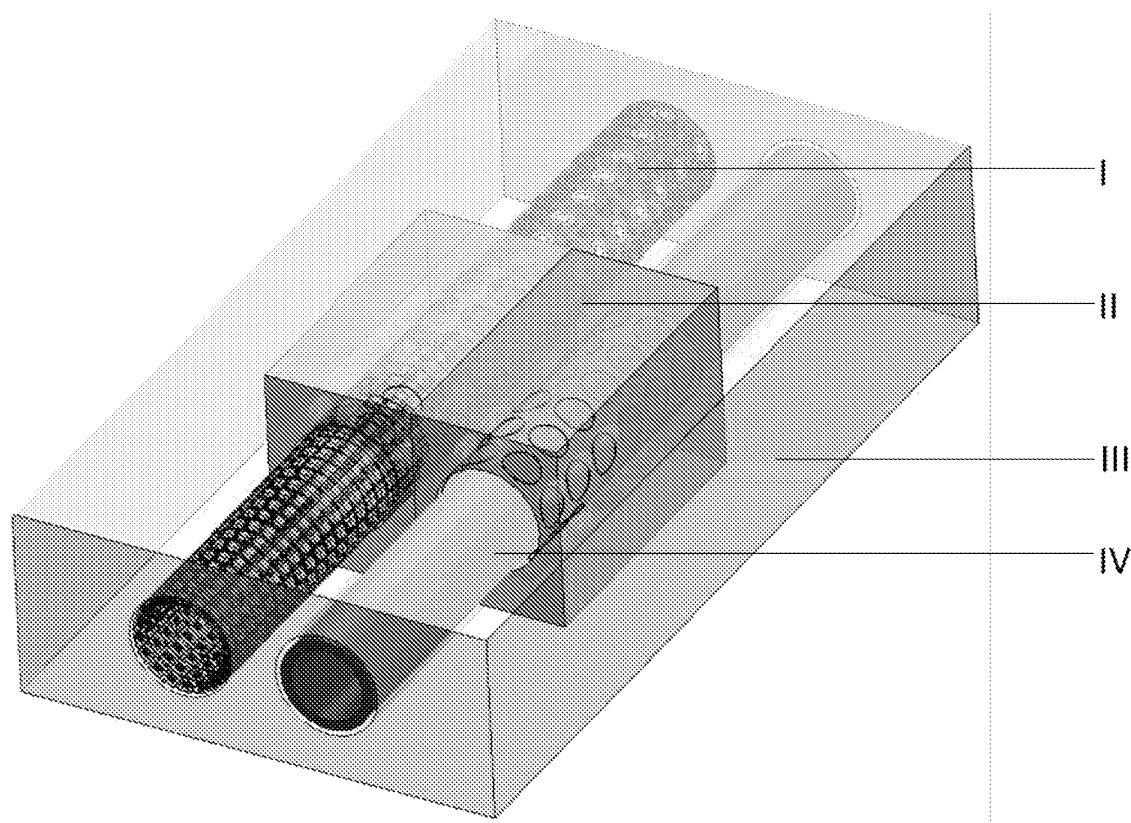


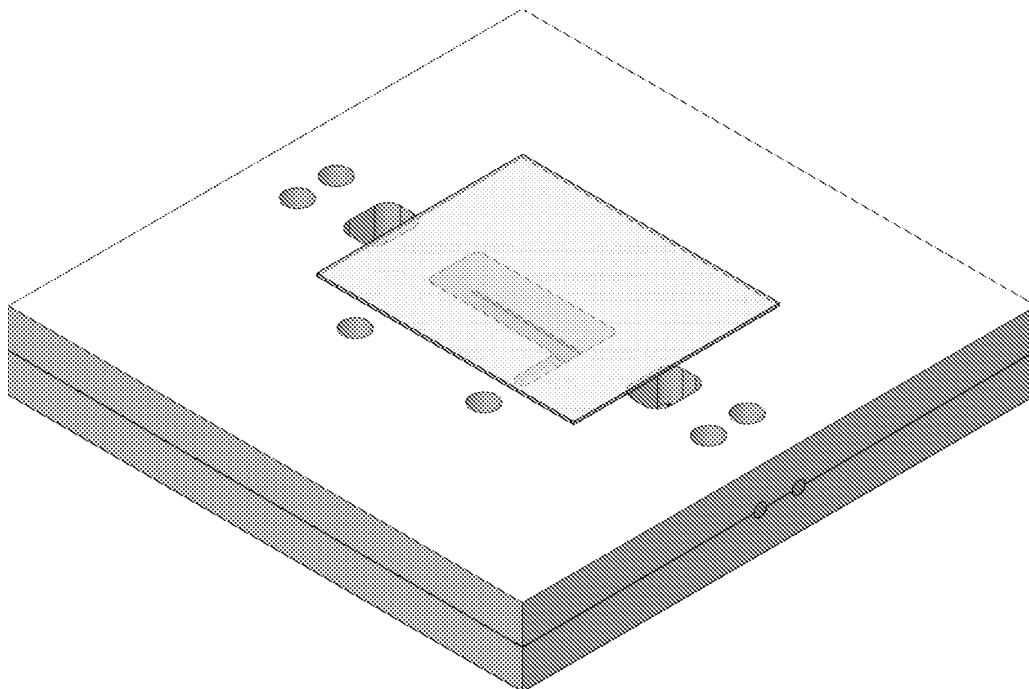
Multi-duct chip design:

[1] Fig. 1 illustrates a schematic view of two ducts surrounded by one stroma, according to an example of the present disclosure.



[1] Fig. 2A illustrates a schematic view of an embodiment of the 2-ducts 1-stroma biochip, according to an example of the present disclosure.

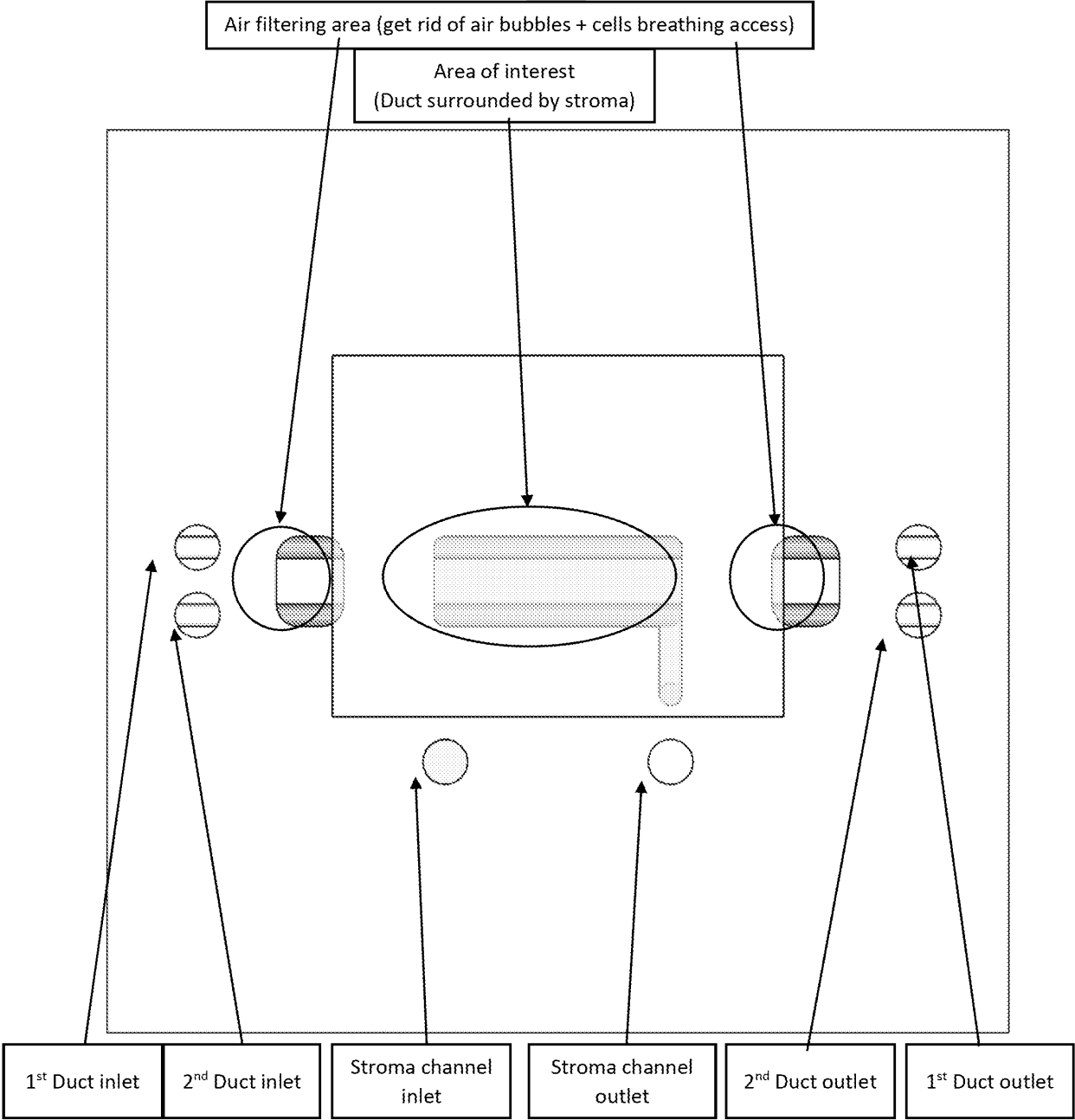
2/132



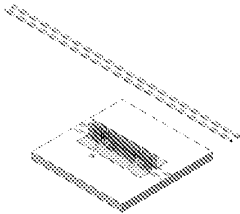
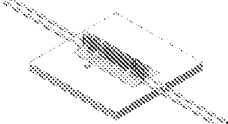
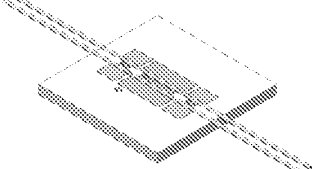
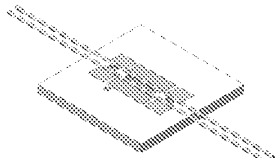
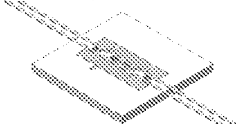
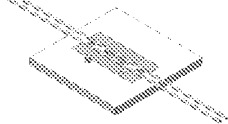
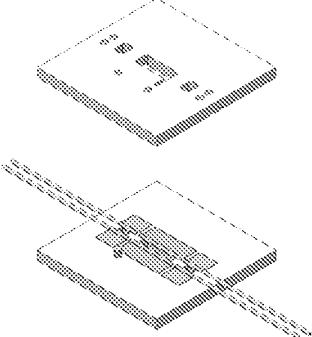
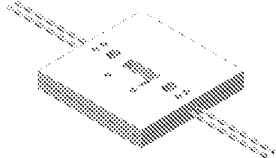
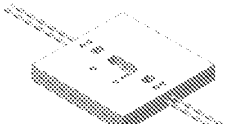
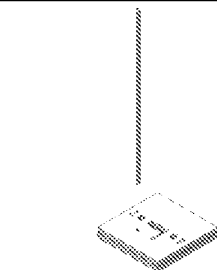
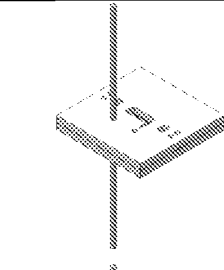
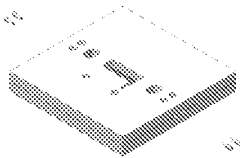
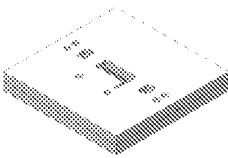
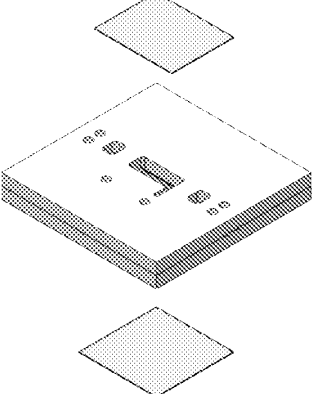
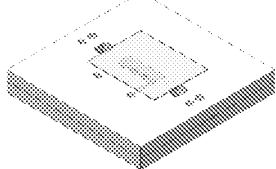
[1] Fig. 2B illustrates a schematic top view of an embodiment of the 2-ducts 1-stroma biochip, according to an example of the present disclosure.

Method 8: 2-ducts 1-stroma chip post bonding 180 degrees curved membranes with extensions & perpendicular tension

Chip Assembly process membrane extension horizontal perpendicular to duct

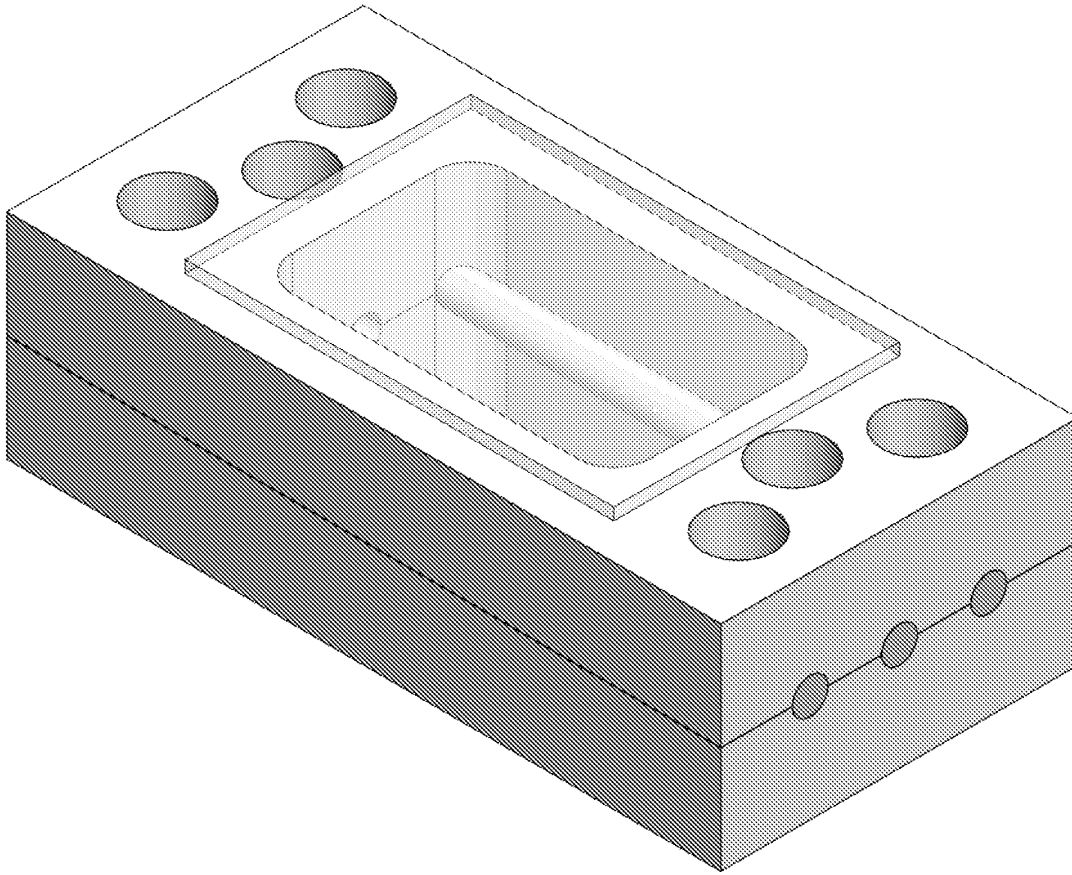


[0073] Fig. 2C illustrates a schematic view of the manufacturing and assembly process of the 2-ducts 1-stroma chip, according to an example of the present disclosure.

	<u>Step 1</u>	<u>Step 2</u>	<u>Step 3</u>	<u>Resulting process</u>
<u>Process 1</u> (Lower chassis membranes & rods assembly)				
<u>Process 2</u> (Pins assembly, upper chassis assembly and chemical & heat press assembly process)				
<u>Process 3</u> (Rods & pins removal process)				
<u>Process 4</u> (Duct plugging & glass assembly)				

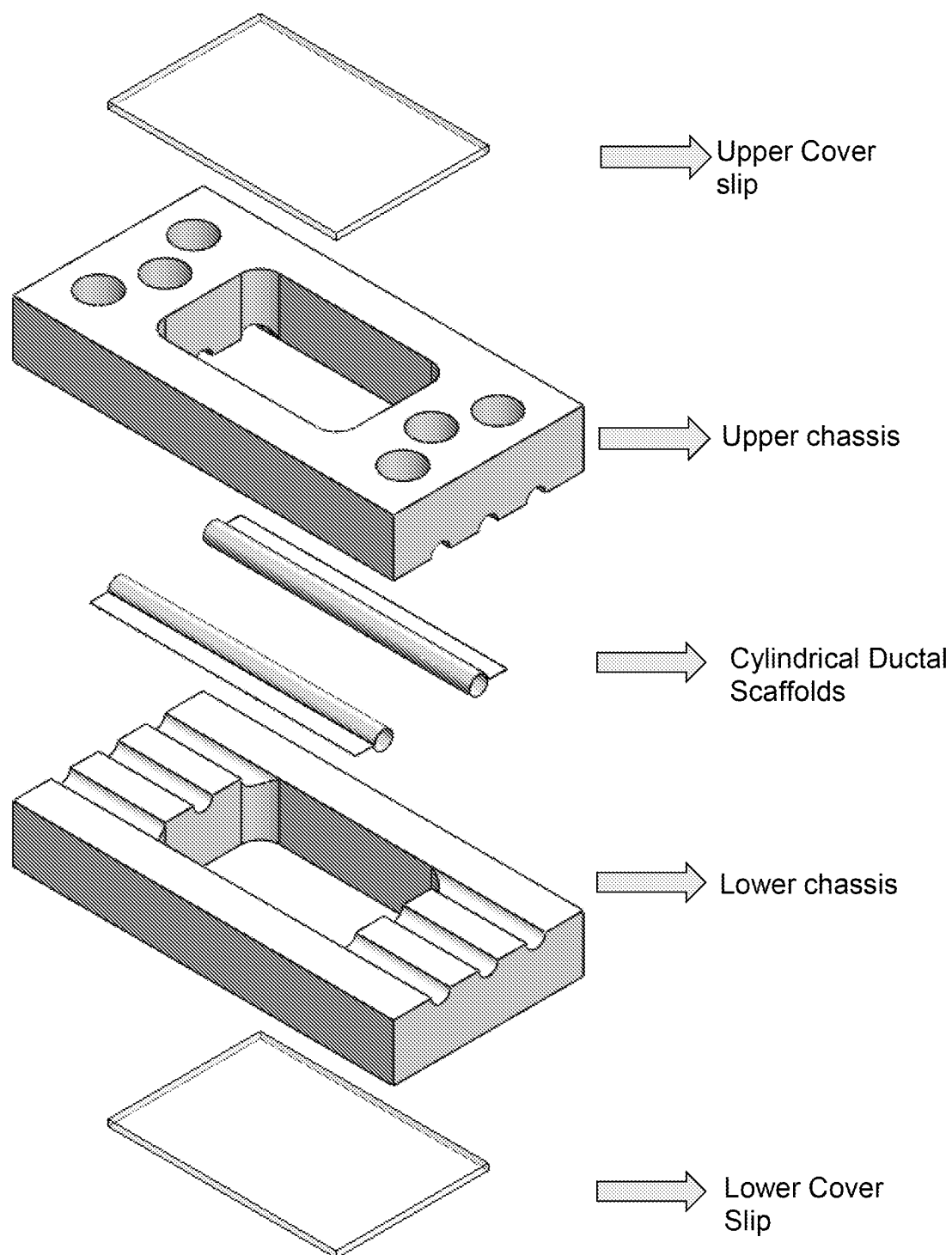
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[1] Fig. 3A illustrates a schematic view of another embodiment of a 2-ducts 1-stroma chip with three parallel channels, according to an example of the present disclosure.



[1] Fig. 3B illustrates an exploded view of a 2-ducts 1-stroma chip with three parallel channels, according to an example of the present disclosure.

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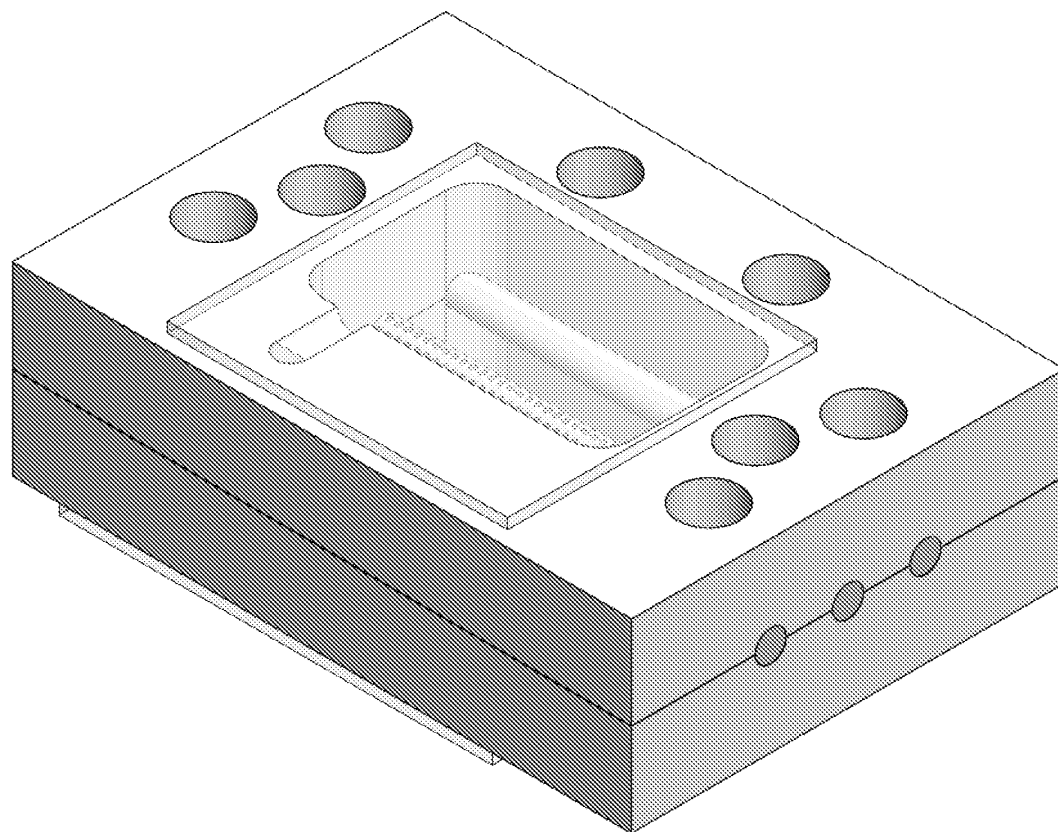


[1] Fig. 3C illustrates a schematic view of the manufacturing and assembly process of an embodiment of a 2-ducts 1-stroma chip with three parallel channels, according to an example of the present disclosure.

	<u>Step 1</u>	<u>Step 2</u>	<u>Step 3</u>	<u>Resulting process</u>
<u>Process 1</u> (Lower chassis membranes & rods assembly)				
<u>Process 2</u> (Rods assembly, upper chassis assembly and chemical & heat press assembly process)				
<u>Process 3</u> (Duct plugging & glass assembly)				

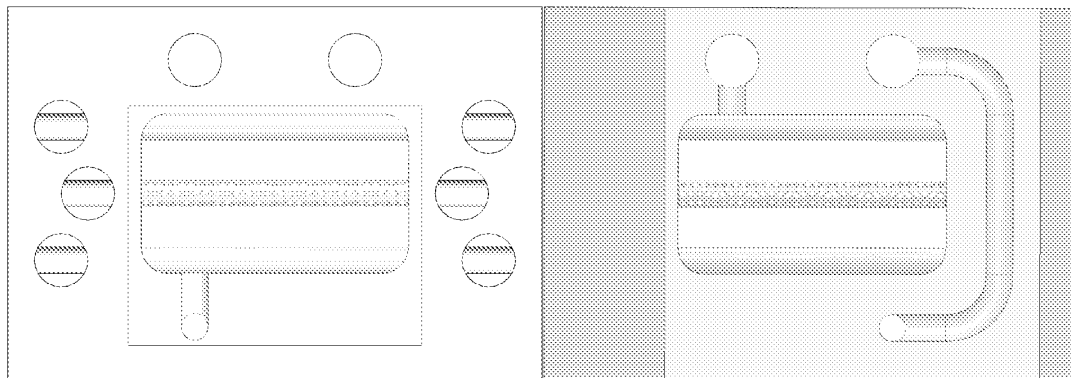
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[1] Fig. 4A illustrates a schematic view of another embodiment of a 2-ducts 1-stroma chip with three parallel channels with a stroma feeding channel, according to an example of the present disclosure.



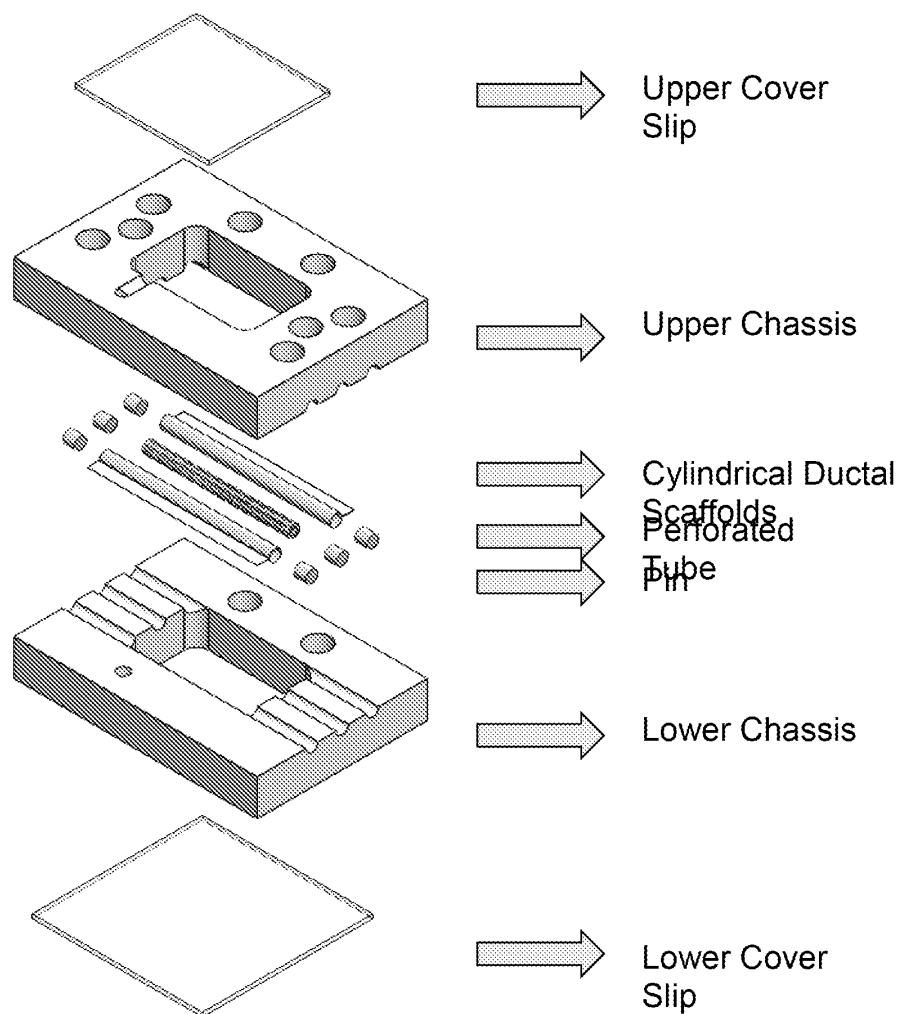
[1] Fig. 4B illustrates a detailed schematic top and bottom view of a 2-ducts 1-stroma chip with three parallel channels with a stroma feeding channel, according to an example of the present disclosure.

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[1] Fig. 4C illustrates an exploded view of the embodiment of a 2-ducts 1-stroma chip with three parallel channels with a stroma feeding channel, according to an example of the present disclosure.

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[1] Fig. 4D illustrates a schematic view of the manufacturing and assembly process of the 2-ducts 1-stroma chip with three parallel channels with a stroma feeding channel, according to an example of the present disclosure.

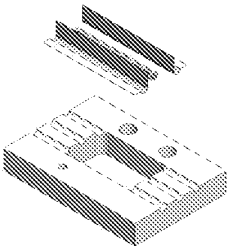
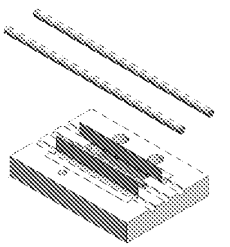
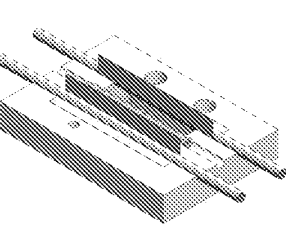
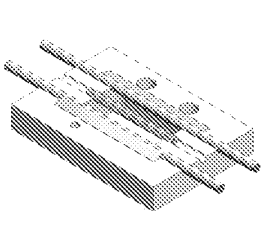
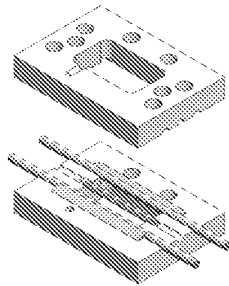
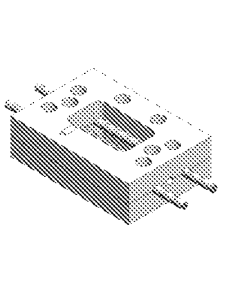
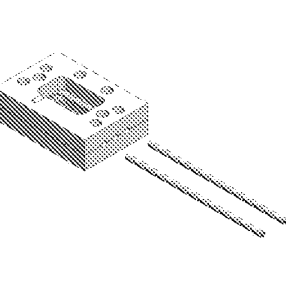
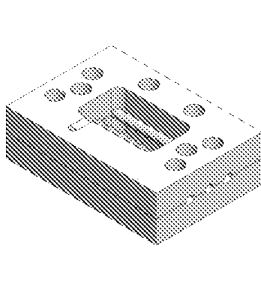
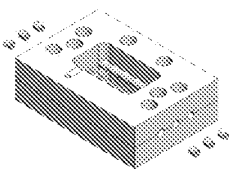
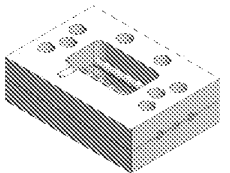
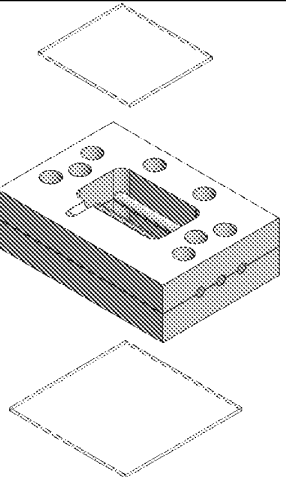
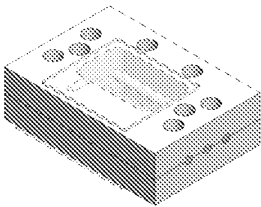
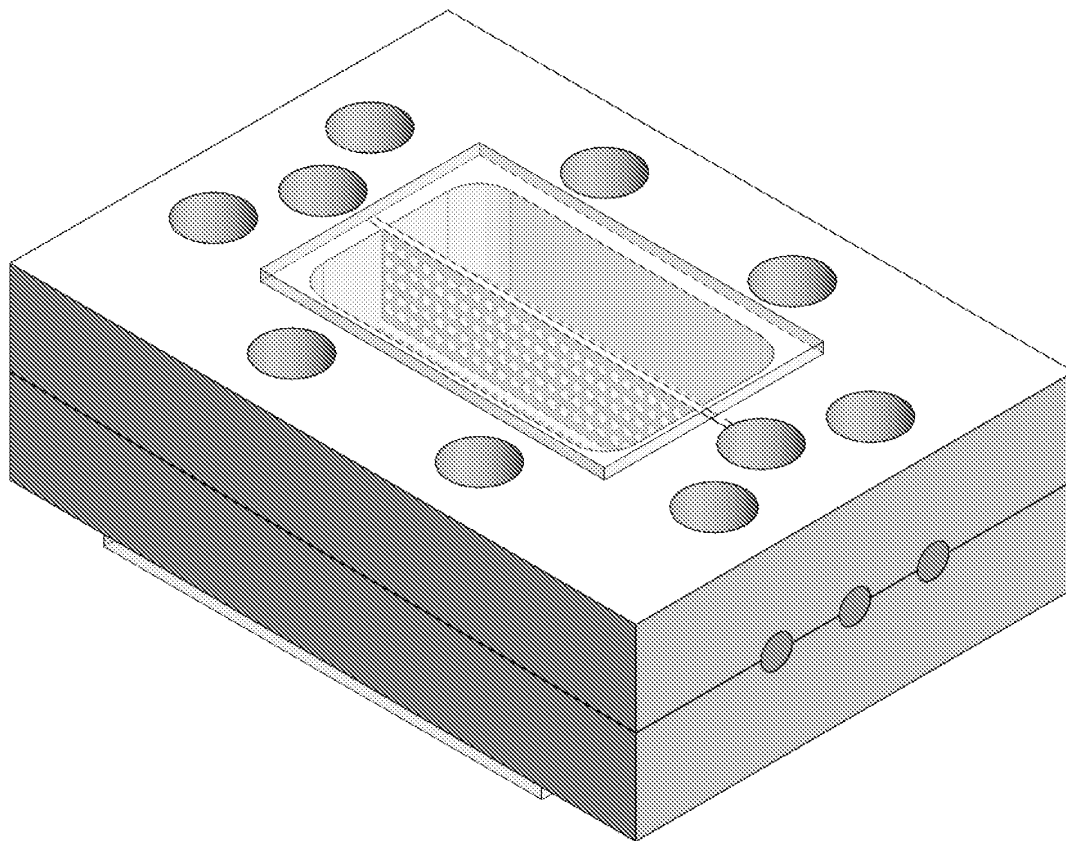
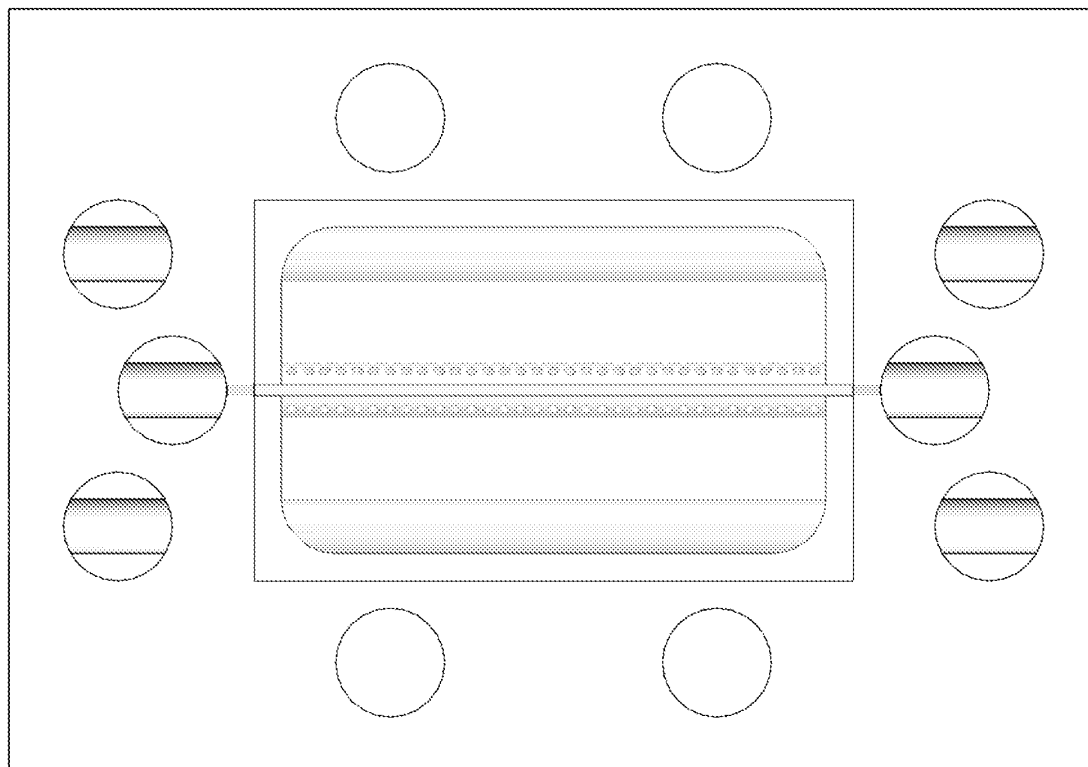
	<u>Step 1</u>	<u>Step 2</u>	<u>Step 3</u>	<u>Resulting process</u>
<u>Process 1</u> (Lower chassis membranes & rods assembly)				
<u>Process 2</u> (Rods assembly, upper chassis assembly and chemical & heat press assembly process)				
<u>Process 3</u> (Duct plugging & glass assembly)				

Fig. 5A illustrates a schematic view of a 2-ducts 1-stroma chip with different stroma inlets, according to an example of the present disclosure.

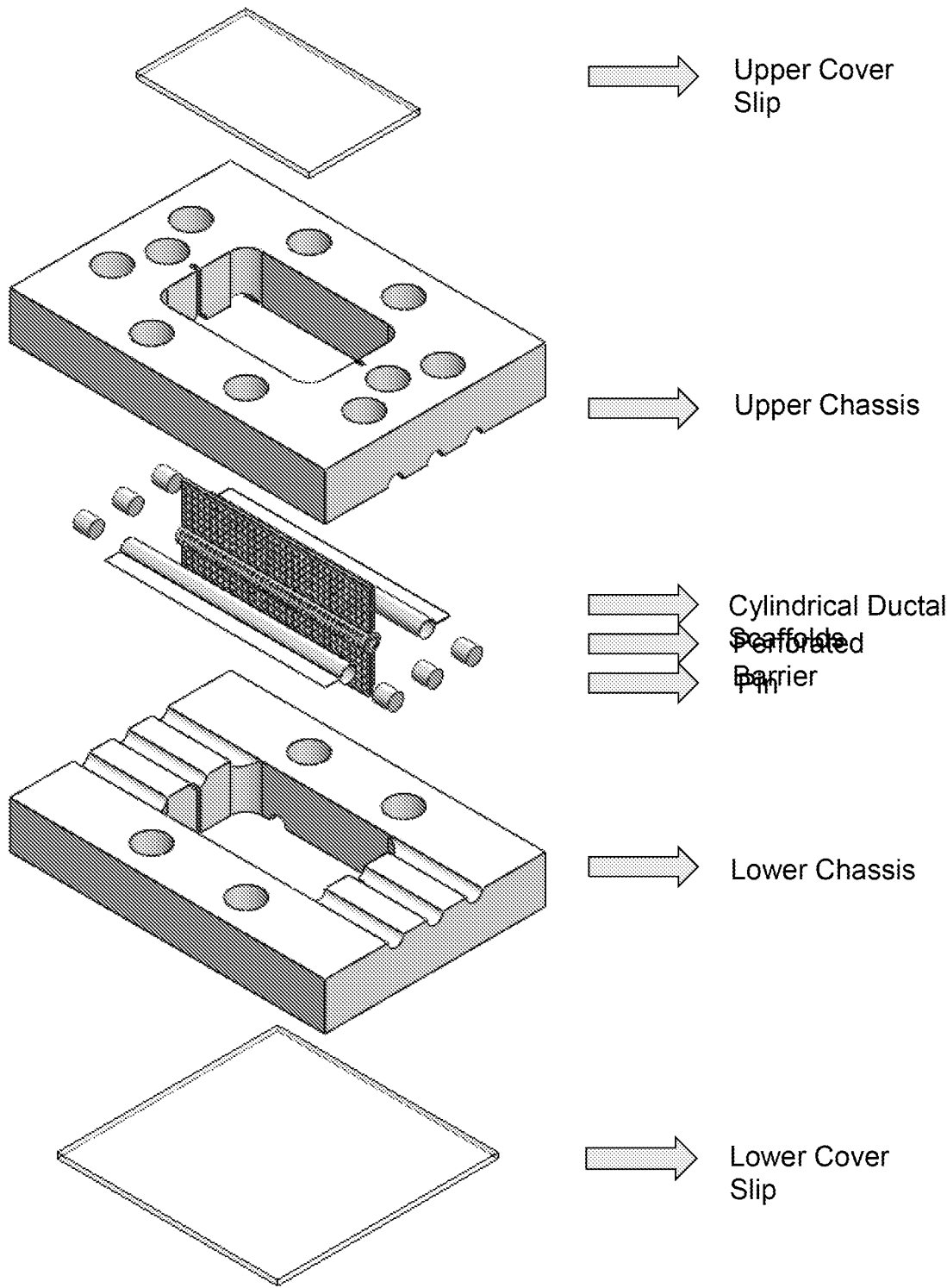


[1] Fig. 5B illustrates a schematic top view of another embodiment of a 2-ducts 1-stroma chip with different stroma inlets, according to an example of the present disclosure.

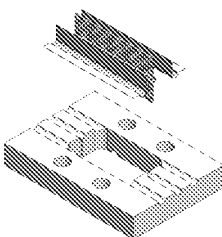
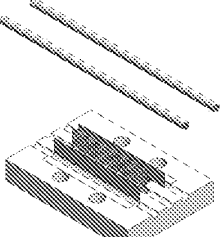
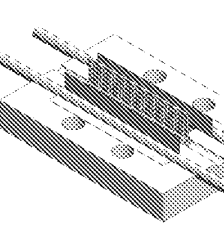
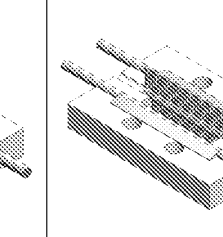
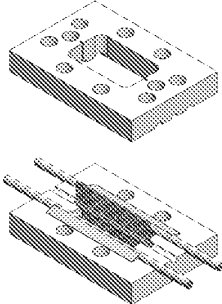
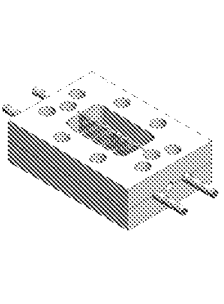
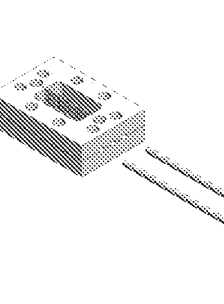
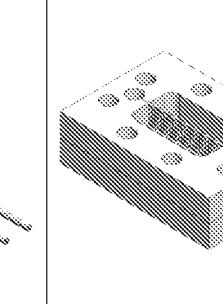
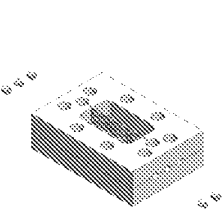
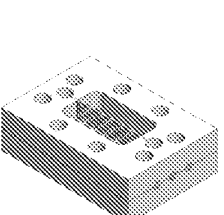
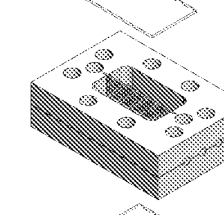
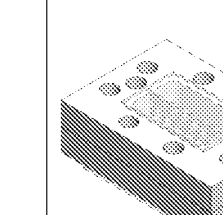


[1] Fig. 5C illustrates an exploded view of a 2-ducts 1-stroma chip with different stroma inlets, according to an example of the present disclosure.

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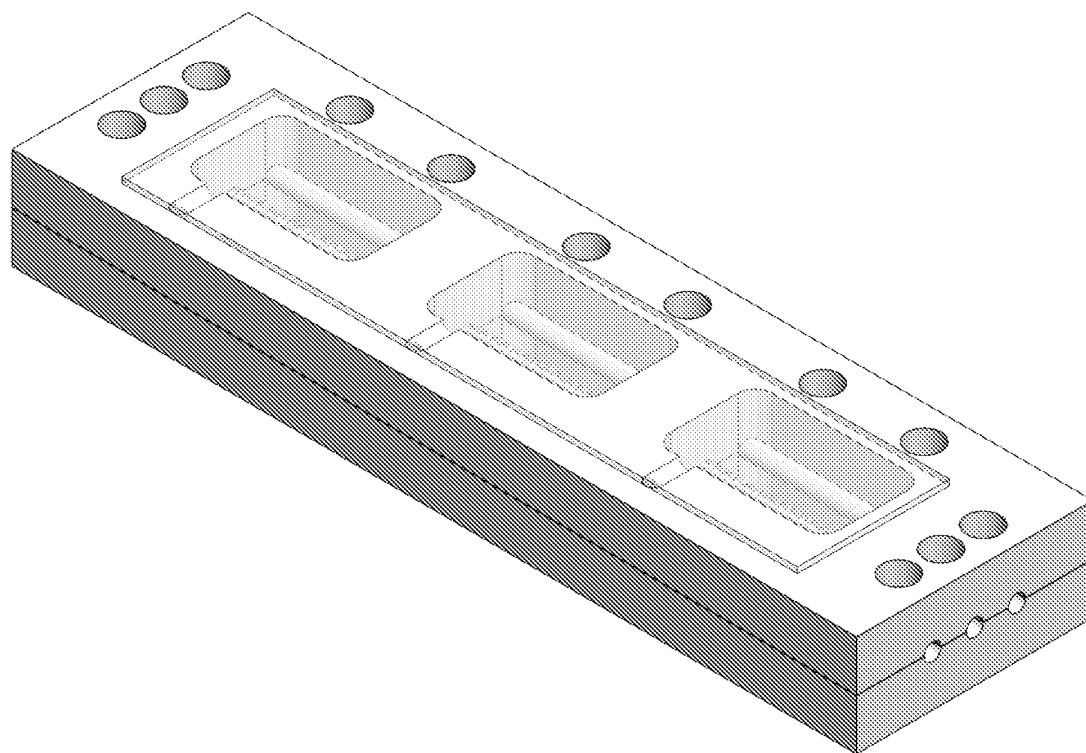


[1] Fig. 5D illustrates a schematic view of the manufacturing and assembly process of the 2-ducts 1-stroma chip with different stroma inlets, according to an example of the present disclosure.

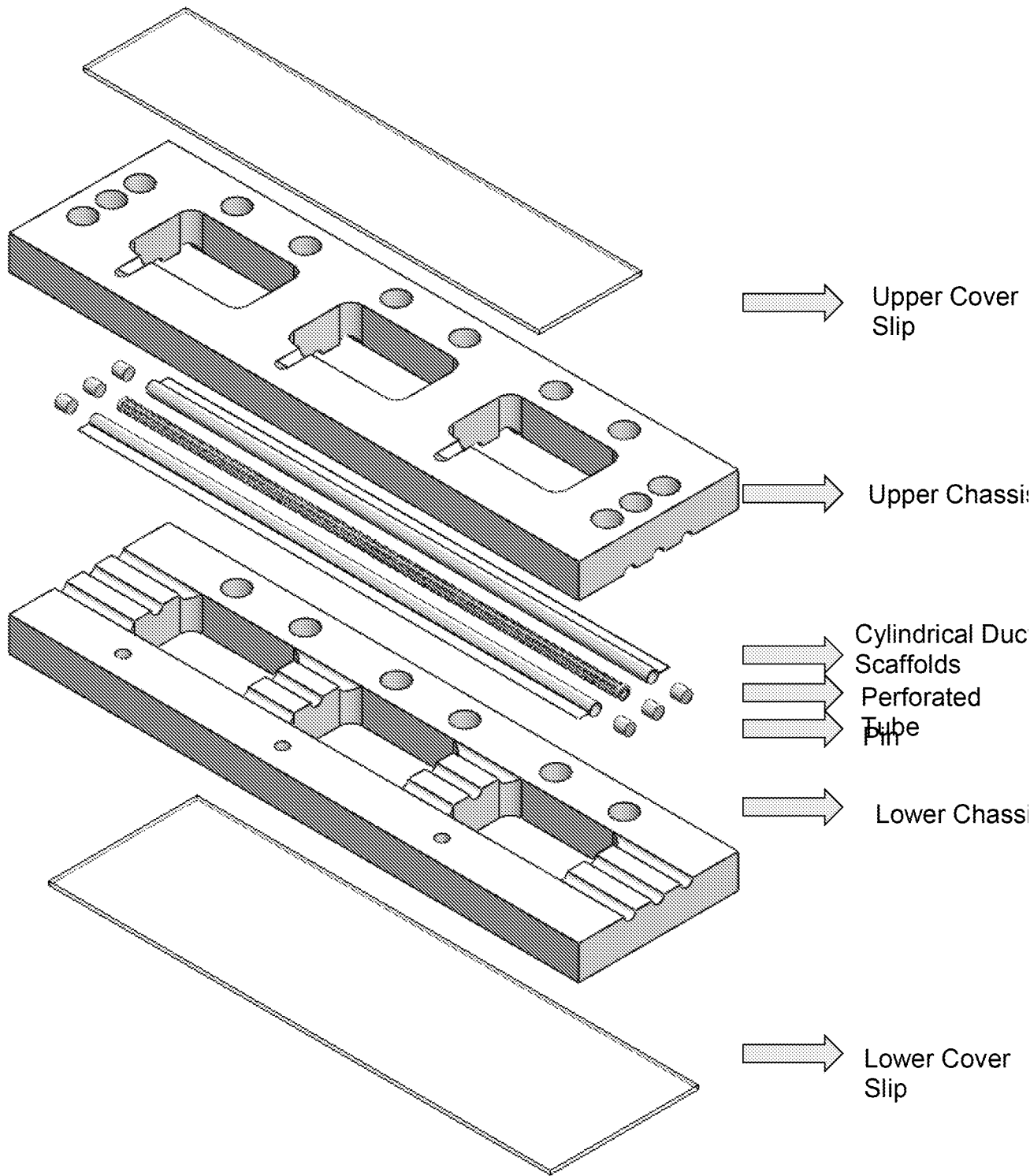
	<u>Step 1</u>	<u>Step 2</u>	<u>Step 3</u>	<u>Resulting process</u>
<u>Process 1</u> (Lower chassis membranes & rods assembly)				
<u>Process 2</u> (Rods assembly, upper chassis assembly and chemical & heat press assembly process)				
<u>Process 3</u> (Duct plugging & glass assembly)				

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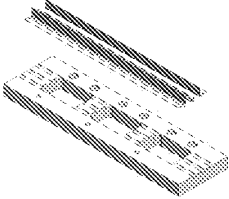
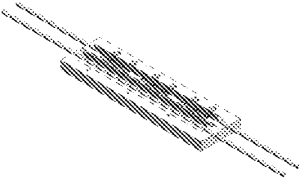
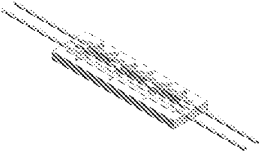
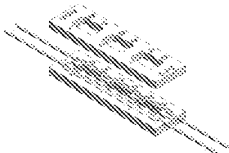
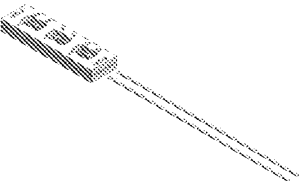
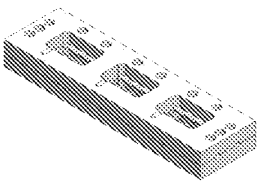
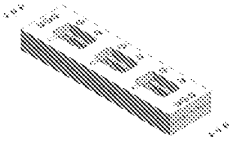
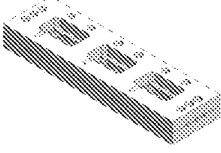
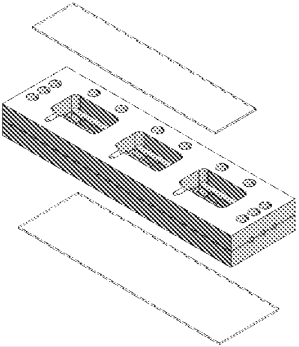
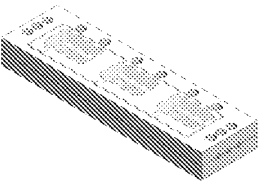
[1] Fig. 6A illustrates a schematic view of a 2-duct 1-stroma chip with multiple stroma per duct, according to an example of the present disclosure.



[1] Fig. 6B illustrates an exploded view of a 2-duct 1-stroma chip with multiple stroma per duct, according to an example of the present disclosure.

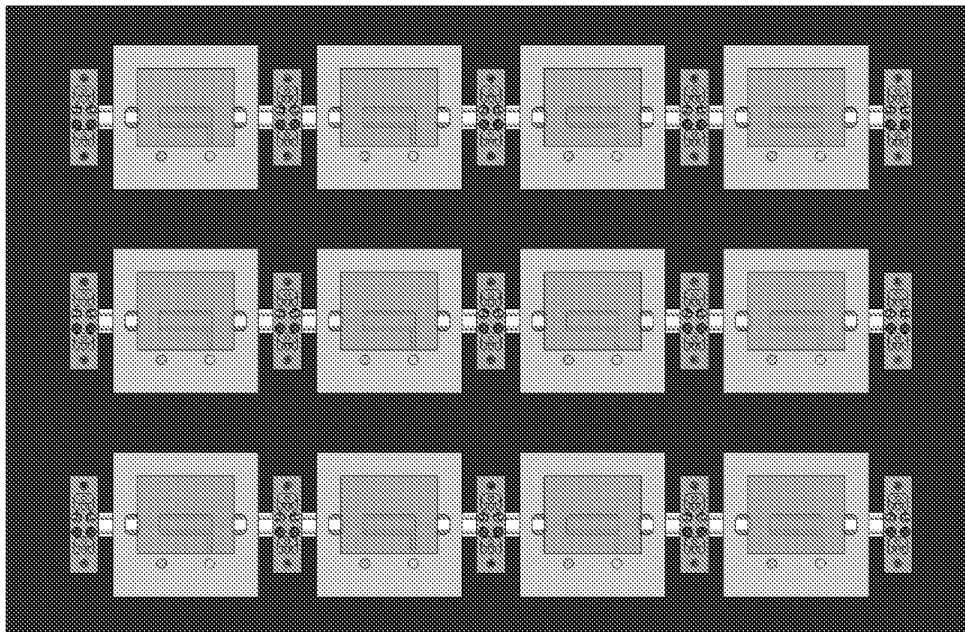


[1] Fig. 6C illustrates a schematic view of the manufacturing and assembly process of the 2-ducts 1-stroma chip with multiple stroma per duct, according to an example of the present disclosure.

	<u>Step 1</u>	<u>Step 2</u>	<u>Step 3</u>	<u>Resulting process</u>
<u>Process 1</u> (Lower chassis membranes & rods assembly)				
<u>Process 2</u> (Rods assembly, upper chassis assembly and chemical & heat press assembly process)				
<u>Process 3</u> (Duct plugging & glass assembly)				

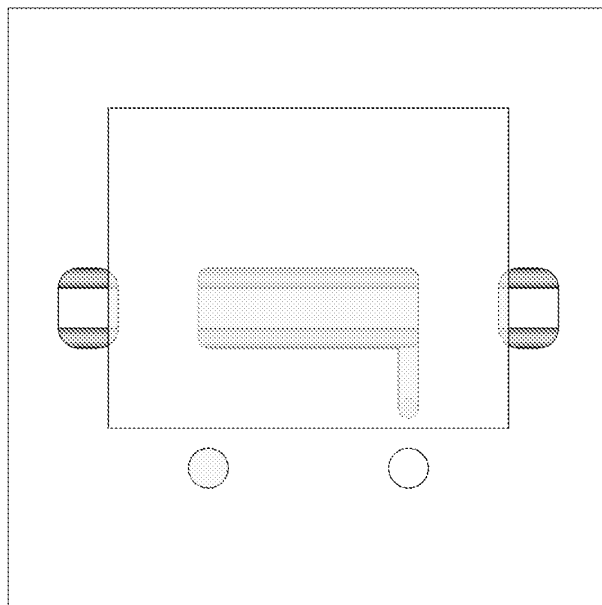
The Human-on-chip Interconnection plate:

[1] Fig. 7A illustrates a schematic view of an embodiment of a human-on-biochip plate, according to an example of the present disclosure.



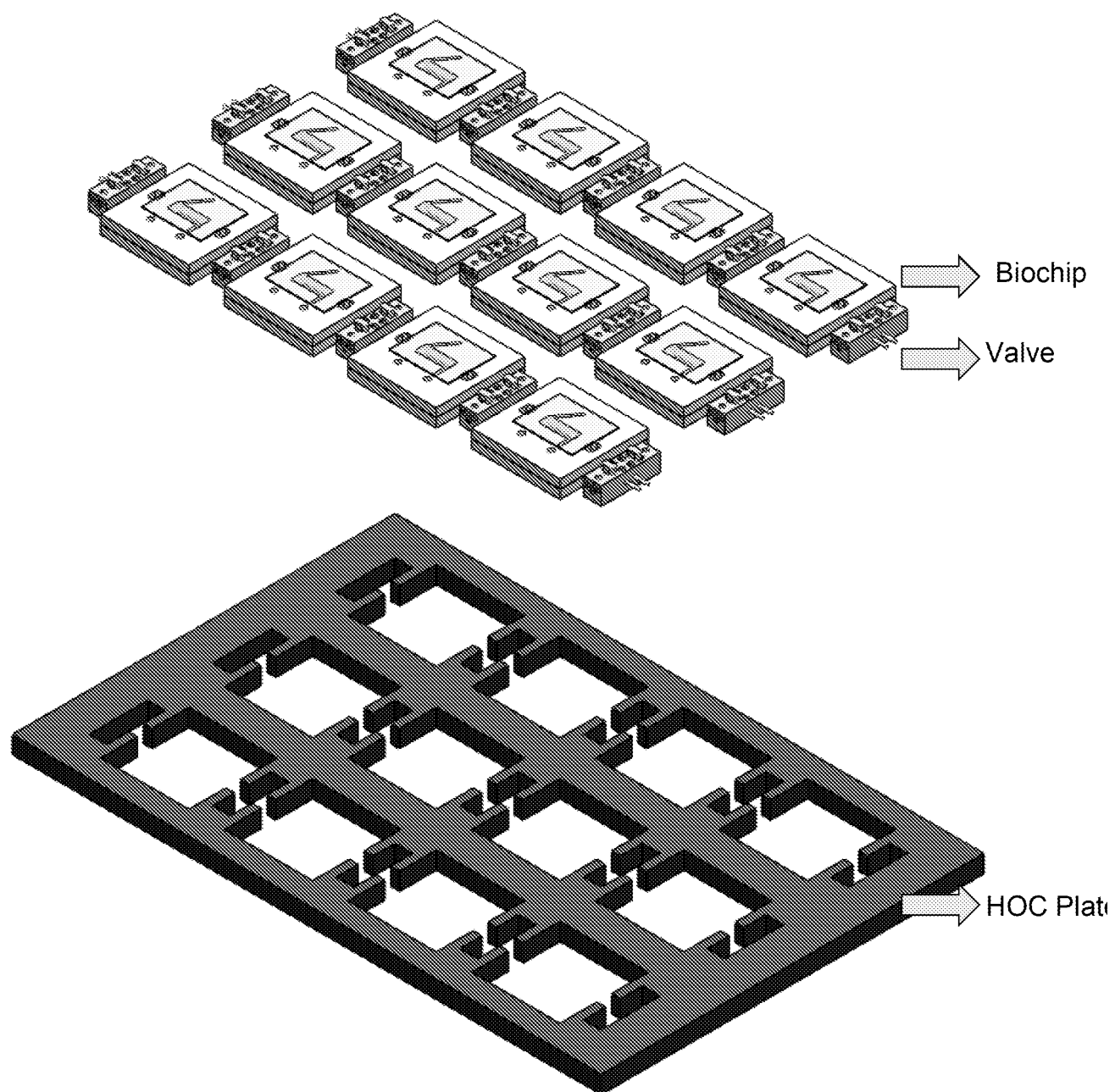
[1] Fig. 7B illustrates a schematic view of the individual biochip component of the human-on-chip plate, according to an example of the present disclosure.

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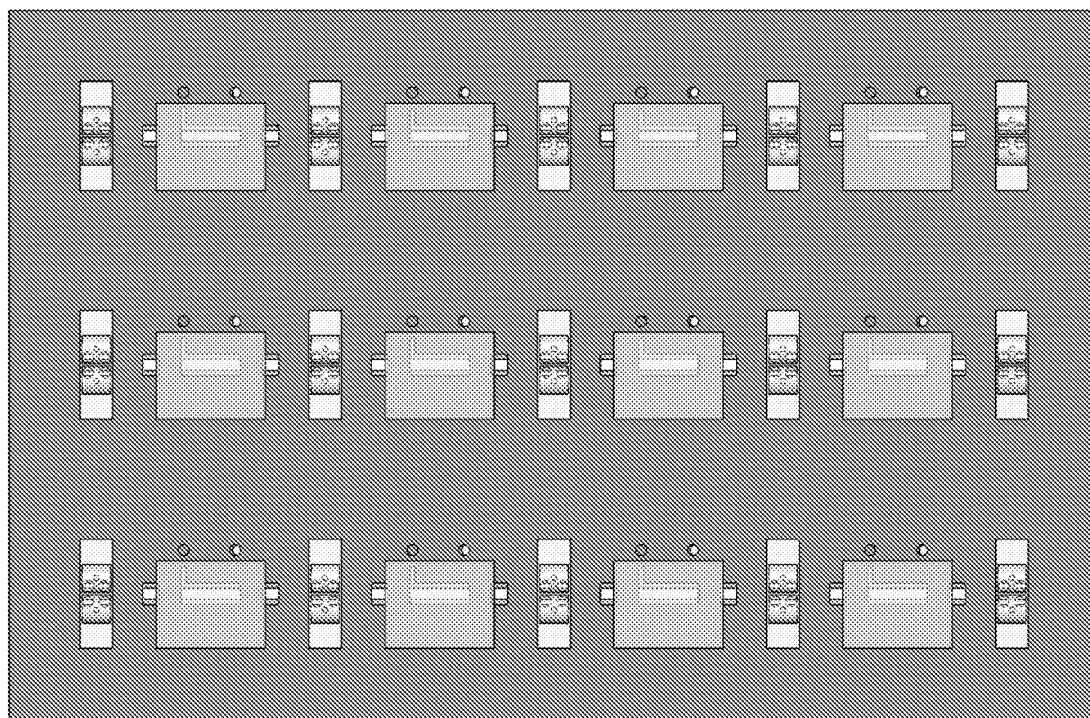
[1] Fig. 7C illustrates an exploded view of the human-on-chip plate, according to an example of the present disclosure.

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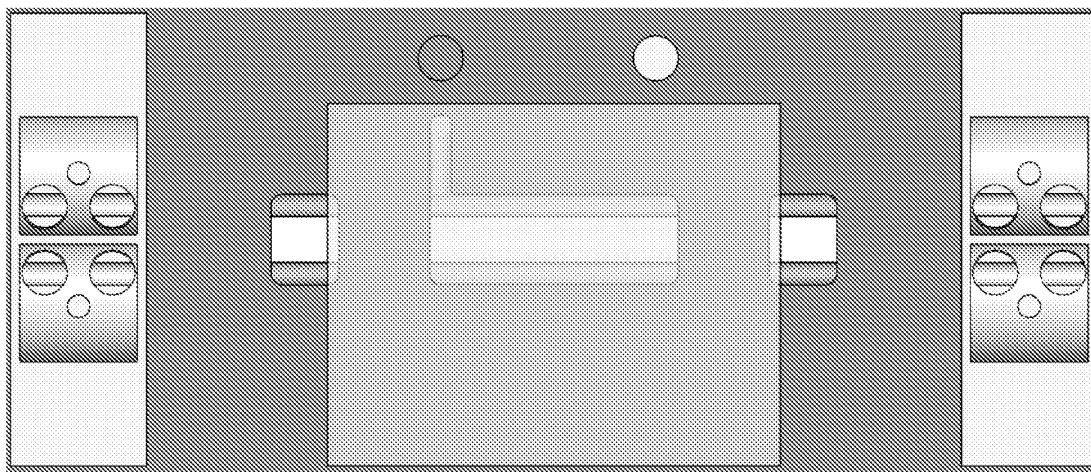
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[1] Fig. 8A illustrates a schematic view of an embodiment of the human-on-chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is cylindrical rotational mechanism, according to an example of the present disclosure.



[1] Fig. 8B illustrates a schematic view of an entity of an embodiment of the human-on-chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is cylindrical rotational mechanism, according to an example of the present disclosure.

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[1] Fig. 8C illustrates an exploded view of an embodiment of the human-on-chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is cylindrical rotational mechanism, according to an example of the present disclosure.

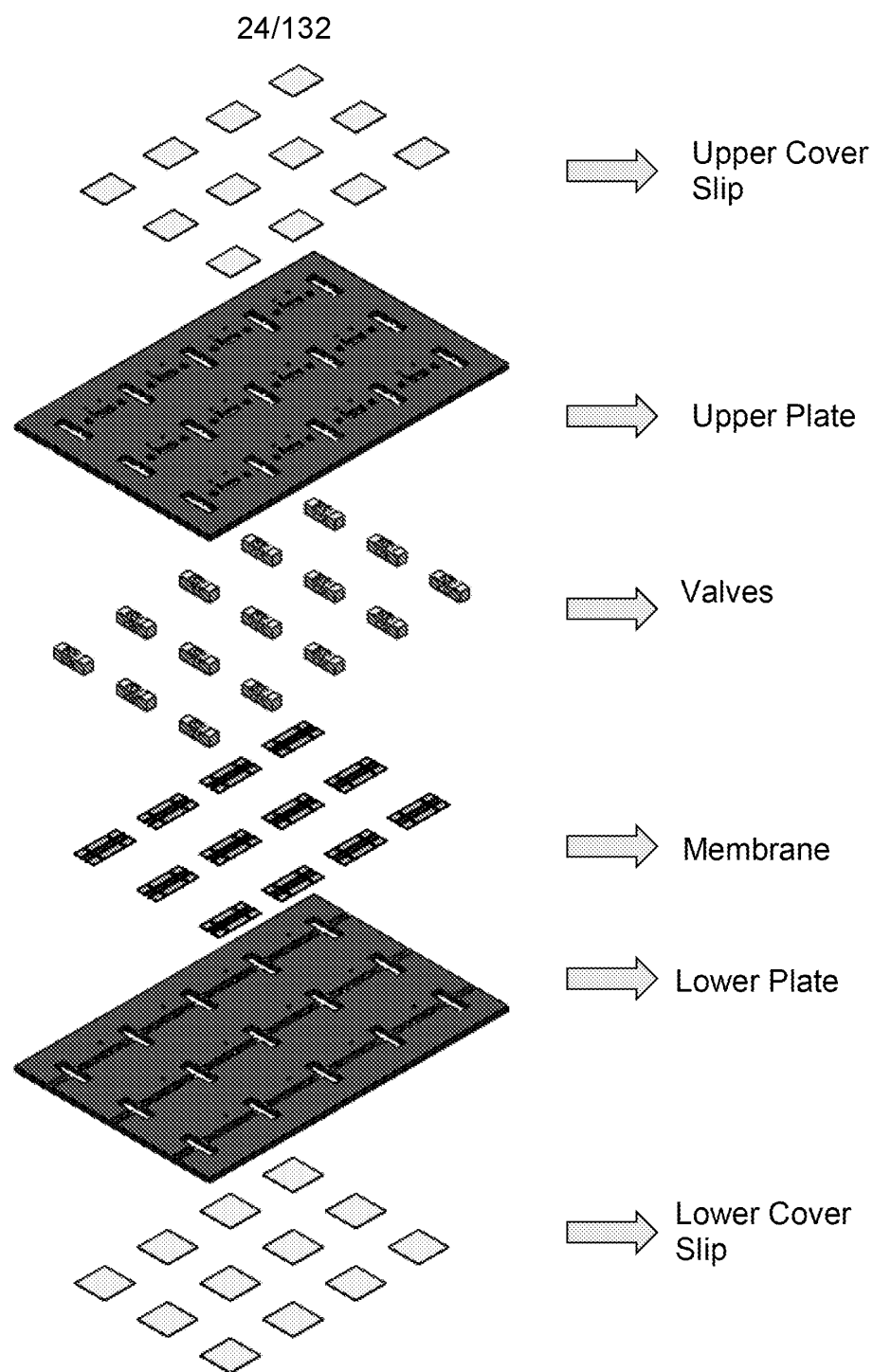
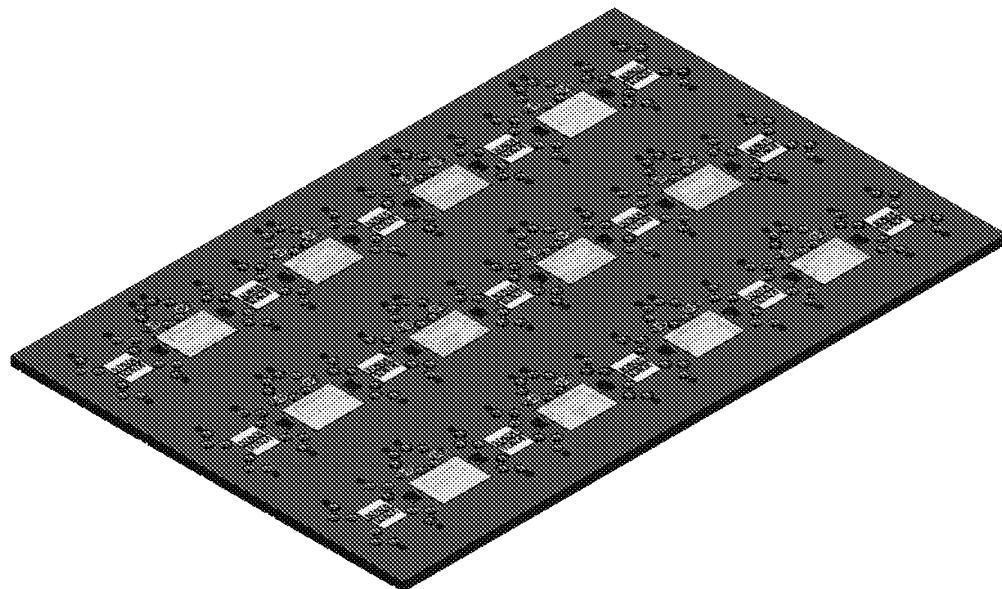


Fig 9A illustrates a schematic view of an embodiment of the human-on-chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual

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chip components is flexible membrane mechanism actuated pneumatically (isometric view), according to an example of the present disclosure.



[1] Fig. 9B illustrates a schematic view of another embodiment of the human-on-chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is flexible membrane mechanism actuated pneumatically (top view), according to an example of the present disclosure.

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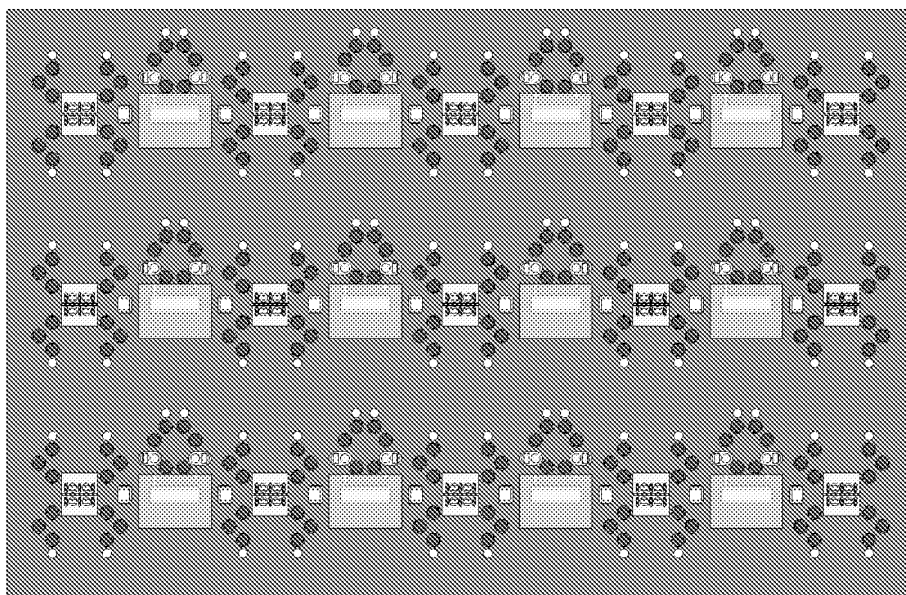
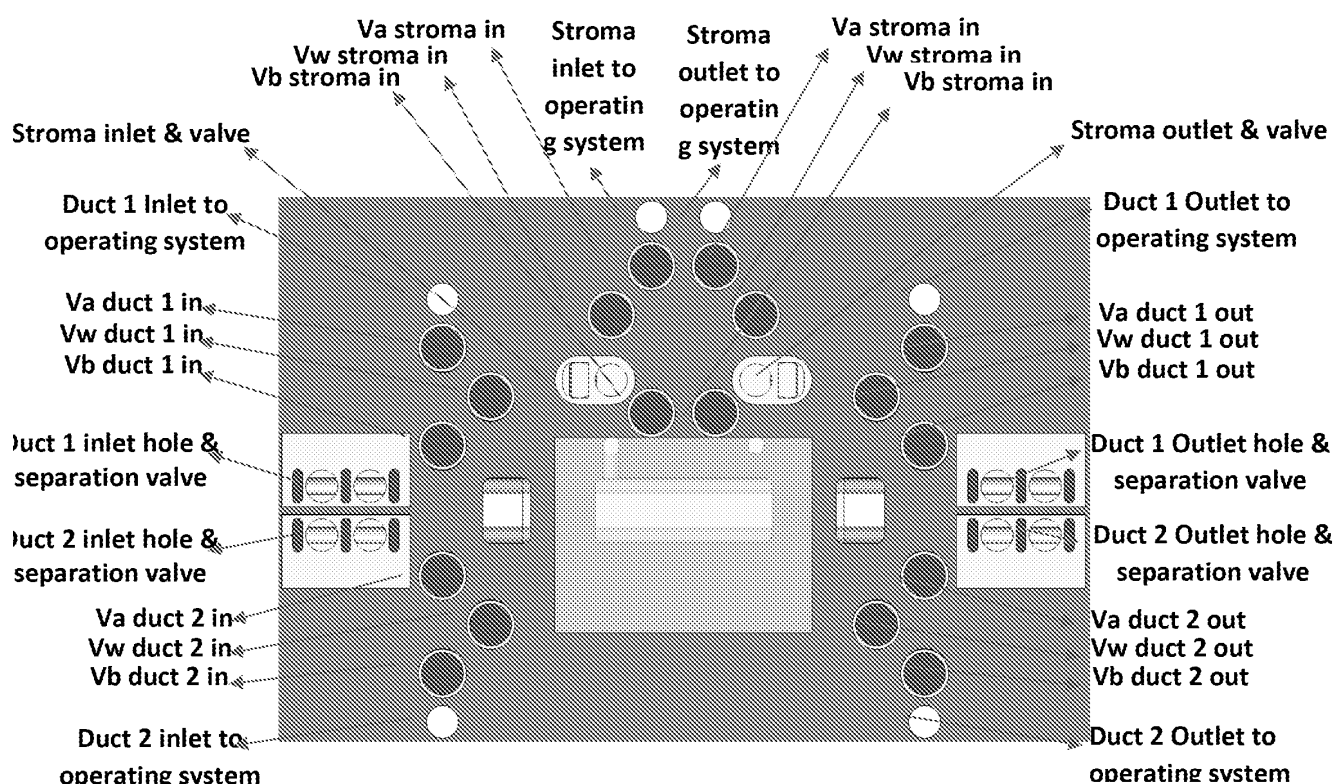
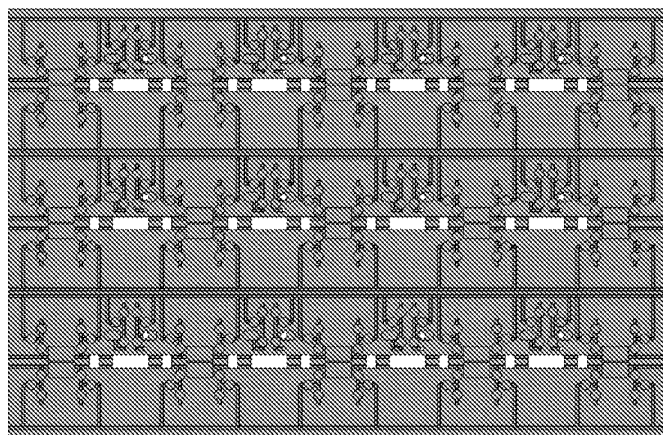


Fig. 9C illustrates a schematic view of another embodiment of the human on chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is flexible membrane mechanism actuated pneumatically (top view), according to an example of the present disclosure.



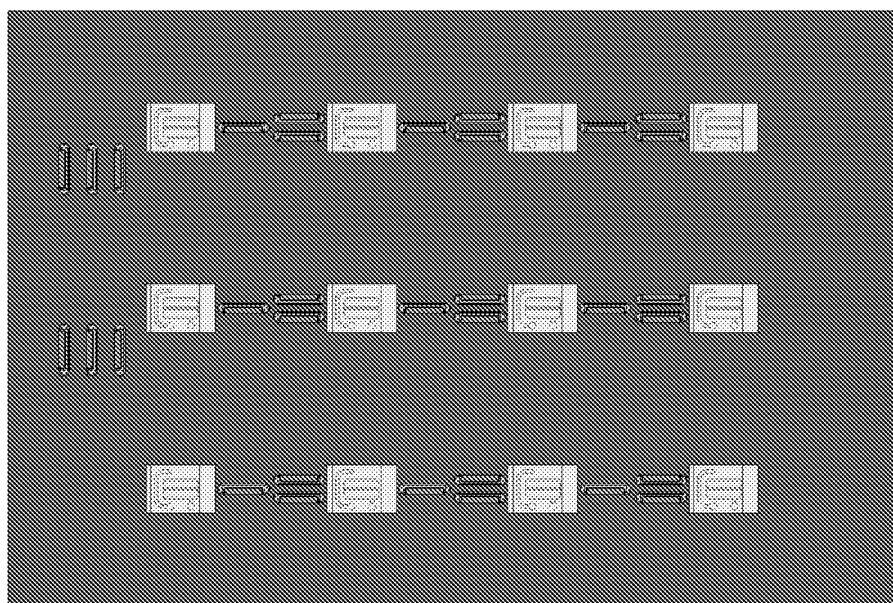
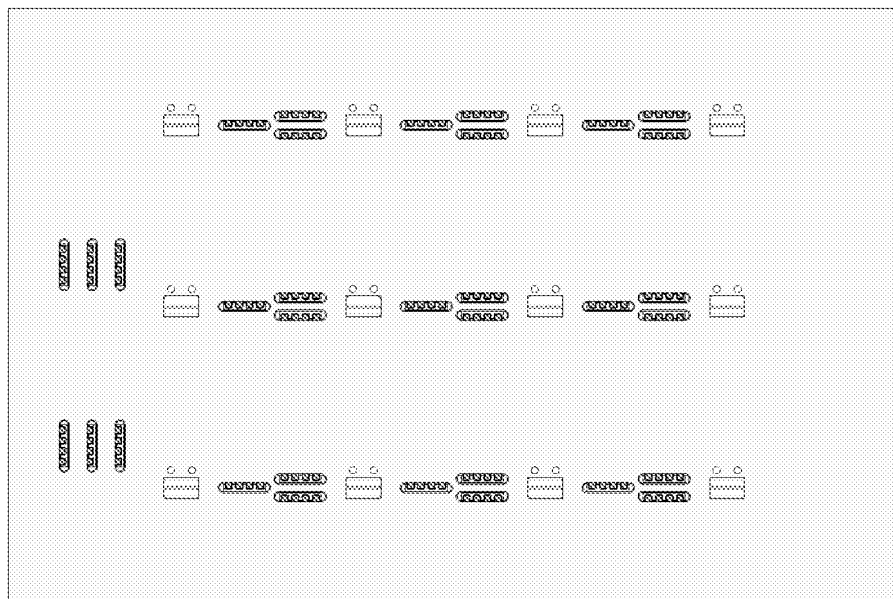
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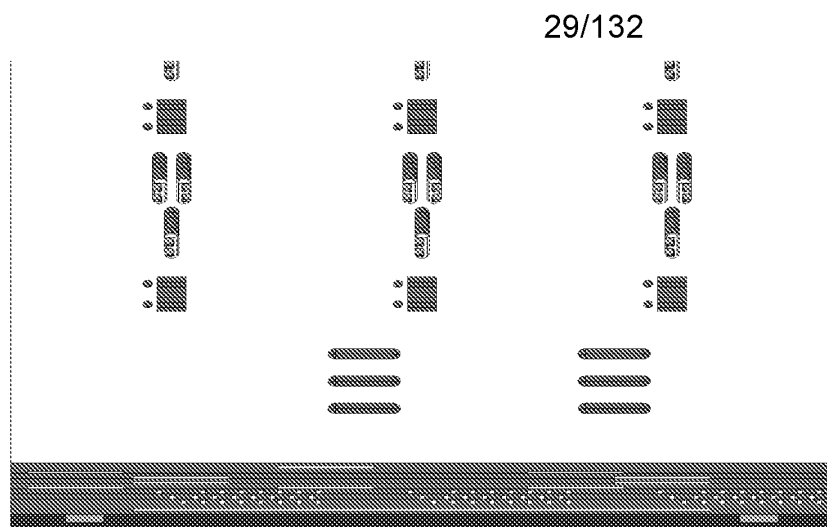
[1] Fig. 9D illustrates a schematic view of an embodiment of the lower chassis features of another embodiment of the human on chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is flexible membrane mechanism actuated pneumatically (top view), according to an example of the present disclosure.



[1] Fig. 10A illustrates a schematic view of an embodiment of the top view of an embodiment of the HOC plate where OOCs are removable from the HOC plate and the fluid is accessed from the side, according to an example of the present disclosure.

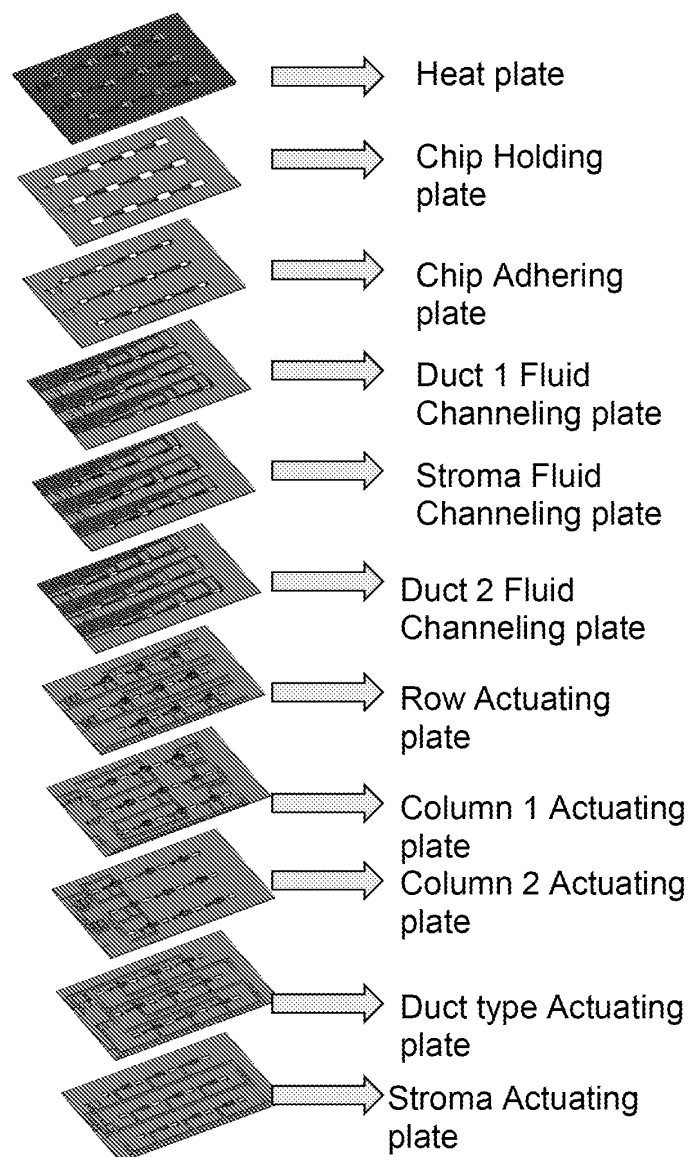
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[1] Fig. 10B illustrates a schematic view of an embodiment of the exploded view of an embodiment of the HOC plate where OOCs are removable from the HOC plate and the fluid is accessed from the side, according to an example of the present disclosure.

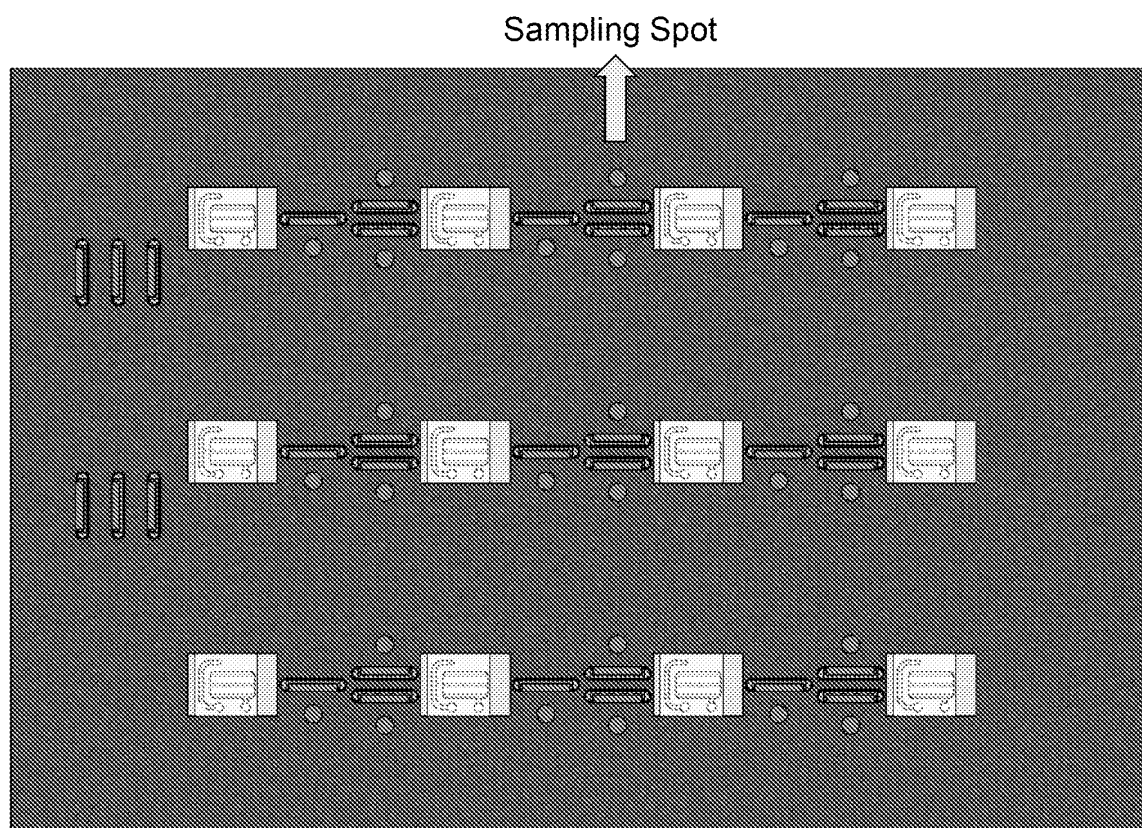
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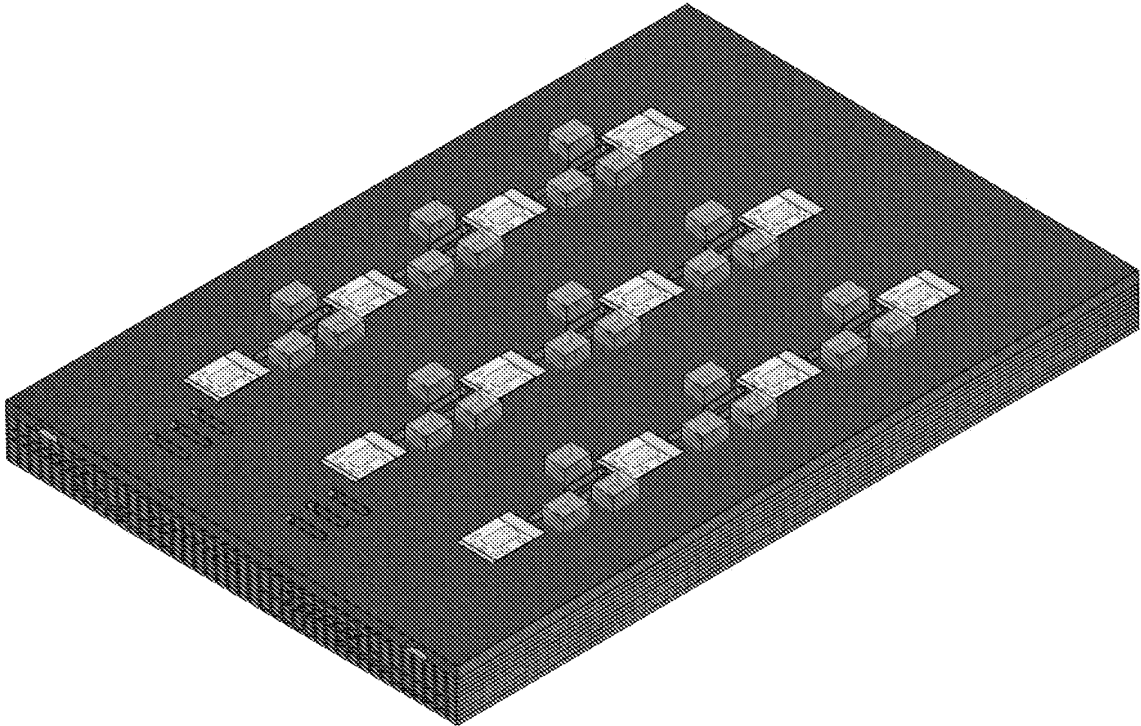
[1] Fig. 10C illustrates a schematic view of an embodiment of the in-plate channeling of an embodiment of the HOC plate where OOCs are removable from the HOC plate and the fluid is accessed from the side, according to an example of the present disclosure.

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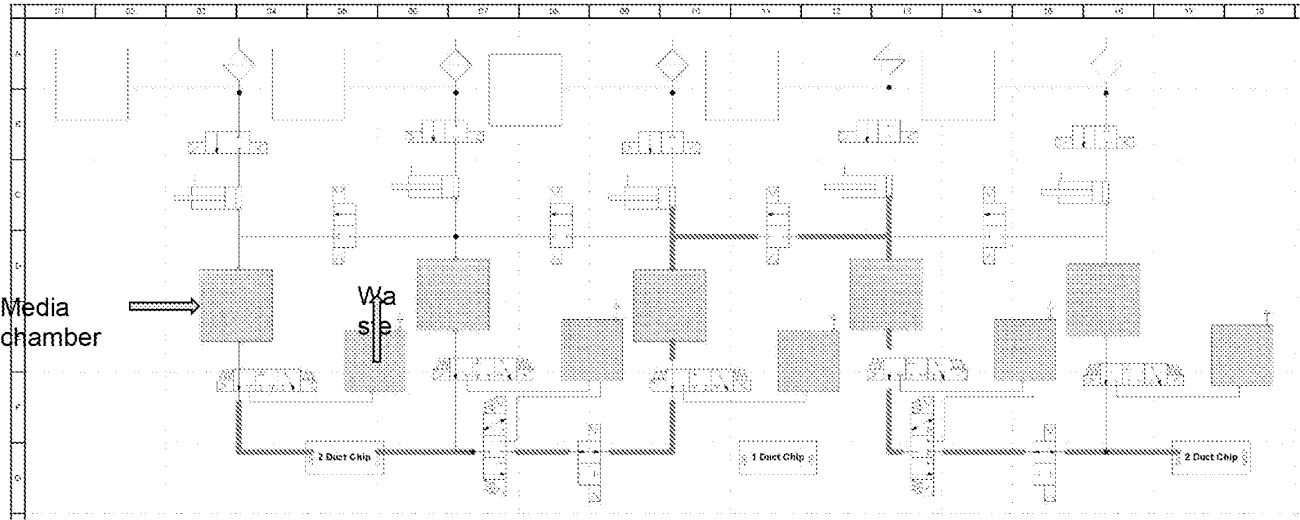
[1] Fig. 11 illustrates a schematic view of an embodiment of the top view of an embodiment of the HOC plate where OOCs are removable from the HOC plate and the fluid and cells are sampled on spot, according to an example of the present disclosure.



[1] Fig. 12 illustrates a schematic view of an embodiment of the top view of an embodiment of the HOC plate where OOCs are removable from the HOC plate and the fluid and cells are sampled on spot through channels, chambers and valves, according to an example of the present disclosure.

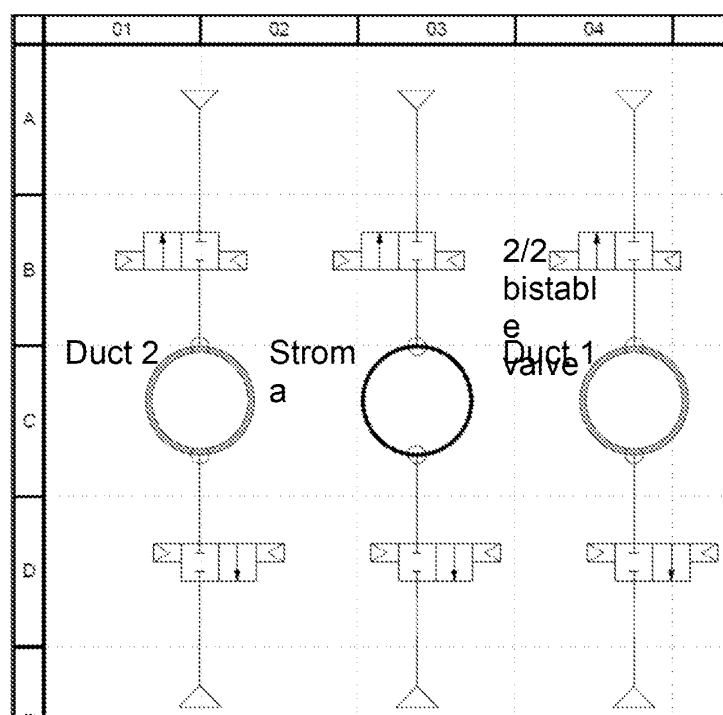


[1] Fig. 13 illustrates a schematic view of an embodiment of the in-plate channeling of an embodiment of the HOC plate where two duct chips are connected to a 1 duct biochip, according to an example of the present disclosure.

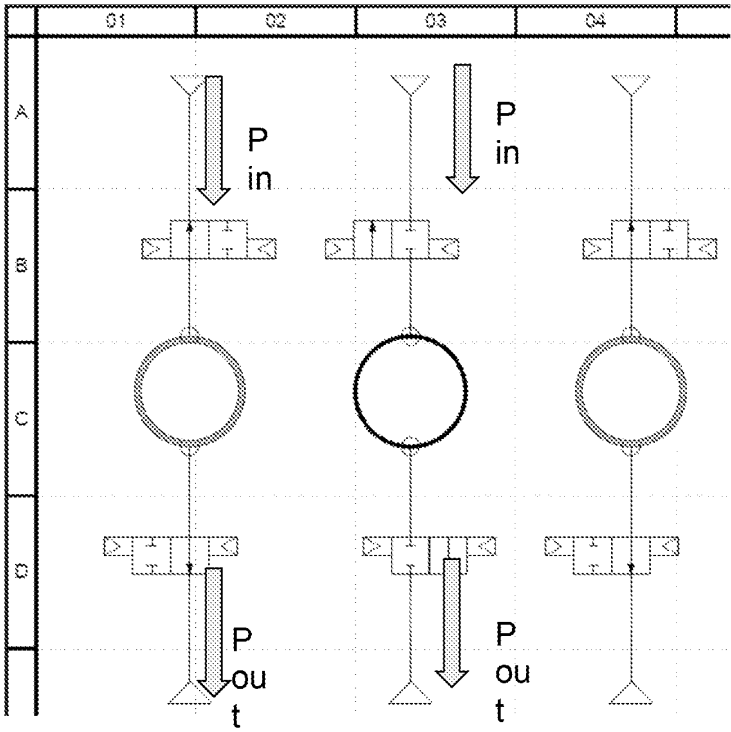
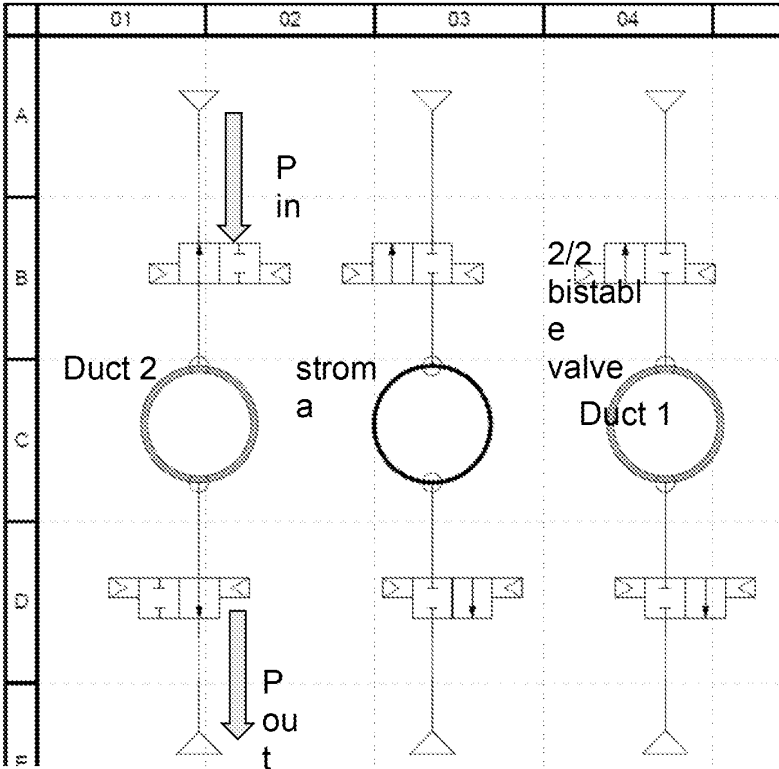


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[1] Fig. 14 illustrates a schematic diagram which contains pressure sensors at each chip inlet and outlet fluid ports to manipulate the pressure inside the chips' channels. This allows for the fluid to controllably perfuse from the ductal channel to the stromal one or vice versa, according to an example of the present disclosure.



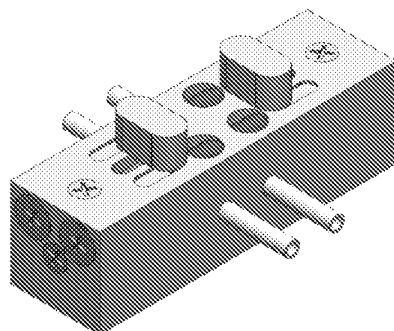
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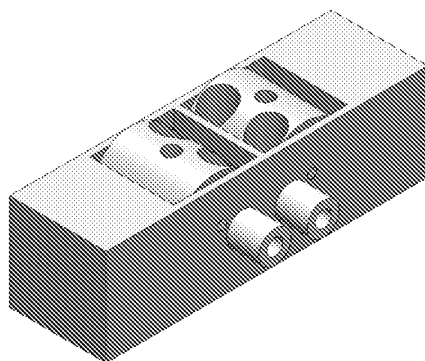
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The In-plate valving mechanism:

[1] Fig. 15A illustrates a perspective view of the hydraulic valving mechanism, connecting individual biochips, according to an example of the present disclosure.

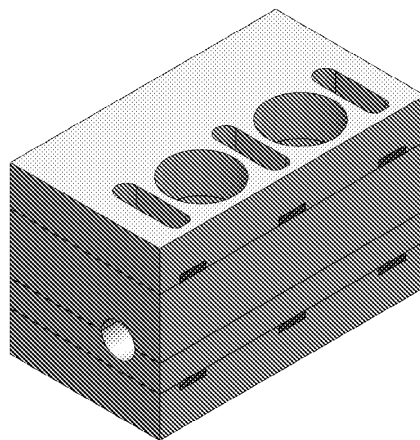


[1] Fig. 15B illustrates a perspective view of the cylindrical roll valving mechanism, connecting individual biochips, according to an example of the present disclosure.

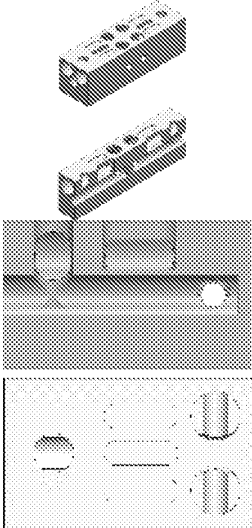
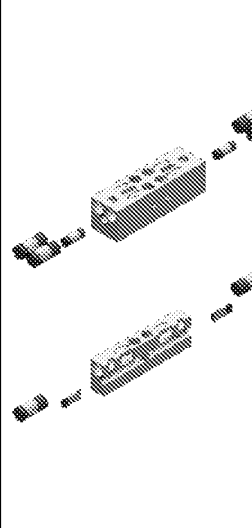
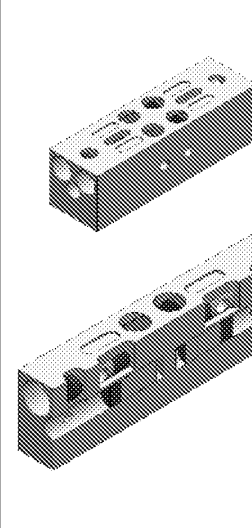
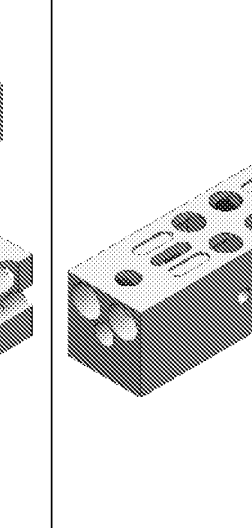
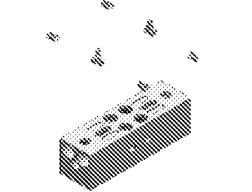
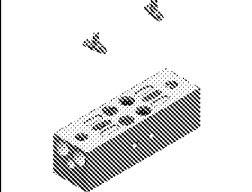
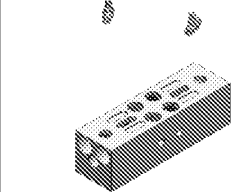
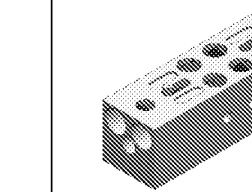
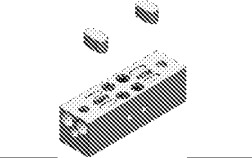
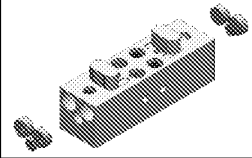
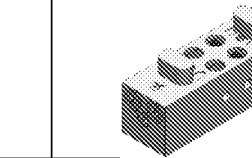
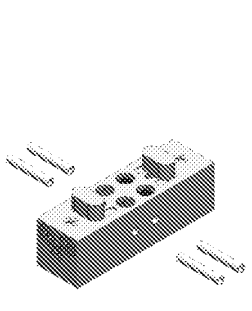
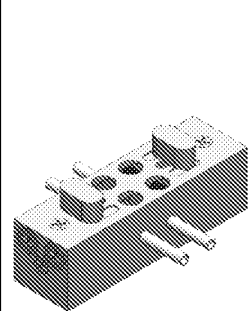
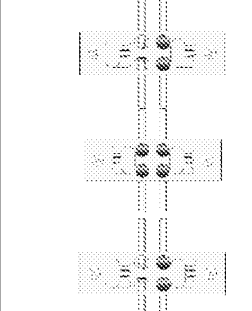
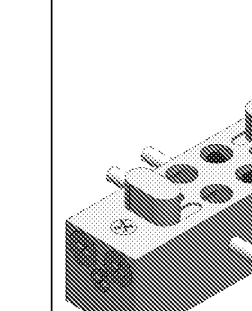


[1] Fig. 15C illustrates a perspective view of the flexible membrane valving mechanism connecting individual biochips, according to an example of the present disclosure.

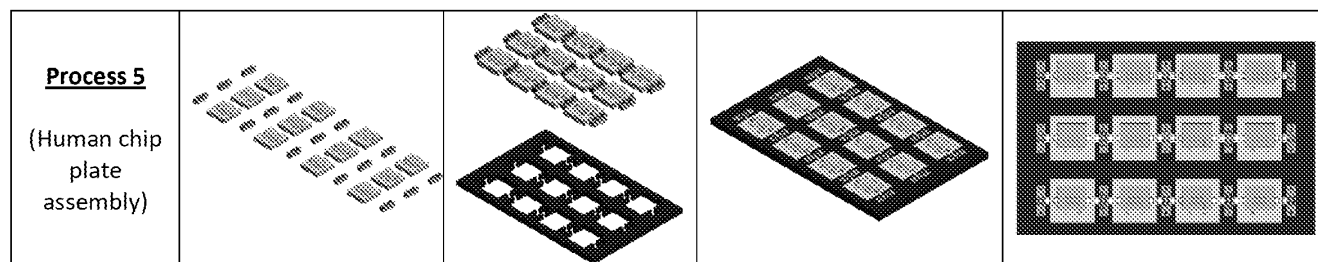
36/132



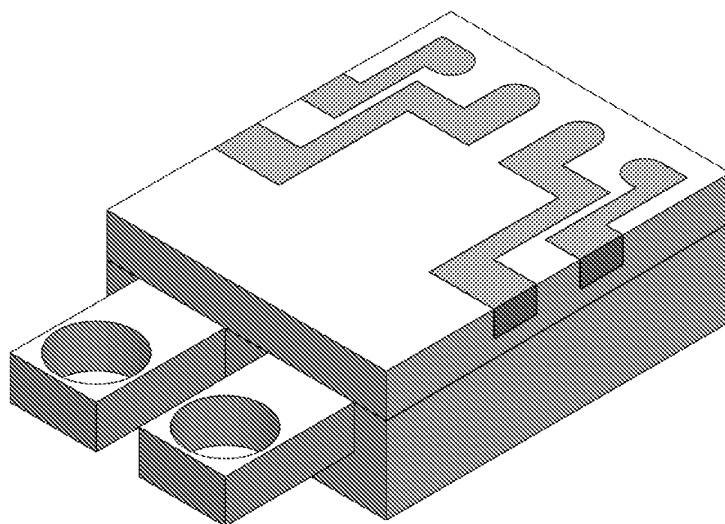
[1] Fig. 15D illustrates a perspective view of the chip connection valve assembly process, according to an example of the present disclosure.

	<u>Step 1</u>	<u>Step 2</u>	<u>Step 3</u>	<u>Resulting process</u>
<u>Process 1</u> (Hydraulic valve pistons assembly)				
<u>Process 2</u> (Hydraulic valve springs assembly)				
<u>Process 3</u> (Hydraulic valve plugs assembly)				
<u>Process 4</u> (Hydraulic valve tube assembly)				

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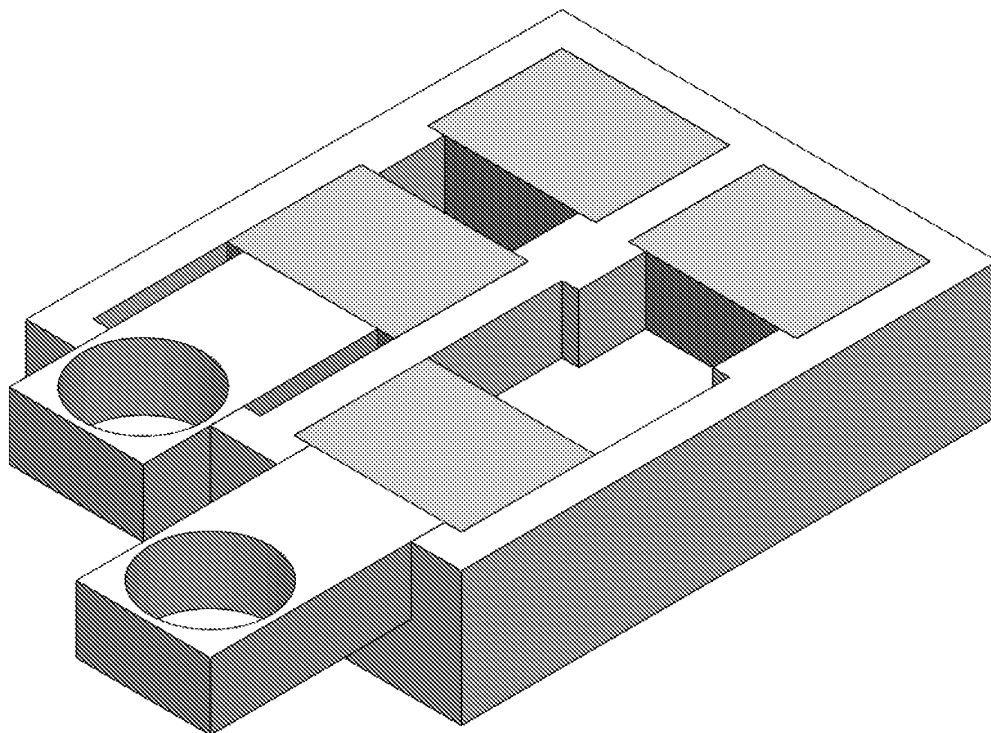


[1] Fig. 16A illustrates a perspective view of the directional change flow valve plate actuator, according to an example of the present disclosure.

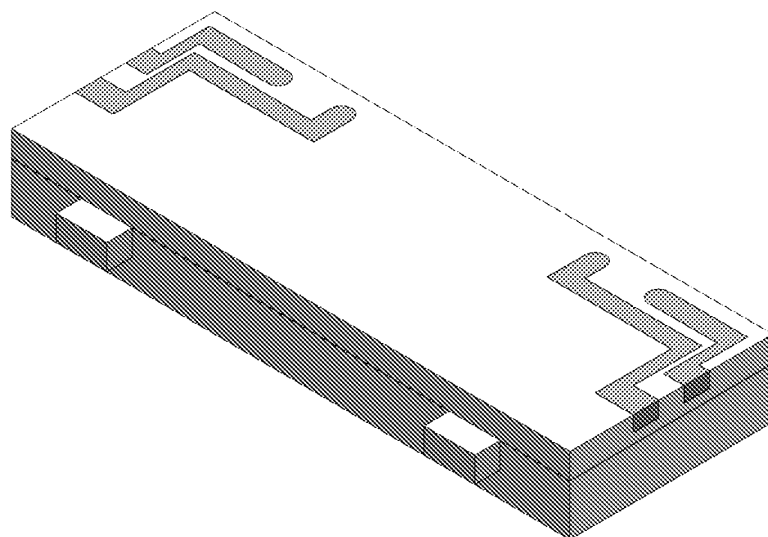


[1] Fig. 16B illustrates a detailed view of the directional change flow valve plate actuator, according to an example of the present disclosure.

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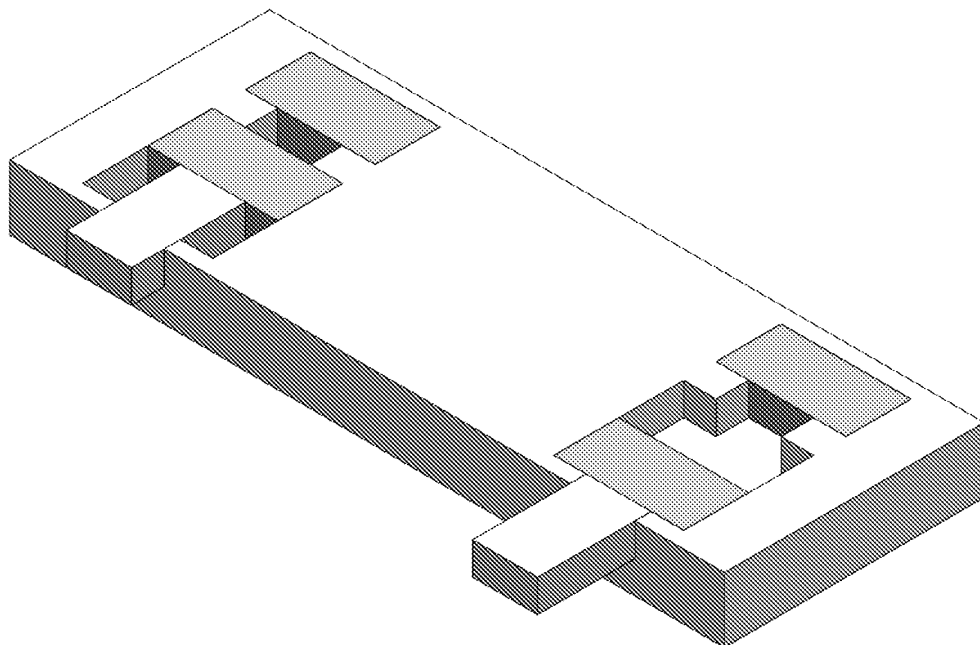


[1] Fig. 16C illustrates a perspective view of the solenoidal magnet open-close valve, according to an example of the present disclosure.

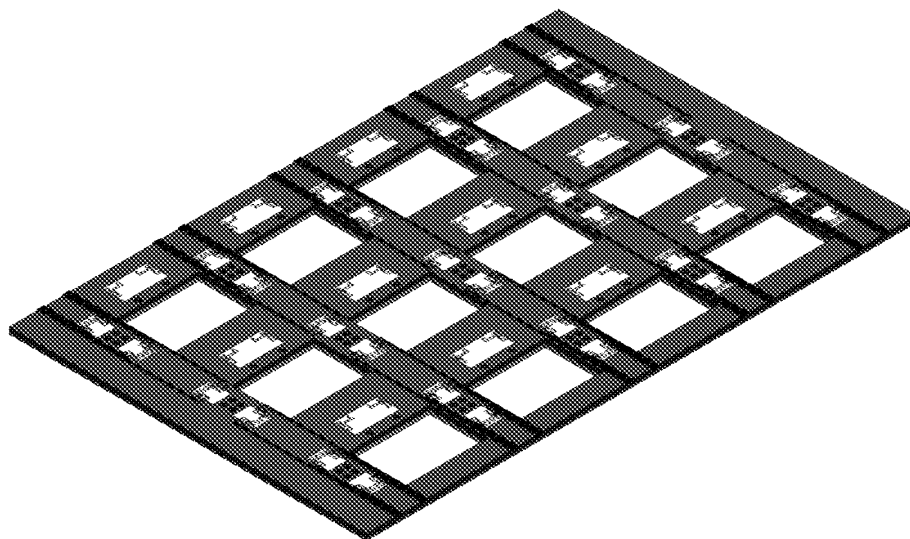


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[1] Fig. 16D illustrates a detailed view of the solenoidal magnet open-close valve, according to an example of the present disclosure.

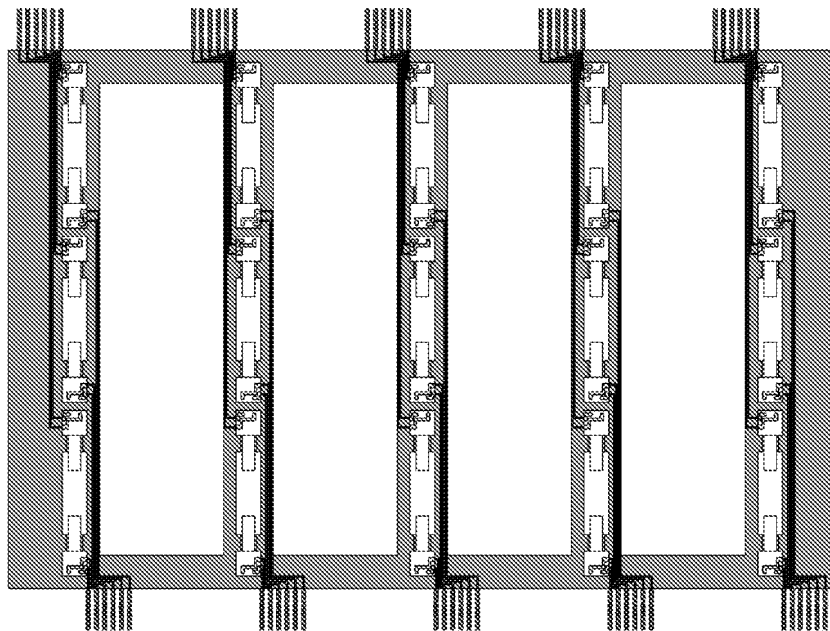


[1] Fig. 16E illustrates a perspective view of the solenoidal magnet open-close valve plate, according to an example of the present disclosure.



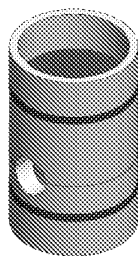
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[1] Fig. 16F illustrates a detailed view of the solenoidal magnet inlet-outlet valve actuator plate, according to an example of the present disclosure.

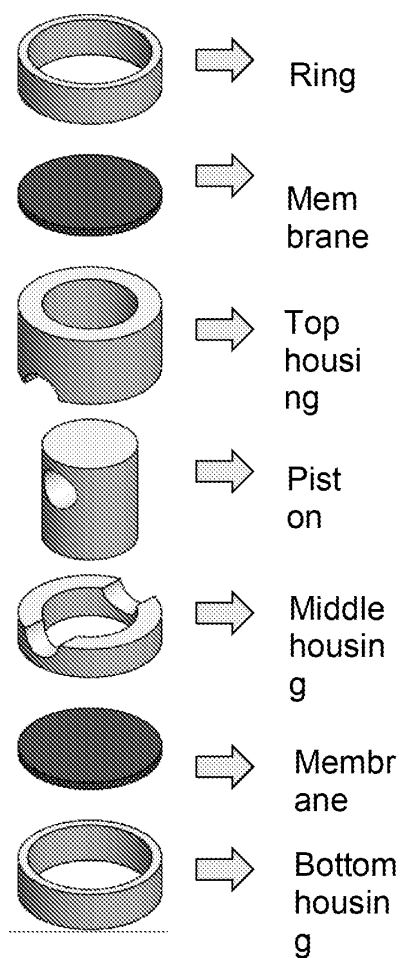


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Fig. 17A illustrates a perspective view of the pneumatic actuated open-close membrane valve that is normally closed, according to an example of the present disclosure.

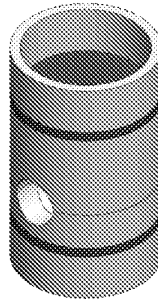


[1] Fig. 17B illustrates an exploded view of the pneumatic actuated open-close membrane valve that is normally closed, according to an example of the present disclosure.

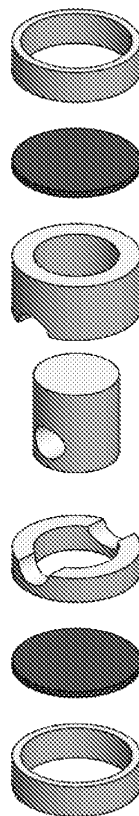


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[1] Fig. 17C illustrates a perspective view of an additional embodiment of the pneumatic actuated open-close membrane valve that is normally opened, according to an example of the present disclosure.



[1] Fig. 17D illustrates an exploded view, an additional embodiment of the pneumatic actuated open-close membrane valve that is normally opened, according to an example of the present disclosure.



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[1] Fig. 18A illustrates a perspective view of the bistable beam pneumatically actuated on a flexible tube valve, according to an example of the present disclosure.

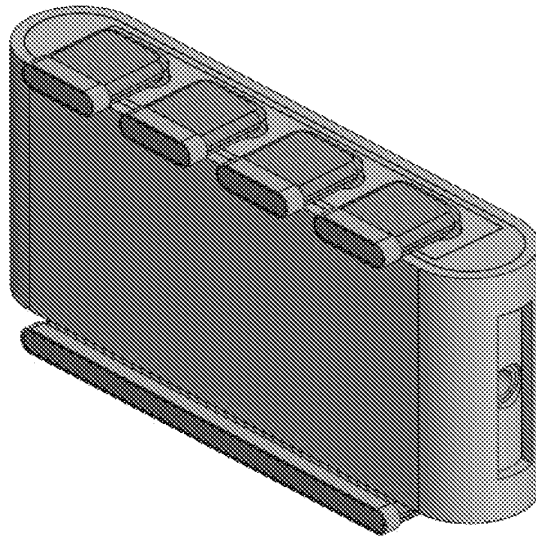
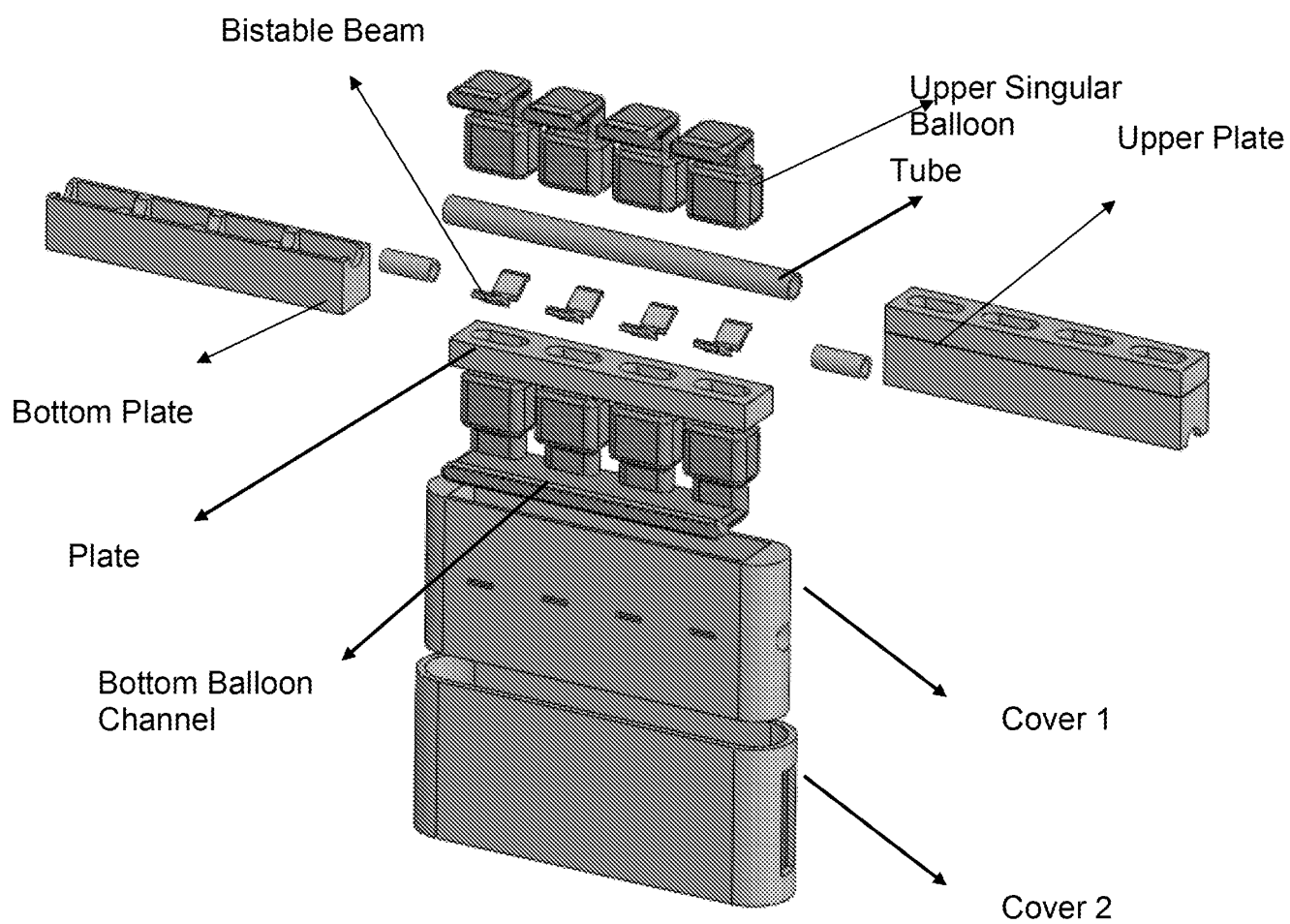


Fig. 18B illustrates an exploded view of the bistable beam pneumatically actuated on a flexible tube valve, according to an example of the present disclosure.

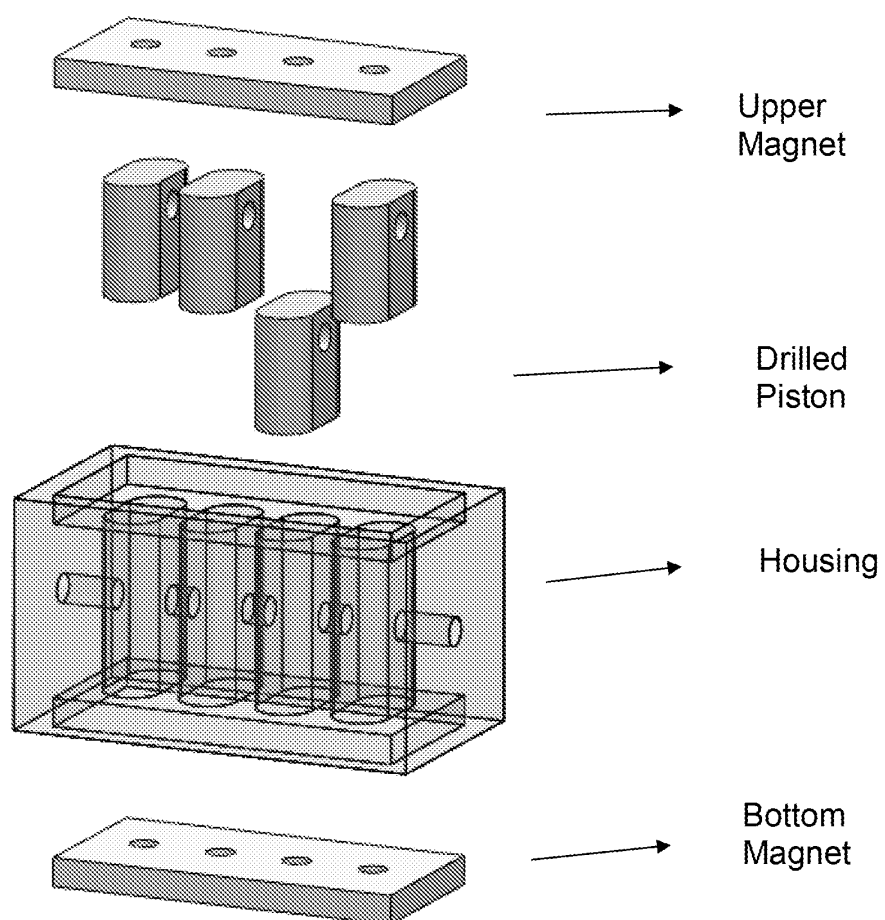
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[1] Fig. 19A illustrates a perspective view of the bistable magnetic drilled-piston valve, according to an example of the present disclosure.

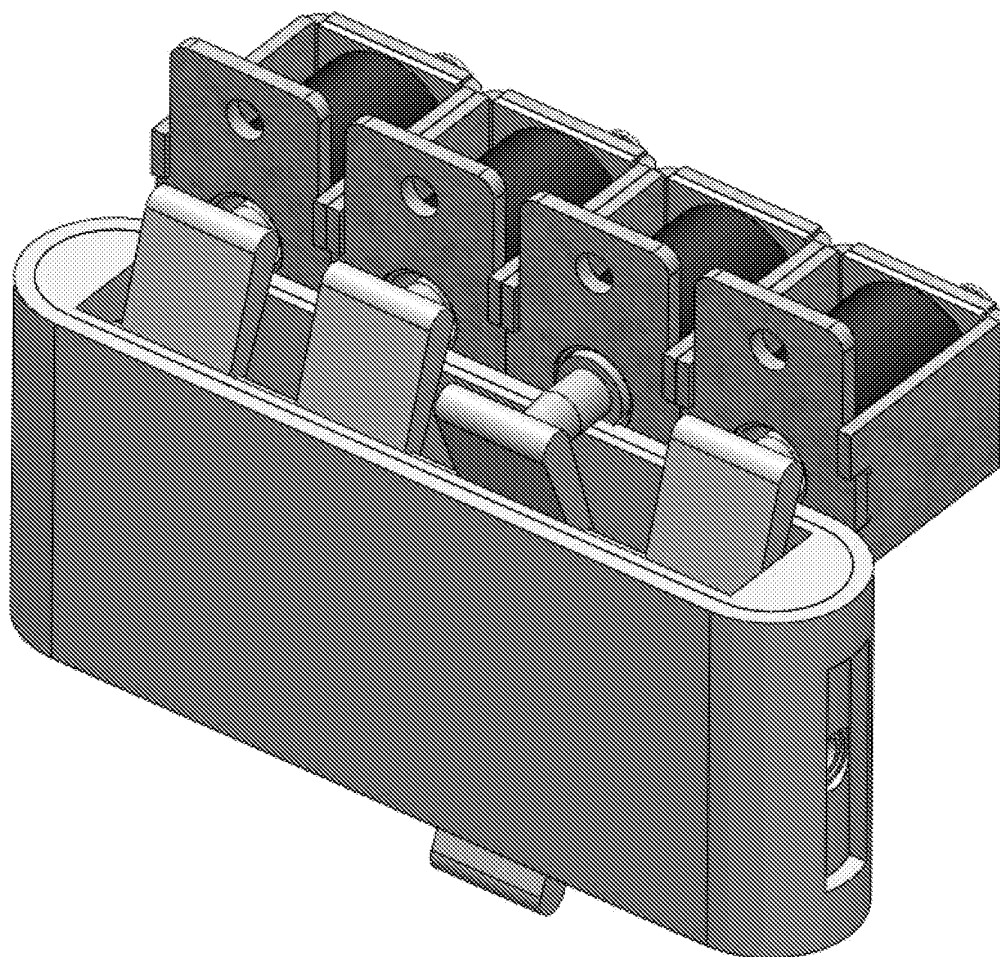
[1] Fig. 19B illustrates an exploded view of an embodiment of a bistable magnetic drilled-piston valve, according to an example of the present disclosure.

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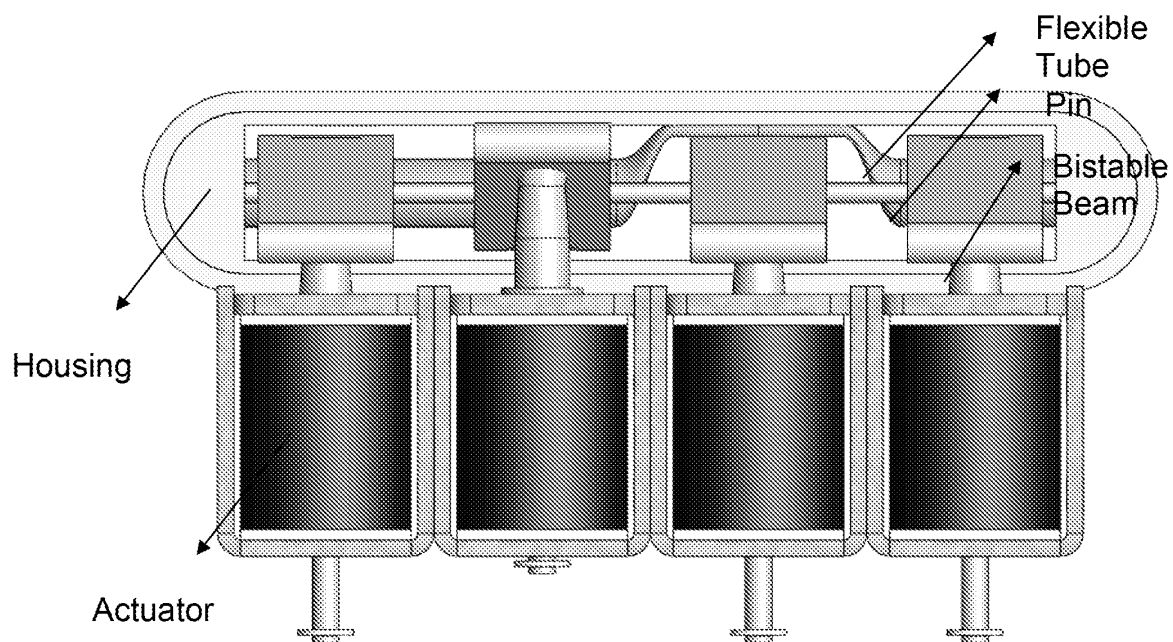
[1] Fig. 20A illustrates a perspective view of the bistable mechanically actuated flexible tube valve, according to an example of the present disclosure.

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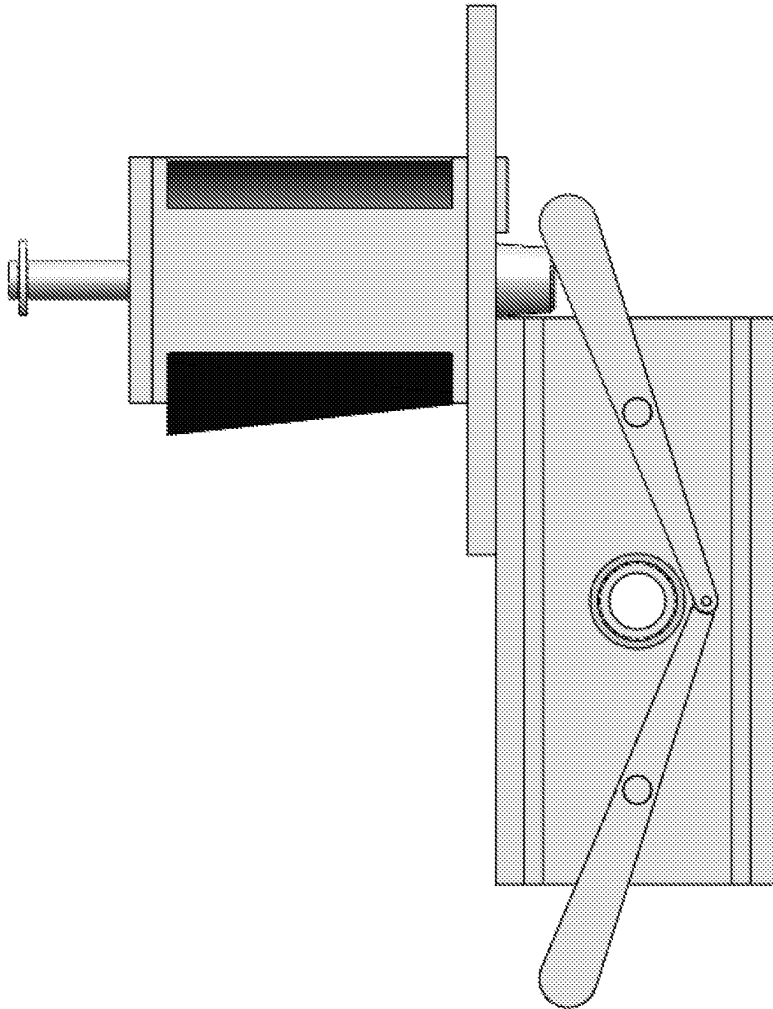
[1] Fig. 20B illustrates a top view of an embodiment of a bistable mechanically actuated flexible tube valve in which one bistable beam is in the close position, according to an example of the present disclosure.

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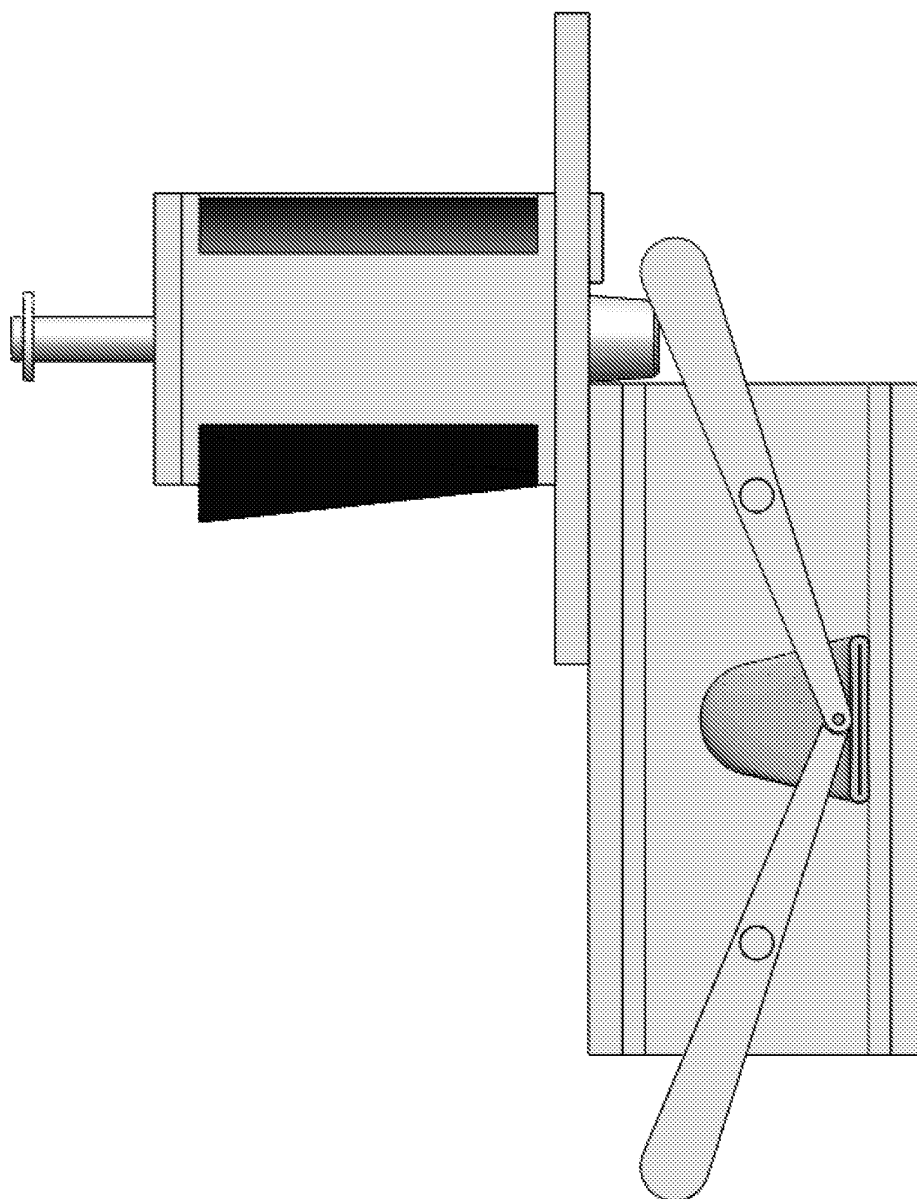
[1] Fig. 20C illustrates a cross sectional view of the bistable mechanically actuated flexible tube valve in the open position, according to an example of the present disclosure.

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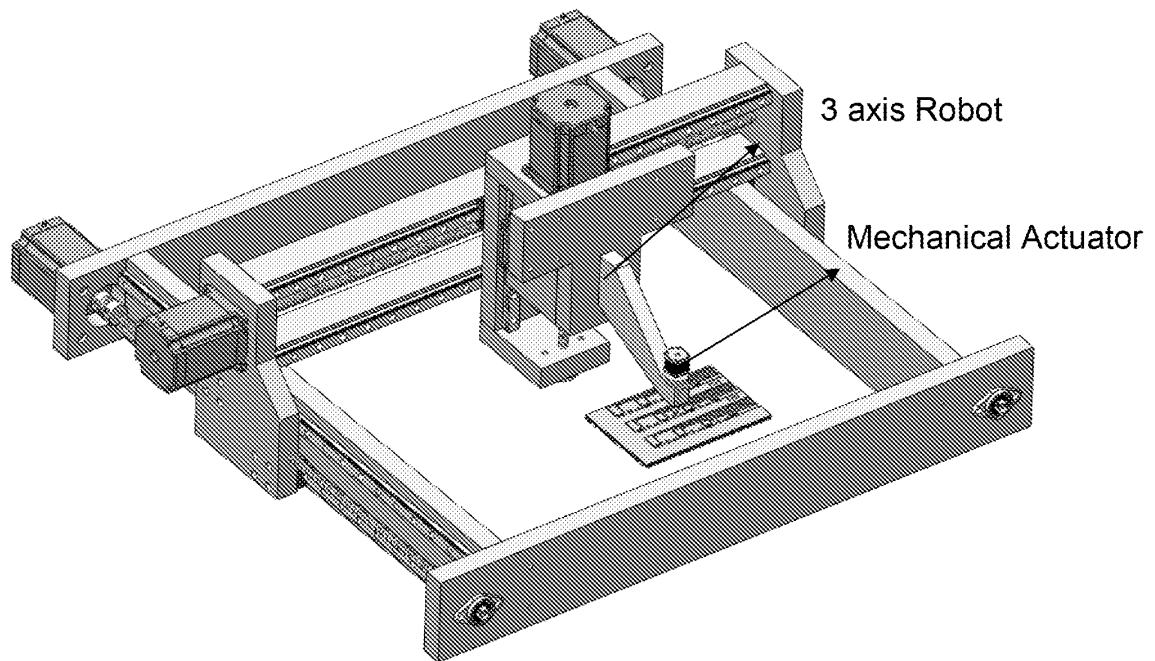
[1] Fig. 20D illustrates a cross sectional view of the bistable mechanically actuated flexible tube valve in the close position, according to an example of the present disclosure.

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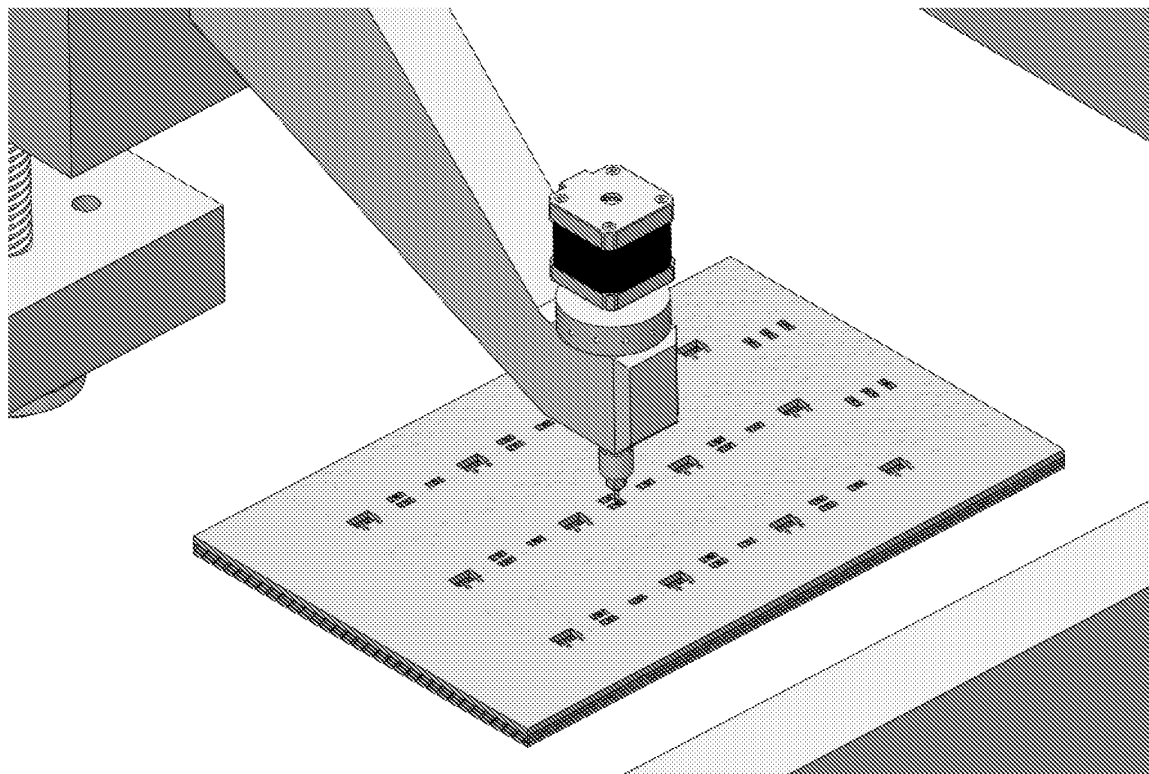
[1] Fig. 21A illustrates a perspective view of the mechanically actuated ball open-close valve, according to an example of the present disclosure.

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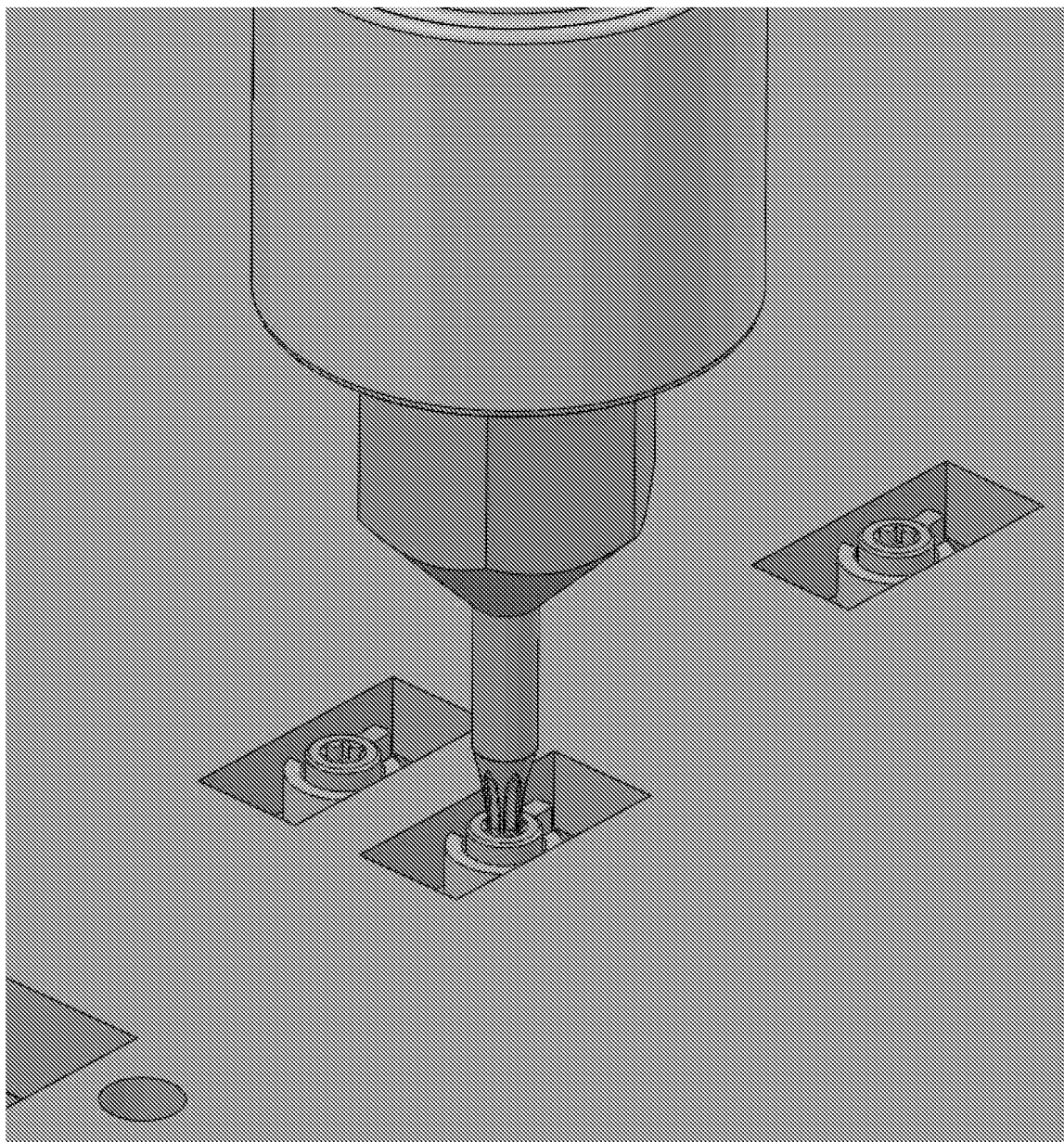
[1] Fig. 21B illustrates a close perspective view of an embodiment of a mechanically actuated ball open-close valve (the chip is moving and the screwdriver is moving), according to an example of the present disclosure.

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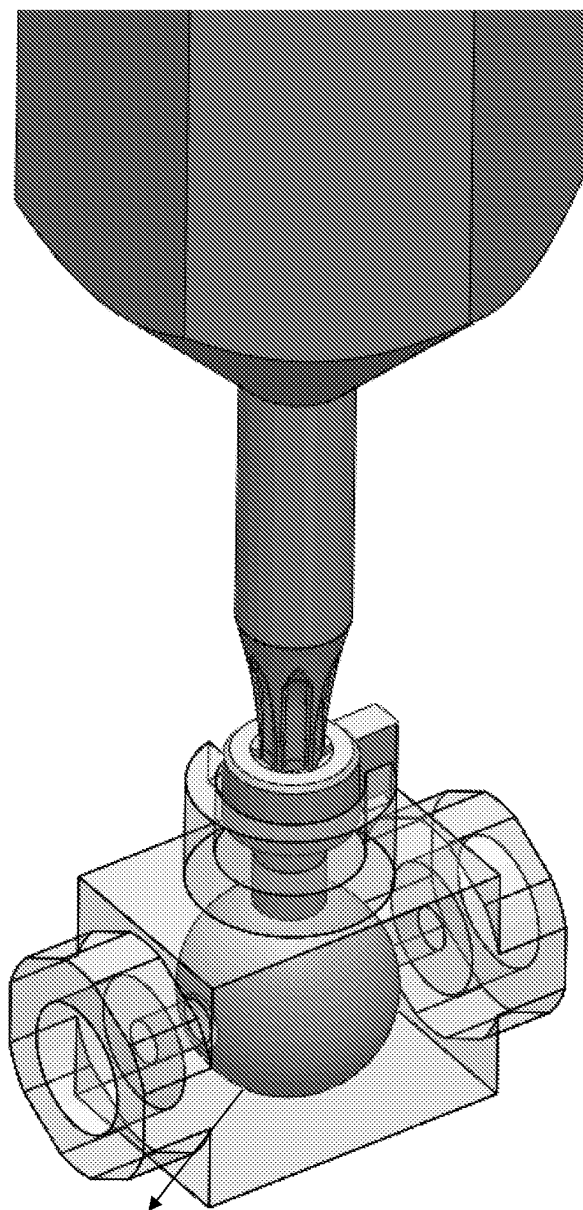
[1] Fig. 21C illustrates a detailed view of the socket engaging with the valve to switch if in the open or close position, according to an example of the present disclosure.

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[1] Fig. 21D illustrates a cross section of the detailed view of the mechanically actuated ball open-close valve, according to an example of the present disclosure.

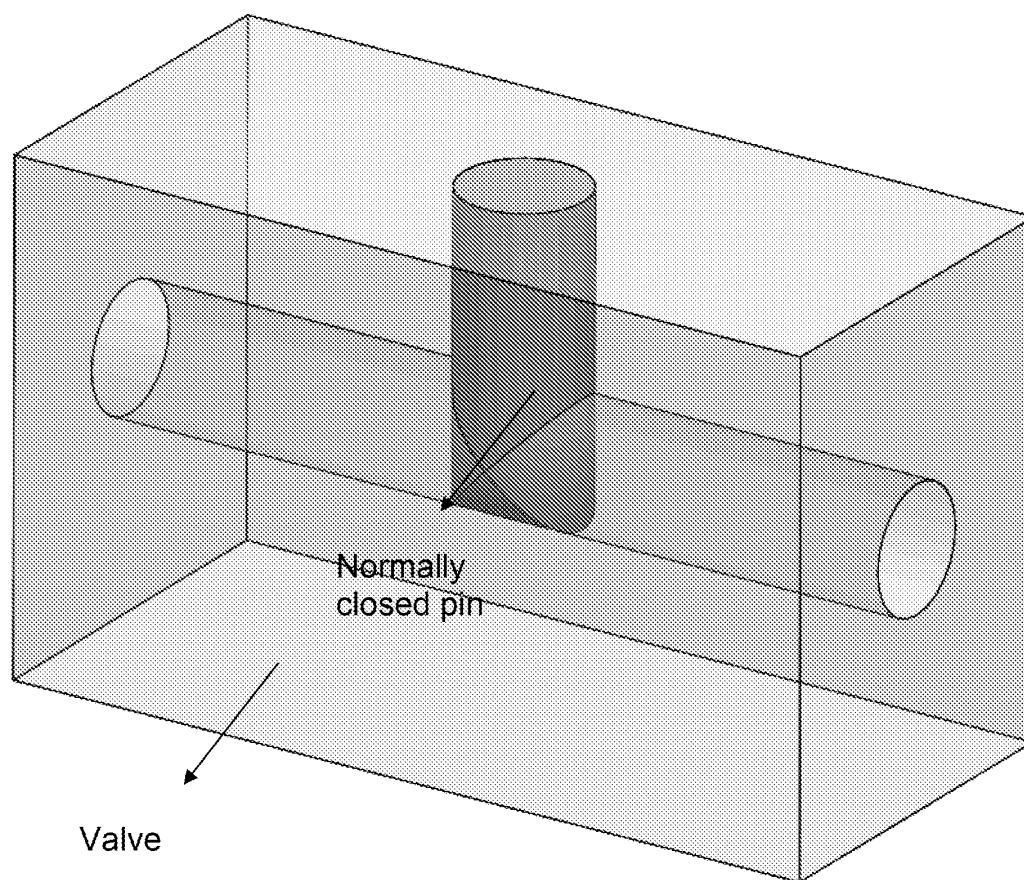
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Ball Valve

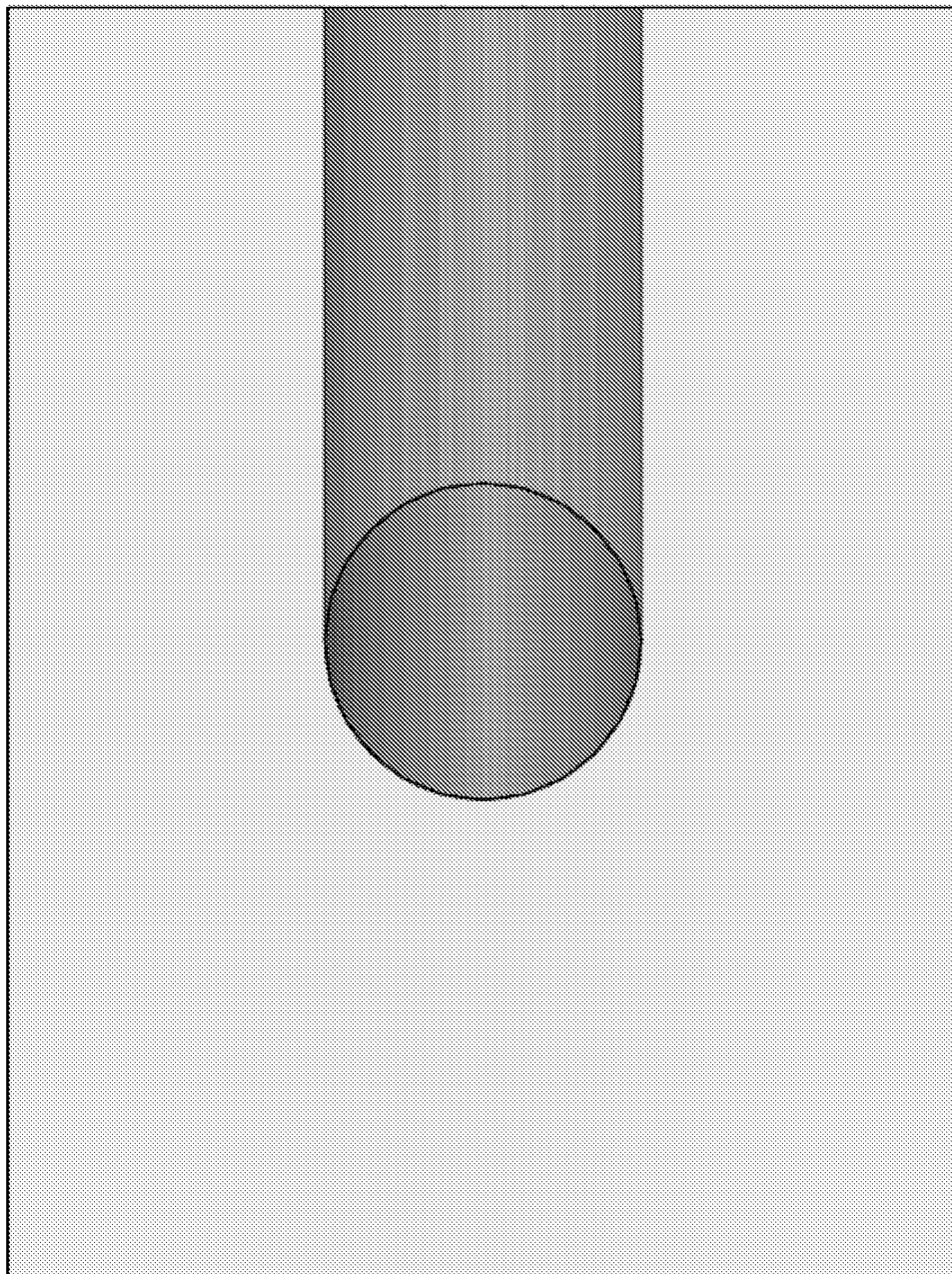
[1] Fig. 22A illustrates a cross section view of the permanently sealed open-close valve in its close position, according to an example of the present disclosure.

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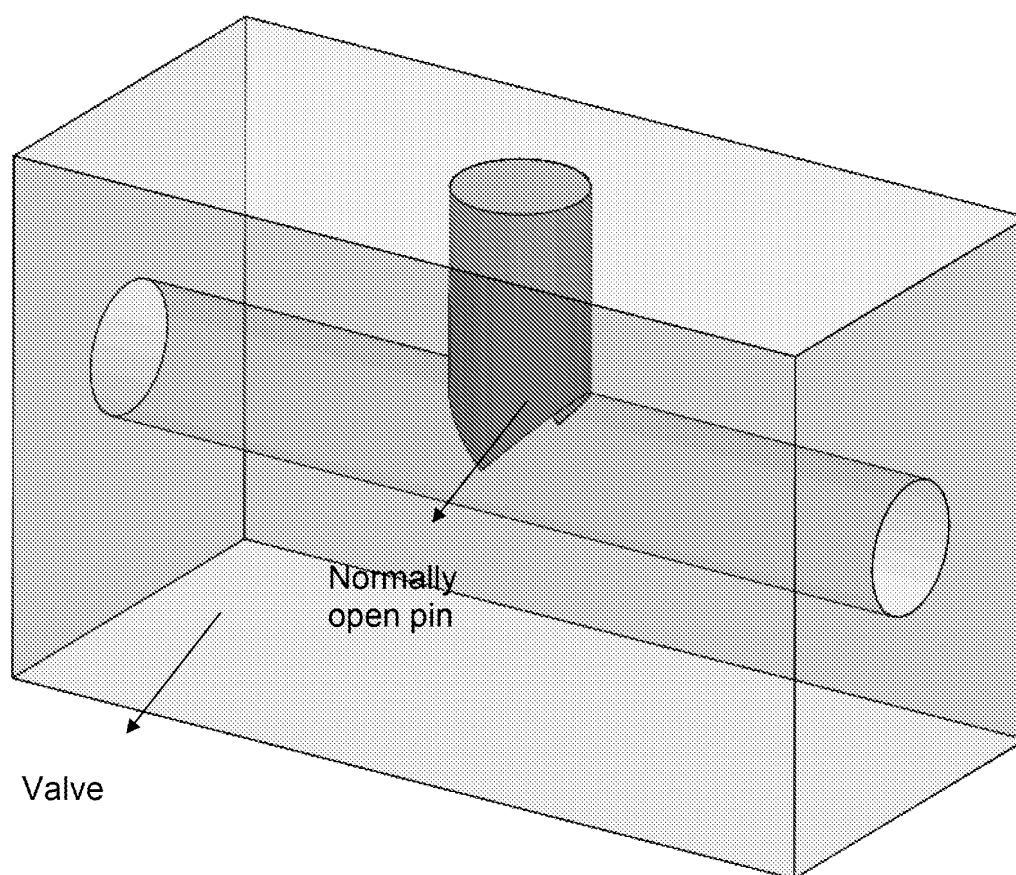
[1] Fig. 22B illustrates a side view of the permanently sealed open-close valve in its pre-set close position where a pin is tightly inserted into the channel blocking it, according to an example of the present disclosure.

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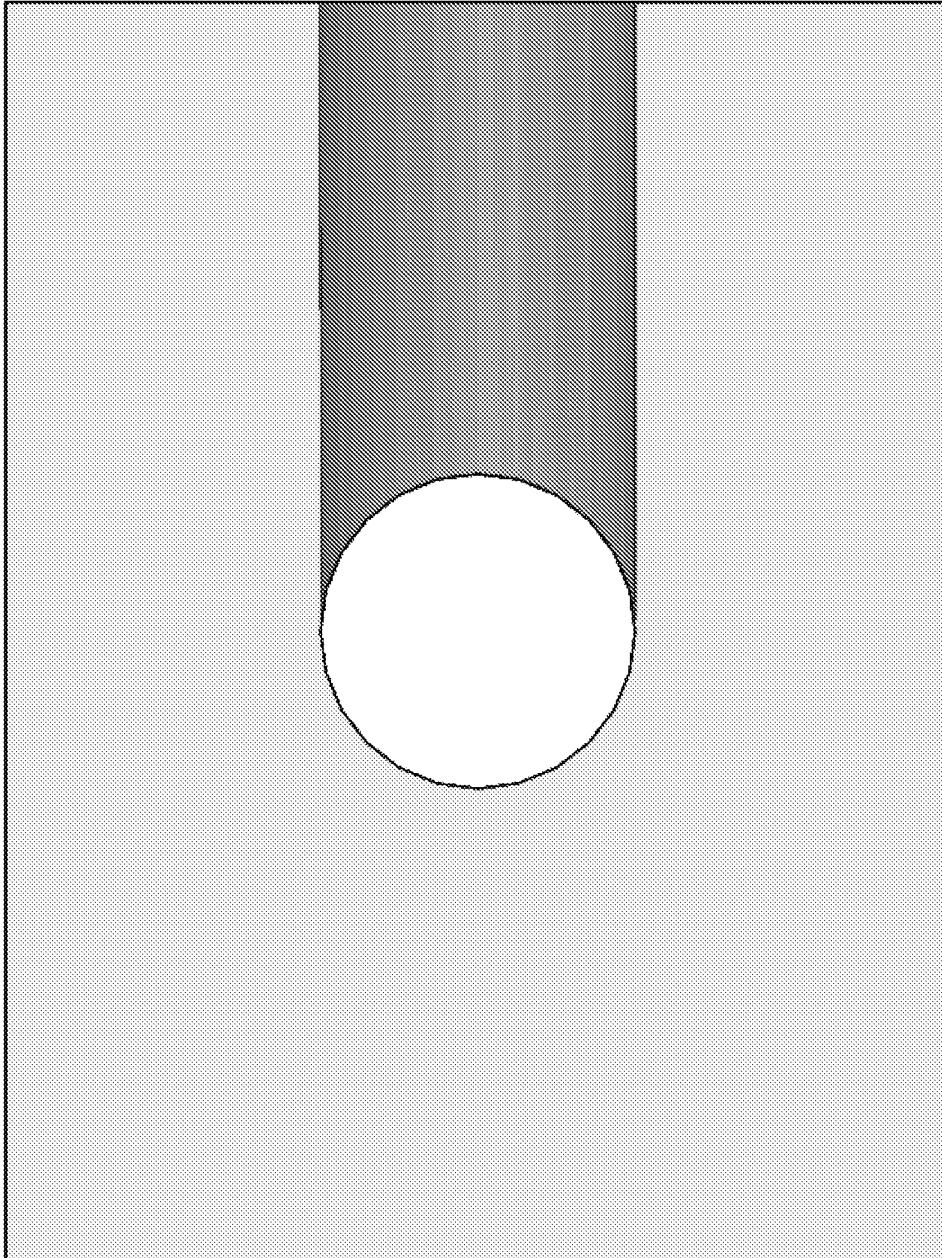


[1] Fig. 22C illustrates a cross section view of the permanently sealed open-close valve in its preset open position, according to an example of the present disclosure.

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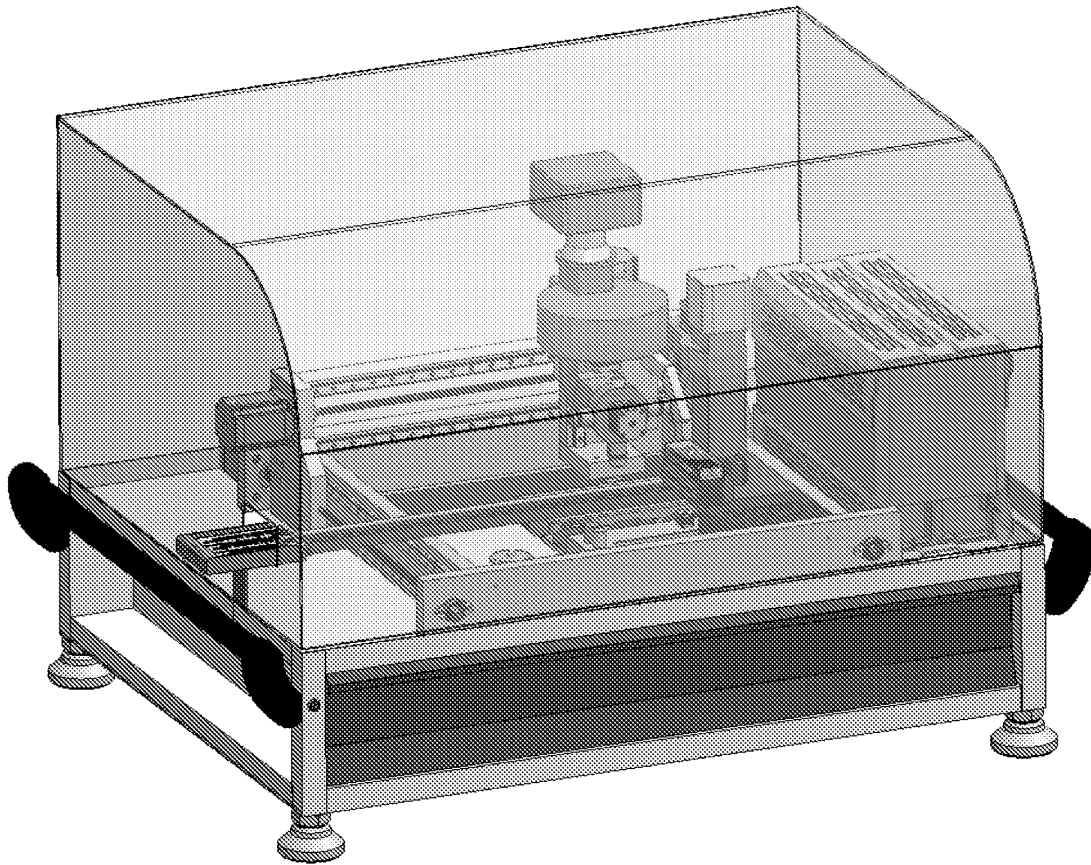
[1] Fig. 22D illustrates a side view of the permanently sealed open-close valve in its open position where the pin is not tightly inserted into the channel, according to an example of the present disclosure.



The Operating system component assembly:

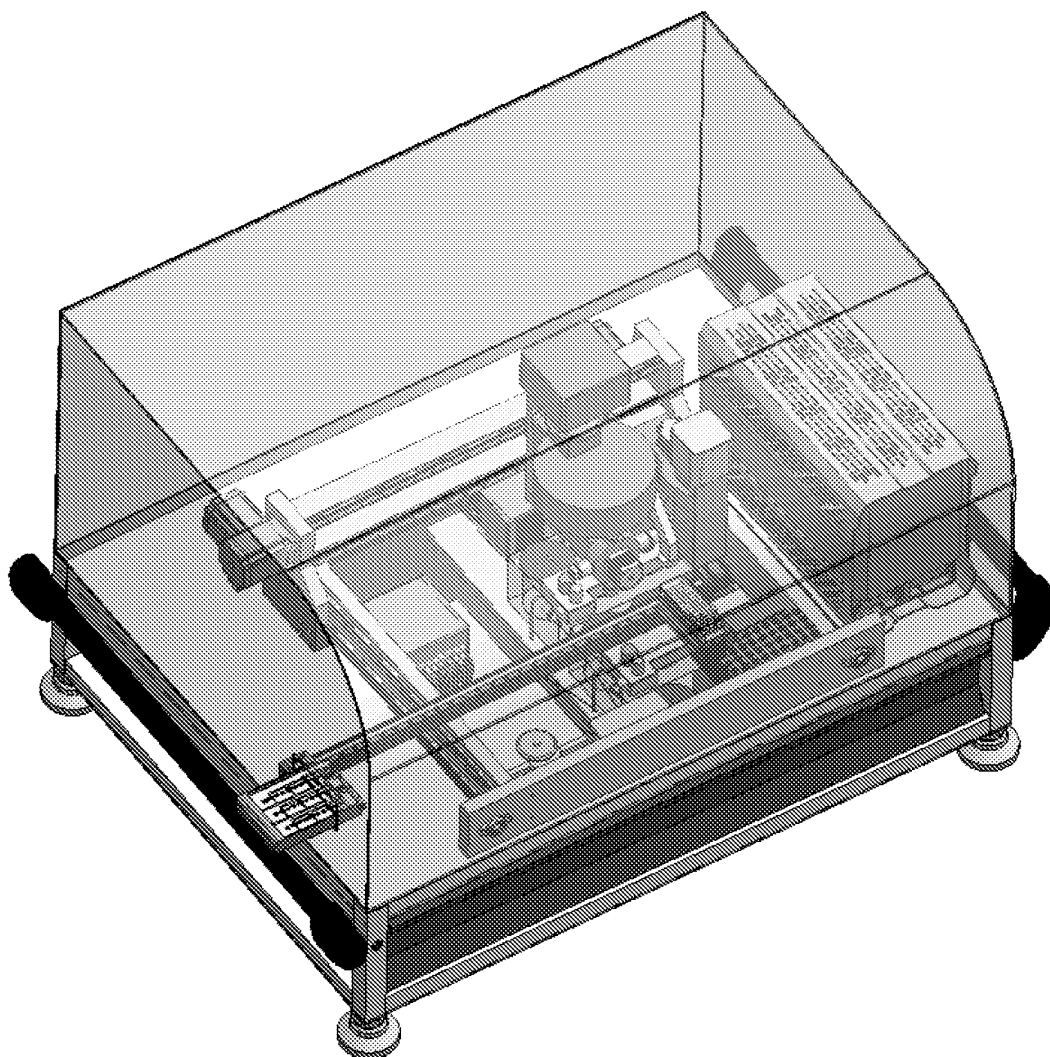
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[1] Fig. 23A illustrates a perspective view of an embodiment of the assembled operating system, according to an example of the present disclosure.



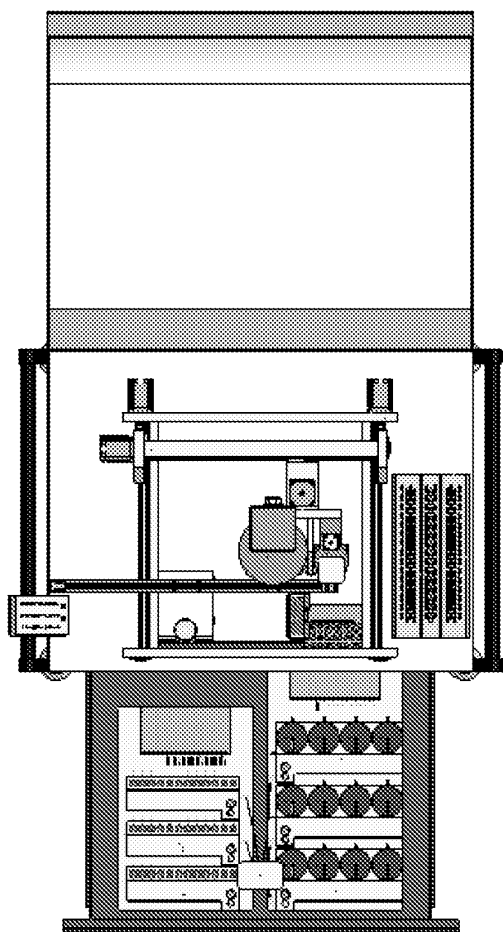
[2] Fig. 23B illustrates a perspective view of an embodiment of the assembled operating system main components, according to an example of the present disclosure.

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[3] Fig. 23C illustrates a perspective of the top view of an embodiment of the assembled operating system fluidic components, according to an example of the present disclosure.

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[4] Fig. 23D illustrates a perspective view of an embodiment of the assembled operating system with the mixing chamber drawer open, according to an example of the present disclosure.

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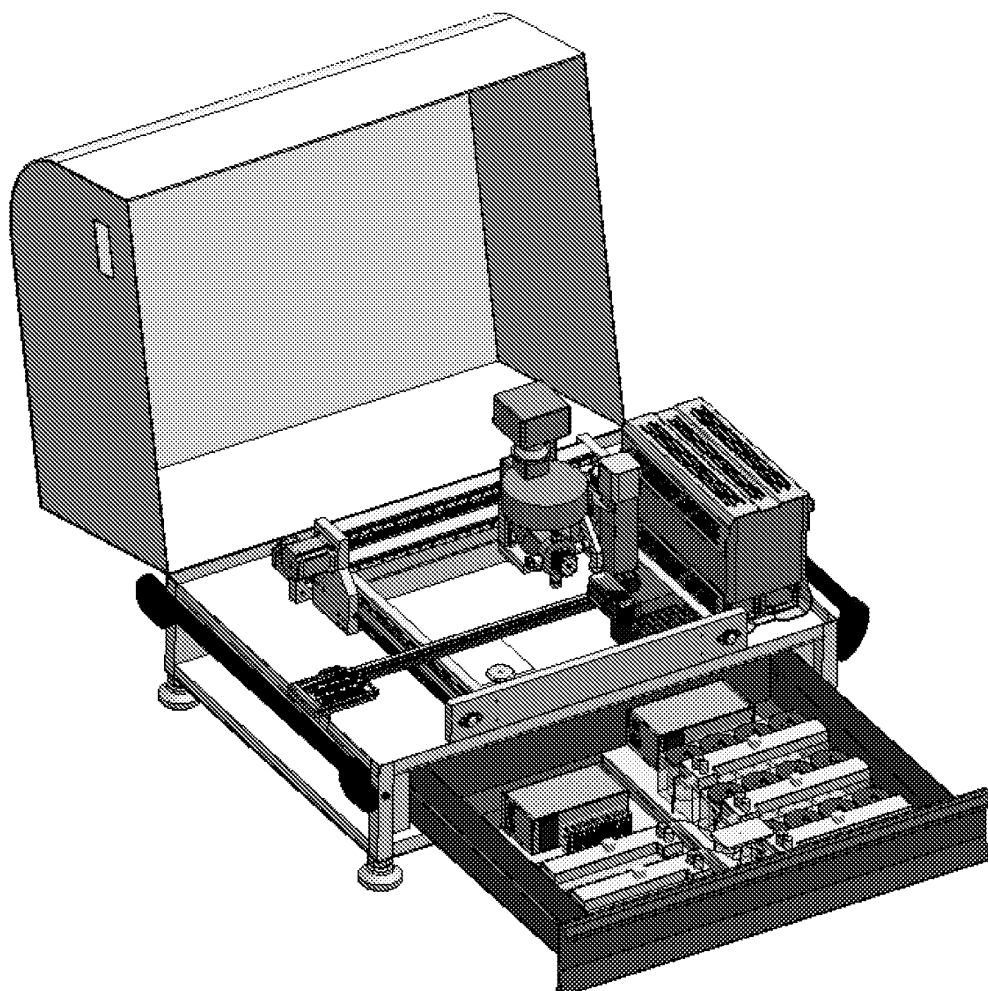
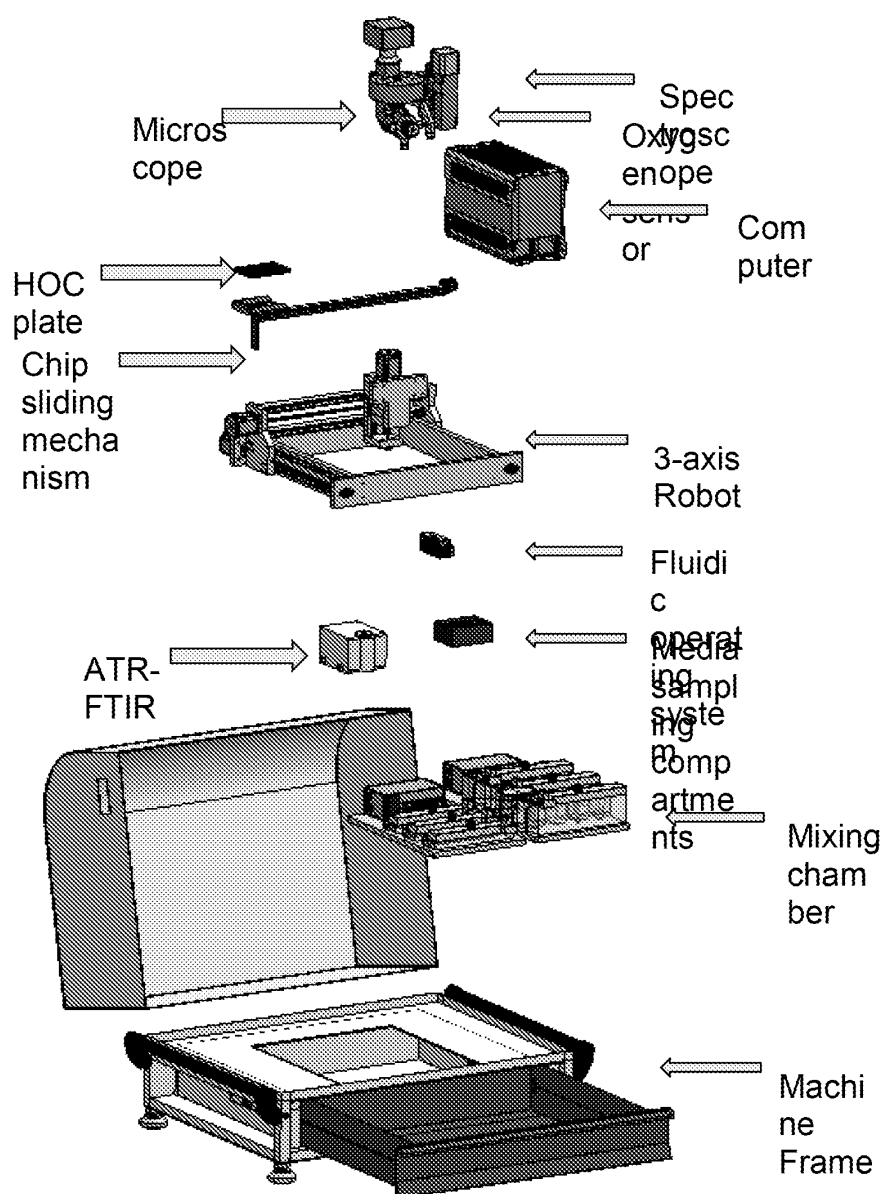


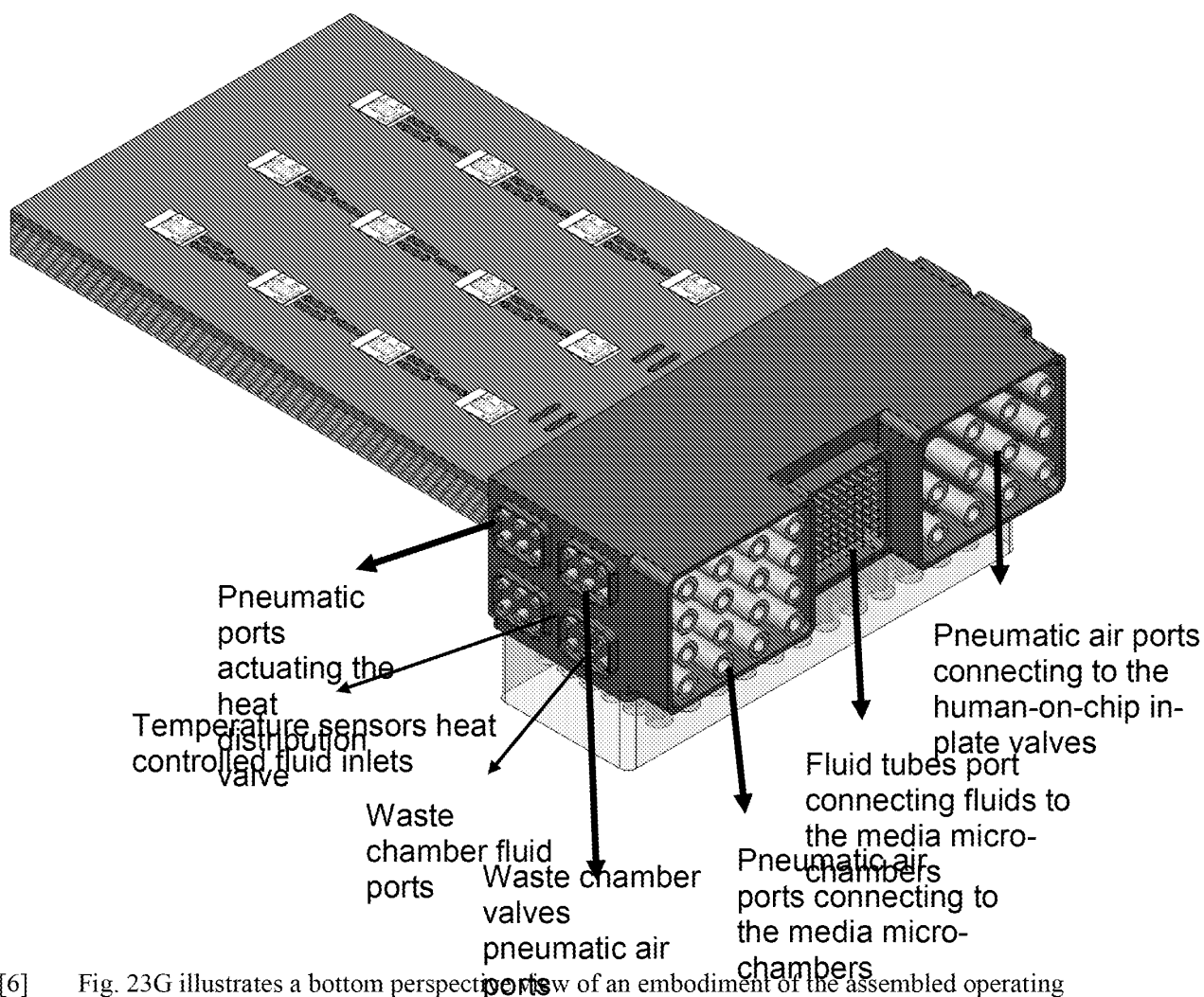
Fig. 23E illustrates an exploded view of an embodiment of the operating system, according to an example of the present disclosure

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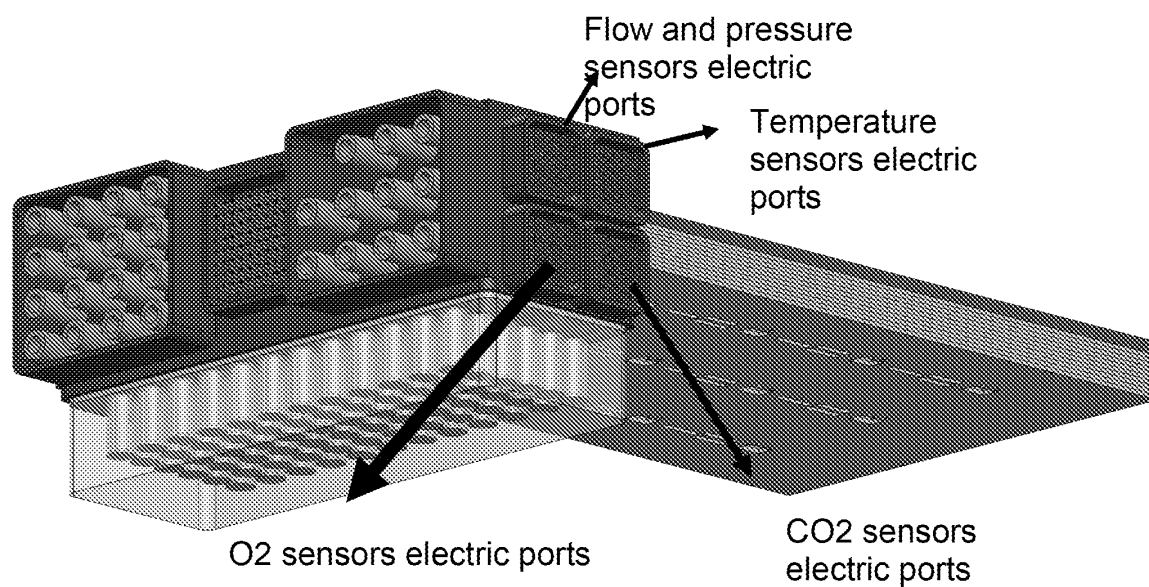
[5] Fig. 23F illustrates a side view of an embodiment of the assembled operating system pressure driven pumping for the micro chambers, according to an example of the present disclosure.

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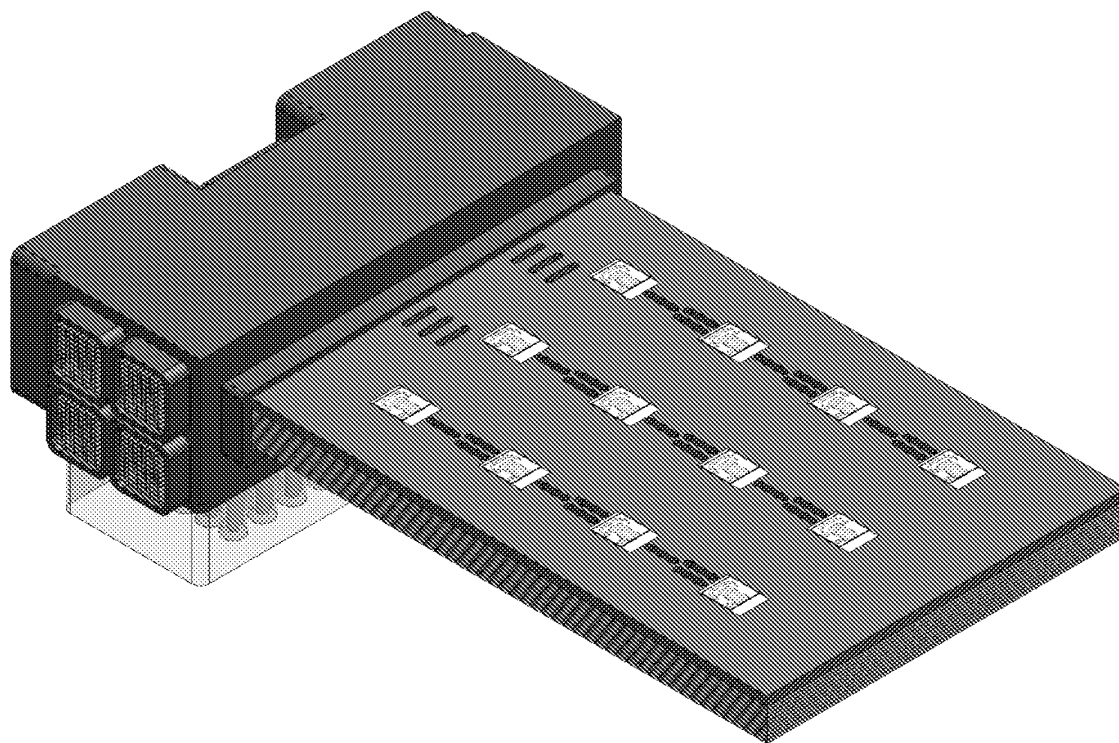
[6] Fig. 23G illustrates a bottom perspective view of an embodiment of the assembled operating system pressure driven pumping for the micro chambers, according to an example of the present disclosure.

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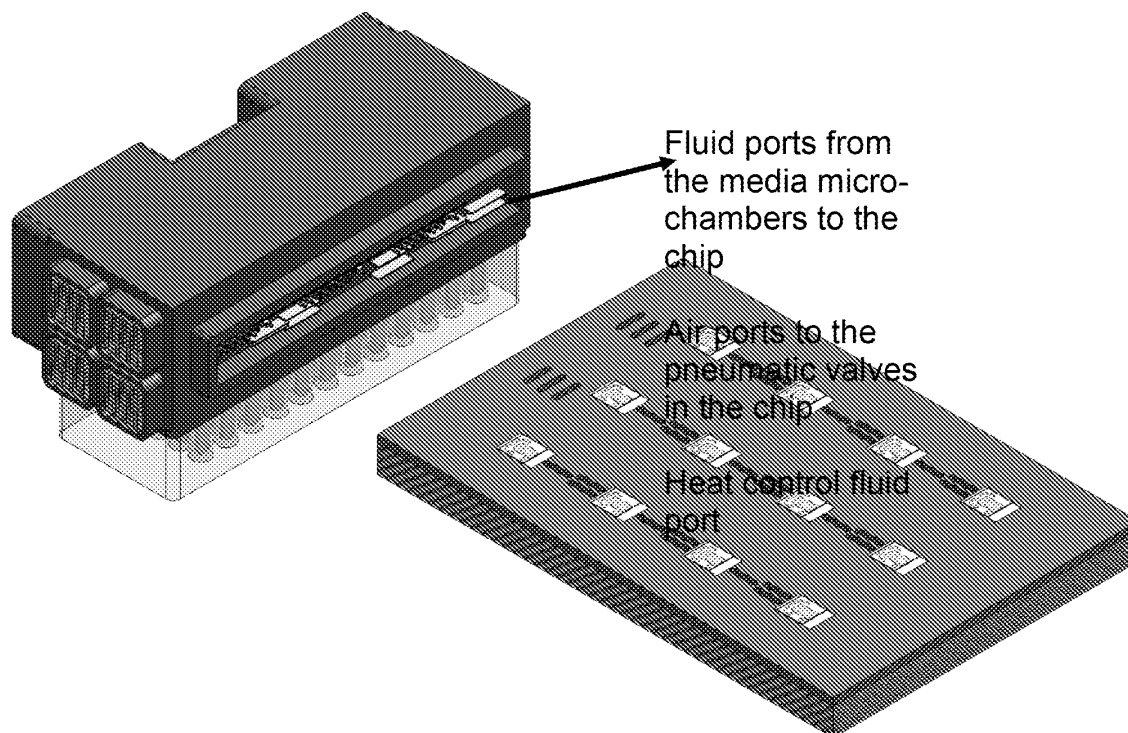
[7] Fig. 23H illustrates a bottom perspective view of an embodiment of the assembled operating system pressure driven pumping for the micro chambers, according to an example of the present disclosure.

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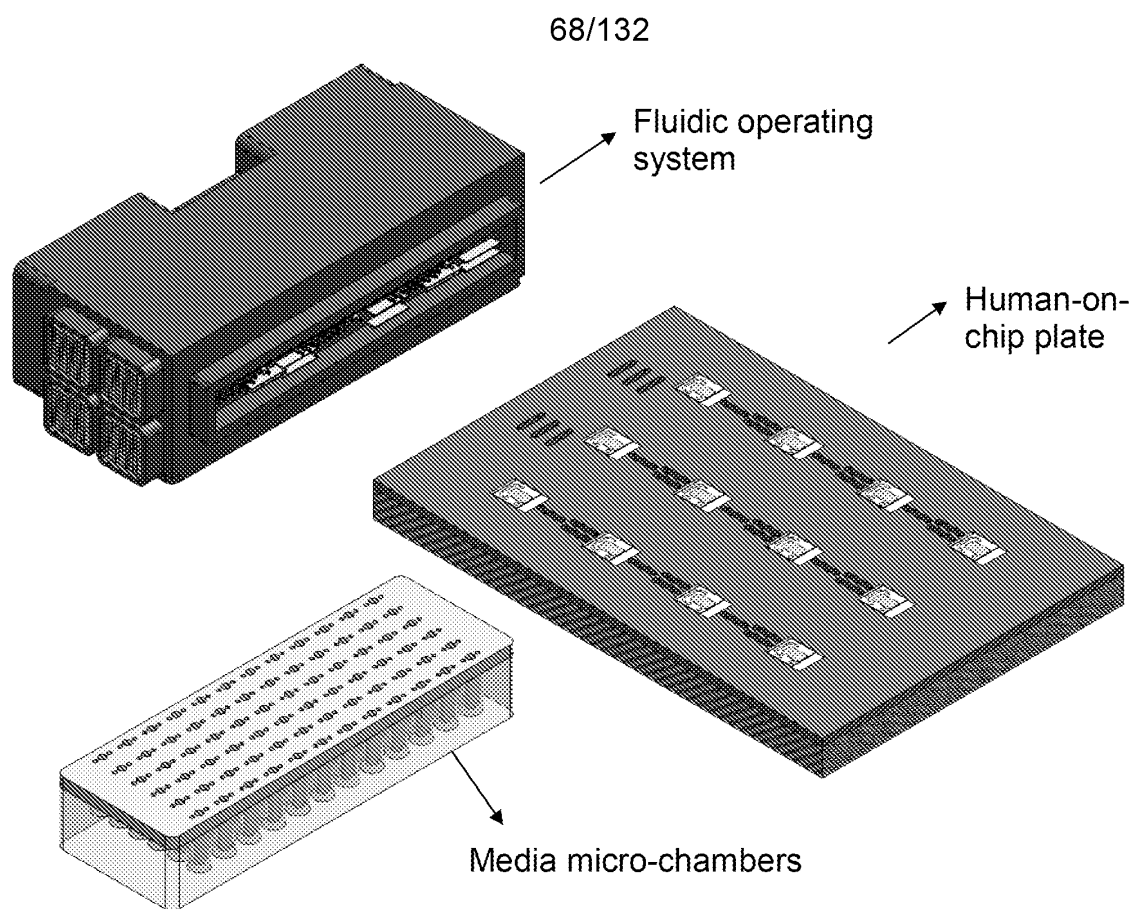


[8] Fig. 23I illustrates a bottom perspective view of an embodiment of the assembled operating system pressure driven pumping for the micro chambers, according to an example of the present disclosure.

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[9] Fig. 23J illustrates a bottom perspective view of an embodiment of the assembled operating system pressure driven pumping for the micro chambers, according to an example of the present disclosure.



[1] Fig. 23K illustrates a perspective view of an embodiment of the assembled operating system flow diagram, according to an example of the present disclosure.

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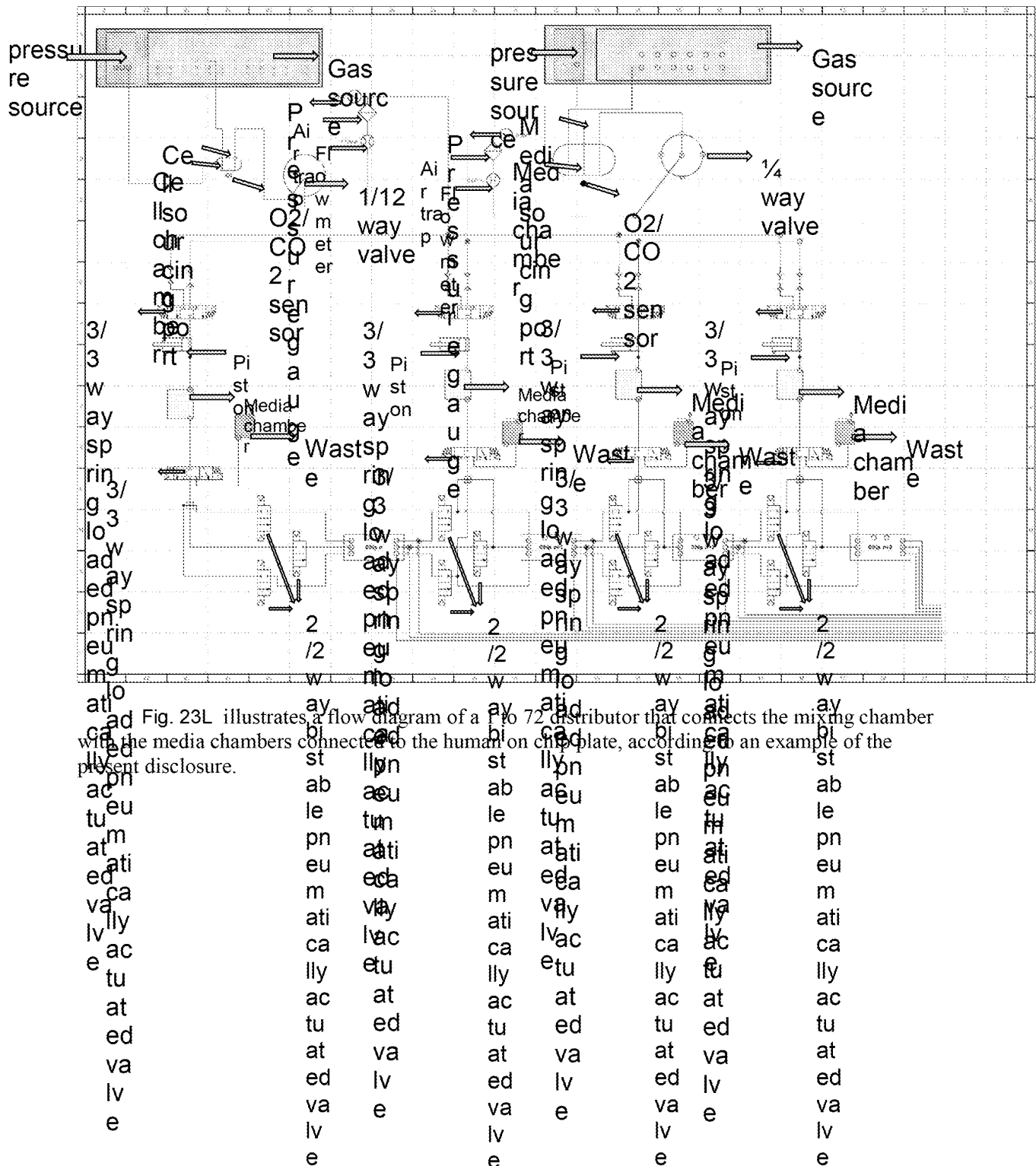
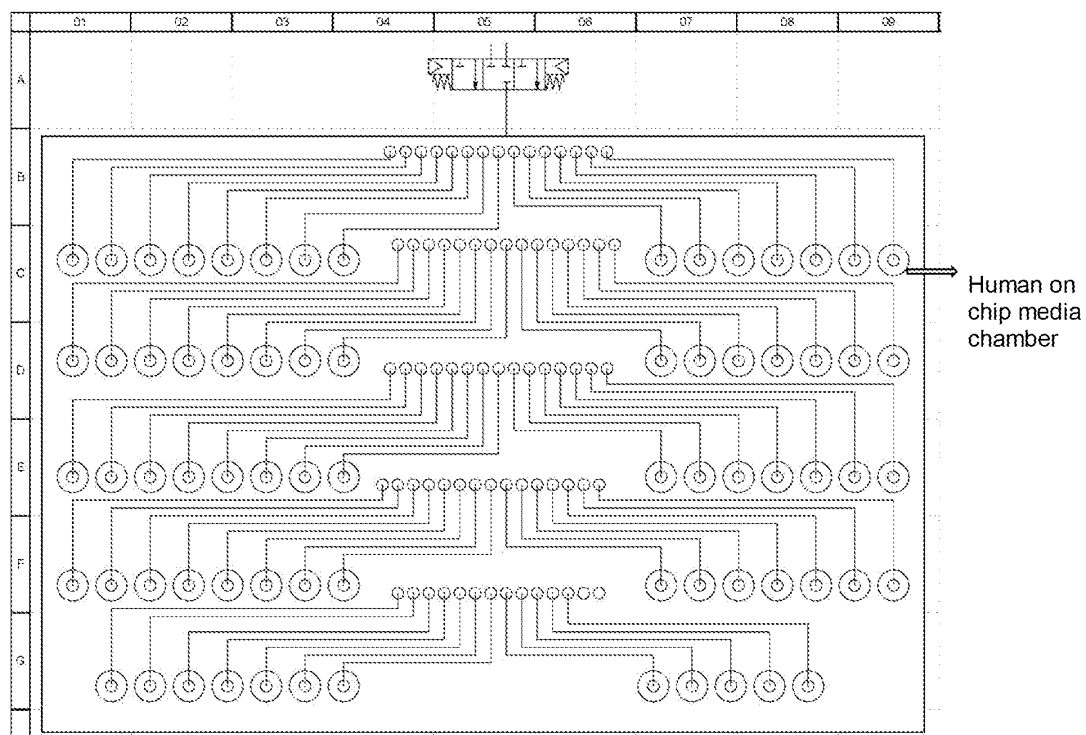


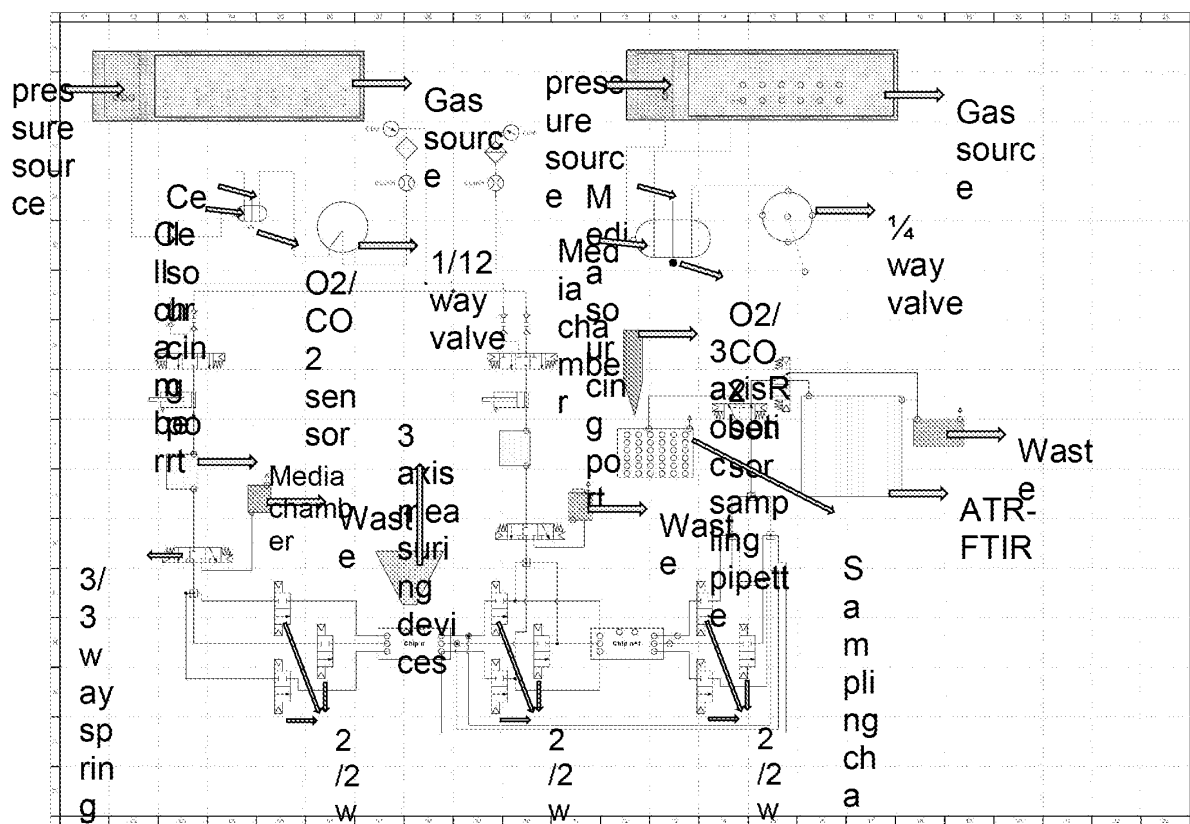
Fig. 23L illustrates a flow diagram of a 1 to 72 distributor that connects the mixing chamber with the media chambers connected to the human on chip plate, according to an example of the present disclosure.

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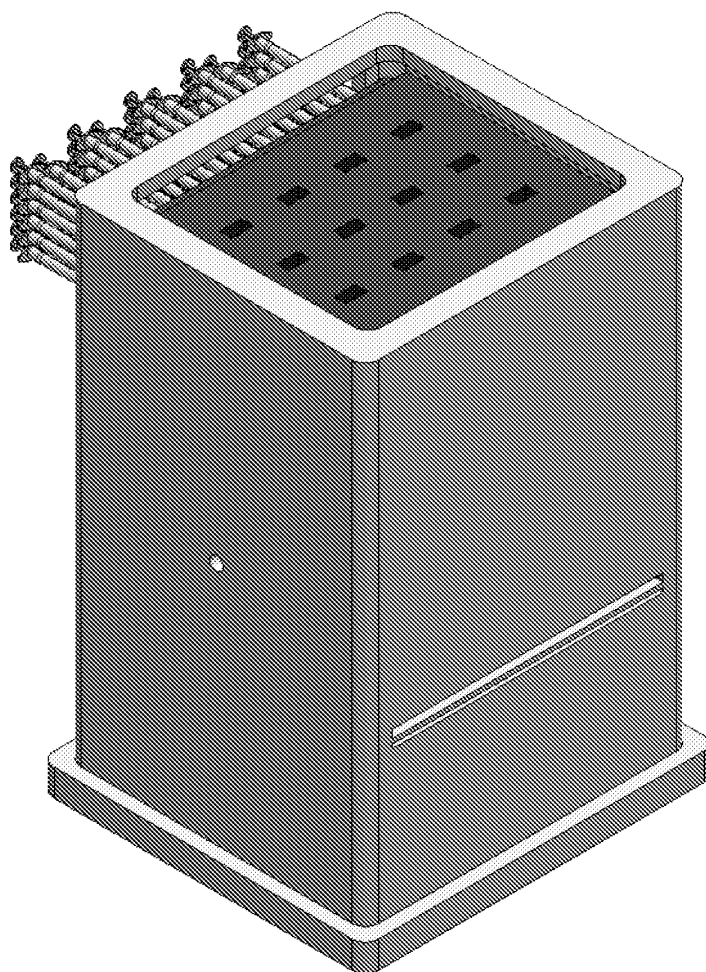
[1] Fig. 24A illustrates a flow diagram of a detailed embodiment of the assembled operating system, according to an example of the present disclosure.

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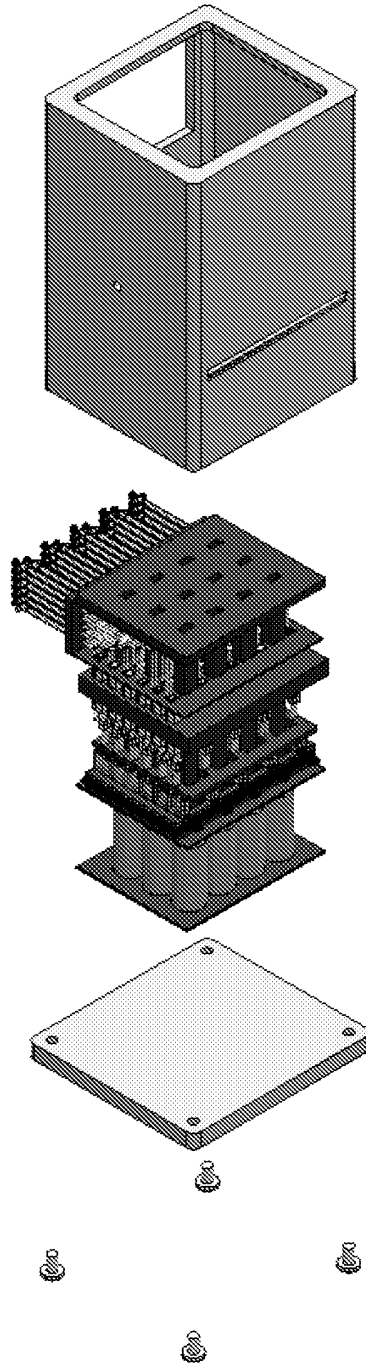
[1] Fig. 25A illustrates a perspective view of another embodiment of the operating system cover, according to an example of the present disclosure.

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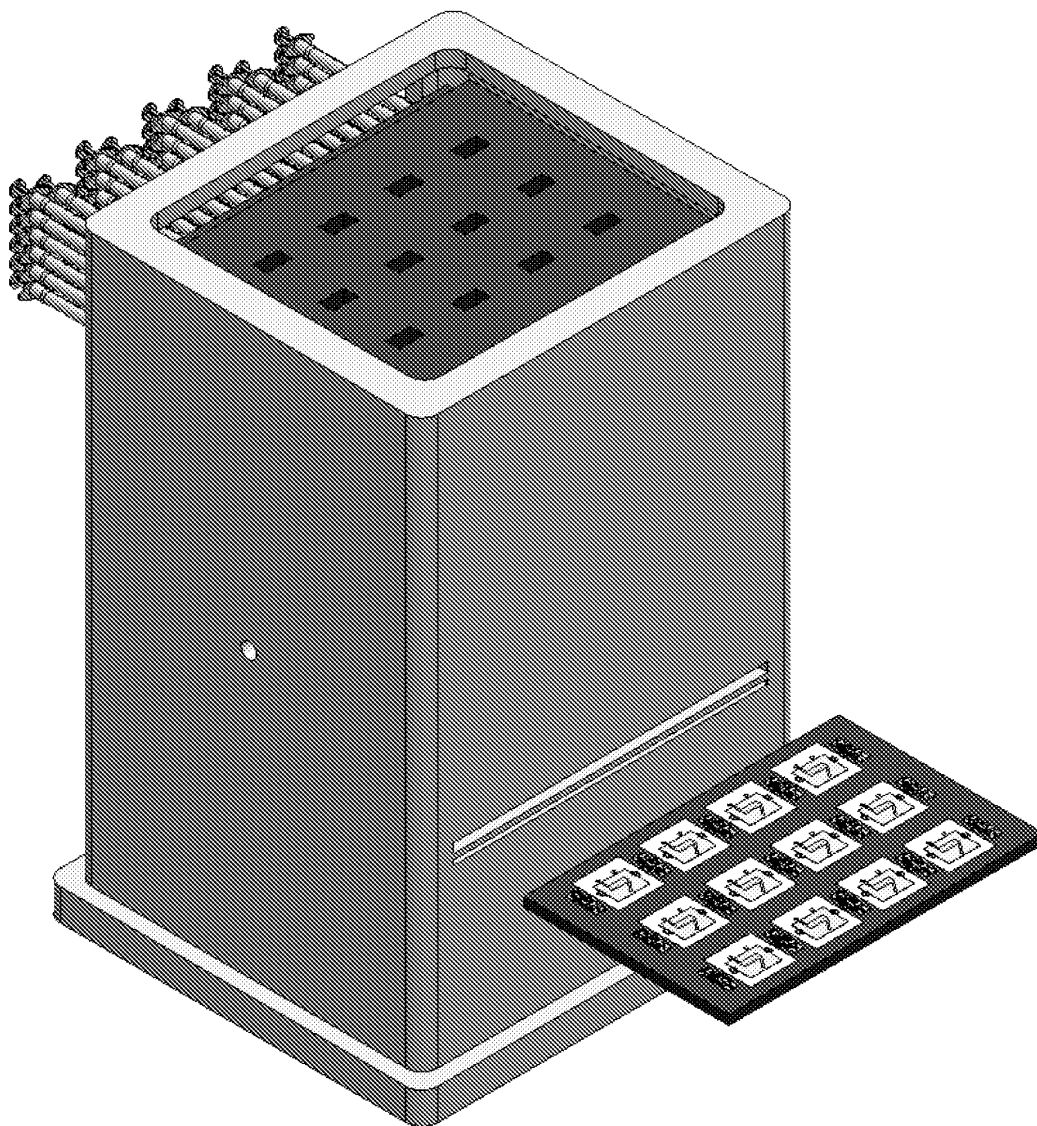
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[1] Fig. 25B illustrates an exploded view of the operating system cover, according to an example of the present disclosure.



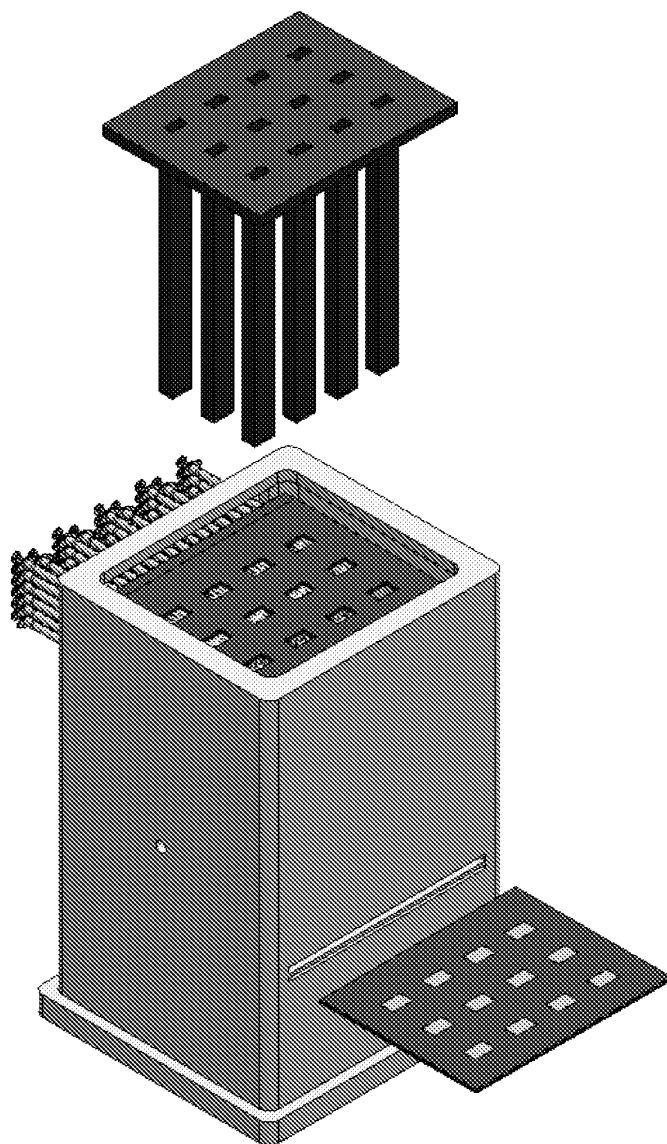
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[1] Fig. 25C illustrates a perspective view of the human-chip insertion process inside the operating system, according to an example of the present disclosure.



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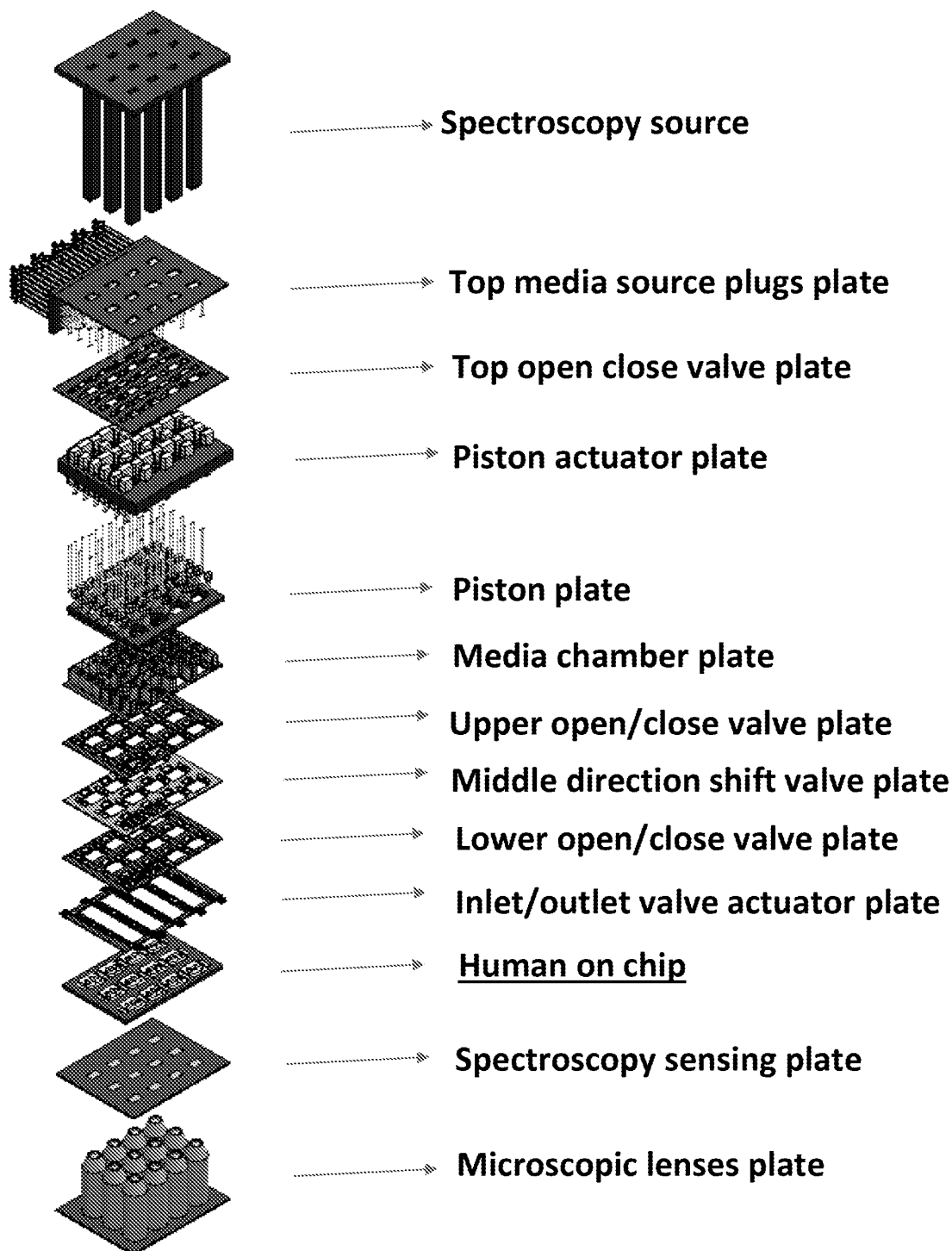
[1] Fig. 25D illustrates a perspective view of the spectroscopy probe and sensing plates insertion into the operating system, according to an example of the present disclosure.



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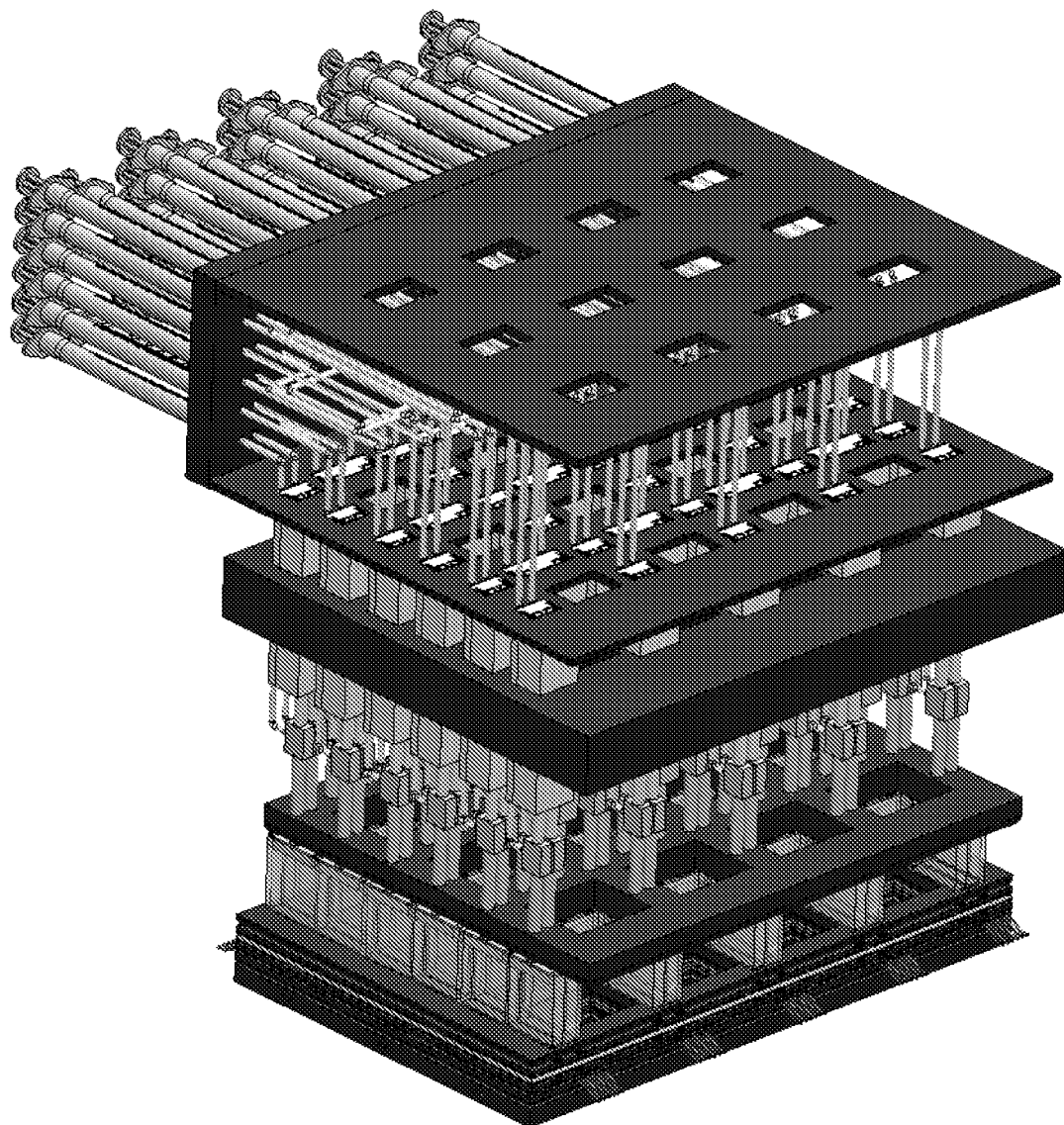
[1] Fig. 25E illustrates an exploded view of all the operating system components, according to an example of the present disclosure.

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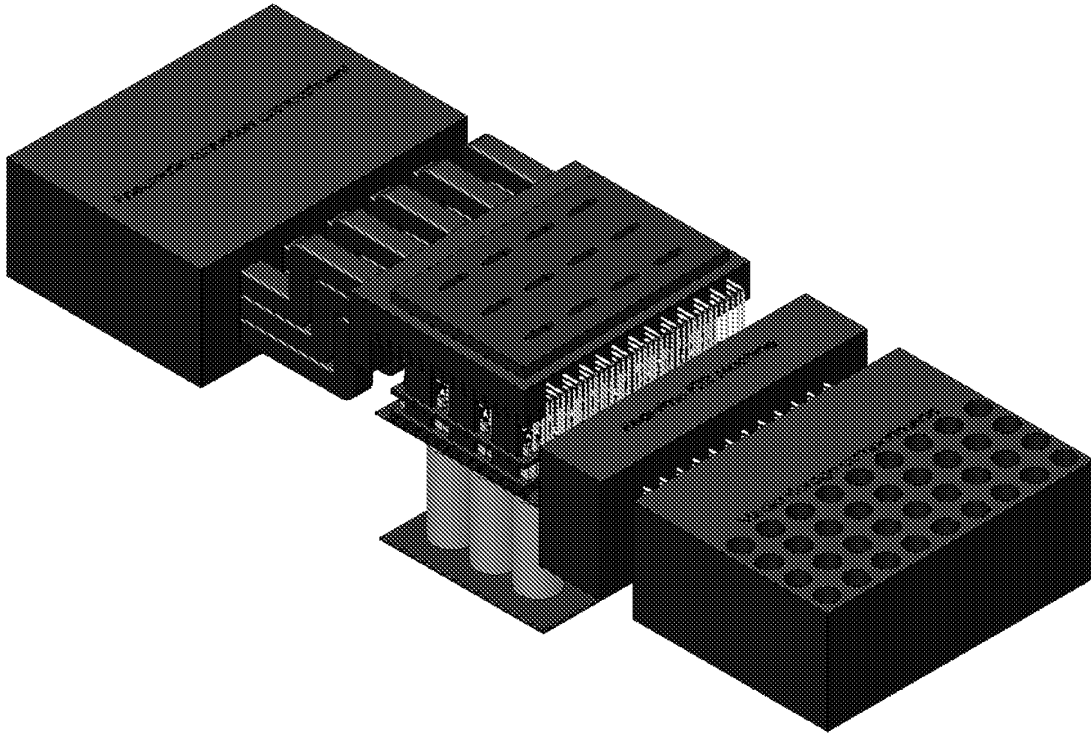
[1] Fig. 25F illustrates a perspective view of the fluidic control part of the operating system, according to an example of the present disclosure.



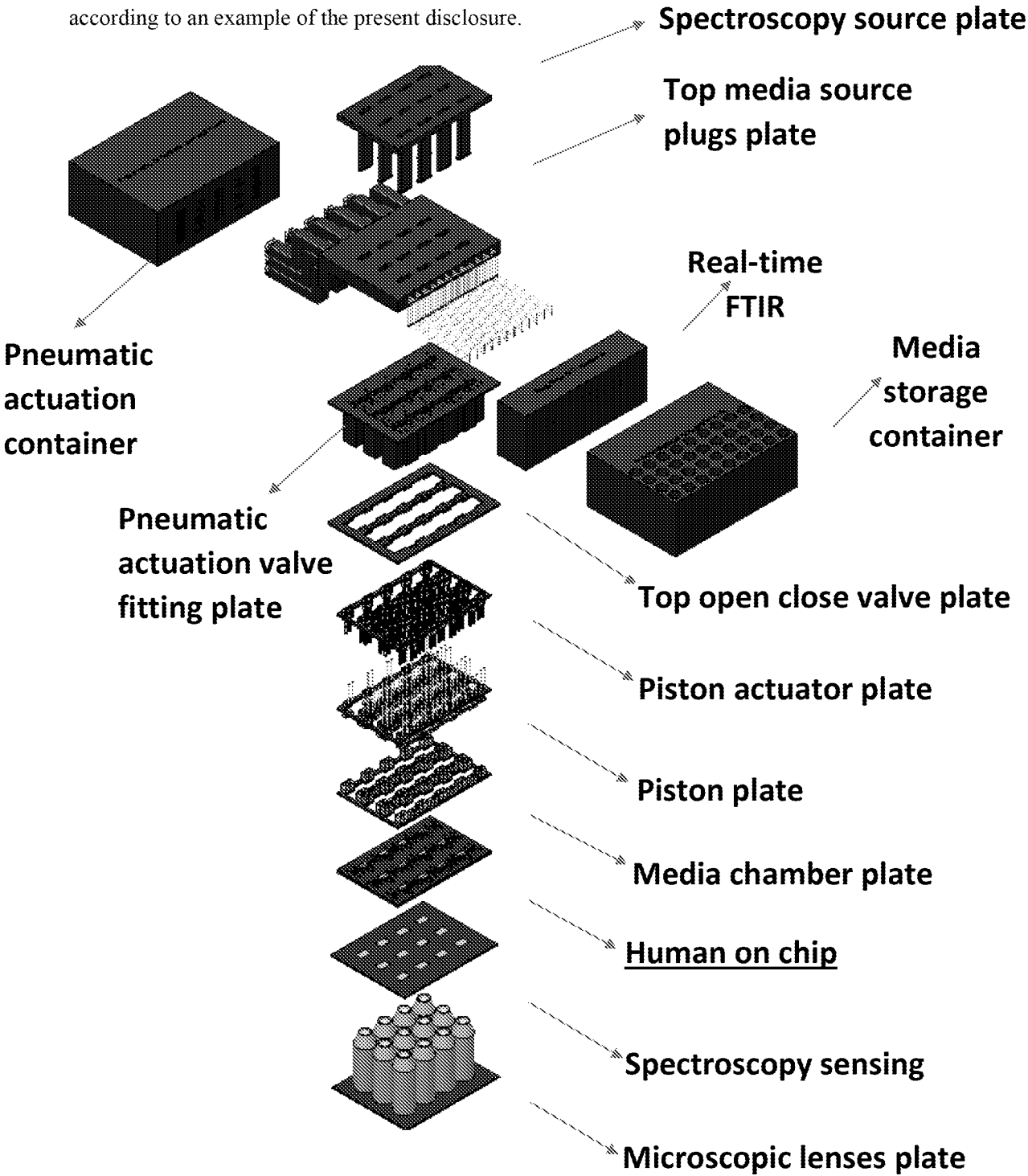
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The Operating system fluidic control mechanism design:

[1] Fig. 26A illustrates a perspective view of an embodiment of the pneumatic valve actuated operating system, according to an example of the present disclosure.

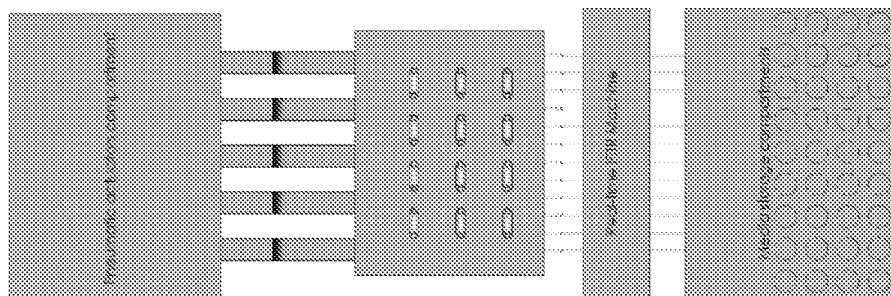


[1] Fig. 26B illustrates an exploded view of the pneumatic valve actuated operating system, according to an example of the present disclosure.

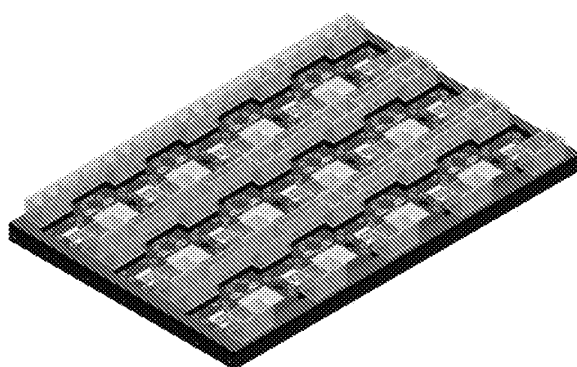


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[1] Fig. 26C illustrates a top view of the pneumatic valve actuated operating system, according to an example of the present disclosure.

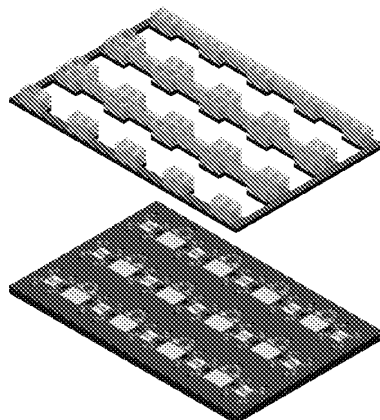


[1] Fig. 27A illustrates an embodiment of the assembly of media chambers of another embodiment of the human-on-chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is flexible membrane mechanism actuated pneumatically (isometric view)

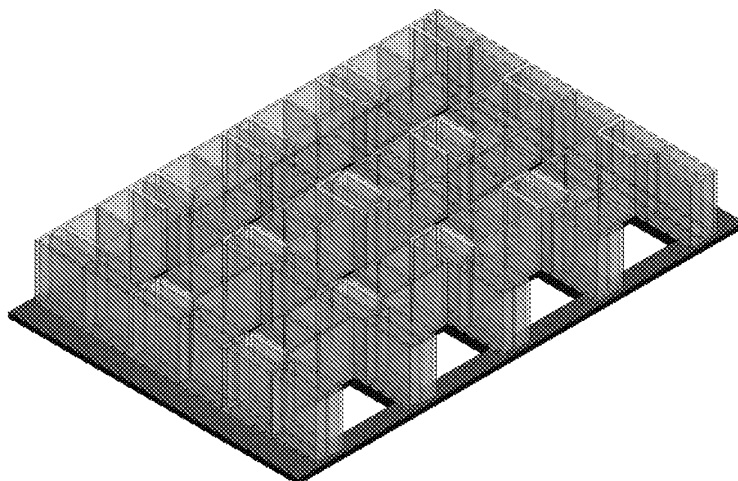


[1] Fig. 27B illustrates an exploded assembly of media chambers of another embodiment of the human on chip where the individual chip entities are incorporated as 1 part within the chassis and the valving mechanism connecting individual chip components is flexible membrane mechanism actuated pneumatically (isometric view)

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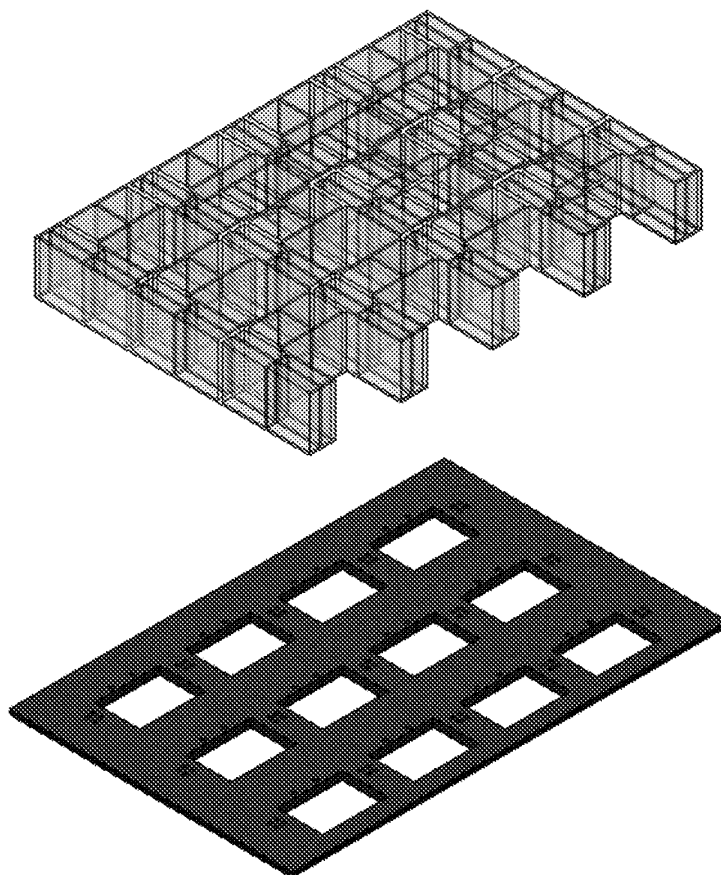


[1] Fig. 27C illustrates a perspective view of the media chamber plate, according to an example of the present disclosure.



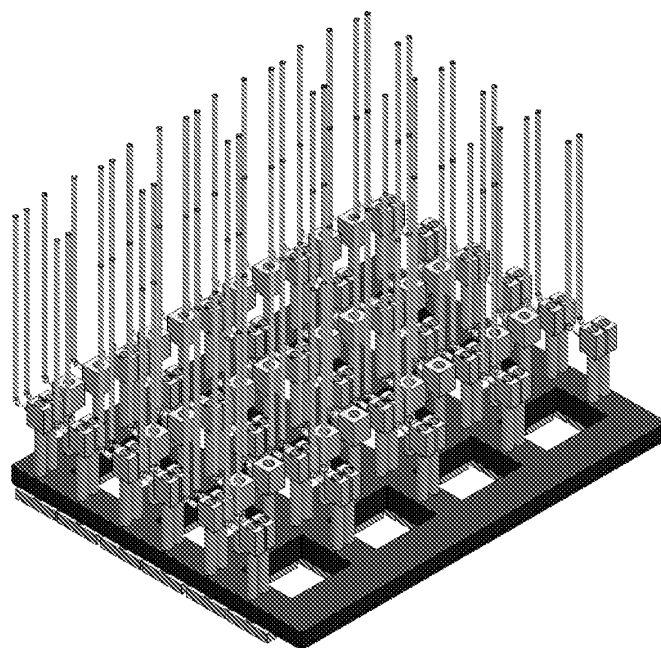
[1] Fig. 27D illustrates an exploded view of the media chamber plate, according to an example of the present disclosure.

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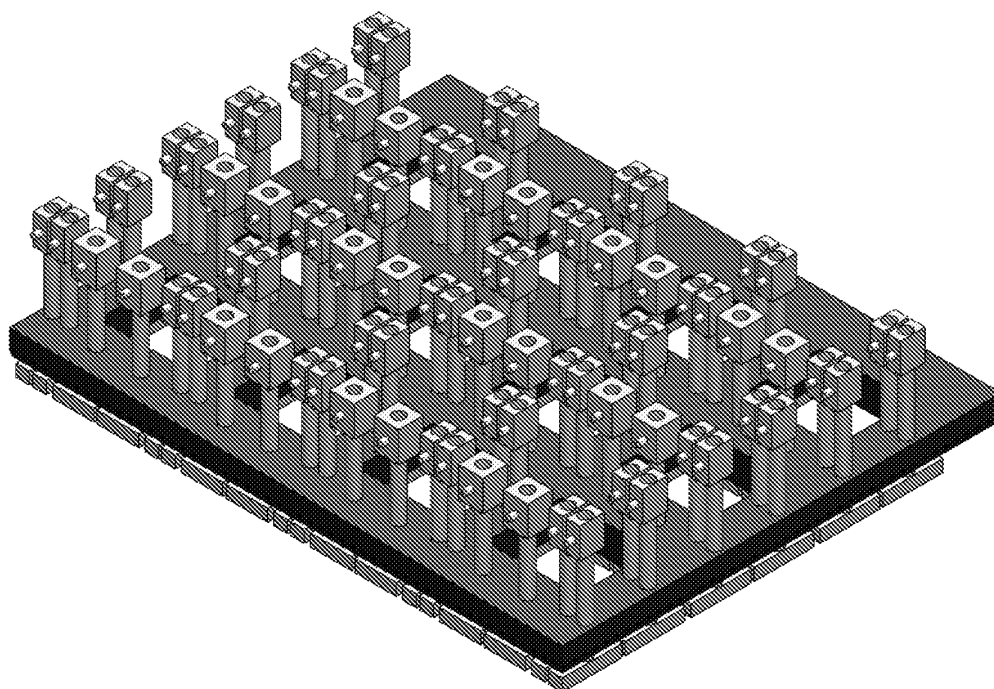


[1] Fig. 27E illustrates a perspective view of the piston plate, according to an example of the present disclosure.

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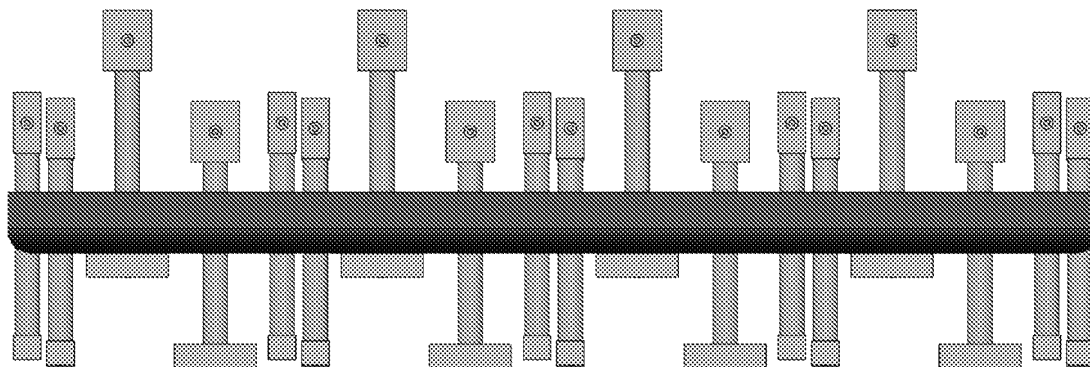


[1] Fig. 27F illustrates a perspective view of an additional embodiment of the piston plate, according to an example of the present disclosure.

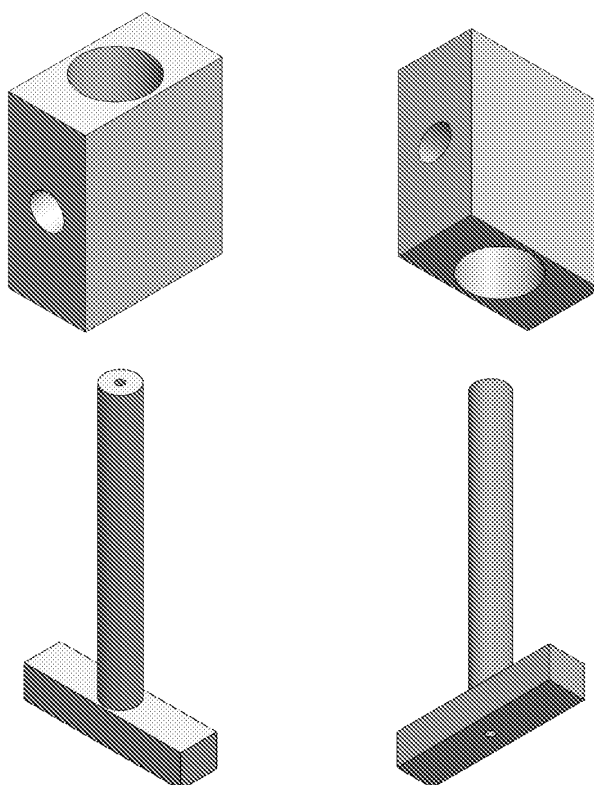


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[1] Fig. 27G illustrates a side view of an embodiment of the piston plate, according to an example of the present disclosure.

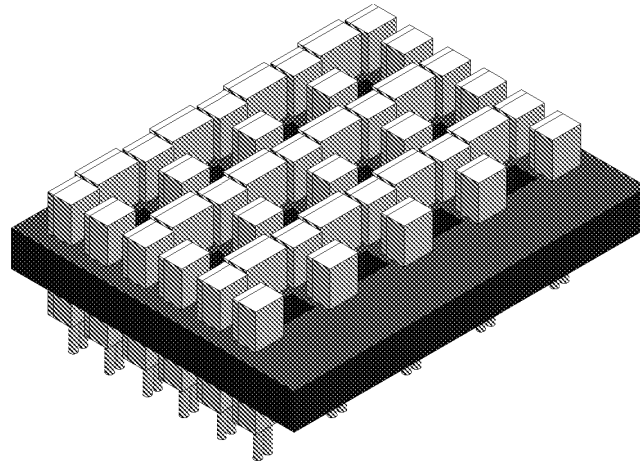


[1] Fig. 27H illustrates a detailed view of a single piston of Figs. 27E-27G, according to an example of the present disclosure.

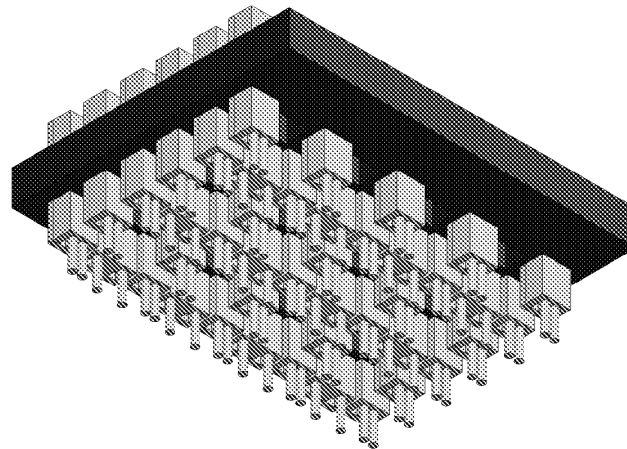


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[1] Fig. 27I illustrates a top perspective view of the piston actuator plate, according to an example of the present disclosure.

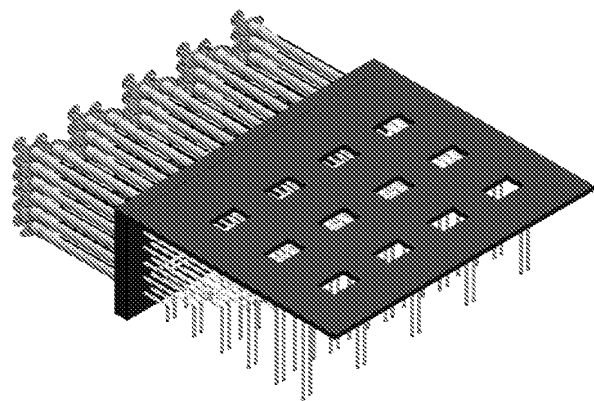


[1] Fig. 27J illustrates a bottom perspective view of the piston actuator plate, according to an example of the present disclosure.



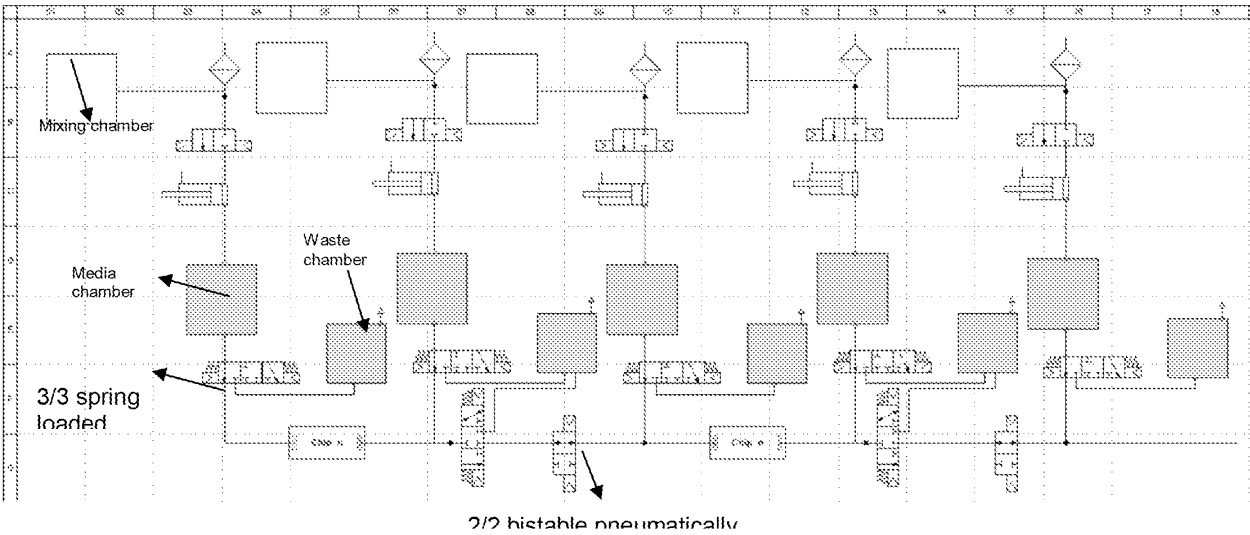
[1] Fig. 27K illustrates a perspective view of the fluid sourcing media plate, according to an example of the present disclosure.

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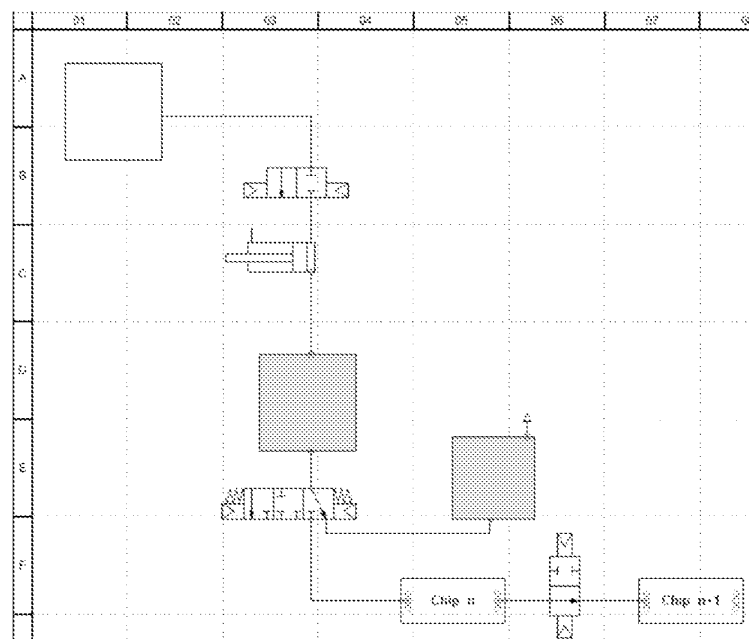
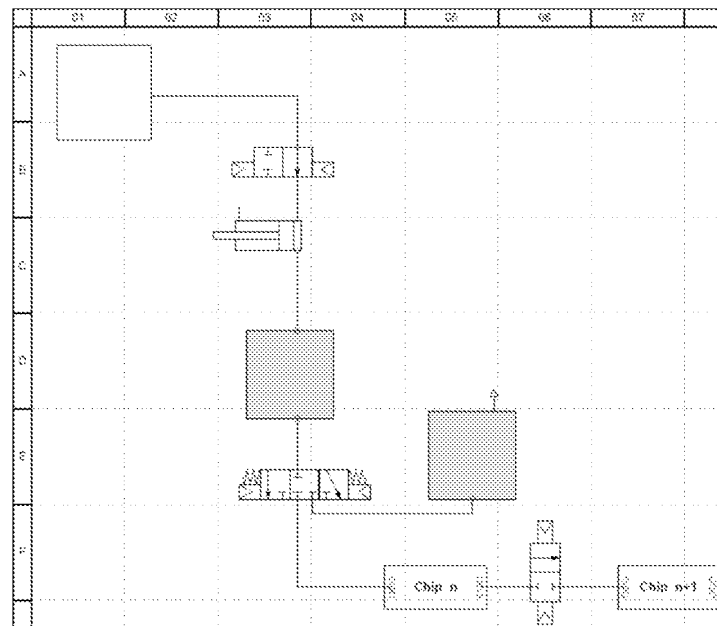
The Operating system fluidic control mechanism design:

[1] Fig. 28A illustrates a flow diagram of the processes of the human-on-chip operating system, according to an example of the present disclosure.



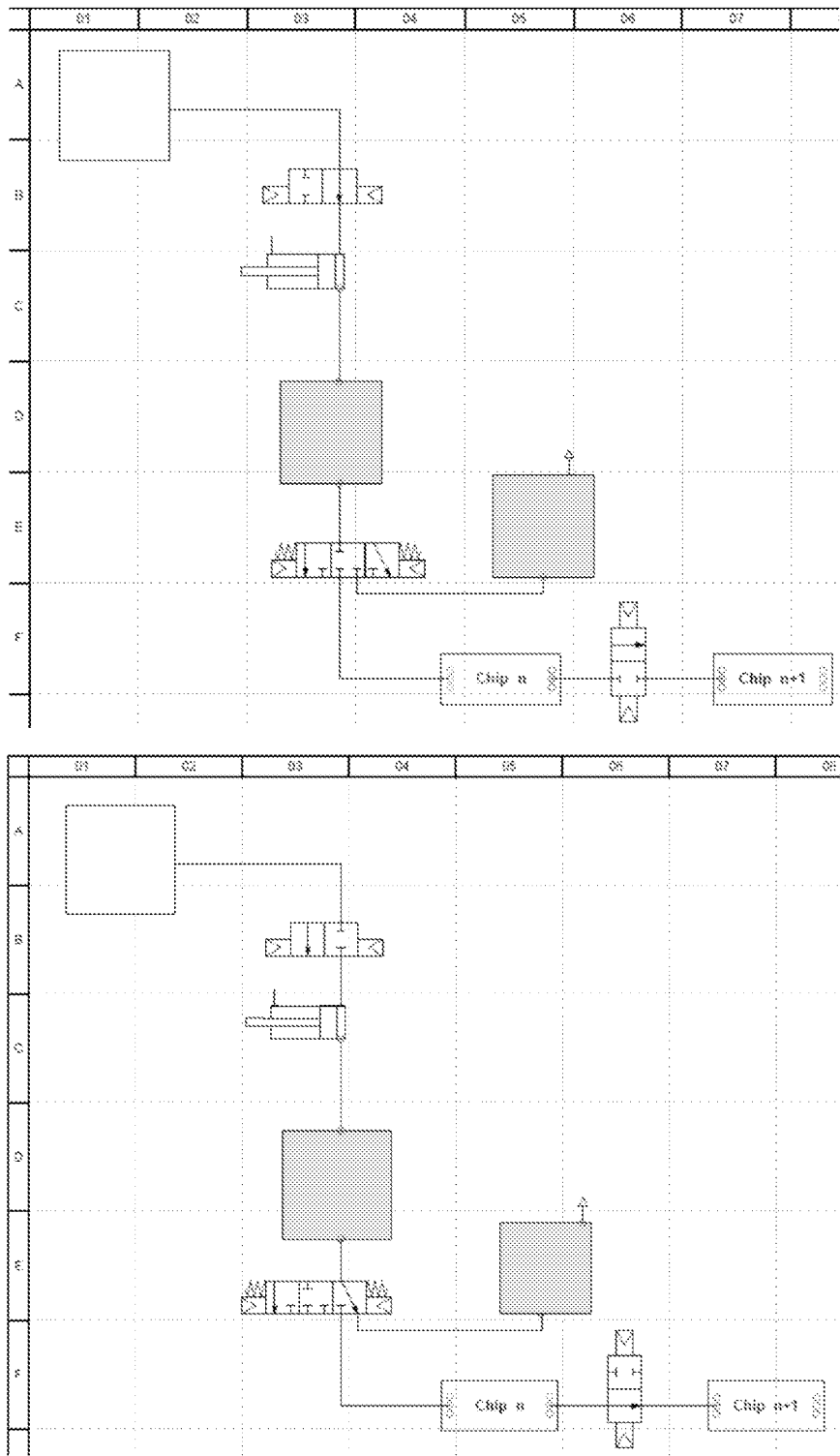
[1] Fig. 28B illustrates a flow diagram of the media chamber filling process of the human-on-chip operating system, according to an example of the present disclosure.

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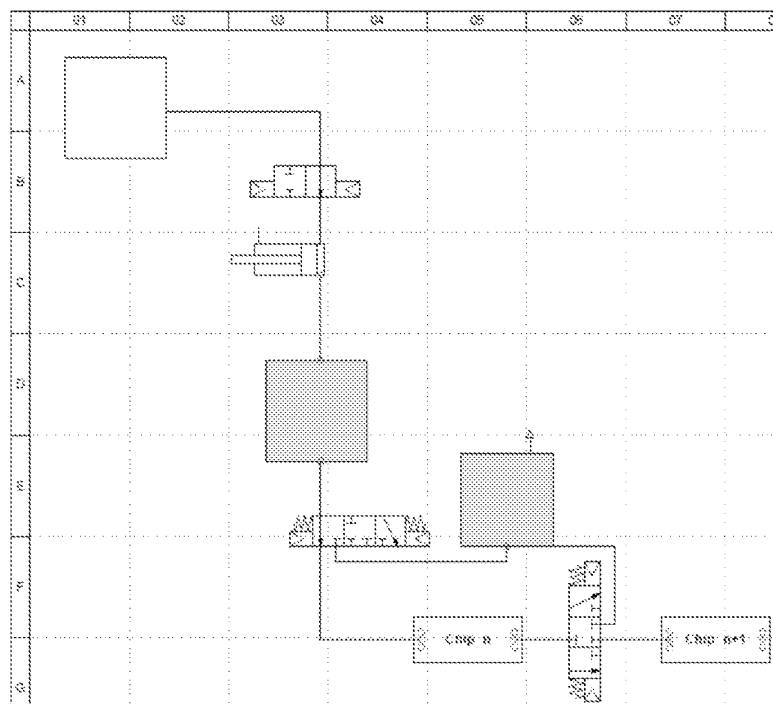
[1] Fig. 28C illustrates a flow diagram of the media chamber emptying process of the human-on-chip operating system, according to an example of the present disclosure.

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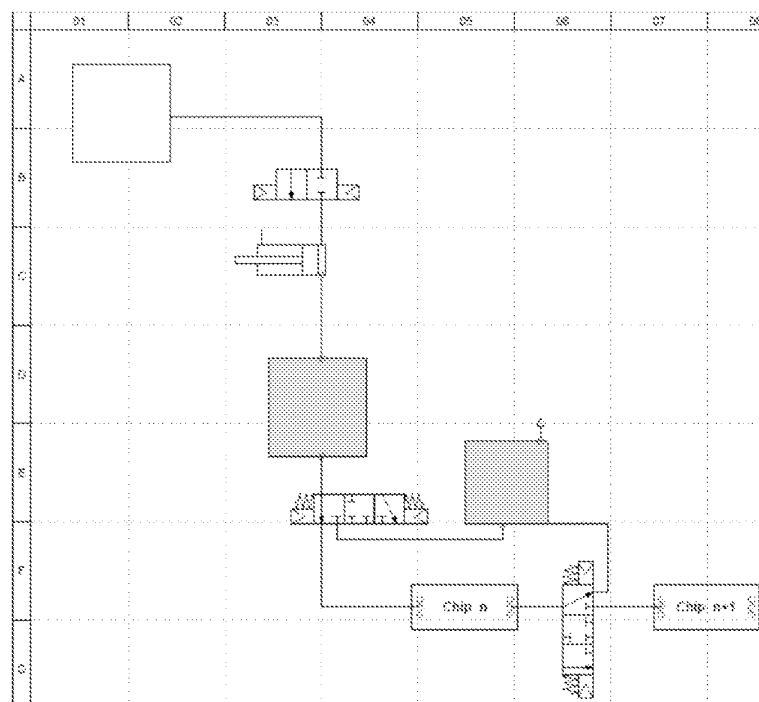


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[1] Fig. 28D illustrates a flow diagram of the media chamber seeding process of the human-on-chip operating system, according to an example of the present disclosure.

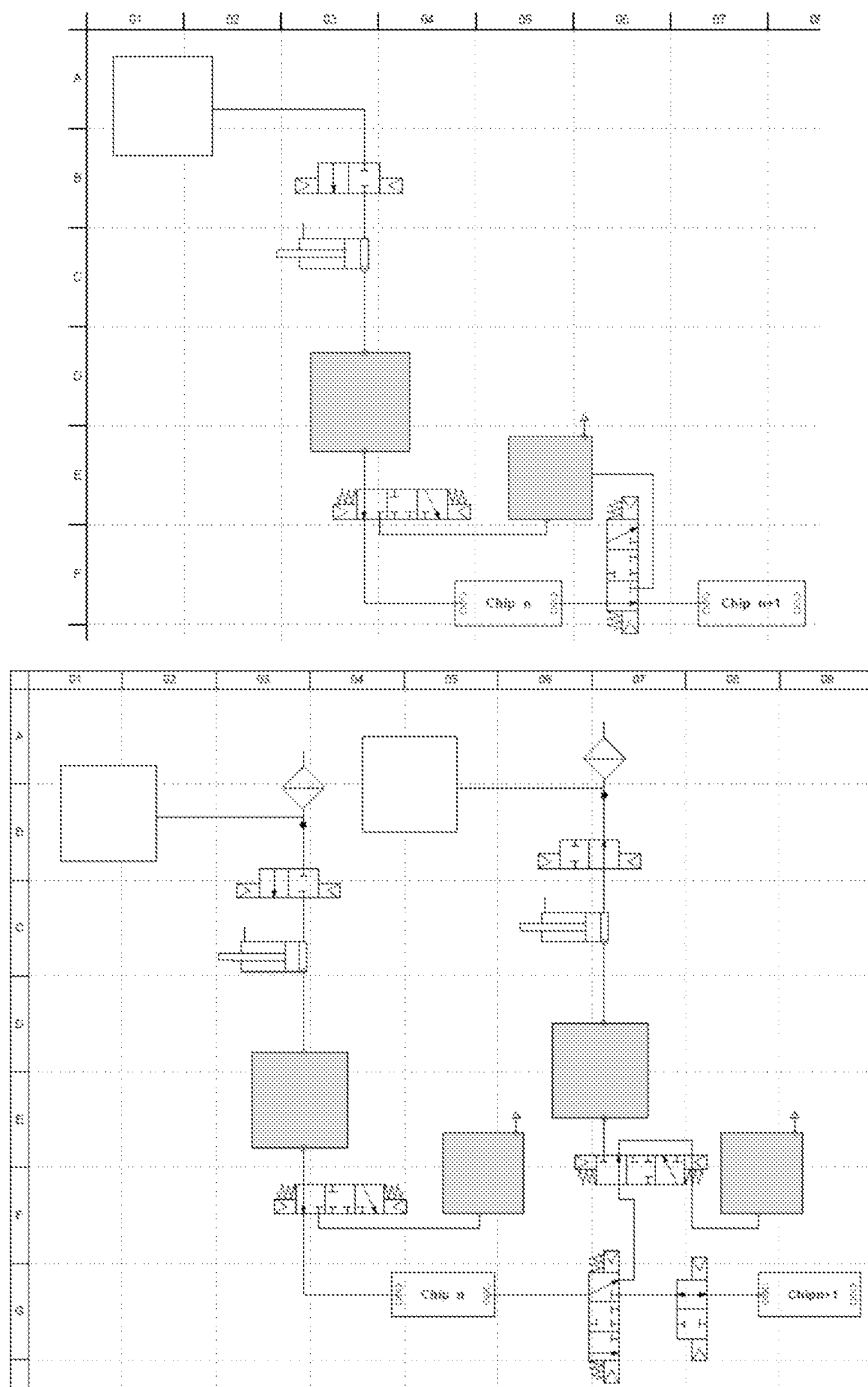


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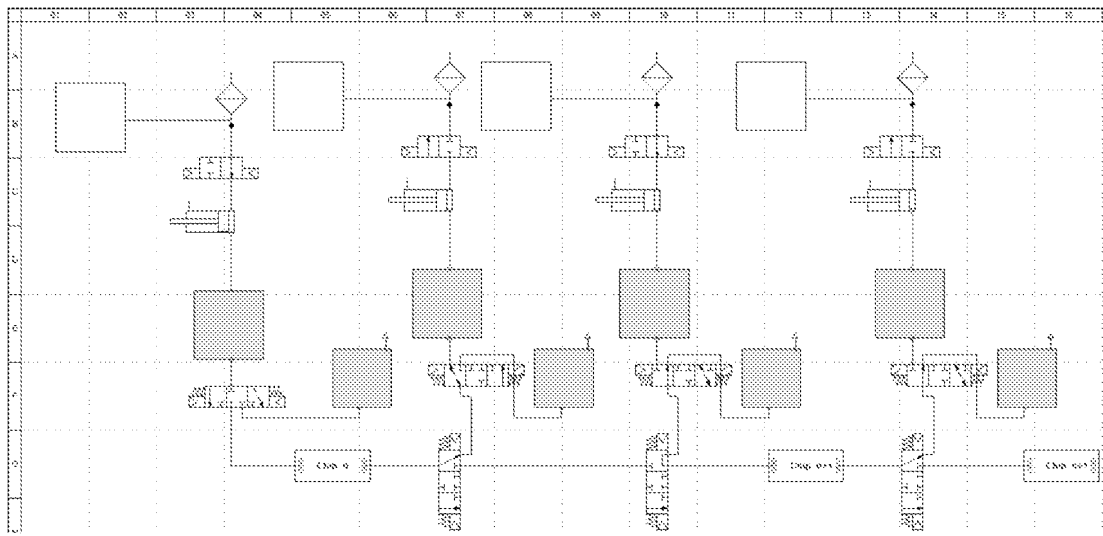
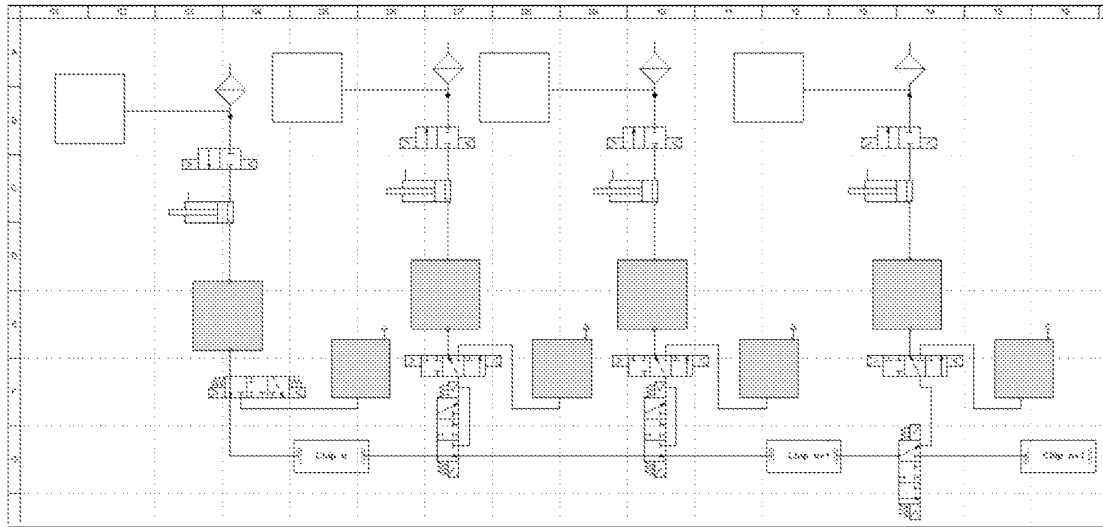
[1] Fig. 28E illustrates a flow diagram of the media sample collecting process of the human-on-chip operating system, according to an example of the present disclosure.

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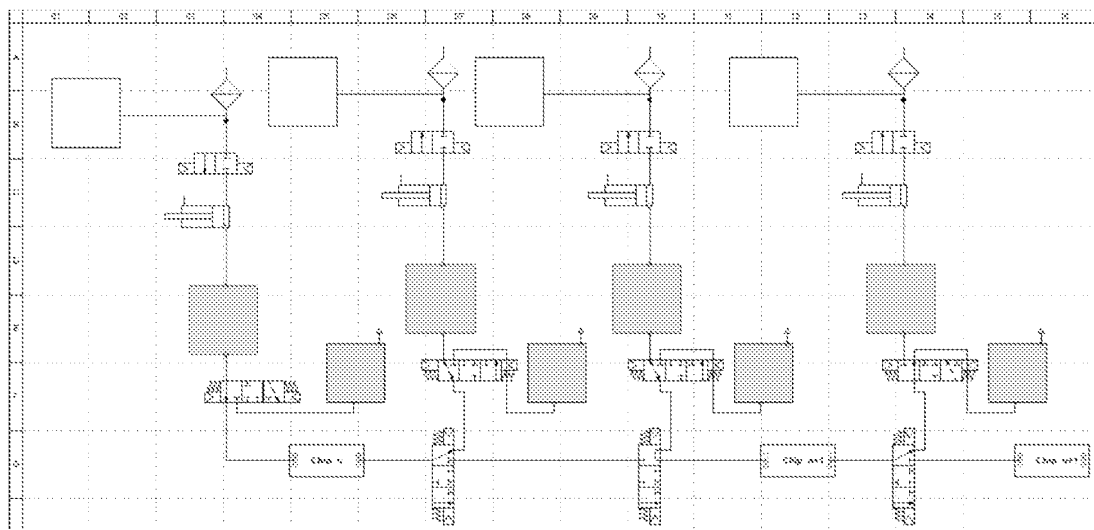


[1] Fig. 28F illustrates a flow diagram of the cell sample collecting process of the human-on-chip operating system, according to an example of the present disclosure.

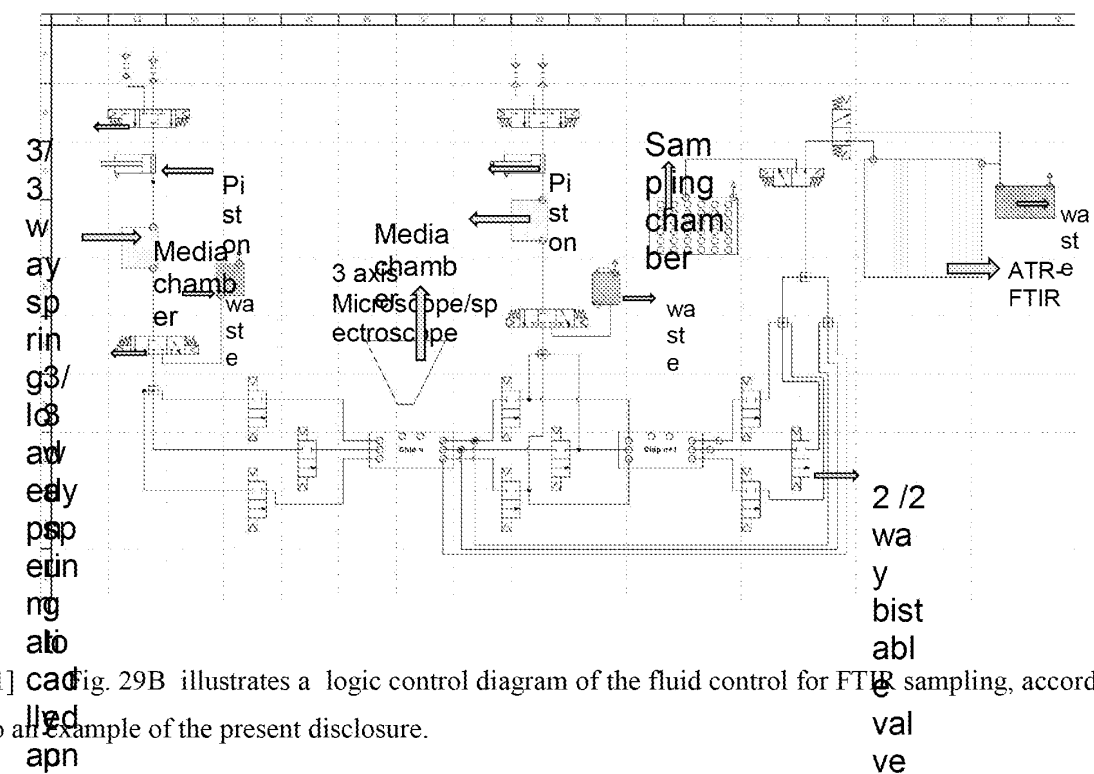
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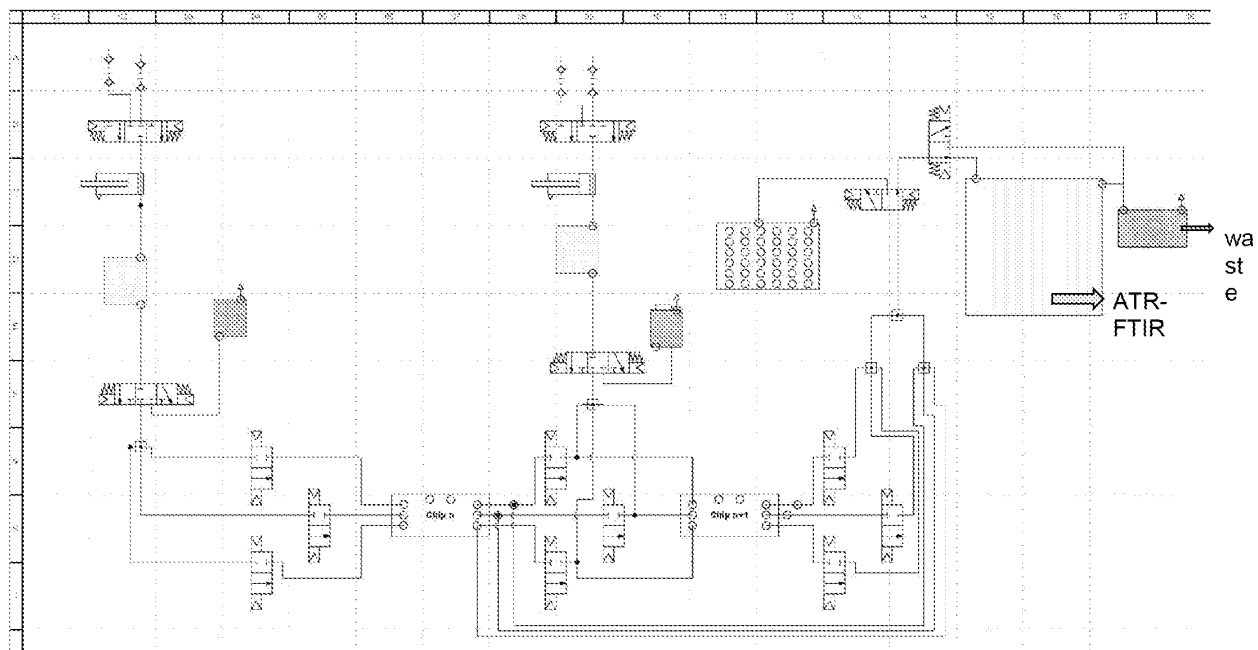


[1] Fig. 29A illustrates a flow diagram of the fluid control in the triple measurement mechanism, according to an example of the present disclosure.

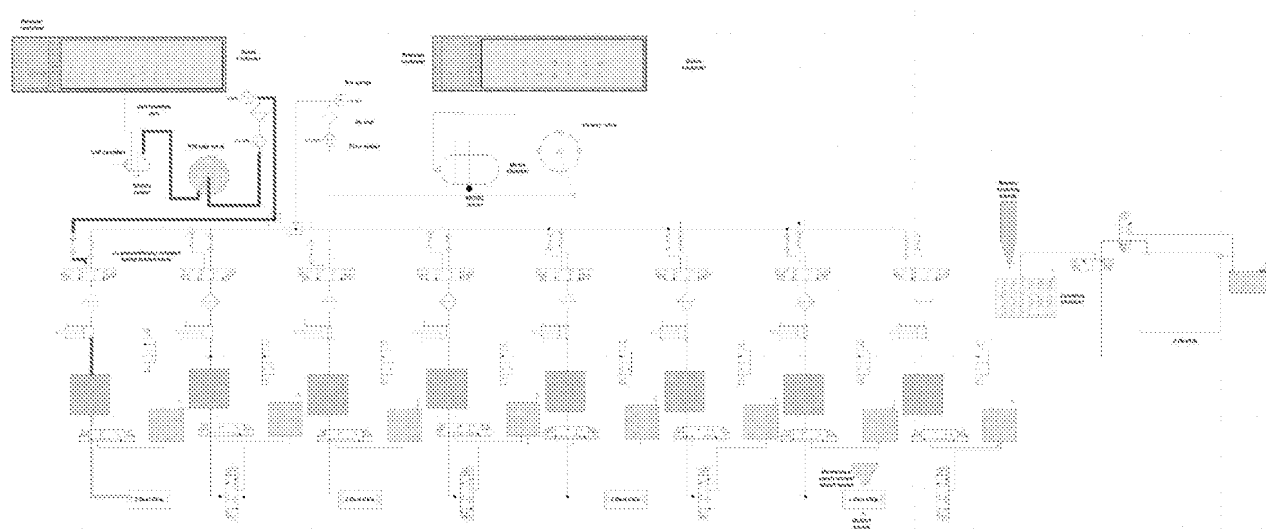


[1] Fig. 29B illustrates a logic control diagram of the fluid control for FTIR sampling, according to an example of the present disclosure.

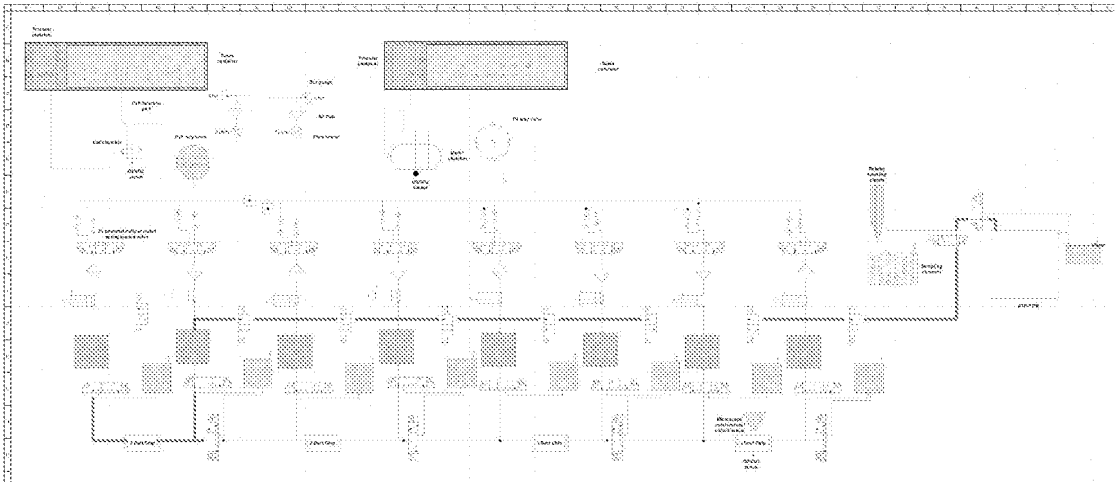
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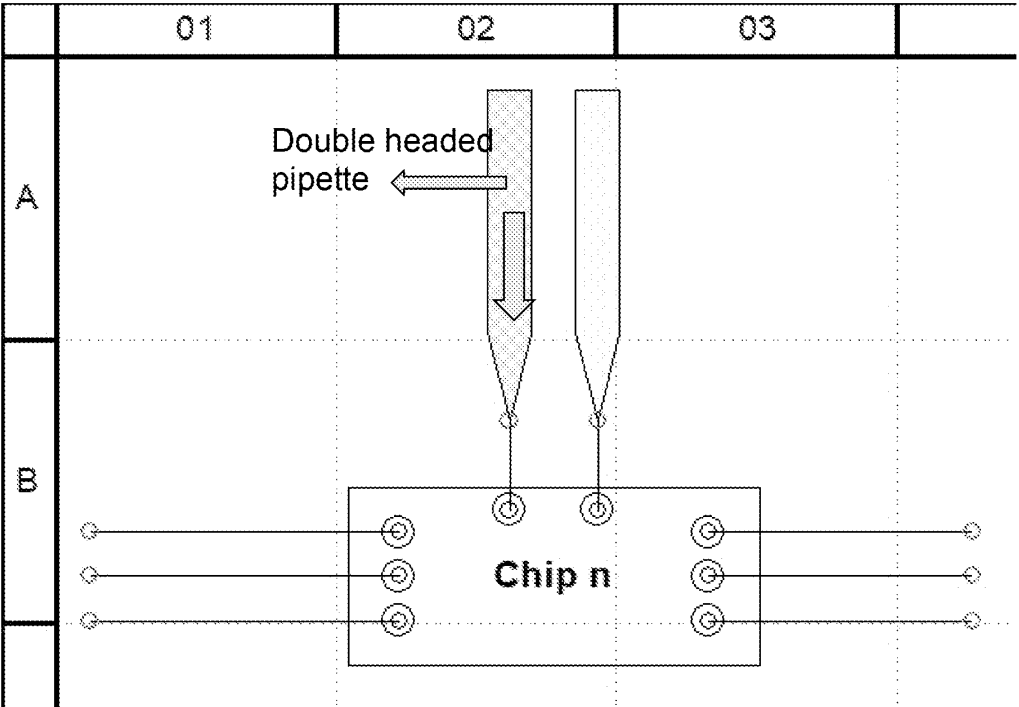
[0071] Fig. 30A shows the flow diagram to pump a sample from the media chamber to a biochip



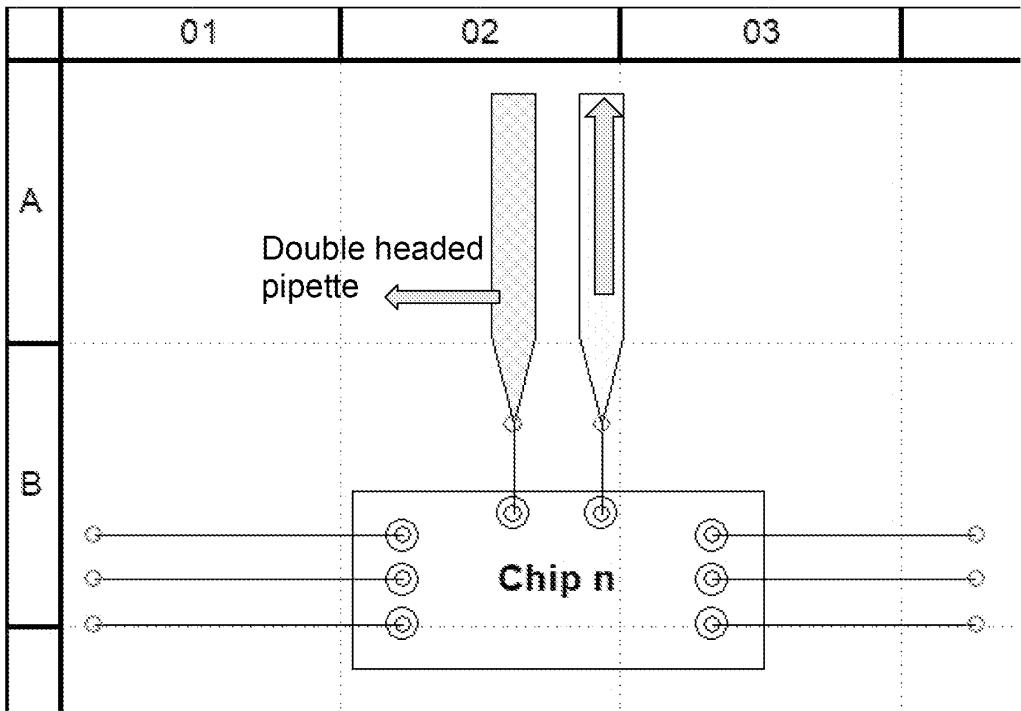
[0071] Fig. 30B shows the flow diagram to pump a sample from the biochip to a measurement device



[1] Fig. 31A illustrates a flow diagram of pump gel into the stroma channel, according to an example of the present disclosure.



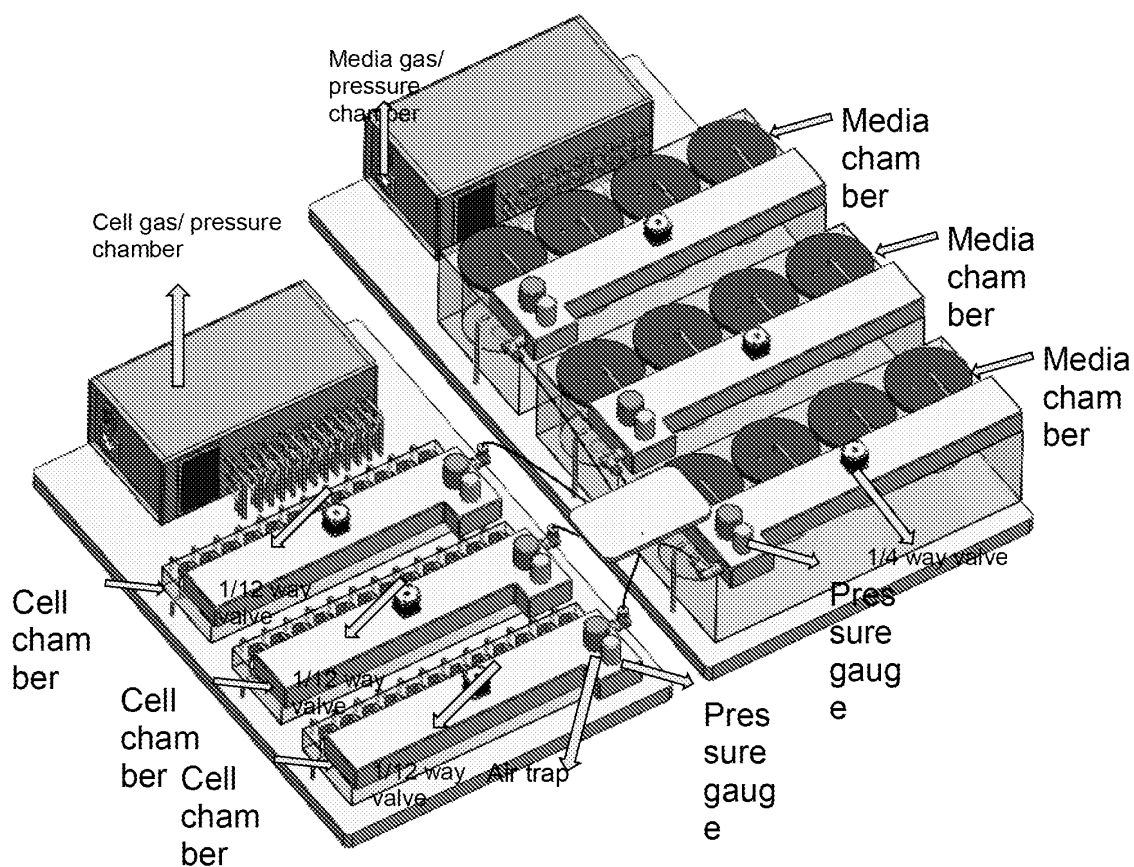
[1] Fig. 31B illustrates a flow diagram of pump gel out of the stroma channel, according to an example of the present disclosure.



Mixing Chambers:

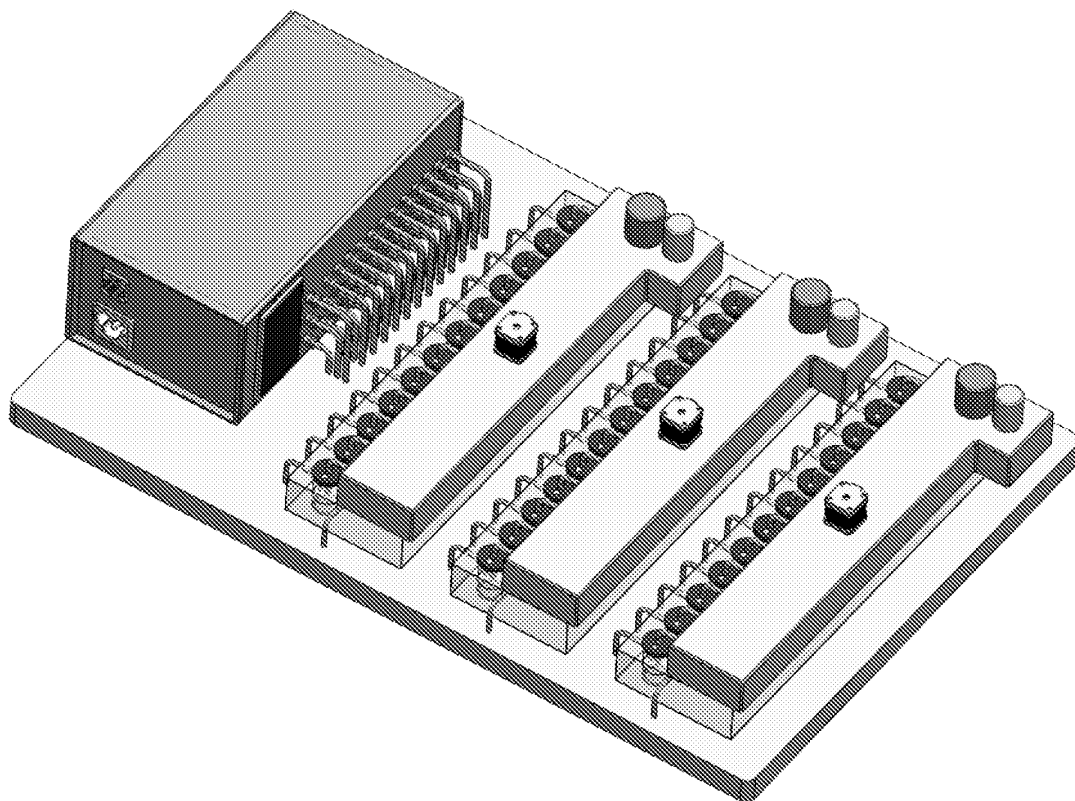
[1] Fig. 32A illustrates a schematic view of the fully assembled embodiment of the mixing chamber, according to an example of the present disclosure.

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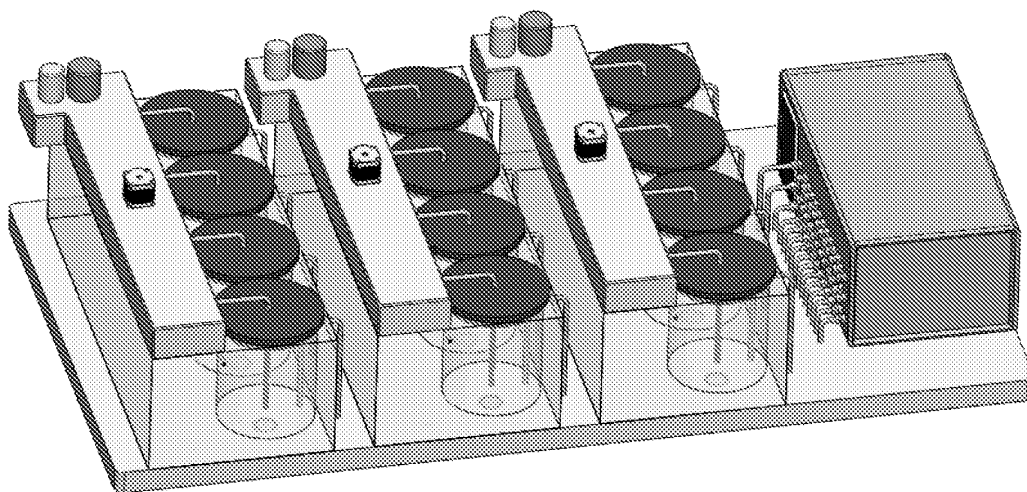
[1] Fig. 32B illustrates a schematic view of the embodiment of the cell sourcing mixing chamber, according to an example of the present disclosure.

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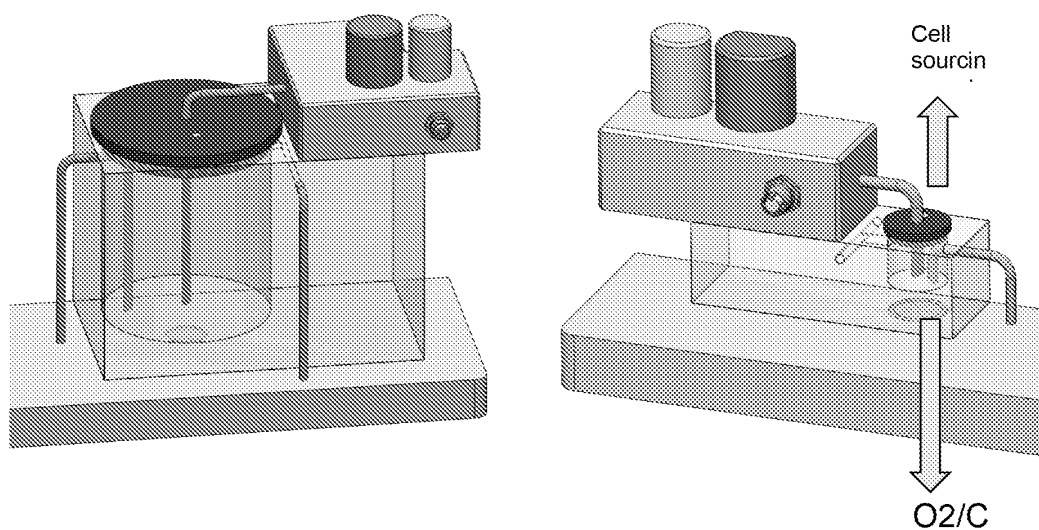


[1] Fig. 32C illustrates a schematic view of the embodiment of the media sourcing mixing chamber, according to an example of the present disclosure.

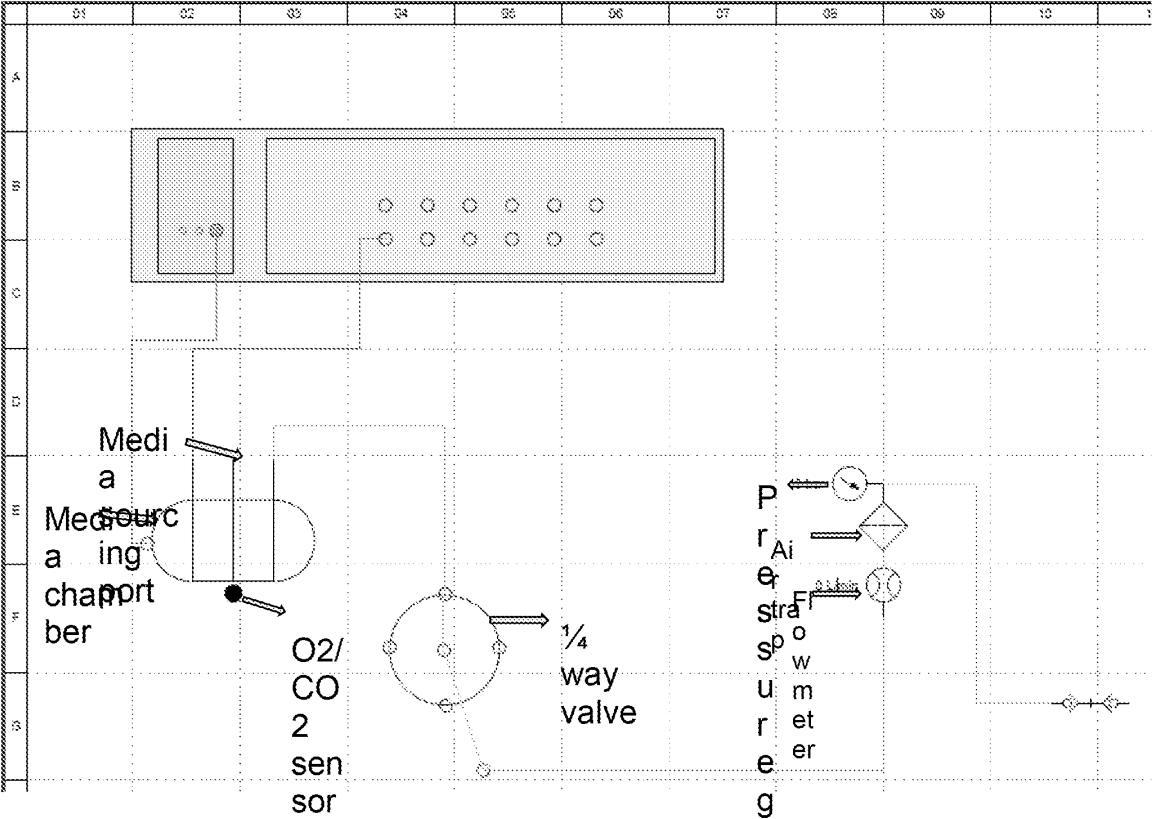
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[1] Fig. 32D illustrates a schematic view of the Cell chamber and media chamber side by side, according to an example of the present disclosure.



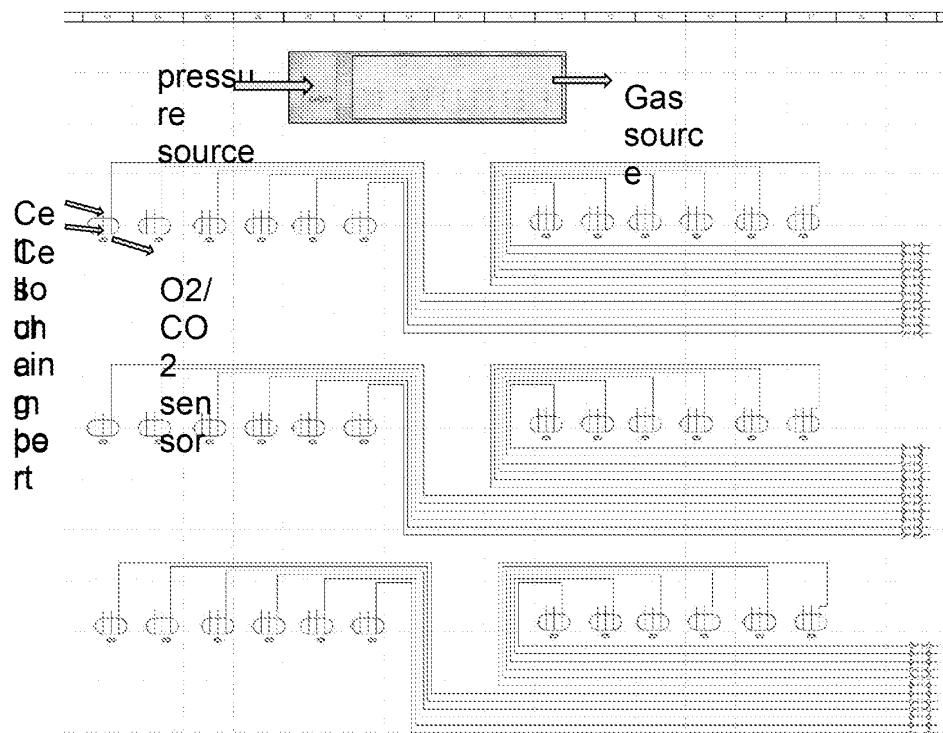
[1] Fig. 32E illustrates a flow diagram of an embodiment of the bubble filter and pressure sensors of the mixing chamber, according to an example of the present disclosure.



[1] Fig. 33A illustrates a flow diagram of an embodiment of the mixing chamber where all 36 tubes leave the mixing system, according to an example of the present disclosure.

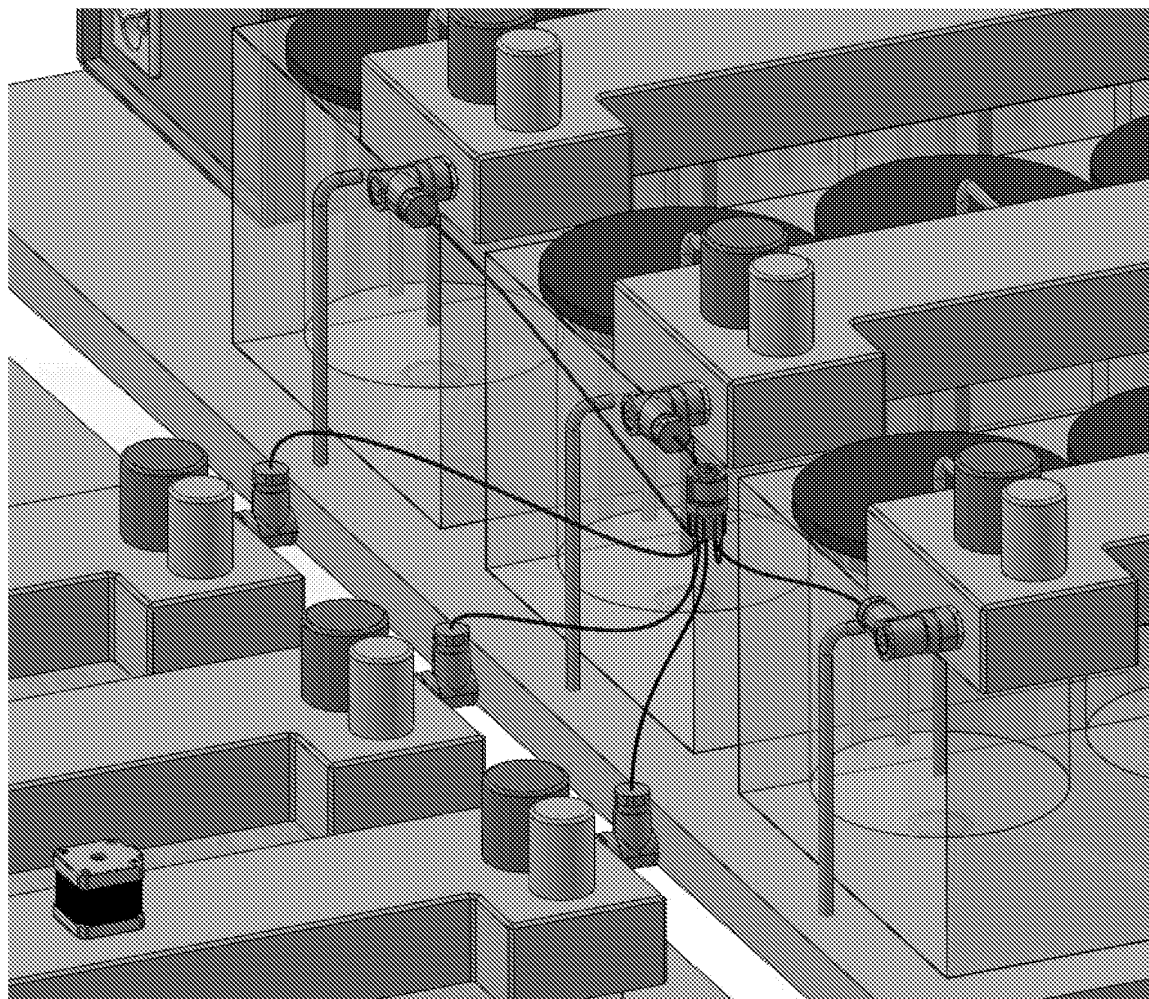
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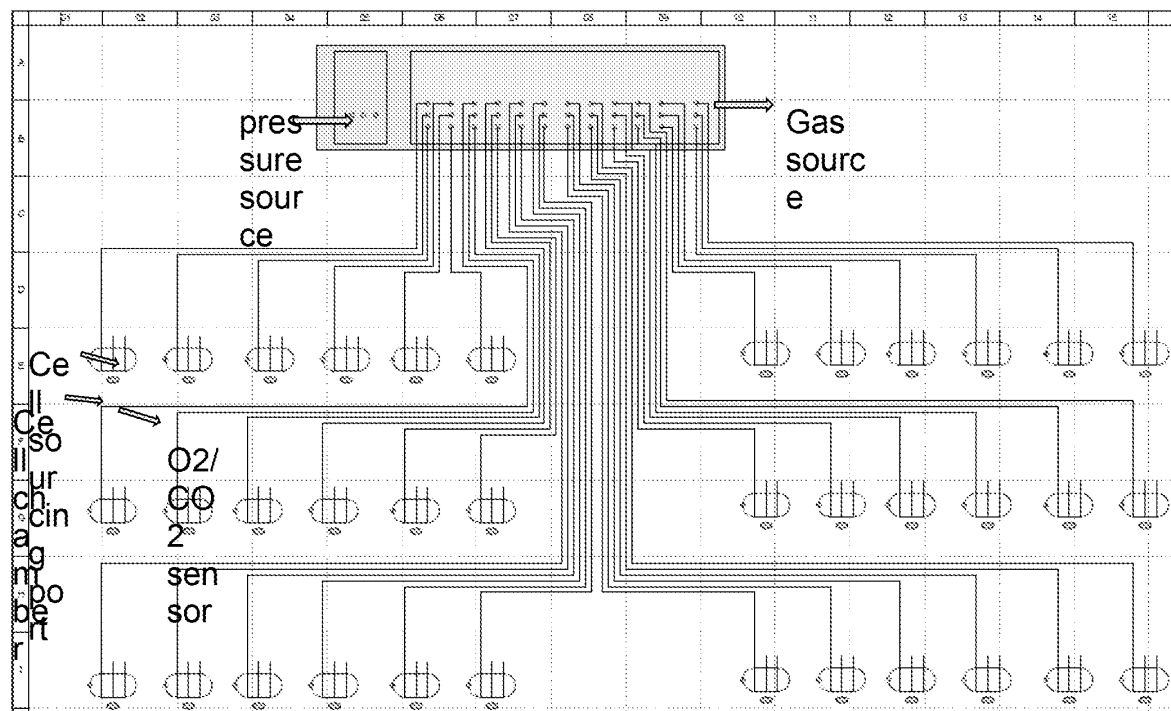
[1] Fig. 33B illustrates a perspective view of an embodiment of the mixing chamber where all 36 tubes feed into only 3 tubes leaving the mixing system, according to an example of the present disclosure.

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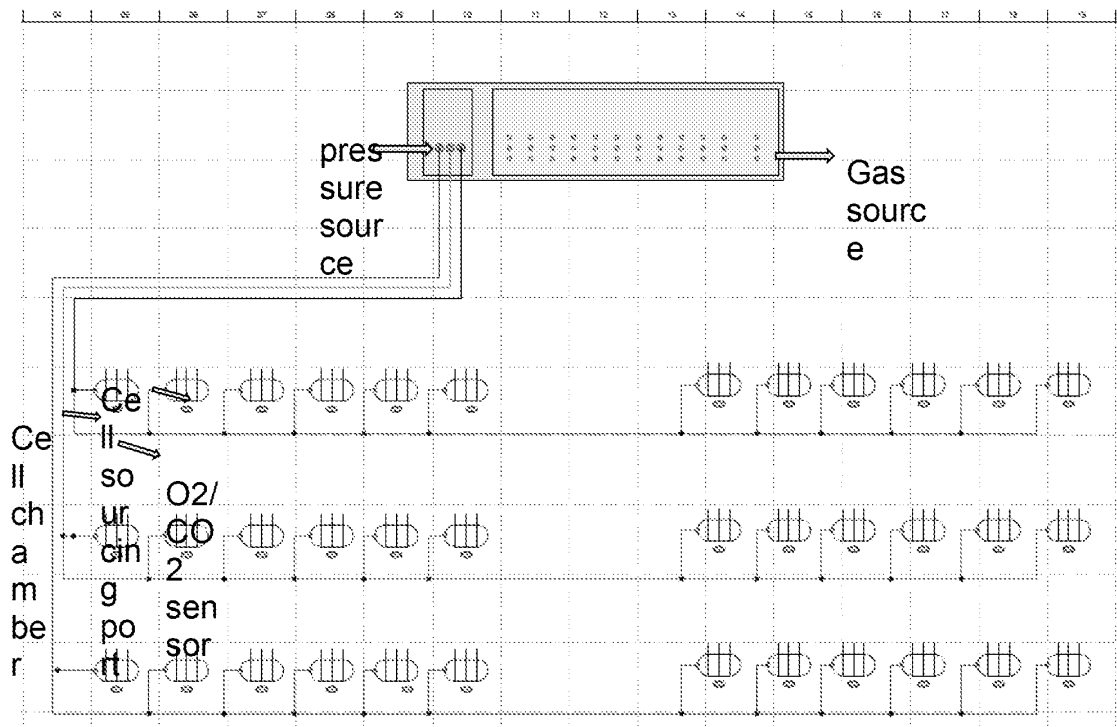


[1] Fig. 33C illustrates a flow diagram of an embodiment of the mixing chamber where all the 36 gas tubes are connected to the cell chamber, according to an example of the present disclosure.

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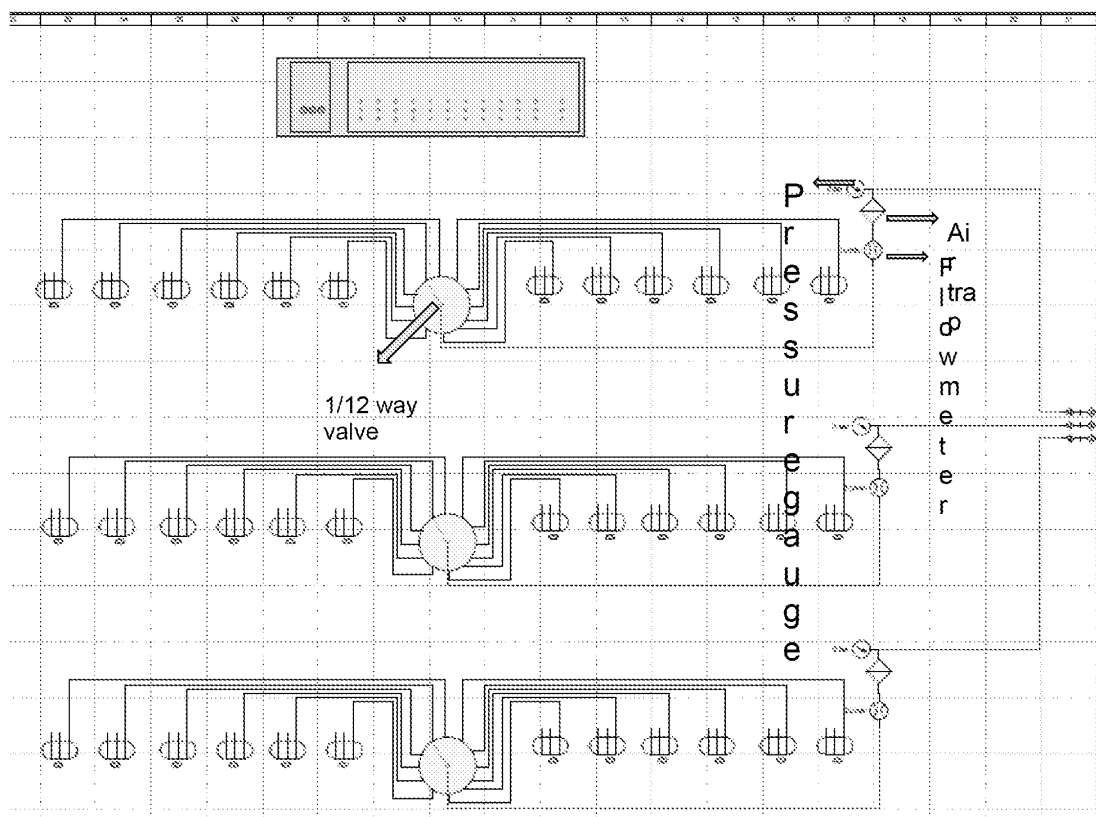


[1] Fig. 33D illustrates a flow diagram of an embodiment of the mixing chamber where all the 3 pressure valves are connected to the cell chambers, according to an example of the present disclosure.



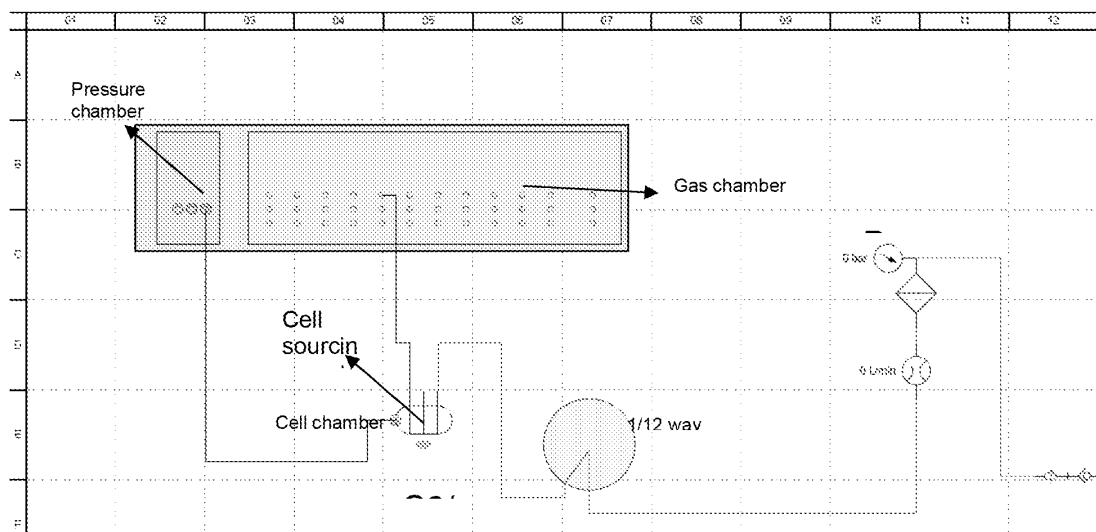
[1] Fig. 33E illustrates a flow diagram of an embodiment of the mixing chamber where each row of the cell chambers is connected to the 1/12 way valve that can switch between them and send a sample through a flow sensor, air filter, and a pressure gauge connected to a quick connect that is linking the mixing chamber with the human-on-chip plate, according to an example of the present disclosure.

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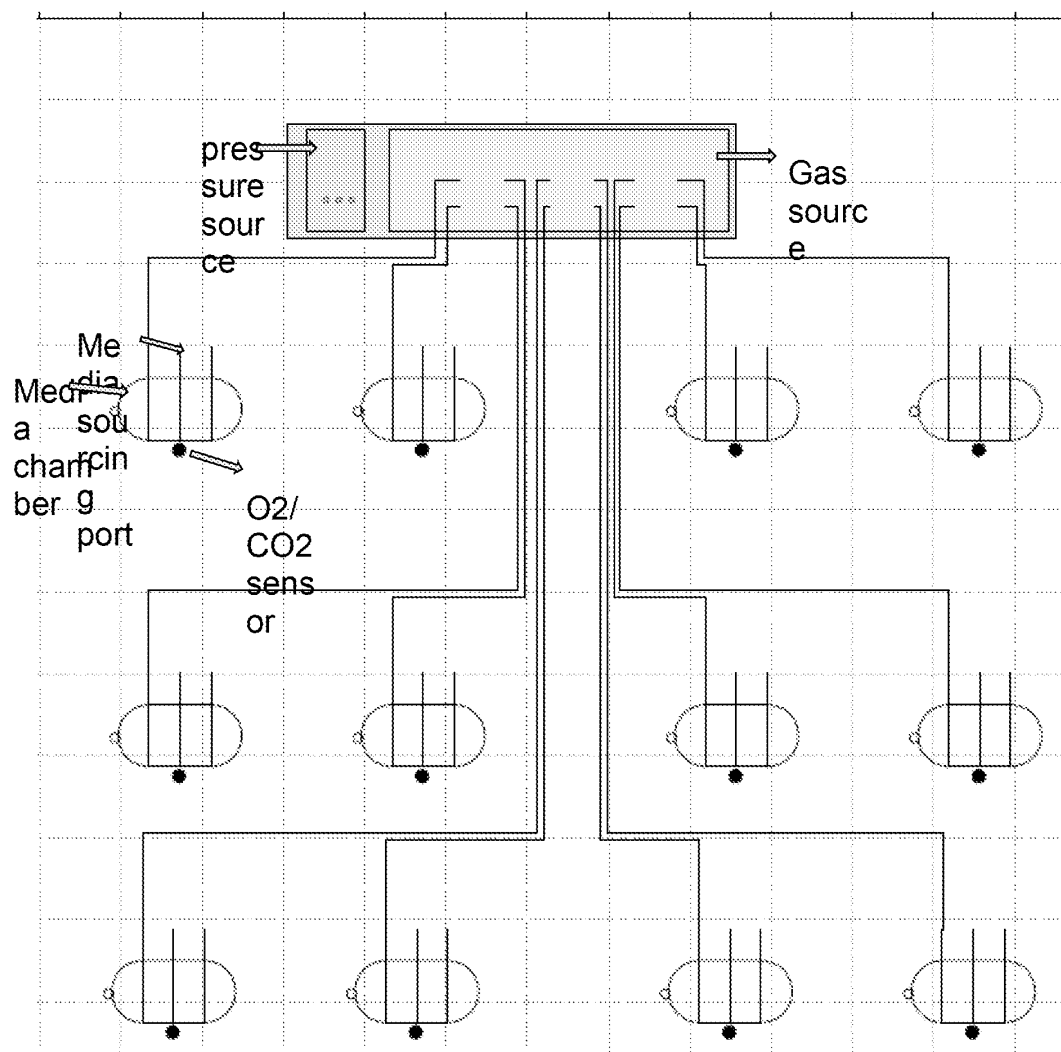
[1] Fig. 33F illustrates a flow diagram of a single cell chamber entity where its connected to the pressure and gas from one side and to the 1/12 way valve from the other which interim is connected to a sensor, air filter, and a pressure gauge connected to a quick connect that's linking the mixing chamber with the human-on-chip plate, according to an example of the present disclosure.

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[1] Fig. 33G illustrates a flow diagram of an embodiment of the mixing chamber where all the 12 tubes are connected to the media chamber, according to an example of the present disclosure.

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[1] Fig. 33H illustrates a flow diagram of an embodiment of the mixing chamber where all the 3 pressure valves are connected to the media chambers, according to an example of the present disclosure.

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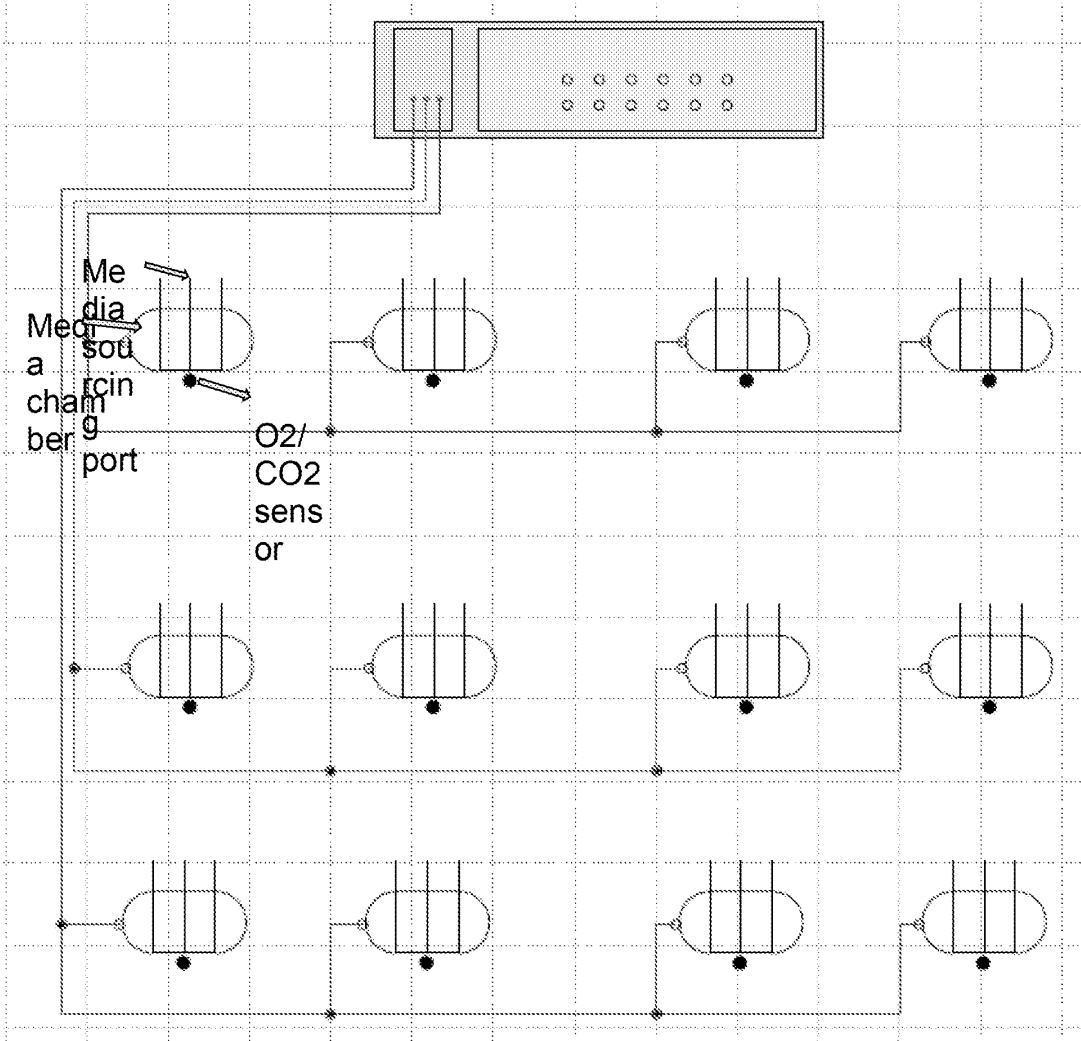


Fig. 33I illustrates a flow diagram of an embodiment of the mixing chamber where each row of the media chambers are connected to the 1/4 way valve that can switch between them and send a sample through a flow sensor, air filter, and a pressure gauge connected to a quick connect that is linking the mixing chamber with the human-on-chip plate, according to an example of the present disclosure. Fig 38G

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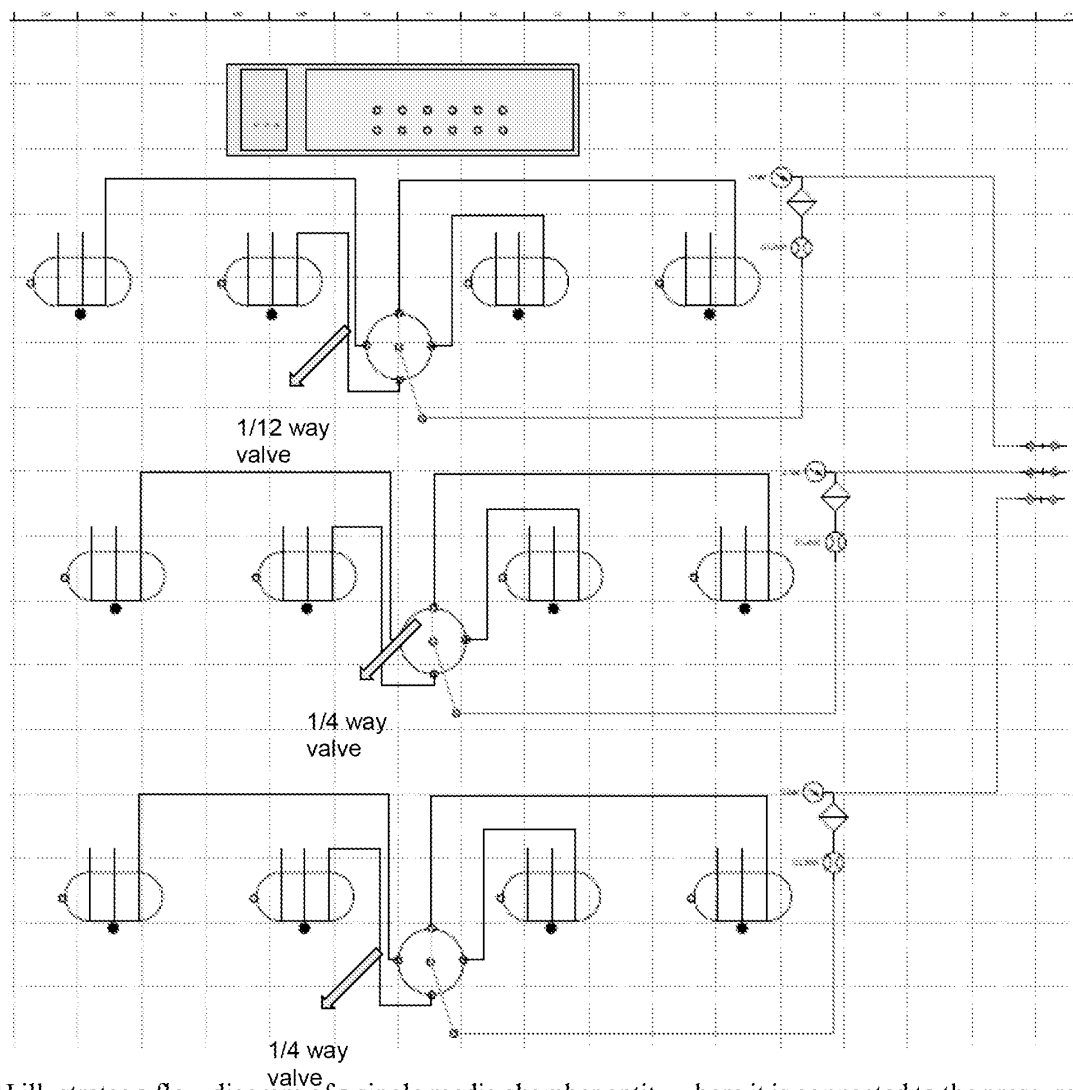
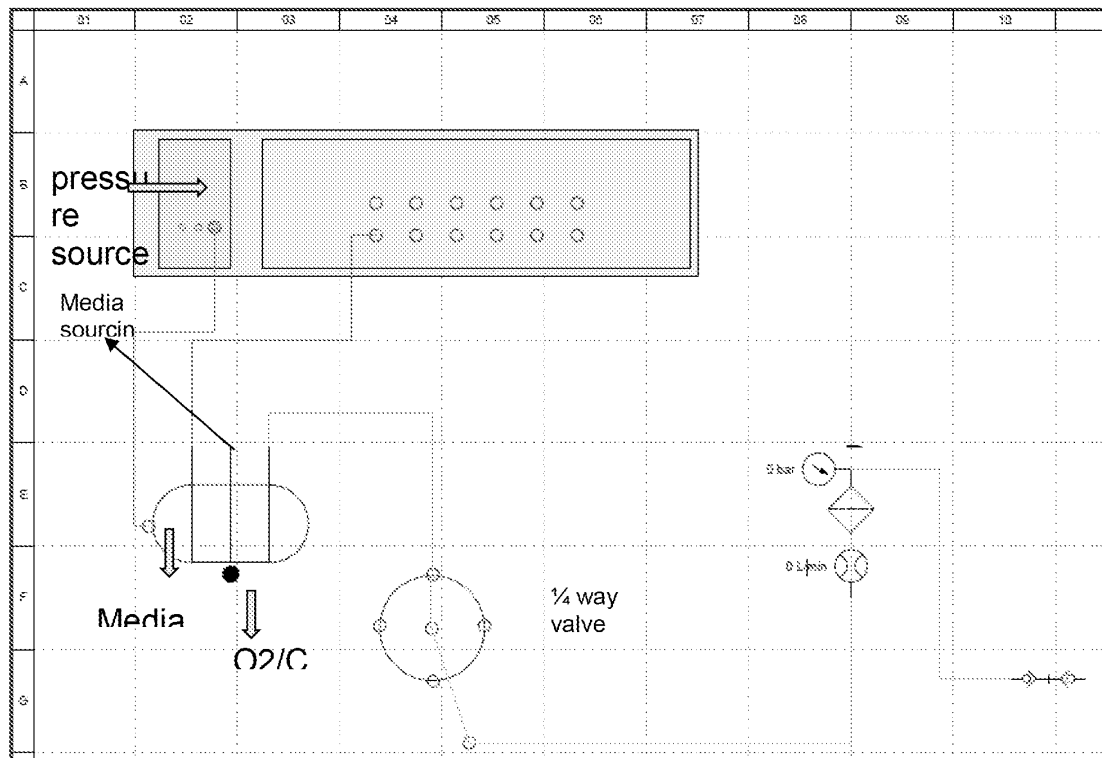


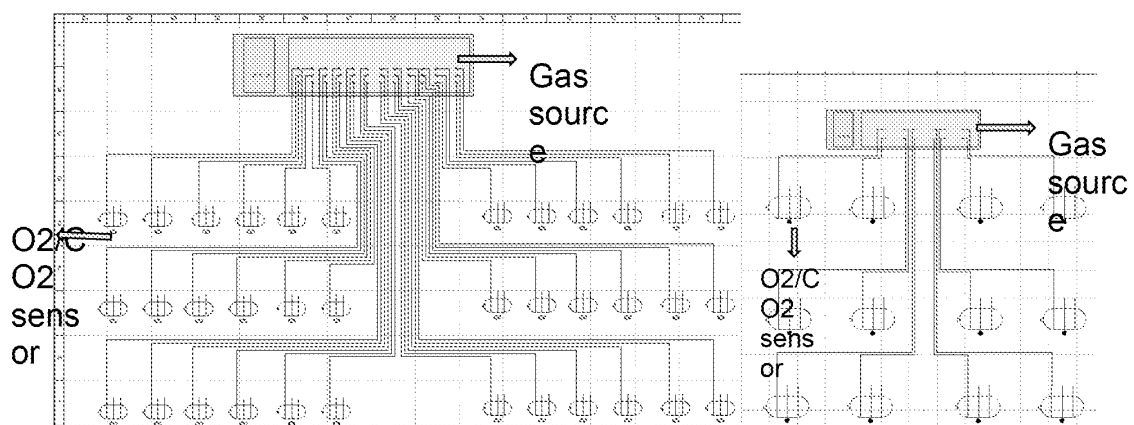
Fig. 33J illustrates a flow diagram of a single media chamber entity where it is connected to the pressure and gas from one side and to the 1/4 way valve from the other which interim is connected to a sensor, air filter, and a pressure gauge connected to a quick connect that is linking the mixing chamber with the human-on-chip plate, according to an example of the present disclosure.

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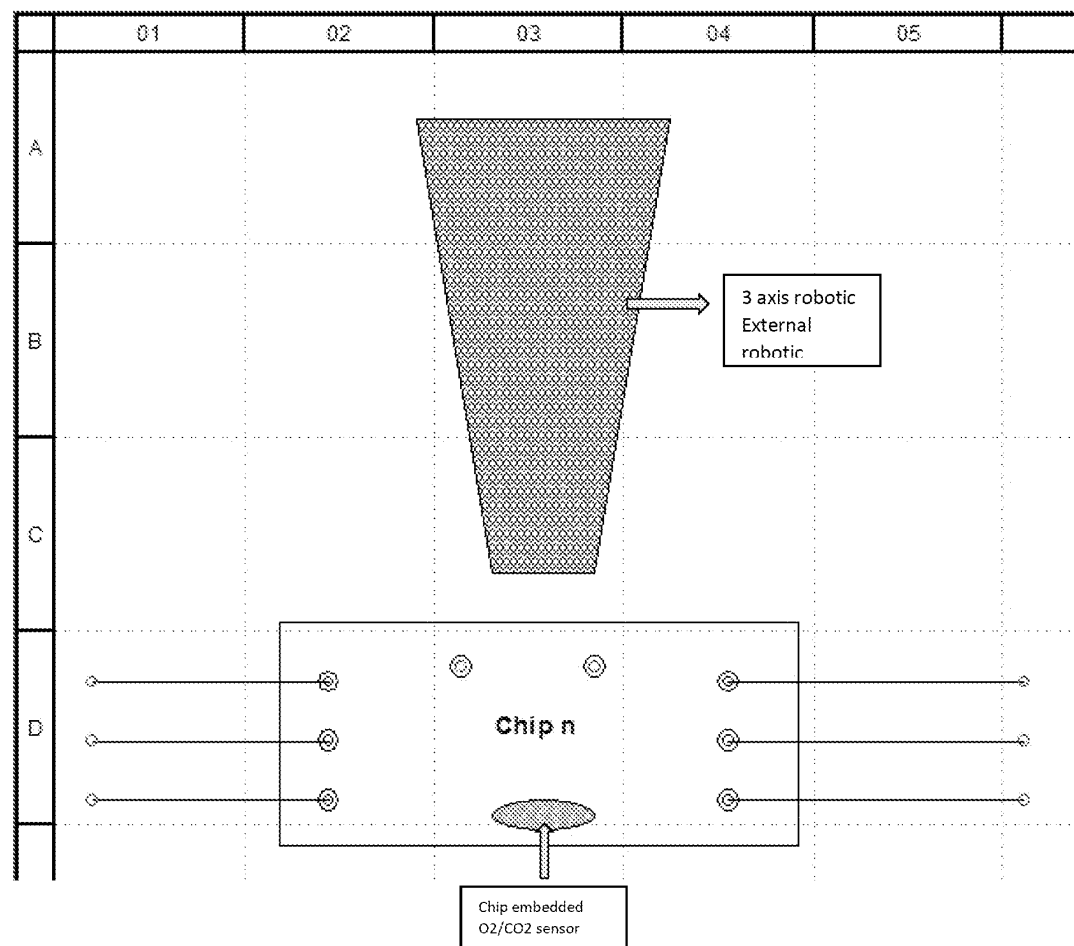
Sensing mechanism and control for the CO₂, O₂, Temperature and bubble sensing:

Fig. 34A illustrates a flow diagram of an embodiment of the mixing chamber where all the containers have access to the O₂, CO₂ and N₂ bottles and O₂ and CO₂ sensors that are located under the cell chambers, according to an example of the present disclosure.



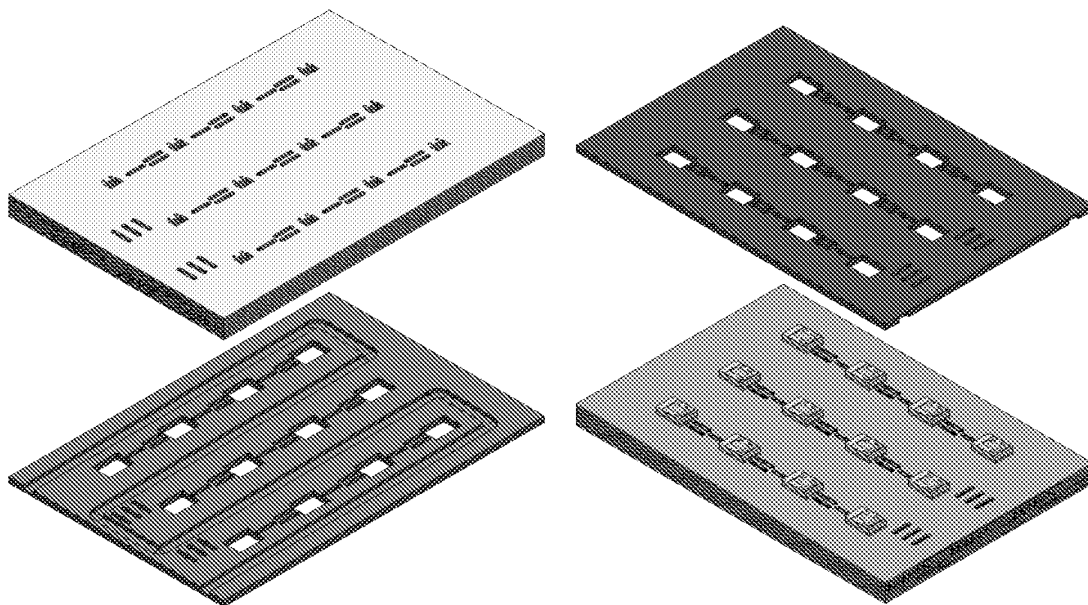
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[1] Fig. 34B illustrates a diagram of an embodiment of the O₂ and CO₂ sensors at the level of the tissues grown in the chips, according to an example of the present disclosure.



[0071] Fig. 35A illustrates an exploded view of the heat exchange plate passing temperature-controlled fluid in contact with the Human-on-chip, according to an example of the present disclosure.

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[0071] Fig. 35B illustrates a schematic view of the exchange generator chamber that heats and cools the fluid coming to the heat exchange plate, according to an example of the present disclosure.

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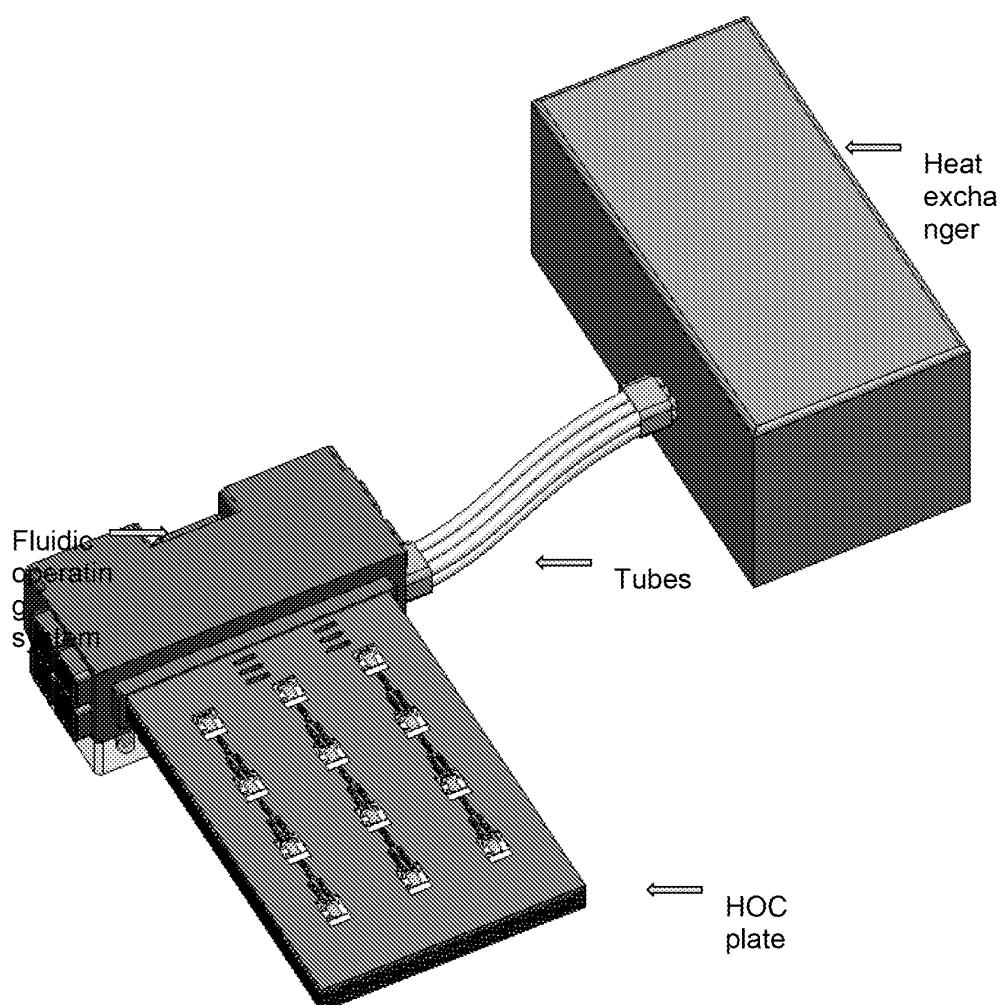
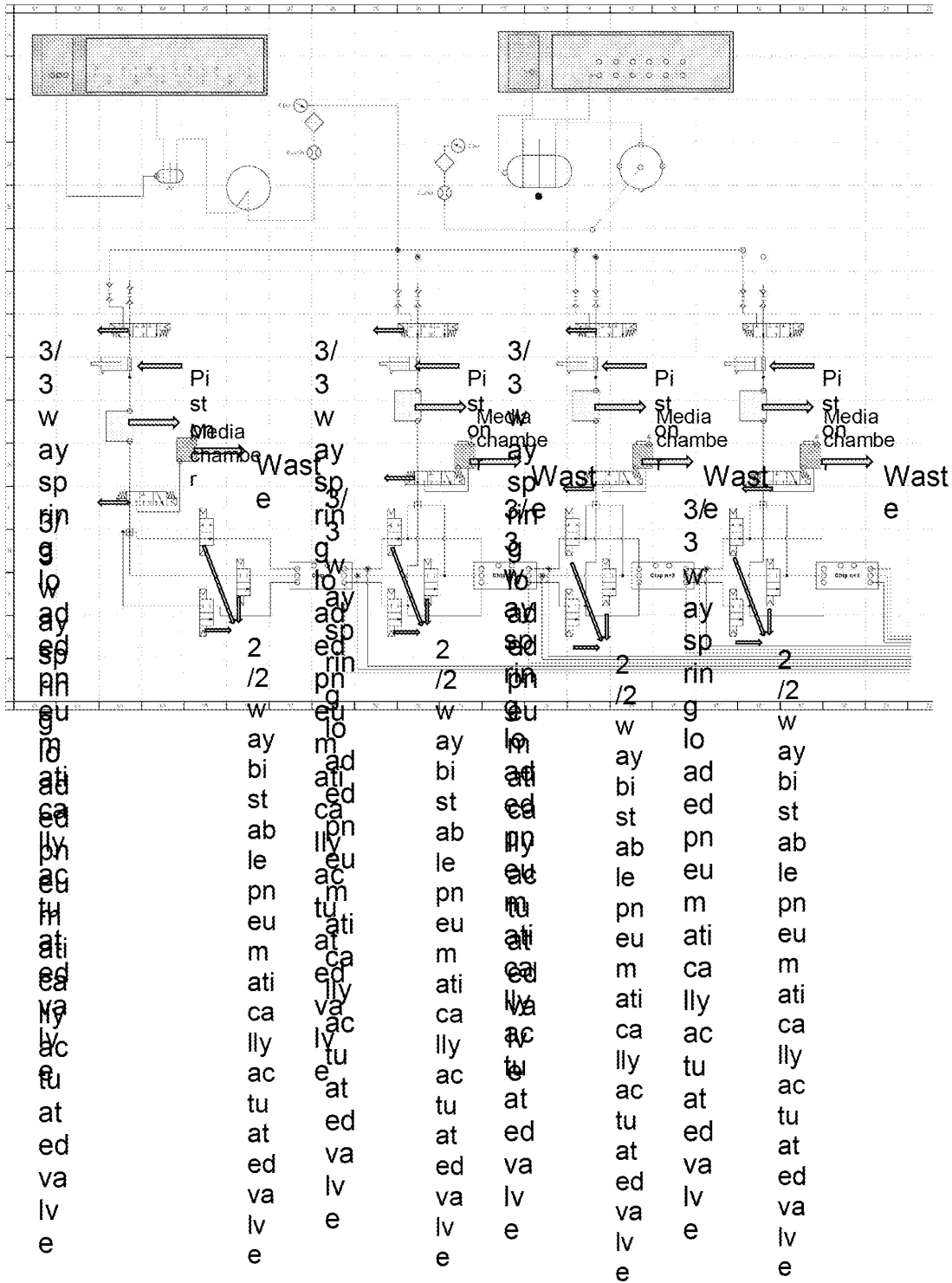
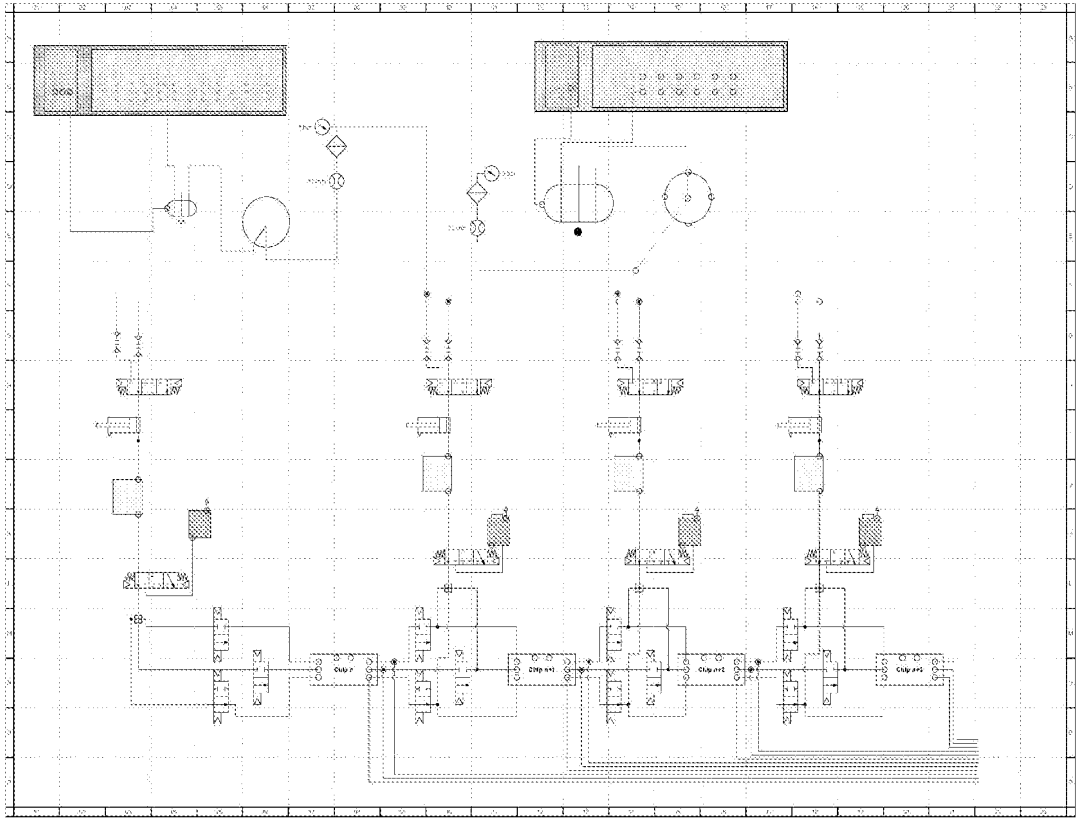
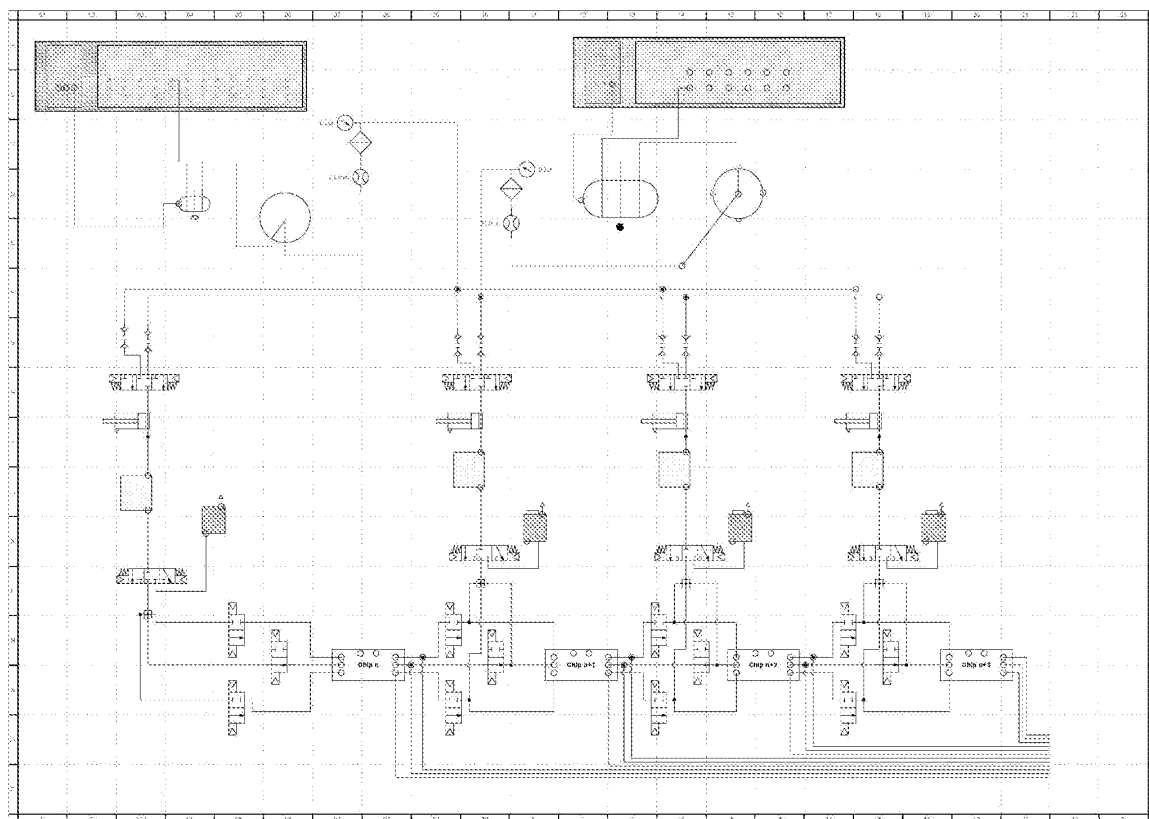


Fig. 36A illustrates a flow diagram of an embodiment of the machine starting mechanism getting the fluid to run into the system while ensuring that there is no channel blocked or any valve, actuator or sensor damaged, according to an example of the present disclosure.

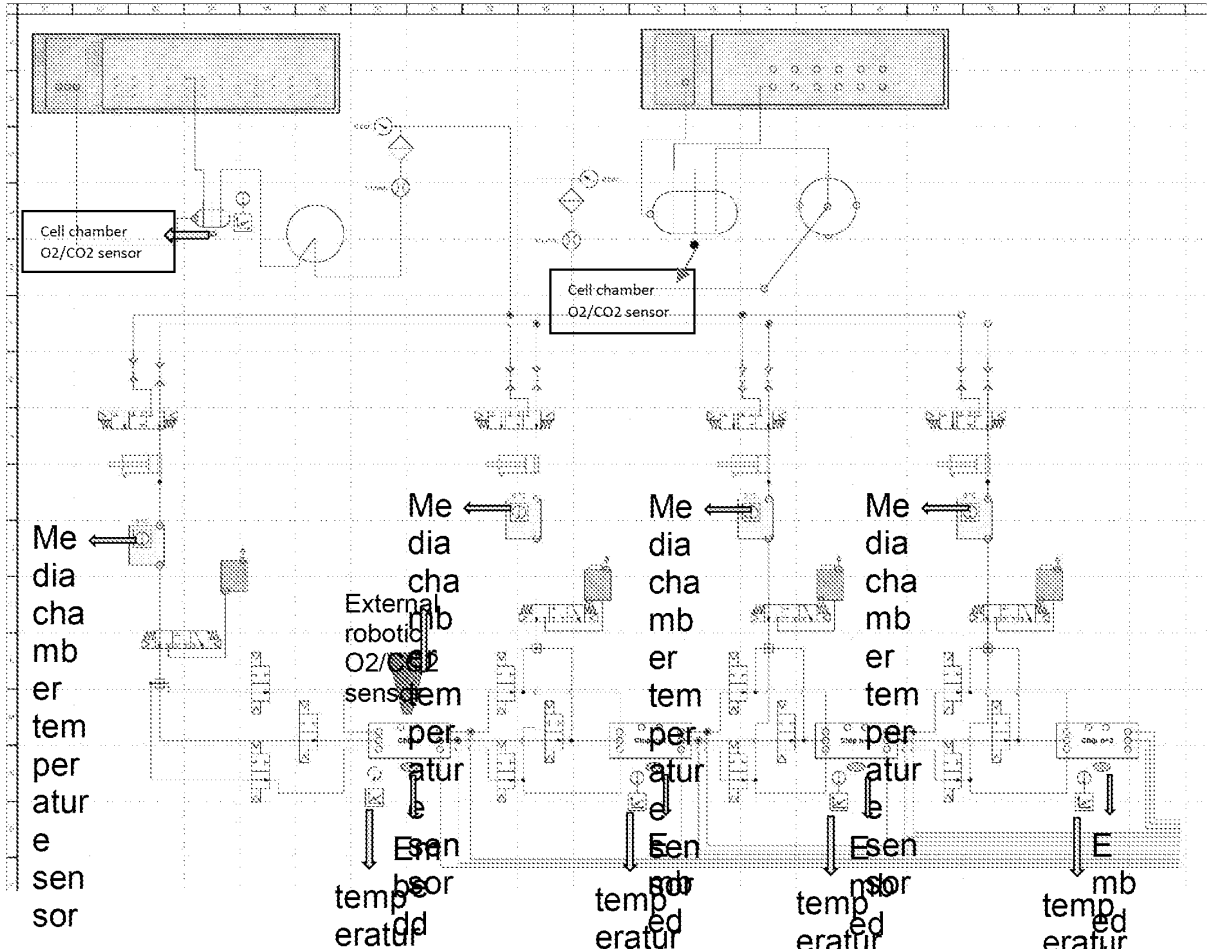




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[1] Fig. 36B illustrates a flow diagram of an embodiment of the machine starting mechanism getting the temperature, O₂ and CO₂ levels to the aimed valve while flushing the system pre-cell seeding, actuator or sensor damaged, according to an example of the present disclosure.



[1] Fig. 36C illustrates a flow diagram of an embodiment of the machine starting mechanism using pressure sensors and with the assistance of the microcomputer vision to make sure there is no air bubble in the system prior to cell seeding (pressurizing all the liquids, imaging, light color cast, fluorescence), according to an example of the present disclosure.

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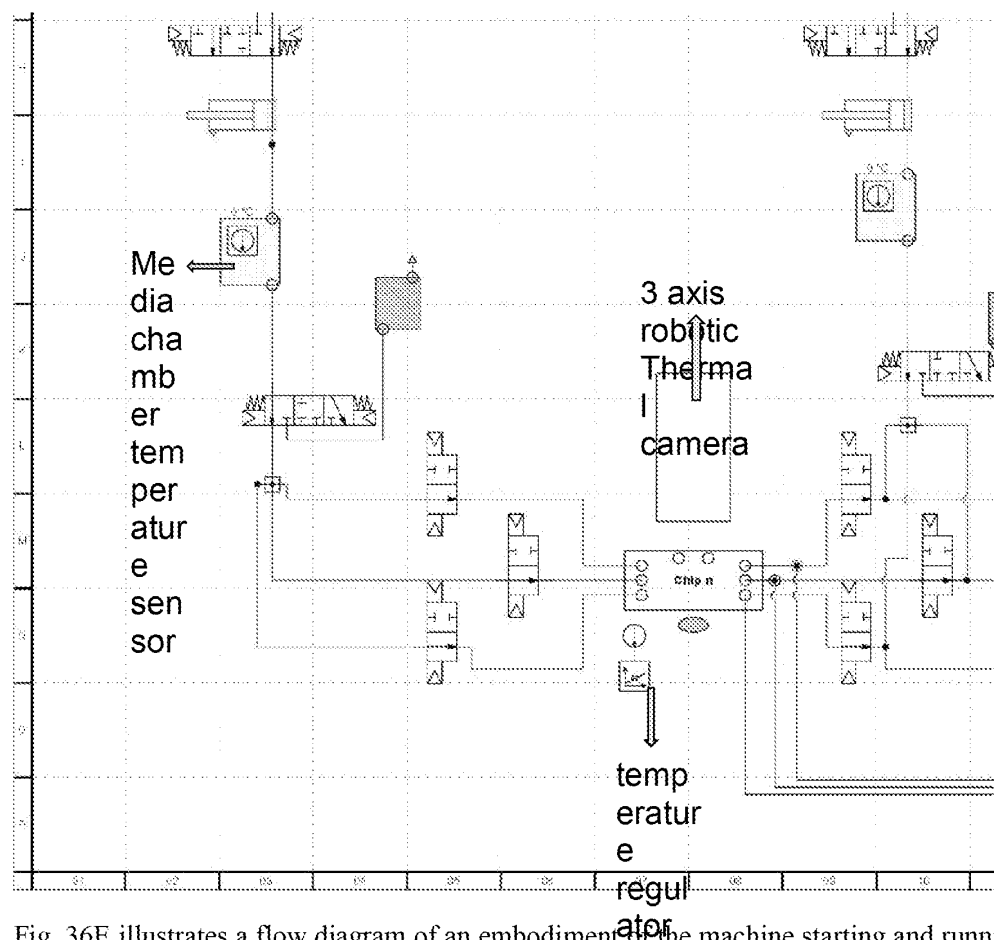
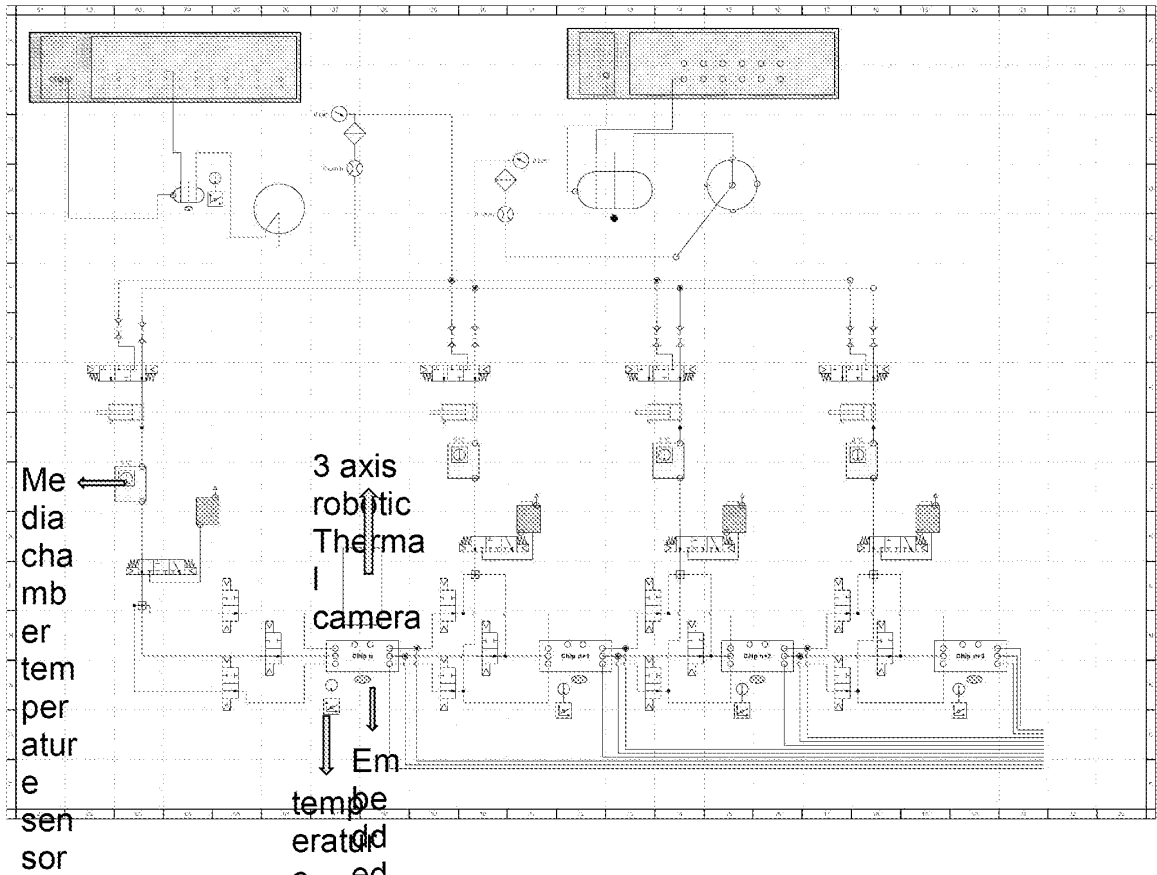


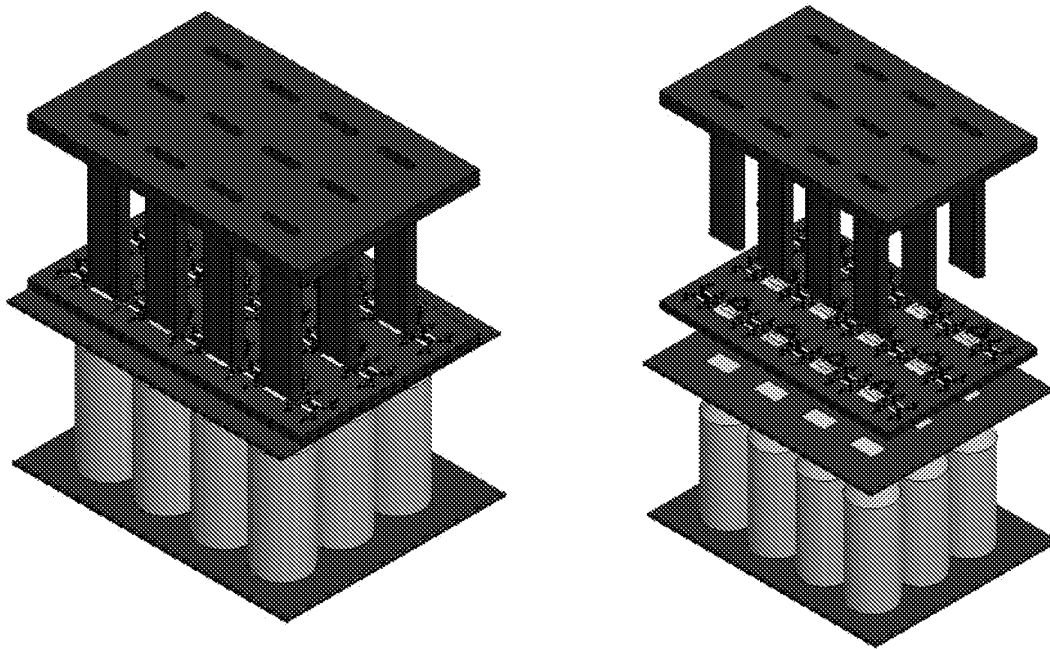
Fig. 36E illustrates a flow diagram of an embodiment of the machine starting and running mechanism showing the temperature, O₂, CO₂, and pressure sensors in addition to the fluid channeling, CO₂ and O₂ mixing, air bubble traps, and heating plates controlling all the parameters of the system, according to an example of the present disclosure.



Microscopy, Spectroscopy and FTIR measurement and interface:

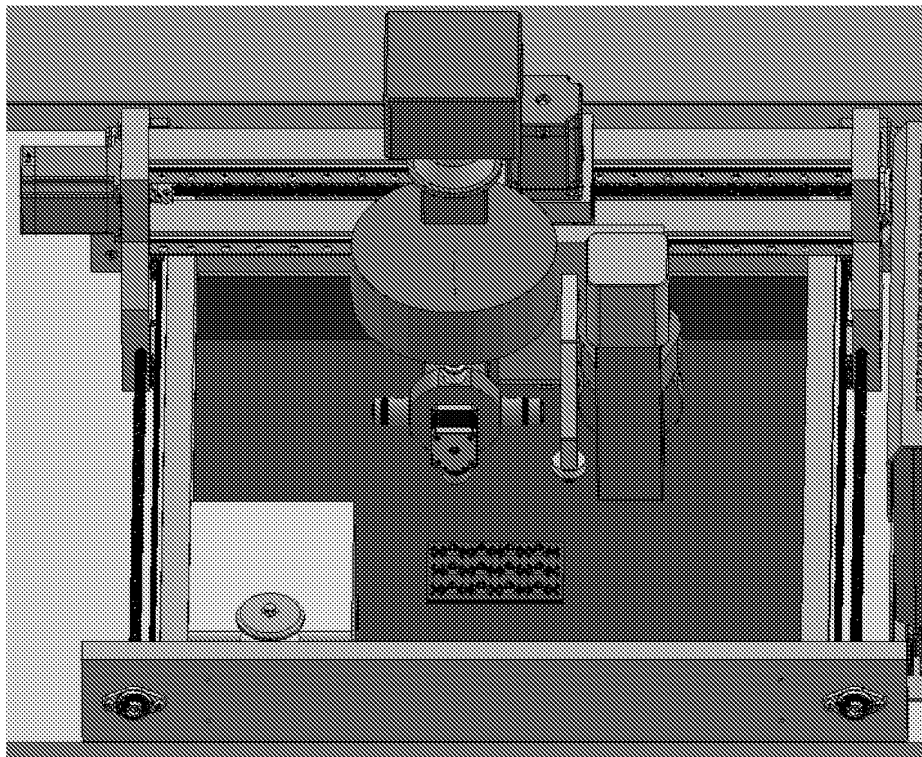
[1] Fig. 37A illustrates a perspective view of the embodiment of the microscopy and spectroscopy mechanism where there is more than one lens, according to an example of the present disclosure.

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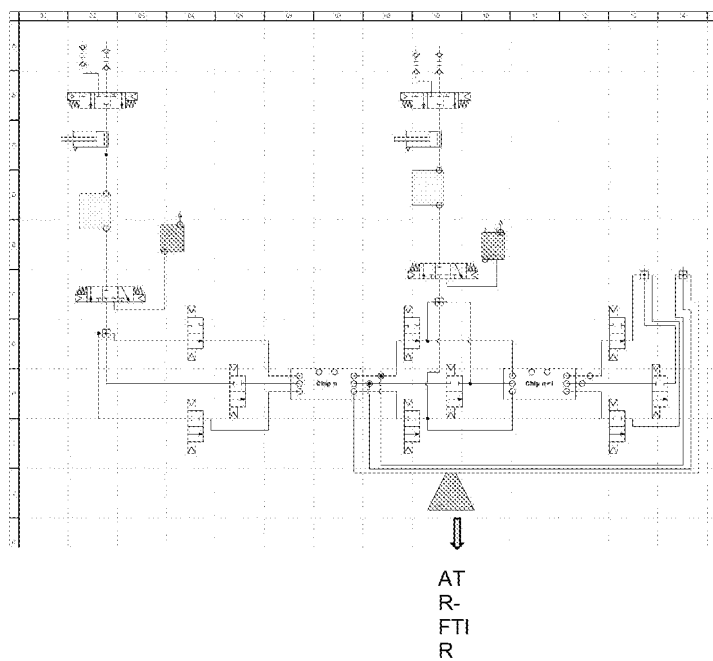


[1] Fig. 38B illustrates a perspective view of the embodiment of the microscopy and spectroscopy mechanism where there is one lens moving in an x-y plane, according to an example of the present disclosure.

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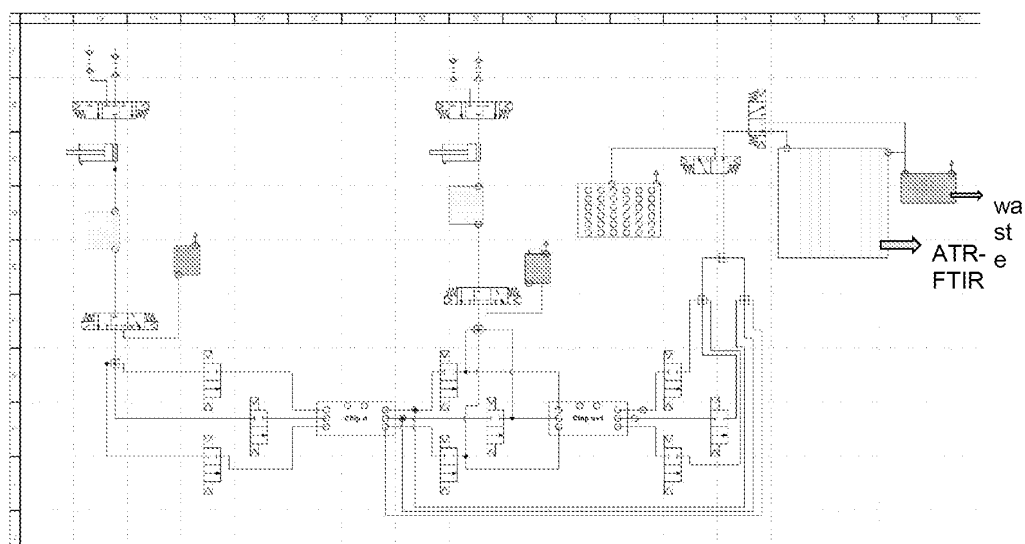


[1] Fig. 37C illustrates a perspective view of the embodiment of the FTIR reading mechanism where there are multiple sensors, according to an example of the present disclosure.

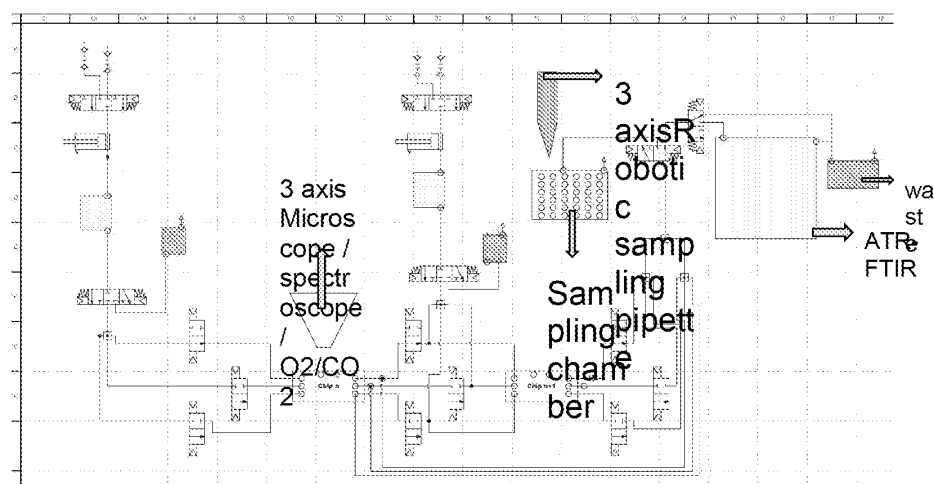


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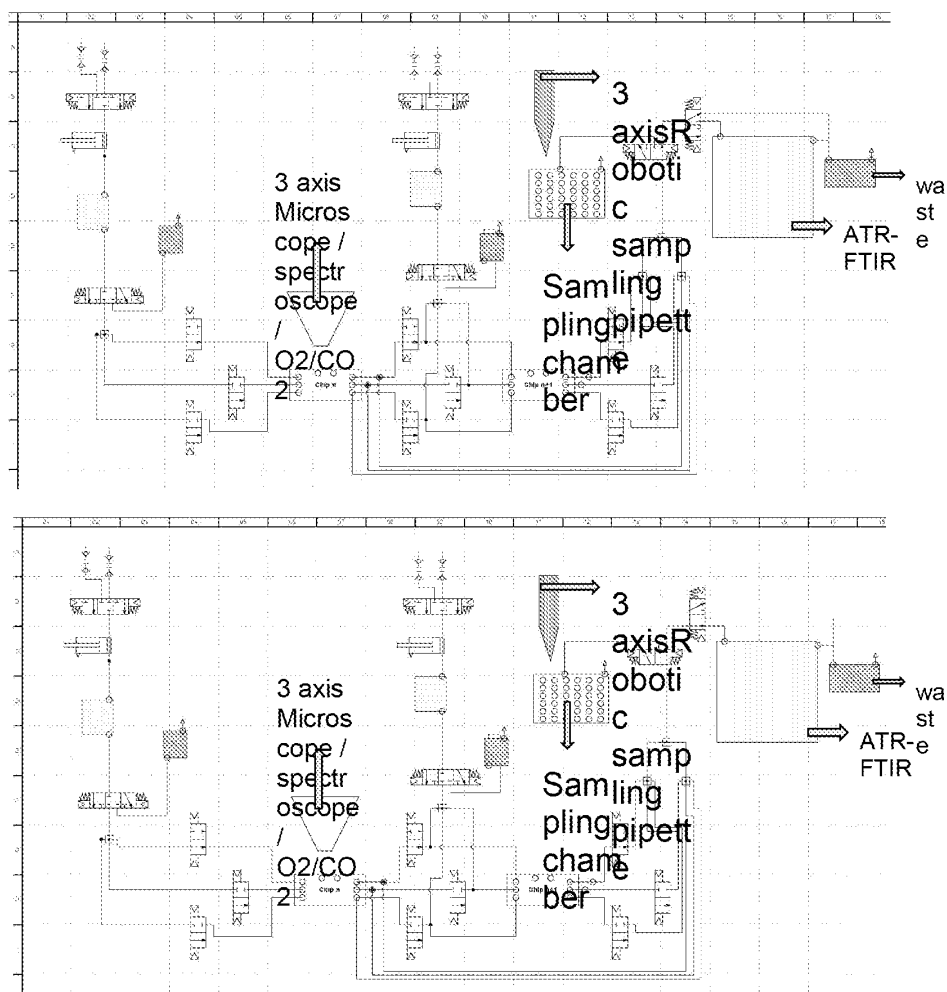
[1] Fig. 37D illustrates a perspective view of the embodiment of the FTIR reading mechanism where there is only one sensor, and the fluid is being sampled and measured with a time gap calculated, according to an example of the present disclosure.



[1] Fig. 37E illustrates a perspective view of the detailed sampling mechanism of an embodiment of the FTIR reading mechanism where there is only one sensor, and the fluid is being sampled and measured with a time gap calculated, according to an example of the present disclosure.

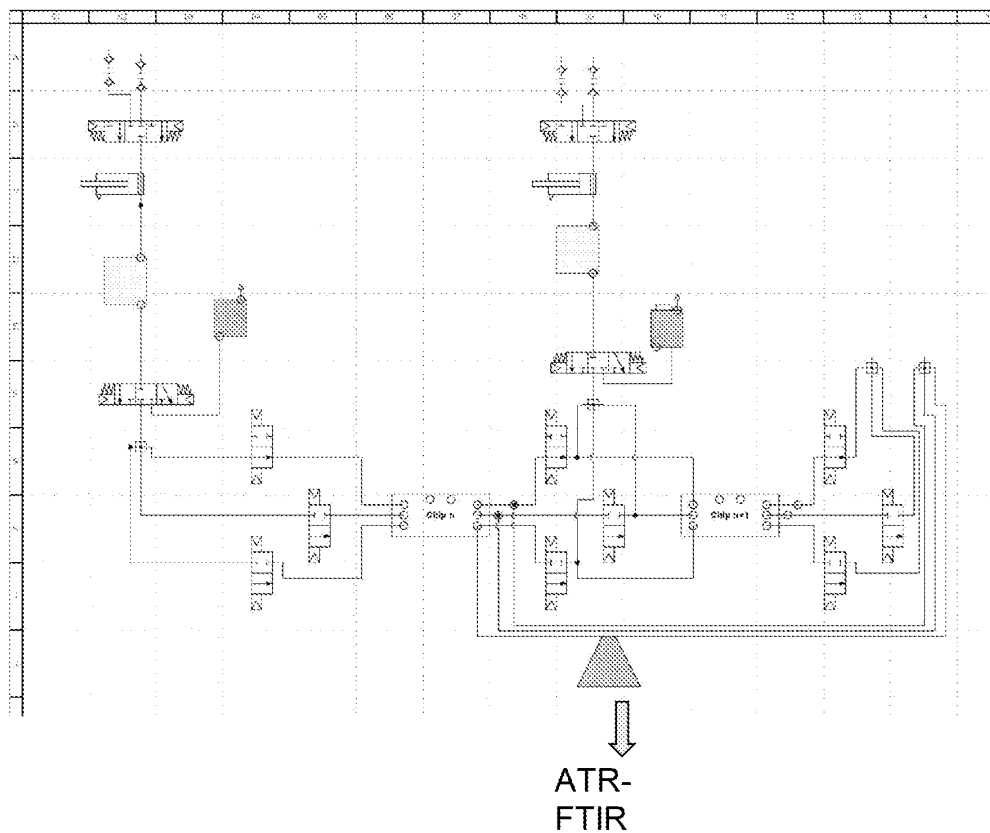


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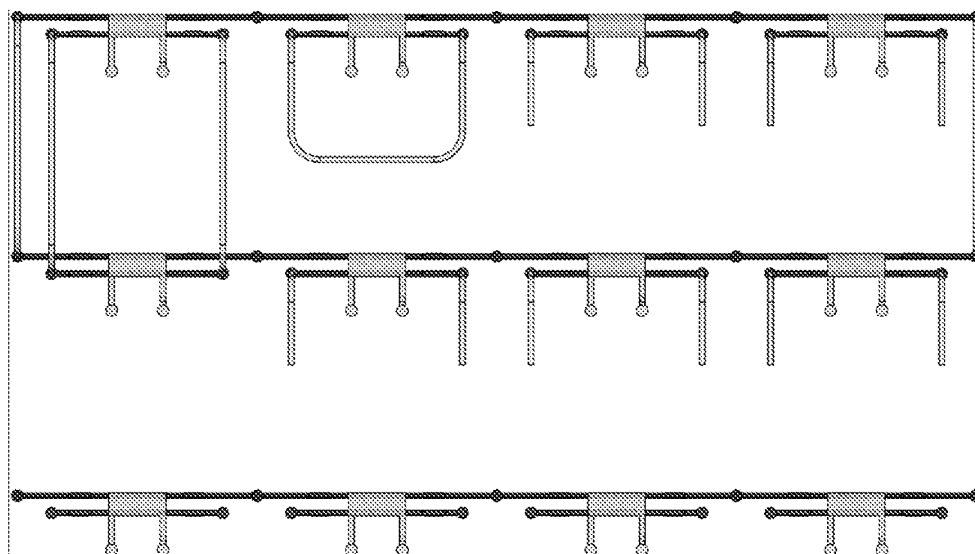
[1] Fig. 37F illustrates a perspective view of the embodiment of the FTIR reading mechanism where there is a flow cell built in the chip, according to an example of the present disclosure.

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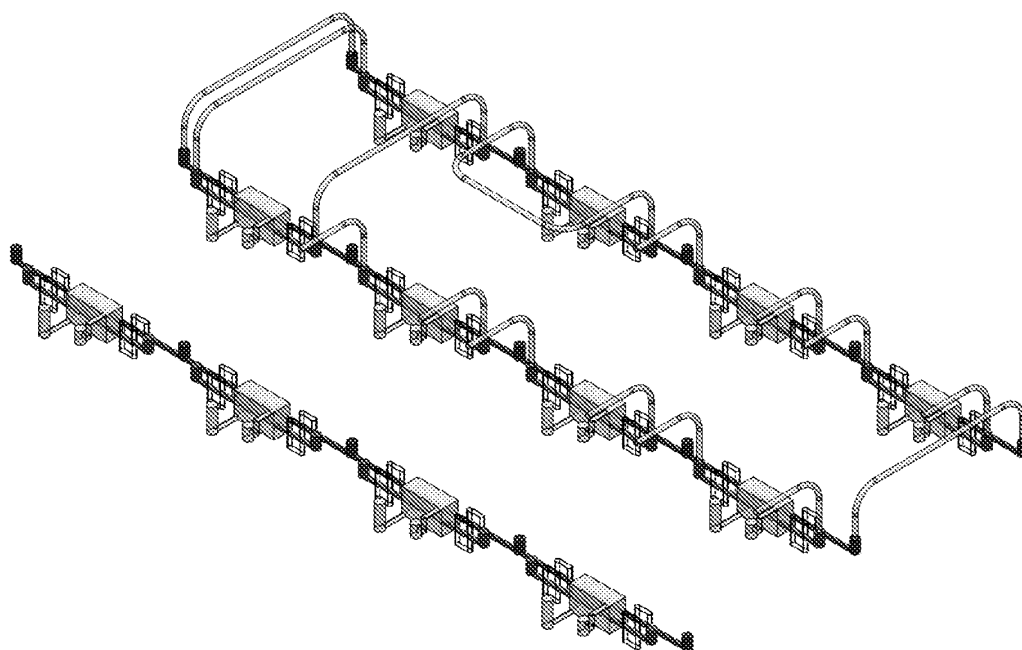
**Chip connection cases and tissue & disease models:**

[1] Fig. 38A illustrates a top view of possible biochip arrangements for human-on-chip modeling, according to an example of the present disclosure.

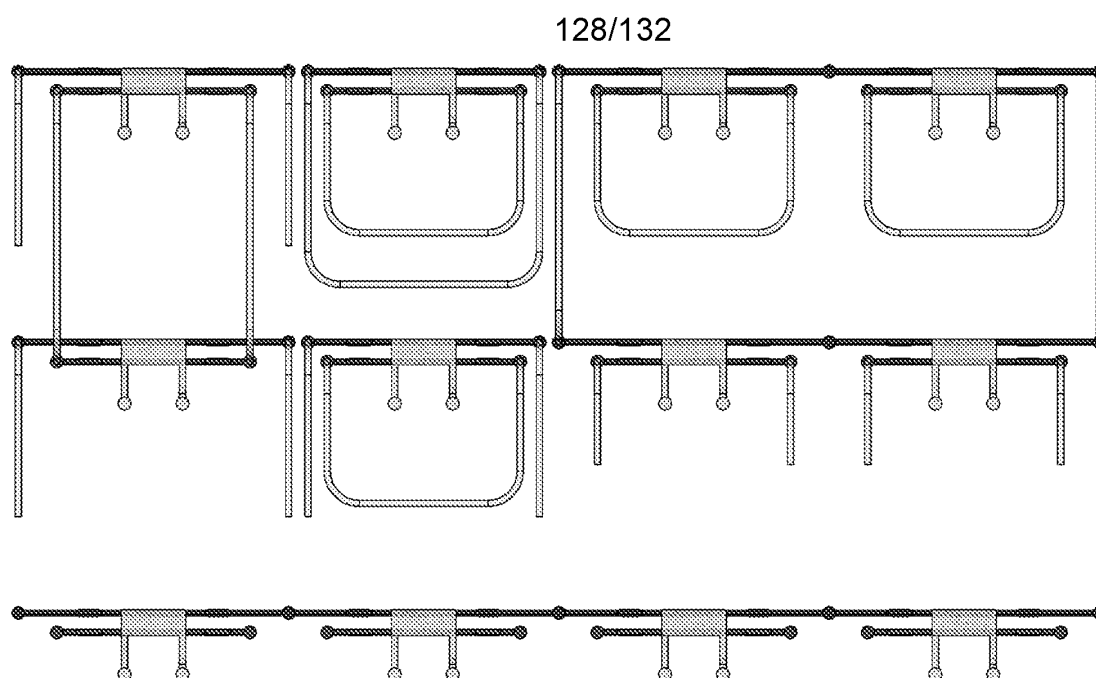
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[1] Fig. 38B illustrates a prospective view of possible biochip arrangements for human-on-chip modeling, according to an example of the present disclosure.

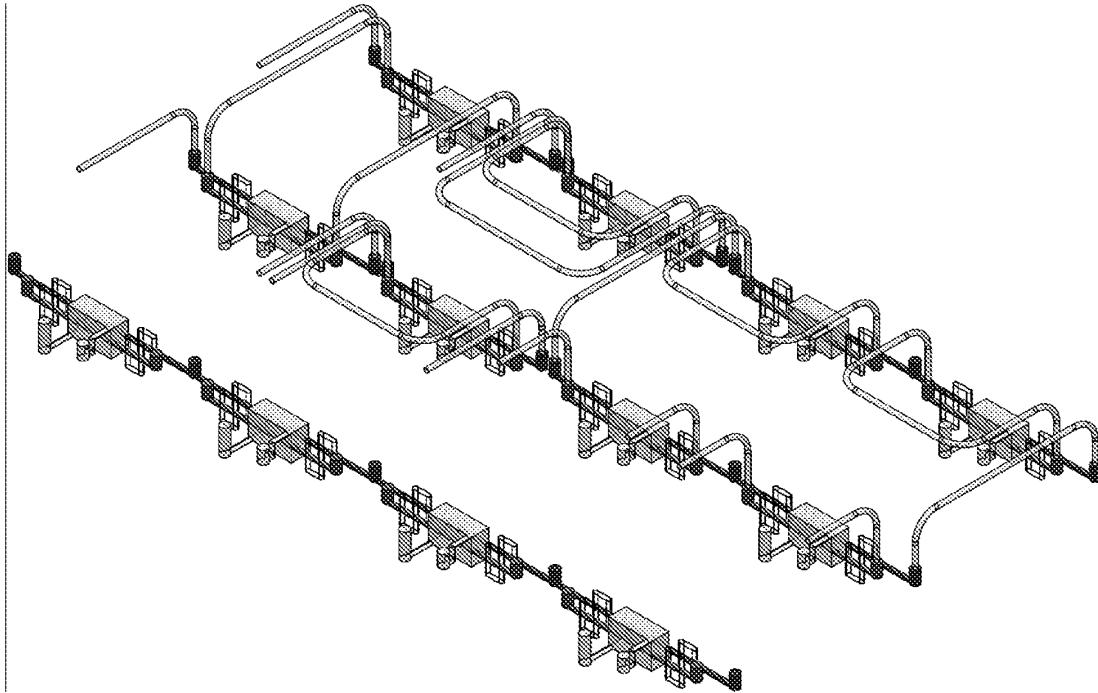


[1] Fig. 38C illustrates a top view of an additional embodiment of possible biochip arrangements for human-on-chip modeling, according to an example of the present disclosure.



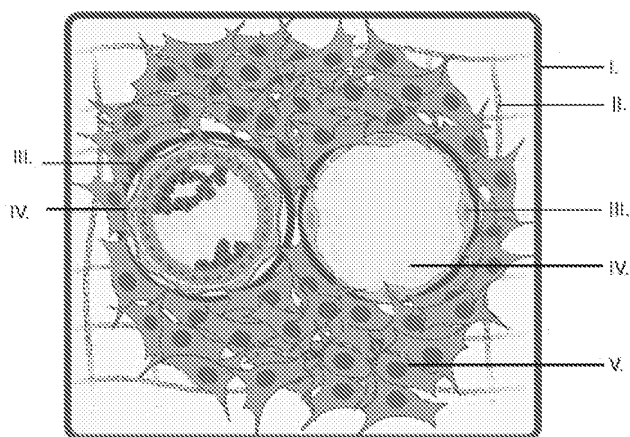
[1] Fig. 38D illustrates a perspective view of an additional embodiment of possible biochip arrangements cell tissue modeling, according to an example of the present disclosure. In brief, the ductal channel containing endothelial or epithelial cells (II) connects one biochip (I) to at least another one (III).

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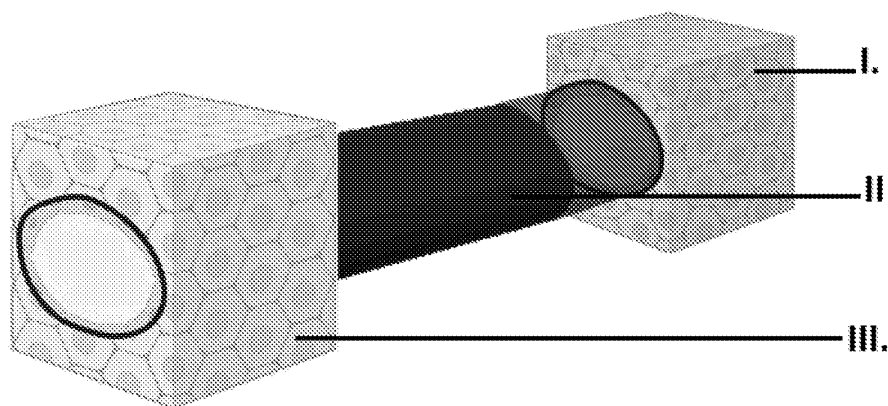


[1] Fig. 39A illustrates a cross-sectional view of the embodiment of the Tubular architecture of a tissue in our 2-duct chips, according to an example of the present disclosure. Where I. is the Biochip's stomal channel; II. is the extracellular matrix, III. are endothelial and/or epithelial cells which may also contain cancer cells, IV. is ductal channel with media V. is stromal channel with cells which may contain cancer cells.

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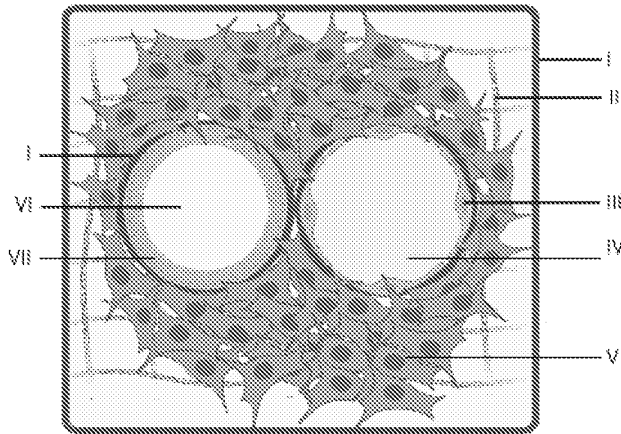


[1] Fig. 39B illustrates a perspective view of the embodiment of multiple cultured tissues in our chips connected with a common duct/vessel, according to an example of the present disclosure.

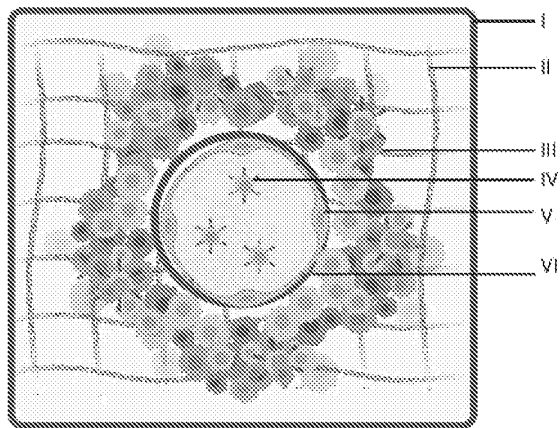


[1] Fig. 39C illustrates a schematic view of the embodiments of an organ on chip grown in the human-on-chip, according to an example of the present disclosure. The cells may be primary cells, cell

lines, iPSCs, patient-derived cells or biopsies and it may be used for precision medicine analysis or for a more general analysis. I. is the Biochip's stomal channel; II. is the extracellular matrix, III. is the tissue or tumor cells of interest, IV. are immune cells, V. are endothelial and/or epithelial cells and VI. is the biochip's ductal channel.



[1] Fig. 39D illustrates a schematic view of the embodiment of a Liquid-air-Interface Lung-on-chip grown in the Human-on-chip, according to an example of the present disclosure. Where, I. is the Biochip's stomal channel; II. is the extracellular matrix, III. represents endothelial cells, IV. as the biochip's ductal channel containing air, V. represents the lung tissue, VI. are respiratory and VI. are astrocytes.



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Fig. 39E Illustrates a schematic of an embodiment of a glioblastoma model and the blood brain barrier in the biochip, according to an example of the present disclosure, where I. is the Biochip's stomal channel; II. is the extracellular matrix, III. represents glioblastoma cells with immune cell infiltration, IV. are immune cells, V. are endothelial cells and pericytes, VI. is the biochip's ductal channel and VI. are astrocytes.

