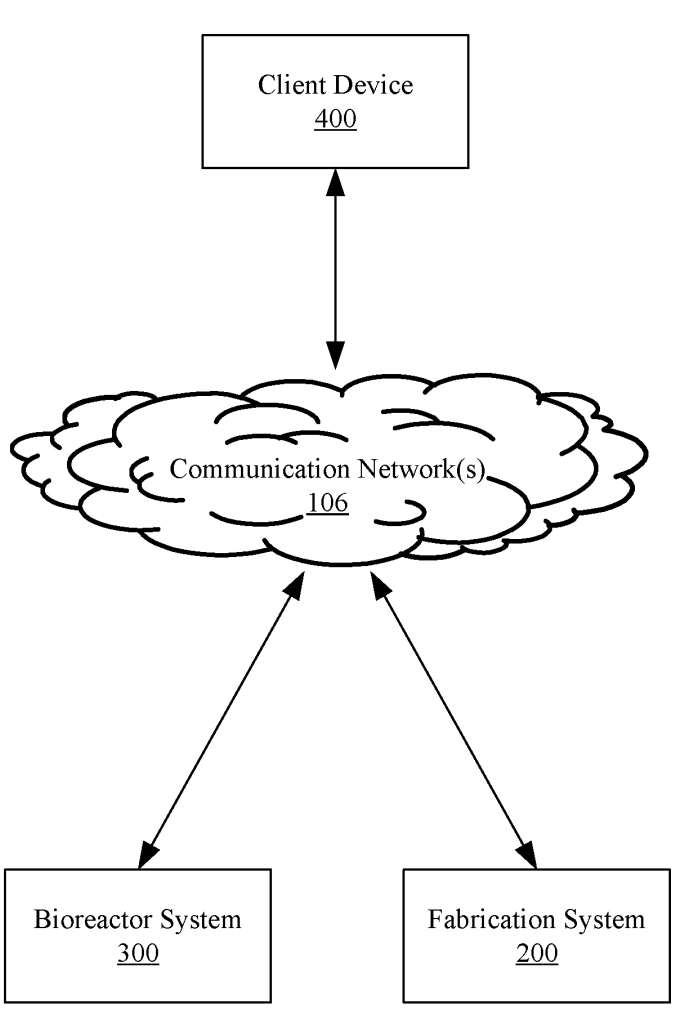

100
Client Device
400
Communication Network(s)
106
Bioreactor System
300
Fabrication System
200

Fig. 1

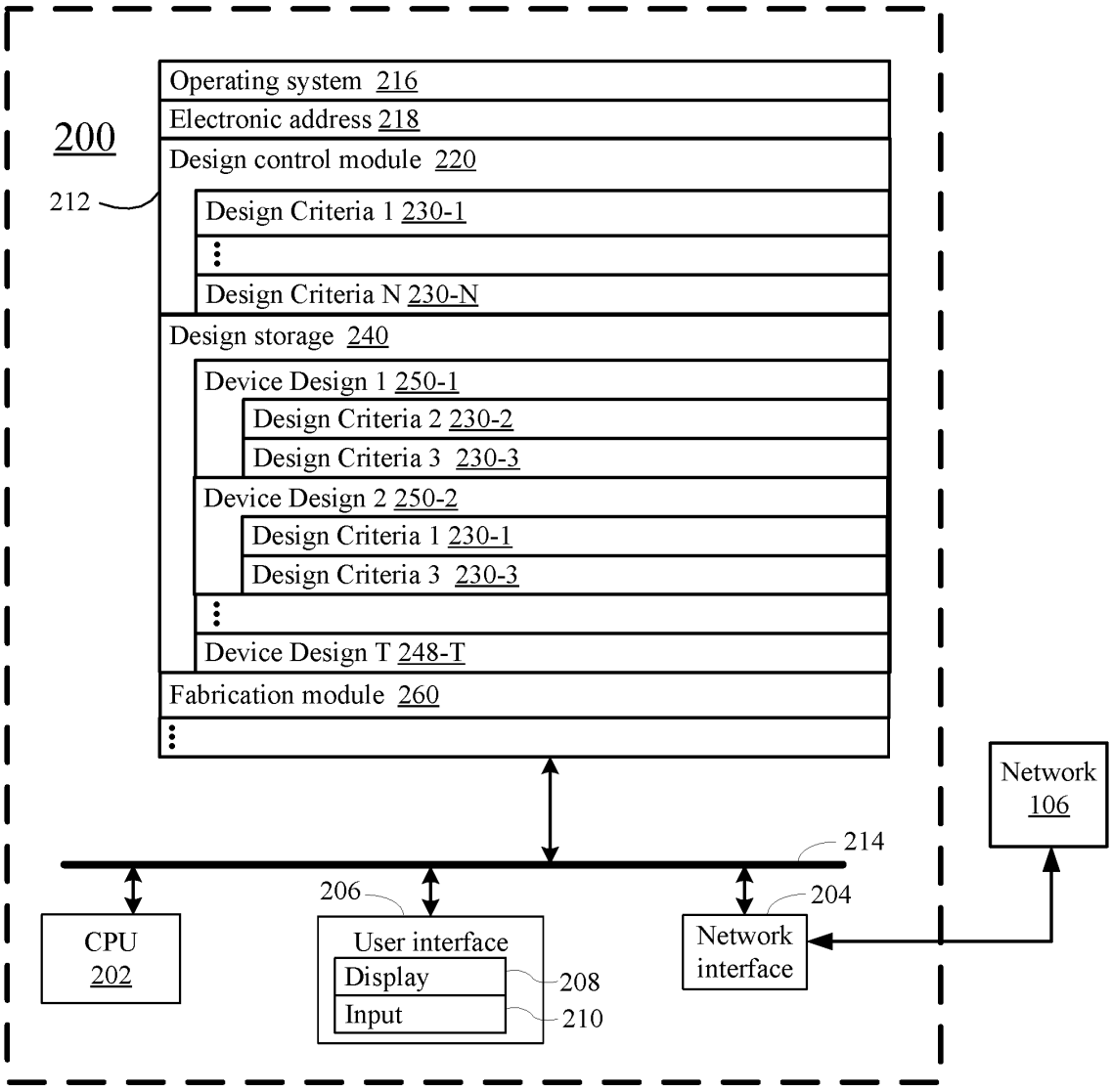

200
212
Operating system 216
Electronic address 218
Design control module 220
Design Criteria 1 230-1
Design Criteria N 230-N
Design storage 240
Device Design 1 250-1
Design Criteria 2 230-2
Design Criteria 3 230-3
Device Design 2 250-2
Design Criteria 1 230-1
Design Criteria 3 230-3
Device Design T 248-T
Fabrication module 260
214
206
204
CPU
202
User interface
Display
Input
208
210
Network interface
Network
106

Fig. 2

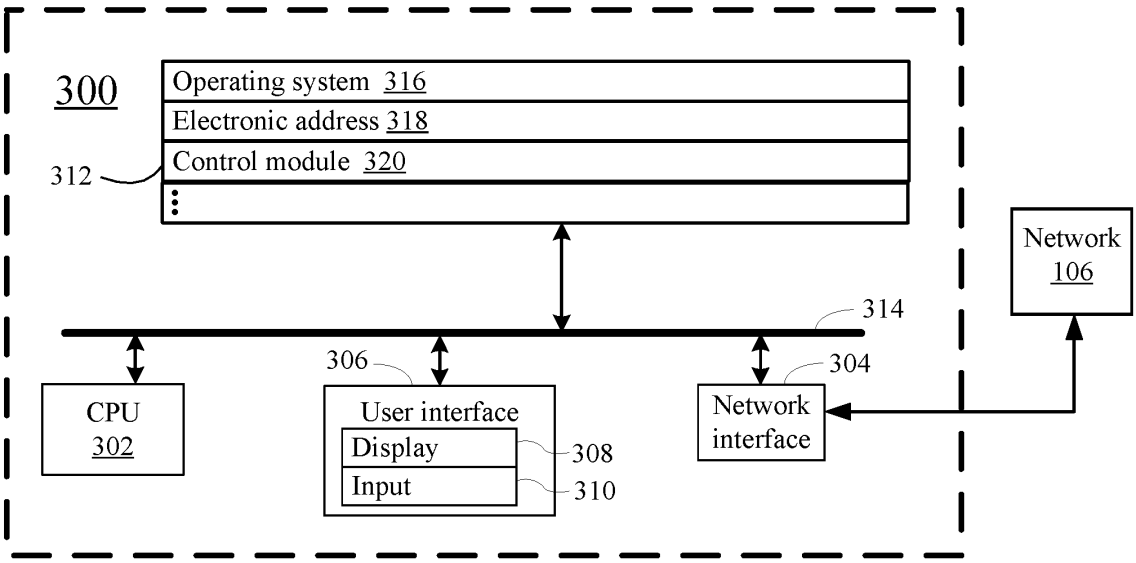

300
Operating system 316
Electronic address 318
Control module 320
312
Network
106
314
306
304
CPU
302
User interface
Display
Input
308
310
Network
interface

Fig. 3

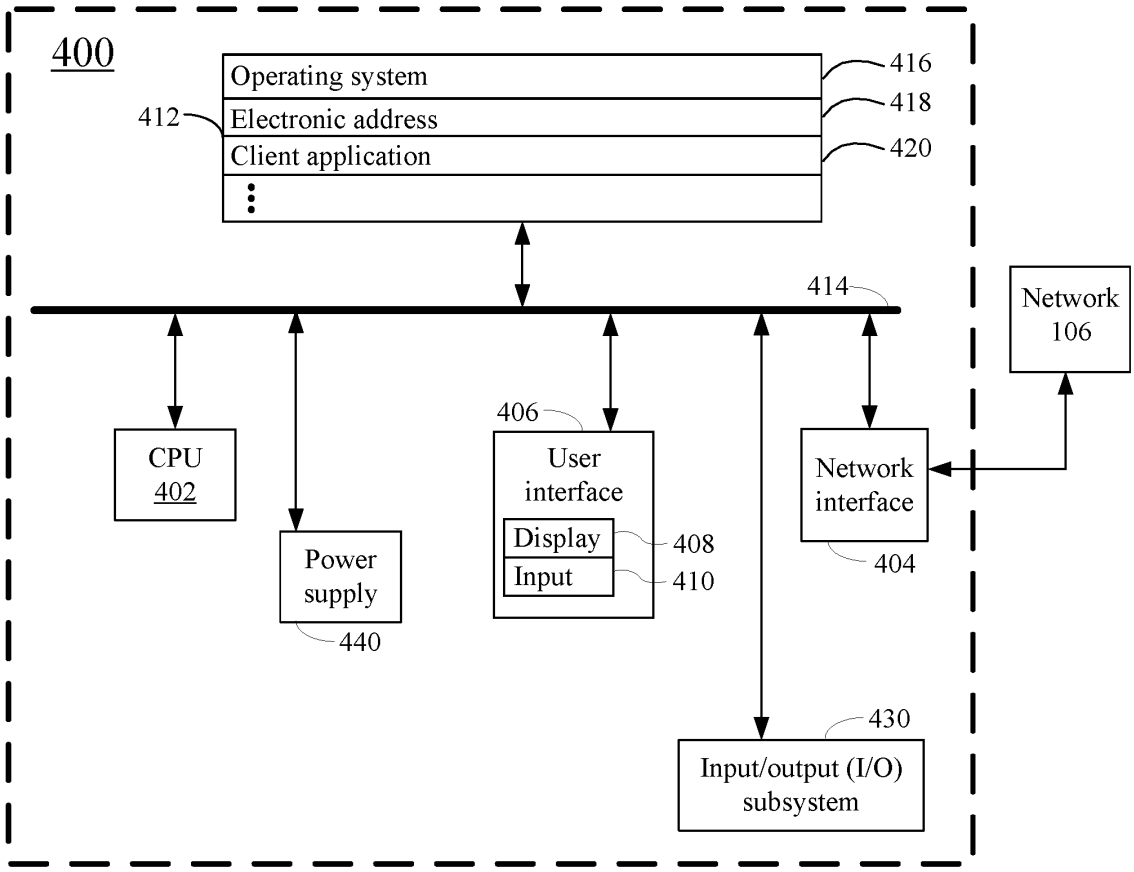

400
Operating system
Electronic address
Client application
412
416
418
420
414
Network
106
CPU
402
406
User
interface
Display
Input
408
410
Network
interface
404
Power
supply
440
430
Input/output (I/O)
subsystem

Fig 4

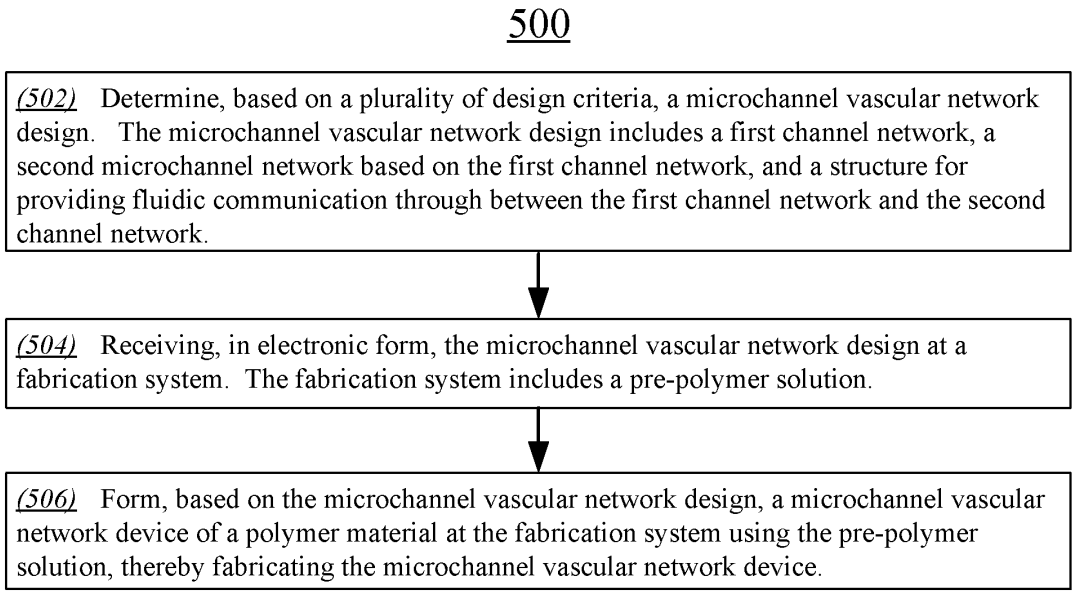

500
(502) Determine, based on a plurality of design criteria, a microchannel vascular network design. The microchannel vascular network design includes a first channel network, a second microchannel network based on the first channel network, and a structure for providing fluidic communication through between the first channel network and the second channel network.
(504) Receiving, in electronic form, the microchannel vascular network design at a fabrication system. The fabrication system includes a pre-polymer solution.
(506) Form, based on the microchannel vascular network design, a microchannel vascular network device of a polymer material at the fabrication system using the pre-polymer solution, thereby fabricating the microchannel vascular network device.

Fig 5

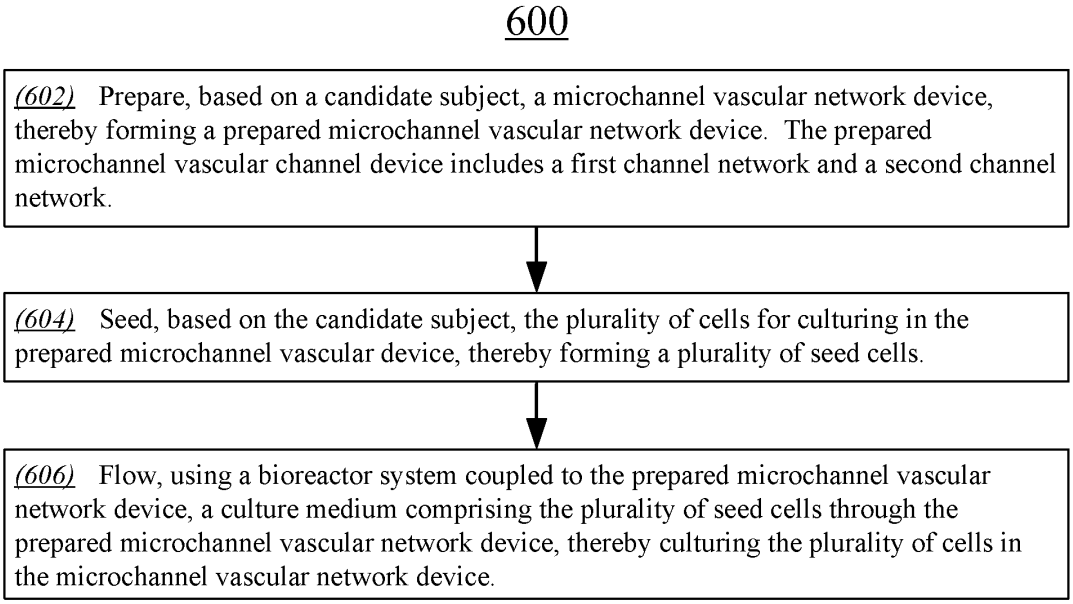

600
(602) Prepare, based on a candidate subject, a microchannel vascular network device, thereby forming a prepared microchannel vascular network device. The prepared microchannel vascular channel device includes a first channel network and a second channel network.
(604) Seed, based on the candidate subject, the plurality of cells for culturing in the prepared microchannel vascular device, thereby forming a plurality of seed cells.
(606) Flow, using a bioreactor system coupled to the prepared microchannel vascular network device, a culture medium comprising the plurality of seed cells through the prepared microchannel vascular network device, thereby culturing the plurality of cells in the microchannel vascular network device.

Fig 6

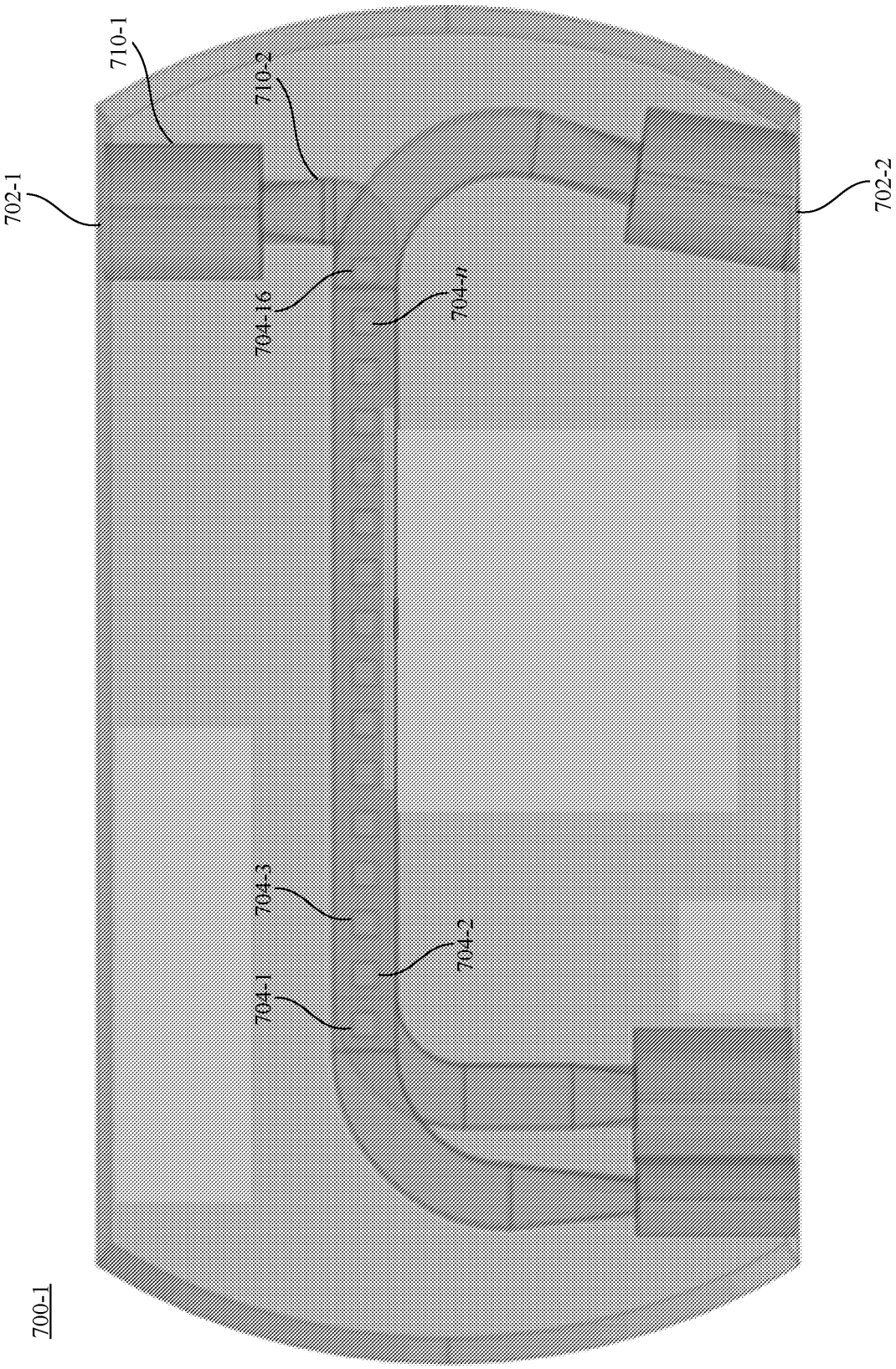


Fig. 7

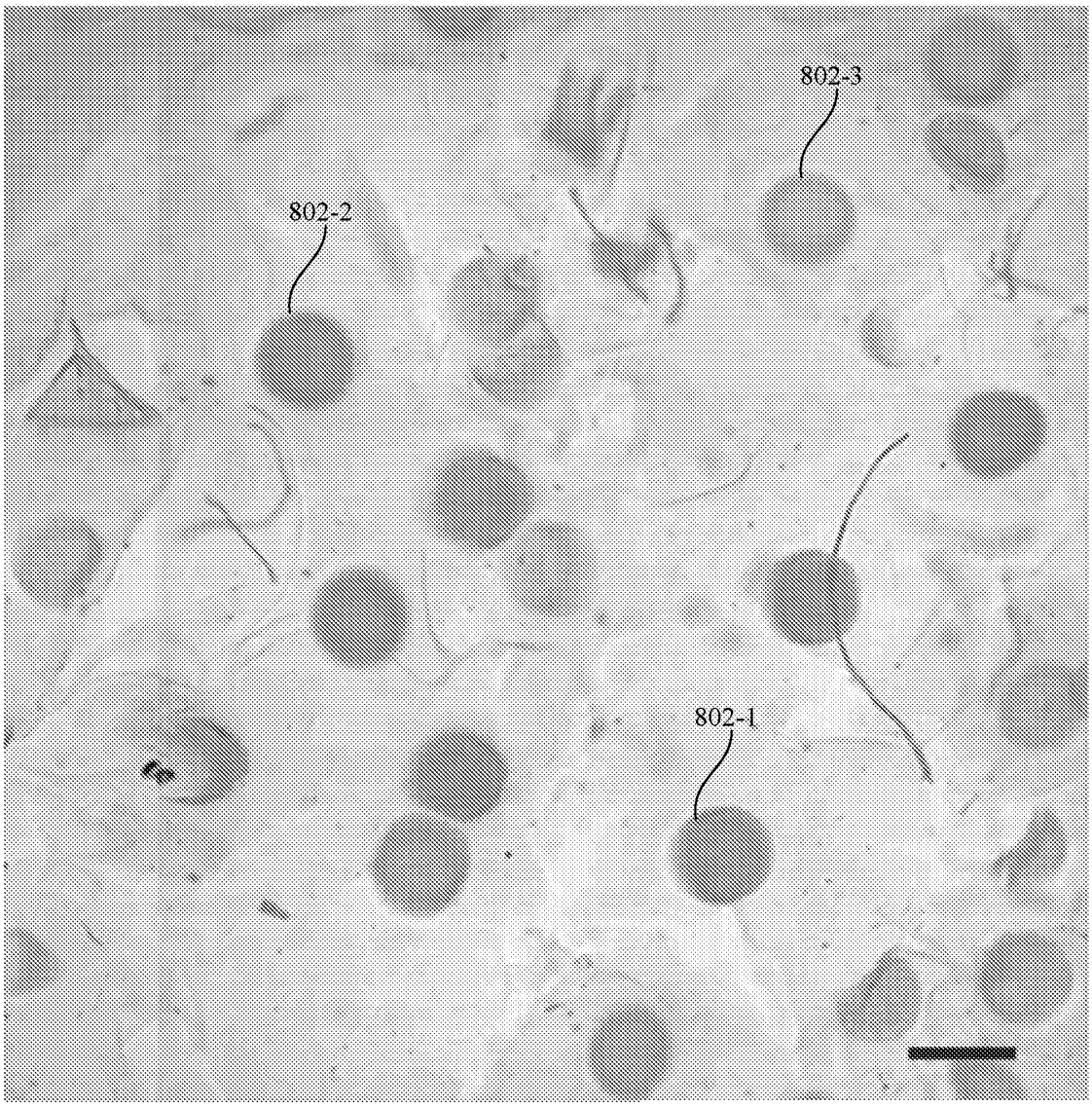


Fig. 8

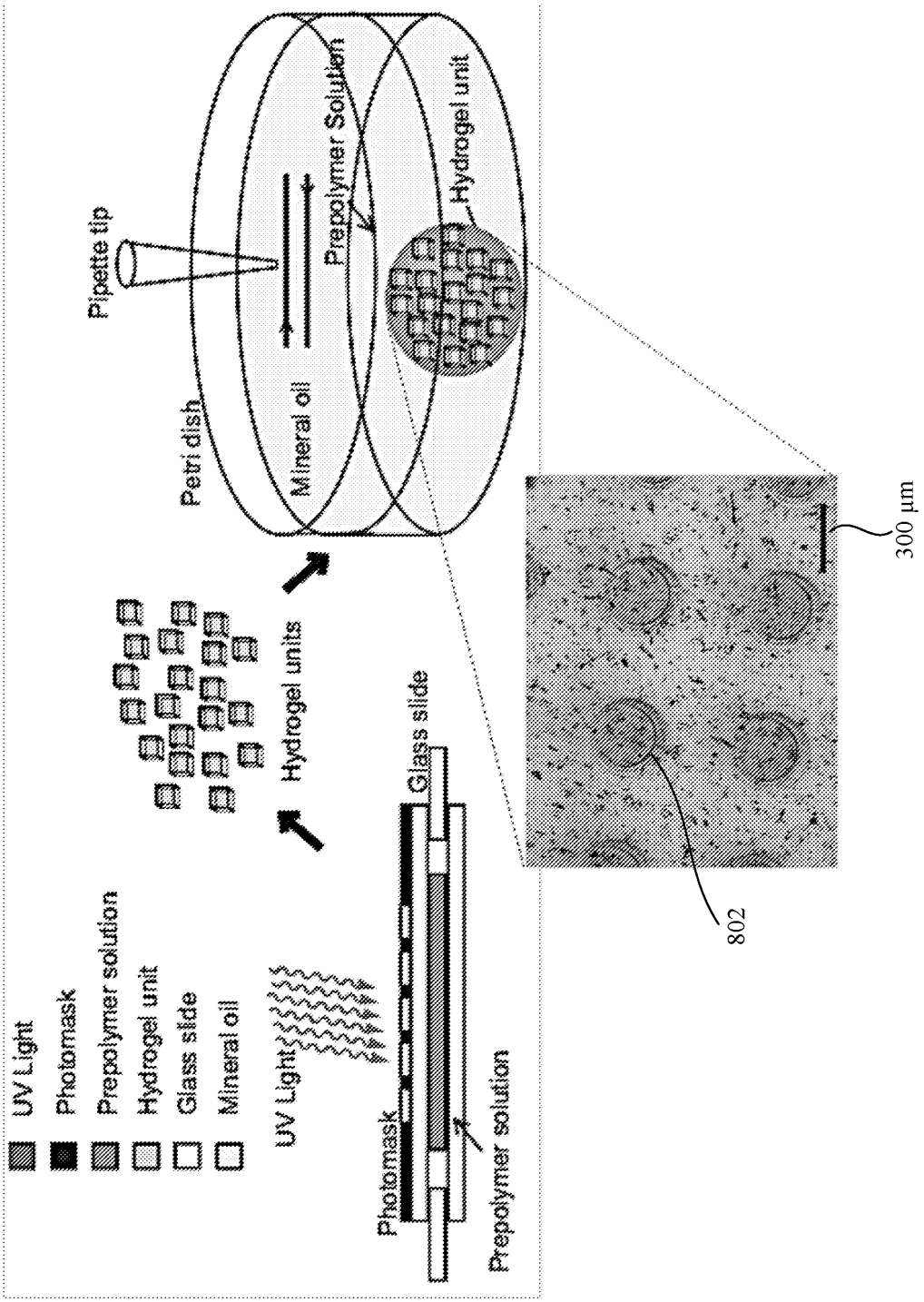
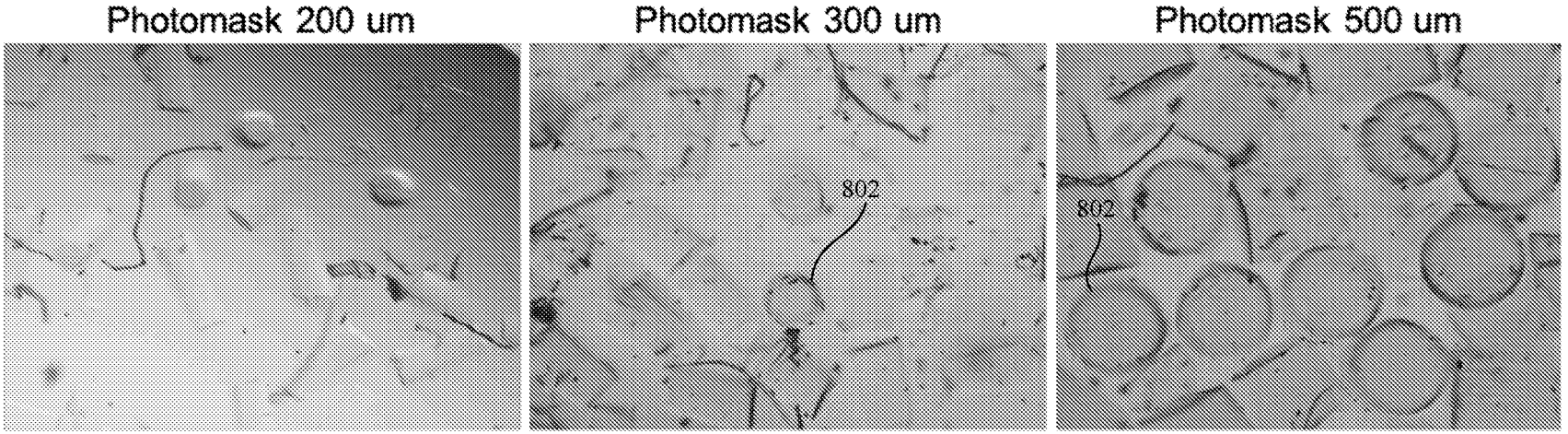

UV Light
Photomask
Prepolymer solution
Hydrogel unit
Glass slide
Mineral oil
UV Light
Photomask
Glass slide
Prepolymer solution
Hydrogel units
Pipette tip
Petri dish
Mineral oil
Prepolymer Solution
Hydrogel unit
802
300 µm

Fig. 9



•	Thickness	300 um	• Thickness	300 um	• Thickness	450 um
•	PI	1%	• PI	1%	• PI	1%
•	Exposure	30 s	• Exposure	30 s	• Exposure	30 s
•	GelMA conc.	10%	• GelMA conc.	10%	• GelMA conc.	10%
•	UV intensity	35%	• UV intensity	35%	• UV intensity	35%
•	$GelMA_{LOW}$		• $GelMA_{MEDIUM}$		• $GelMA_{MEDIUM}$	

Fig. 10

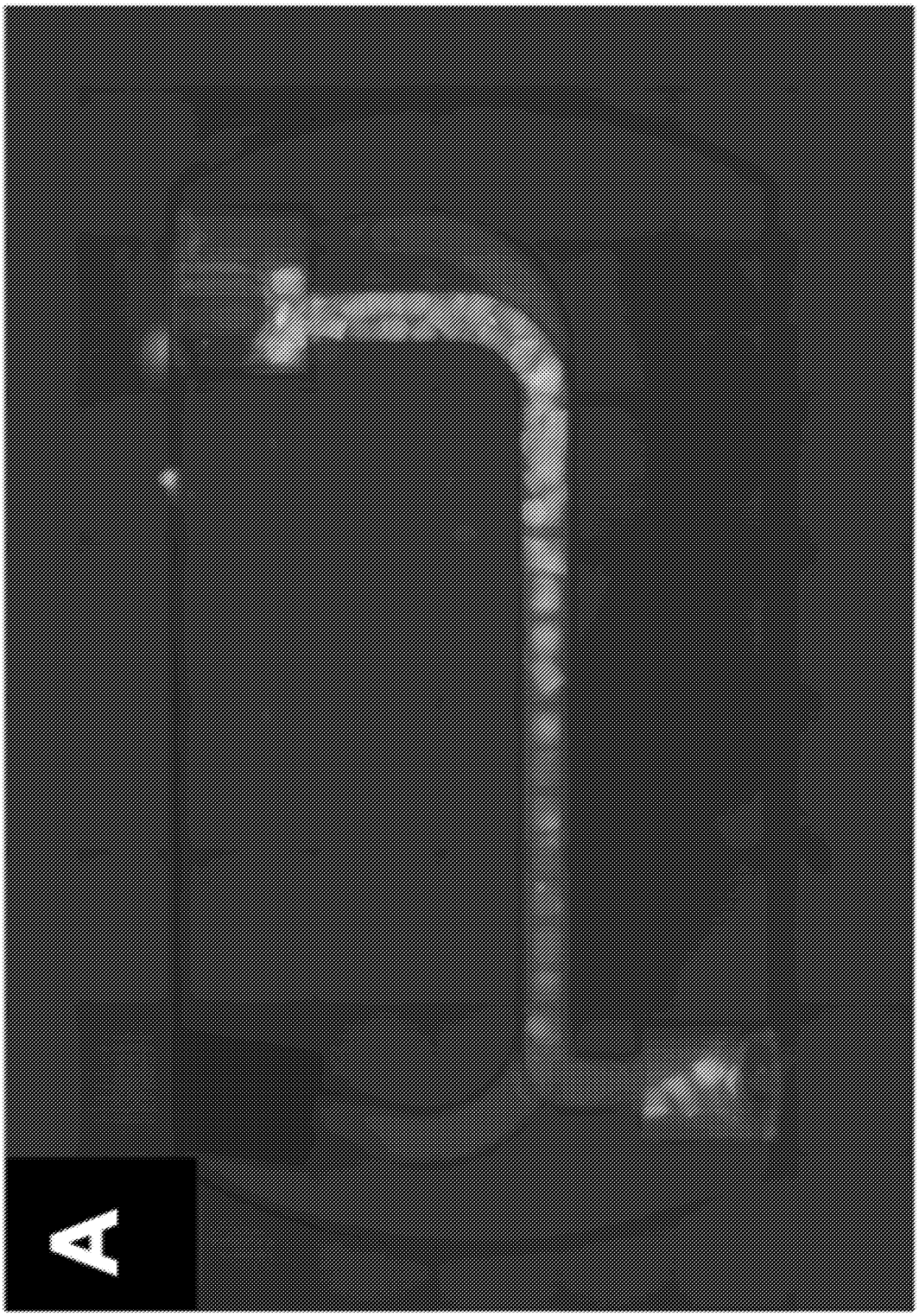


Fig. 11

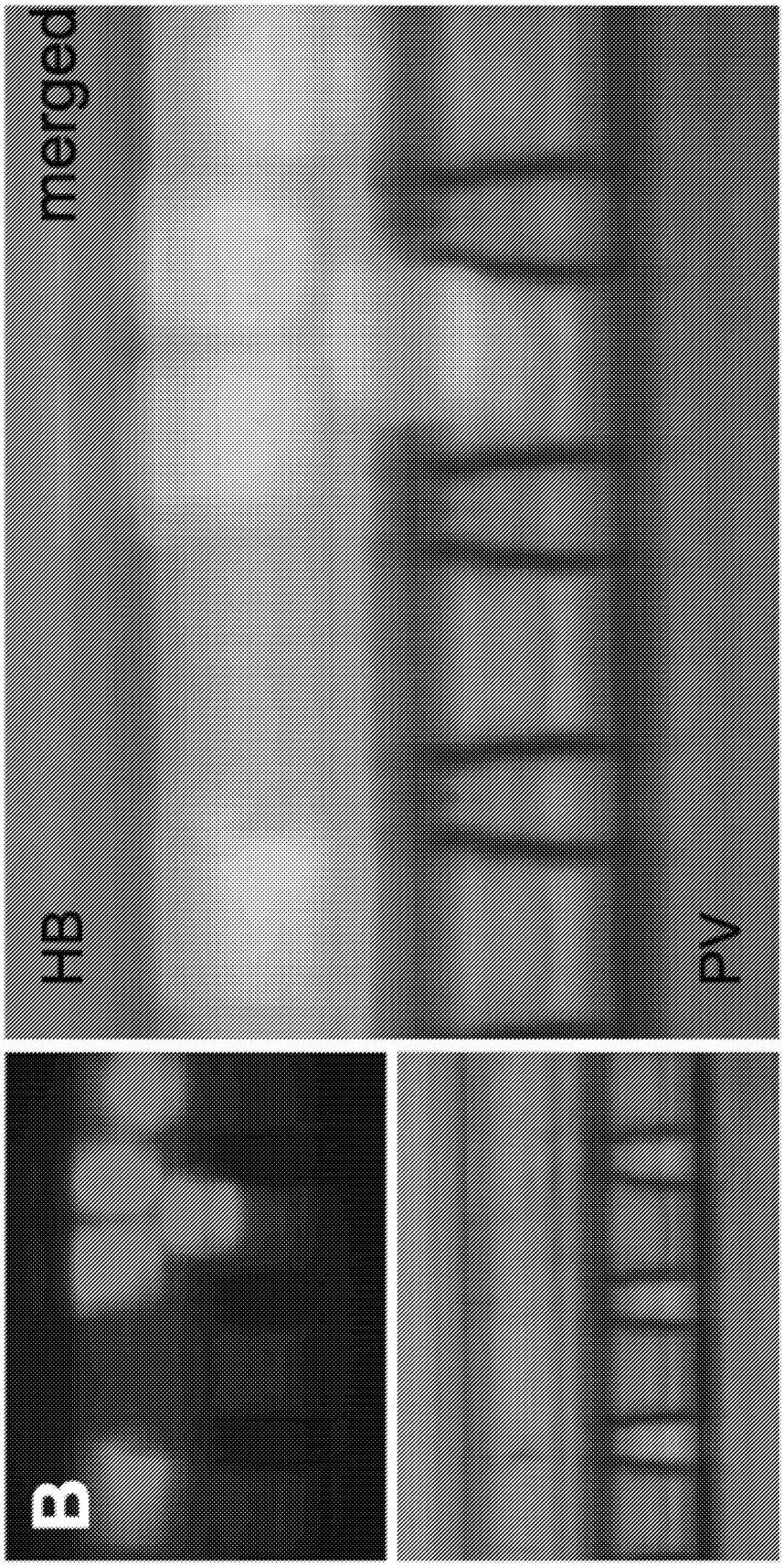


Fig. 12

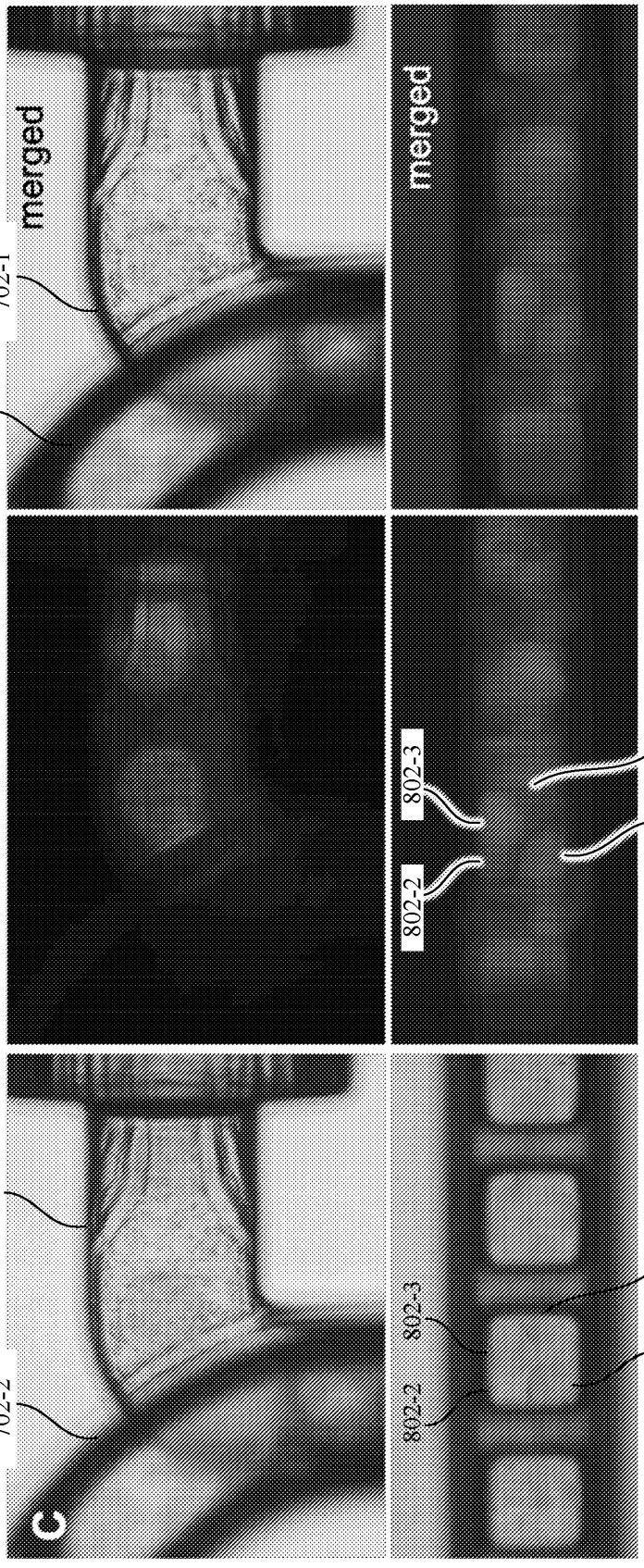


Fig. 13A

Fig. 13B

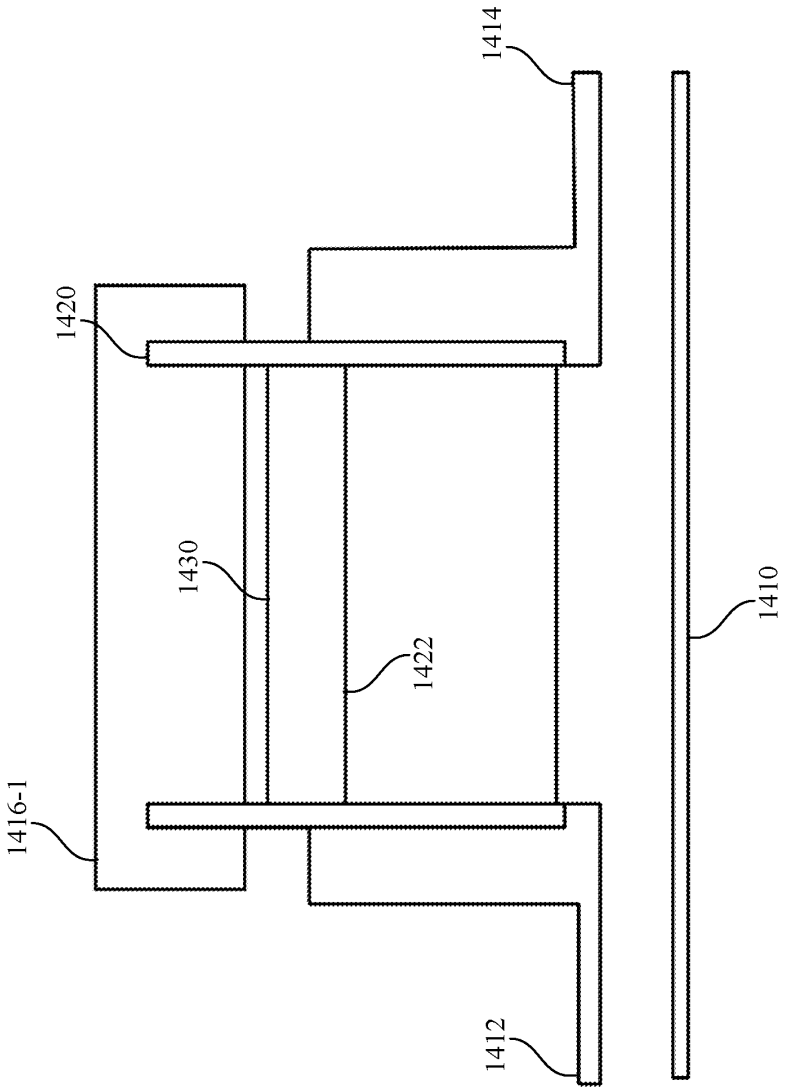


Fig. 14

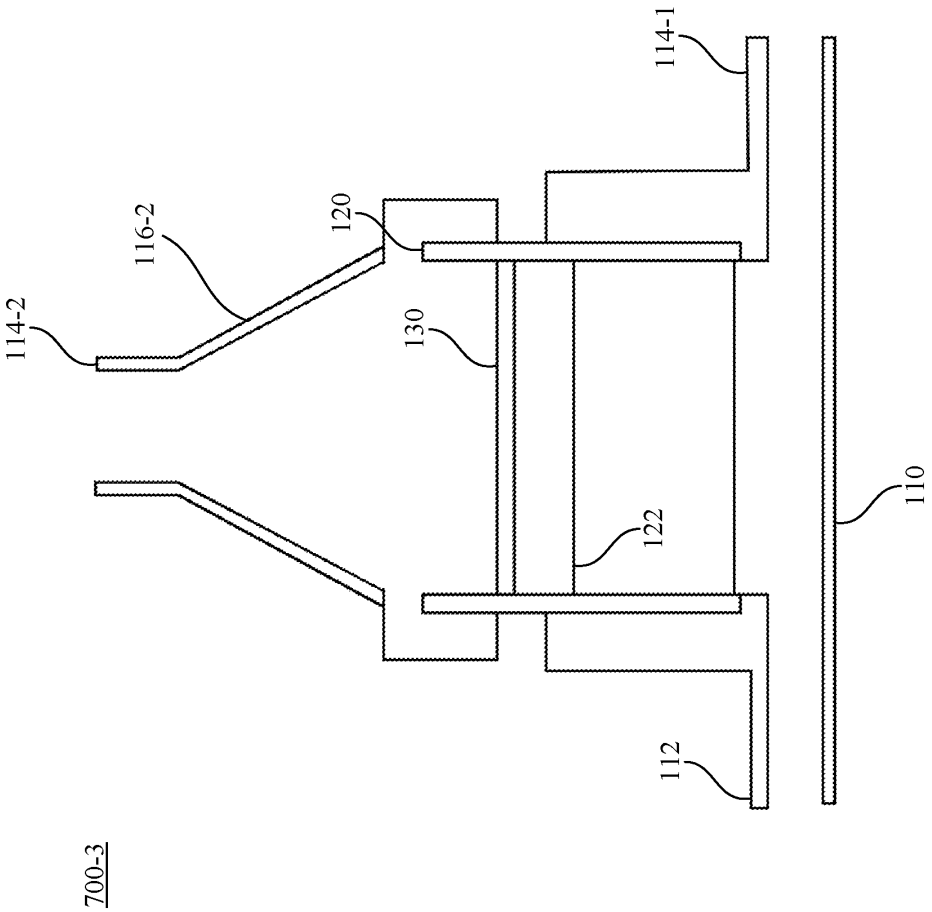


Fig. 15

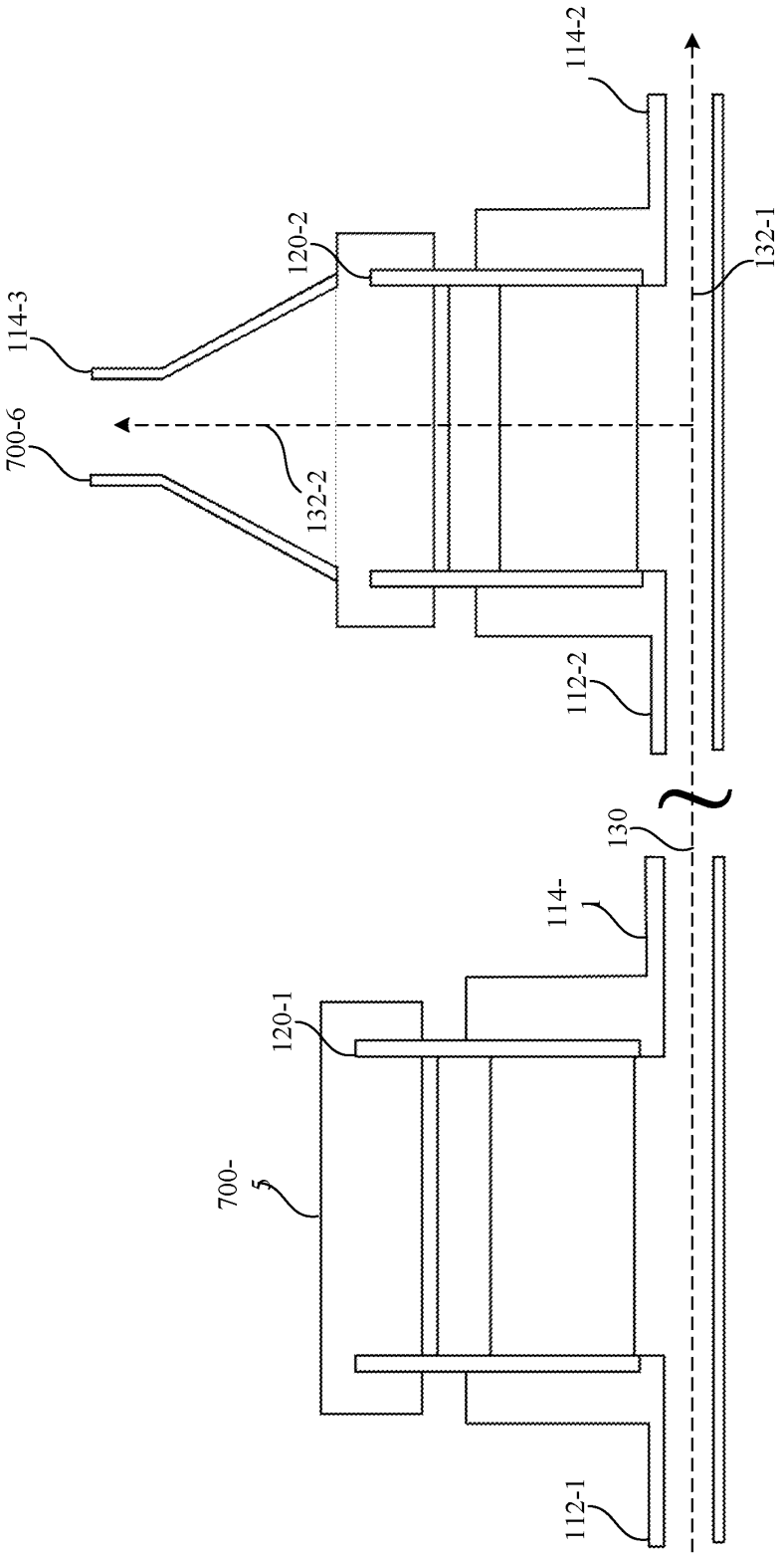


Fig. 16

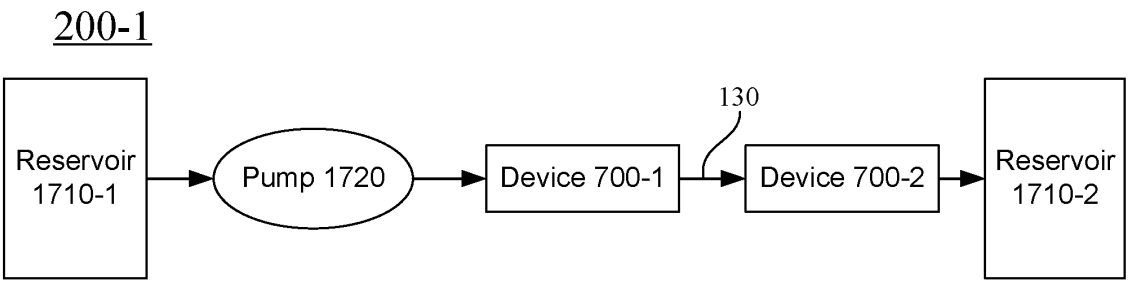


Fig. 17A

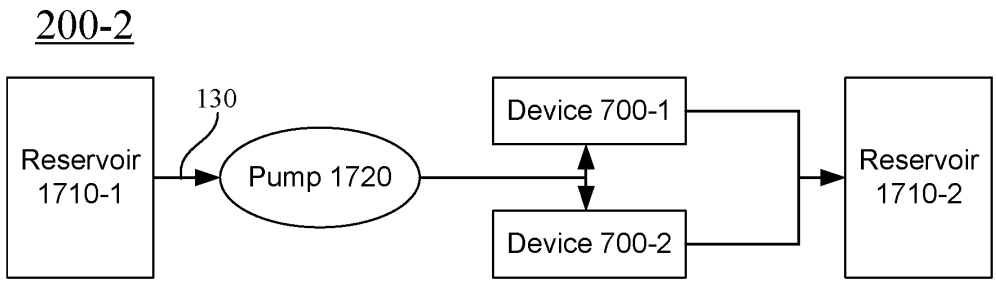


Fig. 17B

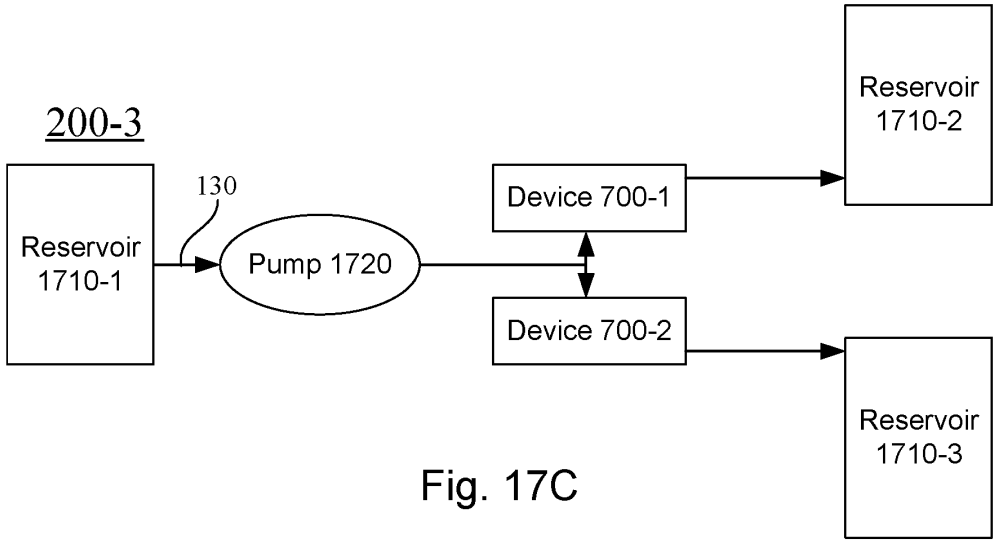


Fig. 17C

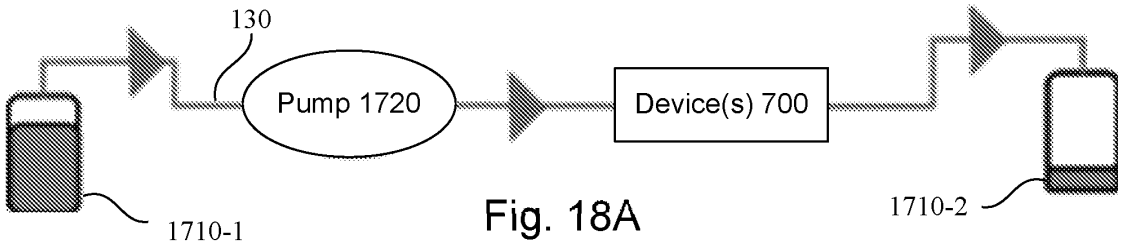


Fig. 18A

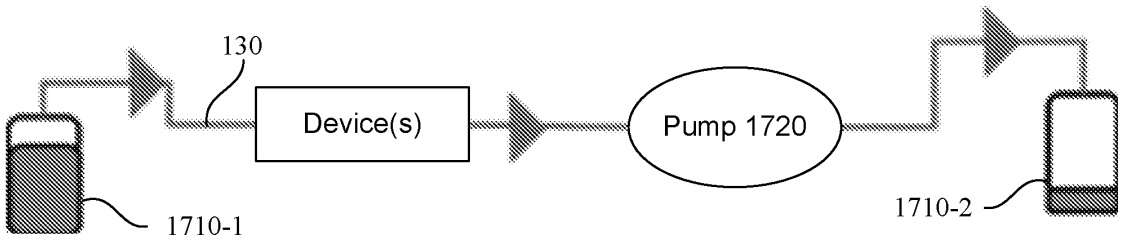


Fig. 18B

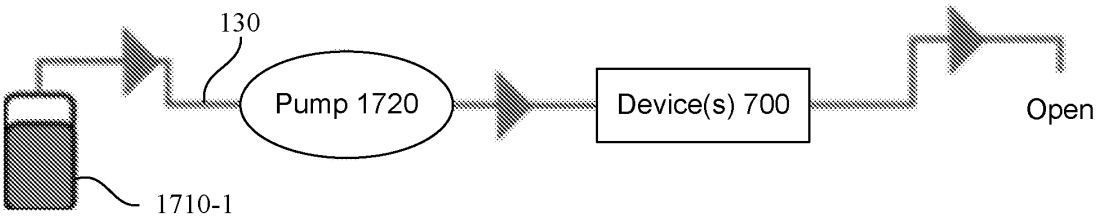


Fig. 18C

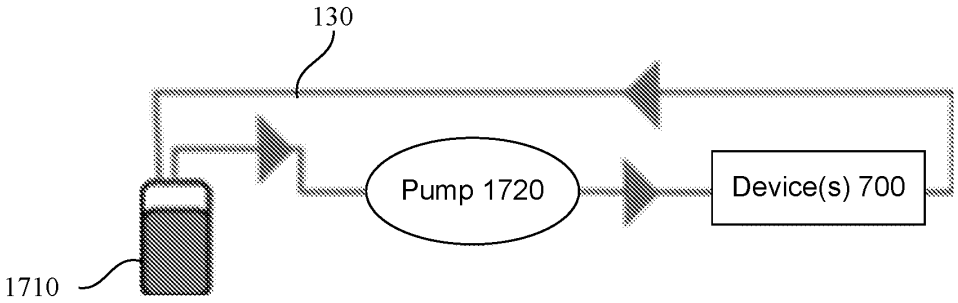


Fig. 18D

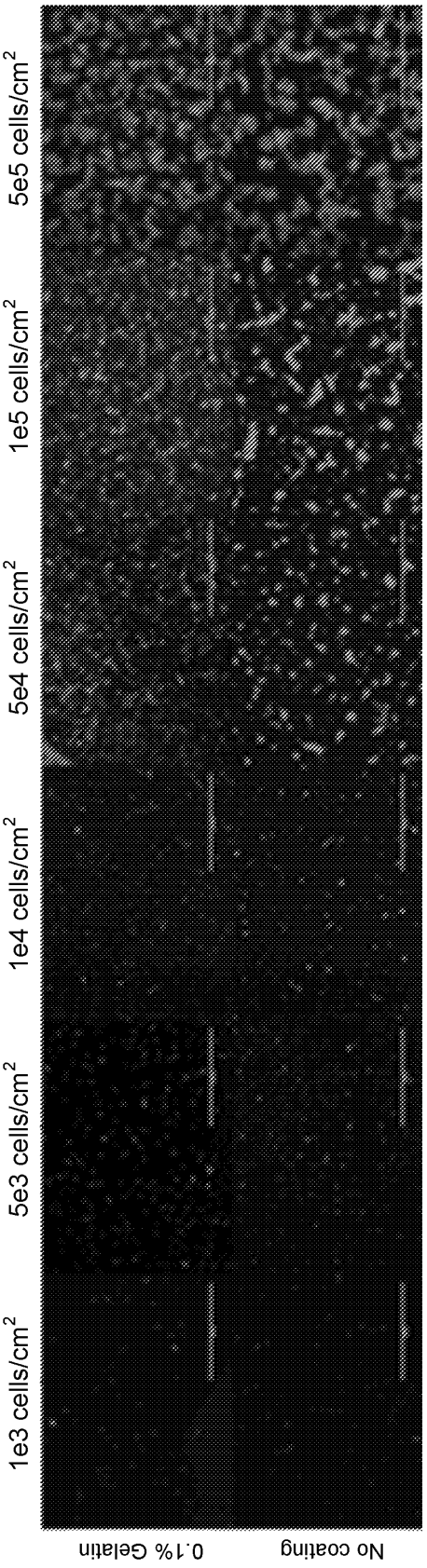

1e3 cells/cm2
5e3 cells/cm2
1e4 cells/cm2
5e4 cells/cm2
1e5 cells/cm2
5e5 cells/cm2
No coating
0.1% Gelatin

Fig. 19

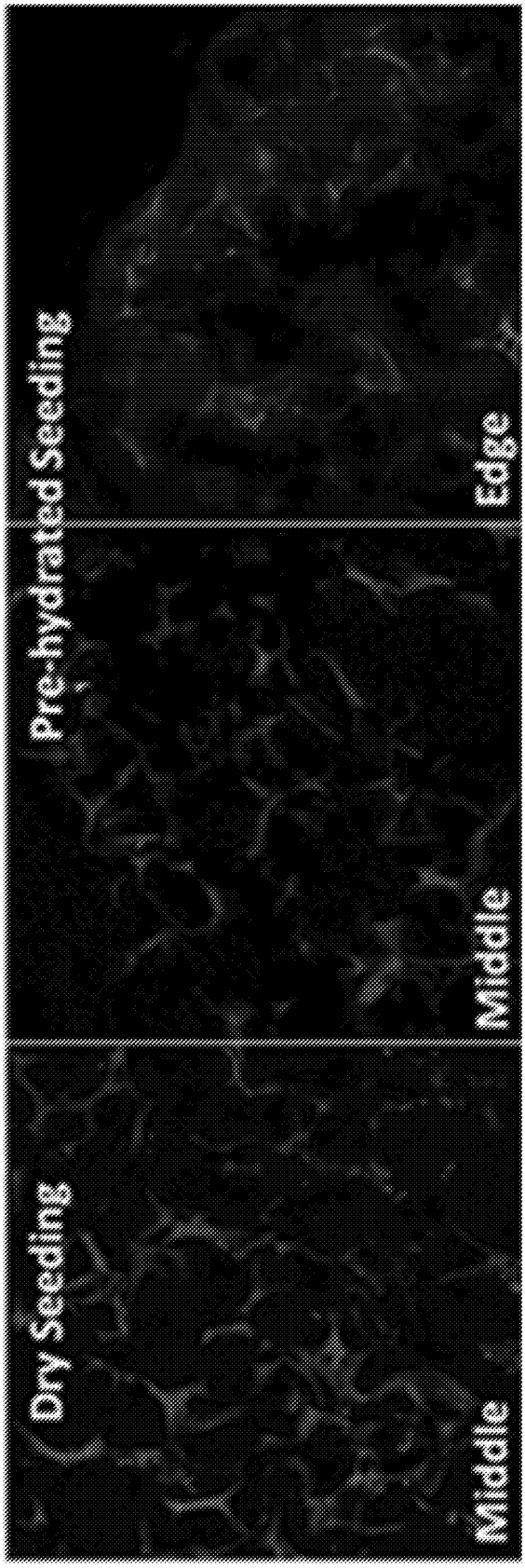


Fig. 20

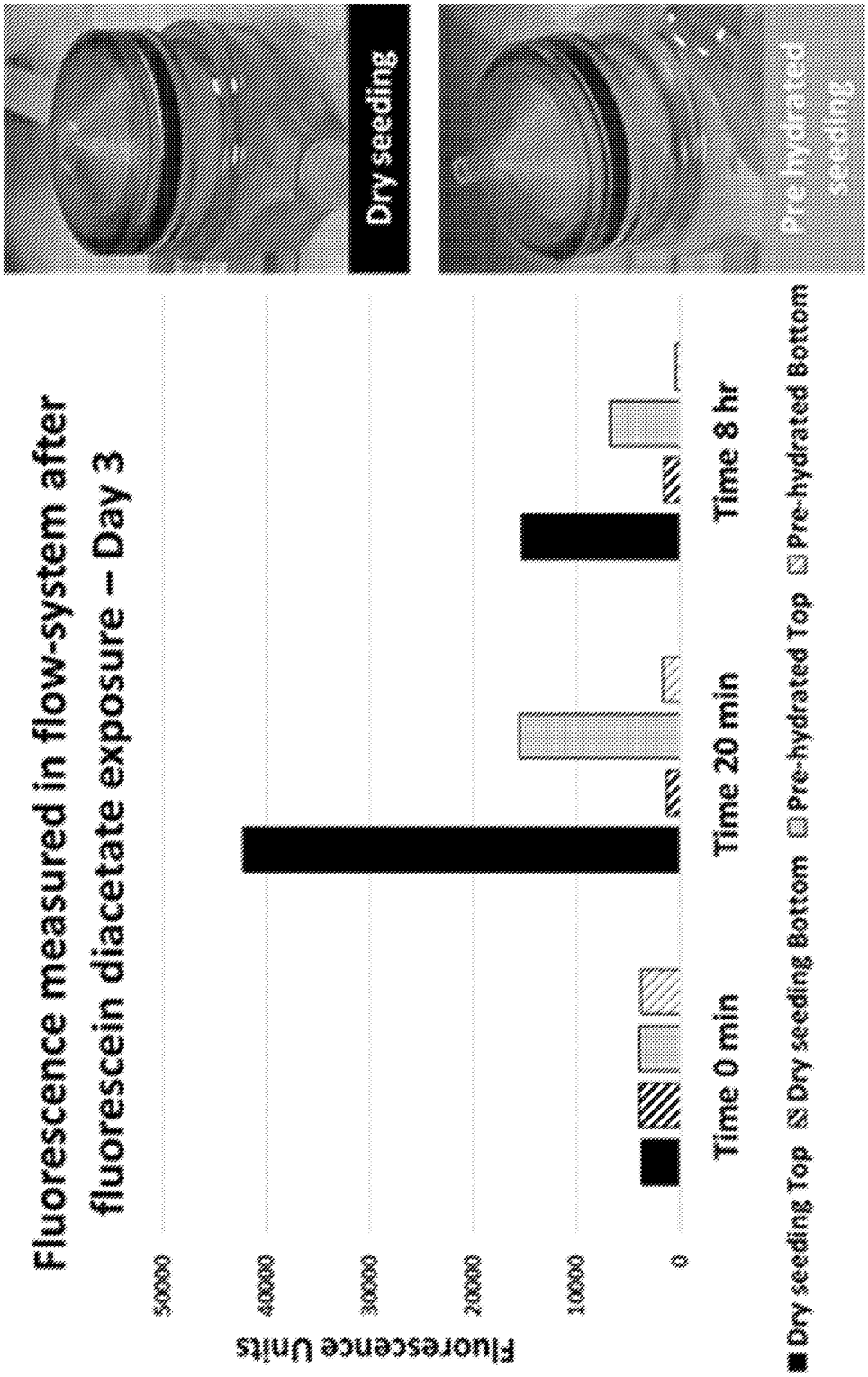

Dry seeding
Pre-hydrated seeding
Fluorescence measured in flow-system after fluorescein diacetate exposure – Day 3
Fluorescence Units
50000
40000
30000
20000
10000
0
Time 0 min
Time 20 min
Time 8 hr
Dry seeding Top
Dry seeding Bottom
Pre-hydrated Top
Pre-hydrated Bottom

Fig. 21

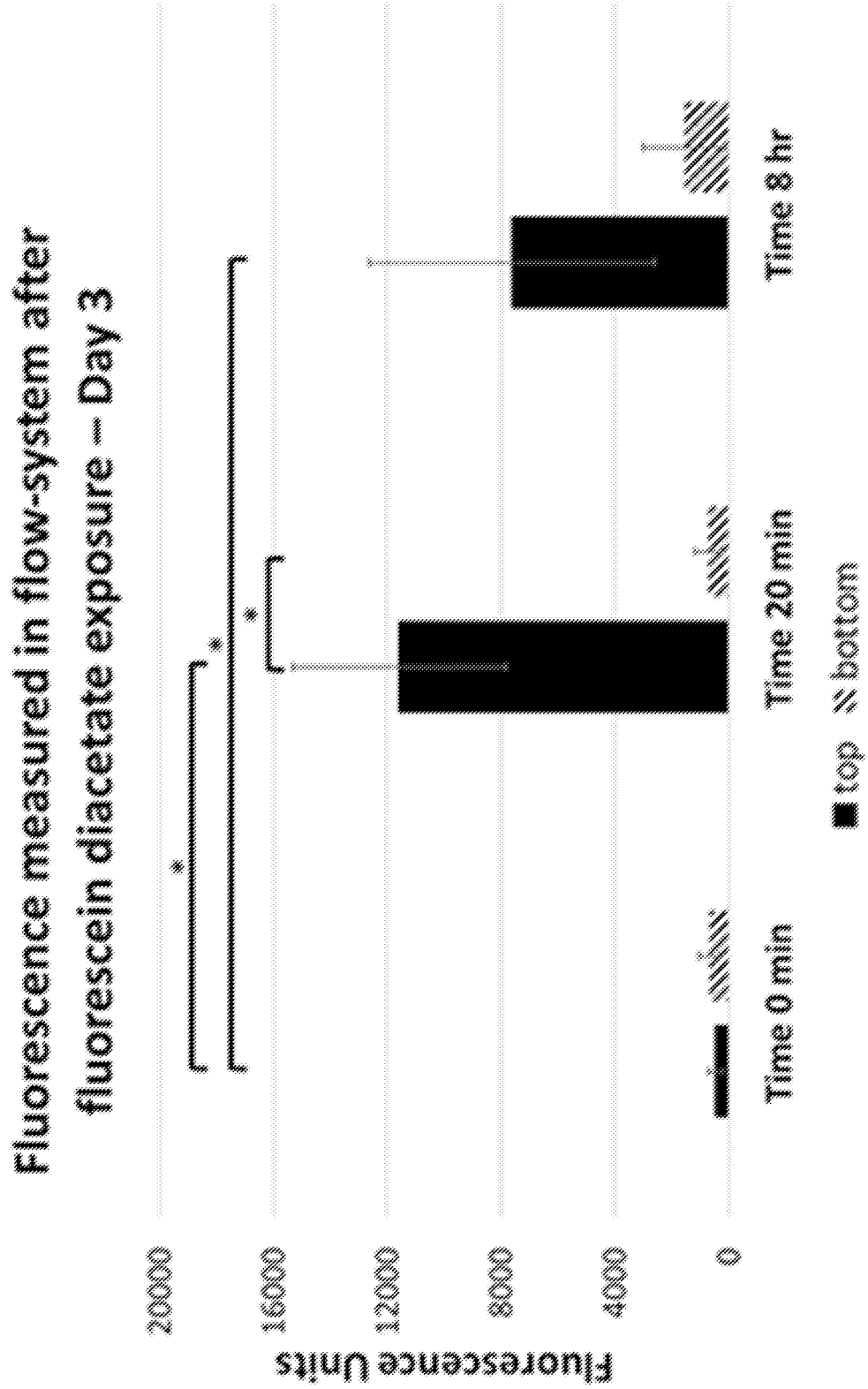

Fluorescence measured in flow-system after fluorescein diacetate exposure – Day 3
Fluorescence Units
2000
1600
1200
800
400
0
*
*
*
Time 0 min
Time 20 min
Time 8 hr
top
bottom

Fig. 22

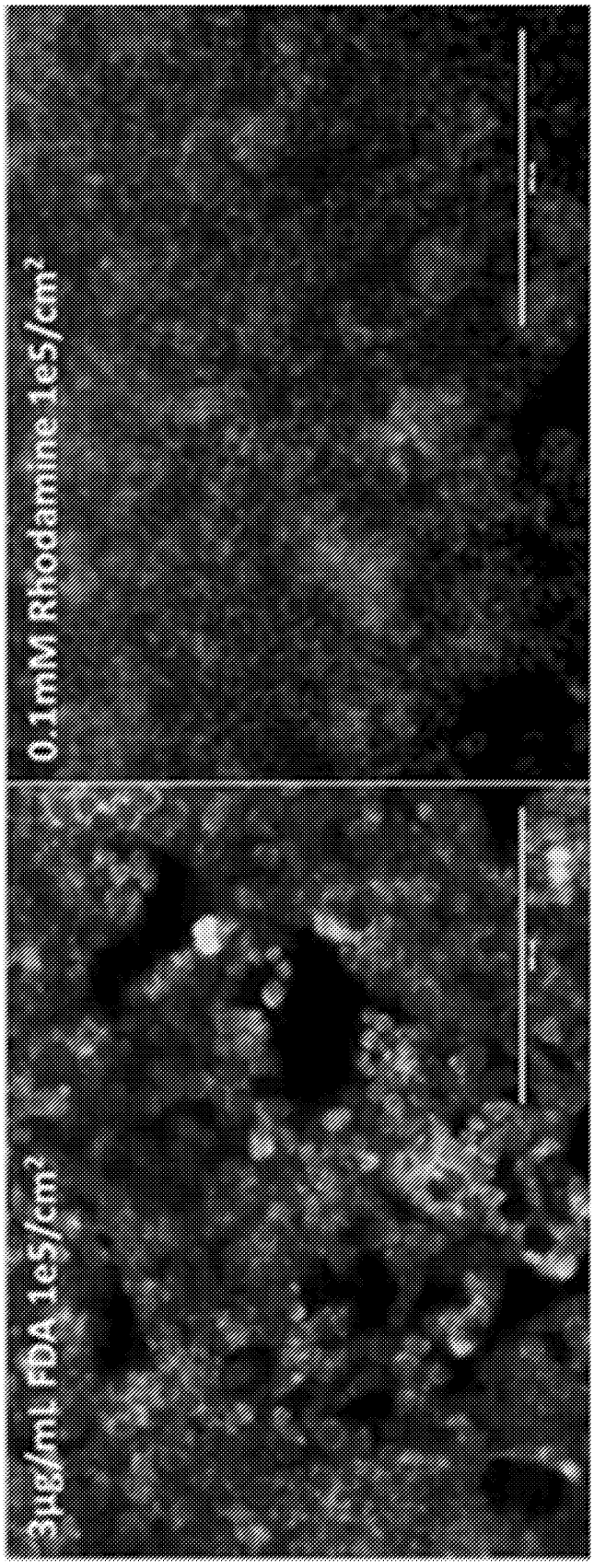


Fig. 23

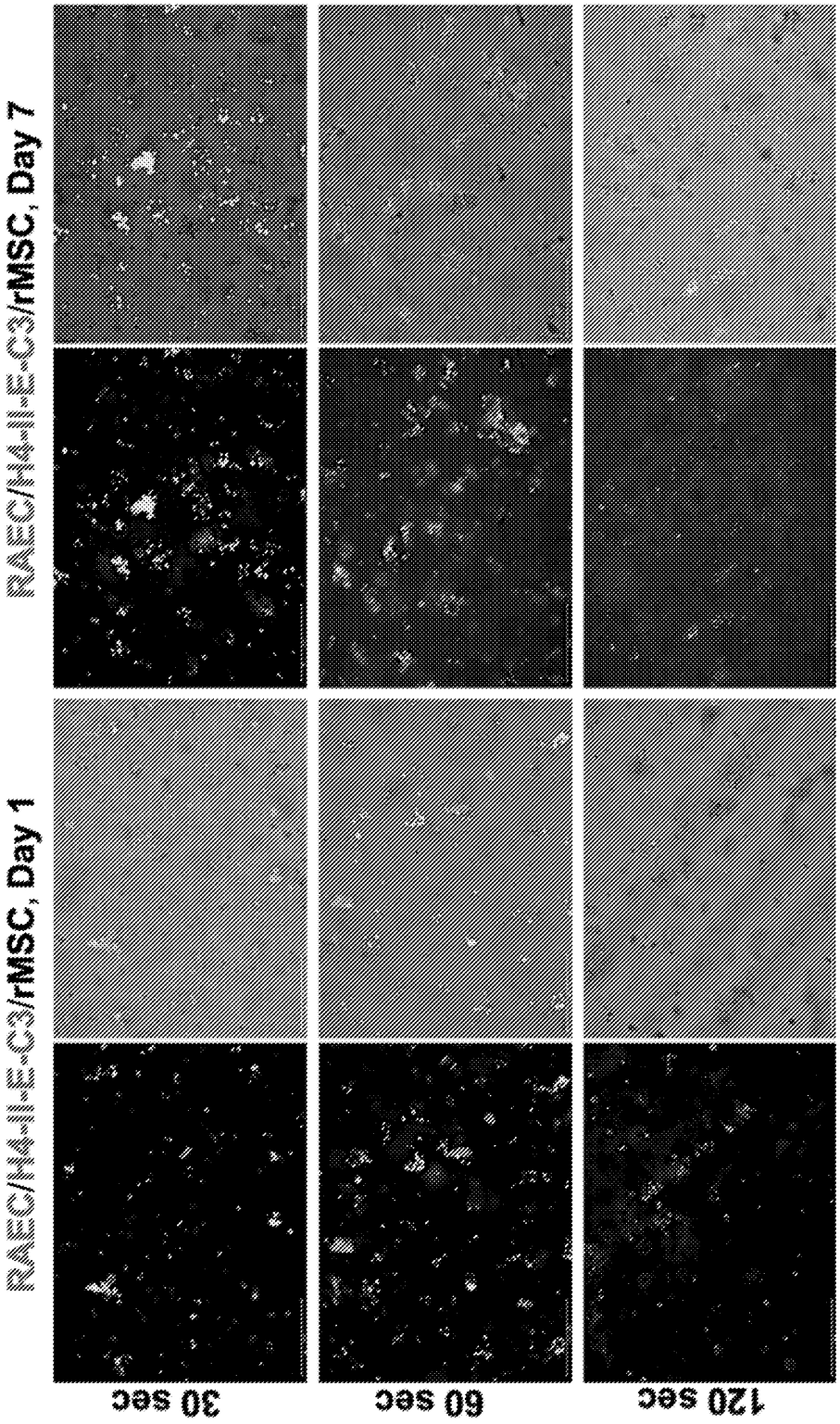

RAEC/H4-II-E-C3/rMSC, Day 7
RAEC/H4-II-E-C3/rMSC, Day 1
30 sec
60 sec
120 sec

Fig. 24

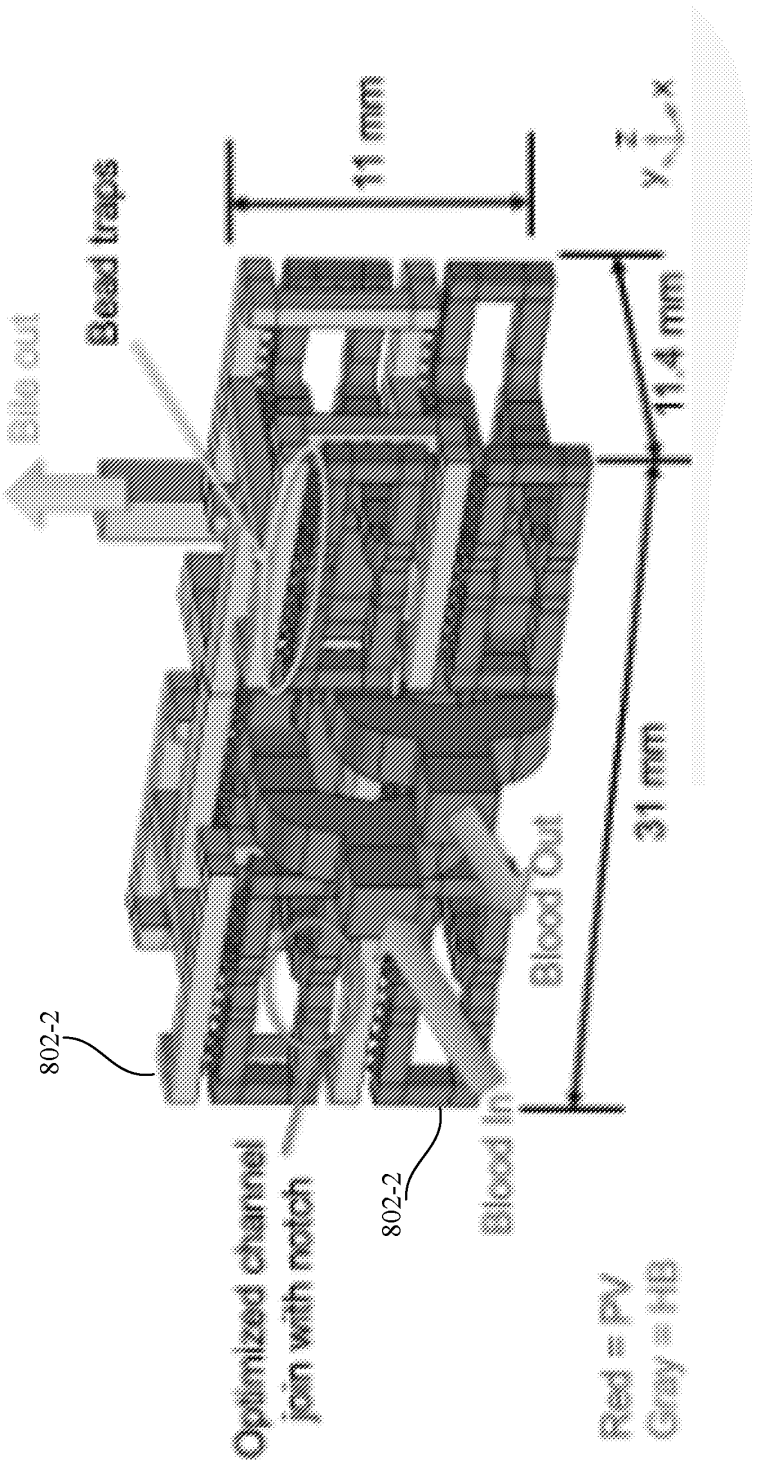

Bio out
Bead traps
11 mm
11.4 mm
31 mm
802-2
Optimized channel join with notch
802-2
Blood in
Blood out
Red = PV
Gray = HB

Fig. 25

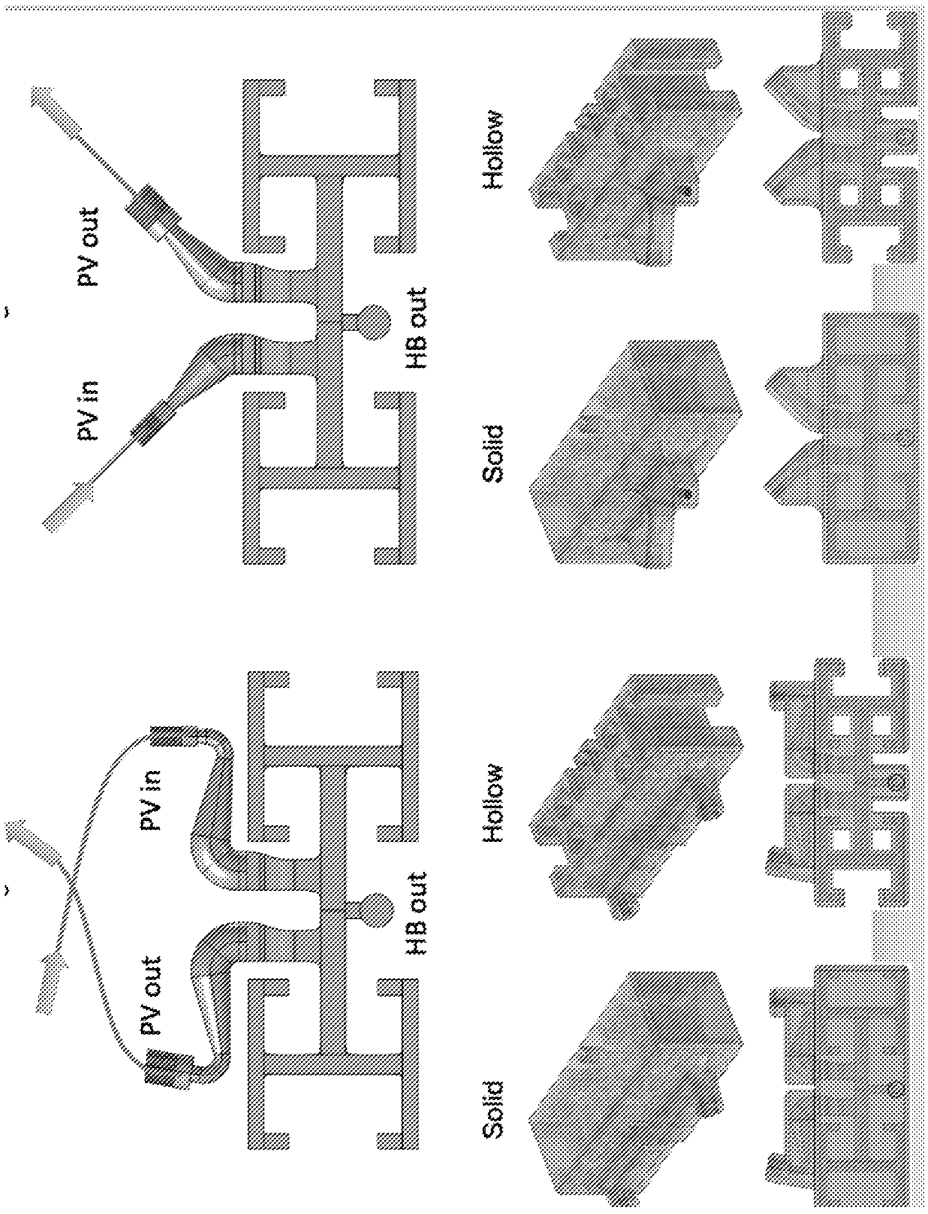

PV out
PV in
HB out
Hollow
Solid
PV in
PV out
HB out
Hollow
Solid

Fig. 26

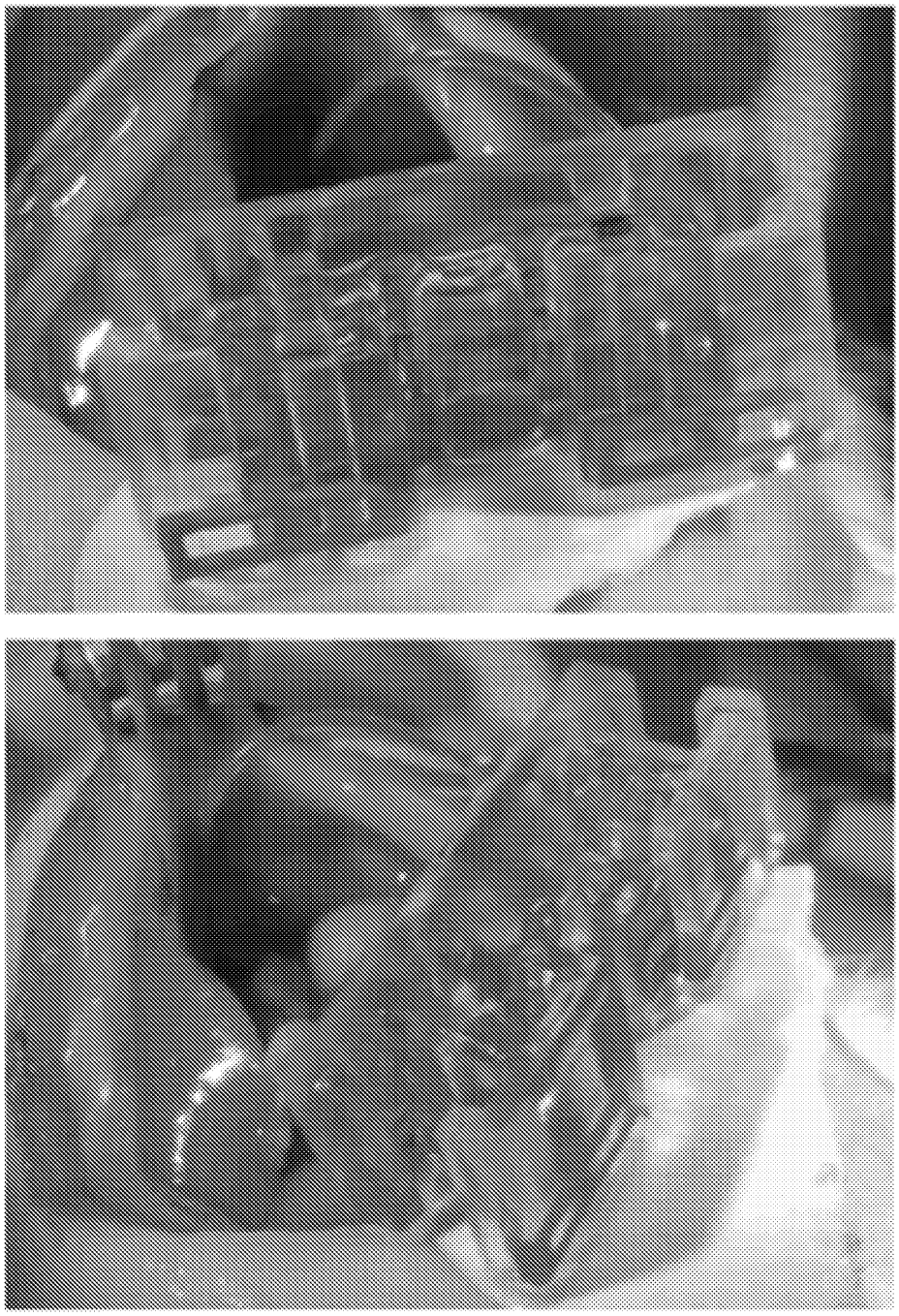


Fig. 27

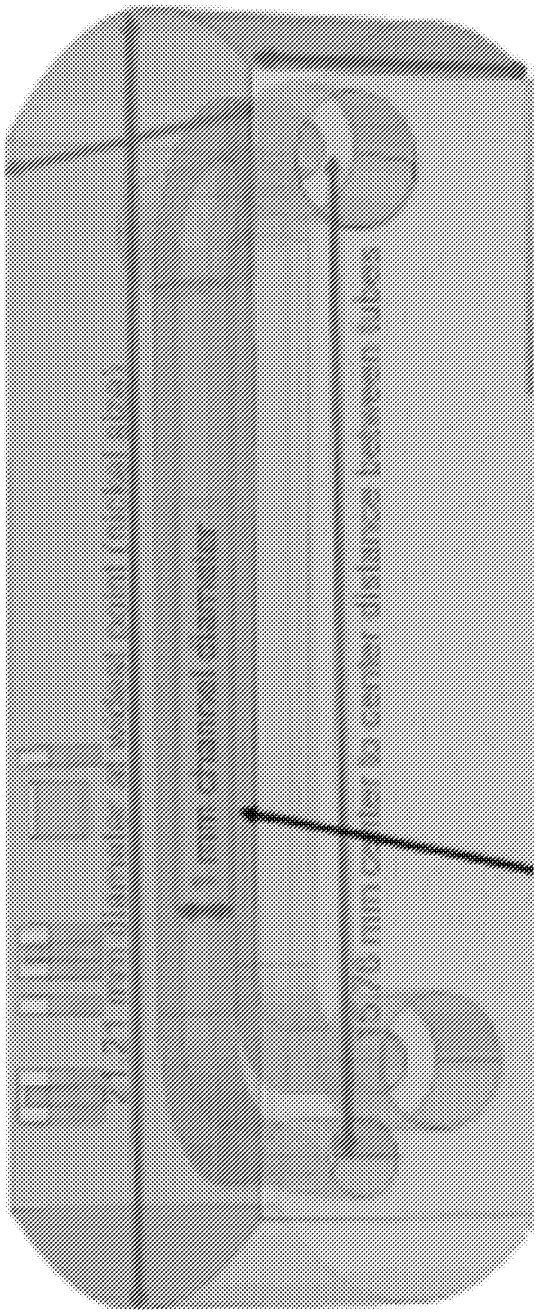


Fig. 28

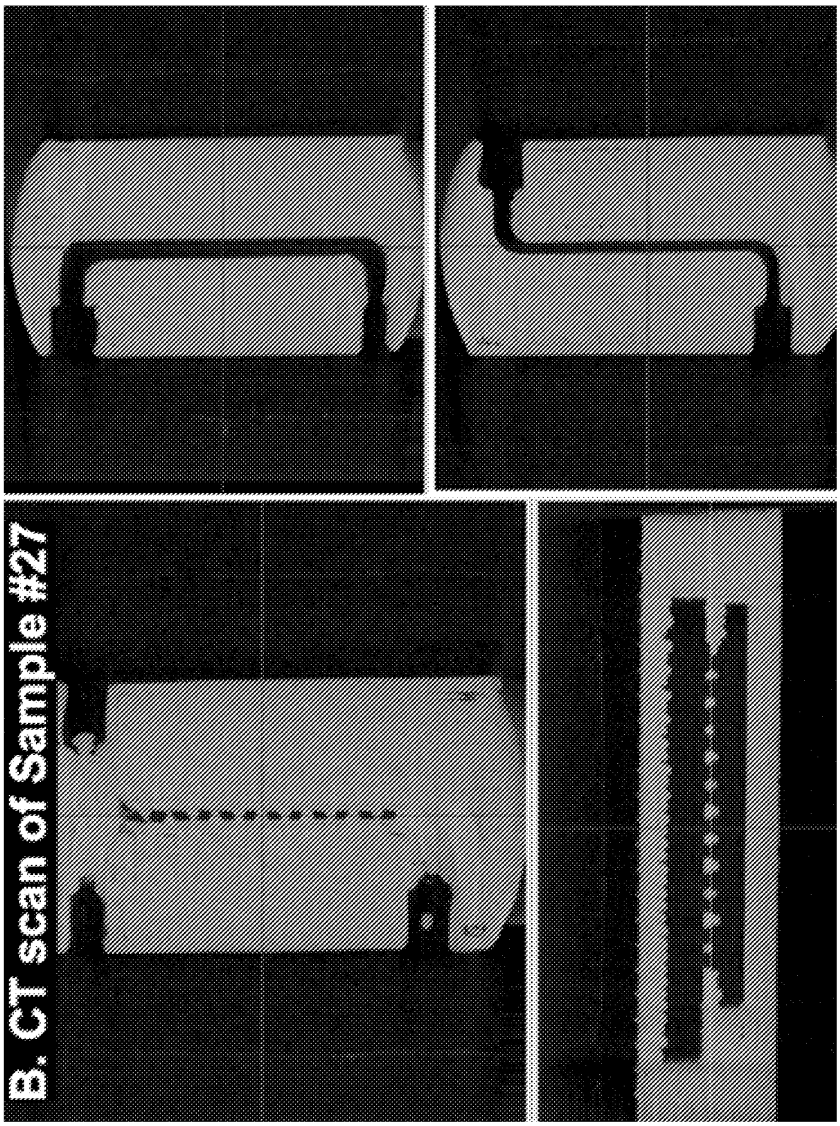


Fig. 29

Fig. 30A

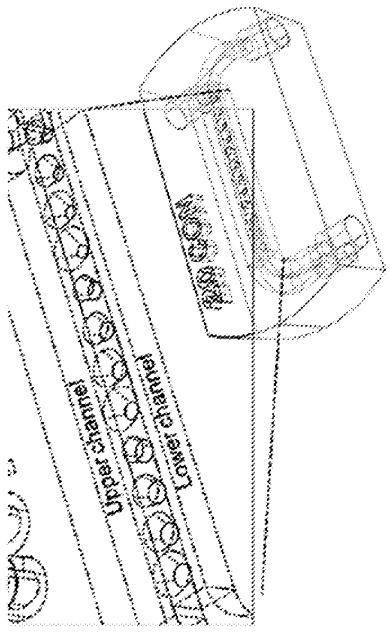


Fig. 30B

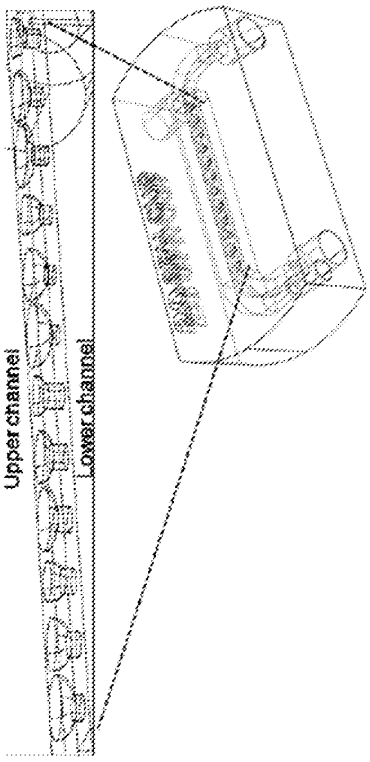
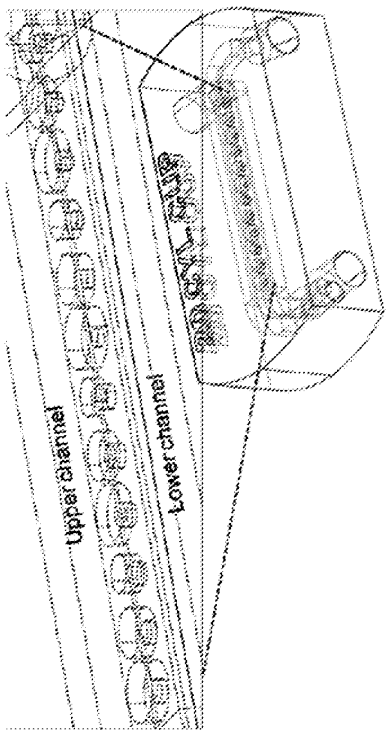


Fig. 30C



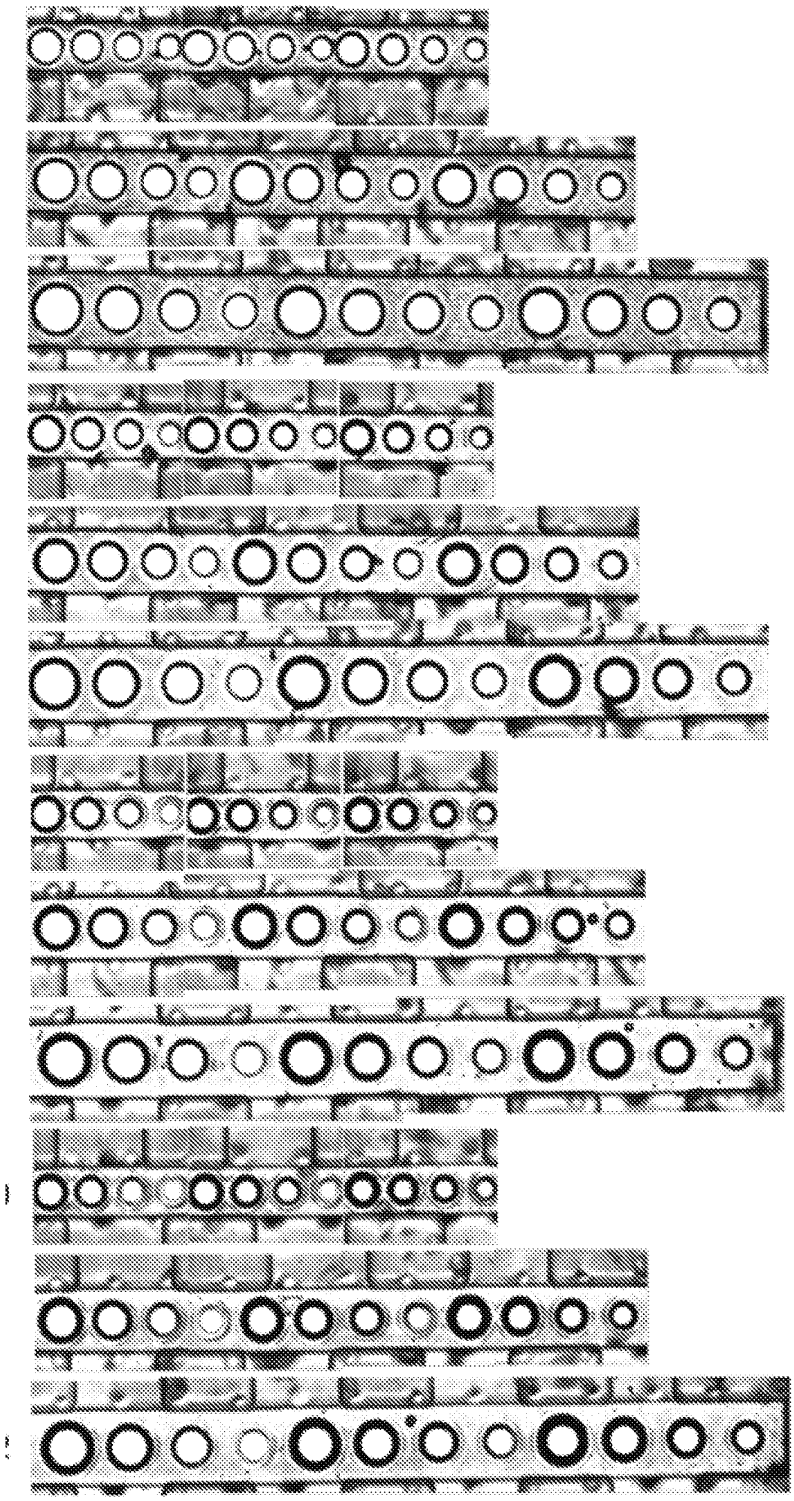


Fig. 30D

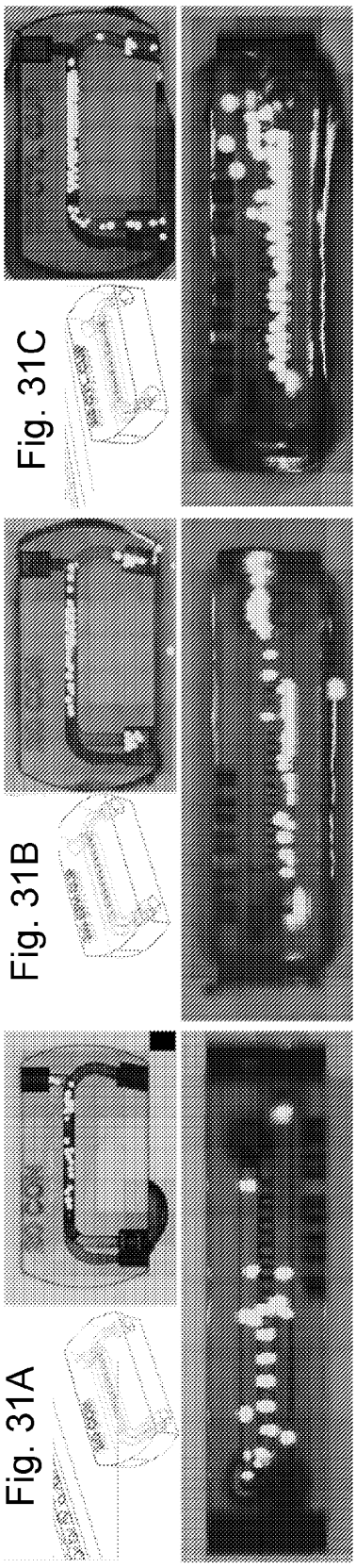


Fig. 31A

Fig. 31B

Fig. 31C

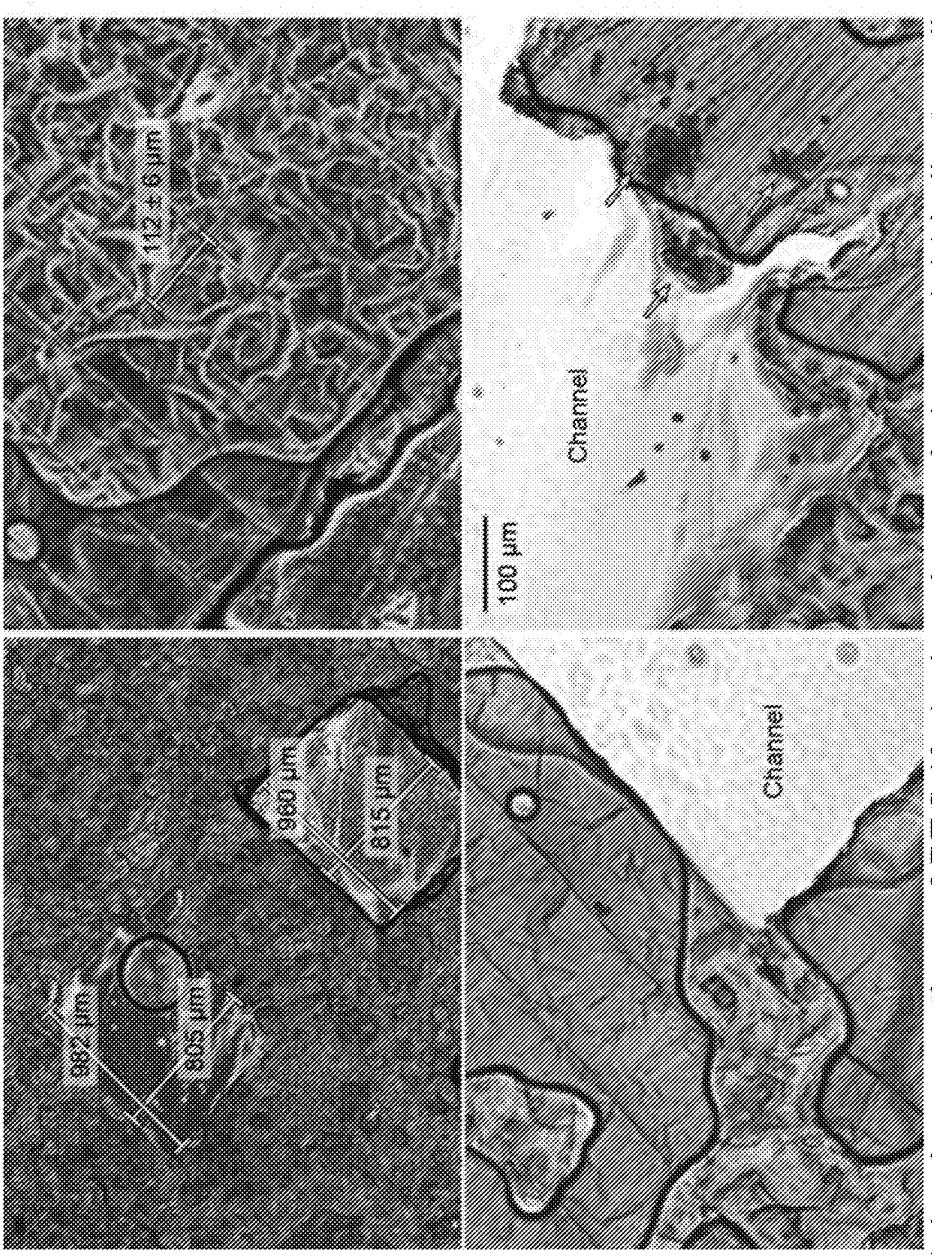


Fig. 32

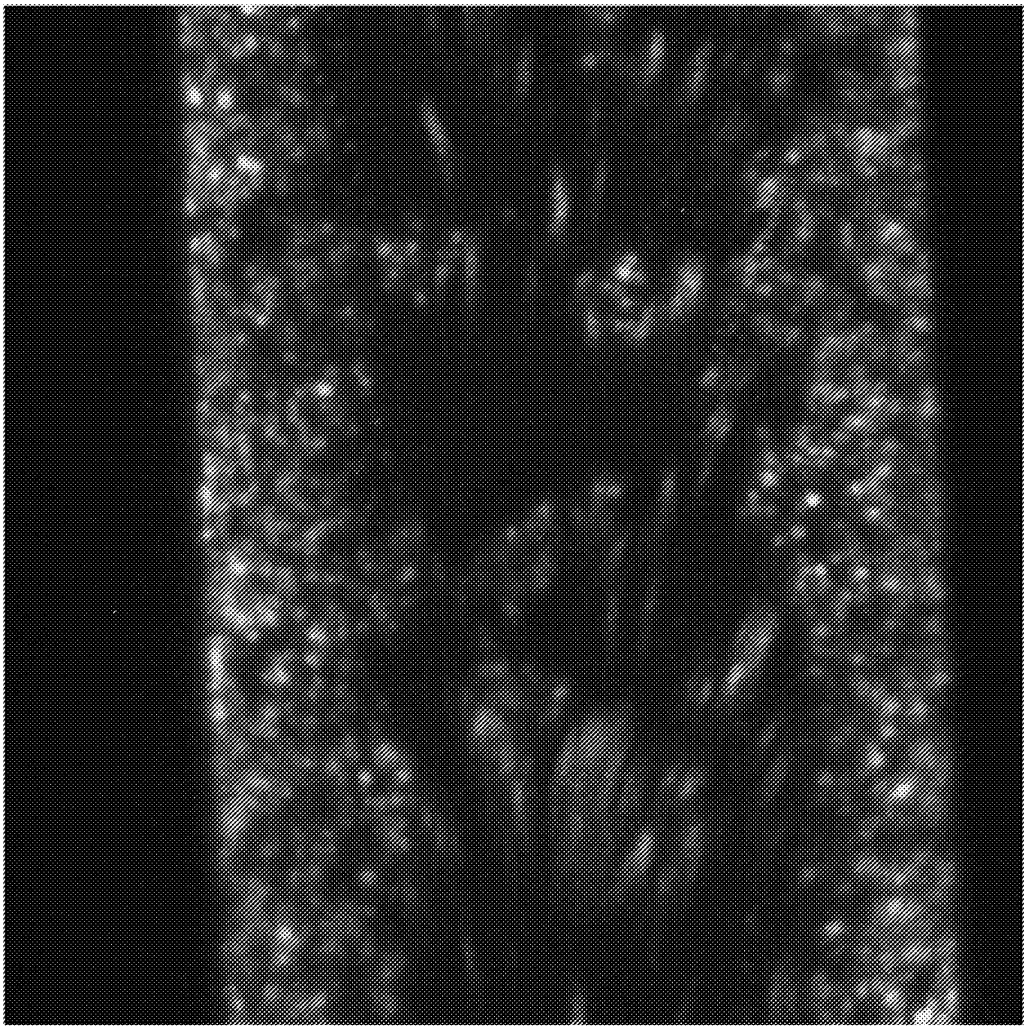


Fig. 33

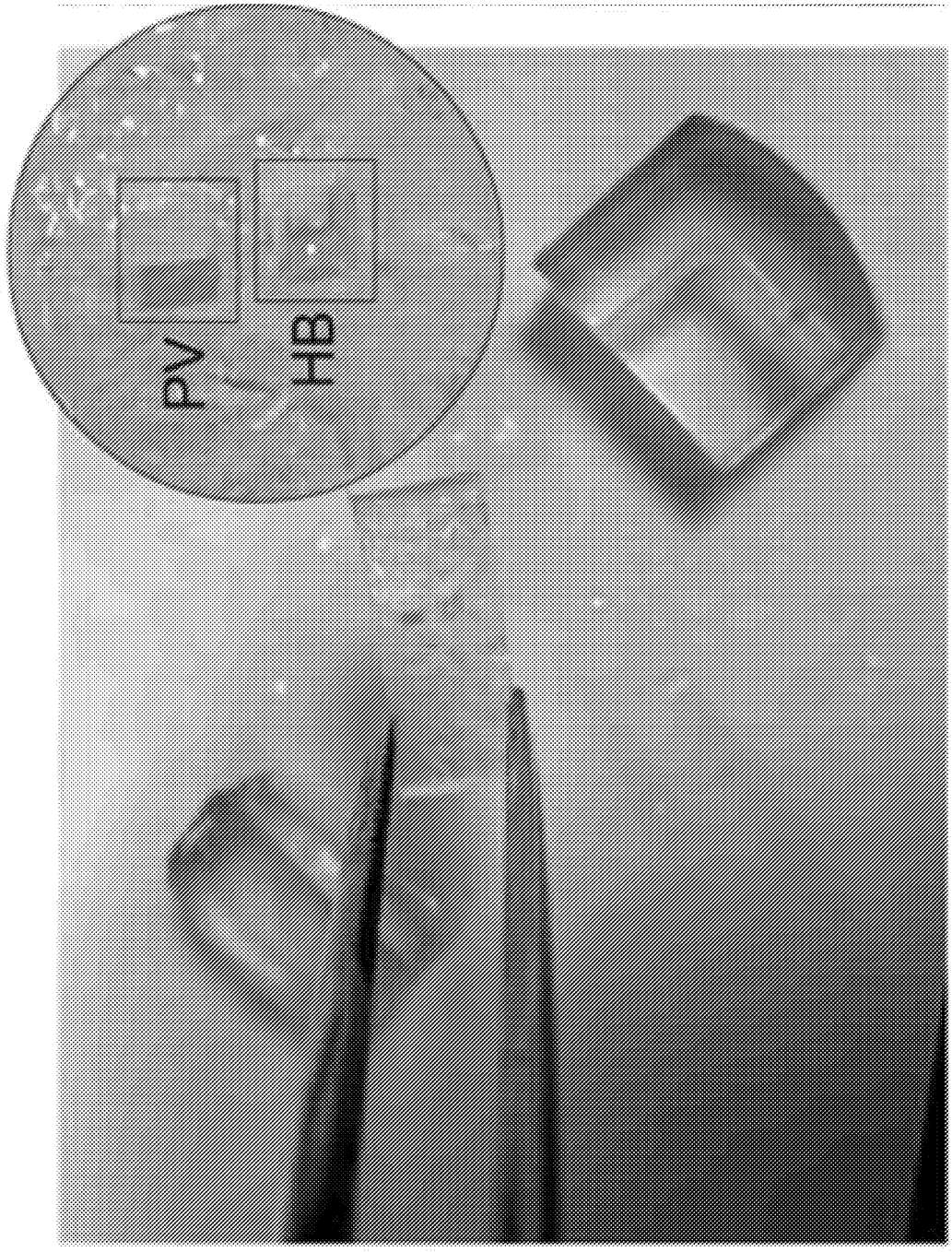


Fig. 34

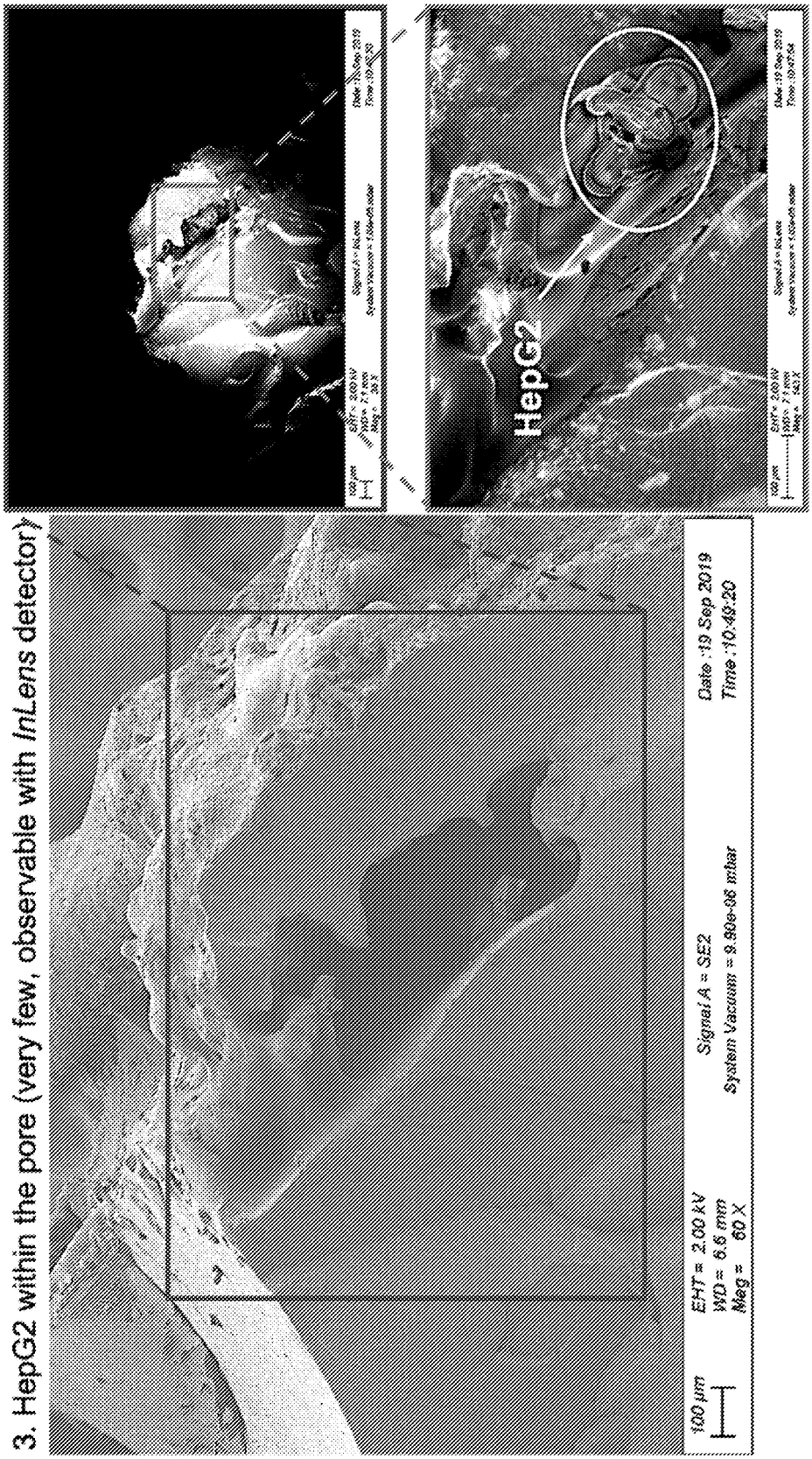

3. HepG2 within the pore (very few, observable with InLens detector)
HepG2
100 µm
EHT = 2.00 kV
WD = 6.6 mm
Mag = 60 X
Signal A = SE2
System Vacuum = 9.90e-06 mbar
Date :19 Sep 2019
Time :10:49:20

Fig. 35

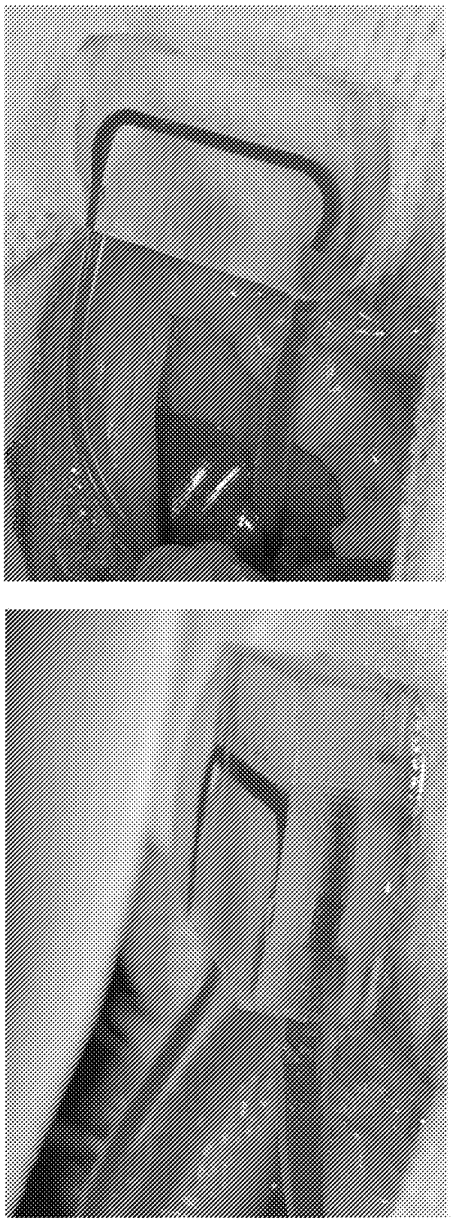


Photo 1. Implantation of 10C_PEGDA500-4S2X_1

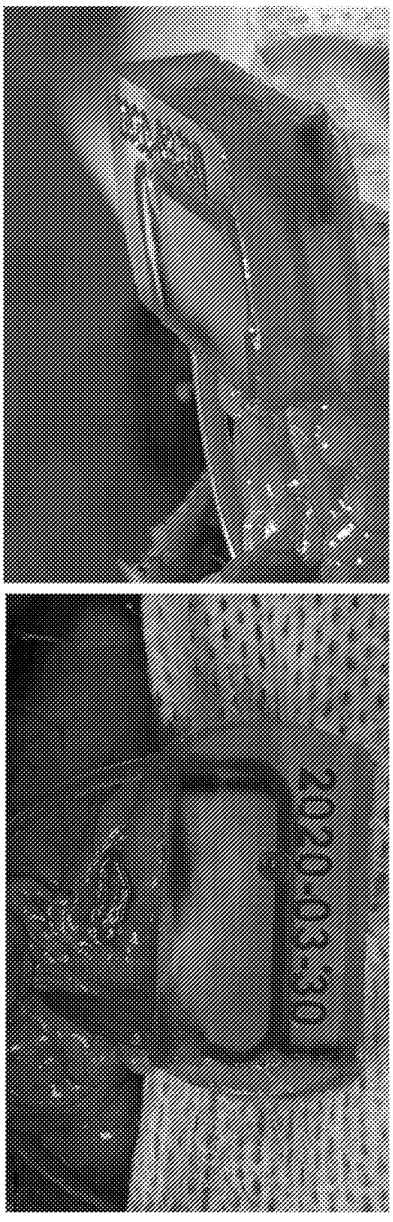


Photo 2. Flow through 10C_PEGDA500-4S2X_1 at day 1 post op

Fig. 36

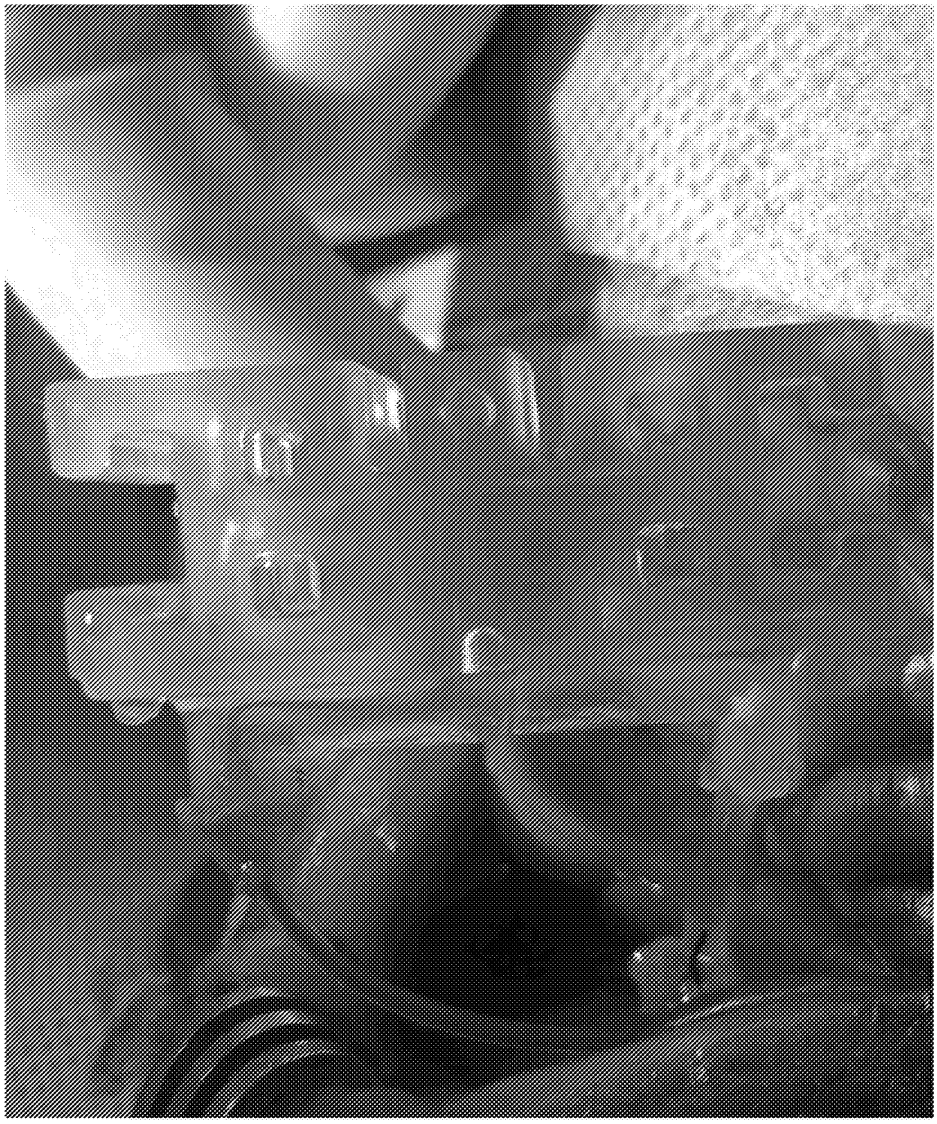


Fig. 37

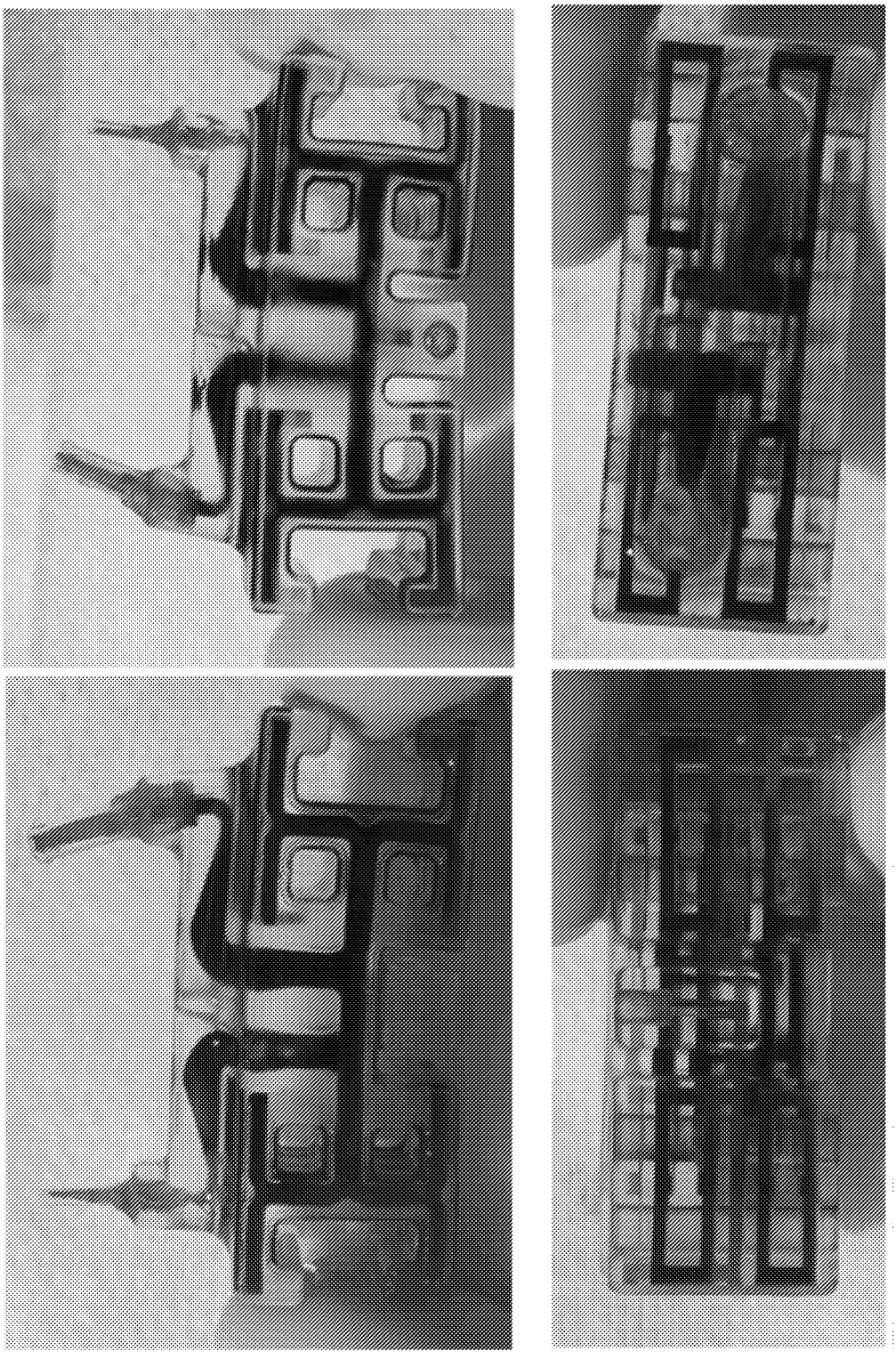


Fig. 38

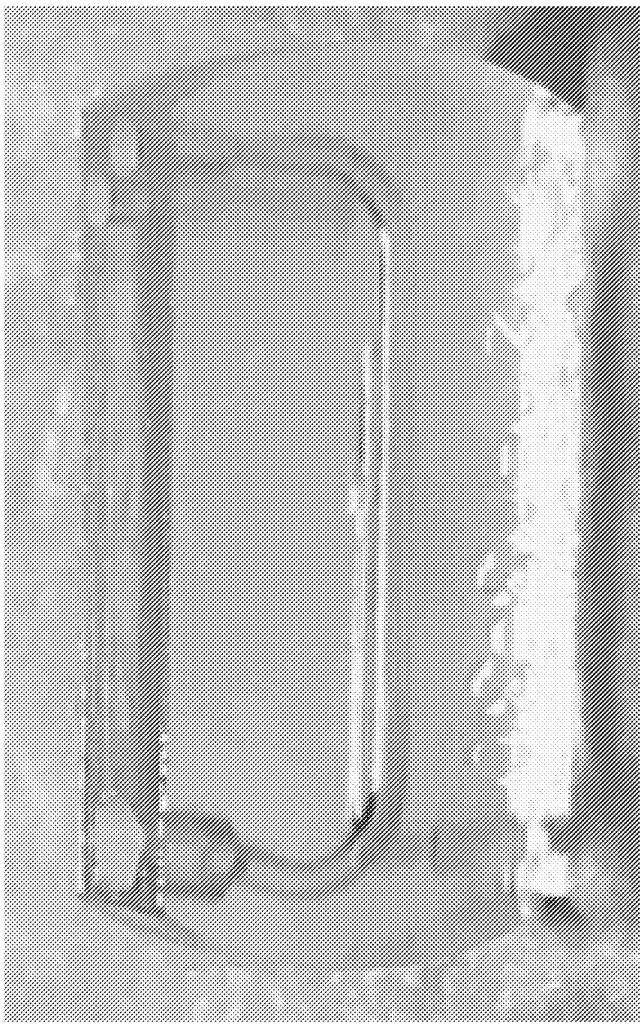


Fig. 39

In Vitro
• Device: PEGDA
• Cells: H4-II-E-C3, 20million/mL (HB only)
• PV flow: High glucose DMEM (flow rate 85 RPM)
In Vivo
• Device: PEGDA
• Cells: H4-II-E-C3, 20million/mL (HB only)
• PV flow (portal blood

Fig. 40

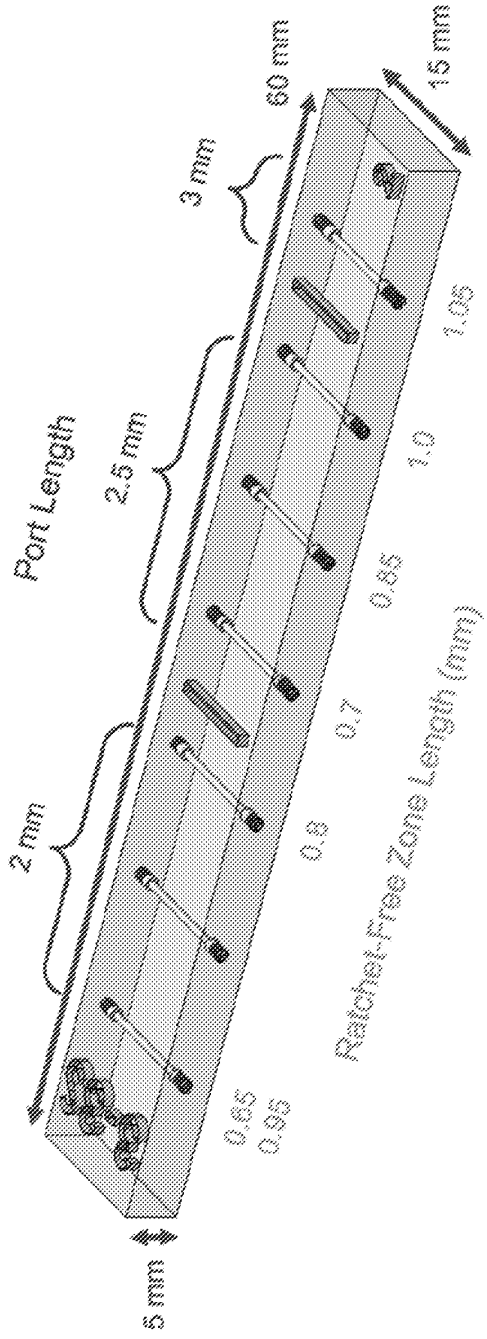

60 mm
15 mm
3 mm
Port Length
2.5 mm
2 mm
1.05
1.0
0.85
0.7
0.8
0.65
0.95
Ratchet-Free Zone Length (mm)
5 mm

Fig. 41

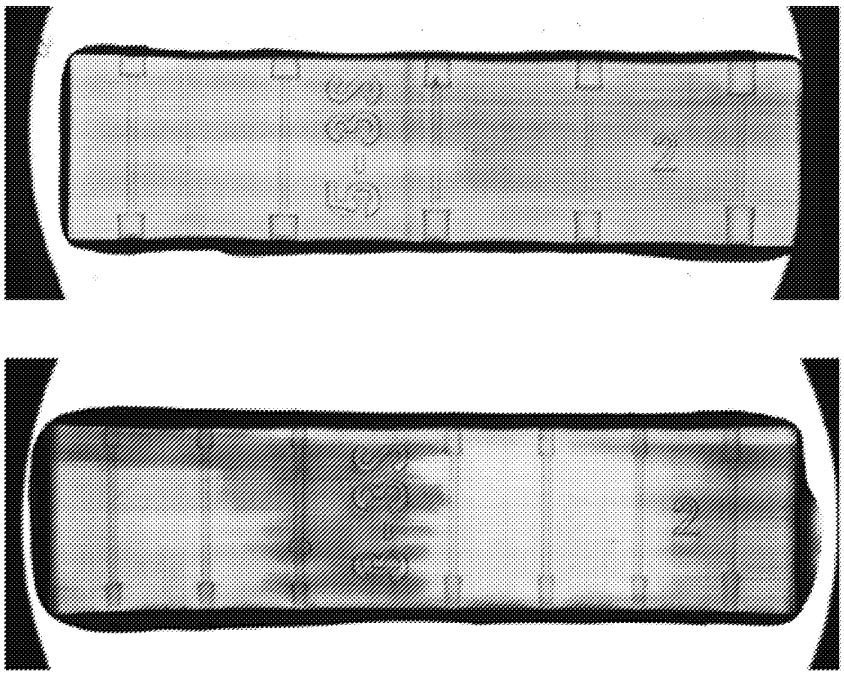


Fig. 42