[DESCRIPTION]

[Invention Title]

AUTOMATED SYSTEM FOR TRANSPORTING/FASTENING DRUM

[Technical Field]

[1] Various embodiments of the present invention relate to an automated system for transporting/fastening a drum and a method for transporting/fastening a drum.

[Background Art]

[2] Generally, semiconductor and chemical plants use various types of chemicals in large quantities.

[3] The chemicals refer to liquid substances such as hydrofluoric acid, sulfuric acid, hydrochloric acid, ammonia, hydrogen peroxide, plating solutions, photoresists, and developers, or substances like slurries used in chemical mechanical polishing and the like.

[4] However, the chemicals often have toxicity or flammability that is harmful to humans or the environment. Accordingly, the chemicals are stored in a container such as a drum and supplied to the plants. In addition, in this case, special caution is required during the handling and transportation of the drum.

[5] Conventionally, an operator wearing protective clothing had to manually push and move a cart loaded with a drum to a position of equipment where the chemical was to be supplied. Accordingly, the risk of safety incidents for operators increased, and productivity decreased due to manual operation.

[6] Accordingly, there is a need to develop an automated system for transporting/fastening a drum, which may transport/fasten a drum in an unmanned, automated manner to reduce safety incidents for operators and improve productivity.

[7] As the related art, there is Korean Utility Model Publication No. 20-2023-

0000497 (hereinafter referred to as Patent Document 1), and Patent Document 1 discloses a material transport system. However, according to the material transport system of Patent Document 1, the system has a structure in which an operator directly moves a transport cart on which an article (i.e., a drum) is loaded, and thus does not employ an automated method for transporting a drum.

[Disclosure]

[Technical Problem]

[8] The present invention is directed to providing an automated system for transporting/fastening a drum capable of performing drum transporting and fastening operations in an automated manner using an autonomous mobile robot (AMR) and a collaborative robot.

[9] The present invention is also directed to providing an automated system for transporting/fastening a drum capable of performing not only drum transport and conveyance but also fastening and unfastening operations between a drum and a coupler in an automated manner using a collaborative robot connected to an AMR.

[10] The present invention is also directed to providing an automated system for transporting/fastening a drum capable of performing drum transporting and fastening operations in an automated manner using an AMR and a collaborative robot.

[11] The present invention is also directed to providing an automated system for transporting/fastening a drum capable of performing drum transport, conveyance, and fastening or unfastening operations with respect to a coupler in an unmanned, automated manner using various lidar scanners and/or sensors applied to an AMR and a collaborative robot.

[12] Objects of the present invention are not limited to the above object, and other objects and advantages of the present invention which are not mentioned can be

understood by the following description and more clearly understood by various embodiments of the present invention. In addition, it will be able to be easily seen that the objects and advantages of the present invention may be achieved by devices and combinations thereof that are described in the claims.

[Technical Solution]

[13] An automated system for transporting/fastening a drum according to an embodiment includes an autonomous mobile robot (AMR) which autonomously moves to transport a drum, and a collaborative robot provided in the AMR to fasten or unfasten the drum and a coupler.

[14] According to one embodiment, the collaborative robot includes a robot body connected to the AMR, a vision unit which is provided on the robot body and acquires image data for fastening or unfastening the drum and the coupler, and a gripper which is provided on the robot body and fastens or unfastens the drum and the coupler.

[15] According to one embodiment, the automated system further includes a plurality of lidar scanners provided in the AMR.

[16] According to one embodiment, the plurality of lidar scanners include a first lidar scanner responsible for a navigation function during the movement of the AMR, and a second lidar scanner responsible for an obstacle detection function during the movement of the AMR.

[17] According to one embodiment, the first lidar scanner may be disposed on an upper portion of a first body unit of the AMR and may map an interior of a movement space to enable the AMR to perform self-avoidance movement when interference with an obstacle occurs in a movement path, and the second lidar scanner may be disposed at corner portions of a base unit of the AMR and may detect obstacles within a 270-degree range.

[18] According to one embodiment, the automated system further includes a communication sensor which is provided in the AMR and enables communication between the AMR and the equipment on which the coupler is installed.

[19] According to one embodiment, the automated system further includes a bumper sensor which is provided at a lower edge of the AMR, detects external collisions of the AMR, and blocks the movement of the AMR upon detection of a collision.

[20] According to one embodiment, the automated system further includes a drum detection sensor which is provided in the AMR and detects whether a drum is present within a drum accommodating space provided inside the AMR.

[21] According to one embodiment, the AMR includes a base unit disposed at a set height on the ground and having driving wheels, a first main body provided above the base unit, and a second main body which is provided above the base unit and disposed to be spaced apart from the first main body with a drum accommodating space interposed therebetween.

[22] According to one embodiment, the AMR may further include a side portion forming a wall surface between the first main body and the second main body, one side of the drum accommodating space may be blocked by the side portion, and the other side of the drum accommodating space may be opened to transport the drum.

[23] According to one embodiment, the automated system includes a roller unit which is disposed in the lower portion of the drum accommodating space and rotates in contact with a lower portion of the drum being transported by the drum transport driving unit.

[24] According to one embodiment, the roller unit includes a central roller horizontally disposed in a lower central portion of the drum accommodating space, and side rollers horizontally disposed at opposite lower ends of the drum accommodating

space.

[25] According to one embodiment, the automated system further includes a drum transport driving unit configured to transport the drum to the drum accommodating space.

[26] According to one embodiment, the drum transport driving unit includes a first linear motion unit configured to linear move to transport the drum to the drum accommodating space, a second linear motion unit which is connected to the first linear motion unit and linearly moves to transport the drum to the drum accommodating space, and a vacuum suction unit which moves by linear movement distances of the first and second linear motion units and is vacuum-suctioned on a surface of the drum to be transported.

[27] According to one embodiment, the first linear motion unit includes a first body unit, a first motor unit disposed on one side of the first body unit, a gear unit rotated by receiving a rotational force of the first motor unit, and a rack body unit linearly moved by the rotation of the gear unit.

[28] According to one embodiment, the second linear motion unit includes a second body unit disposed above the first linear motion unit and connected to the rack body unit, a second motor unit disposed on one side of the second body unit, and a ball screw configured to linearly move the vacuum suction unit using a rotational force of the second motor unit.

[29] According to one embodiment, the vacuum suction unit includes a connecting body connected to the second linear motion unit, an arm unit connected to the connecting body and extending into the drum accommodating space, and a vacuum suction pad connected to the arm unit and vacuum-suctioned to the surface of the drum to be transported.

[30] According to one embodiment, the vacuum suction unit further includes a reinforcing unit configured to reinforce a space between the connecting body and the arm unit.

[31] According to one embodiment, the vacuum suction unit may be provided as a plurality of vacuum suction units, and each of the plurality of vacuum suction units may be vacuum-suctioned on the surface of the drum to be transported at a position close to each other.

[32] According to one embodiment, the automated system further includes a drum detachment prevention unit configured to surround and support a drum transported to the drum accommodating space and prevent the drum from detaching.

[33] According to one embodiment, the drum detachment prevention unit includes a first drum guide configured to surround a circumference of the drum seated in the drum accommodating space from one side, and a second drum guide configured to surround the circumference of the drum seated in the drum accommodating space from one side.

[34] According to one embodiment, the automated system includes a roller unit which is disposed in a lower portion of the drum accommodating space and rotates in contact with a lower portion of the drum when the drum is transported, in which the first and second drum guides may be disposed to be spaced apart upward from the roller unit by a set height and disposed to face each other with a drum accommodated in the drum accommodating space interposed therebetween.

[35] According to one embodiment, the first drum guide includes a first arc frame configured to support the circumference of the drum from one side, and a first roller provided on the first arc frame.

[36] According to one embodiment, the first arc frame includes a first upper arc frame configured to support a circumference of the drum seated in the drum

accommodating space from an upper portion of one side thereof, and a first lower arc frame that supports the circumference of a drum seated in the drum accommodating space from a lower portion of one side thereof, and the first roller may be rotatably connected to a first axis which is fixed vertically between the first upper arc frame and the first lower arc frame.

[37] According to one embodiment, the first drum guide further includes a plurality of first reinforcing frames which cross-connect the first upper arc frame and the first lower arc frame and reinforce the first arc frame.

[38] According to one embodiment, the first drum guide may further include a first anti-slip stopper which is disposed on an outer side of the first arc frame and prevents the first arc frame from being pushed by the drum supported by the first arc frame.

[39] According to one embodiment, the second drum guide includes a second arc frame configured to support the circumference of the drum from the other side, and a second roller provided on the second arc frame and rotatable in contact with the circumference of the drum.

[40] According to one embodiment, the second arc frame includes a second upper arc frame configured to support a circumference of the drum seated in the drum accommodating space from an upper portion of the other side thereof, and a second lower arc frame that supports the circumference of a drum seated in the drum accommodating space from a lower portion of the other side thereof, and the second roller may be rotatably connected to a second axis which is fixed vertically between the second upper arc frame and the second lower arc frame.

[41] According to one embodiment, the second drum guide further includes a plurality of second reinforcing frames which cross-connect the second upper arc frame and the second lower arc frame and reinforce the second arc frame.

[42] According to one embodiment, the second drum guide may further include a second anti-slip stopper which is disposed on an outer side of the second arc frame and prevents the second arc frame from being pushed by the drum supported by the second arc frame.

[43] According to one embodiment, the automated system further includes a turntable unit which is disposed in a lower portion of the drum accommodating space and rotates the drum transported to the drum accommodating space at a set angle.

[44] According to one embodiment, the turntable unit may be disposed so as to be exposed upward through a drum seating unit which is an empty space provided inside the drum accommodating space and on which the drum is seated.

[45] According to one embodiment, the turntable unit includes a turntable body having a disc shape and horizontally disposed to rotate the seated drum, and a turntable rotation motor configured to rotate the turntable body.

[46] According to one embodiment, the turntable unit further includes a drum weight measuring unit configured to detect a weight of the drum seated on the turntable body.

[47] According to one embodiment, the drum weight measuring unit includes a plurality of load cells disposed in contact with a lower portion of the turntable body, and the plurality of load cells may be disposed to be spaced apart from each other at a set distance, and each of the plurality of load cells may be in contact with the lower portion of the turntable body at a different position to detect a weight of the drum seated on an upper portion of the turntable body.

[48] According to one embodiment, the automated system further includes a power base unit configured to adjust a height of the AMR.

[49] According to one embodiment, the power base unit further includes at least one

screw jack which is disposed on a lower portion of the AMR and adjusts a height of the roller unit by lifting or lowering the height of the AMR, and a height adjustment motor configured to provide a rotational force required for the lifting and lowering operations of the screw jack.

[50] According to one embodiment, the automated system further includes a roller unit which is disposed in the lower portion of the drum accommodating space and rotates in contact with a lower portion of the drum being transported by the drum transport driving unit, wherein the roller unit includes a bridge roller unit connected to one end portion of the roller unit and rotatable within a 90-degree range.

[51] According to one embodiment, the bridge roller unit includes a pair of side frames, a bridge roller rotatably connected to the pair of side frames, and a bridge driving motor configured to rotate the pair of side frames and the bridge roller within a 90-degree range, the pair of side frames may be connected by being seated on an upper end of a seating support at a side of the equipment provided with a coupler to which the drum is fastened, a seating detection sensor may be provided at a connecting portion of the pair of side frames, and the seating detection sensor may detect the connection between the bridge roller unit and the upper end of the seating support.

[52] According to one embodiment, the bridge roller unit may rotate in a direction parallel to the roller unit when the drum is transported to the drum accommodating space or discharged from the drum accommodating space, thereby allowing external movement of the drum, and rotate in a direction perpendicular to the roller unit when the drum is seated in the drum accommodating space, thereby blocking external movement of the drum.

[53] A method for transporting/fastening a drum according to one embodiment, which uses an automated system for transporting/fastening a drum including an

autonomous mobile robot (AMR) for autonomously driving to transport a drum within a workplace having equipment having a coupler fastened to a drum containing a product and a buffer zone for temporarily storing a real drum containing a product to be supplied to the equipment and/or an empty drum which has completed supplying the product to the equipment, and a collaborative robot which is provided in the AMR and fastens or unfastens the drum and the coupler, and includes an empty drum recovery operation of transporting the empty drum generated from the equipment to the buffer zone and recovering the empty drum into the buffer zone using the AMR and the collaborative robot, and a real drum supply operation of transporting a real drum stored in the buffer zone to the equipment using the AMR and the collaborative robot and connecting the real drum to the coupler inside the equipment.

[54] According to one embodiment, the empty drum recovery operation includes an empty drum generation signal output operation of outputting an empty drum generation signal from the equipment when the supply of the product to the equipment is completed.

[55] According to one embodiment, the empty drum recovery operation further includes a first AMR movement operation in which the AMR receives the signal output from the equipment and the AMR moves toward the equipment.

[56] According to one embodiment, the empty drum recovery operation further includes a coupler unfastening operation of unfastening the coupler connected to the empty drum inside the equipment using the collaborative robot.

[57] According to one embodiment, the empty drum recovery operation further includes an empty drum transport operation of transporting the empty drum from the equipment to the drum accommodating space provided in the AMR.

[58] According to one embodiment, the empty drum recovery operation further

includes a second AMR movement operation of moving the AMR that has recovered the empty drum to the buffer zone.

[59] According to one embodiment, the empty drum recovery operation may further include an empty drum buffer zone discharge operation of discharging the empty drum into the buffer zone after the AMR arrives at the buffer zone.

[60] According to one embodiment, the real drum supply operation includes a real drum transport operation of transporting the real drum stored in the buffer zone to a drum accommodating space provided in the AMR.

[61] According to one embodiment, the real drum supply operation further includes a third AMR movement operation of moving the AMR that has received the real drum from the buffer zone to the equipment.

[62] According to one embodiment, the real drum supply operation further includes a real drum equipment supply operation of transporting the real drum into the equipment and supplying the real drum to the equipment in after the AMR arrives at the equipment.

[63] According to one embodiment, the real drum supply operation further includes a real drum fastening operation of fastening the real drum transported into the equipment to the coupler using the collaborative robot.

[64] According to one embodiment, the real drum supply operation further includes, prior to the real drum fastening operation, a real drum barcode recognition operation of recognizing a barcode of the real drum transported by the AMR using the collaborative robot.

[65] According to one embodiment, the real drum supply operation further includes, prior to the real drum fastening operation, a real drum rotation operation of rotating the real drum transported by the AMR to a set angle and adjusting a fastening position

between the real drum and the coupler.

[66] According to one embodiment, the real drum supply operation further includes an AMR charging return operation in which the fastening between the real drum and the coupler inside the equipment and the AMR returns to a charging position and is charged.

[67] Details of other embodiments are included in the detailed description and the drawings for carrying out the invention.

[Advantageous Effects]

[68] According to various embodiments, the drum transporting and fastening operations can be performed in an automated manner using an autonomous mobile robot (AMR) and a collaborative robot. Accordingly, safety incidents during the transporting and fastening operations of operators can be prevented, and productivity can be improved by reducing dependence on the operators.

[69] In addition, according to various embodiments, using the collaborative robot connected to the AMR, not only drum transport and conveyance but also fastening and unfastening with respect to the coupler of equipment can be performed in an unmanned, automated manner.

[70] Specific effects together with the above effects have been described together with a description of the following detailed matters for carrying out the invention.

[Description of Drawings]

[71] FIG. 1 is a simplified perspective view showing an automated system for transporting/fastening a drum according to one embodiment.

[72] FIG. 2 is a simplified right side view showing the automated system for transporting/fastening a drum according to one embodiment.

[73] FIG. 3 is a simplified left side view showing the automated system for transporting/fastening a drum according to one embodiment.

[74] FIG. 4 is a simplified front view showing the automated system for transporting/fastening a drum according to one embodiment.

[75] FIG. 5 is a simplified rear view showing the automated system for transporting/fastening a drum according to one embodiment.

[76] FIG. 6 is a simplified plan view showing the automated system for transporting/fastening a drum according to one embodiment.

[77] FIG. 7 is a perspective view with control-related components added to the automated system for transporting/fastening a drum according to one embodiment.

[78] FIG. 8 is a simplified perspective view showing the structure of a roller unit, a bridge roller unit, a turntable unit, and a power base unit according to one embodiment.

[79] FIG. 9 is a simplified front view showing the structure of a roller unit, a bridge roller unit, a turntable unit, and a power base unit according to one embodiment.

[80] FIG. 10 is a simplified perspective view showing a turntable unit according to one embodiment.

[81] FIG. 11 is a simplified perspective view showing a drum transport driving unit according to one embodiment.

[82] FIG. 12 is a simplified perspective view showing a drum detachment prevention unit according to one embodiment.

[83] FIGS. 13 to 15 are flowcharts for describing a method for transporting/fastening a drum according to one embodiment.

[84] FIGS. 16 to 24 are conceptual diagrams showing a method for transporting/fastening a drum according to one embodiment.

[Mode for Invention]

[85] Advantages and features of the present invention and methods for achieving them will become clear with reference to various embodiments to be described below in

detail together with the accompanying drawings. However, the present invention is not limited to the embodiments disclosed below but may be implemented in various different forms, the embodiments are merely provided to make the disclosure of the present invention complete and fully inform those skilled in the art to which the present invention pertains of the scope of the present invention, and the present invention is only defined by the scope of the appended claims. The same reference number denotes the same components throughout the specification.

[86] Although "first," "second," and the like are used to describe various components, these components are not limited by these terms. These terms are used only to distinguish one component from another, and unless otherwise stated, it is obvious that a first component may be a second component.

[87] Throughout the specification, unless otherwise stated, each component may be singular or plural.

[88] Hereinafter, the arrangement of an arbitrary component on an "upper portion (or lower portion)" of a component or "above (or under)" the component may not only mean that the arbitrary component is disposed in contact with an upper surface (or a lower surface) of the component, but also mean that other components may be interposed between the component and the arbitrary component disposed above (or under) the component.

[89] In addition, when a certain component is described as being "connected," "coupled," or "joined" to the other component, the components may be directly connected or joined, but it should be understood that another component may be "interposed" between the components, or the components may be "connected," "coupled," or "joined" through another component.

[90] The singular expression used herein includes the plural expression unless the

context clearly dictates otherwise. In the application, terms such as “composed of” or “comprising” should not be construed as necessarily including all of the various components or operations described in the specification and should be construed as not including some of the components or some of the operations or further including additional components or operations.

[91] Throughout the specification, when “A and/or B” is described, this means A, B, or A and B unless otherwise specified, and when “C to D” is described, this means C or more and D or less unless otherwise specified..

[92] Hereinafter, an automated system for transporting/fastening a drum according to various embodiments will be described in detail with reference to the accompanying drawings.

[93] [Overall structure of an automated system for transporting/fastening a drum]

[94] FIG. 1 is a simplified perspective view showing an automated system for transporting/fastening a drum according to one embodiment. FIG. 2 is a simplified right side view showing the automated system for transporting/fastening a drum according to one embodiment. FIG. 3 is a simplified left side view showing the automated system for transporting/fastening a drum according to one embodiment. FIG. 4 is a simplified front view showing the automated system for transporting/fastening a drum according to one embodiment. FIG. 5 is a simplified rear view showing the automated system for transporting/fastening a drum according to one embodiment. FIG. 6 is a simplified plan view showing the automated system for transporting/fastening a drum according to one embodiment. FIG. 7 is a perspective view with control-related components added to the automated system for transporting/fastening a drum according to one embodiment.

[95] Referring to FIGS. 1 to 7, an automated system 1 for transporting/fastening a drum includes an autonomous mobile robot (AMR) 10 and a collaborative robot 70.

[96] The AMR 10 refers to a mobile robot that autonomously moves to transport a drum to a set position.

[97] The collaborative robot 70 may be provided in the AMR 10.

[98] The collaborative robot 70 includes a robot body 71 having a multi-joint structure capable of driving various motions in the AMR 10, a vision unit 73 for acquiring image data, and a gripper 72 capable of performing set operations (e.g., an fastening or unfastening operation of the drum and a coupler) (see FIG. 7).

[99] In addition, referring to FIG. 7, the automated system 1 for transporting/fastening a drum may further include a lidar scanner 80, a barcode reader 84, a communication sensor 85, a bumper sensor 86, and a drum detection sensor 87.

[100] According to one embodiment, the lidar scanner 80 may be provided in the AMR 10. The lidar scanner 80 may include a first lidar scanner 81 responsible for a navigation function during the movement of the AMR 10 and a second lidar scanner 82 responsible for an obstacle detection function during the movement of the AMR 10 (see FIG. 7).

[101] In addition, according to one embodiment, the barcode reader 84 may be provided in the AMR 10 and may recognize a barcode of the drum (see FIG. 7).

[102] In addition, according to one embodiment, a communication sensor (e.g., a PIO sensor) 85 is provided in the AMR 10 and enables communication between the AMR 10 and equipment (e.g., a chemical supply facility) (see FIG. 7).

[103] In addition, according to one embodiment, the bumper sensor 86 may be provided at a lower edge of the AMR 10 and may detect external collisions of the AMR 10 (see FIG. 7).

[104] In addition, according to one embodiment, the drum detection sensor 87 may detect whether a drum has been transported to a drum accommodating space 14

provided within the AMR 10, that is, whether the drum is present (see FIG. 7).

[105] Referring to FIGS. 1 to 7, the automated system 1 for transporting/fastening a drum further includes a drum transport driving unit 20, a drum detachment prevention unit 30, a roller unit 40, a turntable unit 50, and a power base unit 60.

[106] The drum transport driving unit 20 refers to a device for transporting/fastening a drum for transporting a drum to the drum accommodating space 14 provided within the AMR 10.

[107] The drum detachment prevention unit 30 refers to a device for surrounding and supporting a drum transported to the drum accommodating space 14 and preventing the drum transported into the AMR 10 from detaching from the AMR.

[108] The roller unit 40 may be disposed in a lower portion of the drum accommodating space 14 and may rotate in contact with a lower portion of the drum when the drum is transported.

[109] The turntable unit 50 may be disposed in the lower portion of the drum accommodating space 14 and may rotate the drum transported by the operation of the drum transport driving unit 20 at a set angle.

[110] The power base unit 60 may adjust the height of the AMR 10. The power base unit 60 may adjust the height of the AMR 10 to adjust a difference between the heights of the AMR 10 and the equipment (e.g., a chemical supply facility).

[111] Hereafter, the specific configuration of the automated system 1 for transporting/fastening a drum according to various embodiments will be described in more detail.

[112] [Specific configuration of AMR]

[113] Referring to FIGS. 1 to 7, the AMR 10 refers to a mobile robot that autonomously moves to transport a drum to a set position.

[114] According to one embodiment, the AMR 10 may include a base unit 11 disposed at a set height on the ground and having driving wheels 16.

[115] According to an exemplary embodiment, the second lidar scanners 82 responsible for an obstacle detection function during the movement of the AMR 10 may be disposed at corner portions of the base unit 11. The second lidar scanners 82 may be disposed at the corner portions of the base unit 11 and may detect obstacles within a radius of 270 degrees.

[116] In addition, the AMR 10 may include a first main body 12 and a second main body 13.

[117] According to one embodiment, the first main body 12 may be provided above one side of the base unit 11 (e.g., a left side in the drawing or a rear end of the AMR 10).

[118] According to an exemplary embodiment, the first lidar scanner 81 responsible for a navigation function during the movement of the AMR 10 may be disposed on an upper portion of the first main body 12 (see FIG. 7). The first LiDAR scanner 81 maps an interior of a movement space and enables the AMR 10 to perform self-avoidance movement when interference with an obstacle occurs in a travel path.

[119] According to one embodiment, the second main body 13 may be disposed above the base unit 11, spaced apart from the first main body 12 with the drum accommodating space 14 in which the drum is seated interposed therebetween, and disposed above the other side of the base unit 11 (e.g., a right side in the drawings or a front end of the AMR 10).

[120] According to an exemplary embodiment, the collaborative robot 70 may be disposed on an upper portion of the second main body 13.

[121] In addition, the AMR 10 may further include a side portion 15.

[122] According to one embodiment, the side portion 15 may form a wall surface by

blocking a space between the first main body 12 and the second main body 13. The side portion 15 may form a wall on one side of the drum accommodating space 14 in which the drum is seated, thereby preventing the seated drum from detaching outward.

[123] In this way, one side of the drum accommodating space 14 may be blocked by the side portion 15, and the other side of the drum accommodating space 14 may be opened to transport or remove the drum.

[124] [Specific configuration of a roller unit and a bridge roller unit]

[125] Referring to FIGS. 1 to 8, the roller unit 40 may be disposed in the lower portion of the drum accommodating space 14 and may rotate in contact with the lower portion of the drum when the drum is transported.

[126] According to one embodiment, the roller unit 40 may be configured as a non-driving type free roller.

[127] According to one embodiment, the roller unit 40 may include a central roller 41 and side rollers 42.

[128] The central roller 41 may be horizontally disposed in a lower central portion of the drum accommodating space 14.

[129] The side rollers 42 may be horizontally disposed at opposite lower ends of the drum accommodating space 14.

[130] According to one embodiment, the roller unit 40 may further include a bridge roller unit 43.

[131] The bridge roller unit 43 refers to a roller structure connected to a front end of the roller unit 40 and capable of rotating within a 90-degree range.

[132] When the drum is transported, the bridge roller unit 43 may rotate in a direction parallel to the roller unit 40 (see FIG. 8). Accordingly, the external drum may be transported onto an upper portion of the turntable unit 50.

[133] Conversely, the bridge roller unit 43 may be seated on the upper portion of the turntable unit 50 after the drum is transported, and while the AMR 10 is traveling, the AMR 10 may rotate in a direction perpendicular to the roller unit 40 to maintain an upright position. In this case, external movement or detachment of the drum can be prevented (see FIG. 1).

[134] Referring to FIG. 8, the bridge roller unit 43 according to one embodiment may include a pair of side frames 431, a bridge roller 432, and a bridge driving motor 433.

[135] The pair of side frames 431 refers to straight frames that are connected by extending a set length from opposite ends of the roller unit 40 in a width direction.

[136] The bridge roller 432 may be rotatably connected between the pair of side frames 431.

[137] The bridge driving motor 433 may provide a rotational force necessary to rotate the pair of side frames 431 and the bridge roller 432 within a 90-degree range.

[138] In addition, according to one embodiment, the pair of side frames 431 may be horizontally seated and connected on an upper end of a seating support 92 disposed at a side of equipment 90 provided with a coupler 91 to which a drum is fastened.

[139] According to an exemplary embodiment, seating detection sensors 434 may be provided at connecting end portions of the pair of side frames 431.

[140] The seating detection sensor 434 may detect the horizontal connection (i.e., docking) of the bridge roller unit 43.

[141] When the AMR 10 arrives at the position of the equipment 90, the side frames 431 of the bridge roller unit 43 may be horizontally connected to the seating support 92 provided in the equipment 90.

[142] In this case, the seating detection sensors 434 may be provided on the side frames 431 of the bridge roller unit 43, and the seating detection sensors 434 may detect

whether the bridge roller unit 43 is horizontally seated on the seating support 92. Accordingly, the drum 5 may be transported.

[143] [Specific configuration of a turntable unit and a power base unit]

[144] Referring to FIGS. 8 and 9, the turntable unit 50 according to one embodiment may be provided within the drum accommodating space 14 (see FIG. 1) rather than the central roller 41 and disposed so as to be exposed upward through the drum seating unit 141, which is an empty space in which the drum is seated.

[145] Referring to FIG. 10, the turntable unit 50 according to one embodiment may include a turntable body 51 and a turntable rotation motor 52.

[146] The turntable body 51 may have a disc-shaped structure. The turntable body 51 may rotate the drum seated on the upper portion, that is, the drum seating unit 141, at a set angle.

[147] The turntable body 51 may be horizontally disposed.

[148] The turntable rotation motor 52 refers to a motor for outputting a rotational force required for the rotation of the turntable body 51.

[149] According to one embodiment, the turntable unit 50 may further include a drum weight measuring unit 53.

[150] The drum weight measuring unit 53 refers to a sensor for detecting a weight of the drum seated on the turntable body 51.

[151] According to an exemplary embodiment, the drum weight measuring unit 53 may include a plurality of load cells 531 capable of detecting the weight of the drum. For example, the plurality of load cells 531 may be disposed so as to be in contact with a lower portion of the turntable body 51.

[152] Meanwhile, referring to FIG. 9, the power base unit 60 according to one embodiment may be disposed below the AMR 10 and may include at least one screw

jack 61 capable of lifting and lowering the AMR 10 to adjust a height of the roller unit 40.

[153] The power base unit 60 according to one embodiment may further include a height adjustment motor 62 for providing a rotational force required for the lifting and lowering operations of the screw jack 61.

[154] The power base unit 60 may adjust the height of the AMR 10 (more specifically, the roller unit 40 or the bridge roller unit 43). Accordingly, the height may be adjusted such that heights of the AMR 10 and the equipment 90 (see FIG. 20) provided with the coupler 91 are aligned with each other.

[155] [Specific configuration of a drum transport driving unit and a drum detachment prevention unit]

[156] Referring to FIG. 11, the drum transport driving unit 20 may include a first linear motion unit 21, a second linear motion unit 22, and a vacuum suction unit 23.

[157] The first linear motion unit 21 is a device configured to extend and retract by linearly moving in an X-axis direction by a first set distance to transport a drum to the drum accommodating space 14.

[158] The second linear motion unit 22 is a device that is connected to the first linear motion unit 21 and extends and retracts by further linearly moving in the X-axis direction by a second set distance.

[159] By the linear movement of the first linear motion unit 21 by the first set distance and the linear movement of the second linear motion unit 22 by the second set distance, the first and second linear motion units 21 and 22 may transport a drum to the drum accommodating space 14 by multi-stage extension and retraction (i.e., telescopic operation).

[160] The vacuum suction unit 23 may be vacuum-adsorbed to a surface of the drum

to be transported. Accordingly, the vacuum suction unit 23 may linearly move to the surface of the drum to be transported by a sufficient length through the multi-stage extension and retraction of the first and second linear motion units 21 and 22, and fix and transport the drum using a vacuum suction force.

[161] According to one embodiment, the first linear motion unit 21 may include a first body unit 211, a first motor unit 212, a gear unit 231, and a rack body unit 214.

[162] The first body unit 211 may be disposed to extend in a length direction (i.e., an X-axis direction) of the roller unit 40 at the opposite ends of the roller unit 40 in the width direction (see FIG. 6).

[163] The first motor unit 212 may be disposed on one side of the first body unit 211 and may output a rotational force.

[164] The gear unit 231 may be rotated by receiving a rotational force output from the first motor unit 212. The gear unit 231 may be provided as a plurality of gear units corresponding to a required number.

[165] The rack body unit 214 may be connected to mesh with the gear unit 213 rotated by receiving the rotational force output from the first motor unit 212. The rack body unit 214 may be linearly moved by receiving the rotational force from the gear unit 213.

[166] According to one embodiment, the second linear motion unit 22 may include a second body unit 221, a second motor unit 222, and a ball screw 223.

[167] The second body unit 221 may be disposed on an upper portion of the first linear motion unit 21.

[168] The second body unit 221 may be disposed to extend in the length direction (i.e., the X-axis direction) of the roller unit 40 at the opposite ends of the roller unit 40 in the width direction (see FIG. 6).

[169] The second body unit 221 may be connected to the rack body unit 214 and may be linearly moved by the linear movement of the rack body unit 214 by the first set distance.

[170] The second motor unit 222 may be disposed on one side of the second body unit 221 and may output a rotational force required to linearly move the vacuum suction unit 23.

[171] The ball screw 223 may linearly move the vacuum suction unit 23 by receiving the rotational force from the second motor unit 222. For example, the ball screw 223 may include a screw rotated by receiving the rotational force output from the second motor unit 222 and a nut block that is fastened to the screw and linearly moves in an axial direction of the screw when the screw rotates.

[172] According to one embodiment, the vacuum suction unit 23 may include a connecting body 231, a reinforcing unit 232, an arm unit 233, and a vacuum suction pad 234.

[173] The connecting body 231 may be connected to the second linear motion unit 22. More specifically, the connecting body 231 may be connected to the ball screw 223 and fixed to the ball screw 223 linearly moved by the rotational force of the second motor unit 222 to linearly move by the second set distance.

[174] The arm unit 233 connects the connecting body 231 to the vacuum suction unit 234. According to one embodiment, one end portion of the arm unit 233 may be connected to the connecting body 231, and the other end portion of the arm unit 233 may have a structure that extends toward the drum accommodating space 14.

[175] The reinforcing unit 232 may reinforce a space between the connecting body 231 and the arm unit 233, and may be inserted into the connecting body 231 to provide a structural reinforcement, the reinforcing unit 232 having a U-shaped cross-section.

[176] The vacuum suction pad 234 may be disposed at the other end portion of the arm unit 233 and fixed to the surface of the drum to be transported by vacuum suction.

[177] According to one embodiment, the vacuum suction unit 23 may be provided as a plurality of vacuum suction units, for example, a pair of vacuum suction units (i.e., two vacuum suction units).

[178] The plurality of vacuum suction units 23 may be formed by extending from opposite ends of the roller unit 40 in the width direction (see FIG. 6) toward a center of the roller unit 40 in the width direction in a direction facing each other, and thus, may be vacuum-suctioned on the surface of the drum to be transported at positions close to each other.

[179] The vacuum suction pads 234 provided in the plurality of vacuum suction units 23, respectively, may be disposed vertically (or horizontally) at the positions close to each other, and thus, may be stably vacuum-suctioned on the surface of the drum to be transported, thereby pulling the drum with a large suction force to transport the drum.

[180] Referring to FIG. 12, the drum detachment prevention unit 30 according to one embodiment may surround and support the drum transported by the drum transport driving unit 20 (see FIG. 11). The drum detachment prevention unit 30 may surround and support opposite sides of the drum transported therein and prevent the drum from detaching.

[181] The drum detachment prevention unit 30 according to one embodiment may include a first drum guide 31 and a second drum guide 32.

[182] The first drum guide 31 may surround a circumference of the drum seated in the drum accommodating space from one side.

[183] The second drum guide 32 may surround the circumference of the drum seated in the drum accommodating space from the other side.

[184] According to one embodiment, the first and second drum guides 31 and 32 may be disposed to be spaced apart upward from the roller unit 40 by a set height. Each of the first and second drum guides 31 and 32 may have a semicircle (or arc) shape and may be disposed to face each other with the drum seated in the drum accommodating space interposed therebetween.

[185] According to one embodiment, the first drum guide 31 may include a first arc frame 311 for supporting the circumference of the drum seated in the drum accommodating space from one side, and a first roller 312. The first roller 312 may be provided on the first arc frame 311 and formed to have a structure that is rotatable in contact with the circumference of the drum.

[186] Preferably, the first arc frame 311 may include a first upper arc frame 3111 and a first lower arc frame 3112.

[187] The first upper arc frame 3111 may support the circumference of the drum disposed in the drum accommodating space at an upper portion of one side thereof. The first lower arc frame 3112 may support the circumference of the drum disposed in the drum accommodating space at a lower portion of one side thereof. In this case, the first roller 312 may be rotatably connected to a first axis 313 that is fixed vertically between the first upper arc frame 3111 and the first lower arc frame 3112.

[188] In addition, the first drum guide 31 may further include a plurality of first reinforcing frames 314 that cross-connect the first upper arc frame 3111 and the first lower arc frame 3112. The plurality of first reinforcing frames 314 may structurally reinforce the first arc frame 311.

[189] In addition, the first drum guide 31 may further include a first anti-slip stopper 315. The first anti-slip stopper 315 may be disposed on an outer side of the first arc frame 311 and can prevent the first arc frame 311 from being pushed outward by the

drum supported by the first arc frame 311.

[190] According to one embodiment, the second drum guide 32 may include a second arc frame 321 for supporting the circumference of the drum seated in the drum accommodating space from the other side, and a second roller 322. The second roller 322 may be provided on the second arc frame 321 and formed to have a structure that is rotatable in contact with the circumference of the drum.

[191] Preferably, the second arc frame 321 may include a second upper arc frame 3211 and a second lower arc frame 3212.

[192] The second upper arc frame 3211 may support the circumference of the drum disposed in the drum accommodating space at an upper portion of the other side thereof. The second lower arc frame 3212 may support the circumference of the drum disposed in the drum accommodating space at a lower portion of the other side thereof. In this case, the second roller 322 may be rotatably connected to a second axis 323 that is fixed vertically between the second upper arc frame 3211 and the second lower arc frame 3212.

[193] In addition, the second drum guide 32 may further include a plurality of second reinforcing frames 324 that cross-connect the second upper arc frame 3211 and the second lower arc frame 3212. The plurality of second reinforcing frames 324 may structurally reinforce the second arc frame 321.

[194] In addition, the second drum guide 32 may further include a second anti-slip stopper 325. The second anti-slip stopper 325 may be disposed on an outer side of the second arc frame 321 and can prevent the second arc frame 321 from being pushed outward by the drum supported by the second arc frame 321.

[195] Hereinafter, a method for transporting/fastening a drum according to various embodiments will be described in detail with reference to the accompanying drawings.

[196] [Method for transporting/fastening a drum]

[197] FIGS. 13 to 15 are flowcharts for describing a method for transporting/fastening a drum according to one embodiment, and FIGS. 16 to 24 are conceptual diagrams showing a method for transporting/fastening a drum according to one embodiment.

[198] The method for transporting/fastening a drum using the automated system 1 for transporting/fastening a drum includes an empty drum recovery operation S10, a real drum supply operation S20, and an AMR charging return operation S30.

[199] In a workplace, the equipment 90 and a buffer zone 95 may be provided. The equipment 90 may have the coupler 91 fastened to a drum 5 containing a product (e.g., chemicals) (see FIGS. 16 to 19). The buffer zone 95 may temporarily store a drum containing a product (e.g., chemicals) to be supplied to the equipment 90 (hereinafter referred to as a "real drum") and/or an empty drum after the product has been supplied to the equipment 90 (hereinafter referred to as an "empty drum").

[200] The system 1 for transporting/fastening a drum includes the AMR 10 and the collaborative robot 70. The AMR 10 may move to a set position by autonomous driving to transport the drum 5. The collaborative robot 70 may be provided in the AMR 10 and may fasten or unfasten the drum 5 and the coupler 91 (see FIG. 19).

[201] Referring to FIGS. 13 and 14, in the empty drum recovery operation S10, the empty drum 5 generated in the equipment 90 may be transported to the buffer zone 95 using the system 1 for transporting/fastening a drum, that is, the AMR 10 and the collaborative robot 70. In addition, the empty drum 5 may be recovered into the empty space inside the buffer zone 95.

[202] Referring to FIGS. 13 and 15, in the real drum supply operation S20, a real drum 5a stored in the buffer zone 95 may be transported to the equipment 90 using the

automated system 1 for transporting/fastening a drum, that is, the AMR 10 and the collaborative robot 70, and the real drum may be fastened to the coupler 91 inside the equipment 90.

[203] Referring to FIG. 13, in the AMR charging return operation S30, after completing the empty drum recovery operation and the real drum supply operation, the AMR 10 may return to the charging position and may be charged.

[204] Hereafter, specific operations of the empty drum recovery operation S10 according to one embodiment will be described in detail with reference to FIG. 14.

[205] According to one embodiment, the empty drum recovery operation S10 may include an empty drum generation signal output operation S110. This operation refers to the operation of outputting an empty drum generation signal from the equipment 90 when the supply of a product (e.g., chemicals) from the drum supplied to the equipment 90 is completed.

[206] According to one embodiment, the empty drum recovery operation S10 may include a first AMR movement operation S12. This operation refers to the operation in which the AMR 10 receives the signal output from the equipment 90, that is, the empty drum generation signal, and the AMR 10 moves toward the corresponding equipment 90.

[207] According to one embodiment, the empty drum recovery operation S10 may include a coupler unfastening operation S13. This operation refers to the operation of unfastening the coupler 91 fastened to the empty drum 5 inside the equipment 90 using the collaborative robot 70.

[208] According to one embodiment, the empty drum recovery operation S10 may include an empty drum transport operation S14. This operation refers to the operation of transporting the empty drum 5 from the equipment 90 to the drum accommodating space provided in the AMR 10.

[209] According to one embodiment, the empty drum recovery operation S10 may include a second AMR movement operation S15. This operation refers to the operation in which the AMR 10 that has recovered the empty drum autonomously drives to the buffer zone 95.

[210] According to one embodiment, the empty drum recovery operation S10 may include an empty drum buffer zone discharge operation S16. This operation refers to the operation of discharging the empty drum into the buffer zone 95 after the AMR 10 arrives at the buffer zone 95.

[211] Hereafter, specific operations of the real drum supply operation S20 according to one embodiment will be described in detail with reference to FIG. 15.

[212] According to one embodiment, the real drum supply operation S20 may include a real drum transport operation S21, a third AMR movement operation S22, a real drum equipment supply operation S23, and a real drum fastening operation S24.

[213] The real drum transport operation S21 refers to the operation of transporting the real drum stored in the buffer zone 95 to the drum accommodating space provided in the AMR 10.

[214] The third AMR movement operation S22 refers to the operation in which the AMR 10 that has received the drum (i.e., the real drum) from the buffer zone 95 moves to the equipment 90.

[215] The real drum supply operation S23 refers to the operation of supplying the drum (i.e., the real drum) to the equipment 90 by transporting the drum (i.e., the real drum) into the equipment 90 after the AMR 10 arrives at the equipment 90.

[216] The real drum fastening operation S24 refers to the operation of fastening the drum (i.e., the real drum) transported into the equipment 10 with the coupler 91 using the collaborative robot 70.

[217] Preferably, the real drum supply operation S20 may further include a real drum barcode recognition operation in which the barcode of the drum (i.e., the real drum) transported by the AMR 10 is recognized using the collaborative robot 70 prior to the real drum fastening operation S24.

[218] In addition, preferably, the real drum supply operation S20 may further include a real drum rotation operation in which the drum (i.e., the real drum) transported by the AMR 10 is rotated to a set angle to adjust the fastening position of the drum (i.e., the real drum) and the coupler 91 prior to the real drum fastening operation S24.

[219] Referring to FIG. 16, when an empty drum is generated in one of a plurality of pieces of equipment, the equipment 90 may output the empty drum generation signal. The output empty drum generation signal may be received by a communication sensor of the AMR 10 constituting the automated system 1 for transporting/fastening a drum. In this case, the AMR 10 may be disposed at a charging position (e.g., a position of a charging station).

[220] Referring to FIG. 17, the AMR 10 may move to the equipment 90 from which the empty drum generation signal is output.

[221] Referring to FIG. 18, when the AMR 10 moves to a position close to the equipment 90 from which the empty drum generation signal is output, a door 93 of the equipment 90 may be opened, and the drum 5 (i.e., the empty drum) disposed inside the equipment 90 may be exposed to the outside.

[222] Referring to FIG. 19, before transporting the drum 5 (i.e., the empty drum) disposed inside the equipment 90 to the AMR 10, the operation of unfastening the drum 5 (i.e., the empty drum) and the coupler 91 may be performed. According to one embodiment, the coupler 91 may be unfastened using the gripper 72 and the vision unit 73 provided at the end portion of the robot body 71 of the collaborative robot 70.

Conversely, the gripper 72 and the vision unit 73 may perform the operation of fastening the drum (i.e., the real drum) and the coupler 91.

[223] Referring to FIG. 20, the bridge roller unit 43 of the AMR 10 (more specifically, the pair of side frames 431) may be horizontally connected to the seating support 92 provided at the side of the equipment 90. Whether the bridge roller unit 43 and the seating support 92 are horizontally connected (i.e., docked) may be detected by the seating detection sensor 434. Accordingly, the drum 5 (i.e., the empty drum) may be transported from the equipment 90 toward the AMR 10.

[224] Referring to FIG. 21, it can be confirmed that the drum 5 (i.e., the empty drum) is transported from the equipment 90 toward the AMR 10.

[225] Referring to FIG. 22, the AMR 10 may move to the buffer zone 95 (see FIG. 23) while receiving the drum 5 (i.e., the empty drum).

[226] Referring to FIG. 23, the AMR 10 may move to the buffer zone 95, and the drum 5 (i.e., the empty drum) may be discharged into the empty space inside the buffer zone 95. Although not separately shown, a drum filled with a product (e.g., chemicals), that is, a real drum 5a, may be disposed inside the buffer zone 95. In the real drum supply operation, the AMR 10 may receive the drum (i.e., the real drum) from the buffer zone 95 and transport the received drum to the equipment 90 (see FIG. 24).

[227] Referring to FIG. 24, the AMR 10 transporting the drum (i.e., the real drum) to the equipment 50 is shown. The collaborative robot 70 may acquire image data by capturing an image of the upper portion of the drum using the vision unit 73, and may use this to rotate the drum to a set angle so that the drum may be smoothly fastened to the equipment 90. In addition, before the drum is fastened to the coupler 91 at the side of the equipment 90, a barcode reader may be first recognized to perform the operation of identifying a product (e.g., chemicals) to be supplied to the equipment 90.

[228] Although the present invention has been described above with reference to the exemplary drawings, the present invention is not limited by the embodiments and drawings disclosed in the specification, and it is apparent that various modifications can be made by those skilled in the art within the scope of the technical spirit of the present invention. In addition, even when the operational effects according to the configuration of the present invention have not been explicitly described in the description of the embodiments of the present invention, it goes without saying that the effects predictable by the corresponding configuration should also be recognized.

[CLAIMS]

[Claim 1]

An automated system for transporting/fastening a drum, comprising:

an autonomous mobile robot (AMR) configured to autonomously move to transport the drum to a set position; and

a collaborative robot which is provided in the AMR and performs operation of fastening or unfastening the drum and a coupler.

[Claim 2]

The automated system of claim 1, wherein the collaborative robot includes:

a robot body connected to the AMR;

a vision unit which is provided on the robot body and acquires image data for fastening or unfastening the drum and the coupler; and

a gripper which is provided on the robot body and fastens or unfastens the drum and the coupler.

[Claim 3]

The automated system of claim 1, further comprising a plurality of lidar scanners provided in the AMR.

[Claim 4]

The automated system of claim 3, wherein the plurality of lidar scanners include:

a first lidar scanner responsible for a navigation function during the movement of the AMR; and

a second lidar scanner responsible for an obstacle detection function during the movement of the AMR.

[Claim 5]

The automated system of claim 1, further comprising a communication sensor which is provided in the AMR and enables communication between the AMR and the equipment on which the coupler is installed.

[Claim 6]

The automated system of claim 1, further comprising a bumper sensor which is provided at a lower edge of the AMR, detects external collisions of the AMR, and blocks the movement of the AMR upon detection of a collision.

[Claim 7]

The automated system of claim 1, further comprising a drum detection sensor which is provided in the AMR and detects whether a drum is present within a drum accommodating space provided inside the AMR.

[Claim 8]

The automated system of claim 1, wherein the AMR includes:

a base unit disposed at a set height on the ground and having driving wheels;

a first main body provided above the base unit; and

a second main body which is provided above the base unit and disposed to be spaced apart from the first main body with a drum accommodating space interposed therebetween.

[Claim 9]

The automated system of claim 8, wherein the AMR further includes a side portion forming a wall surface between the first main body and the second main body,

one side of the drum accommodating space is blocked by the side portion, and

the other side of the drum accommodating space is open to transport the drum.

[Claim 10]

The automated system of claim 8, comprising a roller unit which is disposed in a lower portion of the drum accommodating space and rotates in contact with a lower portion of the drum transferred by the drum transport driving unit.

[Claim 11]

The automated system of claim 10, wherein the roller unit includes:

a central roller horizontally disposed in a lower central portion of the drum accommodating space; and

side rollers horizontally disposed at opposite lower ends of the drum accommodating space.

[Claim 12]

The automated system of claim 8, comprising a drum transport driving unit configured to transport the drum to the drum accommodating space.

[Claim 13]

The automated system of claim 12, wherein the drum transport driving unit includes:

a first linear motion unit configured to linear move to transport the drum to the drum accommodating space;

a second linear motion unit which is connected to the first linear motion unit and linearly moves to transport the drum to the drum accommodating space; and

a vacuum suction unit which moves by linear movement distances of the first and second linear motion units and is vacuum-suctioned on a surface of the drum to be transported.

[Claim 14]

The automated system of claim 13, wherein the first linear motion unit includes:

a first body unit;

a first motor unit disposed on one side of the first body unit;

a gear unit rotated by receiving a rotational force of the first motor unit; and

a rack body unit linearly moved by the rotation of the gear unit, and

the second linear motion unit includes:

a second body unit disposed above the first linear motion unit and connected to the rack body unit;

a second motor unit disposed on one side of the second body unit; and

a ball screw configured to linearly move the vacuum suction unit using a rotational force of the second motor unit.

[Claim 15]

The automated system of claim 13, wherein the vacuum suction unit includes:

a connecting body connected to the second linear motion unit;

an arm unit connected to the connecting body and extending into the drum accommodating space; and

a vacuum suction pad connected to the arm unit and vacuum-suctioned to the surface of the drum to be transported.

[Claim 16]

The automated system of claim 13, wherein the vacuum suction unit is provided as a plurality of vacuum suction units, and

each of the plurality of vacuum suction units is vacuum-suctioned on the surface of the drum to be transported at a position close to each other.

[Claim 17]

The automated system of claim 8, further comprising a drum detachment prevention unit configured to surround and support a drum transported to the drum accommodating space and prevent the drum from detaching.

[Claim 18]

The automated system of claim 17, wherein the drum detachment prevention unit includes:

a first drum guide configured to surround a circumference of the drum seated in the drum accommodating space from one side; and

a second drum guide configured to surround the circumference of the drum seated in the drum accommodating space from one side.

[Claim 19]

The automated system of claim 18, wherein the first drum guide includes:

a first arc frame configured to support the circumference of the drum from one side; and

a first roller provided on the first arc frame, and

the second drum guide includes:

a second arc frame configured to support the circumference of the drum from the other side; and

a second roller provided on the second arc frame.

[Claim 20]

The automated system of claim 8, further comprising a turntable unit which is disposed in a lower portion of the drum accommodating space and rotates the drum

transported to the drum accommodating space at a set angle.