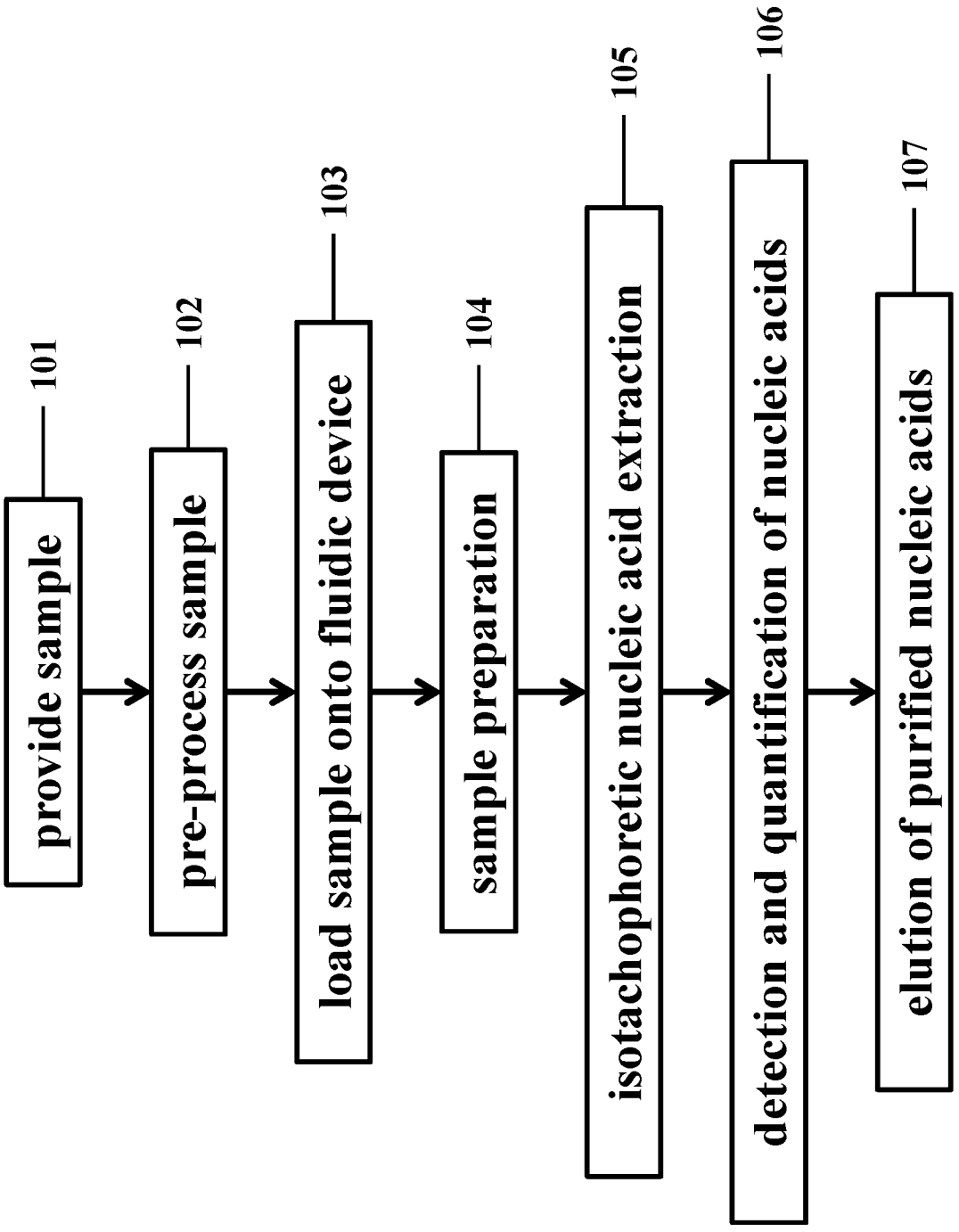

provide sample
101
pre-process sample
102
load sample onto fluidic device
103
sample preparation
104
isotachophoretic nucleic acid extraction
105
detection and quantification of nucleic acids
106
elution of purified nucleic acids
107

FIG. 1A

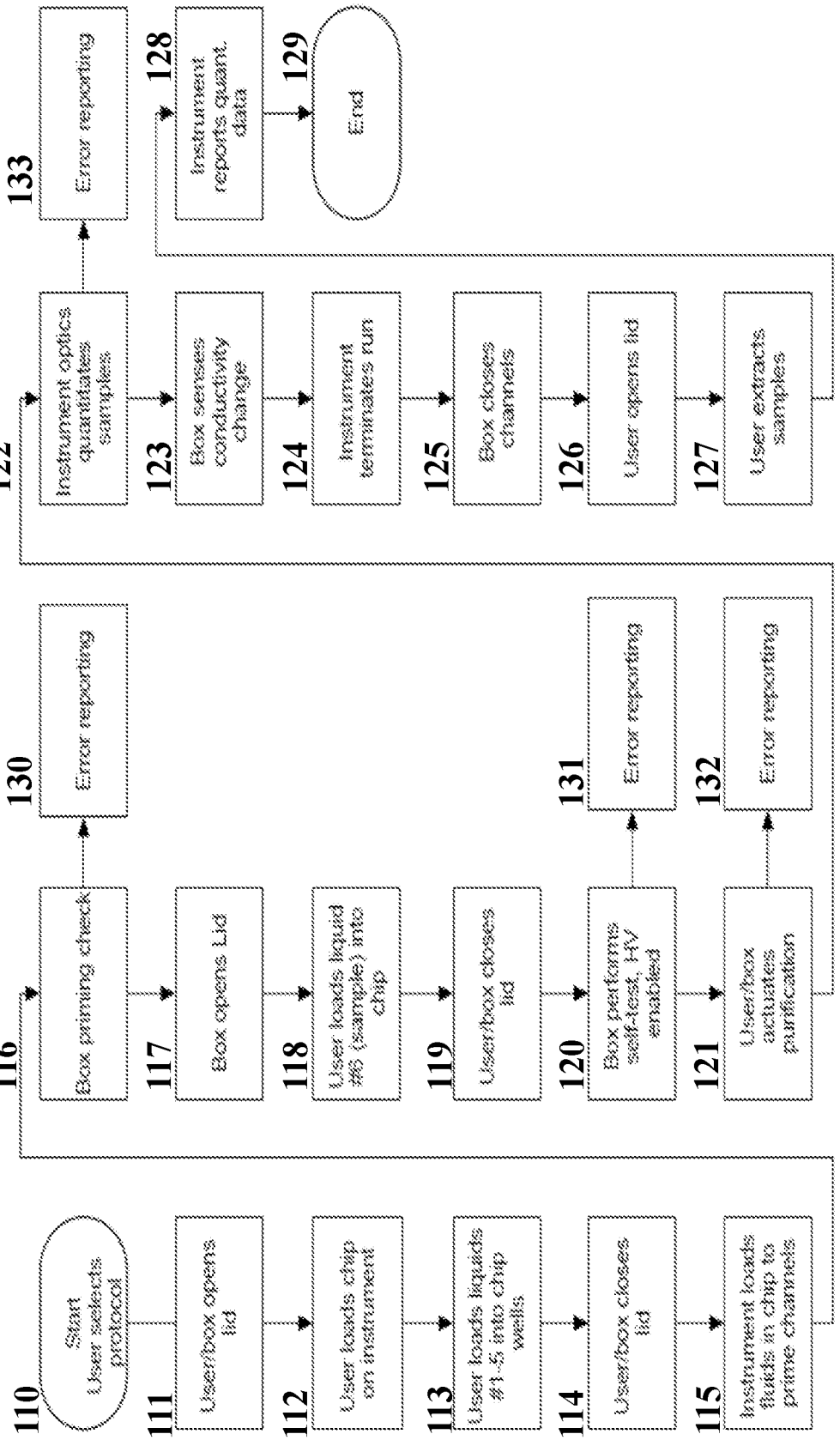

110
Start
User selects protocol
111
Userbox opens lid
112
User loads chip on instrument
113
User loads liquids #1-5 into chip wells
114
Userbox closes lid
115
Instrument loads fluids in chip to prime channels
116
Box priming check
117
Box opens Lid
118
User loads liquid #6 (sample) into chip
119
Userbox closes lid
120
Box performs self-test, HV enabled
121
Userbox actuates purification
122
Instrument optics quantitates samples
123
Box senses conductivity change
124
Instrument terminates run
125
Box closes channels
126
User opens lid
127
User extracts samples
128
Instrument reports quant. data
129
End
130
Error reporting
131
Error reporting
132
Error reporting
133
Error reporting

FIG. 1B

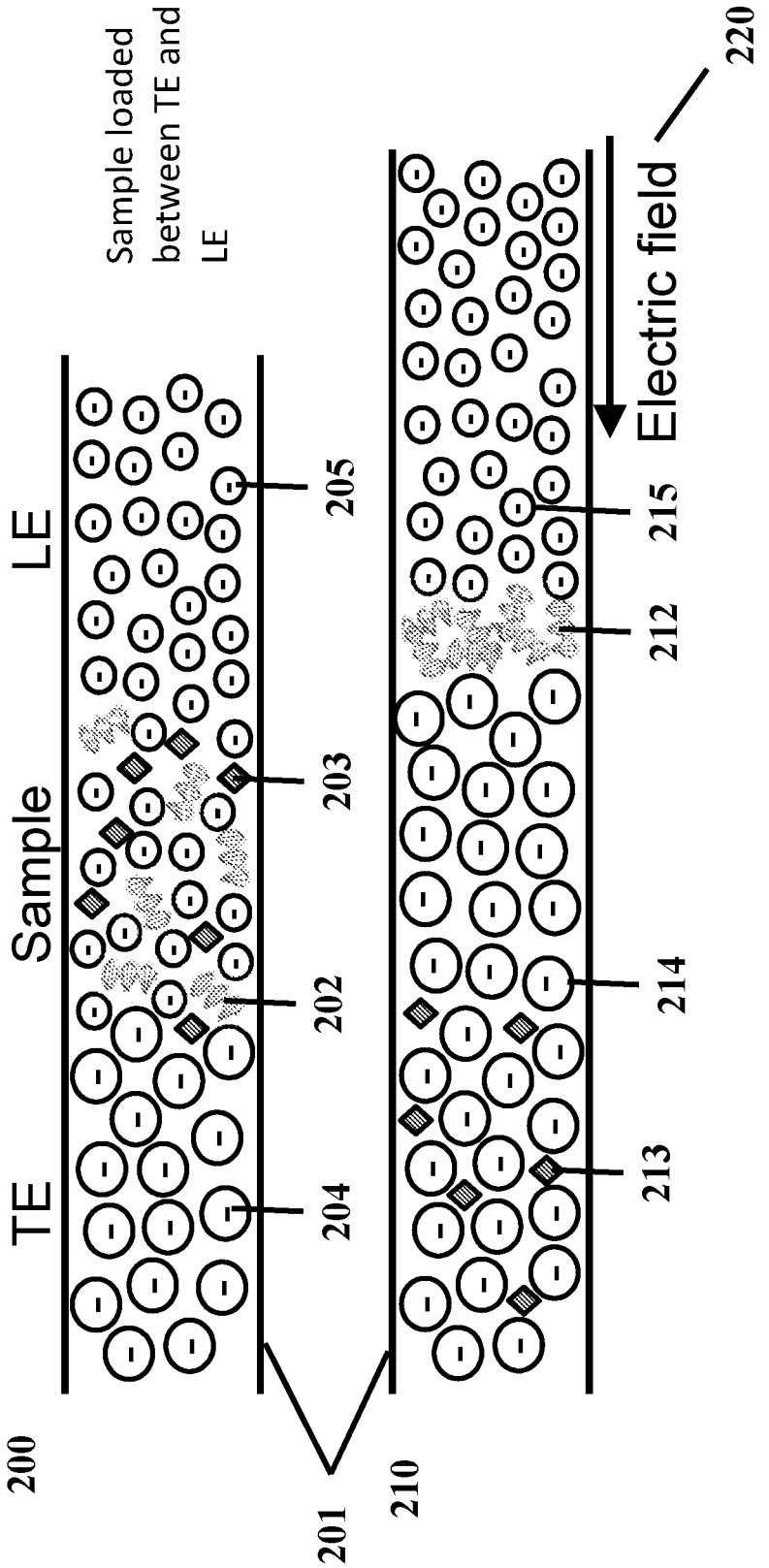

TE
Sample
LE
Sample loaded between TE and LE
Electric field
When E-field is turned on, DNA and RNA migrate to interface between TE and LE
Trailing electrolyte (TE) ion
Leading electrolyte (LE) ion
Inhibitor or contaminant
DNA or RNA
200
201
210
202
203
204
205
212
213
214
215
220

FIG. 2A

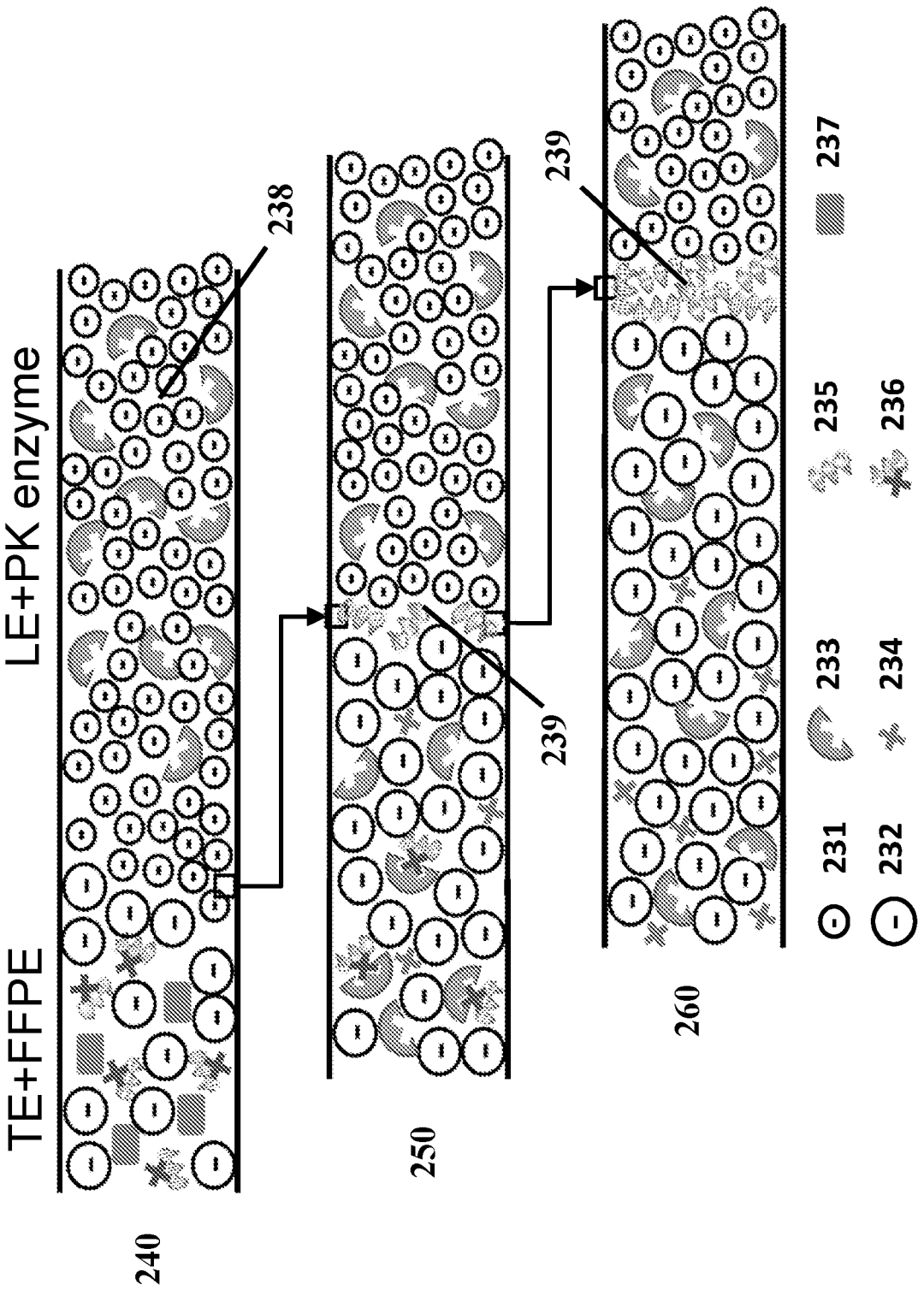

TE+FFPE
LE+PK enzyme
238
239
239
240
250
260
231
232
233
234
235
236
237

FIG. 2B

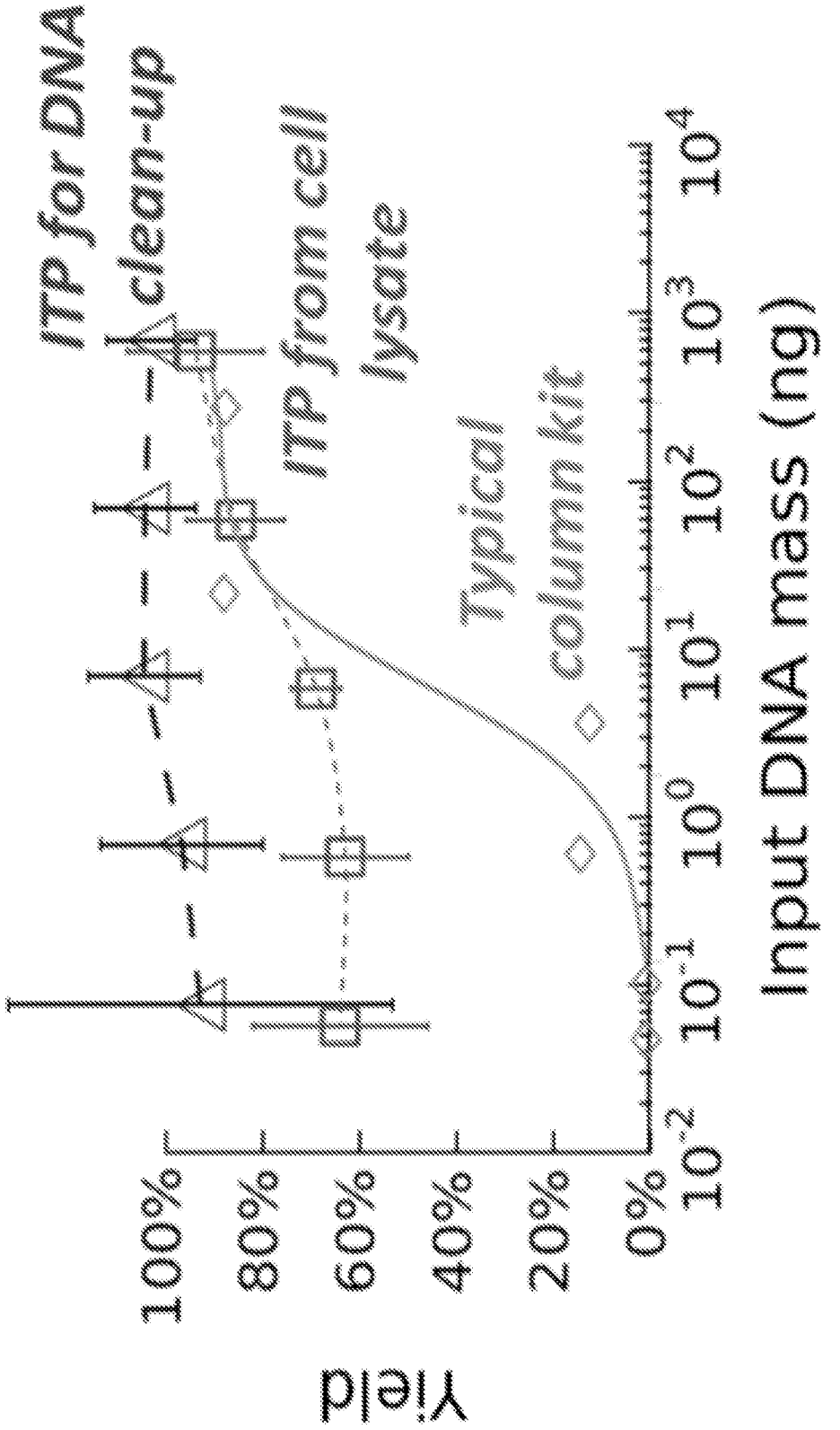

ITP for DNA clean-up
ITP from cell lysate
Typical column kit
Yield
100%
80%
60%
40%
20%
0%
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
Input DNA mass (ng)

FIG. 3

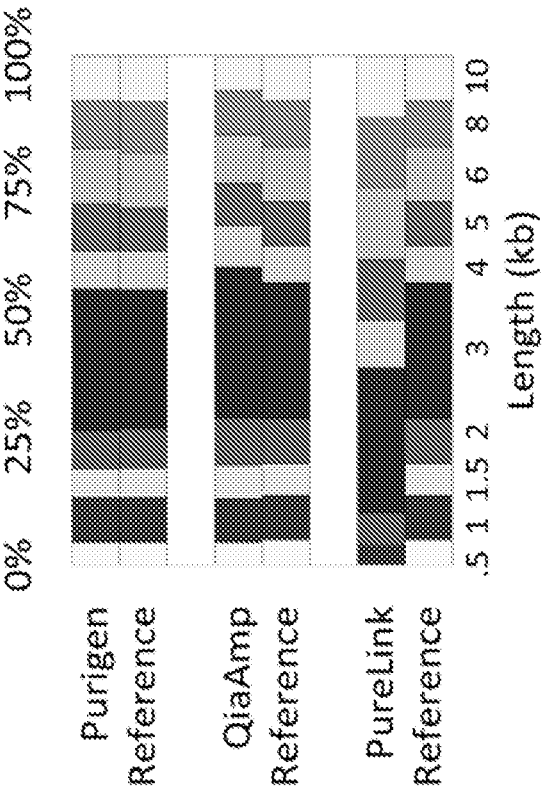

0%
25%
50%
75%
100%
.5 1 1.5 2 3 4 5 6 8 10
Length (kb)
Purigen Reference
QiaAmp Reference
PureLink Reference

FIG. 4B

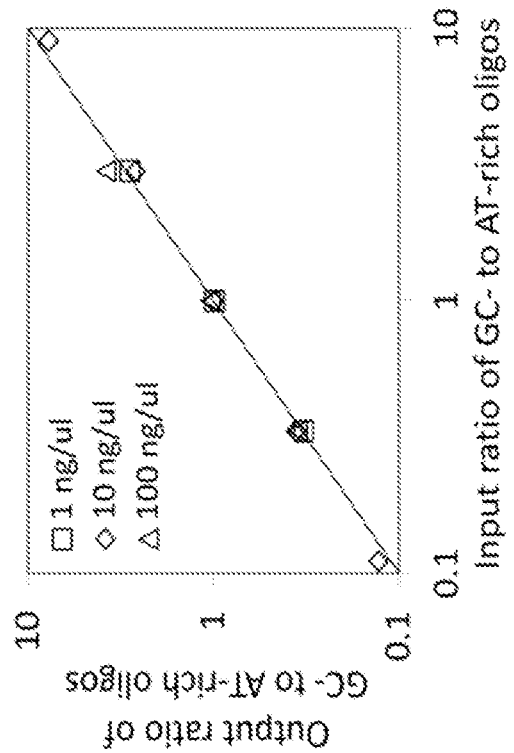

Output ratio of GC- to AT-rich oligos
10
1
0.1
0.1
1
10
Input ratio of GC- to AT-rich oligos
□ 1 ng/ul
◇ 10 ng/ul
△ 100 ng/ul

FIG. 4A

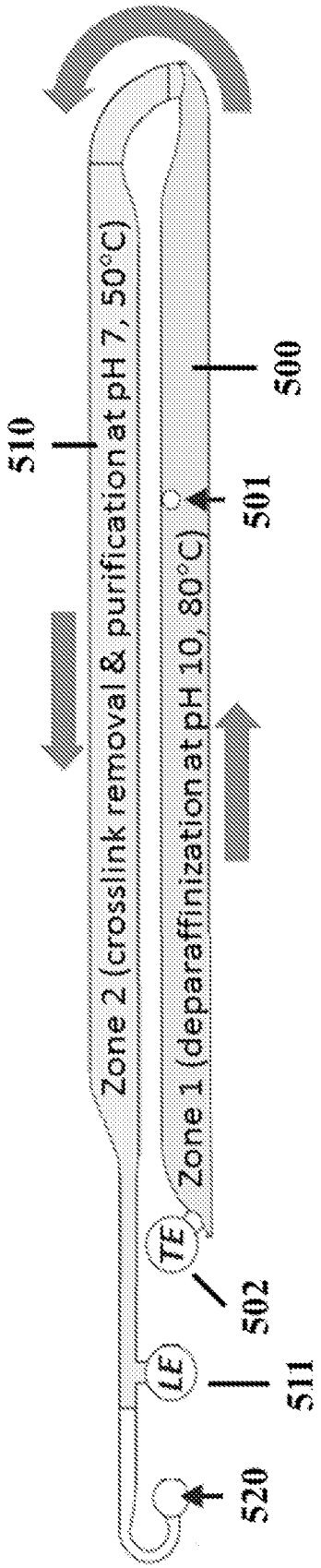

Zone 2 (crosslink removal & purification at pH 7, 50°C)
Zone 1 (deparaffinization at pH 10, 80°C)
TE
LE
510
500
501
502
511
520

FIG. 5A

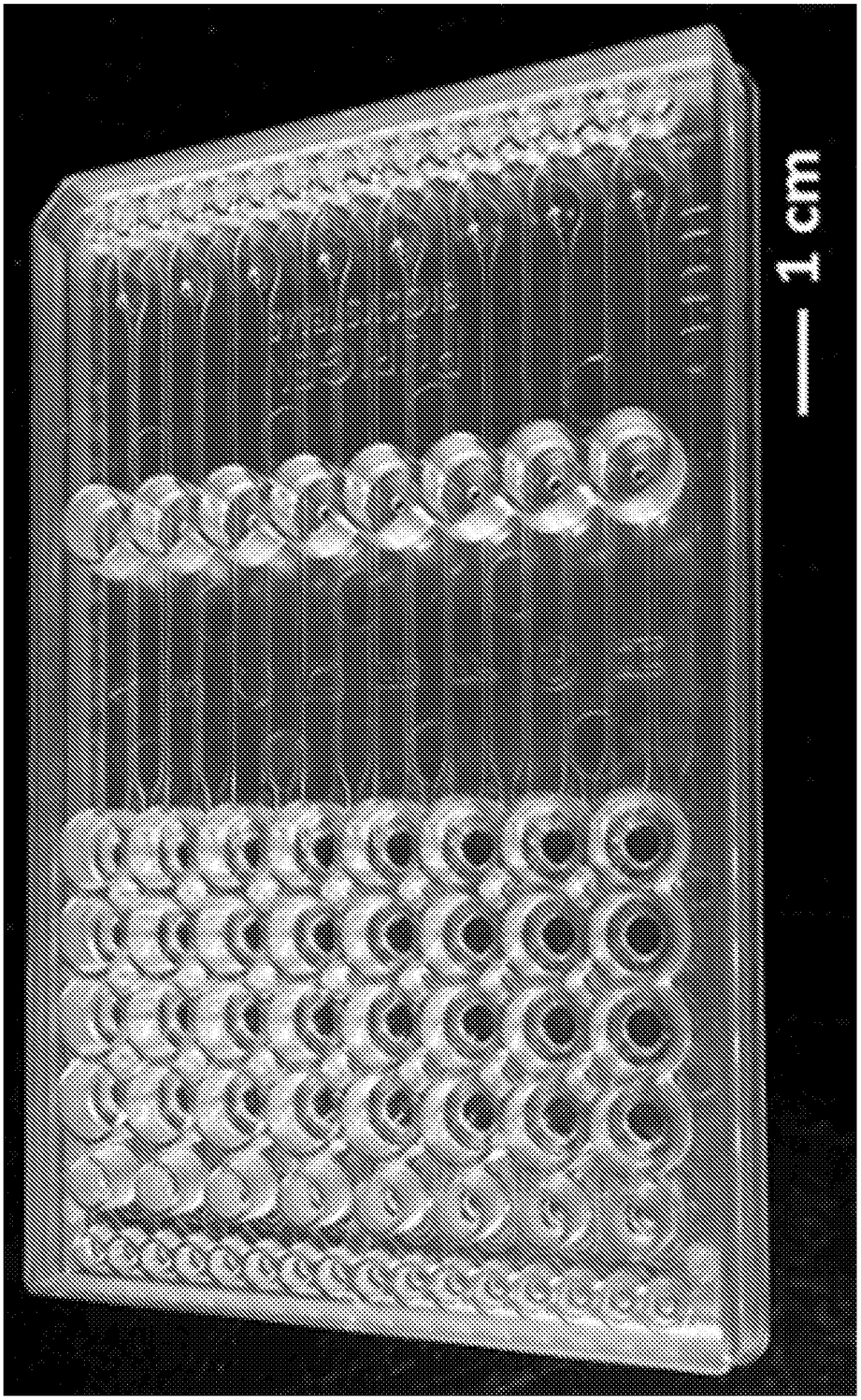


FIG. 5B

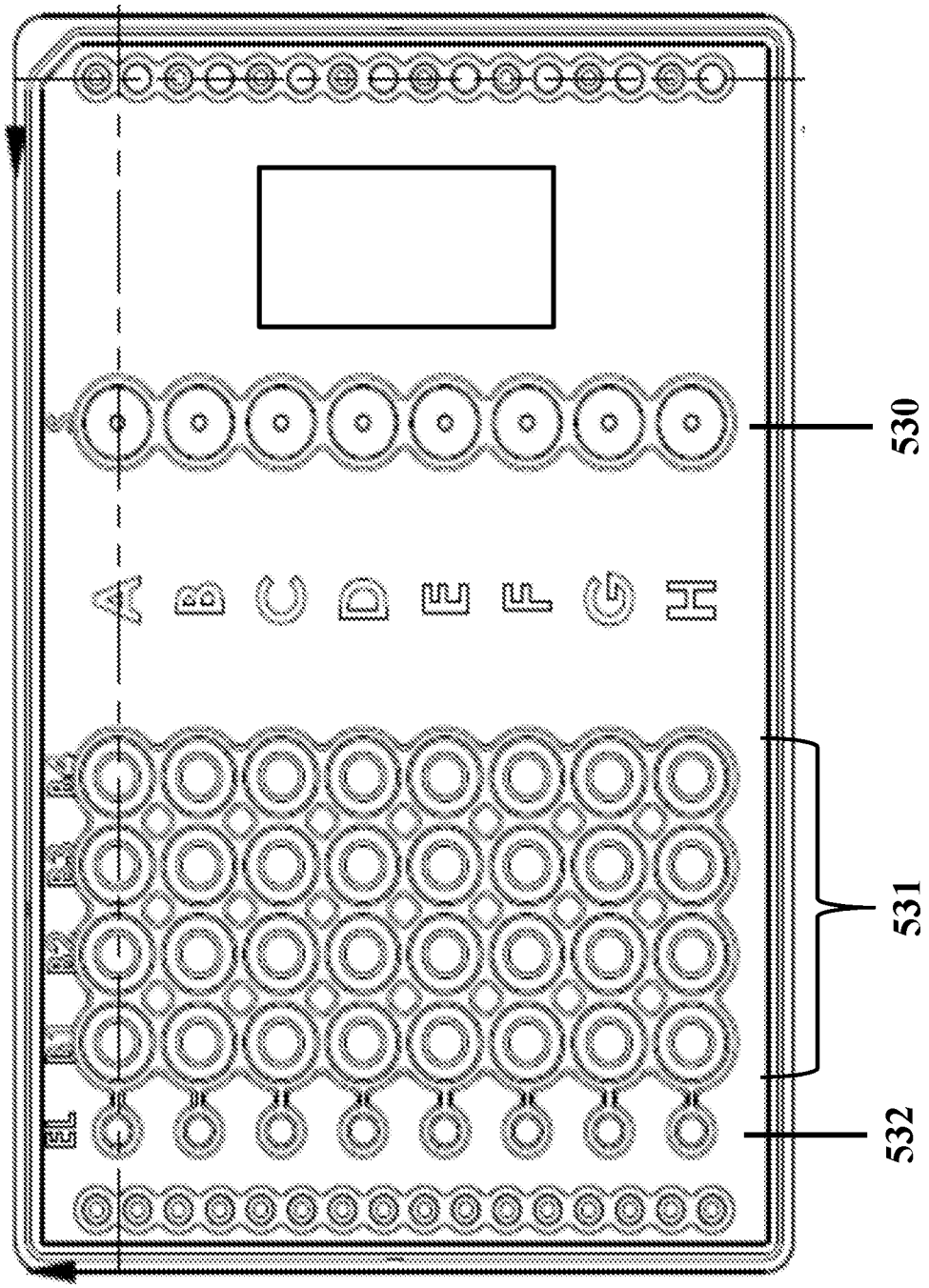


FIG. 5C

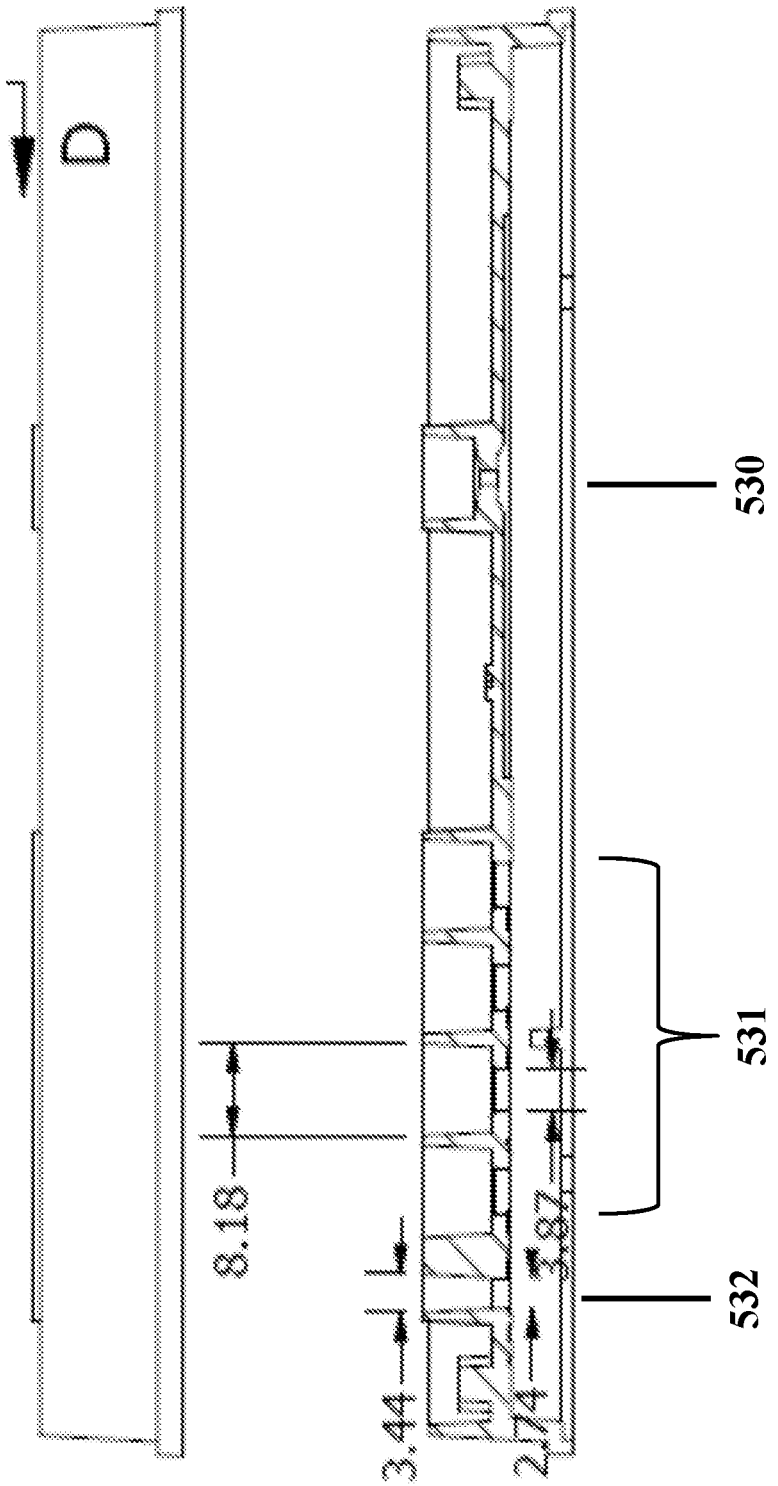


FIG. 5D

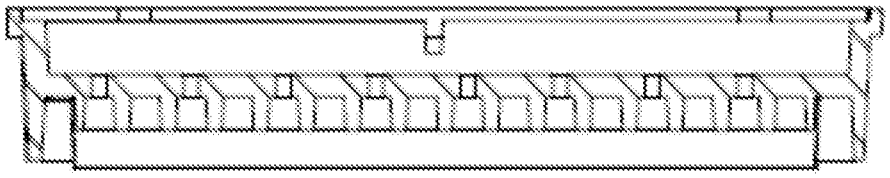


FIG. 5E

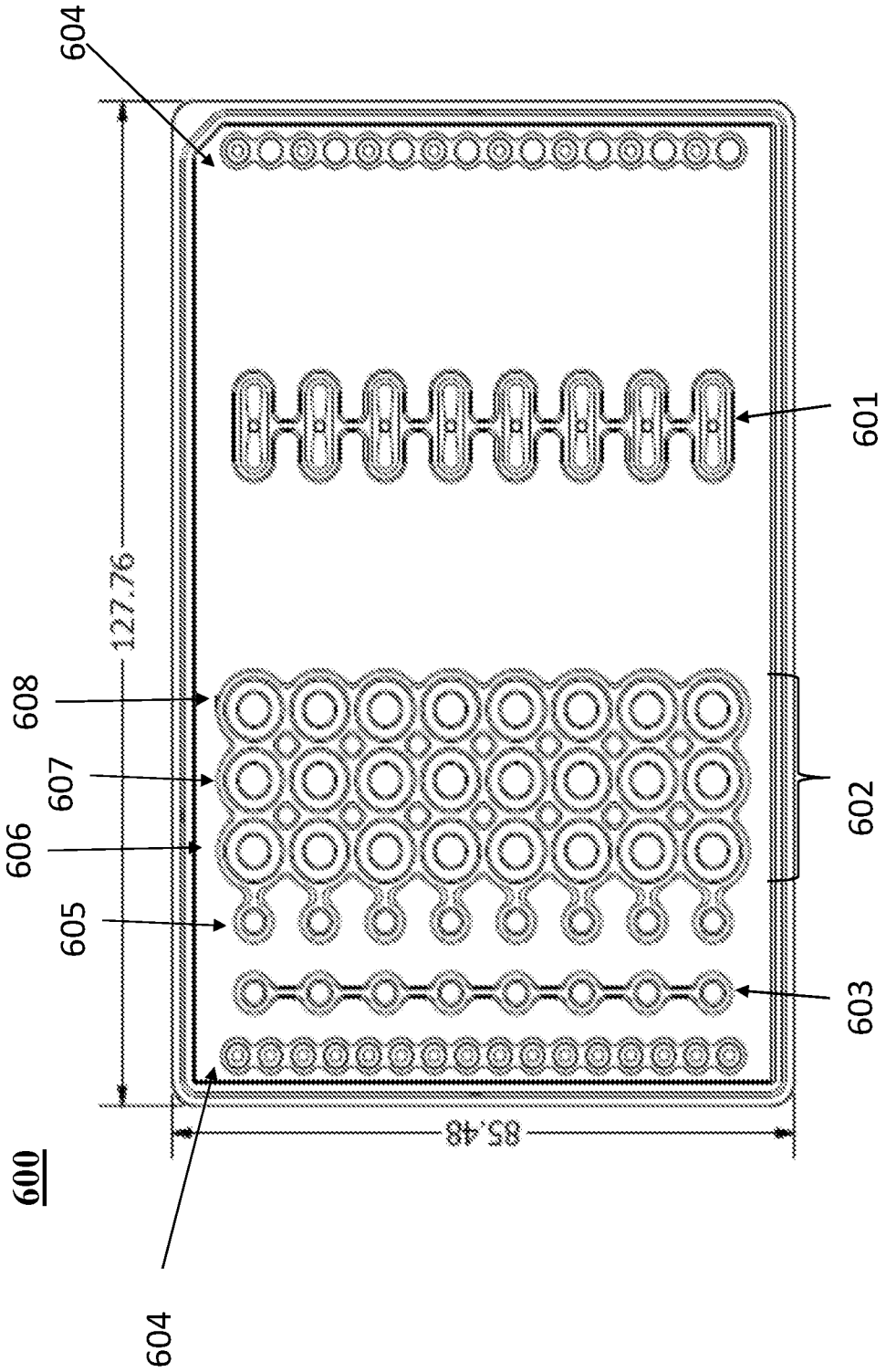


FIG. 6A

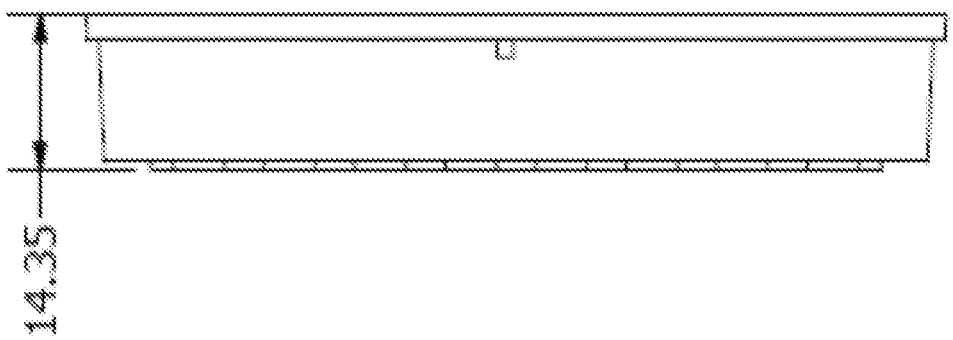


FIG. 6B

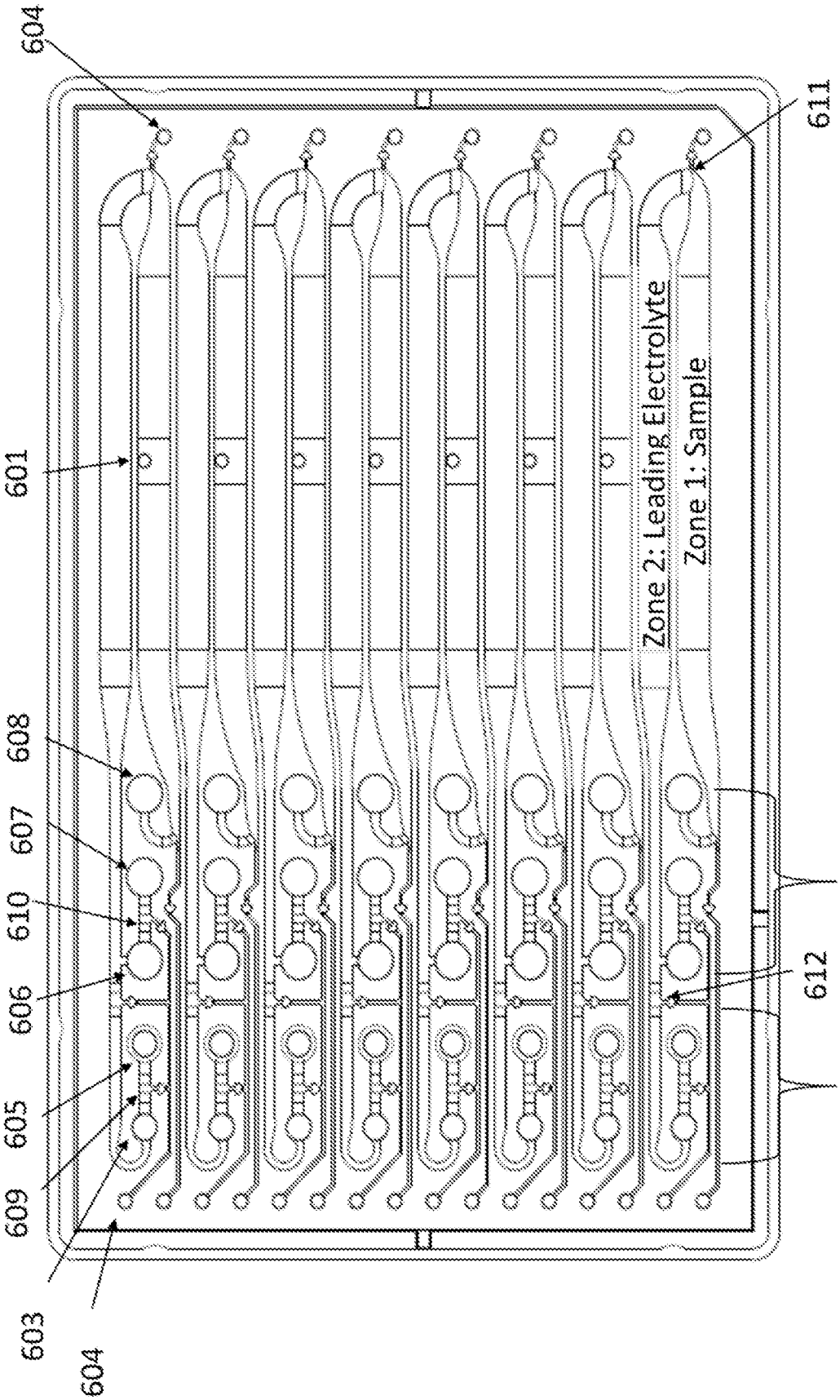

604
611
601
608
607
610
606
605
609
603
604
Zone 2: Leading Electrolyte
Zone 1: Sample
602
612
Zone 3: Elution

FIG. 6C

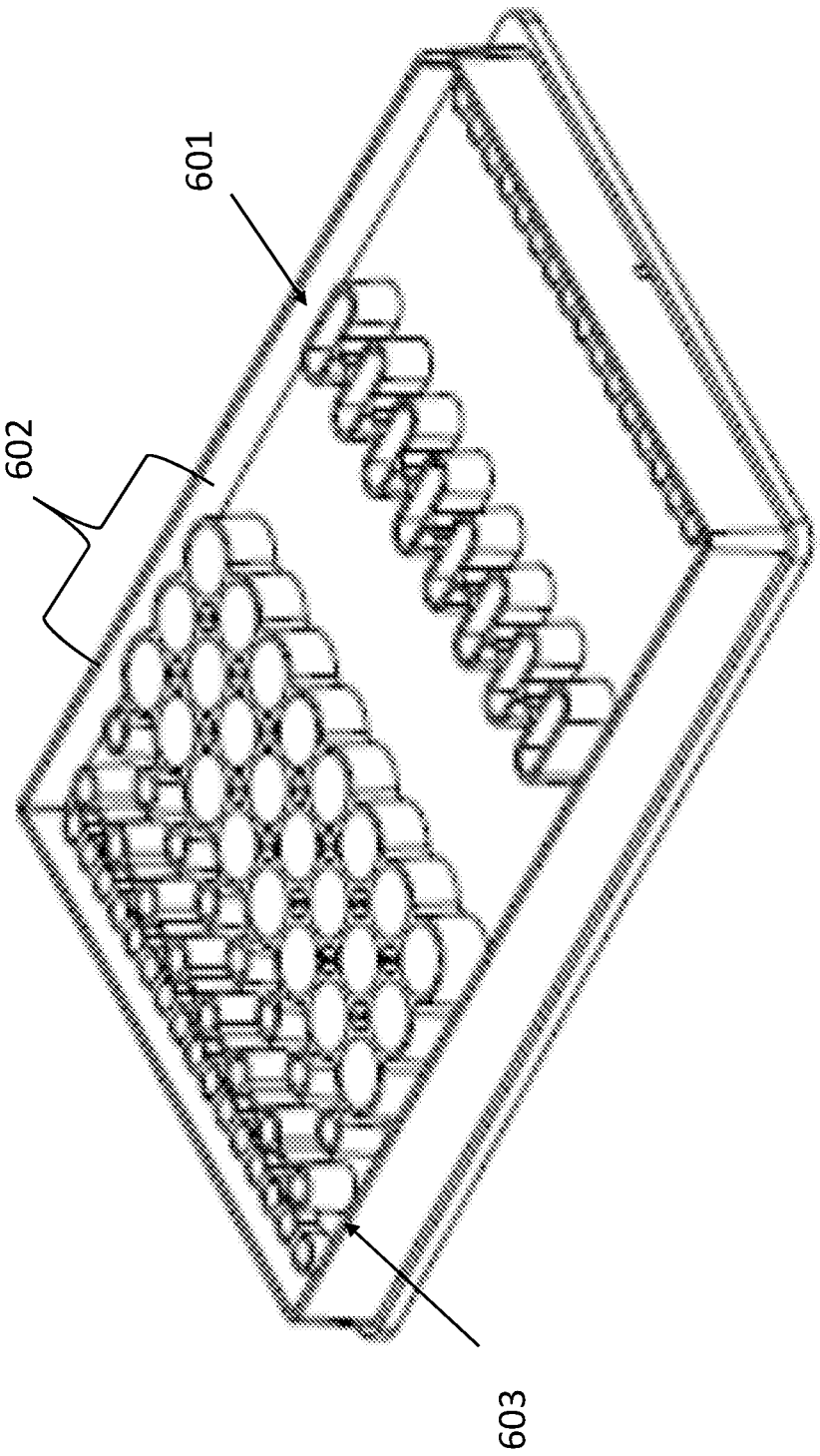


FIG. 6D

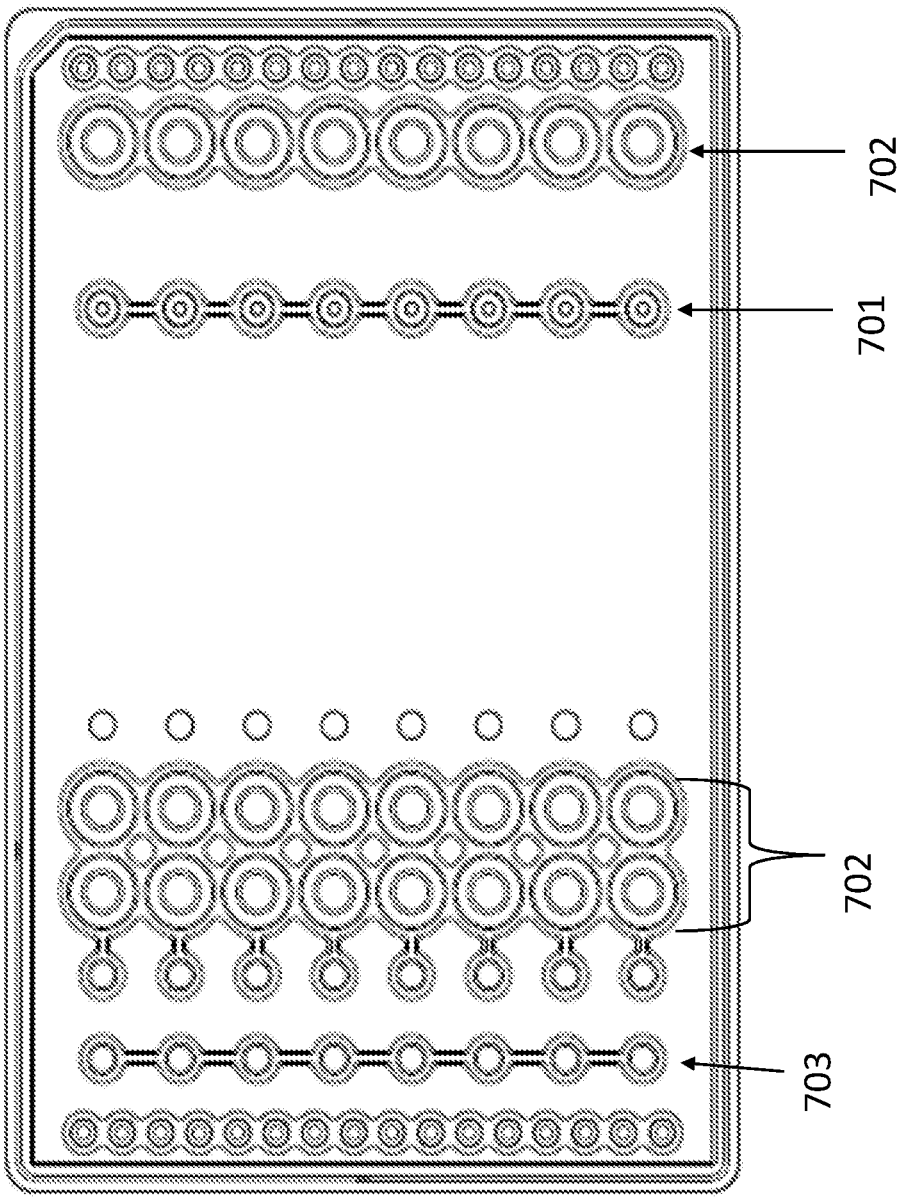


FIG. 7A

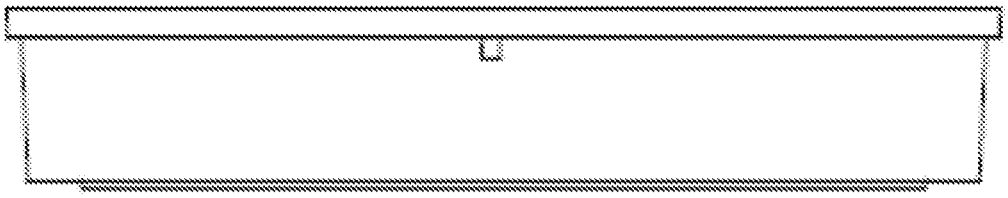


FIG. 7B

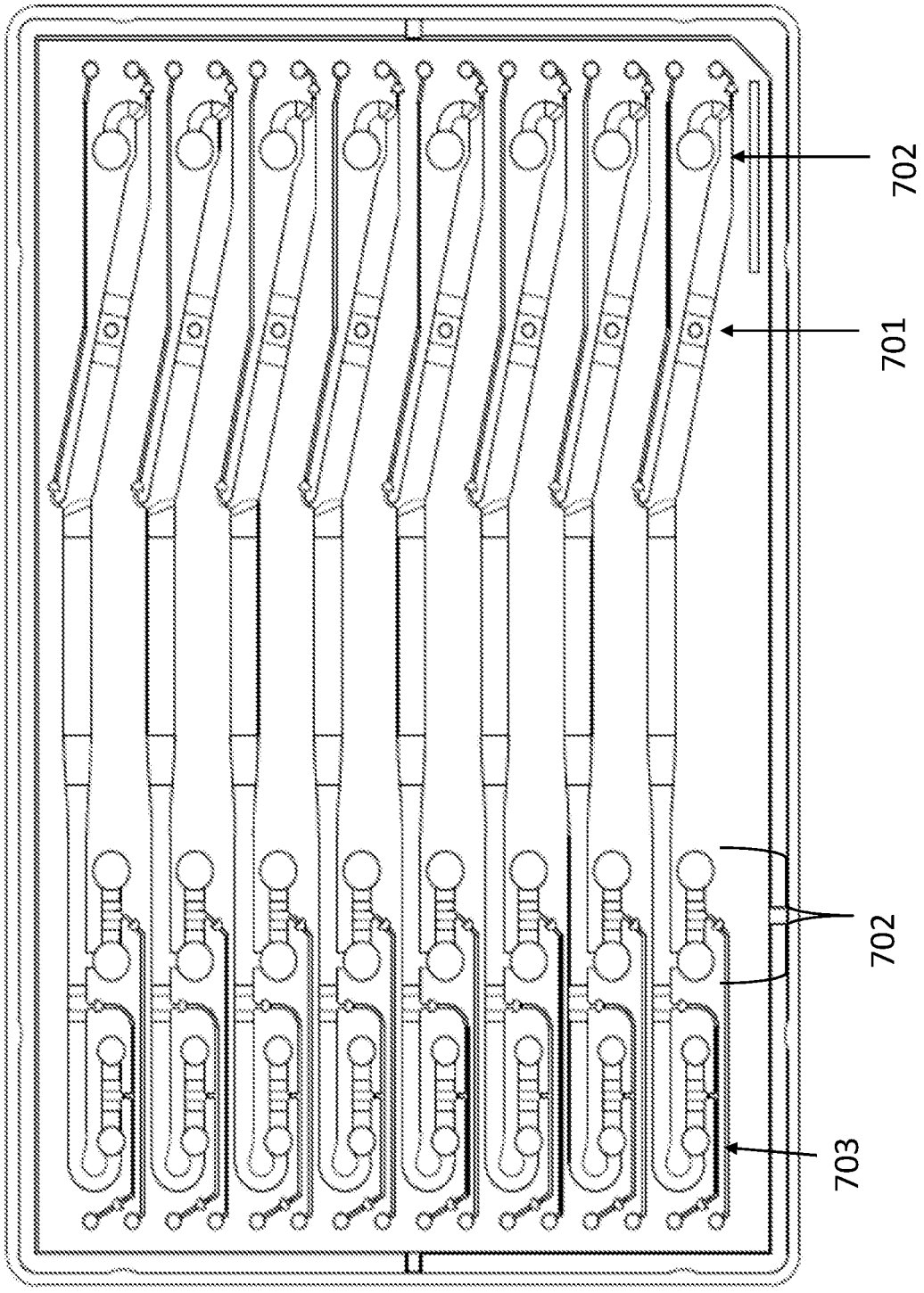


FIG. 7C

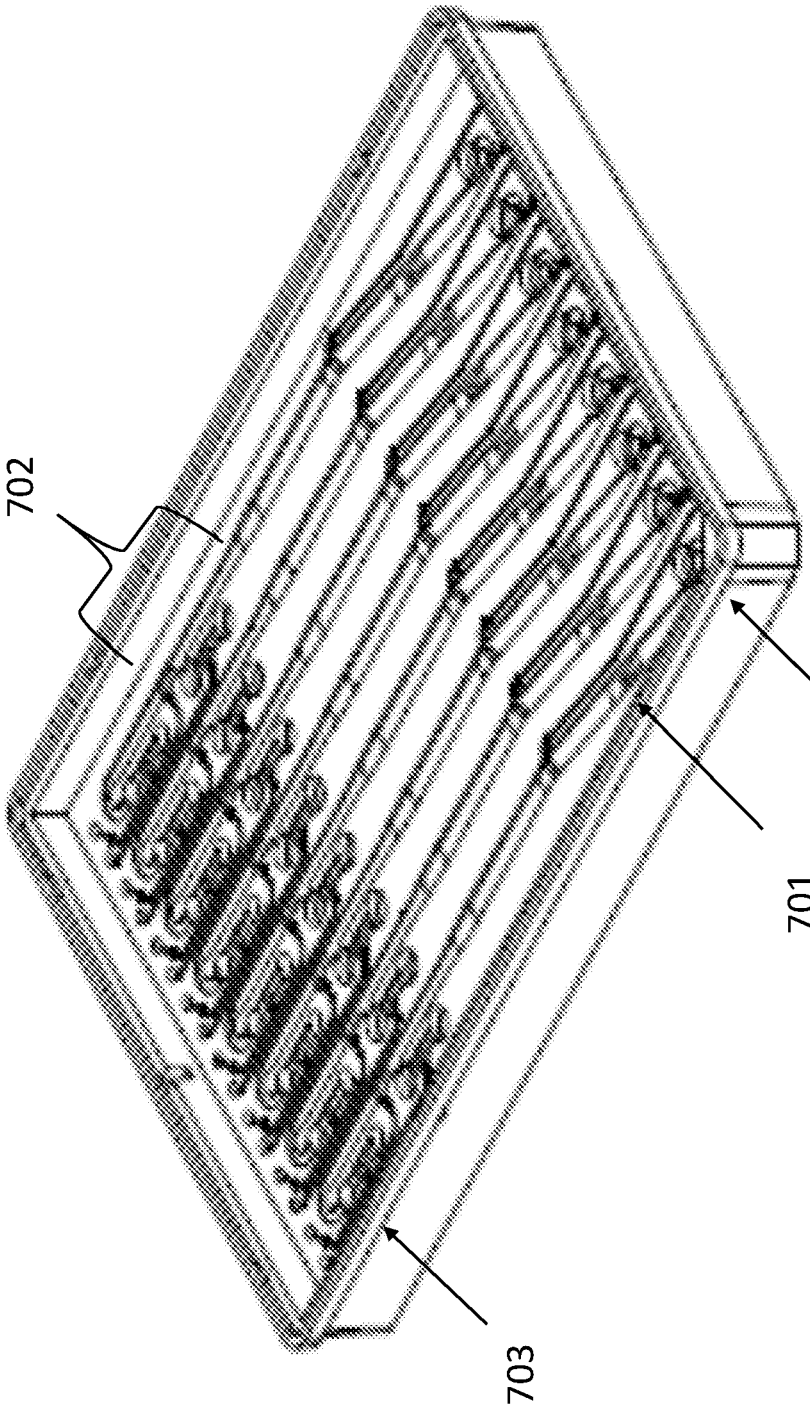


FIG. 7D

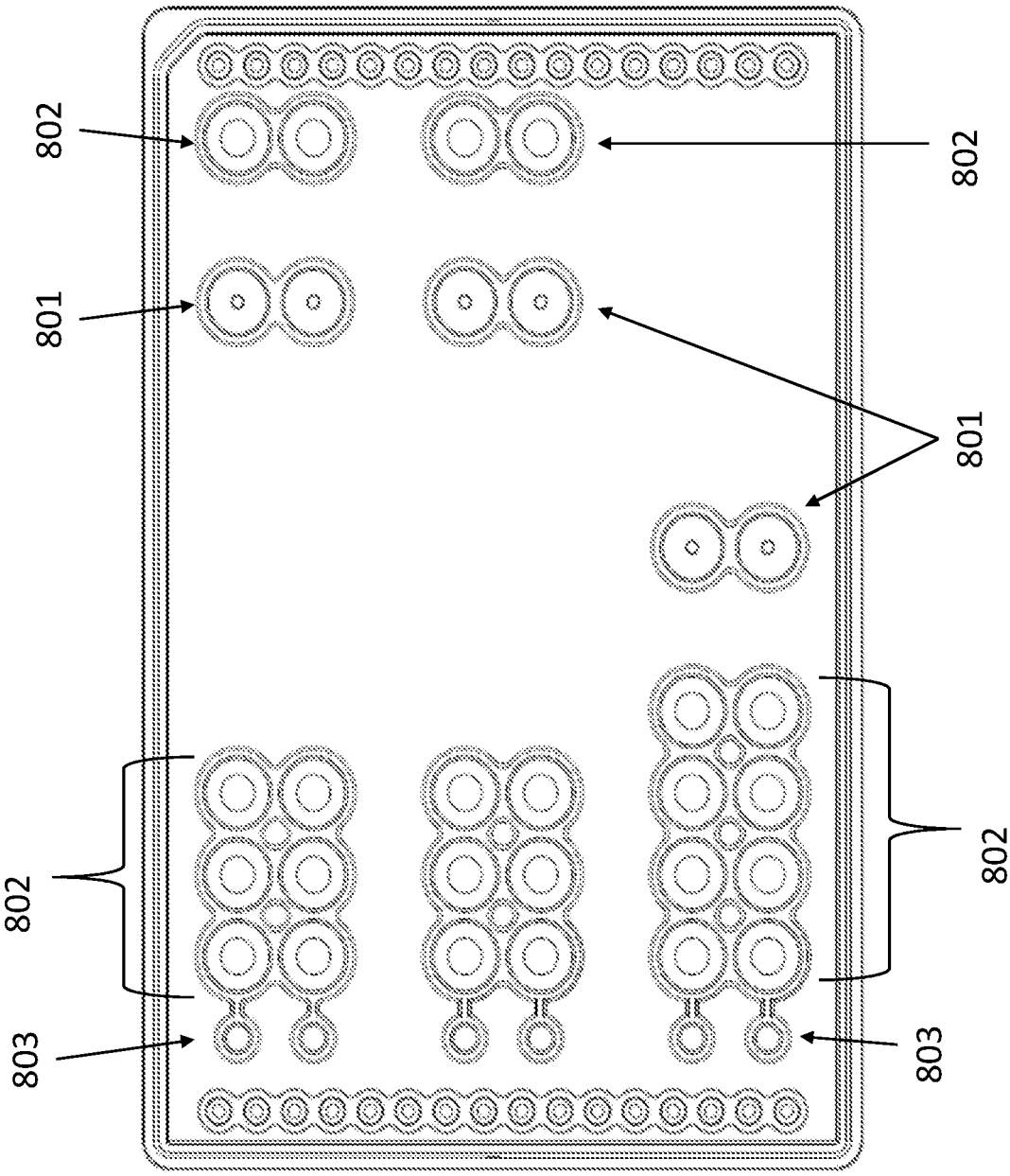


FIG. 8A



FIG. 8B

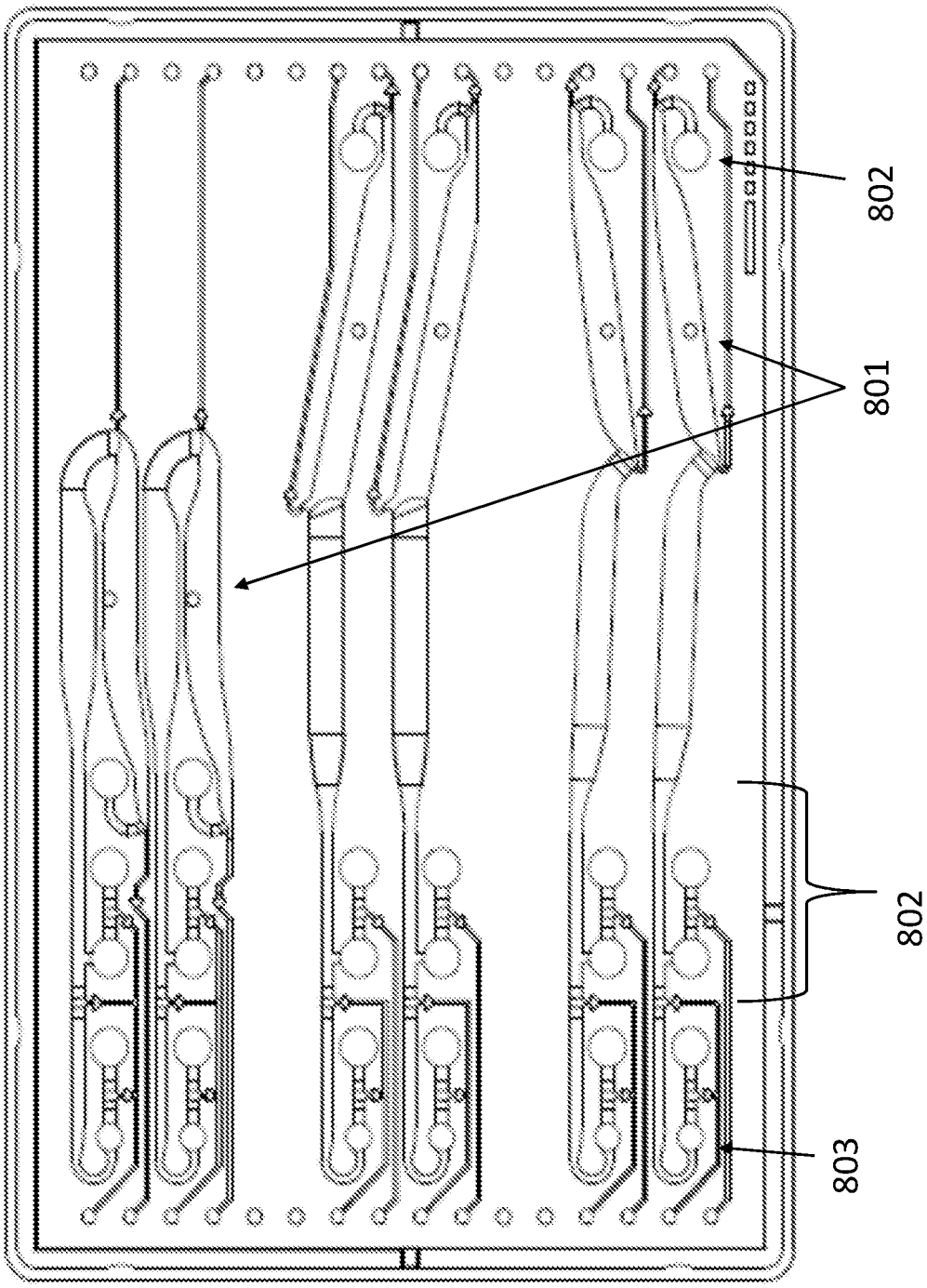


FIG. 8C

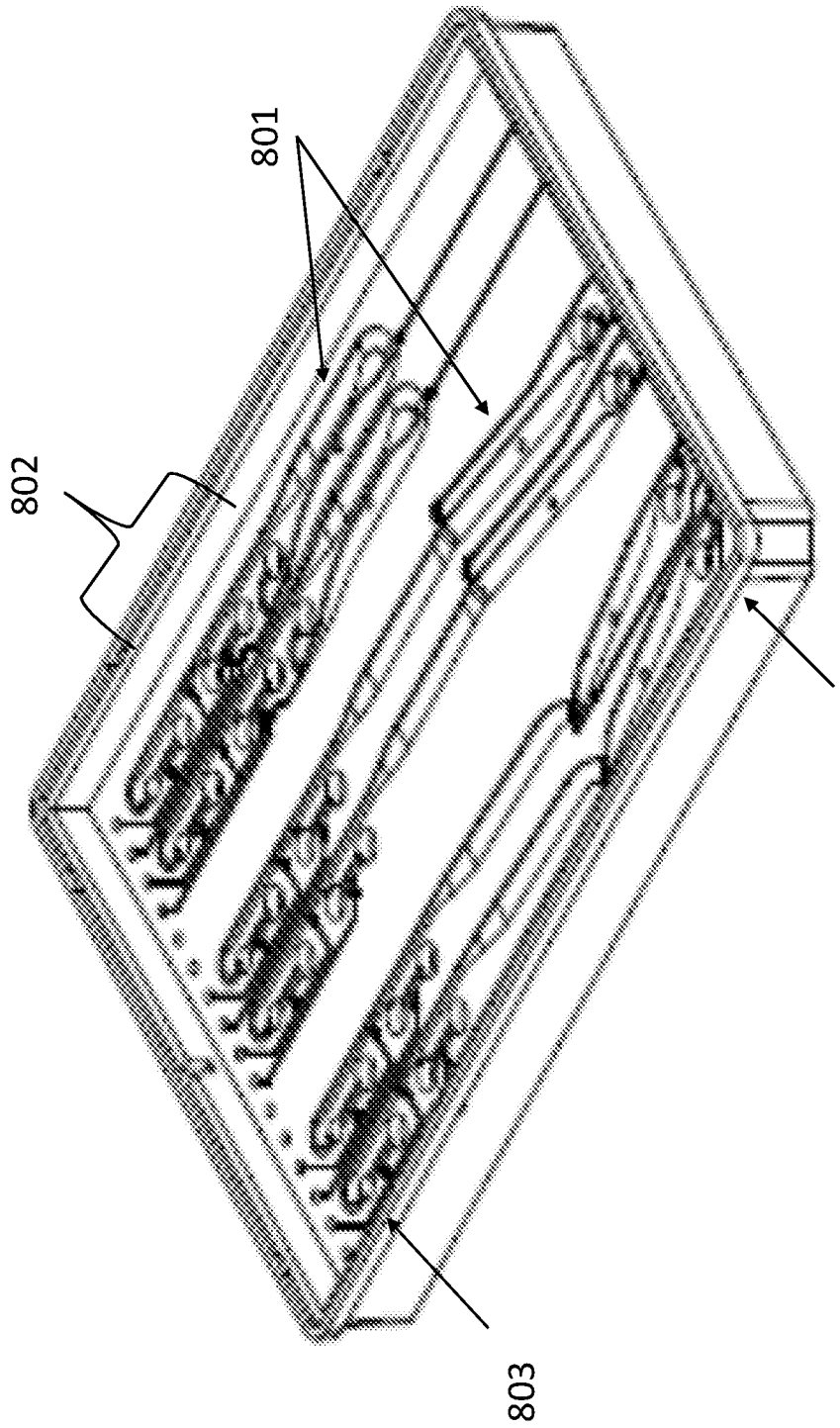


FIG. 8D

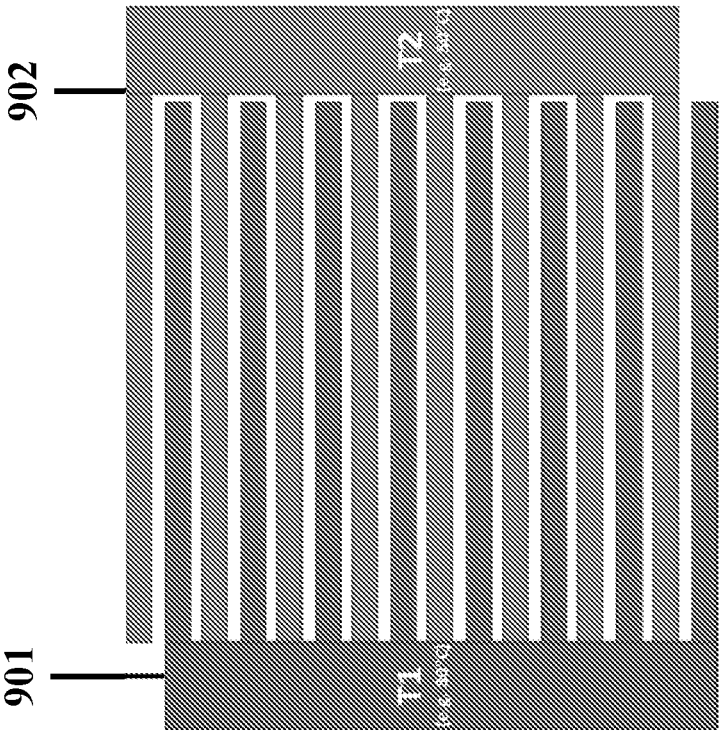


FIG. 9B

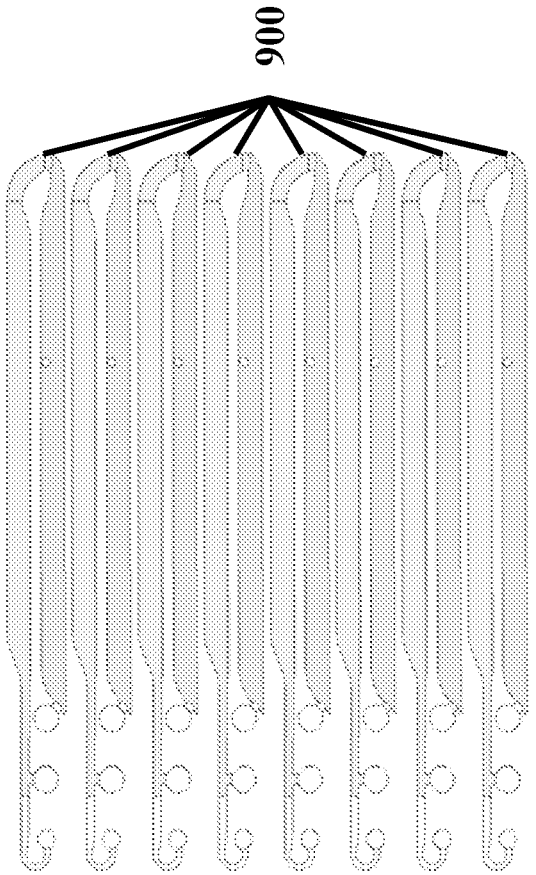


FIG. 9A

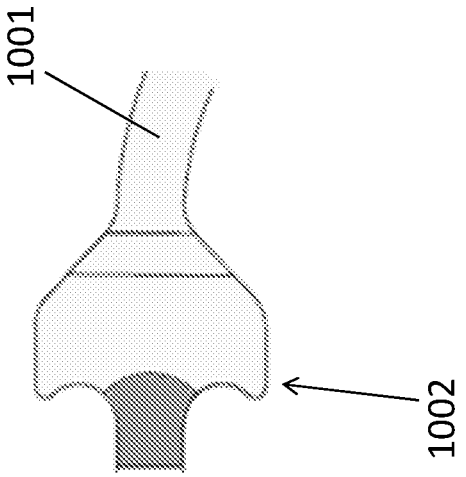


FIG. 10B

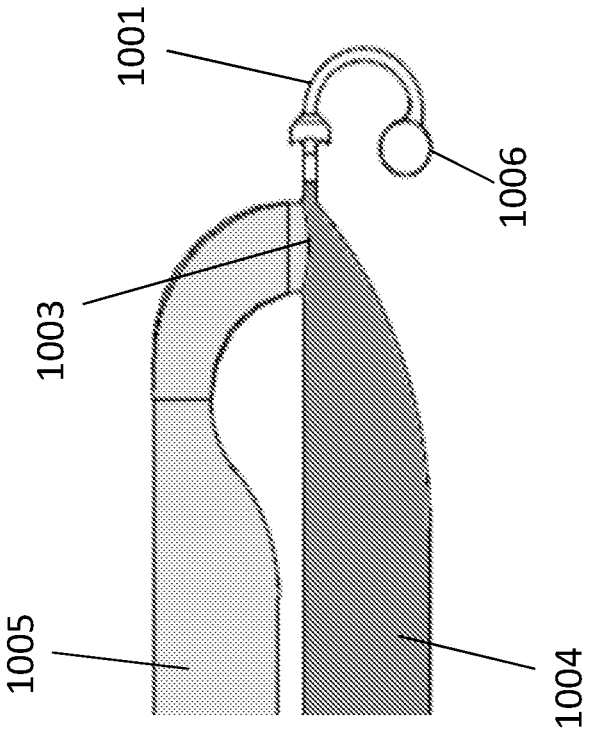


FIG. 10A

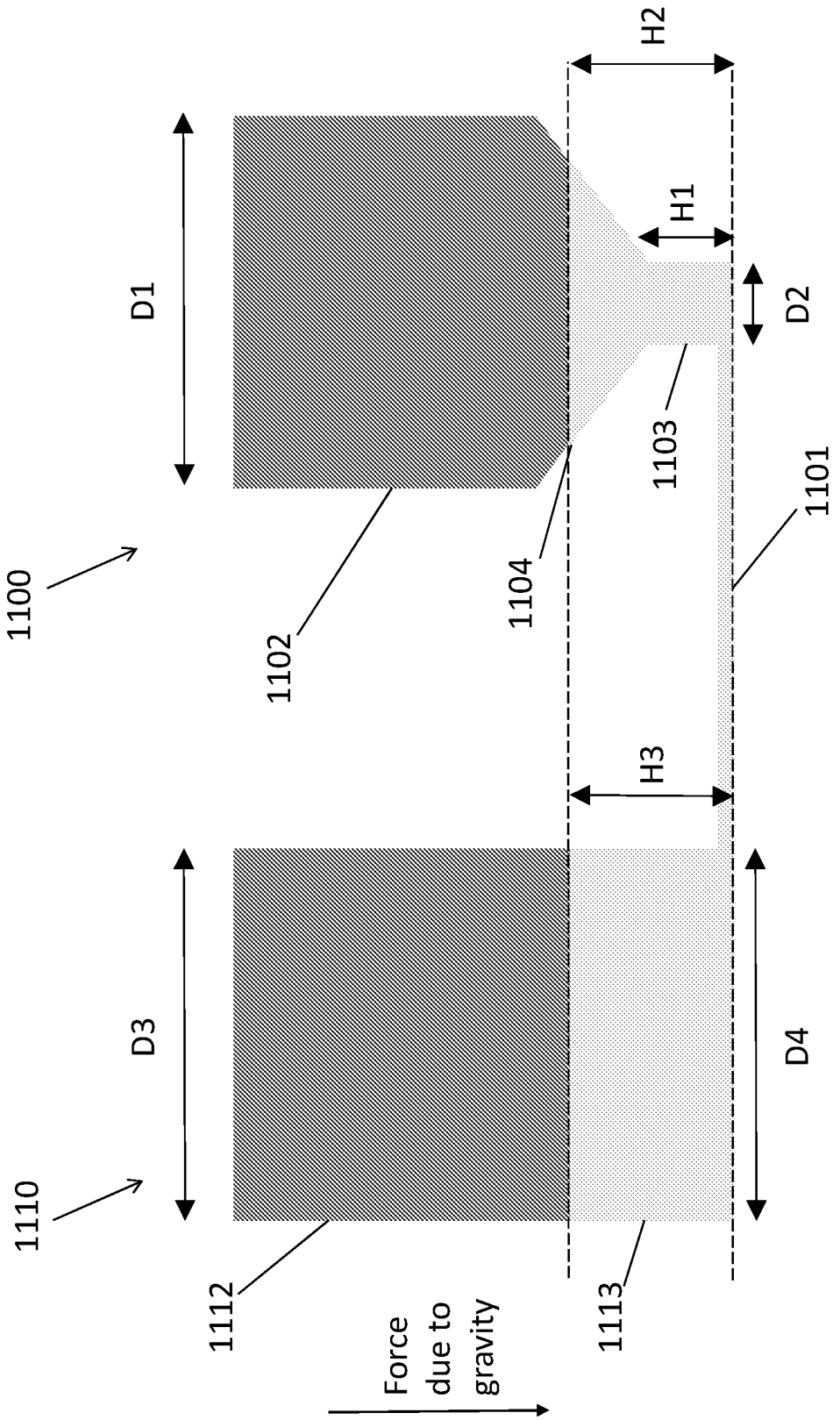

H2
H1
D1
D2
1103
1101
1100
1104
1102
H3
D3
D4
1110
1112
1113
Force due to gravity

FIG. 11

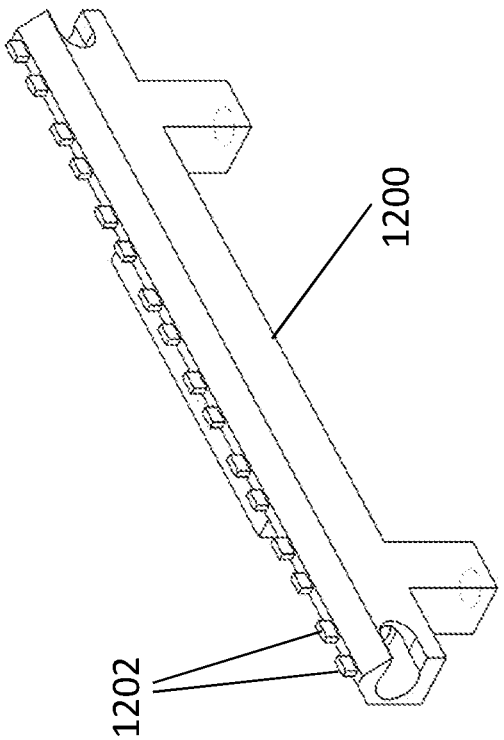


FIG. 12A

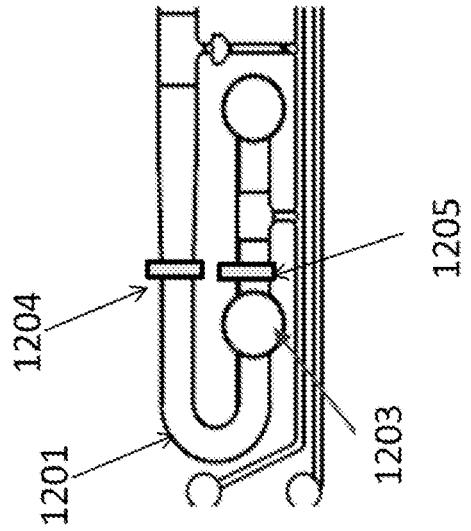


FIG. 12B

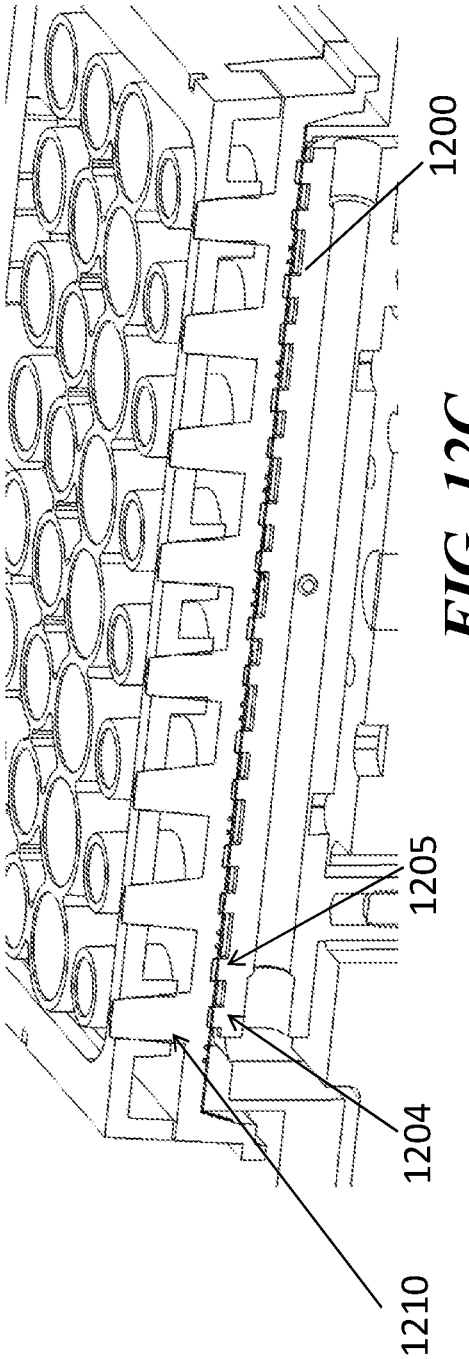


FIG. 12C

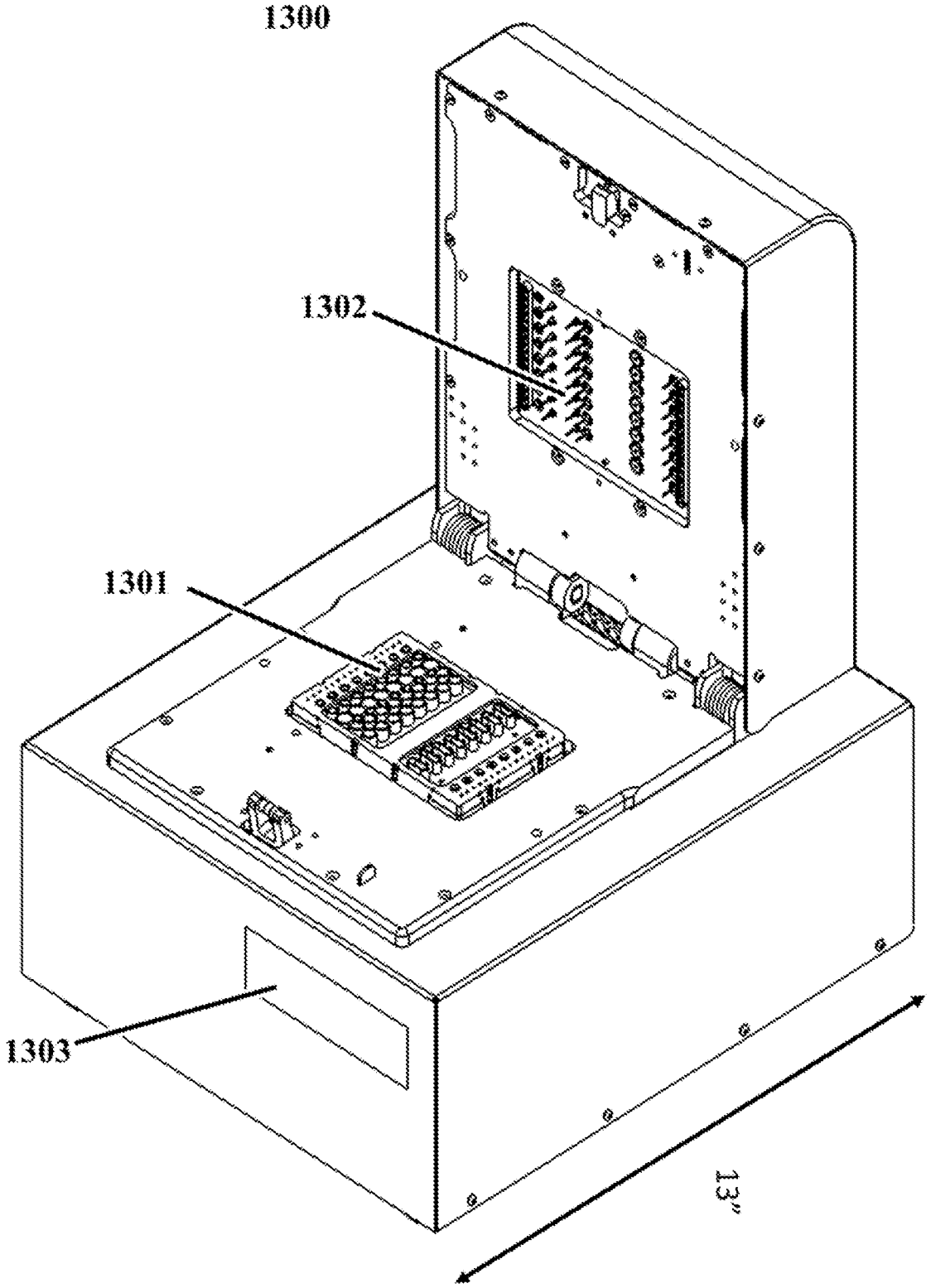


FIG. 13A

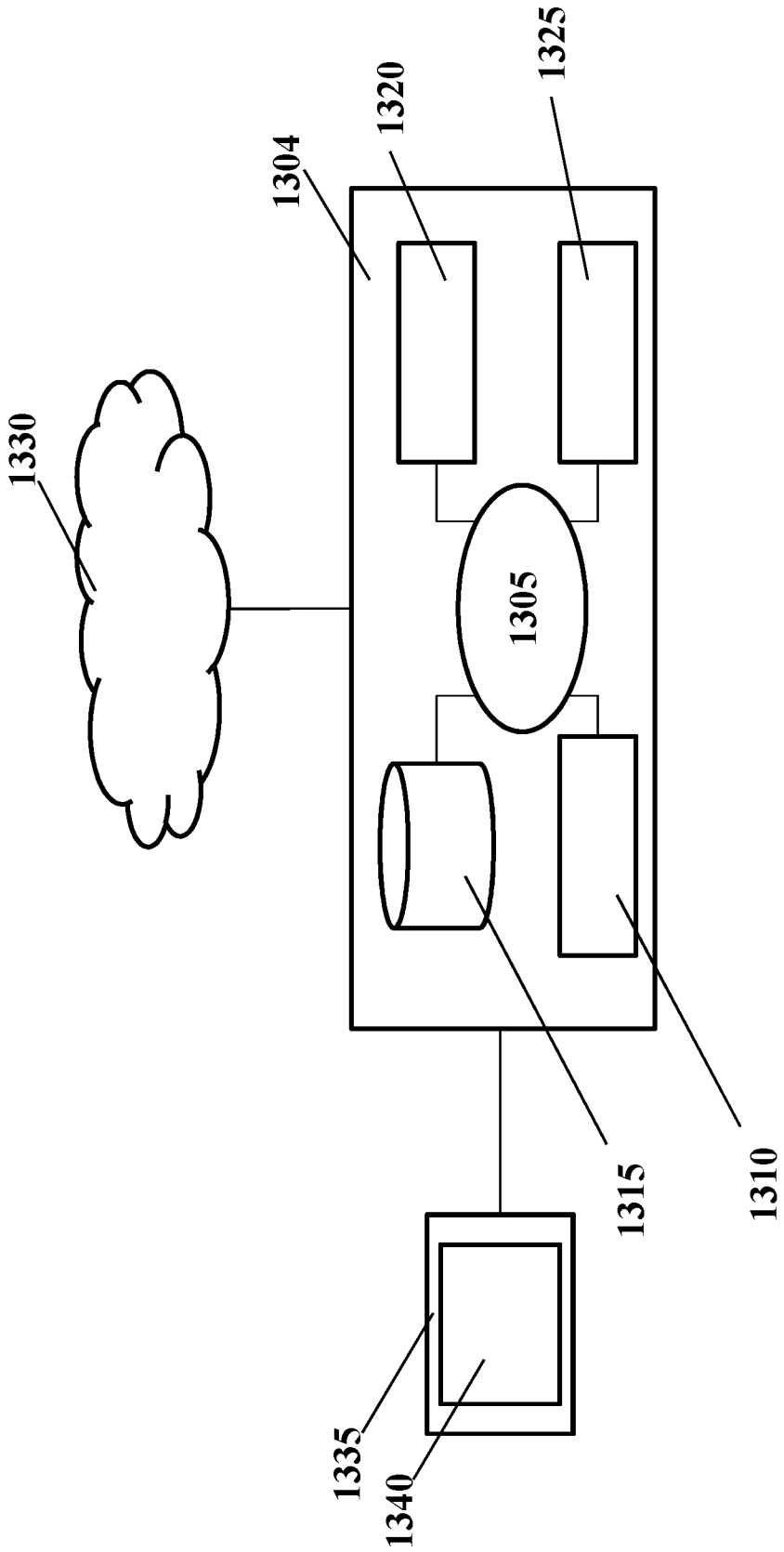


FIG. 13B

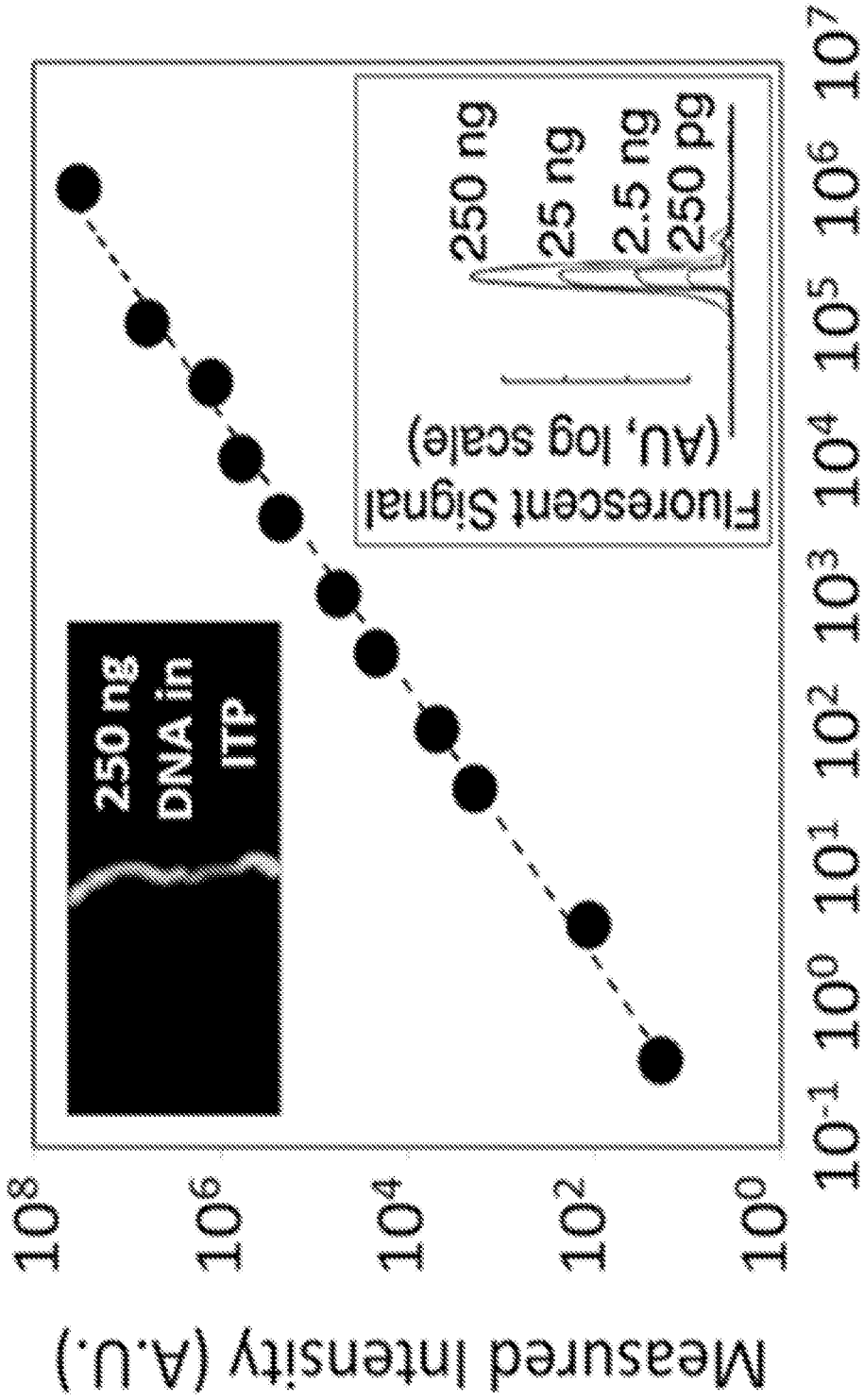

Measured Intensity (A.U.)
10^8
10^6
10^4
10^2
10^0
10^{-1} 10^0 10^1 10^2 10^3 10^4 10^5 10^6 10^7
Sample Mass (pg)
250 nM DNA in ITP
Fluorescent Signal (AU, log scale)
250 ng
25 ng
2.5 ng
250 pg

FIG. 14

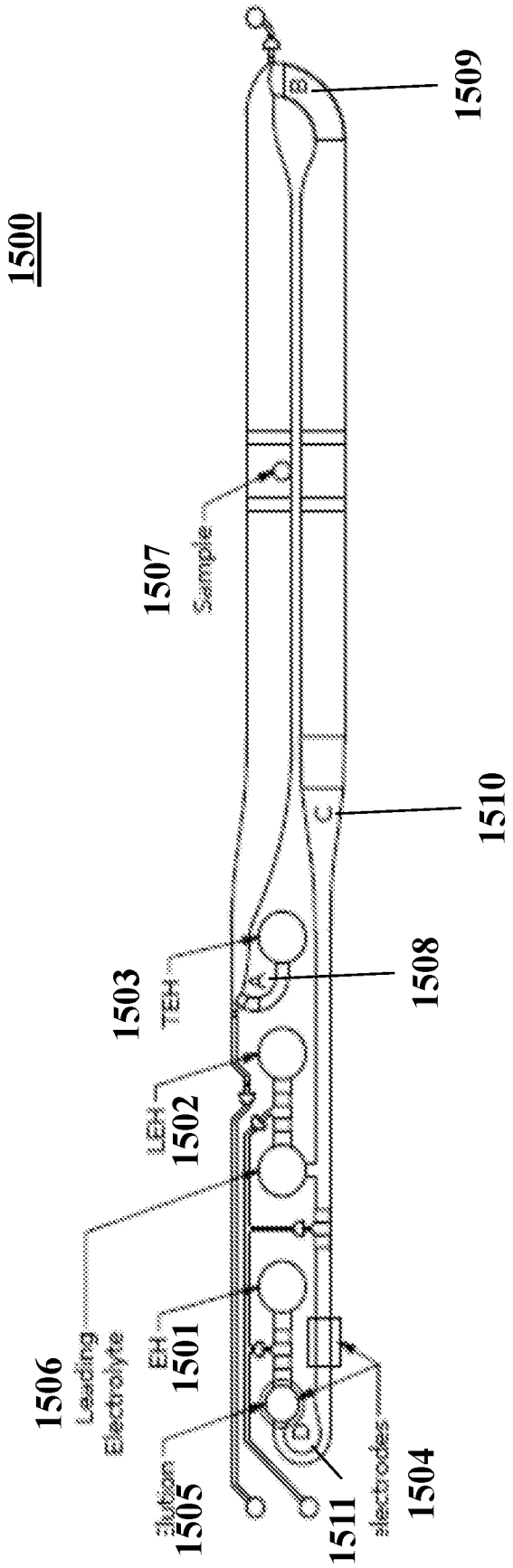

1500
1509
1507
Sample
1510
1503
TEH
1508
LEH
1502
1506
Leading
Electrolyte
EH
1501
Button
1505
1511
Electrodes
1504

FIG. 15

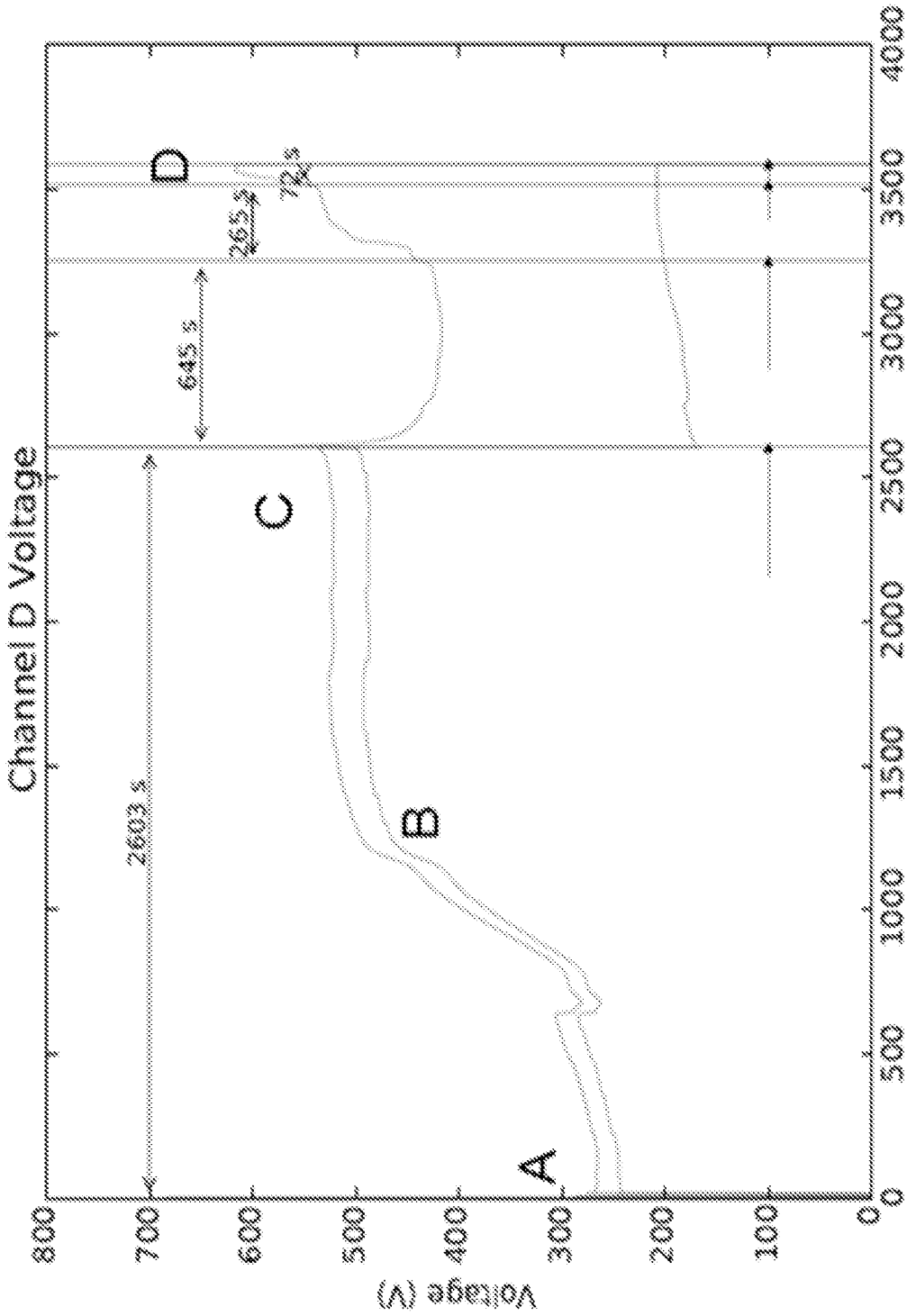

Channel D Voltage
Voltage (V)
Time (s)
A
B
C
D
2603 s
645 s
265 s
72 s
0
500
1000
1500
2000
2500
3000
3500
4000
100
200
300
400
500
600
700
800

FIG. 16

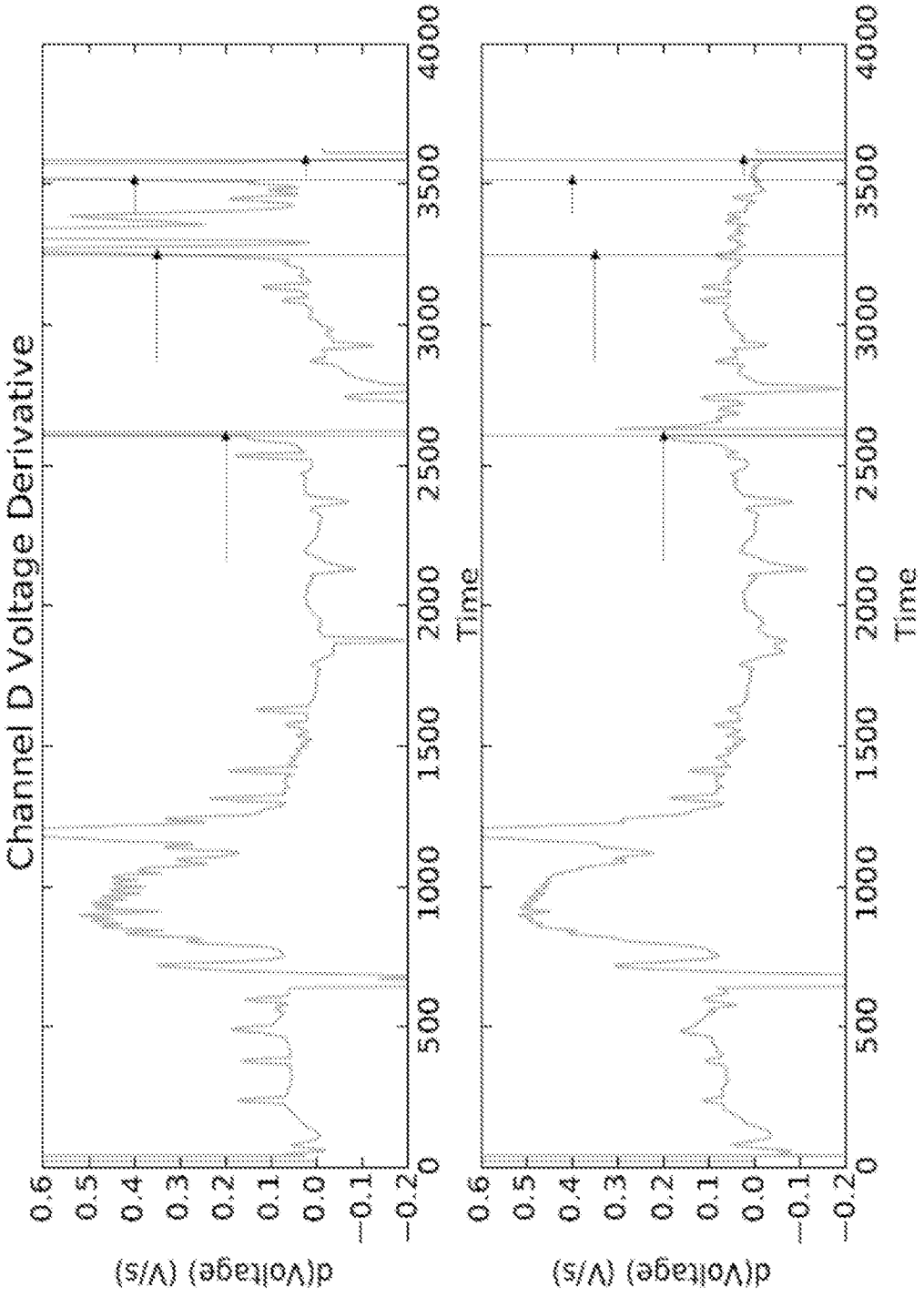

Channel D Voltage Derivative
d(Voltage) (V/s)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
0
500
1000
1500
2000
2500
3000
3500
4000
Time
d(Voltage) (V/s)
Time

FIG. 17

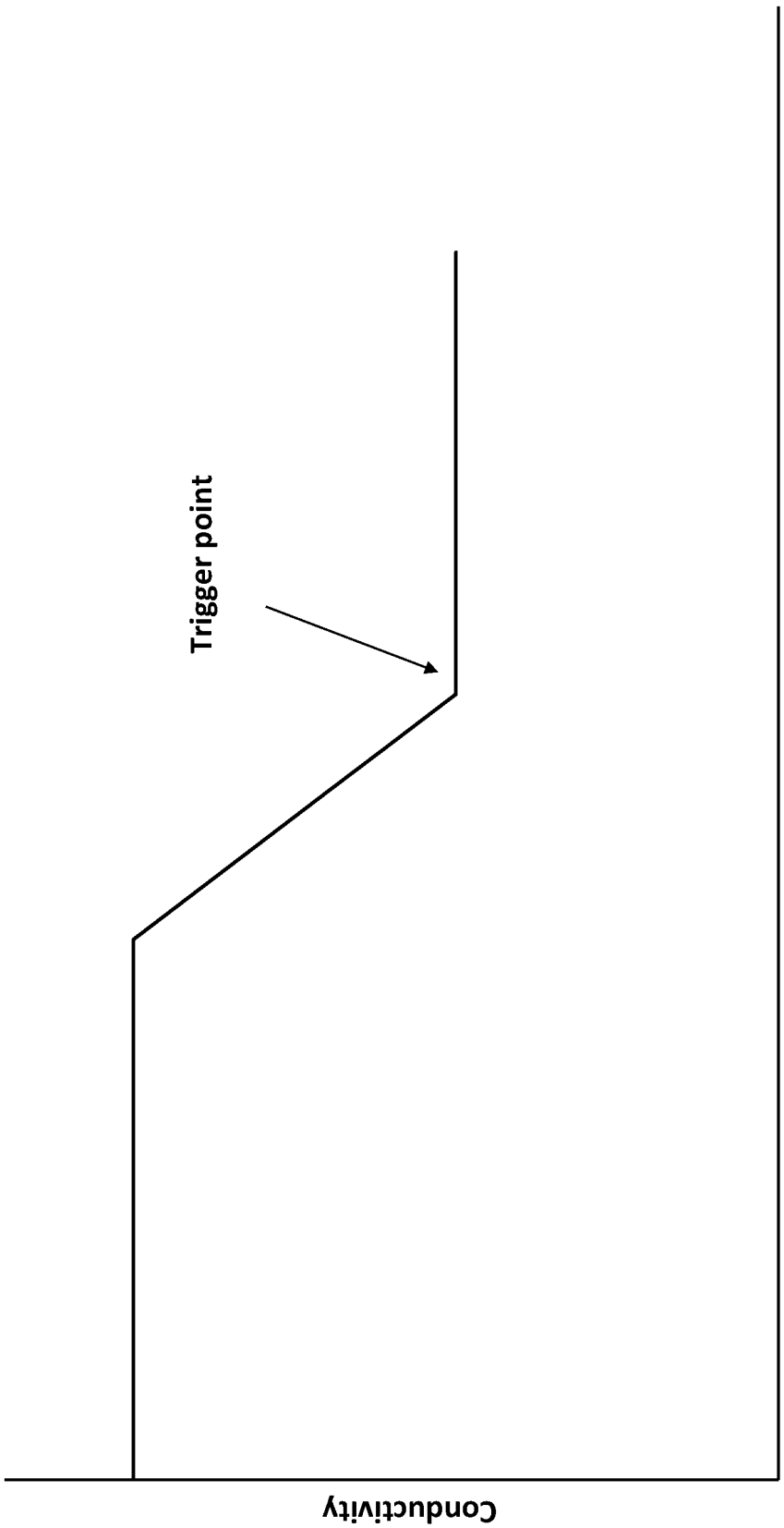


FIG. 18

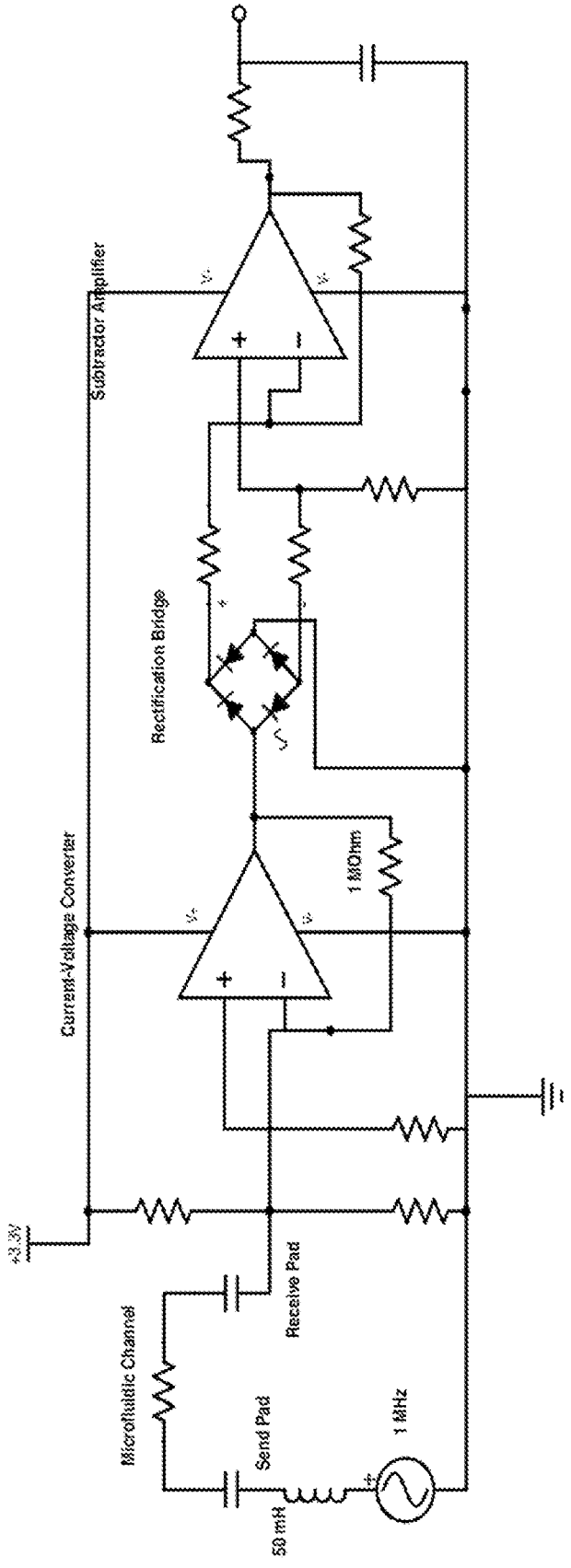

Subtractor Amplifier
Rectification Bridge
Current-Voltage Converter
1 MOhm
+3.3V
Microfluidic Channel
Receive Pad
Send Pad
1 MHz
50 mH

FIG. 19

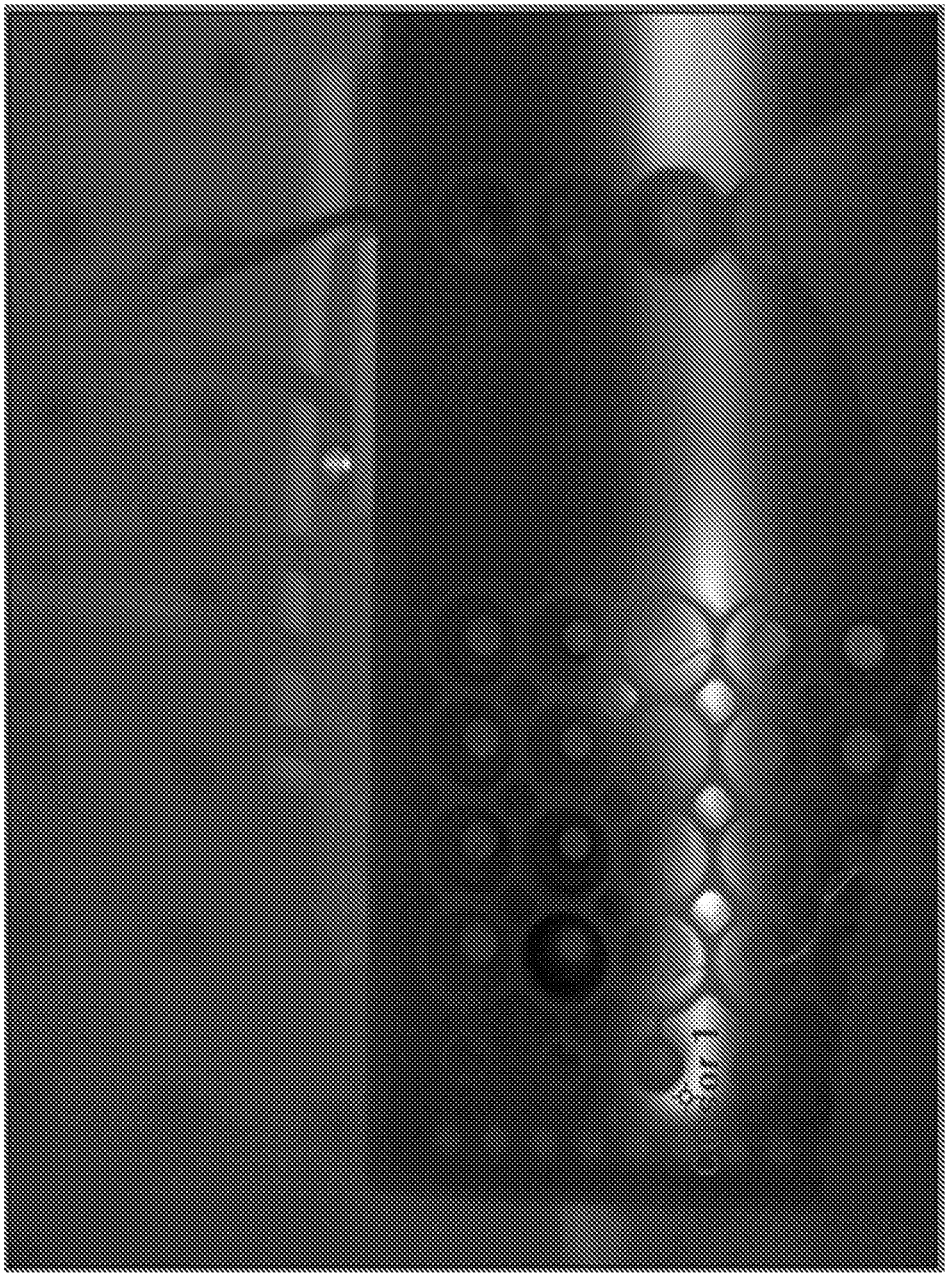


FIG. 20A

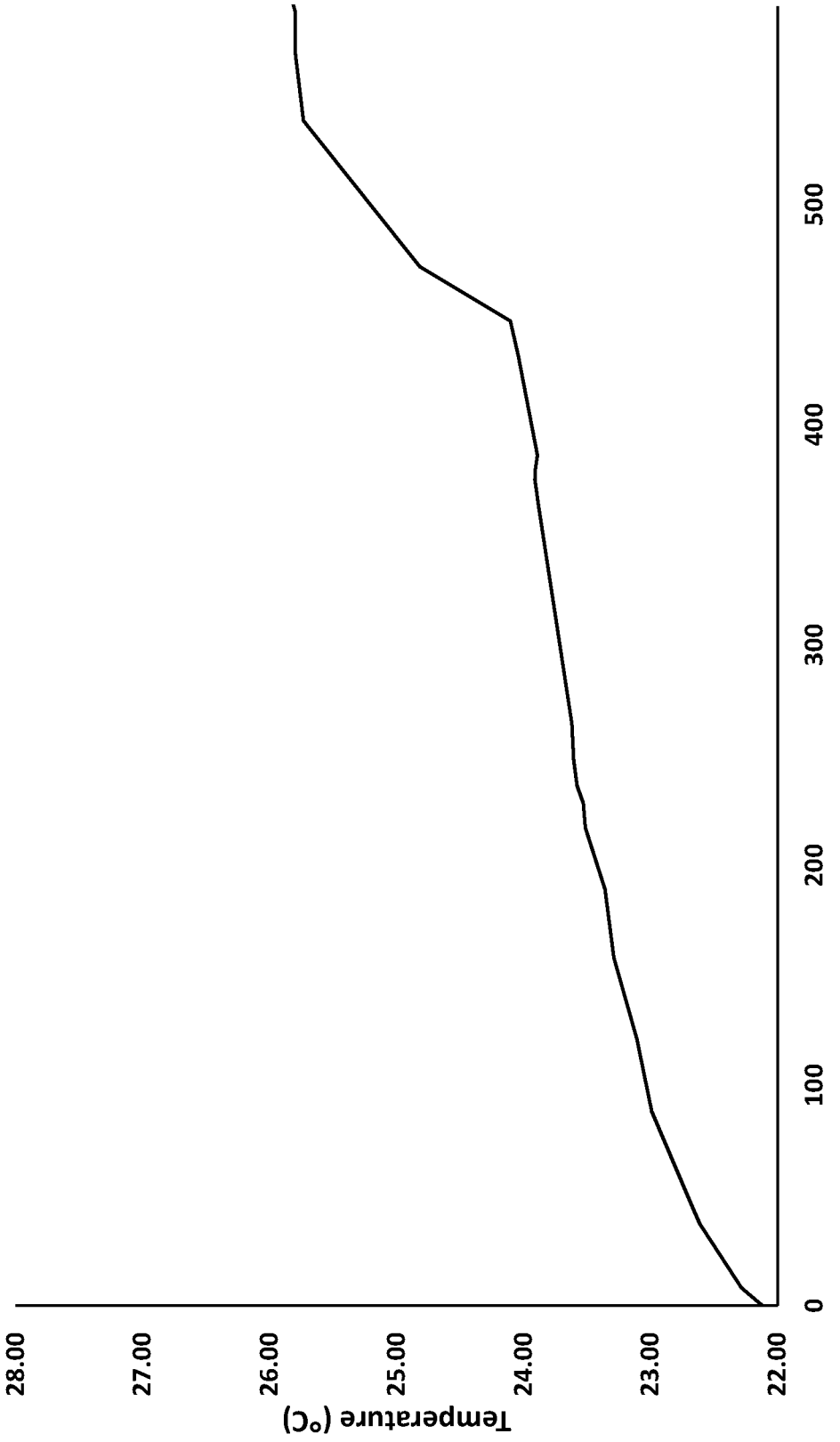

Temperature (°C)
28.00
27.00
26.00
25.00
24.00
23.00
22.00
0
100
200
300
400
500
Time (s)

FIG. 20B

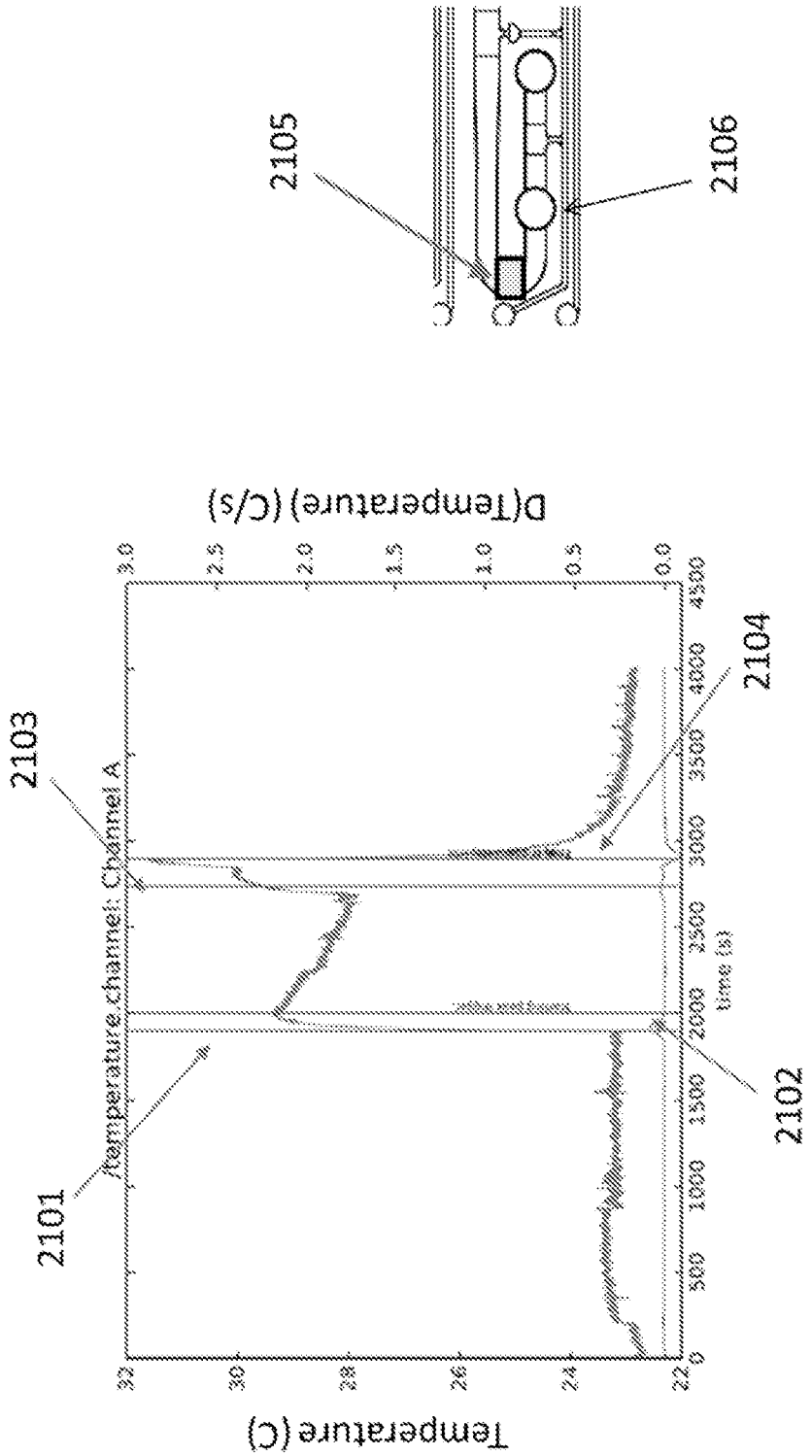

2105
2106
2103
2104
2101
2102
Temperature (C)
D(Temperature) (C/s)
Temperature channel: Channel A
time (s)

FIG. 21

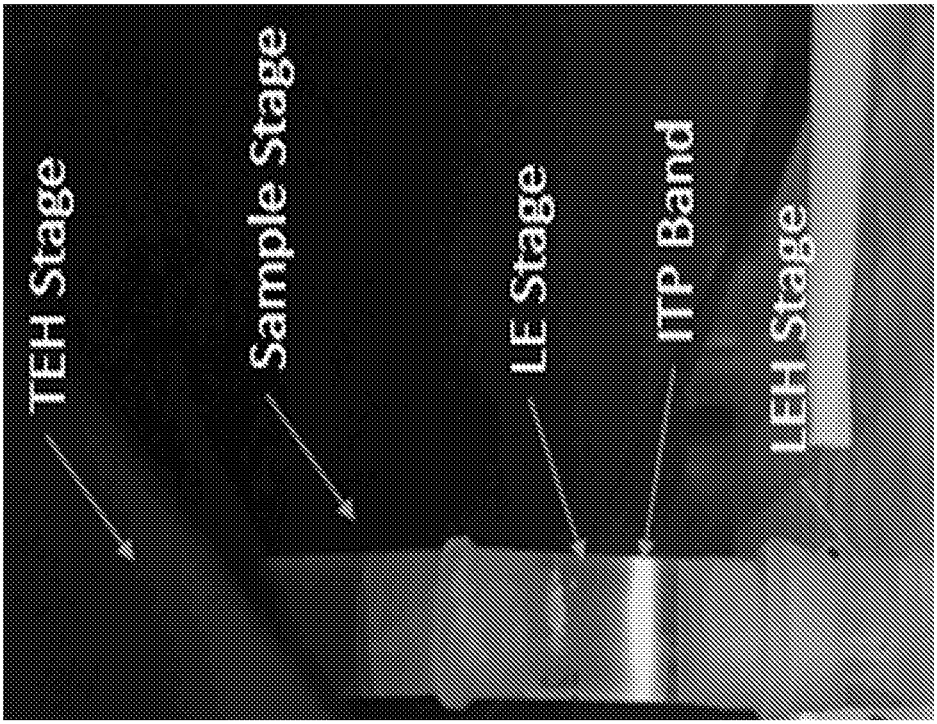


FIG. 22B

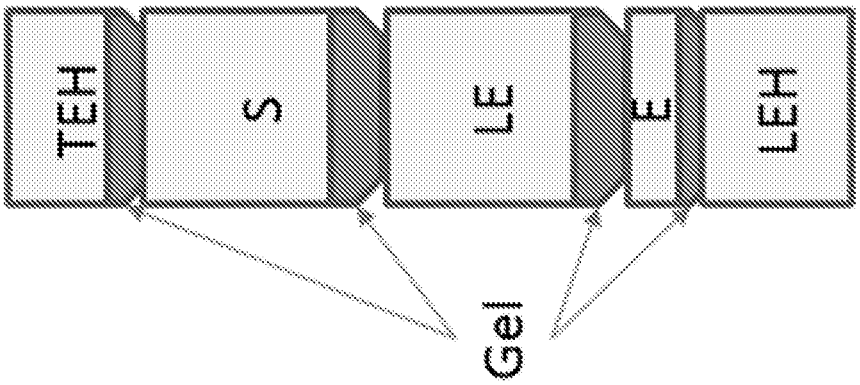


FIG. 22A

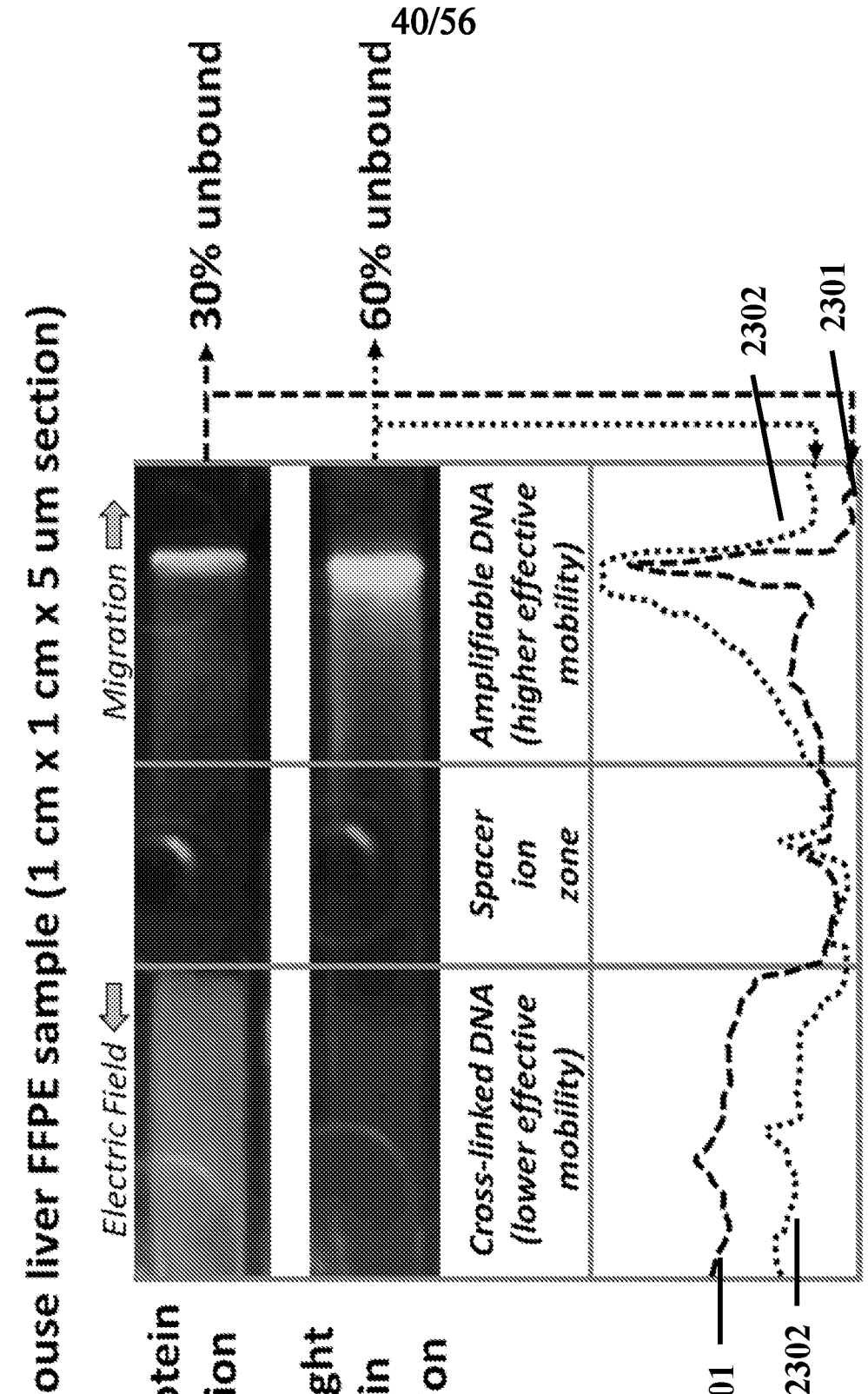

Mouse liver FFPE sample (1 cm x 1 cm x 5 um section)
Electric Field
Migration
30% unbound
60% unbound
2 hr protein digestion
Overnight protein digestion
Cross-linked DNA (lower effective mobility)
Spacer ion zone
Amplifiable DNA (higher effective mobility)
2301
2302
2302
2301

FIG. 23

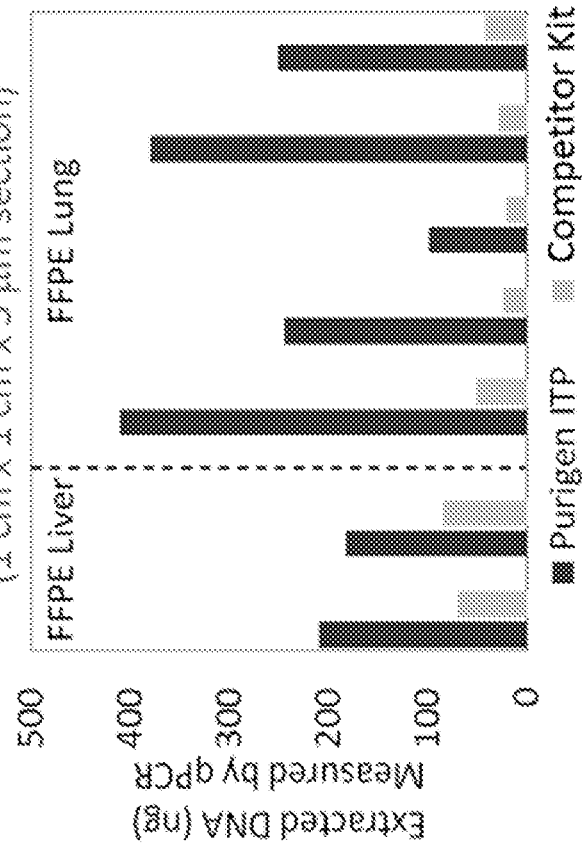


FIG. 24B

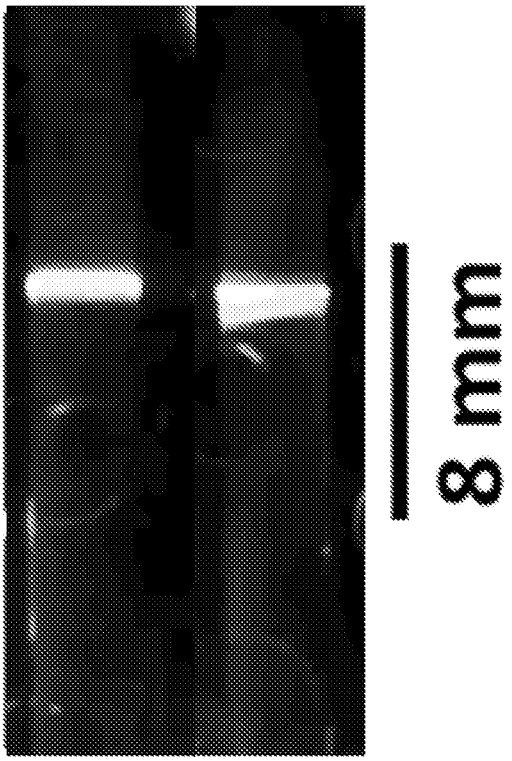


FIG. 24A

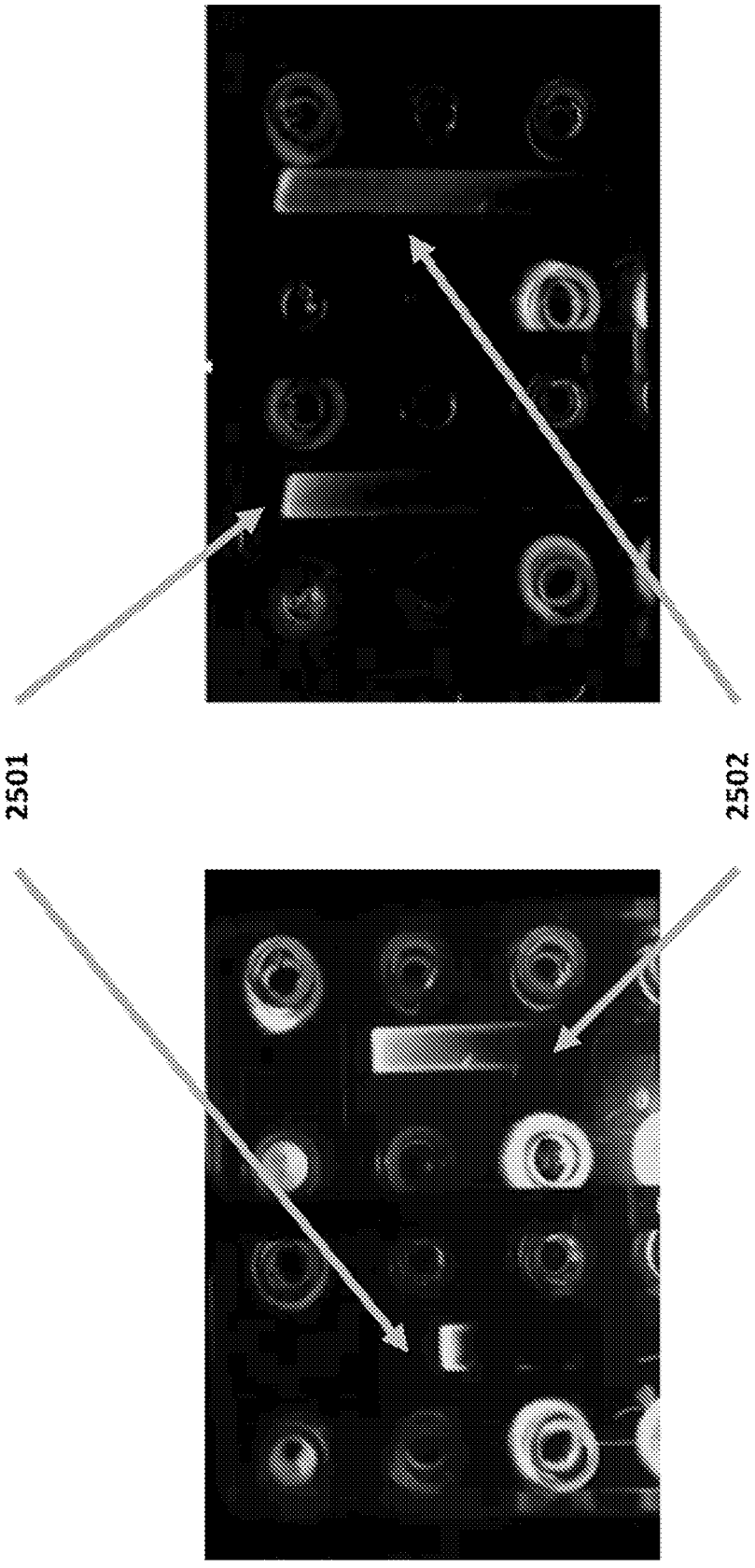


FIG. 25B

FIG. 25A

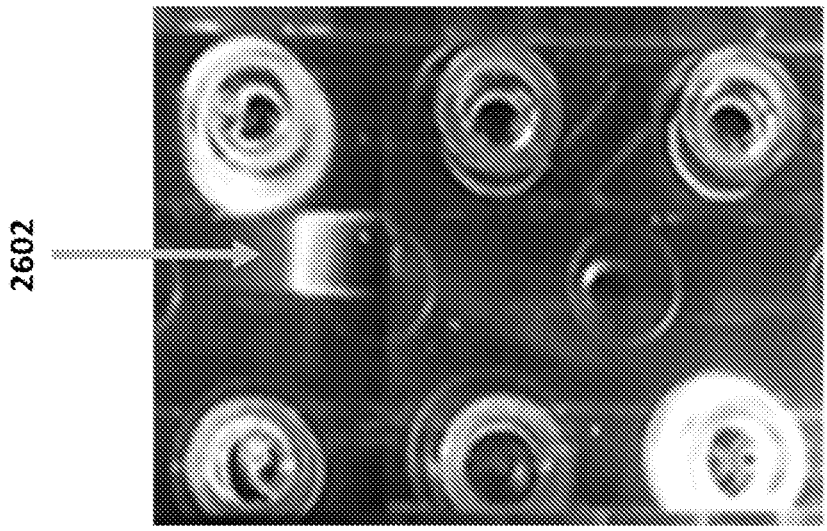


FIG. 26B

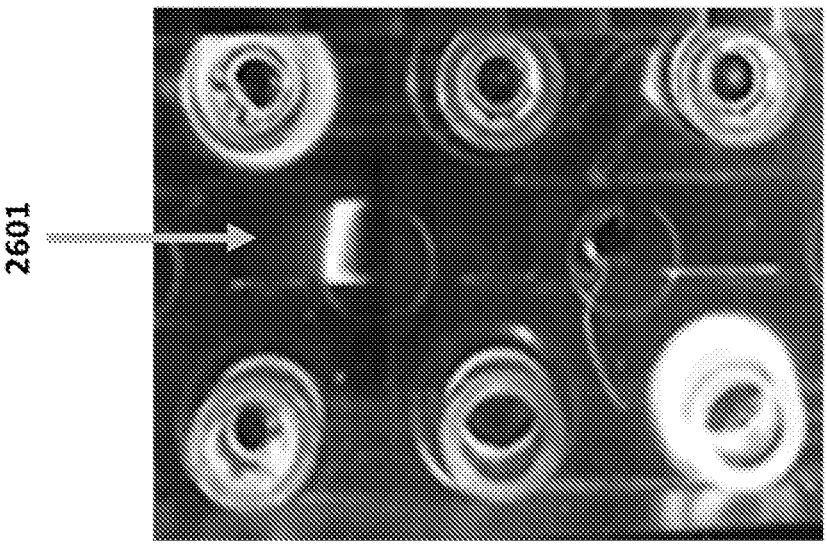


FIG. 26A

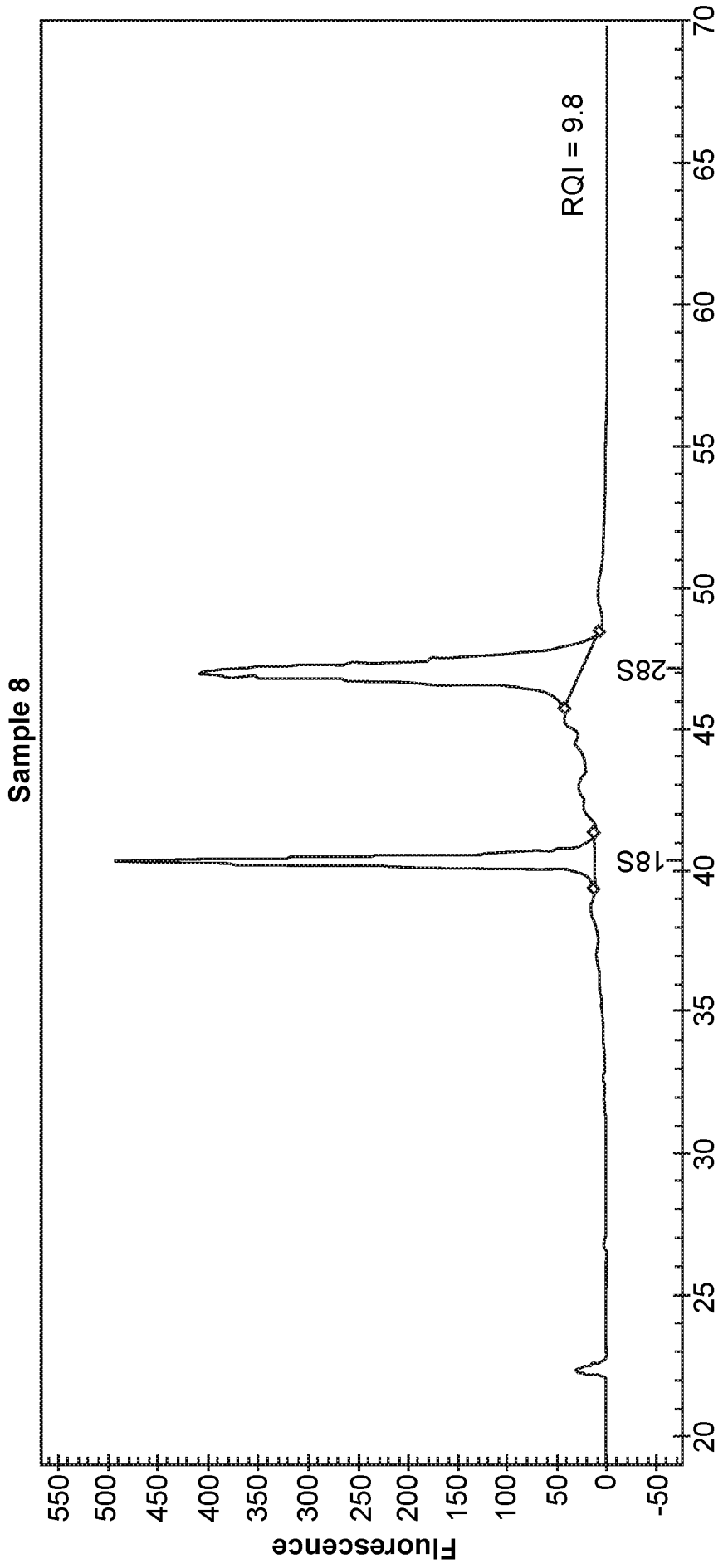

Sample 8
RQI = 9.8
18S
28S
Fluorescence
Time (seconds)
550
500
450
400
350
300
250
200
150
100
50
0
-50
20
25
30
35
40
45
50
55
60
65
70

FIG. 26C

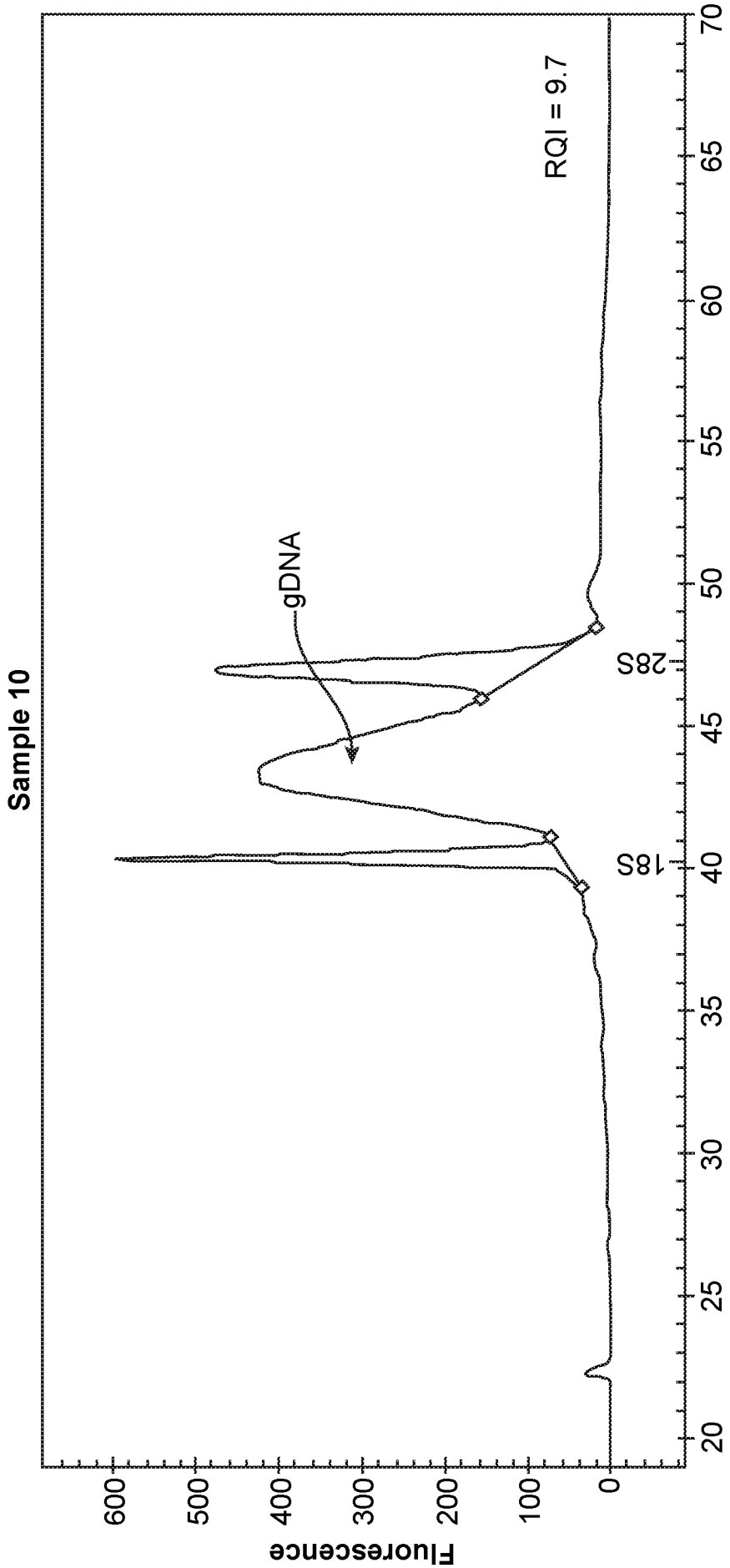

Sample 10
RQI = 9.7
gDNA
18S
28S
Fluorescence
Time (seconds)
0
100
200
300
400
500
600
20
25
30
35
40
45
50
55
60
65
70

FIG. 26D

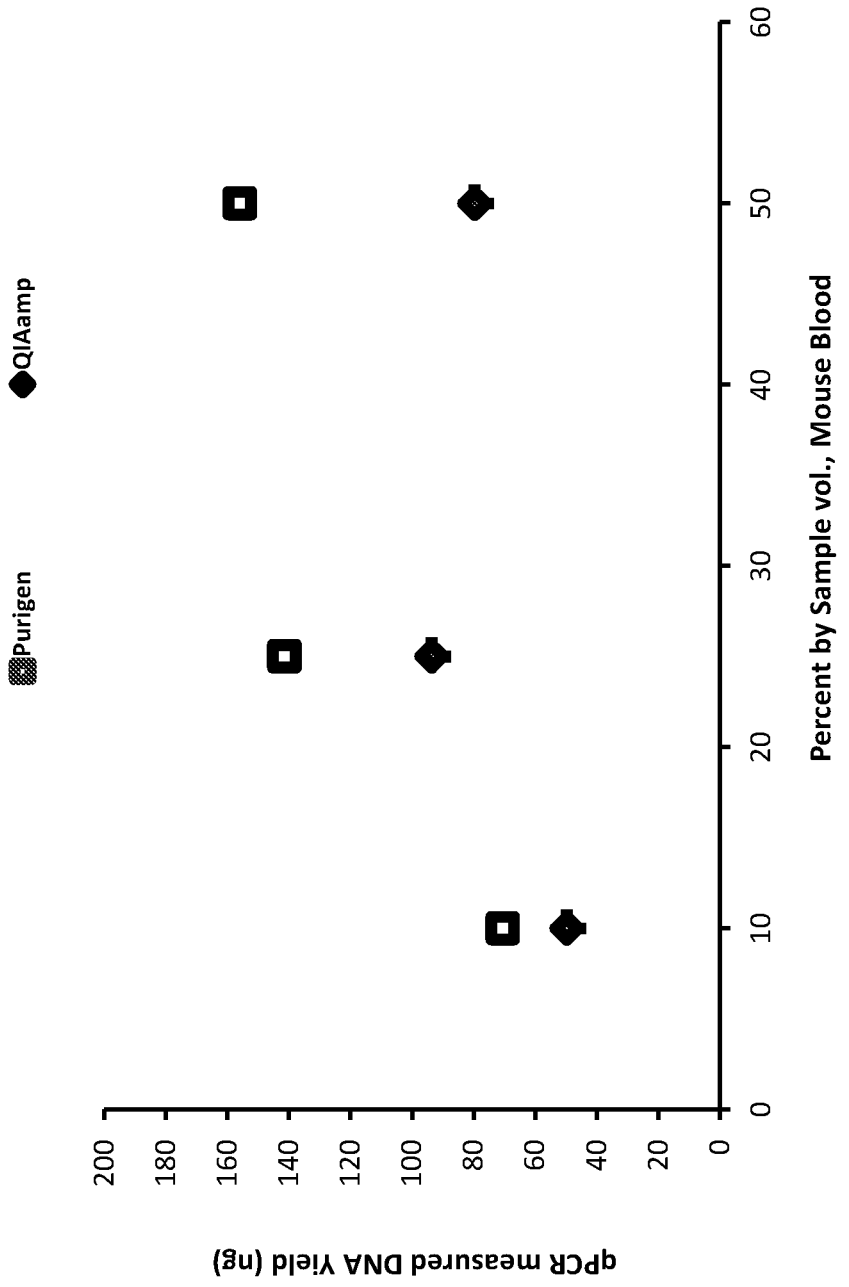

qPCR measured DNA Yield (ng)
200
180
160
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
Percent by Sample vol., Mouse Blood
Purigen
QIAamp

FIG. 27A

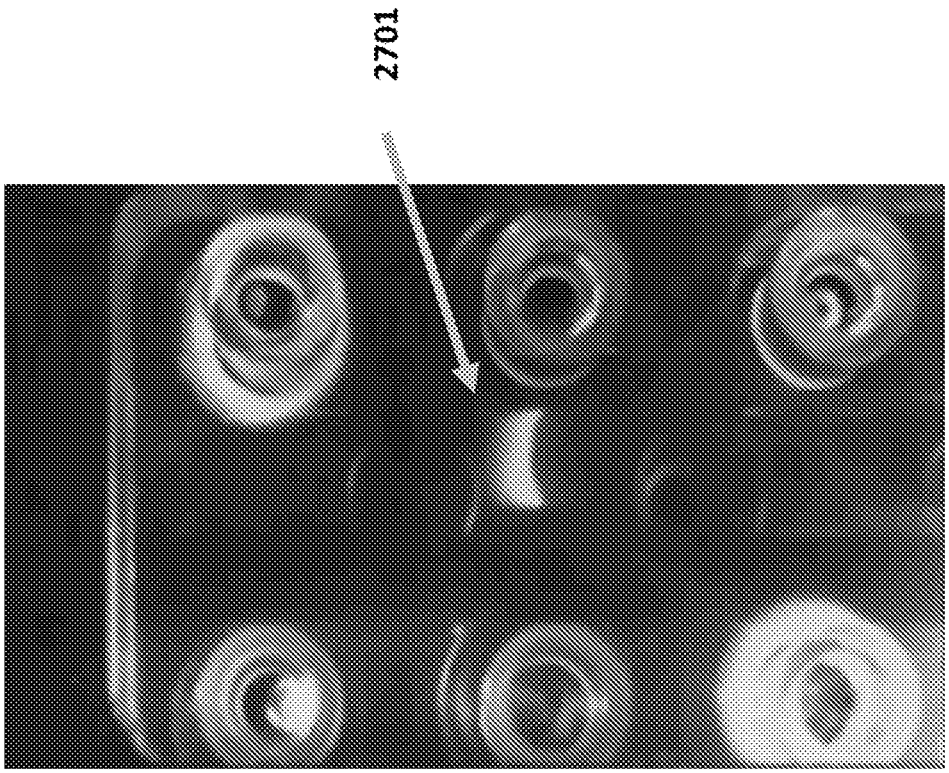


FIG. 27B

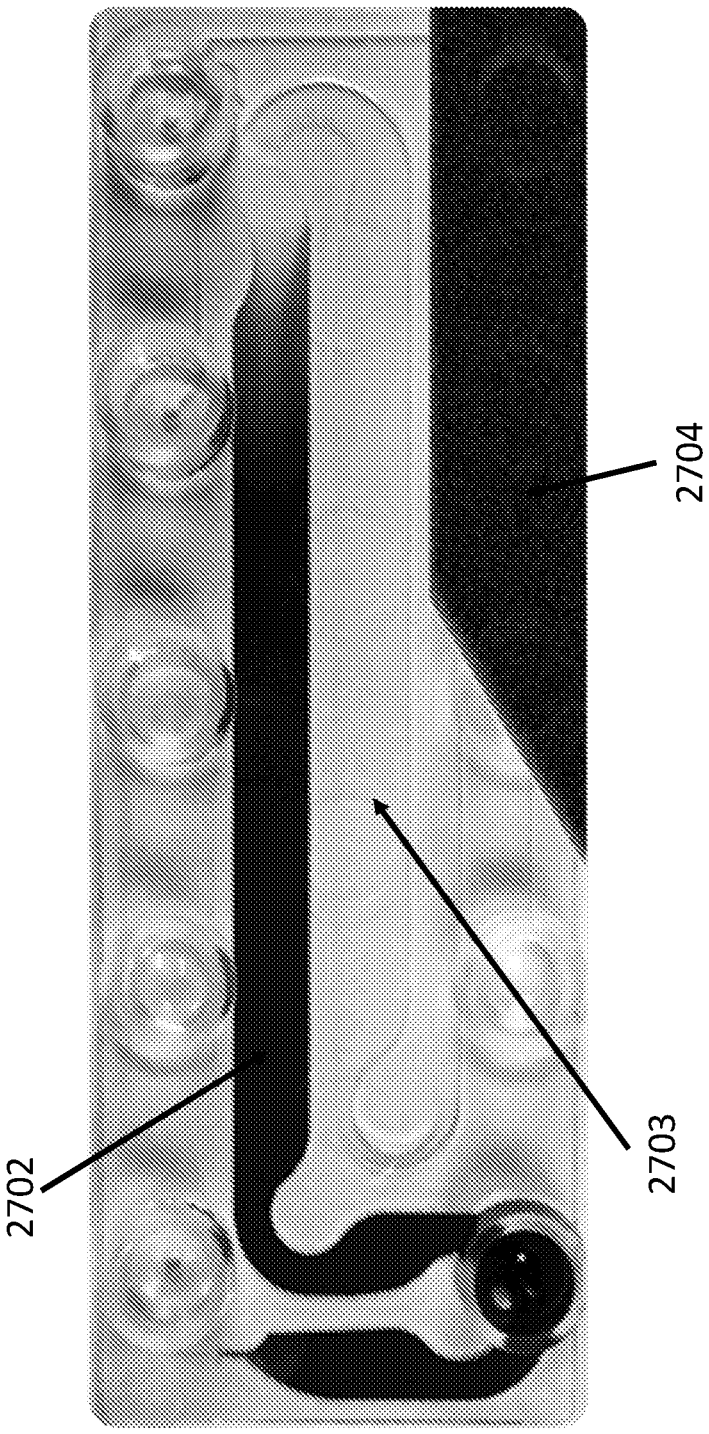


FIG. 27C

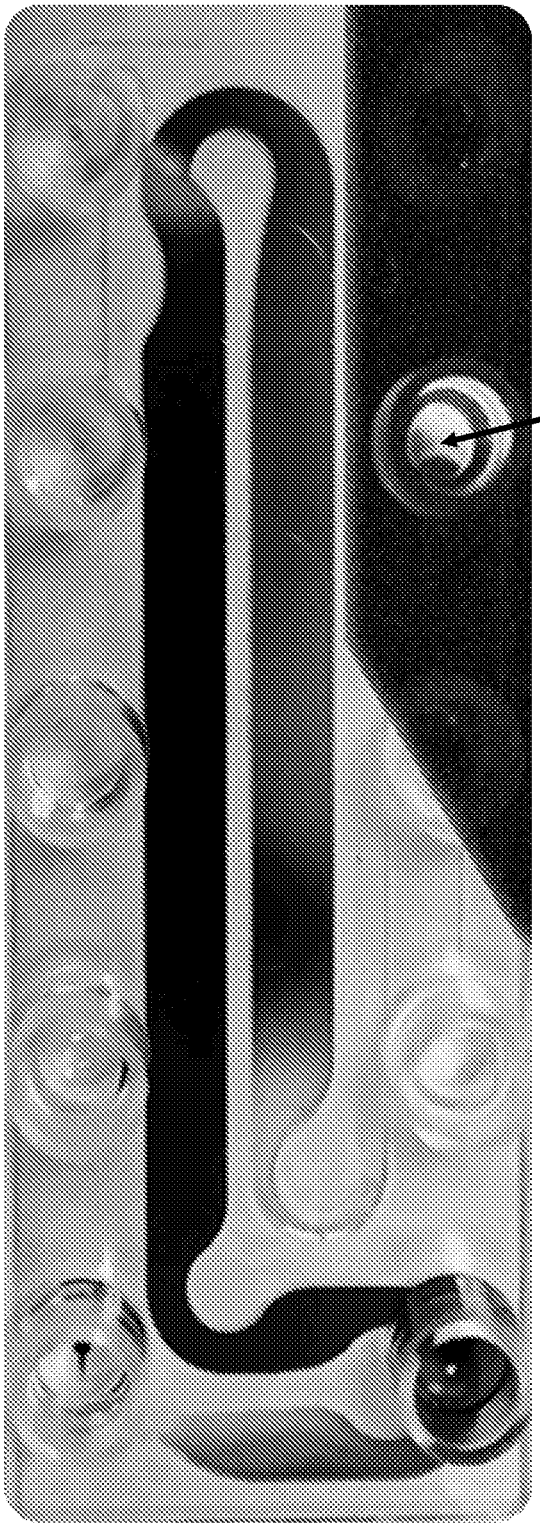


FIG. 27D

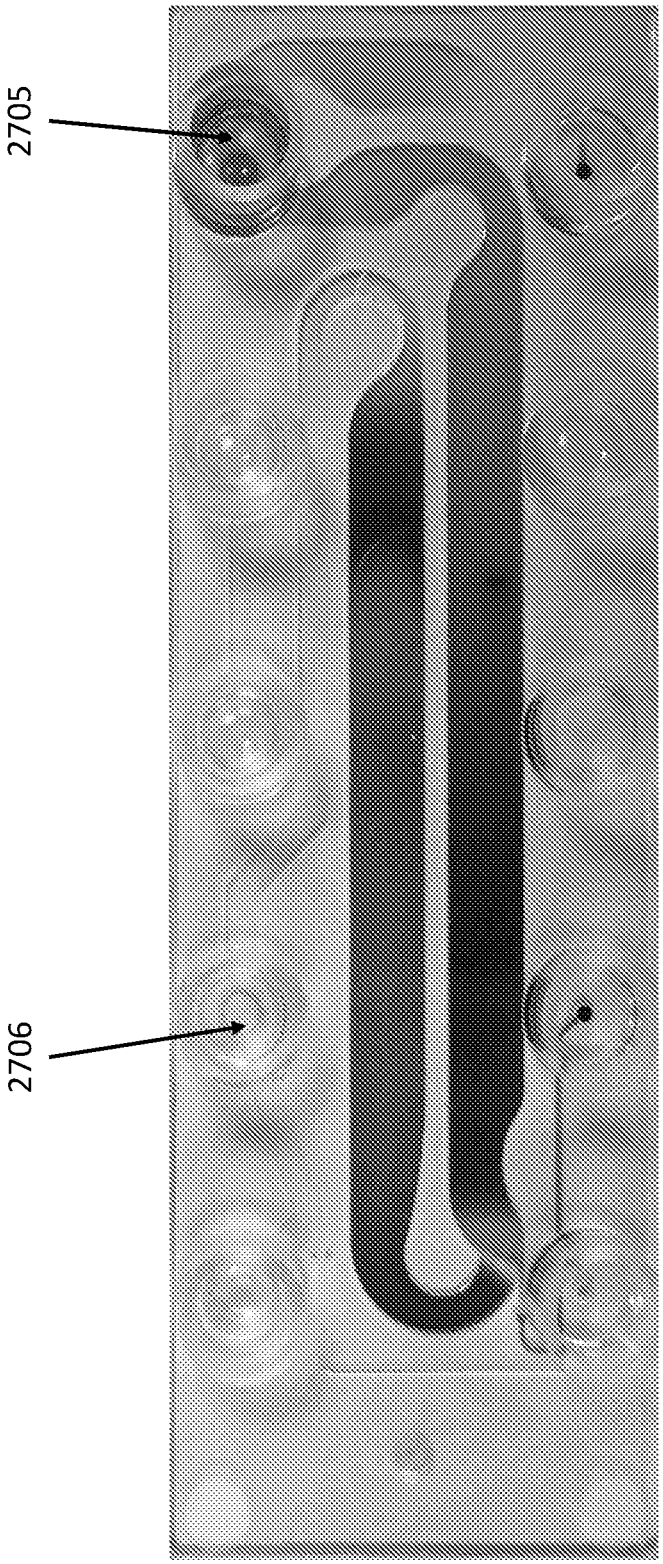


FIG. 27E

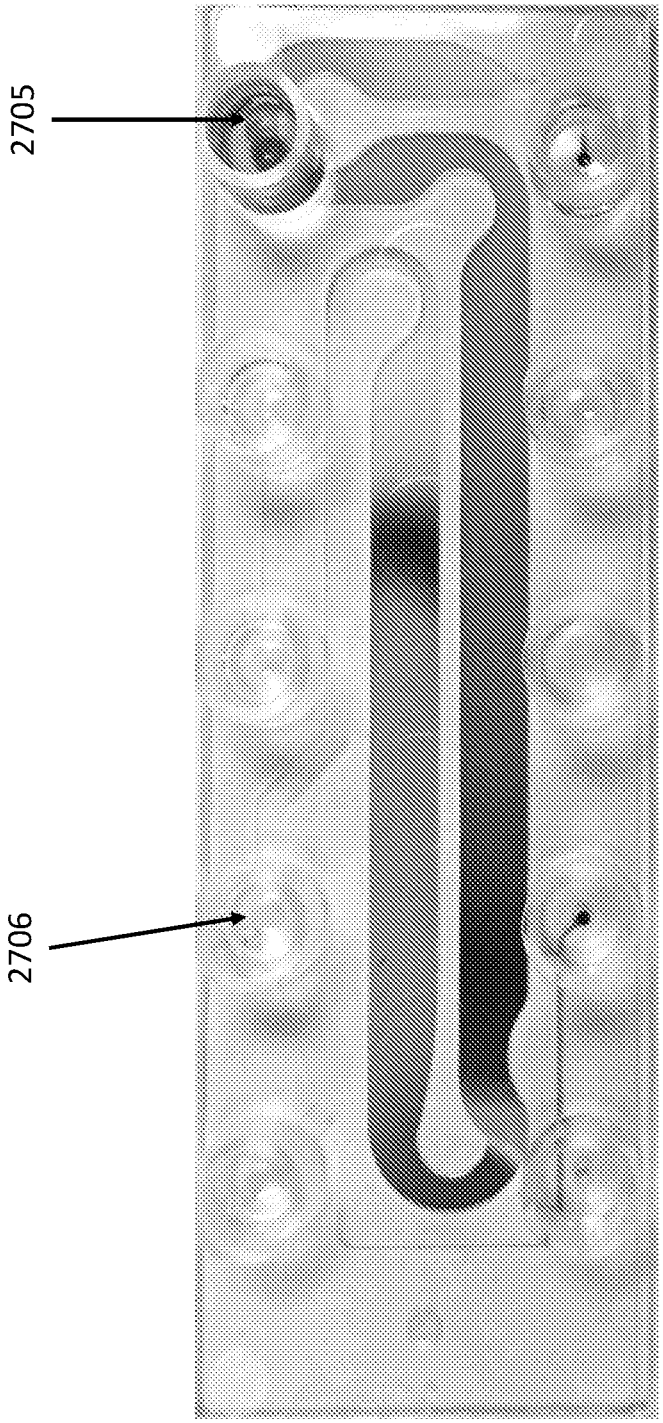


FIG. 27F

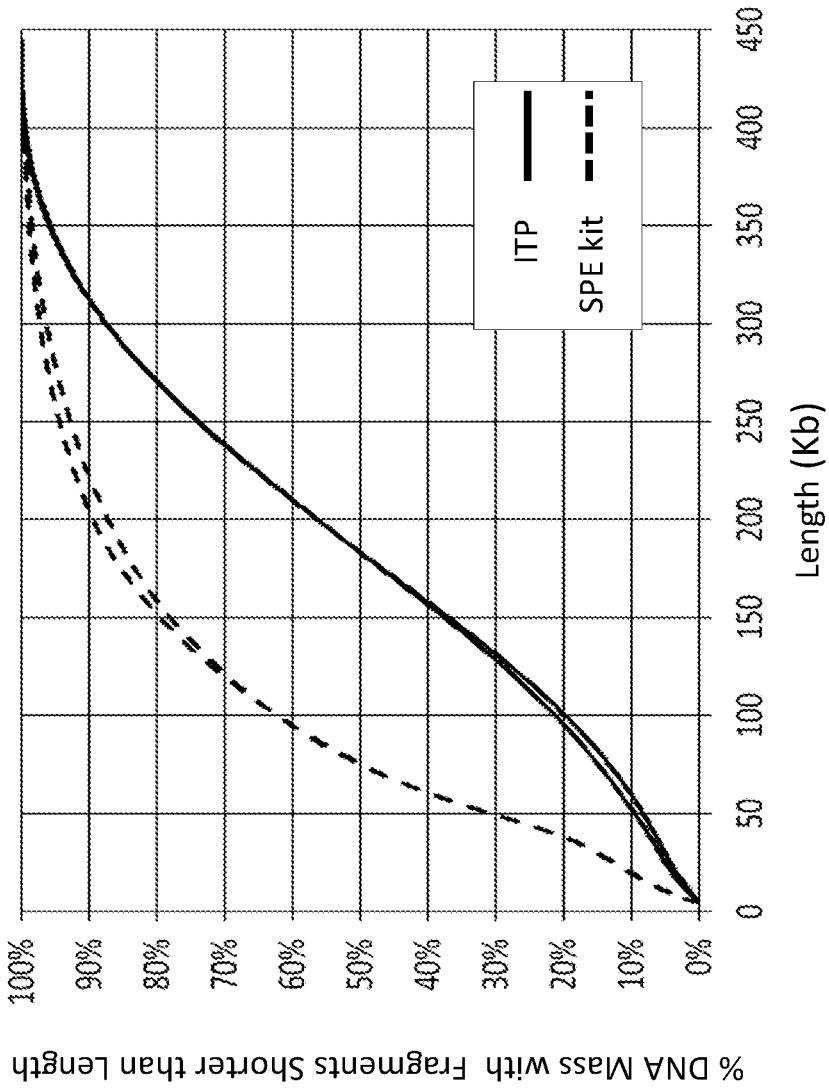

% DNA Mass with Fragments Shorter than Length
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
50
100
150
200
250
300
350
400
450
Length (Kb)
ITP
SPE kit

FIG. 28

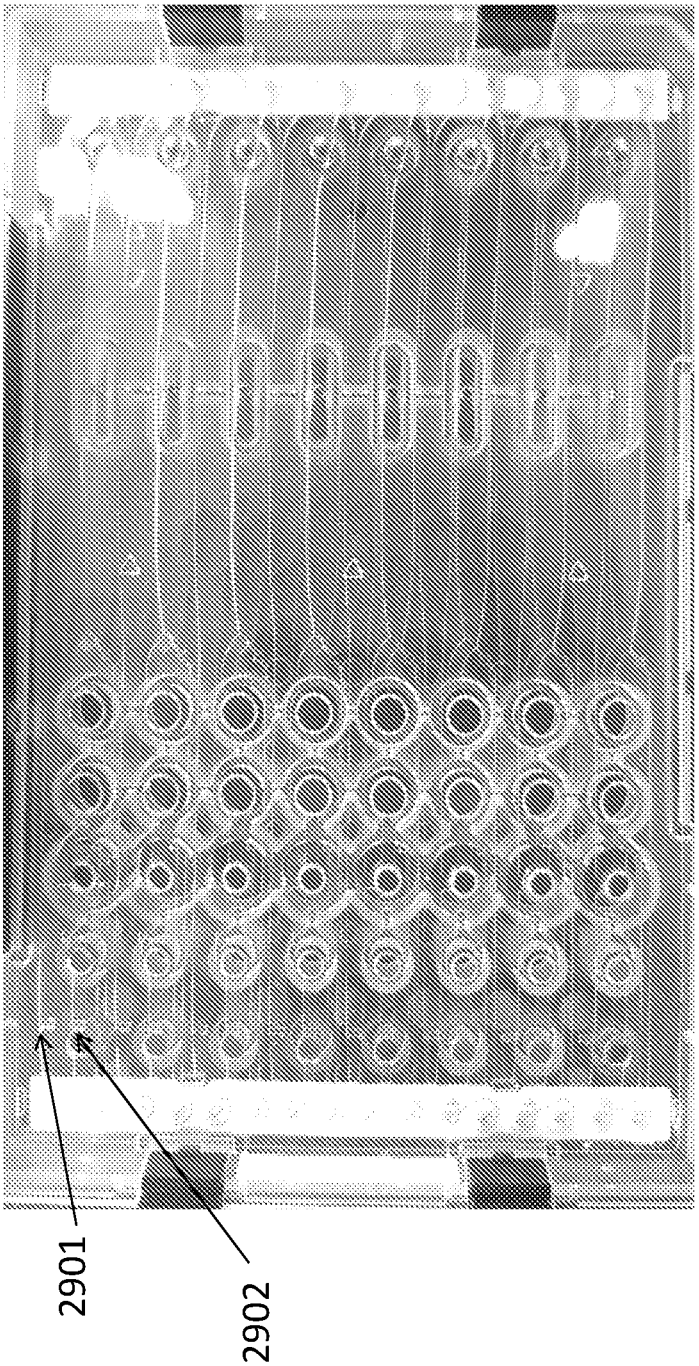


FIG. 29A

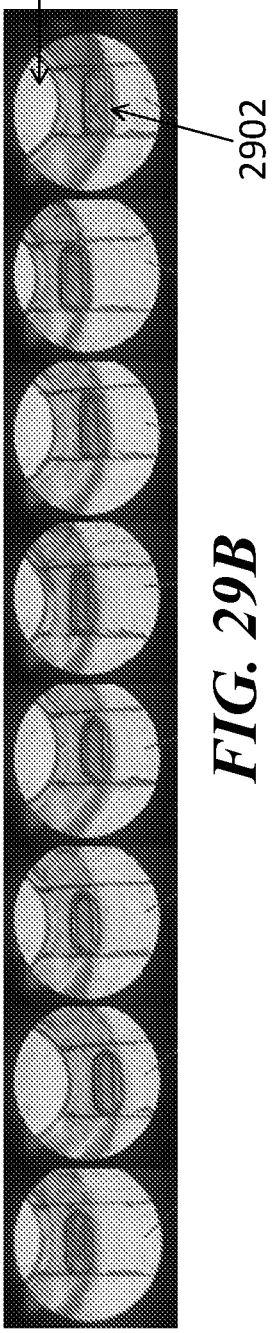


FIG. 29B

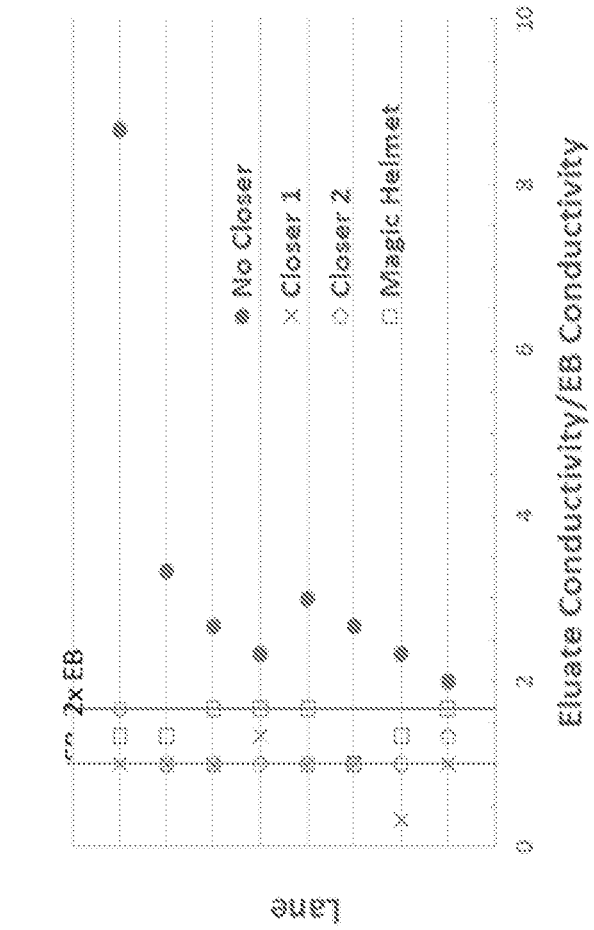


FIG. 29D

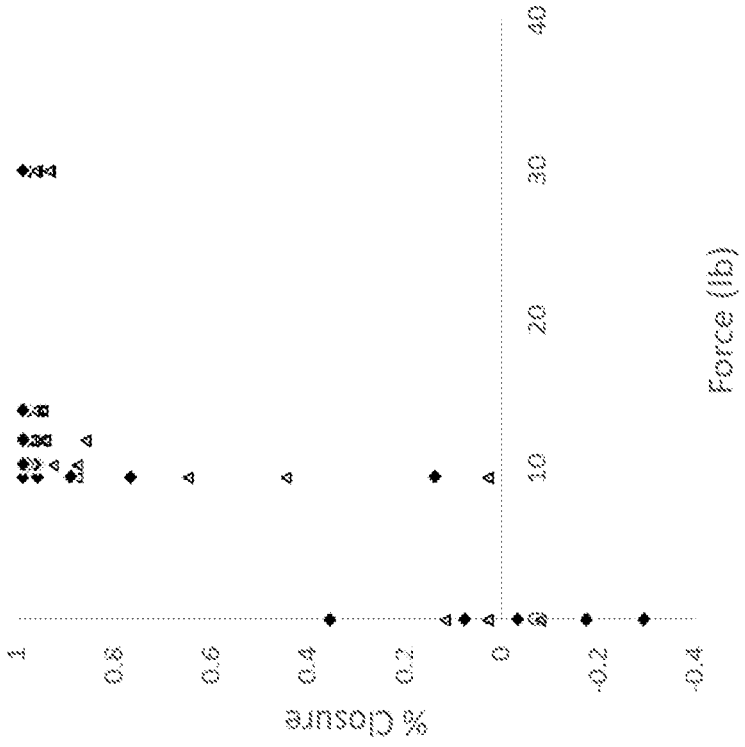


FIG. 29C

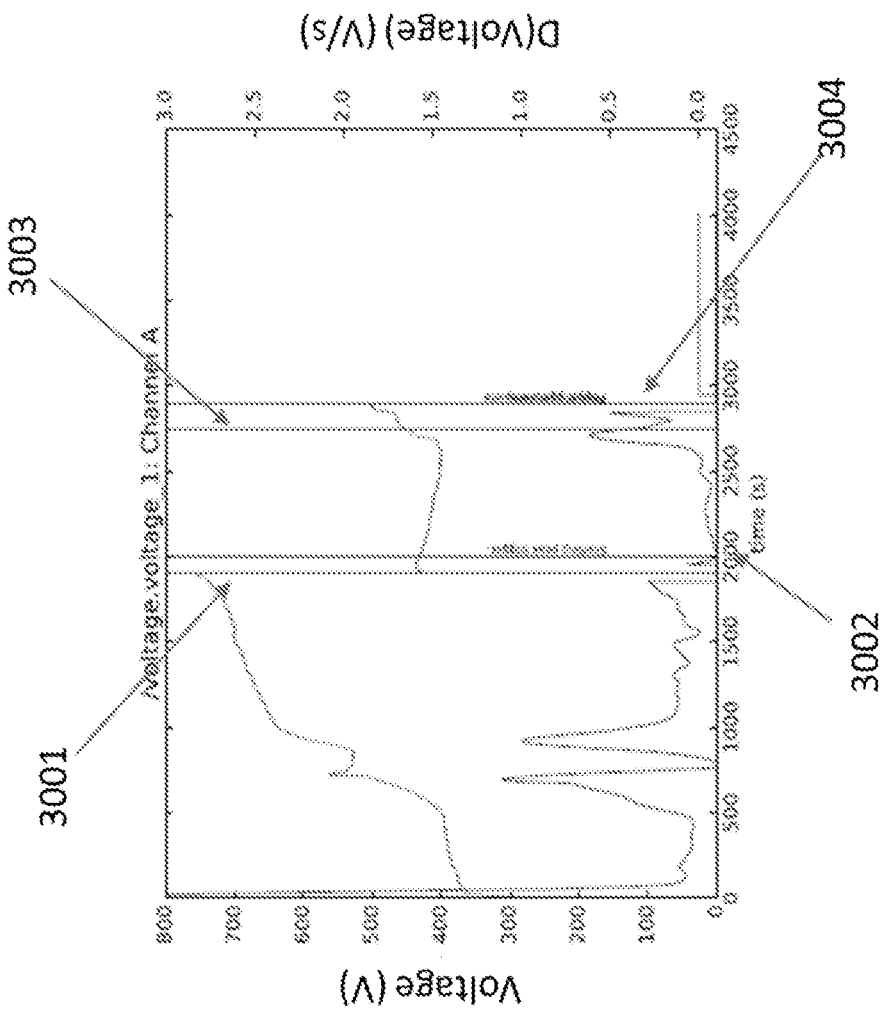

D(Voltage) (V/s)
Voltage (V)
Time (s)
Voltage.voltage_1: Channel A
3001
3002
3003
3004

FIG. 30

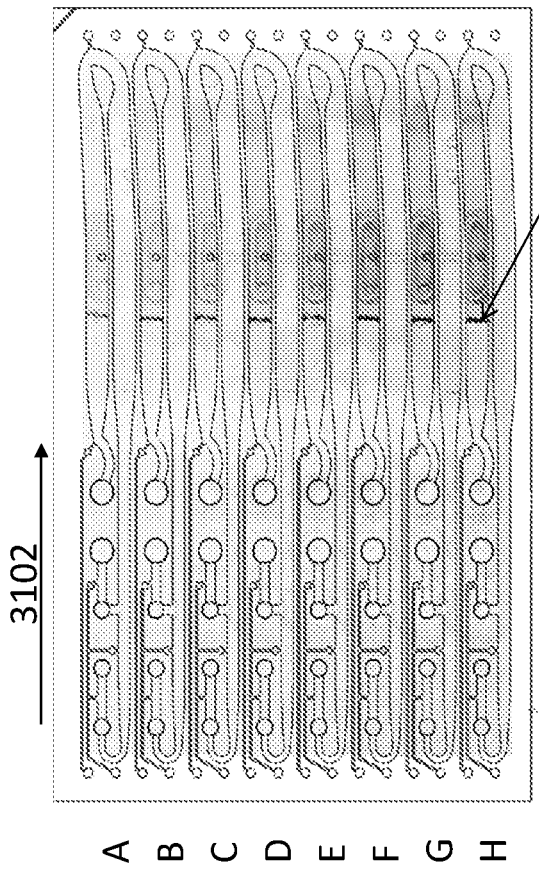


FIG. 31A

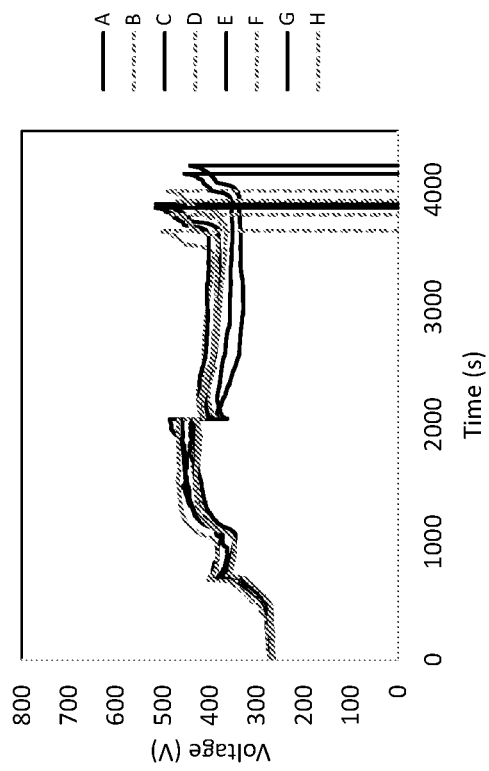


FIG. 31B

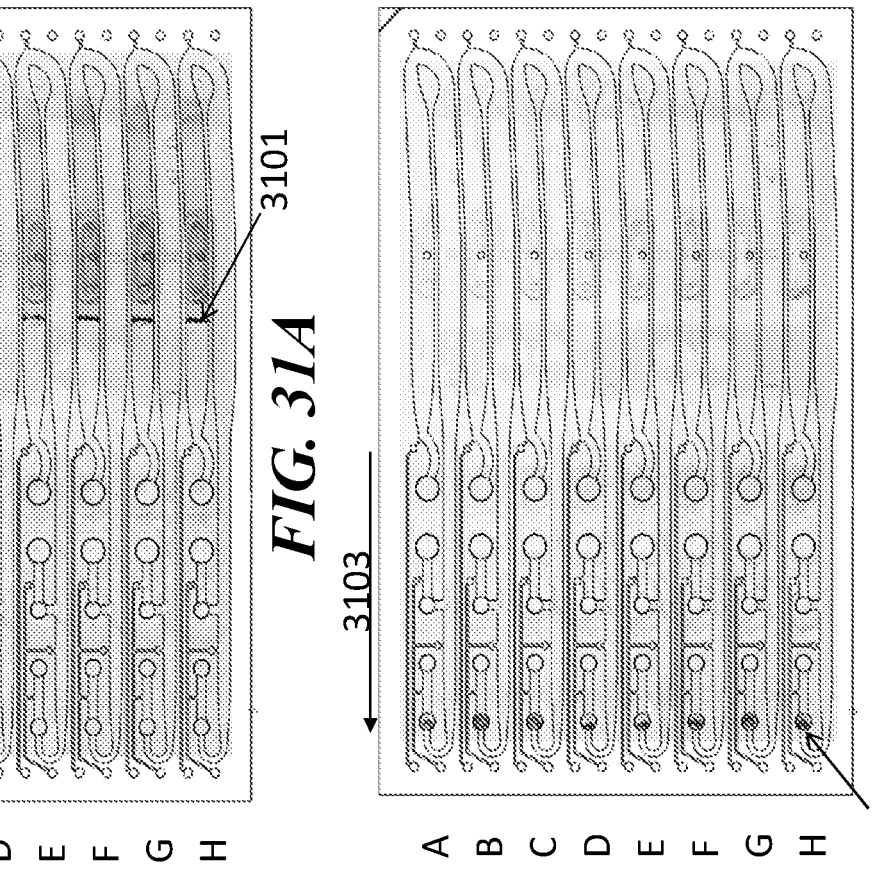


FIG. 31C

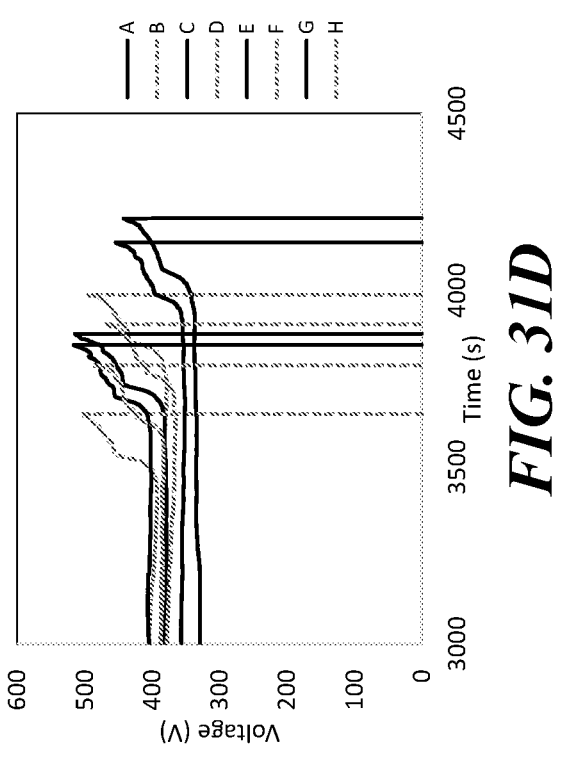


FIG. 31D