vielzahl von winklig voneinander beabstandeten Druckfedern (132) bilden, die zwischen den Enden des rohrförmigen Stütztes (120) und dem geschlossenen Ende der axial verlaufenden Nuten (130, 131) wirken, um die zweiten Dichtflächenteile (124, 125) gegen die erste Dichtflächenanordnung (112) zu drängen.

8. Mechanische Flächendichtung nach Anspruch 7, dadurch gekennzeichnet, daß sich abwechselnde axial verlaufende Nuten (131) in dem äußeren zweiten Dichtflächenteil (125) und sich abwechselnde axial verlaufende Nuten (130) in dem inneren zweiten Dichtflächenteil (124) eine größere Länge bezüglich der Zwischennuten haben, wobei die kürzeren Nuten (131) an dem äußeren zweiten Dichtflächenteil (125) zu den längeren Nuten (130) an dem inneren zweiten Dichtflächenteil (124) fluchtend ausgerichtet sind, so daß angrenzende Federn (132) zwischen dem Stützteil (120) und dem Ende der kürzeren Nut (131) in dem äußeren zweiten Dichtflächenteil (125) oder der kürzeren Nut (130) in dem inneren zweiten Dichtflächenteil (124) wirken.

9. Mechanische Flächendichtung nach einem der Ansprüche 6 bis 8, dadurch gekennzeichnet, daß die Federkonstanten der Federeinrichtung(en) (132), die auf das innere und das äußere Dichtflächenteil (124, 125) wirkt, sich voneinander unterscheiden.

10. Mechanische Flächendichtung nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, daß die Abmessungen der zweiten Dichtflächenteile (124, 125) sich voneinander unterscheiden, so daß sich die Druckgleichgewichte der zweiten Dichtflächenteile (124, 125) voneinander unterscheiden.

11. Mechanische Flächendichtung nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß eine ringförmige Kammer (150) zwischen den dritten Dichtflächenteilen (140, 141) gebildet ist, wobei ein Durchgang (151) zu der ringförmigen Kammer zwischen den Dichtflächen (116, 117 oder 135, 136) des ersten oder zweiten Dichtflächenteiles (112, 124, 125) geschaffen ist, durch den Fluid aus der ringförmigen Kammer (150) entfernt oder in die ringförmige Kammer (150) eingeführt werden kann.

12. Mechanische Flächendichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das oder jedes dritte Dichtflächenteil (140, 141) aus einem Material hergestellt ist, das welcher ist als die Materialien, die zum Bilden der Dichtflächen des ersten und zweiten Dichtflächenteiles (112, 124, 125) verwendet werden.

13. Mechanische Flächendichtung nach Anspruch 12, dadurch gekennzeichnet, daß das oder jedes dritte Dichtflächenteil (140, 141) aus Graphit, Kohlenstoff oder einem Kunststoff hergestellt ist und das erste und zweite Dichtflächenteil (112, 124, 125) aus Metall oder einem gesinterten feuerfesten Material hergestellt sind.

14. Mechanische Flächendichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Dichtflächen (116, 117, 135, 136) des ersten und zweiten Dichtflächenteiles (112, 124,



125) durch austauschbare Einsatzstücke gebildet sind.

15. Mechanische Flächendichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß eines oder mehrere der ringförmigen Teile (112, 124, 125, 140, 141) axial in eine Vielzahl von bogenförmigen Teilen gespalten sind.

16. Mechanische Flächendichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Dichtflächen (116, 117, 135, 136, 142, 143, 144, 145) der Dichtflächenteile (112, 124, 125, 140, 141) eine kegelförmige Gestalt haben.

17. Mechanische Flächendichtung nach einem der Ansprüche 1 bis 15, bei welcher die Dichtflächen (116, 117, 135, 136, 142, 143, 144, 145) der Dichtflächenteile (112, 124, 125, 140, 141) eine halbkugelförmige Gestalt haben.

18. Mechanische Flächendichtung nach einem der vorhergehenden Ansprüche, bei welcher eine Notdichtfläche an dem zweiten Dichtflächenteil (124, 125) zur Anlage mit dem ersten Dichtflächenteil (112) vorgesehen ist, wenn die Abnutzung an dem dritten Dichtflächenteil (140, 141) eine bestimmte Grenze erreicht oder das dritte Dichtflächenteil (140, 141) zusammenbricht.

Revendications

1. Garniture mécanique d'étanchéité de type frontal, permettant d'assurer un joint étanche aux fluides entre deux éléments rotatifs l'un par rapport à l'autre, cette garniture mécanique d'étanchéité de type frontal comprenant deux ensembles de garniture d'étanchéité (112, 140, 124, 132; 112, 141, 125, 130) coaxiaux dont chacun comprend une première pièce frontale annulaire d'étanchéité (112) montée d'une manière fixe en rotation, et de façon étanche, par rapport à l'un des éléments (110, 111), une deuxième pièce frontale annulaire d'étanchéité (124, 125) montée d'une manière fixe en rotation, et de façon étanche, par rapport à l'autre des éléments (110, 111), cette deuxième pièce frontale d'étanchéité (124, 125) étant mobile axialement par rapport aux deux éléments (110, 111), les première et deuxième pièces frontales d'étanchéité (112, 124, 125) comportant des faces d'étanchéité (116, 135, 117, 136) d'inclinaisons opposées, une troisième pièce frontale annulaire d'étanchéité (140, 141) disposée entre les première et deuxième pièces frontales d'étanchéité (112, 124, 125) et libre de tourner par rapport à celles-ci, et des moyens de sollicitation élastique (132) associés à la deuxième pièce frontale d'étanchéité (124, 125) de façon à la repousser élastiquement dans le sens axial vers la première pièce frontale d'étanchéité (112), de manière à maintenir des faces opposées d'étanchéité (142, 143, 144, 145) de la troisième pièce frontale d'étanchéité (140, 141) en contact d'étanchéité avec des faces d'étanchéité (116, 117, 135, 136) respectivement des première et deuxième pièces frontales d'étanchéité (112, 124, 125), caractérisée en ce qu'un premier ensemble de faces d'étanchéité (112) est monté sur un premier élément (111) et comporte deux faces d'étanchéité (116, 117) espacées dans le sens radial, ces faces d'étanchéité

(116, 117) étant inclinées par rapport à l'axe du premier ensemble de faces d'étanchéité (112), tandis que deux deuxième pièces frontales annulaires d'étanchéité (124, 125) sont montées sur l'autre élément (110) en étant espacées l'une de l'autre dans le sens radial, ces deuxième pièces frontales d'étanchéité (124, 125) étant fixes en rotation, mais mobiles d'une manière indépendante dans le sens axial, par rapport à l'autre élément (110).

2. Garniture mécanique d'étanchéité de type frontal suivant la revendication 1, caractérisée en ce que les faces d'étanchéité (116, 117) du premier ensemble de faces d'étanchéité (112) ont des inclinaisons opposées.

3. Garniture mécanique d'étanchéité de type frontal suivant la revendication 1 ou 2, caractérisée en ce que le premier ensemble de faces d'étanchéité (112) est constitué par une bague présentant deux faces annulaires d'étanchéité (116, 117) inclinées et coaxiales.

4. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications 1 à 3, caractérisée en ce que les deuxième pièces frontales d'étanchéité (124, 125) sont montées de manière coulissante, et de façon étanche, par rapport aux surfaces cylindriques intérieure et extérieure d'une pièce tubulaire de support (120) montée sur l'autre élément (110).

5. Garniture mécanique d'étanchéité de type frontal suivant la revendication 4, caractérisée en ce que des clavettes (127) montées sur la pièce tubulaire de support (120) s'engagent dans des rainures de clavette (128) s'étendant axialement dans les deuxième pièces frontales d'étanchéité (124, 125), de façon à empêcher une rotation de ces pièces frontales d'étanchéité (124, 125) par rapport à la pièce de support (120), tout en permettant un déplacement axial.

6. Garniture mécanique d'étanchéité de type frontal suivant la revendication 4 ou 5, caractérisée en ce que des moyens distincts de sollicitation élastique (132) sont prévus pour repousser élastiquement les deuxième pièces frontales d'étanchéité (124, 125) d'une manière indépendante en direction du premier ensemble de faces d'étanchéité (112).

7. Garniture mécanique d'étanchéité de type frontal suivant la revendication 6, caractérisée en ce que plusieurs rainures (130, 131) s'étendant axialement et réparties dans le sens circonférentiel sont prévues dans la surface extérieure de la deuxième pièce frontale d'étanchéité (124) située à l'intérieur et dans la surface intérieure de la deuxième pièce frontale d'étanchéité (125) située à l'extérieur, de sorte que, lorsqu'elles sont alignées, ces gorges (130, 131) constituent des emplacements pour plusieurs ressorts de compression (132), répartis dans le sens circonférentiel, qui agissent entre l'extrémité de la pièce tubulaire de support (120) et l'extrémité fermée des gorges (130, 131) s'étendant axialement, de façon à repousser élastiquement les deuxième pièces frontales d'étanchéité (124, 125) en direction du premier ensemble de faces d'étanchéité (112).

8. Garniture mécanique d'étanchéité de type frontal suivant la revendication 7, caractérisée en ce qu'une sur deux des gorges (131) s'étendant axiale-



ment dans la deuxième pièce frontale d'étanchéité (125) située à l'extérieur et une sur deux des gorges (130) s'étendant axialement dans la deuxième pièce frontale d'étanchéité (124) située à l'intérieur sont d'une longueur plus grande par rapport aux gorges intermédiaires, les gorges plus courtes (131) prévues sur la deuxième pièce frontale d'étanchéité (125) située à l'extérieur étant alignées avec les gorges plus longues (130) prévues sur la deuxième pièce frontale d'étanchéité (124) située à l'intérieur, de sorte que des ressorts adjacents (132) agissent entre la pièce de support (120) et l'extrémité de la gorge plus courte (131) de la deuxième pièce frontale d'étanchéité (125) située à l'extérieur ou de la gorge plus courte (130) de la deuxième pièce frontale d'étanchéité (124) située à l'intérieur.

9. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications 6 à 8, caractérisée en ce que les rigidités des moyens de sollicitation élastique (132) agissant sur les deuxièmes pièces frontales d'étanchéité (124, 125) situées à l'intérieur et à l'extérieur sont différentes.

10. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications 1 à 9, caractérisée en ce que les dimensions des deuxièmes pièces frontales d'étanchéité (124, 125) sont différentes, de sorte que l'équilibre de pression de ces deuxièmes pièces frontales d'étanchéité (124, 125) est différent.

11. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications 1 à 10, caractérisée en ce qu'une chambre annulaire (150) est définie entre les troisièmes pièces frontales d'étanchéité (140, 141), un passage (151) étant prévu, de façon à parvenir dans cette chambre annulaire, entre les faces d'étanchéité (116, 117 ou 135, 136) des premières ou des deuxièmes pièces frontales d'étanchéité (112, 124, 125), un fluide pouvant être extrait de la chambre annulaire (150), ou y être introduit, à l'aide de ce passage (151).

12. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications précédentes, caractérisée en ce que la ou chaque troisième pièce frontale d'étanchéité (140, 141) est réalisée en une matière qui est plus tendre que les matières utilisées pour constituer les faces d'étanchéité des premières et des secondes pièces frontales d'étanchéité (112, 124, 125).

13. Garniture mécanique d'étanchéité de type frontal suivant la revendication 12, caractérisée en ce que la ou chaque troisième pièce frontale d'étanchéité (140, 141) est réalisée en graphite, carbone ou matière plastique et en ce que les premières et les secondes pièces frontales d'étanchéité (112, 124, 125) sont réalisées en un métal ou en une matière réfractaire frittée.

14. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications précédentes, caractérisée en ce que les faces d'étanchéité (116, 117, 135, 136) des premières et des secondes pièces frontales d'étanchéité (112, 124, 125) sont présentées par des pièces rapportées remplaçables.

15. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendica-

tions précédentes, caractérisée en ce qu'une ou plusieurs des pièces annulaires (112, 124, 125, 140, 141) sont divisées axialement en plusieurs parties en forme de secteurs cylindriques.

16. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications précédentes, caractérisée en ce que les faces d'étanchéité (116, 117, 135, 136, 142, 143, 144, 145) et les pièces frontales d'étanchéité (112, 124, 125, 140, 141) ont une forme tronconique.

17. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications 1 à 15, dans laquelle les faces d'étanchéité (116, 117, 135, 136, 142, 143, 144, 145) des pièces frontales d'étanchéité (112, 124, 125, 140, 141) ont une forme de demi-tore.

18. Garniture mécanique d'étanchéité de type frontal suivant l'une quelconque des revendications précédentes, dans laquelle une face d'étanchéité de secours est prévue sur la deuxième pièce frontale d'étanchéité (124, 125) pour venir au contact de la première pièce frontale d'étanchéité (112) lorsque l'usure sur la troisième pièce frontale d'étanchéité (140, 141) atteint une certaine limite ou lorsque cette troisième pièce frontale d'étanchéité (140, 141) s'écrase sur elle-même.

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