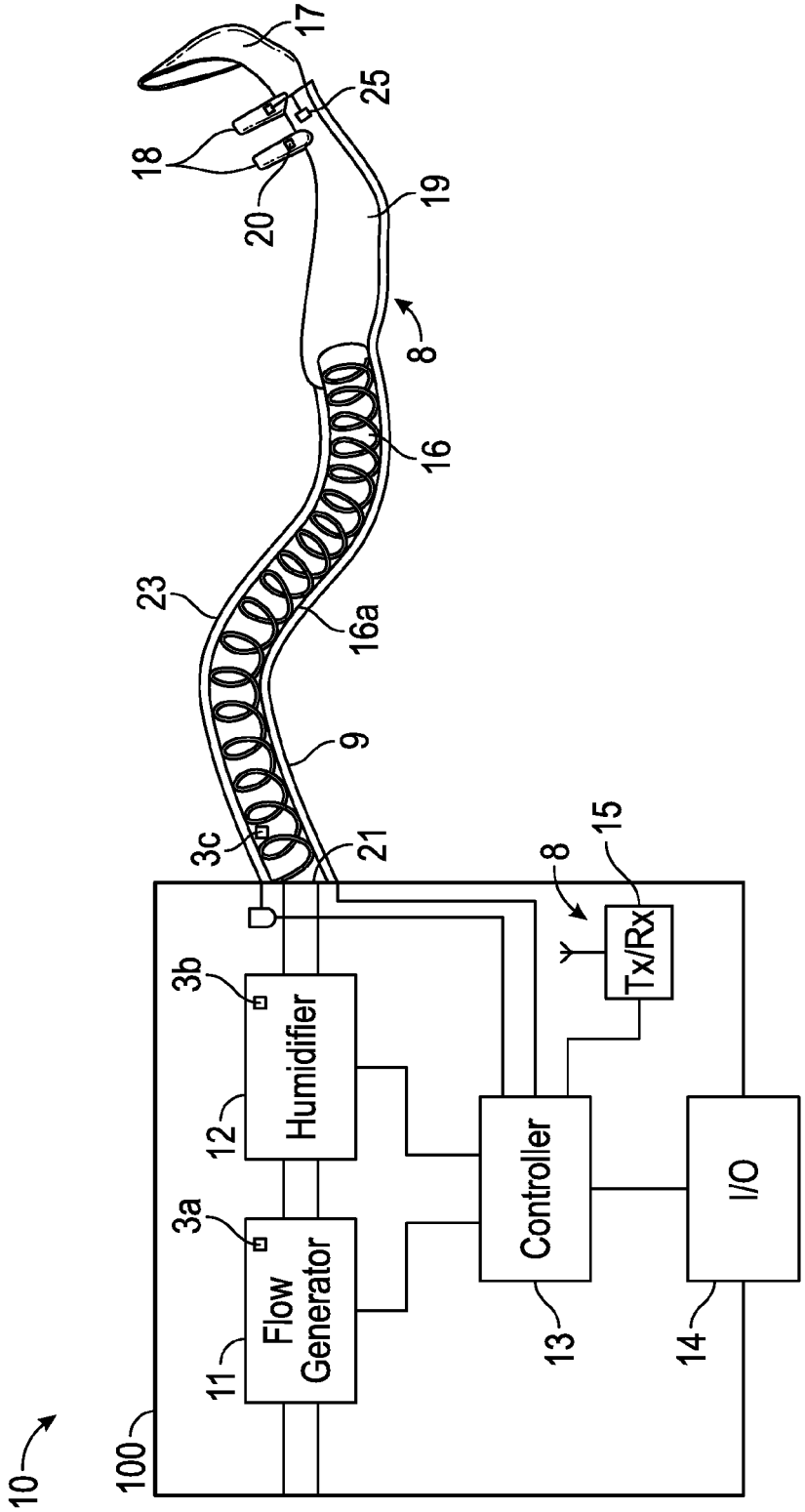

17
25
18
20
19
8
16
23
16a
9
3c
21
8
15
Tx/Rx
3b
Humidifier
12
3a
Flow Generator
11
Controller
13
I/O
14
100
10

FIG. 1

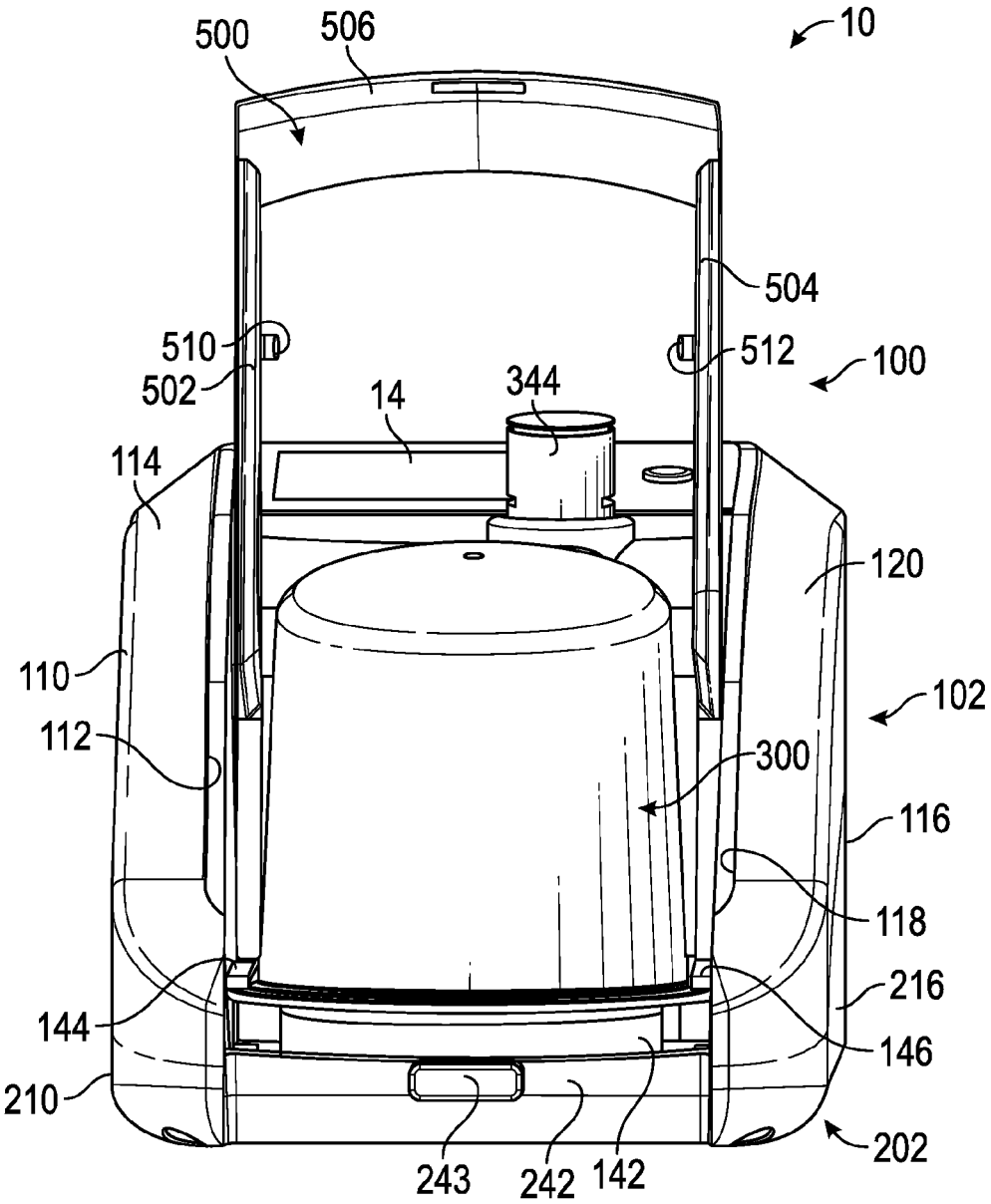

500
506
10
504
510
512
100
502
14
344
114
120
110
102
112
300
116
118
216
144
146
210
202
243
242
142

FIG. 2

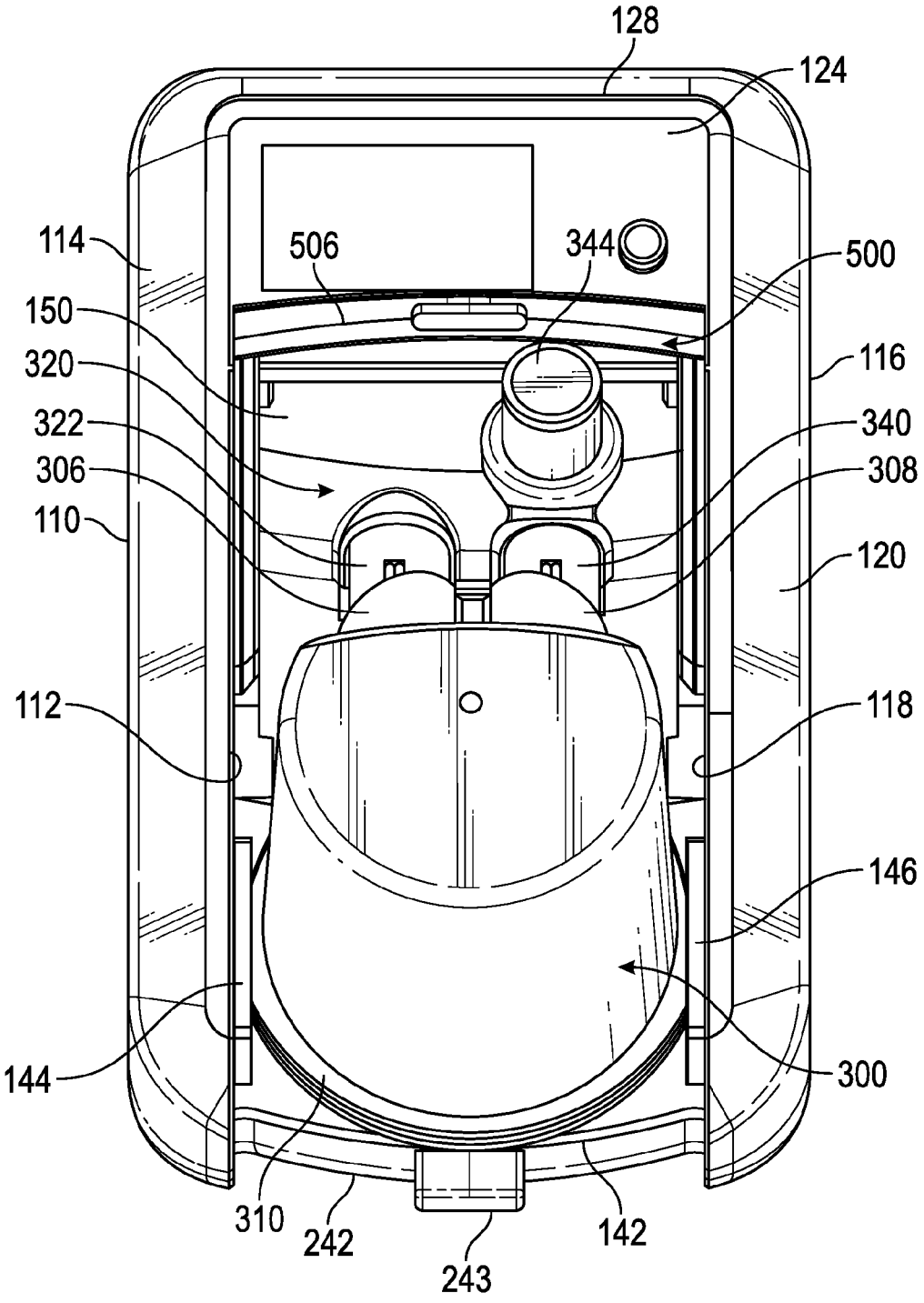

128
124
114
506
344
500
150
320
116
322
340
306
308
110
120
112
118
146
144
300
310
242
243
142

FIG. 3

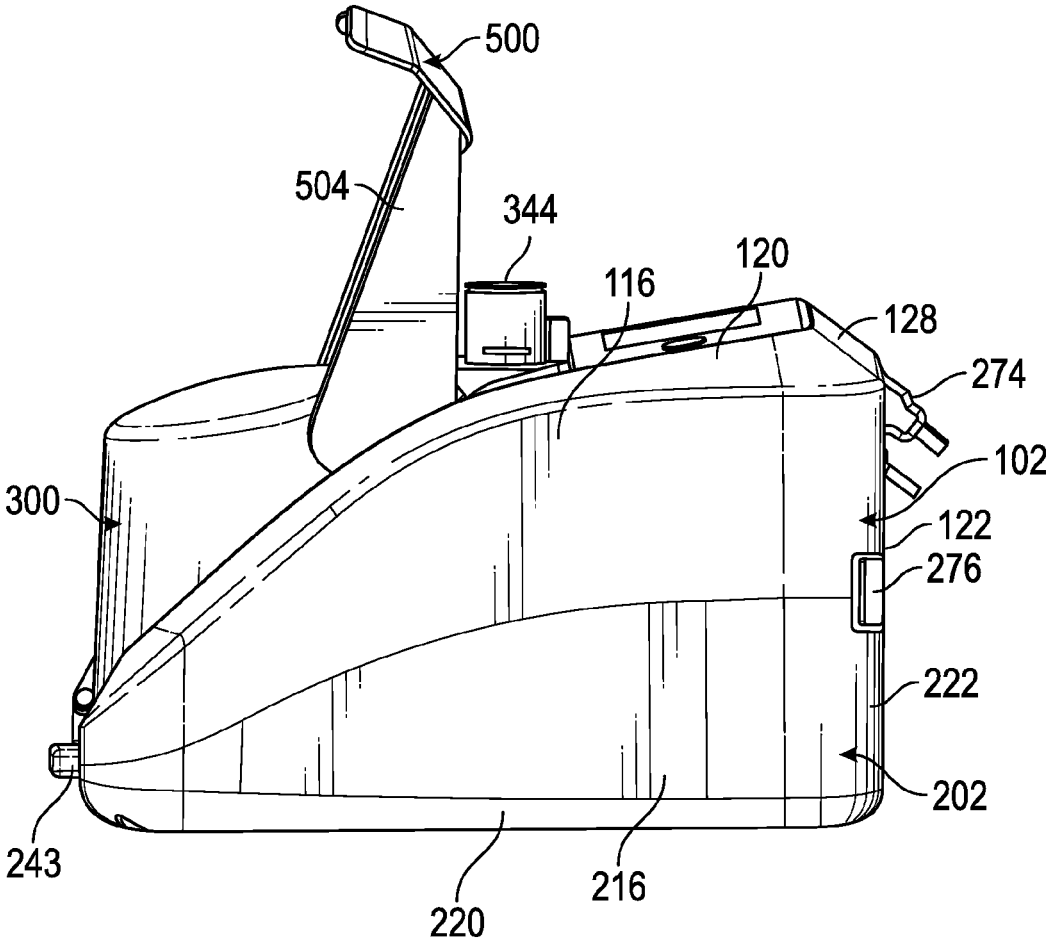


FIG. 4

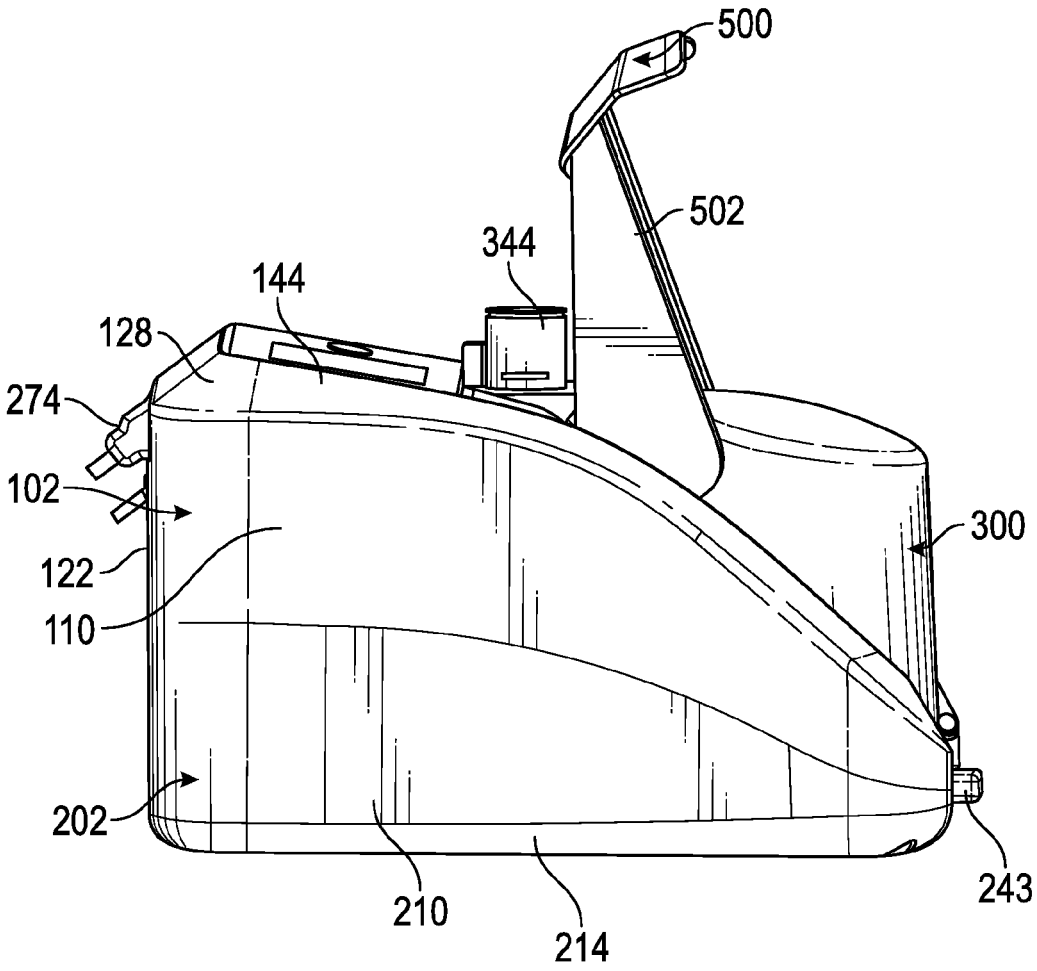


FIG. 5

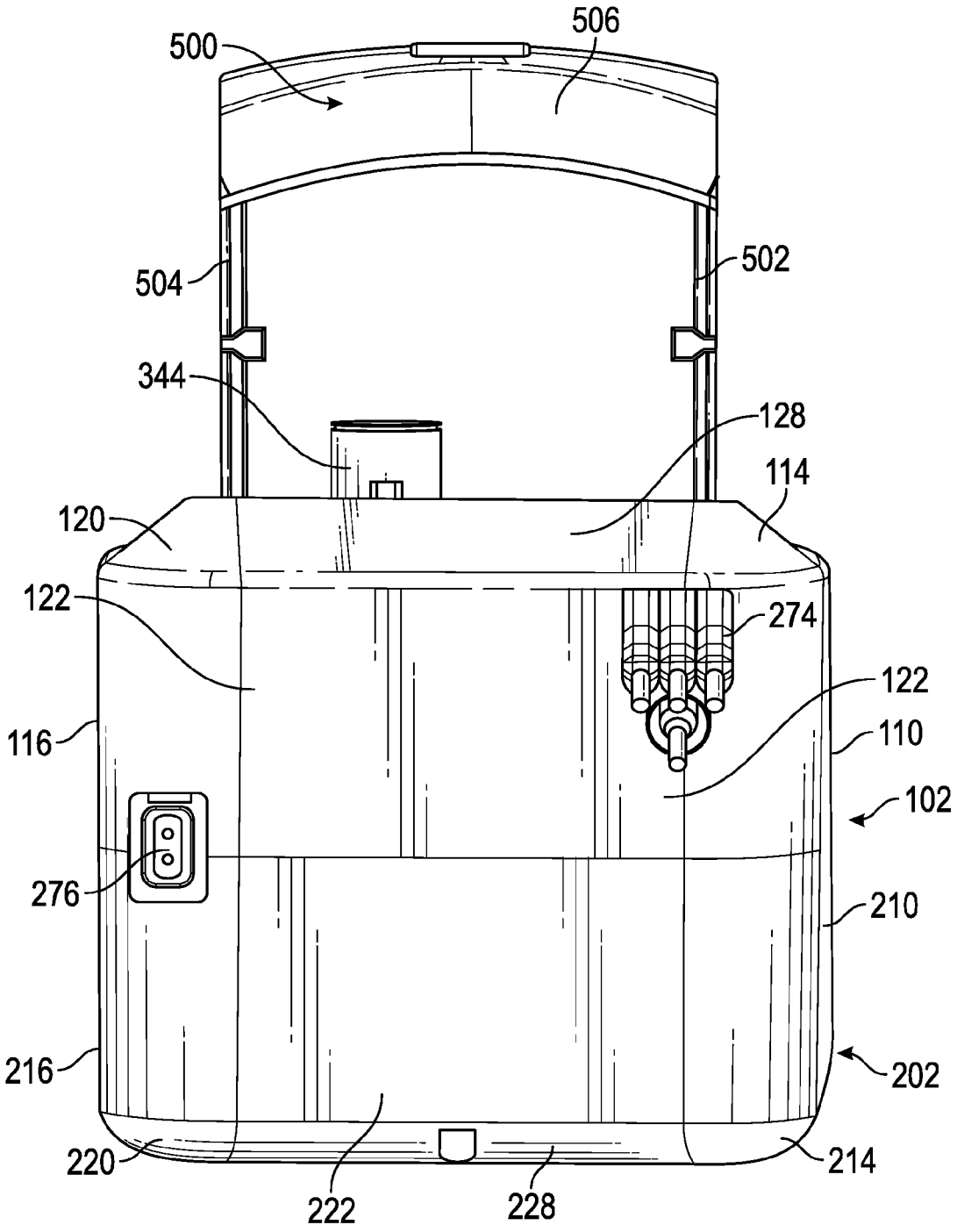

500
506
504
502
344
128
114
120
122
274
122
116
110
102
276
210
216
202
220
214
222
228

FIG. 6

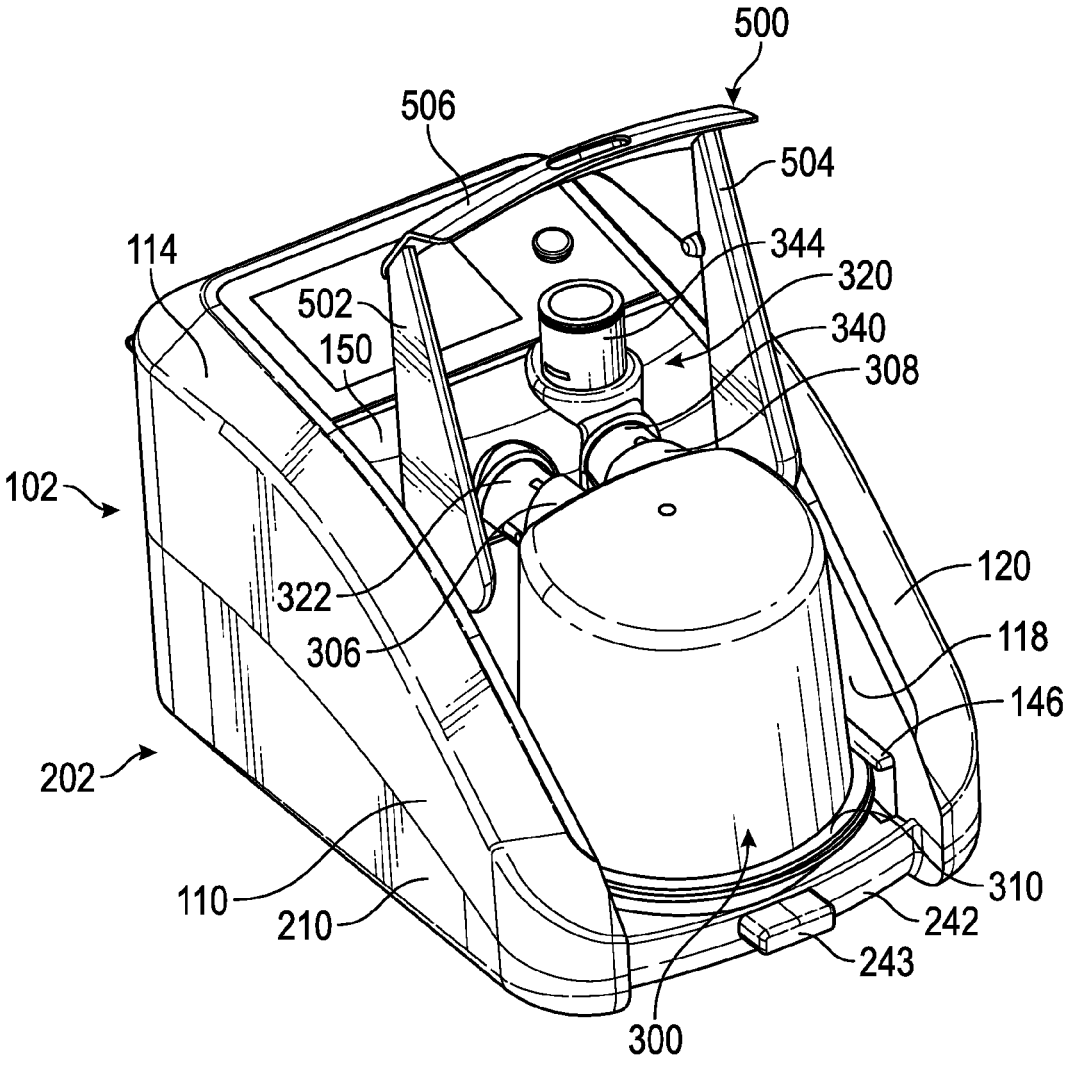

500
506
504
114
344
320
502
150
340
308
102
120
322
118
306
146
202
310
110
242
210
243
300

FIG. 7

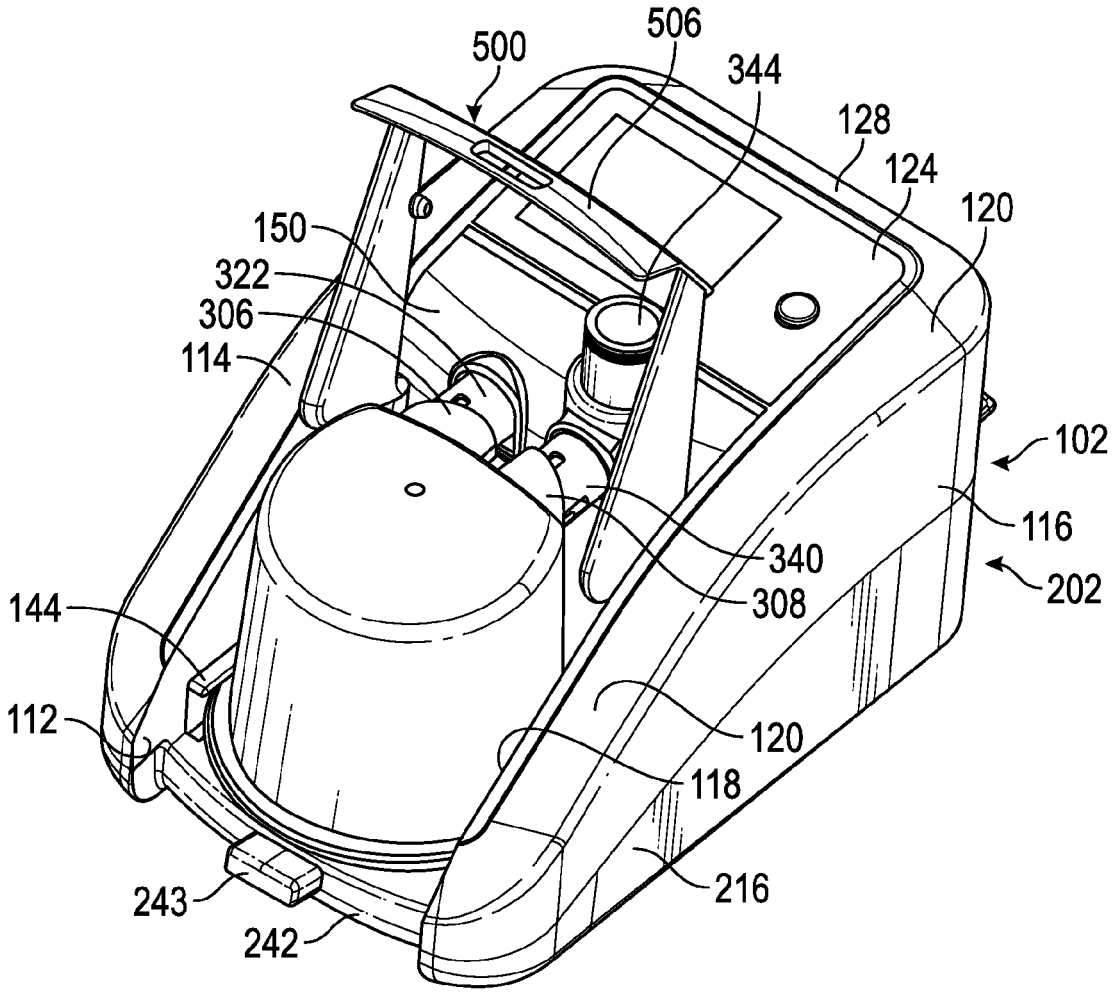

500
506
344
128
124
120
150
322
306
114
102
116
340
308
202
144
112
120
118
216
243
242

FIG. 8

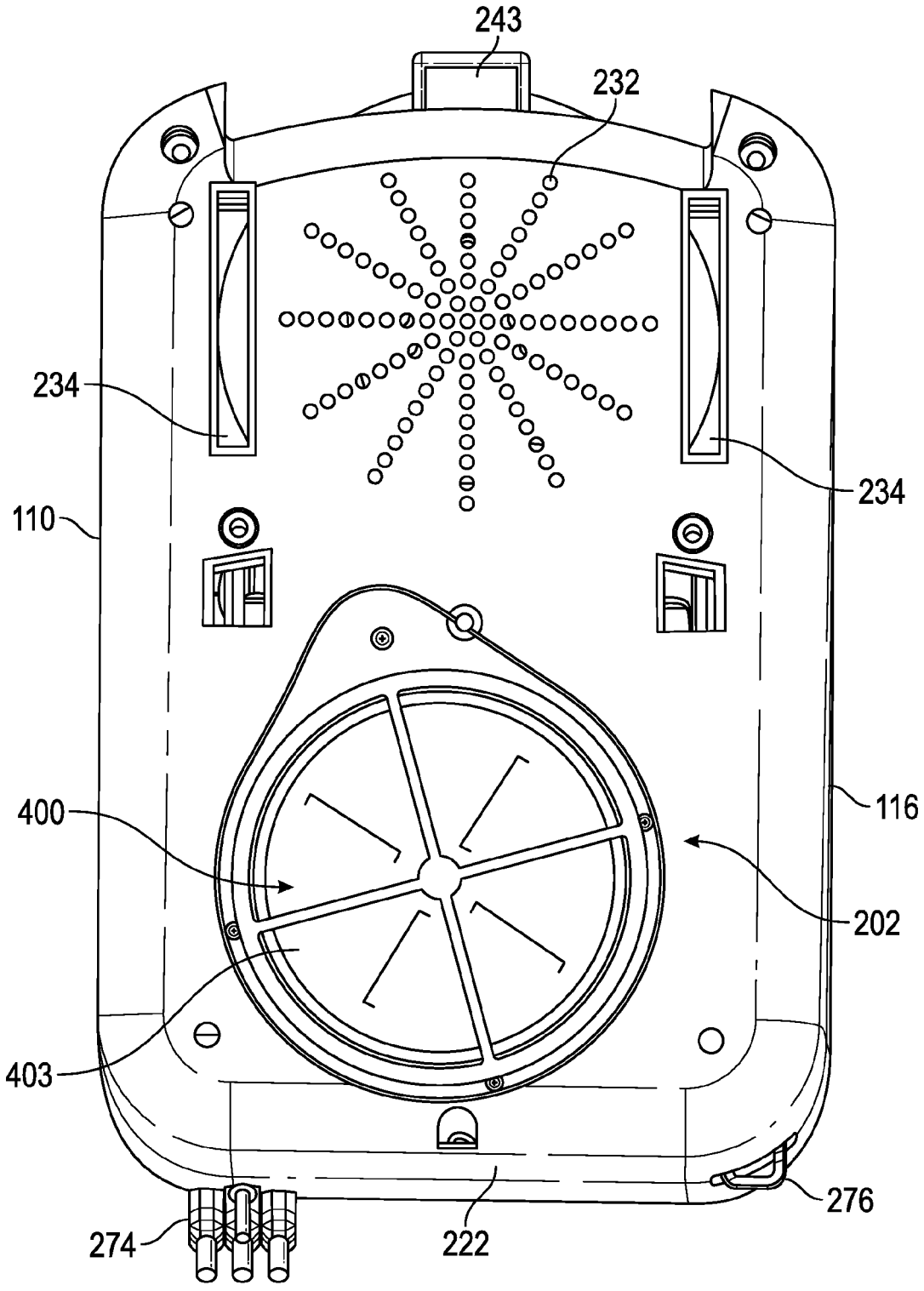


FIG. 9

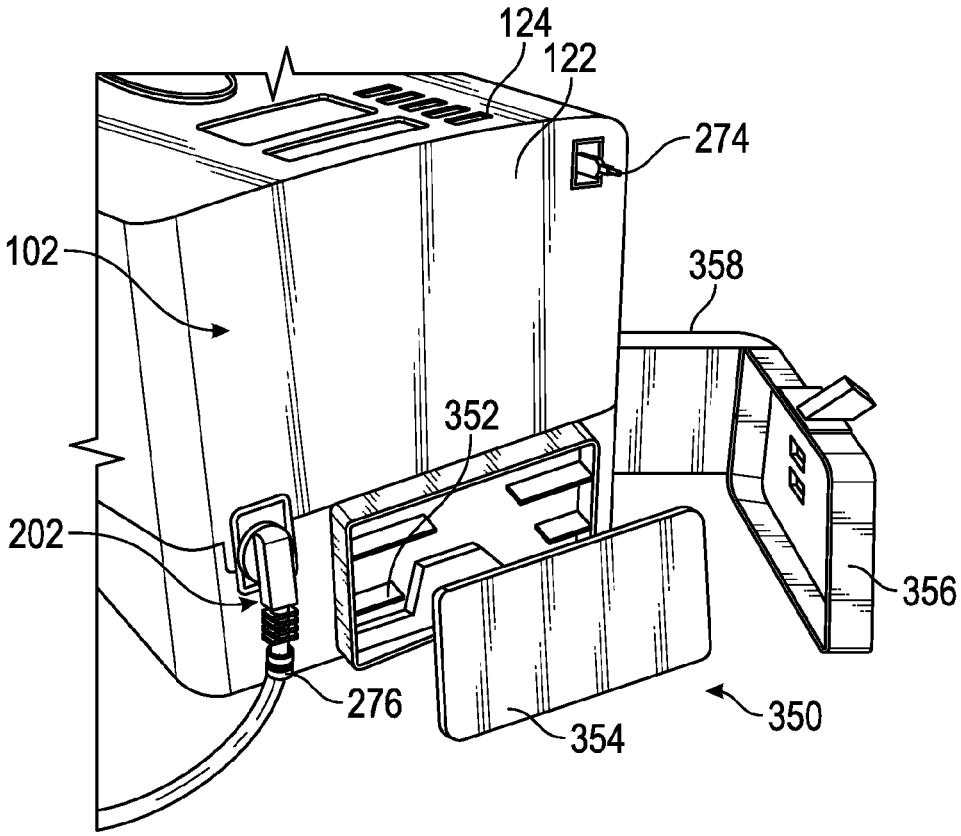


FIG. 10

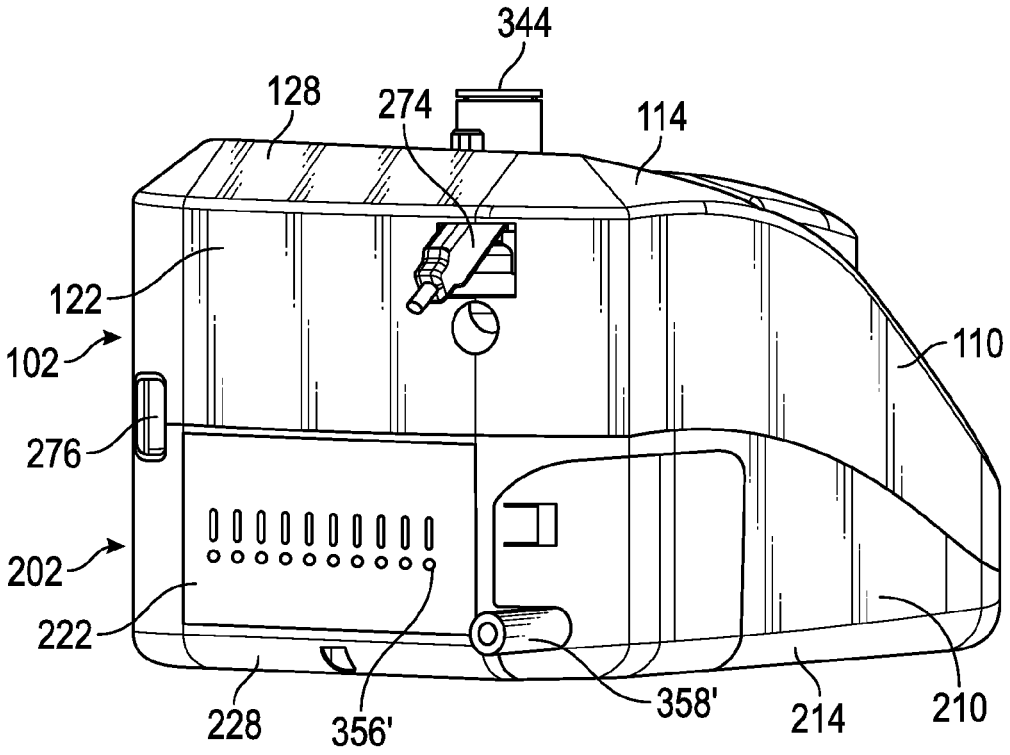


FIG. 11

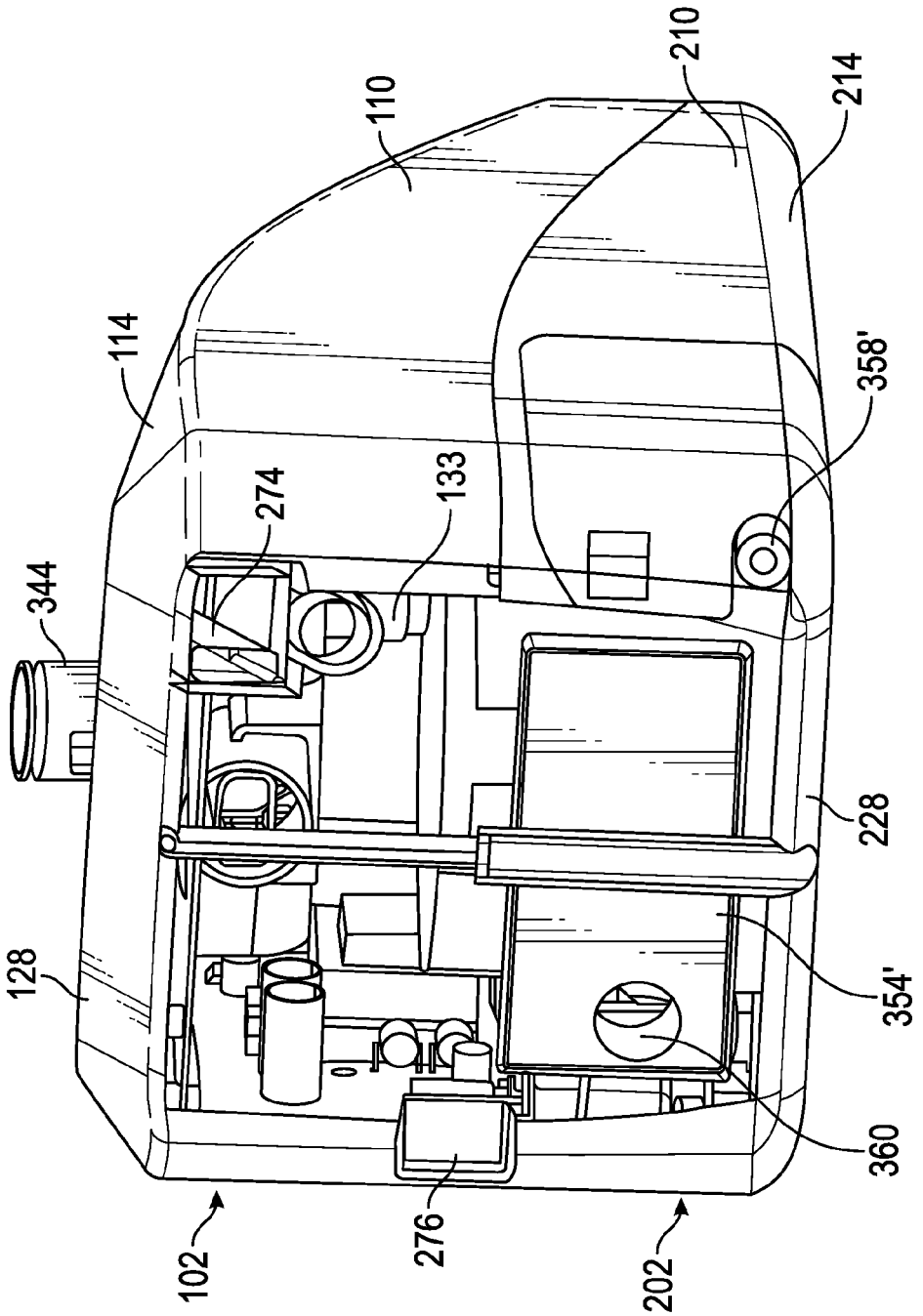


FIG. 12

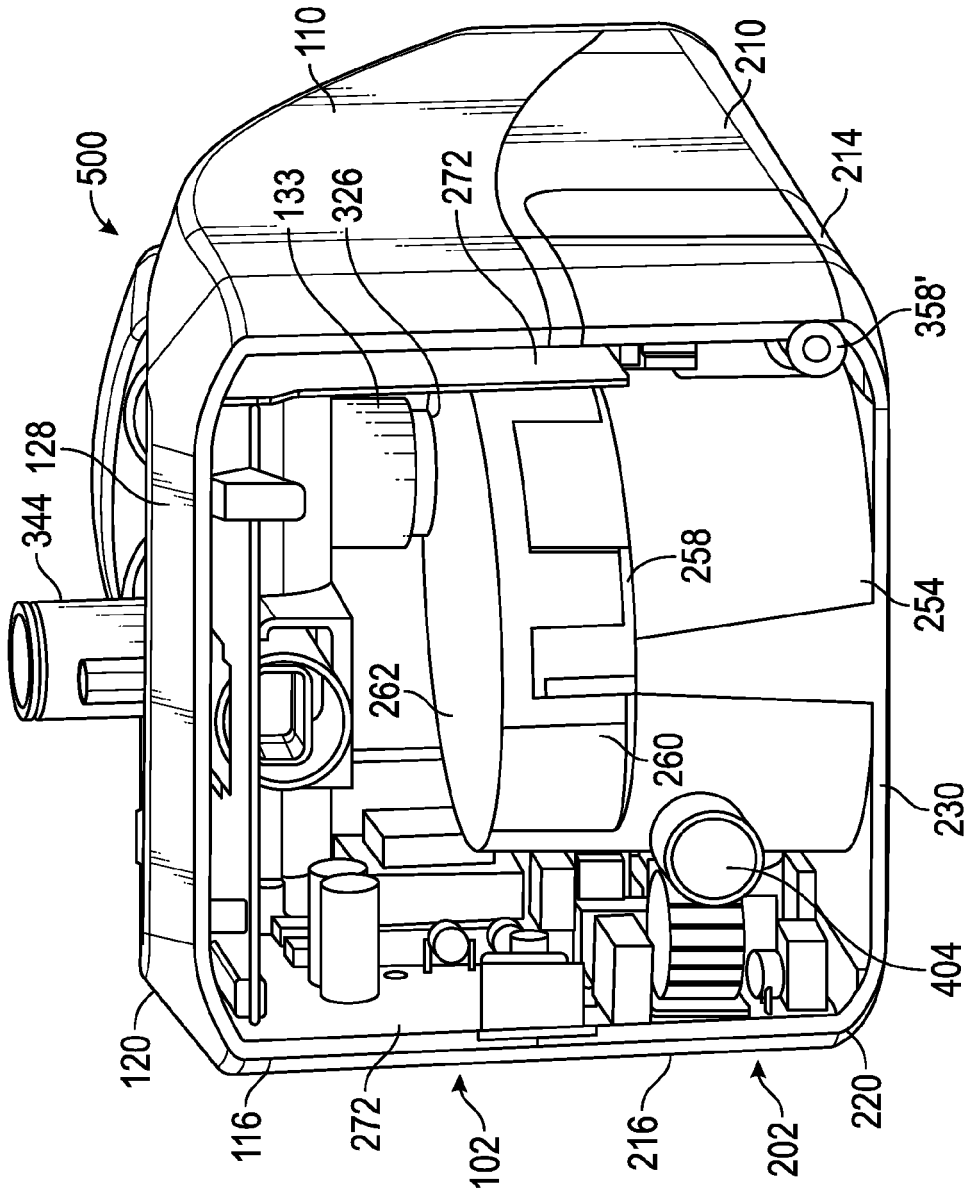

500
110
210
214
133
326
272
358'
128
344
258
254
262
260
230
404
120
116
272
102
216
202
220

FIG. 13

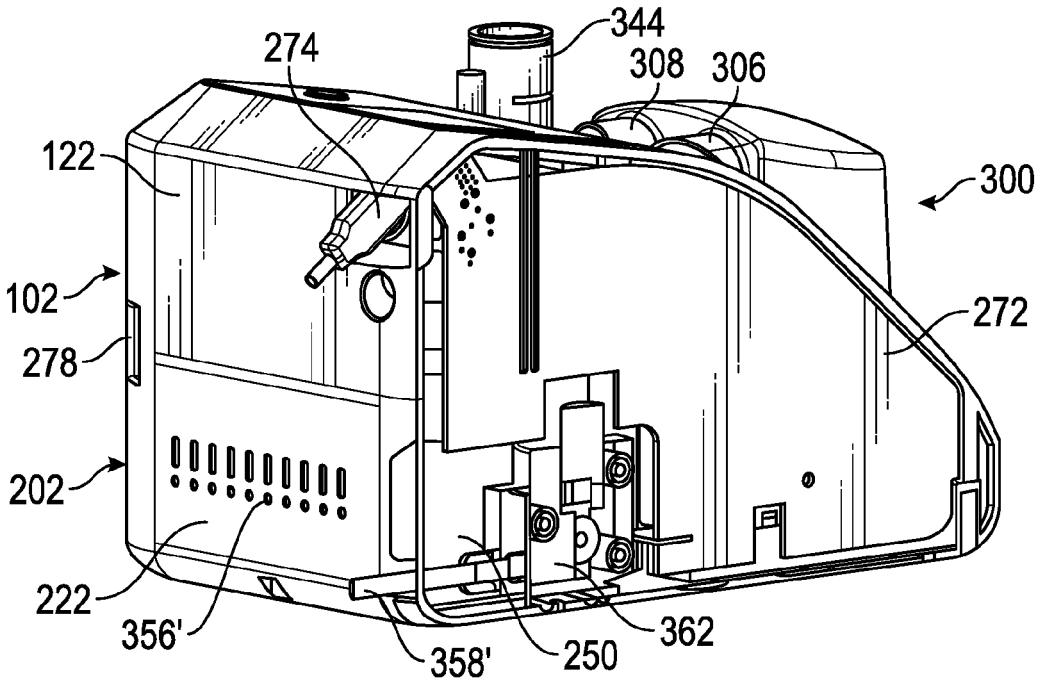


FIG. 14

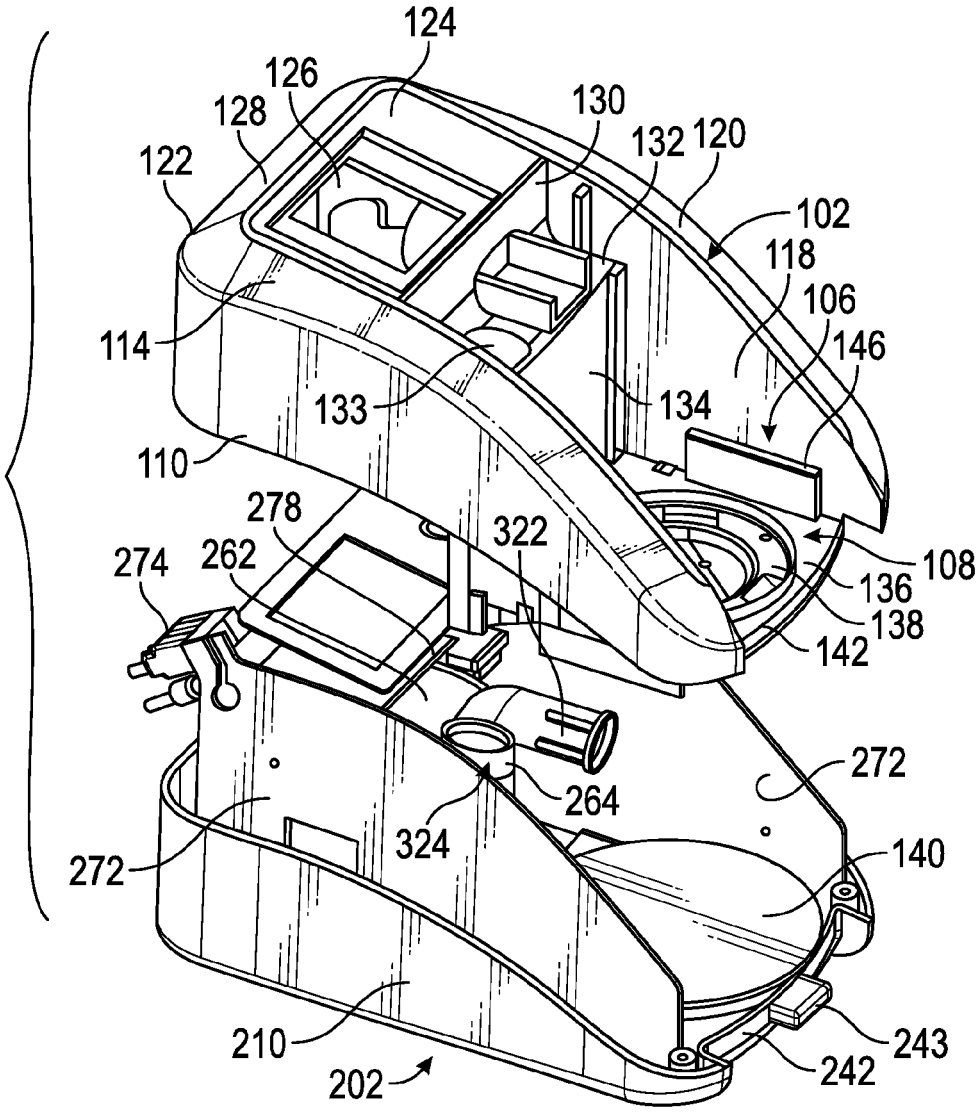

124
126
128
130
132
120
122
102
118
106
146
114
133
134
110
278
322
108
274
262
136
138
142
272
264
324
140
272
210
243
242
202

FIG. 15

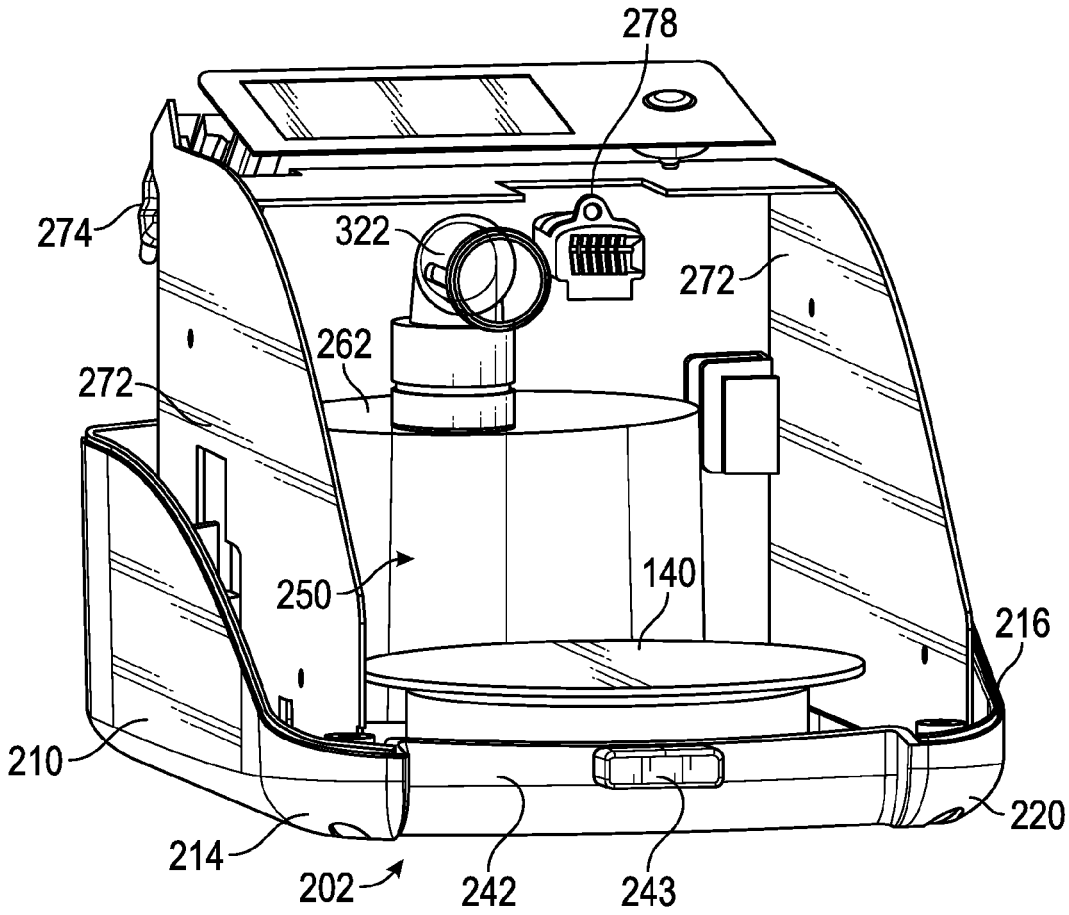


FIG. 16

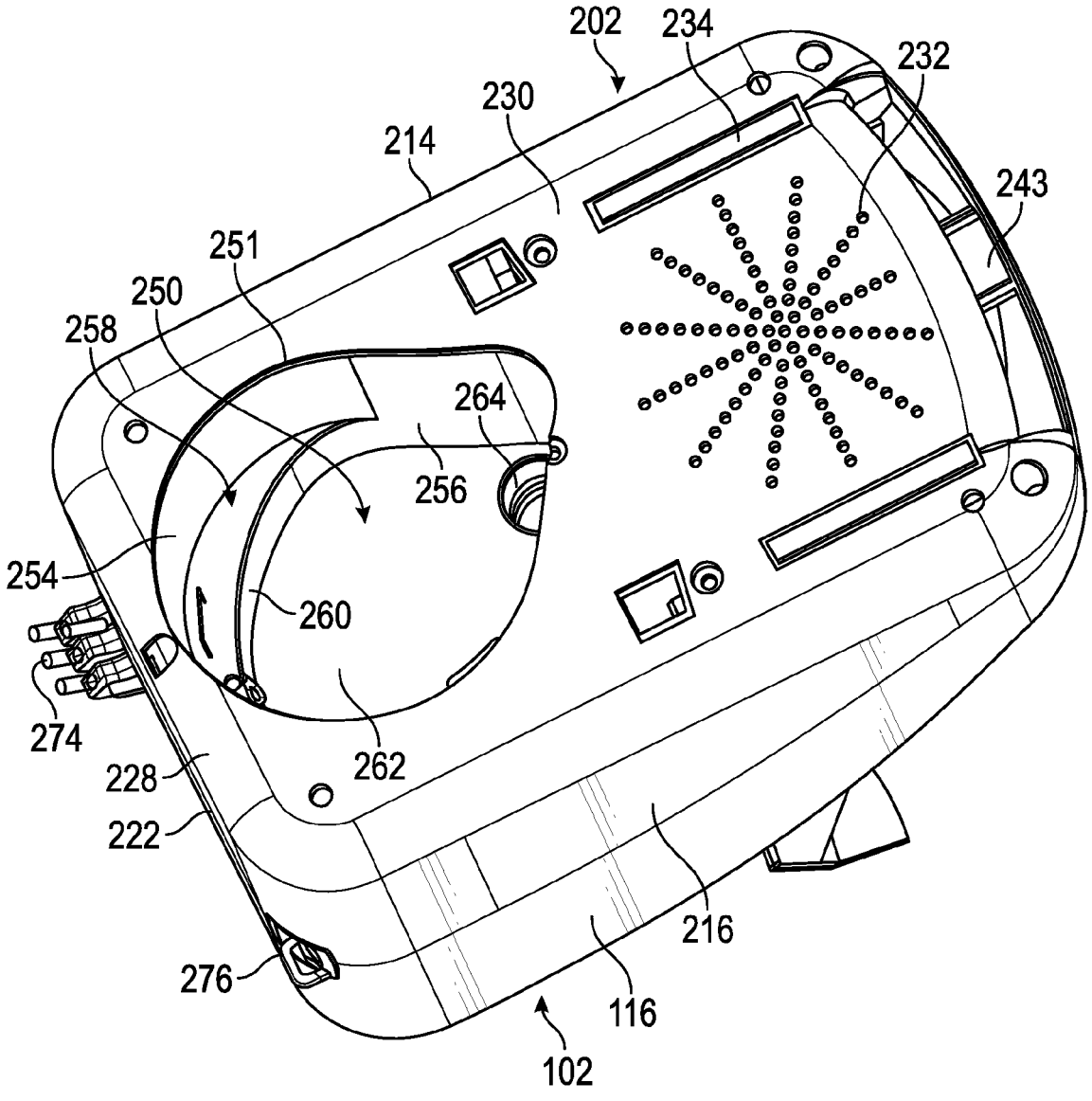

202
234
232
230
214
243
251
250
258
264
256
254
260
274
262
228
222
216
276
116
102

FIG. 17A

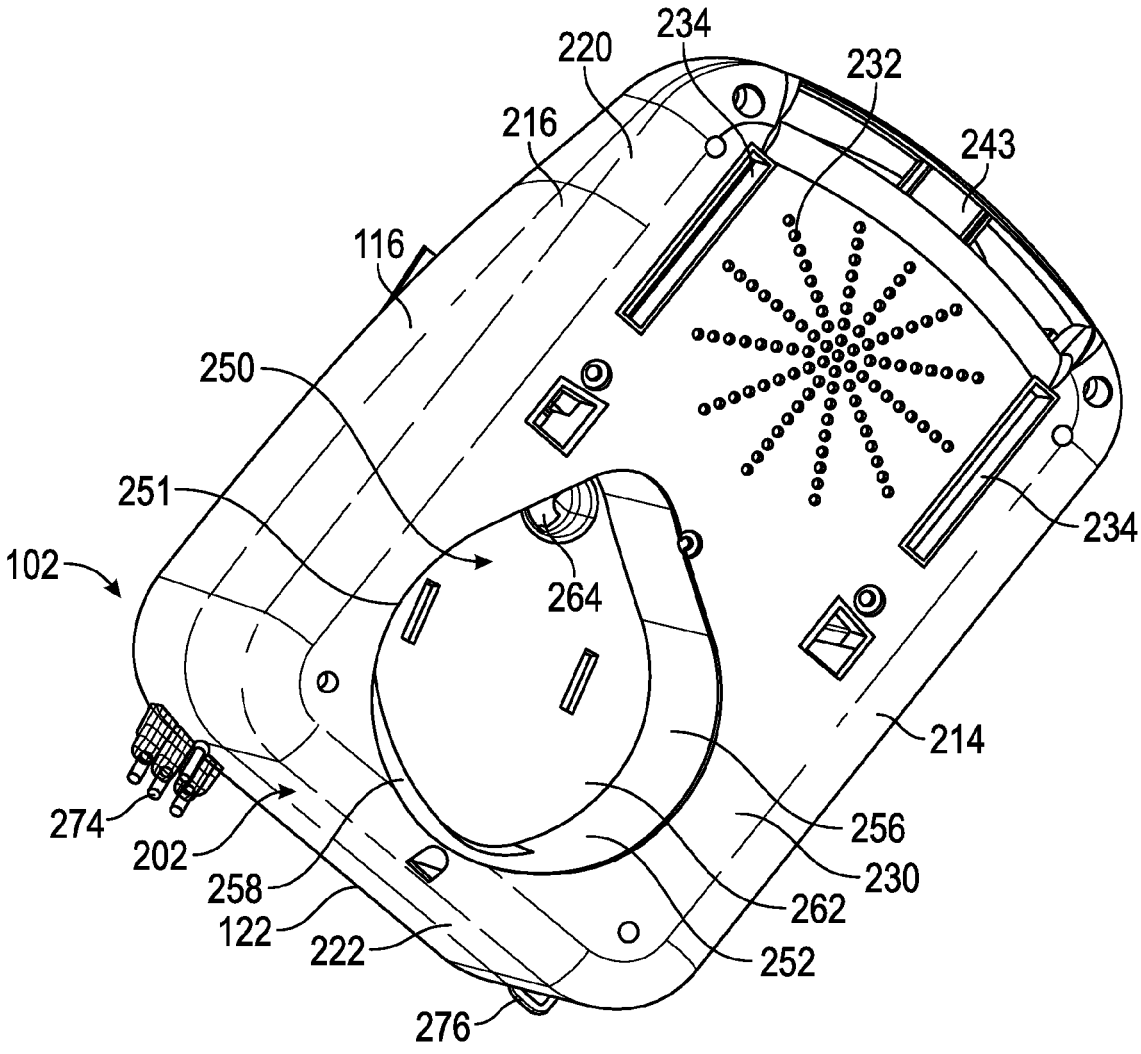

234
220
232
216
243
116
250
251
102
264
234
214
274
202
256
258
230
122
262
222
252
276

FIG. 17B

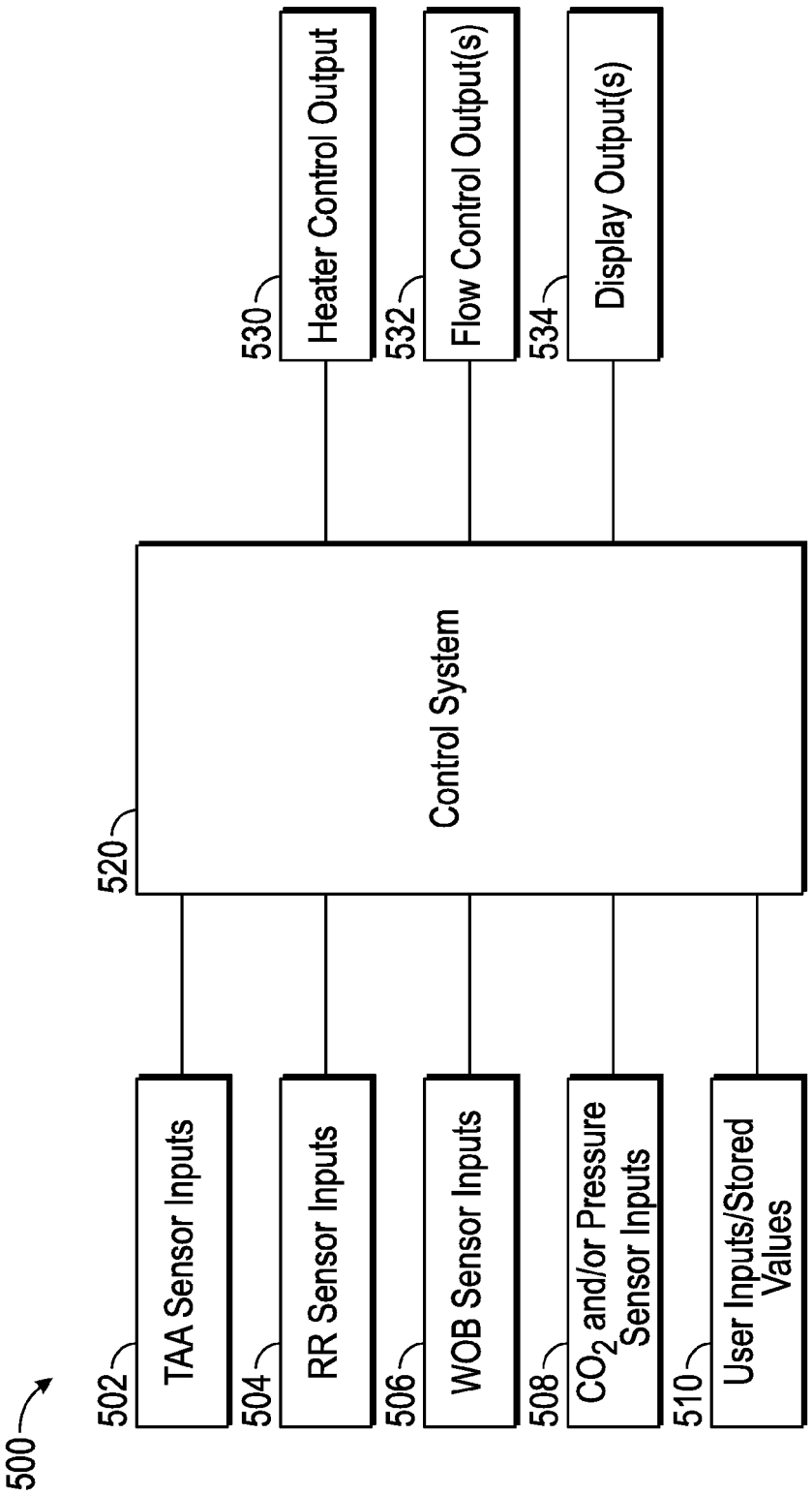

500
502
TAA Sensor Inputs
504
RR Sensor Inputs
506
WOB Sensor Inputs
508
CO_2 and/or Pressure Sensor Inputs
510
User Inputs/Stored Values
520
Control System
530
Heater Control Output
532
Flow Control Output(s)
534
Display Output(s)

FIG. 18

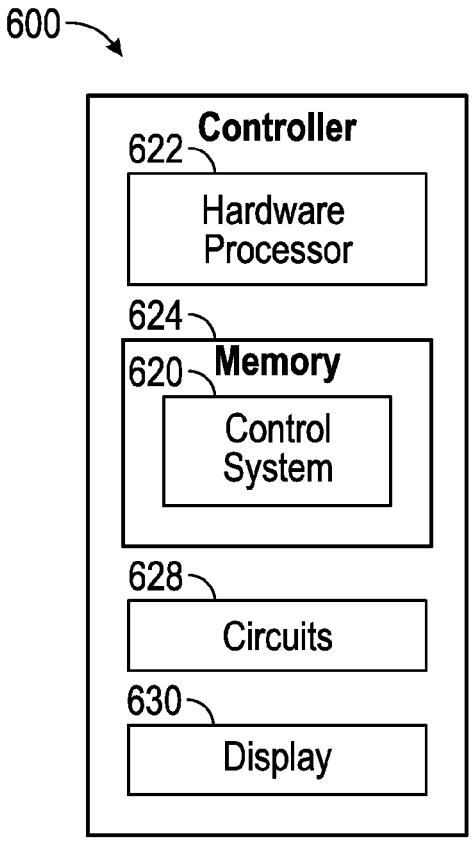

600
Controller
622
Hardware Processor
624
620
Memory
Control System
628
Circuits
630
Display

FIG. 19

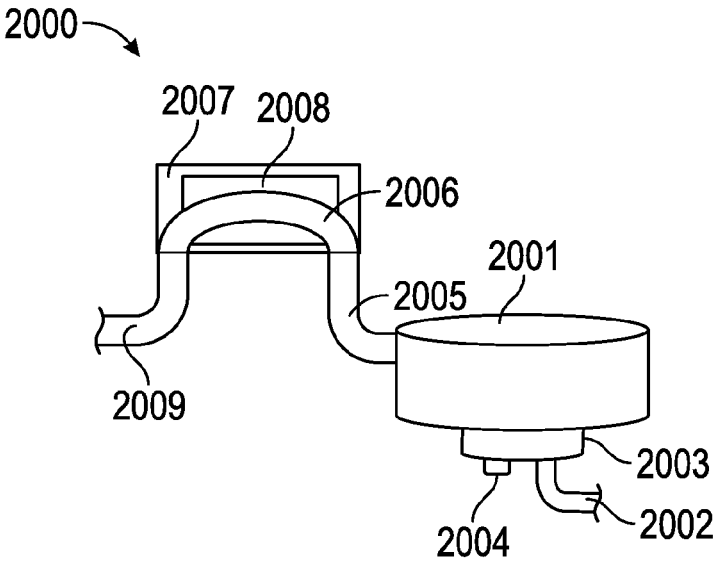

2000
2007
2008
2006
2001
2005
2009
2003
2004
2002

FIG. 20

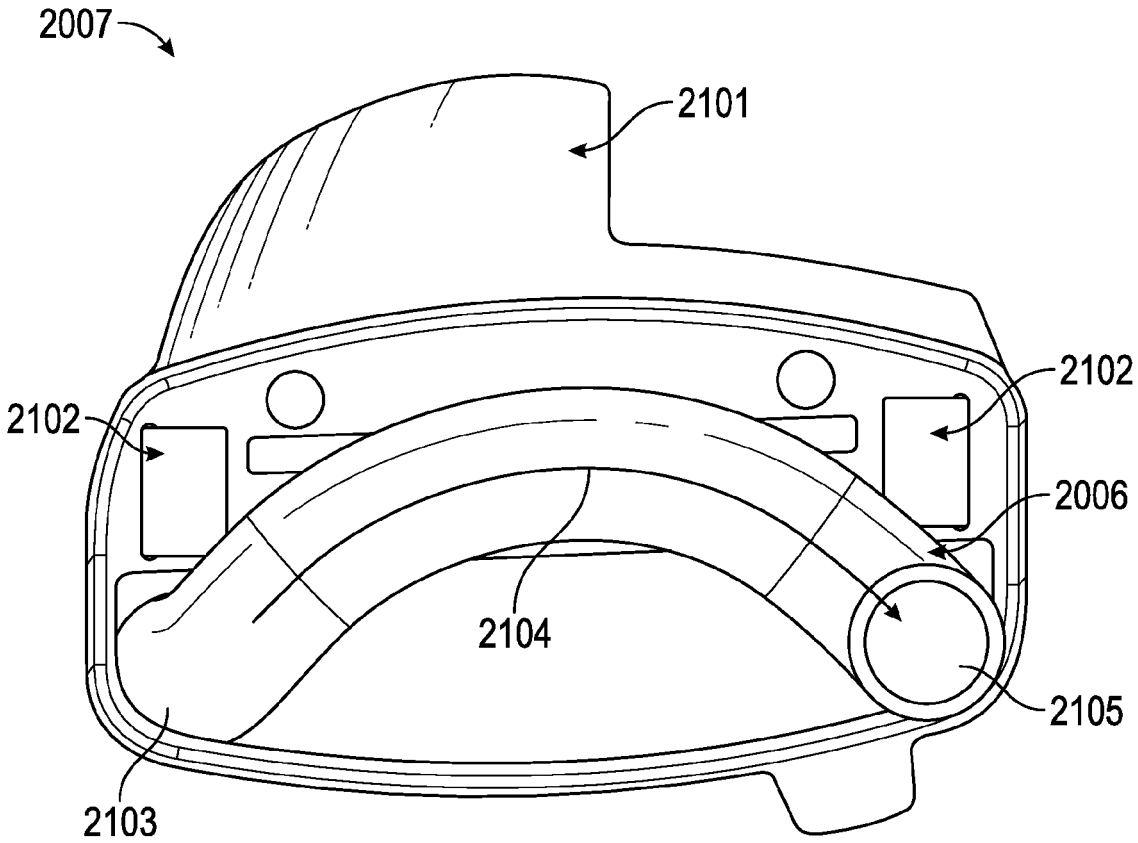


FIG. 21

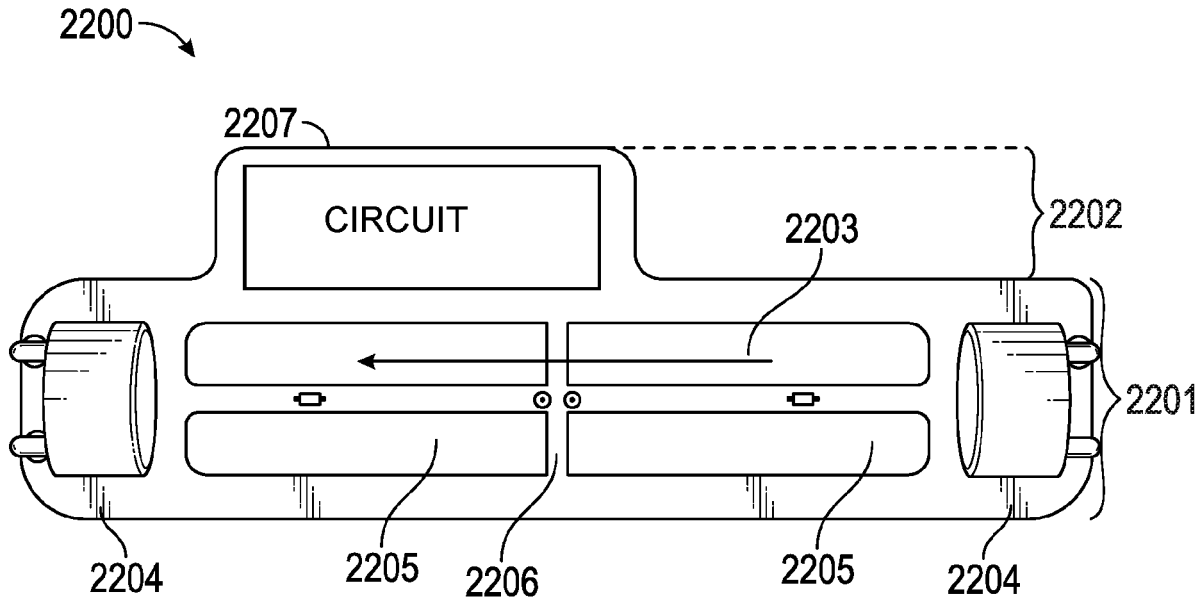


FIG. 22A

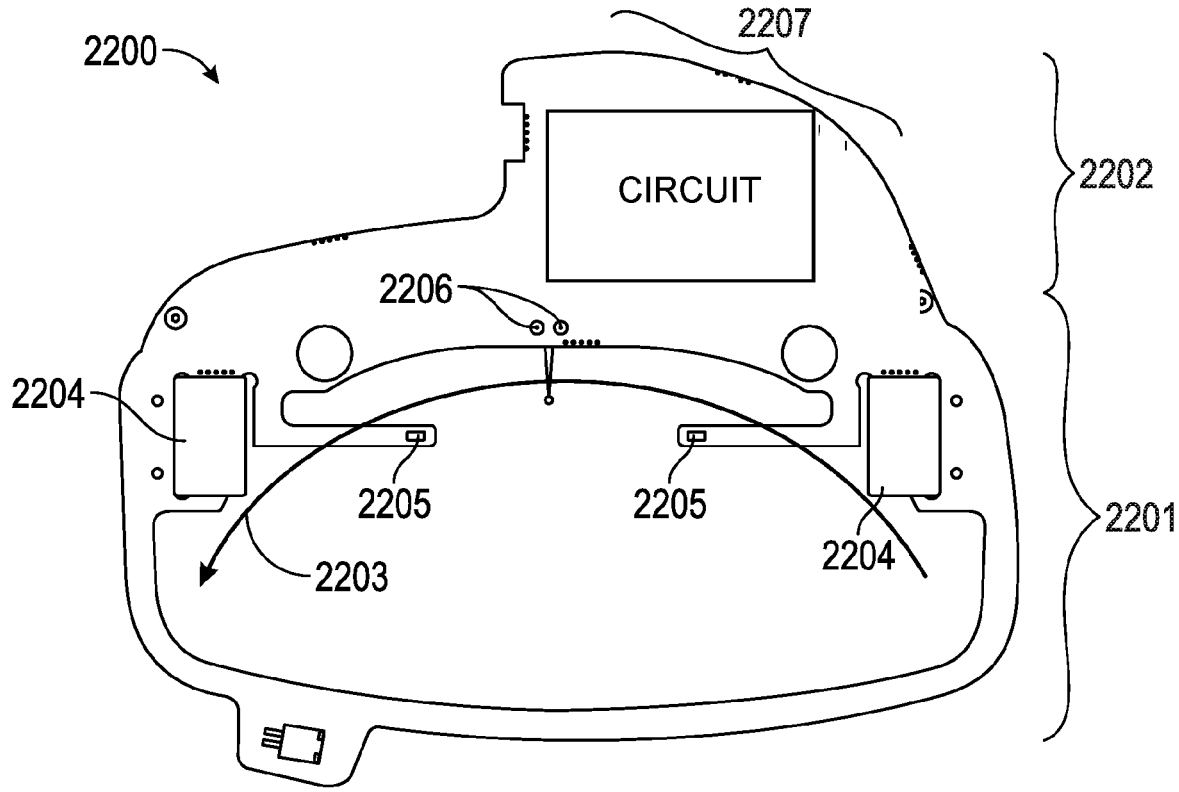


FIG. 22B

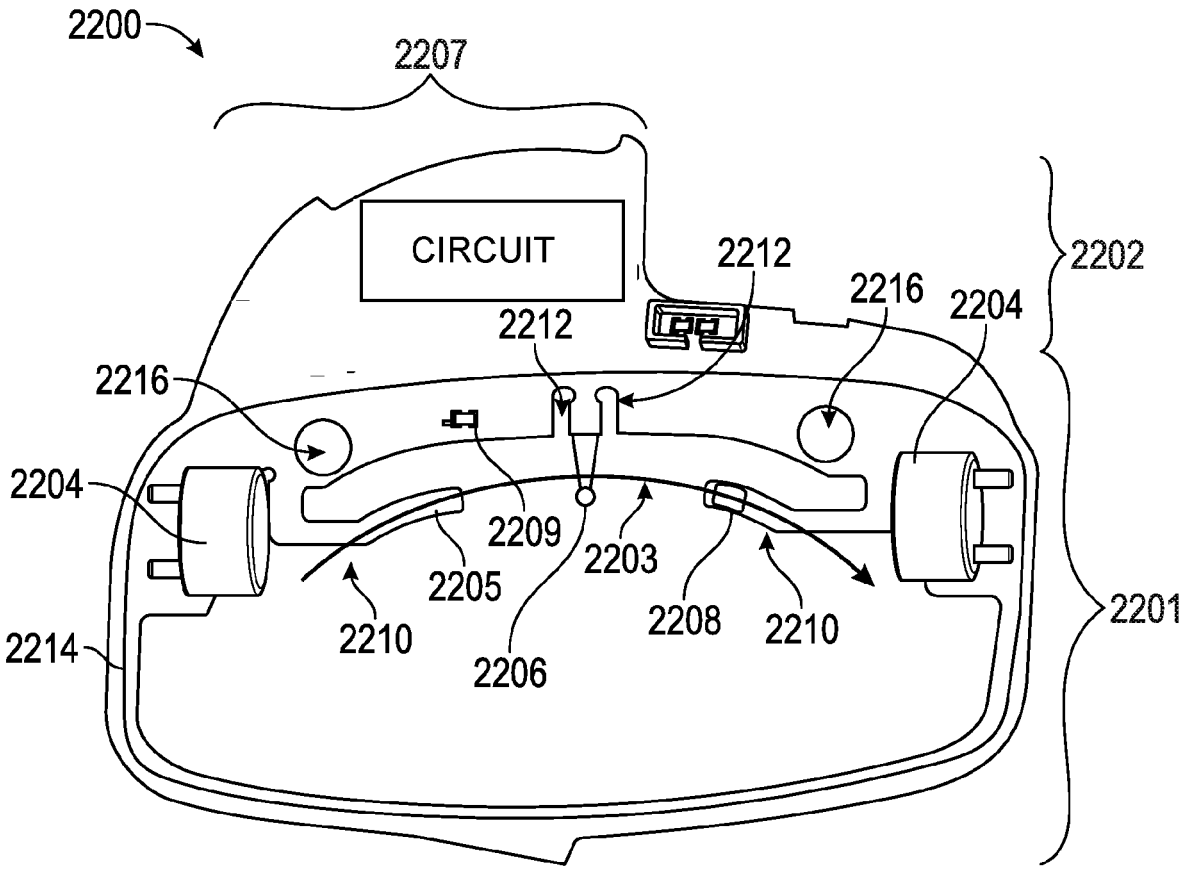


FIG. 22C

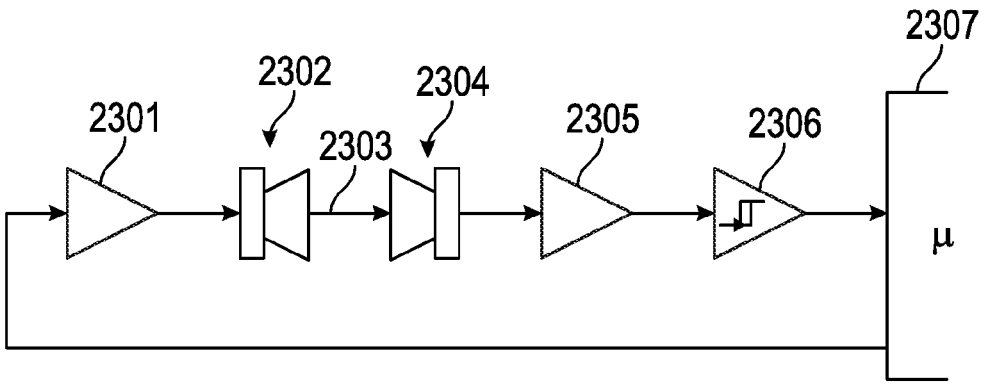


FIG. 23A

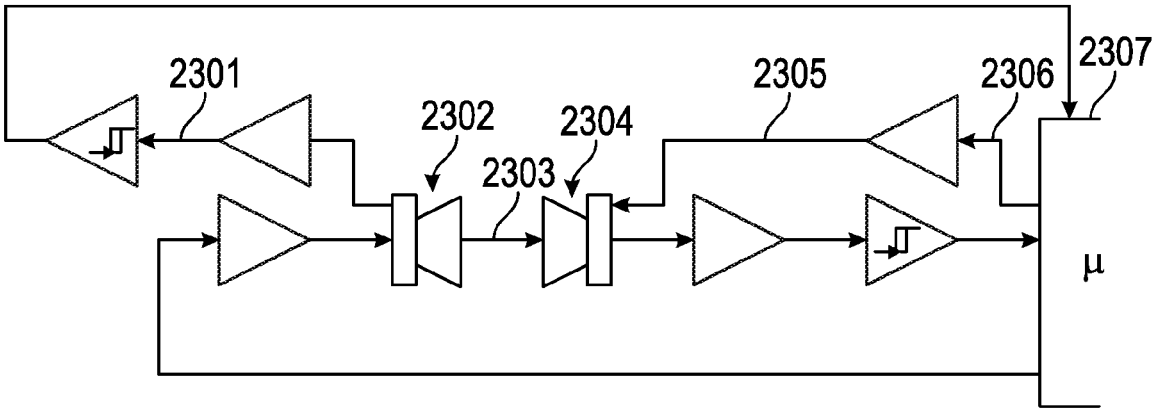


FIG. 23B

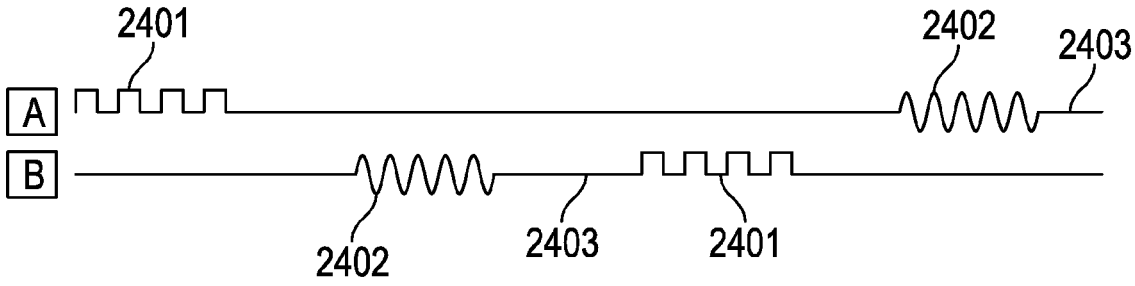


FIG. 24A

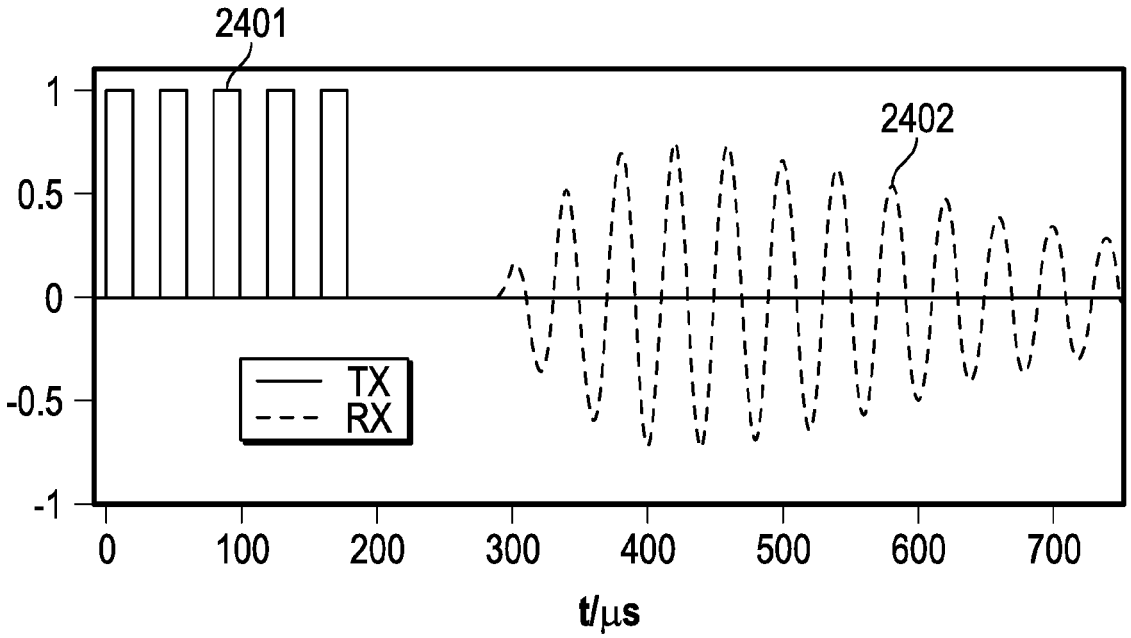


FIG. 24B

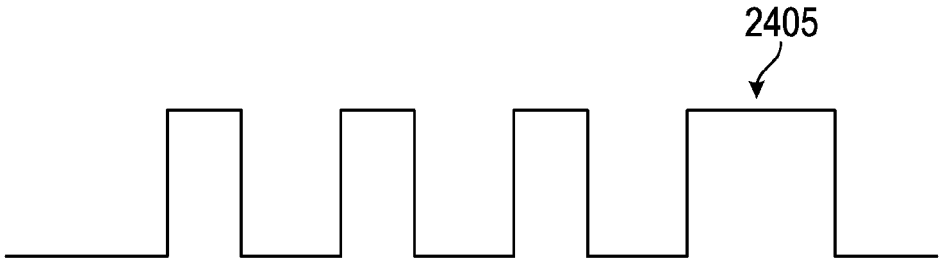


FIG. 24C

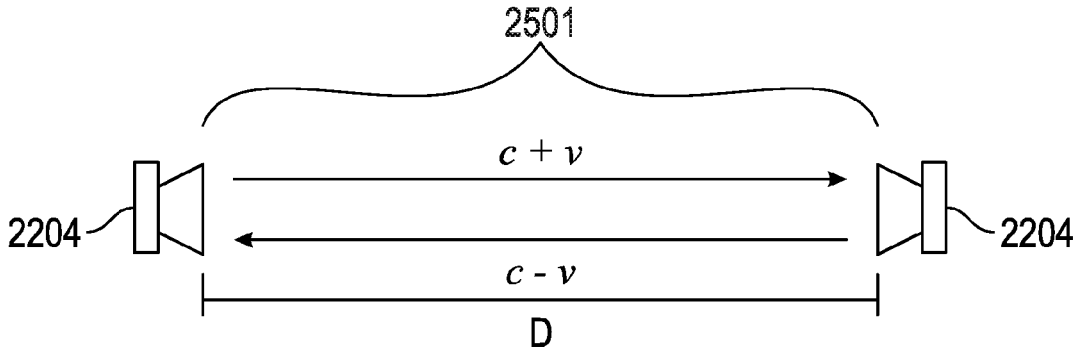


FIG. 25A

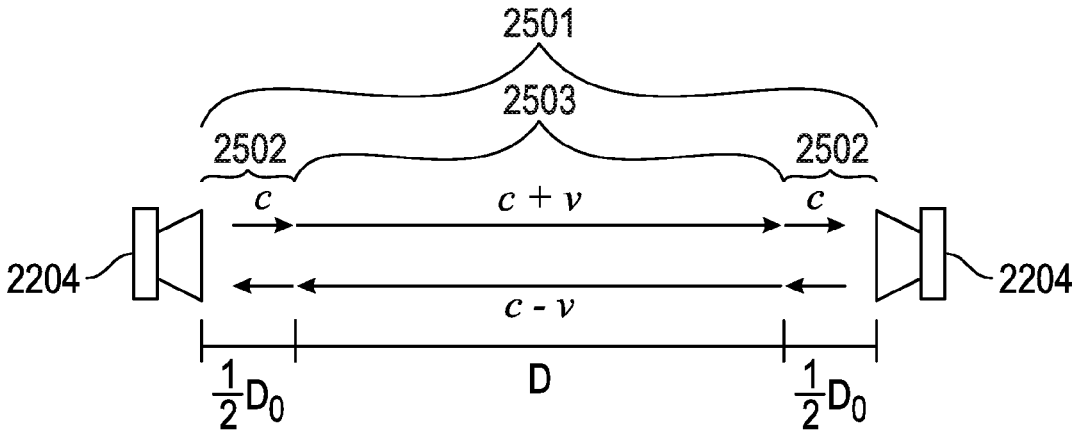


FIG. 25B

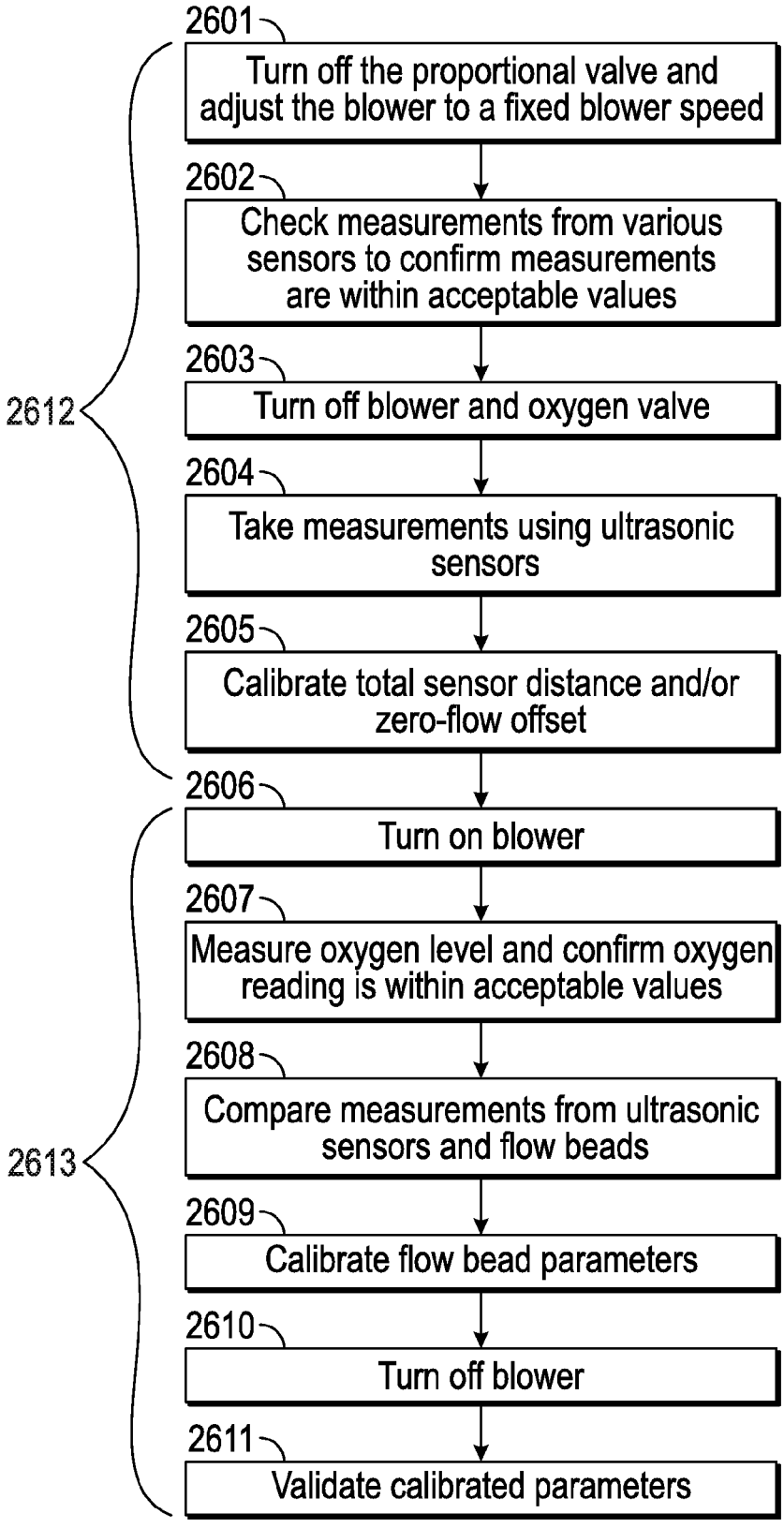

2601
Turn off the proportional valve and adjust the blower to a fixed blower speed
2602
Check measurements from various sensors to confirm measurements are within acceptable values
2603
Turn off blower and oxygen valve
2604
Take measurements using ultrasonic sensors
2605
Calibrate total sensor distance and/or zero-flow offset
2606
Turn on blower
2607
Measure oxygen level and confirm oxygen reading is within acceptable values
2608
Compare measurements from ultrasonic sensors and flow beads
2609
Calibrate flow bead parameters
2610
Turn off blower
2611
Validate calibrated parameters
2612
2613

FIG. 26A

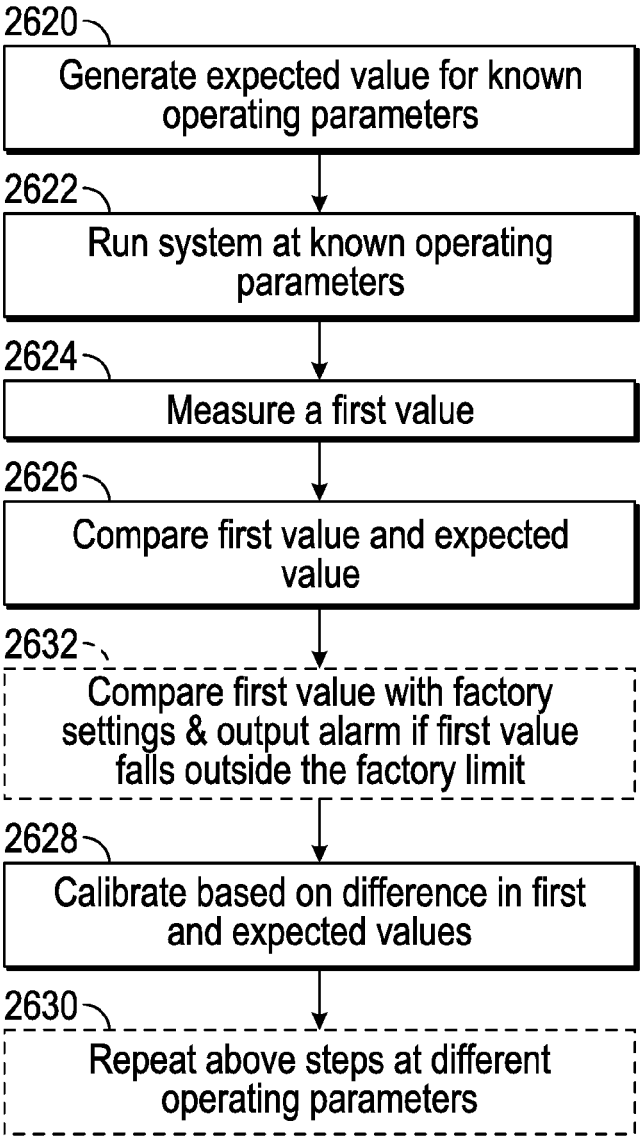

2620
Generate expected value for known operating parameters
2622
Run system at known operating parameters
2624
Measure a first value
2626
Compare first value and expected value
2632
Compare first value with factory settings & output alarm if first value falls outside the factory limit
2628
Calibrate based on difference in first and expected values
2630
Repeat above steps at different operating parameters

FIG. 26B

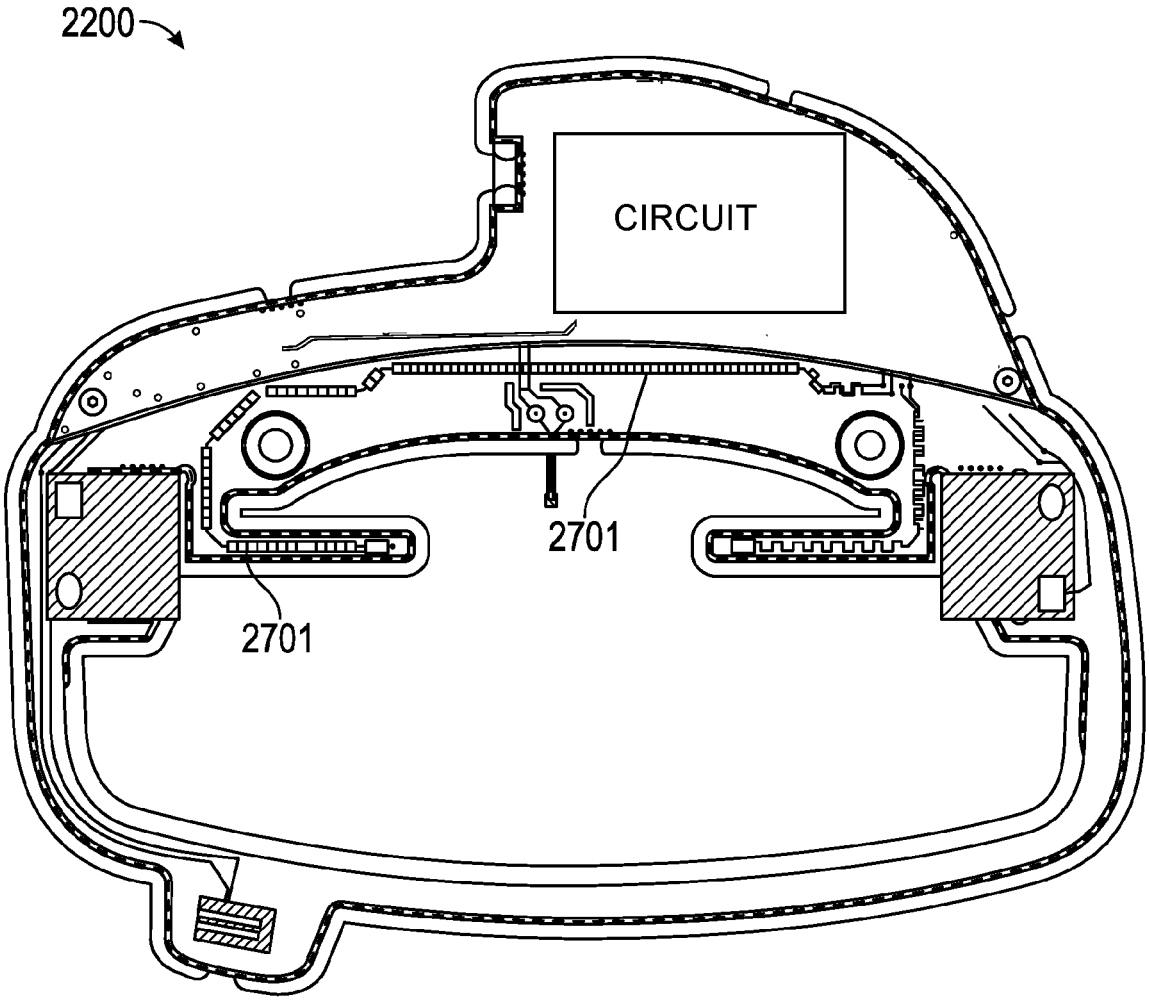


FIG. 27A

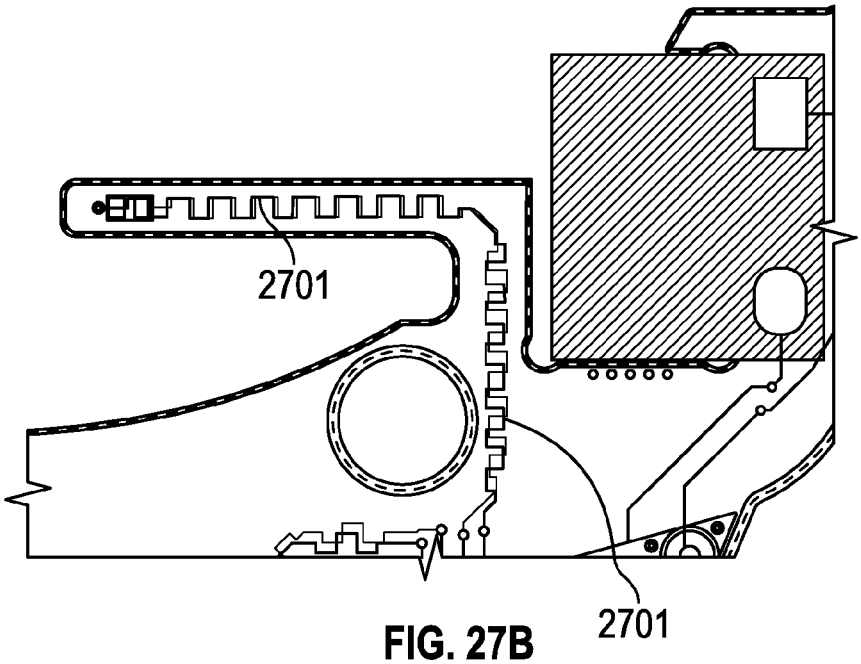


FIG. 27B

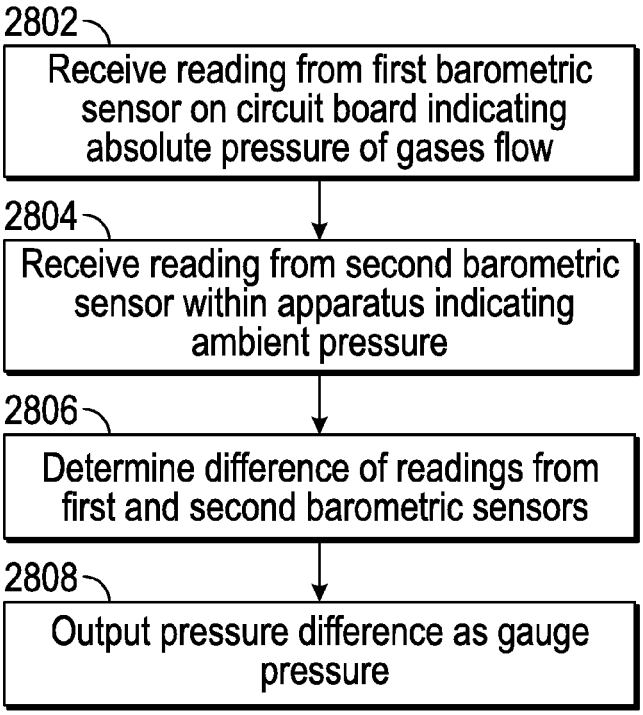

2802
Receive reading from first barometric sensor on circuit board indicating absolute pressure of gases flow
2804
Receive reading from second barometric sensor within apparatus indicating ambient pressure
2806
Determine difference of readings from first and second barometric sensors
2808
Output pressure difference as gauge pressure

FIG. 28

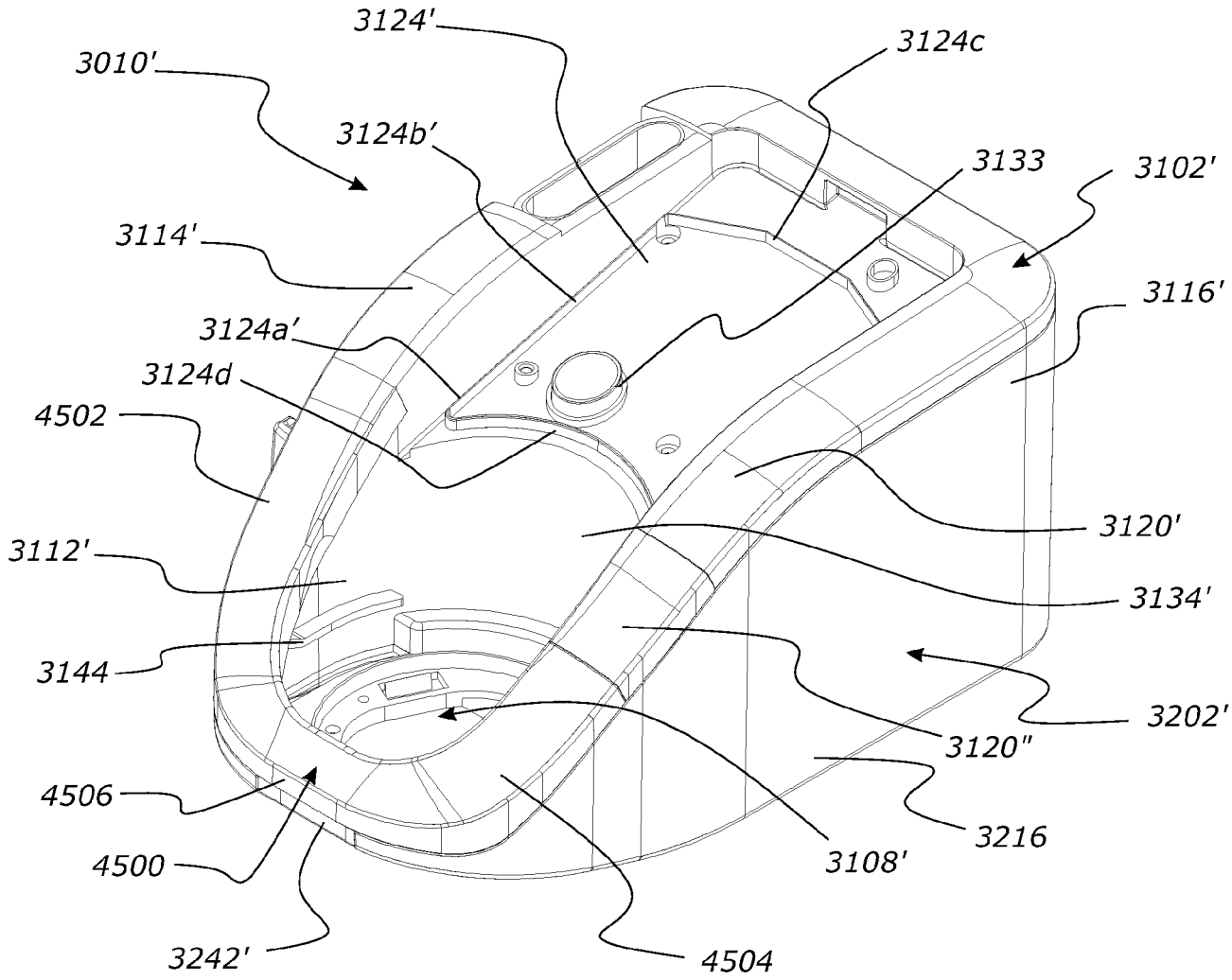

3124'
3124c
3010'
3124b'
3133
3102'
3114'
3116'
3124a'
3124d
4502
3120'
3112'
3134'
3144
3202'
3120"
4506
3216
4500
3108'
3242'
4504

FIG. 29

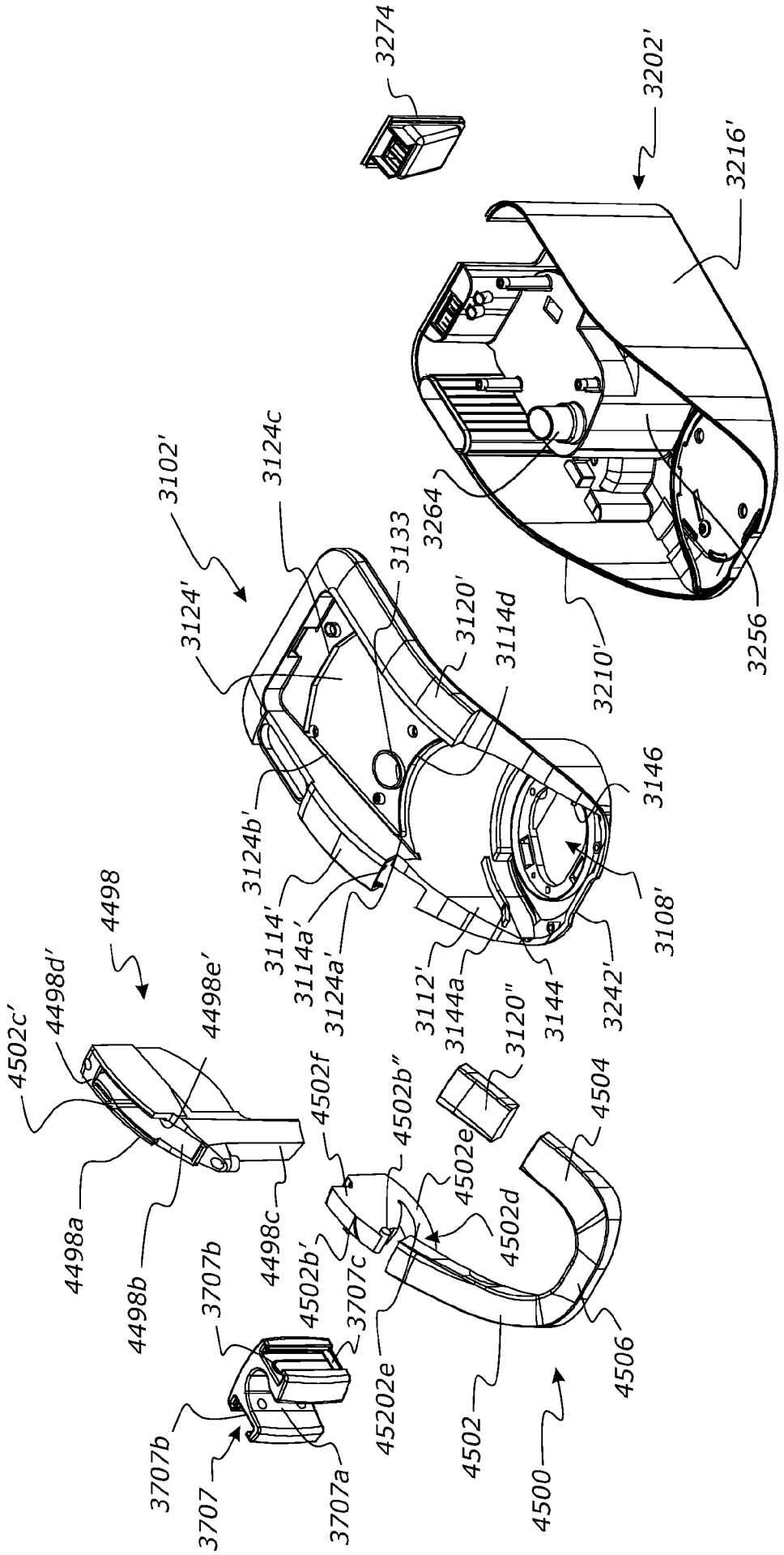

3274
3202'
3216'
3102'
3124c
3124'
3133
3264
3120'
3114d
3210'
3256
3146
3124b'
3114'
3114a'
3124a'
3108'
3112'
3144a
3120"
3144
3242'
4498
4502c'
4498d'
4498e'
4502f
4502b"
4504
4498a
4498b
4498c
4502e
4502d
3707b
4502b'
3707c
4506
3707b
45202e
4502
3707
3707a
4500

FIG. 30

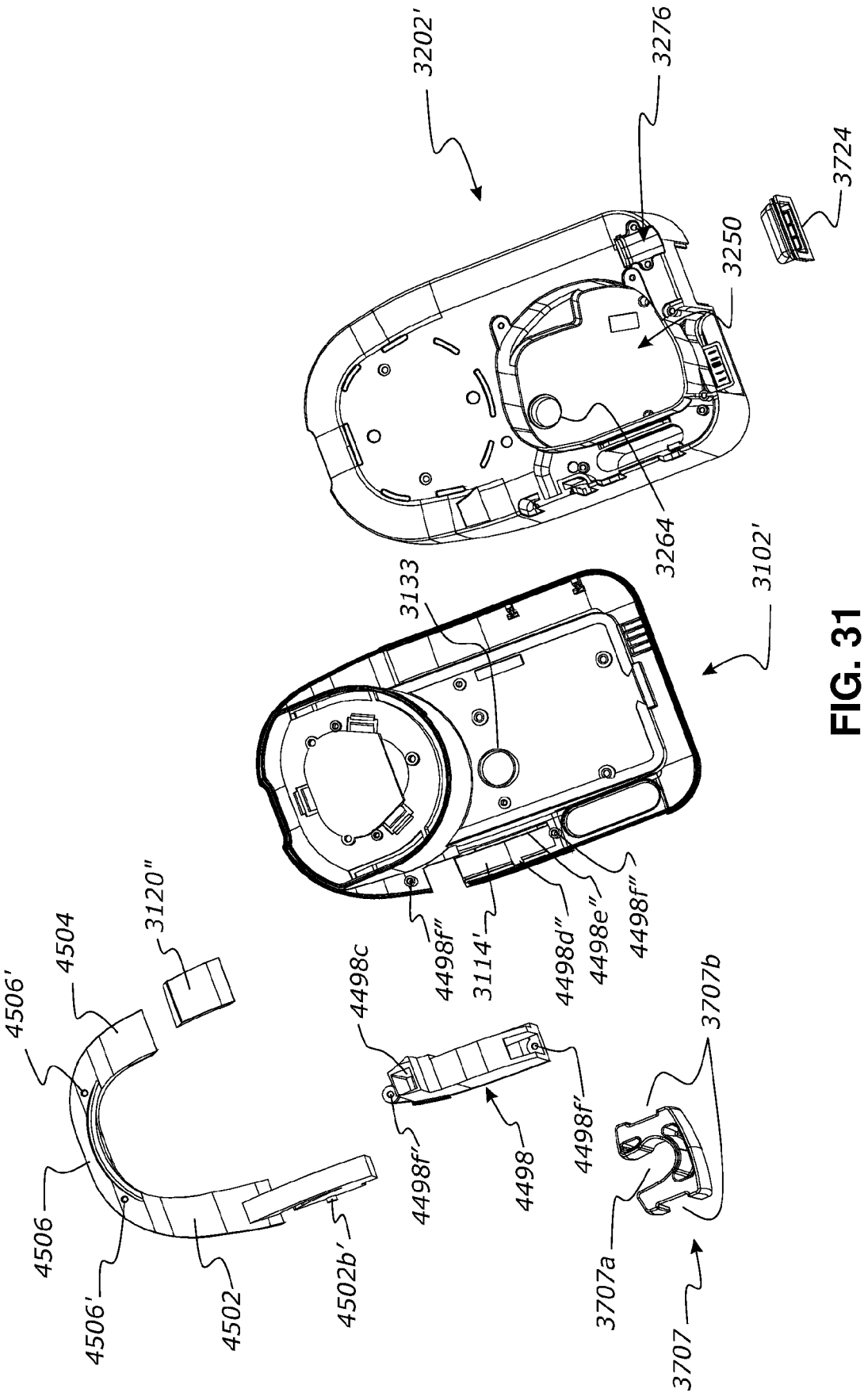

3202'
3276
3724
3250
3264
3102'
3133
3120"
4504
4506'
4498c
4498f"
3114'
4498d"
4498e"
4498f"
4506
4506'
4502
4502b'
4498f'
4498
4498f'
3707b
3707a
3707

FIG. 31

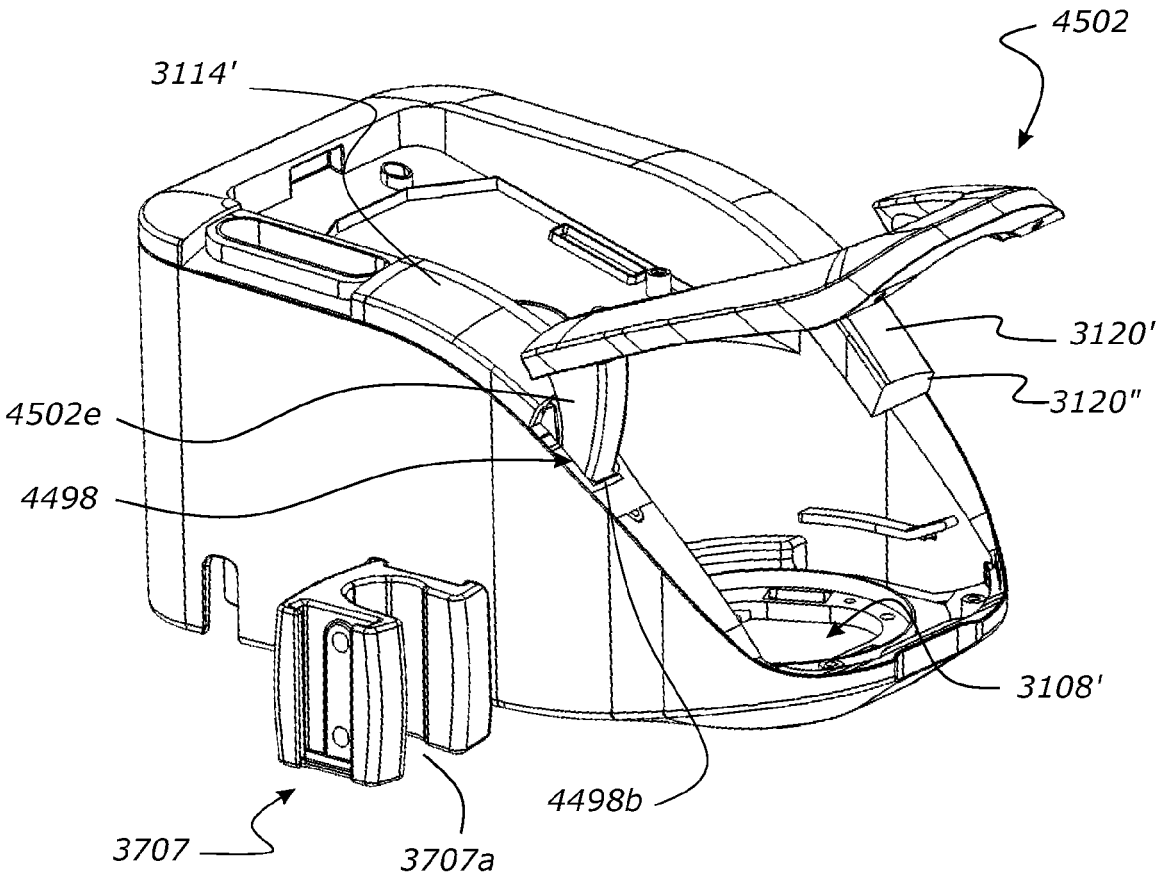


FIG. 32

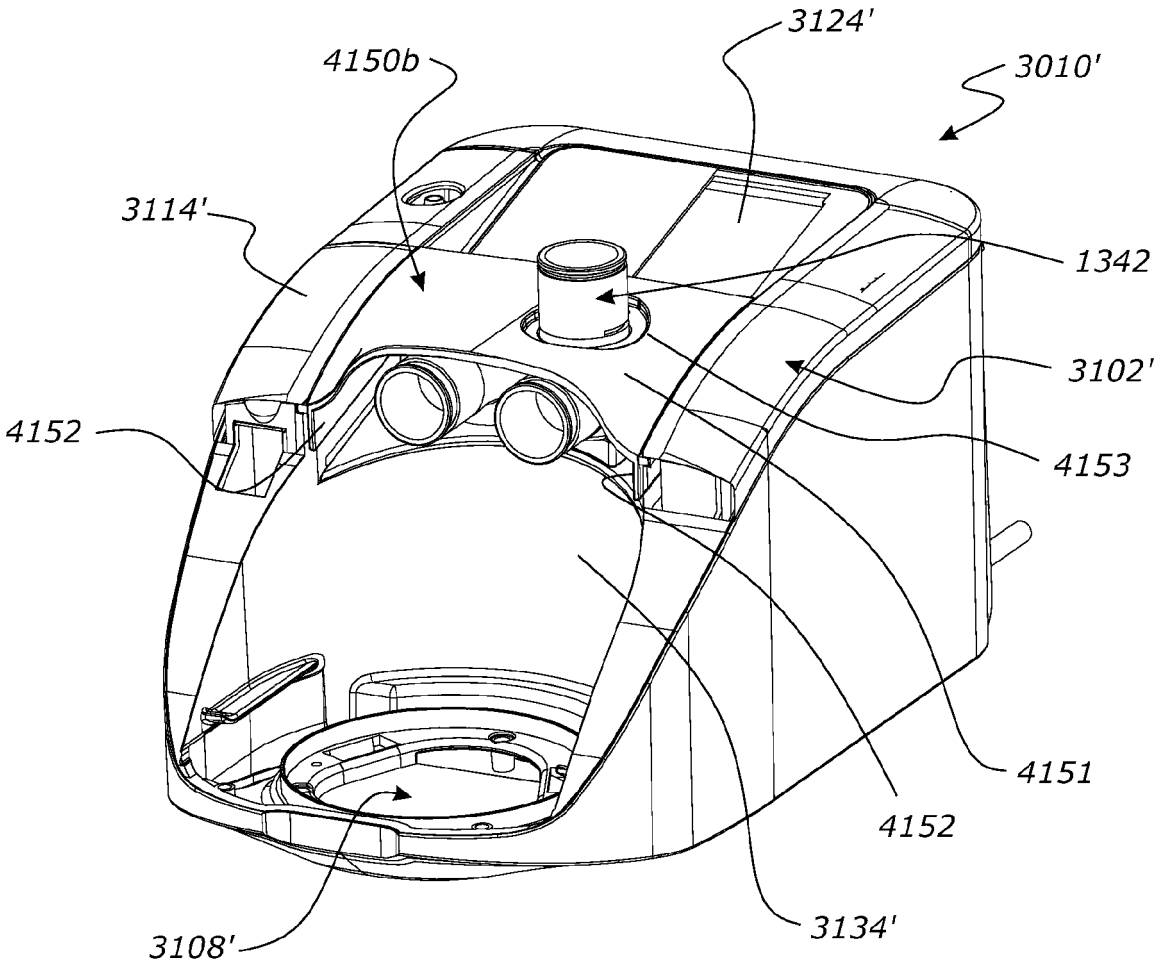


FIG. 33