

WHAT IS CLAIMED IS:

1. A substrate processing apparatus comprising:

a boat including a plurality of slots configured to hold ~~at least one~~ substrate;
a process furnace configured to process the ~~at least one~~ substrate held in the boat;
a boat elevator configured to raise and lower the boat;
a transfer device configured to transfer the ~~at least one~~ substrate between a plurality of carriers in which the ~~at least one~~ substrate is stored and the boat; and
a controller configured to be capable of controlling the boat elevator and the transfer device,

wherein the controller is configured to set a plurality of positions at which the transfer device transfers the ~~at least one~~ substrate to the boat elevator, and perform a selection of the plurality of positions to minimize a number of shifts among the plurality of positions of the boat elevator or a total time taken during the shifts in each of an operation of the transfer device to load the ~~at least one~~ substrate into the boat until the ~~at least one~~ substrate is loadable into the process furnace from the plurality of carriers and an operation of the transfer device to unload the ~~at least one~~ substrate processed in the process furnace from the boat to the plurality of carriers,

wherein the boat includes the slots formed over a range wider than a range in which the substrate is transferrable to the boat, which is stationary,

wherein the plurality of positions include a first position and a second position, and

wherein the selection of the plurality of positions is applied to an operation of loading the substrate and an operation of unloading the substrate with respect to the slots in which the substrate is transferrable using any of the first position and the second position.

2. ~~The substrate processing apparatus of Claim 1, wherein the boat includes the slots formed over a range wider than a range in which the at least one substrate is transferrable to the~~

~~boat, which is stationary,~~

~~wherein the plurality of positions include a first position and a second position, and~~

~~wherein the selection of the plurality of positions is applied to an operation of loading the at least one substrate and an operation of unloading the at least one substrate with respect to the slots in which the at least one substrate is transferrable using any of the first position and the second position.~~

~~3.2.~~ The substrate processing apparatus of Claim ~~12~~, comprising:

a partition wall configured to separate a charging chamber in which the boat is raised and lowered and a transfer chamber in which the transfer device is installed; and

a gate door installed at the partition wall and configured to be opened to a portion of the plurality of slots of the boat mounted on the boat elevator which takes the first position or the second position,

wherein the range in which the ~~at least one~~ substrate is transferrable is limited by a movable range of the transfer device or the opening of the gate door.

~~4.3.~~ The substrate processing apparatus of Claim ~~1 or 2~~, wherein a plural types of the ~~at least one~~ substrate includes plural types of substrates, and the plural types of substrates are held in the boat,

wherein the controller is configured to be capable of controlling the transfer device such that the substrates are mounted in the plurality of slots of the boat sequentially from top to bottom and the substrates are discharged from the plurality of slots of the boat sequentially from bottom to top, for each of the types of substrates, and

wherein at least one selected from the group of the plural types of substrates is a dummy substrate unevenly arranged in slots at the sides of an upper end and a lower end of the boat.

~~5.4.~~ The substrate processing apparatus of Claim ~~34~~, comprising: a memory configured to store a substrate arrangement parameter including the types of substrates mounted in the plurality of slots of the boat,

wherein the controller is configured to be capable of determining substrate transfer information to set a carrier that is a loading and unloading source of the substrates mounted in the plurality of slots of the boat, a holding area of the substrates in the carrier, and a loading and unloading order of the substrates, according to a definition of the substrate arrangement parameter, and creating transfer operation data that coordinates and controls the transfer device and the boat elevator based on the substrate transfer information, and

wherein the transfer operation data is set to minimize the number of position shifts of the boat elevator when the substrates are loaded and unloaded.

6.5. The substrate processing apparatus of Claim 45, wherein the controller is configured to prohibit a transfer operation of the transfer device when the boat elevator is located at a position other than a position set such that the transfer device transfers the substrates.

7.6. The substrate processing apparatus of Claim 1-~~or 2~~, comprising:

a plurality of process modules, each including the process furnace and a charging chamber in which the boat is raised and lowered;

a transfer chamber that is installed in common for the plurality of process modules and in which the transfer device is installed; and

a plurality of ~~pod openers~~~~load ports~~ that are connected to the transfer chamber and configured to hold the carriers while the carriers are being opened to the transfer device such that the transfer device is accessible to the carriers,

wherein the plurality of process modules are configured such that the ~~at least one~~ substrate is accessible to the plurality of process modules and the carriers via the transfer chamber.

8.7. The substrate processing apparatus of Claim 67, comprising: ~~a plurality of~~ gate doors installed at a partition wall that separates the charging chamber and the transfer chamber,

wherein the plurality of process modules are arranged in a horizontal direction,

wherein the ~~plurality of~~ gate doors are arranged in the horizontal direction in a corresponding manner with the plurality of process modules, and at least one gate door selected from the group of the ~~plurality of~~ gate doors slides up or down to be opened or closed, and

wherein the charging chamber has a height that is at least twice a height of the at least one gate door that slides up or down.

~~9.8.~~ The substrate processing apparatus of Claim 12, wherein in the second position, the transfer device is capable of transferring the ~~at least one~~ substrate to a slot at a lowest end of the boat, and a furnace opening shutter of the process furnace is closable without interfering with the boat.

~~10.9.~~ The substrate processing apparatus of Claim 12, wherein in the second position, the transfer device is capable of transferring the ~~at least one~~ substrate to a slot at a lowest end of the boat, and a furnace opening shutter of the process furnace is not closable by interfering with the boat or prohibited from being closed, and

~~wherein the at least one substrate includes a plurality of substrates, and~~

wherein when the substrates are shifted from the second position to the first position during a series of transfers of the substrates and a holding time taken until the substrates are again shifted to the second position is shorter than a predetermined time, the controller is configured to be capable of controlling the furnace opening shutter with the furnace opening shutter being opened during the holding time.

~~11.10.~~ The substrate processing apparatus of Claim 54, wherein the controller is configured to be capable of performing boat mapping on the substrates on the boat based on the substrate transfer information before the substrates are unloaded from the boat, and

wherein a position of the boat elevator when the boat mapping is performed is executable by a position when the substrates are unloaded.

12.11. A method of manufacturing a semiconductor device by using a substrate processing apparatus including a process furnace configured to process a at least one substrate that is held in a boat including a plurality of slots and on which the semiconductor device is formed, a boat elevator configured to raise and lower the boat, a transfer device configured to transfer the ~~at least one~~ substrate between a carrier in which the ~~at least one~~ substrate is stored and the boat, and a controller configured to be capable of controlling the boat elevator and the transfer device, comprising:

creating transfer operation data by the controller, the transfer operation data coordinating and controlling the transfer device and the boat elevator based on substrate transfer information including a carrier that is a loading and unloading source of the ~~at least one~~ substrate mounted in the plurality of slots of the boat, a holding area of the ~~at least one~~ substrate in the carrier, and a loading and unloading order of the ~~at least one~~ substrate;

loading the ~~at least one~~ substrate into the boat based on the transfer operation data by the transfer device and the boat elevator, and inserting the boat loaded with the ~~at least one~~ substrate into the process furnace by the boat elevator;

performing a predetermined process on the ~~at least one~~ substrate by the process furnace, and drawing out the boat holding the ~~at least one~~ substrate for which the predetermined process has been completed, from the process furnace by the boat elevator; and unloading the ~~at least one~~ substrate from the boat based on the transfer operation data by the transfer device and the boat elevator,

wherein the boat includes the slots formed over a range wider than a range in which the substrate is transferrable to the boat, which is stationary,

wherein the act of loading the substrate and the act of unloading the substrate are performed between the transfer device and the boat elevator that has shifted to a first position or a second position,
and

wherein in the transfer operation data, a position of the boat elevator for performing the act of loading the substrate and the act of unloading the substrate, with respect to the slots in which the substrate is transferrable using any of the first position and the second position, is set to minimize the number of position shifts of the boat elevator or a total time taken during the shifts when the ~~at least one~~ substrate is loaded and unloaded.

~~13;~~12. A program that causes, by a computer, a substrate processing apparatus to perform a process comprising:

creating transfer operation data to coordinate and control a transfer device and a boat elevator based on substrate transfer information including a carrier that is a loading and unloading source of ~~a at least one~~ substrate mounted in a plurality of slots of a boat, a holding area of the ~~at least one~~ substrate in the carrier, and a loading and unloading order of the ~~at least one~~ substrate in the carrier;

loading the ~~at least one~~ substrate into the boat based on the transfer operation data by the transfer device and the boat elevator, and inserting the boat loaded with the ~~at least one~~ substrate, into a process furnace configured to process the ~~at least one~~ substrate by the boat elevator ;

performing a predetermined process on the ~~at least one~~ substrate by the process furnace, and drawing out the boat holding the ~~at least one~~ substrate for which the predetermined process has been completed, from the process furnace by the boat elevator; and

unloading the ~~at least one~~ substrate from the boat based on the transfer operation data by the transfer device and the boat elevator,

wherein in the act of creating the transfer operation data, the boat includes the slots formed over a range wider than a range in which the substrate is transferrable to the boat, which is stationary, the act of loading the substrate and the act of unloading the substrate are performed between the transfer device and the boat elevator that has shifted to a first position or a second position, and in the transfer operation data, a position of the boat elevator for performing the act of loading the substrate and the act of unloading the substrate, with respect to the slots in which the substrate is transferrable using any of the first position and

the second position, is set to minimize the number of position shifts of the boat elevator or ~~the~~ a total time required taken during the shifts when the ~~at least one~~ substrate is loaded and unloaded.