

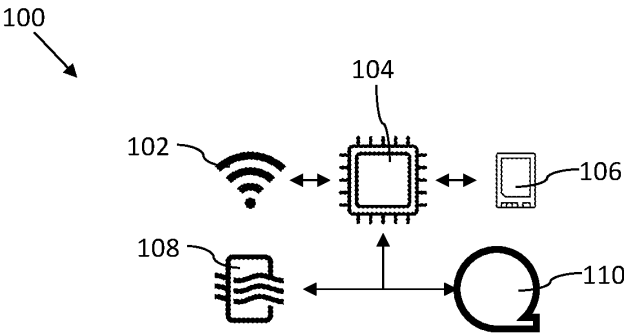


FIG. 1A

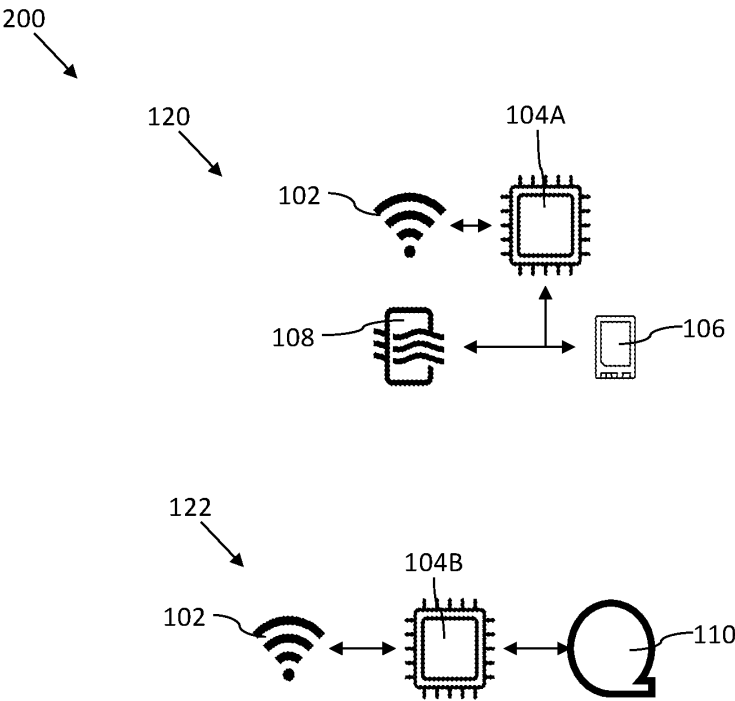


FIG. 2A

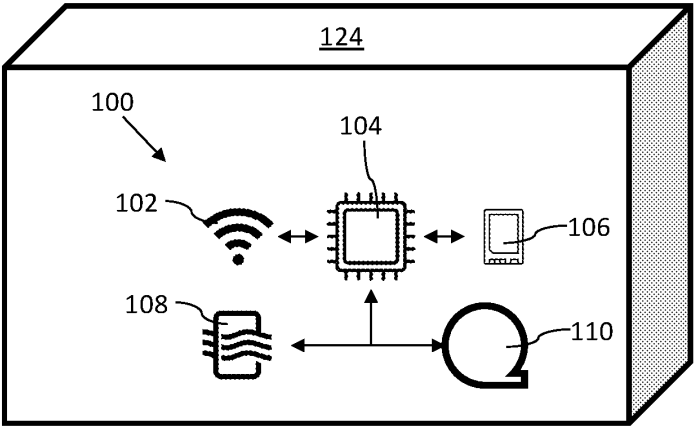


FIG. 1B

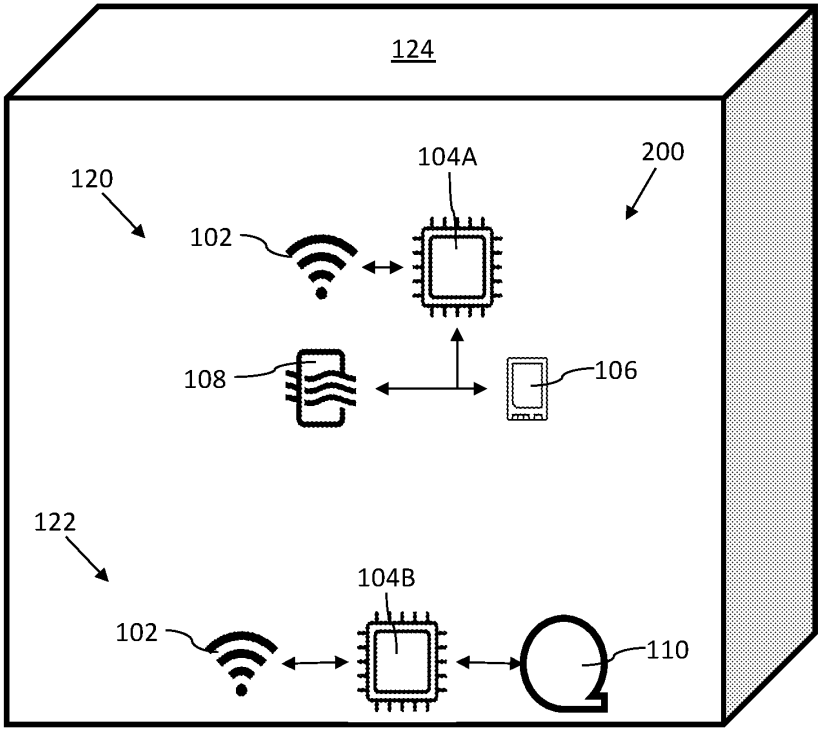


FIG. 2B

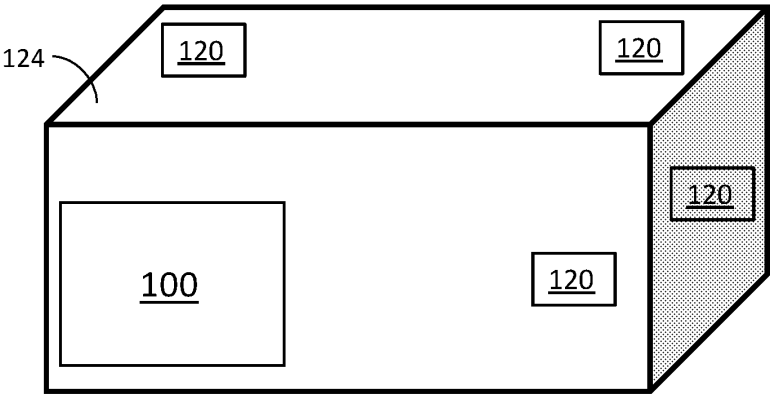


FIG. 1C

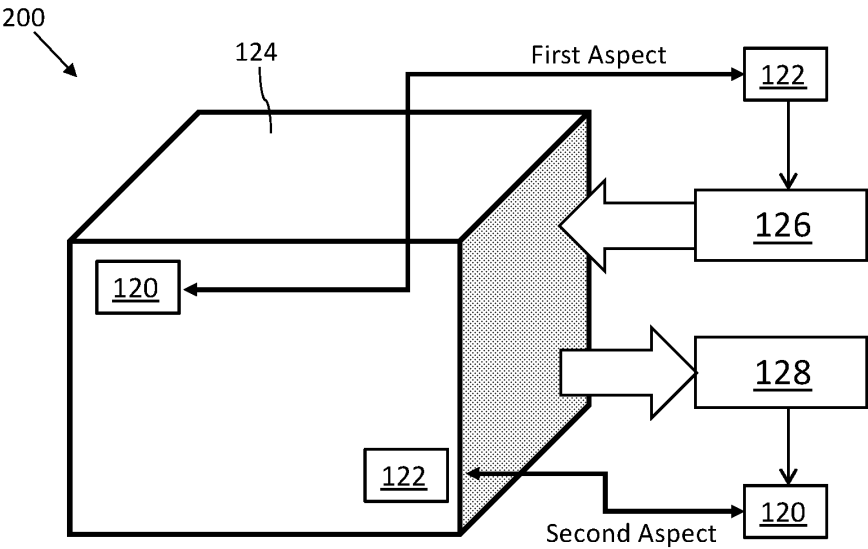


FIG. 2C

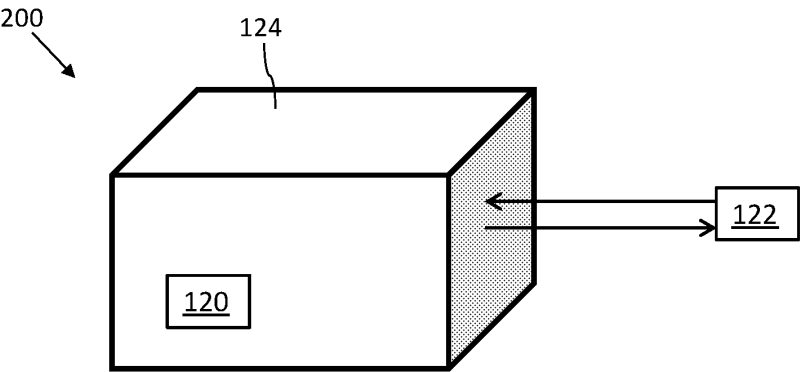


FIG. 2D

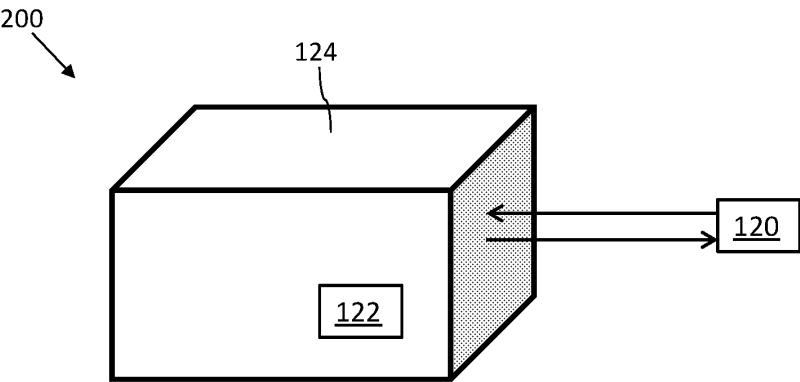


FIG. 2E

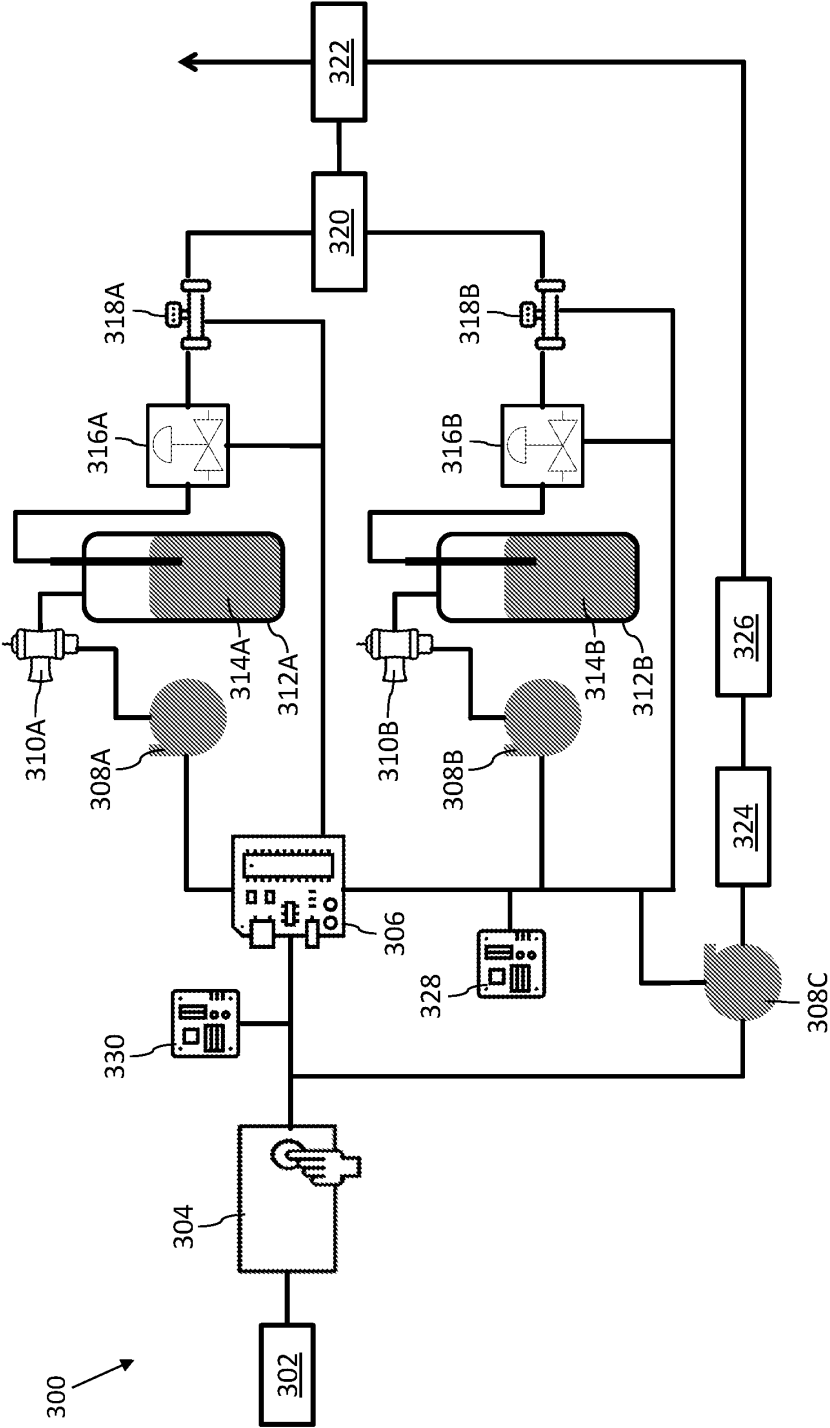


FIG. 3

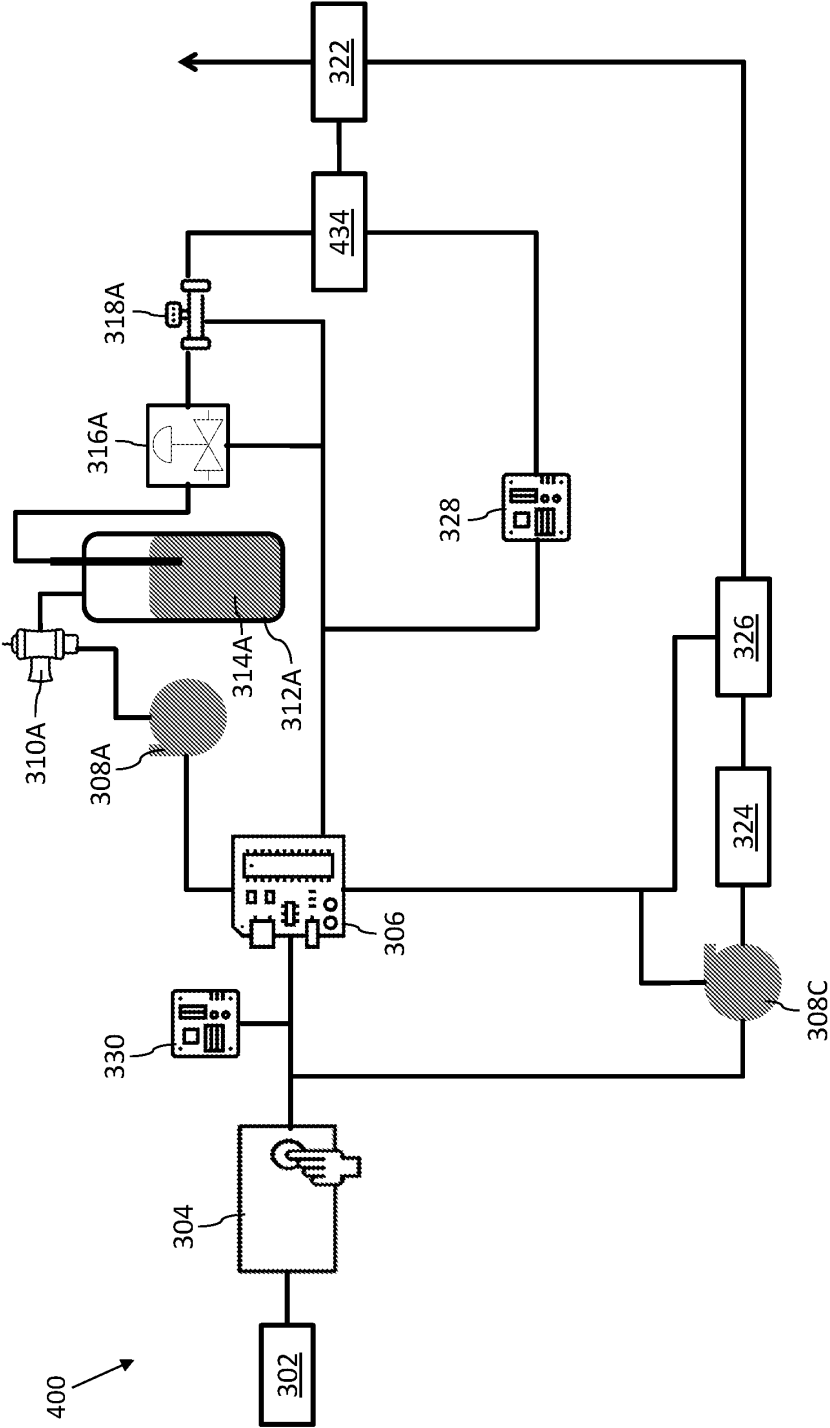


FIG. 4

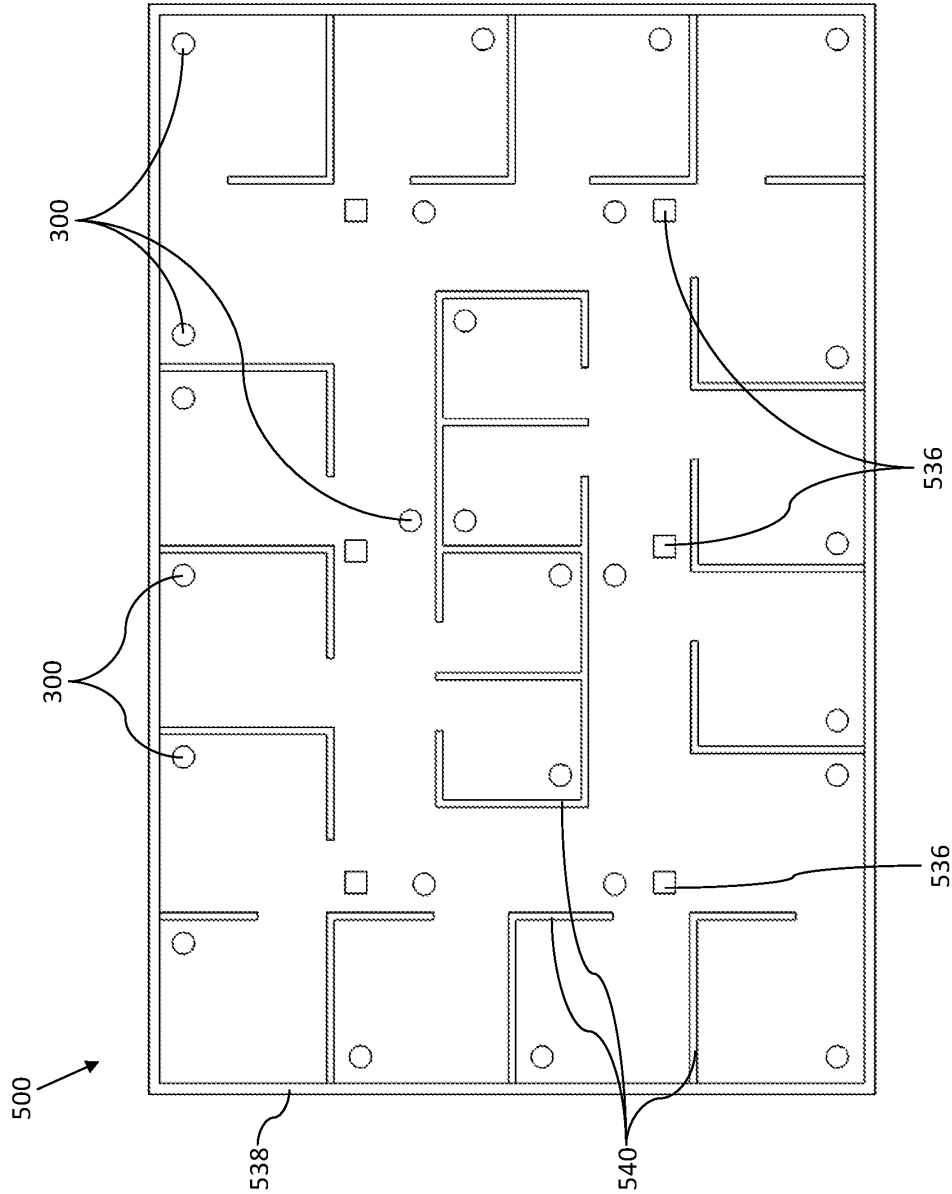


FIG. 5

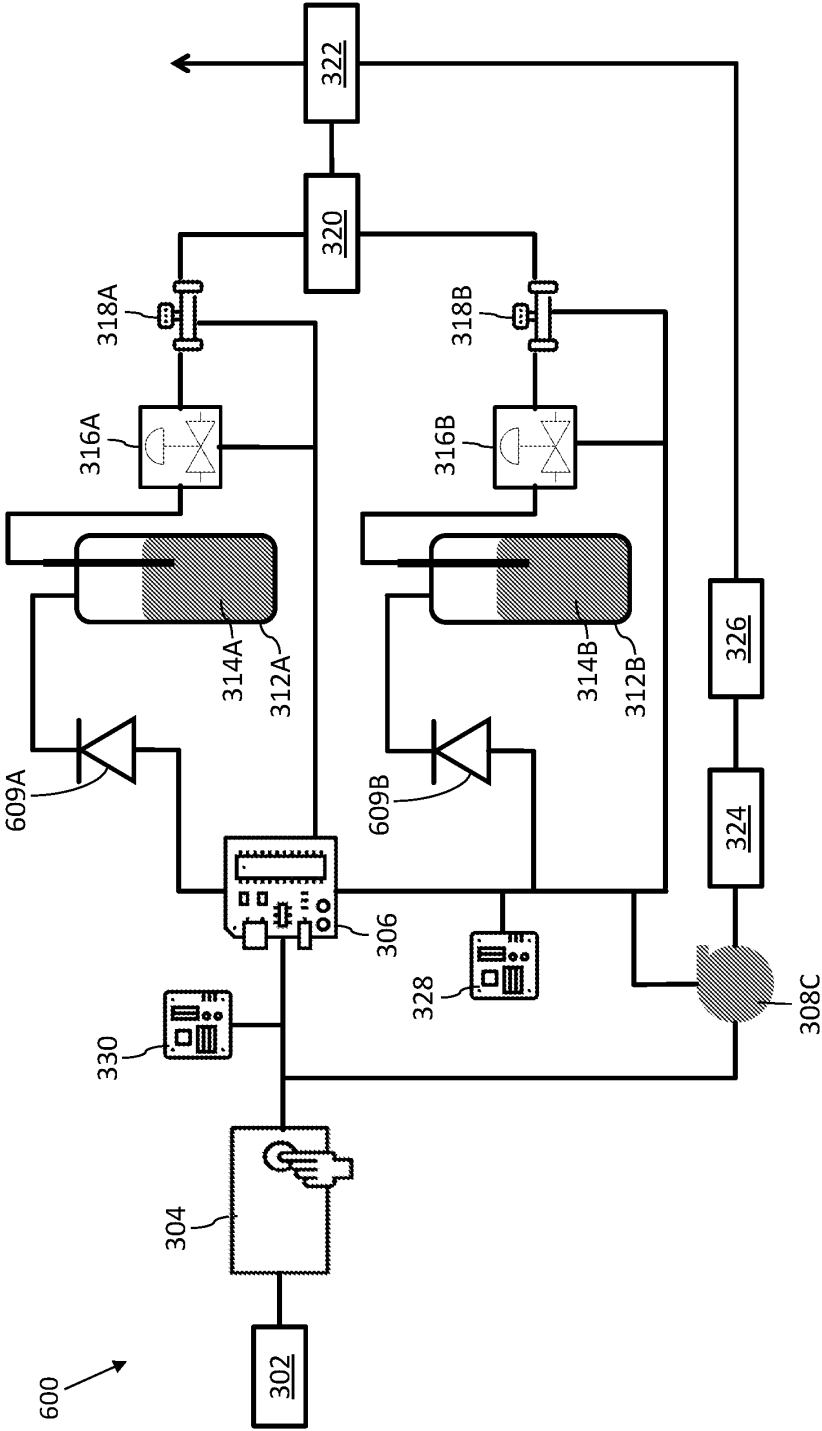


FIG. 6

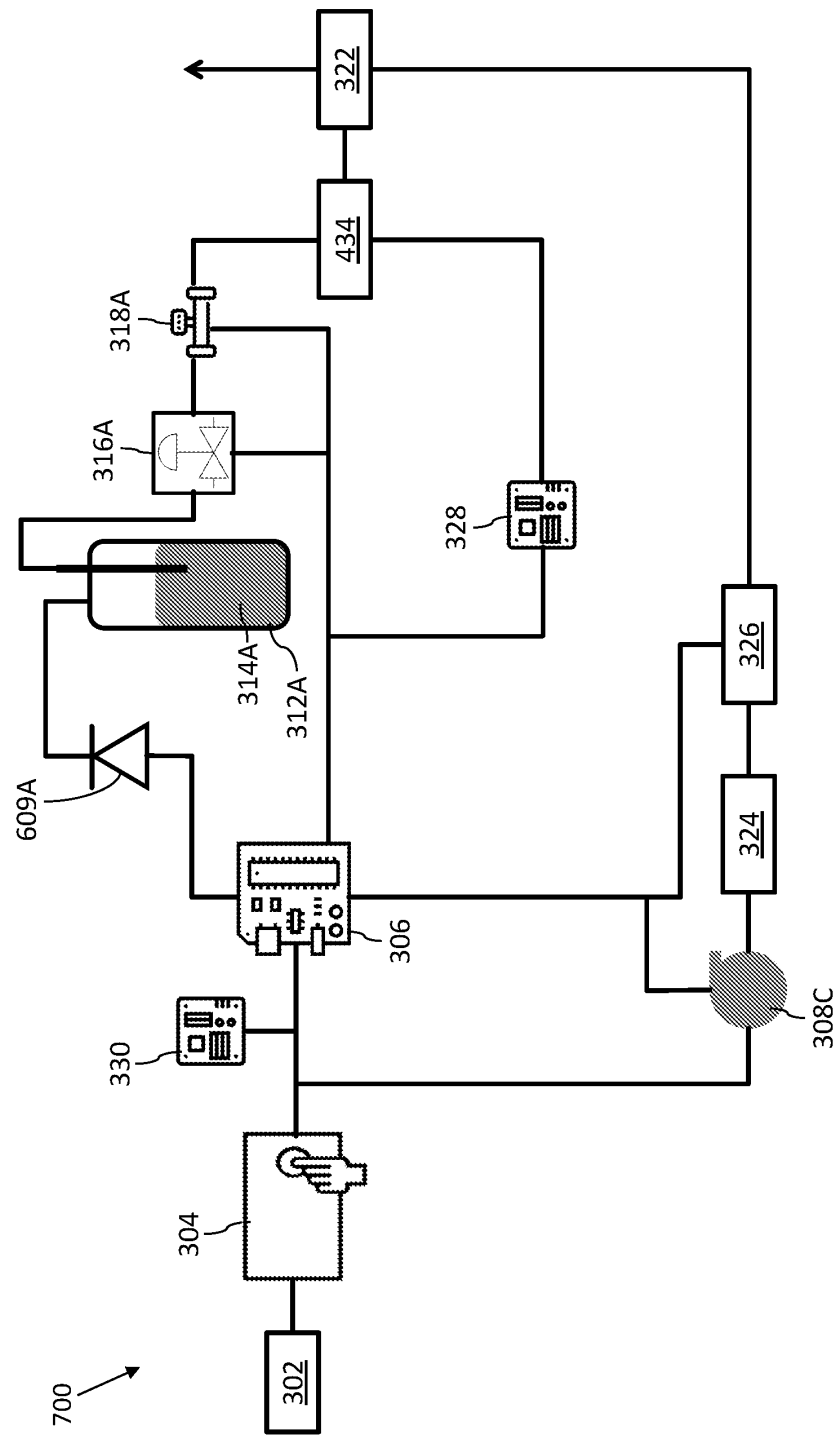


FIG. 7

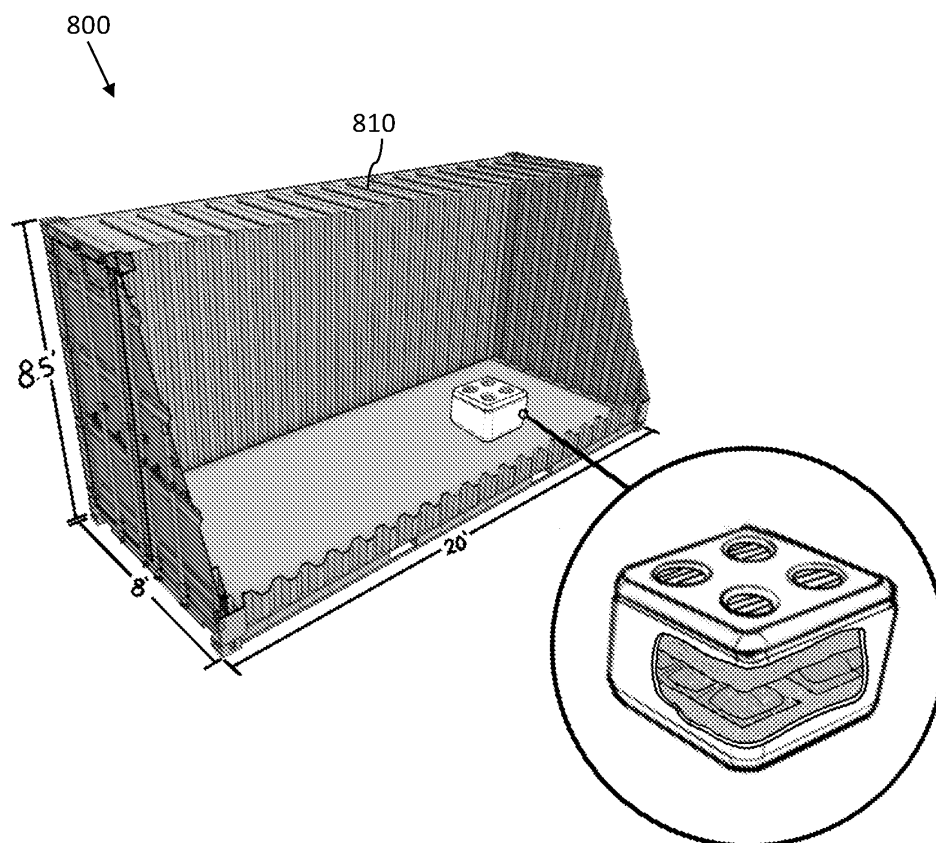


FIG. 8

900
↓

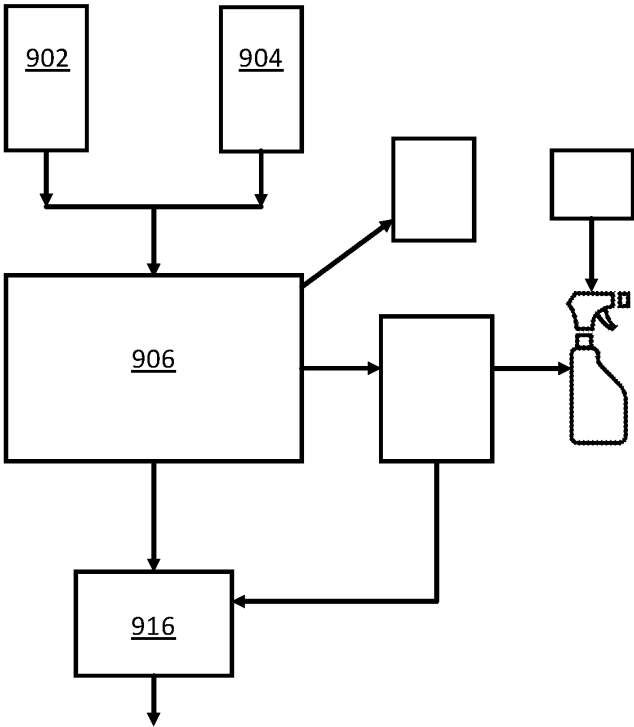


FIG. 9

1000
↘

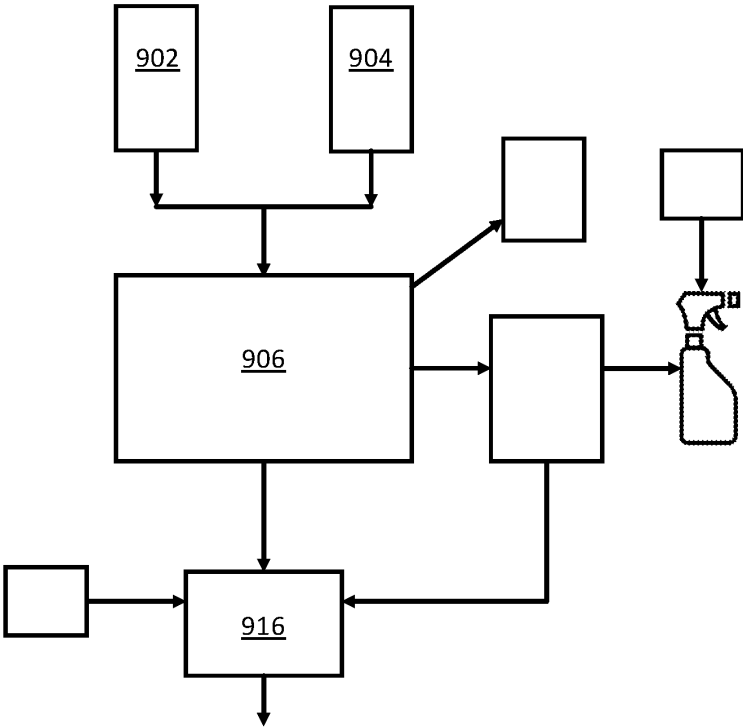


FIG. 10

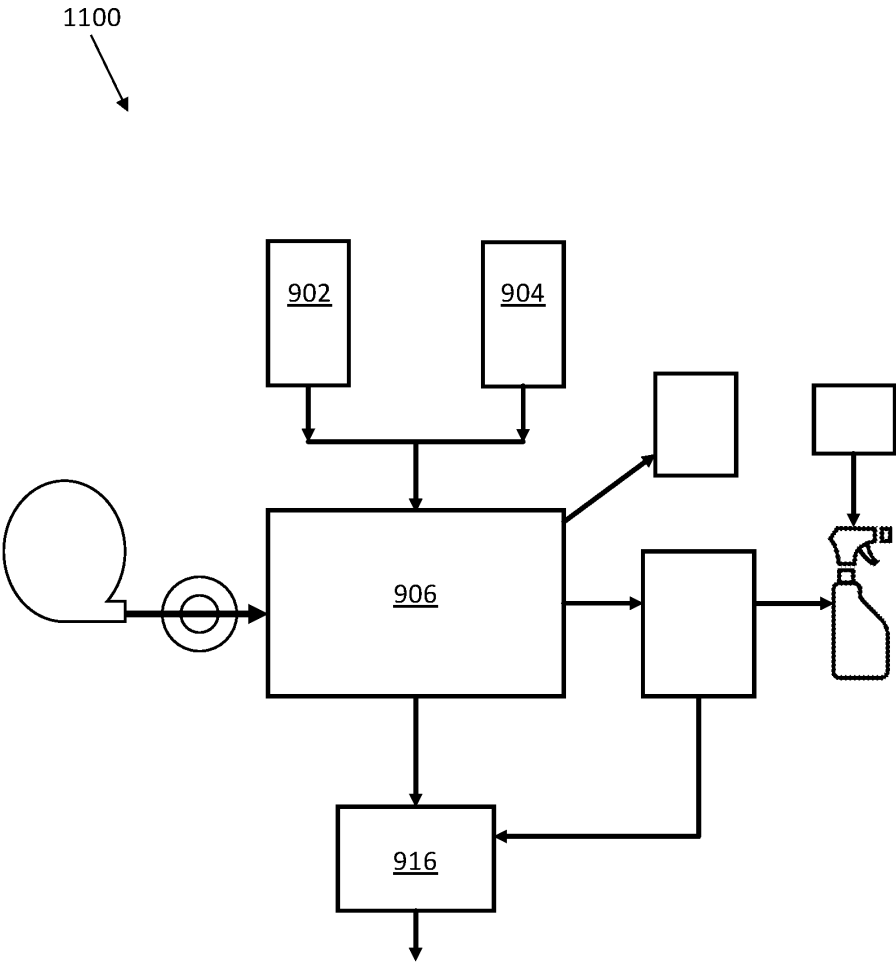


FIG. 11

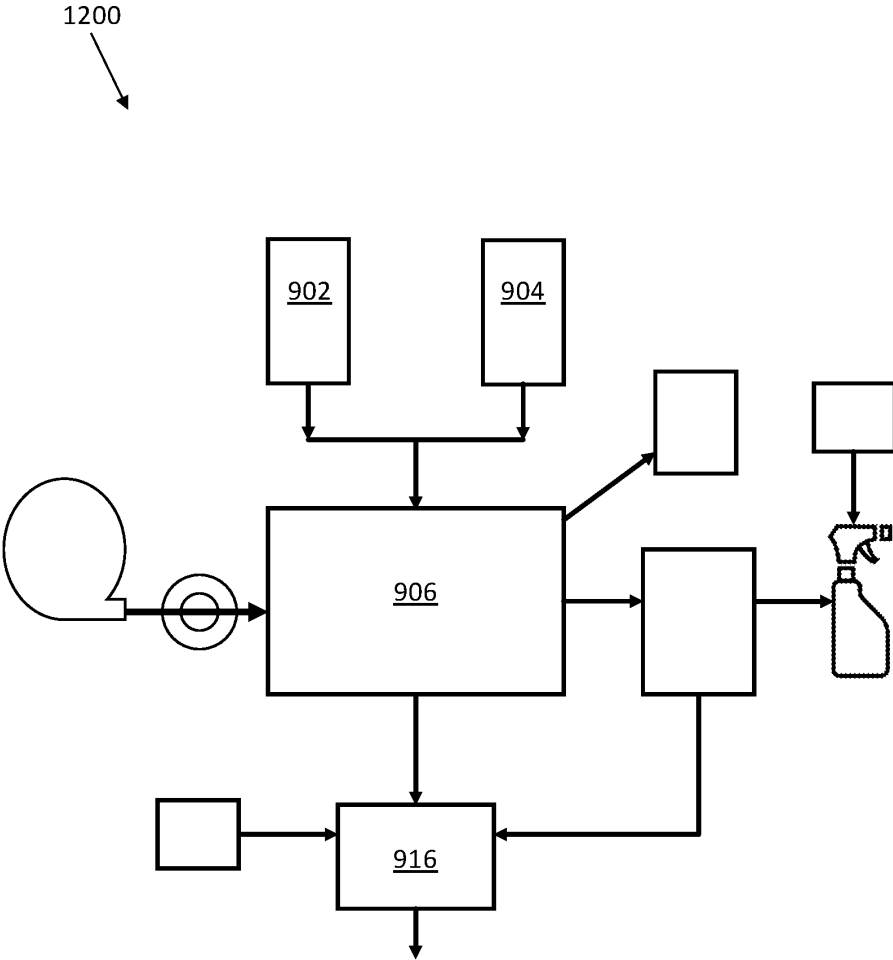


FIG. 12

1300
↘

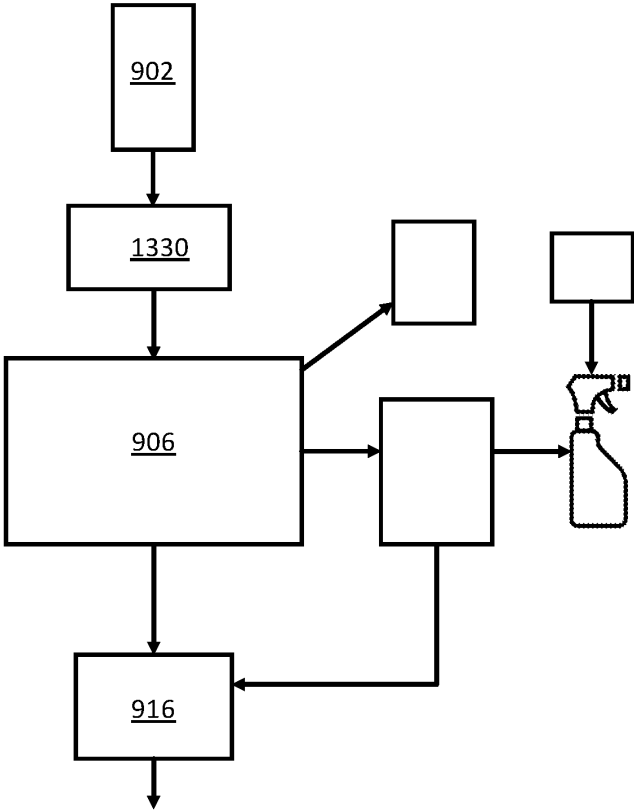


FIG. 13

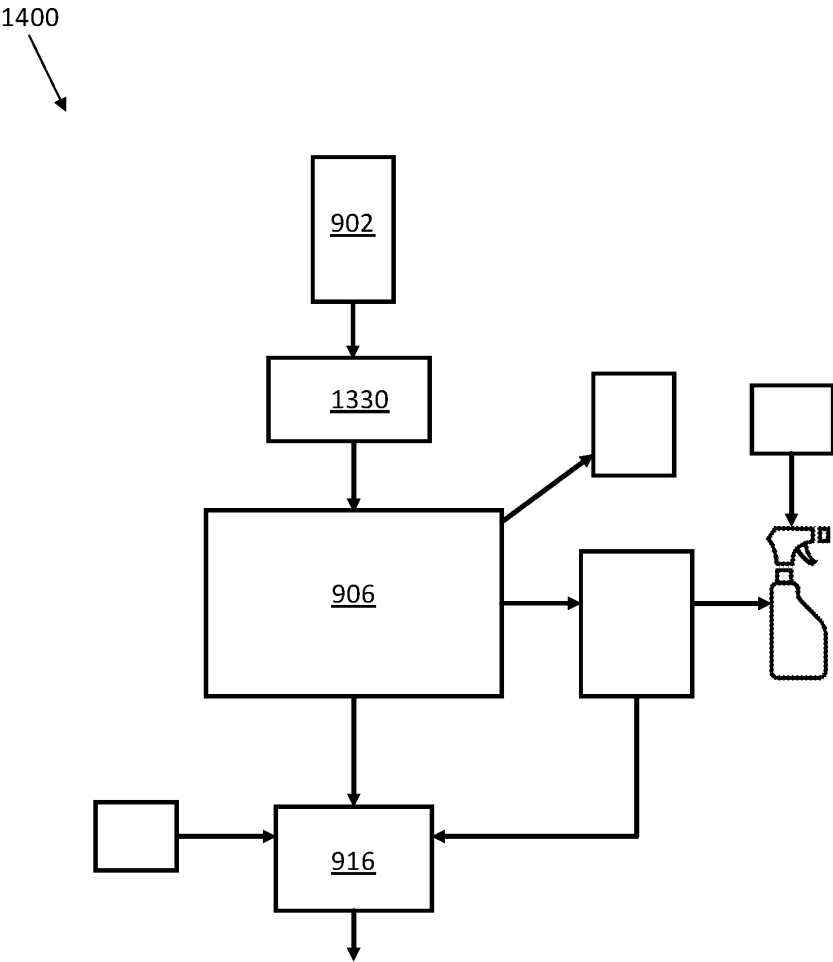


FIG. 14

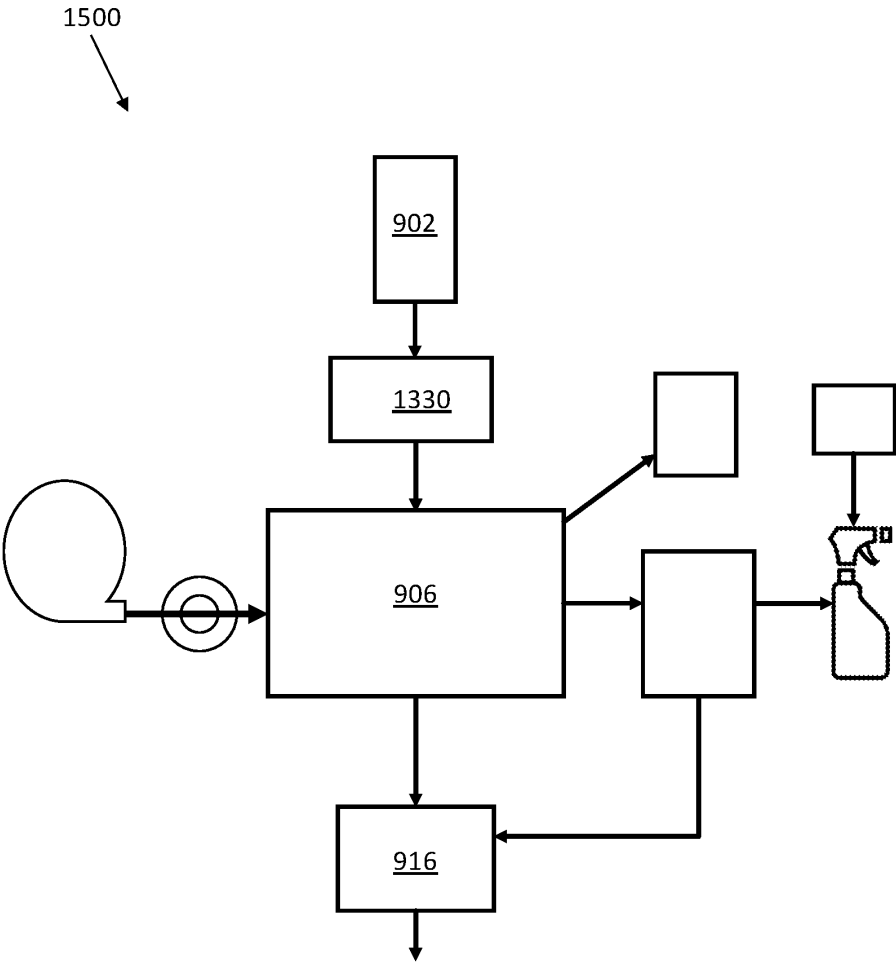


FIG. 15

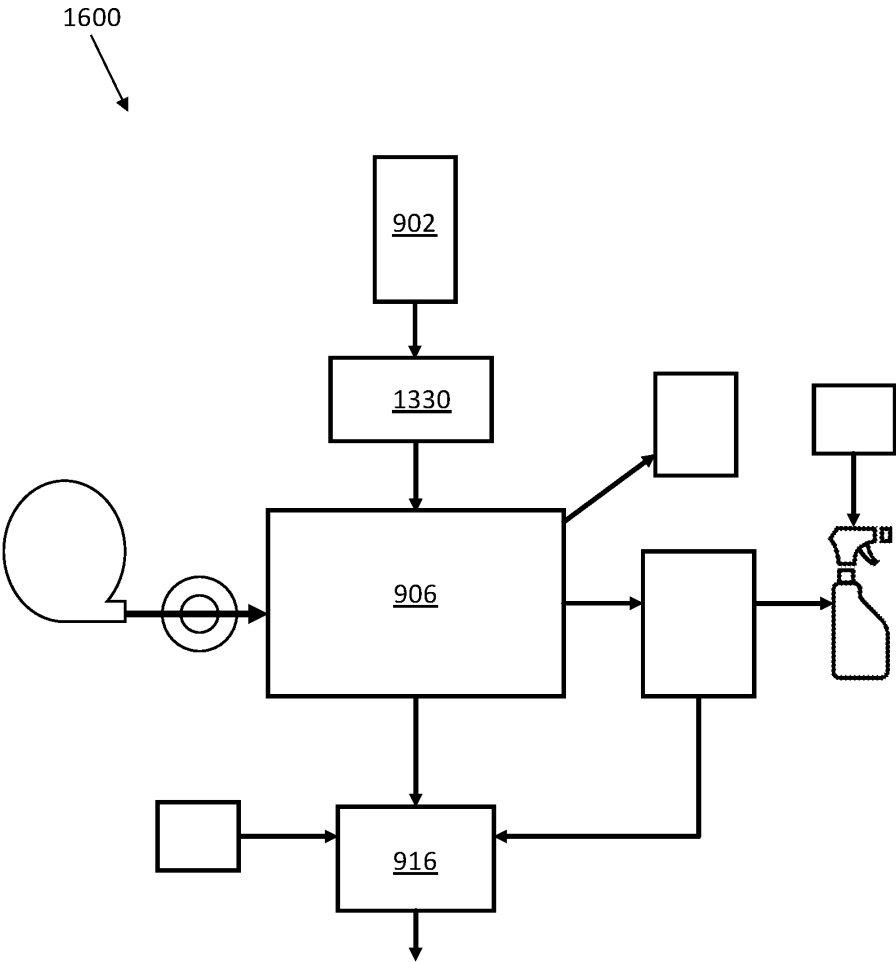


FIG. 16

1700
↓

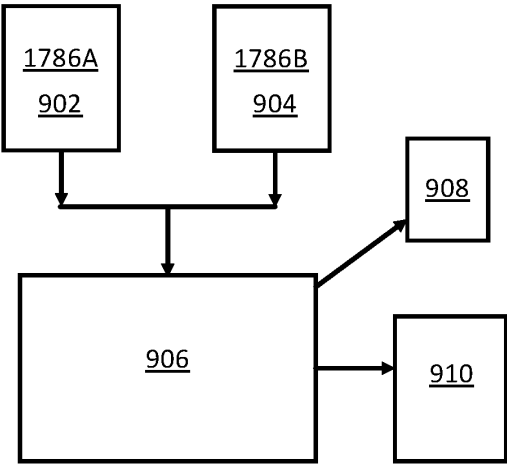


FIG. 17

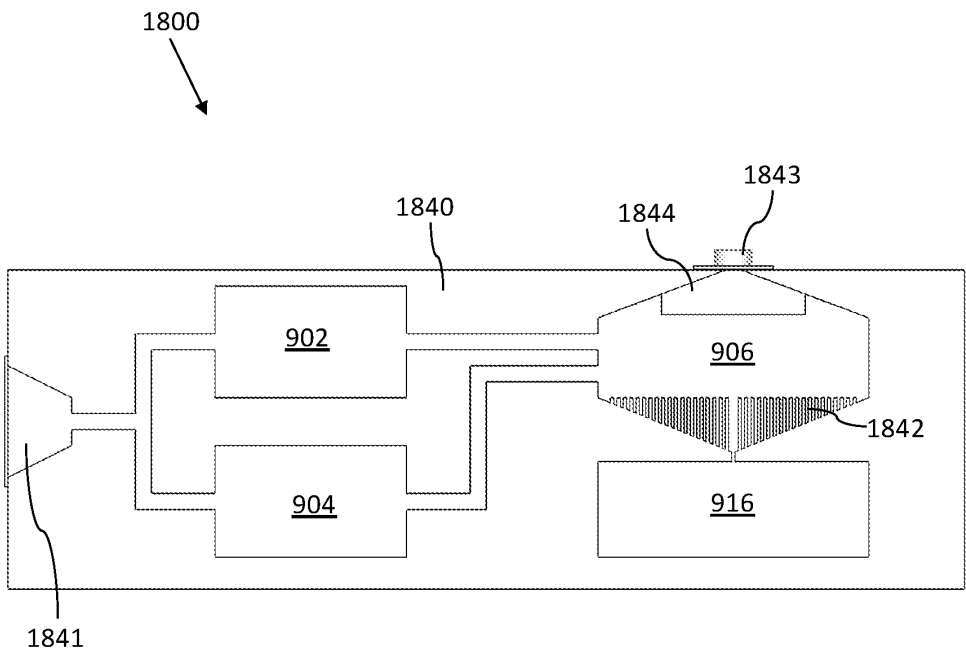


FIG. 18A

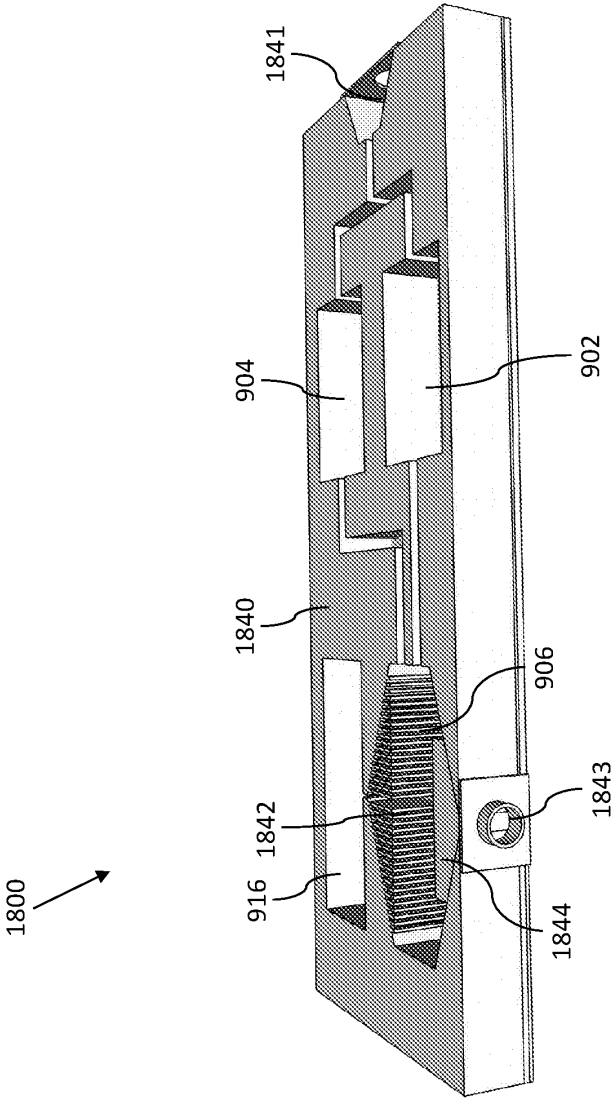


FIG. 18B

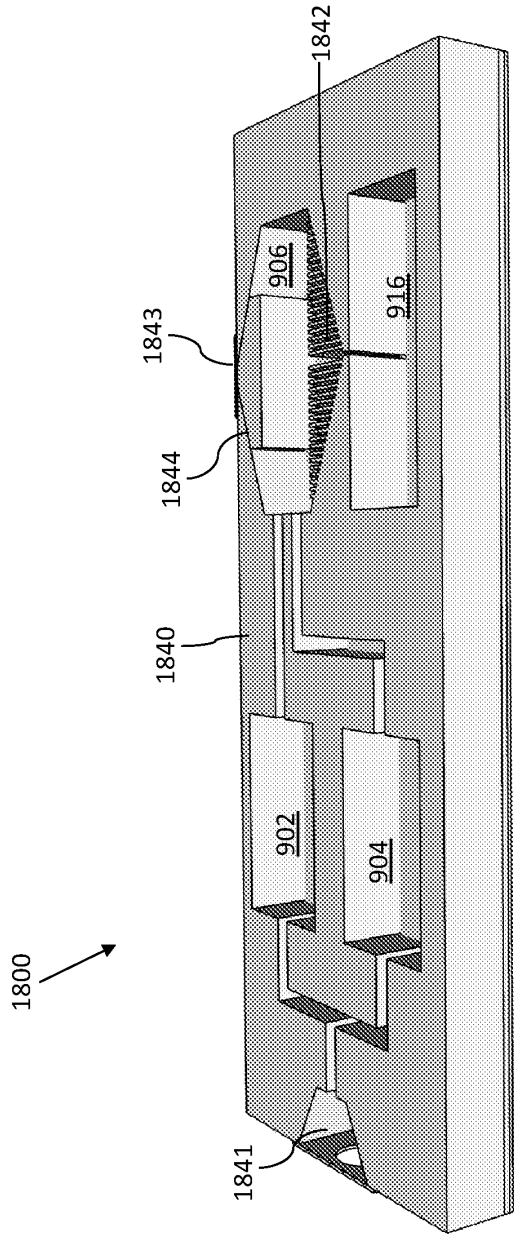
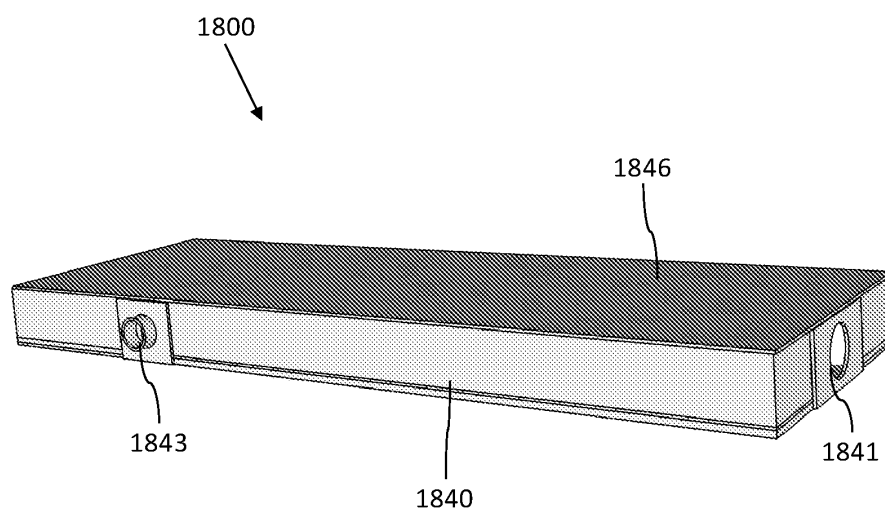
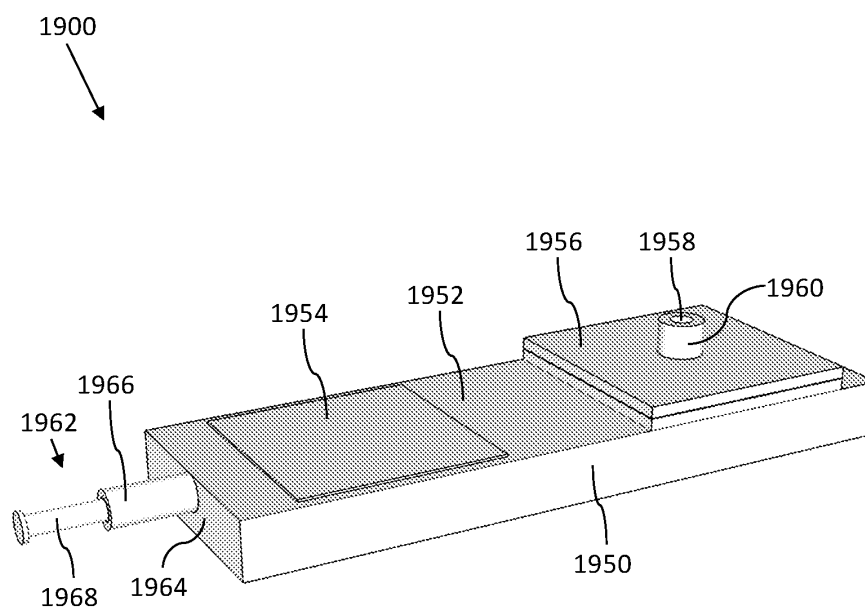


FIG. 18C

**FIG. 18D**

**FIG. 19A**

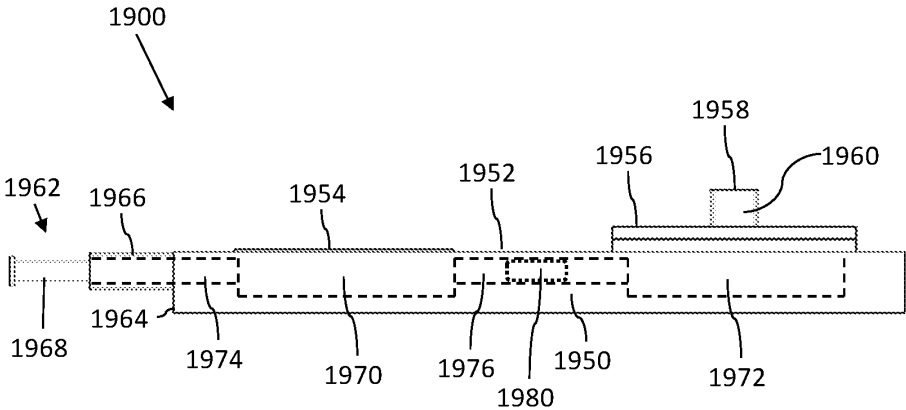


FIG. 19B

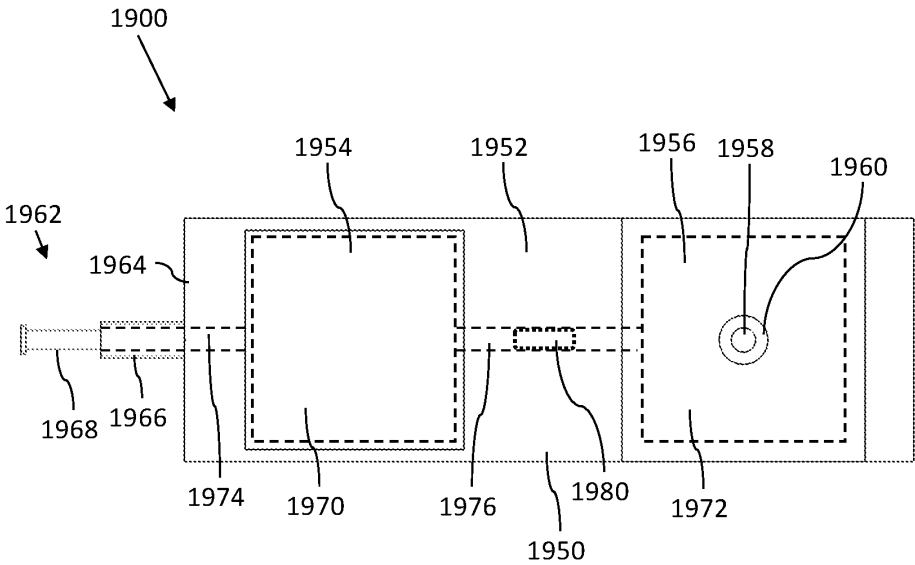


FIG. 19C

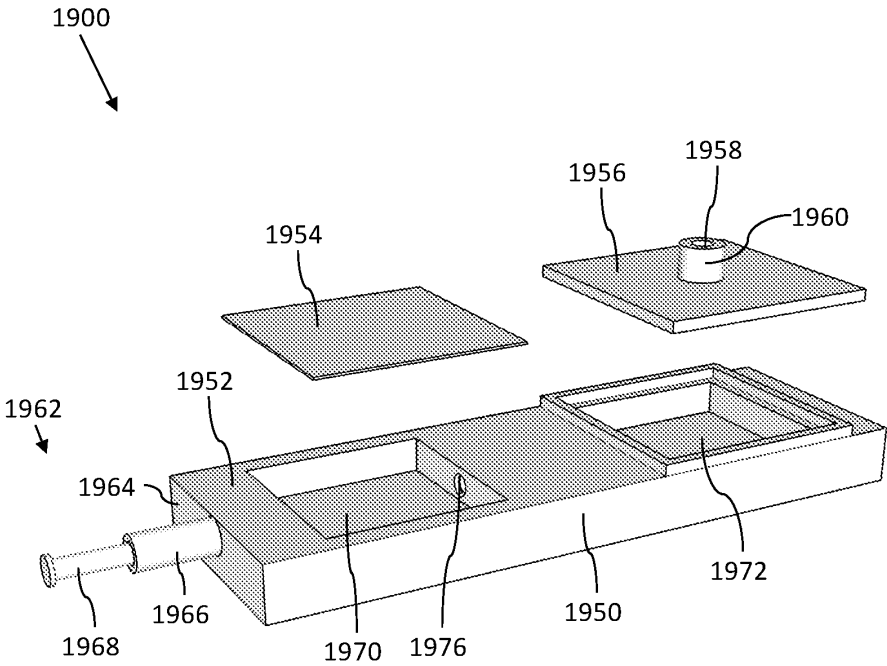


FIG. 19D

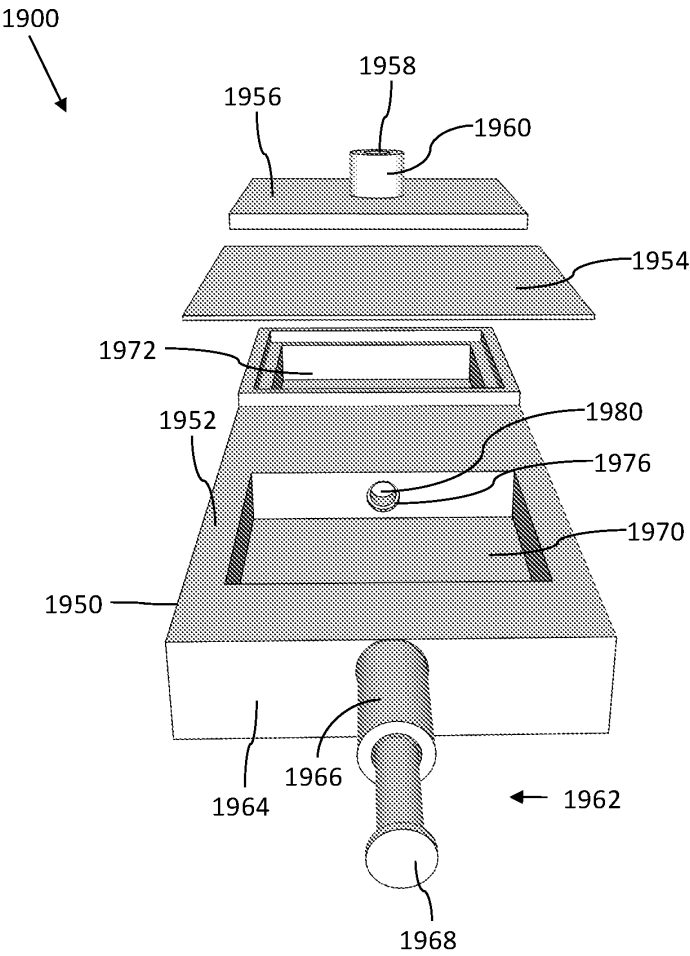


FIG. 19E

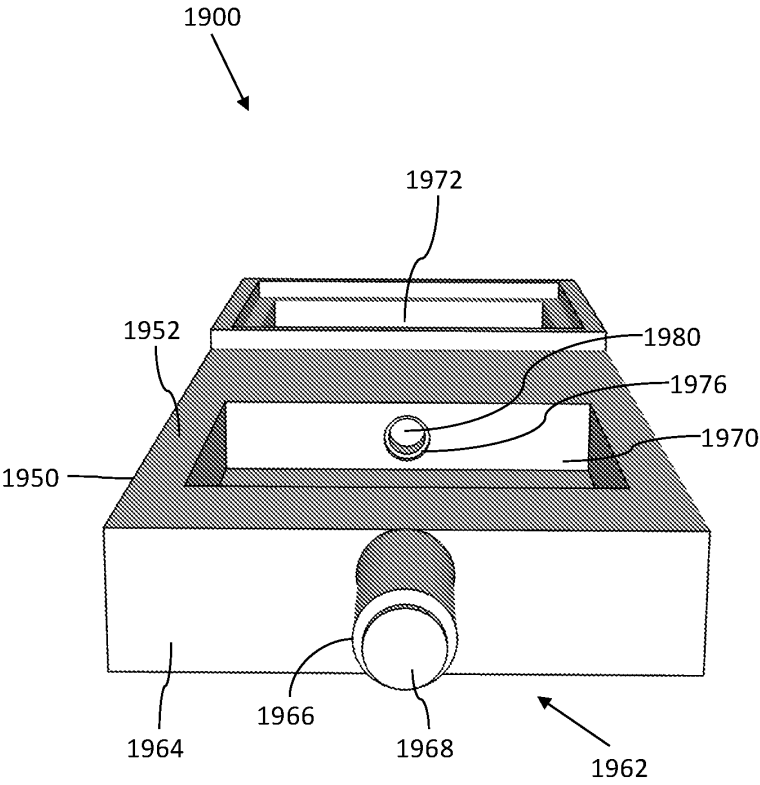


FIG. 19F

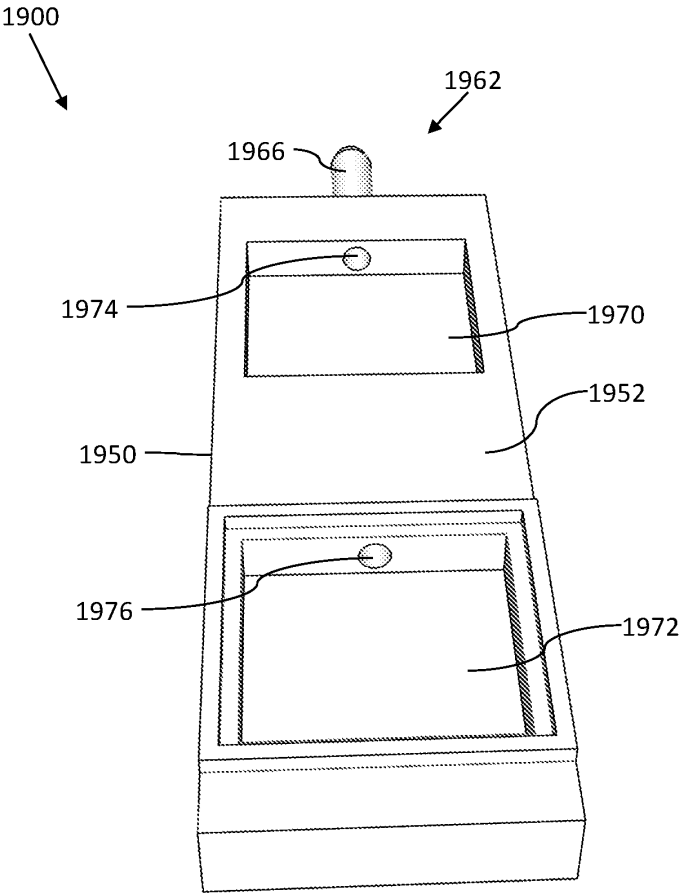


FIG. 19G

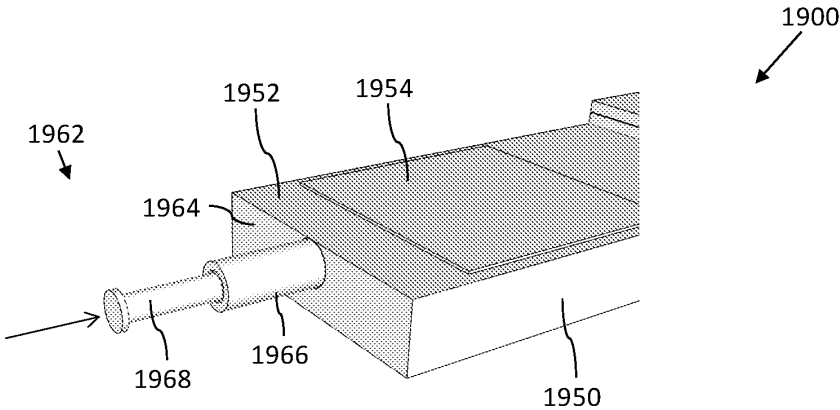


FIG. 19H

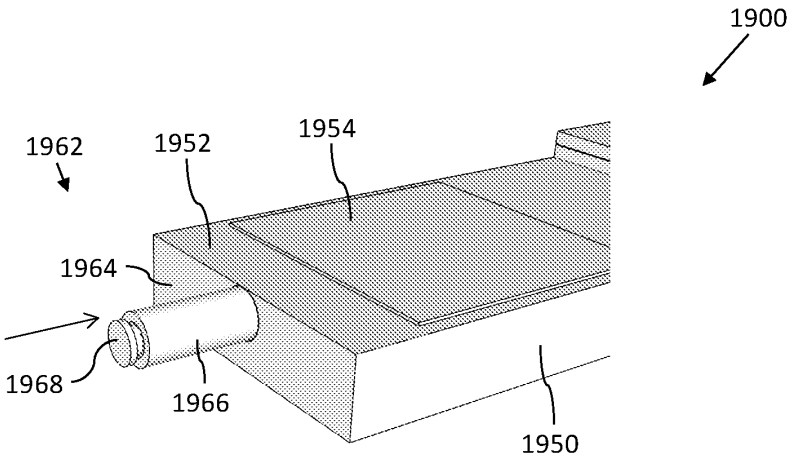


FIG. 19I

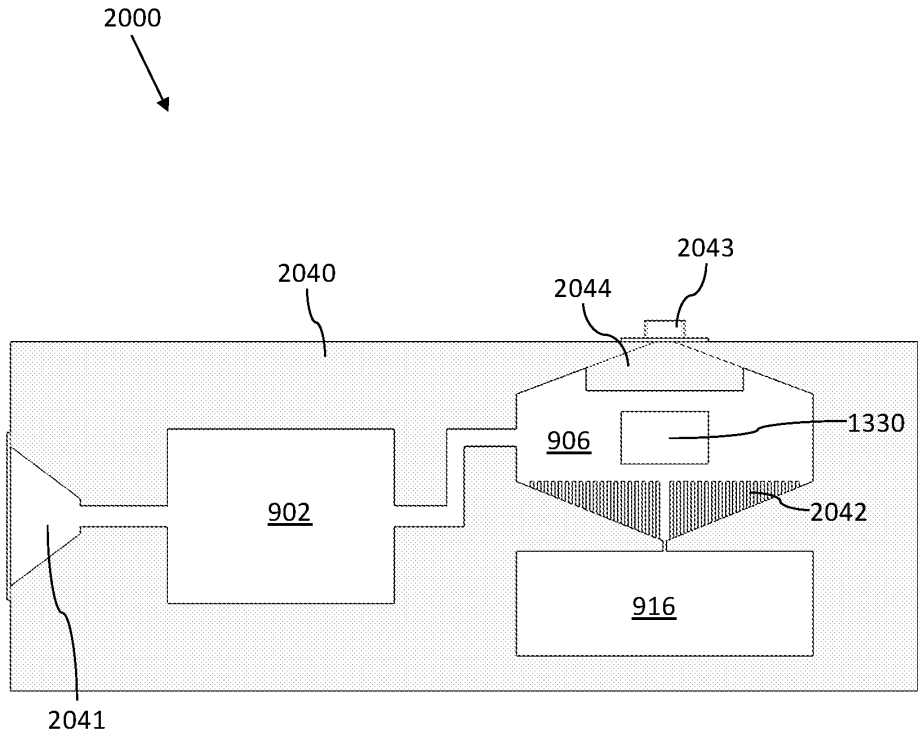


FIG. 20A

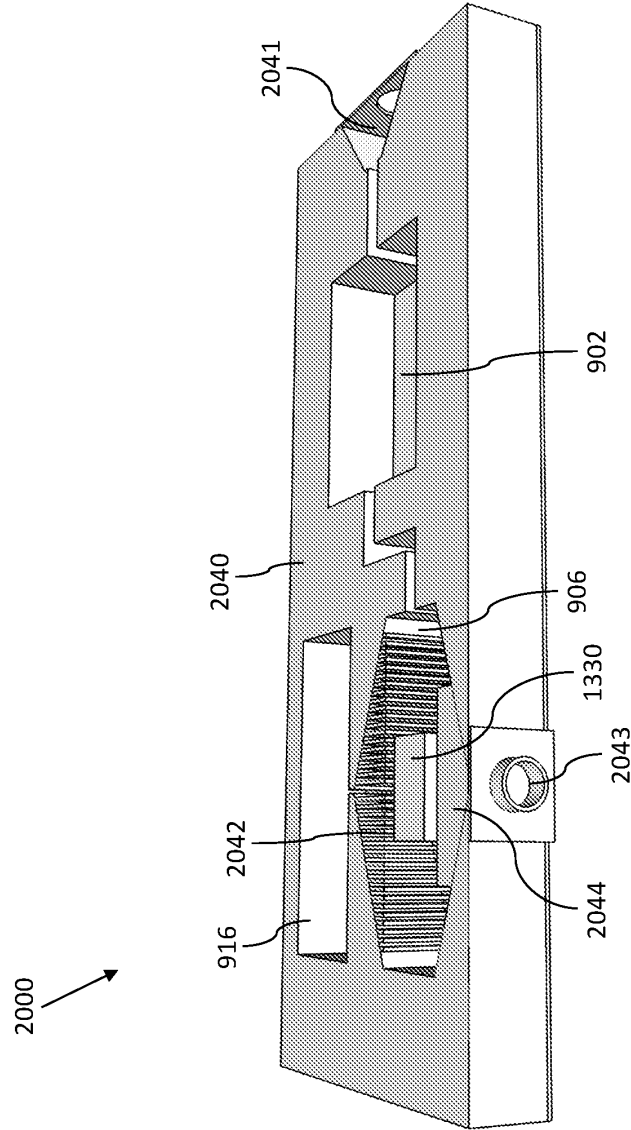


FIG. 20B

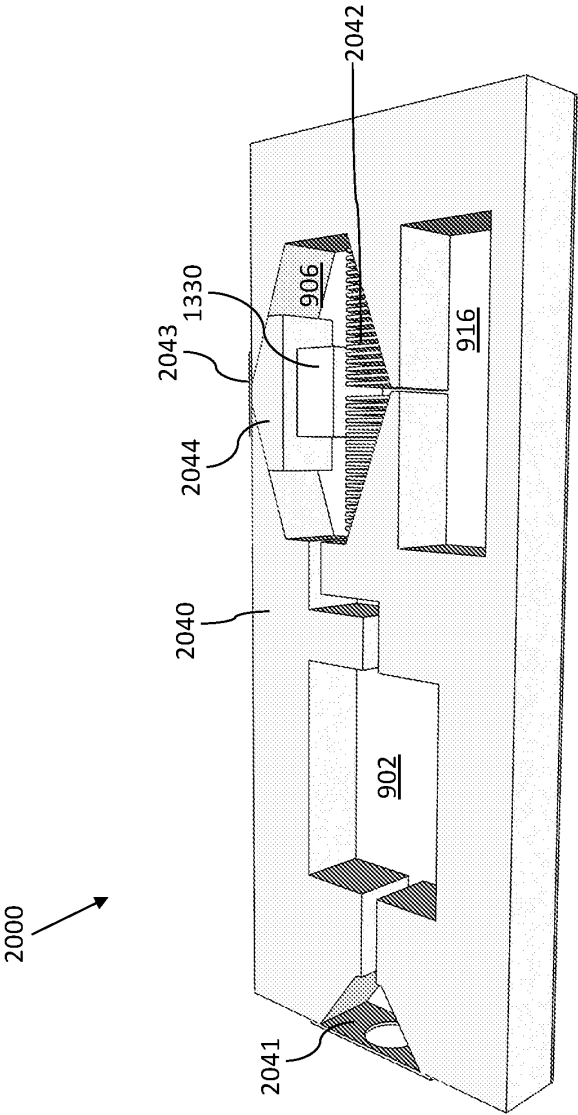


FIG. 20C

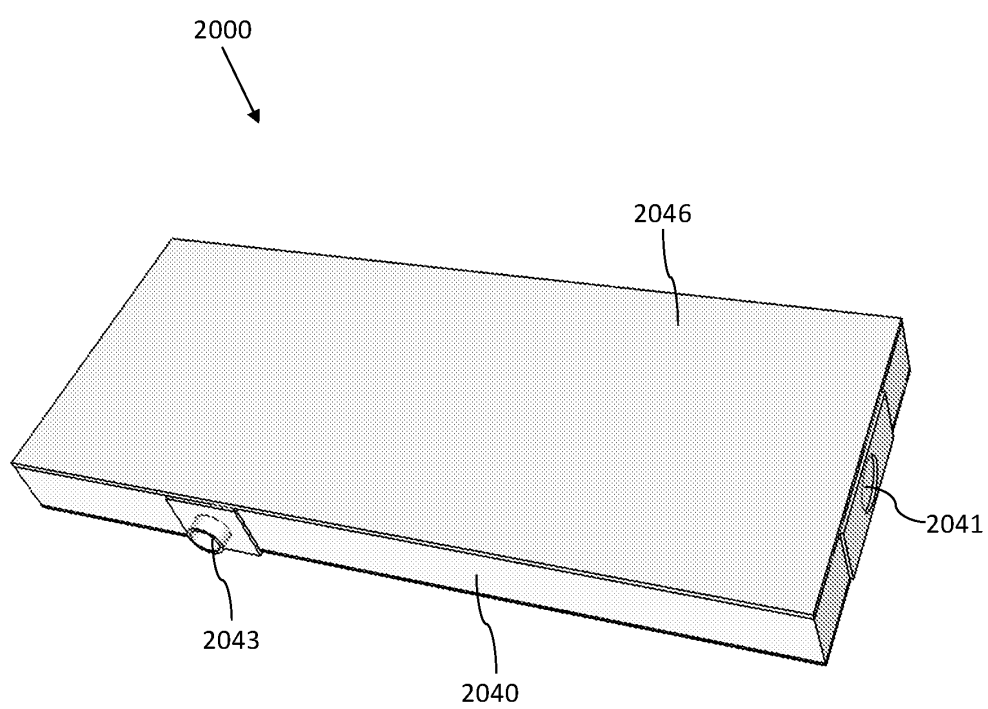


FIG. 20D

2100

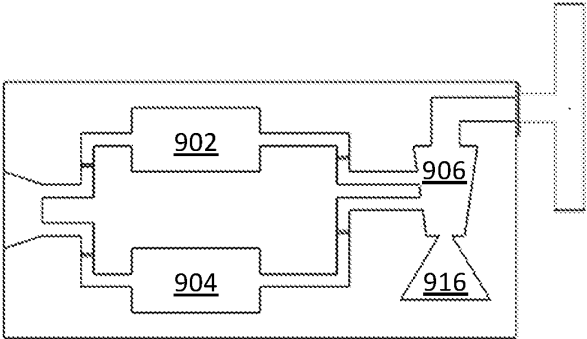


FIG. 21A

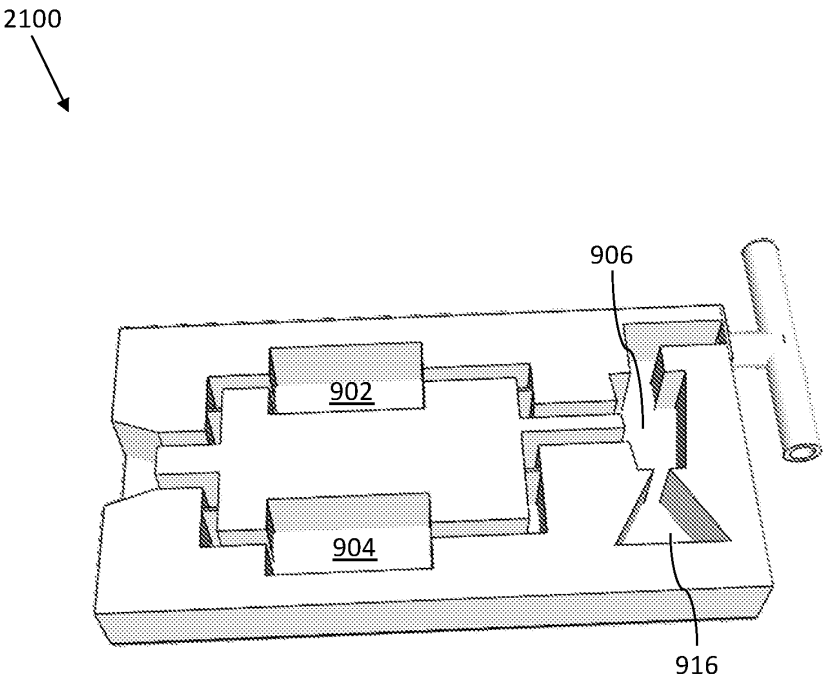


FIG. 21B

2100
↓

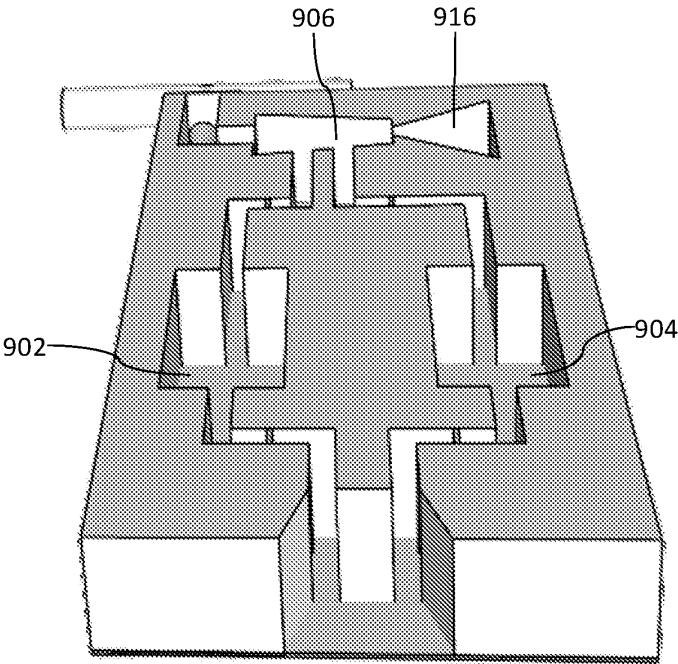


FIG. 21C

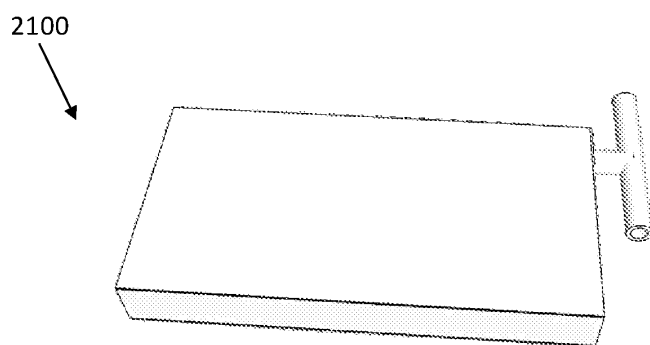


FIG. 21D

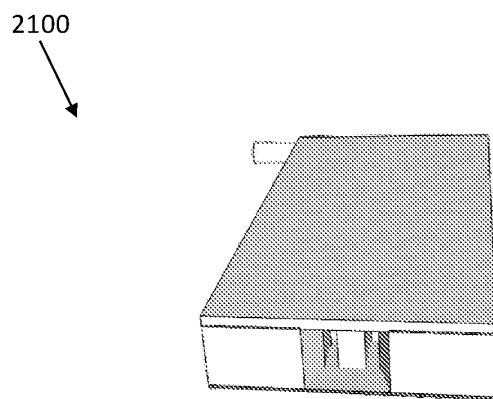


FIG. 21E

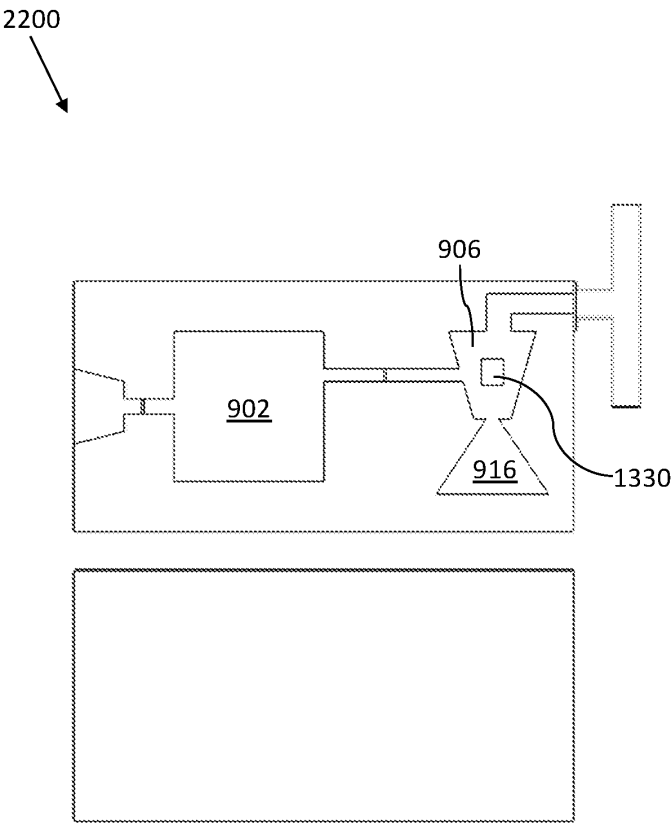


FIG. 22A

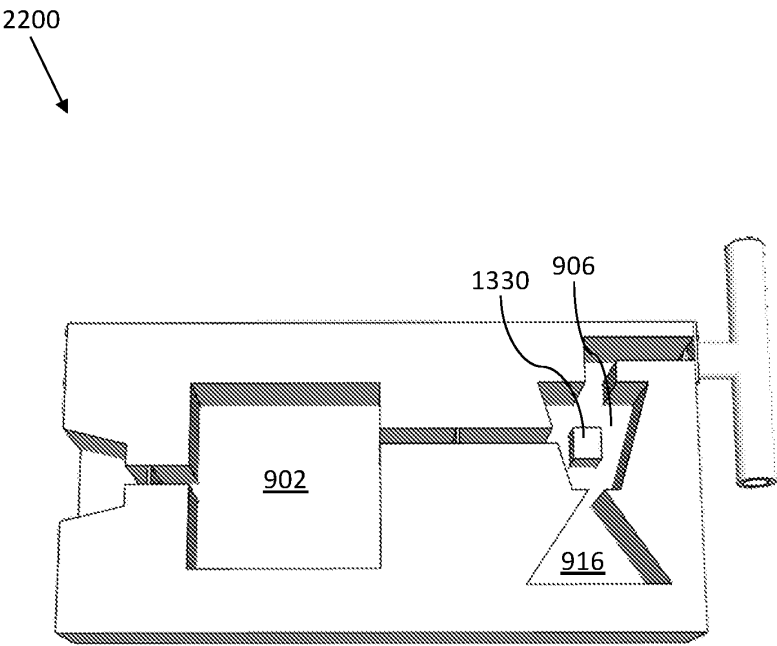


FIG. 22B

2200

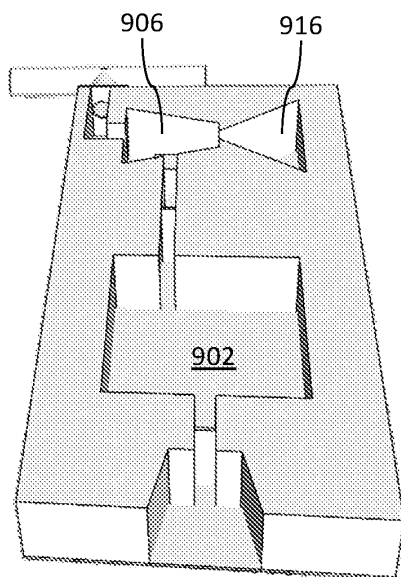


FIG. 22C

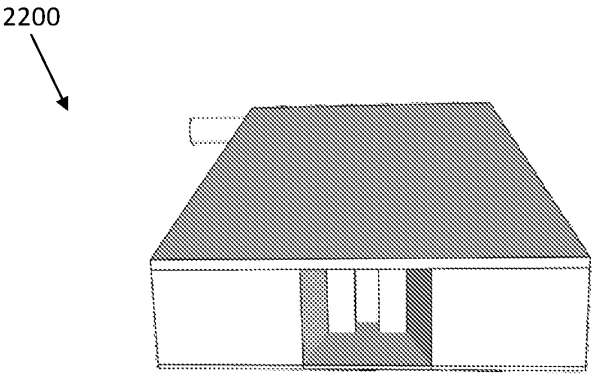


FIG. 22D

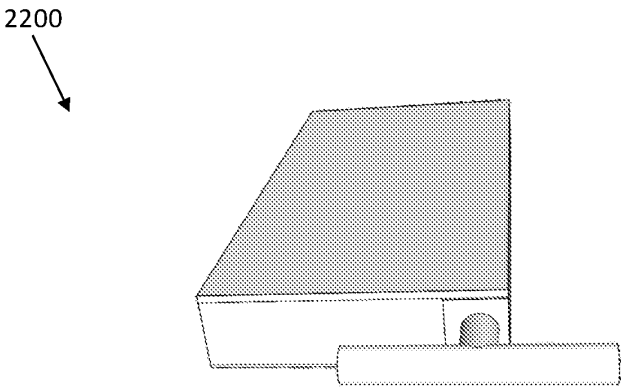


FIG. 22E

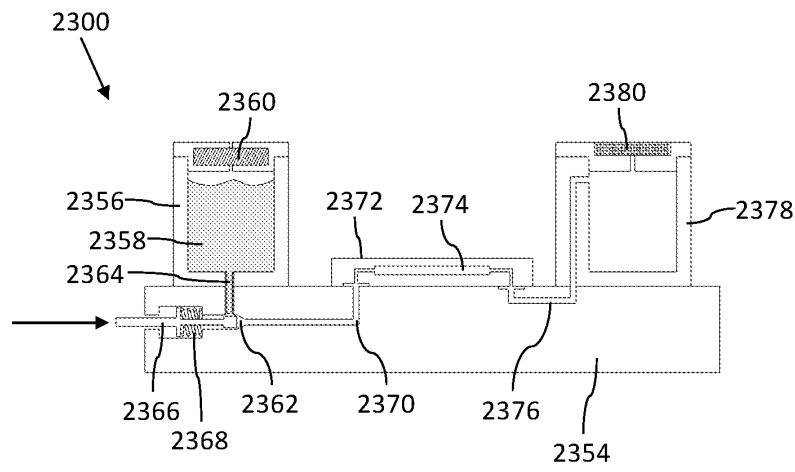


FIG. 23A

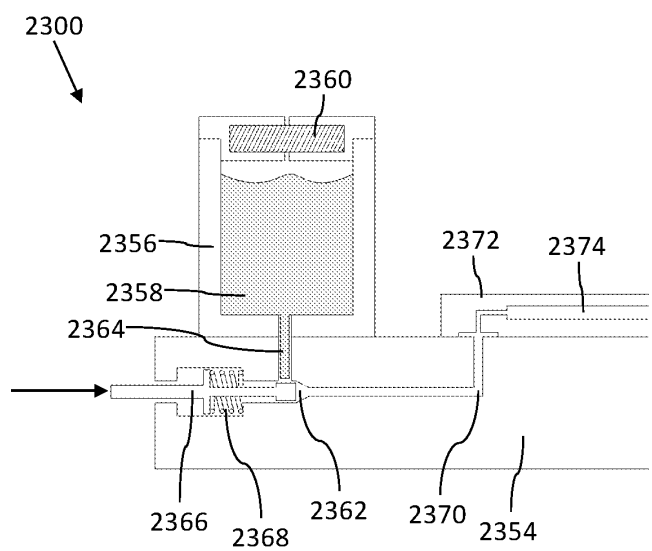


FIG. 23B

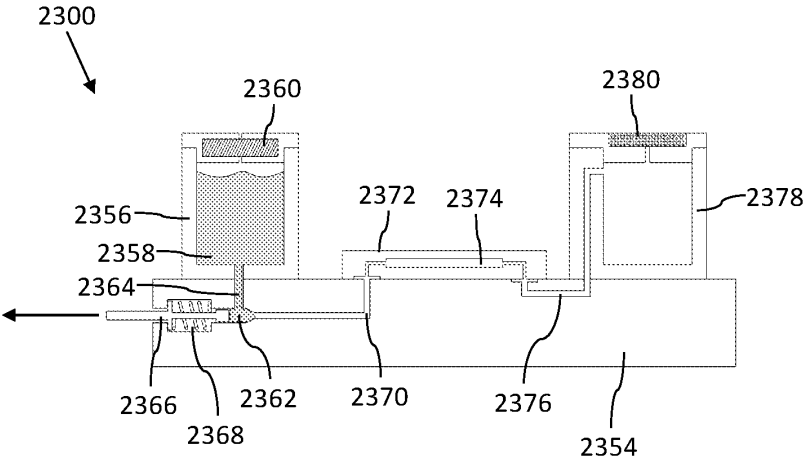


FIG. 23C

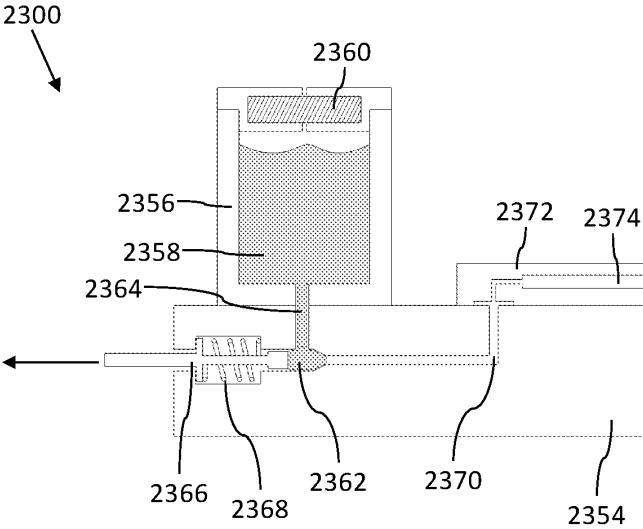


FIG. 23D

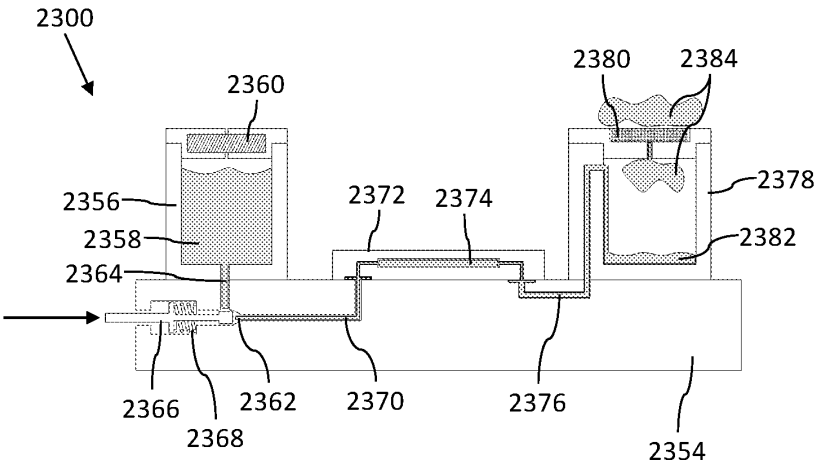


FIG. 23E

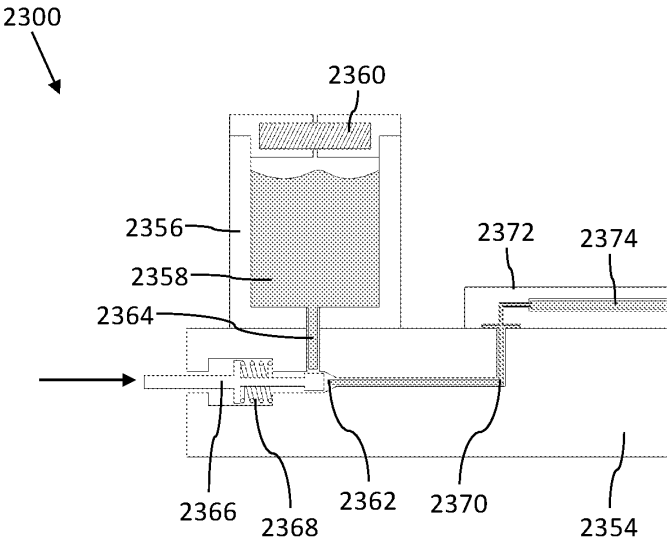


FIG. 23F

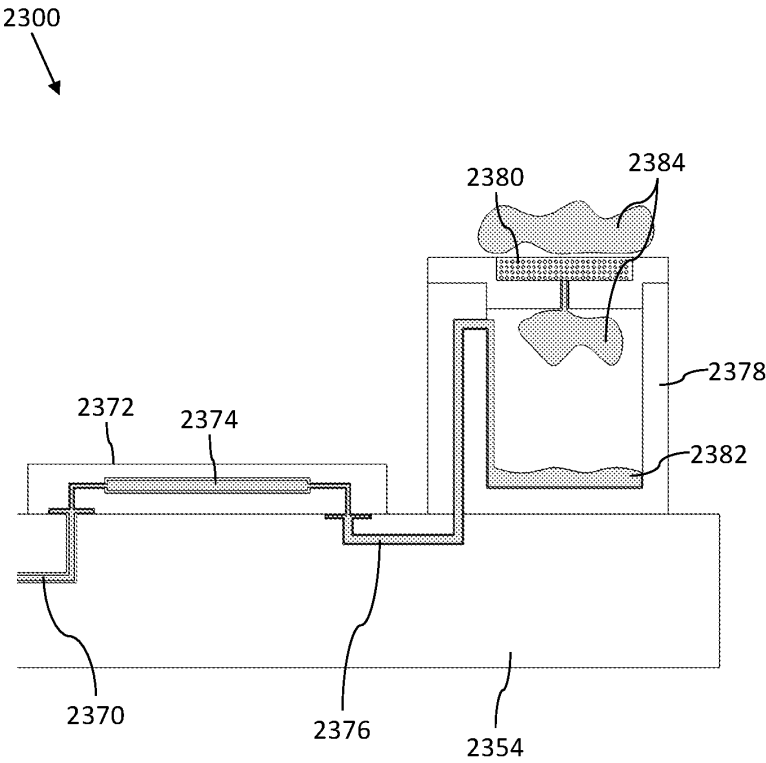


FIG. 23G

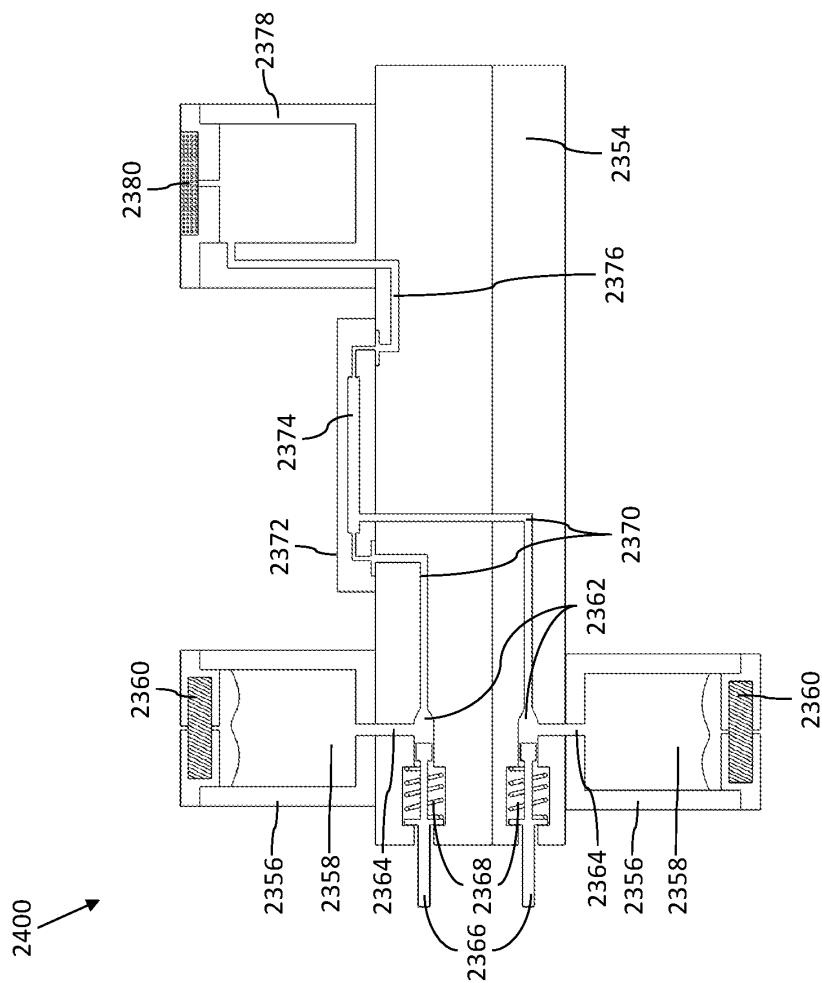


FIG. 24

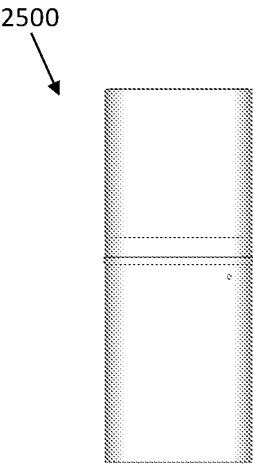


FIG. 25A

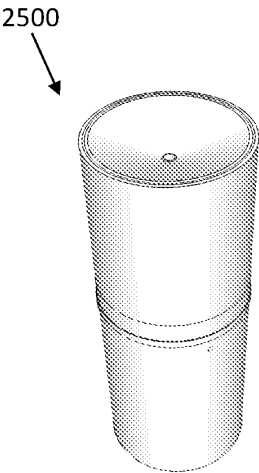


FIG. 25B

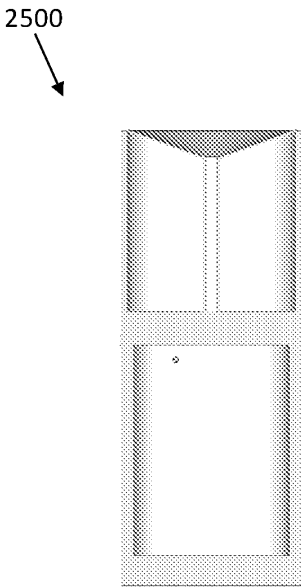


FIG. 25C

2600

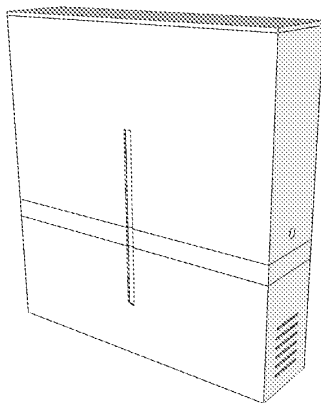


FIG. 26A

2600

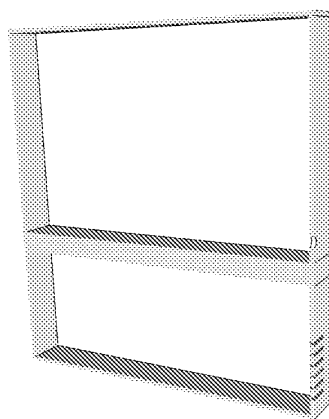


FIG. 26B

2700

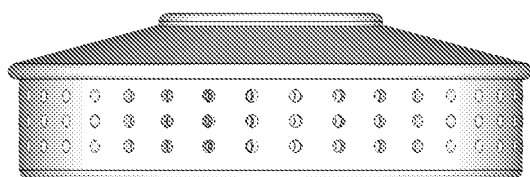


FIG. 27A

2700

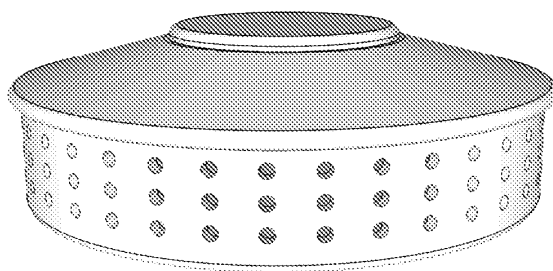


FIG. 27B

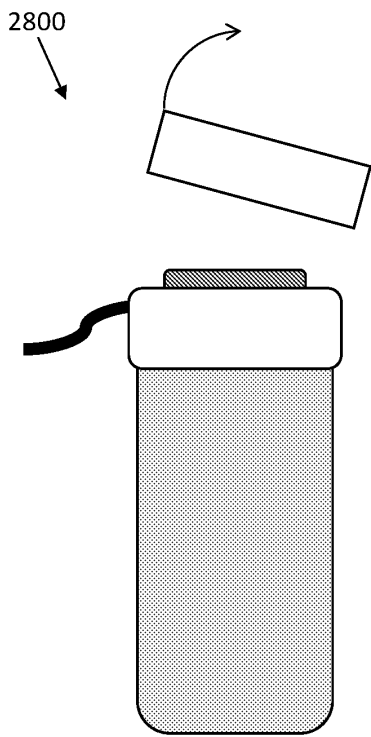


FIG. 28A

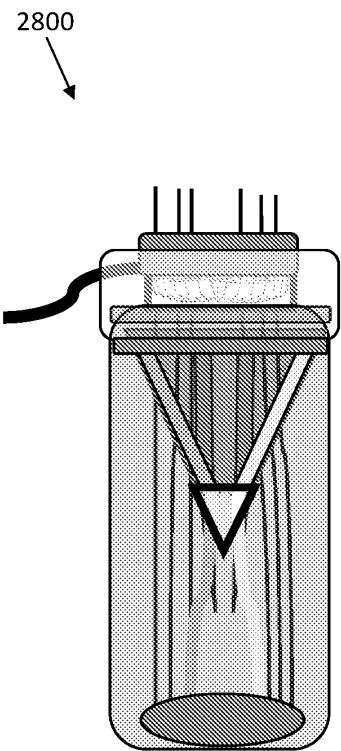


FIG. 28B

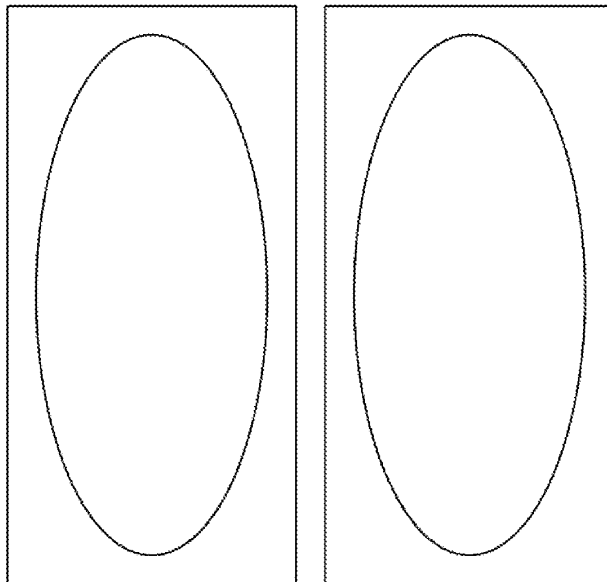


FIG. 29A

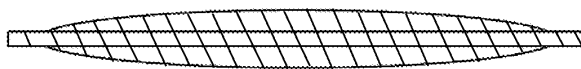


FIG. 29B

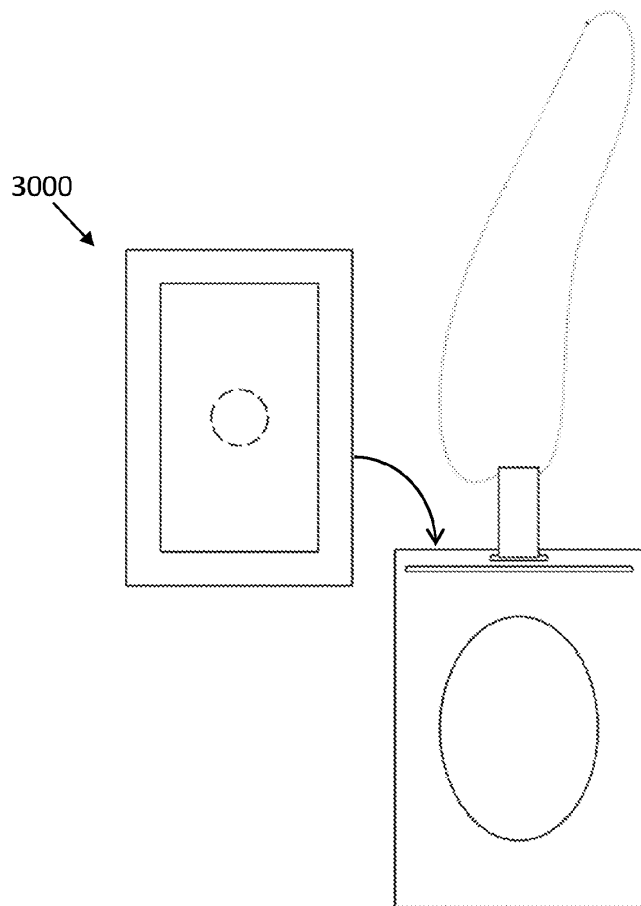


FIG. 30A

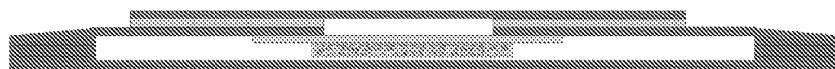


FIG. 30B

3100

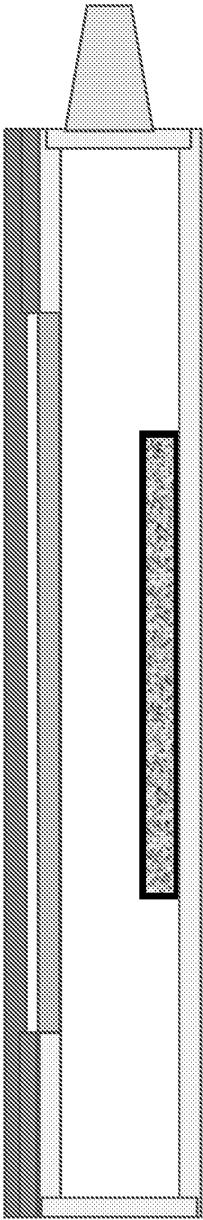


FIG. 31

3200 ↗

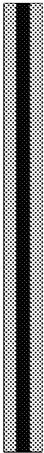


FIG. 32A



FIG. 32B



FIG. 32C



FIG. 32D

3200

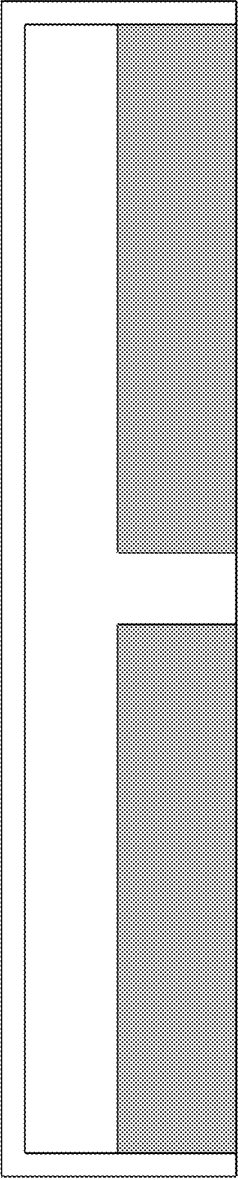


FIG. 32E

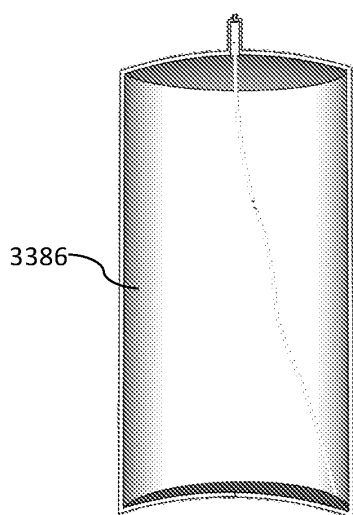


FIG. 33A

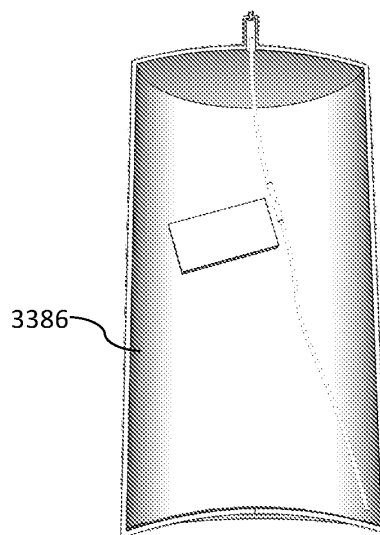


FIG. 33B

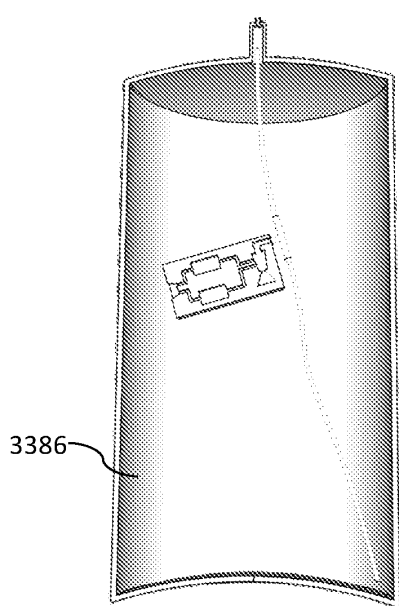


FIG. 33C

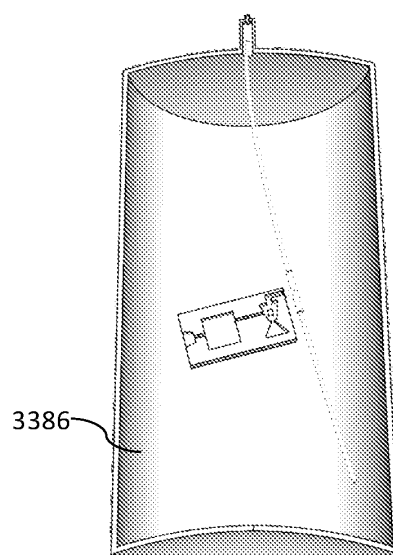


FIG. 33D

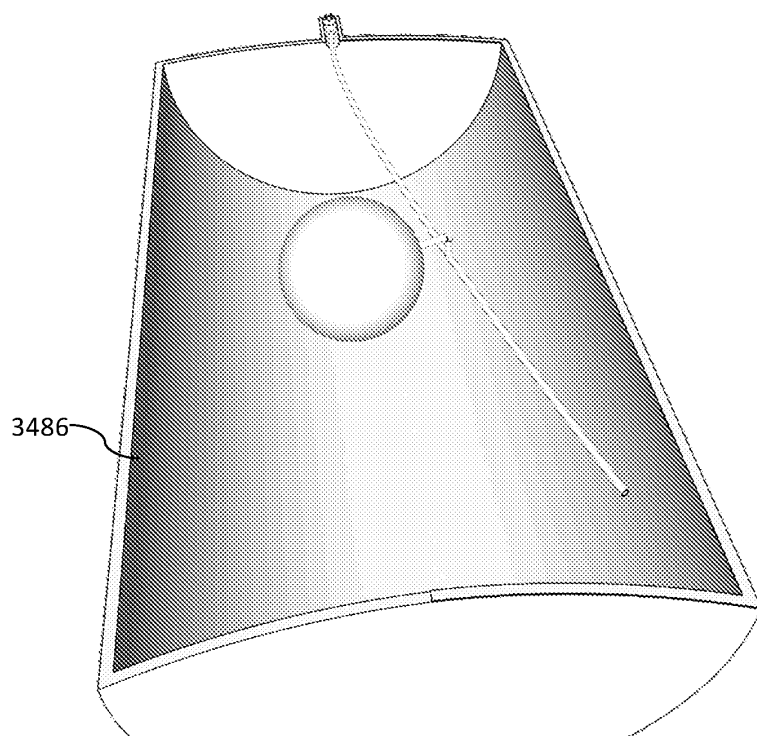


FIG. 34

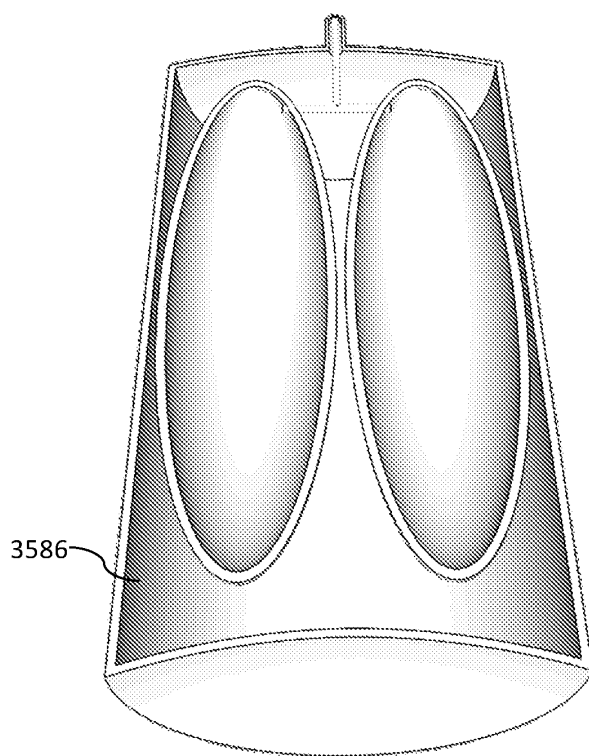


FIG. 35A

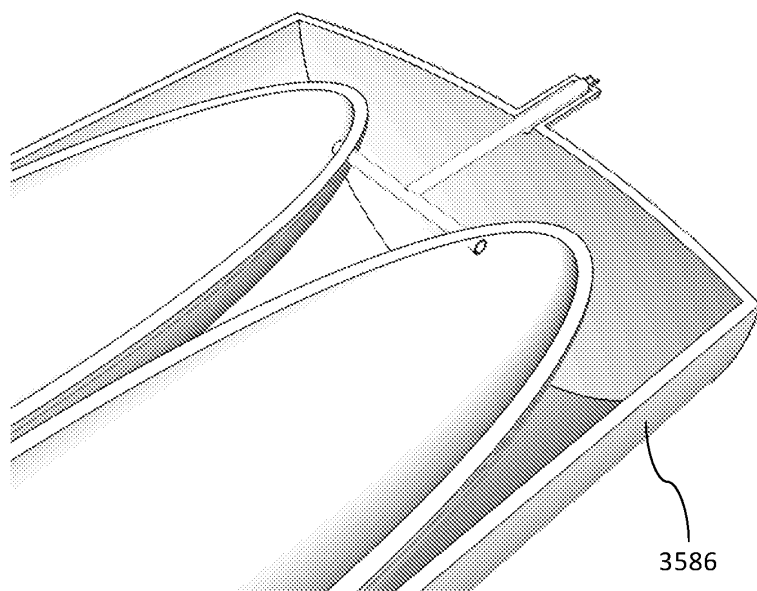


FIG. 35B

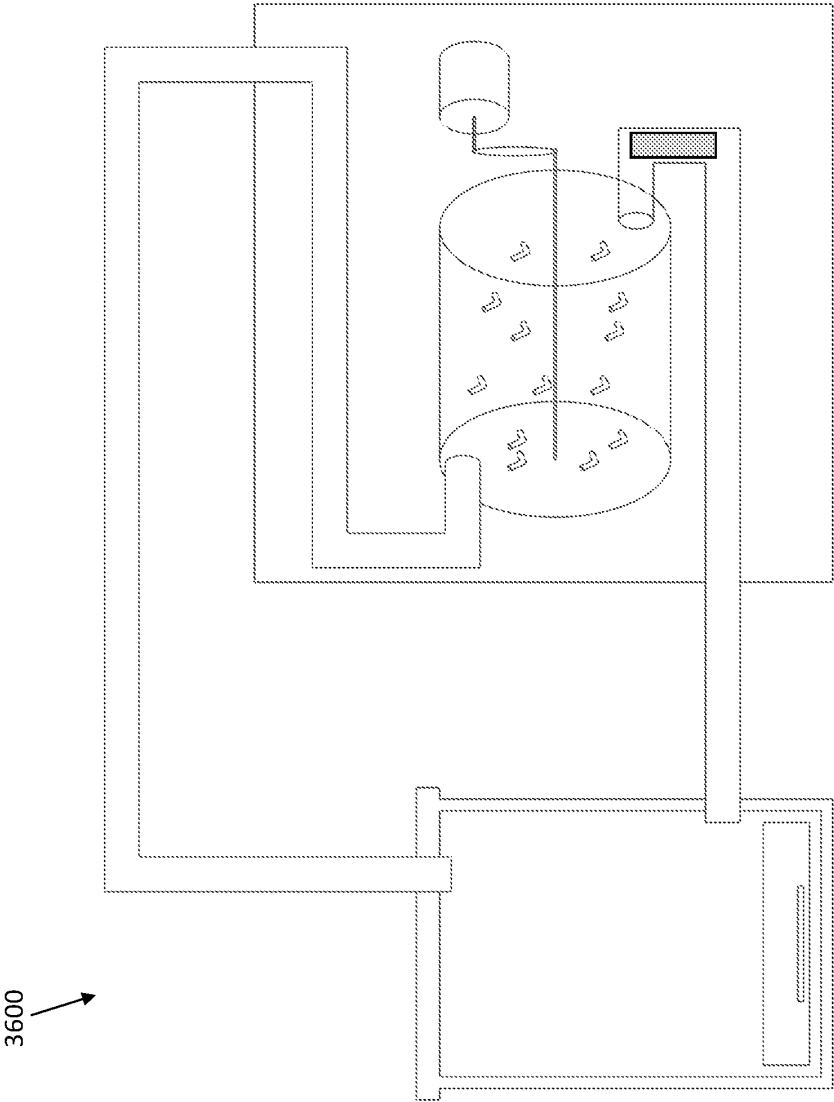


FIG. 36

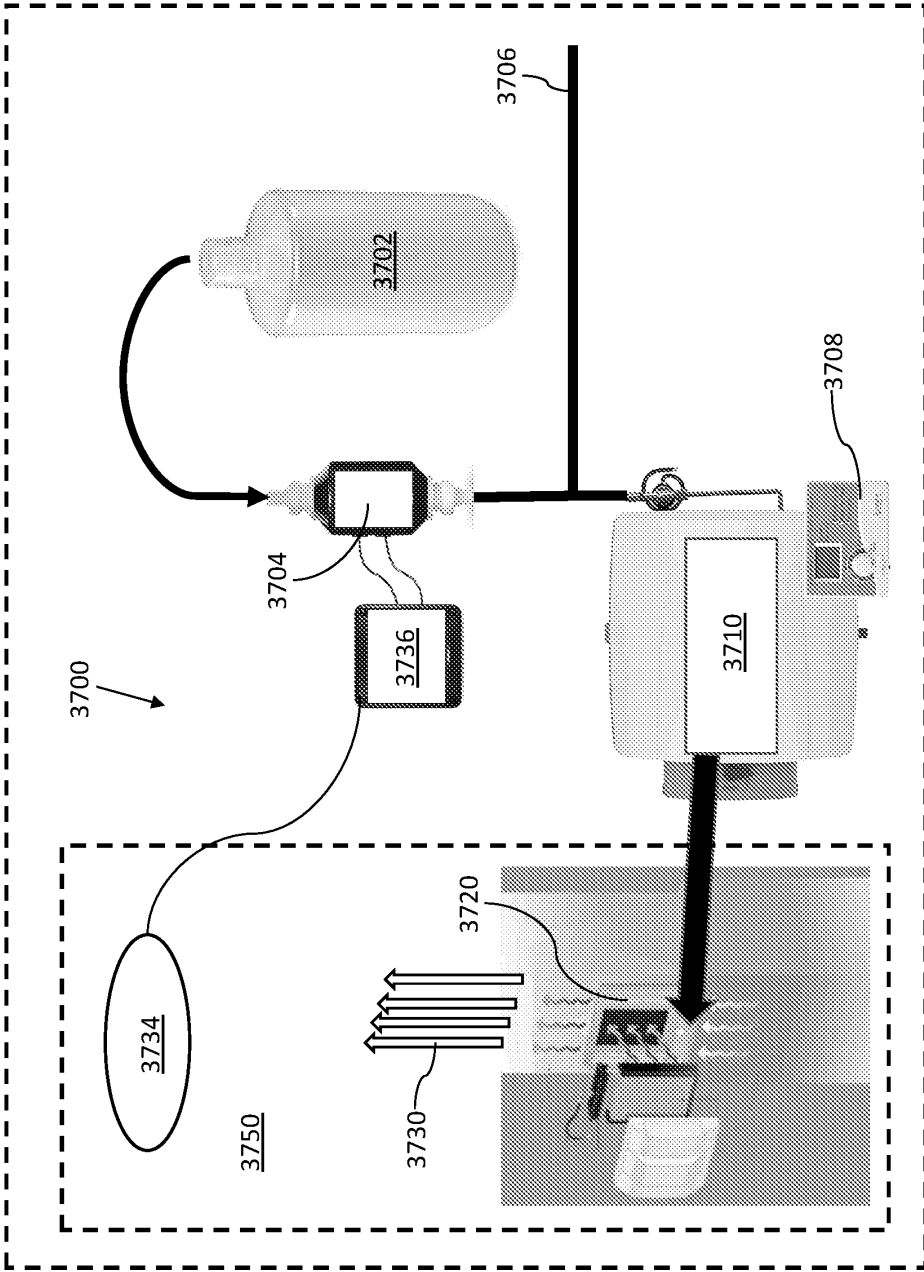


FIG. 37

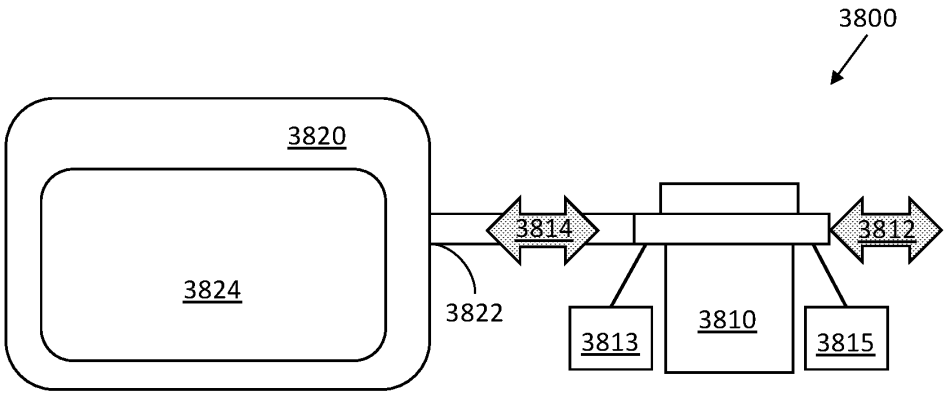


FIG. 38A

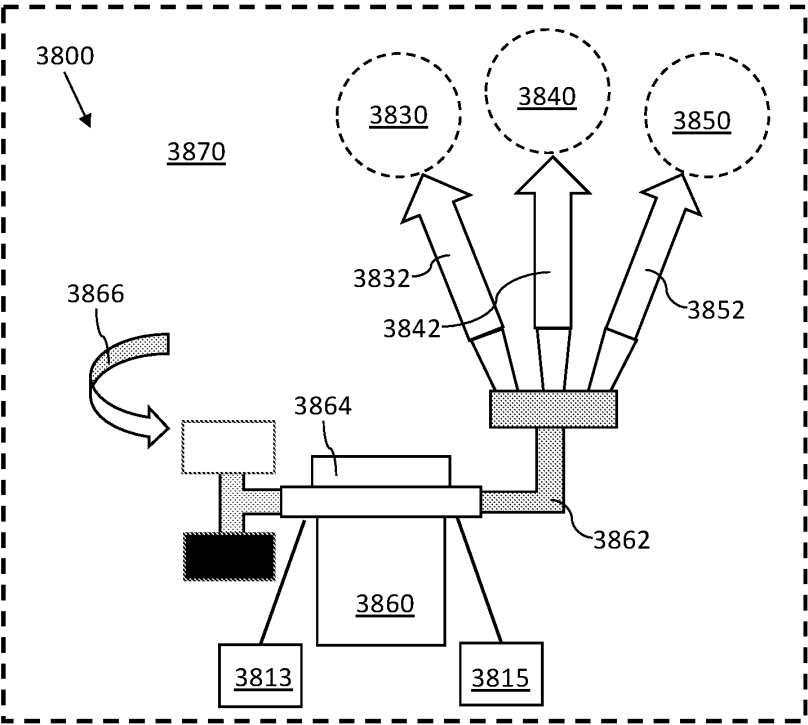


FIG. 38B

3900
↓

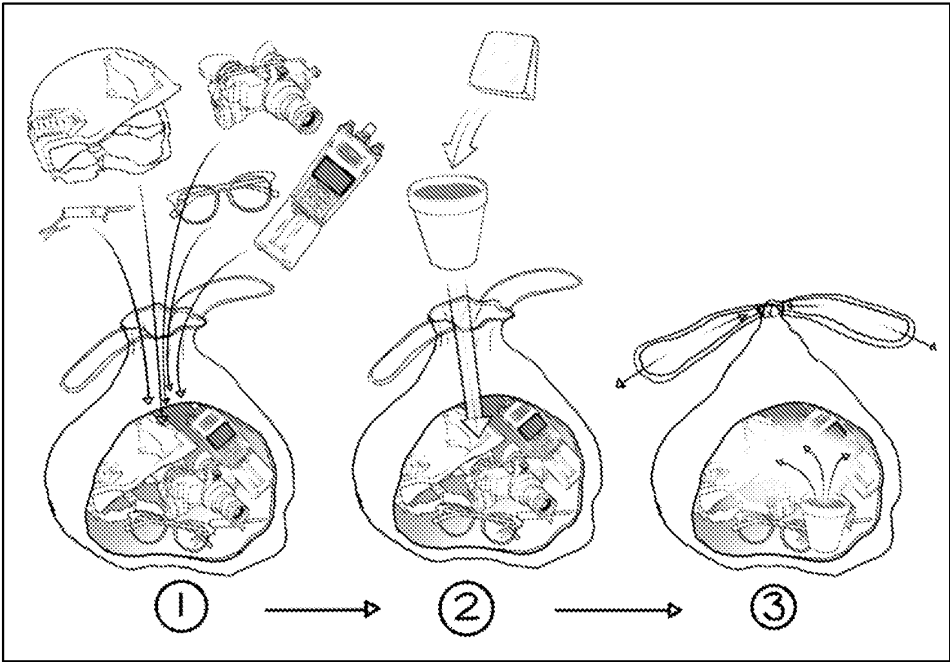
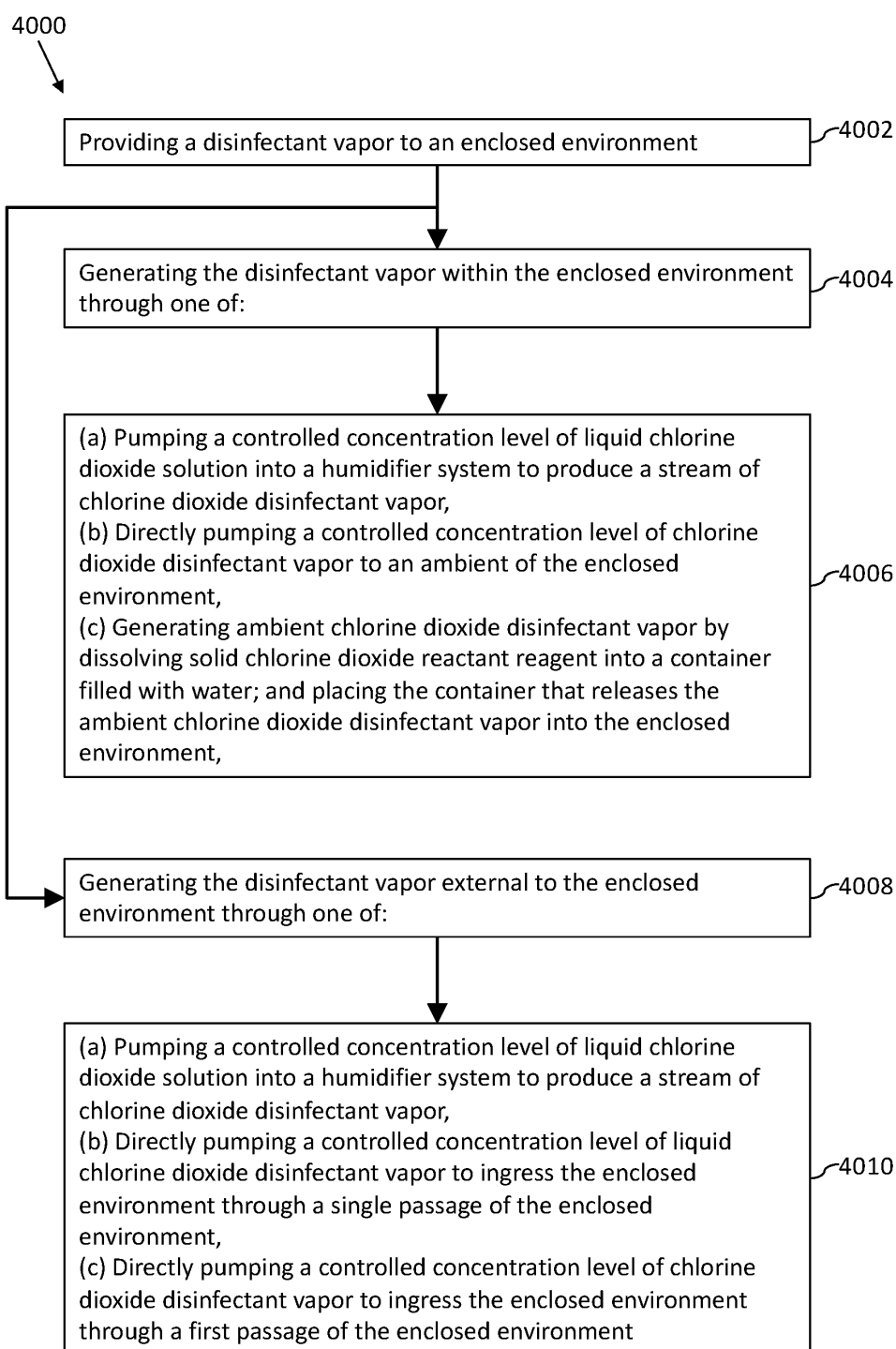


FIG. 39A

FIG. 39B

FIG. 39C

**FIG. 40**

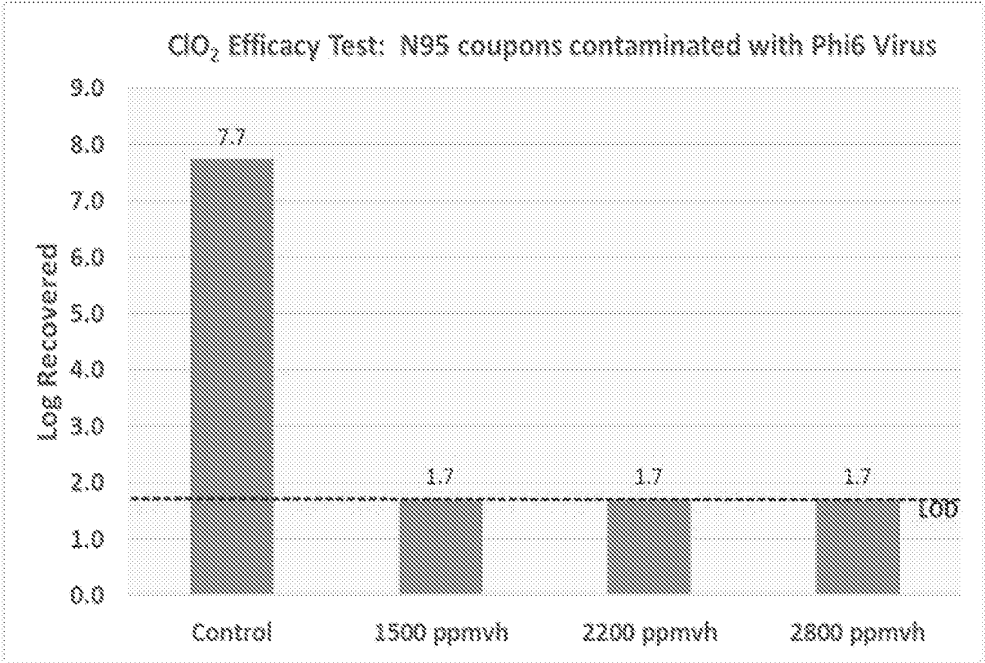


FIG. 41A

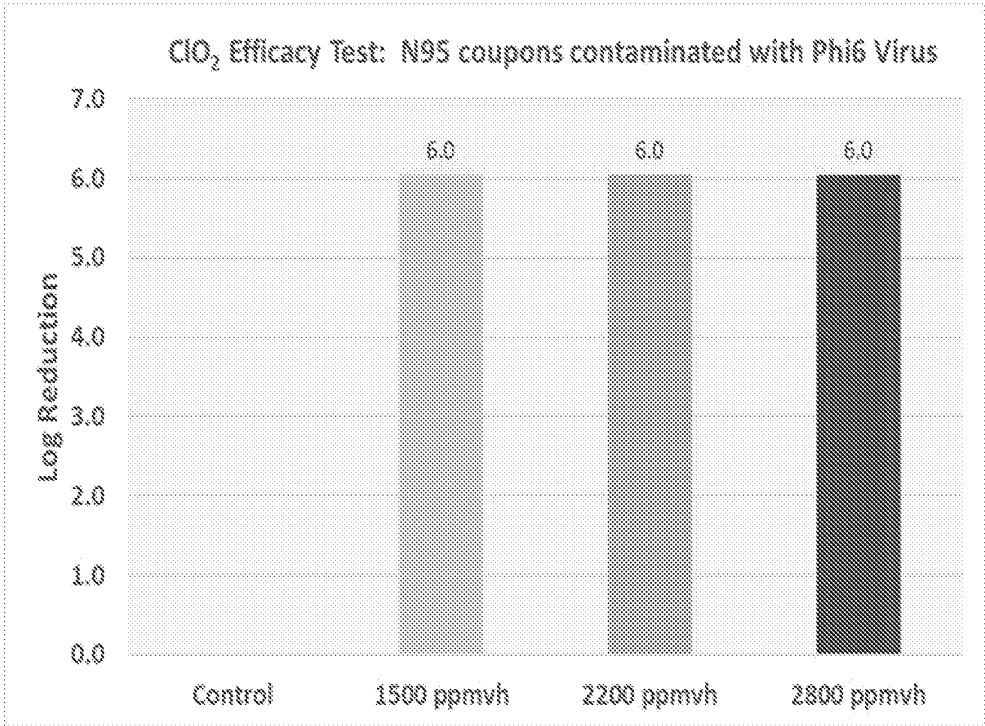


FIG. 41B

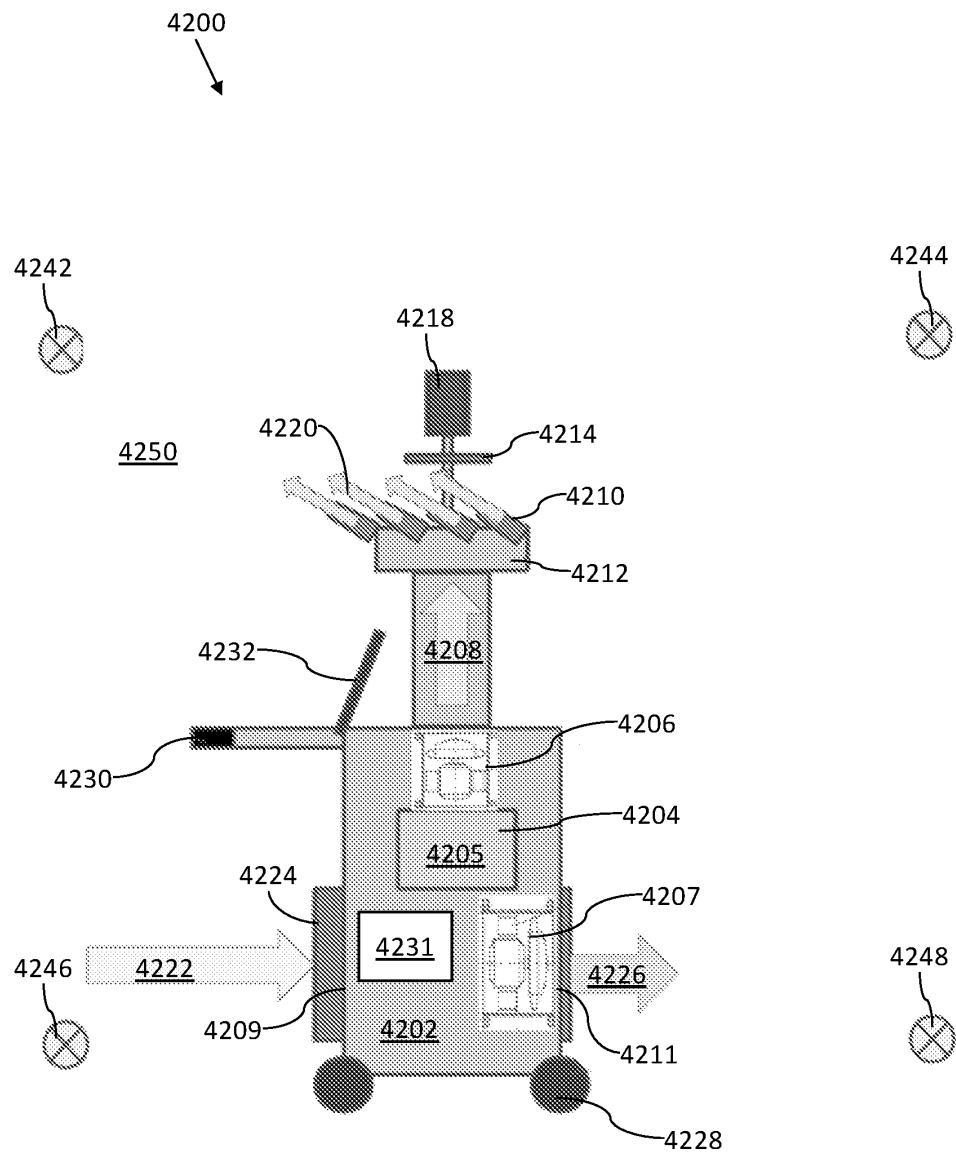


FIG. 42

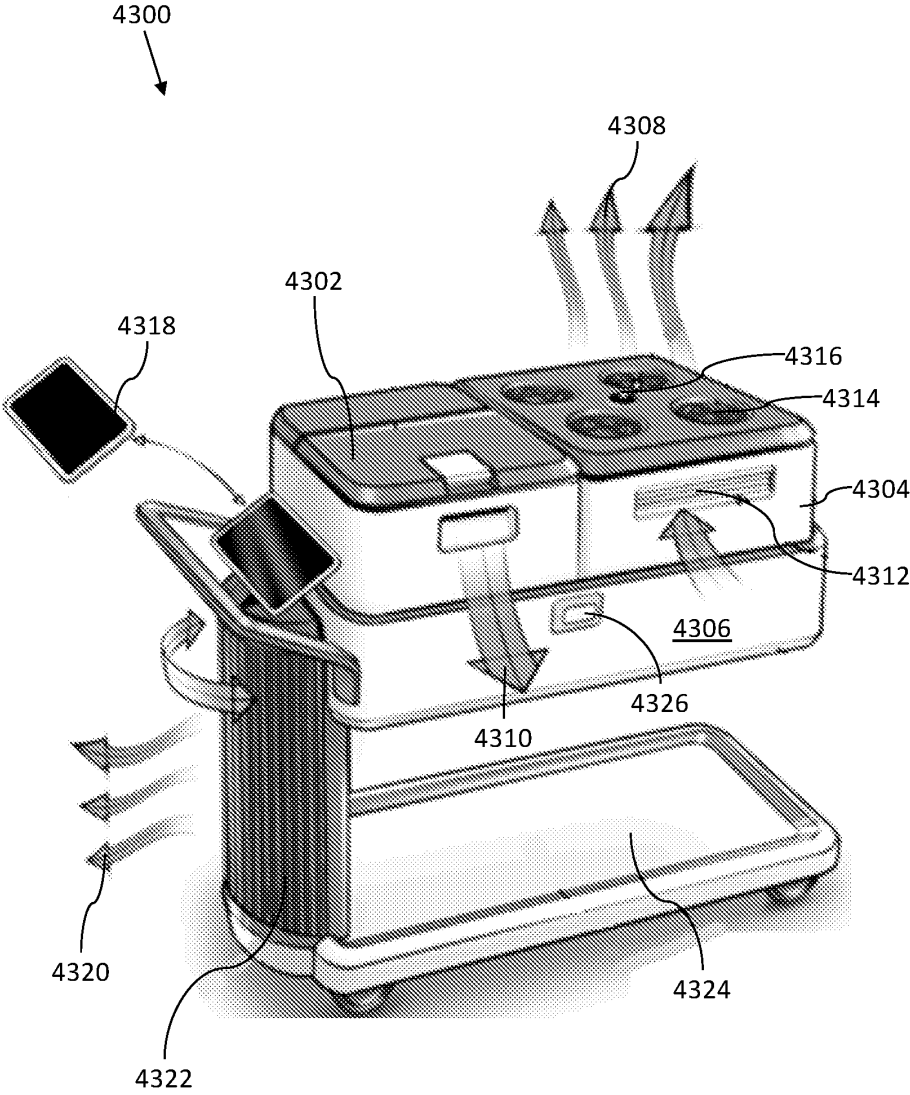


FIG. 43

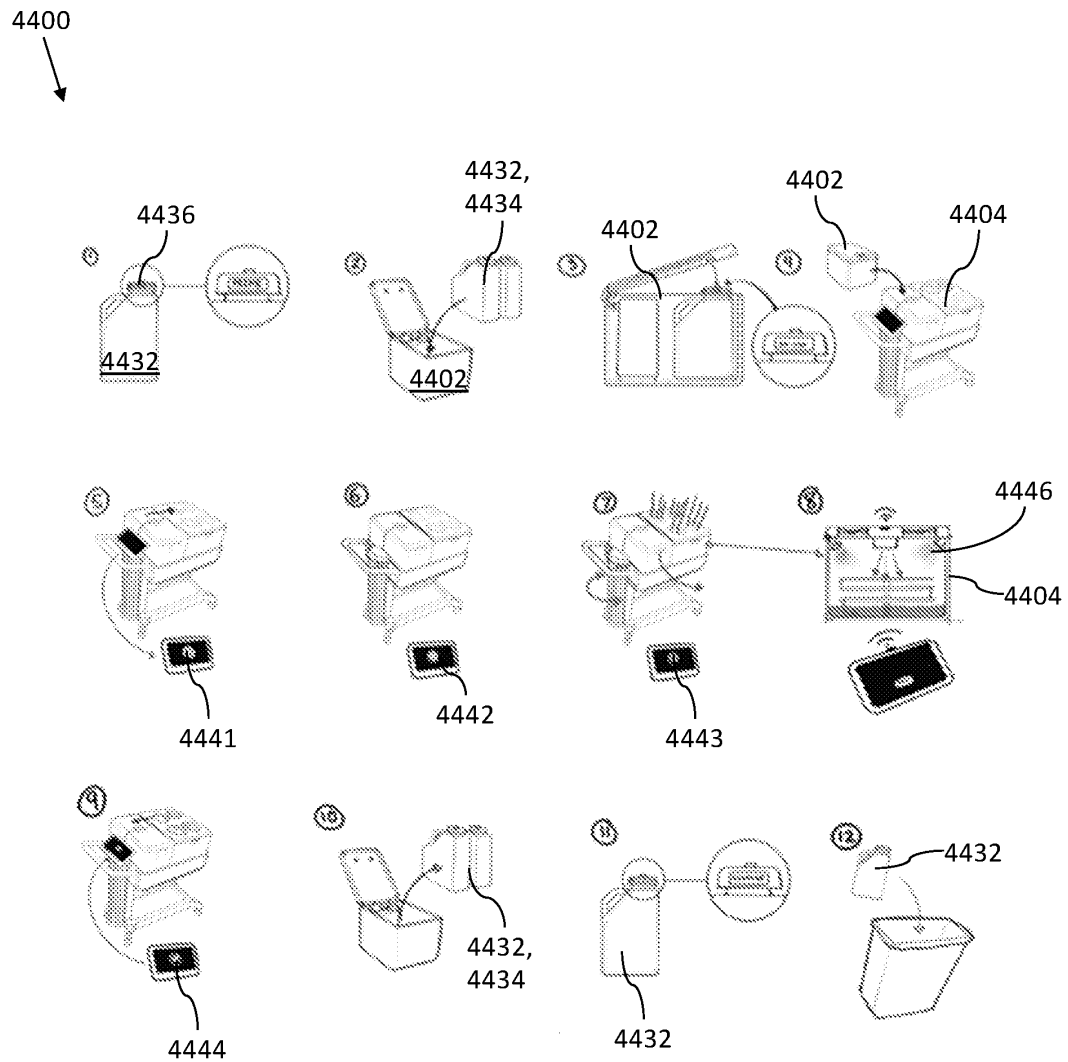


FIG. 44

Volume converter			
L (ft)	W (ft)	H (ft)	
11.2	7.7	7.4	
Volume =		18,001	Liters

Chlorine Dioxide: Prediction of Gas in Water and Air

Volume of water	4	Liters	mol wt ClO2	67.451	Gallons	1
Volume of air	18 001	Liters				
Start ClO2 conc. in H2O	500	ppm				
Mass of ClO2 produced	2000	mg				
Total moles ClO2		0.029651				

Temp (C)	H (T)	Vm (T)	x, mol frac. in H2O	y, mol frac. in gas	mol ClO2 in H2O	ppm ClO2 air	mg/m3 in air	mg ClO2 in air
0	21.96	22.3983	1.65892E-06	0.000364	6.22	36.44	109.7	1976.1342
5	27.46	22.8083	1.35426E-06	0.000372	5.07	37.19	110.0	1979.7008
10	34.06	23.2183	1.11341E-06	0.000379	4.17	37.93	110.2	1983.3110
15	41.94	23.6283	9.21628E-07	0.000387	3.45	38.65	110.3	1986.1856
20	51.27	24.0383	7.67860E-07	0.000394	2.88	39.37	110.5	1988.4905
25	62.26	24.4483	6.43740E-07	0.000401	2.41	40.08	110.6	1990.3609
30	75.11	24.8583	5.42903E-07	0.000408	2.03	40.78	110.7	1991.8624
35	90.08	25.2683	4.60470E-07	0.000415	1.73	41.48	110.7	1993.0980
40	107.40	25.6783	3.92679E-07	0.000422	1.47	42.17	110.8	1994.1141
50	150.19	26.4983	2.89977E-07	0.000436	1.09	43.55	110.9	1995.6535
60	205.86	27.3183	2.18235E-07	0.000449	0.82	44.92	110.9	1996.7289

Henry's law states that the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid. In a mixture of gases, each gas has a partial pressure which is the hypothetical pressure of that gas if it alone occupied the volume of the mixture at the same temperature. The total pressure of an ideal gas mixture is the sum of the partial pressures of each individual gas in the mixture.

$p = RH \times c$; p partial pressure of the solute in the gas above the solution (atm); RH a constant with the dimensions of pressure divided by concentration. The constant, known as the Henry's law constant, depends on the solute, the solvent and the temperature. ($t^{\circ}\text{atm/mol}$); c concentration of the solute (mol/l)

FIG. 45

TEST T13 - Gas Uniformity Test

Date: 2/11/20
Furnished room w/ fan and elevated RH (80% set point {max})
Yellow jacket with one 12G
Portasens datalogger inadvertently not activated for logging

Port ID	Concentration				
	Concentration Measurements (ppm)				
	Round 1	Round 2	Round 3	Mean	Std. Dev.
1	216	186	156	186	21
2	218	186	152	185	23
3	211	176	152	180	21
4	210	178	151	180	21
5	224	171	161	185	24
6	227	191	162	193	23
7	194	164	145	168	17
8	201	170	148	173	19
9	223	183	152	186	25
10	206	172	151	176	20
11	230	184	163	192	24
12	194	180	157	177	13
Mean	213	178	154	182	n/a
Std. Dev.	12	8	6	8	n/a

When making rounds, I tried to follow the same pattern. I started with the door (port 11), moved clockwise and started at the top (port 6), then bottom (port 5), continued clockwise (port 9), and continued this way around the container. However, I did not follow this pattern perfectly (ex. In the first round, forgetting port 12 until I had done the rest).

*Port 5, round 2 was observed to fluctuate between 160 and 180 ppm, never settling at a specific value for very long. This could have been caused by the position of the fan in the room, however it did not fluctuate like this in round 1 or 3.

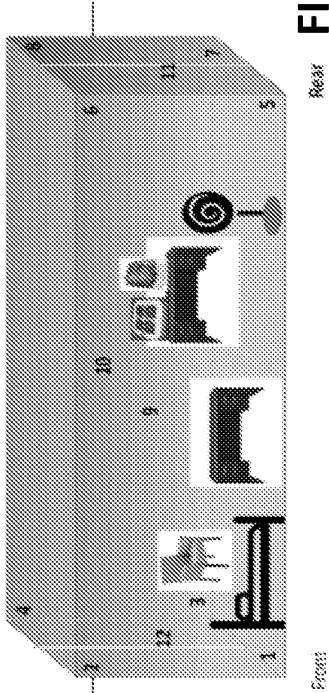


FIG. 46

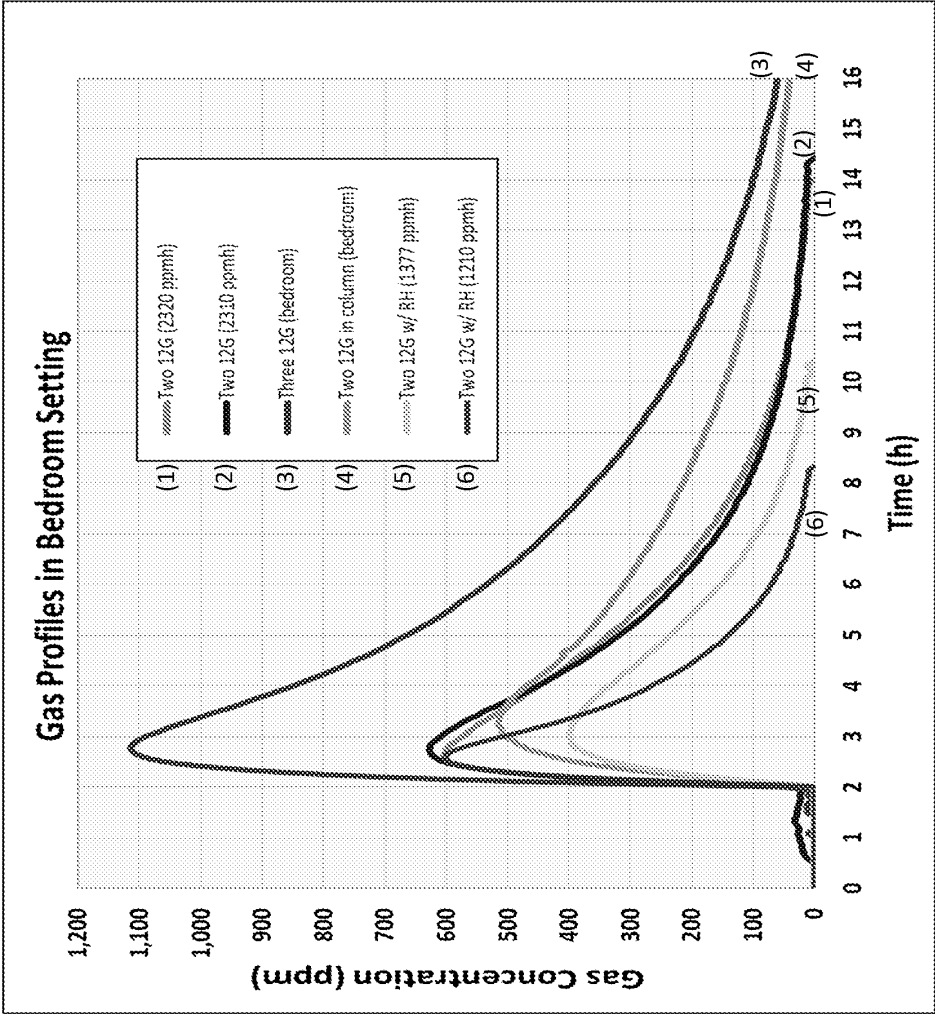


FIG. 47

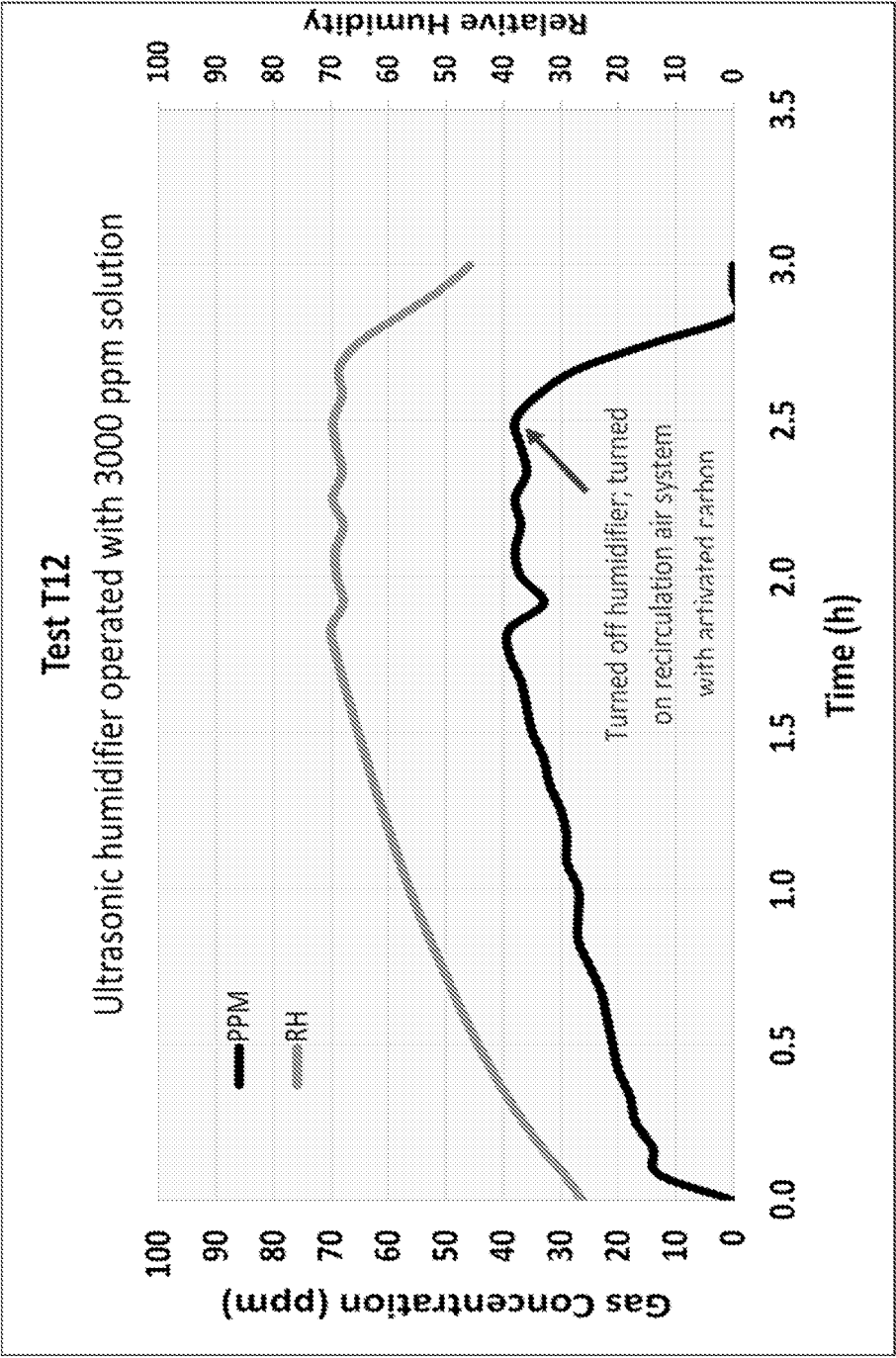


FIG. 48

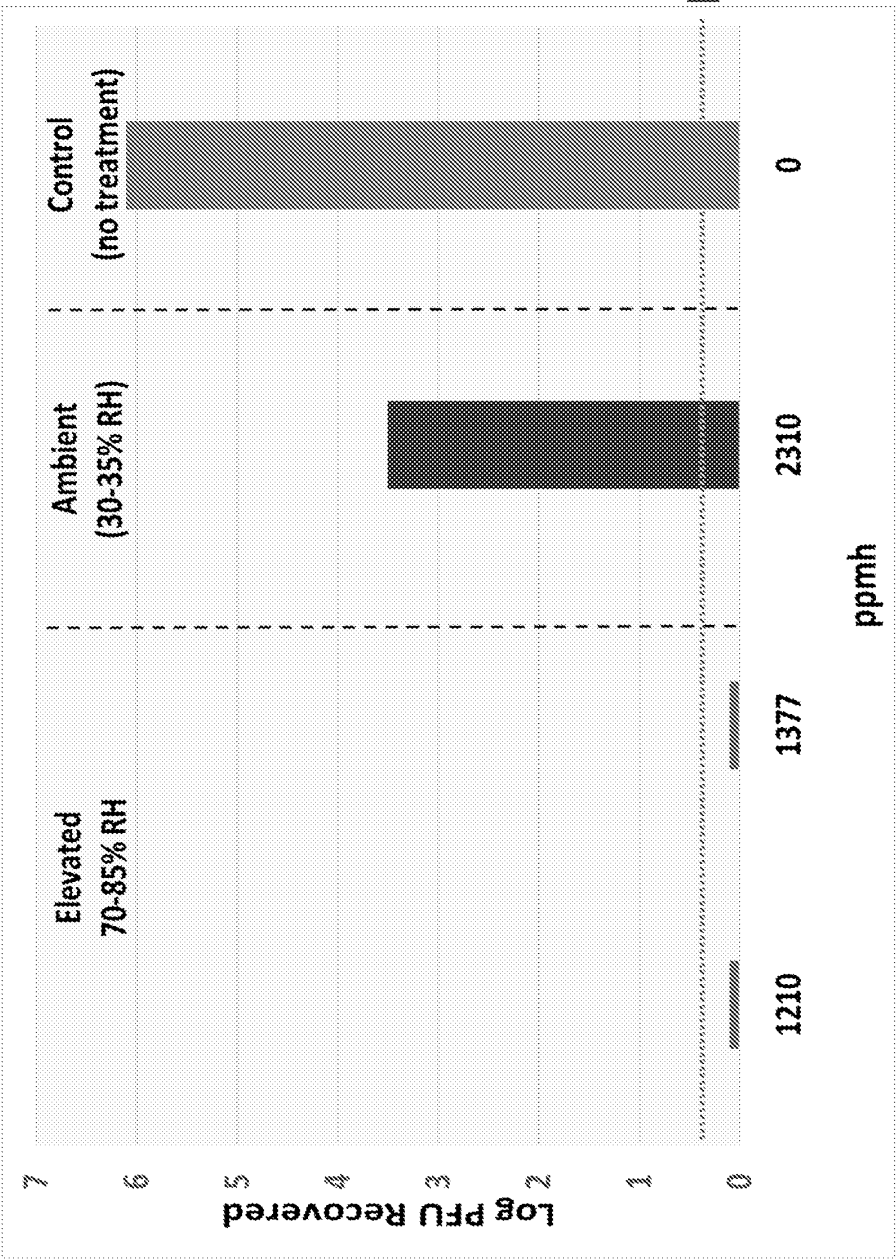
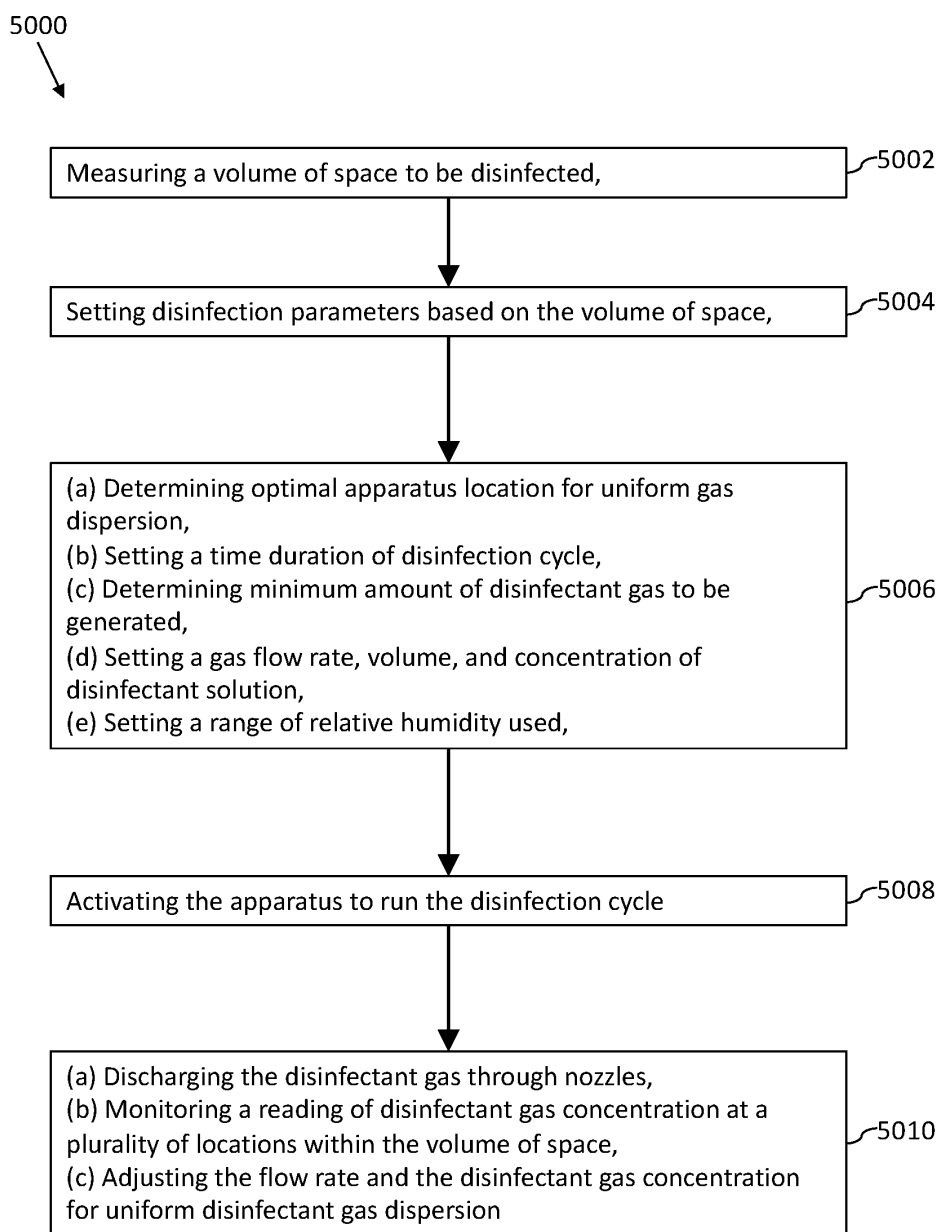


FIG. 49

**FIG. 50**

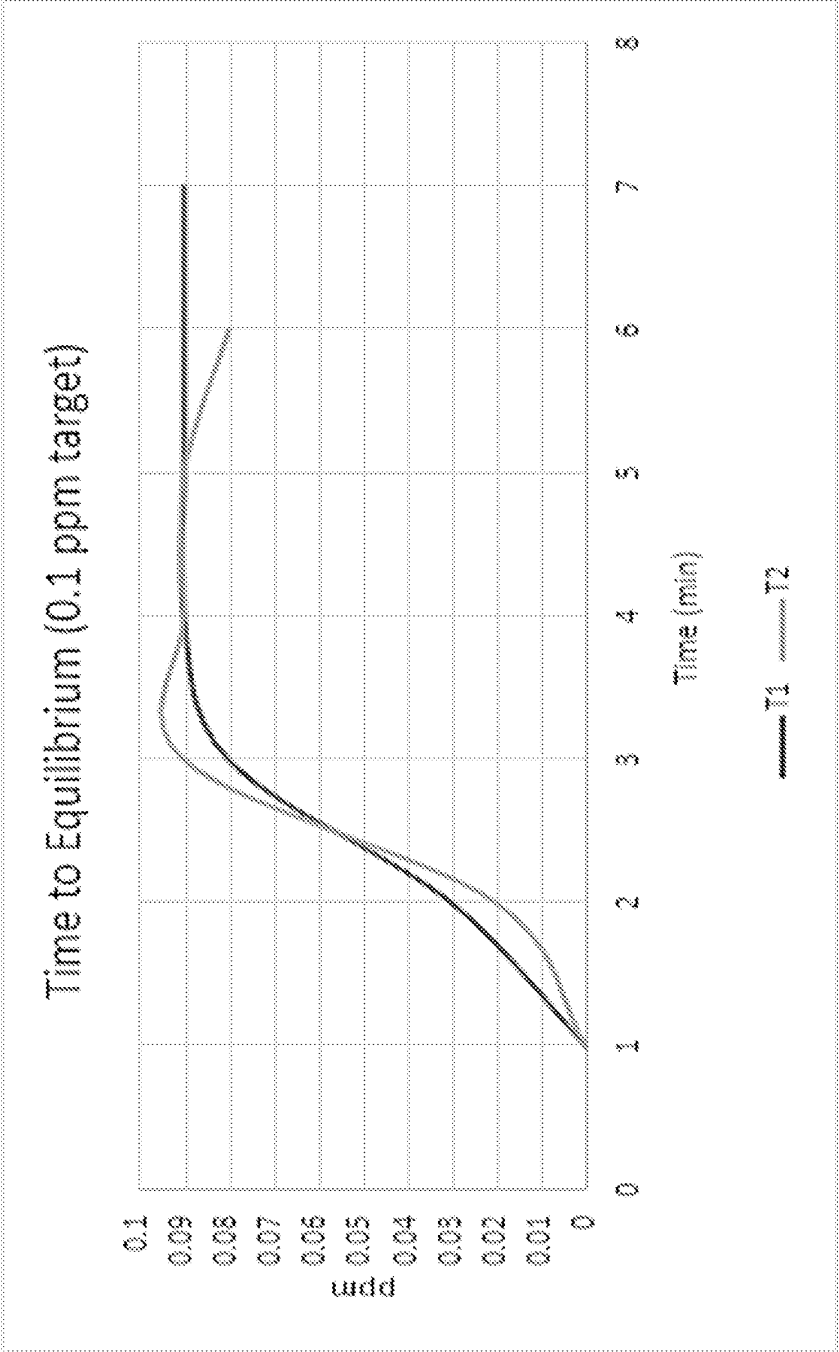


FIG. 51A

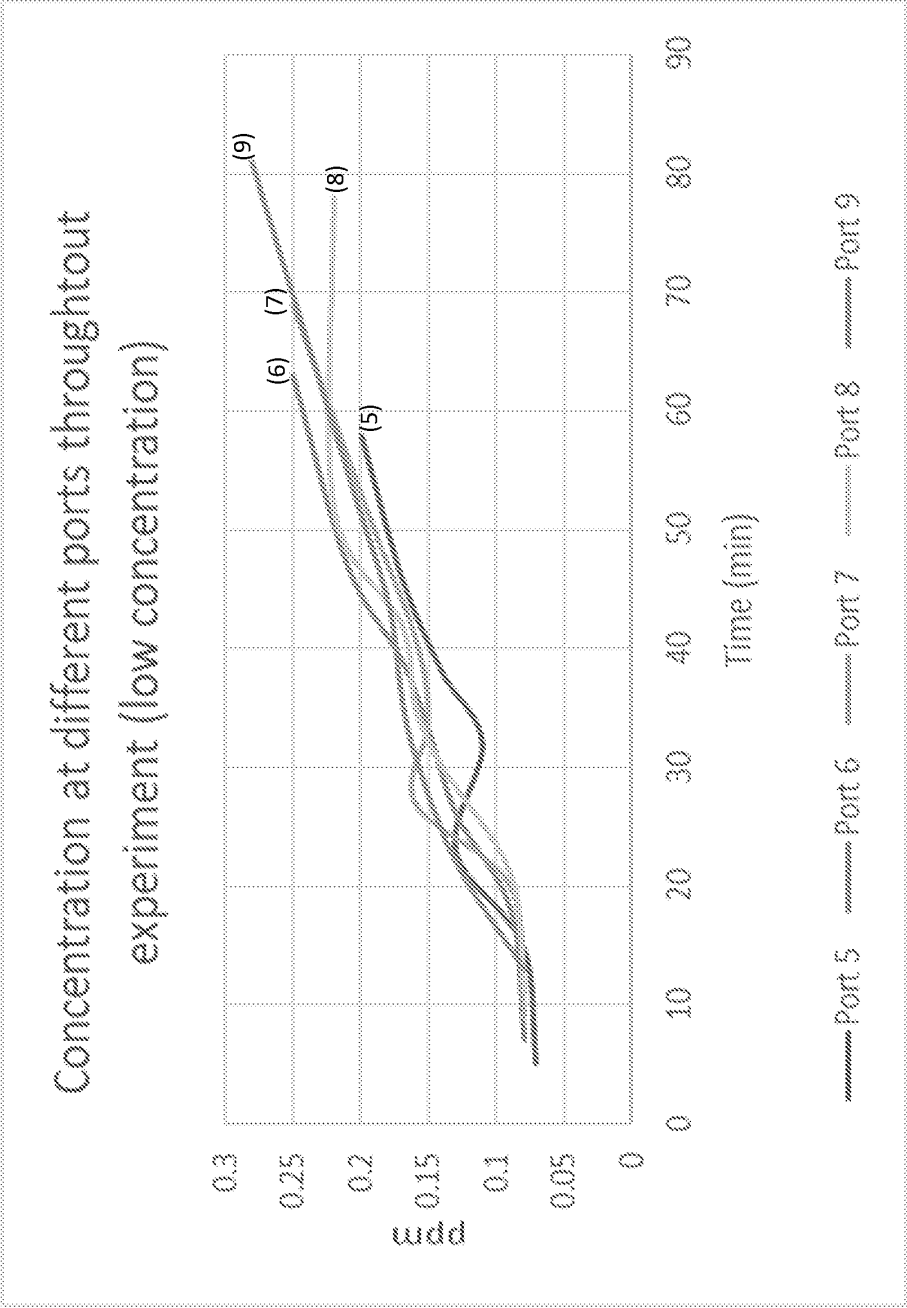


FIG. 51B

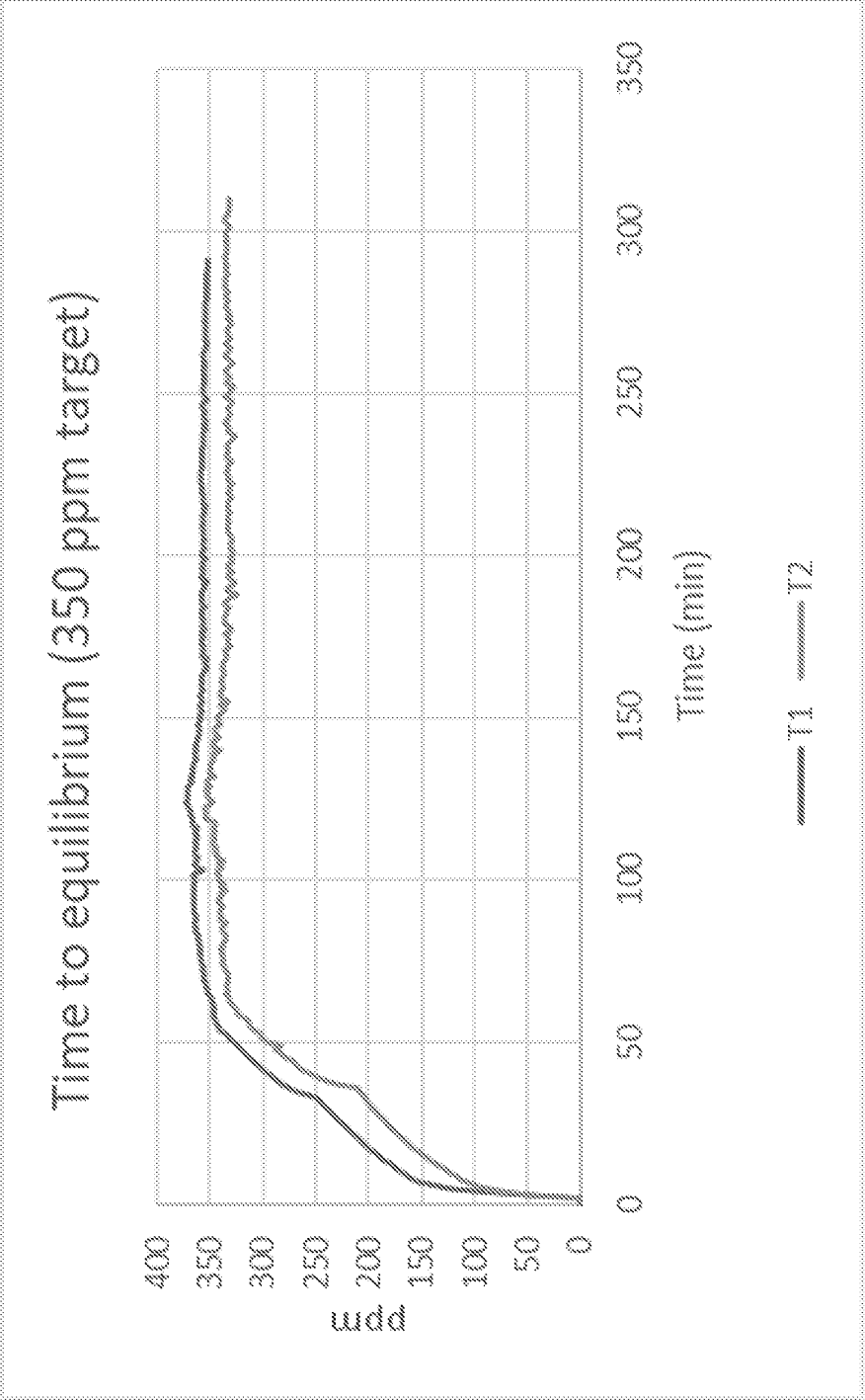


FIG. 52A

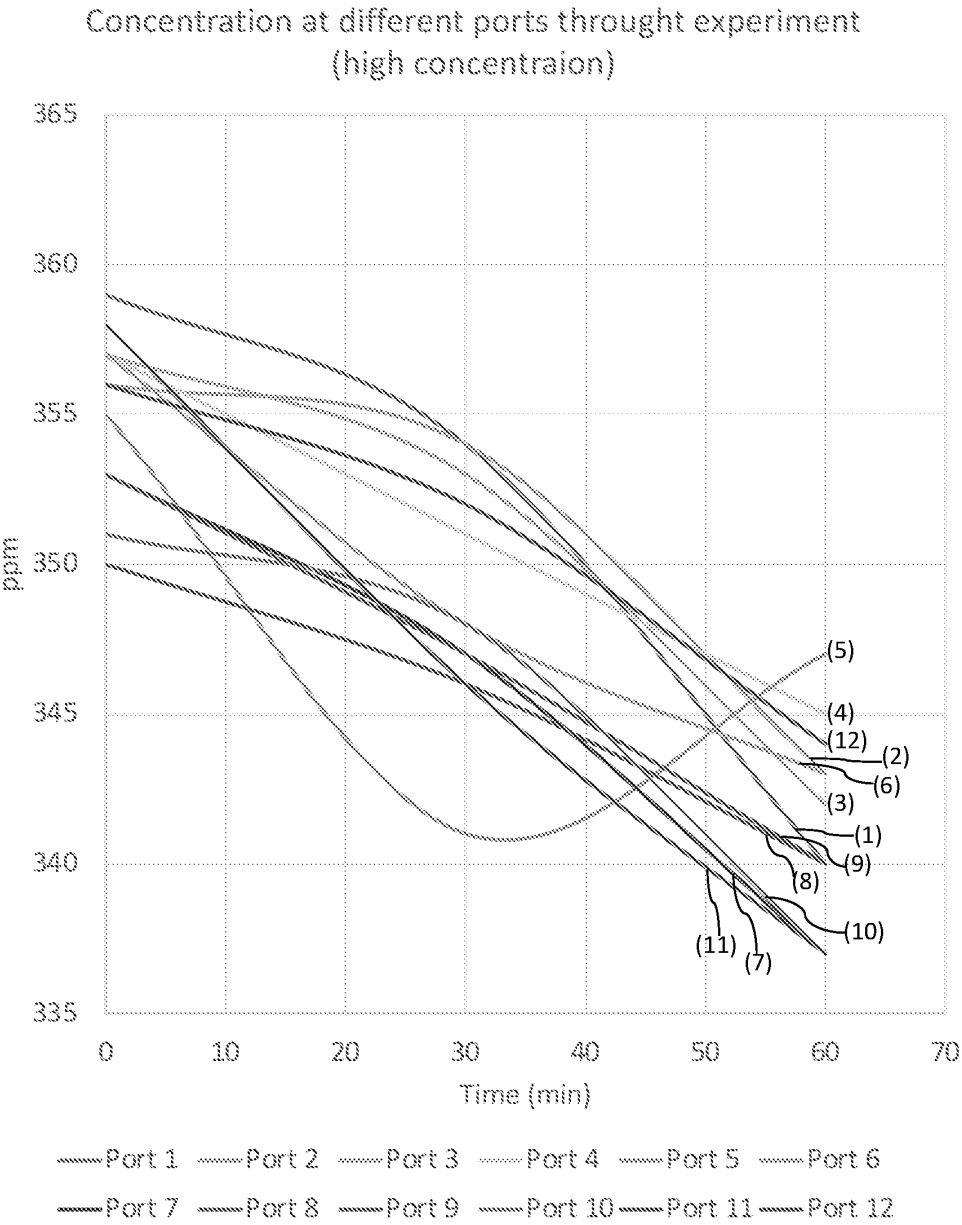


FIG. 52B

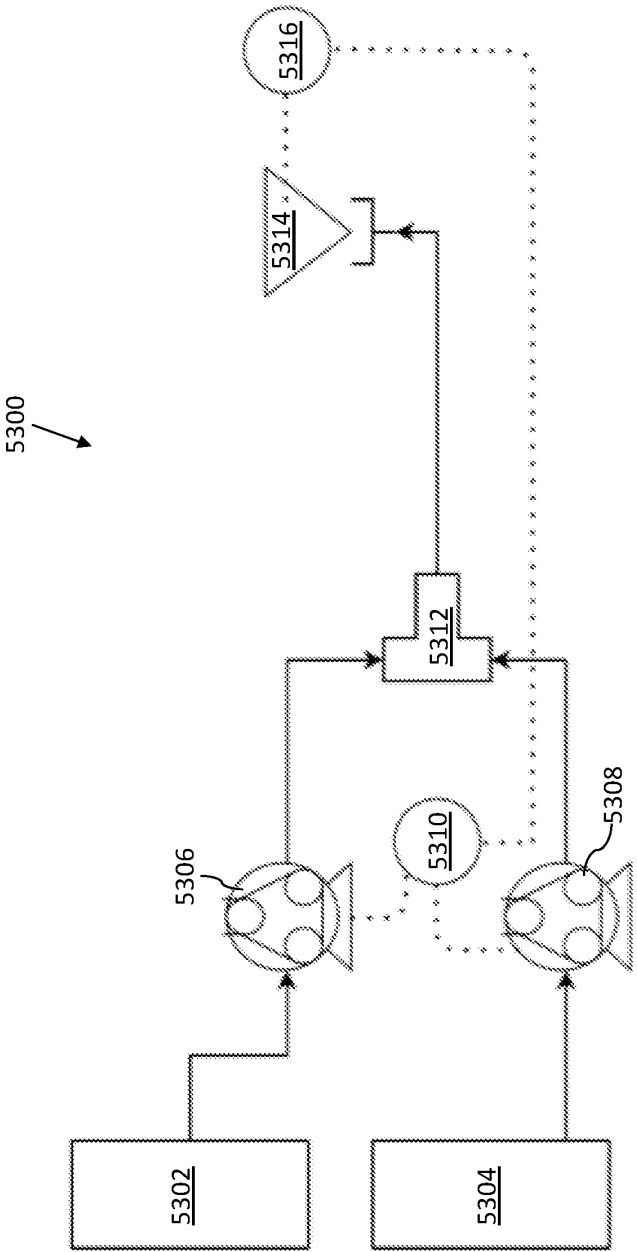


FIG. 53A

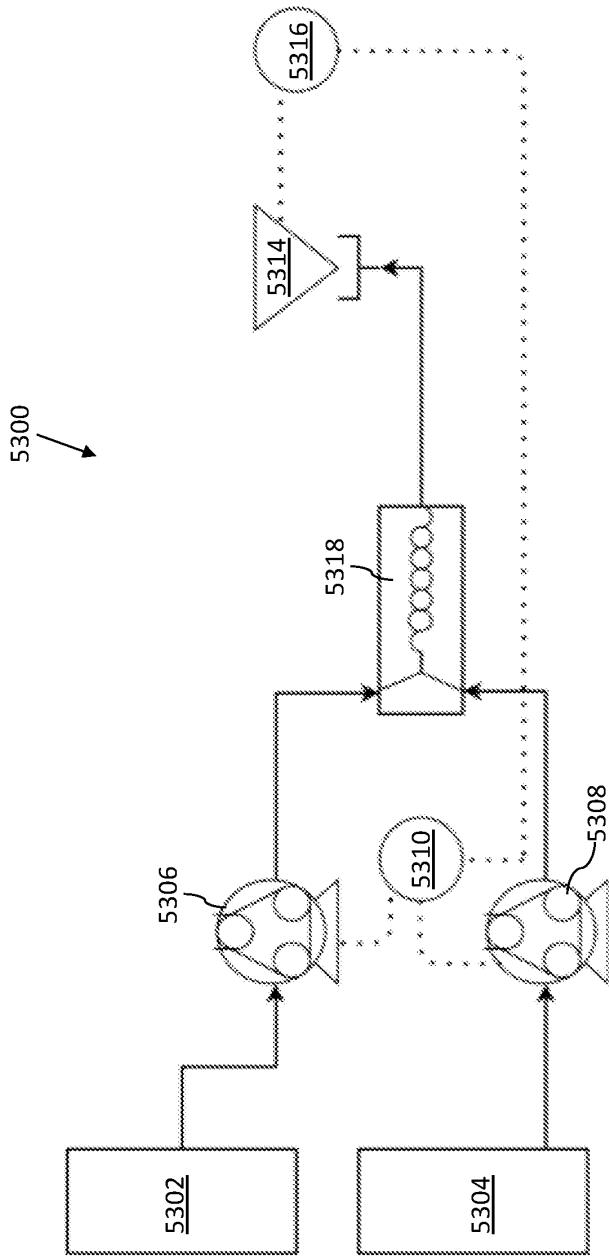


FIG. 53B

Acid Generation	NaClO2 Solution (80%) g/mL	Volume NaClO2 Solution uL	Activator	Activator Conc.	Volume Activator uL	Molar Ratio [NaClO2: Activator]	ClO2 Conc. In Tote ppm	Complete Conversion (mg ClO2)	Measured (mg ClO2)	Measured Efficiency
1	0.75	22	Na2S2O8	0.5 g/mL	139	2	48.6	9.84	10.15	103%
2	0.75	22	HCl	12 M	36	3	44.3	7.88	9.25	117%
3	0.75	22	CH2O2	100%	33	6	54	9.84	11.28	115%

FIG. 54A

Electrolysis Generation	Cell Type	Analyte: NaClO2 Solution (80%) g/mL	NaOH3 Solution g/mL	Potential (V)	Current (A)	Time On (min)	Power (W)	Energy (J)	ClO2 Conc. In Tote ppm	ClO2 (mg) Generated	ClO2 Measured (mg)	Measured Efficiency
5	Membrane	0.25	0.19	12	0.468	3	5.6	1011	114	24.99	23.81	95%
	Membrane	0.50	0.38	12	0.600	1.5	7.2	648	73	16.50	15.00	91%
4	No Membrane	0.50	None	5	1.6	1.35	8.0	648	44	16.50	9.00	55%

FIG. 54B

Chemical Use - 1000 ft3 room				Single Dose - 0.10 ppm in 1000 ft3				1000 ft3 30 days continuous operation 5 air exchanges per hr 250% makeup air	1000 ft3 30 days continuous operation 5 air exchanges per hr 100% makeup air
Generation Method	Activator	Molar Ratio	Volume Ratio	Efficiency	NaClO2 Volume (ul)	Activator Volume (ul)	Total Volume (ul)	Total Volume (ml)	Total Volume (ml)
1	Na2S2O8	2	6.32	100%	17.46	110.27	127.73	114.96	459.82
2	HCl	3	1.64	100%	17.46	28.95	46.41	41.77	167.08
3	CH2O2	6	1.50	100%	17.46	26.22	43.68	39.31	157.23
4	Electrolysis	N/A	N/A	55%	31.74	None	31.74	28.57	114.27
5	Membrane	N/A	N/A	100%	17.46	None	17.46	15.71	62.85

FIG. 54C

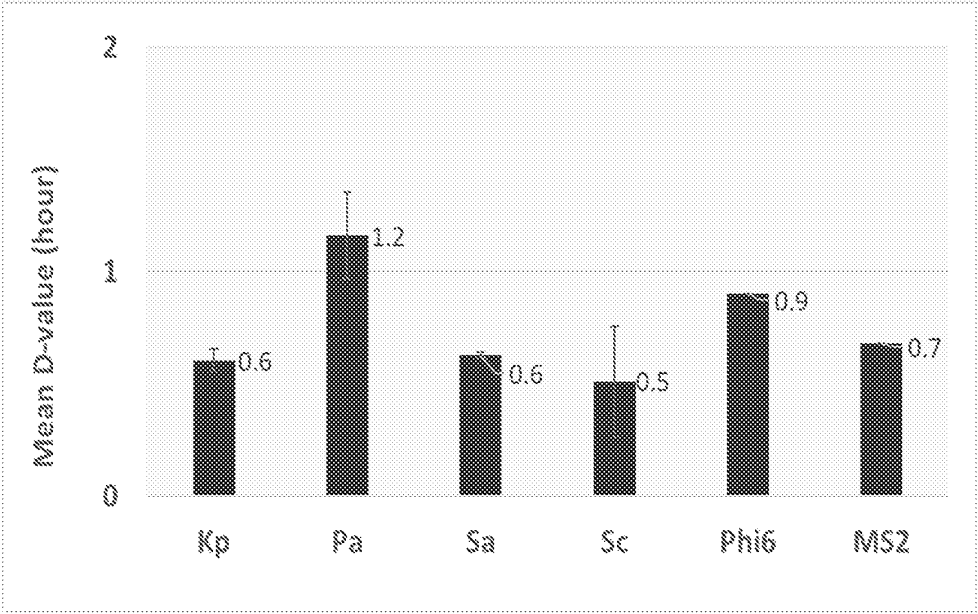


FIG. 55A

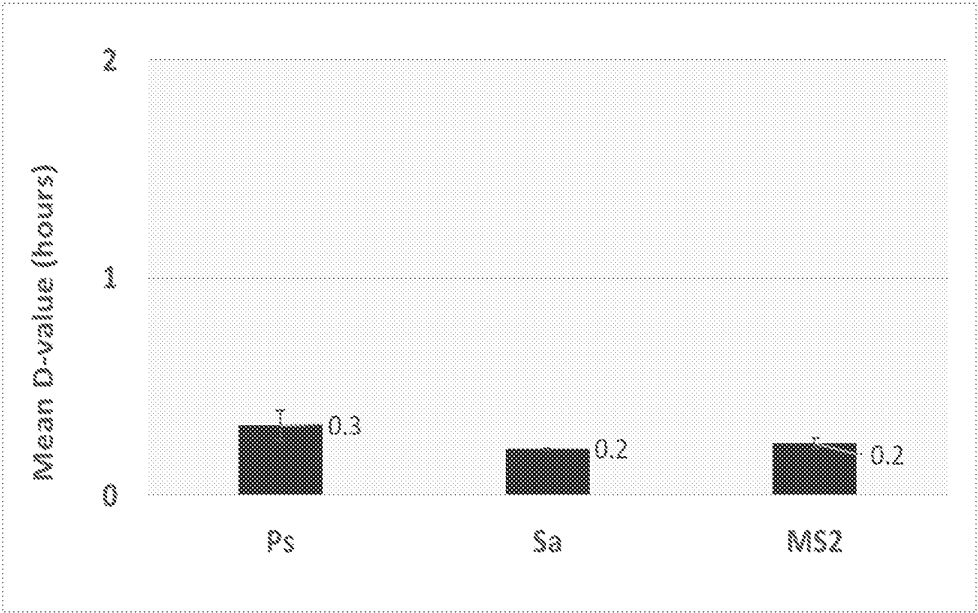


FIG. 55B

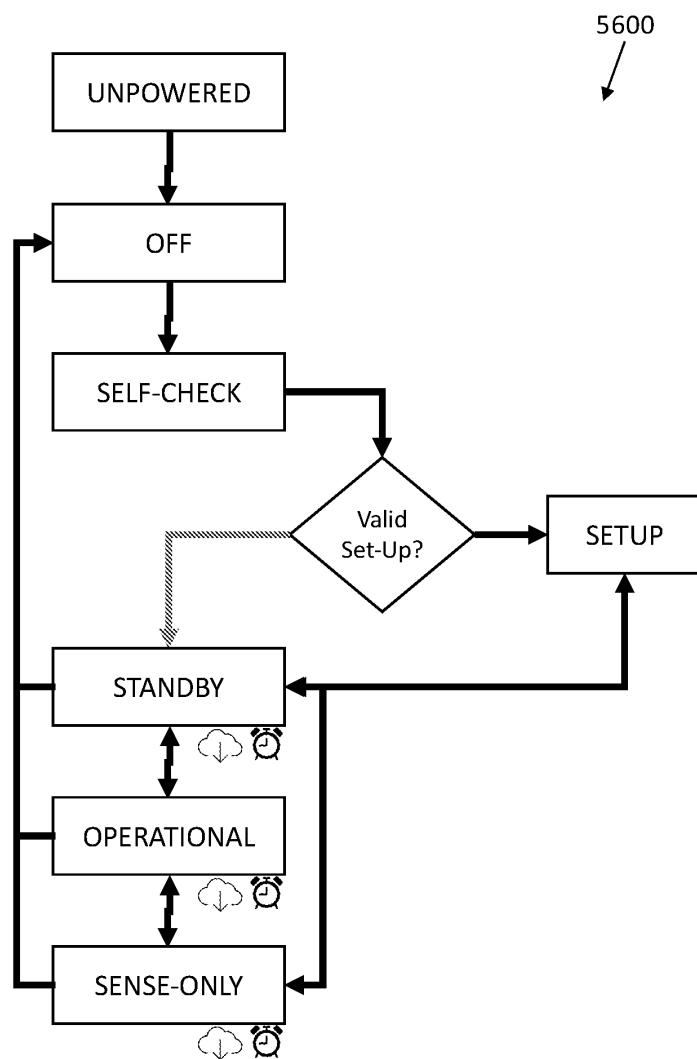


FIG. 56

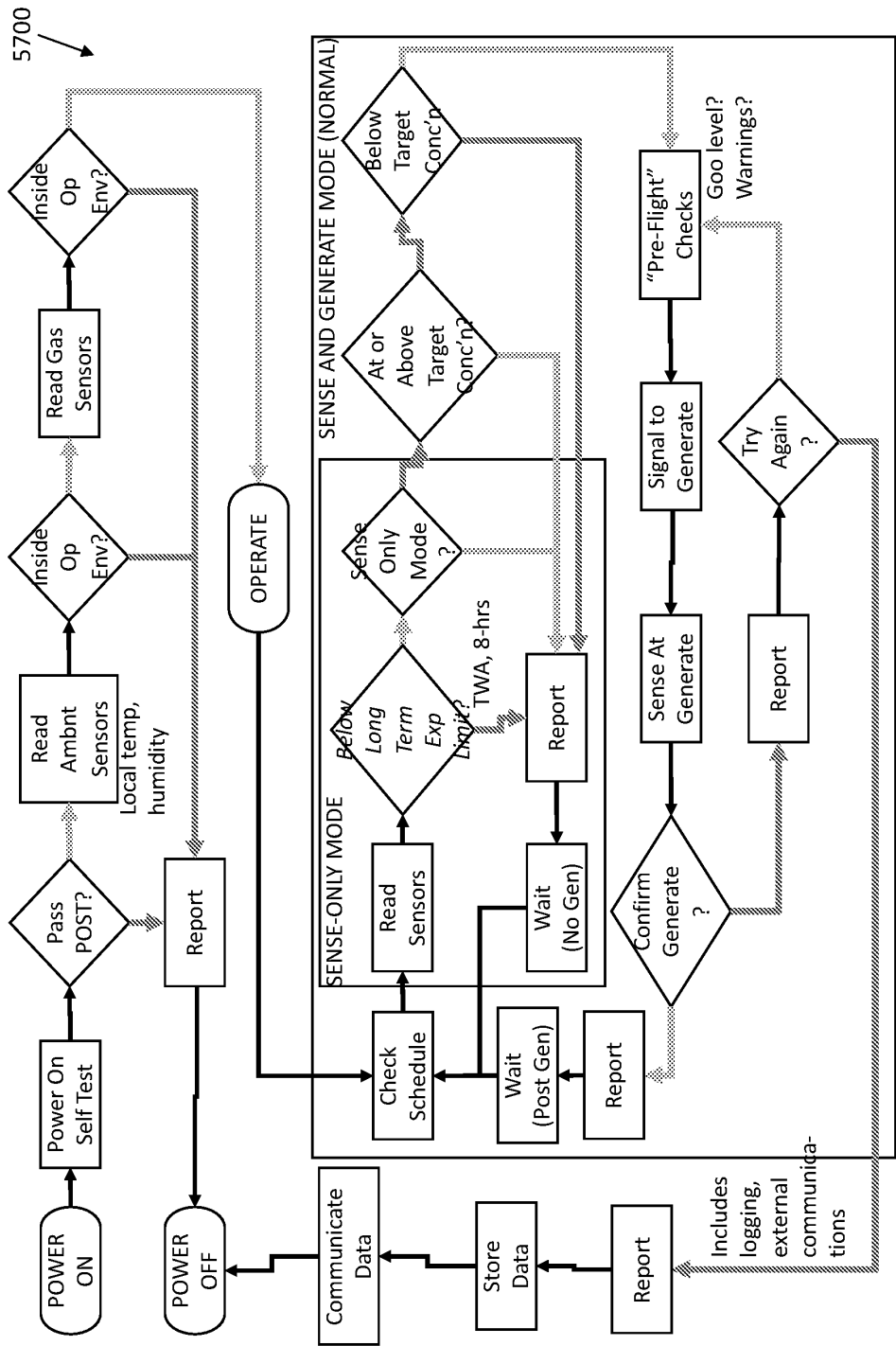
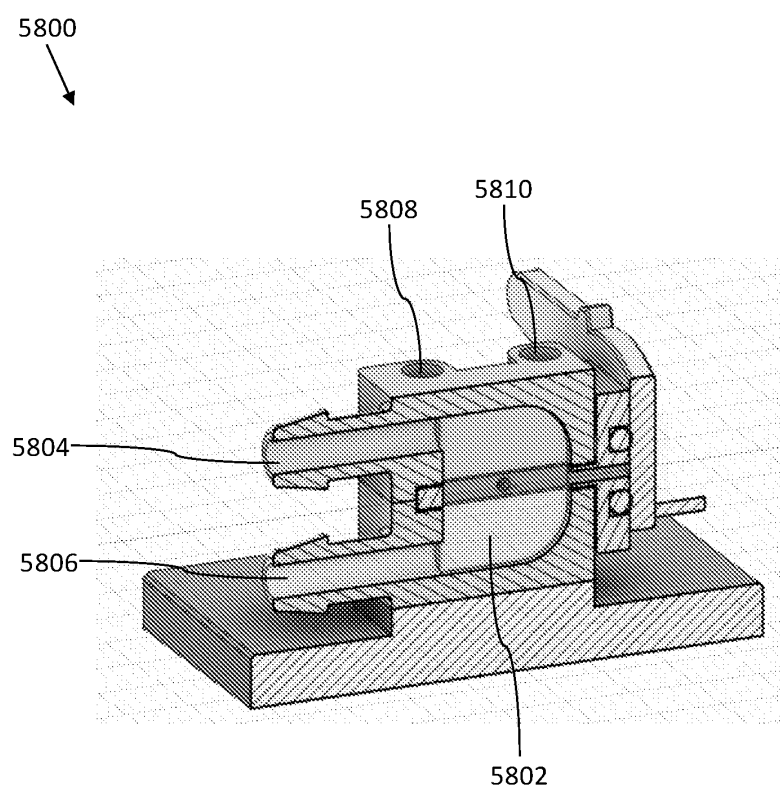
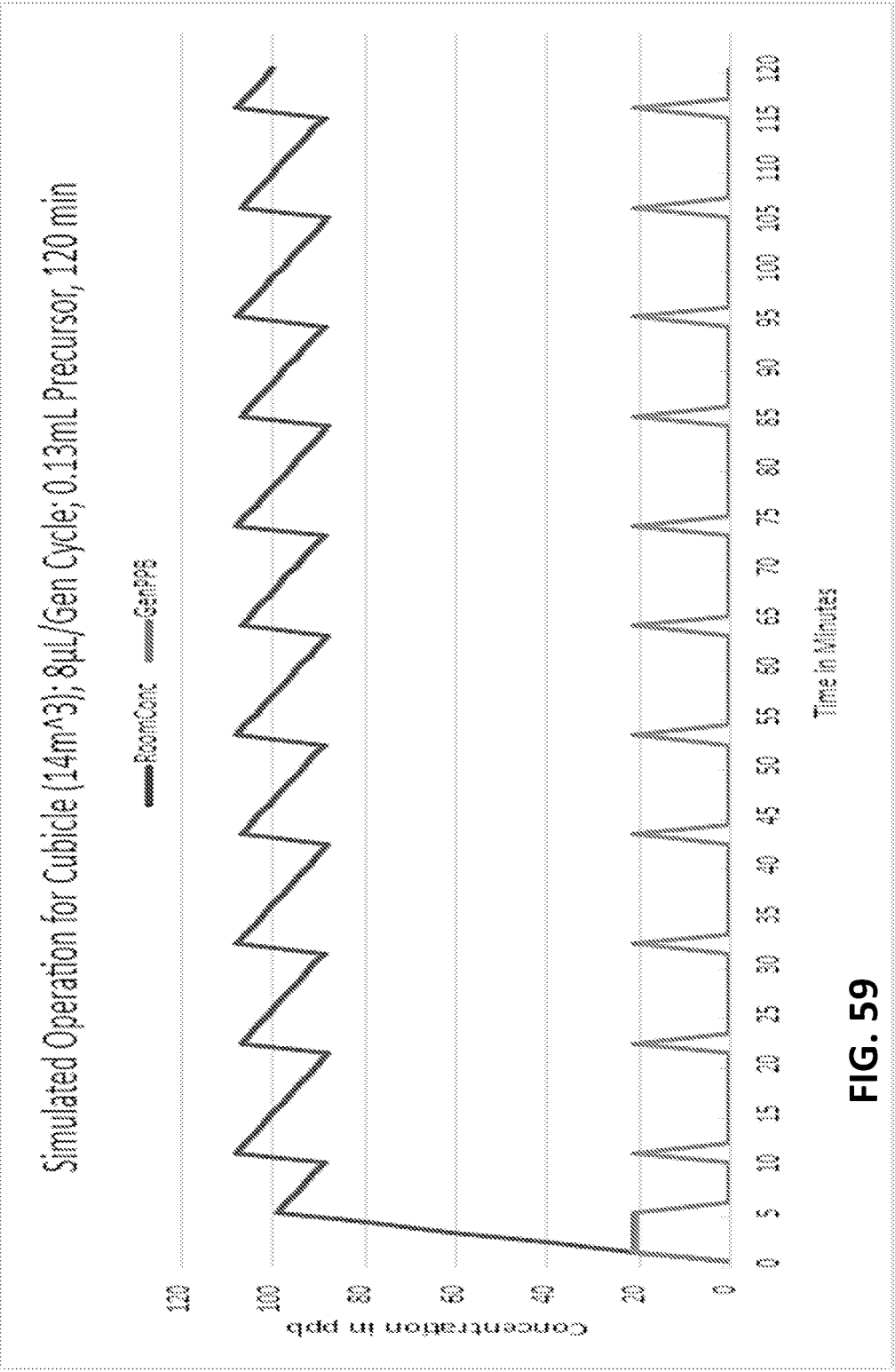


FIG. 57

**FIG. 58**



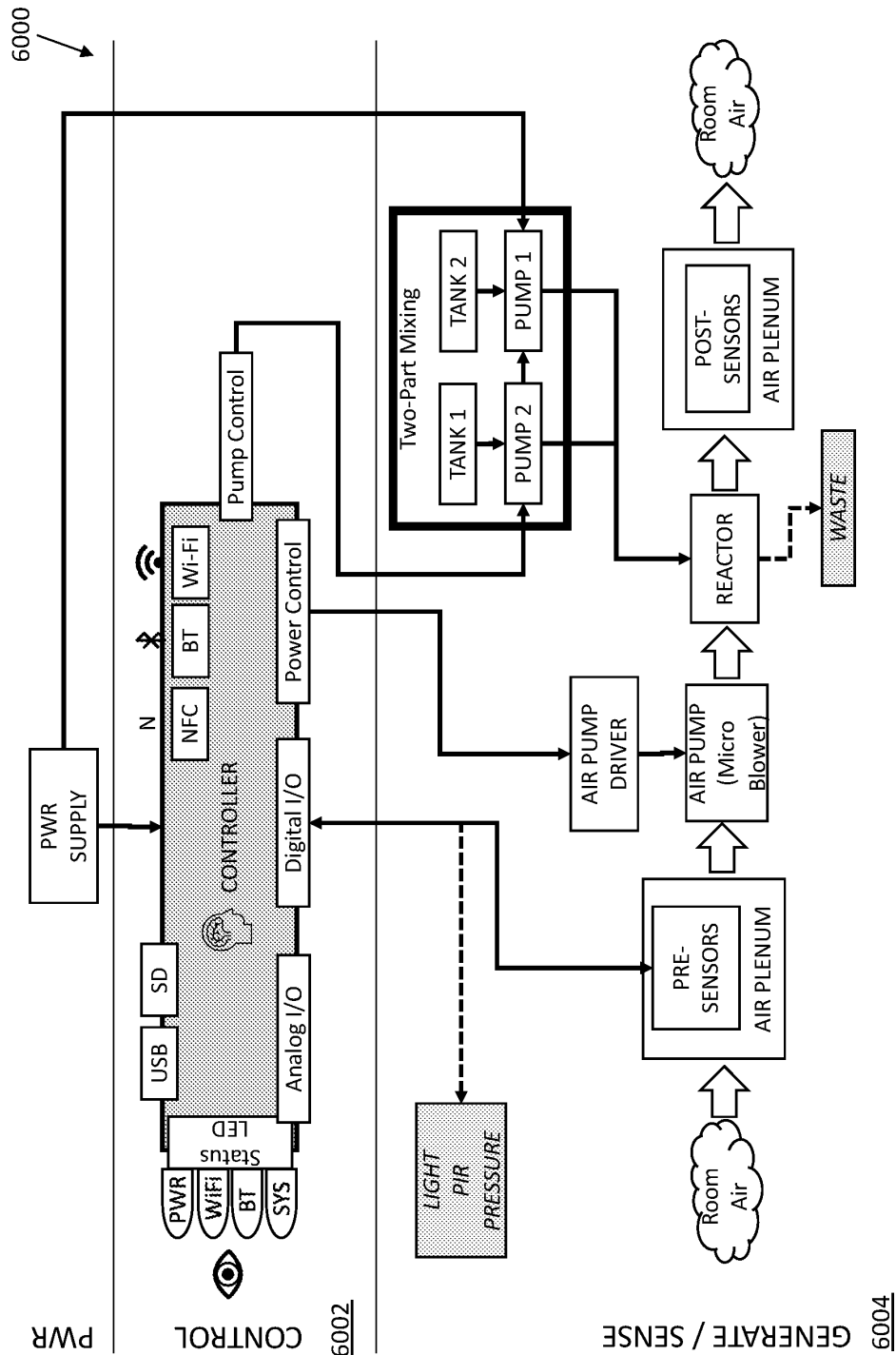


FIG. 60

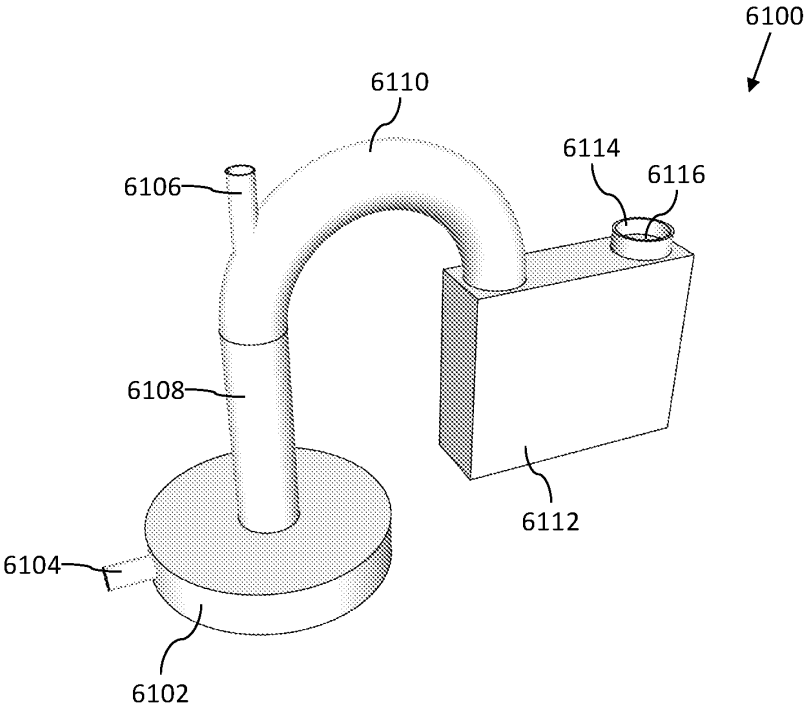


FIG. 61A

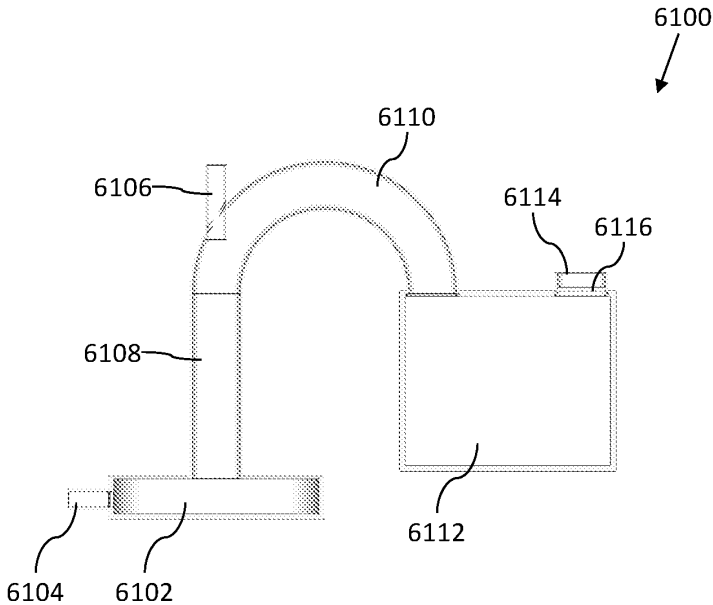


FIG. 61B