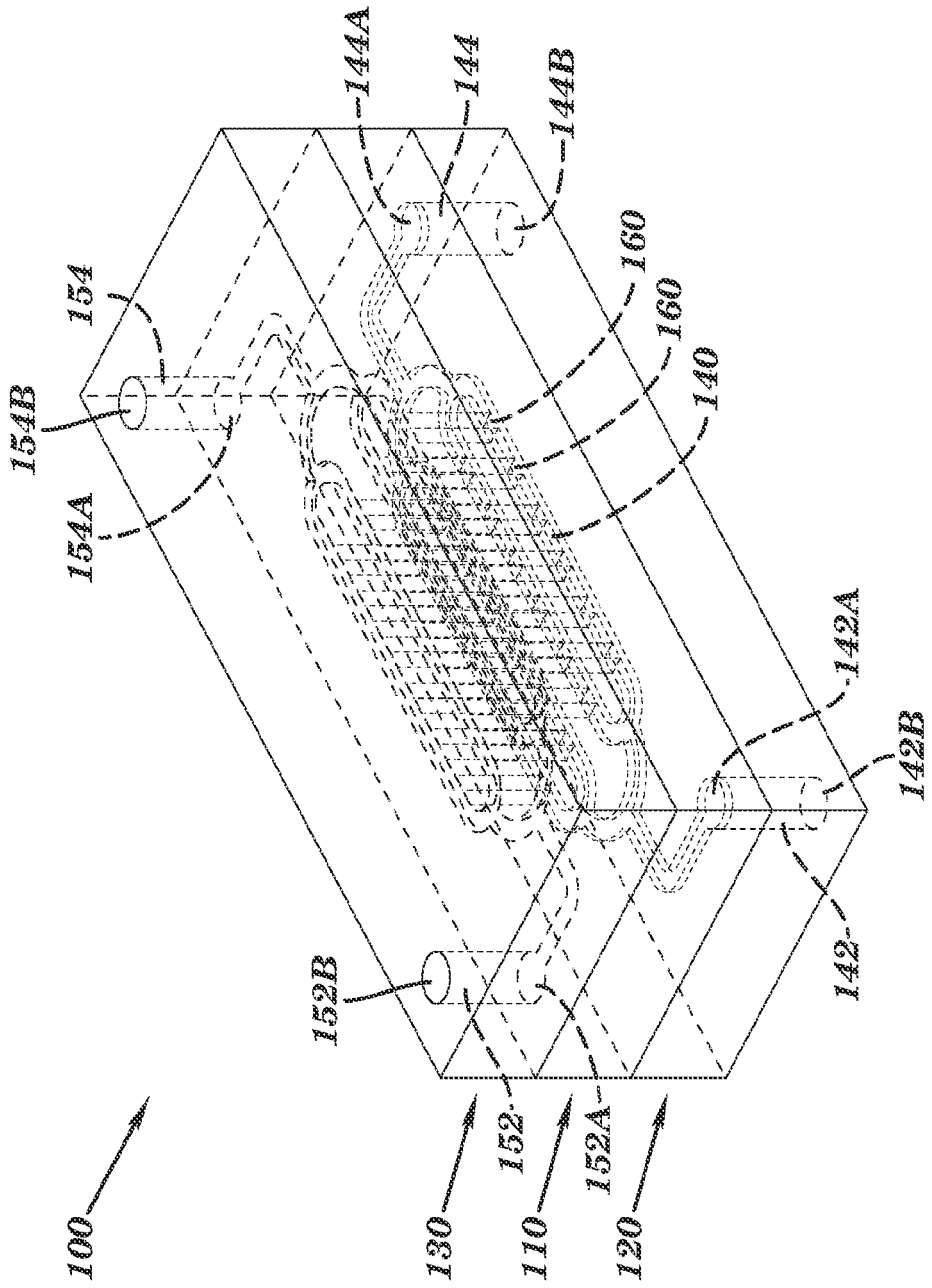

144A
144
144B
160
160
140
154
154B
154A
142A
142B
142
152B
152
152A
100
130
110
120

FIG. 1

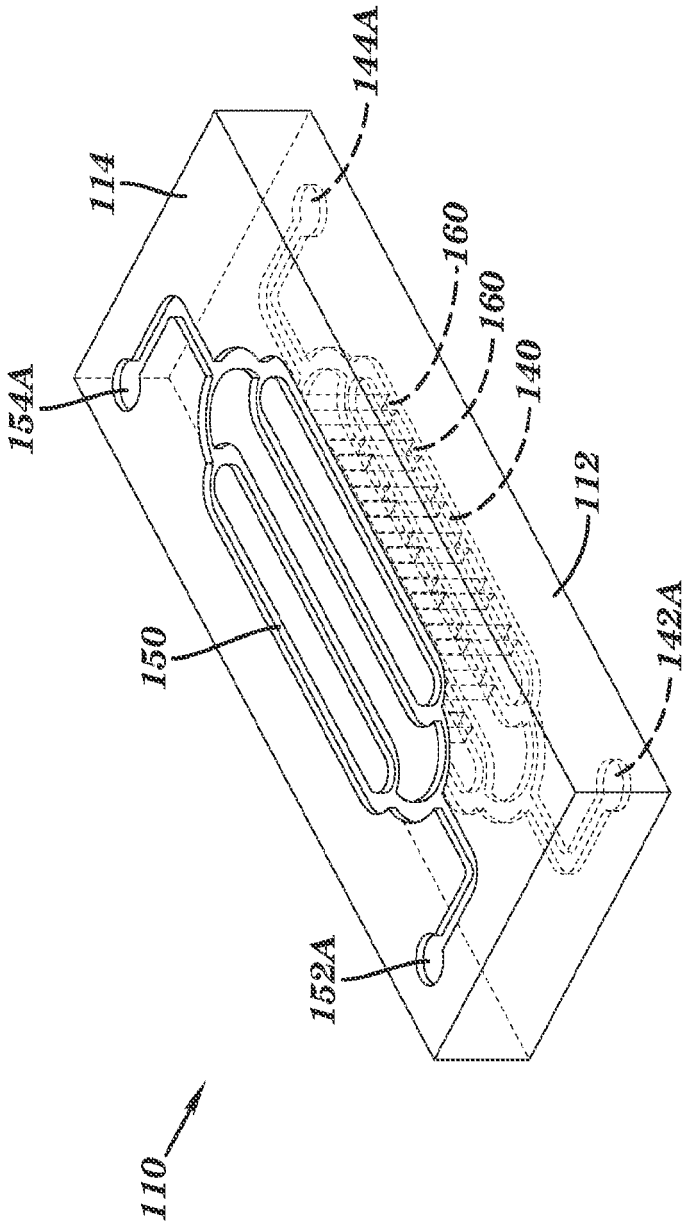


FIG. 2

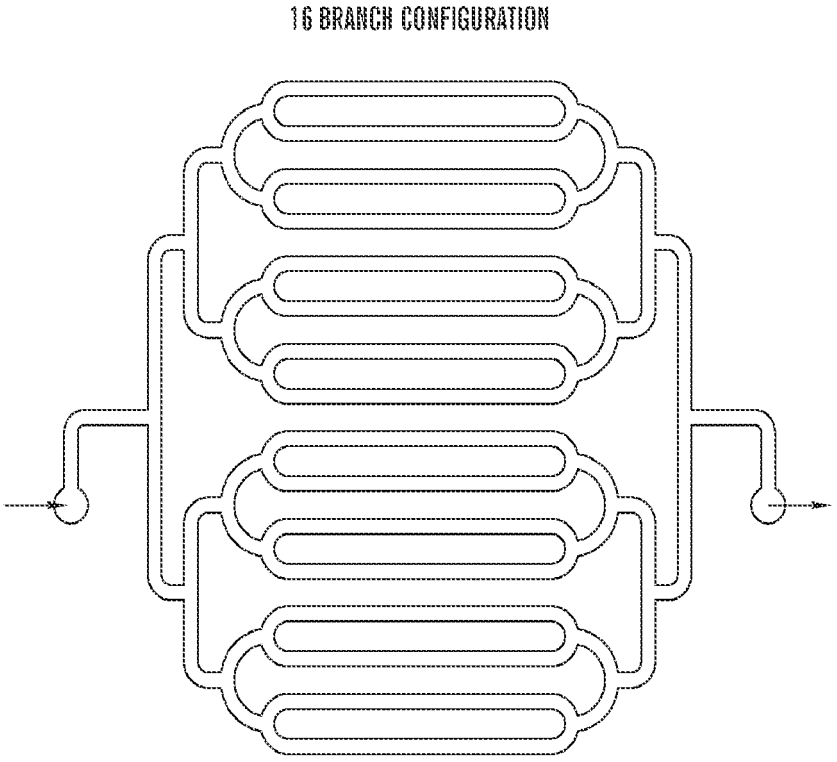


FIG. 3A

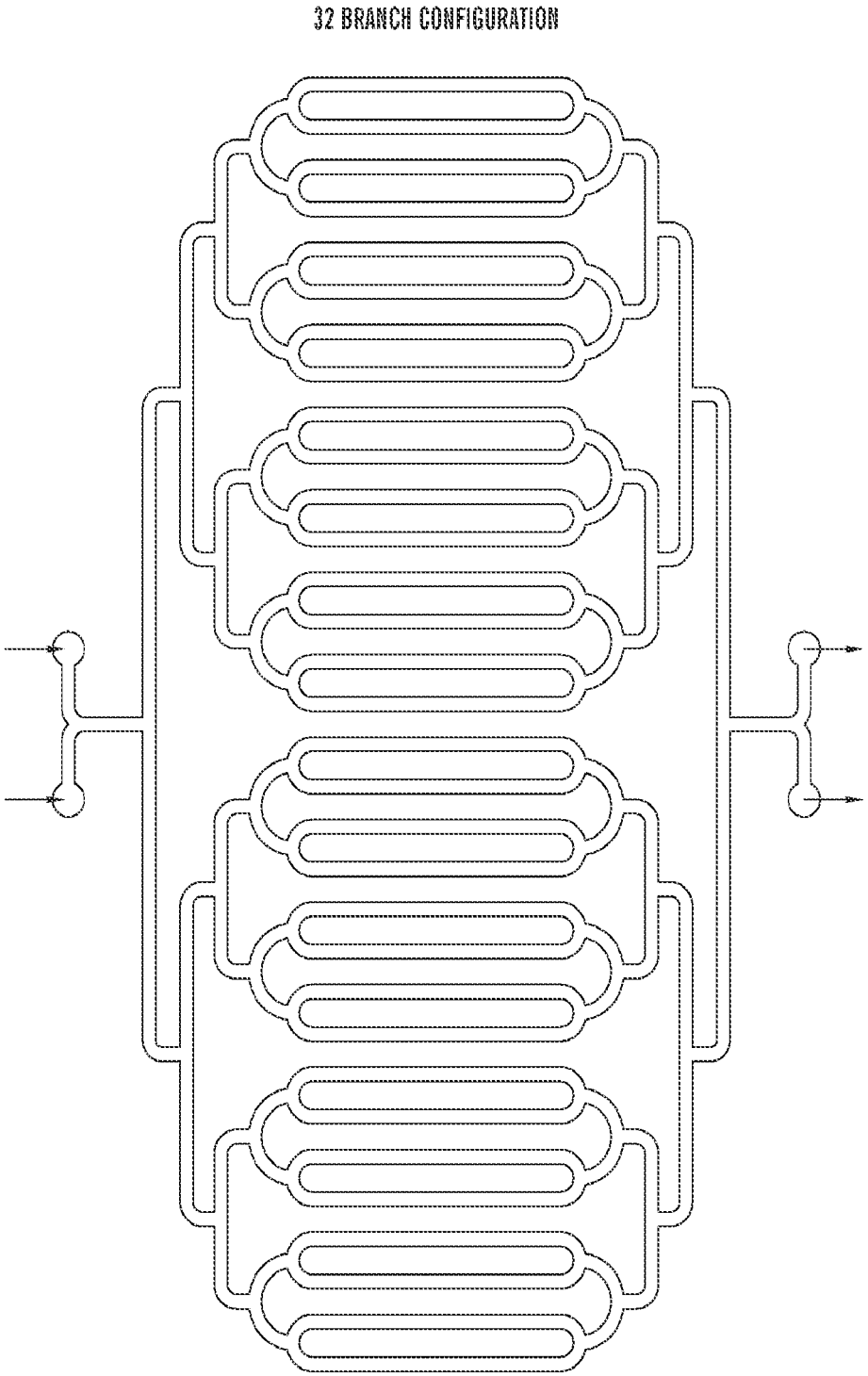


FIG. 3B

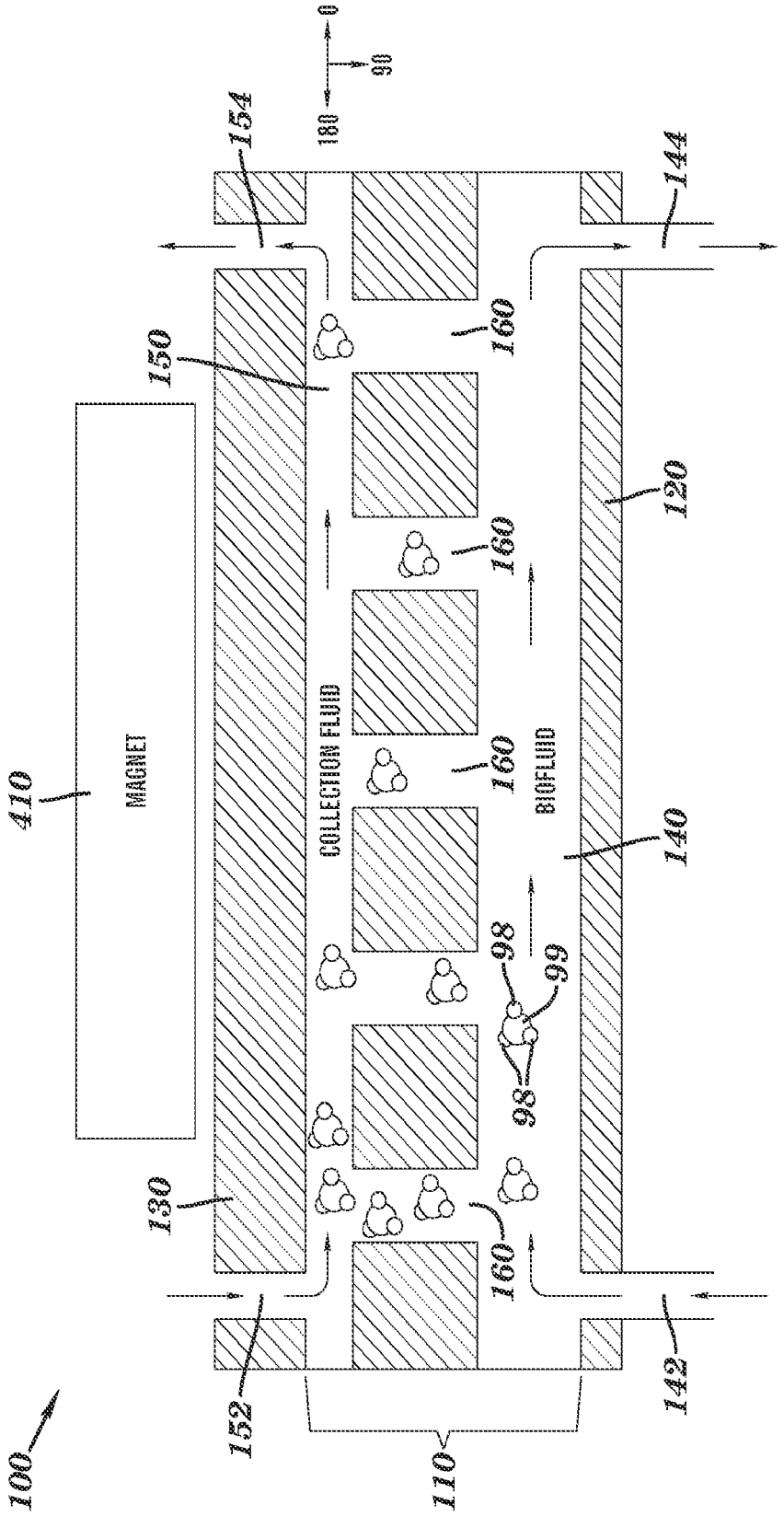

0
90
180
154
144
150
160
120
MAGNET
410
COLLECTION FLUID
BIOFLUID
140
98
99
130
152
110
142
100

FIG. 4

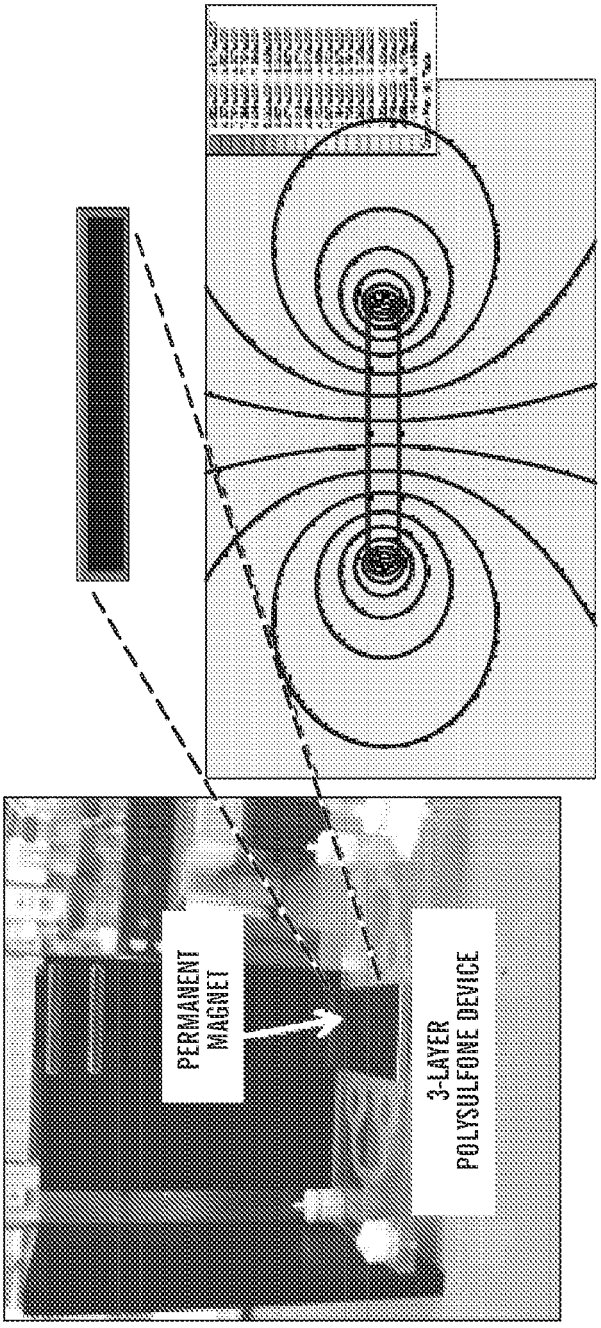


FIG. 5A

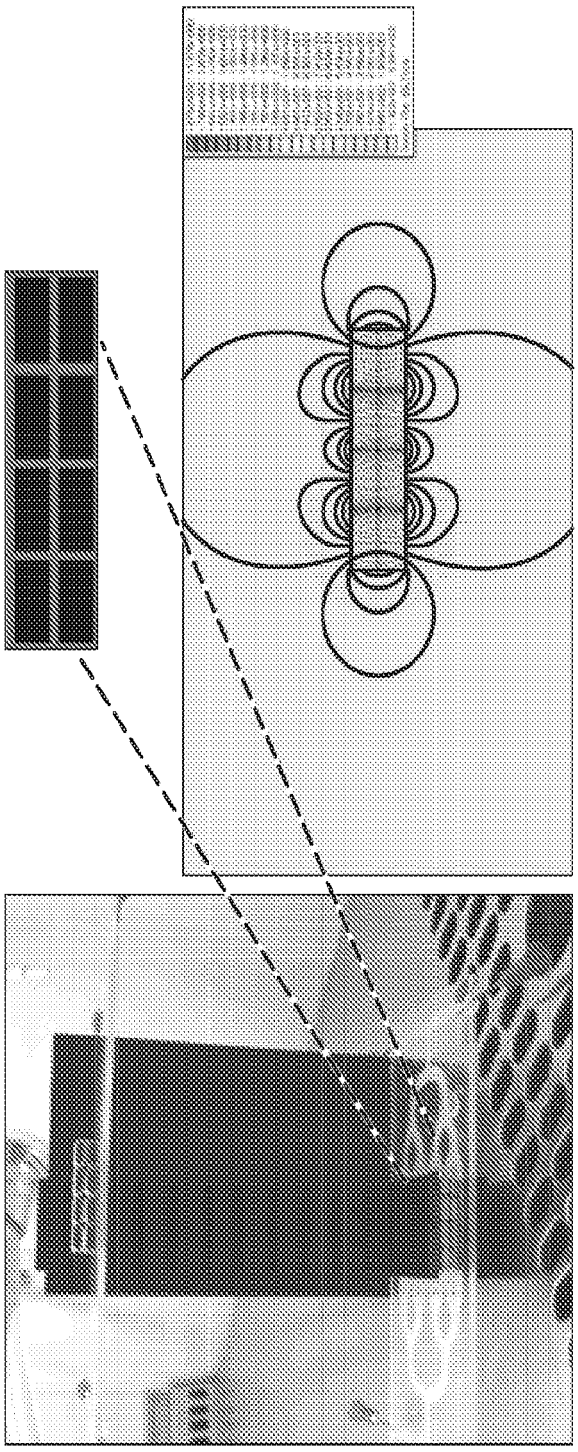


FIG. 5B

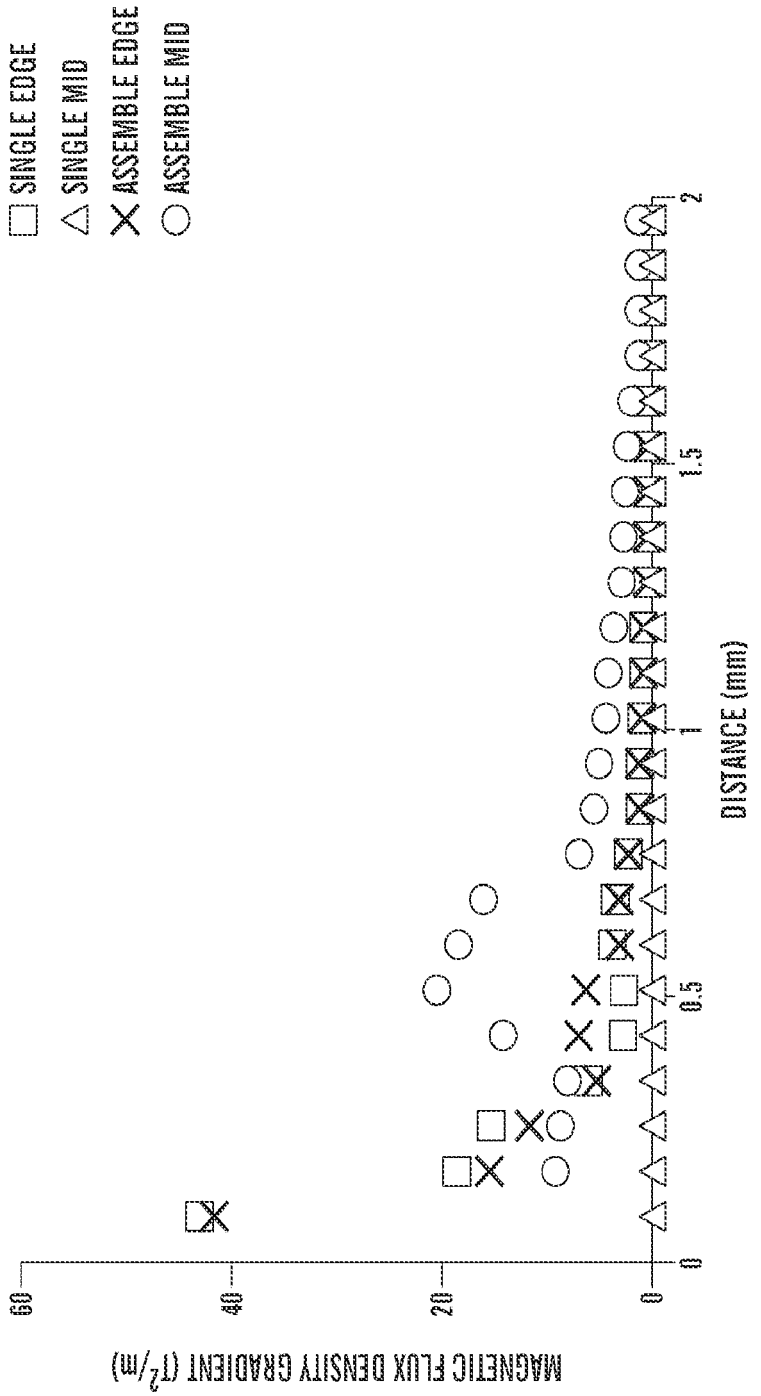

SINGLE EDGE
SINGLE MID
ASSEMBLE EDGE
ASSEMBLE MID
MAGNETIC FLUX DENSITY GRADIENT (T²/m)
60
40
20
0
0
0.5
1
1.5
2
DISTANCE (mm)

FIG. 5C

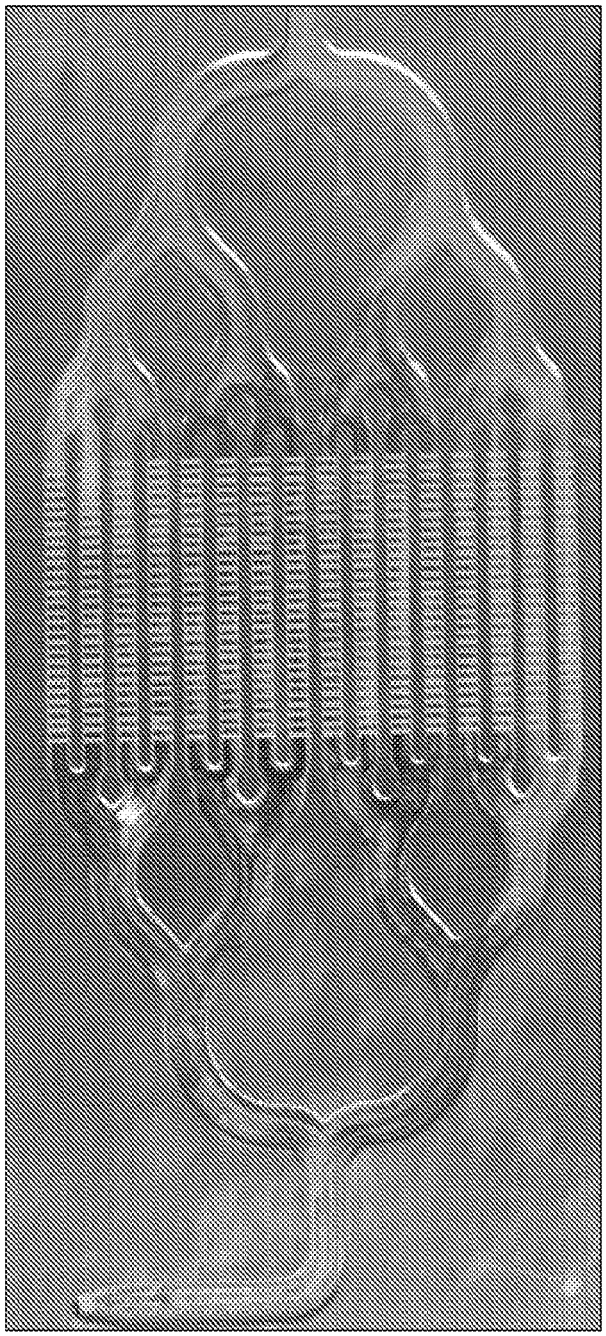


FIG. 6

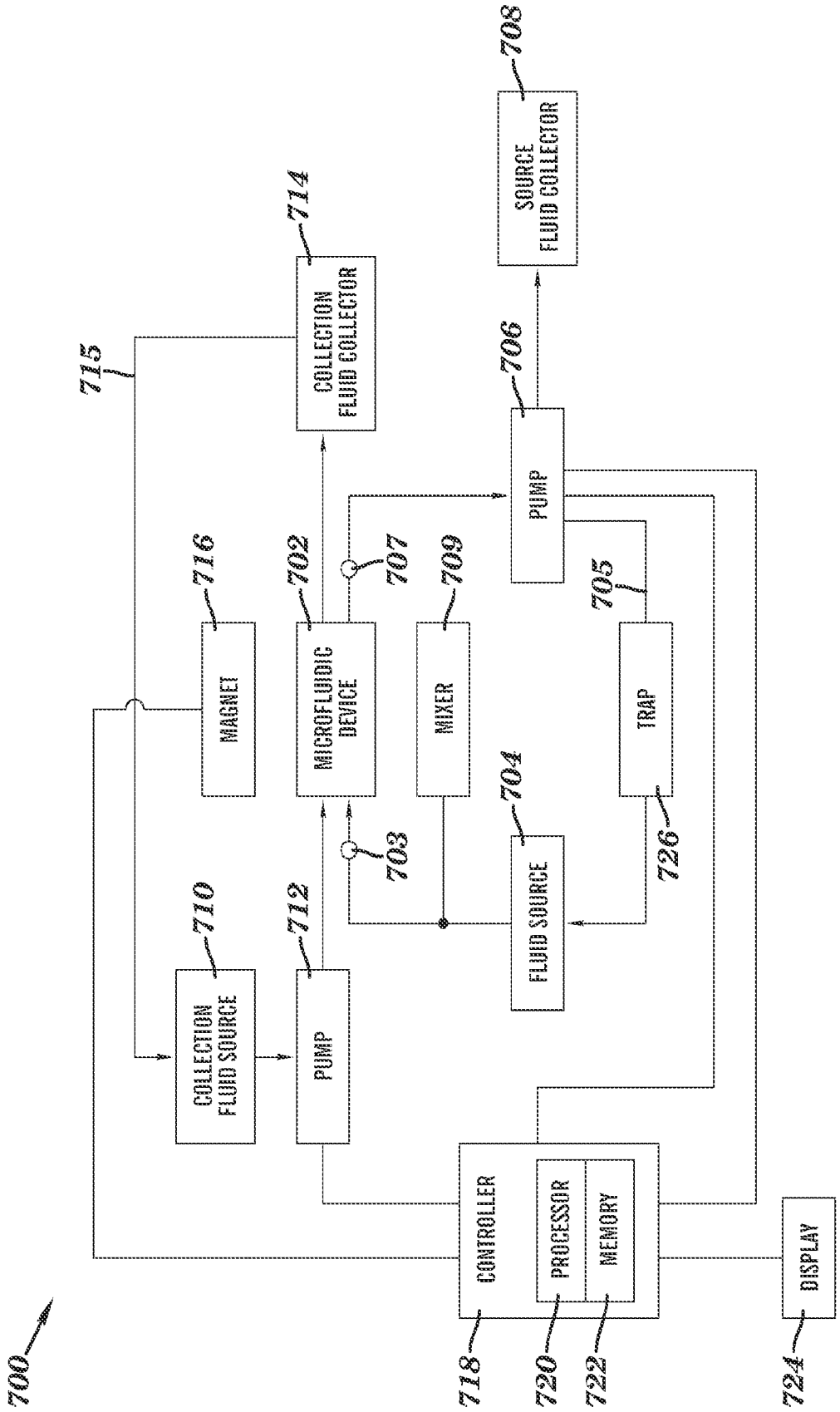
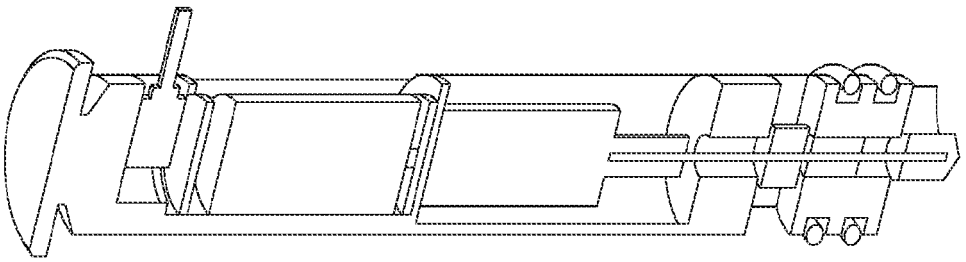

700
715
714
COLLECTION FLUID COLLECTOR
708
SOURCE FLUID COLLECTOR
706
PUMP
716
MAGNET
702
MICROFLUIDIC DEVICE
707
709
MIXER
705
TRAP
704
FLUID SOURCE
703
726
710
COLLECTION FLUID SOURCE
712
PUMP
CONTROLLER
PROCESSOR
MEMORY
DISPLAY
718
720
722
724

FIG. 7



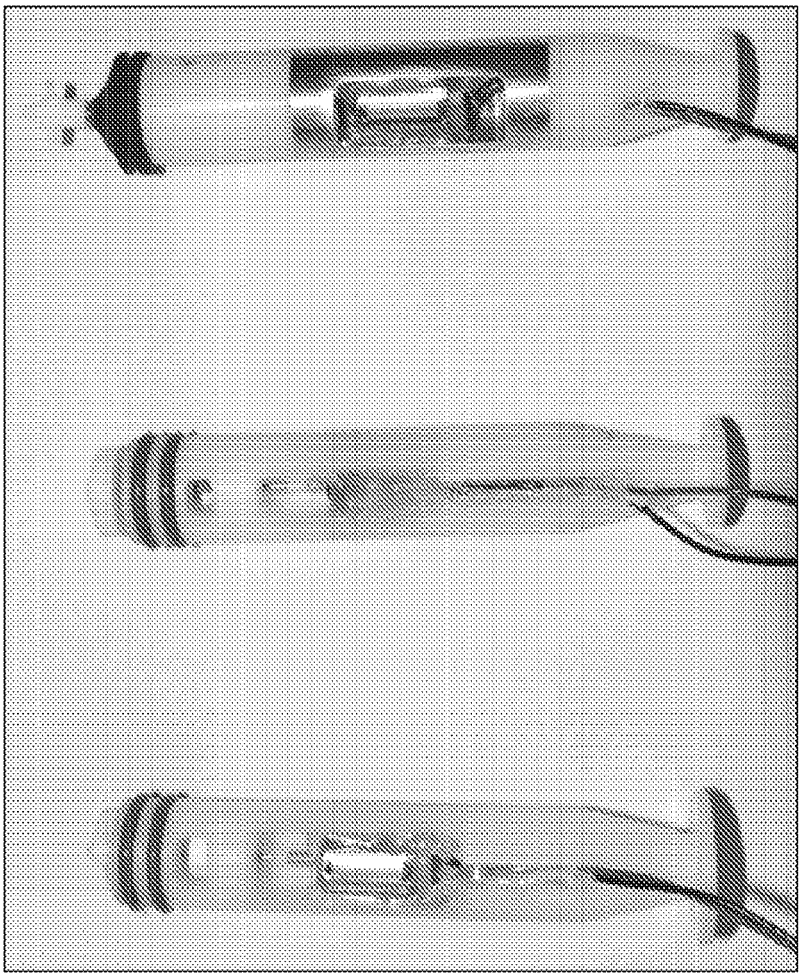


FIG. 8A

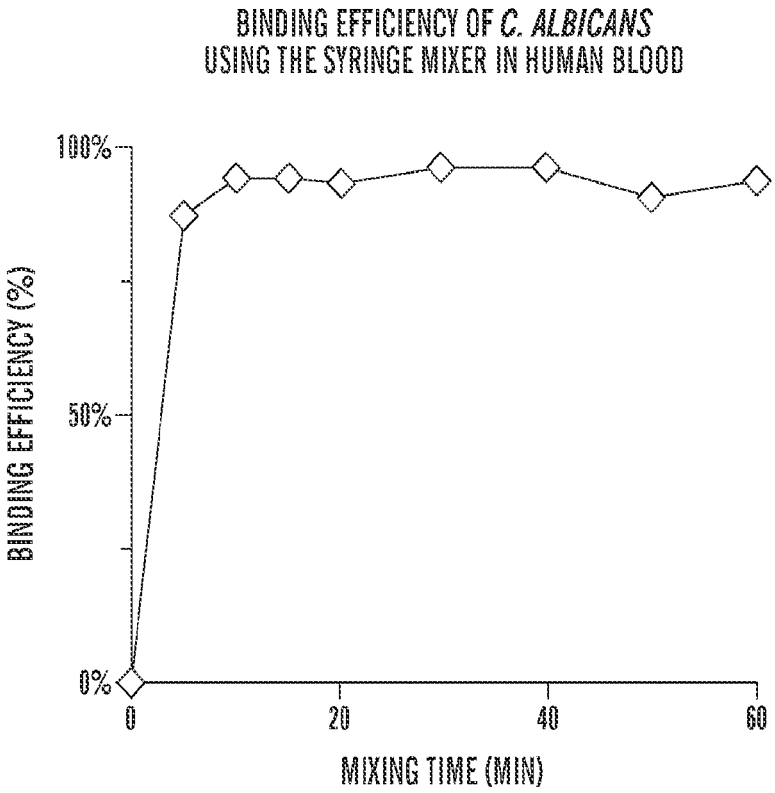

BINDING EFFICIENCY OF C. ALBICANS
USING THE SYRINGE MIXER IN HUMAN BLOOD
100%
50%
0%
BINDING EFFICIENCY (%)
0
20
40
60
MIXING TIME (MIN)

FIG. 8B

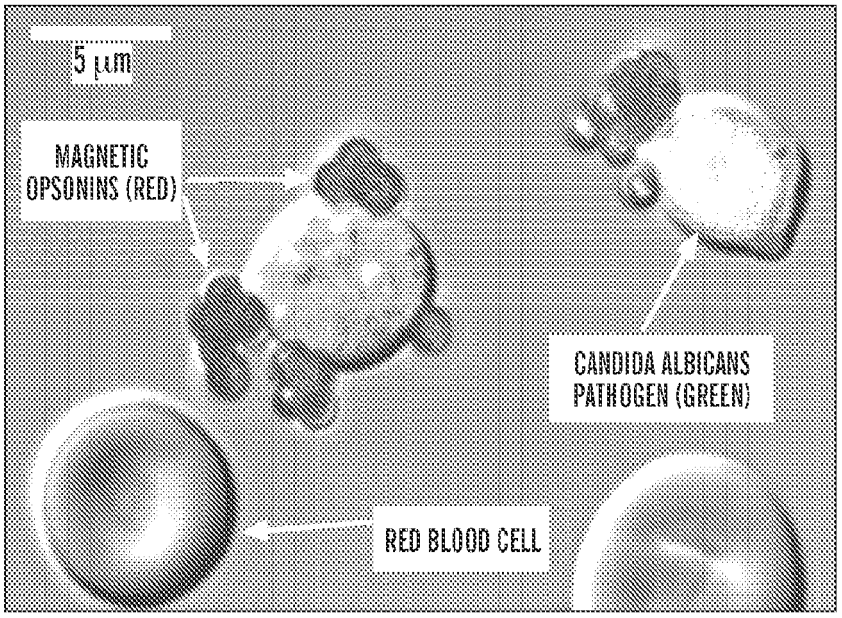

5 µm
MAGNETIC OPSONINS (RED)
CANDIDA ALBICANS PATHOGEN (GREEN)
RED BLOOD CELL

FIG. 9A

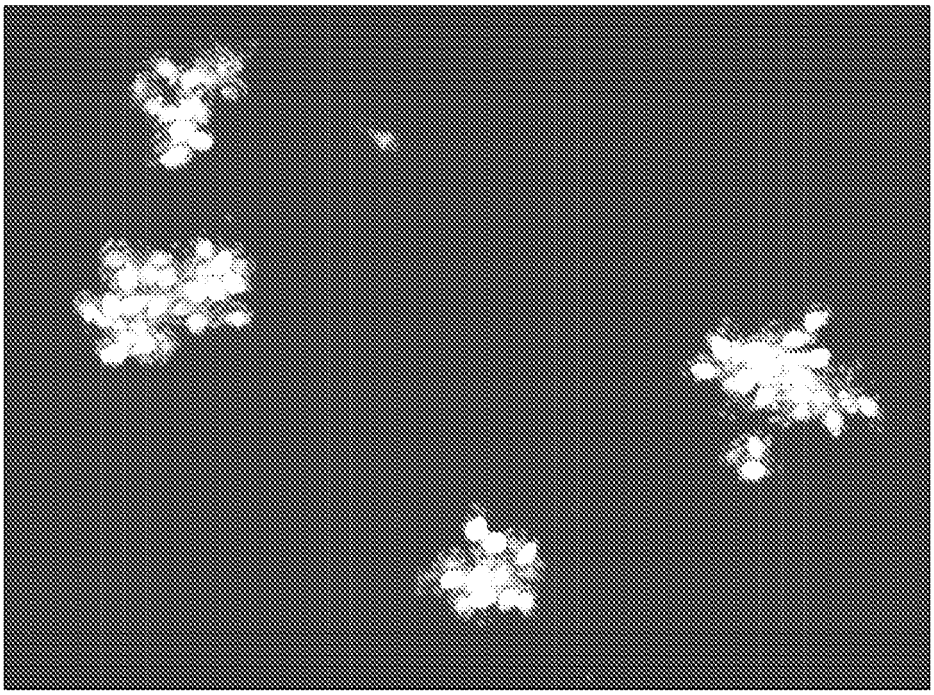


FIG. 9B

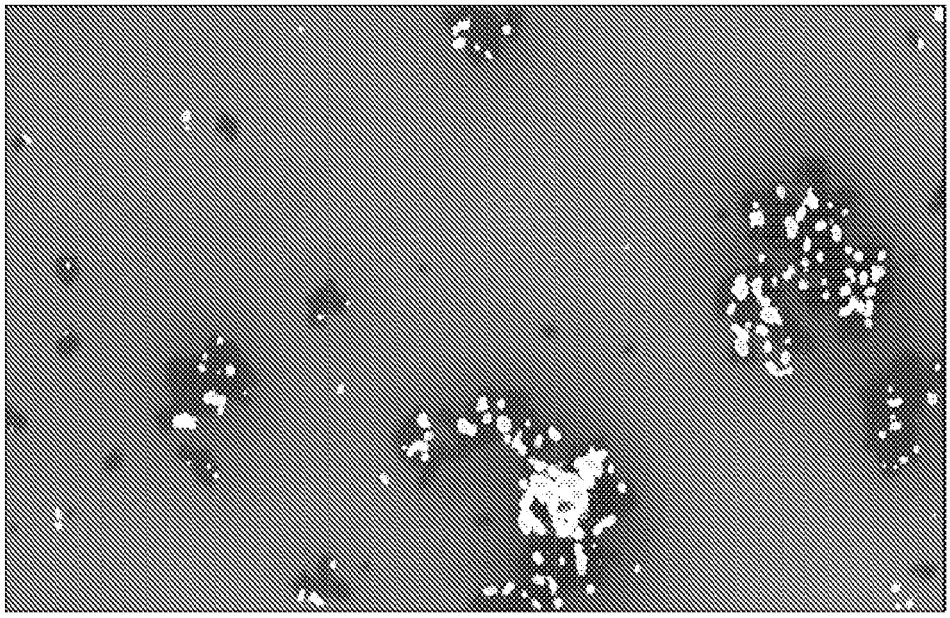


FIG. 9C

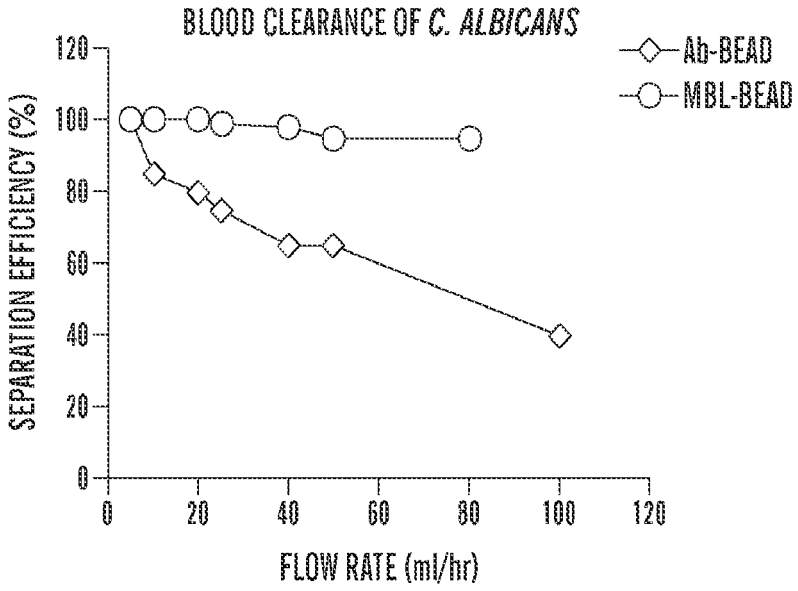

BLOOD CLEARANCE OF C. ALBICANS
Ab-BEAD
MBL-BEAD
SEPARATION EFFICIENCY (%)
120
100
80
60
40
20
0
0
20
40
60
80
100
120
FLOW RATE (ml/hr)

FIG. 9D

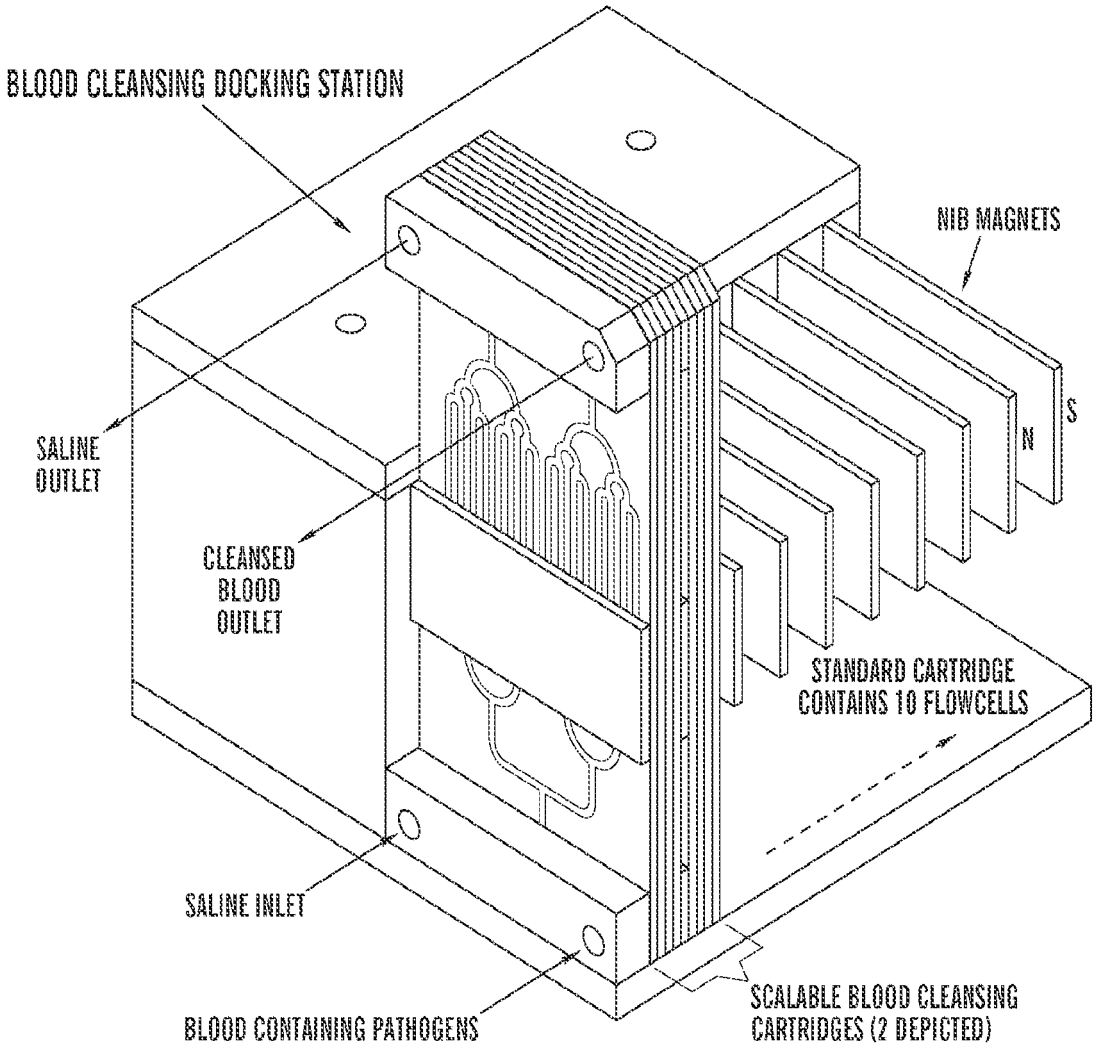

BLOOD CLEANSING DOCKING STATION
NIB MAGNETS
S
N
SALINE OUTLET
CLEANSED BLOOD OUTLET
STANDARD CARTRIDGE CONTAINS 10 FLOWCELLS
SALINE INLET
BLOOD CONTAINING PATHOGENS
SCALABLE BLOOD CLEANSING CARTRIDGES (2 DEPICTED)

FIG. 10A

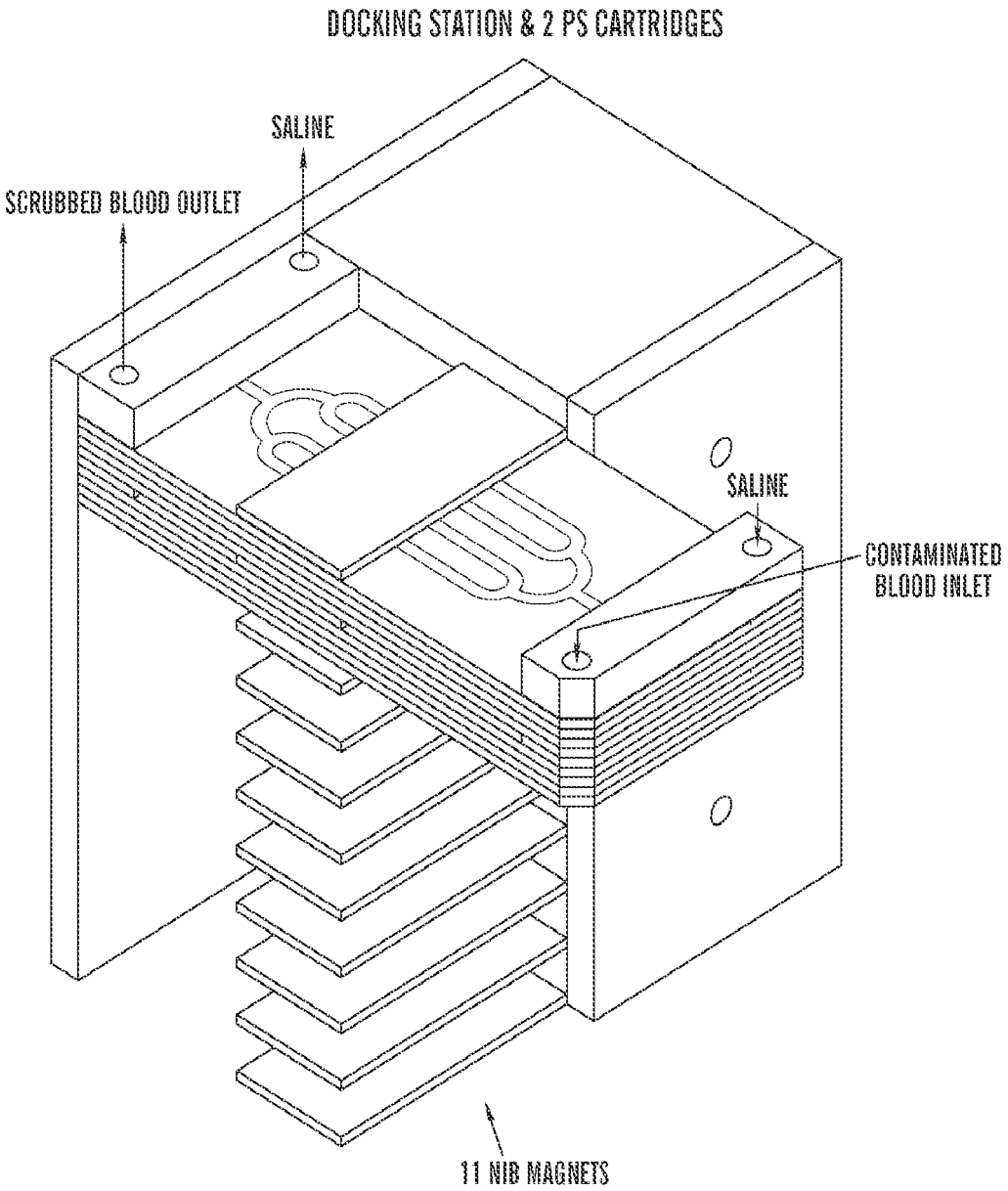

DOCKING STATION & 2 PS CARTRIDGES
SALINE
SCRUBBED BLOOD OUTLET
SALINE
CONTAMINATED BLOOD INLET
11 NIB MAGNETS

FIG. 10B

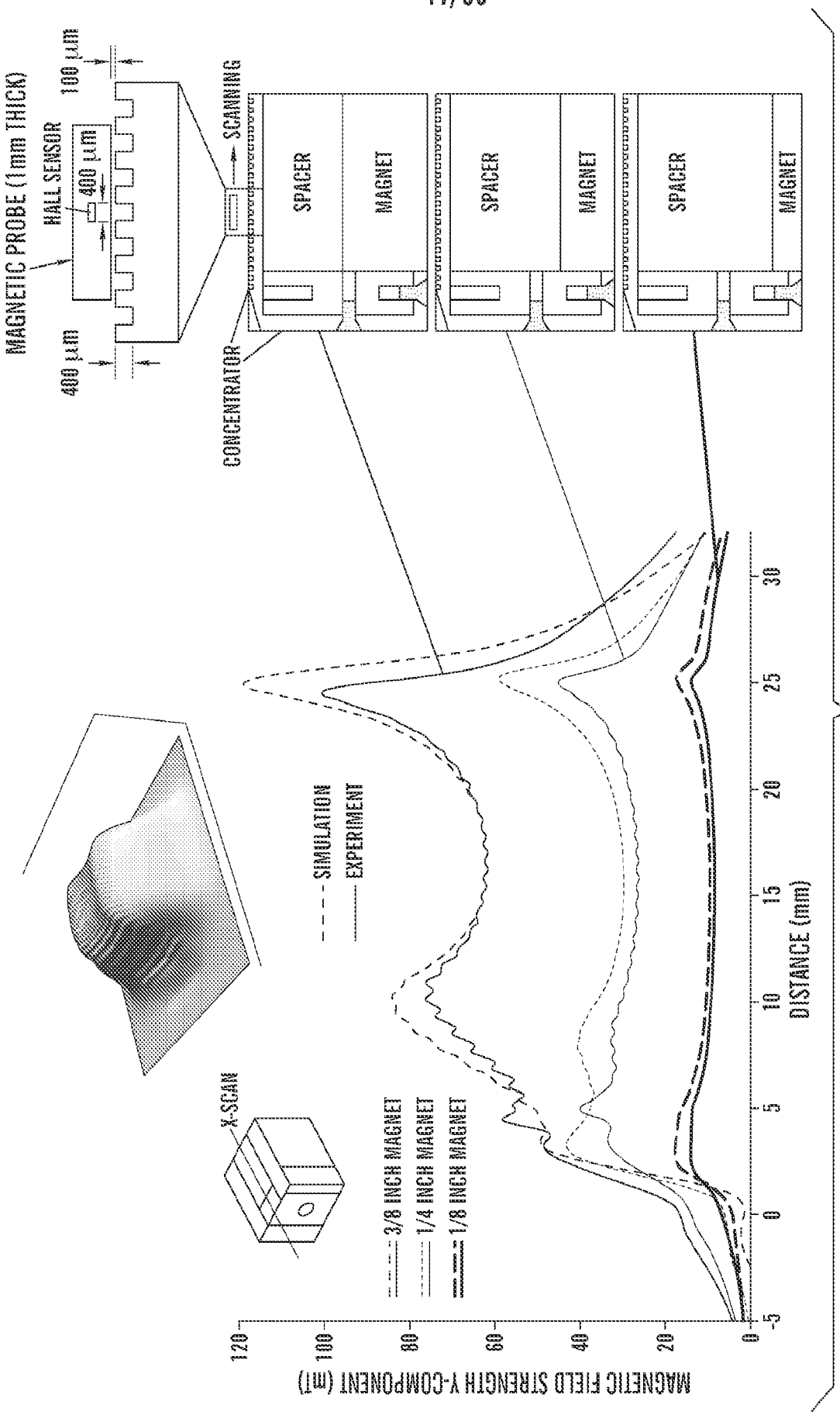

MAGNETIC PROBE (1mm THICK)
HALL SENSOR
400 μm
100 μm
400 μm
SCANNING
CONCENTRATOR
SPACER
MAGNET
SPACER
MAGNET
SPACER
MAGNET
SIMULATION
EXPERIMENT
X-SCAN
3/8 INCH MAGNET
1/4 INCH MAGNET
1/8 INCH MAGNET
MAGNETIC FIELD STRENGTH Y-COMPONENT (mT)
DISTANCE (mm)
120
100
80
60
40
20
0
-5
0
5
10
15
20
25
30

FIG. 11

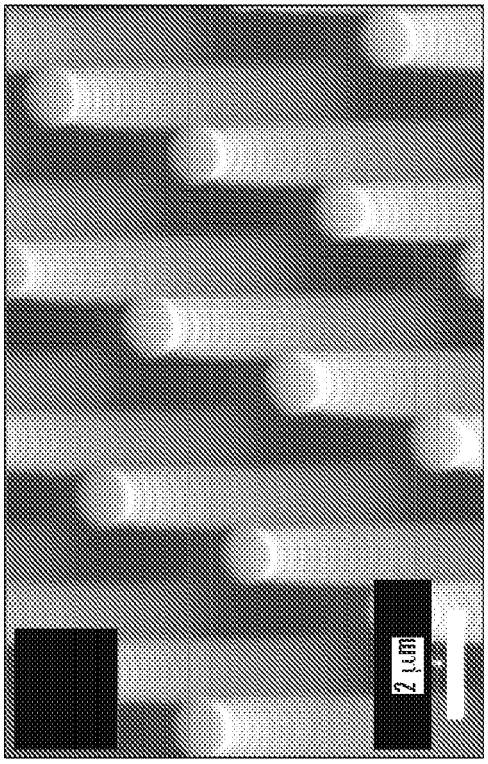


FIG. 12B

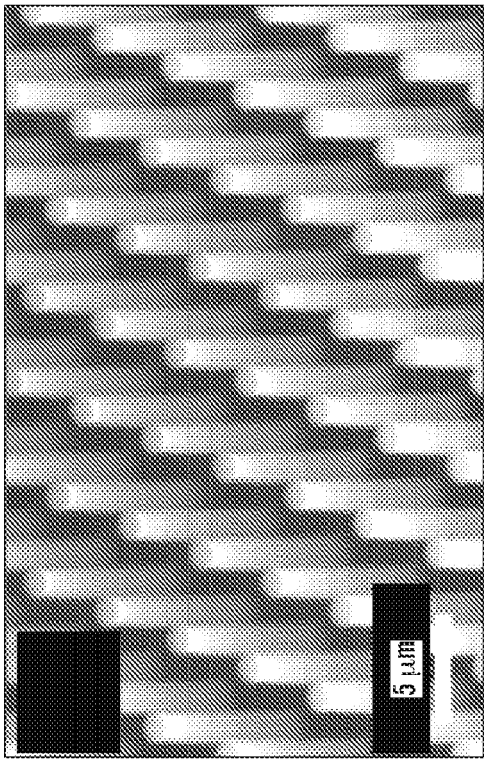


FIG. 12A

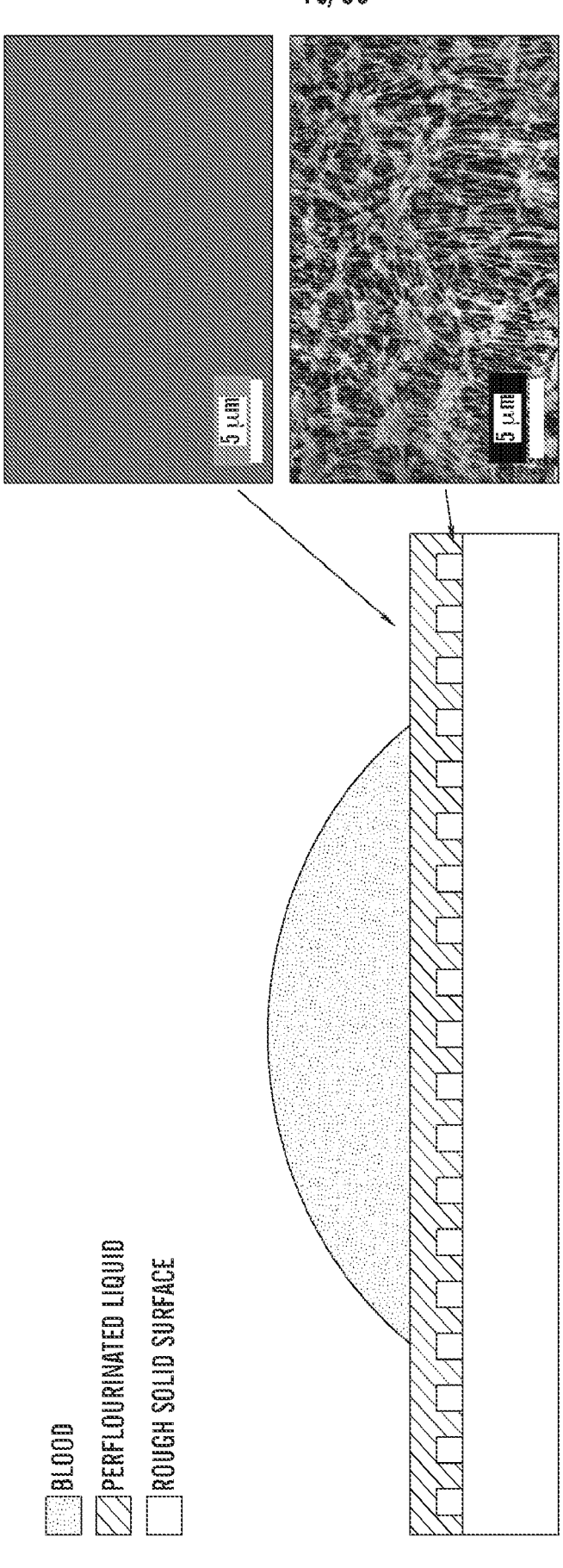


FIG. 12C

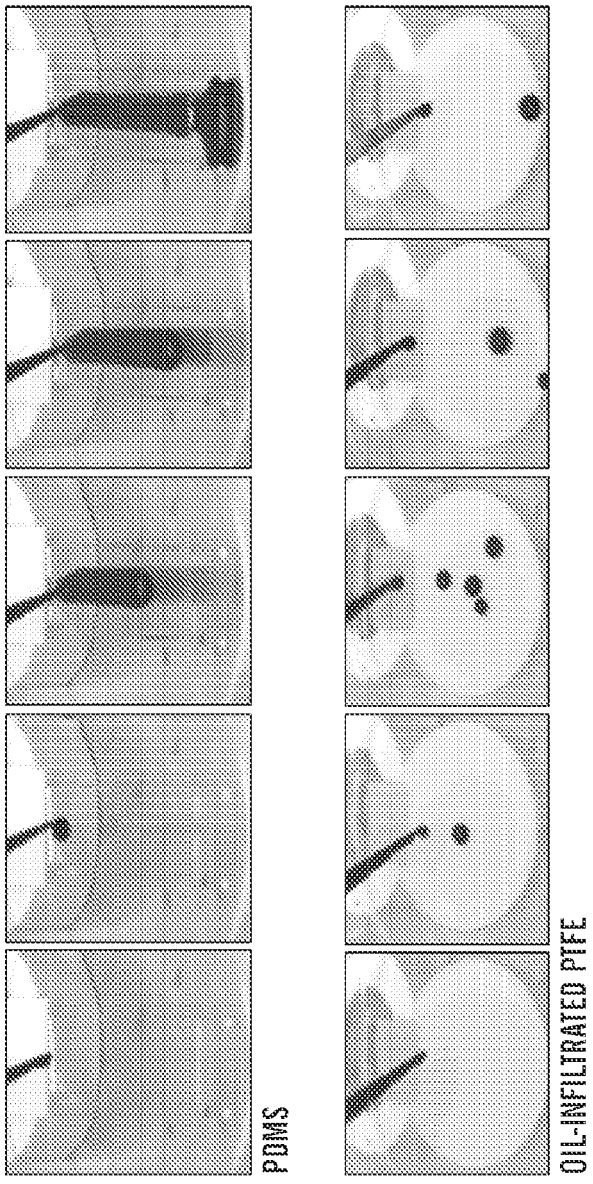


FIG. 13A

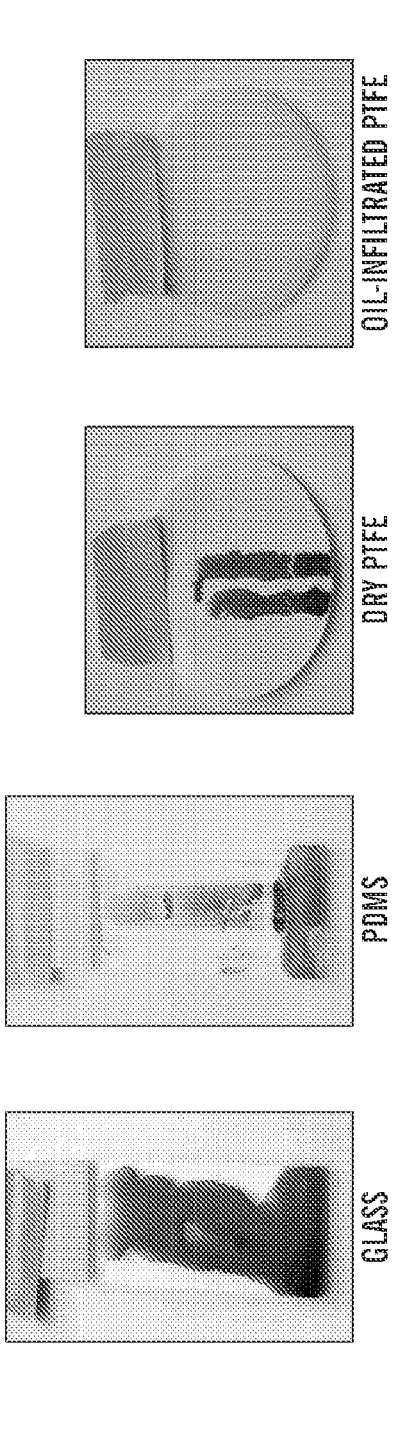


FIG. 13B

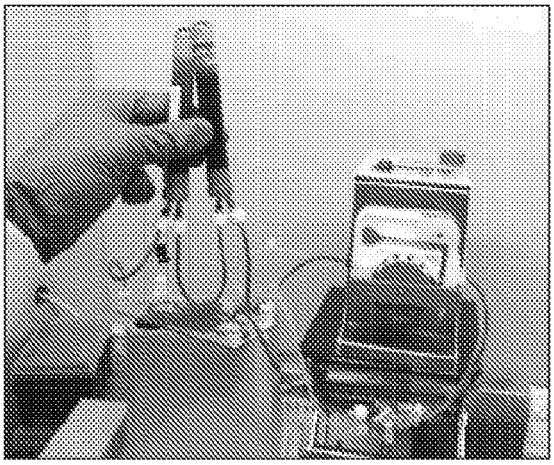


FIG. 14A

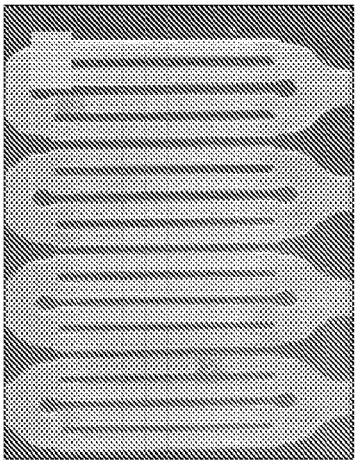


FIG. 14B

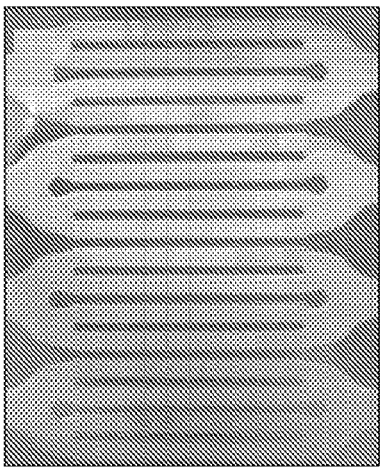


FIG. 14C

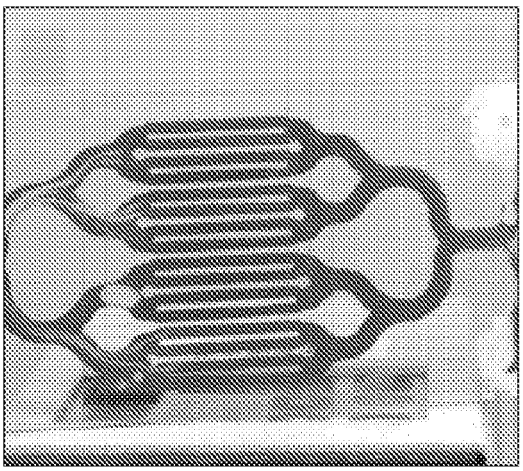


FIG. 14D

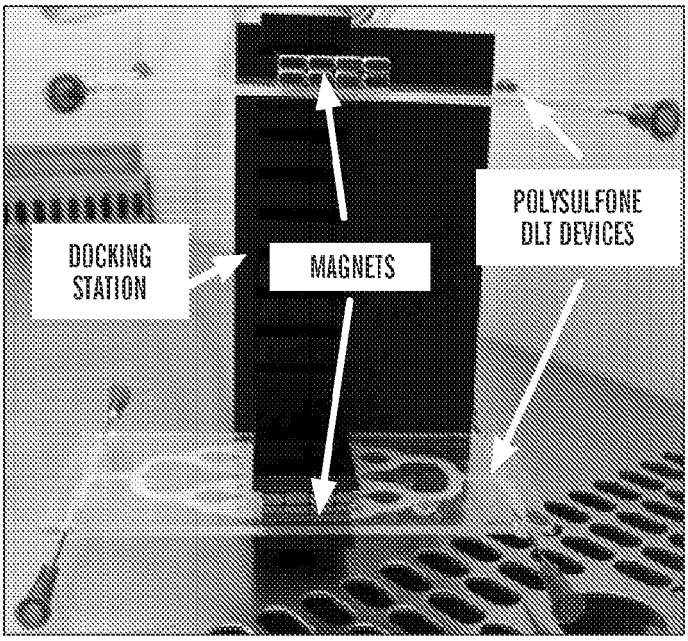


FIG. 15A

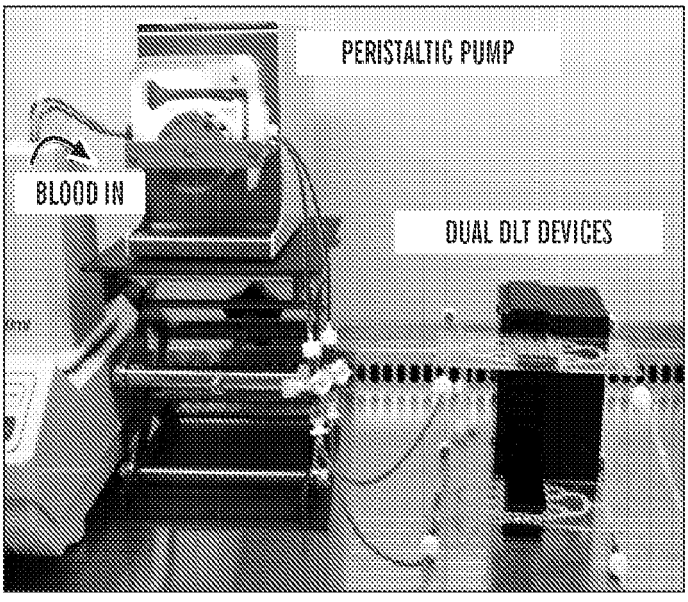


FIG. 15B

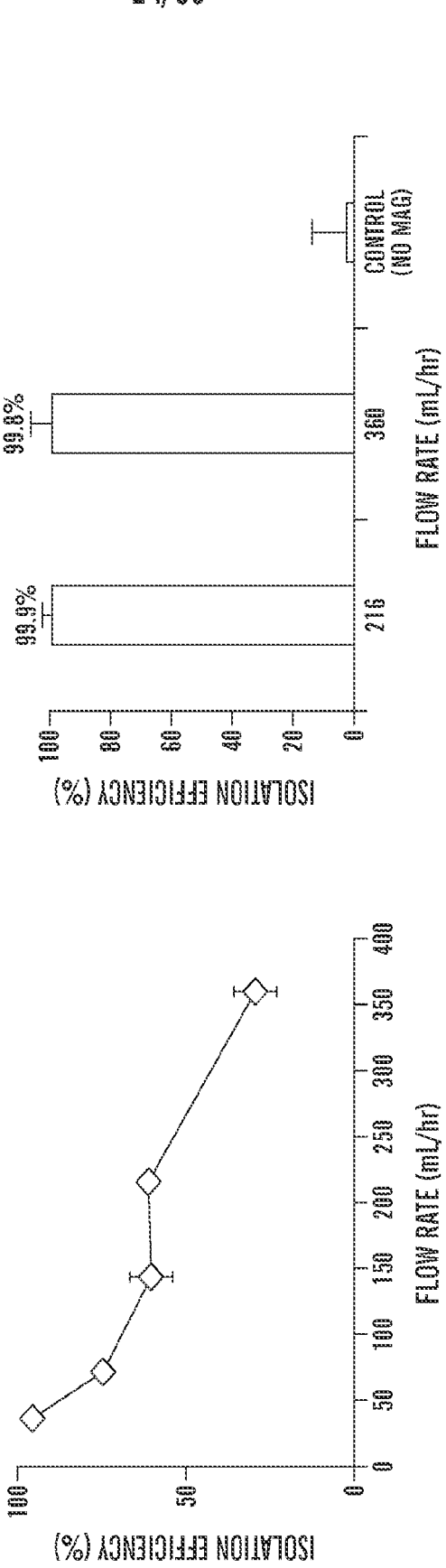
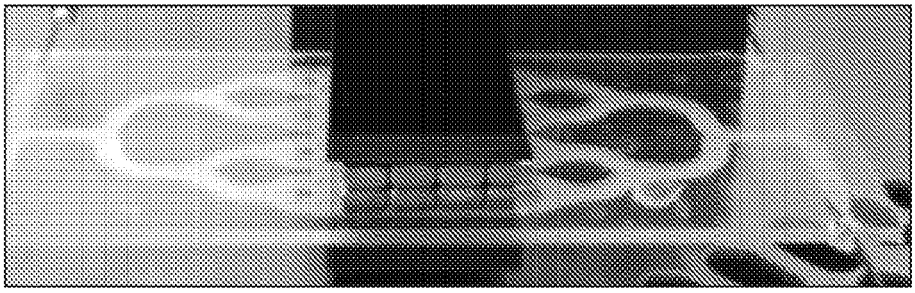

ISOLATION EFFICIENCY (%)
100
50
0
0
50
100
150
200
250
300
350
400
FLOW RATE (mL/hr)
ISOLATION EFFICIENCY (%)
100
80
60
40
20
0
99.9%
99.8%
216
360
FLOW RATE (mL/hr)
CONTROL (NO MAG)

FIG. 16A



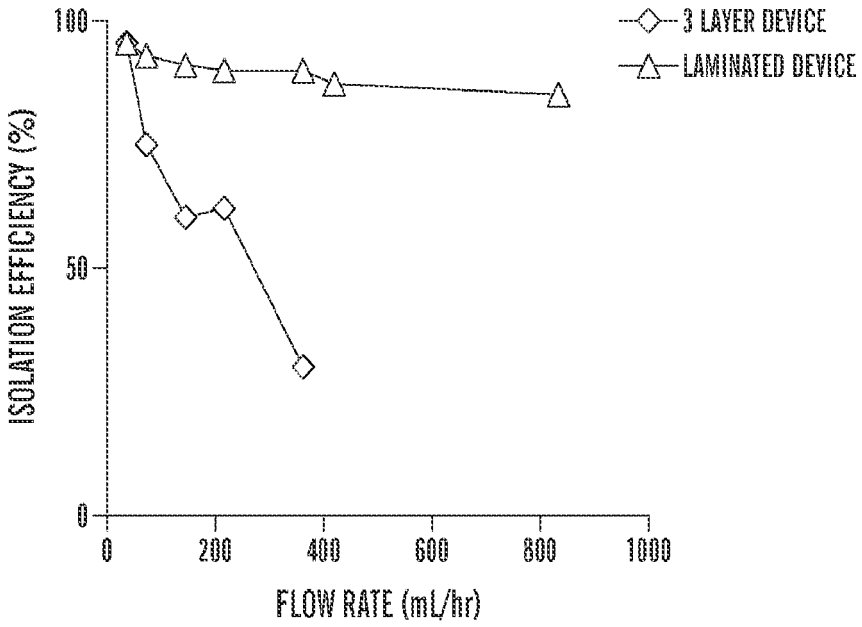

100
50
0
0
200
400
600
800
1000
ISOLATION EFFICIENCY (%)
FLOW RATE (mL/hr)
3 LAYER DEVICE
LAMINATED DEVICE

FIG. 16B

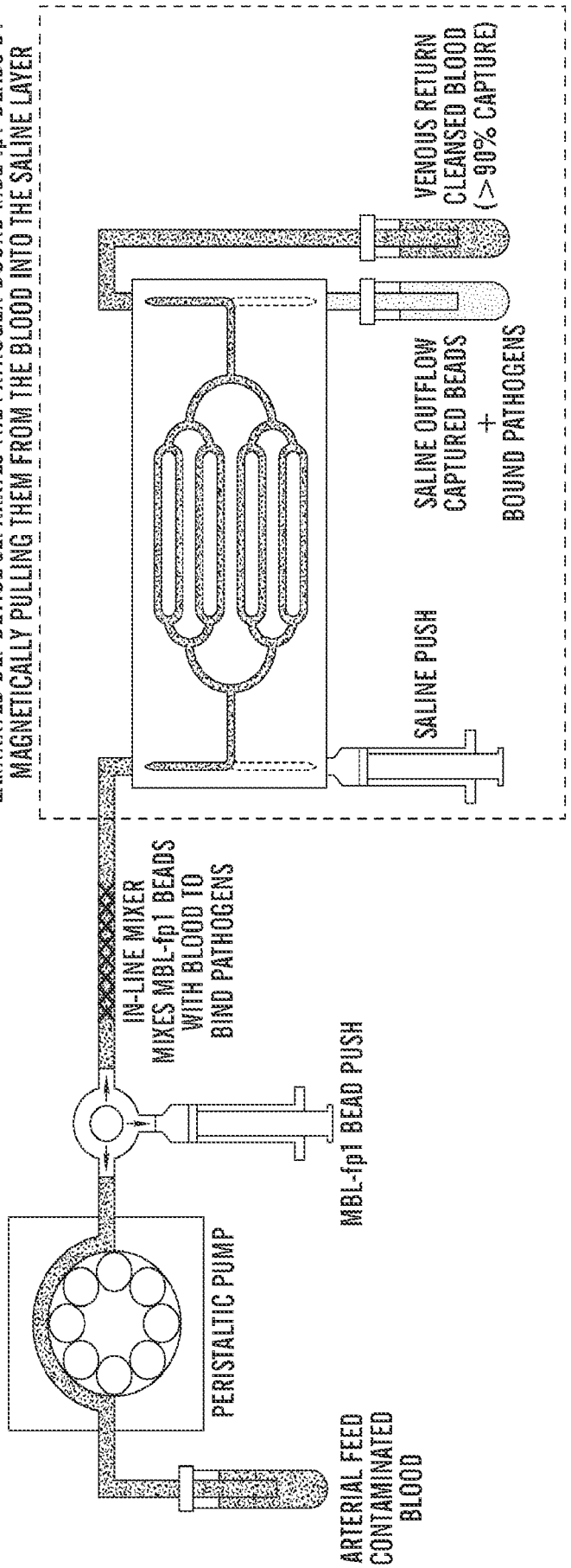

LAMINATED DLT DEVICE SEPARATES THE PATHOGEN-BOUND MBL-fp1 BEADS BY MAGNETICALLY PULLING THEM FROM THE BLOOD INTO THE SALINE LAYER
VENOUS RETURN CLEANSED BLOOD (>90% CAPTURE)
SALINE OUTFLOW CAPTURED BEADS + BOUND PATHOGENS
SALINE PUSH
IN-LINE MIXER MIXES MBL-fp1 BEADS WITH BLOOD TO BIND PATHOGENS
MBL-fp1 BEAD PUSH
PERISTALTIC PUMP
ARTERIAL FEED CONTAMINATED BLOOD

FIG. 17A

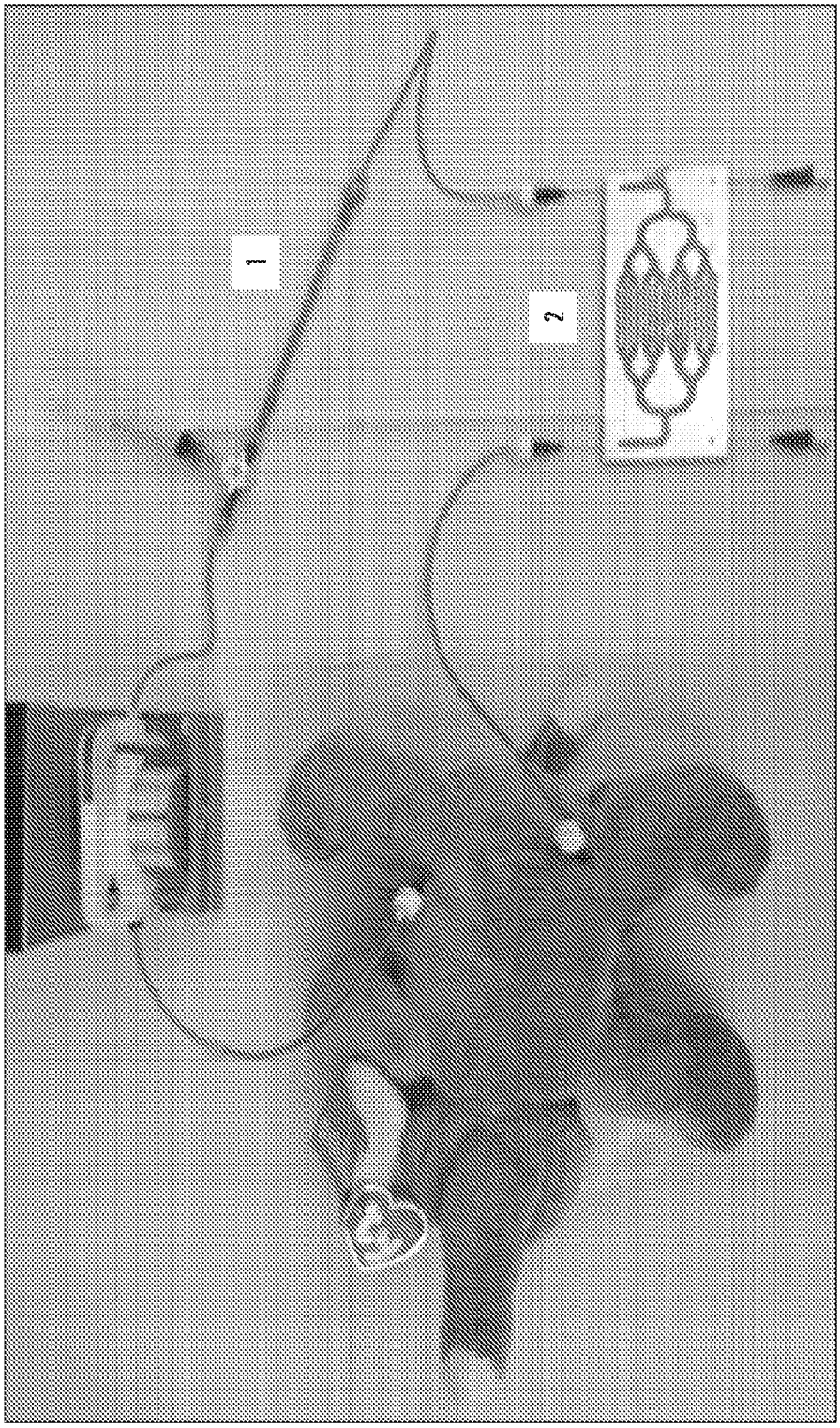


FIG. 17B

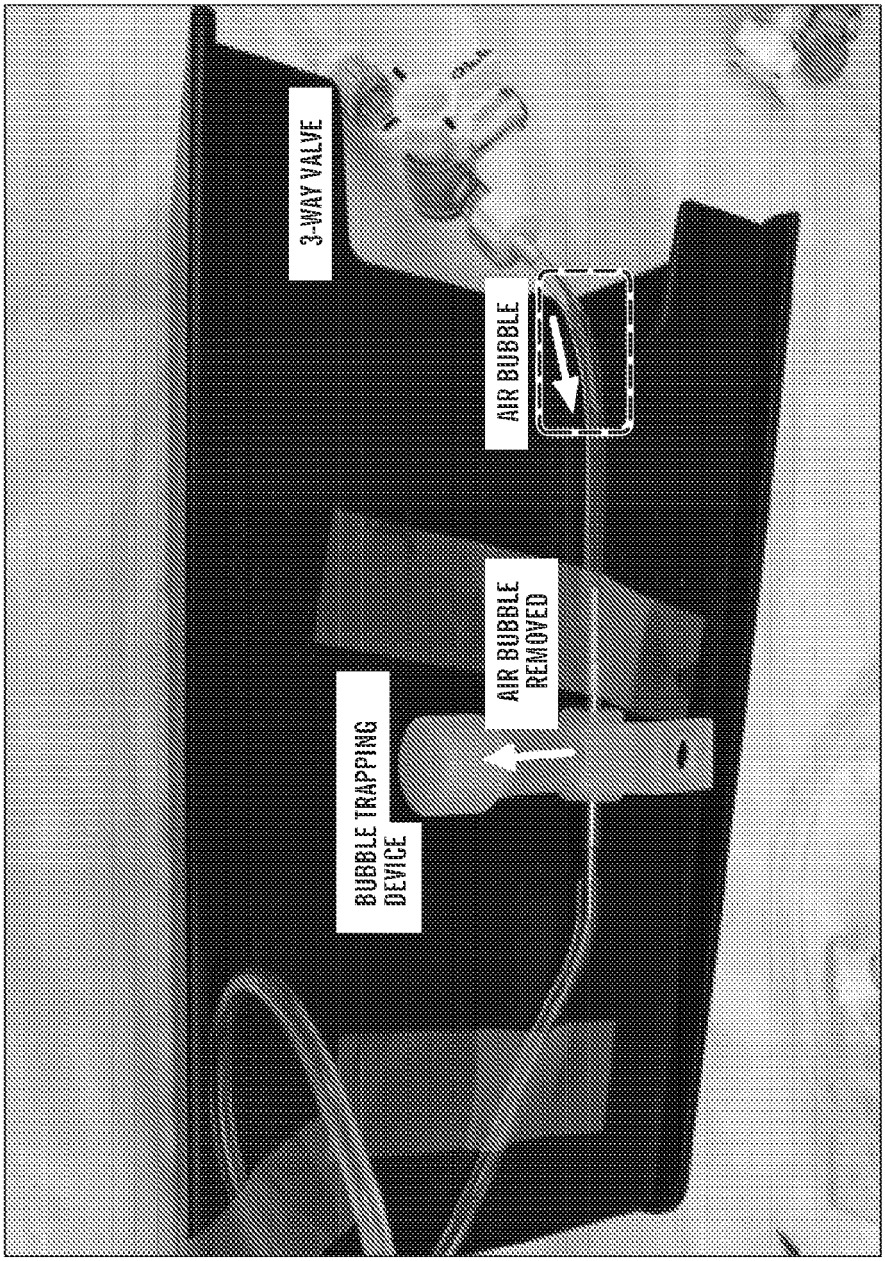

3-WAY VALVE
AIR BUBBLE
AIR BUBBLE REMOVED
BUBBLE TRAPPING DEVICE

FIG. 18

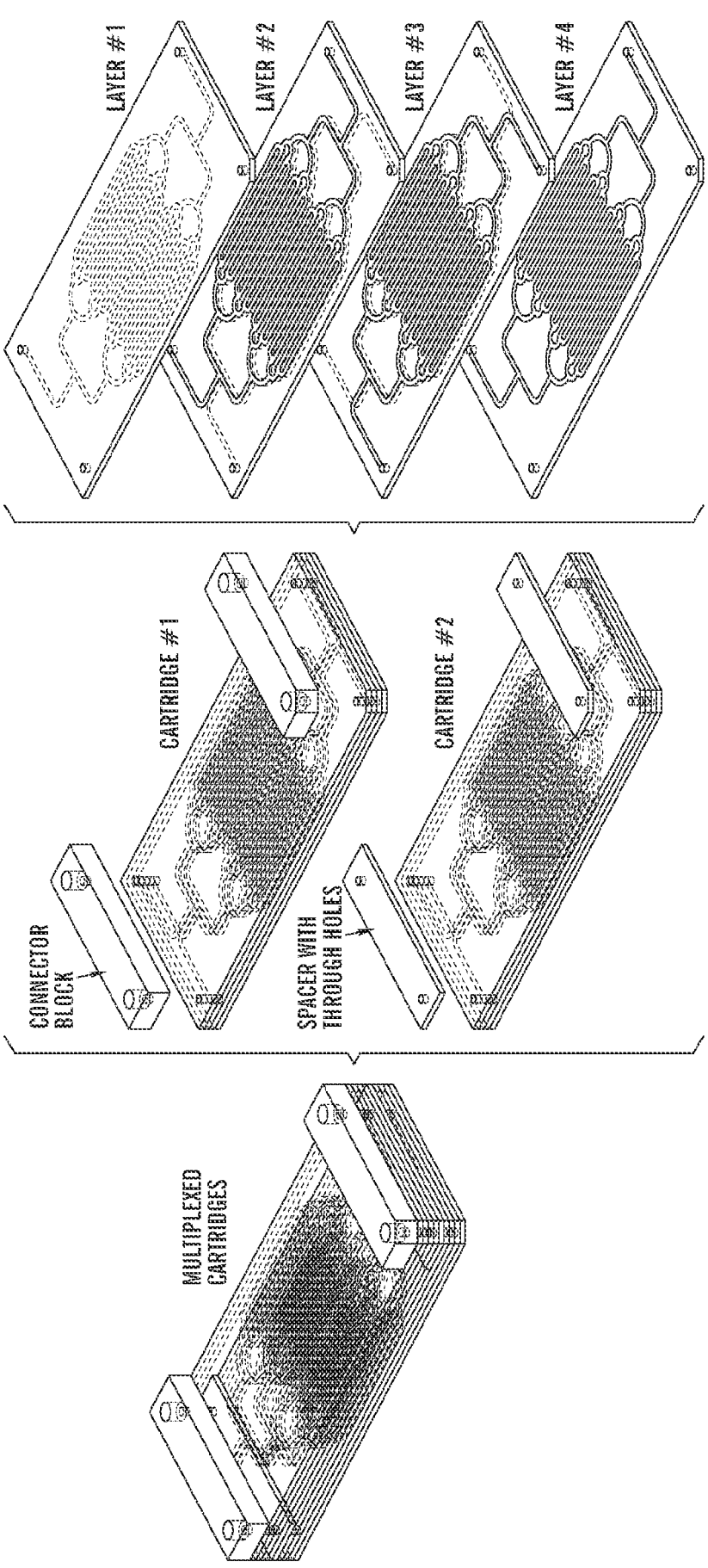

LAYER #1
LAYER #2
LAYER #3
LAYER #4
CARTRIDGE #1
CARTRIDGE #2
CONNECTOR BLOCK
SPACER WITH THROUGH HOLES
MULTIPLEXED CARTRIDGES

FIG. 19

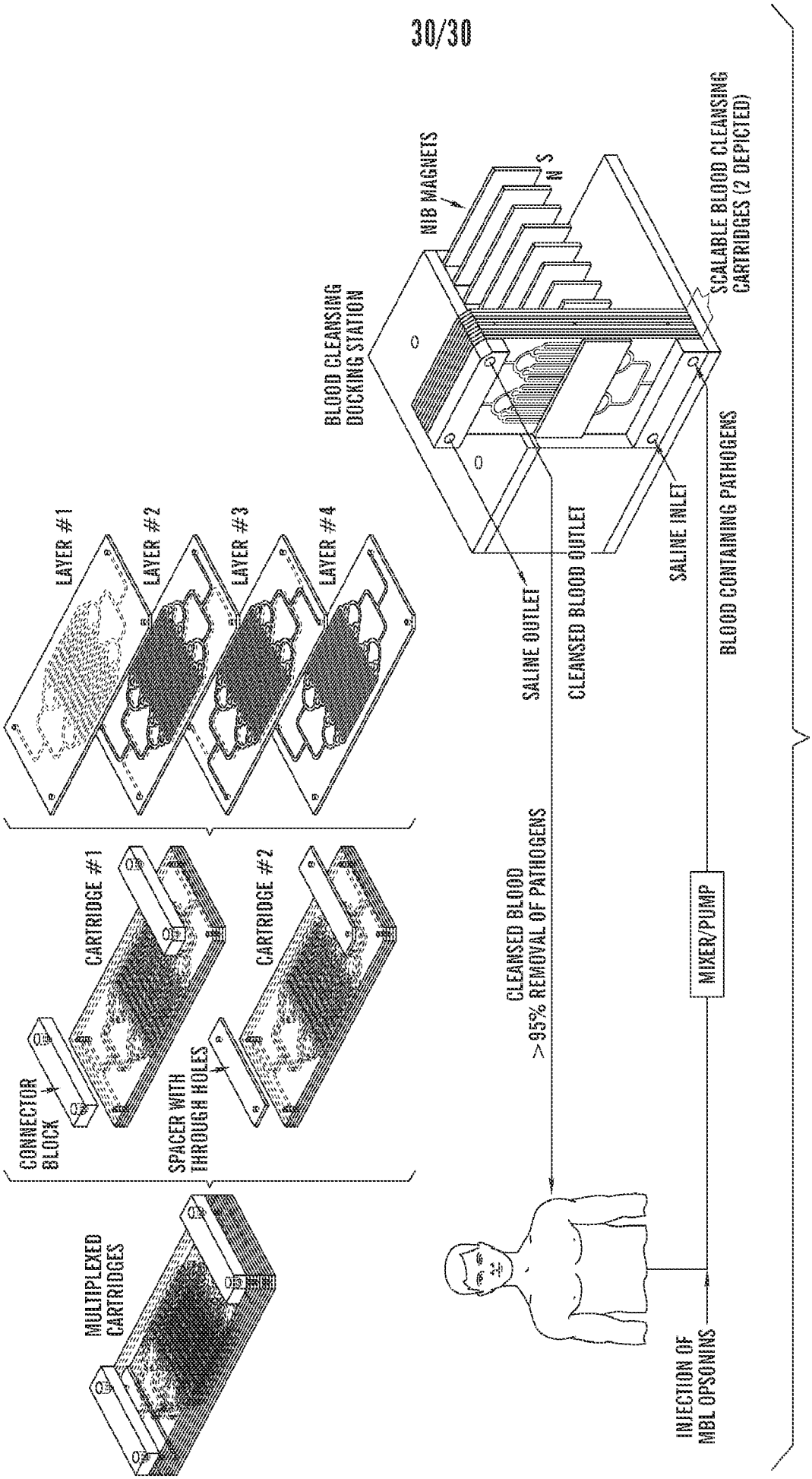

MULTIPLEXED CARTRIDGES
CONNECTOR BLOCK
CARTRIDGE #1
SPACER WITH THROUGH HOLES
CARTRIDGE #2
LAYER #1
LAYER #2
LAYER #3
LAYER #4
BLOOD CLEANSING DOCKING STATION
NIB MAGNETS
N S
SCALABLE BLOOD CLEANSING CARTRIDGES (2 DEPICTED)
SALINE OUTLET
CLEANSED BLOOD OUTLET
SALINE INLET
BLOOD CONTAINING PATHOGENS
CLEANSED BLOOD >95% REMOVAL OF PATHOGENS
MIXER/PUMP
INJECTION OF MBL OPSONINS

FIG. 20