CLAIMS:

1. A mechanical seal device which seals a rotary shaft inserted in a processing equipment where to perform processing under a sterile condition and which is provided between the inside of the processing equipment and the outer atmosphere, the device comprising:

rotary shaft-side seal surfaces disposed at least at two places apart from each other in an axial direction of the rotary shaft and each provided along a plane with the radial direction of the rotary shaft to extend along a whole circumference of the rotary shaft;

casing-side seal surfaces which are provided along an inner circumference of a casing disposed to cover a periphery of the rotary shaft, and seal with the rotary shaft-side seal surfaces;

a biasing means provided for at least one of pairs of the rotary shaft-side seal surfaces and the casing-side seal surfaces and biased so as to press one of the seal surfaces against the other seal surface, to make a space between the casing and the rotary shaft airtight;

a sealing fluid supply port provided in the casing to let a sealing fluid supplied to a space that is between the rotary shaft and the casing and is between one pair and another pair of the rotary shaft-side seal surfaces and the casing-side seal surfaces and to let the sealing fluid flow in gaps between the rotary shaft-side seal surfaces and the casing-side seal surfaces;

a sterilizing gas supply port provided in the casing to let sterilizing gas supplied to the space between the one pair and the other pair of the seal surfaces and to let the gas flow in the gaps between the rotary shaft-side seal surfaces and the casing-side seal surfaces;

a sealing member which includes: a surrounding member surrounding a space that communicates with the gap between the seal surfaces of the pair located on a most downstream side in a flow direction of the sealing fluid out of the pairs of the rotary shaft-side seal surfaces and the casing-side seal surfaces and that is located on a downstream side of the gap in the flow direction of the sealing fluid; and a seal member sealing a gap between the surrounding member and the rotary shaft, the surrounding member and the seal member being capable of making the space on the downstream side an airtight area; and

a discharge port opened to the airtight area to discharge the sealing fluid or the sterilizing gas.

2. The mechanical seal device according to claim 1,

wherein the sterilizing gas is saturated steam or sterilizing gas, and

wherein the seal member is formed as an airtight seal member, to cause steam leaking to the airtight area from the gap, between the seal surfaces, communicating with the airtight area to increase a pressure of the airtight area and become the saturated steam, or to cause the sterilizing gas to increase a gas concentration of the airtight area to a gas concentration necessary for the sterilization.

3. The mechanical seal device according to claim 1, wherein a discharge port to discharge condensed water in the airtight area or to discharge gas in the airtight area is formed in the casing or the surrounding member.

4. The mechanical seal device according to claim 1, wherein a supply

port to supply the sterilizing gas to the airtight area is formed in the surrounding member.

5. A processing apparatus comprising:

a processing equipment where to perform processing under a sterile condition;

a supply port and a discharge port for supplying and discharging sterilizing gas to/from the processing equipment;

a rotary shaft having one end inserted in the processing equipment; and

the mechanical seal device according to claim 1.

Claims

1. A mechanical seal device which seals a rotary shaft inserted in a processing equipment where to perform processing under a sterile condition and which is provided between the inside of the processing equipment and the outer atmosphere, the device comprising:

rotary shaft-side seal surfaces disposed at least at two places apart from each other in an axial direction of the rotary shaft and each provided along a plane with the radial direction of the rotary shaft to extend along a whole circumference of the rotary shaft;

casing-side seal surfaces which are provided along an inner circumference of a casing disposed to cover a periphery of the rotary shaft, and seal with the rotary shaft-side seal surfaces;

a biasing means provided for at least one of pairs of the rotary shaft-side seal surfaces and the casing-side seal surfaces and biased so as to press one of the seal surfaces against the other seal surface, to make a space between the casing and the rotary shaft airtight;

a sealing fluid supply port provided in the casing to let a sealing fluid supplied to a space that is between the rotary shaft and the casing and is between one pair and another pair of the rotary shaft-side seal surfaces and the casing-side seal surfaces and to let the sealing fluid flow in gaps between the rotary shaft-side seal surfaces and the casing-side seal surfaces;

a supply port provided in the casing to let saturated steam or sterilizing gas be supplied to the space between the one pair and the other pair of the seal surfaces and to let the saturated steam or sterilizing gas flow in the gaps between the rotary shaft-side seal surfaces and the casing-side

seal surfaces;

a sealing member which includes: a surrounding member surrounding an area that communicates with the gap between the seal surfaces of the pair located on a most downstream side of the outer atmosphere side in a flow direction of the sealing fluid out of the pairs of the rotary shaft-side seal surfaces and the casing-side seal surfaces and that is located on a downstream side of the gap in the flow direction of the sealing fluid; and a seal member sealing a gap between the surrounding member and the rotary shaft, the surrounding member and the seal member being capable of making the space on the downstream side an airtight area; and

a discharge port opened to the area to discharge the sealing fluid,or saturated steam or the sterilizing gas; and

a pressure detecting part to detect the pressure of the saturated steam or sterilizing gas in the area; and

wherein the seal member is configured as an airtight seal member so that said saturated steam fills the area and sterilizes by said steam leaking to the area from the gap between the seal surface, which communicates with the area, or so that sterilizing gas fills the area to a gas concentration for sterilizing by said sterilizing gas leaking to the area from the gap between the seal surfaces, which communicates with the area.

2. The mechanical seal device according to claim 1, wherein a discharge port to discharge condensed water in the airtight area or to discharge gas in the airtight area is formed in the casing or the surrounding member.

3. The mechanical seal device according to claim 1, wherein a supply

port to supply the saturated steam or the sterilizing gas to the airtight area is formed in the surrounding member.

4. A processing apparatus comprising:

a processing equipment where to perform processing under a sterile condition;

a supply port and a discharge port for supplying and discharging sterilizing gas to/from the processing equipment;

a rotary shaft having one end inserted in the processing equipment; and

the mechanical seal device according to claim 1.