US012394605B2

(12) **United States Patent**
Matsuura et al.

(10) **Patent No.: US 12,394,605 B2**
(45) **Date of Patent: Aug. 19, 2025**

(54) **PLASMA PROCESSING SYSTEM AND EDGE RING REPLACEMENT METHOD**

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(73) Assignee: **TOKYO ELECTRON LIMITED**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **18/398,162**

(22) Filed: **Dec. 28, 2023**

(65) **Prior Publication Data**

US 2024/0136158 A1 Apr. 25, 2024
US 2024/0234102 A9 Jul. 11, 2024

Related U.S. Application Data

(63) Continuation of application No. 17/190,447, filed on Mar. 3, 2021, now Pat. No. 11,901,163.

(30) **Foreign Application Priority Data**

Mar. 3, 2020 (JP) 2020-035948
Oct. 23, 2020 (JP) 2020-178354

(51) **Int. Cl.**
H01J 37/32 (2006.01)
H01L 21/683 (2006.01)
H01L 21/687 (2006.01)

(52) **U.S. Cl.**
CPC .. ***H01J 37/32642*** (2013.01); ***H01J 37/32715*** (2013.01); ***H01L 21/6831*** (2013.01); ***H01L 21/68735*** (2013.01); ***H01L 21/68742*** (2013.01)

(58) **Field of Classification Search**
CPC H01J 37/32642; H01J 37/32715; H01L 21/68742; H01L 21/6875
See application file for complete search history.

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(57) **ABSTRACT**

A plasma processing system includes a control device. The control device executes raising a lifter to deliver a cover ring supporting an edge ring to the lifter; moving a jig supported by a holder to a space between the cover ring and a substrate support surface/an annular support surface; raising a different lifter to deliver the jig to the different lifter; extracting the holder, and then moving the lifter and the different lifter relatively to deliver the edge ring to the jig; lowering only the lifter to deliver the cover ring to the annular member support surface; moving the holder to a space between the cover ring and the jig, and then lowering the different lifter to deliver the jig to the holder; and extracting the holder from the processing chamber to transfer the jig supporting the edge ring from the processing chamber.

24 Claims, 26 Drawing Sheets

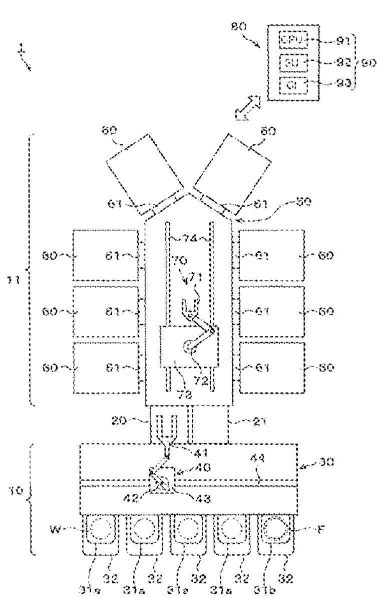

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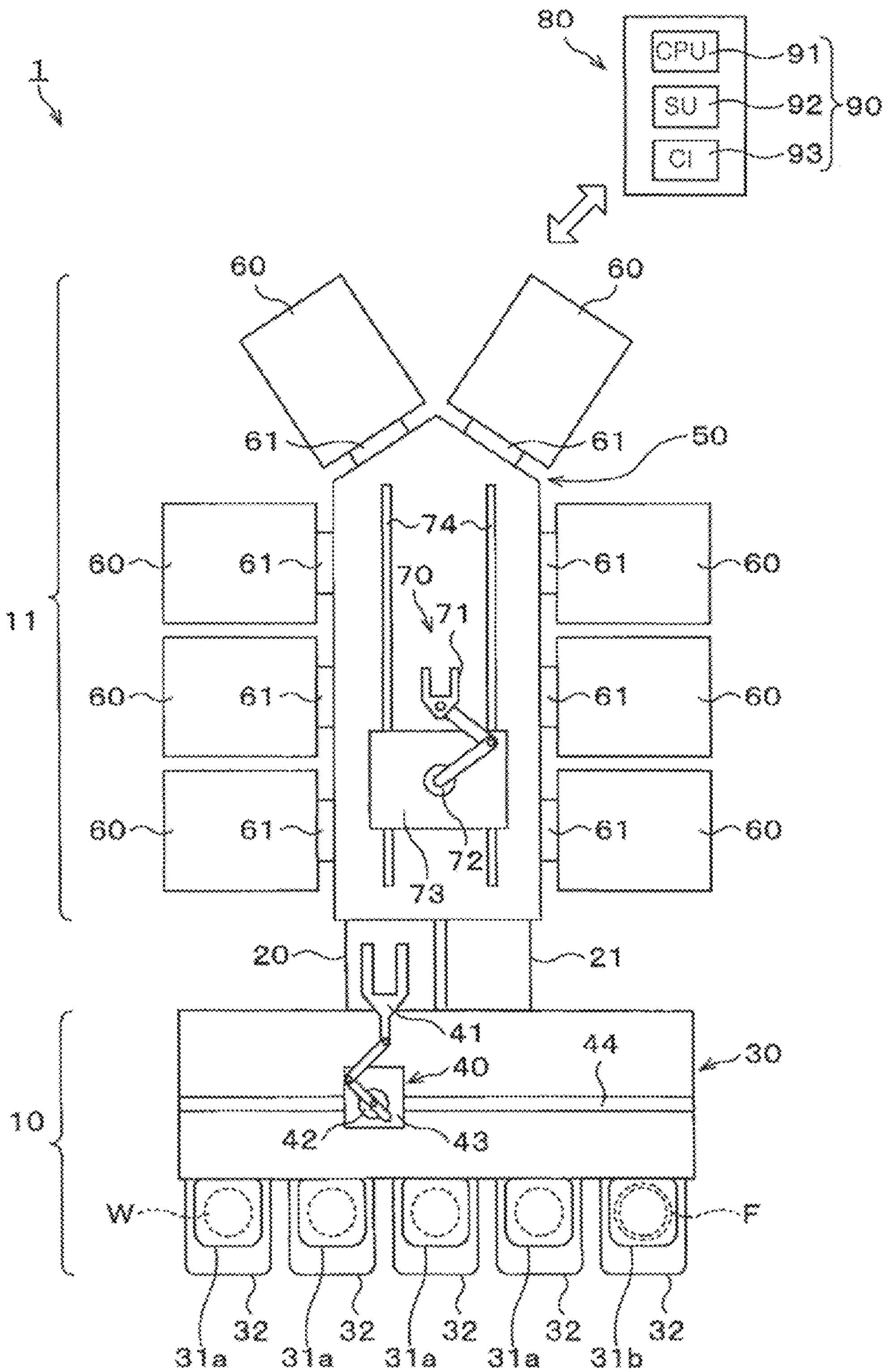
FIG. 1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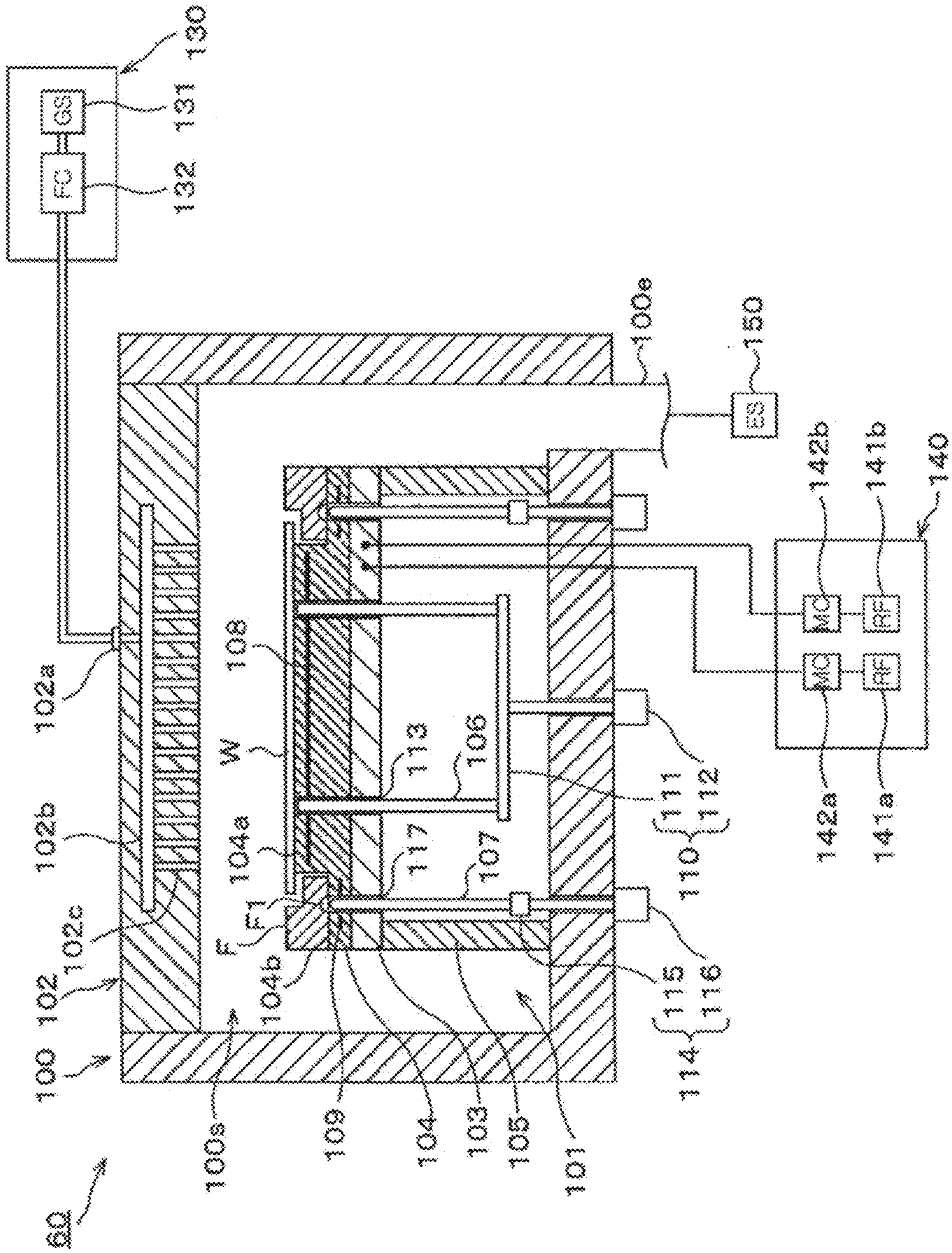
31a
31b

FIG. 2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142a
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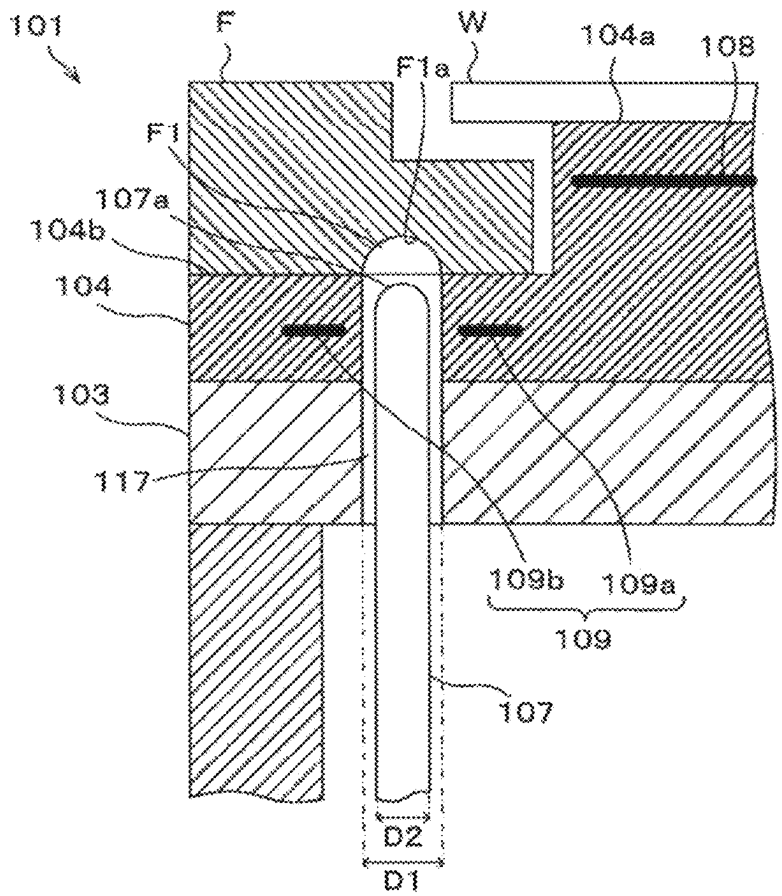
FIG. 3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D1

FIG. 4

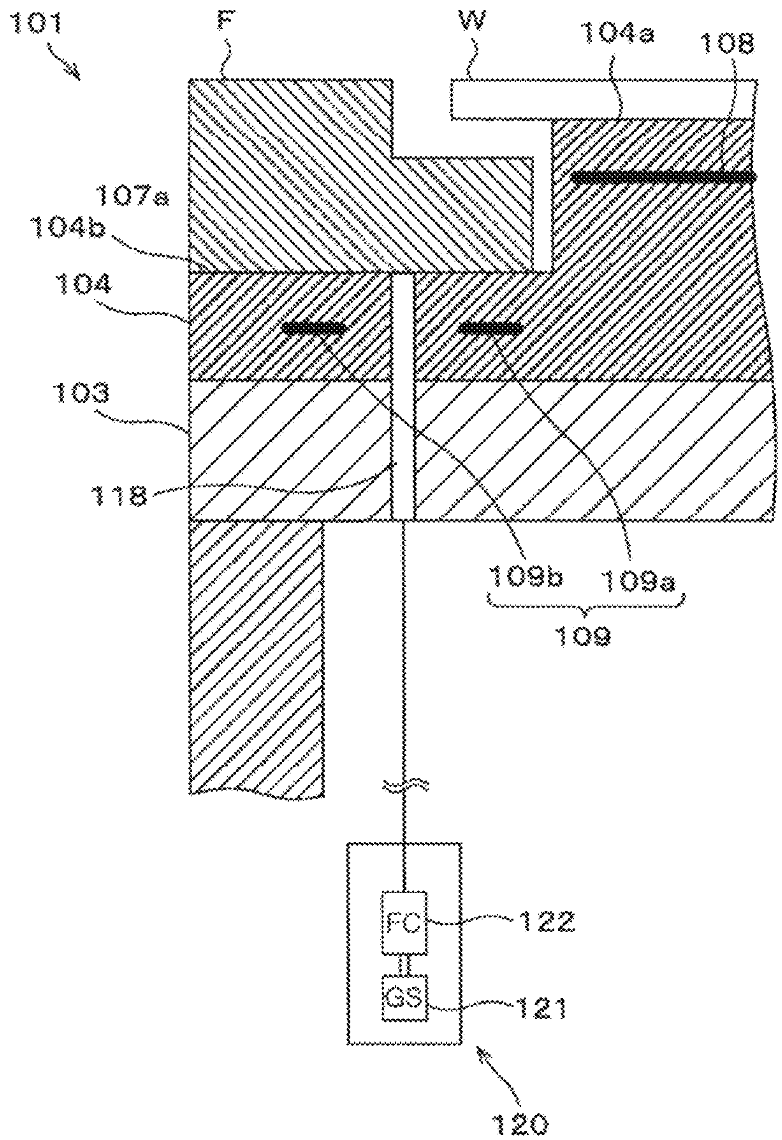
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FIG. 5

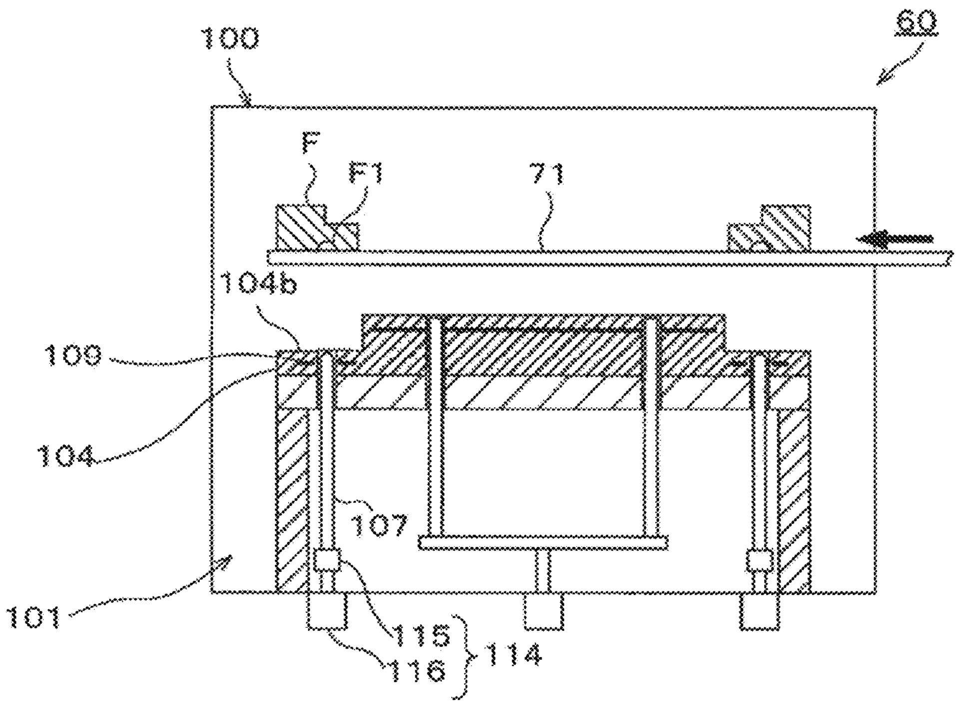
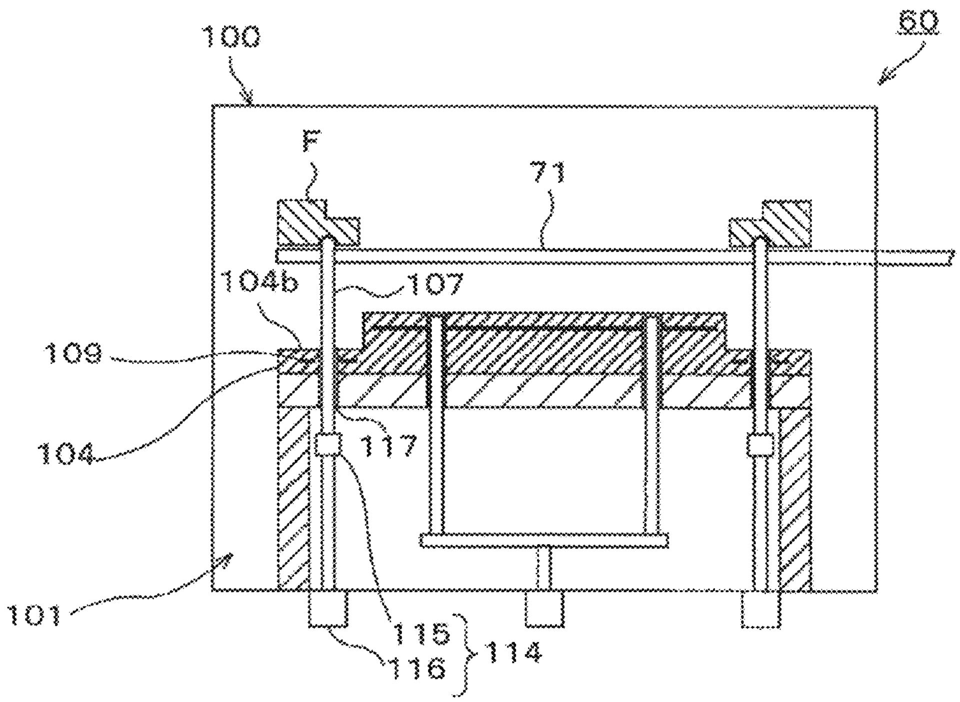


FIG. 6



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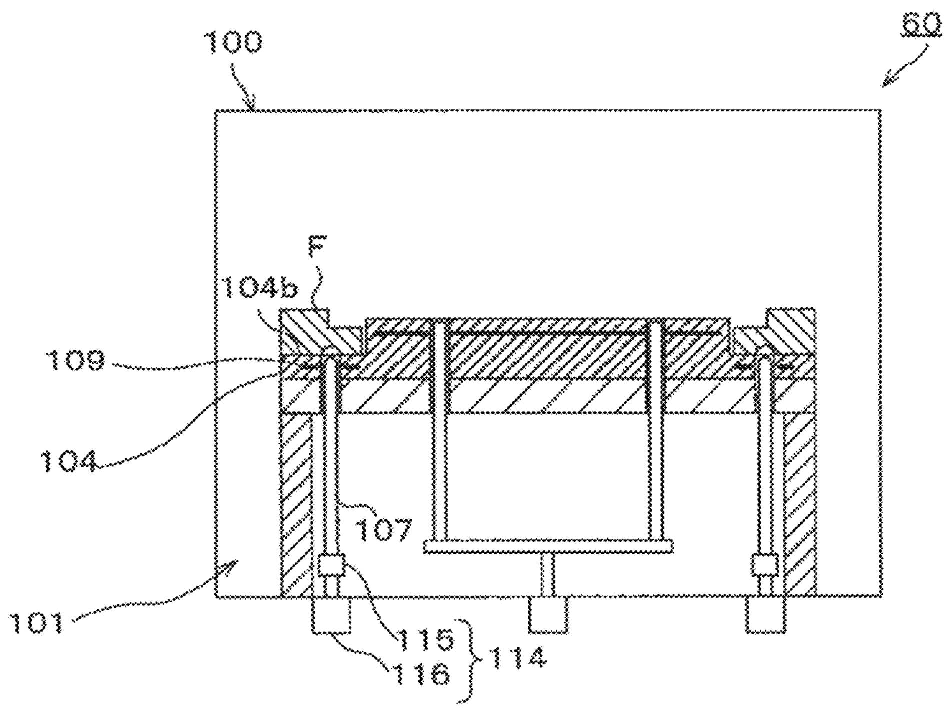
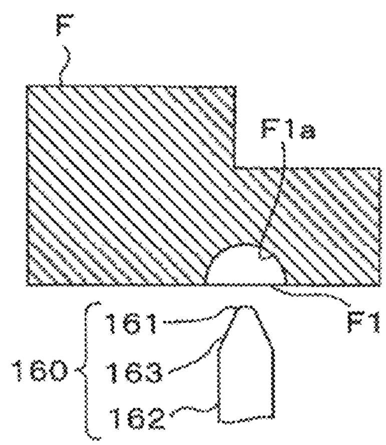


FIG.8



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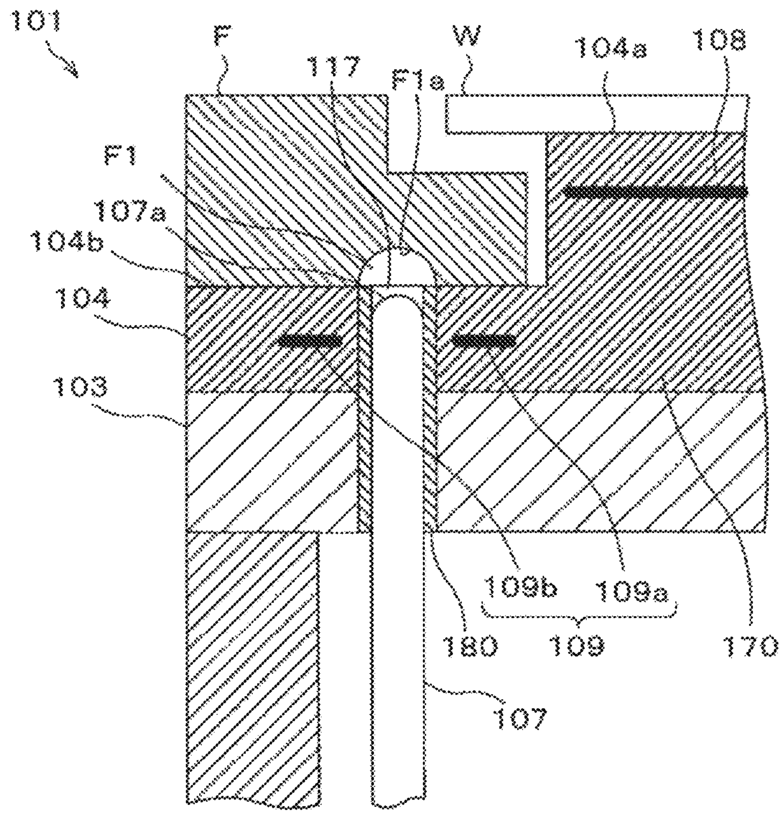

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FIG. 10

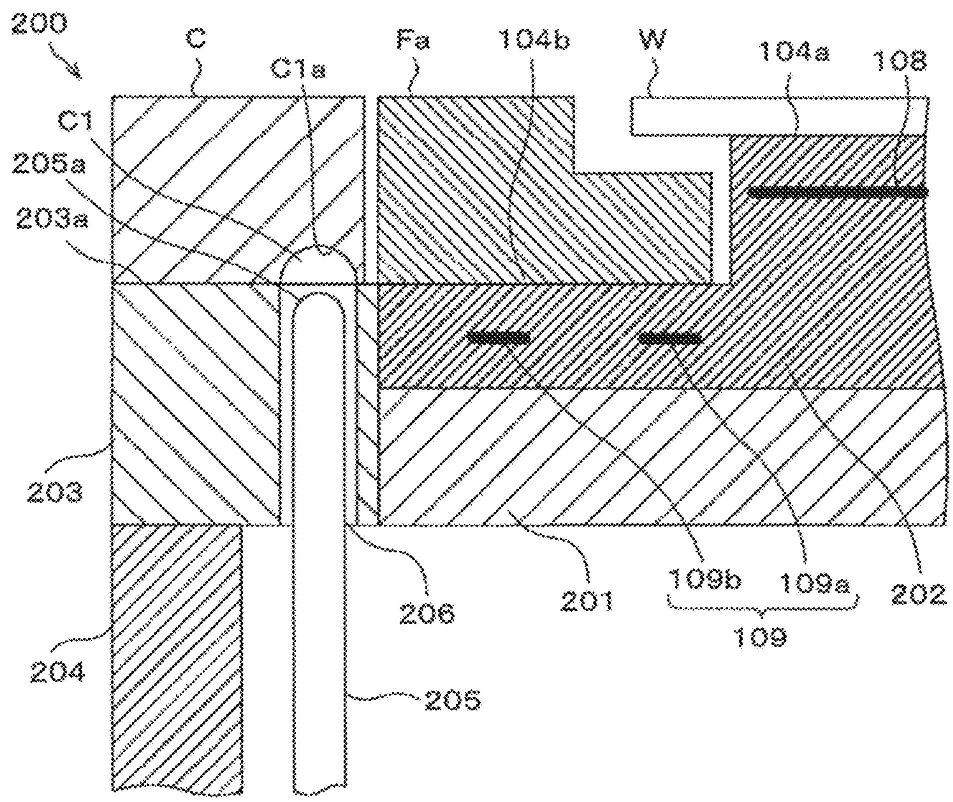
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FIG. 11

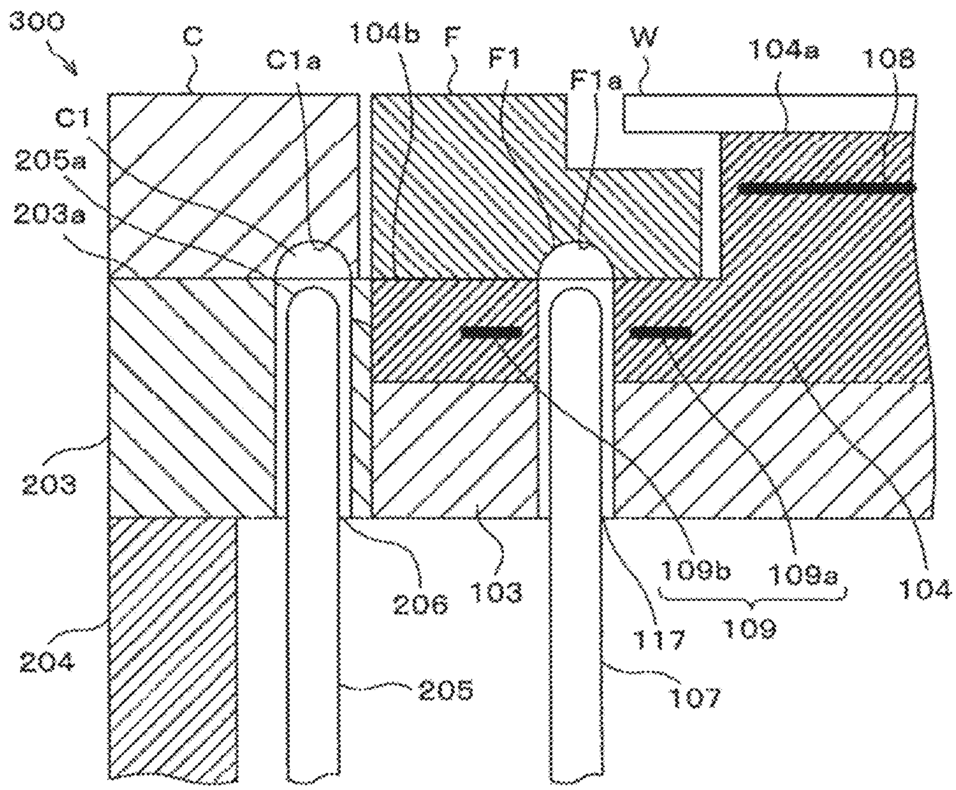
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FIG. 12

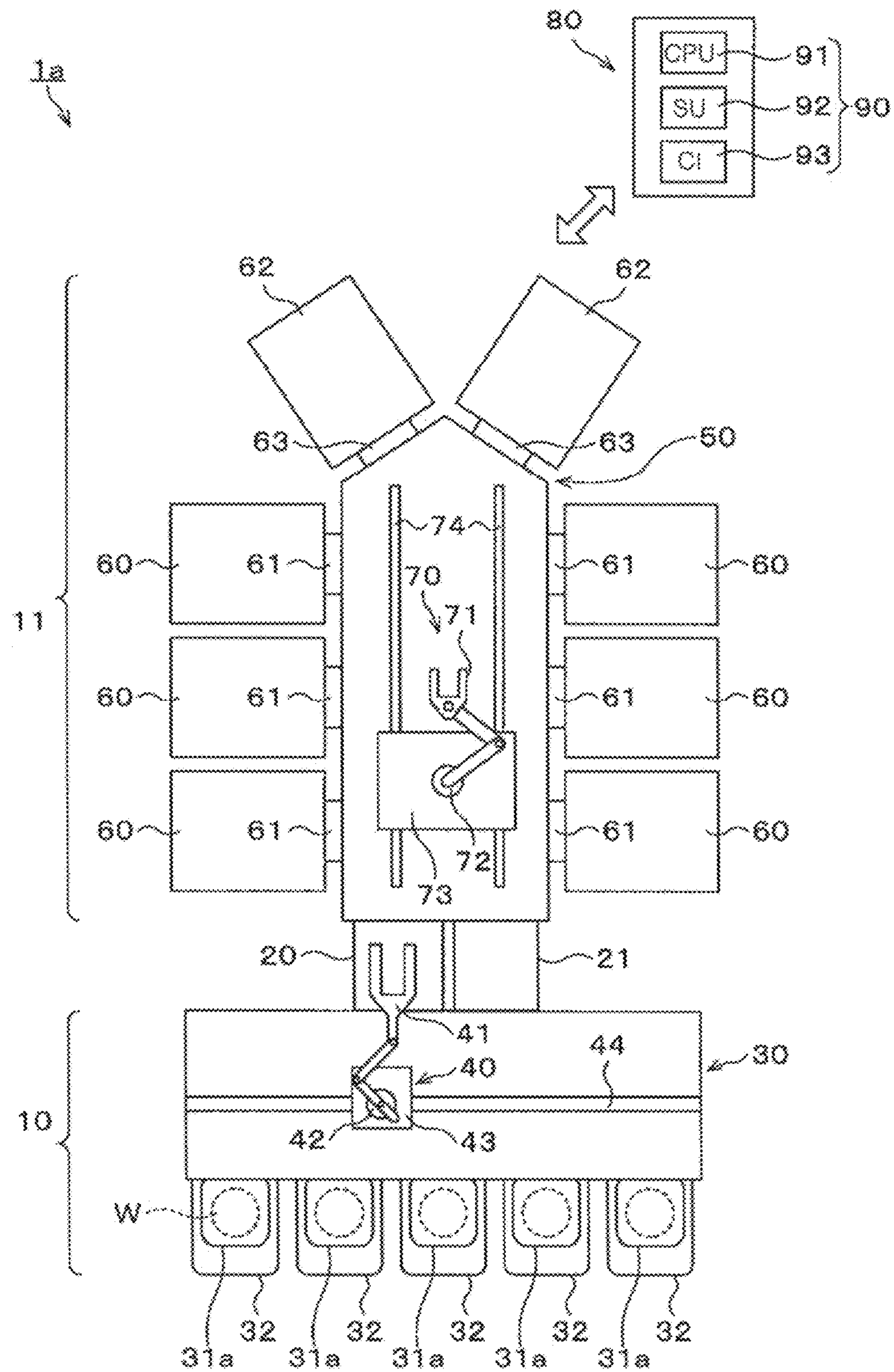

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FIG. 13

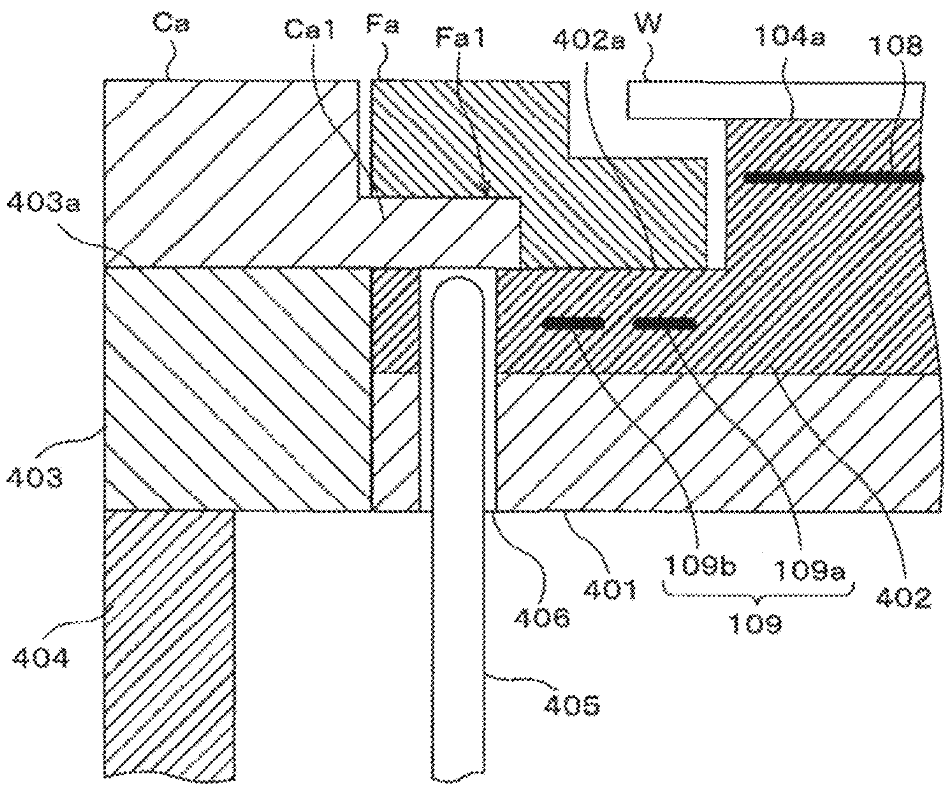
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FIG. 14

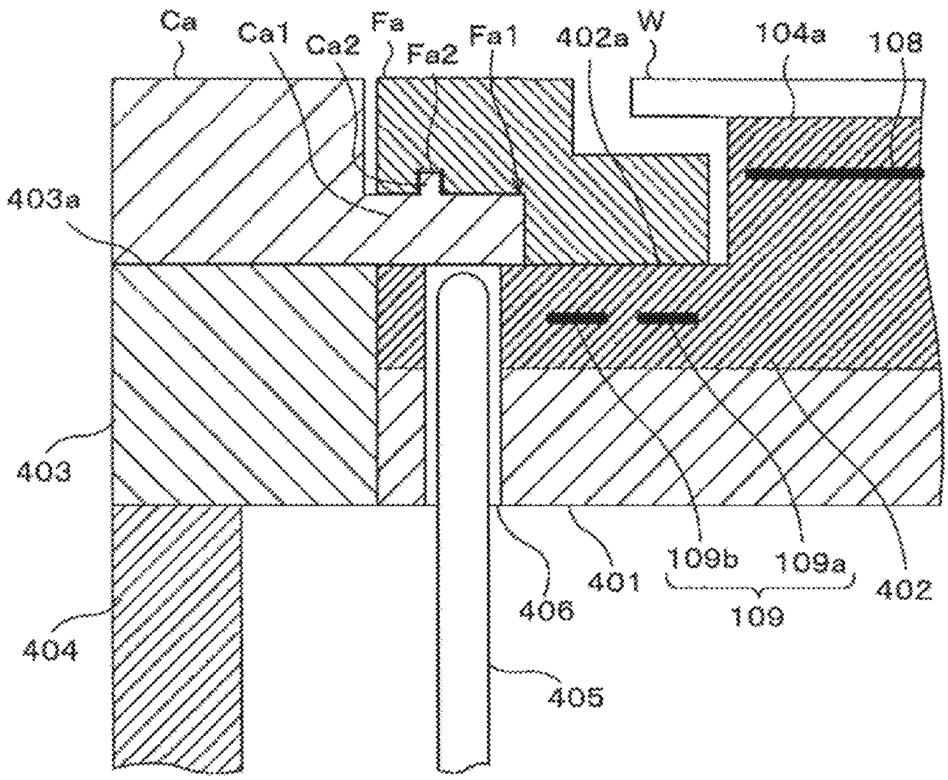
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FIG. 15

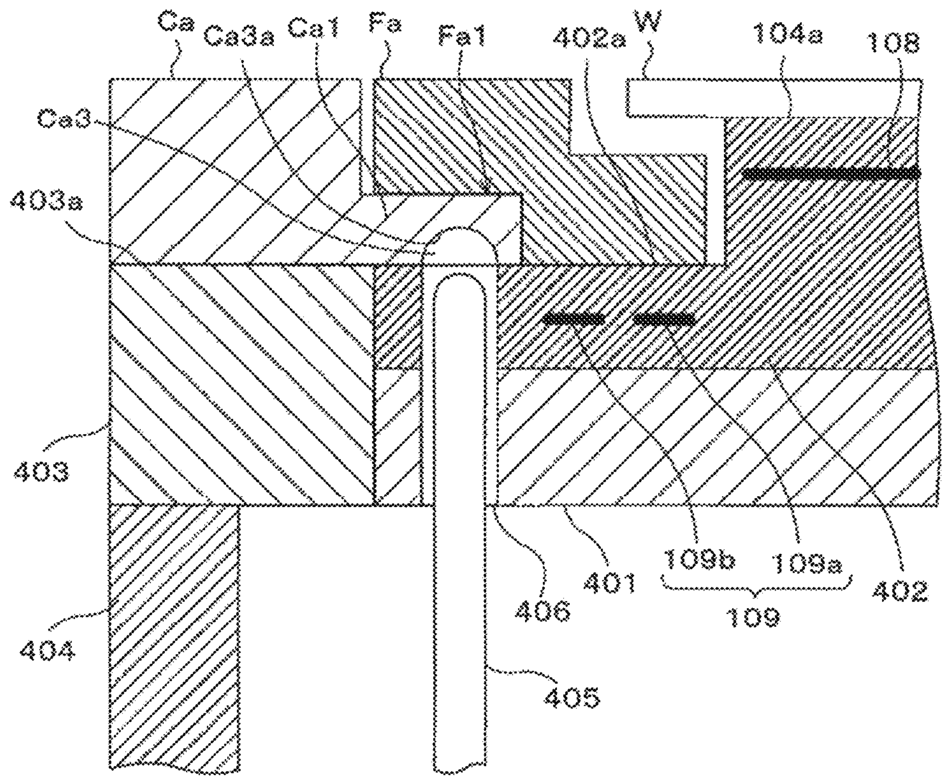
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FIG. 16

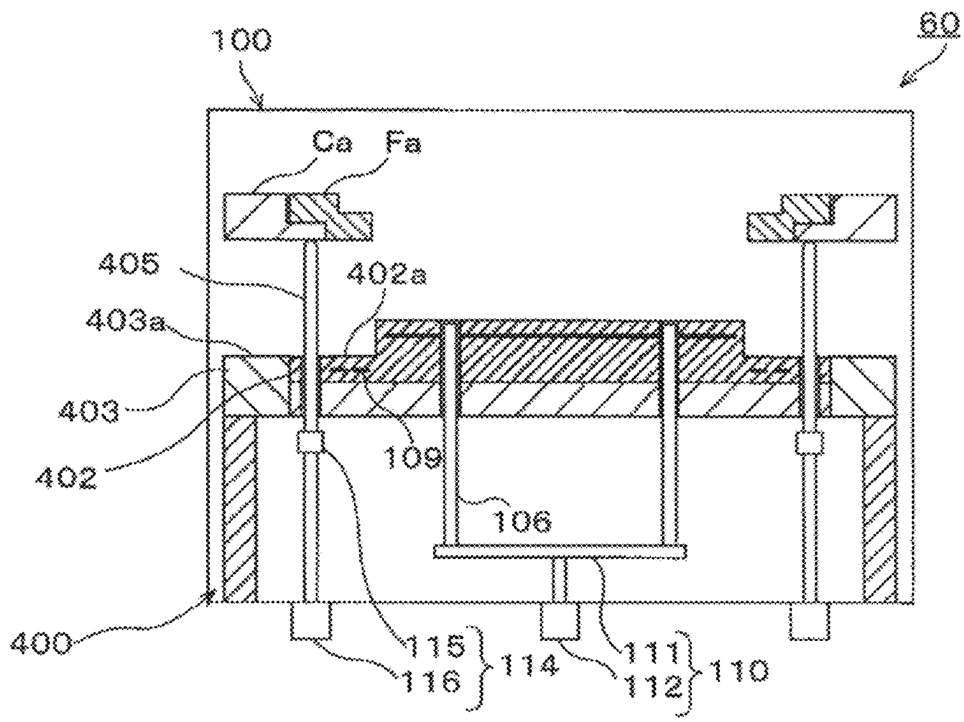

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FIG. 17

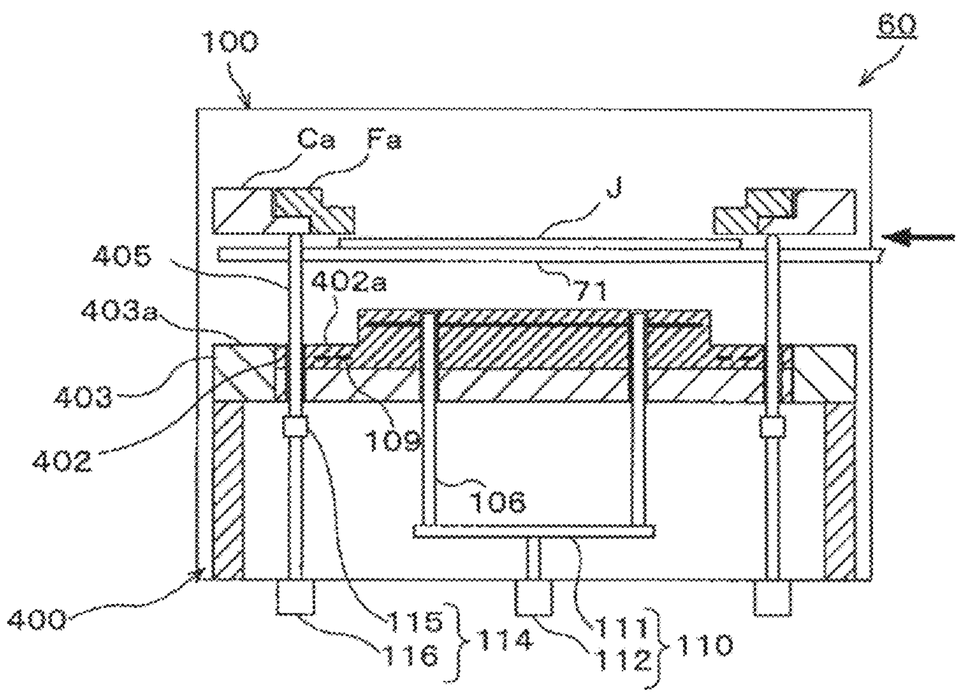
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FIG. 18

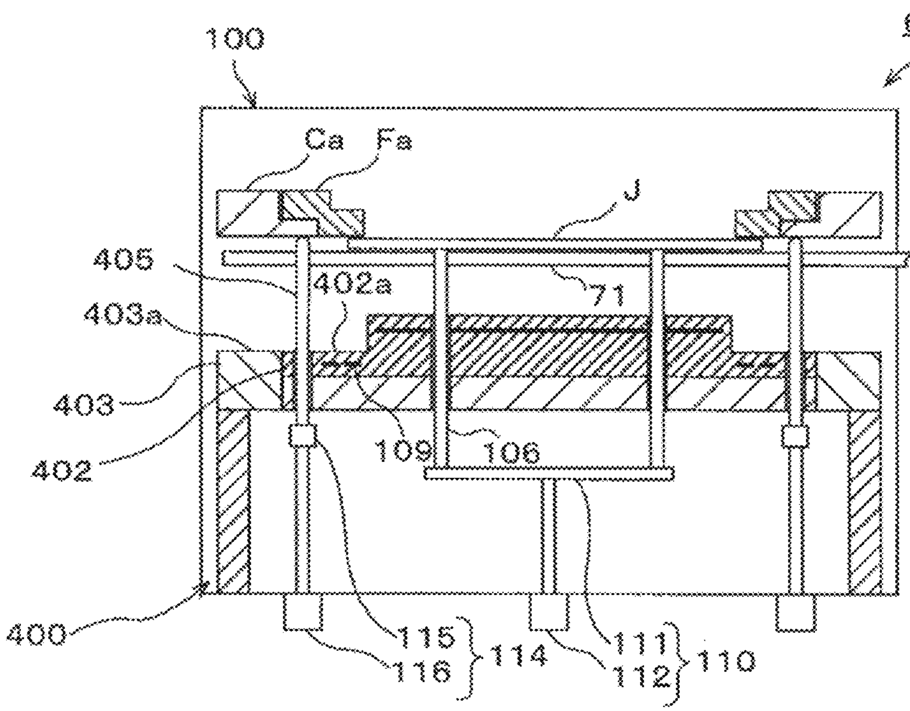
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FIG. 19

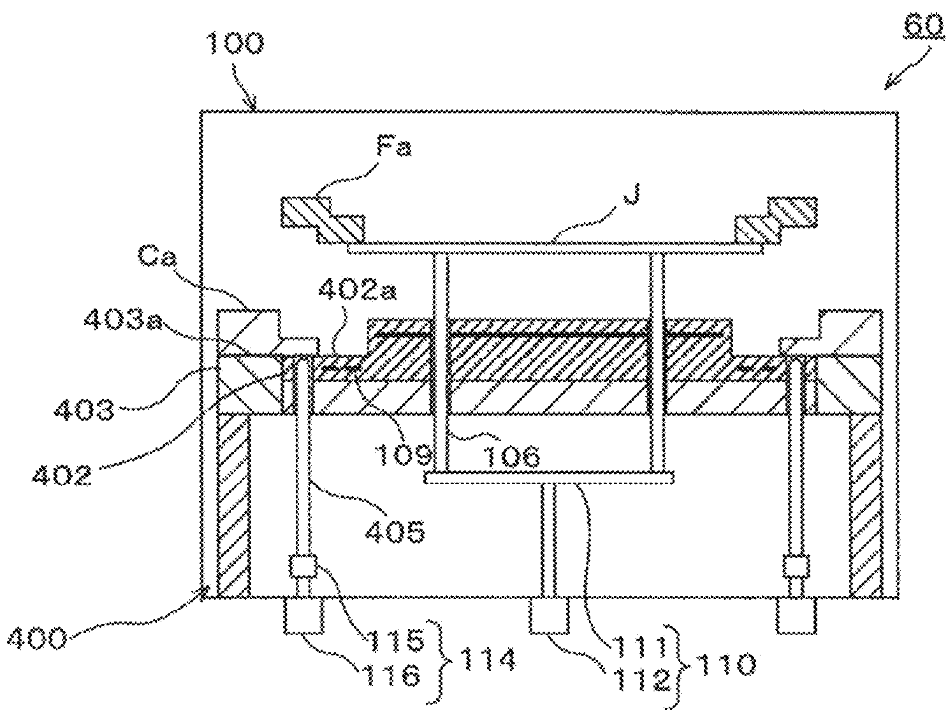
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FIG. 20

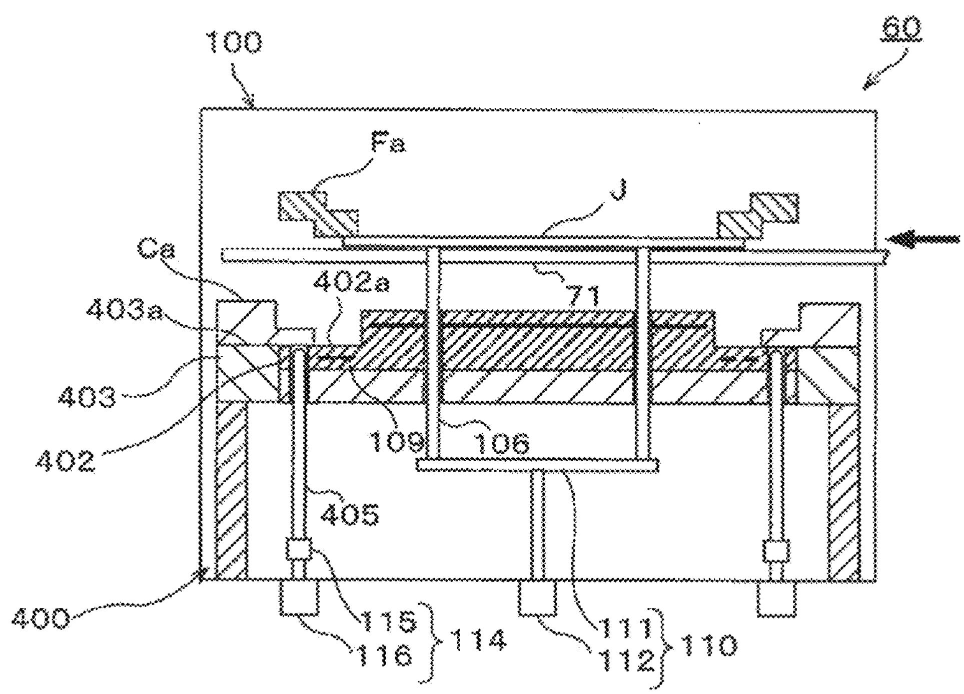
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FIG.21

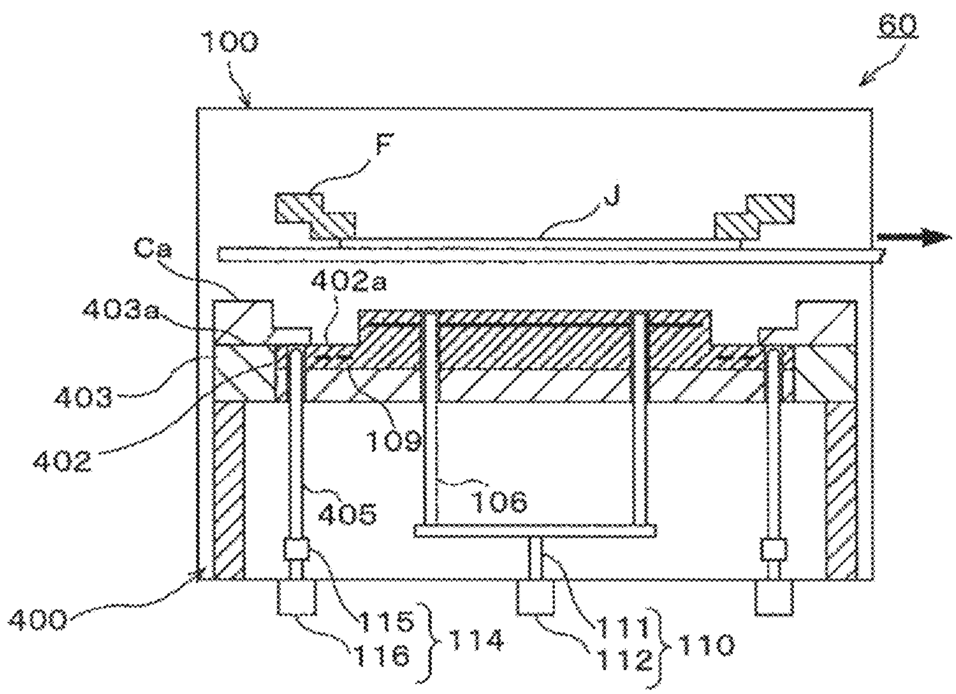

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FIG. 22

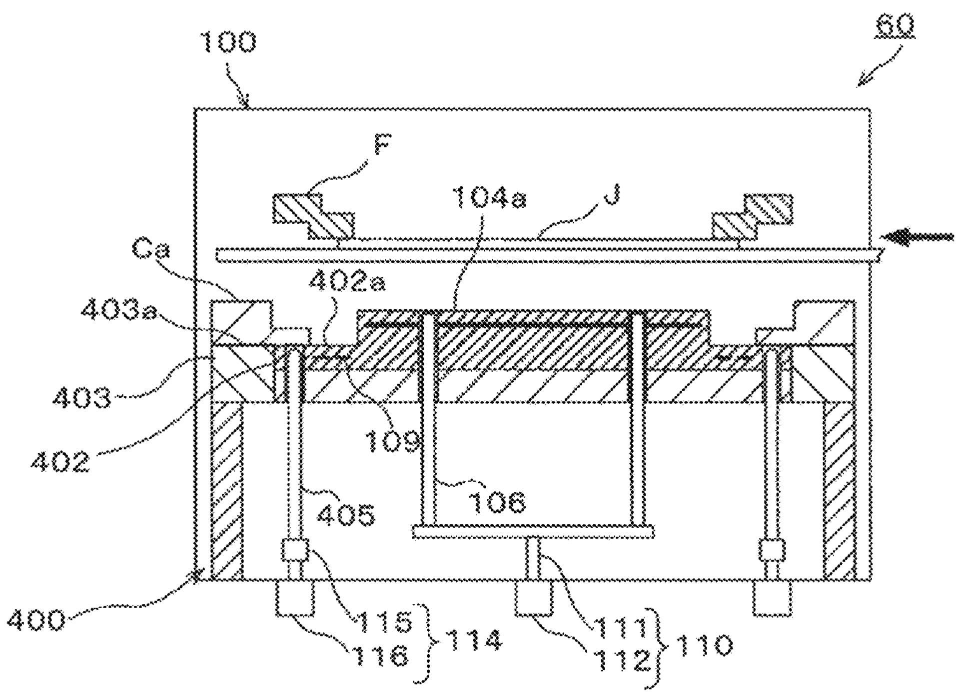
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FIG.23

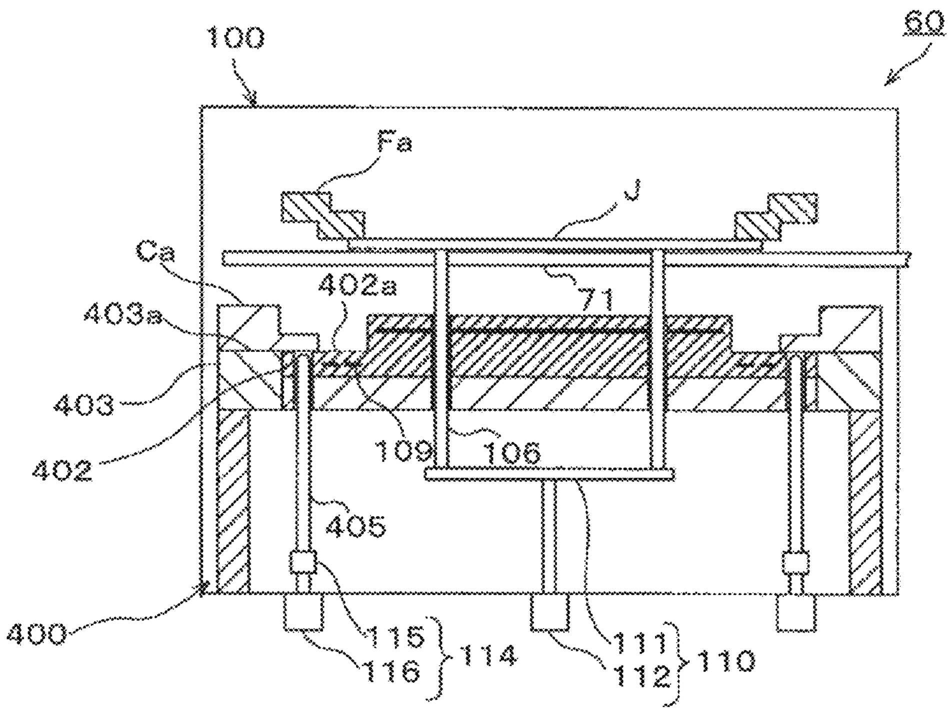
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FIG.24

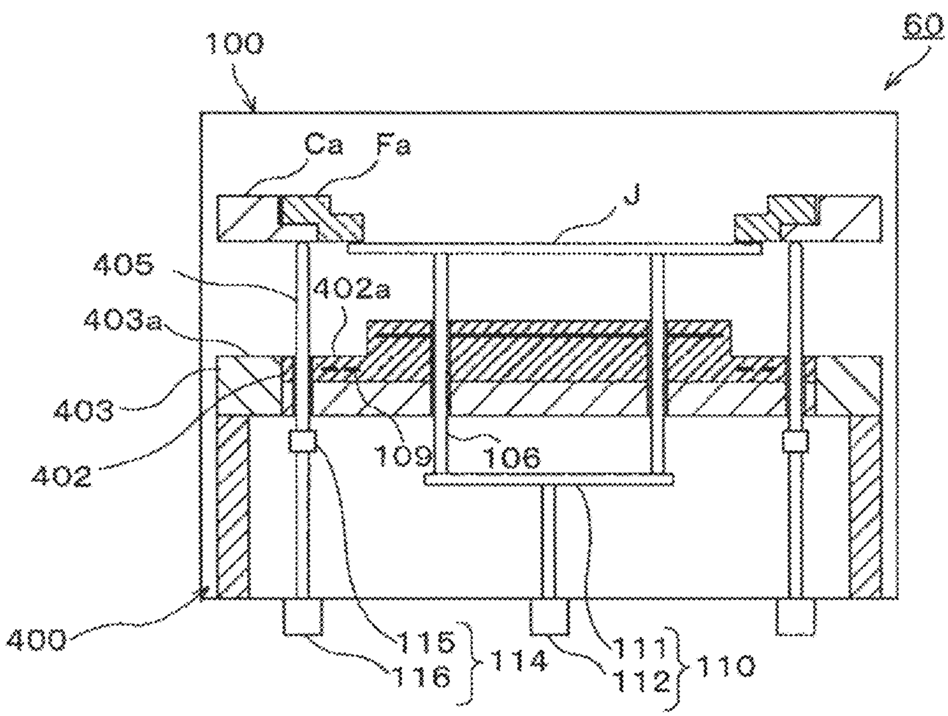
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FIG. 25

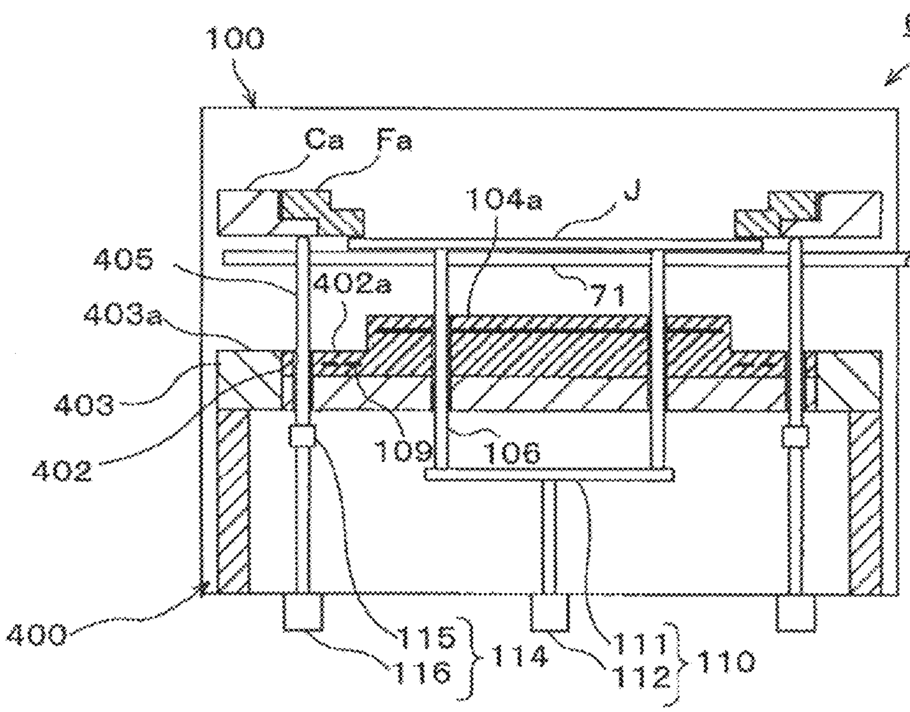
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FIG.26

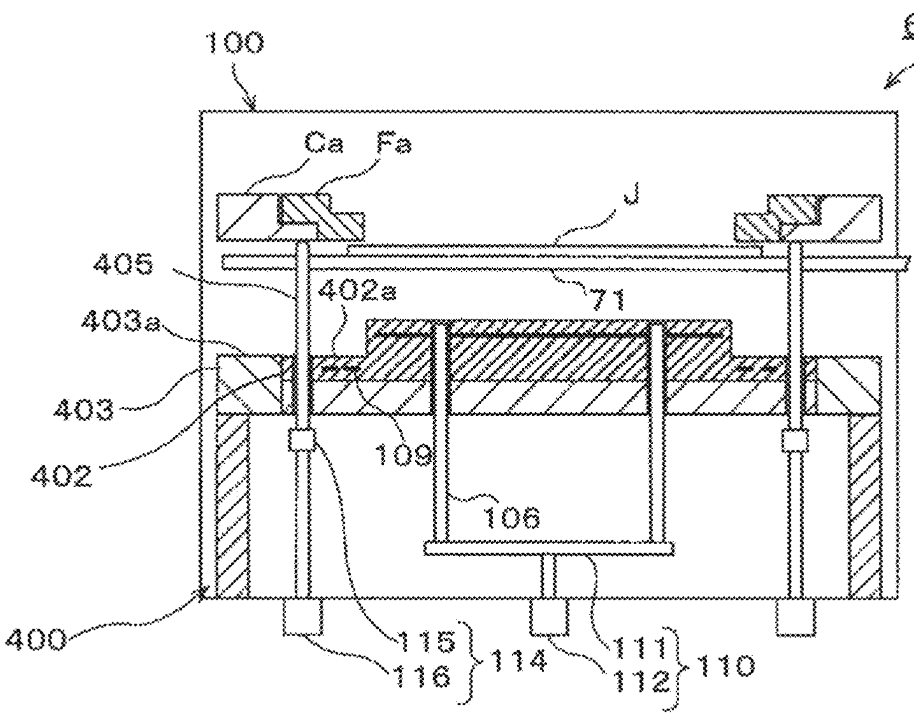

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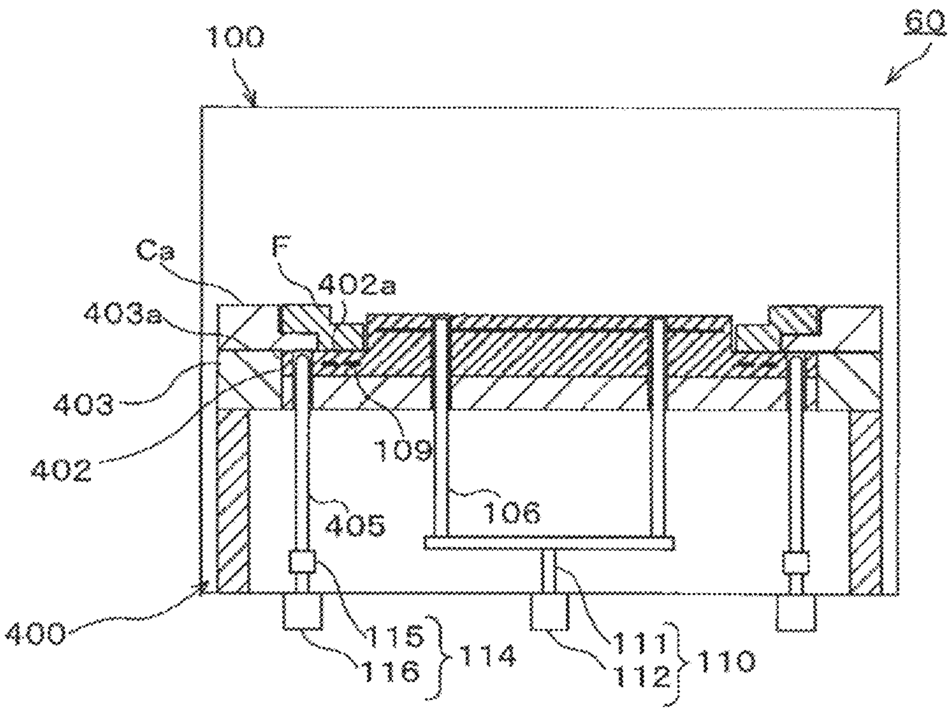
FIG.27



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PLASMA PROCESSING SYSTEM AND EDGE RING REPLACEMENT METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. application Ser. No. 17/190,447, filed Mar. 3, 2021, which claims priority to Japanese Patent Application Nos. 2020-035948 and 2020-178354, respectively filed on Mar. 3, 2020 and Oct. 23, 2020, the entire contents of each are incorporated herein by reference.

TECHNICAL FIELD

Exemplary embodiments of the present disclosure relate to a plasma processing system and an edge ring replacement method.

BACKGROUND

Japanese Patent Application Publication No. 2011-54933 discloses a substrate processing apparatus in which a substrate is disposed in a processing chamber, a focus ring is disposed to surround the substrate, and plasma processing is performed on the substrate. The substrate processing apparatus includes a substrate support having a susceptor including a substrate support surface on which the substrate is placed and a focus ring support surface on which the focus ring is placed, and a plurality of positioning pins. Each positioning pin having a pin shape is made of a material expandable in a radial direction by heating. The positioning pin is attached to the focus ring to protrude from a lower surface of the focus ring and inserted into a positioning hole formed in the focus ring support surface of the susceptor. Accordingly, the positioning pin is expanded in the radial direction by heating and fitted into the positioning hole, thus allowing a position of the focus ring to be aligned. Further, the substrate processing apparatus disclosed in Japanese Patent Application Publication No. 2011-54933 includes lifter pins and a transfer arm. The lifter pins are provided in the substrate support so as to protrude beyond and retract below the focus ring support surface, and configured to lift the focus ring together with respective positioning pins to separate the focus ring from the focus ring support surface. The transfer arm is provided outside the processing chamber and configured to exchange, in between the transfer arm and the lifter pin(s), the focus ring equipped with the positioning pins through a loading/unloading port provided at the processing chamber.

SUMMARY

The present disclosure provides a technique of selectively performing a replacement in a state where an edge ring is supported by a cover ring and a replacement of the edge ring alone when the edge ring is replaced in a plasma processing system in which both the edge ring and the cover ring are used.

In accordance with an aspect of the present disclosure, there is provided a plasma processing system including: a plasma processing device including a substrate support and a pressure-reducible processing chamber in which the substrate support is provided, the plasma processing device being configured to perform plasma processing on a substrate on the substrate support; a transfer device having a holder configured to support the substrate, the transfer device being configured to insert or extract the holder into or from the processing chamber to load or unload the substrate into or from the processing chamber; and a control device. Further, the substrate support includes a substrate support surface on which the substrate is placed, an annular member support surface on which a cover ring, covering an outer surface of an edge ring disposed to surround the substrate placed on the substrate support surface, is placed in a state where the cover ring supports the edge ring, a lifter configured to be vertically moved to protrude beyond a portion of the annular member support surface that overlaps the cover ring in a plan view, an elevating mechanism configured to raise or lower the lifter, a different lifter configured to be vertically moved to protrude beyond the substrate support surface, and a different elevating mechanism configured to raise or lower the different lifter. Further, the holder of the transfer device is configured to support the cover ring supporting the edge ring and a jig having a portion longer than an inner diameter of the edge ring. The control device controls the elevating mechanism, the transfer device, and the different elevating mechanism to execute: raising the lifter to deliver the cover ring supporting the edge ring from the annular member support surface to the lifter; moving the jig supported by the holder to a space between the cover ring supporting the edge ring and the substrate support surface/the annular member support surface; raising the different lifter to deliver the jig from the holder to the different lifter; extracting the holder, and then moving the lifter and the different lifter relatively with each other to deliver the edge ring from the cover ring to the jig; lowering only the lifter to deliver the cover ring from the lifter to the annular member support surface; moving the holder to a space between the cover ring and the jig supporting the edge ring, and then lowering the different lifter to deliver the jig supporting the edge ring from the different lifter to the holder; and extracting the holder from the processing chamber to transfer the jig supporting the edge ring from the processing chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present disclosure will become apparent from the following description of embodiments, given in conjunction with the accompanying drawings, in which:

FIG. **1** is a plan view illustrating a schematic configuration of a plasma processing system according to a first exemplary embodiment;

FIG. **2** is a vertical cross-sectional view illustrating a schematic configuration of a processing module of FIG. **1**;

FIG. **3** is a partially enlarged view of FIG. **2**;

FIG. **4** is a partial cross-sectional view of a portion different from FIG. **2** in a circumferential direction of a wafer support;

FIG. **5** is a view schematically illustrating a state in the processing module during a process of placing an edge ring;

FIG. **6** is a view schematically illustrating a state in the processing module during the process of placing the edge ring;

FIG. **7** is a view schematically illustrating a state in the processing module during the process of placing the edge ring;

FIG. **8** is a view for describing another example of an elevating pin;

FIG. **9** is a view for describing another example of an electrostatic chuck;

FIG. **10** is a partially enlarged cross-sectional view illustrating a schematic configuration of a wafer support that is a substrate support according to a second exemplary embodiment;

FIG. **11** is a partially enlarged cross-sectional view illustrating a schematic configuration of a wafer support that is a substrate support according to a third exemplary embodiment;

FIG. **12** is a plan view illustrating a schematic configuration of a plasma processing system according to a fourth exemplary embodiment;

FIG. **13** is a partially enlarged cross-sectional view illustrating a schematic configuration of a wafer support that is a substrate support according to the fourth exemplary embodiment;

FIG. **14** is a partially enlarged cross-sectional view illustrating another example of a wafer support;

FIG. **15** is a partially enlarged cross-sectional view illustrating still another example of a wafer support;

FIG. **16** is a view schematically illustrating a state in a processing module during a process of removing an edge ring alone;

FIG. **17** is a view schematically illustrating a state in the processing module during the process of removing the edge ring alone;

FIG. **18** is a view schematically illustrating a state in the processing module during the process of removing the edge ring alone;

FIG. **19** is a view schematically illustrating a state in the processing module during the process of removing the edge ring alone;

FIG. **20** is a view schematically illustrating a state in the processing module during the process of removing the edge ring alone;

FIG. **21** is a view schematically illustrating a state in the processing module during the process of removing the edge ring alone;

FIG. **22** is a view schematically illustrating a state in the processing module during a process of removing a cover ring supporting the edge ring;

FIG. **23** is a view schematically illustrating a state in the processing module during the process of removing the cover ring supporting the edge ring;

FIG. **24** is a view schematically illustrating a state in the processing module during the process of removing the cover ring supporting the edge ring;

FIG. **25** is a view schematically illustrating a state in the processing module during the process of removing the cover ring supporting the edge ring;

FIG. **26** is a view schematically illustrating a state in the processing module during the process of removing the cover ring supporting the edge ring; and

FIG. **27** is a view schematically illustrating a state in the processing module during the process of removing the cover ring supporting the edge ring.

DETAILED DESCRIPTION

Exemplary Embodiments

In a manufacturing process of a semiconductor device or the like, a substrate such as a semiconductor wafer (hereinafter, referred to as a "wafer") is subjected to plasma processing such as etching or film formation using plasma. The plasma processing is performed in a state where the wafer is placed on a substrate support provided in a pressure-reducible processing chamber.

Further, in order to obtain good and uniform processing results in a central portion and a peripheral edge portion of the substrate during the plasma processing, an annular member referred to as an edge ring or a focus ring may be disposed to surround a periphery of the substrate on the substrate support. When an edge ring is used, the edge ring is accurately positioned and disposed so that a uniform processing result can be obtained in a circumferential direction at the peripheral edge portion of the substrate. For example, in Japanese Patent Application Publication No. 2011-54933, the edge ring is positioned using a positioning pin that is attached to the edge ring to protrude from a lower surface of the edge ring and is inserted into a positioning hole formed in an edge ring support surface.

When the edge ring is consumed, replacement of the edge ring is generally performed by an operator. However, it is also considered to replace the edge ring using a transfer device for transferring the edge ring. For example, in Japanese Patent Application Publication No. 2011-54933, the edge ring is replaced using both a lifter pin(s) and a transfer arm. The lifter pin is provided to protrude beyond or retract below the edge ring support surface of a substrate support and lifts the edge ring to separate the edge ring from the edge ring support surface, and the transfer arm performs the loading and unloading of both the wafer and the edge ring into and from the processing chamber.

However, when the edge ring is replaced using the transfer device, if a transfer accuracy of the edge ring is low, a portion of the edge ring may be caught on a substrate support surface of the substrate support, and thus the edge ring may not be appropriately placed on the edge ring support surface of the substrate support. For example, in a case where the difference between an inner diameter of the edge ring and a diameter of the substrate support surface is smaller than the transfer accuracy (transfer error) of the edge ring, when a position of the substrate support surface is higher than a position of the edge ring support surface, an inner side of the edge ring may be caught on the substrate support surface, and thus the edge ring may not be placed on the edge ring support surface.

Further, during the plasma processing, an annular member referred to as a cover ring that covers a circumferential outer surface of the edge ring may be disposed. In this case as well, if the transfer device is used to replace the cover ring, the cover ring may not be properly and accurately placed on a support surface for the cover ring.

Therefore, in a technique according to the exemplary embodiments, the annular member is positioned to be appropriately placed on the support surface for the annular member in the substrate support regardless of the transfer accuracy of the annular member.

Hereinafter, the substrate support, a plasma processing system, and an edge ring replacement method according to the exemplary embodiments will be described with reference to the drawings. Throughout the present specification and the drawings, like reference numerals will be given to like parts having substantially the same functions, and redundant description thereof will be omitted.

First Exemplary Embodiment

FIG. **1** is a plan view illustrating a schematic configuration of a plasma processing system according to a first exemplary embodiment.

In a plasma processing system **1** of FIG. **1**, for example, a wafer W that is a substrate is subjected to plasma processing such as etching, film formation, and diffusion using plasma.

As illustrated in FIG. **1**, the plasma processing system **1** has an atmospheric section **10** and a decompression section **11**, and the atmospheric section **10** and the decompression section **11** are integrally connected to each other via load lock modules **20** and **21**. The atmospheric section **10** includes an atmospheric module that performs the desired processing on the wafer W under an atmospheric pressure atmosphere. The decompression section **11** includes a decompression module that performs the desired processing on the wafer W in a pressure-reduced atmosphere.

The load lock modules **20** and **21** are connected to a loader module **30** to be described later of the atmospheric section **10** and a transfer module **50** to be described later of the decompression section **11** through gate valves (not illustrated). The load lock modules **20** and **21** are configured to temporarily hold the wafer W. Further, each of the load lock modules **20** and **21** is configured such that an inner space thereof can be switched between an atmospheric pressure atmosphere and a pressure-reduced atmosphere (vacuum atmosphere).

The atmospheric section **10** includes the loader module having a transfer device **40** to be described later, and load ports **32** in which Front Opening Unified Pods (FOUPs) **31***a* and **31***b* are mounted thereon. Each FOUP **31***a* is configured to store a plurality of wafers W, and the FOUP **31***b* is configured to store a plurality of edge rings F. Moreover, an orienter module (not illustrated) that adjusts horizontal orientations of the wafer W and the edge ring F, and/or a storage module (not illustrated) that stores, for example, the plurality of wafers W may be provided to be adjacent to the loader module **30**.

The loader module **30** includes a rectangular housing, and the inside of the housing is maintained in an atmospheric pressure atmosphere. A plurality of load ports **32**, for example, five load ports **32**, are disposed side by side on one side surface forming a long side of the housing of the loader module **30**. The load lock modules **20** and **21** are disposed side by side on the other side surface forming the long side of the housing of the loader module **30**.

The transfer device **40** configured to transfer the wafer W and the edge ring F is provided inside the loader module **30**. The transfer device **40** has a transfer arm **41** that supports and moves the wafer W or the edge ring F, a rotor **42** that rotatably supports the transfer arm **41**, and a base **43** on which the rotor **42** is placed. Further, a guide rail **44** extending in a longitudinal direction of the loader module **30** is provided inside the loader module **30**. The base **43** is provided on the guide rail **44**, and the transfer device is configured to be movable along the guide rail **44**.

The decompression section **11** has a transfer module **50** configured to transfer the wafer W or the edge ring F, and a processing module **60** serving as a plasma processing device that is configured to perform the desired plasma processing on the wafer W transferred from the transfer module **50**. The inside of each of the transfer module **50** and the processing module **60** is maintained in a pressure-reduced atmosphere. A plurality of processing modules **60**, for example, eight processing modules, are provided for one transfer module **50**. The number and arrangement of the processing modules **60** are not limited to the first exemplary embodiment and may be arbitrarily set as long as at least one processing module that requires replacement of the edge ring F is provided.

The inside of the transfer module **50** is formed with a polygonal (pentagonal shape in the illustrated example) housing, and the transfer module **50** is connected to the load lock modules **20** and **21** as described above. The transfer module **50** is configured to transfer the wafer W loaded into the load lock module **20** to one processing module **60**, and transfer the wafer W subjected to the desired plasma processing in the processing module **60** to the atmospheric section **10** via the load lock module **21**. Further, the transfer module **50** is configured to transfer the edge ring F loaded into the load lock module **20** to one processing module **60**, and transfer the edge ring F that is a replacement target in the processing module **60** to the atmospheric section **10** via the load lock module **21**.

For example, the processing module **60** performs plasma processing such as etching, film formation, and diffusion on the wafer W using plasma. For the processing module **60**, a module that performs the desired plasma processing can be arbitrarily selected. Further, the processing module **60** is connected to the transfer module **50** through a gate valve **61**. A configuration of the processing module **60** will be described later.

A transfer device **70** that is configured to transfer the wafer W or the edge ring F is provided inside the transfer module **50**. The transfer device **70** includes a transfer arm **71** serving as a holder that supports and moves the wafer W or the edge ring F, a rotor **72** that rotatably supports the transfer arm **71**, and a base **73** on which the rotor **72** is placed. Further, guide rails **74** that extend in a longitudinal direction of the transfer module **50** are provided inside the transfer module **50**. The base **73** is provided on the guide rails **74**, and the transfer device **70** is configured to be movable along the guide rails **74**.

In the transfer module **50**, the wafer W or the edge ring F held in the load lock module **20** is received by the transfer arm **71** and transferred into the processing module **60**. Further, the wafer W or the edge ring F held in the processing module **60** is received by the transfer arm **71** and loaded into the load lock module **21**.

Further, the plasma processing system **1** has a control device **80**. In one embodiment, the control device **80** processes computer-executable instructions for causing the plasma processing system **1** to perform various processes described in the present disclosure. The control device **80** may be configured to control the respective components of the plasma processing system **1** to perform the various processes described herein. In one embodiment, the control device **80** may be partially or entirely included within the components of the plasma processing system **1**. For example, the control device **80** may include a computer **90**. For example, the computer **90** may include a processing unit (central processing unit (CPU)) **91**, a storage unit (SU) **92**, and a communication interface (CI) **93**. The processing unit **91** may be configured to perform various control operations based on a program stored in the storage unit **92**. The storage unit **92** may include a random access memory (RAM), a read only memory (ROM), a hard disk drive (HDD), a solid state drive (SSD), or a combination thereof. The communication interface **93** may communicate with the components of the plasma processing system **1** via a communication line such as a local area network (LAN).

Next, wafer processing performed using the plasma processing system **1** configured as described above will be described.

First, the wafer W is extracted from a desired FOUP **31***a* by the transfer device **40** and loaded into the load lock module **20**. When the wafer W is loaded into the load lock module **20**, the inside of the load lock module **20** is sealed and a pressure therein is reduced. Thereafter, the inside of the load lock module **20** and the inside of the transfer module **50** communicate with each other.

Next, the wafer W is held by the transfer device **70** and transferred from the load lock module **20** to the transfer module **50**.

Next, the gate valve **61** is opened, and the wafer W is loaded into a desired processing module **60** by the transfer device **70**. Thereafter, the gate valve **61** is closed, and the wafer W is subjected to the desired processing in the processing module **60**. The processing performed on the wafer W in the processing module **60** will be described later.

Next, the gate valve **61** is opened, and the wafer W is unloaded from the processing module **60** by the transfer device **70**. Thereafter, the gate valve **61** is closed.

Next, the wafer W is loaded into the load lock module **21** by the transfer device **70**. When the wafer W is loaded into the load lock module **21**, the inside of the load lock module **21** is sealed and exposed to the atmosphere. Thereafter, the inside of the load lock module **21** and the inside of the loader module **30** communicate with each other.

Next, the wafer W is held by the transfer device **40**, transferred from the load lock module **21** to the desired FOUP **31***a* via the loader module **30**, and accommodated in the desired FOUP **31***a*. With the above procedure, a series of wafer processing in the plasma processing system **1** is completed.

Moreover, the transfer of the edge ring between the FOUP **31***b* and the desired processing module **60** at the time of replacing the edge ring is performed in the same manner as the transfer of the wafer between the FOUP **31***a* and the desired processing module **60** at the time of the above-described wafer processing.

Next, the processing module **60** will be described with reference to FIGS. **2** to **4**. FIG. **2** is a vertical cross-sectional view illustrating a schematic configuration of the processing module **60**. FIG. **3** is a partially enlarged view of FIG. **2**. FIG. **4** is a partial cross-sectional view of a portion different from FIG. **2** in a circumferential direction of a wafer support **101** to be described later.

As illustrated in FIG. **2**, the processing module **60** includes a plasma processing chamber **100** serving as a processing chamber, a gas supply unit **130**, a radio frequency (RF) power supply unit **140**, and an exhaust system (ES) **150**. Moreover, the processing module **60** also includes a gas supply unit **120** to be described later (see, e.g., FIG. **4**). Further, the processing module **60** includes a wafer support **101** serving as a substrate support and a shower head **102** serving as an upper electrode.

The wafer support **101** is disposed in a lower region of a plasma processing space **100***s* in the pressure-reducible plasma processing chamber **100**. The shower head **102** is disposed above the wafer support **101** and may function as a portion of a ceiling of the plasma processing chamber **100**.

The wafer support **101** is configured to support the wafer W in the plasma processing space **100***s*. In one embodiment, the wafer support **101** includes a lower electrode **103**, an electrostatic chuck **104**, an insulator **105**, elevating pins **106**, and elevating pins **107**. Although not illustrated, in one embodiment, the wafer support **101** may include a temperature control module configured to adjust at least one of the electrostatic chuck **104** and the wafer W to a target temperature. The temperature control module may include a heater, a flow path, or a combination thereof. A temperature control fluid such as a refrigerant or a heat transfer gas flows through the flow path.

The lower electrode **103** is made of, for example, a conductive material such as aluminum. In one embodiment, the temperature control module described above may be provided in the lower electrode **103**.

The electrostatic chuck **104** is a member configured to attract and hold both the wafer W and the edge ring F by an electrostatic force, and is provided on the lower electrode **103**. An upper surface **104***a* of a central portion of the electrostatic chuck **104** is formed to be higher than an upper surface of a peripheral edge portion **104***b* of the electrostatic chuck **104**. The upper surface **104***a* of the central portion of the electrostatic chuck **104** serves as a substrate support surface on which the wafer W is placed, and the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104** serves as an annular member support surface on which the edge ring F serving as an annular member is placed. The edge ring F is the annular member disposed to surround the wafer W placed on the upper surface **104***a* of the central portion of the electrostatic chuck **104**.

An electrode **108** for attracting and holding the wafer W is provided in the central portion of the electrostatic chuck **104**, and an electrode **109** for attracting and holding the edge ring F is provided in the peripheral edge portion of the electrostatic chuck **104**. The electrostatic chuck **104** has a structure in which the electrodes **108** and **109** are interposed between insulators made of an insulating material.

A DC voltage from a DC power supply (not illustrated) is applied to the electrode **108**. Accordingly, the wafer W is attracted and held onto the upper surface **104***a* of the central portion of the electrostatic chuck **104** by an electrostatic force thus generated. Similarly, a DC voltage from a DC power supply (not illustrated) is applied to the electrode **109**. Accordingly, the edge ring F is attracted and held onto the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104** by an electrostatic force thus generated. As illustrated in FIG. **3**, the electrode **109** is a bipolar type electrode including a pair of electrodes **109***a* and **109***b*.

In the first exemplary embodiment, the central portion of the electrostatic chuck **104** having the electrode **108** and the peripheral edge portion of the electrostatic chuck having the electrode **109** are integrated with each other. However, the central portion and the peripheral edge portion may be separate bodies.

Further, in the first exemplary embodiment, the electrode **109** for attracting and holding the edge ring F is a bipolar type electrode. However, the electrode **109** may be a unipolar type electrode.

Further, for example, the central portion of the electrostatic chuck **104** is formed to have a diameter smaller than a diameter of the wafer W. Thus, as illustrated in FIG. **2**, when the wafer W is placed on the upper surface **104***a*, the peripheral edge portion of the wafer W horizontally protrudes from the central portion of the electrostatic chuck **104**.

Moreover, the edge ring F has a stepped portion formed on an upper portion thereof, and an upper surface of an outer peripheral portion of the edge ring F is formed to be higher than an upper surface of an inner peripheral portion thereof. The inner peripheral portion of the edge ring F is formed so as to enter an area below the peripheral edge portion of the wafer W horizontally protruding from the central portion of the electrostatic chuck **104**. That is, an inner diameter of the edge ring F is formed to be smaller than an outer diameter of the wafer W.

The insulator **105** is a cylindrical member made of a ceramic or the like, and supports the electrostatic chuck **104**.

For example, the insulator **105** is formed so as to have an outer diameter equal to an outer diameter of the lower electrode **103**, and supports a peripheral edge portion of the lower electrode **103**. Further, the insulator **105** is provided so that an inner peripheral surface of the insulator **105** is located outside an elevating mechanism **114** to be described later in a radial direction along the electrostatic chuck **104**.

Each elevating pin **106** is a columnar member that is raised or lowered (vertically moved) to protrude beyond or retract below the upper surface **104***a* of the central portion of the electrostatic chuck **104**. The elevating pin **106** is made of, for example, ceramic. Three or more elevating pins **106** are provided at intervals along a circumferential direction of the electrostatic chuck **104**, that is, a circumferential direction of the upper surface **104***a*. For example, the elevating pins **106** are provided at equal intervals along the circumferential direction. The elevating pins **106** are provided so as to extend in an up-down direction.

The elevating pins **106** are connected to an elevating mechanism **110** that raises or lowers the elevating pins **106**. For example, the elevating mechanism **110** has a support member **111** that supports the elevating pins **106**, and a driving unit **112** that generates a driving force for raising or lowering the support member **111** to raise or lower the elevating pins **106**. The driving unit **112** has a motor (not illustrated) that generates the driving force.

Each of the elevating pins **106** is inserted into a through-hole **113** which extends downward from the upper surface **104***a* of the central portion of the electrostatic chuck **104** to reach a bottom surface of the lower electrode **103**. In other words, the through-hole **113** is formed through the central portion of the electrostatic chuck **104** and the lower electrode **103**.

Each elevating pin **107** is a columnar member that is raised or lowered (vertically moved) to protrude beyond or retract below the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104**. The elevating pin **107** is formed of, for example, alumina, quartz, SUS, or the like. Three or more elevating pins **107** are provided at intervals along the circumferential direction of the electrostatic chuck **104**, that is, the circumferential direction of the upper surface **104***b* of the peripheral edge portion. For example, the elevating pins **107** are provided at equal intervals along the circumferential direction. The elevating pins **107** are provided so as to extend in the up-down direction.

Moreover, for example, a thickness of each of the elevating pins **107** in a range from 1 mm to 3 mm.

The elevating pins **107** are connected to an elevating mechanism **114** that drives the elevating pins **107**. For example, the elevating mechanism **114** is provided for each elevating pin **107** and has a support member **115** that movably supports the elevating pin **107** in a horizontal direction. For example, the support member **115** has a thrust bearing in order to movably support the elevating pin **107** in the horizontal direction. Further, the elevating mechanism **114** has a driving unit **116** that generates a driving force for raising or lowering the support member **115** to raise or lower the elevating pin **107**. The driving unit **116** has a motor (not illustrated) that generates the driving force.

The elevating pin **107** is inserted into a through-hole **117** which extends downward from the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104** to reach the bottom surface of the lower electrode **103**. In other words, the through-hole **117** is formed through the peripheral edge portion of the electrostatic chuck **104** and the lower electrode **103**.

The through-hole **117** is formed to have positioning accuracy at least larger than a transfer accuracy (transfer error) of the edge ring with the transfer device **70**. In other words, the size of the through-hole **117** is formed to be larger than the transfer error of the edge ring with the transfer device **70**.

Except for an upper end portion of the elevating pin **107**, the elevating pin **107** is formed in, for example, a columnar shape, and the upper end portion is formed in a hemispherical shape that gradually tapers upward. The upper end portion of the elevating pin **107** comes into contact with the bottom surface of the edge ring F when the elevating pin **107** is raised to support the edge ring F. As illustrated in FIG. **3**, for each of the elevating pins **107**, a recess F**1** formed with an upwardly recessed concave surface Fla is provided at a position corresponding to the elevating pin **107** on the bottom surface of the edge ring F.

In a plan view, a size D**1** (opening diameter) of the recess F**1** of the edge ring F is larger than a transfer accuracy (error) (±X μm) of the edge ring F with the transfer device **70** above the upper surface **104***b* of the electrostatic chuck **104** and larger than a size D**2** of the upper end portion of the elevating pin **107**. For example, a relationship of D**1**>D**2** and D**1**>**2**X is satisfied, and D**1** is about 0.5 mm. In another example, D**1** may range from 0.5 mm to 3 mm.

Further, as described above, the upper end portion of the elevating pin **107** is formed in a hemispherical shape that gradually tapers upward, and a curvature of the concave surface Fla forming the recess F**1** of the edge ring F is set to be smaller than a curvature of a convex surface (that is, the upper end surface) **107***a* forming the hemispherical shape of the upper end portion of the elevating pin **107**. That is, the concave surface Fla has a radius of curvature larger than a radius of curvature of the convex surface **107***a*.

Moreover, for example, when a thickness of the outer peripheral portion of the edge ring F is in a range from 3 mm to 5 mm, a depth of the recess F**1** is in a range from 0.5 mm to 1 mm.

Further, for example, Si or SiC is used as a material of the edge ring F.

Further, as illustrated in FIG. **4**, a heat transfer gas supply path **118** is formed for the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104**. The heat transfer gas supply path **118** is provided to supply a heat transfer gas such as helium gas to the bottom surface of the edge ring F placed on the upper surface **104***b*. The heat transfer gas supply path **118** is provided to be in fluid communication with the upper surface **104***b*. Further, a side of the heat transfer gas supply path **118** opposite to the upper surface **104***b* is in fluid communication with the gas supply unit **120**. The gas supply unit **120** may include one or more gas sources (GS) **121** and one or more flow controllers (FC) **122**. In one embodiment, for example, the gas supply unit **120** is configured to supply a heat transfer gas from the gas source **121** to the heat transfer gas supply path via the flow controller **122**. For example, each flow controller **122** may include a mass flow controller or a pressure-control type flow controller.

Although not illustrated, similarly, in order to supply a heat transfer gas to the bottom surface of the wafer W placed on the upper surface **104***a*, the heat transfer gas supply path **118** is also formed for the upper surface **104***a* of the central portion of the electrostatic chuck **104**.

Further, a suction path for vacuum-attracting the edge ring F placed on the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104** may be formed. For example, the suction path is provided in the electrostatic chuck **104** to be in fluid communication with the upper surface **104**b. The heat transfer gas supply path and the suction path described above may be in common in whole or in part.

Referring back to FIG. **2**, the shower head **102** serving as the upper electrode is configured to supply one or more processing gases from the gas supply unit **130** to the plasma processing space **100**s. In one embodiment, the shower head **102** has a gas inlet **102**a, a gas diffusion chamber **102**b, and a plurality of gas outlets **102**c. For example, the gas inlet **102**a is in fluid communication with the gas supply unit **130** and the gas diffusion chamber **102**b. The plurality of gas outlets **102**c is in fluid communication with the gas diffusion chamber **102**b and the plasma processing space **100**s.

In one embodiment, the shower head **102** is configured to supply one or more processing gases from the gas inlet **102**a to the plasma processing space **100**s via the gas diffusion chamber **102**b and the plurality of gas outlets **102**c. The gas supply unit **130** may include one or more gas sources (GS) **131** and one or more flow controllers (FC) **132**. In one embodiment, for example, the gas supply unit **130** is configured to supply one or more processing gases from the corresponding gas sources **131** to the gas inlet **102**a via the corresponding flow controllers **132**. For example, each flow controller **132** may include, e.g., a mass flow controller or a pressure-control type flow controller. Further, the gas supply unit **130** may include one or more flow modulation devices for modulating or pulsating a gas flow of one or more processing gases.

The RF power supply unit **140** is configured to supply RF power, for example, one or more RF signals, to one or more electrodes such as the lower electrode **103**, the shower head **102**, or both the lower electrode **103** and the shower head **102**. Therefore, plasma is generated from one or more processing gases supplied to the plasma processing space **100**s. Accordingly, the RF power supply unit **140** may function as at least a part of a plasma generation unit configured to generate plasma from one or more processing gases in the plasma processing chamber. For example, the RF power supply unit **140** includes two RF generation units (RF) **141**a and **141**b and two matching circuits (MC) **142**a and **142**b. In one embodiment, the RF power supply unit **140** is configured to supply a first RF signal from a first RF generation unit (RF) **141**a to the lower electrode **103** via a first matching circuit **142**a. For example, the first RF signal may have a frequency in a range of 27 MHz to 100 MHz.

Further, in one embodiment, the RF power supply unit **140** is configured to supply a second RF signal from a second RF generation unit (RF) **141**b to the lower electrode **103** via a second matching circuit **142**b. For example, the second RF signal may have a frequency in a range of 400 kHz to 13.56 MHz. Alternatively, a direct current (DC) pulse generation unit may be used instead of the second RF generation unit **141**b.

Further, although not illustrated, other embodiments may be considered in the present disclosure. For example, in an alternative embodiment, the RF power supply unit **140** may be configured to supply the first RF signal from the RF generation unit to the lower electrode **103**, the second RF signal from another RF generation unit to the lower electrode **103**, a third RF signal from still another RF generation unit to the lower electrode **103**. In addition, in another alternative embodiment, a DC voltage may be applied to the shower head **102**.

Further, in various embodiments, amplitudes of one or more RF signals (that is, first RF signal, second RF signal, and the like) may be pulsated or modulated. The amplitude modulation may include pulsating the RF signal amplitude between an ON state and an OFF state, or between two or more different ON states.

The exhaust system **150** may be connected to, for example, an exhaust port **100**e disposed at a bottom of the plasma processing chamber **100**. The exhaust system **150** may include a pressure valve and a vacuum pump. The vacuum pump may include a turbo molecular pump, a roughing pump or a combination thereof.

Next, an example of wafer processing performed using the processing module **60** configured as described above will be described. Moreover, the processing module **60** performs processing such as etching, film formation, and diffusion on the wafer W.

First, the wafer W is loaded into the plasma processing chamber **100**, and the wafer W is placed on the electrostatic chuck **104** by raising or lowering (vertically moving) the elevating pins **106**. Thereafter, a DC voltage is applied to the electrode **108** of the electrostatic chuck **104**, and thus the wafer W is electrostatically attracted and held on the electrostatic chuck **104** by an electrostatic force. Further, after the wafer W is loaded, the pressure in the plasma processing chamber **100** is reduced to a predetermined vacuum level by the exhaust system **150**.

Next, the processing gas is supplied from the gas supply unit **130** to the plasma processing space **100**s via the shower head **102**. Further, RF power HF for plasma generation is supplied from the RF power supply unit **140** to the lower electrode **103**, and thus the processing gas is excited to generate plasma. Further, RF power LF for ion introduction may be supplied from the RF power supply unit **140**. Then, the wafer W is subjected to plasma processing by the action of the generated plasma.

During the plasma processing, the heat transfer gas such as He gas or Ar gas is supplied to the bottom surface of the wafer W and the bottom surface of the edge ring F, which are attracted and held on the electrostatic chuck **104**, through the heat transfer gas supply path **118** or the like.

In order to end the plasma processing, the supply of the heat transfer gas to the bottom surface of the wafer W may be stopped. Further, the supply of the RF power HF from the RF power supply unit **140** and the supply of the processing gas from the gas supply unit **130** are stopped. When the RF power LF is supplied during the plasma processing, the supply of the RF power LF is also stopped. Next, the attraction and holding of the wafer W on the electrostatic chuck **104** is stopped.

Thereafter, the wafer W is raised by the elevating pins **106** and separated from the electrostatic chuck **104**. During the separation, charge neutralization of the wafer W may be performed. Then, the wafer W is unloaded from the plasma processing chamber **100**, and a series of wafer processing is completed.

Moreover, the edge ring F is attracted and held by the electrostatic force during the wafer processing, and specifically, the edge ring F is attracted and held by the electrostatic force even during the plasma processing and before and after the plasma processing. Before and after the plasma processing, different voltages are applied to the electrodes **109**a and **109**b such that a potential difference is generated between the electrode **109**a and the electrode **109**b. The edge ring F is attracted and held by an electrostatic force caused by the potential difference. In contrast, during the plasma processing, the same voltage (for example, the same positive voltage) is applied to the electrode **109**a and the electrode **109**b, and a potential difference is generated between the electrode **109**a/the electrode **109**b and the edge ring F having a ground potential through the plasma. The edge ring F is attracted and held by an electrostatic force caused by the potential difference. Moreover, while the edge ring F is attracted and held by the electrostatic force, the elevating pins **107** are retracted below the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104**.

As described above, since the edge ring F is attracted and held by the electrostatic force, there is no misalignment between the edge ring F and the electrostatic chuck **104** when the supply of the heat transfer gas to the bottom surface of the edge ring F is started.

Next, an example of a process of placing the edge ring F in the processing module **60**, which is performed using the above-described plasma processing system **1**, will be described with reference to FIGS. **5** to **7**. FIGS. **5** to **7** are views schematically illustrating a state in the processing module **60** during the placement process. Moreover, the following process is performed under the control of the control device **80**. Further, for example, the following process is performed in a state where a temperature of the electrostatic chuck **104** is room temperature.

First, in the plasma processing system **1**, the transfer arm **71** holding the edge ring F is inserted from the transfer module **50** having a vacuum atmosphere into the pressure-reduced plasma processing chamber **100** of the processing module **60** in which the edge ring F is to be placed, through a loading/unloading port (not illustrated). Then, as illustrated in FIG. **5**, the edge ring F held by the transfer arm **71** is transferred above the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104**. The edge ring F is held by the transfer arm **71** while a circumferential orientation thereof is adjusted.

Next, all the elevating pins **107** are raised, and the edge ring F is delivered from the transfer arm **71** to the elevating pins **107** as illustrated in FIG. **6**. Specifically, all the elevating pins **107** are raised, and the upper end portion of each elevating pin **107** comes into contact with the bottom surface of the edge ring F held by the transfer arm **71**. In this case, the upper end portion of the elevating pin **107** enters the recess F**1** provided in the bottom surface of the edge ring F. This is because, as described above, for each of the elevating pins **107**, the recess F**1** is provided at a position corresponding to the elevating pin **107** on the bottom surface of the edge ring F, and in a plan view, the size of the recess F**1** is larger than the transfer accuracy (transfer error) of the edge ring F with the transfer device **70** and larger than the size of the upper end portion of the elevating pin **107**. When the elevating pins **107** are continuously raised even after the upper end portions of the elevating pins **107** are in contact with the bottom surface of the edge ring F, the edge ring F is delivered to the elevating pins **107** and supported by the elevating pins **107** as illustrated in FIG. **6**.

Moreover, as described above, the curvature of the concave surface Fla forming the recess F**1** of the edge ring F is set to be smaller than the curvature of the convex surface **107***a* forming the hemispherical shape of the upper end portion of each elevating pin **107**. Therefore, the edge ring F moves as follows and is positioned with respect to the elevating pin **107** even if the position of the edge ring F with respect to the elevating pin **107** is misaligned immediately after delivery to the elevating pin **107**. That is, the edge ring F relatively moves with respect to the concave surface Fla so that a top of the upper end portion of the elevating pin **107** slides on the concave surface Fla of the edge ring F. Then, the edge ring F stops moving at a point where a center of the recess F**1** and a center of the upper end portion of the elevating pin **107** coincide with each other in a plan view. That is, the edge ring F stops moving at a point where a deepest portion of the recess F**1** and the top of the upper end portion of the elevating pin **107** coincide with each other in a plan view, and the edge ring F is positioned with respect to the elevating pin **107** at that position.

Moreover, in order to promote the movement for the positioning after the edge ring F is delivered to the elevating pins **107**, each elevating pin **107** may be finely moved up and down, or each elevating pin **107** may be lowered at different speeds or at a high speed.

After the edge ring F is positioned with respect to the elevating pin **107**, the transfer arm **71** is extracted from the plasma processing chamber **100** and the elevating pins **107** are lowered. Thus, the edge ring F is placed on the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104** as illustrated in FIG. **7**.

The edge ring F is positioned with respect to each elevating pin **107** as described above, and further because the through-hole **117** and the elevating pin **107** are provided with respect to the center of the electrostatic chuck **104** with high accuracy, the edge ring F is placed on the upper surface **104***b* in a state of being positioned with respect to the center of the electrostatic chuck **104**.

Moreover, for example, the elevating pin **107** is lowered until the upper end surface of the elevating pin **107** is retracted below the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104**.

Thereafter, a DC voltage from a DC power supply (not illustrated) is applied to the electrode **109** provided in the peripheral edge portion of the electrostatic chuck **104**, and the edge ring F is attracted and held onto the upper surface **104***b* by an electrostatic force generated by the DC voltage. Specifically, different voltages are applied to the electrode **109***a* and the electrode **109***b*, and the edge ring F is attracted and held onto the upper surface **104***b* by an electrostatic force according to a potential difference thus generated.

With the above procedure, a series of processes of placing the edge ring F is completed.

When the above-described suction path is provided, after the edge ring F is placed on the upper surface **104***b*, vacuum-attraction may be performed on the upper surface **104***b* using the suction path before being attracted and held by the electrostatic force. Then, after switching from the vacuum-attraction using the suction path to the attraction and holding using the electrostatic force, a vacuum level of the suction path is measured, and based on the measurement result, it may be determined whether to place the edge ring F on the upper surface **104***b* again.

A process of removing the edge ring F is performed in a reverse procedure of the process of placing the edge ring F described above.

Moreover, when the edge ring F is removed, the edge ring F may be cleaned first and unloaded from the plasma processing chamber **100**.

As described above, the wafer support **101** according to the first exemplary embodiment includes the upper surface **104***a* on which the wafer W is placed, the upper surface **104***b* on which the edge ring F, which is disposed to surround the wafer W held on the upper surface **104***a*, is placed, three or more elevating pins **107** that are raised or lowered to protrude beyond or retract below the upper surface **104***b*, and the elevating mechanism **114** that raises or lowers the elevating pins **107**. Further, for each of the elevating pins **107**, the recess F**1** having the concave surface Fla recessed upward is provided at a position corresponding to the elevating pin **107** on the bottom surface of the edge ring F. Then, in a plan view, the recess F**1** is formed so that the size of the recess F**1** is larger than the transfer error of the edge ring F above the upper surface **104***b* and larger than the size of the upper end portion of the elevating pin **107**. Therefore, when the elevating pin **107** is raised and comes into contact with the bottom surface of the edge ring F, the upper end portion of the elevating pin **107** can be accommodated in the recess F**1** of the edge ring F. Further, in the first exemplary embodiment, the upper end portion of the elevating pin **107** is formed in a hemispherical shape that gradually tapers upward, and the curvature of the concave surface Fla of the recess F**1** is smaller than the curvature of the convex surface of the hemispherical shape of the upper end portion of the elevating pin **107**. Therefore, when the edge ring F is supported by the elevating pin **107**, the edge ring F can be positioned with respect to the elevating pin **107** at the position where the deepest portion of the recess F**1** and the top of the upper end portion of the elevating pin **107** coincide with each other in a plan view. Accordingly, when the elevating pin **107** supporting the edge ring F is lowered, the elevating pin **107** can be positioned with respect to the electrostatic chuck **104** and the edge ring F is placed on the upper surface **104***b*. That is, according to the first exemplary embodiment, the edge ring F can be positioned and placed on the wafer support **101** regardless of the transfer accuracy of the edge ring F.

Further, when the wafer support **101** according to the first exemplary embodiment is provided in the plasma processing device, the edge ring F can be replaced using the transfer device **70** without the intervention of an operator. When the operator replaces the edge ring, it is necessary to expose the processing chamber in which the edge ring is disposed to the atmosphere. However, when the wafer support **101** according to the first exemplary embodiment is provided, since the edge ring F can be replaced using the transfer device **70**, it is not necessary to expose the plasma processing chamber **100** to the atmosphere at the time of the replacement. Therefore, according to the first exemplary embodiment, the time required for replacement can be significantly shortened. Further, in the first exemplary embodiment, since three or more elevating pins are provided, in addition to the positional alignment of the edge ring F in a radial direction (direction from the center of the wafer support **101** toward an outer periphery), the positional alignment of the edge ring F in a circumferential direction can be performed.

Further, in the first exemplary embodiment, the elevating mechanism **114** is provided for each elevating pin **107**, and further has the support member **115** that movably supports the elevating pin **107** in the horizontal direction. Therefore, when the electrostatic chuck **104** is thermally expanded or contracted, the elevating pin **107** can be moved in the horizontal direction in response to the thermal expansion or contraction. Therefore, when the electrostatic chuck **104** is thermally expanded or contracted, the elevating pin **107** is not damaged.

Further, in the first exemplary embodiment, after the edge ring F is placed, the electrode **109** is used to attract and hold the edge ring F by an electrostatic force. Therefore, it is not necessary to provide a protrusion or a recess on the bottom surface of the edge ring F or the support surface (upper surface **104***b* of the electrostatic chuck **104**) of the edge ring F for suppressing the misalignment of the placed edge ring F. In particular, since it is not necessary to provide the protrusions or the like on the upper surface **104***b* of the electrostatic chuck **104**, it is possible to suppress the complexity of a configuration of the electrostatic chuck **104**.

Moreover, in the first exemplary embodiment, since there is no other member between the electrostatic chuck **104** of the wafer support **101** and the edge ring F, a cumulative tolerance is small.

FIG. **8** is a view for describing another example of the elevating pin.

An elevating pin **160** of FIG. **8** has a columnar portion **162** and a connection portion **163** in addition to an upper end portion **161** formed in a hemispherical shape.

The columnar portion **162** is formed in a columnar shape thicker than the upper end portion **161**. Specifically, for example, the columnar portion **162** is formed in a cylindrically columnar shape thicker than the upper end portion **161**.

The connection portion **163** is a portion that connects the upper end portion **161** and the columnar portion **162**. This connection portion is formed in a truncated cone shape that gradually tapers upward. Specifically, for example, the connection portion is formed in a truncated cone shape whose lower end has the same diameter as that of the columnar portion **162** and whose upper end has the same diameter as that of the upper end portion **161**.

By using the elevating pin **160**, positioning accuracy of the edge ring F with respect to the elevating pin **160** can be further improved.

Moreover, by using the elevating pin **160** described above, the recess F**1** can be made shallower, and thus the edge ring F can be made thinner and lighter.

FIG. **9** is a view for describing another example of the electrostatic chuck.

An electrostatic chuck **170** of FIG. **9** includes an insulating guide **180** in the through-hole **117** through which the elevating pin **107** is inserted.

For example, the guide **180** is a cylindrical member made of resin, and is fitted into the through-hole **117**.

In the electrostatic chuck **170**, the elevating pin **107** is inserted into the guide **180** provided in the through-hole **117**, and a moving direction of the elevating pin **107** when the elevating pin **107** is raised or lowered is defined in the up-down direction by the guide **180**. Therefore, the upper end portion of the elevating pin **107** is more accurately positioned with respect to the electrostatic chuck **170**. Accordingly, in the state where the edge ring F is supported by the elevating pin **107** after the positioning of the edge ring F is performed, when the elevating pin **107** is lowered to be placed on the upper surface **104***b* of the electrostatic chuck **170**, the edge ring F can be placed on the upper surface **104***b* in a state where the edge ring F is positioned more accurately with respect to the electrostatic chuck **170**.

Second Exemplary Embodiment

FIG. **10** is a partially enlarged cross-sectional view illustrating a schematic configuration of a wafer support **200** serving as a substrate support according to a second exemplary embodiment.

In the first exemplary embodiment, the edge ring F is the replacement target. However, in the second exemplary embodiment, a cover ring C is the replacement target. The cover ring C is an annular member that covers an outer surface of the edge ring F in the circumferential direction.

The wafer support **200** of FIG. **10** has a lower electrode **201**, an electrostatic chuck **202**, a support **203**, an insulator **204**, and an elevating pin **205**.

In the lower electrode **103** and the electrostatic chuck **104** illustrated in FIG. **2** or the like, the through-hole **117** that extends through the lower electrode **103** and the electrostatic chuck **104** is provided. However, the through-hole **117** is not provided in the lower electrode **201** and the electrostatic chuck **202**. In this respect, the lower electrode **201** and the electrostatic chuck **202** are different from the lower electrode **103** and the electrostatic chuck **104**.

For example, the support **203** is a member that is made of quartz and formed in an annular shape in a plan view. The support **203** supports the lower electrode **201** and the cover ring C. An upper surface **203***a* of the support **203** becomes an annular member support surface on which the cover ring C that is the annular member to be replaced is placed.

The insulator **204** is a cylindrical member made of a ceramic or the like. The insulator **204** supports the support **203**. For example, the insulator **204** is formed to have an outer diameter equal to an outer diameter of the support **203**, and supports a peripheral edge portion of the support **203**.

While the elevating pin **107** of FIG. **2** or the like is inserted through the through-hole **117** extending through the lower electrode **103** and the electrostatic chuck **104**, the elevating pin **205** is inserted through a through-hole **206** extending through the support **203** from the upper surface **203***a* in the up-down direction. In this respect, the elevating pin **205** is different from the elevating pin **107**. Meanwhile, similar to the elevating pin **107**, three or more elevating pins **205** are provided at intervals along a circumferential direction of the electrostatic chuck **202**.

Further, similar to the elevating pin **107**, the elevating pin **205** is formed in a hemispherical shape of which an upper end portion gradually tapers upward. The upper end portion of the elevating pin **205** comes into contact with a bottom surface of the cover ring C when the elevating pin **205** is raised to support the cover ring C. Further, for each elevating pin **205**, a recess C**1** having an upwardly recessed concave surface C**1***a* is provided at a position corresponding to the elevating pin **205** on the bottom surface of the cover ring C.

In a plan view, a size of the recess C**1** of the cover ring C is larger than the transfer accuracy (transfer error) of the cover ring C with the transfer device **70** and larger than a size of the upper end portion of the elevating pin **205**.

Further, as described above, the upper end portion of the elevating pin **205** is formed in a hemispherical shape that gradually tapers upward, and a curvature of the concave surface C**1***a* of the recess C**1** of the cover ring C is set to be smaller than a curvature of a convex surface **205***a* of the hemispherical shape of the upper end portion of the elevating pin **205**.

Processes of placing and removing the cover ring C are the same as the processes of placing and removing the edge ring F according to the first exemplary embodiment, and thus descriptions thereof will be omitted.

Moreover, the elevating pin **107** for the edge ring F illustrated in FIG. **2** or the like is configured to protrude beyond or retract below the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104**. Then, when the edge ring F is attracted and held by the electrostatic force, the upper end surface of the elevating pin **107** is retracted below the upper surface **104***b* of the peripheral edge portion of the electrostatic chuck **104**. On the other hand, as long as the elevating pin **205** can protrude from the upper surface **203***a* of the support **203** and an amount of protrusion is adjustable, the elevating pin **205** may not be configured to protrude beyond or retract below the upper surface **203***a* of the support **203**. Further, when the edge ring F is attracted and held by the electrostatic force, the upper end surface of the elevating pin **205** may protrude from the upper surface **203***a* of the support **203**.

Third Exemplary Embodiment

FIG. **11** is a partially enlarged cross-sectional view illustrating a schematic configuration of a wafer support **300** that is the substrate support according to a third exemplary embodiment.

In the first exemplary embodiment, the edge ring F is the replacement target, and in the second exemplary embodiment, the cover ring C is the replacement target. However, in the third exemplary embodiment, both the edge ring F and the cover ring C are the replacement targets.

In the third exemplary embodiment, the edge ring F and the cover ring C are replaced separately. Therefore, the elevating pin **107** and the through-hole **117** are provided for the edge ring F, and the elevating pin **205** and the through-hole **206** are provided for the cover ring C. Further, the above-described recesses F**1** and C**1** are formed on the bottom surface of the edge ring F and the bottom surface of the cover ring C, respectively.

In the third exemplary embodiment, processes of placing and removing the edge ring F and processes of placing and removing the cover ring C are the same as the processes of placing and removing the edge ring F according to the first exemplary embodiment, and thus descriptions thereof will be omitted.

Fourth Exemplary Embodiment

The edge ring F is the replacement target in the first exemplary embodiment, the cover ring C is the replacement target in the second exemplary embodiment, and both the edge ring F and the cover ring C are the replacement targets in the third exemplary embodiment. On the other hand, in the fourth exemplary embodiment, the cover ring supporting the edge ring or the edge ring alone is the replacement target.

That is, in the fourth exemplary embodiment, both the edge ring and the cover ring are used as described in the third exemplary embodiment. However, in a technique according to the fourth exemplary embodiment, when the edge ring is replaced in the plasma processing system in which both the edge ring and the cover ring are used, a replacement in a state where the edge ring is supported by the cover ring (that is, a replacement in a state where the edge ring is integrated with the cover ring), and a replacement of the edge ring alone are selectively performed.

FIG. **12** is a plan view illustrating a schematic configuration of a plasma processing system according to the fourth exemplary embodiment.

Unlike the plasma processing system **1** of FIG. **1**, in a plasma processing system **1***a* of FIG. **12**, the decompression section **11** includes a storage module **62** that stores at least one of jigs to be described later for replacing the cover ring supporting the edge ring and the edge ring alone, in addition to the transfer module **50** and the processing module **60**.

In the example of FIG. **12**, two storage modules **62** are provided for one transfer module **50**. The cover ring supporting the edge ring is stored in at least one of the two storage modules **62**, and the jig is stored in the other of the two storage modules **62**. The number and arrangement of the storage modules **62** are not limited thereto and may be arbitrarily set as long as at least one storage module **62** is provided.

The storage module **62** is connected to the transfer module **50** through a gate valve **63**. Then, the inside of the storage module **62** is also maintained in a pressure-reduced atmosphere similar to the insides of the transfer module **50** and the processing module **60**.

In the transfer module **50** of the plasma processing system **1***a*, the cover ring supporting the edge ring or the jig stored in the storage module **62** is received by the transfer arm **71** and transferred to the processing module **60**. Further, in the transfer module **50**, the cover ring supporting the edge ring or the jig held in the processing module **60** is received by the transfer arm **71** and transferred to the storage module **62**.

Further, the plasma processing system **1***a* of FIG. **12** and the plasma processing system **1** of FIG. **1** differ in the configuration of the wafer support that is the substrate support in the processing module **60**.

FIG. **13** is a partially enlarged cross-sectional view illustrating a schematic configuration of a wafer support **400** that is the substrate support according to the present embodiment.

The wafer support **400** of FIG. **13** includes a lower electrode **401**, an electrostatic chuck **402**, a support **403**, an insulator **404**, and a lifter **405**.

The lower electrode **401** and the electrostatic chuck **402** include an insertion hole **406** through which the lifter **405** is inserted. For example, the insertion hole **406** is formed to extend downward from an upper surface **402***a* of a peripheral edge portion of the electrostatic chuck **402** and reach a bottom surface of the lower electrode **401**.

Moreover, in the example of FIG. **13**, the electrostatic chuck **402** includes a bipolar electrode **109** for attracting and holding an edge ring Fa. However, an electrode for attracting and holding the edge ring Fa may be a unipolar electrode. Alternatively, the electrode for attracting and holding the edge ring Fa may be omitted from the electrostatic chuck **402**.

Further, when the electrostatic chuck includes the electrode for attracting and holding the edge ring Fa, in the electrostatic chuck, a peripheral edge portion where the electrode for attracting and holding the edge ring Fa is provided and a central portion where the electrode **108** for attracting and holding the wafer W is provided may be integrated with each other or may be separate bodies.

The support **403** is a member formed in an annular shape in a plan view using, for example, quartz, and supports the lower electrode **401**.

An upper surface **403***a* of the support **403** and the upper surface **402***a* of the peripheral edge portion of the electrostatic chuck **402** become annular member support surfaces having thereon a cover ring Ca supporting the edge ring Fa, which is one of the annular members to be replaced according to the fourth exemplary embodiment.

The insulator **404** is a cylindrical member made of a ceramic or the like, and supports the support **403**. For example, the insulator **404** is formed to have an outer diameter equal to an outer diameter of the support **403**, and supports a peripheral edge portion of the support **403**.

In the fourth exemplary embodiment, the cover ring Ca is configured to support the edge ring Fa, and is formed to at least partially overlap the edge ring Fa in a plan view. For example, the cover ring Ca supports the edge ring Fa in a state where the edge ring Fa is substantially concentric with the cover ring Ca. In one embodiment, a diameter of an innermost peripheral portion of the cover ring Ca is smaller than a diameter of an outermost peripheral portion of the edge ring Fa, and when the cover ring Ca and the edge ring Fa are disposed substantially concentrically, an inner peripheral portion of the cover ring Ca at least partially overlaps an outer periphery of the edge ring Fa in a plan view. For example, in one embodiment, the edge ring Fa has a concave portion Fa**1** that is recessed inward in a radial direction on an outer peripheral portion of a bottom portion thereof, the cover ring Ca has a convex portion Ca**1** that protrudes inward in the radial direction at a bottom portion thereof, and the edge ring Fa is supported by an engagement between the convex portion Ca**1** and the concave portion Fa**1**.

Moreover, in the fourth exemplary embodiment, the edge ring Fa has a stepped portion formed on an upper portion thereof similar to the edge ring F shown in FIG. **2**, an upper surface of an outer peripheral portion of the edge ring Fa is formed to be higher than an upper surface of an inner peripheral portion of the edge ring Fa, and an inner diameter of the edge ring Fa is smaller than the outer diameter of the wafer W.

Further, in one embodiment, in order to suppress the misalignment between the cover ring Ca and the edge ring Fa, a protrusion may be provided in one of the cover ring Ca and the edge ring Fa, and a recess into which the protrusion is fitted may be provided in the other. Specifically, as illustrated in FIG. **14**, an annular protrusion Ca**2** concentric with the cover ring Ca may be formed on an upper surface of the cover ring Ca, and an annular recess Fa**2** concentric with the edge ring Fa may be formed in a lower surface of the edge ring Fa at a position corresponding to the annular protrusion Ca**2**. By fitting the annular protrusion Ca**2** into the annular recess Fa**2**, the misalignment between the cover ring Ca and the edge ring Fa can be suppressed. Further, instead of the above example, an annular recess may be formed in the upper surface of the cover ring Ca, an annular protrusion may be formed on the lower surface of the edge ring Fa, and by fitting the annular protrusion into the annular recess, the misalignment between the cover ring Ca and the edge ring Fa may be suppressed.

Moreover, the edge ring Fa may be an integrated body or two bodies (that is, may be divided into a plurality of members).

The lifter **405** is a member that is raised or lowered to protrude from a position overlapping the cover ring Ca on the upper surface **402***a* of the peripheral edge portion of the electrostatic chuck **402** in a plan view. When the lifter **405** is raised or lowered from the above position, the edge ring Fa can be raised and lowered by the lifter **405** while the cover ring Ca that supports the edge ring Fa is supported by the lifter **405**. In one embodiment, the lifter **405** is a long columnar member, similar to the elevating pin **107** described above.

Further, when a jig to be described later is raised or lowered by an elevating pin **106** (see FIG. **16** to be described later), the lifter **405** is provided so as not to hinder the raising and lowering of the jig. Moreover, the elevating pin **106** is an example of a lifter for the wafer W that is raised or lowered to protrude beyond or retract below an upper surface (that is, substrate support surface) **104***a* of a central portion of the electrostatic chuck **402**.

For example, the lifter **405** protrudes or retracts from a position corresponding to the convex portion Ca**1** of the cover ring Ca on the upper surface **402***a* of the peripheral edge portion of the electrostatic chuck **402**. The insertion hole **406** through which the lifter **405** is inserted is formed at a position corresponding to the convex portion Ca**1** of the cover ring Ca. Moreover, in the example of FIG. **14**, since the lifter **405** is the long columnar member, the insertion hole **406** extends through the electrostatic chuck **402** and the lower electrode **401**. However, depending on a shape of the lifter **405**, the insertion hole **406** may not extend through the electrostatic chuck **402** and the lower electrode **401**.

Similar to the elevating pin **107** in FIG. **2**, three or more lifters **405** are provided at intervals along a circumferential direction of the electrostatic chuck **402**.

A lifting mechanism for raising and lowering the lifter **405** may be provided for each lifter **405**, or a common lifting mechanism may be provided for the plurality of lifters **405**.

Similar to the elevating pin **107**, the lifter **405** may be formed in a hemispherical shape of which an upper end portion gradually tapers upward. For example, when the lifter **405** is raised, the upper end portion of the lifter **405** comes into contact with a bottom surface of the convex portion Ca**1** of the cover ring Ca and supports the cover ring Ca that supports the edge ring Fa. As illustrated in FIG. **15**, for each of the lifters **405**, a recess Ca**3** formed with a concave surface Ca**3***a* recessed upward may be provided at a position corresponding to the lifter **405** on the bottom surface of the convex portion Ca**1** of the cover ring Ca.

When the recess Ca**3** is provided, for example, a size of the recess Ca**3** is larger than the transfer accuracy (transfer error) of the cover ring Ca with the transfer device **70** and larger than a size of the upper end portion of the lifter **405** in a plan view.

Further, when the upper end portion of the lifter **405** is formed in a hemispherical shape that gradually tapers upward as described above, a curvature of the concave surface Ca**3***a* forming the recess Ca**3** may be set to be smaller than that of a convex surface **405***a* forming the hemispherical shape of the upper end portion of the lifter **405**.

Next, an example of a process of placing the cover ring Ca supporting the edge ring Fa, which is performed using the plasma processing system **1***a*, will be described. Moreover, the following process is performed under the control of the control device **80**.

First, in the plasma processing system **1***a*, the cover ring Ca supporting the edge ring Fa is held by the transfer arm **71** of the transfer module **50** having a vacuum atmosphere and extracted from the storage module **62**. Next, the transfer arm **71** that holds the cover ring Ca supporting the edge ring Fa is inserted into the pressure-reduced plasma processing chamber **100** of the processing module **60** that is a placement target through the loading/unloading port (not illustrated). Then, the cover ring Ca supporting the edge ring Fa is transferred above the upper surface **402***a* of the peripheral edge portion of the electrostatic chuck **402** and the upper surface **403***a* of the support **403** (hereinafter, the upper surface **402***a* and the upper surface **403***a* may be referred to as "annular member support surface of the wafer support **400**") by the transfer arm **71**.

Next, all the lifters **405** are raised, and the cover ring Ca supporting the edge ring Fa is delivered from the transfer arm **71** to the lifters **405**. Specifically, all the lifters **405** are raised, and first, the upper end portion of each lifter **405** comes into contact with the bottom surface of the cover ring Ca held by the transfer arm **71**. When the lifters **405** are continuously raised even after the contact, the cover ring Ca supporting the edge ring is delivered to and supported by the lifters **405**.

Moreover, the transfer arm **71** is extracted (retracted) from the plasma processing chamber **100**, and then the lifters **405** are lowered. Accordingly, the cover ring Ca supporting the edge ring Fa is placed on the annular member support surface of the wafer support **400**.

With the above procedure, a series of processes of placing the cover ring Ca supporting the edge ring Fa is completed.

Next, an example of a process of removing the cover ring Ca supporting the edge ring Fa, which is performed using the plasma processing system **1***a*, will be described. Moreover, the following process is performed under the control of the control device **80**.

First, all the lifters **405** are raised, and the cover ring Ca supporting the edge ring Fa is delivered to the lifters **405** from the annular member support surface of the wafer support **400**. Thereafter, the lifters **405** are continuously raised, and the cover ring Ca supporting the edge ring Fa moves upward.

Next, in the plasma processing system **1***a*, the transfer arm **71** is inserted from the transfer module **50** having the vacuum atmosphere into the pressure-reduced plasma processing chamber **100** through the loading/unloading port (not illustrated). Then, the transfer arm **71** is moved to a space between the annular member support surface of the wafer support **400** and the cover ring Ca supporting the edge ring Fa.

Subsequently, the lifters **405** are lowered, and the cover ring Ca supporting the edge ring Fa is delivered from the lifters **405** to the transfer arm **71**. Thereafter, the transfer arm **71** is extracted from the plasma processing chamber **100**, and the cover ring Ca supporting the edge ring Fa is extracted from the processing module **60**. Then, the cover ring Ca that supports the edge ring Fa is stored in the storage module **62** by the transfer arm **71**.

With the above procedure, a series of processes of removing the cover ring Ca supporting the edge ring Fa is completed.

Next, an example of a process of removing the edge ring Fa alone, which is performed using the plasma processing system **1***a*, will be described with reference to FIGS. **16** to **21**. Moreover, the following process is performed under the control of the control device **80**. Further, a jig J is used in the process of placing the edge ring Fa alone. The jig J is configured to support only the edge ring Fa without supporting the cover ring Ca. For example, the jig J is a plate-shaped member having a portion longer than an inner diameter of the edge ring Fa and shorter than an inner diameter of the cover ring Ca. Specifically, for example, the jig J may be an approximately rectangular plate-shaped member having a diagonal line longer than the inner diameter of the edge ring Fa and shorter than the inner diameter of the cover ring Ca in a plan view, or may be a disk-shaped member having a diameter longer than the inner diameter of the edge ring Fa and shorter than the inner diameter of the cover ring Ca.

In the process of removing the edge ring Fa alone, first, all the lifters **405** are raised, and the cover ring Ca supporting the edge ring Fa is delivered from the upper surface **402***a* of the peripheral edge portion of the electrostatic chuck **402** and the upper surface **403***a* of the support **403** (that is, the annular member support surface of the wafer support **400**) to the lifters **405**. Thereafter, the lifters **405** are continuously raised, and the cover ring Ca supporting the edge ring Fa moves upward as illustrated in FIG. **16**.

Next, in the plasma processing system **1**, the transfer arm **71** that holds and extracts the jig J from the processing module **60** is inserted from the transfer module **50** having the vacuum atmosphere into the pressure-reduced plasma processing chamber **100** through the loading/unloading port (not illustrated). Then, as illustrated in FIG. **17**, the jig J held by the transfer arm **71** is moved to a space between the cover ring Ca supporting the edge ring Fa and the annular member support surface of the wafer support **400** (i.e., the upper surface **402***a* of the peripheral edge portion of the electrostatic chuck **402** and the upper surface **403***a* of the support **403**).

Subsequently, the elevating pins **106**, which are an example of the lifters for the wafer W, are raised, and the jig J is delivered from the transfer arm **71** to the elevating pins **106** as illustrated in FIG. **18**.

Next, the transfer arm **71** is extracted (retracted) from the plasma processing chamber **100**, and then the lifters **405** and the elevating pins **106** are relatively moved with each other, and specifically, only the lifters **405** are lowered. As a result, as illustrated in FIG. **19**, the edge ring Fa is delivered from the cover ring Ca to the jig J. Thereafter, only the lifters **405** are continuously lowered, and thus, the cover ring Ca is delivered from the lifters **405** to the annular member support surface.

Next, the transfer arm **71** is inserted into the plasma processing chamber **100** through the loading/unloading port (not illustrated). Then, as illustrated in FIG. **20**, the transfer arm **71** is moved to a space between the cover ring Ca and the jig J that supports the edge ring Fa.

Subsequently, the elevating pins **106** are lowered, and as illustrated in FIG. **21**, the jig J supporting the edge ring Fa is delivered from the elevating pins **106** to the transfer arm **71**.

Then, the transfer arm **71** is extracted from the plasma processing chamber **100**, and the jig J supporting the edge ring Fa is unloaded from the plasma processing chamber **100**. The jig J that supports the edge ring Fa is stored in the storage module **62** by the transfer arm **71**.

With the above procedure, a series of processes of removing the edge ring Fa alone is completed.

Next, an example of a process of placing the edge ring Fa alone, which is performed using the plasma processing system **1***a*, will be described. Moreover, the following process is performed under the control of the control device **80**. Further, as described below, the jig J is also used in the process of placing the edge ring Fa alone as in the process of removing the edge ring Fa alone.

First, in the plasma processing system **1***a*, the jig J supporting the edge ring Fa is held by the transfer arm **71** of the transfer module **50** having the vacuum atmosphere and extracted from the storage module **62**. Next, the transfer arm **71** that holds the jig J supporting the edge ring Fa is inserted into the pressure-reduced plasma processing chamber **100** of the processing module **60** that is the placement target through the loading/unloading port (not illustrated). Then, as illustrated in FIG. **22**, the jig J supporting the edge ring Fa is transferred above the upper surface **104***a* of the central portion of the electrostatic chuck **402**, by the transfer arm **71**.

Next, the elevating pins **106** are raised, and the jig J supporting the edge ring Fa is delivered from the transfer arm **71** to the elevating pins **106** as illustrated in FIG. **23**.

Subsequently, the transfer arm **71** is extracted (retracted) from the plasma processing chamber **100**, and then the lifters **405** that supports only the cover ring Ca are raised. Accordingly, as illustrated in FIG. **24**, the edge ring Fa is delivered from the jig J on the elevating pins **106** to the cover ring Ca.

Next, the transfer arm **71** is inserted into the plasma processing chamber **100** again through the loading/unloading port (not illustrated). Then, as illustrated in FIG. **25**, the transfer arm **71** is moved to a space between the upper surface (that is, the substrate support surface) **104***a* of the central portion of the electrostatic chuck **402** and the jig J.

Subsequently, the elevating pins **106** are lowered, and the jig J that does not support the edge ring Fa is delivered from the elevating pins **106** to the transfer arm **71**.

Then, the transfer arm **71** is extracted from the plasma processing chamber **100**, and the jig J is unloaded from the plasma processing chamber **100**. The jig J is stored in the storage module **62** by the transfer arm **71**.

Further, the lifters **405** are lowered, and as a result, the cover ring Ca supporting the edge ring Fa is placed over the upper surface **402***a* of the peripheral edge portion of the electrostatic chuck **402** and the upper surface **403***a* of the support **403**.

With the above procedure, a series of processes of placing the edge ring Fa alone is completed.

As described above, according to the fourth exemplary embodiment, when the edge ring Fa is replaced in the plasma processing system **1***a* in which both the edge ring Fa and the cover ring Ca are used, the replacement in the state where the edge ring Fa is supported by the cover ring Ca and the replacement of the edge ring alone can be selectively performed. Further, according to the fourth exemplary embodiment, the edge ring Fa can be replaced in the state where the edge ring Fa is supported by the cover ring Ca, that is, the edge ring Fa and the cover ring Ca can be replaced at the same time. Accordingly, the time required for replacement can be further shortened. Further, since it is not necessary to provide a mechanism for raising and lowering the edge ring Fa, costs can be reduced. Further, according to the present embodiment, when the cover ring Ca does not need to be replaced and only the edge ring Fa needs to be replaced, only the edge ring Fa can be replaced even if a mechanism for directly raising and lowering the edge ring Fa is not provided.

Moreover, at least one of the cover ring Ca supporting the edge ring Fa and the jig J may be stored in a container placed on the load port **32**.

In addition, the edge ring is an example of a first annular member, and the cover ring is an example of a second annular member. The first annular member is an annular member disposed to surround the substrate placed on the wafer support, and the second annular member is an annular member formed to at least partially overlap the first annular member in a plan view. More specifically, the second annular member is configured to support the first annular member, and is formed to at least partially overlap the first annular member in a plan view. For example, the second annular member supports the first annular member in a state where the first annular member is substantially concentric with the second annular member.

In the above, the technique according to the embodiments is described with an example using the edge ring and the cover ring, but the technique according to the embodiments can be applied to any plasma processing system using the first annular member and the second annular member.

By applying the technique according to the embodiments to the plasma processing system using the first annular member and the second annular member, when the first annular member is replaced, a replacement in a state where the first annular member is supported by the second annular member and a replacement of the first annular member alone can be selectively performed.

While various embodiments have been described above, various omissions, substitutions, and changes may be made without being limited to the above-described embodiments. Further, other embodiments can be implemented by combining elements in different embodiments.

In addition to the above-described embodiments, the following additional notes will be further disclosed.

APPENDIX 1

A substrate support includes:

a substrate support surface on which a substrate is placed;

an annular member support surface on which an annular member, which is disposed to surround the substrate placed on the substrate support surface, is placed;

three or more elevating pins configured to protrude beyond the annular member support surface and further configured to be raised to adjust an amount of protrusion from the annular member support surface; and

an elevating mechanism configured to raise or lower the elevating pins.

Further, a recess having a concave surface recessed upward is provided at a position corresponding to each of the elevating pins on a bottom surface of the annular member, and

a curvature of an upper end portion of each of the elevating pins is larger than a curvature of the recess.

APPENDIX 2

In the substrate support according to Appendix 1, in a plan view, an opening of the recess is larger in size than a transfer error of the annular member above the annular member support surface.

APPENDIX 3

In the substrate support according to Appendix 1 or 2, the elevating mechanism raises and lowers the elevating pins independently.

The invention claimed is:

1. A plasma processing system, comprising:

a control device; and

a plasma processing device including:

a processing chamber,

a substrate support provided in the processing chamber, the substrate support including an electrostatic chuck having a central portion supporting a substrate on an upper surface thereof, a first ring positioned outside the central portion so as to surround the central portion, a second ring surrounding the first ring, and a supporter positioned below the second ring and supporting the second ring, and

a lifter for raising and lowering the first ring and the second ring, the lifter provided inside an outermost periphery of the supporter and below the second ring, wherein

a portion of the second ring is positioned below the first ring,

the control device controls the lifter to raise the second ring so that the first ring is supported and raised by the second ring,

a protrusion is provided on one of a lower surface of the first ring and an upper surface of the second ring,

a recess, into which the protrusion is fitted, is provided on an other of the lower surface of the first ring and the upper surface of the second ring, and

the lifter is positioned radially inward of the protrusion and the recess.

2. The plasma processing system of claim **1**, wherein a diameter of an innermost peripheral portion of the second ring is smaller than a diameter of an outermost peripheral portion of the first ring.

3. The plasma processing system of claim **1**, wherein an inner peripheral portion of the second ring at least partially overlaps an outer peripheral portion of the first ring in a plan view.

4. The plasma processing system of claim **1**, wherein the second ring covers an outer side surface of the first ring.

5. The plasma processing system of claim **1**, wherein the protrusion and the recess are formed along a circumferential direction of the first ring and the second ring.

6. The plasma processing system of claim **1**, wherein the first ring is an edge ring.

7. The plasma processing system of claim **6**, wherein the second ring is a cover ring that covers an outer surface of the edge ring.

8. The plasma processing system of claim **1**, wherein the first ring includes Si or SiC.

9. The plasma processing system of claim **1**, wherein another recess is formed on a lower surface of the second ring to engage with an upper end portion of the lifter.

10. The plasma processing system of claim **1**, further comprising:

a transfer device having a holder, wherein

the control device controls the transfer device to move the holder between the second ring supporting the first ring and the substrate support, and

the control device controls the lifter to lower the lifter to deliver the second ring supporting the first ring from the lifter to the holder.

11. The plasma processing system of claim **1**, wherein the plasma processing device further includes another lifter which moves up and down so as to protrude from the upper surface of the central portion of the electrostatic chuck.

12. The plasma processing system of claim **11**, further comprising:

a transfer device having a holder which supports a jig, the jig having a portion longer than an inner diameter of the first ring.

13. The plasma processing system of claim **12**, wherein the control device is configured to:

control the transfer device to move the jig supported by the holder between the second ring supporting the first ring and the substrate support,

control the another lifter to raise to deliver the jig from the holder to the another lifter,

control the lifter and the another lifter, after extracting the holder, to move relatively with each other to deliver the first ring from the second ring to the jig,

control the lifter to lower to deliver the second ring from the lifter to the supporter,

controls the transfer device to move the holder between the second ring and the jig supporting the first ring, and then control the another lifter to lower to deliver the jig supporting the first ring from the another lifter to the holder, and

control the transfer device to extract the holder from the processing chamber to deliver the jig supporting the first ring from the processing chamber.

14. The plasma processing system of claim **12**, wherein the control device is further configured to:

control the transfer device to move the jig, which supports the first ring and is supported by the holder, above the substrate support,

control the another lifter to raise to deliver the jig supporting the first ring from the holder to the another jig,

control the lifter, after extracting the holder, to raise while supporting only the second ring to deliver the first ring from the jig to the second ring,

control the transfer device to move the holder between the substrate support and the jig, and then control the another lifter to lower to deliver the jig from the another lifter to the holder, control the transfer device to extract the holder from the processing chamber to deliver the jig from the processing chamber, and

control the lifter to lower the lifter to deliver the second ring.

15. A substrate support, comprising:

an electrostatic chuck having a central portion supporting a substrate on an upper surface thereof;

a first ring positioned outside the central portion so as to surround the central portion;

a second ring surrounding the first ring, a portion the second ring being positioned below the first ring;

a supporter positioned below the second ring and supporting the second ring; and

a lifter for raising and lowering the first ring and the second ring, the lifter being provided inside an outermost periphery of the supporter and below the second ring, wherein

the lifter protrudes from the supporter,

the lifter raises the second ring so that the first ring is supported and raised by the first second ring when raised,

a protrusion is provided on one of a lower surface of the first ring and an upper surface of the second ring,

a recess, into which the protrusion is fitted, is provided on an other of the lower surface of the first ring and the upper surface of the second ring, and

the lifter is positioned radially inward of the protrusion and the recess.

16. The substrate support of claim **15**, wherein a diameter of an innermost peripheral portion of the second ring is smaller than a diameter of an outermost peripheral portion of the first ring.

17. The substrate support of claim **15**, wherein an inner peripheral portion of the second ring at least partially overlaps an outer peripheral portion of the first ring in a plan view.

18. The substrate support of claim **15**, wherein the second ring covers an outer side surface of the first ring.

19. The substrate support of claim **15**, wherein the protrusion and the recess are formed along a circumferential direction of the first ring and the second ring.

20. The substrate support of claim **15**, wherein the first ring is an edge ring.

21. The substrate support of claim **20**, wherein the second ring is a cover ring that covers an outer surface of the edge ring.

22. The substrate support of claim **15**, wherein the first ring includes Si or SiC.

23. The substrate support of claim **15**, wherein a recess is formed on a lower surface of the second ring to engage with an upper end portion of the lifter.

24. The substrate support of claim **15**, further comprising another lifter which moves up and down so as to protrude from the upper surface of the central portion of the electrostatic chuck.

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