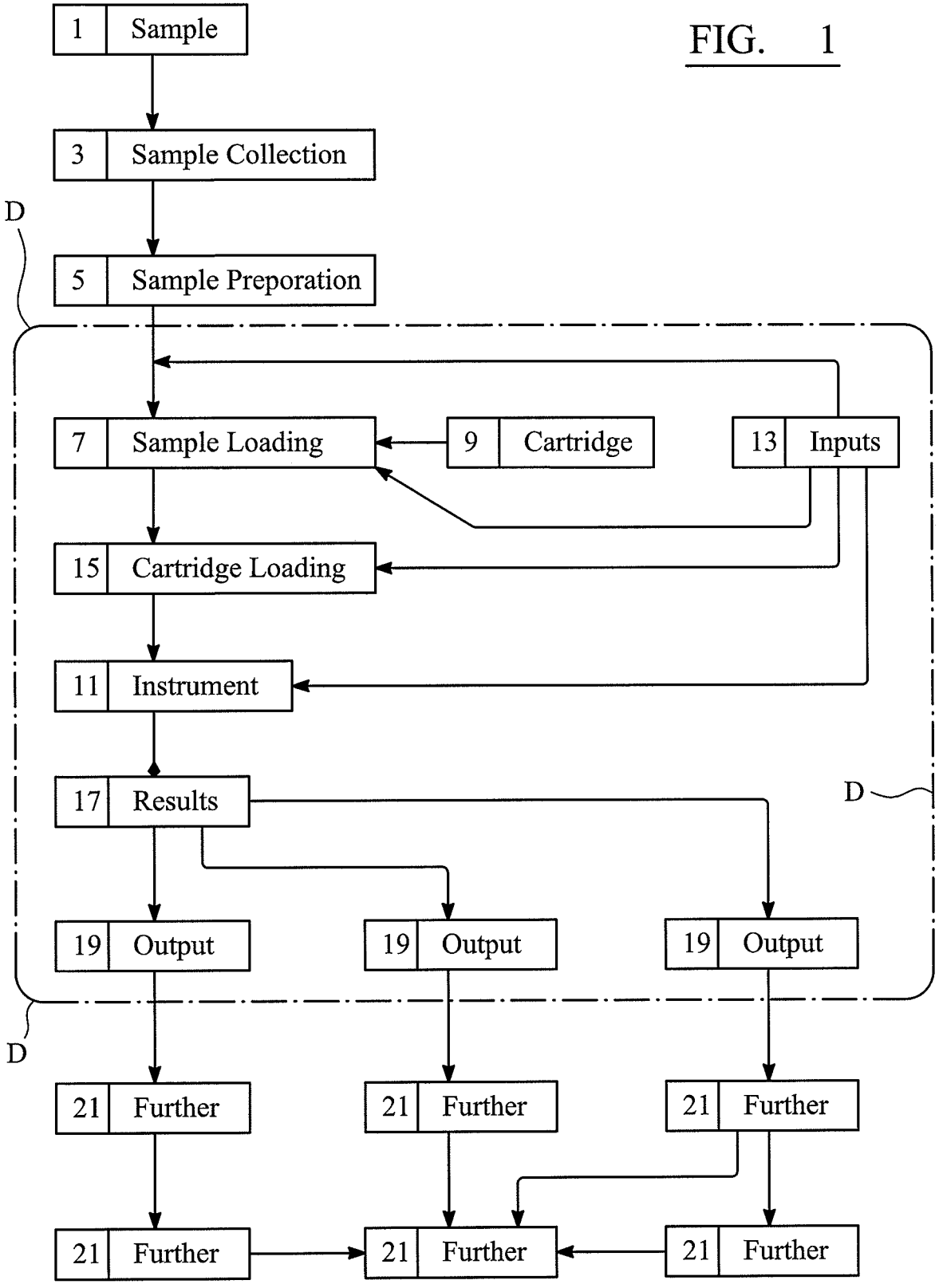
FIG. 1


1 Sample
3 Sample Collection
D
5 Sample Preporation
7 Sample Loading
9 Cartridge
13 Inputs
15 Cartridge Loading
11 Instrument
17 Results
D
19 Output
19 Output
19 Output
D
21 Further
21 Further
21 Further
21 Further
21 Further
21 Further

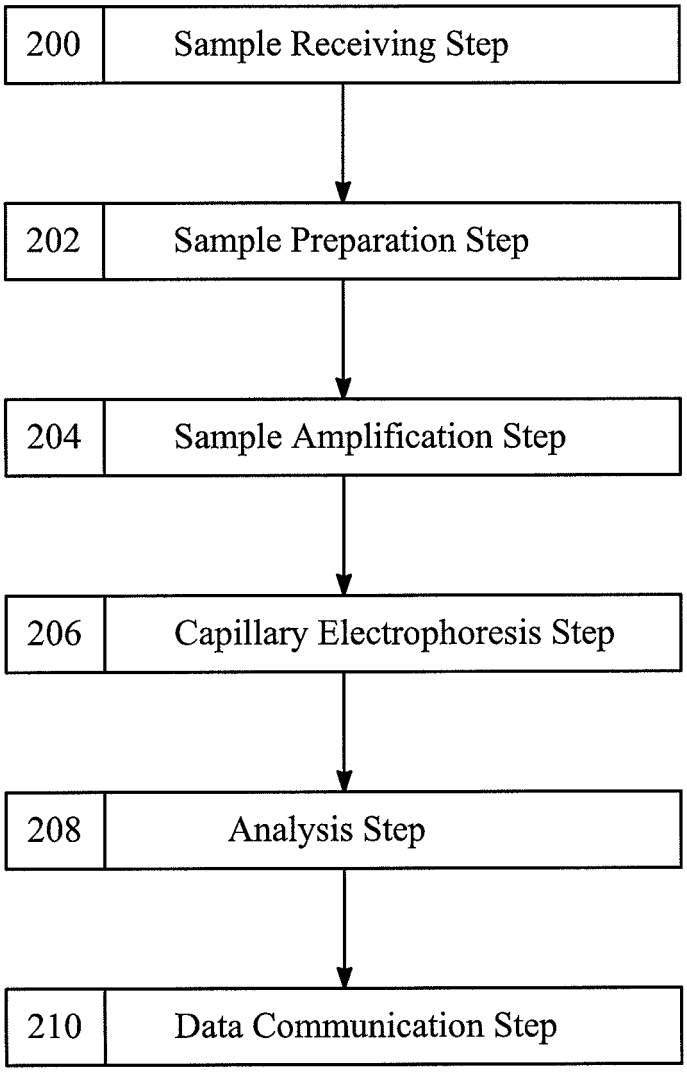

200
Sample Receiving Step
202
Sample Preparation Step
204
Sample Amplification Step
206
Capillary Electrophoresis Step
208
Analysis Step
210
Data Communication Step

FIG. 2

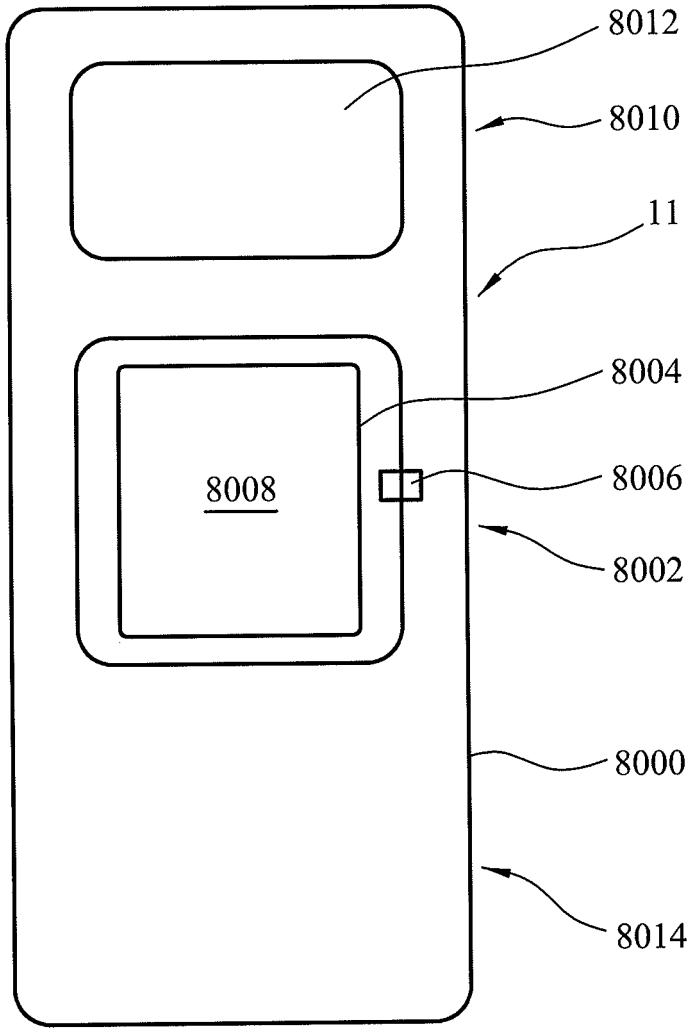


FIG. 3

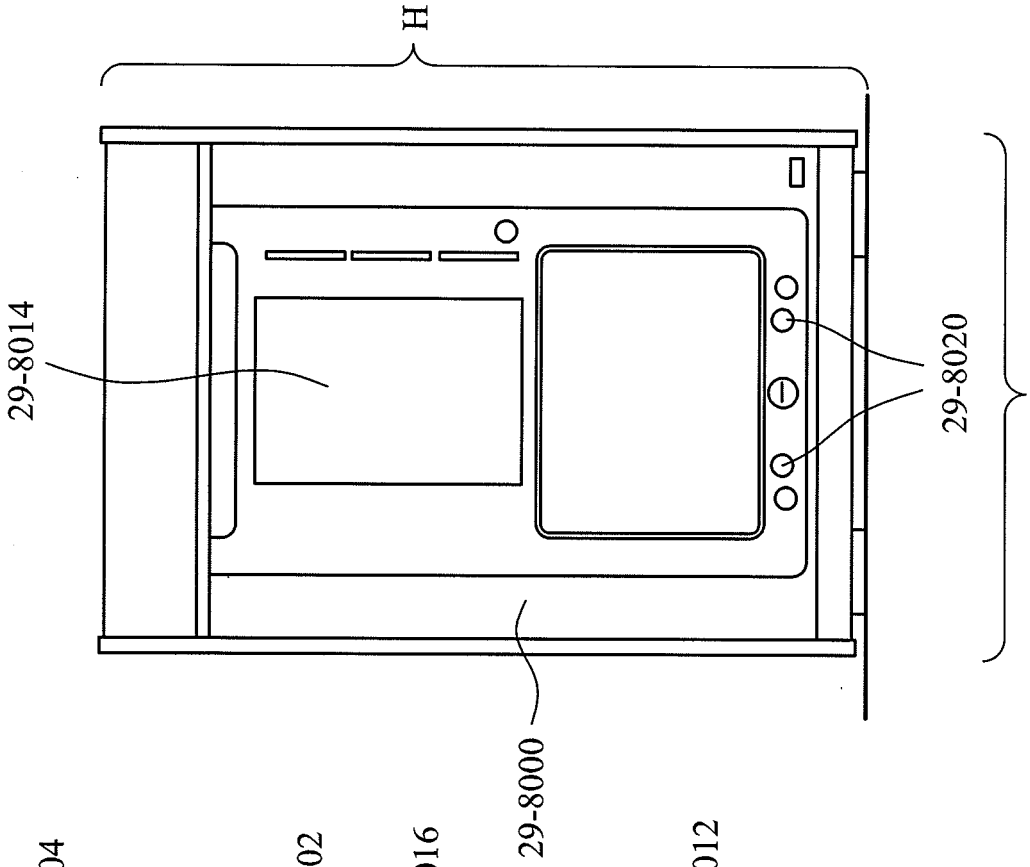

H
29-8014
29-8020
W
29-8000

FIG. 4b

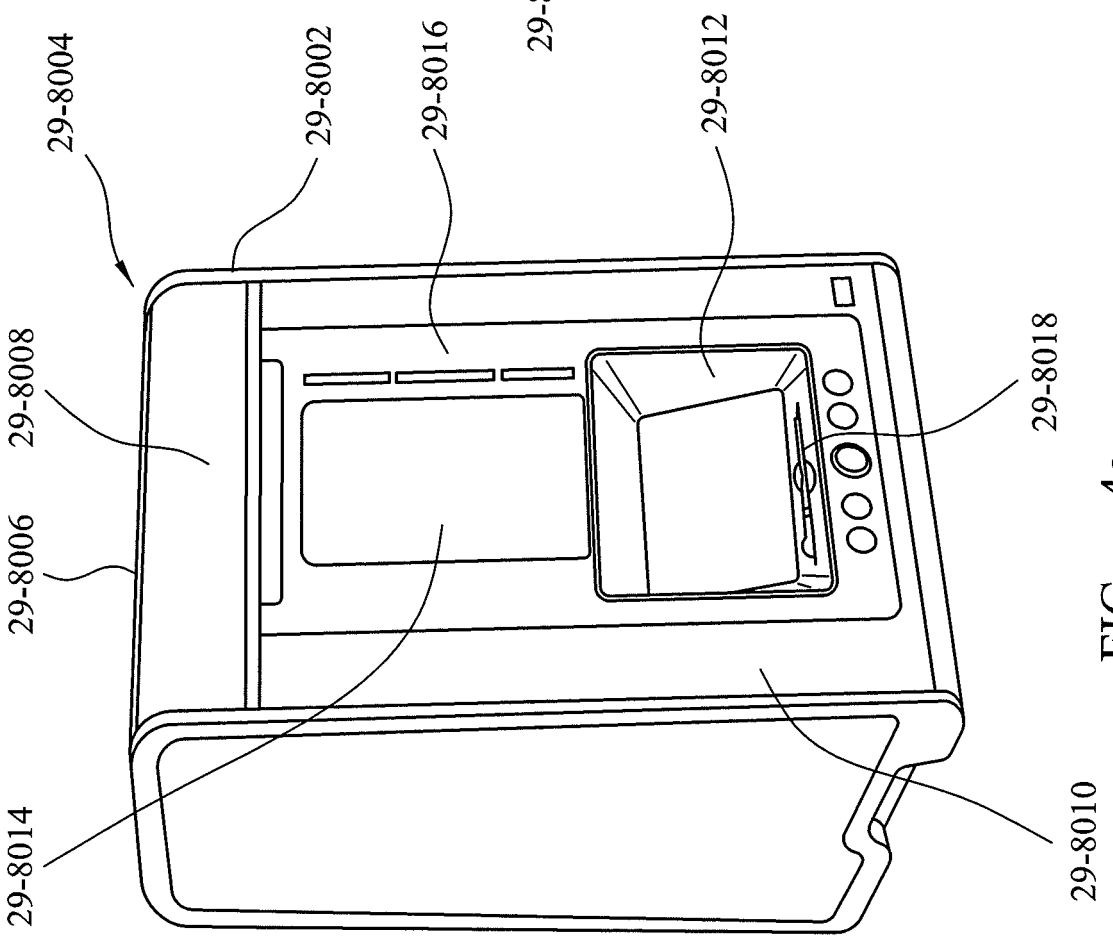

29-8004
29-8002
29-8016
29-8012
29-8008
29-8018
29-8006
29-8014
29-8010

FIG. 4a

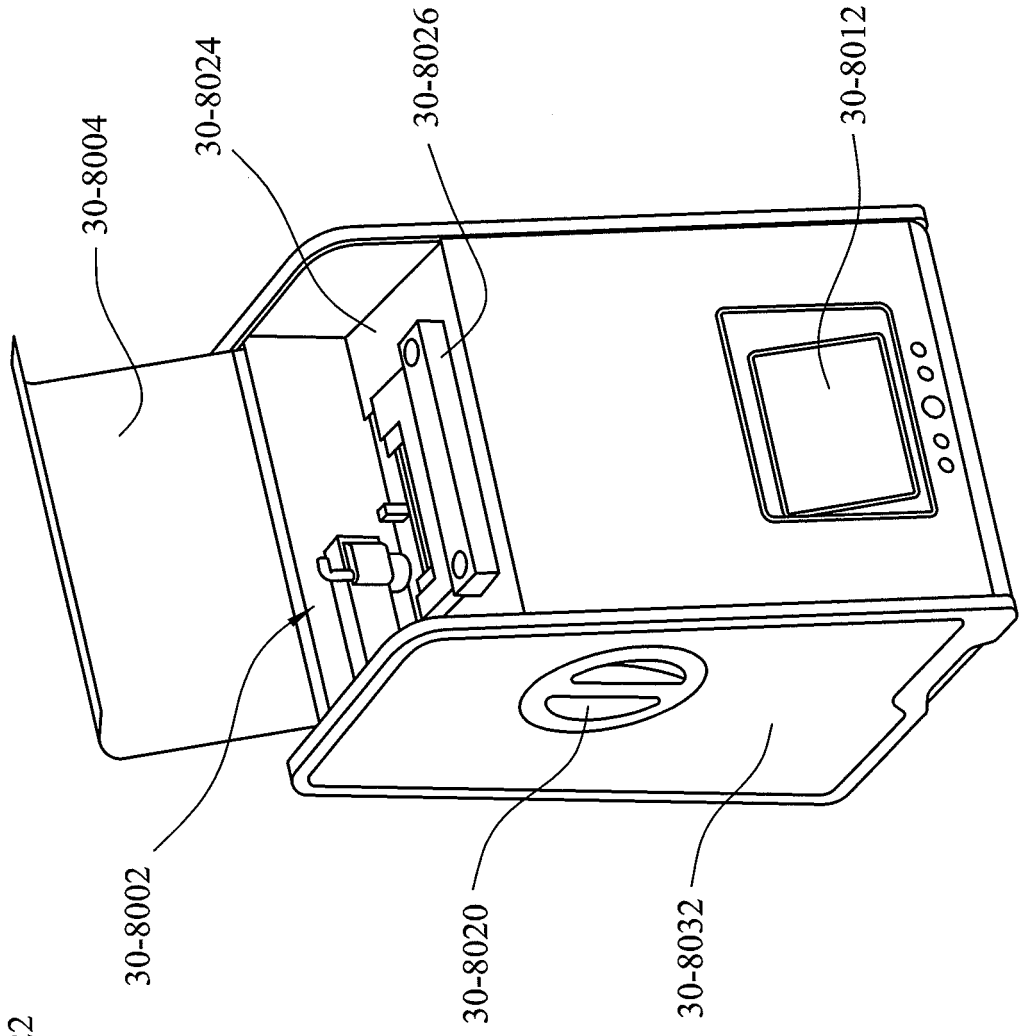


FIG. 5

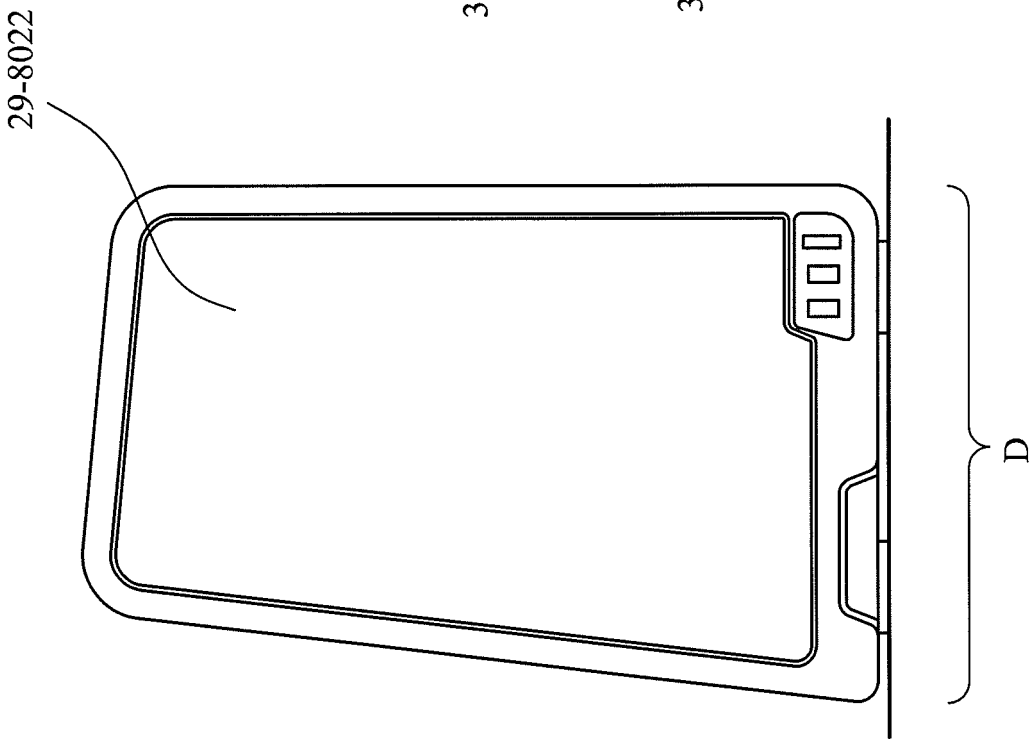


FIG. 4c

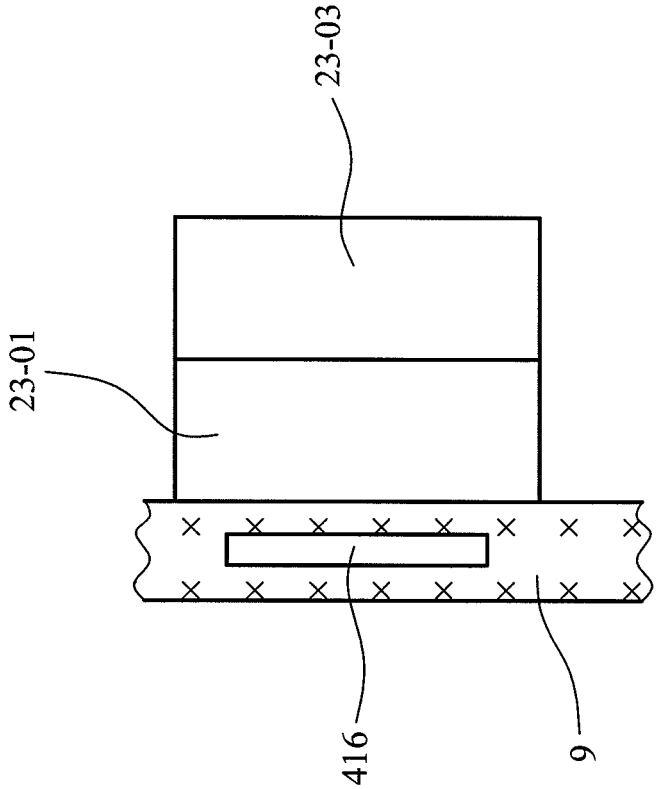


FIG. 7

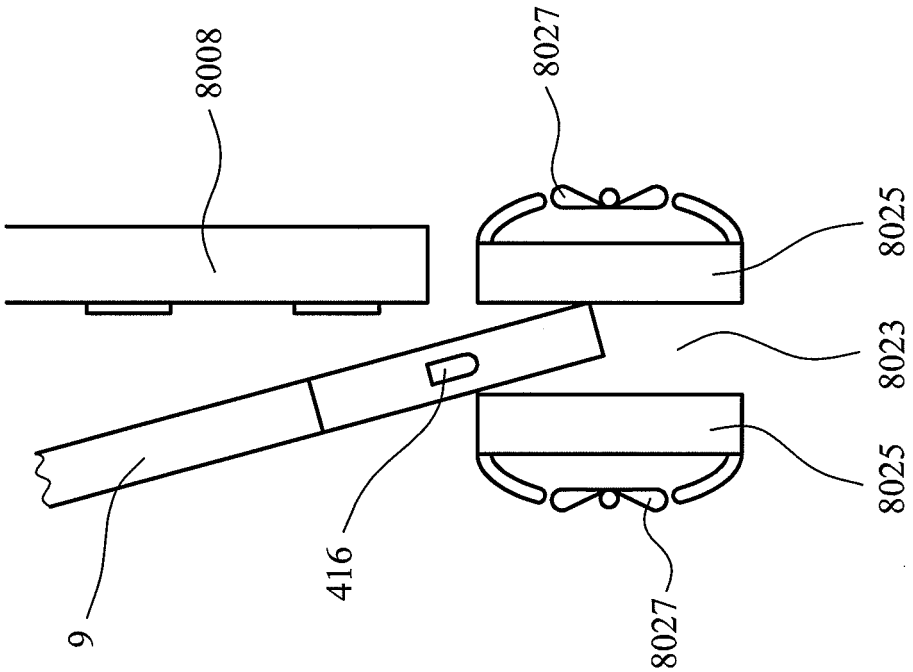


FIG. 6

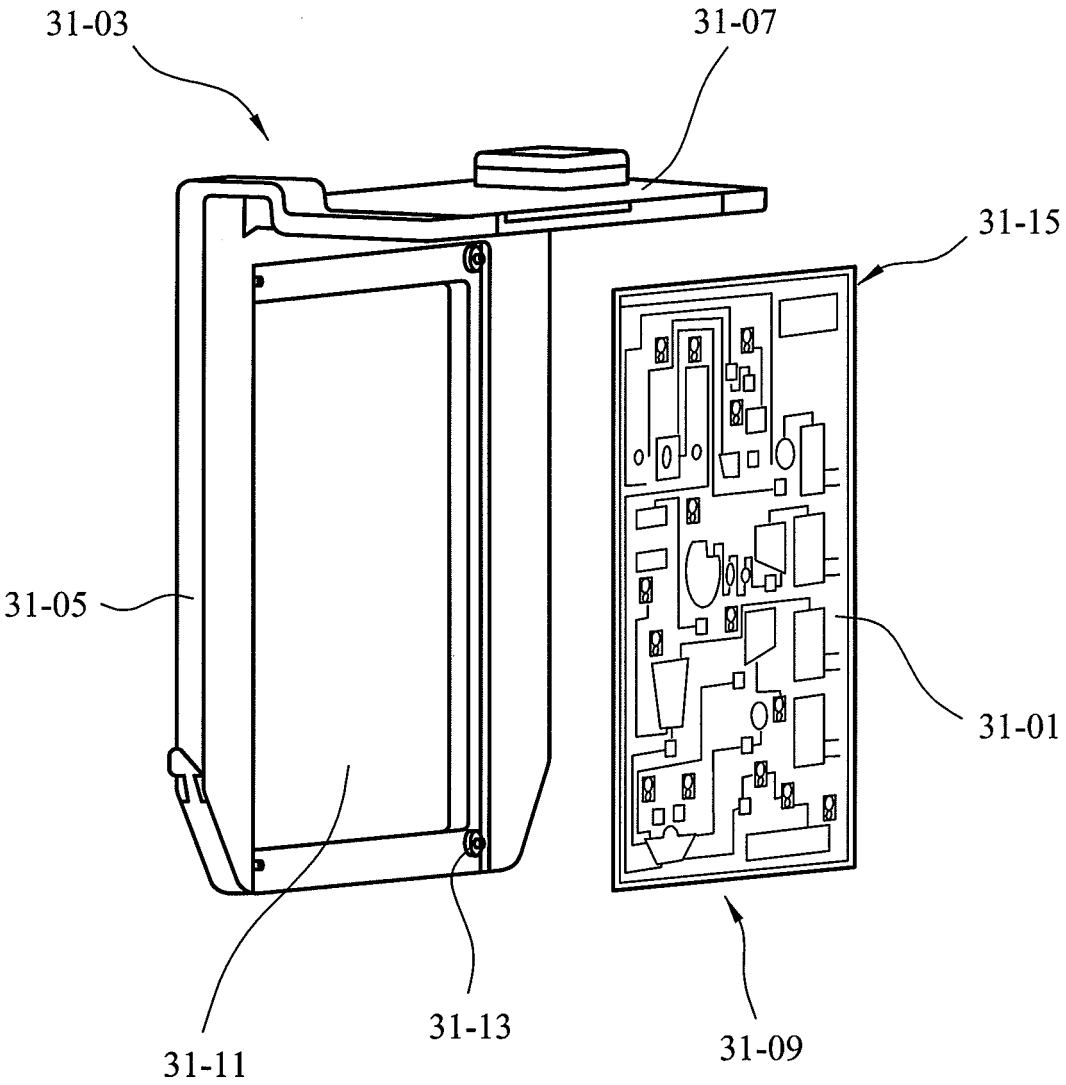


FIG. 8

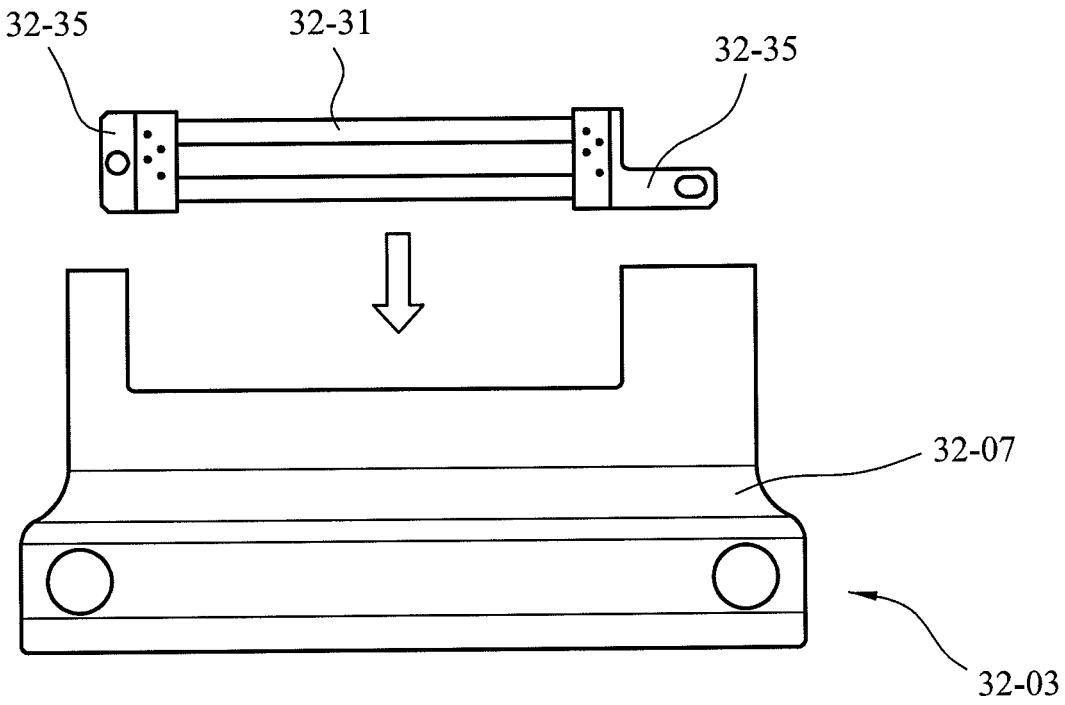


FIG. 9

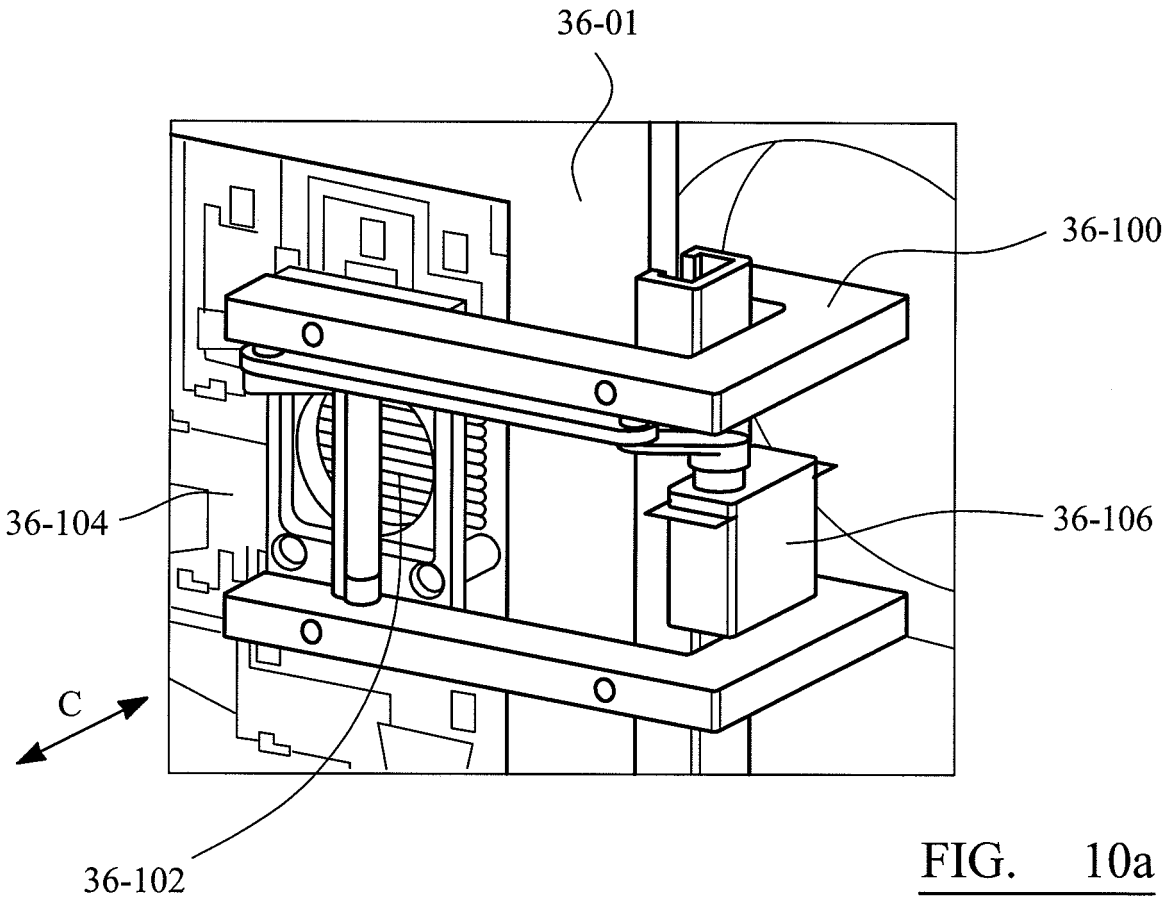


FIG. 10a

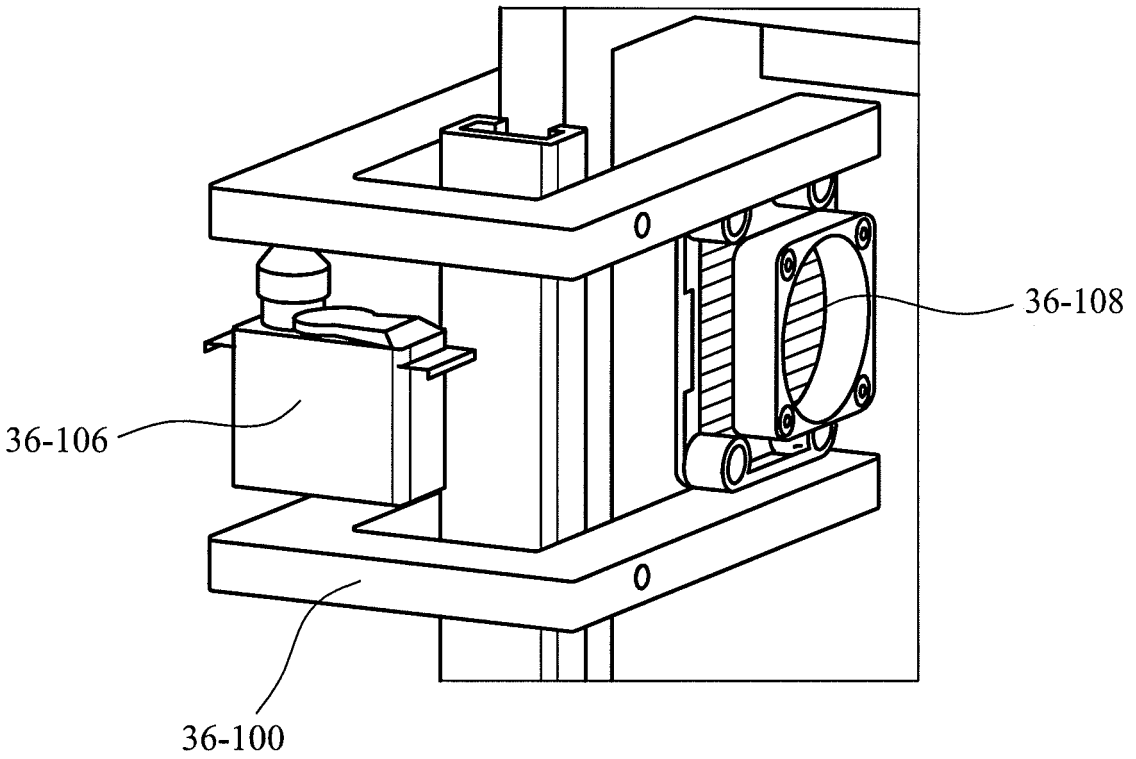


FIG. 10b

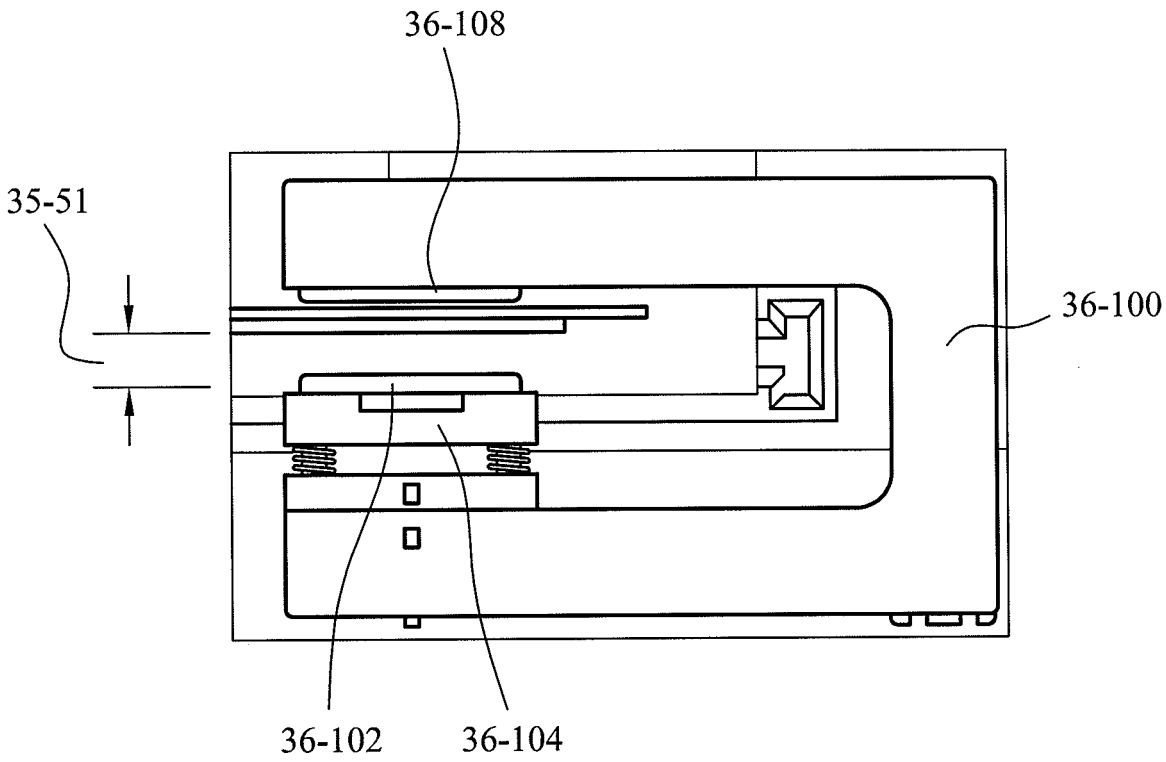


FIG. 10c

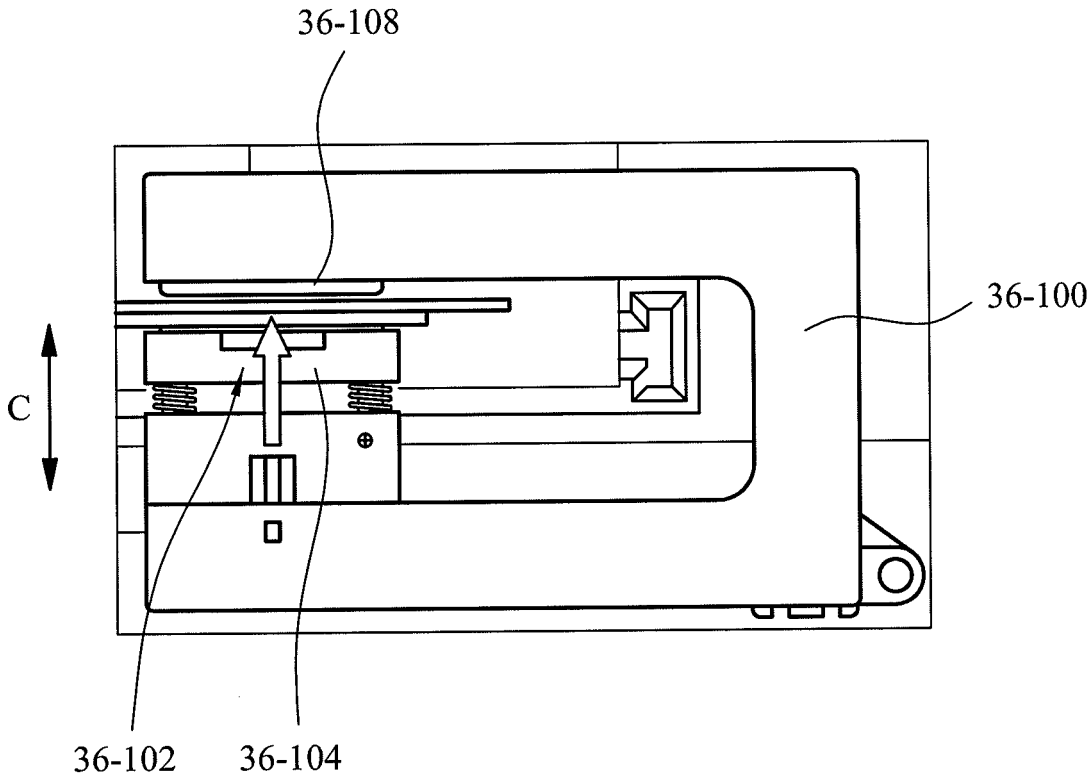


FIG. 10d

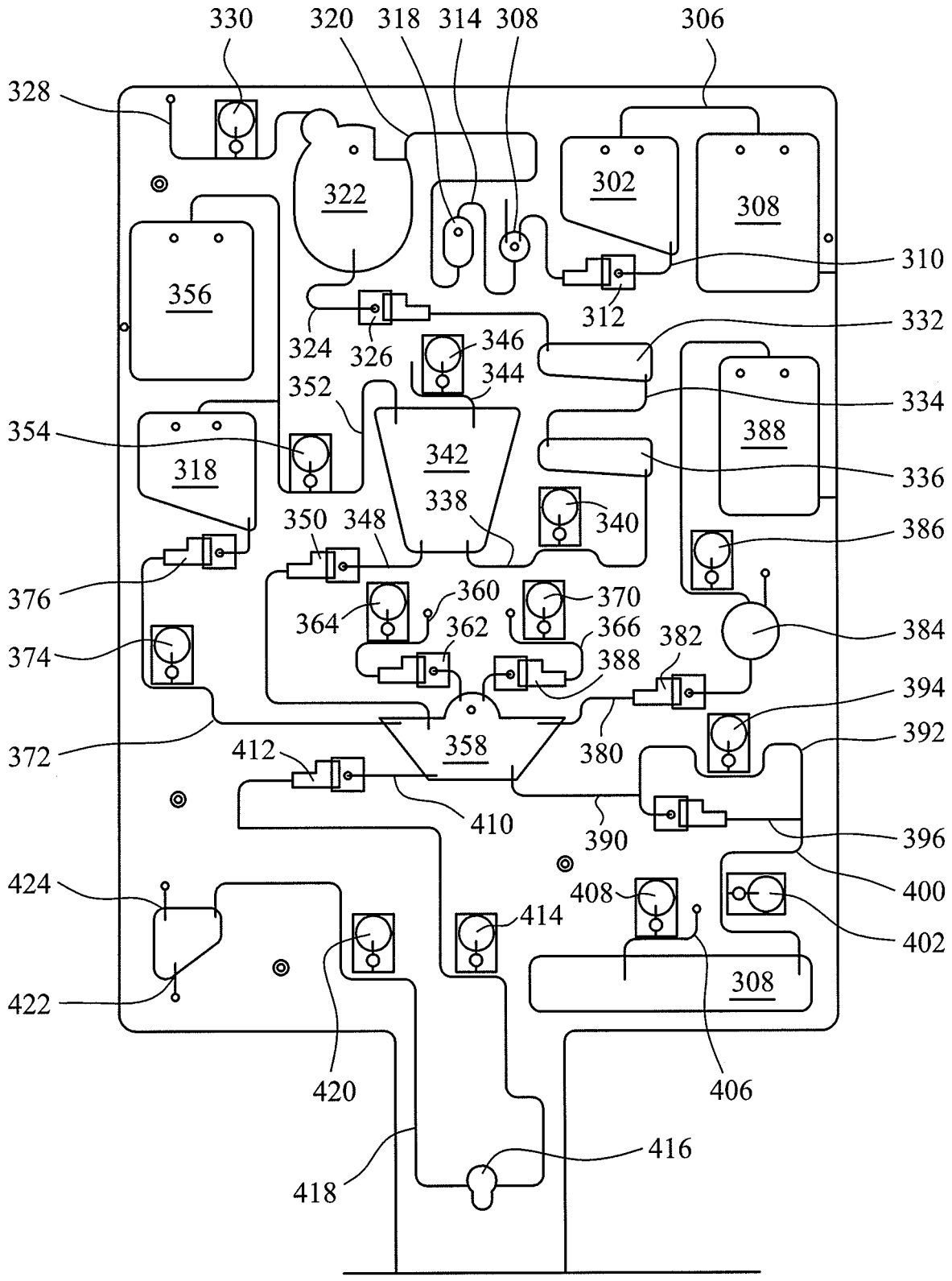

330
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FIG. 11a

FIG. 11b

Design Specifications

Design Specification : fSS Buccal					
Functional Chambers	Volume	Depth	Tool	Vent	Note
C1 (Lysis)	300ul total	1mm			
C2 (Purification/Beads)	311ul total	0.75mm		Yes	
Expansion Chamber	67ul total	0.75mm			
C3 (Dwell)	250ul total	0.5mm		Yes	
C4 (Heating/Magnet)	250ul total	1.0mm		Yes	
Bead Storage Chamber	30ul total	1.0mm		Yes	
PCR Chamber	23ul	1.0mm			
Binding Buffer Chamber	40ul total	2.0mm		Yes	
Auxiliary Chambers					
Elution	150ul total	2.0mm		Yes	
Wash Buffer	250ul total	1.0mm		No	
Recovery	200ul	2.0mm		Yes	
EC Pump	1124ul total	2.0mm			
Waste	1000ul total	2.5mm		Yes	
Channel					
Flow Channel		0.5mm	0.5mm BEM		
Pump Channel		0.5mm	0.5mm BEM		See A.N.
PCR Entrance Channel		1.0mm	1.5mm BEM		
Paraffin Valve	Diameter				
Open Valve	1.0mm	0.5mm			
Close Valve	2.0mm	1.0mm			
Close Valve 12/13	3.0mm	1.0mm			PCR Close valves enlarged
Cartridge Specification					
Height	160mm				
Width	125mm				
Thickness	3.0mm				
Electrode Glue	UV Glue				
Alignment Pin	2.3mm				
Bonding Tape	90106				
Fabrication Note					
Tape trimmed in chambers					

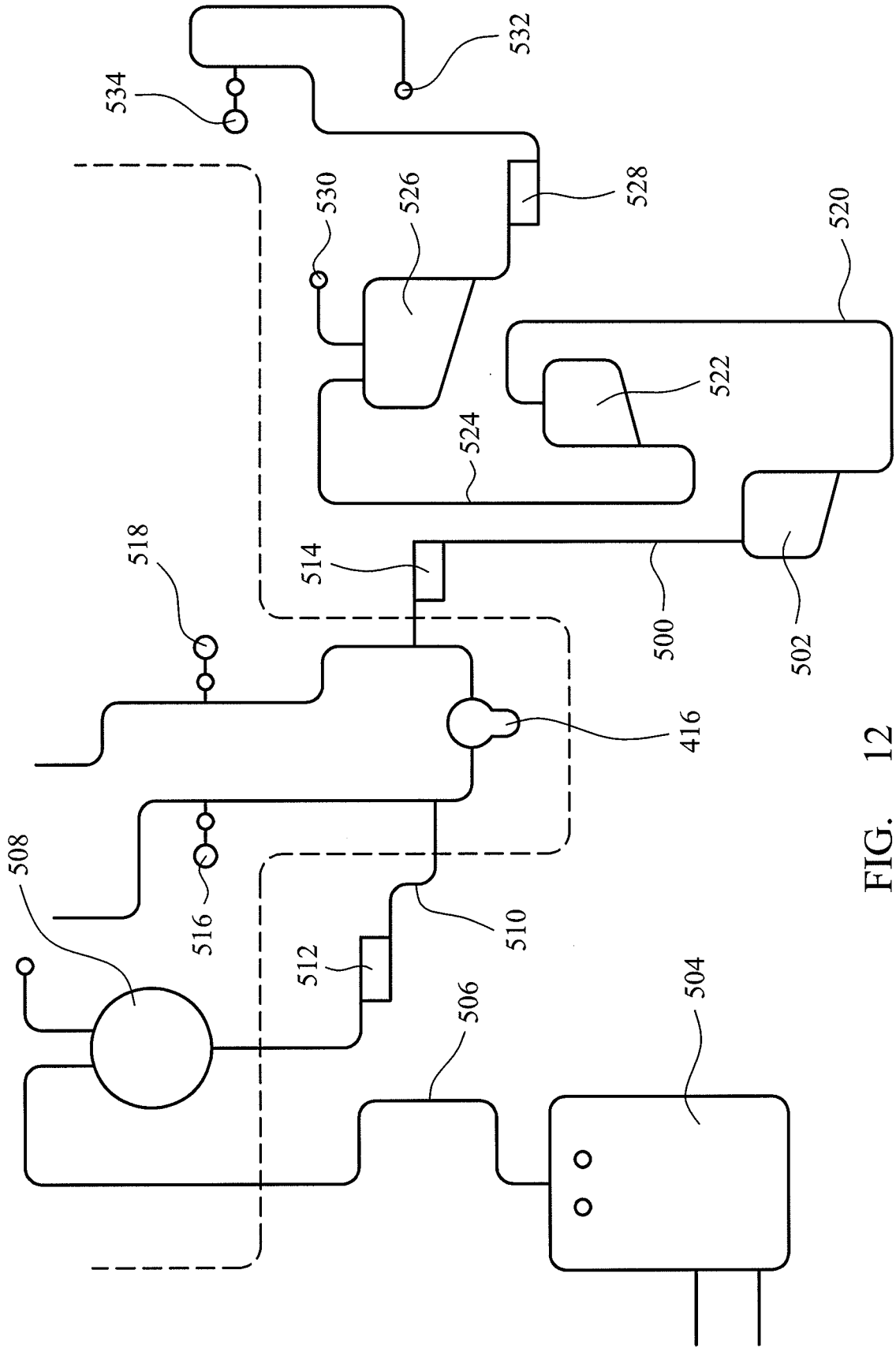

532
534
530
526
528
520
522
524
518
514
500
502
416
508
516
512
510
506
504

FIG. 12

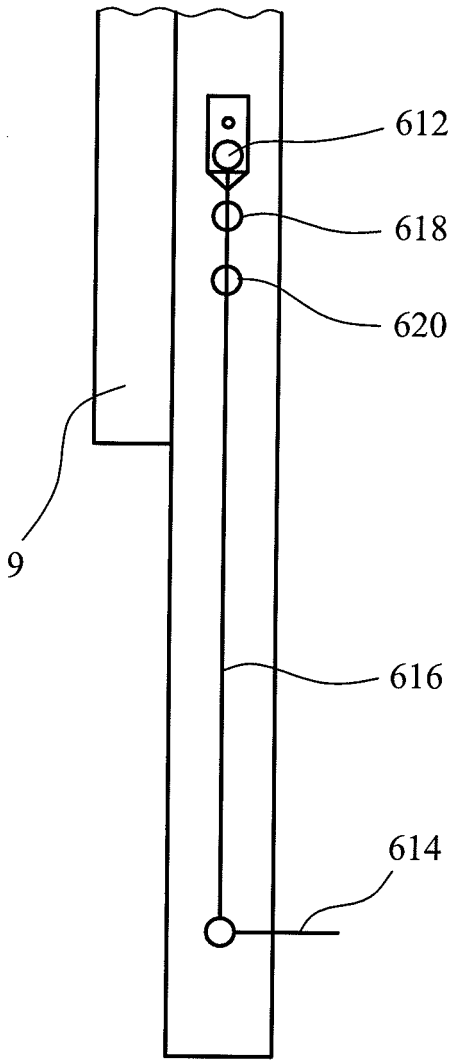


FIG. 13a

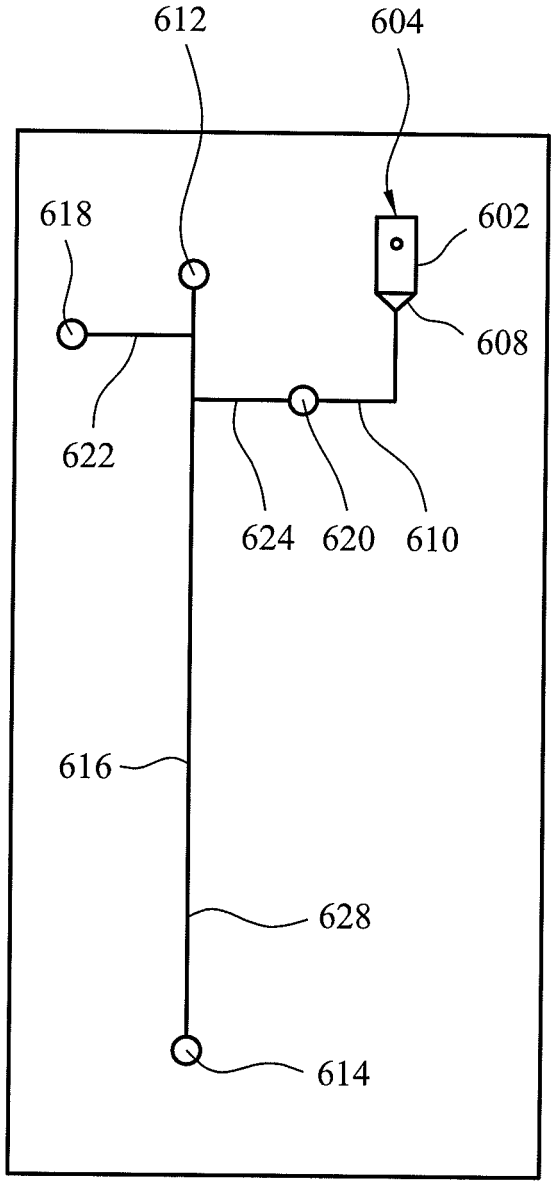


FIG. 13b

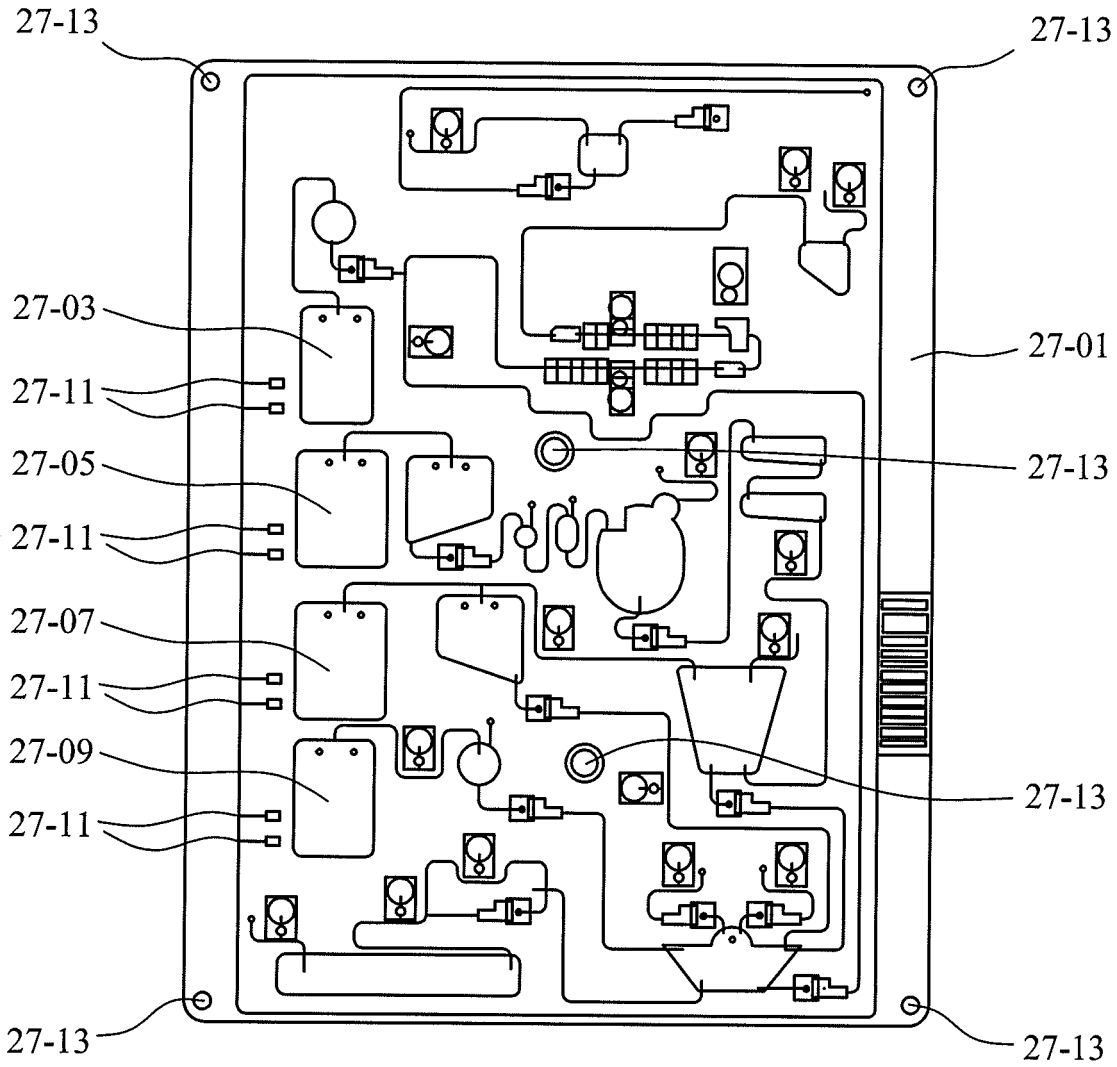

27-13
27-13
27-03
27-11
27-05
27-11
27-07
27-11
27-09
27-11
27-01
27-13
27-13
27-13
27-13

FIG. 14

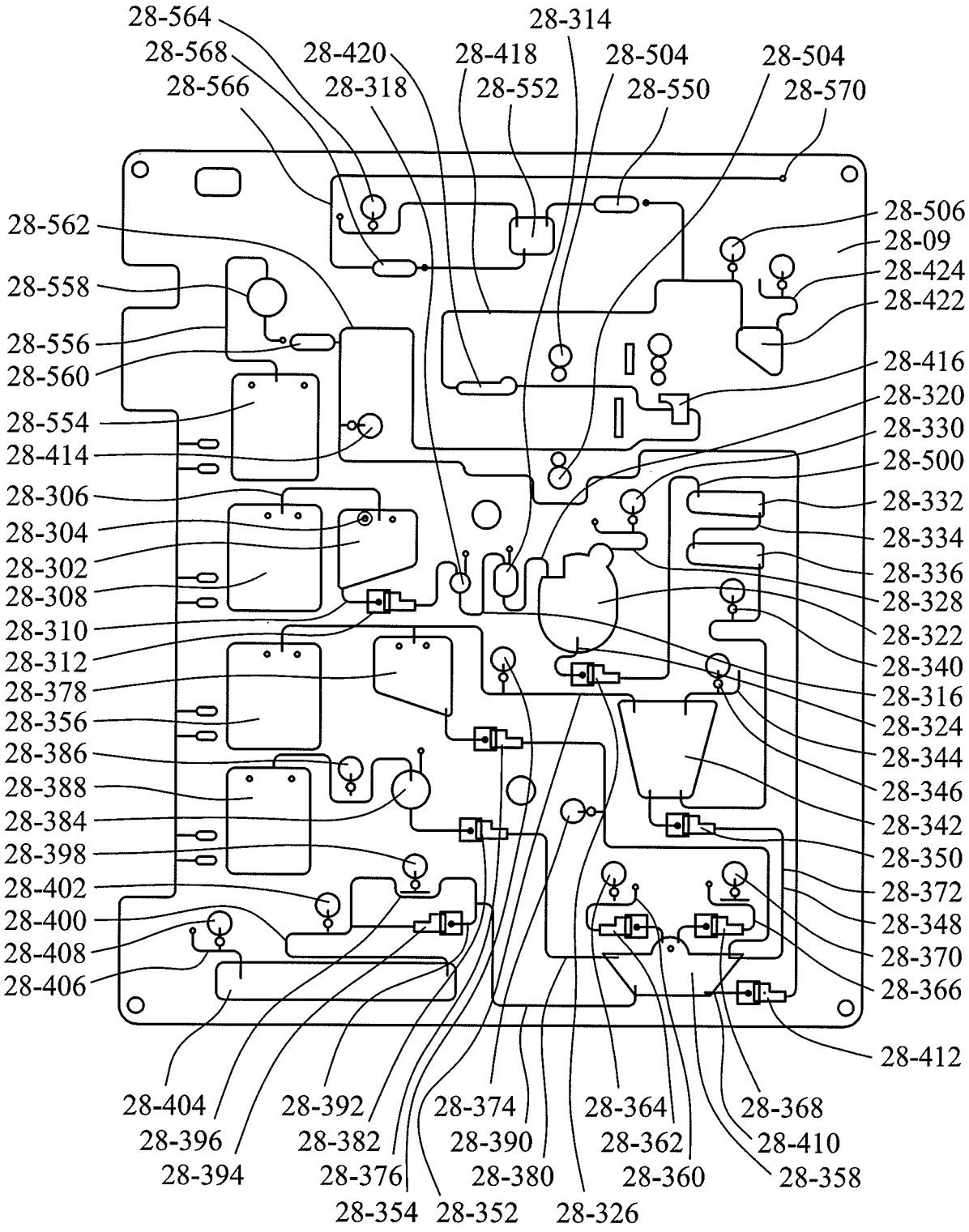

28-564
28-568
28-566
28-420
28-318
28-418
28-552
28-314
28-504
28-550
28-504
28-570
28-562
28-558
28-556
28-560
28-554
28-414
28-306
28-304
28-302
28-308
28-310
28-312
28-378
28-356
28-386
28-388
28-384
28-398
28-402
28-400
28-408
28-406
28-506
28-09
28-424
28-422
28-416
28-320
28-330
28-500
28-332
28-334
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28-328
28-322
28-340
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28-372
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28-370
28-366
28-412
28-404
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28-394
28-392
28-382
28-376
28-354
28-374
28-390
28-380
28-352
28-326
28-364
28-362
28-360
28-368
28-410
28-358

FIG. 15a

Functional Chambers	Volume	Depth	Tool	Vent	Note
C1 (Lysis)	300ul	1mm	Std Cutter	No	
C2 (Purification)	311ul	0.75mm	Std Cutter	Yes	
Expansion/Mixing Chambers	67ul	0.75mm	Std Cutter	No	
C3 (Dwell or Initial Binding))	250ul	0.5mm	Std Cutter	Yes	
C4 (PCR washing and release)	250ul	1.0mm	Std Cutter	Yes	
Bead Storage (BSC)	30ul	1.0mm	Std Cutter	No	
Binding Buffer (BBC)	40ul	2.0mm	Std Cutter	No	
Elution	150ul	2.0mm	Std Cutter	No	
Wash Buffer	250ul	2.0mm	Std Cutter	No	
Archive	200ul	2.0mm	Std Cutter	No	
Waste	1000ul	2.5mm	Std Cutter	Yes	
PCR	10ul	1.0mm	Std Cutter	No	
Formamide	105ul	1.0mm	Std Cutter	No	
Denaturing	105ul	1.0mm	Std Cutter	No	
Channel					
PCR Red		0.25mm	0.5mm BEM		Sigma-Aldrich 411663
PCR Cyan		1.0mm	1.0mm BEM		Sigma-Aldrich 411663
PCR White/Black		0.35mm	0.5mm BEM		Sasolwax H1
Magenta		0.5mm	1.0mm BEM		
EC PUMP Yellow		2.0mm	1.0mm BEM		
Paraffin Valve	Volume	Depth	Tool		
LMW OV's 1.5mm diameter	1.77ul	0.5mm	Std Cutter		
LMW OV's 3.0mm diameter	7.1ul	1.0mm	Std Cutter		
HMWV CV15	7.1ul	1.0mm	Std Cutter		
Cartridge Specification					
Substrate width - 175mm					
Substrate length - 228mm					
Substrate 3.0mm PC					
Capping Layer 0.5mm PC					
PSA 90106 cold bond assy					Adhesives Research
EC pump UV glue 1180-M					
Bar Code pocket	N/A	0.2mm	Std Cutter		May opt for flduclai:marks instead

FIG. 15b

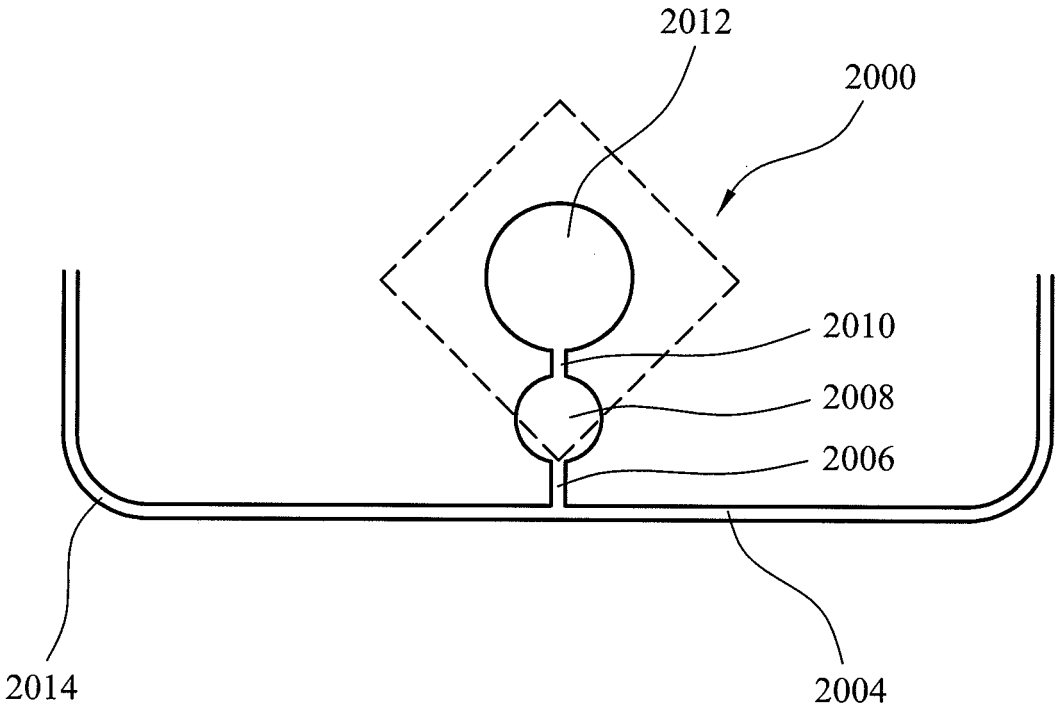


FIG. 16a

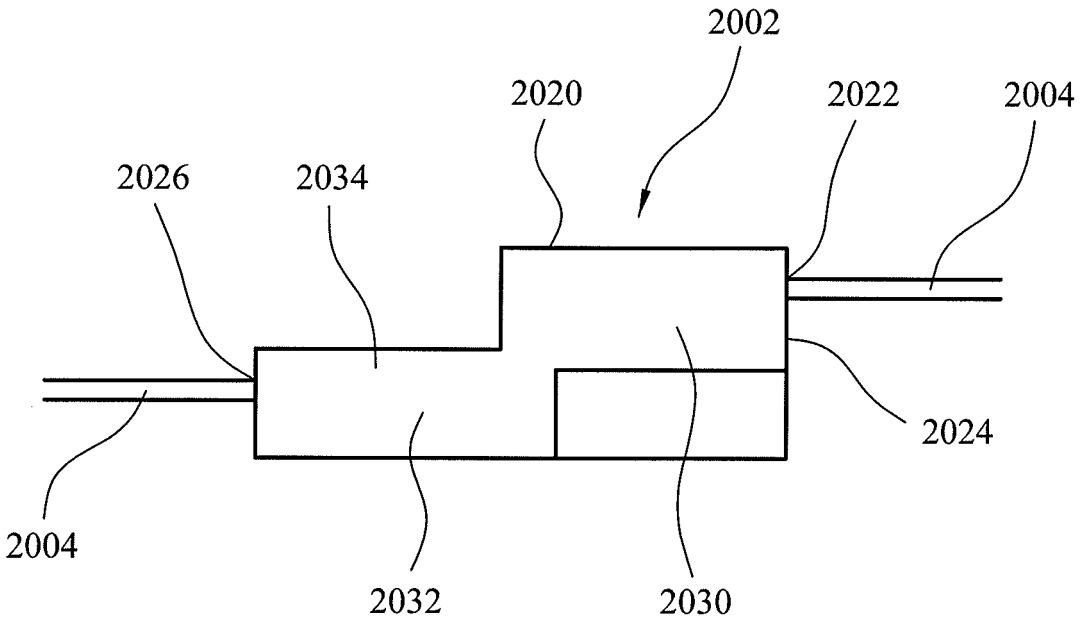
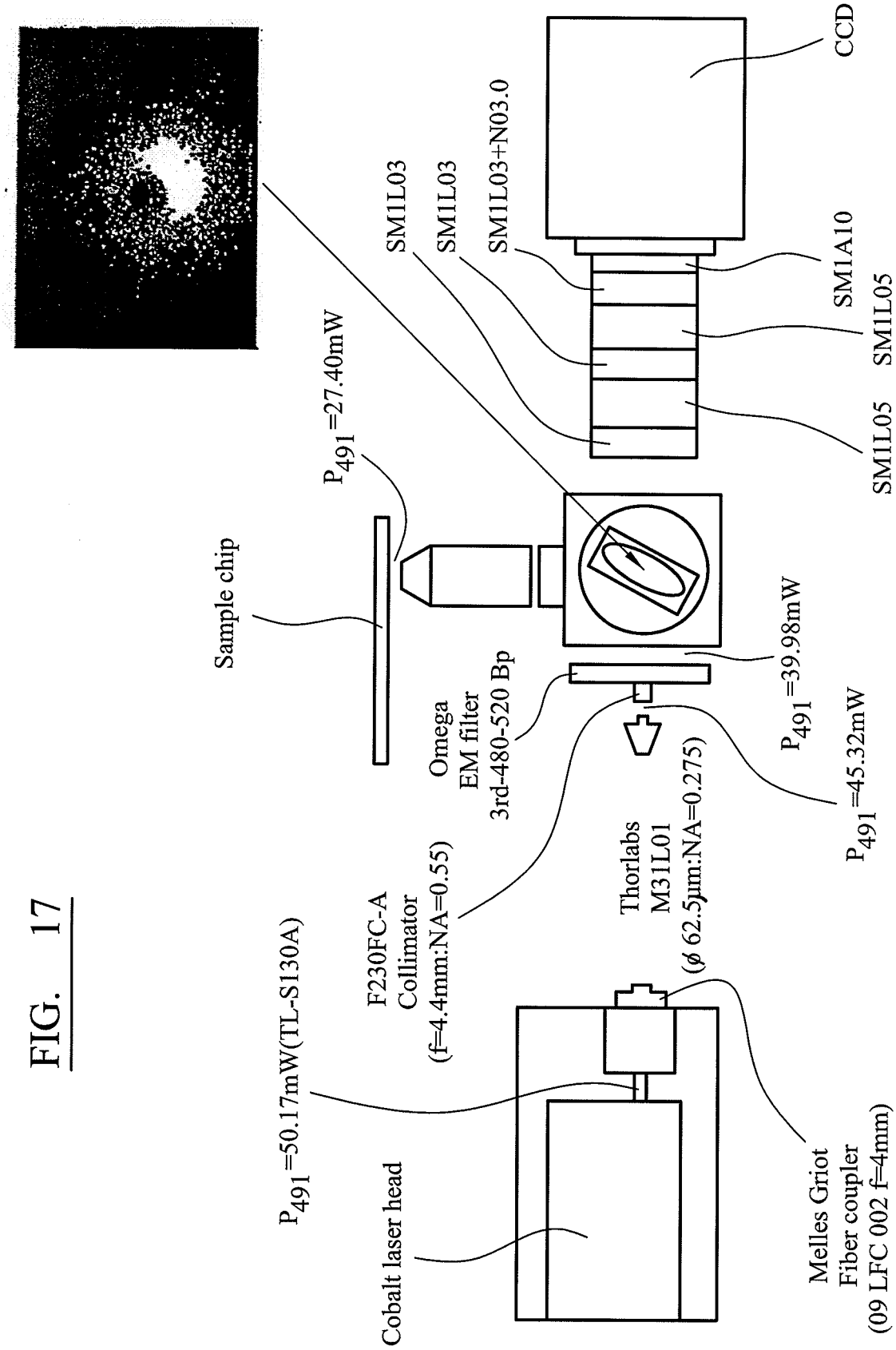


FIG. 16b

FIG. 17


CCD
SM1L03+N03.0
SM1L03
SM1L03
SM1A10
SM1L05
SM1L05
P_{491}=27.40mW
Sample chip
Omega
EM filter
3rd-480-520 Bp
P_{491}=39.98mW
P_{491}=45.32mW
F230FC-A
Collimator
(f=4.4mm:NA=0.55)
Thorlabs
M31L01
(ϕ 62.5μm:NA=0.275)
P_{491}=50.17mW(TL-S130A)
Cobalt laser head
Melles Griot
Fiber coupler
(09 LFC 002 f=4mm)

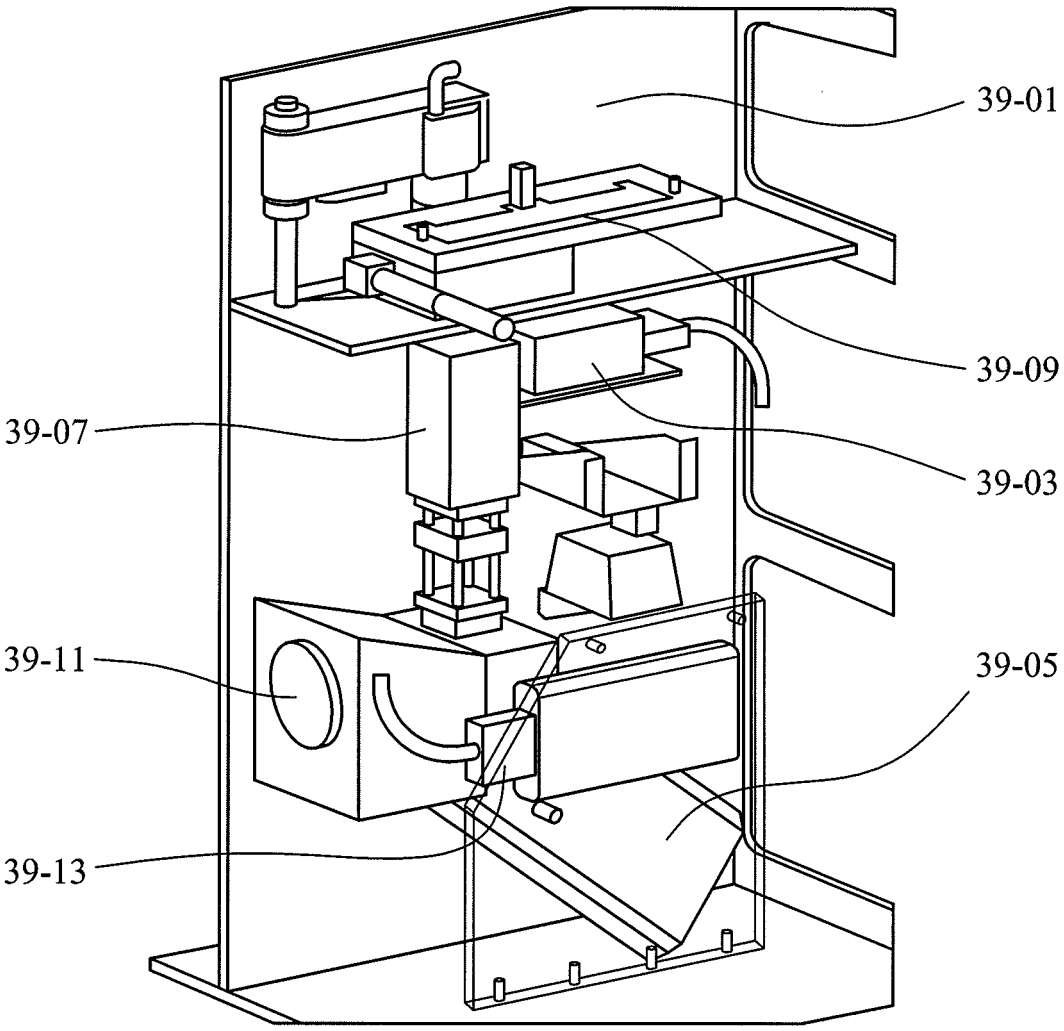


FIG. 18

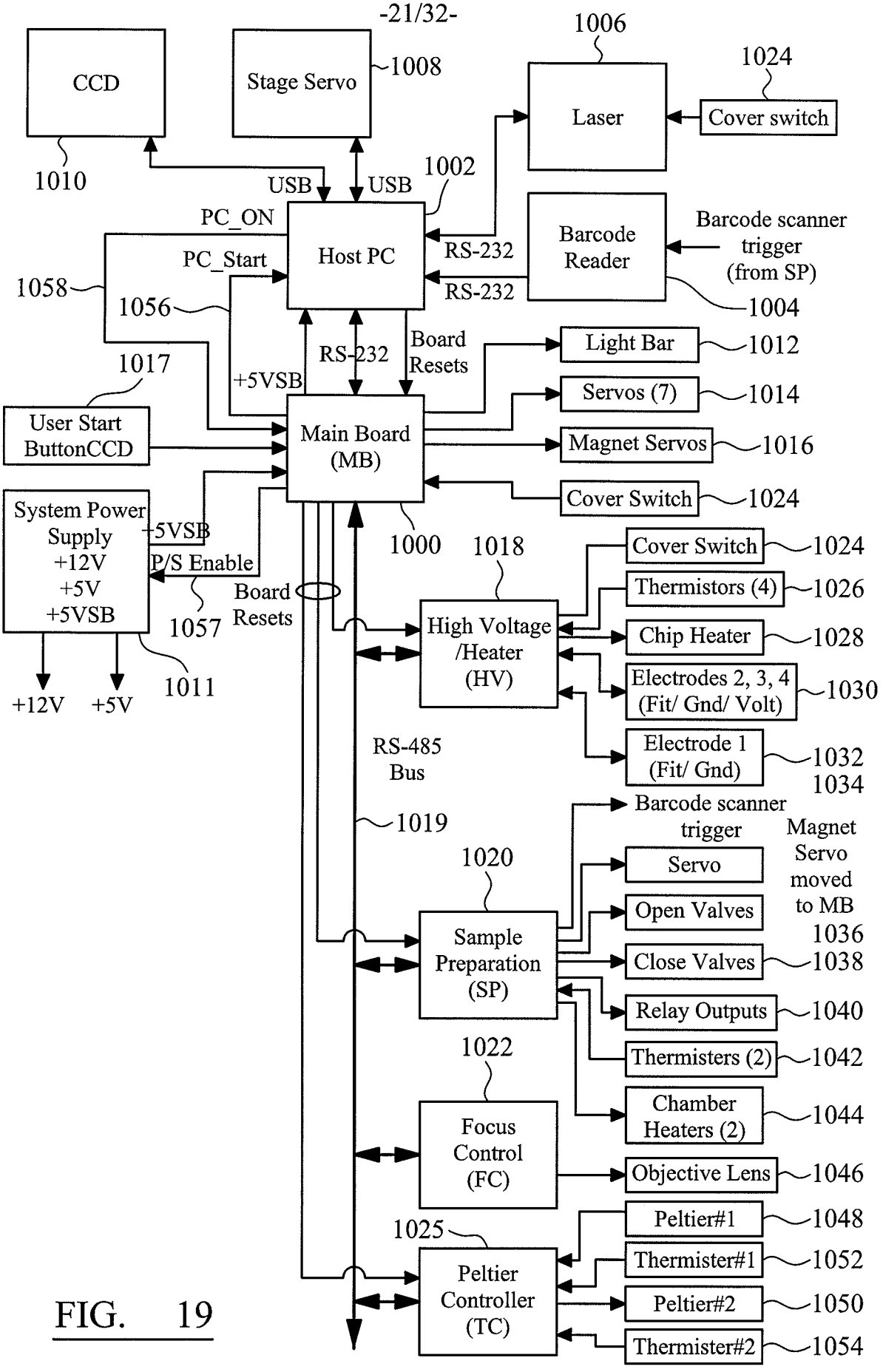

CCD
1010
Stage Servo
1008
USB
USB
1002
Host PC
PC_ON
PC_Start
1058
1056
1017
User Start ButtonCCD
+5VSB
RS-232
Board Resets
Main Board (MB)
1000
1006
Laser
1024
Cover switch
Barcode Reader
RS-232
RS-232
Barcode scanner trigger (from SP)
1004
Light Bar
1012
Servos (7)
1014
Magnet Servos
1016
Cover Switch
1024
System Power Supply +12V +5V +5VSB
+5VSB
P/S Enable
1057
Board Resets
1011
+12V
+5V
1018
High Voltage /Heater (HV)
Cover Switch
1024
Thermistors (4)
1026
Chip Heater
1028
Electrodes 2, 3, 4 (Fit/ Gnd/ Volt)
1030
Electrode 1 (Fit/ Gnd)
1032
1034
RS-485 Bus
1019
Barcode scanner trigger
Magnet Servo moved to MB
1020
Sample Preparation (SP)
Servo
Open Valves
Close Valves
1036
1038
Relay Outputs
1040
Thermisters (2)
1042
1022
Focus Control (FC)
Chamber Heaters (2)
1044
Objective Lens
1046
1025
Peltier Controller (TC)
Peltier#1
1048
Thermister#1
1052
Peltier#2
1050
Thermister#2
1054

FIG. 19

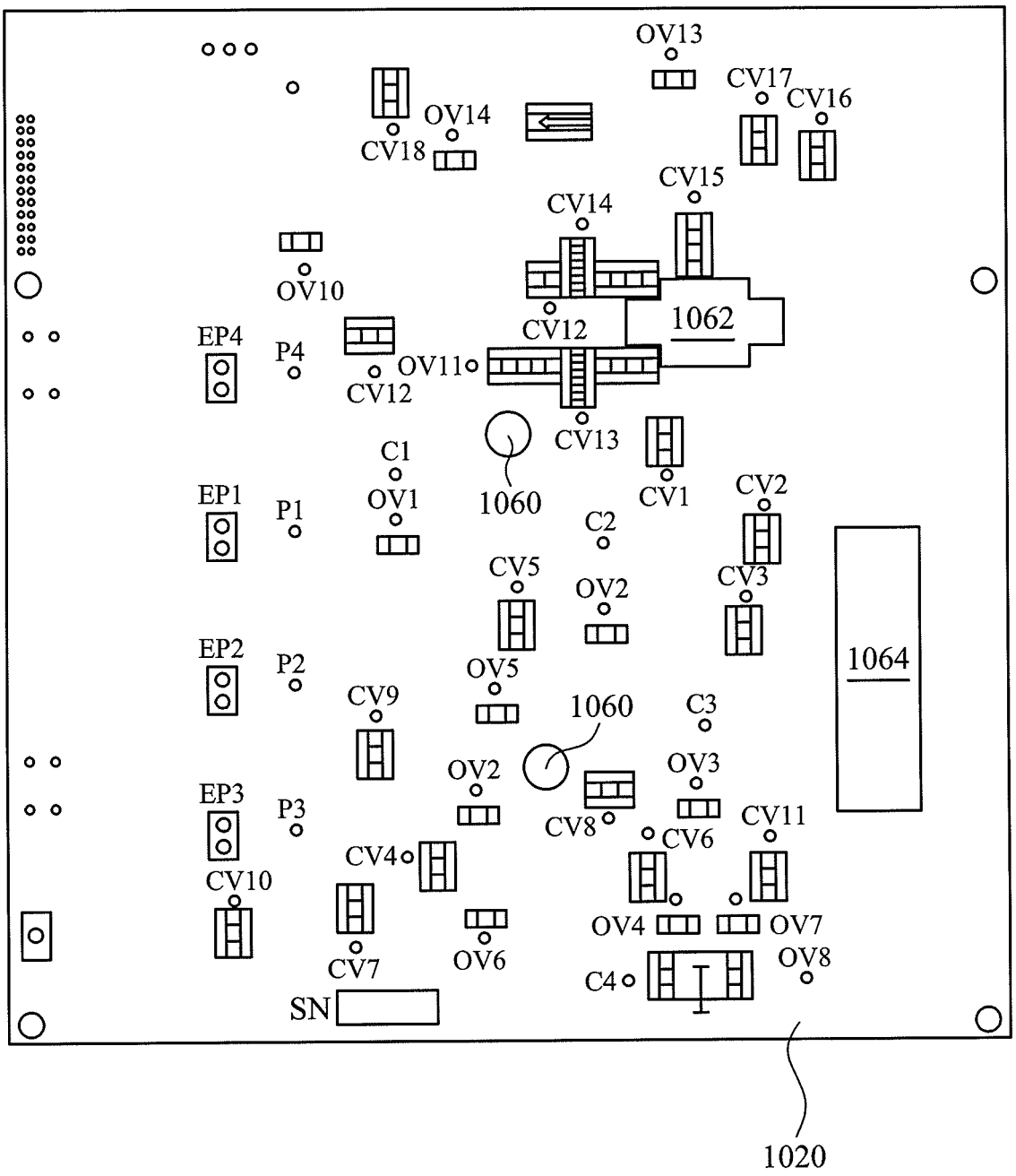

OV13
CV17
CV16
OV14
CV18
CV15
CV14
OV10
1062
CV12
EP4
P4
OV11
CV12
CV13
C1
1060
CV1
CV2
EP1
P1
OV1
C2
CV5
OV2
CV3
1064
EP2
P2
OV5
CV9
1060
C3
OV2
OV3
EP3
P3
CV8
CV6
CV11
CV4
CV10
OV4
OV7
CV7
OV6
OV8
C4
SN
1020

FIG. 20

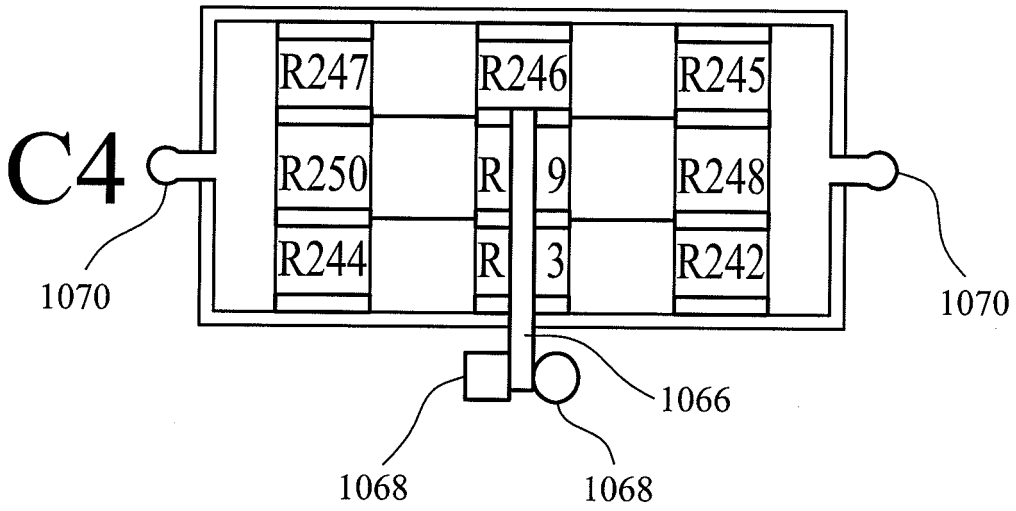

C4
R247
R246
R245
R250
R 9
R248
R244
R 3
R242
1070
1070
1066
1068
1068

FIG. 21

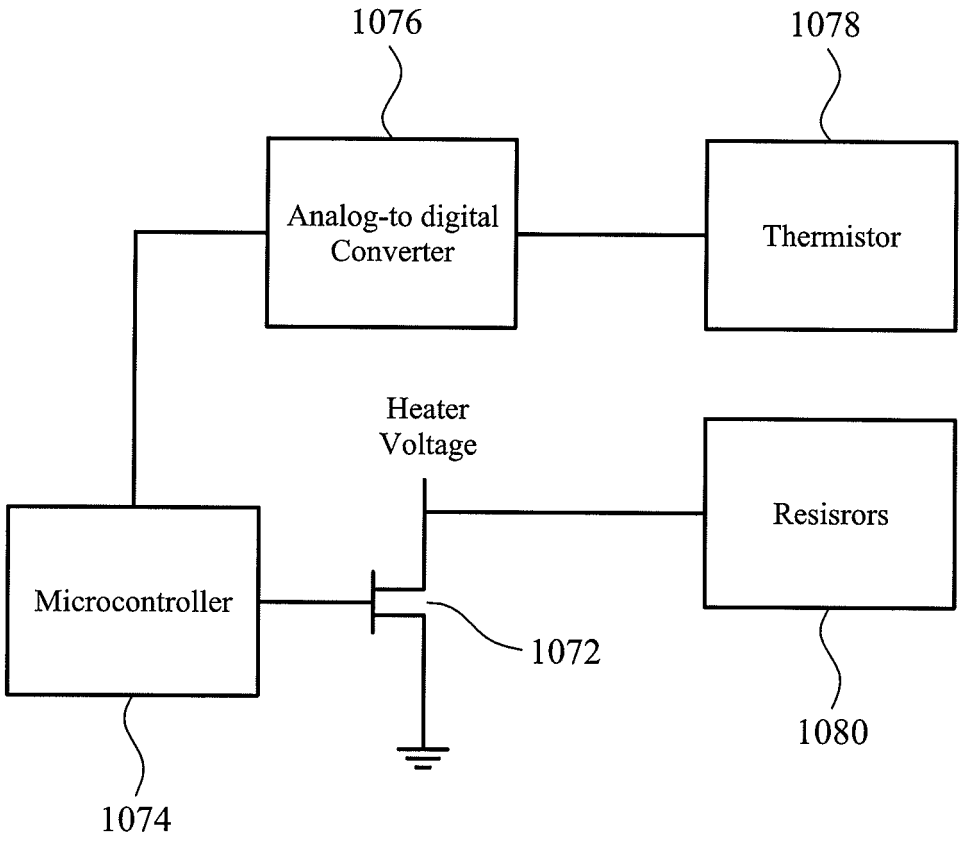

1076
1078
Analog-to digital Converter
Thermistor
Heater Voltage
Resisrors
Microcontroller
1072
1074
1080

FIG. 22

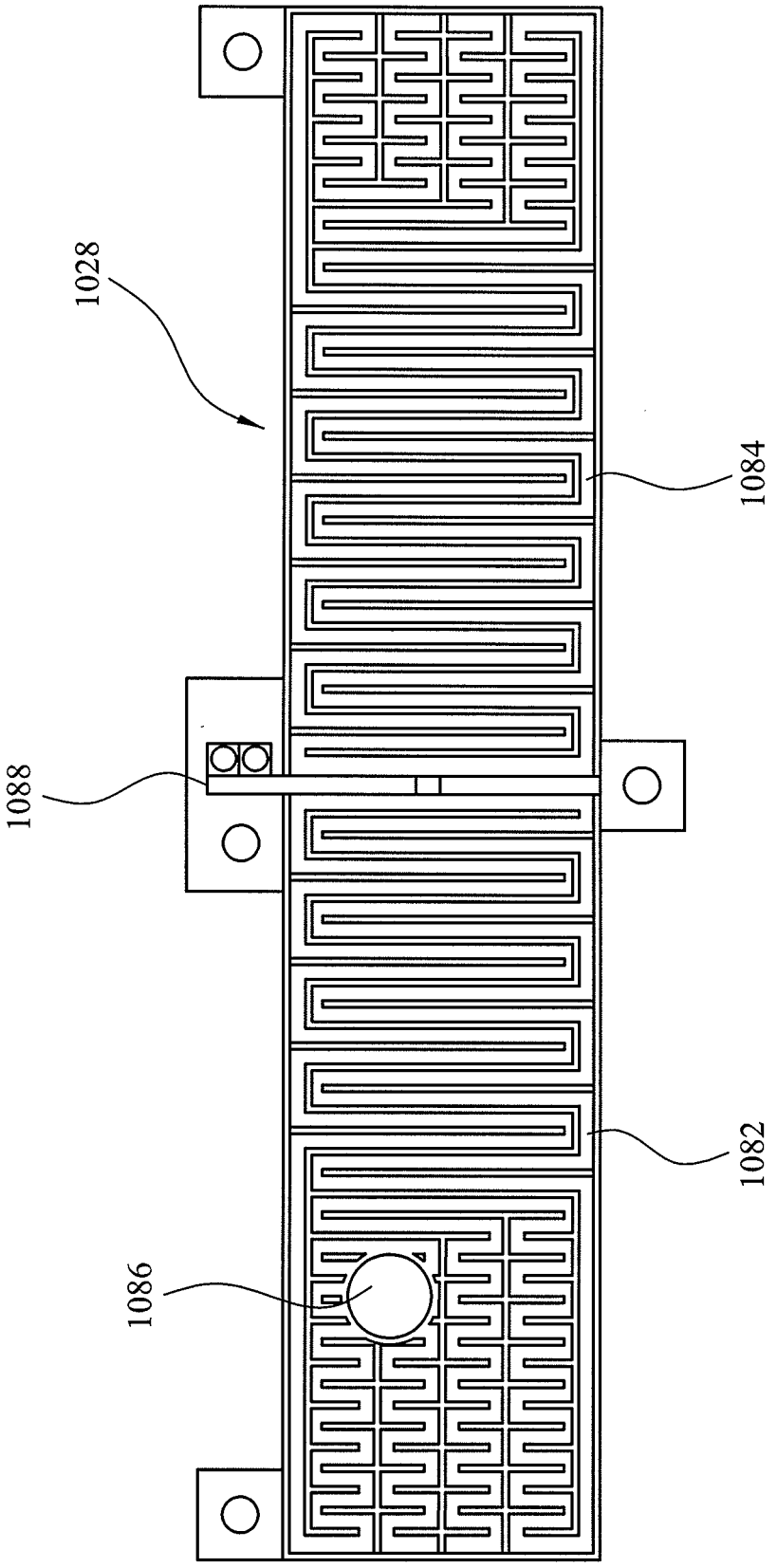


FIG. 23

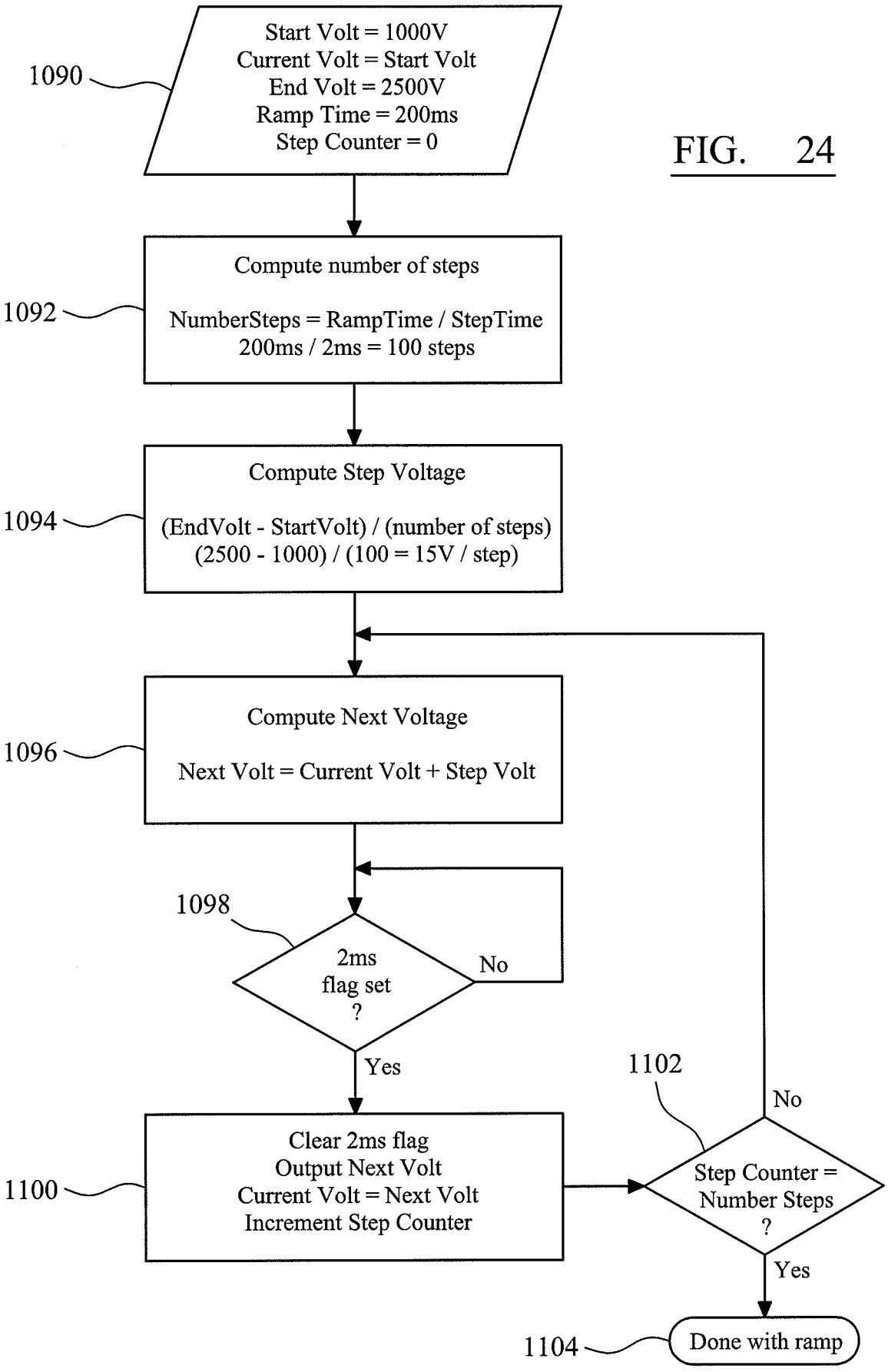

1090
Start Volt = 1000V
Current Volt = Start Volt
End Volt = 2500V
Ramp Time = 200ms
Step Counter = 0
1092
Compute number of steps
NumberSteps = RampTime / StepTime
200ms / 2ms = 100 steps
1094
Compute Step Voltage
(EndVolt - StartVolt) / (number of steps)
(2500 - 1000) / (100 = 15V / step)
1096
Compute Next Voltage
Next Volt = Current Volt + Step Volt
1098
2ms flag set ?
No
Yes
1100
Clear 2ms flag
Output Next Volt
Current Volt = Next Volt
Increment Step Counter
1102
Step Counter = Number Steps ?
No
Yes
1104
Done with ramp

FIG. 24

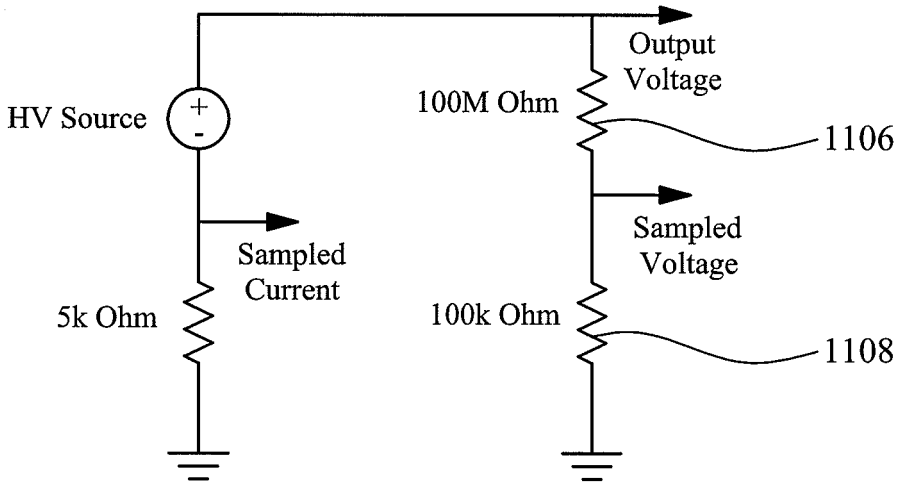

HV Source
+
-
5k Ohm
Sampled
Current
Output
Voltage
100M Ohm
1106
Sampled
Voltage
100k Ohm
1108

FIG. 25

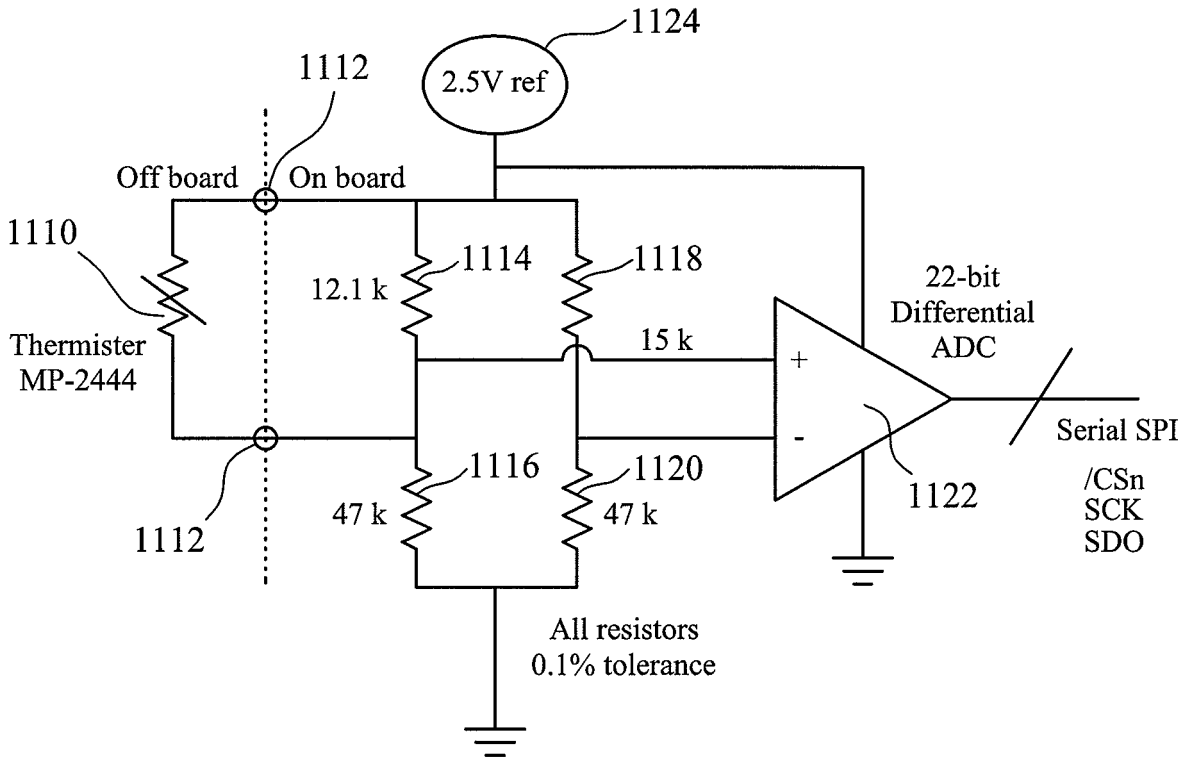

1124
2.5V ref
1112
Off board
On board
1110
Thermister
MP-2444
12.1 k
1114
1118
15 k
22-bit
Differential
ADC
+
-
Serial SPI
/CSn
SCK
SDO
1122
1116
47 k
1120
47 k
1112
All resistors
0.1% tolerance

FIG. 26

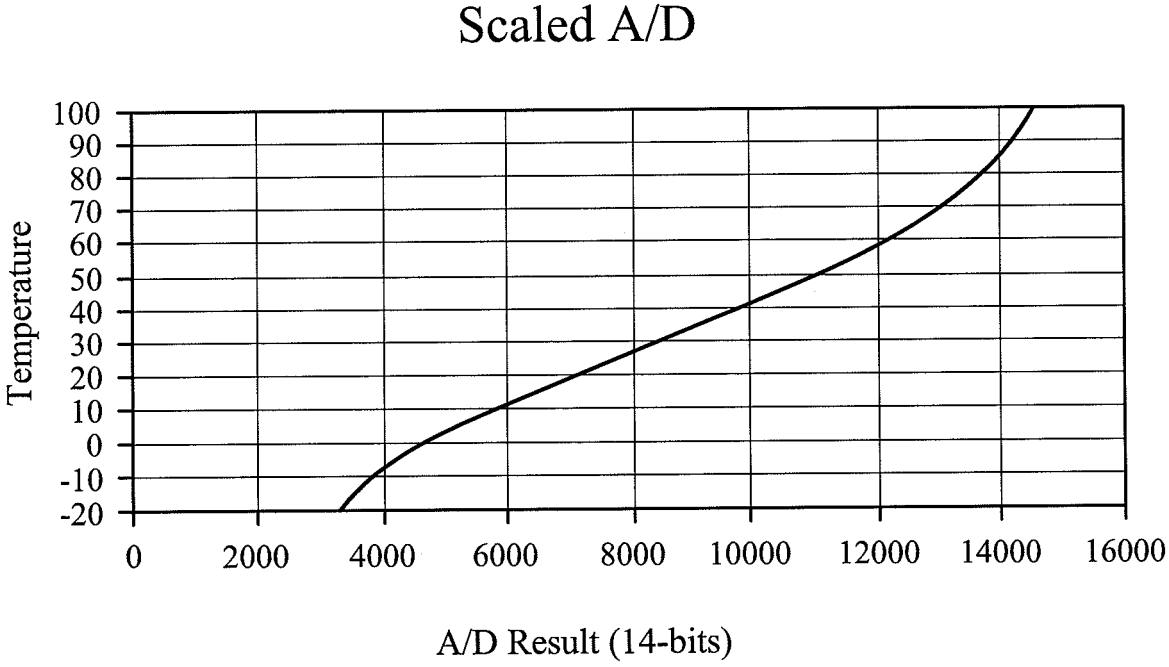

Scaled A/D
Temperature
100
90
80
70
60
50
40
30
20
10
0
-10
-20
0
2000
4000
6000
8000
10000
12000
14000
16000
A/D Result (14-bits)

FIG. 27

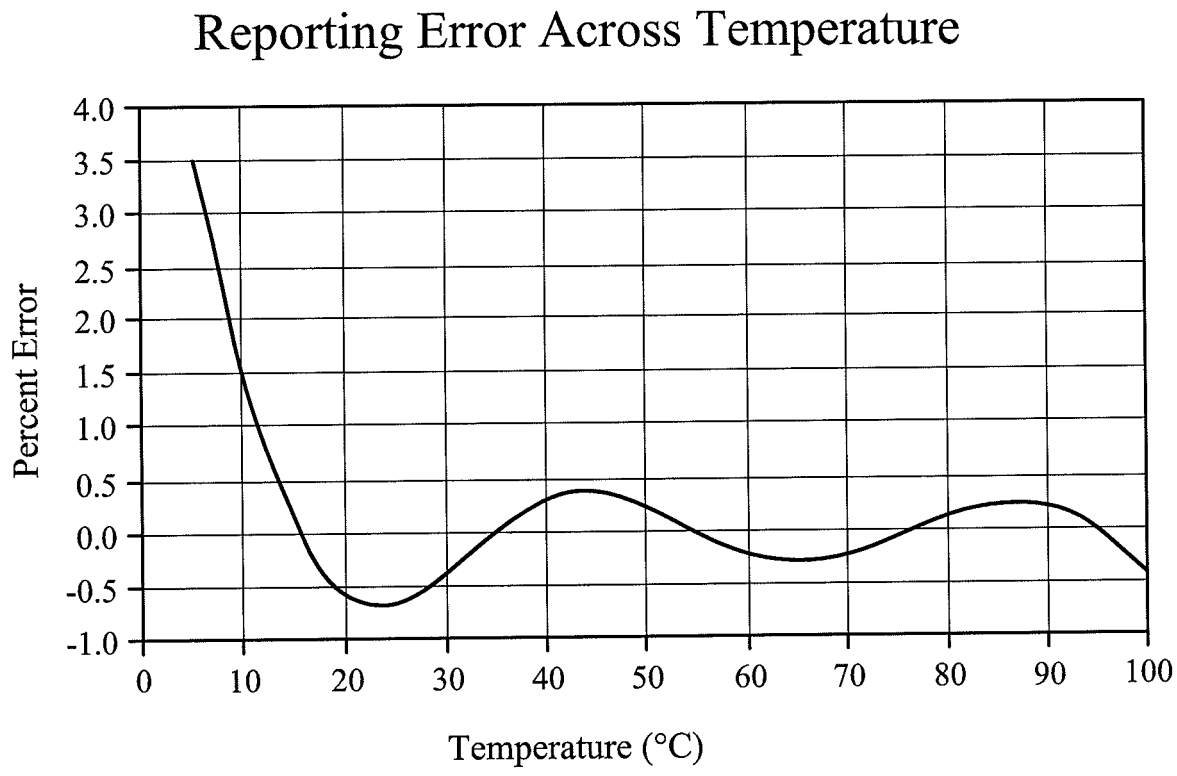

Reporting Error Across Temperature
Percent Error
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
0
10
20
30
40
50
60
70
80
90
100
Temperature (°C)

FIG. 28

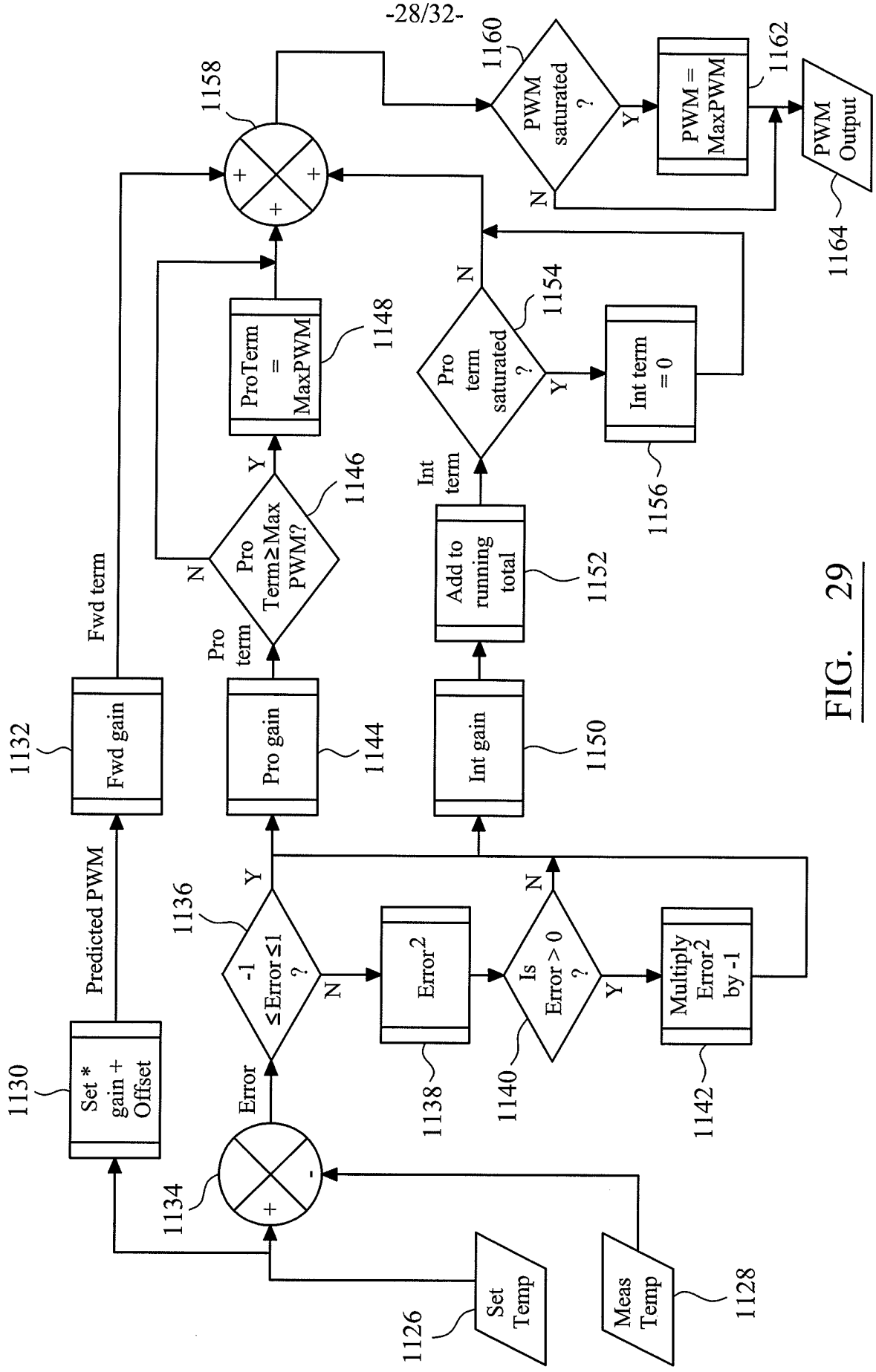

Set Temp
1126
Meas Temp
1128
Set * gain + Offset
1130
Predicted PWM
Fwd gain
1132
Fwd term
Error
1134
-1 ≤ Error ≤ 1 ?
1136
Y
N
Error²
1138
Is Error > 0 ?
1140
N
Y
Multiply Error² by -1
1142
Pro gain
1144
Pro term
Pro Term ≥ Max PWM?
1146
N
Y
ProTerm = MaxPWM
1148
Add to running total
1152
Int term
Int gain
1150
Pro term saturated ?
1154
N
Y
Int term = 0
1156
PWM saturated ?
1160
N
Y
PWM = MaxPWM
1162
PWM Output
1164
1158
+
+
+
-

FIG. 29

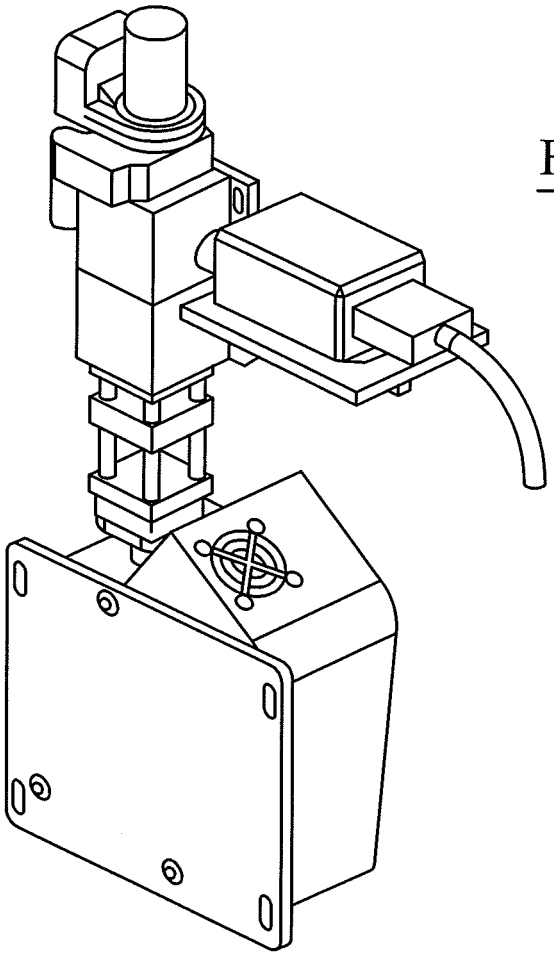


FIG. 30A

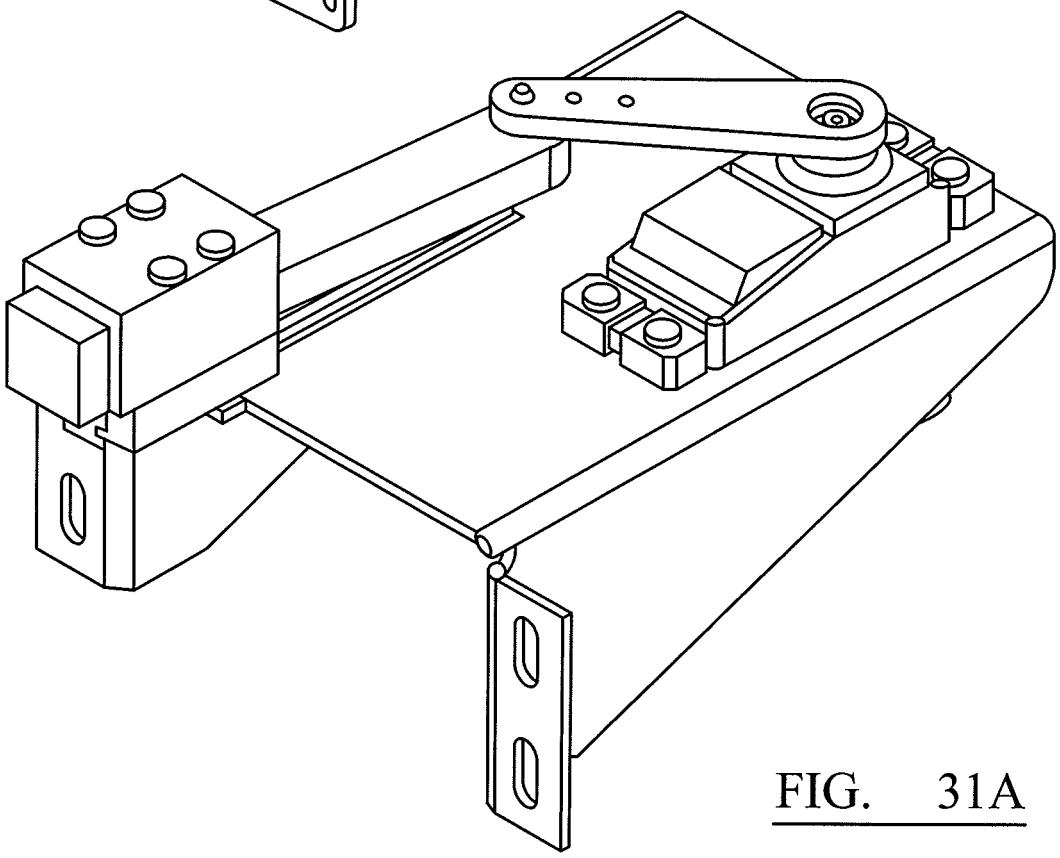


FIG. 31A

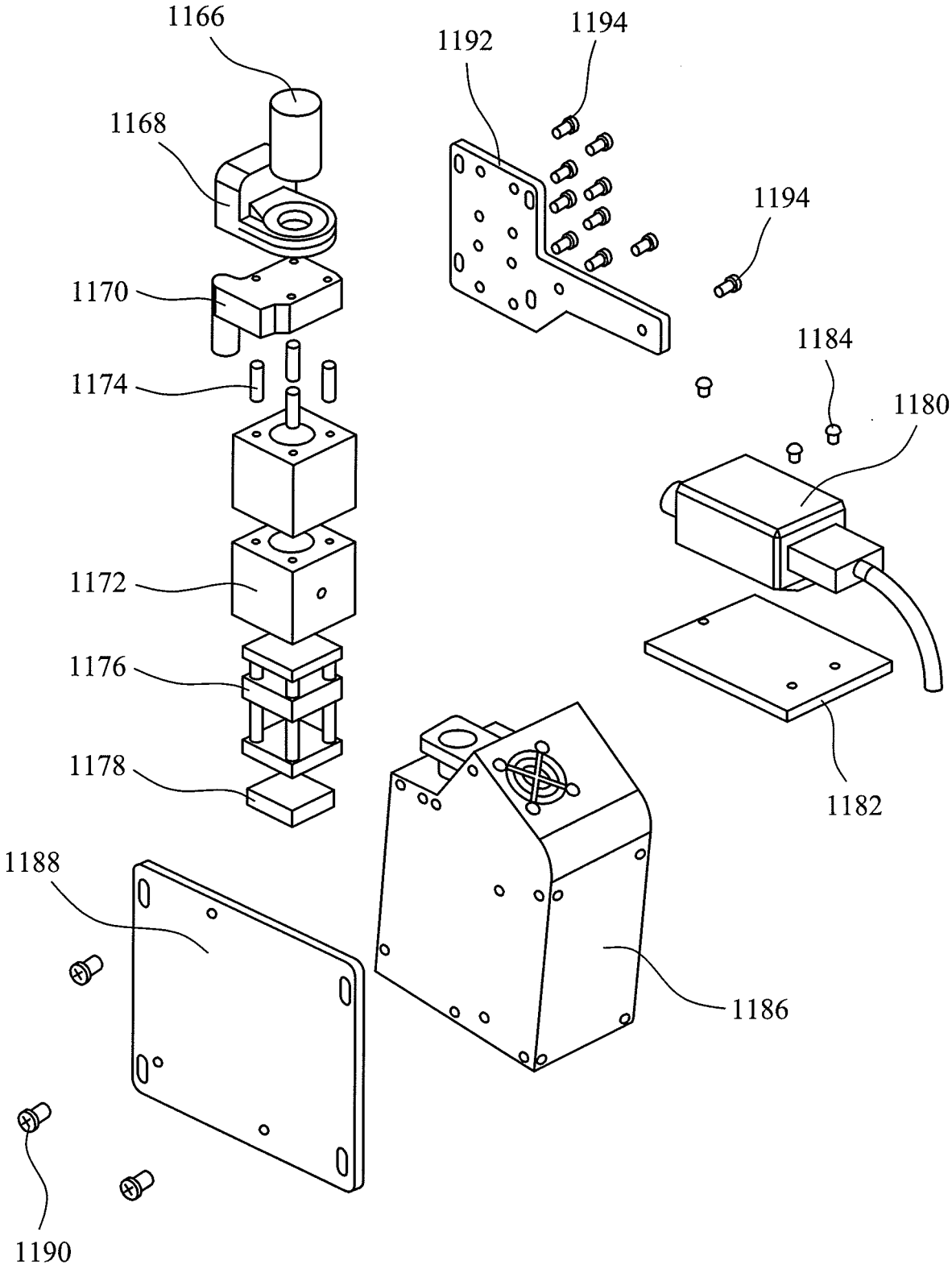

1166
1168
1170
1174
1172
1176
1178
1188
1190
1192
1194
1194
1184
1180
1182
1186

FIG. 30B

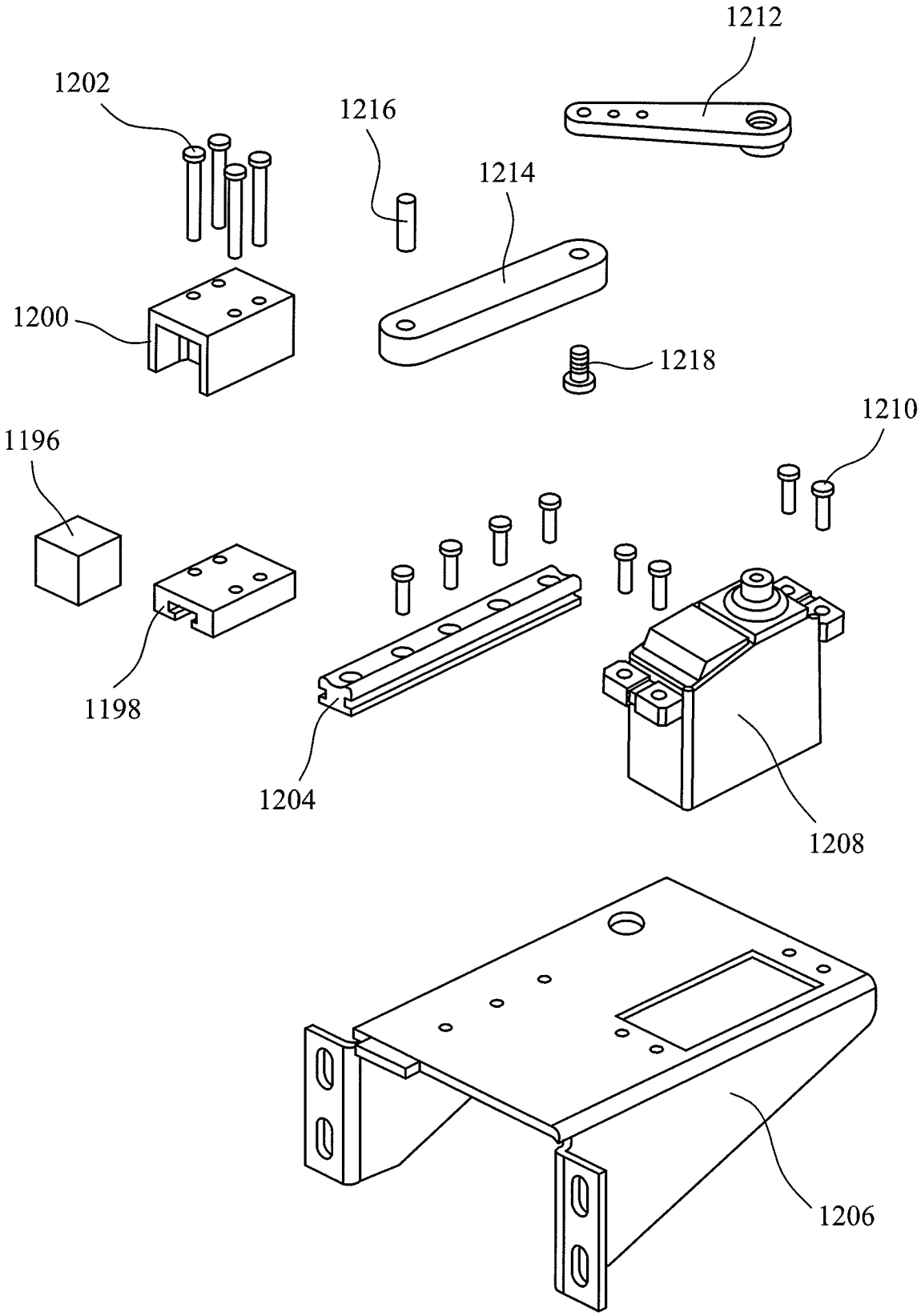
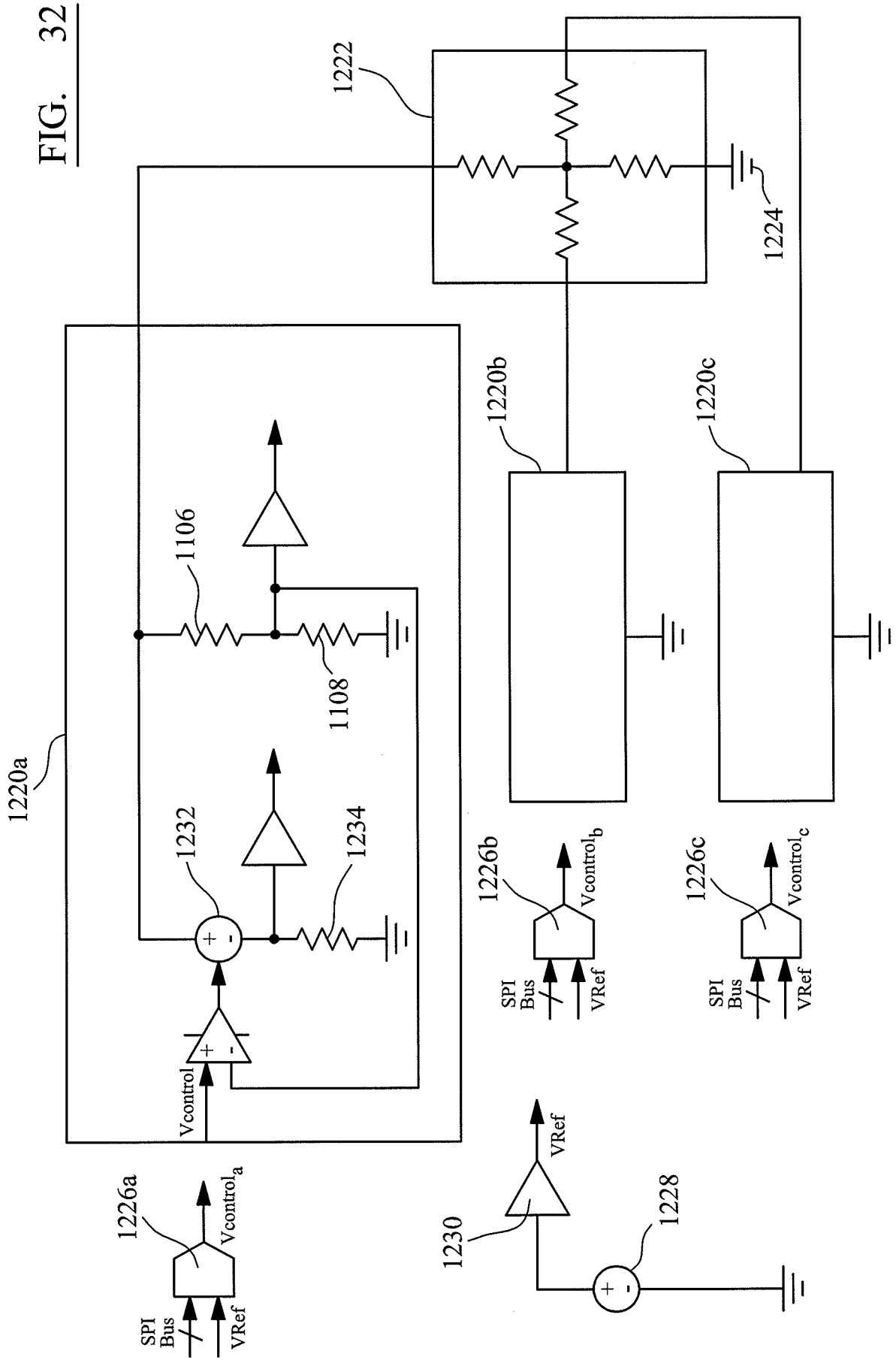


FIG. 31B

FIG. 32


1222
1224
1220b
1220c
1220a
1106
1108
1232
1234
Vcontrol
1226a
Vcontrol$_a$
SPI Bus
VRef
1226b
Vcontrol$_b$
1226c
Vcontrol$_c$
1230
1228