

What is claimed is:

1. A substrate holding apparatus comprising:

a top ring main body to which an elastic film comprising a surface that can suck a substrate can be attached, wherein when the elastic film is attached to the top ring main body, a plurality of areas are formed between the elastic film and the top ring main body;

a first line communicating with a first area among the plurality of areas;

a second line communicating with a second area different from the first area among the plurality of areas;

a pressure adjuster capable of pressurizing the first area by feeding fluid into the first area through the first line, and capable of generating negative pressure in the second area through the second line; and

a determiner configured to perform determination of whether the substrate is sucked to the elastic film based on a measurement value corresponding to a volume of the fluid fed into the first area or corresponding to pressure in the first area, wherein

when the determination is performed, exhaust from the first area is not performed;

the pressure adjuster comprises a pressurizing mechanism configured to feed fluid into the first area through the first line; and

the determiner comprises a position sensor configured to detect a part of the pressurizing mechanism that moves when

feeding fluid into the first area as the measurement value corresponding to the volume of the fluid fed into the first area.

2. The substrate holding apparatus according to claim 1, wherein

the determiner performs the determination by using a fact that when the substrate is sucked to the elastic film, the volume of the fluid fed into the first area is smaller or the pressure in the first area is higher as compared with those when the substrate is not sucked to the elastic film.

~~3. The substrate holding apparatus according to claim 1, wherein~~

~~the pressure adjuster comprises a pressurizing mechanism configured to feed fluid into the first area through the first line, and~~

~~the determiner comprises a position sensor configured to detect a part of the pressurizing mechanism that moves when feeding fluid into the first area as the measurement value corresponding to the volume of the fluid fed into the first area.~~

43. The substrate holding apparatus according to claim 1, wherein

the determiner comprises a pressure gauge configured to measure pressure in the first area.

54. A substrate holding apparatus comprising:

a top ring main body to which an elastic film comprising a surface that can suck a substrate can be attached, wherein when the elastic film is attached to the top ring main body, a plurality of areas are formed between the elastic film and

the top ring main body;

a first line communicating with a first area among the plurality of areas;

a second line communicating with a second area different from the first area among the plurality of areas;

a pressure adjuster capable of pressurizing the first area by feeding fluid into the first area through the first line, and capable of generating negative pressure in the second area through the second line; and

a determiner configured to perform determination of whether the substrate is sucked to the elastic film based on a measurement value corresponding to a volume of the fluid fed into the first area or corresponding to pressure in the first area, wherein

when the determination is performed, exhaust from the first area is not performed;~~The substrate holding apparatus according to claim 1, wherein~~

the pressure adjuster comprises a pressurizing mechanism configured to feed fluid into the first area through the first line, ~~;~~ and

the determiner comprises:

a position sensor configured to detect a part of the pressurizing mechanism that moves when feeding fluid into the first area as the measurement value corresponding to the volume of the fluid fed into the first area, and

a pressure gauge configured to measure pressure in the first area.

65. The substrate holding apparatus according to claim 54,
wherein

the determiner determines that

the substrate is not sucked to the elastic film
based on a detection result of the position sensor, and

the substrate is sucked to the elastic film based
on a measurement result of the pressure gauge.

76. The substrate holding apparatus according to claim 65,
wherein

the pressurizing mechanism comprises a cylinder and a
weight main body coupled to a piston of the cylinder, and

fluid is fed into the first area when the weight main body
is moved downward by gravity.

87. The substrate holding apparatus according to claim 76,
wherein

the piston is capable of moving up and down in a state
where the piston is in contact with an inner surface of the
cylinder,

the piston divides inside of the cylinder into a lower
space and an upper space, and

the cylinder is provided with

a first opening provided to the lower space and
connected to the first line,

a second opening provided to the lower space,

a third opening provided to the upper space, wherein
a piston rod that couples the weight main body and the piston
penetrates through the third opening, and

a fourth opening provided to the upper space.

98. The substrate holding apparatus according to claim 87, wherein

when the determination is performed, the second opening is closed and the fourth opening is opened, and

after the determination is performed, the second opening is opened and the weight is raised by sucking the upper space from the fourth opening.

109. The substrate holding apparatus according to claim 87, wherein

the first line is connected to the first opening of the cylinder and a polishing pressure controller configured to pressurize the first area when polishing the substrate sucked to the elastic film, and

a switch that switches whether to cause the first area, through the first line, to communicate with the first opening of the pressurizing mechanism or communicate with the polishing pressure controller is provided.

~~11. A substrate polishing apparatus comprising;~~

~~the substrate holding apparatus according to claim 1; and~~

~~a polishing table configured to polish the substrate held by the substrate holding apparatus.~~

~~12. A substrate suction determination method of a substrate holding apparatus, the method comprising:~~

~~generating negative pressure in a second area formed between a top ring main body and an elastic film in a substrate holding apparatus and pressurizing a first area by feeding fluid~~

~~into the first area different from the second area, which is formed between the top ring main body and the elastic film; and~~
~~performing determination of whether the substrate is sucked to the elastic film based on a measurement value corresponding to a volume of the fluid fed into the first area or corresponding to pressure in the first area, wherein~~
~~when the determination is performed, exhaust from the first area is not performed.~~

~~13. A substrate polishing method comprising;~~

~~causing a substrate holding apparatus to suck a substrate held by a transport mechanism;~~

~~performing determination of whether the substrate is sucked to an elastic film of the substrate holding apparatus by the substrate suction determination method according to claim 12; and~~

~~polishing the substrate when it is determined that the substrate is sucked.~~

~~14. A method of polishing a wafer by using a polishing head comprising a center side pressure chamber and an outer side pressure chamber formed of an elastic film, the method comprising:~~

~~causing a central portion of the elastic film to come into contact with a central portion of an upper surface of the wafer; and then~~

~~removing liquid from the upper surface of the wafer by causing an outer circumferential portion of the elastic film to come into contact with an outer circumferential portion of~~

~~the upper surface of the wafer; and~~

~~—— pressing a lower surface of the wafer against a polishing surface by the elastic film to polish the lower surface of the wafer.~~

~~15. The method according to claim 14, wherein~~

~~—— the central portion of the elastic film is caused to come into contact with the central portion of the upper surface of the wafer in a state where pressure in the center side pressure chamber is higher than pressure in the outer side pressure chamber.~~

~~16. The method according to claim 15, wherein~~

~~—— the center side pressure chamber communicates with an air cylinder and a weight is placed on a piston of the air cylinder.~~

~~17. A method of polishing a wafer by using a polishing head comprising a center side pressure chamber and an outer side pressure chamber formed of an elastic film, the method comprising:~~

~~—— causing the elastic film to come into contact with an upper surface of the wafer; and then~~

~~—— generating vacuum firstly in the outer side pressure chamber and secondly in the center side pressure chamber to move liquid existing on the upper surface of the wafer to outside; and then~~

~~—— pressing a lower surface of the wafer against a polishing surface by the elastic film to remove liquid from the upper surface of the wafer; and~~

~~—— causing the polishing head to bring the lower surface of~~

~~the wafer into sliding contact with the polishing surface to polish the lower surface of the wafer.~~

~~18. The method according to claim 17, further comprising:
—— supplying compressed gas firstly into the center side pressure chamber and secondly into the outer side pressure chamber to press the lower surface of the wafer against the polishing surface by the elastic film and remove liquid from the upper surface of the wafer.~~

~~19. The method according to claim 17, wherein
—— the outer side pressure chamber and the center side pressure chamber comprise at least a first pressure chamber, a second pressure chamber, and a third pressure chamber, the second pressure chamber being located outside the first pressure chamber, and the third pressure chamber being located outside the second pressure chamber, and
—— the liquid existing on the upper surface of the wafer is moved to outside by generating vacuum firstly in the third pressure chamber, secondly in the second pressure chamber, and thirdly in the first pressure chamber.~~

~~20. A method of polishing a wafer by using a polishing head, the method comprising:
—— removing liquid from an upper surface of the wafer on a transport apparatus; and then
—— holding the wafer on the transport apparatus by the polishing head; and
—— pressing a lower surface of the wafer against a polishing surface by the polishing head to polish the lower surface of~~

~~the wafer.~~

~~21. The method according to claim 20, wherein~~

~~removing liquid from the upper surface of the wafer on the transport apparatus is removing liquid from the upper surface of the wafer by tilting the wafer by the transport apparatus.~~

~~22. The method according to claim 20, wherein~~

~~removing liquid from the upper surface of the wafer on the transport apparatus is removing liquid from the upper surface of the wafer by swinging the wafer by the transport apparatus.~~

~~23. The method according to claim 20, wherein~~

~~removing liquid from the upper surface of the wafer on the transport apparatus is removing liquid from the upper surface of the wafer by sending a jet of gas to the upper surface of the wafer on the transport apparatus.~~

~~24. A method of polishing a wafer by using a polishing head having an elastic film, the method comprising:~~

~~causing the elastic film to come into contact with an upper surface of the wafer;~~

~~removing liquid from the upper surface of the wafer by causing liquid existing on the upper surface of the wafer to flow into a liquid flow path formed in the elastic film; and then~~

~~pressing a lower surface of the wafer against a polishing surface by the elastic film to polish the lower surface of the wafer.~~

~~25. The method according to claim 24, wherein~~
~~—— the elastic film comprises a contact surface that comes~~
~~into contact with the upper surface of the wafer, and~~
~~—— the liquid flow path comprises:~~
~~—— an opening that opens at the contact surface; and~~
~~—— a horizontal hole connected to the opening and~~
~~extending in the elastic film; and~~
~~—— the horizontal hole opens at an outside surface of the~~
~~elastic film.~~

~~26. The method according to claim 24, wherein~~
~~—— causing liquid existing on the upper surface of the wafer~~
~~to flow into the liquid flow path is sucking liquid existing~~
~~on the upper surface of the wafer through the liquid flow path,~~
~~and~~
~~—— the liquid flow path communicates with a suction line~~
~~connected to the elastic film.~~

~~27. The method according to claim 24, wherein~~
~~—— the elastic film comprises a contact surface that comes~~
~~into contact with the upper surface of the wafer, and~~
~~—— the liquid flow path is a groove formed in the contact~~
~~surface.~~

~~28. The method according to claim 27, wherein~~
~~—— a width of the groove inside the elastic film is greater~~
~~than a width of the groove on the contact surface.~~

~~29. An elastic film for pressing a wafer against a polishing~~
~~surface, the elastic film comprising:~~
~~—— a contact portion comprising a contact surface capable~~

~~of coming into contact with the wafer; and~~
~~—— an outer wall portion that is connected to the contact portion, wherein~~
~~—— the contact portion comprises:~~
~~—— an opening that opens at the contact surface; and~~
~~—— a horizontal hole that is connected to the opening and extends in the contact portion.~~

~~30. The elastic film according to claim 29, wherein~~
~~—— the horizontal hole opens at an outside surface of the elastic film.~~

~~31. The elastic film according to claim 29, wherein~~
~~—— the horizontal hole opens at a surface opposite to the contact surface of the contact portion.~~

~~32. An elastic film for pressing a wafer against a polishing surface, the elastic film comprising:~~
~~—— a contact portion comprising a contact surface capable of coming into contact with the wafer; and~~
~~—— an outer wall portion that is connected to the contact portion, wherein~~
~~—— the contact portion has a groove formed in the contact surface.~~

~~33. The elastic film according to claim 32, wherein~~
~~—— a width of the groove inside the contact portion is greater than a width of the groove on the contact surface.~~

~~34. A substrate polishing apparatus comprising;~~
~~—— a top ring main body;~~
~~—— an elastic film comprising a first surface facing the top~~

~~ring main body and a second surface that is a surface opposite to the first surface and can suck and hold a substrate;~~
~~—— a pressure adjustment apparatus that can pressurize and depressurize a space between the top ring main body and the first surface of the elastic film through a first valve provided on a first line communicating with the space; and~~
~~—— a constant amount gas supply apparatus that can supply a certain amount of gas to the space through a second valve provided on the first line.~~

~~35. The substrate polishing apparatus according to claim 34, wherein~~

~~—— when causing the second surface of the elastic film to suck the substrate, the second valve closes, the first valve opens, and the pressure adjustment apparatus depressurizes the space,~~

~~—— when polishing the substrate, the second valve closes, the first valve opens, and the pressure adjustment apparatus pressurizes the space, and~~

~~—— when releasing the substrate from the second surface of the elastic film, the first valve closes, the second valve opens, and the constant amount gas supply apparatus supplies a certain amount of gas to the space.~~

~~36. The substrate polishing apparatus according to claim 34, wherein~~

~~—— by moving a weight coupled to a piston in a cylinder downward due to gravity, the constant amount gas supply apparatus supplies a certain amount of gas corresponding to an~~

~~area of the piston and a stroke of the piston to the space from the cylinder.~~

~~37. The substrate polishing apparatus according to claim 36, wherein~~

~~—— the constant amount gas supply apparatus comprises the cylinder, the piston, and the weight,~~

~~—— the piston is, under a state where the piston is in contact with an inner surface of the cylinder, can move up and down,~~

~~—— inside of the cylinder is divided into a lower space and an upper space by the piston,~~

~~—— the cylinder is provided with a first opening at a position corresponding to the lower space and second and third openings at positions corresponding to the upper space,~~

~~—— the first opening is connected with a second line connected to the first line through the second valve,~~

~~—— the second opening is connected with a third line,~~

~~—— the third opening is penetrated with a piston rod that couples the weight and the piston,~~

~~—— the lower space can be opened to atmosphere by opening the third valve provided on the second line opens, and~~

~~—— the upper space can be depressurized and opened to atmosphere through the third line.~~

~~38. The substrate polishing apparatus according to claim 37, wherein~~

~~—— when causing the second surface of the elastic film to suck the substrate and when polishing the substrate, the upper space is depressurized and the lower space is opened to~~

~~atmosphere, and~~

~~—— when releasing the substrate from the second surface of the elastic film, the upper space is opened to atmosphere and the third valve closes.~~

~~39. The substrate polishing apparatus according to claim 34, wherein~~

~~—— the constant amount gas supply apparatus supplies a certain amount of gas according to a volume of a chamber to the space from a bladder by compressing the bladder stored in the chamber.~~

~~40. The substrate polishing apparatus according to claim 39, wherein~~

~~—— the constant amount gas supply apparatus comprises the bladder and the chamber,~~

~~—— the chamber is provided with a fourth opening and a fifth opening,~~

~~—— the fourth opening is penetrated with a fourth line that connects the first line and the bladder through the second valve,~~

~~—— the fifth opening is connected with a fifth line,~~

~~—— the bladder can be opened to atmosphere by opening a fourth valve provided on the fourth line, and~~

~~—— the chamber can be pressurized and depressurized through the fifth line.~~

~~41. The substrate polishing apparatus according to claim 40, wherein~~

~~—— when causing the second surface of the elastic film to~~

~~suck the substrate and when polishing the substrate, the chamber is depressurized and the bladder is opened to atmosphere, and ——— when releasing the substrate from the second surface of the elastic film, the chamber is pressurized and the fourth valve closes.~~

~~42. A substrate release method of releasing a substrate sucked and held by a second surface of an elastic film of a top ring from the elastic film, the substrate release method comprising: ——— a gas supply step of supplying a certain amount of gas to a space between a top ring main body and a first surface of the elastic film in the top ring to generate a gap between the elastic film and the substrate; and~~

~~——— a fluid injection step of injecting fluid into the gap.~~

~~43. The substrate release method according to claim 42, wherein ——— in the gas supply step, a certain amount of gas corresponding to an area of a piston and a stroke of the piston is supplied to the space from a cylinder by moving down a weight coupled to the piston in the cylinder.~~

~~44. The substrate release method according to claim 42, wherein ——— in the gas supply step, a certain amount of gas corresponding to a volume of a chamber is supplied to the space from a bladder by compressing the bladder stored in the chamber.~~

~~45. A constant amount gas supply apparatus connected to a substrate holding apparatus comprising:~~

~~——— a top ring main body,~~

~~——— an elastic film comprising a first surface facing the top ring main body and a second surface that is a surface opposite~~

~~to the first surface and can suck and hold a substrate, and
—— a pressure adjustment apparatus that can pressurize and
depressurize a space between the top ring main body and the first
surface of the elastic film through a first valve provided on
a first line communicating with the space, wherein
—— the constant amount gas supply apparatus can supply a
certain amount of gas to the space through a second valve
provided on the first line.~~