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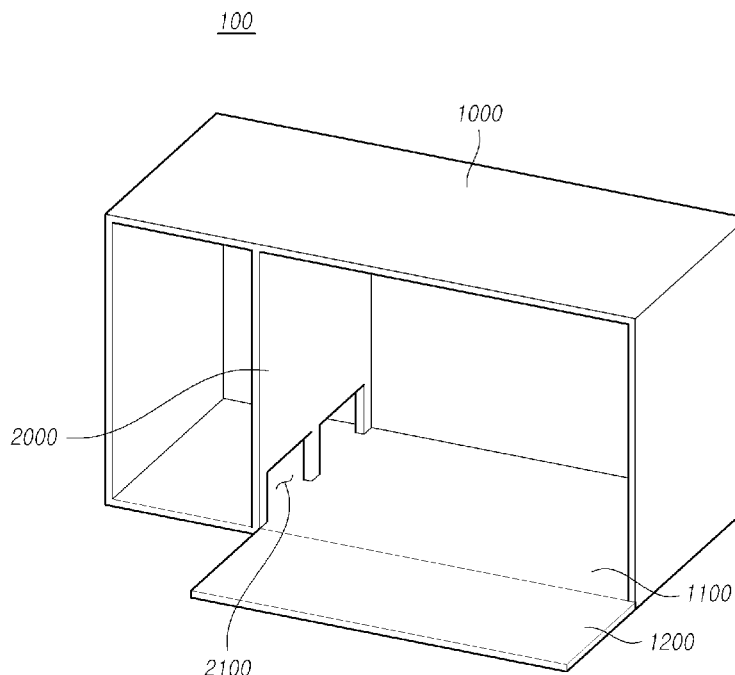
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(54) Title: AUTOMATED ANALYSIS SYSTEM, METHOD AND STORAGE MEDIA



(57) Abstract: Embodiments of the disclosure relate to an automated analysis system, method, and a storage medium capable of automating sample preparation and sample analysis by operatively connecting a sample preparation device for preparing an analysis sample for biological analysis and a sample analysis device for performing analysis.



Description

Title of Invention: AUTOMATED ANALYSIS SYSTEM, METHOD AND STORAGE MEDIA

Technical Field

- [1] Embodiments of the disclosure relate to an automated analysis system, methods and storage media capable of automating sample preparation and sample analysis by operatively connecting a sample preparation device for preparing an analysis sample for biological analysis and a sample analysis device for performing analysis.

Background Art

- [2] Nucleic acid amplification is an essential process for a wide range of methods in molecular biology, and various amplification methods have been proposed. For example, Miller, HI et al. (WO 89/06700) discloses nucleic acid amplification method which hybridizes a promoter/primer sequence to a target single-stranded DNA ("ssDNA"), and then amplifies a nucleic acid sequence that includes transcription of many RNA copies of the sequence. Other known nucleic acid amplification methods include transcription-based amplification systems (Kwoh, D. et al., Proc. Natl. Acad. Sci. USA, 86:1173 (1989); And Gingeras TR et al., WO 88 /10315).
- [3] Nucleic acid amplification reaction well known as polynucleotide chain reaction (PCR) includes repeated cycles of double-stranded DNA denaturation, annealing of the oligonucleotide primers to DNA templates, and extension/elongation of the primers with the DNA polymerase (Mullis et al., U.S. Patent Nos. 4,683,195, 4,683,202, and 4,800,159; Saiki et al., (1985) Science 230, 1350-1354).
- [4] PCR-based technologies are widely used not only for amplification of target DNA sequences, but also for scientific applications or methods in the fields of biological and medical research, and include, for example, reverse transcriptase PCR (RT-PCR), fractional display PCR (DD-PCR), and cloning of known or unknown genes by the PCR, rapid amplification of cDNA ends (RACE), random priming PCR (AP-PCR), multiplex PCR, SNP genome typing, and PCR-based genome analysis ((McPherson and Moller, 2000) PCR. BIOS Scientific Publishers, Springer-Verlag New York Berlin Heidelberg, NY)).
- [5] The above-described PCR-based techniques amplify a target nucleic acid of interest and detect it to determine the presence or absence of the target nucleic acid in a sample. In particular, when the target nucleic acid is associated with a specific disease (e.g., when the target nucleic acid is derived from a specific pathogen), the presence of the target nucleic acid may help diagnose disease risk in the subject.
- [6] In order to confirm the presence or absence of the target nucleic acid in the sample

by amplifying and detecting such a target nucleic acid, a thermocycling mechanism for amplifying the nucleic acid and an optical mechanism for detecting the amplified nucleic acid are required. Conventionally, the thermocycling mechanism was performed in a thermal cycler, and the optical mechanism was performed in an electrophoresis device, but as an RT-PCR device capable of performing real-time PCR was developed, it was possible to perform amplification and detection of the nucleic acid in one device.

- [7] In addition, PCR-based techniques requires the use of target nucleic acid detection reagents including oligonucleotides (e.g., primers and/or probes) that specifically hybridize to target nucleic acids to amplify and detect the target nucleic acid of interest, a label, a DNA polymerase, a dNTP, a Mg ion, a buffer, etc. A pretreatment process for preparing the sample for nucleic acid amplification and detection using such target nucleic acid detection reagents is required, and this pretreatment process is performed in a liquid handling device.
- [8] Therefore, the user performing the experiment moves the pretreated sample from the liquid handling device to the RT-PCR device by, and then the RT-PCR device amplifies and detects the target nucleic acid included in the sample.
- [9] However, there is a problem in that contamination may occur during movement of the sample from the liquid handling device to the RT-PCR device by a user. In addition, there is a problem in that the user has to wait to move the sample from the liquid handling device to the RT-PCR device.
- [10] Therefore, there is a need for a new method and system to solve these problems.
- [11] Several patents and documents are cited herein. The disclosures of such patents and documents are incorporated by reference herein in their entireties to clearly describe the art in the field.

Disclosure of Invention

Technical Problem

- [12] The present inventors have made diligent efforts to develop a system, a method, etc. to be used in conjunction with various devices that perform a process of detecting a target nucleic acid by performing amplification of a target nucleic acid. As a result, the present inventors provide a barrier between a sample preparation device and a sample analysis device used to detect the target nucleic acid, so that they can develop an automated analysis system to environmentally separate the sample preparation device and the sample analysis device from each other while interoperably connect between them as necessary.
- [13] Accordingly, embodiments of the disclosure provide the automated analysis system including the sample preparation device and the sample analysis device.

- [14] Embodiments of the disclosure provide an automated analysis method using the automated analysis system including the sample preparation device and the sample analysis device.
- [15] Embodiments of the disclosure provide a storage medium for the automated analysis system including the sample preparation device and the sample analysis device.
- [16] Embodiments of the disclosure provide a barrier between the sample preparation device and the sample analysis device so as to environmentally block the two devices while operationally connect between them.
- [17] Embodiments of the disclosure provide a barrier for environmentally separating the sample preparation device and the sample analysis device from each other to prevent the occurrence of deterioration in various reagents and/or analysis samples accommodated in the sample preparation device since heat generated from the sample analysis device is transmitted to the sample preparation device.
- [18] Embodiments of the disclosure provide a barrier for environmentally separating the sample preparation device and the sample analysis device from each other to prevent the occurrence of deterioration in various reagents and/or analysis samples accommodated in the sample preparation device since the wind of the cooling fan generated from the sample analysis device moves to the sample preparation device.
- [19] Embodiments of the disclosure provide a barrier for environmentally separating a sample preparation device and a sample analysis device from each other wherein the barrier includes a barrier hole to easily transfer the analysis sample to the sample analysis device between the separated sample preparation device and the sample analysis device.
- [20] Embodiments of the disclosure may more effectively block the flow of light, heat and/or air by configuring an opening/closing module to open/close the barrier hole formed in the barrier.
- [21] Embodiments of the disclosure may automatically move the sample holder of the sample analysis device to a sample preparation device through the barrier hole formed in the barrier when moving the analysis sample prepared by the sample preparation device to the sample analysis device in order to prevent contamination from the user. When the sample analysis container is mounted on the sample holder in the sample preparation device, the sample analysis device may automatically receive the sample holder.
- [22] Embodiments of the disclosure provide a barrier that environmentally separates the sample preparation device and the sample analysis device from each other to prevent the occurrence of unnecessary actions, contamination, and/or errors in other devices when user manipulation is required on any one of a sample preparation device or a sample analysis device.

- [23] Other objects and advantages of the present invention will become more apparent by the following embodiments, claims, and drawings.

Solution to Problem

- [24] According to an aspect of the disclosure, an automated analysis system comprises: a sample preparation device for preparing an analysis sample for detection of an analyte wherein the analysis sample is accommodated in an analytical sample vessel; and a sample analysis device comprises a sample holder for receiving the analysis sample vessel; a barrier for spatially separating the sample preparation device and the sample analysis device wherein the barrier comprises a barrier hole for operatively connecting the sample preparation device and the sample analysis device, and the sample holder is moved to the sample preparation device through the barrier hole to receive a sample analysis container.
- [25] According to the other aspect of the disclosure, a automated analysis method for analyzing an analysis sample by an automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprises a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole, the automated analysis method comprising: preparing an analysis sample in the sample preparation device; accommodating the analysis sample in an analytical sample vessel in the sample preparation device; moving the sample holder to the sample preparation device through the barrier hole; mounting the analysis sample vessel to the sample holder; moving the sample holder to the sample analysis device through the barrier hole; and analyzing the analysis sample in the sample analysis device.
- [26] According to another aspect of the disclosure, an automated analysis system comprising: memory, one or more of processor configured to access the memory, and one or more of program code stored in the memory and configured to be executed by the processor, when executed by the processor to analyze the analysis sample, one or more of program code comprises instructions which enable the automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprises a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole to perform the following: preparing an analysis sample

in the sample preparation device; accommodating the analysis sample in an analytical sample vessel in the sample preparation device; moving the sample holder to the sample preparation device through the barrier hole; mounting the analysis sample vessel to the sample holder; moving the sample holder to the sample analysis device through the barrier hole; and analyzing the analysis sample in the sample analysis device.

- [27] According to still another aspect of the disclosure, a non-transitory computer-readable storage medium storing instructions executed by the one or more processors when executed by one or more processors, wherein the instructions enable the automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprises a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole to perform the following: preparing an analysis sample in the sample preparation device; accommodating the analysis sample in an analytical sample vessel in the sample preparation device; moving the sample holder to the sample preparation device through the barrier hole; mounting the analysis sample vessel to the sample holder; moving the sample holder to the sample analysis device through the barrier hole; and analyzing the analysis sample in the sample analysis device.

Advantageous Effects of Invention

- [28] The features and advantages of the present invention are summarized as follows:
- [29] (1) The system, method, and storage medium according to an embodiment may environmentally separate the sample preparation device and the sample analysis device from each other using a barrier while operatively connect the two devices using a barrier hole in the barrier.
- [30] (2) The system, method, and storage medium according to an embodiment provide a barrier for environmentally separating the sample preparation device and the sample analysis device to block the transmission of heat generated from the sample analysis device to the sample preparation device, thereby preventing deterioration in various reagents and/or analysis samples accommodated in the sample preparation device.
- [31] (3) The system, method, and storage medium according to an embodiment provide a barrier for environmentally separating the sample preparation device and the sample analysis device from each other to effectively block the movement of the wind of cooling fan generated from the sample analysis device to the sample preparation device, thereby preventing contamination of various reagents and/or analysis samples

contained in the sample analysis device from occurring.

- [32] (4) The system, method, and storage medium according to an embodiment provide a barrier hole in the barrier to which a sample holder capable of accommodating an analysis sample in the sample analysis device can be moved, thereby easily transfer the prepared analysis sample between the separated sample preparation device and the sample analysis device to the sample analysis device.
- [33] (5) The system, method, and storage medium according to an embodiment may more effectively block the flow of light, heat and/or air by configuring an opening/closing module to open/close the barrier hole in the barrier for environmentally separating the sample preparation device and the sample analysis device from each other.
- [34] (6) The system, method, and storage medium according to an embodiment automatically move the sample holder of the sample analysis device to the sample preparation device through the barrier hole of the barrier for environmentally separating the sample preparation device and the sample analysis device from each other. When the sample analysis container is mounted on the sample holder in the sample preparation device, it is possible to prevent contamination from the user by automatically allowing the sample analysis device to receive the analysis sample.
- [35] (7) The system, method, and storage medium according to an embodiment provide a barrier for environmentally separating the sample preparation device and the sample analysis device, thereby blocking the occurrence of unnecessary actions, contamination, and/or errors in devices other than the device requiring user manipulation when the user manipulation is required for driving a sample preparation device or a sample analysis device.

Brief Description of Drawings

- [36] FIG. 1 is a configuration diagram showing a first embodiment of the automated analysis system.
- [37] FIG. 2 is a configuration diagram showing a sample preparation device according to the first embodiment of the automated analysis system.
- [38] FIG. 3 is a configuration diagram showing a sample analysis device according to a first embodiment of the automated analysis system.
- [39] FIG. 4 is a block diagram showing the system housing according to the first embodiment of the automated analysis system.
- [40] FIG. 5 is a configuration diagram showing a second embodiment of the automated analysis system of the present invention,
- [41] FIG. 6 is a configuration diagram showing a sample analysis device according to a second embodiment of the automated analysis system.
- [42] FIG. 7 is a configuration diagram showing a system housing according to a second

embodiment of the automated analysis system.

[43] FIG. 8 is a configuration diagram showing an embodiment of a barrier and a barrier opening and closing module separating the sample analysis device and the sample preparation device from each other.

[44] FIG. 9 is a plan view for showing an embodiment of the sample preparation device.

[45] FIG. 10 is a perspective view for showing an embodiment of the sample preparation device.

[46] FIG. 11 is a layout view for showing the location of the configuration included in the sample preparation device.

[47] FIG. 12 is a flowchart illustrating the operation of the sample preparation device and the sample analysis device of the automated analysis system.

Mode for the Invention

[48] The configuration and effects of the disclosure are now described in further detail in connection with embodiments thereof. The embodiments are provided merely to specifically describe the disclosure, and it is obvious to one of ordinary skill in the art that the scope of the disclosure is not limited to the embodiments.

[49] In addition, terms, such as first, second, A, B, (A), (B) or the like may be used herein when describing components of the present disclosure. Each of these terminologies is not used to define an essence, order or sequence of a corresponding component but used merely to distinguish the corresponding component from other component(s). If two or more components are described as being "connected", "combined", or "coupled" to each other, it should be understood that two or more components may be directly "connected", "combined", or "coupled" to each other, and that two or more components may be "connected", "combined", or "coupled" to each other with another component "interposed" therebetween.

[50] The present inventors have made diligent efforts to develop a system, a method, etc. to be used in conjunction with various devices that perform a process of detecting a target nucleic acid by performing amplification of a target nucleic acid. As a result, the present inventors provide a barrier between a sample preparation device and a sample analysis device used to detect the target nucleic acid, so that they can develop an automated analysis system to environmentally separate the sample preparation device and the sample analysis device from each other while interoperably connect between them as necessary.

[51] An automated analysis system according to an embodiment comprises a sample preparation device for preparing an analysis sample which includes or is presumed to include an analyte and a sample analysis device comprises a sample holder for receiving the analysis sample vessel. The automated analysis system further comprises

a barrier and a barrier hole for operatively connecting the sample preparation device and the sample analysis device.

[52] The term "analysis sample" used herein refers to a substance that includes or is presumed to include an analyte.

[53] "Analytical samples" includes biological samples (e.g., cells, tissues and body fluids from biological sources) and non-biological samples (e.g., food, water and soil).

[54] The biological sample may include viruses, bacteria, tissues, cells, blood (including whole blood, plasma and serum), lymph, bone marrow, sputum, swab, aspiration, bronchial lavage, bronchopulmonary lavage, nasal lavage, milk, urine, feces, eye fluid, saliva, semen, brain extract, spinal fluid (SCF), joint fluid, appendix, spleen and tonsil tissue extract, amniotic fluid, and ascites, but are not limited thereto. In addition, the analysis sample may include naturally occurring nucleic acid molecules and synthetic nucleic acid molecules isolated from biological sources.

[55] In one embodiment, the term "analytical sample" may include a substance used for preservation, processing, detection, etc. of an analysis sample. The "analytical sample" may include additional substances such as amplification reagent, detection reagent, preservative, water, deionized water, saline, pH buffer, acidic solution, and basic solution, but is not limited thereto.

[56] The term "specimen" used herein may be used interchangeably with the term "analytical sample", and in particular, is used to denote an analysis sample used in the preparation of a sample for final detection in a sample preparation device.

[57] In one embodiment, the analyte is an antigen, antibody, enzyme or nucleic acid.

[58] In one embodiment, the analyte is a nucleic acid. Herein, when the analyte to be analyzed is a nucleic acid molecule, a nucleic acid may be extracted from the sample through a nucleic acid extraction process known in the art (see Sambrook, J. et al., Molecular Cloning). A Laboratory Manual, 3rd ed. Cold Spring Harbor Press (2001)). The nucleic acid extraction process may vary depending on the type of sample. In addition, when the extracted nucleic acid is RNA, a reverse transcription process for synthesizing cDNA may be additionally performed (see Sambrook, J. et al., Molecular Cloning. A Laboratory Manual, 3rd ed. Cold Spring. Harbor Press (2001)).

[59] One or more types of analytes may be included in the analysis sample, and a plurality of analysis samples may be prepared for detection thereof.

[60] The term "sample preparation device" used herein is a device that prepares an analysis sample that includes or is presumed to include an analyte.

[61] The sample preparation device automatically performs the process of preparing a detection sample used for detection of an analyte (eg, target nucleotide sequence) using a microrobot. In the present disclosure, the preparation of the sample for detection includes extraction of nucleic acids from the sample, preparation of a reaction solution

for amplification (e.g., a reaction solution for PCR (polymerase chain reaction)), and preparation of a reaction solution for extraction and amplification of nucleic acids to which they are bound.

[62] When the sample preparation device does not include a nucleic acid extraction module, nucleic acid extraction from a specimen may be performed using a separate device.

[63] Nucleic acid extraction can be used to extract a nucleic acid from a sample by using a nucleic acid extraction module 3041 when the analyte to be analyzed herein is a nucleic acid.

[64] That is, when the preparation work of the nucleic acid extract, the preparation work to be performed in the sample preparation device begins with the act of fractionating the sample in the container containing the sample, the act of dispensing the cell lysis solution into the fractionated sample, the act of heating, etc the act, proceeds a series of actions for separation and purification of nucleic acids and finally the act of collecting the isolated nucleic acid. The preparation of the nucleic acid extract may be performed through a nucleic acid extraction module included in the sample preparation device.

[65] In one embodiment, there is often used a magnetic bead-based method using magnetic beads capable of binding to a nucleic acid and eluting the bound nucleic acid in the process of extracting the nucleic acid from a sample. The magnetic bead-based automated nucleic acid extraction method may be divided into a liquid transfer method and a bead transfer method according to the type of process for eluting the nucleic acid bound to the magnetic beads.

[66] In addition, the sample preparation device may perform the preparation of a reaction mixture for nucleic acid amplification. In one embodiment, the sample preparation device may simultaneously perform a nucleic acid extract preparation operation and a nucleic acid amplification reaction solution preparation operation.

[67] The sample preparation device performs a process of preparation of an analysis sample including extraction of nucleic acids from a sample, preparation of a reaction solution for amplification, and preparation of an analysis sample in which these are mixed. In the sample preparation device, the preparation process of the analysis sample is implemented by a control device (not shown) for controlling the sample preparation device, and the operation of the preparation process of each analysis sample is performed by the control device controlling each component.

[68] The control device may be configured to be embedded in the sample preparation device, and may be provided as a separate device to be connected to the sample preparation device through a network.

[69] The control device according to an embodiment is of a software control type. The control method of the sample preparation device may be controlled by software.

Methods implemented through software or algorithms may be stored on a computer-readable recording medium as computer-readable codes or program instructions executable on a processor.

- [70] The computer-readable recording medium includes magnetic storage media (e.g., read-only memory (ROM), random access memory (RAM), floppy disk, hard disk, etc.) and optical reading media (e.g., CD-ROM and DVD (Digital Versatile Disc)). The computer-readable recording medium is distributed over networked computer systems, so that computer-readable codes can be stored and executed in a distributed manner. The medium is readable by a computer, stored in a memory, and executed on a processor.
- [71] The sample preparation device according to an embodiment is an automated liquid handling device. The automated liquid handling device is capable of automatically and programmatically aspirating(inhaling) and/or dispensing a desired amount of reagents, analysis samples or other liquids from containers designated for automation in a chemical or biochemical laboratory. Various configurations of the automated liquid handling device are known to those of skill in the art.
- [72] All components of the sample preparation device are designed as an integrated device and located within the system housing.
- [73] In one embodiment, the sample preparation device may use products such as Hamilton's "Microlab VANTAGE", "Microlab STAR", "Microlab NIMBUS", or "Microlab Prep" (<https://www.hamiltoncompany.com/automated-liquid-handling/platforms>).
- [74] The term "sample analysis device" used herein refers to a device that amplifies a nucleic acid having a specific nucleotide sequence and detects the amplified nucleic acid. In particular, a device that performs a nucleic acid amplification reaction through temperature control typically includes a thermal cycler.
- [75] The thermal cycler may perform various amplification reactions. For example, there have been known various amplification reactions such as PCR (polymerase chain reaction), LCR (ligase chain reaction, see U.S. Pat. Nos. 4683195 and 4683202; A Guide to Methods and Applications (Innis et al., eds, 1990); Wiedmann M, et al., "Ligase chain reaction (LCR)- overview and applications." PCR Methods and Applications 1994 Feb;3(4):S51-64), GLCR (gap filling LCR, see WO 90/01069, EP 439182 and WO 93/00447), Q-beta (Q-beta replicase amplification, see Cahill P, et al., Clin Chem., 37(9): 1482-5(1991), U.S. Pat. No. 5556751), SDA (strand displacement amplification, see G T Walker et al., Nucleic Acids Res. 20(7): 1691-1696(1992), EP 497272), NASBA (nucleic acid sequence-based amplification, see Compton, J. Nature 350(6313):91-2(1991)), TMA (Transcription-Mediated Amplification, see Hofmann WP et al., J Clin Virol. 32(4):289- 93(2005); U.S. Pat. No. 5888779) or RCA (Rolling

Circle Amplification, see Hutchison C.A. et al., Proc. Natl Acad. Sci. USA. 102:17332-17336(2005)).

- [76] In particular, the thermal cycler, which is a nucleic acid amplification device included in the sample analysis device according to an embodiment, is usefully used in a nucleic acid amplification reaction based on a polymerase chain reaction (PCR). There are known various nucleic acid amplification methods based on PCR such as quantitative PCR, digital PCR, asymmetric PCR, reverse transcriptase PCR (RT-PCR), differential display PCR (DDPCR), nested PCR, arbitrarily primed PCR (AP-PCR), multiplex PCR, SNP genome typing PCR, and the like.
- [77] For example, the thermal cycler, which is a nucleic acid amplification device according to an embodiment, may perform a denaturing step, an annealing step, and an extension (or amplification) step to amplify DNA (deoxyribonucleic acid) having a specific nucleotide sequence.
- [78] The denaturation step is a step of heating a solution containing a sample containing the double-stranded DNA as a template nucleic acid and a reagent to a specific temperature, for example, about 95°C and separating double-stranded DNA into single-stranded DNA. The annealing step is a step of forming a partial DNA-primer complex by preparing an oligonucleotide primer having a nucleotide sequence complementary to the nucleotide sequence of the nucleic acid to be amplified, and cooling the primer together with the separated single-stranded DNA to a specific temperature, for example, 60°C to bind the primer to a specific nucleotide sequence of the single-stranded DNA. The extension step is a step of maintaining the solution at a specific temperature, for example, 72°C and forming double-stranded DNA based on the primer of the partial DNA-primer complex by DNA polymerase after the annealing step.
- [79] In one embodiment, the sample analysis device may exponentially amplify the DNA having the specific nucleotide sequence by repeating the above-described three steps, for example, 10 to 50 times.
- [80] In another embodiment, the sample analysis device may perform the annealing step and the extension step at the same time. In this case, the sample analysis device may complete the first cycle by performing two steps consisting of the denaturation step and the annealing/extending step.
- [81] Meanwhile, a nucleic acid detecting device included in the sample analysis device according to an embodiment is a device for detecting a target nucleic acid in an analysis sample subjected to a polymerase chain reaction (PCR) through a nucleic acid amplification device. The nucleic acid detecting device includes an optical module for detecting the emission light emitted from the fluorescent material in the target nucleic acid.
- [82] The optical module is an optics mechanism that analyzes (or monitors) an ampli-

fication reaction performed in the nucleic acid amplification device in real time. In one embodiment, the optical module may be composed of components such as a light source, an optical filter, a convex lens, a beam splitter, a photo detector, and the like and detects fluorescence generated in the nucleic acid amplification reaction performed in the optical module in real time.

- [83] The term "barrier" used herein is a configuration for separating the sample preparation device and the sample analysis device environmentally/spatially. The barrier includes a material capable of reducing or blocking the mutual inflow of light of the sample preparation device and heat and/or air flow of the sample analysis device while spatially separating the sample preparation device and the sample analysis device.
- [84] In one embodiment, the material for reducing or blocking light included in the barrier may be included in the raw material of the barrier to be integrally manufactured. In another embodiment, the material for reducing or blocking light included in the barrier may be manufactured in a form that is bonded or attached to the barrier.
- [85] The term "barrier hole" used herein, is a hole formed in a barrier, and provides a passage through which the sample holder of the sample analysis device is moved to the sample preparation device.
- [86] The barrier hole is formed in the barrier according to the number of sample holders included in the sample analysis device of the automated analysis system. In one embodiment, when the number of sample holders used in the automated analysis system is two, two barrier holes may be formed in the barrier.
- [87] In another embodiment, when the number of sample holders used in the automated analysis system is three, it is preferable that three barrier holes are formed in the barrier.
- [88] That is, the barrier hole corresponding to the sample holder is formed in the barrier.
- [89] The term "vessel" used herein refers to a space for accommodating substances used in the sample preparation device and the sample analysis device. The substances generally include solutions. The vessel may be used as a "sample vessel", "analytical sample vessel", "analysis sample vessel" and the like containing an analysis sample.
- [90] In addition, the space accommodating the substances used in the sample preparation device and the sample analysis device used herein may be referred to as a "carrier" or a "container". There is no special distinction between "vessel", "carrier" and "container", but it may be selected and used depending on the device used, its shape, or the substance contained inside.
- [91] In addition, the vessel refers to a container used for nucleic acid extraction, amplification reaction solution composition, and amplification reaction setup (eg, PCR setup) performed by the sample preparation device. That is, a sample, one or more ex-

traction reagents, one or more compositions for a reaction solution, an analysis sample obtained by mixing the extracted nucleic acid and the reaction solution (master mix), etc. can be accommodated in the container and the analysis sample which the reaction is to be performed through the sample analysis device may be dispensed and accommodated in the analysis sample vessel. In one embodiment, the container includes a tube, a tube strip, and the like. In another embodiment, the container may include a cartridge, a well plate, and the like.

- [92] The container may be of various sizes depending on the substance to be accommodated, and various means for storing or holding the container may be prepared according to the container of various sizes. The means for holding the container may be a carrier, a rack, an adapter, etc., and each means can be stored by inserting one or more containers.
- [93] In one embodiment, the container may include a cap. In another embodiment, the container may be sealed using a film or the like.
- [94] The term "analytical sample vessel" used herein is a sample vessel that can be accommodated in a sample holder. The analysis sample vessel accommodates a predetermined volume of an analysis sample containing a target nucleic acid or a predetermined volume of an analysis sample not containing a target nucleic acid, and is accommodated in the sample holder to react (e.g., amplify) or detect (e.g., Fluorescent signal). The analysis sample vessel described in the present specification is a tube capable of accommodating an analysis sample as an example, but analysis sample vessels of various materials and shapes may be used according to the shape of the reaction region. The analysis sample vessel is inserted into a well formed in the reaction region so that a reaction cycle of heating and cooling is performed while performing a reaction on the analysis sample. That is, the "analytical sample vessel" refers to a closed space in which a reaction is carried out. The analysis sample vessel contains one or more than one. The analysis sample vessel refers to a portion capable of receiving an analysis sample (eg, an analyte or reaction mixture). Each of a test tube, an amplification tube, a strip tube, a well plate, and a multi-well PCR plate is an embodiment of the analysis sample vessel including one or two or more.
- [95] In one embodiment, one or more analysis sample vessels may be mounted on a sample holder.
- [96] In another embodiment, at least one analysis sample vessel is accommodated in a multi-well plate (hereinafter, referred to as a "well plate"). The well plate containing one or more analysis sample vessels may be mounted on a sample holder.
- [97] In another embodiment, the analysis sample vessel is a well plate capable of holding an analysis sample in one or more wells. The well plate containing the analysis sample in one or more wells may be mounted on a sample holder.

- [98] Embodiments of the analysis sample vessel are some of the preferred embodiments to be practiced in the present invention. Therefore, it is obvious that the analysis sample vessel can be variously implemented according to other embodiments.
- [99] The term 'specimen' used herein is an object to be analyzed by an automated analysis system, and may be collected from a substance or organism. The term 'sample' may be used as the term analysis sample. In general, samples include saliva, blood, urine, and stool. The sample container containing the sample may contain a sample collection composition for collecting the sample and/or a medium for transporting the sample. The medium for transporting samples performs inactivation by lysis of infectious pathogens and stabilization of nucleic acid substances released from the crushed pathogen.
- [100] The term 'reaction mixture' used herein is a solution mixed with an analyte to facilitate detection of an analyte, and the reaction solution is composed of one or more reaction reagents for amplification.
- [101] The term "sample holder" used herein is included in the sample analysis device, and receives an analysis sample vessel containing an analysis sample in which a reaction is performed. The sample holder is moved to a sample preparation device separated by a barrier to receive an analysis sample. The sample preparation device may provide an analysis sample to the moved sample holder.
- [102] The analysis sample mounted on the sample holder may be accommodated in various types of containers and mounted on the sample holder. In one embodiment, the analysis sample is accommodated in an analysis sample vessel, and the analysis sample vessel may be mounted on the sample holder. In another embodiment, the sample holder itself may be used as a analysis sample vessel.
- [103] FIG. 1 is a configuration diagram showing a first embodiment of an automated analysis system.
- [104] As shown in FIG. 1, an automated analysis system 100 according to the first embodiment may include two devices in one system housing 1000. One is a sample preparation device 3000 and the other is a sample analysis device 4000.
- [105] A barrier 2000 for spatially separating each of the devices is included between the two devices. In FIG. 1, the sample preparation device 3000 and the sample analysis device 4000 are not substantially shown in the system housing 1000, and the space within the system housing 1000 in which the sample preparation device 3000 and the sample analysis device 4000 can be located is shown.
- [106] In one embodiment, the system housing 1000 is formed of a hexahedron having a size in which the sample preparation device 3000 and the sample analysis device 4000 may be provided. However, referring to FIG. 4, the front surface of the system housing 1000 may include an opening/closing module 1300, which is a door for a sample

preparation device so that a user can manipulate it. In one embodiment, the opening/closing module 1300 is included in the sample preparation device 3000 side. In another embodiment, the opening/closing module 1300 may be included in the sample analysis device 4000 side as needed.

[107] The opening/closing module 1300 included in the system housing 1000 may include a window in all or part of the sample preparation device 3000 so that the user can check the operation state of the sample preparation device 3000.

[108] The barrier 2000 is formed in the shape of a wall inside the system housing 1000 so that each device can be spatially separated within the system housing 1000. However, the barrier 2000 includes one or more barrier holes 2100 through which two devices can be operatively connected to each other.

[109] The one or more barrier holes 2100 are passages that can only connect the interior of the system housing 1000 that is spatially separated. In one embodiment, the barrier hole 2100 has a shape of a rectangular hole, but may be implemented in various other embodiments such as a square, a triangle, and a circle.

[110] The barrier 2000 includes a material capable of reducing or blocking light flowing from the sample preparation device 3000 to the sample analysis device 4000. Since the sample preparation device 3000 is not an enclosed space, external light enters. Therefore, the barrier 2000 may also include a material capable of blocking light in order to block the light flowing from the outside from being transferred to the sample analysis device 4000.

[111] At this time, the blocked light is at least one of visible rays, ultraviolet rays, and infrared rays.

[112] In one embodiment, the barrier 2000 may be manufactured including a material for blocking light. In another embodiment, a thin film such as a film made of a material capable of blocking light may be attached to the barrier 2000.

[113] The barrier 2000 includes a material capable of reducing or blocking heat generated from the sample analysis device 4000 from being transferred to the sample preparation device 3000. The sample analysis device 4000 generates heat because it includes a thermal cycler, which is a heating module for reaction of an analysis sample. When the generated heat is transferred to the sample preparation device 3000, unnecessary reactions may occur in reagents located in the sample preparation device, so that the barrier 2000 is made of a material capable of blocking heat in order to prevent an analysis error.

[114] In one embodiment, the barrier 2000 may be manufactured with including a material for blocking heat. In another embodiment, a thin film such as a film made of a material capable of blocking heat may be attached to the barrier 2000.

[115] In addition, the barrier 2000 includes a material capable of reducing or blocking the

movement of air flow generated from the sample analysis device 4000 to the sample preparation device. The heating module included in the sample analysis device 4000 may include a cooling fan for cooling heat generated inside. When the floating material such as dust included in the flow of air generated from the cooling fan is moved to the sample preparation device, the barrier 2000 may be made of a material capable of blocking the flow of air in order to prevent an analysis error caused by the floating material included in a reagent located in the sample preparation device.

[116] In one embodiment, the barrier 2000 may be manufactured with including a material capable of blocking the flow of air. In another embodiment, a thin film such as a film capable of blocking the flow of air may be attached to the barrier 2000.

[117] Among the spatially separated devices of the system housing 1000, the bottom surface on which the sample preparation device is located is called a deck, and components included in the sample preparation device can be mounted and fixed to the deck in the form. In one embodiment, the deck is formed in the form of a guide rail, and components of the sample preparation device 3000 may be inserted in a sliding manner to be positioned on the deck. The guide rail is an example of a deck, and may be provided in the form of another example. In one embodiment, the deck and each component located on the deck may be prevented from moving during the operation of the device by the protrusions and grooves respectively formed.

[118] The system housing 1000 includes a flat loading tray 1200 extending from the deck of the sample preparation device.

[119] The loading tray 1200 is installed to extend with the deck 1100 so that components inserted into the sample preparation device can be easily inserted into the guide and moved into the sample preparation device, and a guide rail connected to the guide rail of the deck is prepared.

[120] In the first embodiment, the sample analysis device of the system housing 1000 has an exhaust port for exhausting internal air and an inhalation port for inhaling external air. The sizes of the exhaust port and the inhalation port are not limited, but are preferably formed to correspond to the sizes of the exhaust module and the inhalation module described below.

[121] In one embodiment, the exhaust port may include an exhaust module for exhausting air, and the inhalation port may include an inhalation module for inhaling air. For example, the exhaust module and the inhalation module may be composed of a fan, a blower, a ventilator, and the like.

[122] In another embodiment, at least one of the exhaust module and the inhalation module may not be provided.

[123] FIG. 2 is a configuration diagram showing a sample preparation device according to the first embodiment of the automated analysis system.

- [124] As shown in FIG. 2, the sample preparation device 3000 of the system housing 1000 is configured on the deck 1100 that is an inner plane of the system housing 1000.
- [125] In one embodiment, a pipette module including a pipette arm for dispensing liquid and at least one pipetting channel connected to the pipette arm (not shown) is configured on the upper side inside the system housing 1000. In addition, a transport module for transporting an analysis sample vessel or the like from the sample preparation device 3000 is configured on one side of the system housing 1000.
- [126] In another embodiment, the transport module is configured on the upper side of the inside of the system housing 1000 together with the pipette module. In another embodiment, the transport module is implemented by a pipetting channel of the pipette module and a gripper coupled to the pipetting channel.
- [127] FIG. 3 is a configuration diagram showing a sample analysis device according to a first embodiment of the automated analysis system.
- [128] As shown in FIG. 3, the sample analysis device 4000 is included in the system housing 1000.
- [129] In one embodiment, the sample analysis device 4000 may include a system housing 1000 and a separate case as shown in FIG. 3. The separate case of the sample analysis device 4000 includes the exhaust port and/or the inhalation port described in FIG. 1. Meanwhile, in one embodiment, the exhaust module included in the exhaust port and the inhalation module included in the inhalation port are provided in separate cases. In another embodiment, the exhaust module included in the exhaust port and the inhalation module included in the inhalation port may be provided in the exhaust port and/or the inhalation port configured in the system housing 1000. In another embodiment, the exhaust module included in the exhaust port and the inhalation module included in the inhalation port may be provided in the separate case and the system housing 1000.
- [130] When the exhaust port and/or the inhalation port are provided in the separate case, the location provided is not limited, but the location provided in a location capable of effectively exhausting the heat generated inside the sample analysis device 4000.
- [131] In another embodiment, the sample analysis device 4000 may include only internal components without the separate case in the system housing 1000. In this case, the system housing 1000 includes an exhaust port and/or an inhalation port for exhausting heat generated by the sample analysis device therein (see description of FIG. 1).
- [132] The system housing 1000 includes one or more sample analysis devices 4000, and the sample analysis device 4000 includes one or more sample holders 4100 that are moved to the outside (sample preparation device). In one embodiment shown in FIG. 3, the sample analysis device 4000 is provided in two, and each sample holder 4100 movable to the outside in each sample analysis device is moved to the sample

preparation device 3000 through a barrier hole 2100.

[133] As in the embodiment shown in FIG. 3, one sample analysis device 4000 may be provided with one sample holder, and there may be included two sample analysis devices 4000 in the inside of the system housing 1000 of one automated analysis system 100.

[134] In another embodiment, two or more sample holders may be configured in one sample analysis device. In this case, one sample analysis device is included in the system housing 1000, and a barrier hole may be formed according to the number of sample holders provided in the sample analysis device.

[135] That is, the automated analysis system includes one sample analysis device, but when three sample holders are provided in the sample analysis device, three barrier holes may be provided in the the barrier so that the three sample holders can be moved to the sample preparation device.

[136] In another embodiment, one sample holder may be configured in one sample analysis device, and three sample analysis devices may be included in the system housing 1000. In this case, three barrier holes be provided in the barrier according to the number of sample holders.

[137] In one embodiment, the sample holder 4100 included in the sample analysis device 4000 is moved in a sliding mechanism method inside the sample analysis device 4000 to the sample preparation device 3000.

[138] When the sample holder 4100 of the sample analysis device 4000 is moved to the sample preparation device 3000 through the barrier hole 2100 in the sliding mechanism method, the sample preparation device 3000 mounts the analysis sample vessel prepared for analysis in the sample holder 4100. The sample holder 4100 in which the analysis sample vessel is mounted is moved back into the sample analysis device 4000 through the barrier hole 2100.

[139] When the sample holder 4100 of the sample analysis device 4000 may be moved to the sample preparation device 3000 through the barrier hole 2100 but the analysis sample vessel is already mounted in the sample holder 4100 for analysis, the sample preparation device 3000 may remove the mounted analysis sample vessel and mount the prepared analysis sample vessel in the sample holder 4100.

[140] In one embodiment, when the sample analysis device 4000 includes two sample holders 4100, ny one sample holder moves to the sample preparation device 3000 to receive a prepared first analysis sample vessel. At that time, when the second analysis sample vessel is prepared in the sample preparation device 3000, another sample holder may move to the sample preparation device 3000 to receive a prepared second analysis sample vessel.

[141] In another embodiment, when the sample analysis device 4000 includes two sample

holders 4100, each of the sample holders 4100 moves to the sample preparation device 3000, and a prepared first and a prepared second analysis sample vessel, respectively.

[142] The sample holder 4100 of the sample analysis device 4000 may accommodate an analysis sample vessel, and the analysis sample vessel includes an analysis sample.

[143] In one embodiment, the analysis sample vessel may include one or more independent analysis sample vessels. In this case, the sample holder 4100 may accommodate one or more containers for each analysis sample.

[144] In another embodiment, the analysis sample vessel may be provided in the form of a strip tube to which two or more analysis sample vessels are connected. In this case, the sample holder 4100 may accommodate one or more analysis sample vessels in the form of the strip tube.

[145] In another embodiment, the analysis sample vessel may be provided in the form of a multi-well plate for amplification including a plurality of analysis samples to be analyzed in each of a plurality of wells. In this case, the sample holder 4100 may accommodate one multi-well plate for amplification. If necessary, the well plate contains $n \times m$ (n and m are natural numbers of 2 or more). The well plate may have a rectangular shape in which $n \times m$ wells are arranged in rows and columns. For example, 16 wells of 4×4 are shown. The well plate having $n \times m$ wells may be mounted on the sample holder 4100.

[146] Various examples of well plates are as follows.

[147] Well plate may be one of 4 wells of 2×2 , 9 wells of 3×3 , 16 wells of 4×4 , 25 wells of 5×5 , 36 wells of 6×6 , 49 wells of 7×7 , or 8 X 8 64 wells, and the like. In addition, the well plate may be one of 8 wells of 2×4 , 18 wells of 3×6 , 32 wells of 4×8 , 50 wells of 5×10 , 72 wells of 6×12 , 98 wells of 7×14 , or 8 X It may contain 16 128 wells and the like. In addition, the well plate may be one of 2×6 12 wells, 3×9 27 wells, 4×12 48 wells, 5×15 75 wells, 6×18 108 wells, 7×21 147 wells, or 8×24 , 192 wells, and the like. In addition, the well plate may be one of 2×8 16 wells, 3×12 36 wells, 4×16 64 wells, 5×20 100 wells, 6×24 144 wells, 7×28 196 wells, or 8×32 , 256 wells, and the like. In addition, the well plate may be one of 96 wells of 8×12 , 192 wells of 12×16 , 384 wells of 16×24 , and the like.

[148] FIG. 4 is a block diagram showing the system housing according to the first embodiment of the automated analysis system.

[149] As shown in FIG. 4, the system housing 1000 may include a sample preparation device opening/closing module 1300 to facilitate a user's operation of the sample preparation device 3000.

[150] The sample preparation device opening/closing module 1300 allows all or part of the front surface of the sample preparation device 3000 to be opened. In addition, when the sample preparation device opening/closing module 1300 is closed, a transparent

material or a transparent window may be included so that the user can check the operation state of the sample preparation device 3000 inside the system housing 1000. The transparency at this time may be set to such an extent that the inside can be identified by the user.

- [151] In one embodiment, the sample preparation device opening/closing module 1300 may be sized to open all the front surfaces of the sample preparation device 3000. In another embodiment, referring to FIG. 4, the sample preparation device opening/closing module 1300 may be sized to open a part of the front surface of the sample preparation device 3000. In addition, the sample preparation device opening/closing module 1300 may have a size smaller than the size of the front surface so that a part of the front surface can be always opened.
- [152] FIG.4 shows an embodiment in which the sample preparation device opening/closing module 1300 is located on the front of the system housing 1000, but the sample preparation device opening/closing module 1300 may be implemented on the side or other positions of the system housing 1000 as needed.
- [153] The sample analysis device 4000 is located in the area closed by the system housing 1000, but the sample analysis device viewer 1400 provided in the front of the system housing 1000 is used to to check the inside or check the information to be analyzed.
- [154] In one embodiment, the sample analysis device viewer 1400 may include a transparent window so that a user can check the operation state of the sample analysis device 4000. The transparency at this time may be set to such an extent that the inside can be identified by the user.
- [155] In another embodiment, the sample analysis device viewer 1400 may include a display that provides various types of information through which a user can check the operation state of the sample analysis device 4000. For example, when the sample analysis device viewer 1400 includes a transparent window, as shown in FIG. 3, the sample analysis device 4000 provided with the separate case does not allow a user to check the internal operation state. Therefore, in this case, as shown in FIG. 4, the sample analysis device viewer 1400 of the sample analysis device 4000 may include the display.
- [156] The sample analysis device viewer 1400 including a display may provide information on the sample analysis device 4000 as follows. i) Information in the nucleic acid amplification step (e.g., number of amplification cycles, temperature of the sample holder, etc.), and ii) information in the nucleic acid detection step (e.g., Ct value for nucleic acid detection, etc.) may be provided, but it is not limited thereto. As an example, any information collected and/or calculated through the sample analysis device 4000 may be provided. In addition, the sample analysis device viewer 1400 including a display may provide information (e.g., type and quantity of an analysis

sample, information on a current execution step, etc.) by the sample preparation device 3000.

[157] Various information provided by the sample analysis device viewer 1400 is basically provided by a user through a control device (e.g., PC, notebook computer, mobile device, etc.) that controls the automated analysis system 100, or the sample analysis device viewer 1400 including a display may also be provided as needed.

[158] In another embodiment, the system housing 1000 may not include the sample analysis device viewer 1400.

[159] FIG. 4 shows an example in which the sample analysis device viewer 1400 is located on the front of the system housing 1000, but the sample analysis device viewer 1400 may be implemented on the side or other positions of the system housing 1000 as needed.

[160] Alternatively, the sample analysis device viewer 1400 including the display may be provided as the separate device without being included in or combined with the system housing 1000.

[161] FIG. 5 is a configuration diagram showing a second embodiment of the automated analysis system of the present invention.

[162] As shown in FIG. 5, the automated analysis system 100 according to the second embodiment is configured to include a sample preparation device 3000 in one system housing 1000, and the sample analysis device 4000 may be located in a position adjacent to the outside of the system housing 1000. Accordingly, the sample preparation device 3000 and the sample analysis device 4000 are spatially separated by the system housing 1000.

[163] In one embodiment, the system housing 1000 is formed of a hexahedron having a size in which the sample preparation device 3000 can be provided. However, referring to FIG. 7, the front surface of the system housing 1000 may include the sample preparation device opening/closing module 1300 so that a user can easily operate the sample preparation device 3000.

[164] The sample preparation device opening/closing module 1300 for the sample preparation device 3000 allows all or part of the front surface of the sample preparation device 3000 to be opened. In addition, when the sample preparation device opening/closing module 1300 is closed, a transparent material or a transparent window may be included so that the user can check the operation state of the sample preparation device 3000 inside the system housing 1000. The transparency at this time may be set to such an extent that the inside can be identified by the user.

[165] In one embodiment, the sample preparation device opening/closing module 1300 may be sized to open all the front surfaces of the sample preparation device 3000. In another embodiment, referring to FIG. 4, the sample preparation device opening/

closing module 1300 may be sized to open a part of the front surface of the sample preparation device 3000. In addition, the sample preparation device opening/closing module 1300 may have a size smaller than the size of the front surface so that a part of the front surface can be always opened.

- [166] The barrier 2000 provided as an outer wall adjacent to the sample analysis device 4000 in the system housing 1000 may be made in the shape of a wall so that the sample analysis device 4000 and the sample preparation device 3000 can be spatially separated. However, the barrier 2000 includes one or more barrier holes 2100 for operatively connecting two devices to each other.
- [167] Since the shape of the barrier hole 2100 according to the second embodiment is the same as the barrier described in the first embodiment, a separate description will be omitted.
- [168] In the second embodiment, since the sample preparation device 3000 is the same as the sample preparation device described in the first embodiment, a separate description will be omitted.
- [169] In the second embodiment, since the sample analysis device 4000 is not included in the system housing 1000, it is allocated adjacent to the system housing 1000 including a separate case. That is, in order for the sample analysis device 4000 to be located outside the system housing 1000, the sample analysis device 4000 must include the separate case.
- [170] In the second embodiment, the separate case of the sample analysis device 4000 includes an exhaust port for exhausting internal air and an inhalation port for inhaling external air. The sizes of the exhaust port and the inhalation port are not limited, but are preferably formed to correspond to the sizes of the exhaust module and the inhalation module described below.
- [171] In one embodiment, the exhaust port may include an exhaust module for exhausting air, and the inhalation port may include an inhalation module for inhaling air. For example, the exhaust module and the inhalation module may be composed of a fan, a blower, a ventilator, and the like.
- [172] In another embodiment, any one or more of the exhaust module and the inhalation module may not be provided.
- [173] FIG. 6 is a configuration diagram showing a sample analysis device according to a second embodiment of the automated analysis system.
- [174] As shown in FIG. 6, the sample analysis device 4000 is allocated adjacent to the side of the system housing 1000.
- [175] In the second embodiment, since the sample analysis device 4000 is located outside the system housing 1000, a separate case is included. In this case, the separate case of the sample analysis device 4000 includes the exhaust port and/or the inhalation port

described in FIG. 5.

- [176] When the exhaust port and/or the inhalation port are provided in the separate case, the location provided is not limited, but it may be provided at a location capable of effectively exhausting the heat generated inside the sample analysis device 4000.
- [177] The sample analysis device 4000 includes a sample holder 4100 that is moved to the outside (a sample preparation device). In one embodiment shown in FIG. 6, the sample analysis device 4000 including the separate case is provided in two, and the sample holders 4100 included in each sample analysis device have a barrier hole 2100. Through it, it is possible to move to the sample preparation device 3000.
- [178] As in the embodiment shown in FIG. 6, each of the two sample analysis devices 4000 may include one sample holder 4100, and the two sample analysis devices 4000 may be located adjacent to the outer surface of the system housing 1000.
- [179] In another embodiment, one sample analysis device including the separate case may include two or more sample holders. In this case, the barrier 2000 of the system housing 1000 may include a barrier hole corresponding to the number of sample holders included in the sample analysis device 4000.
- [180] That is, when three sample holders are provided in one sample analysis device included in the automated analysis system, three barrier holes are formed in the barrier so that each sample holder can be moved to the sample preparation device.
- [181] In another embodiment, when three sample analysis devices provided with one sample holder are included in the automated analysis system, three barrier holes are formed in the barrier so that the sample holder of each sample analysis device can be moved to the sample preparation device.
- [182] In one embodiment, the sample holder 4100 included in the sample analysis device 4000 is moved in a sliding mechanism method inside the sample analysis device 4000 to the sample preparation device 3000.
- [183] The sliding mechanism does not separate the sample holder independently, and includes a mechanical device capable of moving the sample holder by power while connected to a guide rail or the like. The mechanical device includes elements capable of providing movement of wheels, bearings, guide rails, and the like.
- [184] When the sample holder 4100 of the sample analysis device 4000 moves to the sample preparation device 3000 through the barrier hole 2100, the sample preparation device 3000 receives the analysis sample for analysis. The analysis sample vessel is mounted in the sample holder 4100. The sample holder 4100 in which the analysis sample vessel is mounted is moved back into the sample analysis device 4000 through the barrier hole 2100.
- [185] In one embodiment, when the sample holder 4100 of the sample analysis device 4000 has been moved to the sample preparation device 3000 through the barrier hole 2100,

but the analysis sample vessel that previously performed the analysis is mounted in the sample holder 4100, the sample preparation device 3000 may remove the mounted analysis sample vessel that previously performed the analysis and mount the prepared analysis sample vessel in the sample holder 4100.

[186] Hereinafter, since the sample analysis device 4000 and the sample holder 4100 according to the second embodiment are the same as the sample analysis device and the sample holder of the first embodiment, a separate description will be omitted.

[187] FIG. 7 is a configuration diagram showing a system housing according to a second embodiment of the automated analysis system.

[188] As shown in FIG. 7, the system housing 1000 includes a sample preparation device opening/closing module 1300 to facilitate user access to the sample preparation device 3000.

[189] Since the sample preparation device opening/closing module 1300 of the sample preparation device 3000 according to the second embodiment is the same as the sample preparation device opening/closing module of the first embodiment, a separate description will be omitted.

[190] The sample analysis device 4000 is located outside the system housing 1000 and, if necessary, checks the inside or the analysis information using the sample analysis device viewer 1400 described in the first embodiment. The sample analysis device viewer 1400 according to the second embodiment may be provided in a separate case of the sample analysis device.

[191] The sample analysis device viewer according to an embodiment may be provided on any one or more of the plurality of outer surfaces of the separate case of the sample analysis device 4000 according to user convenience.

[192] According to another embodiment, the sample analysis device 4000 may not include a sample analysis device viewer.

[193] The sample analysis device viewer of the sample analysis device 4000 according to the second embodiment differs from the sample analysis device viewer of the first embodiment only in a location provided, and the shape and provided functions are the same. Therefore, a separate description will be omitted.

[194] FIG. 8 is a configuration diagram showing an embodiment of a barrier and a barrier opening and closing module separating the sample analysis device and the sample preparation device from each other.

[195] As shown in (a) of FIG. 8, the barrier 2000 includes one or more barrier holes 2100 to allow the sample holder of the sample analysis device to move to the sample preparation device. In one embodiment, when there are two sample holders included in the automated analysis system, the barrier 2000 has two barrier holes 2100 formed therein. In this case, in the automated analysis system, one sample analysis device may

include two sample holders, or two sample analysis devices may each include one sample holder.

- [196] The barrier 2000 in which the two barrier holes 2100 are included may include a barrier hole opening/closing module 2110 capable of opening or closing the barrier hole 2100, as shown in (b) of FIG. 8. Two barrier hole opening/closing modules 2110 may be provided to correspond to the two barrier holes 2100 formed in the barrier 2000, respectively.
- [197] The barrier hole opening/closing module 2110 is made of the same material as the barrier 2000, or a film of the same material is attached to the barrier hole opening/closing module 2110 to reduce or block light and/or heat flowing from the sample preparation device to the sample analysis device. In addition, it is possible to reduce or block the flow of air generated from the sample analysis device from moving to the sample preparation device.
- [198] The material of the barrier hole opening/closing module 2110 may be the same as the material of the barrier 2100, but it is not limited thereto.
- [199] The barrier hole opening/closing module 2110 capable of opening or closing the barrier hole 2100 is operated to open or close the barrier hole by a control device that controls the automated analysis system 100. The barrier hole opening/closing module 2110 may be operated only when the sample holder is moved or restored to the sample preparation device.
- [200] The barrier hole opening/closing module 2110 may be operated in any one of the following two types.
- [201] i) As shown in (c-1) of FIG. 8, when the barrier hole 2100 is opened, the barrier hole opening/closing module 2110 slides upward along the surface of the barrier 2000 to move by using a sliding guide or the like to. Conversely, when the barrier hole 2100 is closed, the barrier hole opening/closing module 2110 slides downward along the surface of the barrier 2000 to move.
- [202] In one embodiment, the sliding guide is configured to slide up and down. In another embodiment, the sliding guide may be configured to slide left and right.
- [203] ii) As shown in (c-2) of FIG. 8, when the barrier hole 2100 is opened, the barrier hole opening/closing module 2110 is raised while rotating upward by a hinge structure provided on the upper side. Conversely, when the barrier hole 2100 is closed, the barrier hole opening/closing module 2110 raised to the upper side is lowered while rotating downward by the hinge structure.
- [204] When the barrier hole opening/closing module 2110 is raised while rotating upward, the sample holder of the sample analysis device is moved to the sample preparation device, and the sample holder equipped with the analysis sample vessel is moved back to the sample analysis device. It may be raised to a predetermined height so that it can

be moved.

- [205] At this time, an operation that the barrier hole opening/closing module 2110 is rotated open or closed by the hinge structure may be implemented with an electrically operated overhead door, a piston, a gear, etc., but it is not limited thereto, and may be used in the case of a mechanism capable of rotating and opening the barrier hole opening/closing module 2110.
- [206] In the embodiment of FIG. 8, the barrier hole opening/closing module 2110 capable of opening and closing the barrier hole 2100 has been described.
- [207] However, in another embodiment, the barrier 2000 does not include the barrier hole opening/closing module, and the sample holder 4100 moves and returns through the normally open barrier hole 2100.
- [208] FIG. 9 is a plan view for showing an embodiment of the sample preparation device. FIG. 10 is a perspective view for showing an embodiment of the sample preparation device.
- [209] As shown in FIGS. 9 and 10, the sample preparation device 3000 is located on the deck 1100 formed in the system housing 1000.
- [210] All components of the sample preparation device 3000 are designed as an integrated device and are located on top of the deck 1100 provided in the system housing 1000. The sample preparation device includes a nucleic acid extraction module for extracting a nucleic acid from a sample and various components for setting up an amplification reaction (e.g., PCR setup).
- [211] The sample preparation device 3000 according to an embodiment includes a pipette tip adapter 3021, a container carrier 3031, a nucleic acid extraction module 3041, a well plate adapter 3051, and scanners 3061 and 3062, a waste container 3071, an automatic sealing module 3081, a transport module 3091, and a pipette module (not shown).
- [212] 1) The pipette tip adapter 3021 accommodates one or more pipette tips coupled to the pipetting channel. The pipette tip is coupled to the pipetting channel to aspirate and dispense a solution such as a sample or reagent contained in the container.
- [213] One or more pipette tips accommodated in the pipette tip adapter 3021 may be provided with different sizes and dispensing amounts depending on the preparation work environment such as the size of the container and the volume of the solution to be dispensed.
- [214] In one embodiment, the pipette tip adapter 3021 of the sample preparation device 3000 is composed of 10 pieces, of which 6 pieces of pipette tip adapters can accommodate 1 ml piercing tip, and 3 pieces of pipette tip adapters can hold a 300 μ l piercing tip, and one piece of pipette tip adapter can hold a 150 μ l piercing tip.
- [215] Each pipette tip adapter can accommodate more than one pipette tip. After the pipette

module positions the pipetting channel on the top of the pipette tip adapter, and then moves the pipette tip in the direction of the pipette tip allow the pipette channel to engage the pipette tip.

[216] The number of pipette tip adapters and the capacity and size of each pipette tip accommodated in the pipette tip adapter may be modified or changed according to various embodiments.

[217] 2) The container carrier 3031 includes various containers for accommodating various types of solutions used in the sample preparation device 3000. The sample preparation device 3000 may prepare an analysis sample including the extracted nucleic acid using the nucleic acid extraction module 3041. Various types of containers are used for the operation of the various sample preparation device 3000, and containers other than a well plate may be inserted into the container carrier 3031 among them.

[218] The container carrier 3031 may be provided in various forms so that each container can be easily inserted and fixed according to the capacity and/or size of the container to be inserted.

[219] In one embodiment, the container to be inserted includes a container containing a sample, a container containing an extraction reagent, a container containing a reaction reagent, and the like. The container carrier 3031 may insert containers in a line, as shown in FIG. 9.

[220] The container carrier 3031 may have an opening portion formed on the side so that the identification code printed or attached to the container may be exposed. Accordingly, the scanner 3062 can recognize the exposed identification code.

[221] 3) The nucleic acid extraction module 3041 automatically performs a detection sample preparation process used for detection of a target nucleotide sequence in the sample preparation device 3000.

[222] The preparation of a sample for detection according to the embodiment includes extraction of a nucleic acid from a sample, preparation of a reaction solution for amplification, and preparation of a detection sample to which they are bound.

[223] If the nucleic acid extraction module 3041 is not included in the sample preparation device 3000, the sample may be a nucleic acid obtained through a nucleic acid extraction process in advance.

[224] In other embodiments, a magnetic bead-based method using magnetic beads capable of binding to and eluting the bound nucleic acid is frequently used for nucleic acid extraction. The magnetic bead-based automated nucleic acid extraction method may use a liquid transfer method or a bead transfer method depending on the type of process for eluting the nucleic acid bound to the magnetic beads.

[225] 4) The well plate adapter 3051 is a structure in which an analysis sample vessel for accommodating a specimen to be detected may be located, and the analysis sample

vessel may be mounted in a sample holder of the sample analysis device. The well plate adapter 3051 may load an analysis sample vessel (well plate), and a specimen for detection may be dispensed into the analysis sample vessel located in the well plate adapter 3051. The well plate adapter 3051 may be positioned by loading two or more well plates used in the sample preparation device 3000. In one embodiment, the term well plate adapter 3051 may be used as an analysis sample vessel adapter.

[226] Since an embodiment of the well plate, which is an analysis sample vessel, has been described in FIG. 3, a detailed description thereof will be omitted.

[227] 5) The scanners 3061 and 3062 can read an identification code displayed on a sample, reagent, reaction solution, or the like. The identification code is a display including information such as a barcode and a matrix code. The scanners 3061 and 3062 may recognize the identification code and receive information such as the type and volume of the solution contained in the container.

[228] In one embodiment, a plurality of scanners 3061 and 3062 are provided, but may be configured with any one scanner, if necessary. In addition, the scanner may be configured as a barcode scanner and/or a 2D scanner. This configuration may be provided to recognize different types of identification codes marked on the analysis sample vessel or the like.

[229] In one implementation, the scanner 3061 may be a 2D barcode scanner. The matrix (e.g., two-dimensional) code can be recognized, and the identification code printed or attached to the bottom of the container can be recognized. The container includes a container used in the sample preparation device 3000 such as an analysis sample vessel, a reagent container, and a sample container.

[230] Accordingly, when a plate formed to have an opening portion in all or part of the bottom of each well is mounted on the scanner 3061, the scanner 3061 is printed or attached to the bottom of the container inserted in the plate. The identified identification code can be recognized. The scanner 3061 can recognize codes of containers inserted in a plurality of plates at a time.

[231] In one embodiment, the plane on which the container is mounted in the scanner 3061 is made of a transparent material, and the identification code on the bottom of the container can be recognized using an optical signal generated from the bottom. In addition, the identification code can be recognized by photographing the identification code from the bottom. Accordingly, the scanner 3061 has a shape in which a well plate can be mounted so that the identification code located on the bottom of the container inserted in the well plate can be recognized.

[232] The 2D scanner 3061 according to an embodiment may use Hamilton's "easyCode Carrier" product

(<https://www.hamiltoncompany.com/automated-liquid-handling/small-devices/>)

easycode-carrier).

- [233] Further, the scanner 3062 is a scanner capable of recognizing 1D and/or 2D barcodes. The scanner 3062 may recognize a code printed or attached to the side of the container and provide information such as a type of solution and/or a volume of the solution contained in the container. The container includes a container used in the sample preparation device 3000 such as an analysis sample vessel, a reagent container, and a sample container. The scanner 3062 may sequentially recognize the identification codes of containers inserted into the deck 1100 one by one. The scanner 3062 moves to a position adjacent to which the container or the carrier containing the container is coupled to the deck, and scans an identification code on the side of the container.
- [234] 6) The waste container 3071 may collect a pipette tip and/or a solution used for preparing an analysis sample in the sample preparation device 3000. The waste container 3701 may be divided into a container in which a pipette tip is collected and a container in which a solution is collected.
- [235] In one embodiment, each of the waste containers 3071 is located on the bottom of the system housing 1000, and the container inlet is provided in the inside of the sample preparation device 3000. Accordingly, the pipette tip and/or solution injected through the inlet of the sample preparation device 3000 may be collected in a container located on the bottom of the system housing 1000. At this time, the inlet and the container are interconnected through a hole formed in the system housing 1000. When the automated analysis system 100 is located on a table or the like, a hole connecting the inlet and the container may be formed in the table in consideration of the location of the container.
- [236] 7) The automatic sealing module 3081 seals the container used in the sample preparation device.
- [237] In one embodiment, the automatic sealing module 3081 may seal the upper surface of the analysis sample vessel (e.g., well plate for amplification) that directly accommodates the analysis sample in each well to prevent mixing and contamination of samples.
- [238] In another embodiment, the automatic sealing module 3081 may seal an inlet of each analysis sample vessel at the same time when the analysis sample is accommodated in an analysis sample vessel that can be inserted into each well of the amplification well plate.
- [239] That is, the analysis sample vessel (e.g., amplification well plate) may be sealed after the analysis sample is injected into the well closed at the bottom. However, after a tube capable of accommodating a solution is inserted into each well and the analysis sample is accommodated in the inserted tube, the inlet of each tube may be sealed.

- [240] The automatic sealing module 3018 may thermally bond the inlet of the analysis sample vessel using a transparent film. Alternatively, it can be bonded with an adhesive.
- [241] In one embodiment, the automatic sealing module 3081 may use Hamilton's Plate Sealer product ([https://www.hamiltoncompany.com/automated-liquid-handling/small-devices / hamilton-plate-sealer](https://www.hamiltoncompany.com/automated-liquid-handling/small-devices/hamilton-plate-sealer)).
- [242] 8) The transport module 3091 is a mechanical device in the form of a gripper for moving an analysis sample vessel or the like. It is operated by the control device of the automated analysis system 100 of the transport module 3091.
- [243] In one embodiment, the transport module 3091 is configured to move the analysis sample vessel up and down, left and right, front and rear, and in rotation while being located at the rear of the sample preparation device.
- [244] In another embodiment, the transport module 3091 is positioned above the system housing 1000 and may be configured to move the analysis sample vessel up and down, left and right, front and rear, and in rotation through the same operation form as the pipette module.
- [245] In another embodiment, the transport module 3091 may be configured to move the analysis sample vessel up and down, left and right by using grippers coupled to at least two pipetting channels of the pipette module.
- [246] The transport module 3091 may move components necessary for preparation of an analysis sample, such as an analysis sample vessel, a reagent container, an adapter, a cartridge, and a well plate, within the sample preparation device 3000. In addition, the transport module 3091 may mount an analysis sample vessel on the sample holder 4100 moved from the sample analysis device 4000. The analysis sample vessel is of a type that can be mounted on a sample holder.
- [247] In one embodiment, the analysis sample vessel is a multi-well plate for amplification containing an analysis sample.
- [248] The transport module 3091 may move the analysis sample vessel to the automatic sealing module 3081 for sealing the analysis sample vessel mounted on the sample holder. In addition, the sealed analysis sample vessel may be mounted on the sample holder transferred to the sample preparation device. The transport module 3091 operates in the area of the deck 1100 within the system housing 1000.
- [249] 9) The pipette module is not shown in the drawing, but is included in the sample preparation device 3000 and is located above the system housing 1000. The pipette module, which is a solution fractionator, includes a pipette arm and a pipetting channel, and the pipetting channel can be automatically moved up and down, left and right, and front and rear by a control device.

- [250] The pipette arm may include one or more independently or dependently moving the pipetting channels. In one embodiment, a pipette tip or needle is coupled to the end of the pipetting channel to be used for aspirate and dispense of a solution.
- [251] In another embodiment, a gripper may be coupled to an end of the pipetting channel and may be used as a transport module that can move a container (including an analysis sample vessel) used in the sample preparation device 3000 such as an analysis sample vessel.
- [252] The pipette arm may perform an act of moving one or more pipetting channels to the pipette tip for fractionation, an act of fixing the pipette tip for fractionation in the pipetting channel, an act of moving the pipette tip in which the pipetting channel is fixed to a certain place, and an act of inserting the pipette tip for fractionation into the container at a certain depth, etc.
- [253] The pipette arm is located on the upper side of the system housing, and the pipetting channel is operated in the sample preparation device 3000 by the pipette arm. At least one pipetting channel couples the pipette tip inserted in the pipette tip adapter 3021 to the end of the pipetting channel.
- [254] The pipette arm can be moved so that the pipetting channel is positioned above the container containing the solution to be dispensed. The pipetting channel descends from the moved position in the direction of the container to receive the solution in the pipette tip, and is positioned to rise again. The pipetting channel moves to the top of another container to be dispensed by the pipette arm, descends and dispenses the solution contained in the pipette tip and then rises again to terminate the dispensing.
- [255] A plurality of pipetting channels may be operated simultaneously, and the number of containers that can be dispensed at the same time may be determined according to the number of pipetting channels.
- [256] The pipette arm and the pipetting channel can be removed the pipette tip attached to the end after the dispensing is completed. The removed pipette tip can be disposed of using a waste container.
- [257] Each component of the sample preparation device 3000 is inserted and installed at regular intervals by guides formed on the deck 1100. Accordingly, each component of the sample preparation device 3000 listed above is a component necessary to prepare an analysis sample. In one implementation, each component can be installed and removed as needed. In other implementations, each of the components may be installed and used in different locations.
- [258] Depending on the size of the system housing 1000 of the automated analysis system 100, components may be added or excluded.
- [259] FIG. 11 is a layout view for showing the location of the configuration included in the sample preparation device.

- [260] As shown in FIG. 11, the deck 1100 of the system housing 1000 having a flat surface may include each component of the sample preparation device 3000 at a specific position. The control device that controls the automated analysis system 100 performs control such as the dispensing of the solution by the pipette module and the movement of the container by the transport module 3091. Each component must be located in the correct place. And the preparation of the analysis sample can be performed.
- [261] In one embodiment, the deck 1100 includes 1) a sample holder placing portion 3010, which is a position in which the sample holder passing through the barrier hole can be moved to the sample preparation device.
- [262] The sample holder placing portion 3010 is formed in the area of the deck 1100 in which the barrier adjacent to the sample analysis device is located. The sample holder placing portion 3010 is formed in a plane so that the sample holder can be moved from the sample analysis device, and has an area in which one or more sample holders to be moved can be placed.
- [263] In one embodiment, the sample analysis device included in the automated analysis system is configured on the left side of the system housing, and the sample holder placing portion 3010 is disposed on the right deck of the barrier separating the sample analysis device and the sample preparation device.
- [264] In one embodiment, the deck 1100 includes 2) a pipette tip adapter placing portion 3020 in which a pipette tip adapter capable of classifying and accommodating one or more pipette tips connected to a pipetting channel by type and/or size is disposed.
- [265] Referring to FIGS. 9 and 10, the pipette tip adapter placing portion 3020 according to an embodiment will be described below. The pipette tip adapters arranged in two rows are provided with five adapters in each row. The configuration of the pipette tip adapter is only an embodiment, and the arrangement of the pipette tip adapter may be changed according to the size of the deck 1100 on which the sample preparation device 3000 is disposed.
- [266] In one embodiment, the deck 1100 includes 3) a container carrier placing portion 3030 in which a container for accommodating a reagent for nucleic acid extraction and a reagent for preparing a reaction solution may be disposed.
- [267] Referring to Figures 9 and 10, the container carrier placing portion 3030 according to an embodiment will be described below. The container carrier inserted along the guide of the deck and positioned on the deck 1100 includes a container that accommodates a solution for preparation of a sample for analysis, extraction of nucleic acids, preparation of a reaction solution, and the like. When five container carriers 3030 are provided, two carriers may contain reagents for preparing a reaction solution for amplification, and three carriers may contain samples. If four container carriers 3030 are provided, one carrier may contain a reaction reagent for amplification, and three

carriers may contain a sample. Each carrier may be inserted into a container containing a solution such as a sample, a reagent for preparing a reaction solution for amplification, and a nucleic acid extraction reagent. The type, the number and the like of containers to be inserted according to the number of carriers may be changed according to the use.

[268] In one embodiment, the deck 1100 includes 4) a nucleic acid extraction module placing portion 3040 in which a nucleic acid extraction module, which is a component for extracting a nucleic acid to be analyzed from a sample, may be located.

[269] In one embodiment, the nucleic acid extraction module placing portion 3040 is divided into a heating portion for heating the specimen and a purification portion for purifying the nucleic acid.

[270] Nucleic acid extraction module by magnetic bead-based method using magnetic beads capable of binding to nucleic acid and eluting the bound nucleic acid may be included in the nucleic acid extraction module placing portion 3040. The magnetic bead-based automated nucleic acid extraction method may use a liquid transfer method or a bead transfer method depending on the type of process for eluting the nucleic acid bound to the magnetic beads.

[271] In one embodiment, the deck 1100 includes 5) a well plate adapter placing portion 3050 including a multi-well plate for amplification used as a analysis sample vessel. The well plate placing portion 3050 may be provided by stacking a plurality of well plates, and may be provided with an extraction reagent cartridge including a nucleic acid extraction reagent.

[272] The well plate placing portion 3050 is composed of an area in which one or more well plates can be placed, and the nucleic acid and the amplification reaction solution may be dispensed by the pipette module to prepare an analysis sample in the well plate provided in the well plate placing portion 3050.

[273] In one embodiment, the deck 1100 includes 6) a scanner placing portion 3060 in which two scanners 3061 and 3062 disposed. The scanner 3061 may scan the bottom of a container inserted into the well plate and a scanner 3062 may scan the side of the container inserted into the container carrier.

[274] The scanners 3061 and 3062 disposed in the scanner placing portion 3060 may be selected from among a fixed method and a moving method as needed. In one embodiment, the scanner uses both a fixed method and a moving method. When the scanner 3062 is a movable type, the scanner placing portion 3060 includes a moving means such as a guide rail for moving the scanner 3062.

[275] In one embodiment, the deck 1100 includes 7) a waste container placing portion 3070 capable of collecting a pipette tip used for preparing an analysis sample and a solution. The waste container 3071 is divided so that the pipette tip and the solution

can be separately collected. When the pipette tip and the solution are injected into the inlet by the pipetting channel, the injected pipette tip and the solution are collected in the container below through the hole formed in the deck of the system housing 1000.

[276] That is, in one embodiment, the waste container placing portion 3070 is connected to the system housing 1000 through a hole, and the waste container is provided external to the system housing 1000 placed on a table or the like. Accordingly, an inlet of the waste container may be located at the deck portion of the waste container placing portion 3070, and a container in which a pipette tip and/or a solution is collected may be located at the bottom of the system housing 1000.

[277] In one embodiment, the deck 1100 includes 8) an automatic sealing module placing portion 3080 for automatically sealing an inlet of an analysis sample vessel to be mounted on the sample holder. When the automatic sealing module placing portion 3080 according to an embodiment is described with reference to FIGS. 9 and 10, it is located on the far right side of the deck, and suction or dispensing by the pipette module is not performed. On the other hand, the transport module 3091 may move the analysis sample vessel to the automatic sealing module 3081 for sealing the analysis sample vessel.

[278] In one embodiment, the deck 1100 includes 9) a transport module placing portion 3090 in which a transport module 3091 for moving various containers used in the sample preparation device 3000 is disposed.

[279] The transport module 3091 may be provided on an upper side inside the system housing like a pipette module, but in one embodiment, the transport module 3091 may be disposed on the inner side or the inner floor of the deck. In the above embodiment, the transport module placing portion 3090 for arranging the transport module 3091 may be included in the deck 1100.

[280] FIG. 12 is a flowchart illustrating the operation of the sample preparation device and the sample analysis device of the automated analysis system.

[281] As shown in FIG. 12, the operation of the automated analysis system starts from the step of preparing an analysis sample in the sample preparation device.

[282] The sample preparation device prepares the analysis sample using components provided in the deck at S110.

[283] To prepare the analysis sample, a sample contained in a container carrier, a nucleic acid extraction reagent, a reagent for preparing a reaction solution for amplification and the like are used. In one embodiment, a method of extracting a nucleic acid from a specimen may use the nucleic acid extraction method described herein.

[284] The sample preparation device can prepare the reaction solution for amplification necessary for preparing the analysis sample, including the nucleic acid extracted from the sample.

- [285] In another embodiment, the sample preparation device may prepare the analysis sample obtained by mixing the sample with the reaction solution for amplification without a nucleic acid extraction process.
- [286] The sample preparation device dispenses the prepared analysis sample to be accommodated in the analysis sample vessel at S120.
- [287] The sample preparation device can prepare the analysis sample for detection by dispensing the nucleic acid extracted from the sample and the prepared amplification reaction solution into an analysis sample vessel through a pipette module. In one embodiment, the analysis sample vessel is a multi-well plate for amplification that can be mounted on the sample holder of the sample analysis device. The pipette module dispenses the prepared analysis sample into each well of a multi-well plate for amplification.
- [288] After that, when the transport module transfers the analysis sample vessel containing the analysis sample to the automatic sealing module, the automatic sealing module seals the inlet of the analysis sample vessel.
- [289] The sample holder of the sample analysis device is moved to the sample preparation device at S130.
- [290] When the preparation of the analysis sample is completed, the sample analysis device provides a sample holder mounted therein to a sample preparation device. The sample holder moves to the sample preparation device using a guide rail provided inside the sample analysis device, and moves to it through the barrier hole of the barrier for separating the sample analysis device and the sample preparation device.
- [291] If the barrier includes a barrier hole opening/closing module, the barrier hole opening/closing module may be opened according to the movement of the sample holder. The opening of the barrier hole opening/closing module is performed by a control device included in the automated analysis system.
- [292] The sample preparation device mounts the analysis sample vessel in which the analysis sample is accommodated in the sample holder at S140.
- [293] When the sample holder moves to the sample holder placing portion and is placed in the sample holder placing portion, the sample preparation device mounts an analysis sample vessel containing an analysis sample to the sample holder. More specifically, the analysis sample vessel containing the analysis sample is mounted on the sample holder by the transport module.
- [294] In one embodiment, the transport module moves and mounts the sealed analysis sample vessel from the automatic sealing module to the sample holder.
- [295] In another embodiment, the transport module moves and mounts the sealed analysis sample vessel from the well plate adapter to the sample holder. At this time, the analysis sample vessel is in a state of being transferred to the well plate adapter by the

transport module after sealing is completed in the automatic sealing module.

[296] The sample analysis device moves the sample holder equipped with the analysis sample vessel to the sample analysis device at S150.

[297] The sample analysis device moves a sample holder including an analysis sample vessel mounted by the transport module into the inside of the sample analysis device. The barrier hole opening/closing module of the barrier is opened while the sample holder is placed in the sample preparation device. Thereafter, the barrier hole opening/closing module is operated to close the barrier hole again when the sample holder is returned to the sample analysis device.

[298] The sample analysis device performs analysis on the analysis sample of the analysis sample vessel mounted on the sample holder and moved to the inside at S160.

[299] The sample analysis device includes a thermal cycler capable of carrying out a reaction on the sample to be analyzed. The sample analysis device performs an amplification reaction or the like through the thermal cycler when the analysis sample vessel containing the analysis sample is mounted on the sample holder and moved to the inside.

[300] According to one embodiment, when the sample analysis device includes an optical module, the sample analysis device provides an analysis result according to the reaction by performing a result measurement on the analysis sample on which the reaction was performed.

[301] According to another embodiment, an automated analysis system comprising: memory, one or more of processor configured to access the memory, and one or more of program code stored in the memory and configured to be executed by the processor, when executed by the processor to analyze the analysis sample, one or more of program code comprises instructions which enable the automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprising a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole to perform the following:

[302] preparing an analysis sample in the sample preparation device;

[303] accommodating the analysis sample in an analytical sample vessel in the sample preparation device;

[304] moving the sample holder to the sample preparation device through the barrier hole; mounting the analysis sample vessel to the sample holder;

[305] moving the sample holder to the sample analysis device through the barrier hole; and

[306] analyzing the analysis sample in the sample analysis device.

- [307] According to still another embodiment, a non-transitory computer-readable storage medium storing instructions executed by the one or more processors when executed by one or more processors, wherein the instructions enable the automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprising a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole to perform the following:
- [308] preparing an analysis sample in the sample preparation device; accommodating the analysis sample in an analytical sample vessel in the sample preparation device;
- [309] moving the sample holder to the sample preparation device through the barrier hole;
- [310] mounting the analysis sample vessel to the sample holder;
- [311] moving the sample holder to the sample analysis device through the barrier hole; and
- [312] analyzing the analysis sample in the sample analysis device.
- [313] While embodiments of the disclosure have been described above, it will be easily appreciated by one of ordinary skill in the art that the scope of the disclosure is not limited thereto. Thus, the scope of the disclosure is defined by the appended claims and equivalents thereof.
- [314] **[CROSS-REFERENCE TO RELATED APPLICATIONS]**
- [315] This application claims priority from Korean Patent Application No. 10-2020-0065475, filed on May 29, 2020, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

Claims

- [Claim 1] An automated analysis system comprising:
a sample preparation device for preparing an analysis sample for detection of an analyte wherein the analysis sample is accommodated in an analysis sample vessel;
a sample analysis device comprises a sample holder for receiving the analysis sample vessel; and
a barrier for spatially separating the sample preparation device and the sample analysis device wherein the barrier comprises a barrier hole for operatively connecting the sample preparation device and the sample analysis device, and the sample holder is moved to the sample preparation device through the barrier hole to receive a sample analysis container.
- [Claim 2] The automated analysis system of claim 1, wherein the barrier hole comprises a door module that opens when the sample holder moves to the sample preparation device and closes when the sample holder returns to the sample analysis device.
- [Claim 3] The automated analysis system of claim 1, wherein the sample analysis device comprises a sliding mechanism for moving the sample holder to the sample preparation device.
- [Claim 4] The automated analysis system of claim 1, wherein the sample preparation device mounts the analysis sample vessel to the sample holder when the sample holder passes through the barrier hole and moves to the sample preparation device.
- [Claim 5] The automated analysis system of claim 1, wherein the sample preparation device is comprises a nucleic acid extraction module.
- [Claim 6] The automated analysis system of claim 1, wherein the sample preparation device comprises an automatic sealing module capable of automatically sealing the inlet of the sample analysis container.
- [Claim 7] The automated analysis system of claim 1, wherein the sample preparation device prepares a plurality of analysis samples for different types of analysis.
- [Claim 8] The automated analysis system of claim 1, wherein the sample analysis device is comprises a thermal cycler for performing an amplification reaction of the sample to be analyzed.
- [Claim 9] The automated analysis system of claim 8, wherein the sample analysis device comprises an optical mechanism for measuring a reaction result

of the analysis sample in which the amplification reaction has been performed.

- [Claim 10] The automated analysis system of claim 1, wherein the barrier comprises a material capable of reducing or blocking light flowing from the sample preparation device to the sample analysis device, and the light comprises one or more of visible rays, ultraviolet rays and/or infrared rays.
- [Claim 11] The automated analysis system of claim 1, wherein the barrier comprises a material capable of reducing or blocking the movement of heat generated from the sample analysis device to the sample preparation device.
- [Claim 12] The automated analysis system of claim 1, wherein the barrier comprises a material capable of reducing or blocking the movement of air flow generated from the analysis sample device to the sample preparation device.
- [Claim 13] The automated analysis system of claim 1, wherein the sample analysis device comprises an exhaust port for exhausting internal air and/or an inhalation port for inhaling external air.
- [Claim 14] The automated analysis system of claim 13, wherein the exhaust port comprises an exhaust module for exhausting the air, and the inhalation port comprises an inhalation module for inhaling the air.
- [Claim 15] The automated analysis system of claim 1, wherein the sample preparation device removes the analysis sample vessel from the sample holder when the sample holder mounted with the analysis sample vessel is moved to the sample preparation device.
- [Claim 16] The automated analysis system of claim 15, wherein the sample preparation device, when an additional analysis sample vessel to be analyzed is prepared, mounts the additional analysis sample vessel to the sample holder from which the analysis sample vessel is removed.
- [Claim 17] The automated analysis system of claim 1, wherein the sample preparation device comprises a well plate capable of accommodating the analysis sample vessel.
- [Claim 18] The automated analysis system of claim 1, wherein the sample preparation device comprises:
a pipette module comprising a pipette arm for dispensing liquid and one or more of pipetting channel connected to the pipette arm; and
a transport module for moving the analysis sample vessel.
- [Claim 19] The automated analysis system of claim 18, wherein the sample

preparation device further comprises:

a pipette tip adapter accommodating a plurality of pipette tips;
an analysis sample vessel adapter in which the analysis sample vessel
for accommodating the analysis sample is located; and
a waste container in which the pipette tip used in the sample
preparation device is collected.

[Claim 20]

A automated analysis method for analyzing an analysis sample by an automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprising a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole, the automated analysis method comprising:

preparing an analysis sample in the sample preparation device;
accommodating the analysis sample in an analytical sample vessel in the sample preparation device;
moving the sample holder to the sample preparation device through the barrier hole;
mounting the analysis sample vessel to the sample holder;
moving the sample holder to the sample analysis device through the barrier hole; and
analyzing the analysis sample in the sample analysis device.

[Claim 21]

The automated analysis method of claim 20, further comprising:
after the analyzing the analysis sample in the sample analysis device,
moving the sample holder to the sample preparation device through the barrier hole; and
removing the analysis sample vessel from the sample holder moved to the sample preparation device.

[Claim 22]

The automated analysis method of claim 20, wherein the analyzing the analysis sample in the sample analysis device comprises:
an amplification process in which the nucleic acid contained in the analysis sample is amplified; and
a measurement process in which the amplified nucleic acid is measured.

[Claim 23]

The automated analysis method of claim 20, wherein the barrier hole opens when the sample holder moves to the sample preparation device

and closes when the moved sample holder moves to the sample analysis device.

[Claim 24] The automated analysis method of claim 20, wherein, in the moving to the sample preparation device, the sample holder is moved by a sliding mechanism.

[Claim 25] The automated analysis method of claim 20, wherein, in the mounting the analysis sample vessel to the sample holder, the transport module comprised in the sample preparation device mounts the analysis sample vessel to the sample holder.

[Claim 26] The automated analysis method of claim 20, wherein, before the mounting the analysis sample vessel to the sample holder, the inlet of the analysis sample vessel is automatically sealed by an automated sealing module included in the sample preparation device.

[Claim 27] An automated analysis system comprising:
Memory;
one or more of processor configured to access the memory; and
one or more of program code stored in the memory and configured to be executed by the processor,
when executed by the processor to analyze the analysis sample,
one or more of program code comprises instructions which enable the automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprising a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole to perform the following:
preparing an analysis sample in the sample preparation device;
accommodating the analysis sample in an analytical sample vessel in the sample preparation device;
moving the sample holder to the sample preparation device through the barrier hole;
mounting the analysis sample vessel to the sample holder;
moving the sample holder to the sample analysis device through the barrier hole; and
analyzing the analysis sample in the sample analysis device.

[Claim 28] A non-transitory computer-readable storage medium storing in-

structions executed by the one or more processors when executed by one or more processors, wherein

the instructions enable the automated analysis system which comprises a sample preparation device and a sample analysis device, wherein the sample preparation device and the sample analysis device are spatially separated by a barrier, and the barrier comprising a barrier hole for operatively connecting the sample preparation device and the sample analysis device, wherein the sample holder comprised in the sample analysis device is moved to the sample preparation device through the barrier hole to perform the following:

preparing an analysis sample in the sample preparation device;

accommodating the analysis sample in an analytical sample vessel in the sample preparation device;

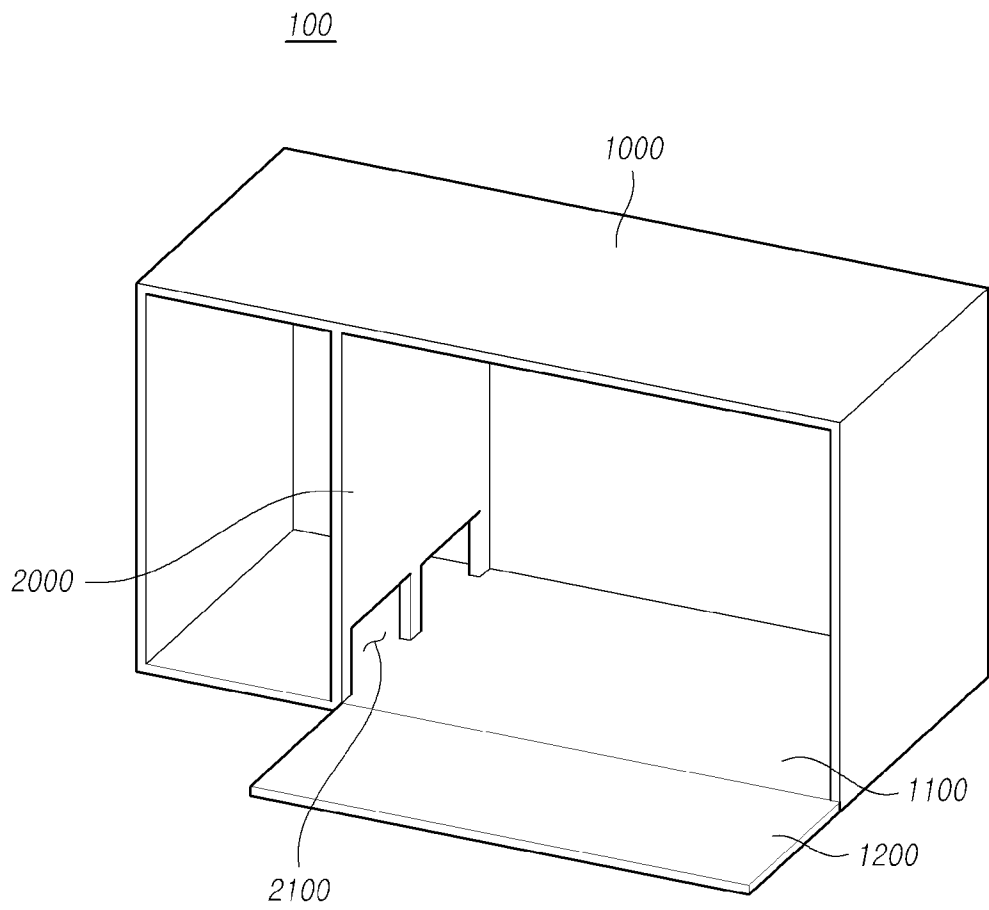
moving the sample holder to the sample preparation device through the barrier hole;

mounting the analysis sample vessel to the sample holder;

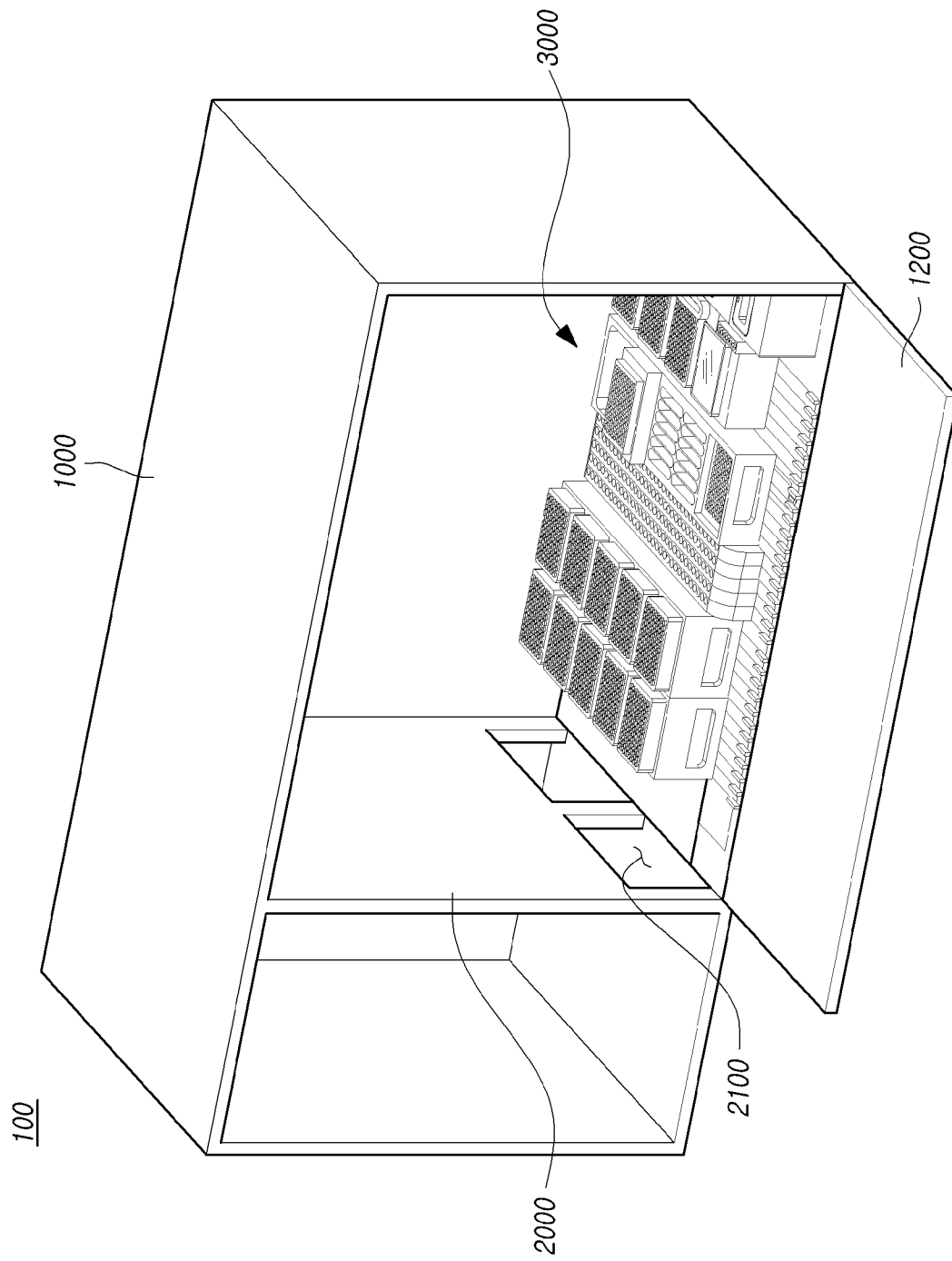
moving the sample holder to the sample analysis device through the barrier hole; and

analyzing the analysis sample in the sample analysis device.

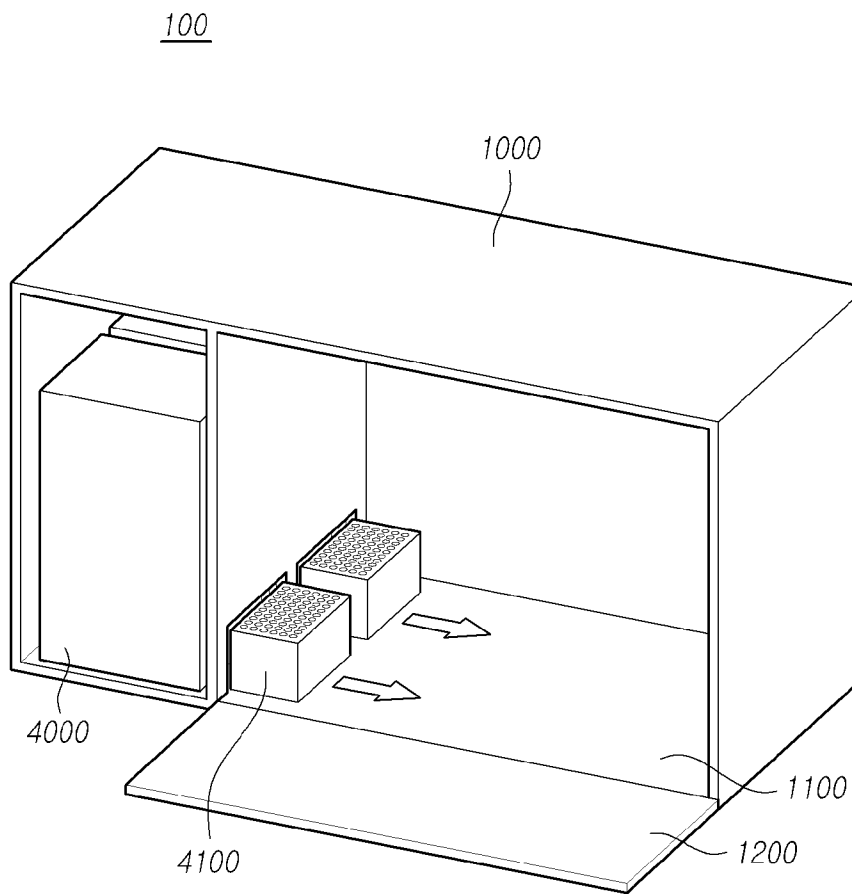
[Fig. 1]



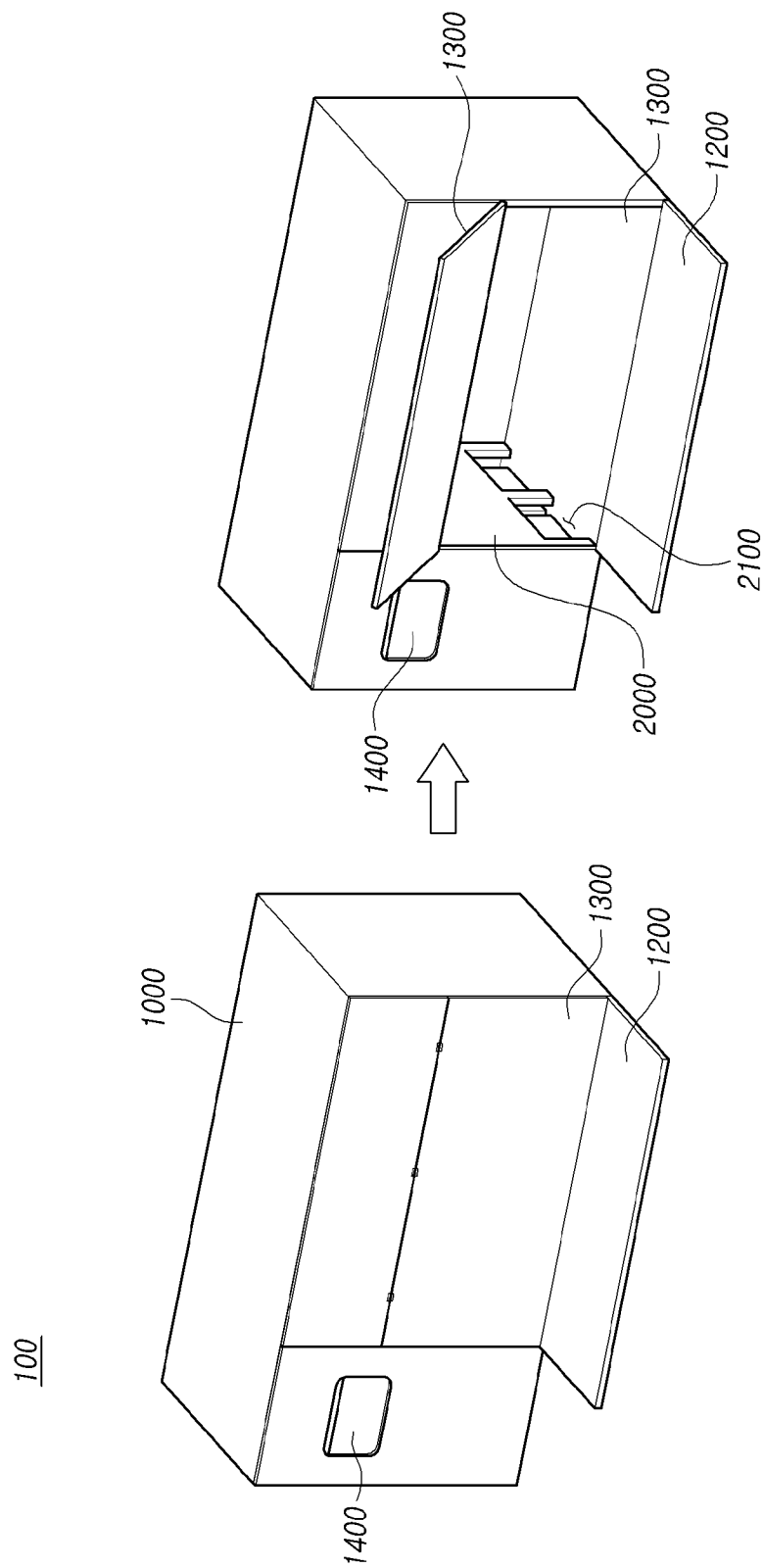
[Fig. 2]



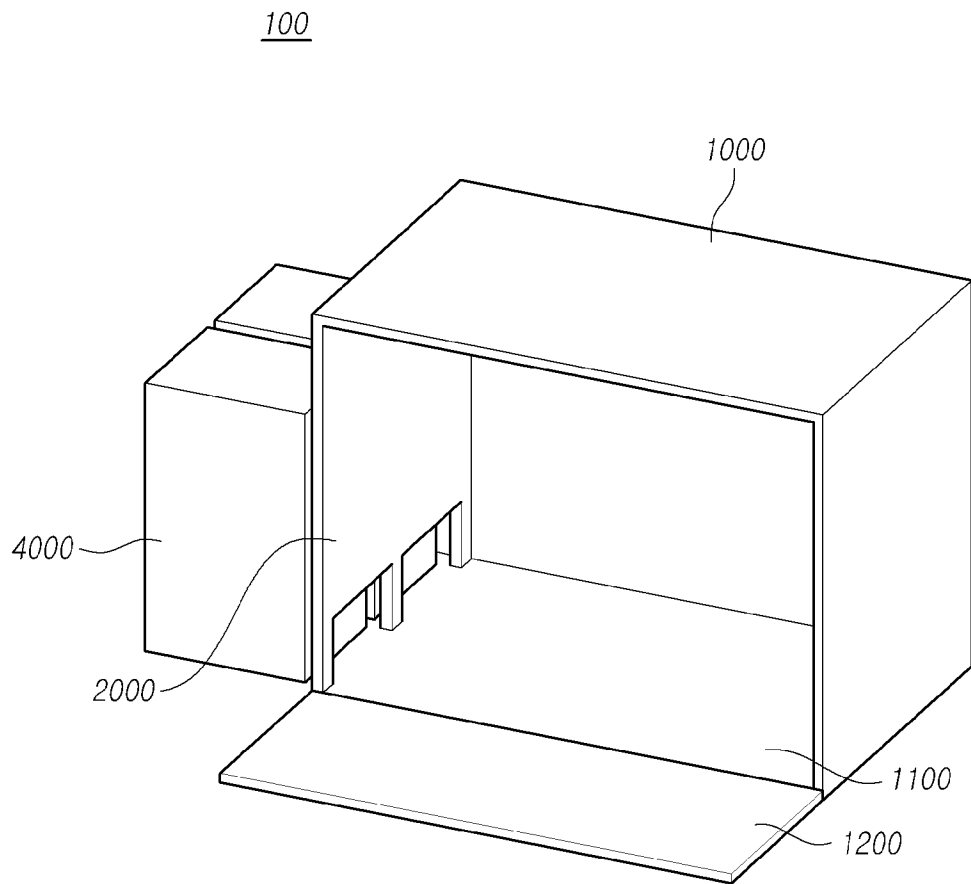
[Fig. 3]



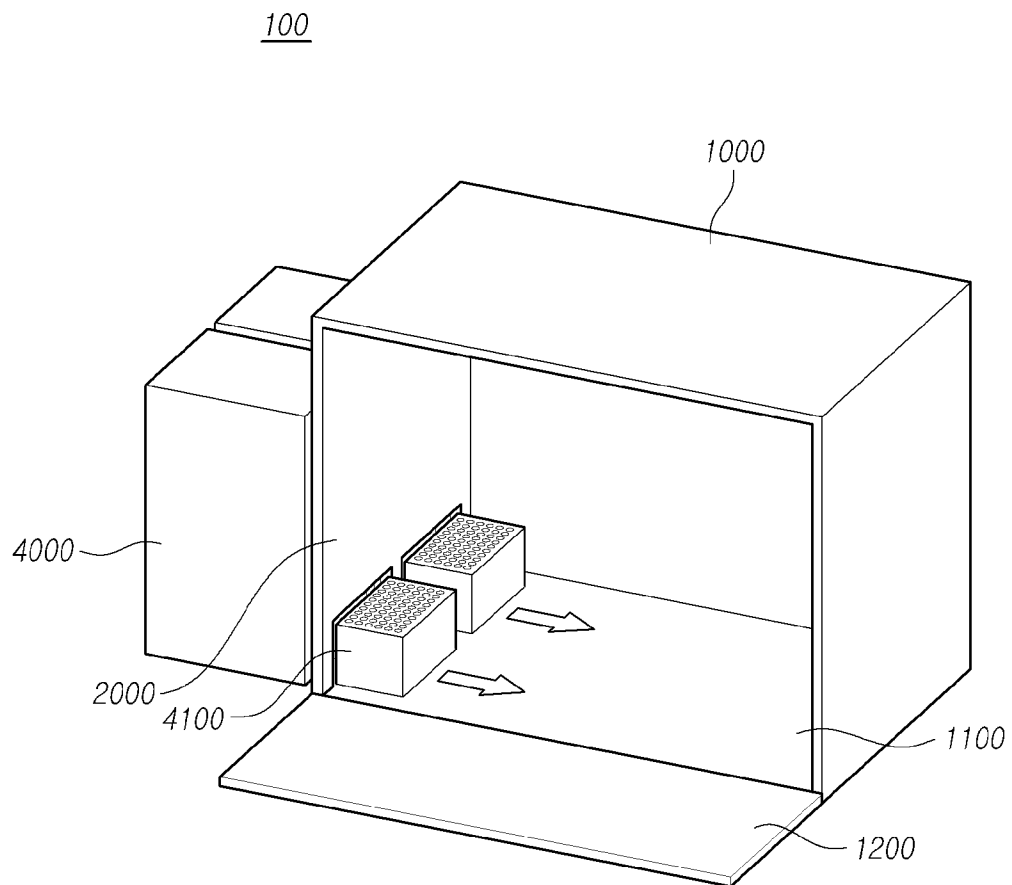
[Fig. 4]



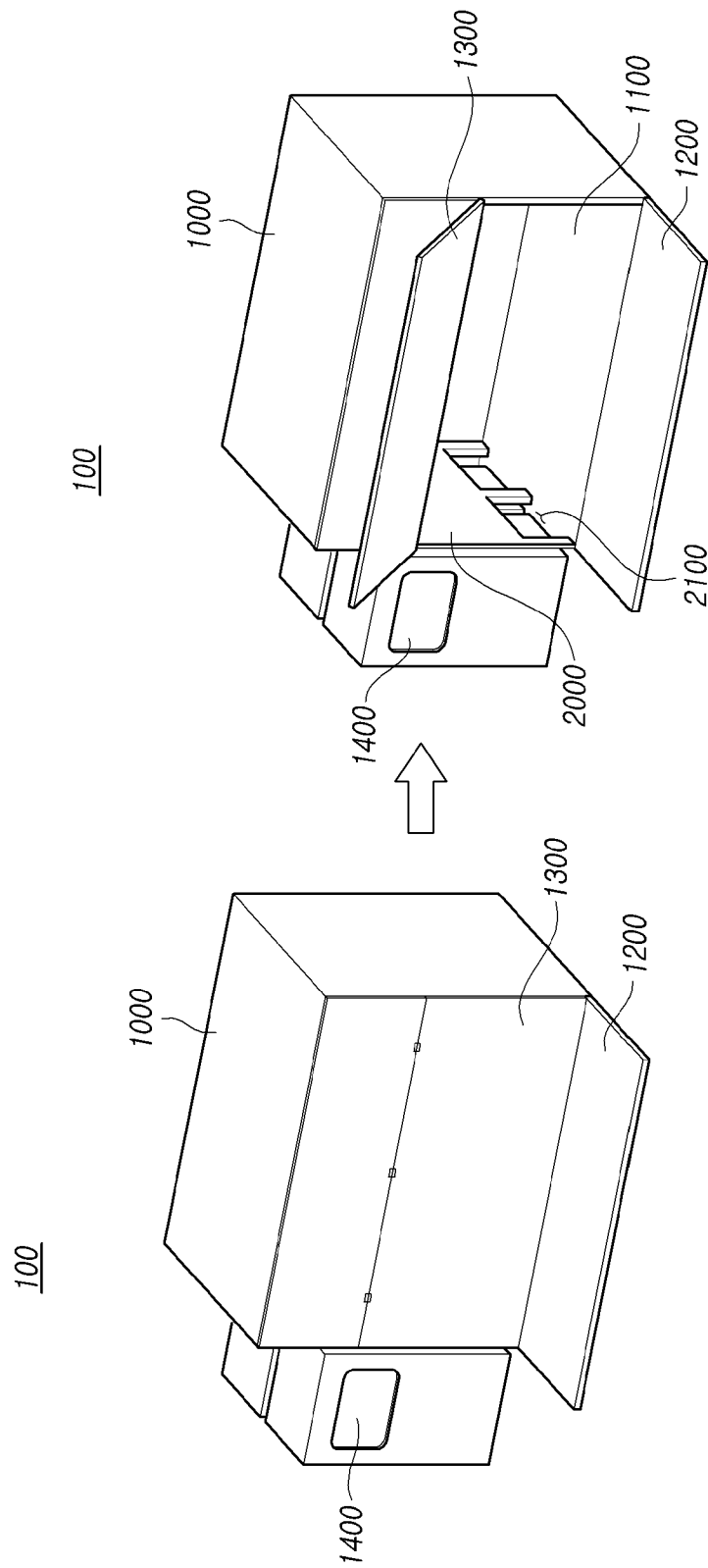
[Fig. 5]



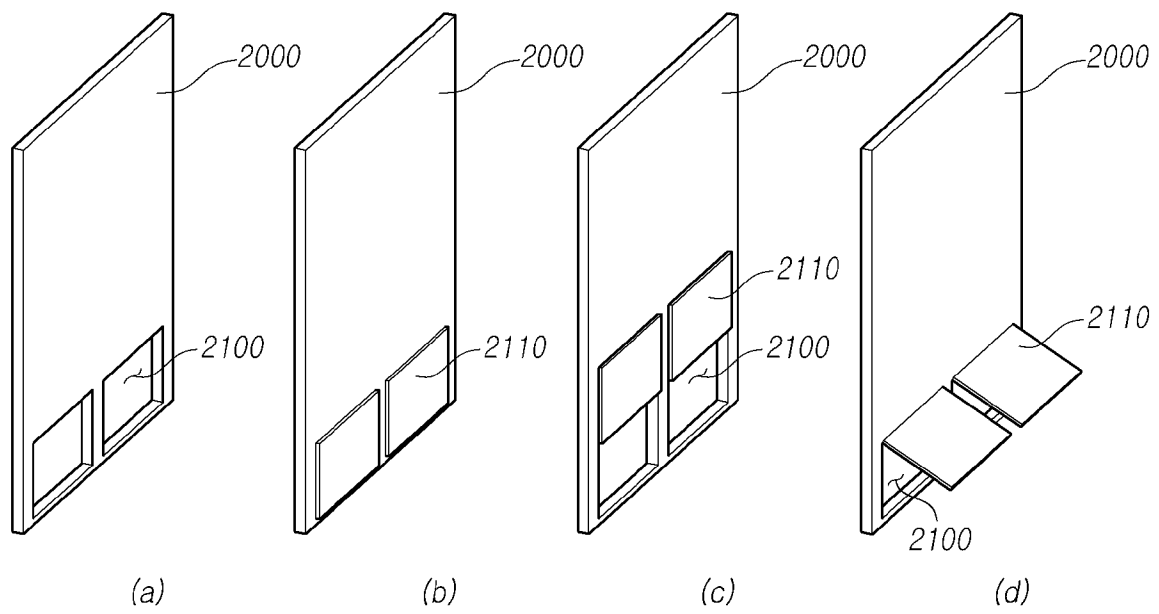
[Fig. 6]



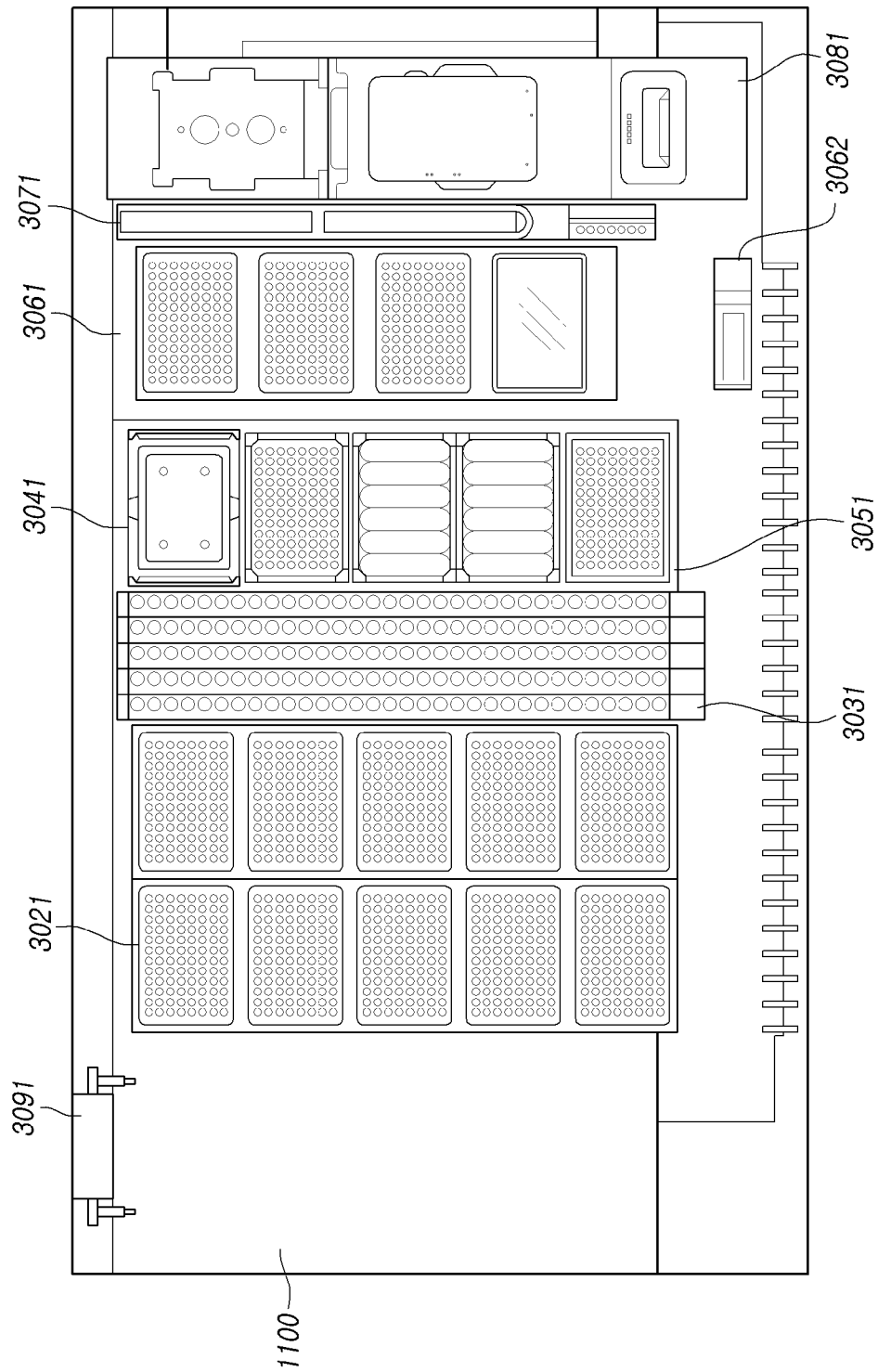
[Fig. 7]



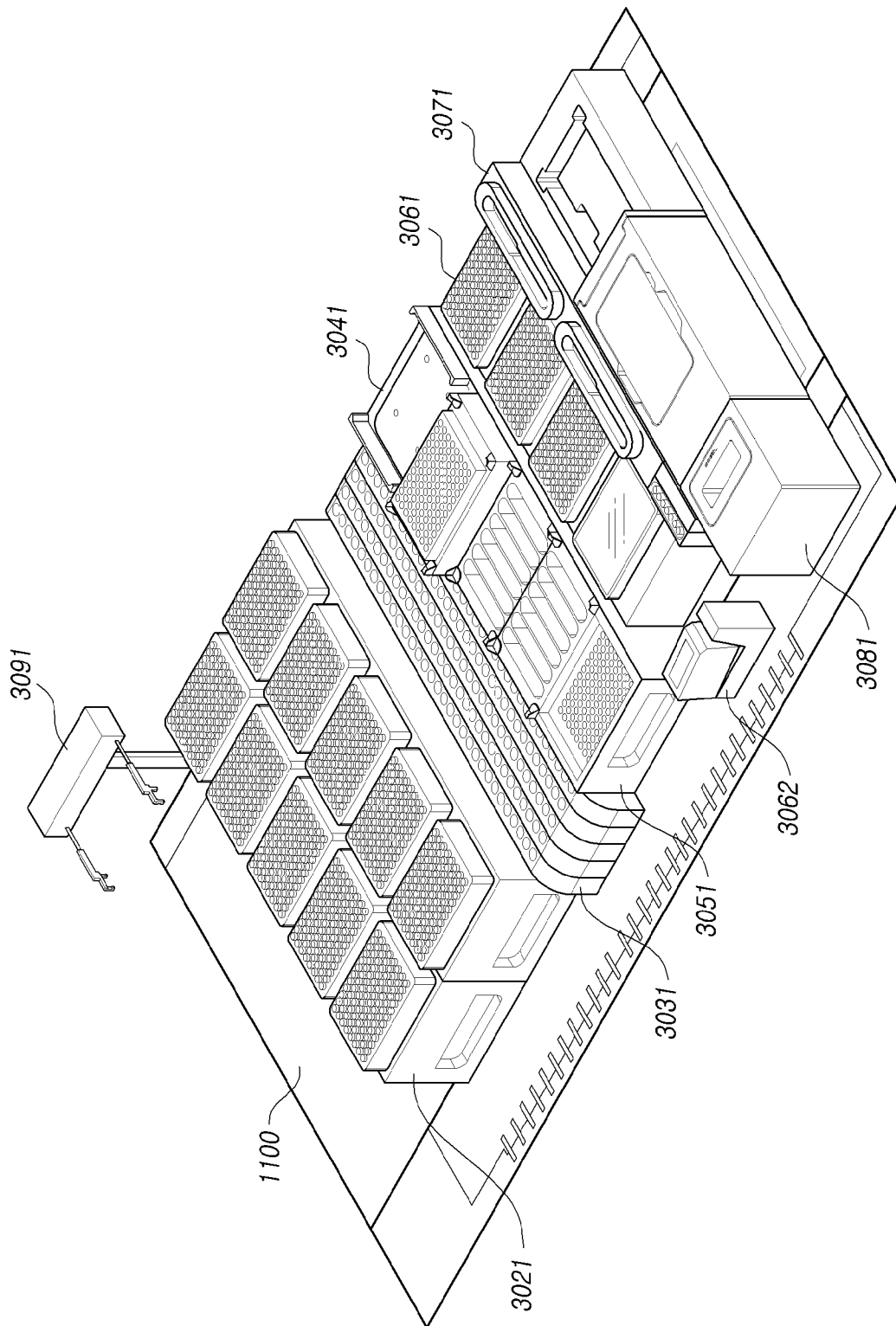
[Fig. 8]



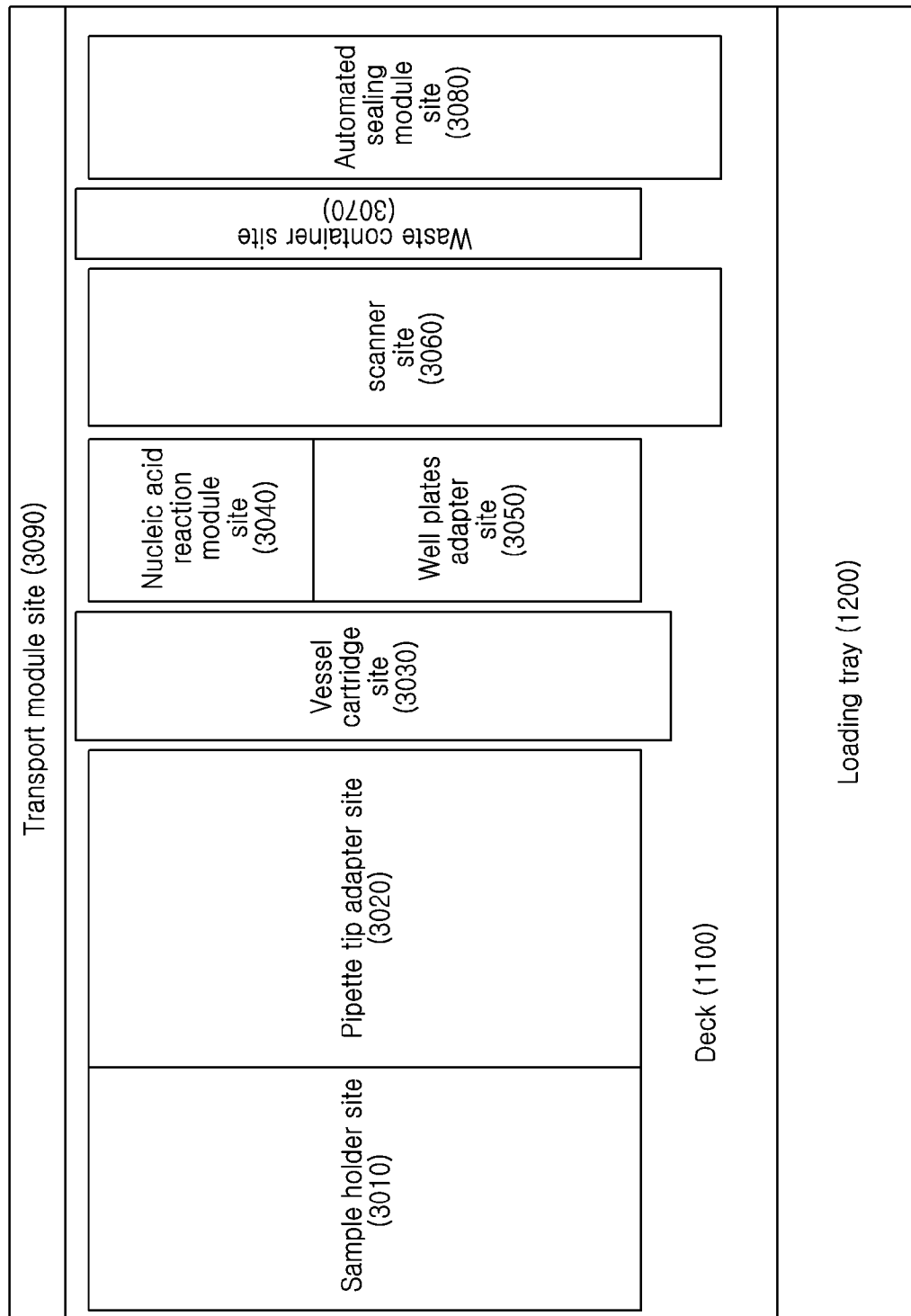
[Fig. 9]



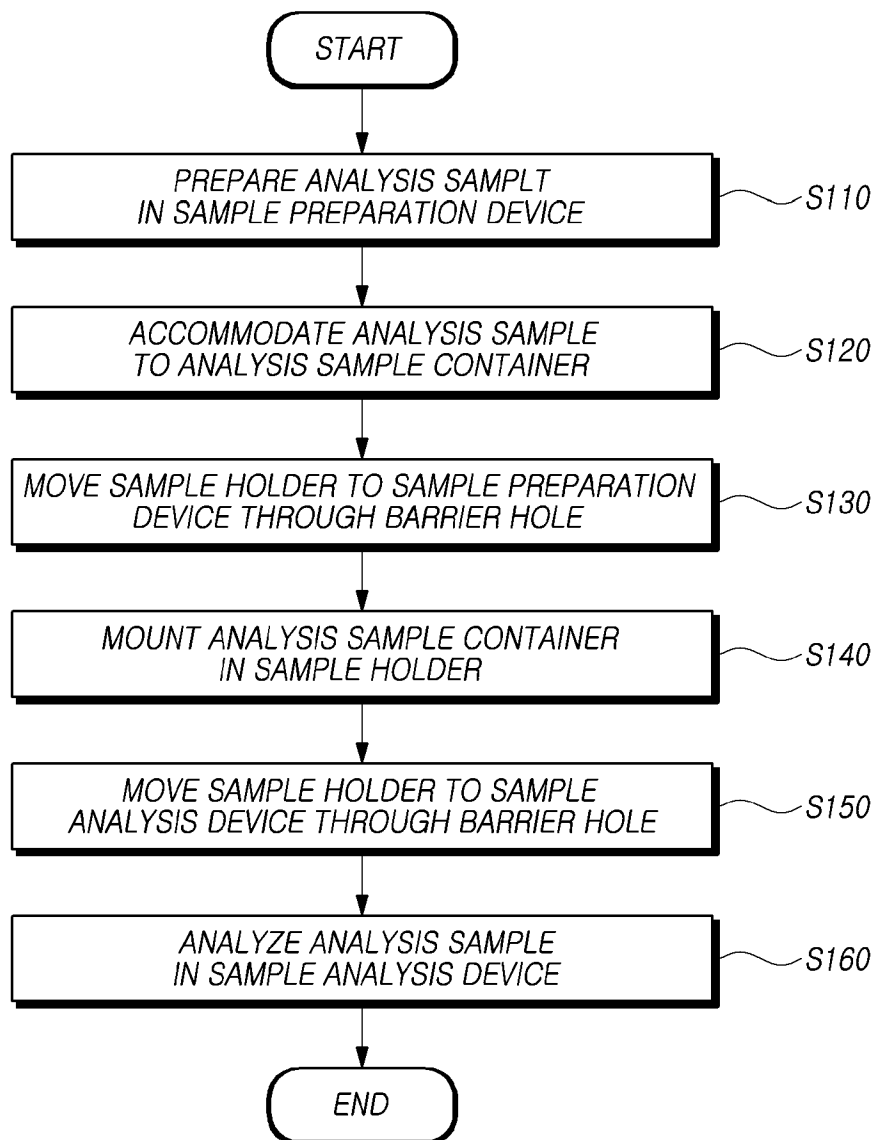
[Fig. 10]



[Fig. 11]



[Fig. 12]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2021/006531

A. CLASSIFICATION OF SUBJECT MATTER G01N 35/00(2006.01)i; G01N 35/10(2006.01)i; G01N 35/02(2006.01)i; B01L 7/00(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) G01N 35/00(2006.01); C12M 1/00(2006.01); C12M 1/42(2006.01); C12Q 1/25(2006.01); C12Q 3/00(2006.01); G01N 21/64(2006.01); G01N 21/75(2006.01); G01N 30/24(2006.01); G01N 35/04(2006.01); G05B 13/02(2006.01) Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models Japanese utility models and applications for utility models Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS(KIPO internal) & Keywords: extraction, thermal cyclers, amplification, barrier, hole, analysis, PCR		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2015-0337400 A1 (BECKMAN COULTER, INC.) 26 November 2015 (2015-11-26) See paragraphs [0007], [0019], [0030]-[0031], [0178], [0183], [0189], [0191]-[0197], [0205], [0213]-[0214], [0289], [0321], [0336], [0475], [0588], [0674], [0686]; figures 1(b), 2(a).	1-28
Y	WO 2020-090159 A1 (SHIMADZU CORPORATION) 07 May 2020 (2020-05-07) See paragraphs [0018], [0046], [0067], [0069], [0076]; figures 1, 5.	1-28
A	US 2012-0171678 A1 (MALTEZOS, GEORGE et al.) 05 July 2012 (2012-07-05) See the whole document.	1-28
A	JP 2019-068859 A (GEN PROBE INC.) 09 May 2019 (2019-05-09) See the whole document.	1-28
A	CN 106701566 A (SHANDONG ACV BIOTECH CO., LTD.) 24 May 2017 (2017-05-24) See the whole document.	1-28
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "D" document cited by the applicant in the international application "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 30 August 2021		Date of mailing of the international search report 30 August 2021
Name and mailing address of the ISA/KR Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon 35208, Republic of Korea Facsimile No. +82-42-481-8578		Authorized officer Jung, Da Won Telephone No. +82-42-481-5373

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2021/006531

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
US	2015-0337400	A1	26 November 2015	CN	103119451	A	22 May 2013
				CN	103540517	A	29 January 2014
				CN	103540518	A	29 January 2014
				CN	103540530	A	29 January 2014
				CN	103543281	A	29 January 2014
				CN	103543282	A	29 January 2014
				CN	103551212	A	05 February 2014
				CN	103555558	A	05 February 2014
				CN	103555815	A	05 February 2014
				CN	103589627	A	19 February 2014
				CN	103657754	A	26 March 2014
				CN	103675303	A	26 March 2014
				CN	103725591	A	16 April 2014
				CN	104345161	A	11 February 2015
				CN	104345165	A	11 February 2015
				EP	2596135	A2	29 May 2013
				EP	2743704	A2	18 June 2014
				EP	2743705	A2	18 June 2014
				EP	2743705	B1	12 October 2016
				EP	2746777	A2	25 June 2014
				EP	2749356	A2	02 July 2014
				EP	2749887	A2	02 July 2014
				EP	2752245	A2	09 July 2014
				EP	2752246	A2	09 July 2014
				EP	2752247	A2	09 July 2014
				EP	2752668	A2	09 July 2014
				EP	2752670	A2	09 July 2014
				EP	2752671	A2	09 July 2014
				EP	2754496	A2	16 July 2014
				JP	2013-150623	A	08 August 2013
				JP	2013-535193	A	12 September 2013
				JP	2014-193114	A	09 October 2014
				JP	2016-036345	A	22 March 2016
				JP	2016-200604	A	01 December 2016
				JP	5948271	B2	06 July 2016
				JP	6013959	B2	25 October 2016
				KR	10-2013-0029127	A	21 March 2013
				KR	10-2013-0029128	A	21 March 2013
				KR	10-2013-0041255	A	24 April 2013
				US	2013-0130369	A1	23 May 2013
				US	2013-0132006	A1	23 May 2013
				US	2013-0136670	A1	30 May 2013
				US	2013-0137087	A1	30 May 2013
				US	2013-0137109	A1	30 May 2013
				US	2013-0137110	A1	30 May 2013
				US	2013-0137164	A1	30 May 2013
				US	2013-0137166	A1	30 May 2013
				US	2013-0142711	A1	06 June 2013
				US	2013-0143199	A1	06 June 2013
				US	2013-0196422	A1	01 August 2013

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2021/006531

Patent document cited in search report				Publication date (day/month/year)		Patent family member(s)		Publication date (day/month/year)	
				US	2013-0203046	A1	08 August 2013		
				US	2013-0209334	A1	15 August 2013		
				US	2015-0111288	A1	23 April 2015		
				US	2015-0217291	A1	06 August 2015		
				US	8840848	B2	23 September 2014		
				US	8932541	B2	13 January 2015		
				US	8956570	B2	17 February 2015		
				US	8962308	B2	24 February 2015		
				US	8996320	B2	31 March 2015		
				US	9046455	B2	02 June 2015		
				US	9140715	B2	22 September 2015		
				US	9274132	B2	01 March 2016		
				US	9285382	B2	15 March 2016		
				US	9519000	B2	13 December 2016		
				WO	2012-012779	A2	26 January 2012		
WO	2020-090159	A1	07 May 2020	None					
US	2012-0171678	A1	05 July 2012	CN	101522909	A	02 September 2009		
				EP	2027251	A2	25 February 2009		
				EP	2535427	A2	19 December 2012		
				EP	2535427	A3	24 April 2013		
				JP	2009-537152	A	29 October 2009		
				US	2008-0003649	A1	03 January 2008		
				US	2009-0275014	A1	05 November 2009		
				US	2009-0275113	A1	05 November 2009		
				US	8003370	B2	23 August 2011		
				US	8008046	B2	30 August 2011		
				US	8232091	B2	31 July 2012		
				US	9316586	B2	19 April 2016		
				WO	2008-070198	A2	12 June 2008		
JP	2019-068859	A	09 May 2019	CN	105188938	A	23 December 2015		
				CN	108441404	A	24 August 2018		
				CN	108456714	A	28 August 2018		
				CN	108456715	A	28 August 2018		
				CN	108467830	A	31 August 2018		
				CN	108479869	A	04 September 2018		
				CN	108490201	A	04 September 2018		
				CN	108546629	A	18 September 2018		
				CN	108627662	A	09 October 2018		
				EP	2969223	A2	20 January 2016		
				EP	2969223	B1	03 October 2018		
				EP	3444035	A1	20 February 2019		
				JP	2016-513975	A	19 May 2016		
				JP	2017-060534	A	30 March 2017		
				JP	2018-015006	A	01 February 2018		
				JP	2018-015007	A	01 February 2018		
				JP	2019-068858	A	09 May 2019		
				JP	2019-068860	A	09 May 2019		
				JP	2019-071906	A	16 May 2019		
				JP	2019-187450	A	31 October 2019		
				JP	2020-039365	A	19 March 2020		

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2021/006531

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
		JP 6316931 B2	25 April 2018
		JP 6564441 B2	21 August 2019
		JP 6799625 B2	16 December 2020
		JP 6807416 B2	06 January 2021
		JP 6824306 B2	03 February 2021
		JP 6906592 B2	21 July 2021
		US 10711297 B2	14 July 2020
		US 10889851 B2	12 January 2021
		US 2016-0032358 A1	04 February 2016
		US 2016-0060680 A1	03 March 2016
		US 2017-0335373 A1	23 November 2017
		US 2018-0298426 A1	18 October 2018
		US 2018-0298427 A1	18 October 2018
		US 2019-0284612 A1	19 September 2019
		US 2020-0239935 A1	30 July 2020
		US 2021-0017578 A1	21 January 2021
		US 2021-0017579 A1	21 January 2021
		US 2021-0079452 A1	18 March 2021
		US 9732374 B2	15 August 2017
		WO 2014-153193 A2	25 September 2014
CN 106701566 A	24 May 2017	CN 106701566 B	20 November 2018