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(54) **A BIOLOGICAL ANALYSIS SYSTEM AND METHOD**

(57) A biological analysis system includes a housing, a chassis, a block assembly and a transport. The chassis is disposed within the housing. The block assembly is mounted to the chassis, and is configured to receive a plurality of samples and cycle the plurality of samples through a series of temperatures. The transport includes a guide that is configured to reversibly move the block assembly relative to the chassis between an open position and a closed position according to a manual force on the block assembly. The plurality of samples are accessible by a user at the open position.

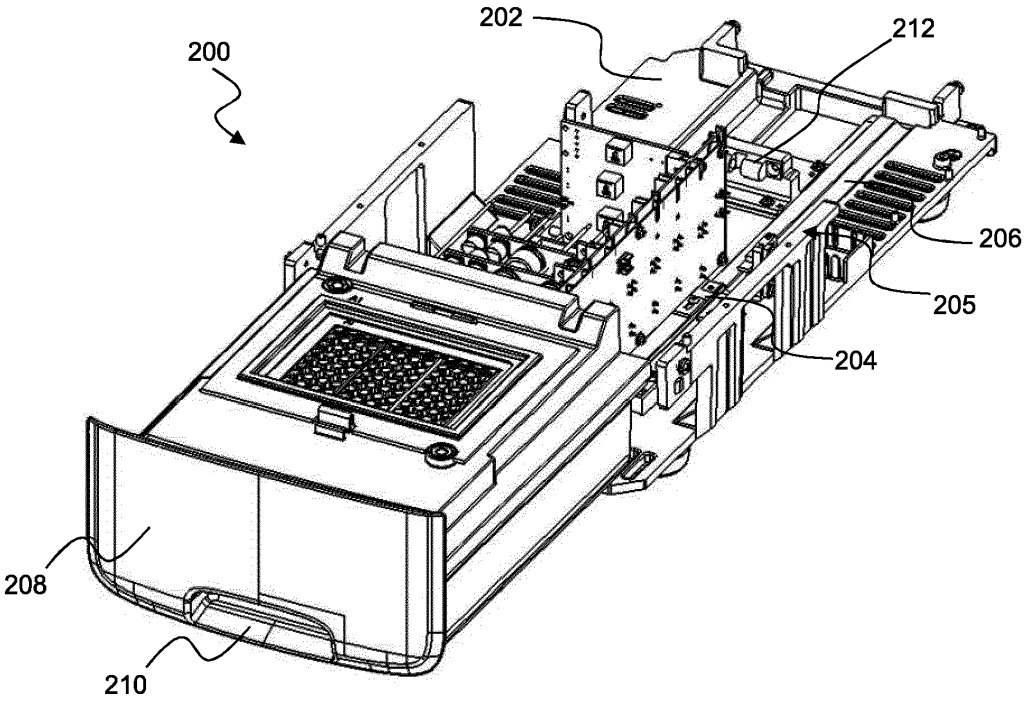

Fig. 2A

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Description

FIELD OF INVENTION

[0001] The present invention relates broadly, but not exclusively, to biological analysis systems and methods including polymerase chain reaction (PCR) systems and methods such as real-time PCR (qPCR) systems and methods.

BACKGROUND

[0002] Biological analysis systems, such as PCR systems, are useful tools for conducting diagnostics and research in biological or biochemical samples. A PCR system typically has a thermal cycler that heats and cools the samples over a number of cycles to achieve the desired amplification of one or more target molecules. qPCR systems allow monitoring of a PCR assay during each thermal cycle of the process.

[0003] Sophisticated qPCR instruments and systems are currently available that allow for automated processing of large numbers of assays without intervention by a user once a process has been initiated. Such automated systems typically include various motors and mechanisms which carry out the automated functions of moving various components within the system, such as the loading and unloading of the samples within an analysis housing. However, it has been noticed that with these known automated systems, the additional automated mechanisms such as the motors create additional temperature variations within the analysis housing and at certain times during the analysis, particularly during the start of the process, which may affect the precision and reliability of the temperature-sensitive analysis being carried out on the samples. Such variations typically do not occur in a uniform manner across all samples, which additionally may cause further variations in the analysis of the various samples.

[0004] Thus, it is desirable to provide a qPCR system that can address at least one of the above problems.

SUMMARY

[0005] According to an aspect of the present disclosure, there is provided a biological analysis system comprising a housing; a chassis disposed within the housing; a block assembly mounted to the chassis, the block assembly configured to receive a plurality of samples and cycle the plurality of samples through a series of temperatures; and a transport comprising a guide that is configured to reversibly move the block assembly relative to the chassis between an open position and a closed position according to a manual force on the block assembly, wherein the plurality of samples are accessible by a user at the open position.

[0006] The system may comprise a catch mounted to the chassis, wherein the catch is configured to releasably retain the block assembly in the closed position. The catch may comprise a double ball catch.

[0007] The system may further comprise a sensor configured to detect the block assembly in the closed position. The sensor may comprise a proximity sensor.

[0008] The system may further comprise a cover member attached to the block assembly, and the cover may be configured to be flush with the housing when the block assembly is in the closed position. The cover member may comprise a recess or handle configured to allow the user to exert the manual force to move the block assembly from the closed position to the open position.

[0009] The block assembly may comprise at least one sample block for receiving the plurality of samples; at least one thermoelectric device having one major surface in thermal communication the at least one sample block; a heat exchanger in thermal communication with the other major surface of the at least one thermoelectric device; and a seal configured to block a circulation of air from the heat exchanger to the at least one sample block.

[0010] The system may further comprise a control board and a plurality of cables connecting the at least one thermoelectric device and the control board, the plurality of cables passing through a corresponding plurality of holes disposed on the heat exchanger, and the seal may be positioned to cover the plurality of holes.

[0011] The guide may comprise a slide mechanism configured to reversibly slide the block assembly relative to the chassis between the open position and the closed position according to the manual force on the block assembly.

[0012] The guide is configured to reversibly move the block assembly relative to the chassis between the open position and the closed position in reaction to, concert with or sympathy with, the manual force on the block assembly. The manual force on the block assembly is a force exerted by a user. The biological analysis system does not comprise an automated means, for example, a motor, to move the block assembly relative to the chassis between the open position and the closed position. The guide is configured to reversibly move the block assembly relative to the chassis between the open position and the closed position in reaction to, concert with or sympathy with, an external force on the block assembly, the external force being external to the biological analysis system.

[0013] According to another aspect of the present disclosure, there is provided a method of performing a biological analysis, comprising: providing system comprising: a housing; a chassis disposed within the housing; and a block assembly mounted to the chassis; placing a plurality of samples in or on the block assembly while the block assembly is in an open position; moving the block assembly relative to the chassis from the open position to a closed position according to a manual force on the block assembly; cycling the plurality of samples through a series of temperatures.

[0014] Cycling the plurality of samples through a series

of temperatures may comprise cycling the temperatures to provide a PCR assay.

[0015] The method may further comprise reading a fluorescence signal from at least some of the plurality of samples during cycling the plurality of samples through a series of temperatures.

[0016] The method may further comprise, after cycling the plurality of samples through a series of temperatures, moving the block assembly relative to the chassis from the closed position to the open position according to a manual force on the block assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Fig. 1A shows a front perspective view of a biological analysis system according to an example embodiment. Fig. 1B shows a schematic system block diagram of the biological analysis system of Fig. 1A.

Fig. 2A shows a perspective view of a block assembly of the biological analysis system of Fig. 1 in an open position. Fig. 2B shows a perspective view of the block assembly of Fig. 2A in a closed position.

Fig. 3 shows a schematic plan view of a catch for releasably retaining the block assembly in the closed position.

Fig. 4 shows a schematic perspective view of a sensor for detecting the block assembly in the closed position.

Fig. 5 shows an exploded view of a portion of the block assembly of Fig. 2A.

Fig. 6 shows a sample block of the block assembly of Fig. 2A.

DETAILED DESCRIPTION

[0018] Fig. 1A shows a front perspective view of a biological analysis system 100 according to an example embodiment. Fig. 1B shows a schematic system block diagram of the biological analysis system 100 of Fig. 1A.

[0019] The biological analysis system 100 includes a thermal cycler 102, an optical system 104 and a user interface 106, each connected to a control system 108. As shown in Fig. 1A, the user interface 106 in the example embodiment may comprise a touchscreen 110 capable of receiving touch input from a user and providing colour output or feedback to the user. The thermal cycler 102 and optical system 104 are contained within a housing 112 which has an opening for mounting the touchscreen 110. The system 100 further comprises a drawer or transport 114 which allows a user to manually access at least some components of the thermal cycler 102, as described in more detail below.

[0020] The thermal cycler 102 includes at least one sample block 116, a heating/cooling element 118 and a heat exchanger or thermal block 120. The at least one sample block 116 can receive a plurality of samples 122, for example, in the form of a microtiter plate comprising a plurality of sample wells or vials each containing one or more samples. The heating/cooling element 118 in use can thermally cycle the samples 122 according to the test, assay, or experiment selected by the user, and is typically in the form of one or more thermoelectric devices 118, such as one or more Peltier devices. At least a portion of the thermal cycler 102 may be disposed in the drawer or transport 114 that is accessible by the user. In certain embodiments, the biological analysis system 100 comprises a polymerase chain reaction (PCR) system, such as a real-time PCR (qPCR) system. In such embodiments, the thermal cycler 102 is configured to perform a qPCR assay, process, or experiment so that the plurality of samples 122 experience a specified temperature profile for a predetermined number of cycles.

[0021] For the sake of brevity, a power supply is not shown in Fig. 1B, but it will be appreciated that a power supply may be included in such as system. Further, the components and functions of the optical system 104 are not further elaborated, but it is generally understood that the optical system 104 may be configured to emit electromagnetic radiation onto or into the samples and receive electromagnetic radiation from the samples for analysis. For example, for embodiments in which the biological analysis system 100 comprises a qPCR system, the optical system 104 may be configured to produce and/or read a fluorescence signal produced by one or more of the plurality of samples 122.

[0022] Fig. 2A shows a perspective view of a block assembly 200 of the biological analysis system 100 disposed within the drawer or transport 114, which is in an open position. The block assembly 200 is moveably or slidably mounted on a chassis 202, which is fixedly positioned within the housing 112 (Fig. 1A). For example, the drawer or transport 114 in the illustrated embodiment has a slide mechanism or guide system 205 in the form of a pair of slides 204 attached to the block assembly 200 that cooperate with corresponding rails 206 provided on the chassis 202. In the open position, filling, replacement and/or inspection of the samples can be conducted by the user. In the illustrated embodiment, block assembly 200 comprises the thermal cycler 102. In other embodiments, block assembly 200 comprises sample block 116, while heating/cooling element 118 and/or thermal block 120 are located at a fixed position within chassis 202.

[0023] From the open position shown in Fig. 2A, the user can slide the block assembly 200 to a closed position

shown in Fig. 2B by providing a force on the drawer or transport 114 to manually push on a cover member 208 attached to the block assembly 200. The force is applied externally from the analysis system 100. In the closed position, the cover member 208 may be flush with the exterior of the housing 112 (see Fig. 1A) and the user can select an operation of the system 100 to be run via the user interface 106 (Fig. 1B). As can be seen in Figs. 2A and 2B, the cover member 208 includes a handle or recess 210 from which the user may exert a force on the drawer or transport 114 to move or slide the block assembly 200 from the closed position to the open position. Advantageously, the cover member 208, in combination with the guide system 205, allows the user to control the operation of the system 100 without additional motors/mechanisms which may result in a reduction in unwanted temperature variations within the sample block which may allow for an improvement in the precision and reliability of the analysis being carried out on the samples 122.

[0024] The system 100 may include a catch 212 which can releasably retain the block assembly 200 in the closed position. As shown in Fig. 2A, the catch 212 is mounted to the chassis 202 at a position which allows it to engage with the block assembly 200 only when the block assembly 200 is in the closed position. Fig. 3 shows a plan view in which the catch 212 engages with an end part 300 of the block assembly 200. In this example, the catch 212 is a double ball catch in which each ball is releasably urged (e.g. by a respective spring) toward one side of the end part 300, and a tactile feedback is provided upon successful engagement. It will be appreciated that other types of catch can be used in alternate embodiments.

[0025] The system 100 further includes a sensor 400 which can detect whether the block assembly 200 is in the closed position. Fig. 4 shows a schematic perspective view of an arrangement of the sensor 400. Here, the sensor 400 is a proximity sensor that is mounted on the chassis 202 and configured to detect a corresponding flange or part 402 on the block assembly 200 if the flange or part 402 is adjacent to it, e.g. when the block assembly 200 is fully in the closed position. Other types of sensors, e.g. an optical sensor, a pressure sensor, etc. can be used in alternate embodiments.

[0026] The catch 212 and sensor 400 in the example embodiments can provide affirmative indication that the block assembly 200 of the biological analysis system 100 is properly in the closed position before thermal cycling operations begin. For example, the control system 108 (Fig. 1B) may be configured so that it only activates the heating/cooling element 118 based on a signal from the sensor 400 confirming that the block assembly 200 is in the closed position. The catch 212 can prevent accidental slippage of the block assembly 200 and be configured to accurately position the block assembly 200 within biological analysis system 100, while allowing release of the block assembly 200 by a manual force applied by a user to again move the block assembly 200 to the open position, as shown in FIG. 2A. Optionally, a manual lock (not shown) can also be provided to additionally secure the block assembly 200 in the closed position.

[0027] Fig. 5 shows an exploded view of a portion of the block assembly 200 of Fig. 2A. As described above, the block assembly 200 includes at least one sample block 116 and at least one thermoelectric device 118. The at least one sample block 116 includes a plurality of cavities corresponding to a plurality of reaction vessels, as can be seen in Fig. 6. As a non-limiting example, one sample block 116 may have an array of 32 cavities 600 to receive 32 reaction vessels. In a block assembly employing three sample blocks 116, a total of 96 reaction vessels can be provided. In such an example, three thermoelectric devices 118 corresponding to the three sample blocks 116 may be used. It will be appreciated that the number of sample blocks, the number of thermoelectric devices and/or the number of reaction vessels may vary in alternate embodiments.

[0028] In the block assembly 200, one surface of the at least one thermoelectric device 118 is configured to be in thermal communication with the at least one sample block 116 to provide the necessary heating or cooling of the samples received by the at least one sample block 116. Another surface of the at least one thermoelectric device 118 may be configured to be in thermal communication the thermal block 120. A plurality of cables 500 connect the at least one thermoelectric device 118 and a control board of the control system 108 (Fig. 1B). In one implementation, the plurality of cables 500 pass through a corresponding plurality of holes 502 formed on the thermal block 120, and a seal 504 is positioned to cover the plurality of holes 502 such that the seal 504 can block a circulation of hot air from the thermal block 120 to the at least one sample block 116. In use, the seal 504 preferably can prevent waste heat from interfering with the thermal cycling of the samples in the at least one sample block 116.

[0029] With the use of direct cables between the at least one thermoelectric device and the control board, the number of control circuits may be reduced. Moreover, by having a manual drawer or tray containing the block assembly, an electric motor and its associated electronics can be eliminated. As a result of these improvements, the power requirement by the system is reduced which may result in a reduction in unwanted temperature variations within the sample block which may allow for an improvement in the precision and reliability of the analysis being carried out on the samples 122.

[0030] It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

Claims

1. A biological analysis system comprising:

   a housing;
   a chassis disposed within the housing;
   a block assembly mounted to the chassis, the block assembly configured to receive a plurality of samples and cycle the plurality of samples through a series of temperatures; and
   a transport comprising a guide that is configured to reversibly move the block assembly relative to the chassis between an open position and a closed position according to a manual force on the block assembly, wherein the plurality of samples are accessible by a user at the open position.

2. The system as claimed in claim 1, further comprising a catch mounted to the chassis, wherein the catch is configured to releasably retain the block assembly in the closed position.

3. The system as claimed in claim 2, wherein the catch comprises a double ball catch.

4. The system as claimed in any preceding claim, further comprising a sensor configured to detect the block assembly in the closed position.

5. The system as claimed in claim 4, wherein the sensor comprises a proximity sensor.

6. The system as claimed in any preceding claim, further comprising a cover member attached to the block assembly, wherein the cover is configured to be flush with the housing when the block assembly is in the closed position.

7. The system as claimed in claim 6, wherein the cover member comprises a recess or handle configured to allow the user to exert the manual force to move the block assembly from the closed position to the open position.

8. The system as claimed in any preceding claim, wherein the block assembly comprises:

   at least one sample block for receiving the plurality of samples;
   at least one thermoelectric device having one major surface in thermal communication with the at least one sample block, the at least one thermoelectric device configured to perform a qPCR assay, process, or experiment by cycling the temperature of the plurality of samples;
   a heat exchanger in thermal communication with the other major surface of the at least one thermoelectric device; and
   a seal configured to block a circulation of air from the heat exchanger to the at least one sample block.

9. The system as claimed in claim 8, further comprising a control board and a plurality of cables connecting the at least one thermoelectric device and the control board, the plurality of cables passing through a corresponding plurality of holes disposed on the heat exchanger, and wherein the seal is positioned to cover the plurality of holes.

10. The system as claimed in any preceding claim, wherein the guide comprises a slide mechanism configured to reversibly slide the block assembly relative to the chassis between the open position and the closed position according to the manual force on the block assembly.

11. A method of performing a biological analysis, comprising:

    providing a system comprising:

       a housing;
       a chassis disposed within the housing; and
       a block assembly mounted to the chassis;

    placing a plurality of samples in or on the block assembly while the block assembly is in an open position;
    moving the block assembly relative to the chassis from the open position to a closed position according to a manual force on the block assembly;
    cycling the plurality of samples through a series of temperatures.

12. The method of claim 11, wherein cycling the plurality of samples through a series of temperatures comprises cycling the temperatures to provide a PCR assay.

13. The method of claims 11 or 12, further comprising reading a fluorescence signal from at least some of the plurality of samples during cycling the plurality of samples through a series of temperatures.

14. The method of any of claims 11-13, further comprising, after cycling the plurality of samples through a series of temperatures, moving the block assembly relative to the chassis from the closed position to the open position according to a manual force on the block assembly.

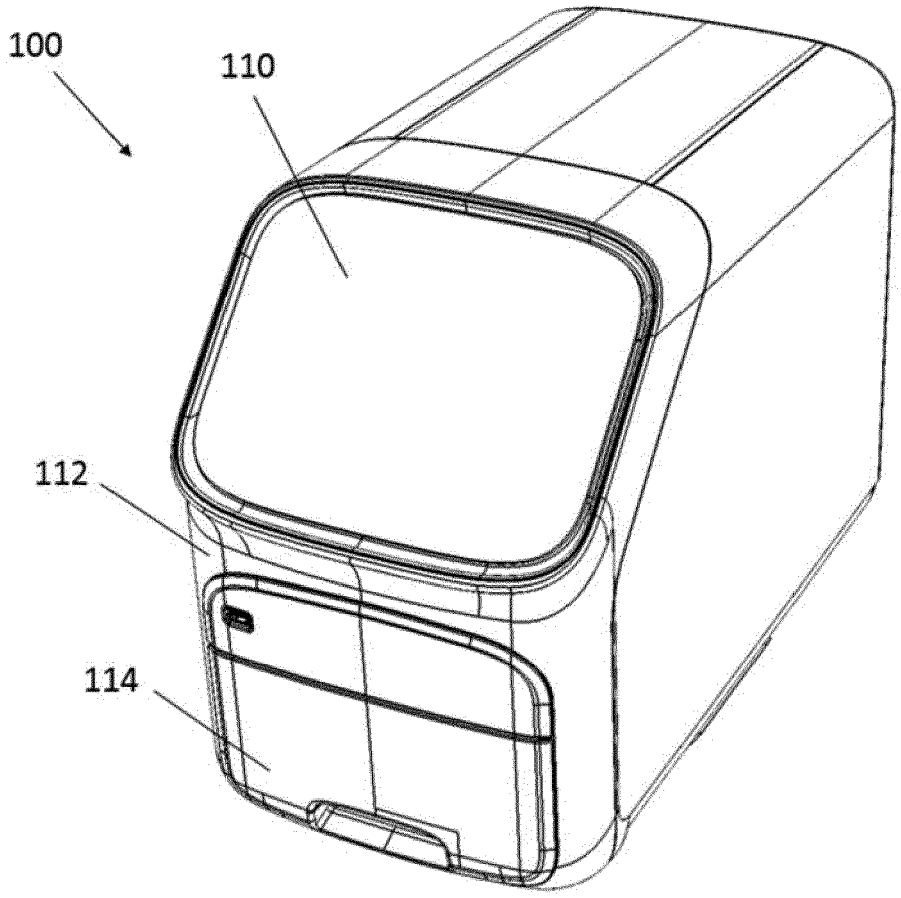

Fig. 1A

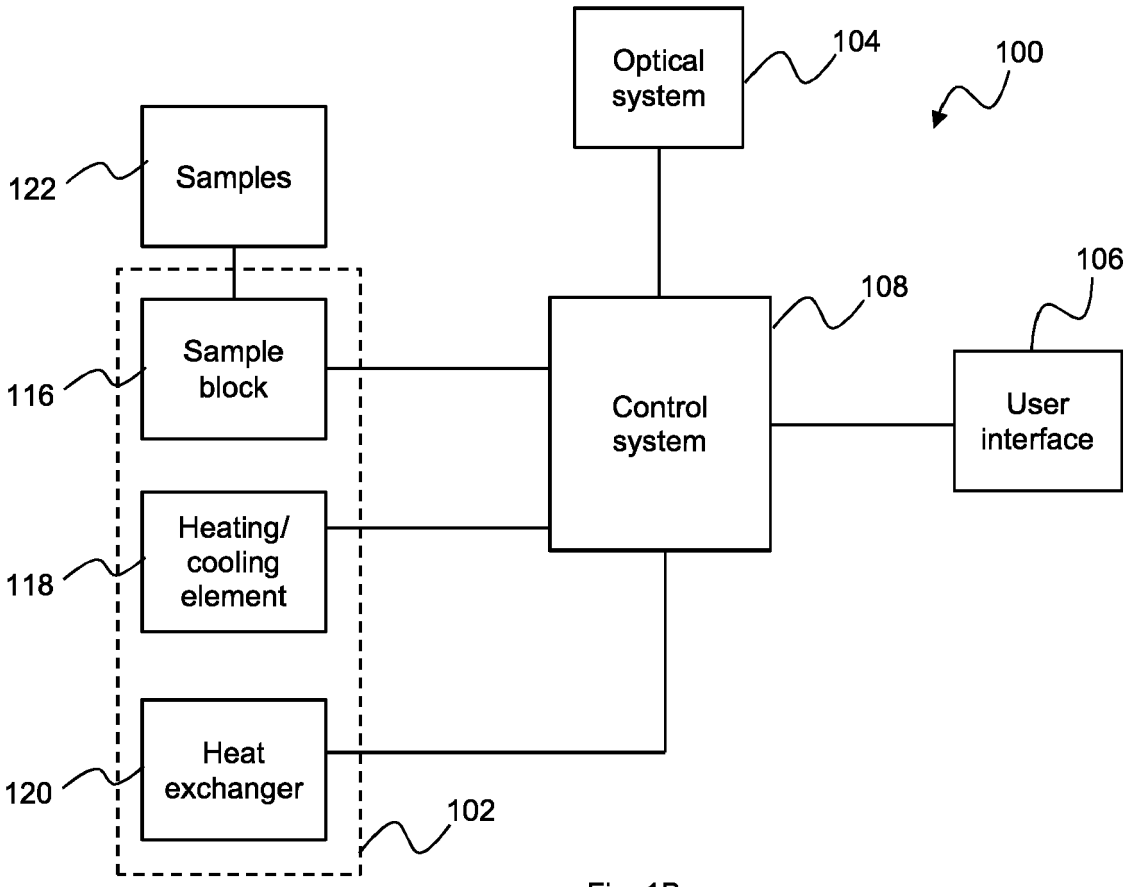
Optical system
104
100
122
Samples
106
108
Sample block
116
Control system
User interface
Heating/ cooling element
118
Heat exchanger
120
102

Fig. 1B

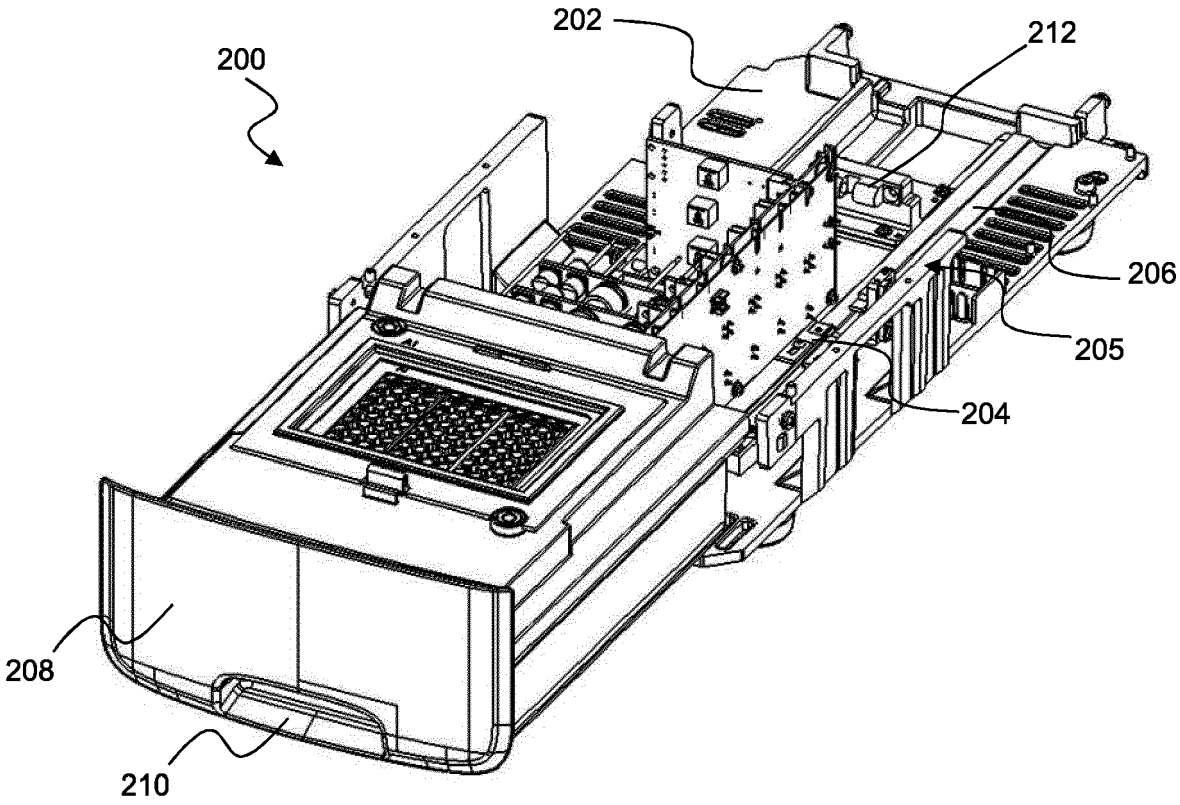

Fig. 2A

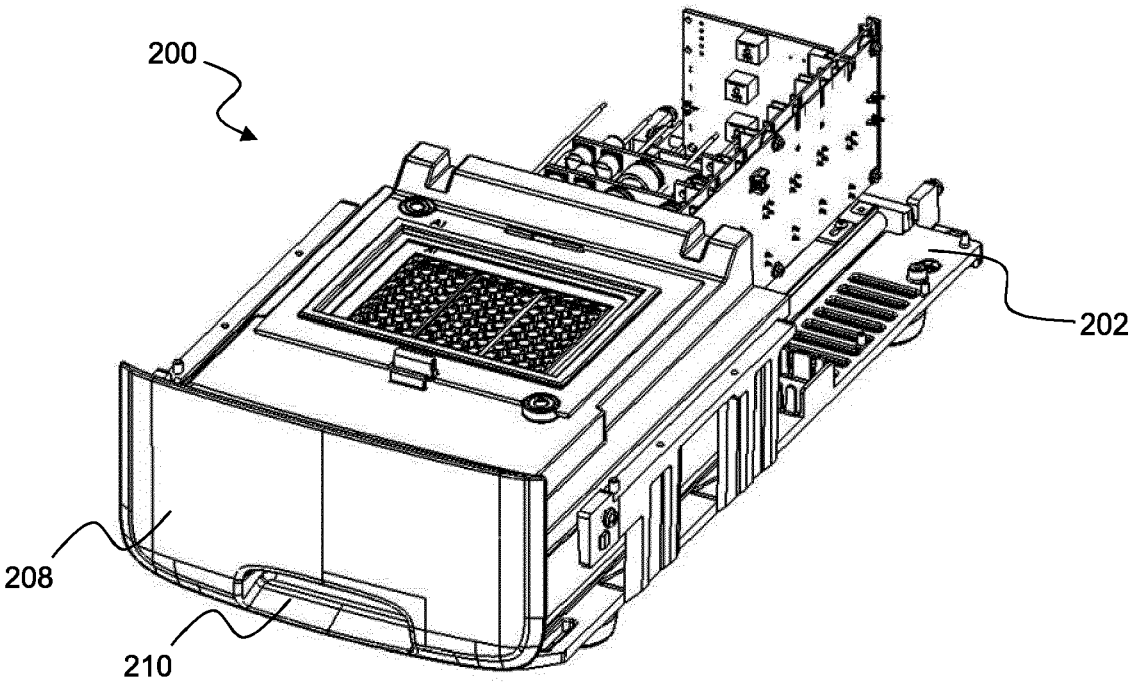

Fig. 2B

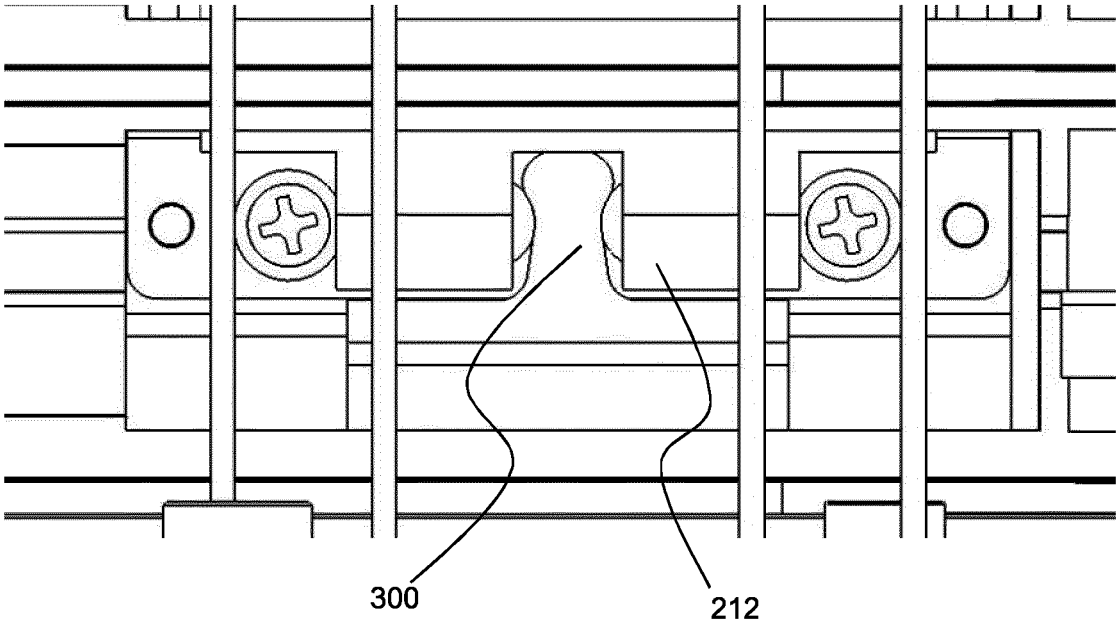

Fig. 3

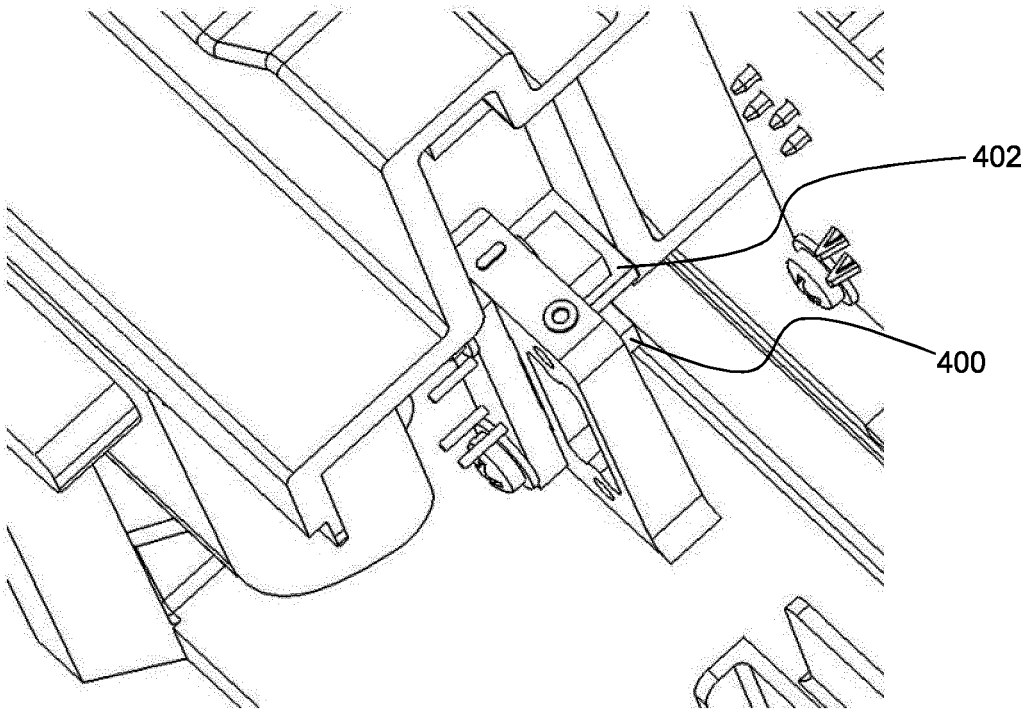

Fig. 4

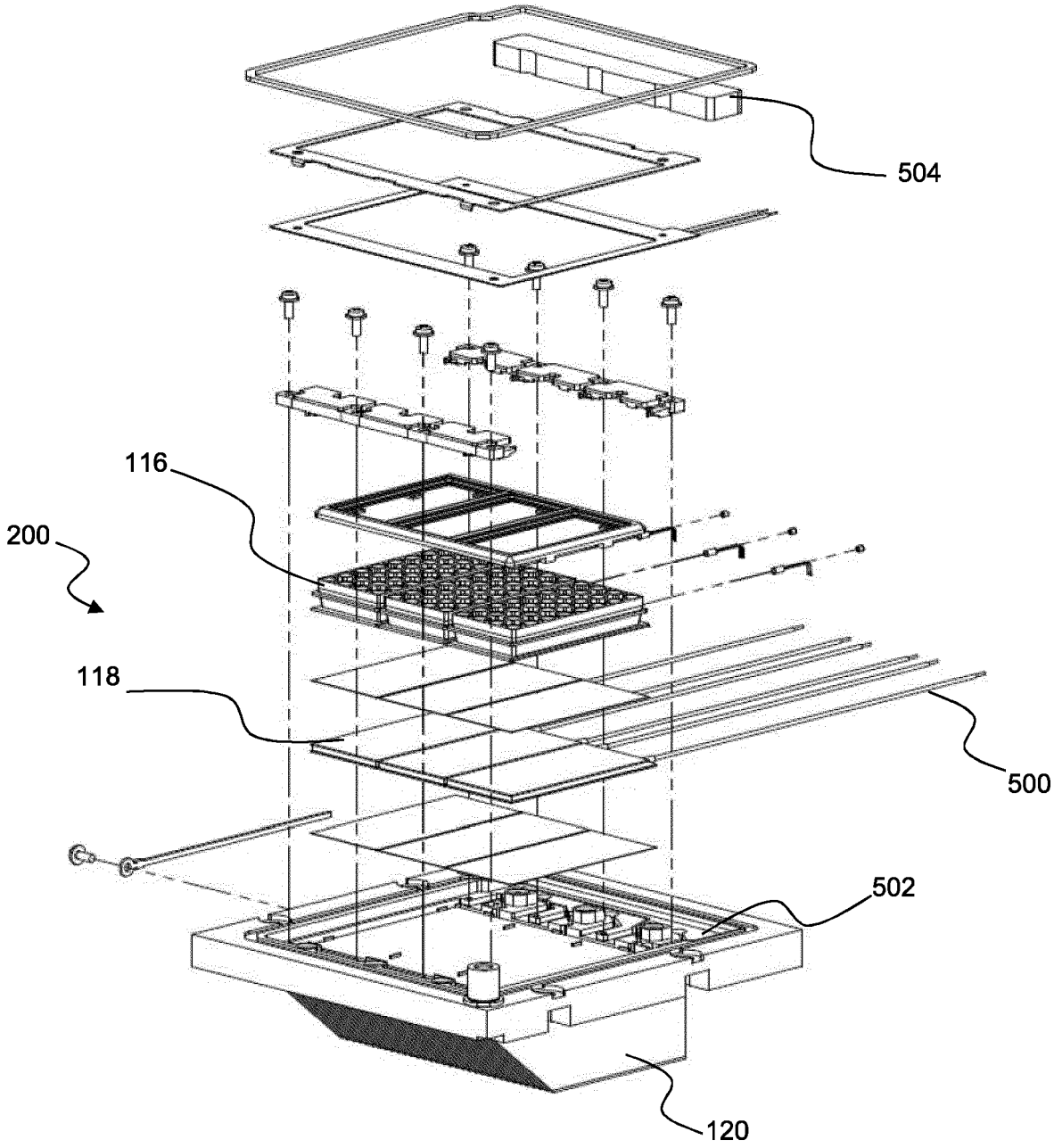

Fig. 5

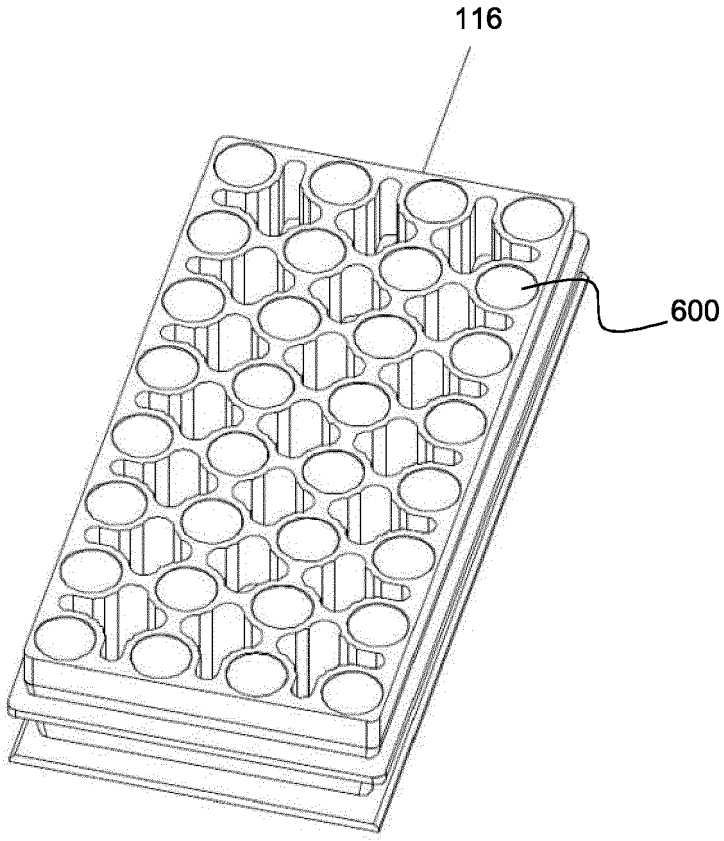

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 0276

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 January 2019	Bischoff, Laura

CATEGORY OF CITED DOCUMENTS

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