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United States Patent	12389581
Kind Code	B2
Date of Patent	August 12, 2025
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Component storing member storage cabinet and method of managing component storing members

Abstract

A parts tower that stores reels storing components to be mounted on substrates includes storing sections storing the reels, loading and unloading sections in which the reels are disposed, a moving section that moves the reels inside the parts tower, an operation section receiving an instruction of unloading of the reels, and a controller. Some of the storing sections that are disposed around the loading and unloading sections are defined as unloading waiting sections. The controller performs a first moving process in which the reels that are to be unloaded relatively early among the stored reels to the unloading waiting sections are moved by the moving section before receiving the instruction of unloading the reels, and a second moving process in which the reels stored in the unloading waiting sections are moved to the loading and unloading sections by the moving section in response to receiving the instruction.

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Appl. No.:	18/249050
Filed (or PCT Filed):	October 13, 2020
PCT No.:	PCT/JP2020/038619
PCT Pub. No.:	WO2022/079799
PCT Pub. Date:	April 21, 2022

Prior Publication Data

Document Identifier	Publication Date
US 20230397387 A1	Dec. 07, 2023

Publication Classification

Int. Cl.: H05K13/00 (20060101); B65G1/04 (20060101); H05K13/02 (20060101); H05K13/08 (20060101)

U.S. Cl.:

CPC H05K13/086 (20180801); B65G1/0407 (20130101); H05K13/0084 (20130101); H05K13/021 (20130101); H05K13/0882 (20180801);

Field of Classification Search

CPC: H05K (13/086); H05K (13/0084); H05K (13/0882); H05K (13/021); B65G (1/0407)

USPC: 414/281

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This application is a National Stage of International Patent Application No.

PCT/JP2020/038619, filed Oct. 13, 2020, the entire content of which is incorporated herein by reference.

BACKGROUND

Technical Field

(2) The technology described herein relates to a component storing member storage cabinet and a method of managing component storing members.

Background Art

(3) There has been known a surface mounting device for mounting components on a substrate as described, for example, in Japanese Examined Patent Publication No. 6603616. Specifically, a component mounting device (a surface mounter) described in Japanese Examined Patent Publication No. 6603616 includes a mounting section for mounting components on a substrate and a component supply device for supplying the components to the mounting section. The mounting section includes a head unit and a head driving mechanism. The head unit includes mounting heads that suction and release electronic components. The head driving mechanism is for moving the head unit in a direction parallel to the plate surface of the substrate. The component supply device is for supplying the components stored in a tape (a component tape) and reels around which the tapes are wound are set in the component supply device. The component supply device supplies the components stored in the tape one by one to the mounting section by feeding the tape.

(4) There has been known a component storing member storage cabinet that stores component storing members (reels around which the component tapes are wound and component trays on which the components are disposed) storing the components to be mounted on the substrate, as described, for example, in Japanese Unexamined Patent Application Publication No. 2018-164018. Specifically, the component storing member storage cabinet described in Japanese Unexamined Patent Application Publication No. 2018-164018 includes an inlet and outlet section through which the component storing members are loaded in and unloaded from the cabinet, a transfer means for transferring the stored component storing members to the inlet and outlet section, and a control section that controls the transfer means. If receiving a preparation instruction from a management computer (a component storing member management device), the control section transfers the component storing members to the inlet and outlet section.

SUMMARY

(5) In the component storing member storage cabinet described in Japanese Examined Patent Publication No. 6603616, time required for unloading the component storing members from the storage cabinet can be shortened. In the present specification, the technology of shortening the time required for unloading the component storing members from the storage cabinet is disclosed. (1) According to one aspect of the present disclosure, a component storing member storage cabinet that stores component storing members storing components to be mounted on substrates includes storing sections storing the component storing members, unloading sections in which the component storing members to be unloaded are disposed, a moving section configured to move the component storing members inside the component storing member storage cabinet, an instruction receiving section receiving an instruction of unloading the component storing members, and a

control section. Some of the storing sections that are disposed around the unloading sections are defined as unloading waiting sections. The control section is configured to perform a first moving process and a second moving process. In the first moving process, the component storing members that are to be unloaded relatively early among the stored component storing members are moved to the unloading waiting sections by the moving section before receiving the instruction of unloading the component storing members. In the second moving process, the component storing members stored in the unloading waiting sections are moved to the unloading sections by the moving section in response to receiving the instruction of unloading the component storing members.

(6) In the component storing member storage cabinet described in Japanese Examined Patent Publication No. 6603616, when the component storing member that is stored in a storage far from the inlet and outlet section, time required for obtaining the preparation instruction and transferring the component storing member to the inlet and outlet section becomes longer because of the long distance from the storage to the inlet and outlet section. In the component storing member storage cabinet according to the present disclosure, the storage sections around the unloading sections are defined as the unloading waiting sections. The component storing members that are to be unloaded relatively early are moved to the unloading waiting sections before receiving the instruction of unloading the component storing members. Therefore, time required for moving the component storing members that are stored in the storage sections far away from the unloading sections to the unloading sections after receiving the instruction of unloading can be shortened. According to the component storing member storage cabinet of the present disclosure, the time required for unloading the component storing members can be shortened compared to the component storing member storage cabinet of Japanese Examined Patent Publication No. 6603616. (2) According to one aspect of the present disclosure, after moving the component storing members to the unloading sections in the second moving process, the control section may be configured to perform a third moving process of controlling the moving section to move the component storing members stored in the unloading waiting sections to be closer to the unloading sections.

(7) According to the above component storing member storage cabinet, time required for unloading the component string members can be further shortened. (3) According to one aspect of the present disclosure, a component storing member storage cabinet that stores component storing members storing components to be mounted on substrates includes storing sections storing the component storing members, unloading sections in which the component storing members to be unloaded are disposed, a moving section configured to move the component storing members inside the component storing member storage cabinet, an instruction receiving section receiving an instruction of unloading the component storing members, and a control section. Some of the storing sections that are disposed around the unloading sections are defined as unloading waiting sections. The control section is configured to perform a fourth moving process and a fifth moving process. In the fourth moving process, the component storing members that are to be unloaded relatively early among the stored component storing members are moved to the unloading sections by the moving section before receiving the instruction of unloading the component storing members. In the fifth moving process, the component storing members are moved to the unloading waiting sections by the moving section before receiving the instruction of unloading the component storing members, and the component storing members moved to the unloading waiting sections are to be unloaded relatively early among the component storing members except for the component storing members that are to be moved to the unloading sections in the fourth moving process.

(8) According to the above-described component storing member storage cabinet, the component storing members that are to be unloaded earlier are moved to the unloading sections and therefore, the component storing members are already moved to the unloading sections when the instruction of unlading is received. Therefore, the time required for unloading the component storing members can be shortened. Furthermore, according to the component storing member storage cabinet, among the component storing members except for the component storing members that are to be moved to

the unloading sections, the component storing members that are to be unloaded earlier are moved to the unloading waiting sections. Therefore, if receiving an instruction of unloading another component storing member right after the component storing member that is just moved to the unloading section is unloaded, the time required for moving the component storing member to the unloading section after receiving the instruction of loading can be shortened. (4) According to one aspect of the present disclosure, after unloading the component storing members that are moved to the unloading sections, the control section may be configured to perform a sixth moving process of controlling the moving section to move the component storing members stored in the unloading waiting sections to the unloading sections and subsequently to move the component storing members stored in the unloading waiting sections to be closer to the unloading sections.

(9) According to the component storing member storage cabinet, time required for unloading the component storing members can be further shortened. (5) According to one aspect of the present disclosure, the control section may be configured to move the component storing members to only some of the unloading sections in the fourth moving process.

(10) If the component storing members are moved to all the unloading sections, the component storing member that is necessary to be unloaded urgently cannot be unloaded. According to the component storing member storage, the component storing members are moved only to some of the unloading sections. Therefore, other unloading sections can be used as the unloading sections for urgent use. If the component storing member is necessary to be unloaded urgently, the component storing member that is necessary to be unloaded urgently can be unloaded. (6) One aspect of the disclosure provides a method of managing component storing members in a component storing member storage cabinet that stores the component storing members storing components that are to be mounted on substrates. The component storing member storage cabinet includes storing sections storing the component storing members, unloading sections in which the component storing members to be unloaded are disposed, a moving section configured to move the component storing members inside the component storing member storage cabinet, and an instruction receiving section receiving an instruction of unloading the component storing members, and some of the storing sections that are disposed around the unloading sections are defined as unloading waiting sections. The method includes a first moving step of moving the component storing members that are to be unloaded relatively early among the stored component storing members to the unloading waiting sections by the moving section before receiving an instruction of unloading the component storing members, and a second moving step of moving the component storing members stored in the unloading waiting sections to the unloading sections by the moving section in response to receiving the instruction of unloading the component storing members.

(11) According to the above method, time required for unloading the component storing members can be shortened. (7) Another aspect of the present disclosure provides a method of managing component storing members in a component storing member storage cabinet that stores the component storing members storing components that are to be mounted on substrates. The component storing member storage cabinet includes storing sections storing the component storing members, unloading sections in which the component storing members to be unloaded are disposed, a moving section configured to move the component storing members inside the component storing member storage cabinet, and an instruction receiving section receiving an instruction of unloading the component storing members, and some of the storing sections that are disposed around the unloading sections are defined as unloading waiting sections. The method includes a fourth moving step of moving the component storing members that are to be unloaded relatively early among the stored component storing members to the unloading sections by the moving section before receiving an instruction of unloading the component storing members, and a fifth moving step of moving the component storing members to the unloading waiting sections by the moving section before receiving the instruction of unloading the component storing members, the component storing members to be moved to the unloading waiting sections being to be

unloaded relatively early among the component storing members except for the component storing members that are to be moved to the unloading sections in the fourth moving process.

(12) According to the component storing member storage, time required for unloading the component storing members can be shortened. Furthermore, according to the component storing member storage, if receiving an instruction of unloading another component storing member right after the component storing member that is just moved to the unloading section is unloaded, the time required for moving the component storing member to the unloading section after receiving the instruction of loading can be shortened.

(13) The disclosure described herein can be achieved in various forms such as a device, a method, a computer program implementing the function of the device or the method, and a medium storing the computer program.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

- (1) FIG. 1 is a typical view of a substrate production system according to a first embodiment;
- (2) FIG. 2 is a perspective view of a component tape;
- (3) FIG. 3 is an elevation view of a reel and the component tape;
- (4) FIG. 4 is a perspective view of a parts tower;
- (5) FIG. 5 is a perspective view of the inside of the parts tower;
- (6) FIG. 6 is a perspective view of the inside of the parts tower (without including a front storage shelf);
- (7) FIG. 7 is a block diagram illustrating an electric configuration of the parts tower;
- (8) FIG. 8 is a typical view illustrating loading and unloading sections and unloading waiting sections;
- (9) FIG. 9 is a typical view illustrating loading and unloading sections and unloading waiting sections according to a third embodiment; and
- (10) FIG. 10 is a typical view illustrating loading and unloading sections and unloading waiting sections according to another embodiment.

DETAILED DESCRIPTION

First Embodiment

(11) A first embodiment will be described with reference to FIGS. 1 to 8. In the following description, an upper-bottom direction, a front-rear direction, and a right-left direction are defined with reference to the upper-bottom direction, the front-rear direction, and the right-left direction in FIG. 4. In the following description, for components having the same configuration, some of the components may be indicated by reference signs and the rest of the components may not be indicated by the reference signs.

(1) Substrate Production System

(12) A substrate production system 1 for mounting components on substrates will be described with reference to FIG. 1. The substrate production system 1 includes a production line 2 for mounting components on substrates and a parts tower 3 (one example of the component storing member storage cabinet). The production line 2 and the parts tower 3 are connected via a communication network 4 such as local area network (LAN) and can communicate each other.

(13) The production line 2 includes a loader 10, a screen printer 11, a print checking machine 12, a dispenser 13, surface mounters 14, a checking machine 15 checking an outer appearance after a mounting operation, a reflow device 16, a checking machine 17 checking an outer appearance after a hardening operation, and an unloader 18 that are connected in series via conveyers 19. The surface mounter 14 includes a mounting section in which components are mounted on the substrate and a component supply device that supplies the components to the mounting section. Reels 26

(refer to FIG. 3) around which component tapes **25** (refer to FIG. 2) are wound are set in the component supply device. The reel **26** is one example of the component storing member. The component supply device includes feeding devices that electrically feed the component tapes **25**. With the component tape **25** being fed by the feeding device, the components are supplied to the mounting section.

(14) If the number of components stored in the component tape **25** becomes smaller, an operator of the substrate production system detaches the reel **26** of the component tape **25** currently used and sets a new reel **26**. Then, the operator connects a tip end of a new component tape **25** to a last end of the currently used component tape **25** with an adhesive tape. The operation of connecting the tip end of the new component tape **25** to the last end of the currently used component tape **25** is generally referred to as splicing. The feeding device in which two component tapes **25** can be set may have an autoloading function. Such a feeding device automatically feeds another component tape **25** if one component tape **25** has no component.

(2) Component Tape and Reel

(15) As illustrated in FIG. 2, the component tape **25** stores components E and includes a carrier tape **25B**, the components E, and a top tape **25C**. The carrier tape **25B** includes storing recesses **25A** that are arranged at equal intervals in an elongated direction. The components E are stored in the storing recesses **25A**, respectively. The top tape **25C** adheres to the carrier tape **25B** to close the storing recesses **25A**. The component E tape **25** includes holes **25D** in an edge section with respect to a width direction. The holes **25D** are arranged at equal intervals along the elongated direction. Teeth of a sprocket included in the feeding device of the component supply device are to be fitted in the holes **25D**. Various kinds of components E are prepared and one component tape **25** stores components E of one single kind.

(16) As illustrated in FIG. 3, the component tape **25** is wound around the reel **26**. The reel **26** has a two-dimensional code **27** representing an identifier for identifying the reel **26** and various information (the kind and the number of components E stored in the component tape **25**) related to the component tape **25** that is wound around the reel **26**. The reel **26** may not have the two-dimensional code **27** but may have a bar code with which the reel **26** can be identified.

(17) In the following description, the components E stored in the component tape **25** that is wound around the reel **26** is simply referred to as components E stored in the reel **26**.

(3) Parts Tower

(18) An outer appearance of a parts tower **3** will be described with reference to FIG. 4. The parts tower **3** is a storage cabinet that stores the reels **26** including the component tapes **25**. The parts tower **3** includes a cabinet body **30** of about a box shape having a lateral dimension (W) of 2600 cm, a depth (L) of 1350 cm, and a height (H) of 2500 cm. The cabinet body **30** includes a rectangular hole, which is not illustrated, in a front surface thereof. The rectangular hole is in front of a loading and unloading shelf **33** (refer to FIG. 5), which will be described later. An opening and closing door **31** with which the hole is opened and closed is rotatably connected to the cabinet body **30**. The cabinet body **30** includes an operation section **41** on the front surface and on the right side of the opening and closing door **31**.

(19) An inner configuration of the parts tower **3** will be described with reference to FIGS. 5 and 6. The parts tower **3** includes storage shelves **32** (**32A** and **32B**) storing the reels **26**, the loading and unloading shelf **33** in which the reels **26** to be loaded in and unloaded from the shelf **32** are disposed, and a moving section **34** (refer to FIG. 6) that moves the reel **26** stored in the storage shelf **32** and the reel **26** placed in the loading and unloading shelf **33**.

(20) As illustrated in FIGS. 5 and 6, the storage shelves **32** include a front storage shelf **32A** and a rear storage shelf **32B**. The rear storage shelf **32B** includes thirty-four boxes in the vertical direction and seven boxes in the lateral direction. One reel **26** is stored in each of the boxes. In the following description, one box storing one reel **26** is referred to as a storage section **38**. A whole configuration of the front storage shelf **32A** is same as that of the rear storage shelf **32B** but

includes the loading and unloading shelf **33** in a middle section. The loading and unloading shelf **33** includes fourteen boxes in the vertical direction and two boxes in the lateral direction and one reel **26** can be disposed in each of the boxes. In the following description, one box of the loading and unloading shelf **33** where one reel **26** is disposed is referred to as a loading and unloading section **39**. The loading and unloading section **39** is one example of an unloading section.

(21) The moving section **34** will be described with reference to FIG. **6**. The moving section **34** is a mechanism that moves the reel **26** between the loading and unloading section **39** and the storage section **38**. Details will be described later. The moving section **34** moves the reel **26** between the storage sections **38**. The moving section **34** includes a moving head **34A** that holds the reel **26** and a head movement portion **34B** that moves the moving head **34A** two-dimensionally in the upper-bottom direction and the right-left direction.

(22) The moving head **34A** is configured to hold the reel **26** from upper and lower sides. The moving head **34A** includes a head body **35**, a holder **36** holding the reel **26**, a front-rear movement mechanism, and an upper-lower movement mechanism, which are not illustrated. The holder **36** is supported by the head body **35** so as to be movable in the front-rear direction. The holder **36** includes two upper extending portions **37** and lower extending portions. The upper extending portions **37** project frontward and are arranged on an upper side of the reel **26**. The lower extending portions, which are not illustrated in FIG. **6**, project frontward and are arranged on a lower side of the reel **26**. The head body **35** includes the front-rear movement mechanism that moves the holder **36** frontward and rearward. The holder **36** includes the upper-lower movement mechanism that moves the upper extending portions **37** up and down. The head movement portion **34B** includes a movement mechanism for moving the moving head **34A** in the upper-lower direction and the right-left direction and a rotation mechanism for rotating the moving head **34A** around a vertical line by 180 degrees.

(23) In the parts tower **3**, the moving head **34A** is moved to a target storage section **38** by the head movement portion **34B** in order to unload the reel **26** from the storage section **38** by the moving head **34A**. With the upper extending portions **37** of the parts tower **3** being moved upward, the holder **36** is moved frontward with the front-rear movement mechanism. After the frontward movement of the holder **36**, the upper extending portions **37** are disposed above the reel **26** and the lower support portions are disposed below the reel **26**. In such a state, the upper-lower movement mechanism of the parts tower **3** moves the upper extending portions **37** downward. With the upper extending portions **37** being moved downward, the reel **26** is held by the upper extending portions **37** and the lower support portions. In such a state, the front-rear movement mechanism moves the holder **36** rearward. Accordingly, the reel **26** is taken out from the storage section **38**. The operation is performed in a reversed order to store the reel **26** in the storage section **38**.

(24) The moving head **34A** is rotated around the vertical line by 180 degrees by the rotation mechanism of the parts tower **3** to take out the reel **26** from the rear storage shelf **32**. After the rotation of the moving head **34A** by 180 degrees, the operation is similar and will not be described.

(4) Electric Configuration of Parts Tower

(25) An electric configuration of the parts tower **3** will be described with reference to FIG. **7**. The parts tower **3** includes a control section **40**, the moving head **34A**, the head movement portion **34B**, the operation section **41** (one example of an instruction receiving section), and a handy scanner **42**. The control section **40** includes a microcomputer **40A** including a CPU and a RAM as one chip, a storing section **40B**, and a communication section **40C**. The storing section **40B** stores various control programs and a management table for managing the reels **26** stored in the storage sections **38**. The microcomputer **40A** controls each section of the parts tower **3** by executing the control program stored in the storing section **40B**. The communication section **40C** is a communication circuit for communication between the microcomputer **40A** and other devices via the communication network **4**. The control section **40** may include an application specific integrated circuit (ASIC) or a field programmable gate array (FPGA) instead of the microcomputer **40A**.

(26) The operation section **41** includes a display device such as a liquid crystal display and an input device such as a keyboard, a mouse, and a touch panel. The operator instructs loading and unloading of the reels **26** by operating the operation panel. The handy scanner **42** is for scanning the two-dimensional code **27** on the reel **26**. When loading the reel **26** in the parts tower **3**, the operator uses the handy scanner **42** to read the two-dimensional code **27**. The control section **40** obtains an identifier of the reel **26** and various information related to the component tape **25** from the two-dimensional code **27** read by the handy scanner **42**. If the reel **26** that is disposed in the loading and unloading section **39** is moved to the storage section **38**, the control section **40** links the identifier of the reel **26**, the various information related to the component tape **25**, and the storage section **38** storing the reel **26** and registers the linked information in a management table. Accordingly, the reels **26** stored in the parts tower **3** are managed.

(5) Unloading Waiting Section

(27) Unloading waiting sections will be described with reference to FIG. **8**. Some of the storage sections **38** that are disposed around the loading and unloading shelf **33** are defined as the unloading waiting sections **50**. The unloading waiting sections **50** are provided for moving the reel **26** in a short time in response to the instruction of unloading the reel **26**. In the configuration illustrated in FIG. **8**, the unloading waiting sections **50** includes first unloading waiting sections **50A**, second unloading waiting sections **50B**, and third unloading waiting sections **50C**. The storage sections **38** that are disposed to surround the loading and unloading sections **39** are defined as the first unloading waiting sections **50A**. The storage sections **38** included in the two rows of boxes above the first unloading waiting sections **50A** and the storage sections **38** included in the two rows of boxes below the first unloading waiting sections **50A** are defined as the second unloading waiting sections **50B**. The storage sections **38** included in the two rows of boxes above the second unloading waiting sections **50B** and the storage sections **38** included in the two rows of boxes below the second unloading waiting sections **50B** are defined as the third unloading waiting sections **50C**. If the number of reels **26** to be stored is large, the unloading waiting sections **50** are used as the storage sections **38** (not used as the unloading waiting sections **50**).

(6) Moving of Reel

(28) Since the unloading waiting sections **50** are closer to the loading and unloading sections **39** than the storage sections **38** are, the reels **26** can be moved to the loading and unloading sections **39** in a shorter time compared to the storage sections **38**. The control section **40** determines the order in which the reels **26** are unloaded based on the production planning information of the substrates, which will be described later, and the information related to the remaining number of components in each of the reels **26** that are set in the component supply device. The control section **40** moves the reels **26** that are to be unloaded relatively earlier among the reels **26** stored in the storage sections to the unloading waiting sections **50** previously before receiving the instruction of unloading.

(29) Specifically, the control section **40** receives the production planning information and the information related to the remaining number of components from the surface mounter **14** via the communication network **4**. The control section **40** may receive such information from devices other than the surface mounter **14**. For example, the management computer that manages the production line **2** may be connected to the communication network **4** and manage the information. In such a system, the control section **40** may receive the information from the management computer.

(30) The production planning information includes the type of substrates to be produced, the order in which the substrates of every type are to be produced, the number of substrates of every type to be produced, the type of components **E** to be mounted on the substrate of every type, and the number of components **E** of every type. The information related to the remaining number of components in each of the reels **26** that are set in the component supply device includes the remaining number of components in each of the reels **26**.

(31) In response to starting of production of the substrates, the control section **40** determines the

number of components E of each reel **26** (each of the reels **26** set in the component supply device) to be used for producing one substrate based on the number of components E of every type that are mounted on one substrate. The control section **40** calculates the number of substrates that can be produced for each of the reels **26** that is set in the component supply device by dividing the remaining number of components in the reel **26** by the number of components E of the reel **26** necessary to be mounted on one substrate.

(32) As the remaining number of components included in the reel **26** becomes smaller, the number of substrates that can be produced with the remaining number of components in the reel **26** is reduced. Therefore, the reel **26** including the smaller number of components with which the number of substrates to be produced is small is required to be replaced with another one first. The reel **26** including the components E of the same type of the components E included in the reel **26** with which the number of substrates to be produced is small is required to be unloaded from the storage section first. Therefore, the control section determines the order of the reels **26**, which are set in the component supply device, starting from the reel **26** including the smallest number of components, with which the number of substrates to be produced is smallest. The control section **40** determines the order in which the components E of every type are unloaded based on the type of components E in each reel **26**. The control section **40** determines the order in which the reels **26** are unloaded according to the order in which the components E of every type are to be unloaded.

(33) For example, among the reels **26** set in the component supply device, the components E in the reel **26** with which the number of substrates to be produced is smallest are components of type A, the components E in the reel **26** with which the number of substrates to be produced is second smallest are components of type B, and the components E in the reel **26** with which the number of substrates to be produced is third smallest are components of type C. In such a case, the control section **40** determines to unload the reel **26** storing the components E of type A, the reel **26** storing the components E of type B, and the reel **26** storing the components E of type C in this order. In the following description, the reel **26** that is to be unloaded first is referred to as a reel **26** having high priority.

(34) After determining the order in which the reels **26** are unloaded (namely, the priority of the reels **26**), the control section **40** moves the reel **26** having high priority from the storage section **38** where the reel **26** is stored to the unloading waiting section **50** (an example of a first moving process and a first moving step). In the following, the operation will be specifically described. In the following description, the unloading waiting sections are empty at first for easy understanding.

(35) The control section **40** controls the moving head **34A** and the head movement portion **34B** to move the reels **26** stored in the storage sections **38** to the unloading waiting sections **50A** sequentially from the reel **26** having highest priority. For example, when moving one reel **26** storing the components E of type A to the first unloading waiting section in a configuration including multiple reels **26** storing the components E of type A, any one of the reels **26** storing the components E of type A may be moved to the first unloading waiting section **50A**. If the order in which the reels **26** are unloaded is previously determined in the configuration including multiple reels **26** storing the components E of type A, one of the reels **26** having the earliest order may be moved to the first unloading waiting section **50A**. For example, one of the reels **26** storing the components E that are used for products of earlier production time may be unloaded first. In such a case, one of the reels **26** storing the components E of type A that are used for products of earlier production time may be moved to the first unloading waiting section **50A**.

(36) If determining that the first unloading waiting sections **50A** are full, the control section **40** moves the reels **26** stored in the storage sections **38** to the second unloading waiting sections **50B** sequentially from the reel **26** having highest priority. If determining that the second unloading waiting sections **50B** are full, the control section **40** moves the reels **26** stored in the storage sections **38** to the third unloading waiting sections **50C** sequentially from the reel **26** having highest priority. If determining that the third unloading waiting sections are full, the control section **40**

temporally stops moving the reels **26**.

(37) If determining that the remaining number of components in any one of the reels **26** is a predefined number or less, the surface mounter **14** informs an operator to set a new reel **26**. The surface mounter **14** informs the control section **40** of the parts tower **3** of the type of components **E** stored in the reel **26** whose remaining number is the predetermined number or less. If the operator is informed of replacement of the reel **26**, the operator moves to the parts tower **3** and operates the operation section **41** to instruct unloading of the reel **26**. If receiving the instruction of the unloading, the control section **40** moves the reel **26** storing the components **E** of the type, which is informed by the surface mounter **14**, from the unloading waiting section **50** to the loading and unloading shelf **33** (an example of a second moving process and a second moving step).

(38) After moving the reel **26** stored in the unloading waiting section **50** to the loading and unloading shelf **33**, the control section **40** moves the reels **26** among the unloading waiting sections **50** to be closer to the loading and unloading shelf **33**. Specifically, if determining that the reel **26** stored in the first unloading waiting section **50A** is unloaded and one of the first unloading waiting sections **50A** becomes empty, the control section **40** moves one of the reels **26** having the highest priority in the second unloading waiting sections **50B** to the empty first unloading waiting section **50A**. Similarly, if determining that one of the second unloading waiting sections **50B** becomes empty, the control section **40** moves one of the reels **26** having the highest priority in the third unloading waiting sections **50C** to the empty second unloading waiting section **50B**.

(39) If determining that one of the third unloading waiting sections **50C** is empty, the control section **40** moves one of the reels **26** in the storage sections **38** (the storage sections **38** other than the unloading waiting sections **50**) having the highest priority to the empty third unloading waiting section **50C** (one example of a third moving process). If determining that the third unloading waiting sections **50C** are full, the control section **40** temporally stops moving the reels **26**.

(5) Effects of the Embodiment

(40) In the parts tower **3** according to the first embodiment, the component tapes **25** that are to be unloaded relatively early are moved to the unloading waiting sections **50** before the instruction of unloading the component tapes **25**. Therefore, the time required for moving the component tapes **25** that are stored in the storage sections **38** far away from the loading and unloading shelf **33** to the loading and unloading shelf **33** after receiving the instruction of unloading can be shortened. According to the storage cabinet of storing the component tapes **25**, the time required for unloading the component tapes **25** can be shortened.

(41) According to the parts tower **3**, after moving the component tape **25** to the loading and unloading shelf **33** in the second moving process, the moving section **34** is controlled to perform the third moving process and move the component tape **25** that is stored in one unloading waiting section of the unloading waiting sections **50** to another one of the unloading waiting sections **50** that is closer to the loading and unloading shelf **33** than the one unloading waiting sections **50** is. This shortens the time required for unloading the component tape **25**.

Second Embodiment

(42) Next, a second embodiment will be described with reference to FIG. **8**. In the first embodiment, the reel **26** having high priority is moved to the unloading waiting section **50**. In the second embodiment, the control section **40** moves the reels **26** having high priority to the loading and unloading shelf **33** and the unloading waiting sections **50**.

(43) Specifically, the control section **40** controls the moving head **34A** and the head movement portion **34B** to move the reels **26** stored in the storage sections **38** to the loading and unloading shelf **33** sequentially from the one having highest priority (an example of a fourth moving process and a fourth moving step). If determining that the loading and unloading shelf **33** is full, the control section **40** moves the reels **26** stored in the storage sections **38** to the first unloading waiting sections **50A** sequentially from the reel **26** having highest priority. If determining that the first unloading waiting sections **50A** are full, the control section **40** moves the reels stored in the storage

sections **38** to the second unloading waiting sections **50B** sequentially from the reel **26** having highest priority. If determining that the second unloading waiting sections **50B** are full, the control section **40** moves the reels **26** stored in the storage sections **38** to the third unloading waiting sections **50C** sequentially from the reel **26** having highest priority (one example of a fifth moving process and a fifth moving step). If determining that the third unloading waiting sections **50C** are full, the control section **40** temporally stops moving the reels **26**.

(44) If the reels **26** that are moved to the loading and unloading shelf **33** are unloaded from the loading and unloading shelf **33**, the control section **40** moves the reels **26** stored in the first unloading waiting sections **50A** to the loading and unloading shelf **33** sequentially from the one having highest priority. If determining that the loading and unloading shelf **33** is full, the control section **40** moves the reels **26** among the unloading waiting sections **50** to be closer to the loading and unloading shelf **33**. Specifically, if determining that the reel **26** stored in the first unloading waiting section **50A** is moved out to the loading and unloading shelf **33** and one of the first unloading waiting sections **50A** becomes empty, the control section **40** moves one of the reels **26** having the highest priority in the second unloading waiting sections **50B** to the empty first unloading waiting section **50A**. Similarly, if determining that one of the second unloading waiting sections **50B** becomes empty, the control section **40** moves one of the reels **26** having the highest priority in the third unloading waiting sections **50C** to the empty second unloading waiting section **50B**. If determining that one of the third unloading waiting sections **50C** is empty, the control section **40** moves one of the reels **26** in the storage sections **38** (the storage sections **38** other than the unloading waiting sections **50**) having the highest priority to the empty third unloading waiting section **50C** (one example of a sixth moving process). If determining that the third unloading waiting sections **50C** are full, the control section **40** temporally stops moving the reels **26**.

According to the parts tower **3** of the second embodiment, the reels **26** that are to be unloaded earlier are moved to the loading and unloading shelf **33** and therefore, the reel **26** is already moved to the loading and unloading shelf **33** when the instruction of unloading is received. Therefore, the time required for unloading the reels **26** can be shortened. Furthermore, according to the parts tower **3**, among the reels **26** except for the reels **26** that are to be moved to the loading and unloading shelf **33**, the reels **26** that are to be unloaded earlier are moved to the unloading waiting sections **50**. Therefore, if receiving an instruction of unloading another reel **26** right after the reel **26** that is just moved to the loading and unloading shelf **33** is unloaded, the time required for moving the reel **26** to the loading and unloading shelf **33** after receiving the instruction of loading can be shortened.

(45) According to the parts tower **3**, after the reel **26** that is moved to the loading and unloading shelf **33** is unloaded, the moving section **34** is controlled to move the reel **26** stored in the unloading waiting section **50** to the loading and unloading shelf **33**. Then, the reel **26** stored in the unloading waiting section **50** is moved to another unloading waiting section **50** that is closer to the loading and unloading shelf **33**. Therefore, the time required for unloading the reel **26** can be shortened.

Third Embodiment

(46) Next, a third embodiment will be described with reference to FIG. **9**. The third embodiment is a modification of the second embodiment. In the second embodiment, the reels **26** having high priority are moved to the loading and unloading shelf **33** until the loading and unloading shelf **33** becomes full. As illustrated in FIG. **9**, in the parts tower **3** according to the third embodiment, some of the loading and unloading sections **39** of the loading and unloading shelf **33** are defined as the loading and unloading sections **39** for urgent use.

(47) When moving the reels **26** having high priority to the loading and unloading shelf **33**, the control section **40** moves the reels **26** to loading and unloading sections **39A** other than the loading and unloading sections **39** for urgent use and does not move the reels **26** to the loading and unloading sections **39** for urgent use.

(48) According to the parts tower 3 of the third embodiment, in the fourth moving process of moving the reels 26 that are to be unloaded early to the loading and unloading shelf 33, the reels 26 are moved only to some of the loading and unloading sections 39 (the loading and unloading sections 39A). Therefore, other loading and unloading sections 39 (the loading and unloading sections 39B) can be used as the loading and unloading sections 39 for urgent use. If the reel 26 is necessary to be unloaded urgently, the reel 26 that is necessary to be unloaded urgently can be unloaded.

Other Embodiments

(49) The technology described herein is not limited to the embodiments described in the above description and the drawings. The following embodiments may be included in the technical scope of the technology described herein, for example. (1) In the above embodiments, the unloading waiting sections 50 include the first unloading waiting sections 50A, the second unloading waiting sections 50B, and the third unloading waiting sections 50C. The unloading waiting sections 50 may include only the first unloading waiting sections 50A. (2) In the above embodiments, if the substrates are started to be produced, the order in which the reels 26 are to be unloaded is determined and the reels 26 are moved. However, the timing of moving the reels 26 is not limited to the timing of the above embodiments. For example, the reels 26 may be moved before starting the production of substrates. By connecting a new component tape 25 to the last end of the currently used component tape 25 with splicing, the remaining number of components varies. Therefore, every time a new component tape 25 is connected with splicing, the order in which the reels 26 are to be unloaded may be determined and the reels 26 may be moved. (3) In the above embodiments, the control section 40 determines the order, in which the reels 26 are to be unloaded, based on the production planning information and the information related to the remaining number of components. The surface mounter 14 or an external management computer may determine the order in which the reels 26 are to be unloaded and inform the control section 40 of the order. (4) In the above embodiments, the unloading waiting sections 50 are included only in the front storage shelf 32A out of the front storage shelf 32A and the rear storage shelf 32B. However, the rear storage shelf 32B may also include the unloading waiting sections 50. For example, the storage sections 38 of the rear storage shelf 32B that are disposed to overlap the loading and unloading shelf 33 seen from the front side may be defined as the unloading waiting sections 50. The front storage shelf 32A may not include the unloading waiting sections 50 and only the rear storage shelf 32B may include the unloading waiting sections 50. (5) In the above embodiments, the first unloading waiting sections 50A are disposed to surround the loading and unloading shelf 33, and the second unloading waiting sections 50B and the third unloading waiting sections 50C are disposed on upper and lower sides of the loading and unloading shelf 33. As illustrated in FIG. 10, the second unloading waiting sections 50B may be disposed surround the loading and unloading shelf 33. Further, the second unloading waiting sections 50B and the third unloading waiting sections 50C may be disposed to surround the loading and unloading shelf 33. (6) In the above embodiments, the reel 26 is described as an example of the component storing member. However, the component storing member may be a component tray on which components are disposed.

Claims

1. A component storing member storage cabinet that stores component storing members storing components to be mounted on substrates, the component storing member storage cabinet comprising: storing sections storing the component storing members; unloading sections in which the component storing members to be unloaded are disposed; unloading waiting sections that are some of the storing sections disposed around the unloading sections and in which the component storing members are disposed; a moving section configured to move the component storing members inside the component storing member storage cabinet; an instruction receiving section

receiving an instruction of unloading the component storing members; and a control section configured to control the moving section to move the component storing members that are to be unloaded early among the component storing members stored in the storing sections to the unloading waiting sections before receiving the instruction of unloading the component storing members, and control the moving section to move the component storing members stored in the unloading waiting sections to the unloading sections in response to receiving the instruction of unloading the component storing members.

2. The component storing member storage cabinet according to claim 1, wherein after moving the component storing members from the unloading waiting sections to the unloading sections, the control section is configured to control the moving section to move the component storing members stored in the unloading waiting sections to be closer to the unloading sections.

3. A component storing member storage cabinet that stores component storing members storing components to be mounted on substrates, the component storing member storage cabinet comprising: storing sections storing the component storing members; unloading sections in which the component storing members to be unloaded are disposed; unloading waiting sections that are some of the storing sections disposed around the unloading sections and in which the component storing members are disposed; a moving section configured to move the component storing members inside the component storing member storage cabinet; an instruction receiving section receiving an instruction of unloading the component storing members; and a control section configured to control the moving section to move the component storing members that are to be unloaded early among the component storing members stored in the storing sections to the unloading sections before receiving the instruction of unloading the component storing members, and control the moving section to move the component storing members to the unloading waiting sections before receiving the instruction of unloading the component storing members, the component storing members being moved to the unloading waiting sections being to be unloaded early among the component storing members except for the component storing members that are moved to the unloading sections.

4. The component storing member storage cabinet according to claim 3, wherein after unloading the component storing members that are disposed in the unloading sections, the control section is configured to control the moving section to move the component storing members stored in the unloading waiting sections to the unloading sections and subsequently to move the component storing members stored in the unloading waiting sections to be closer to the unloading sections.

5. The component storing member storage cabinet according to claim 3, wherein the control section is configured to move the component storing members to only some of the unloading sections.

6. A method of managing component storing members in storing sections and unloading sections of a component storing member storage cabinet, the storing sections storing the component storing members, and the unloading sections in which the component storing members to be unloaded are disposed, the method comprising: moving the component storing members that are to be unloaded relatively early among the stored component storing members to unloading waiting sections that are some of the storing sections disposed around the unloading sections before receiving an instruction of unloading the component storing members, and moving the component storing members stored in the unloading waiting sections to the unloading sections in response to receiving the instruction of unloading the component storing members.

7. A method of managing component storing members in storing sections and unloading sections of a component storing member storage cabinet, the storing sections storing the component storing members, and the unloading sections in which the component storing members to be unloaded are disposed, the method comprising: a fourth moving step of moving the component storing members that are to be unloaded relatively early among the stored component storing members to the unloading sections before receiving an instruction of unloading the component storing members, and moving the component storing members to unloading waiting sections that are some of the

storing sections disposed around the unloading sections before receiving the instruction of unloading the component storing members, the component storing members being moved to the unloading waiting sections being to be unloaded early among the component storing members except for the component storing members that are moved to the unloading sections.

8. The component storing member storage cabinet according to claim 4, wherein the control section is configured to move the component storing members to only some of the unloading sections.
