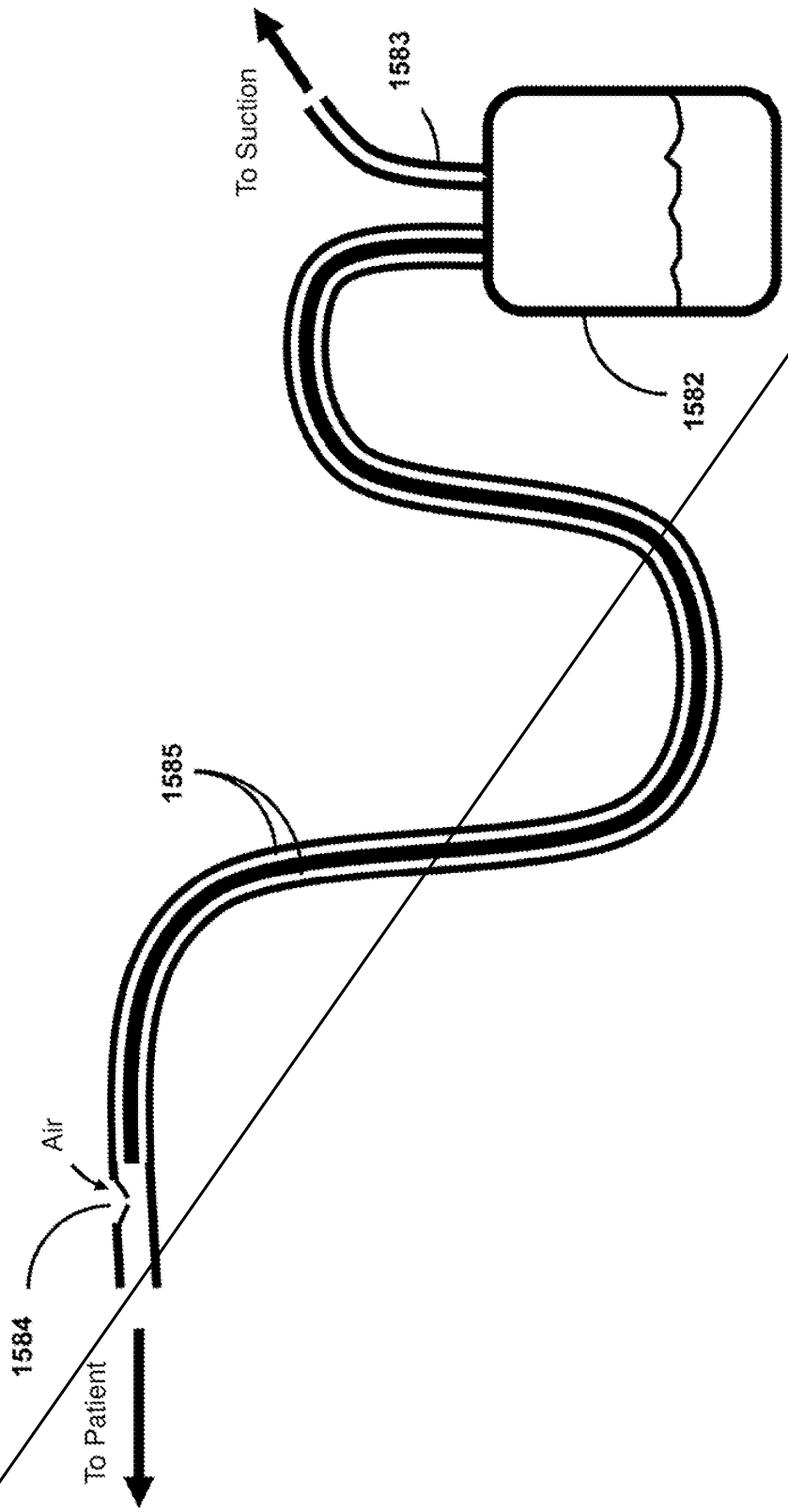


Fig. 15

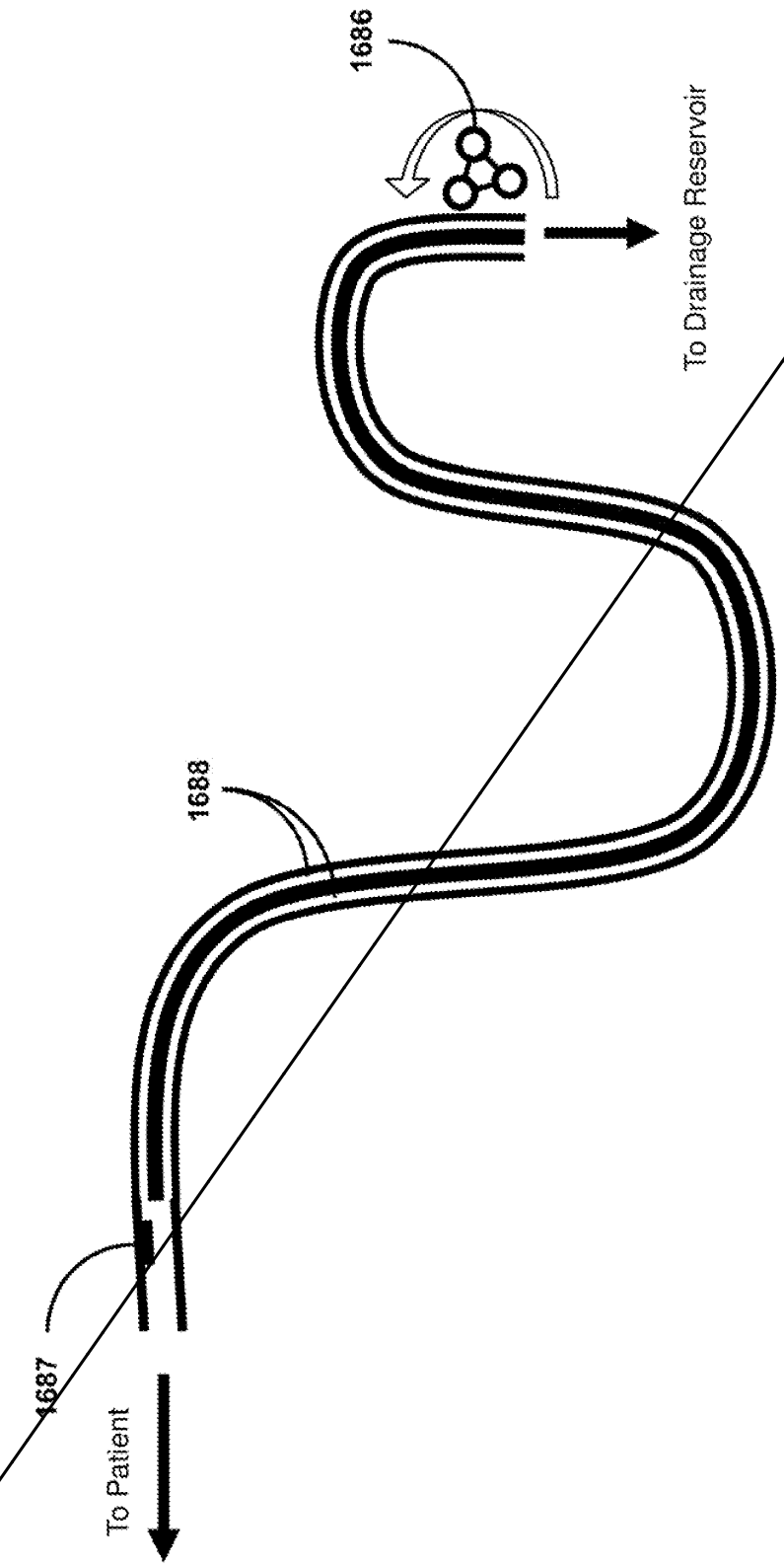


Fig. 16

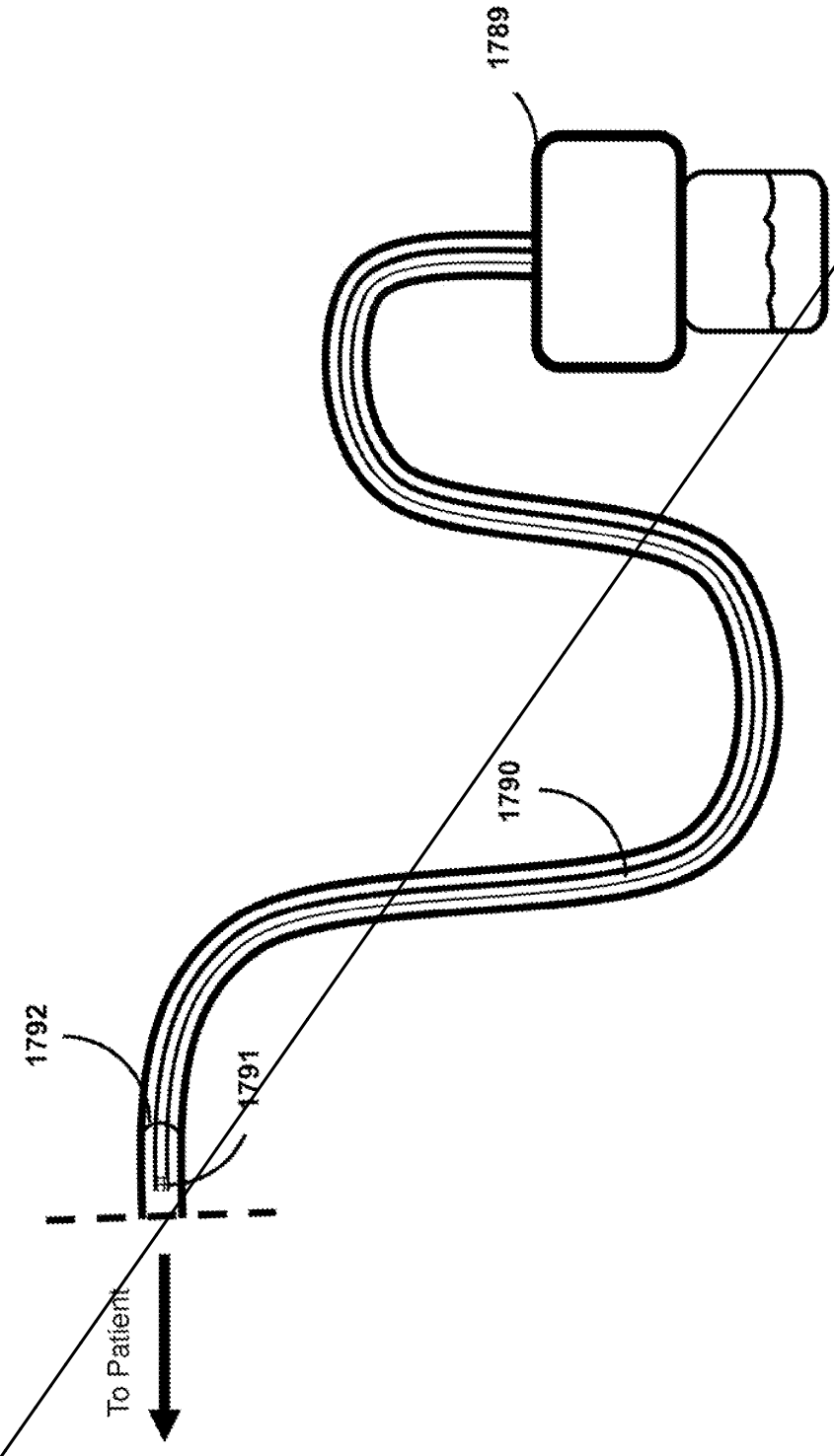


Fig. 17

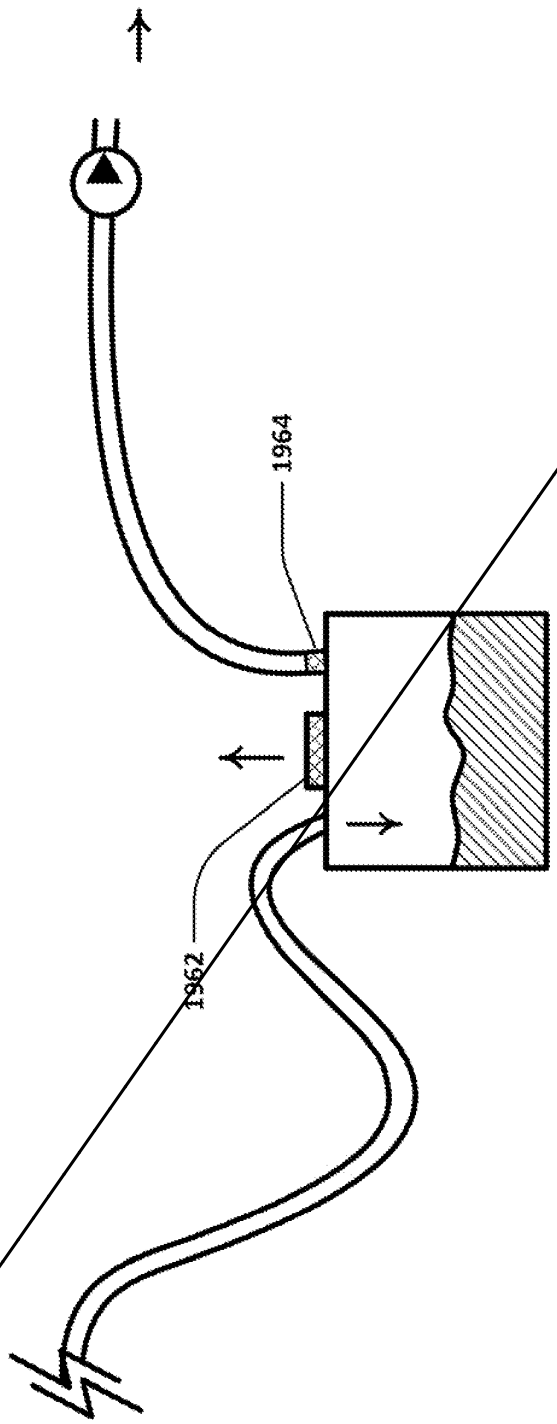


Fig. 19

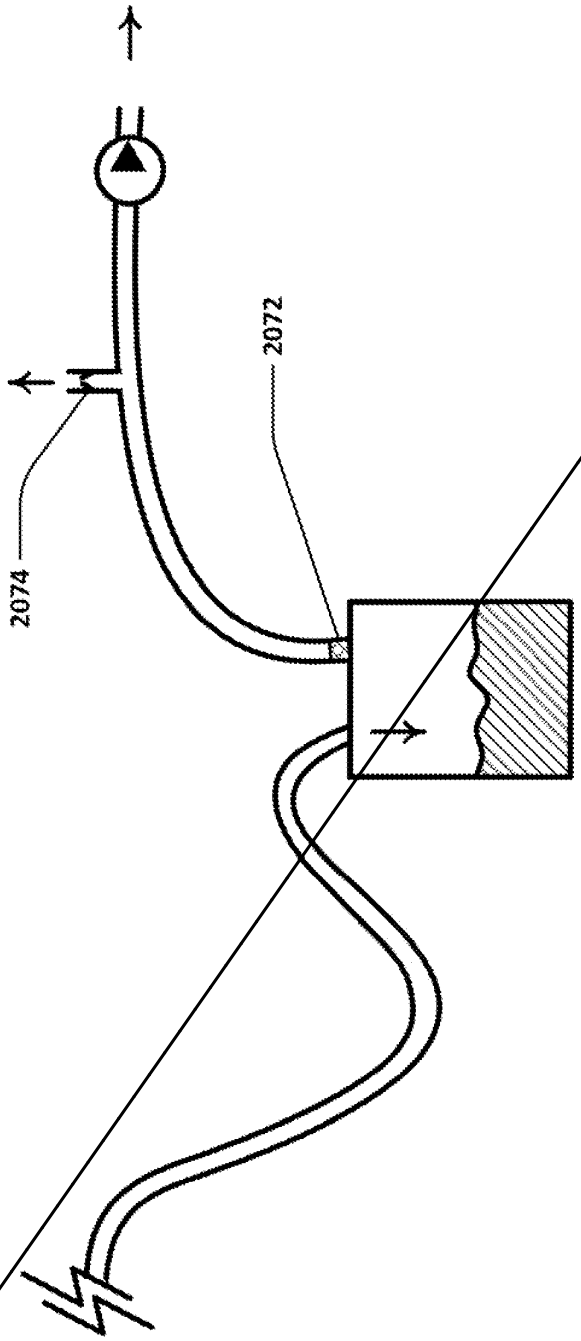


Fig. 20

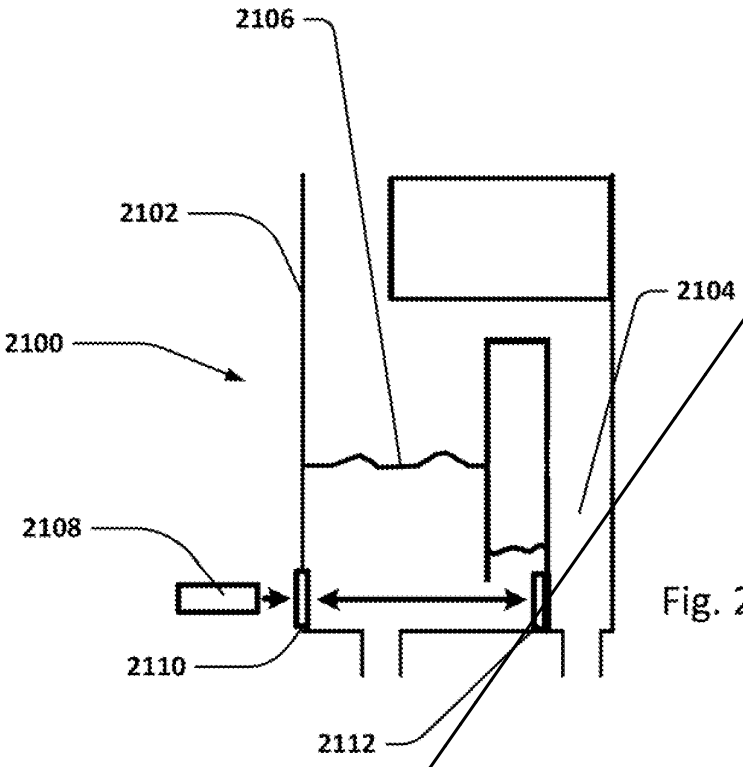

2106
2102
2104
2100
2108
2110
2112

Fig. 21

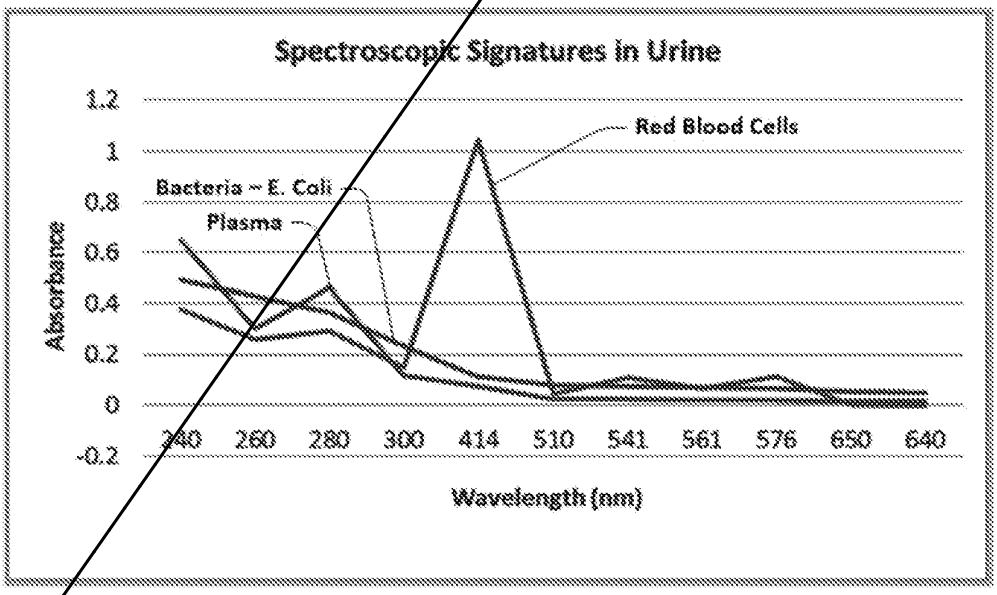

Spectroscopic Signatures in Urine
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
Absorbance
Red Blood Cells
Bacteria – E. Coli
Plasma
240
260
280
300
414
510
541
561
576
650
640
Wavelength (nm)

Fig. 22

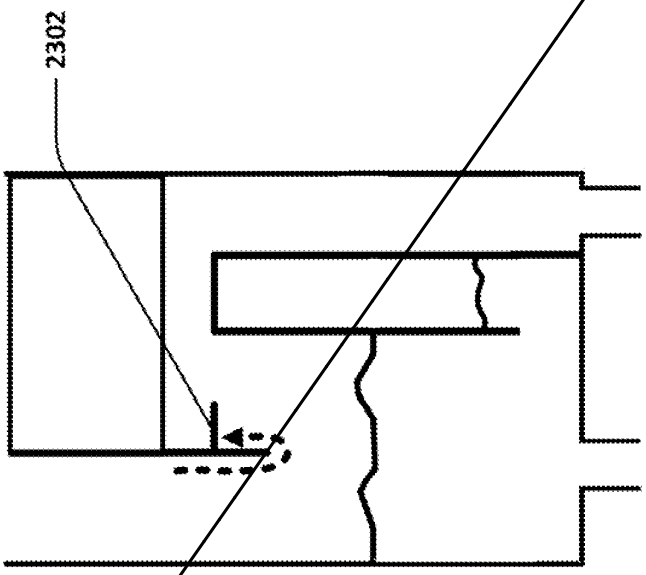


Fig. 23

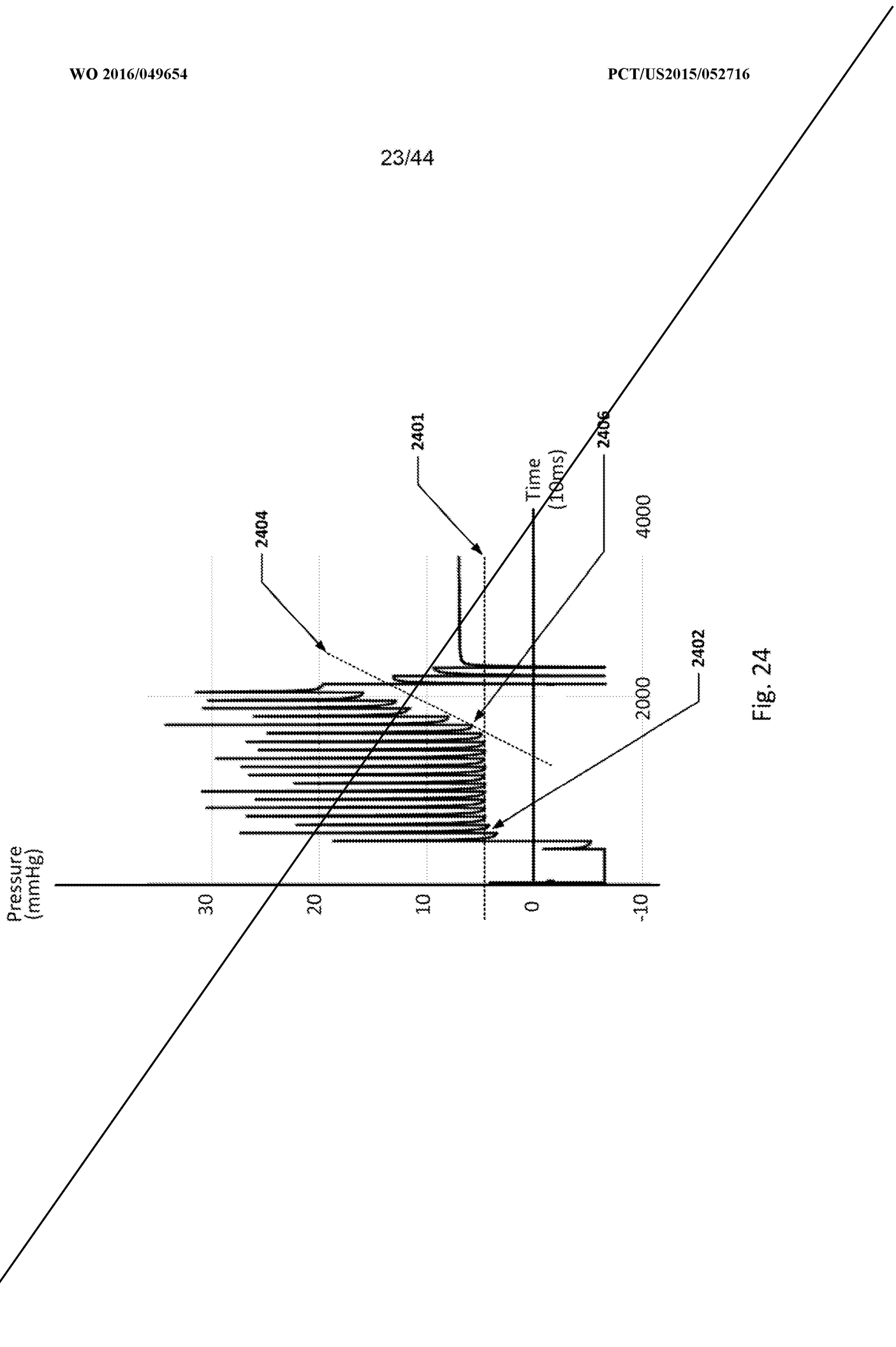

2401
2406
2404
2402
Time
(10ms)
4000
2000
Pressure
(mmHg)
30
20
10
0
-10

Fig. 24

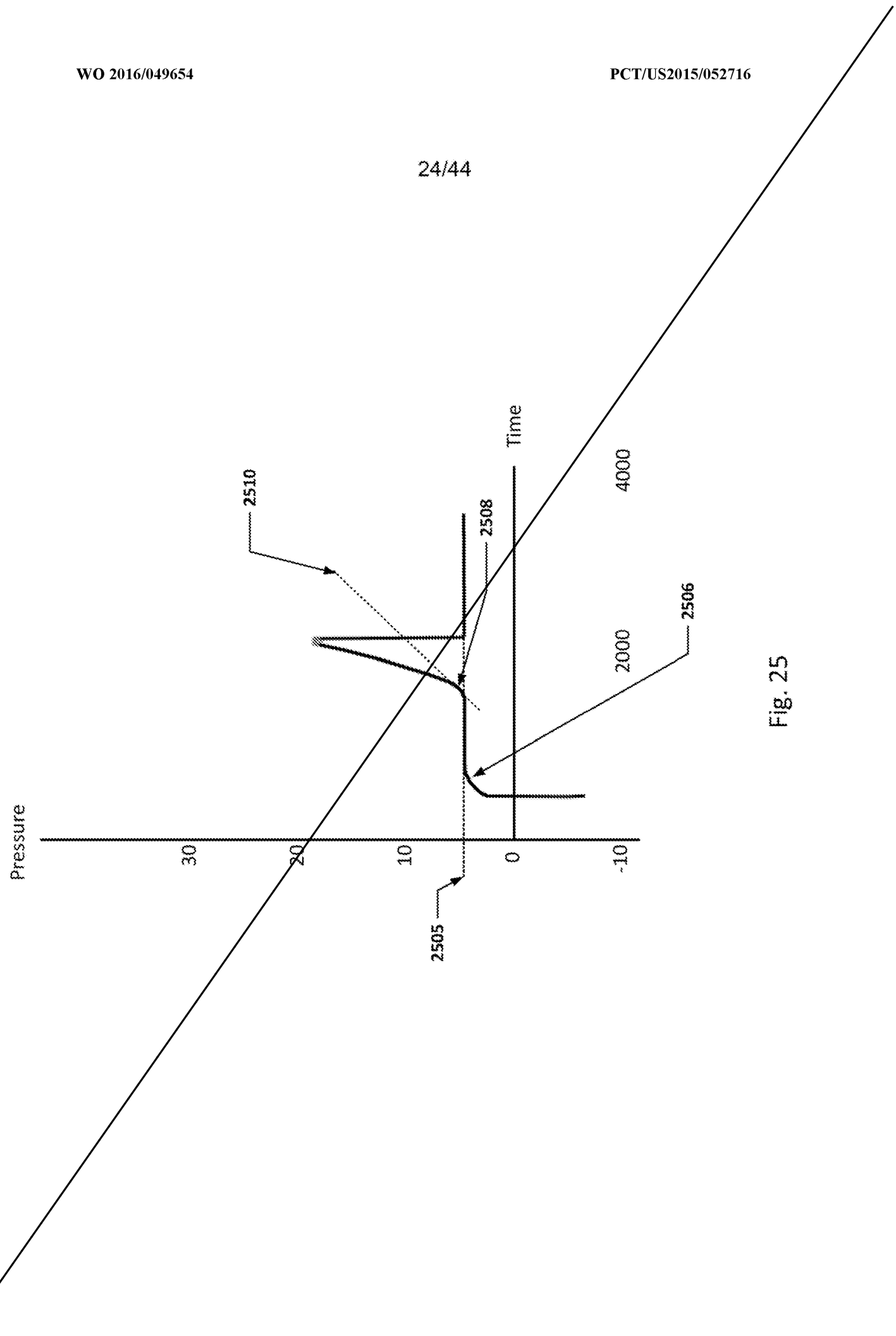


Fig. 25

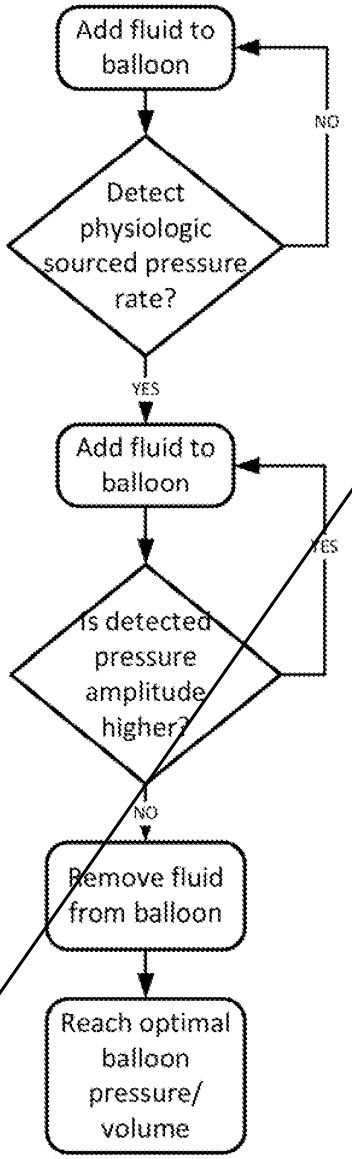

Add fluid to balloon
NO
Detect physiologic sourced pressure rate?
YES
Add fluid to balloon
YES
Is detected pressure amplitude higher?
NO
Remove fluid from balloon
Reach optimal balloon pressure/ volume

Fig. 26

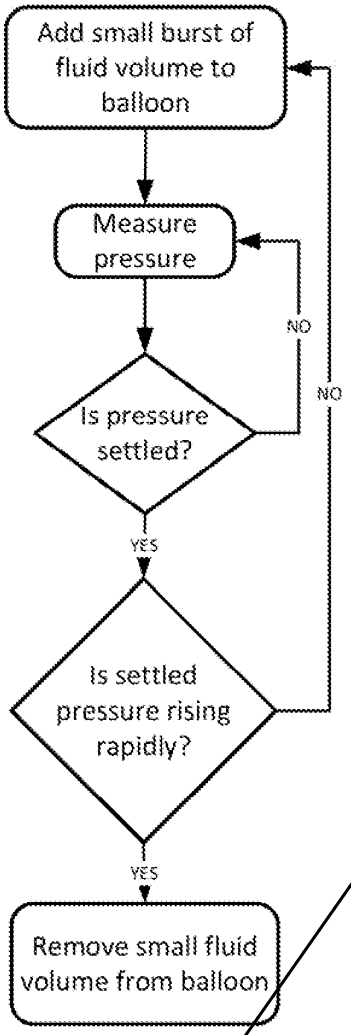

Add small burst of fluid volume to balloon
Measure pressure
NO
Is pressure settled?
NO
YES
Is settled pressure rising rapidly?
YES
Remove small fluid volume from balloon

Fig. 27

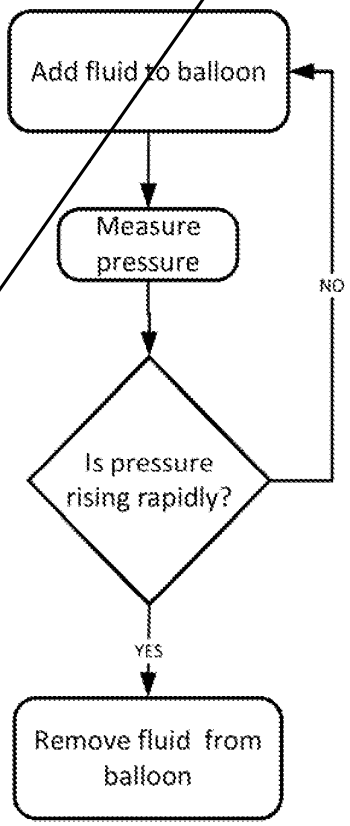

Add fluid to balloon
Measure pressure
NO
Is pressure rising rapidly?
YES
Remove fluid from balloon

Fig. 28

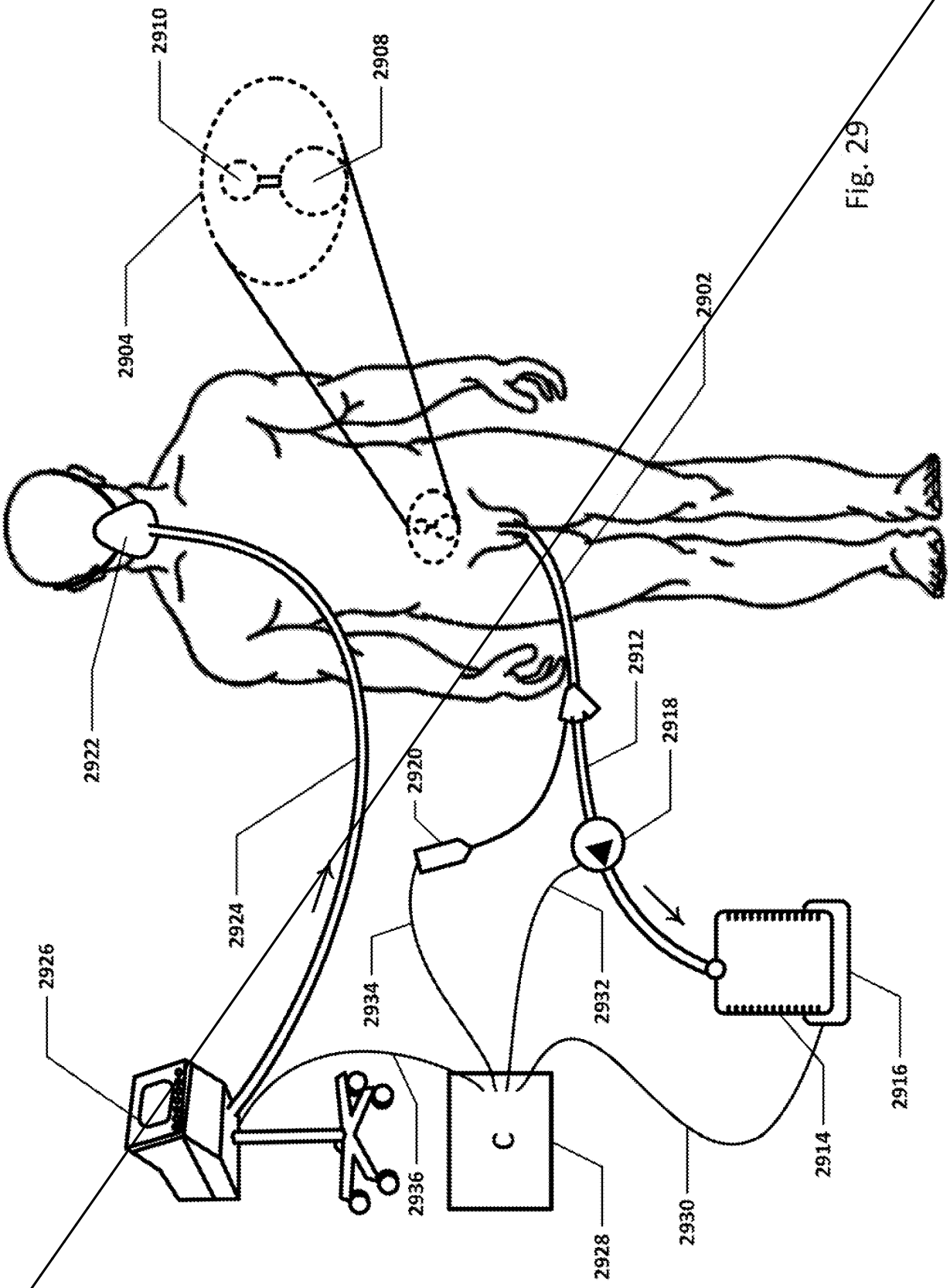

2910
2908
2904
2902
2922
2912
2918
2920
2924
2926
2934
2932
2916
2936
C
2914
2930
2928

Fig. 29

Fig. 30

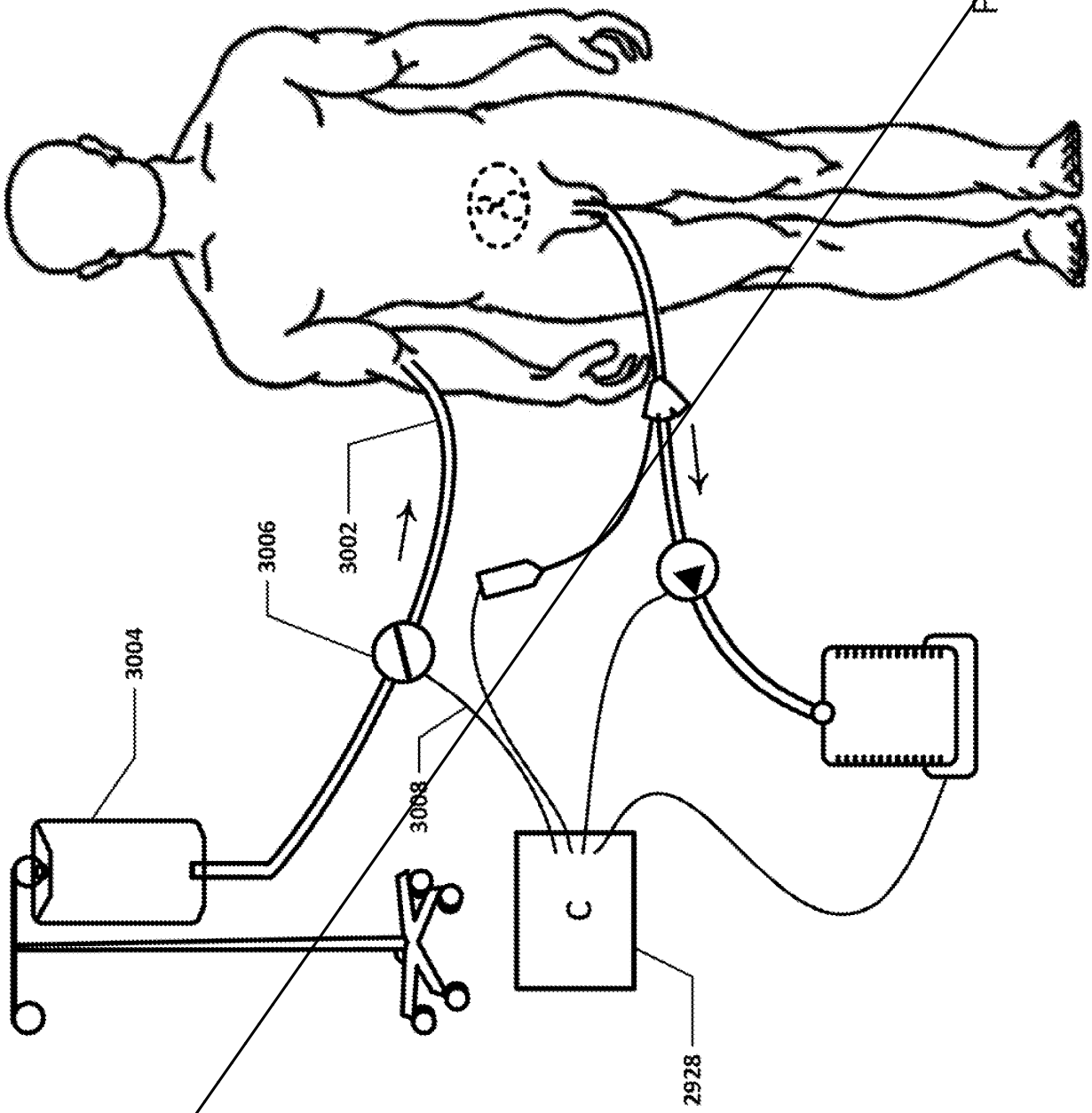


Fig. 31

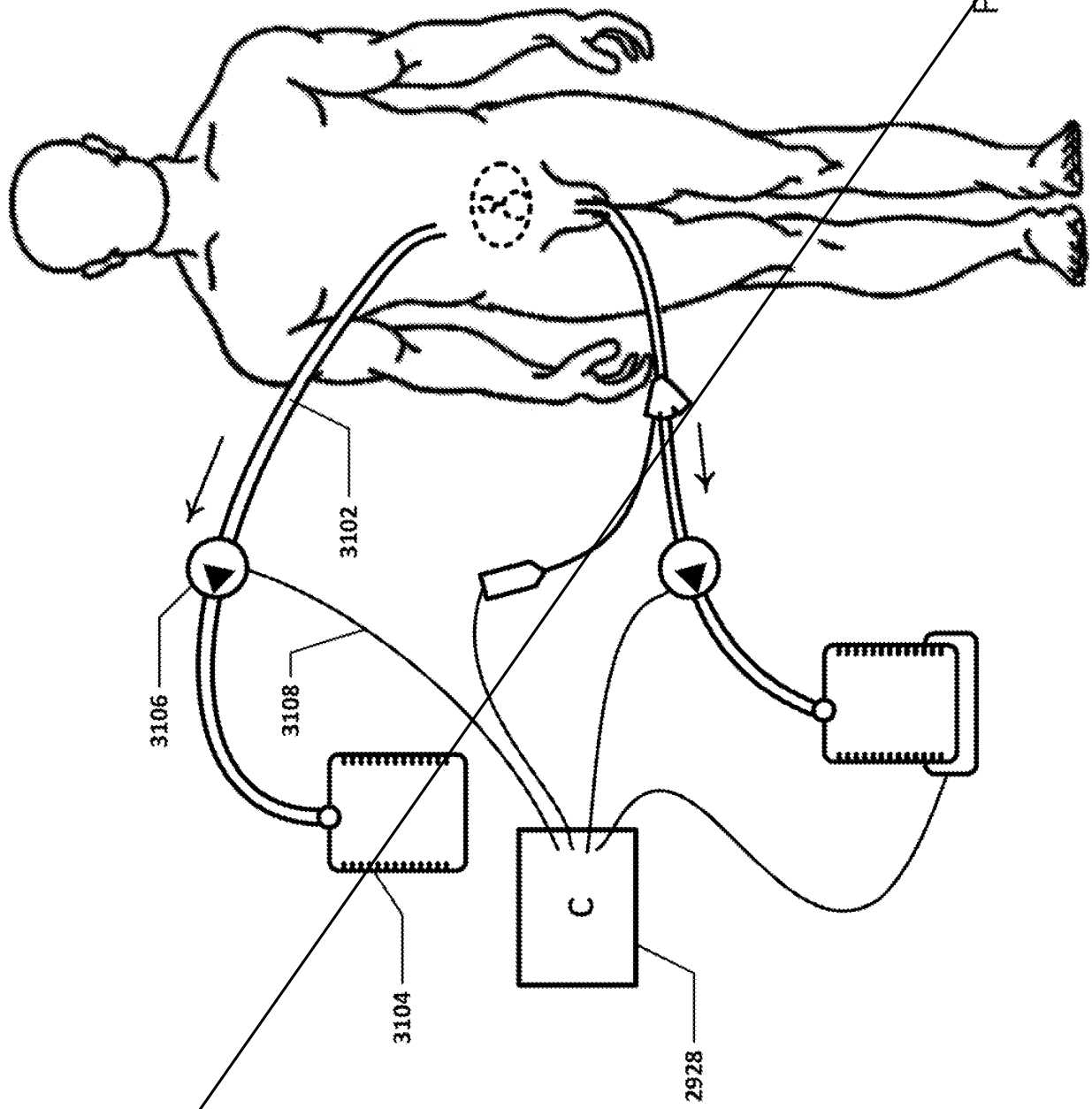
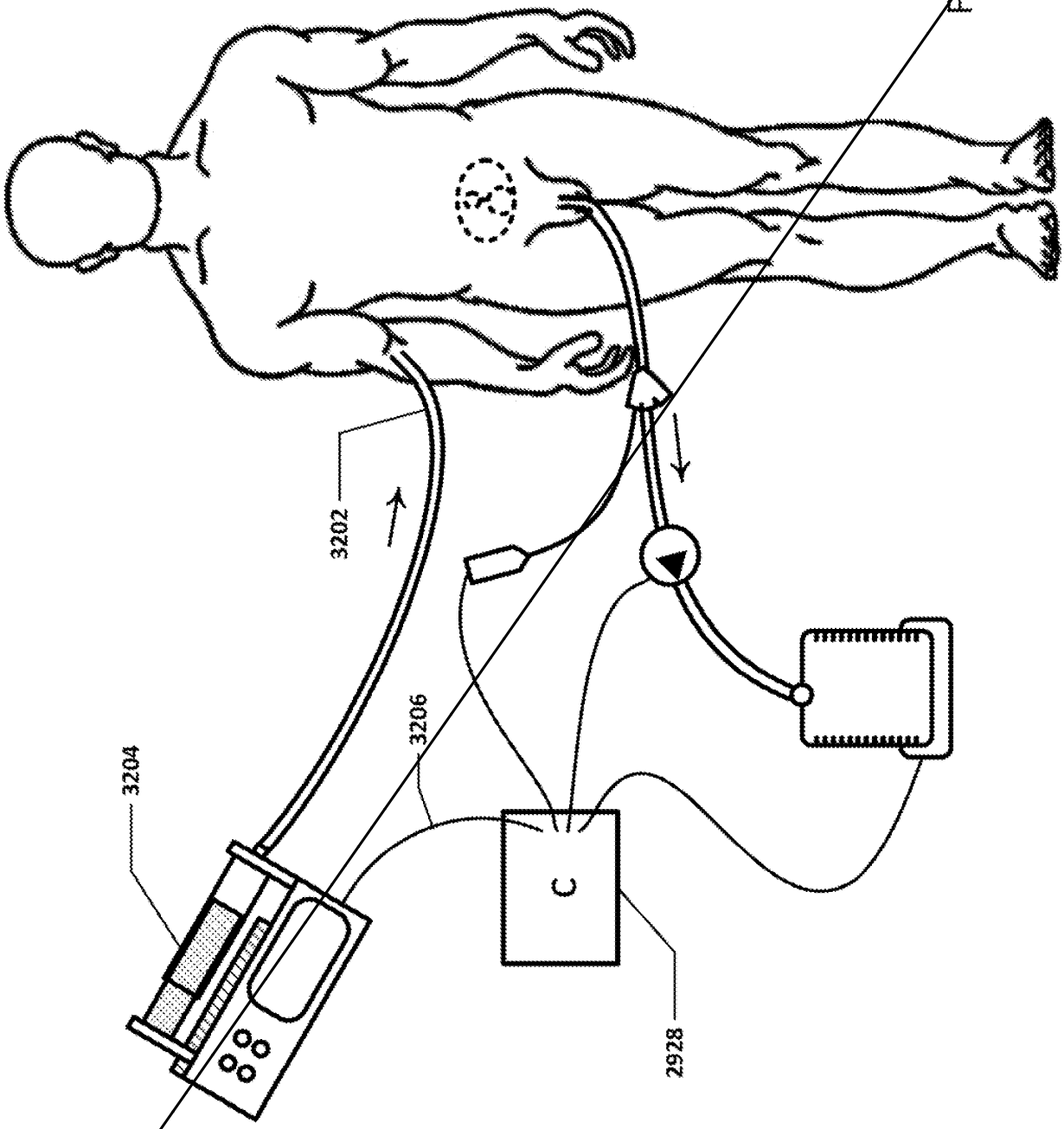


Fig. 32



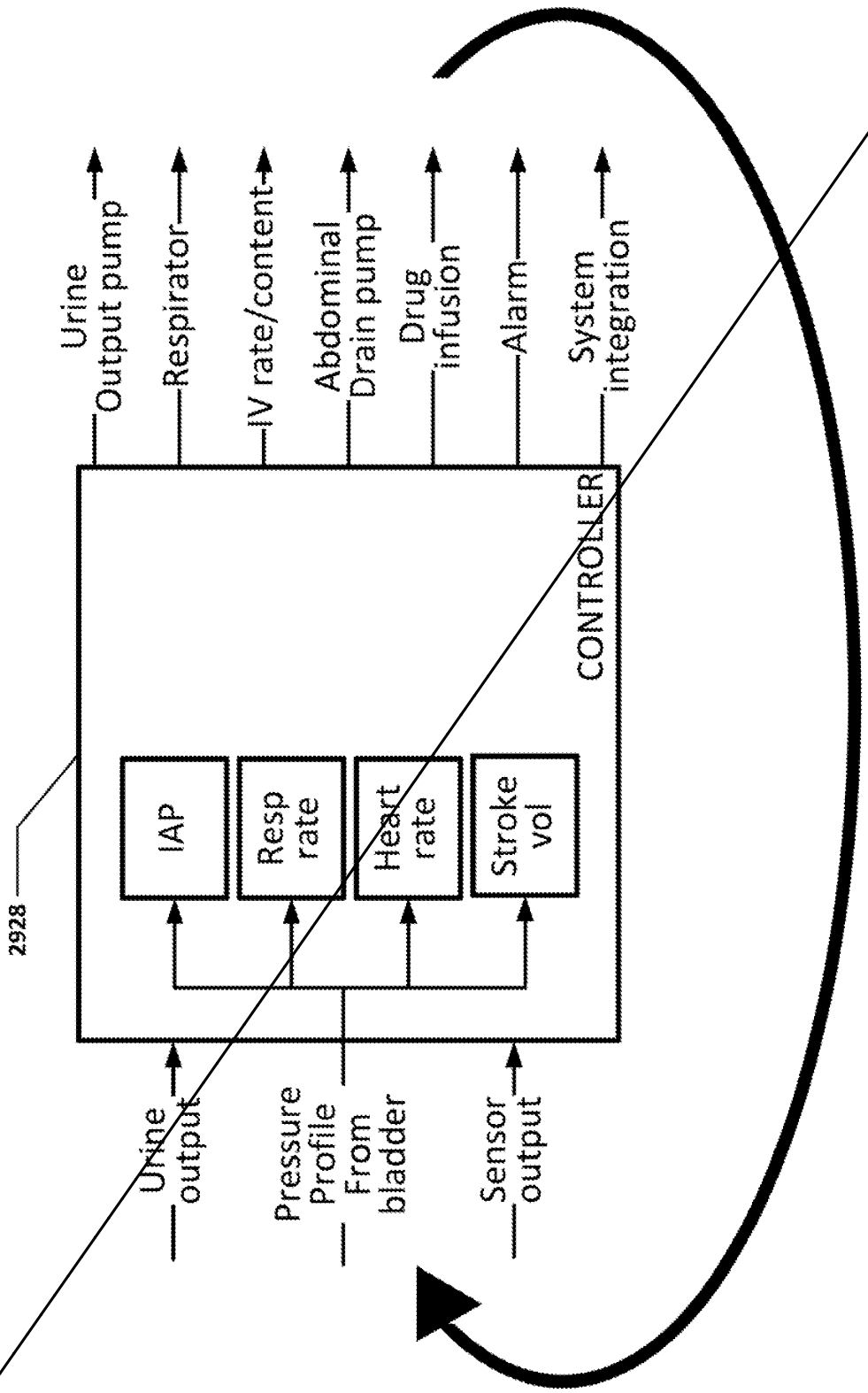

Urine
Output pump
Respirator
IV rate/content
Abdominal
Drain pump
Drug
infusion
Alarm
System
integration
CONTROLLER
2928
IAP
Resp
rate
Heart
rate
Stroke
vol
Urine
output
Pressure
Profile
From
bladder
Sensor
output

Fig. 33

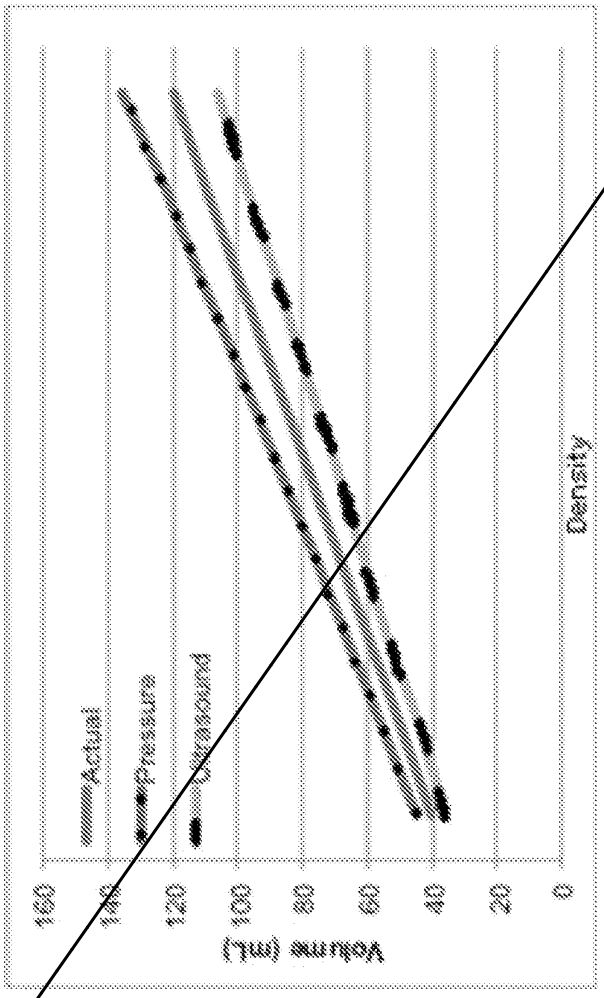

Actual
Pressure
Ultrasound
Density
Volume (mL)
160
140
120
100
80
60
40
20
0

Fig. 34

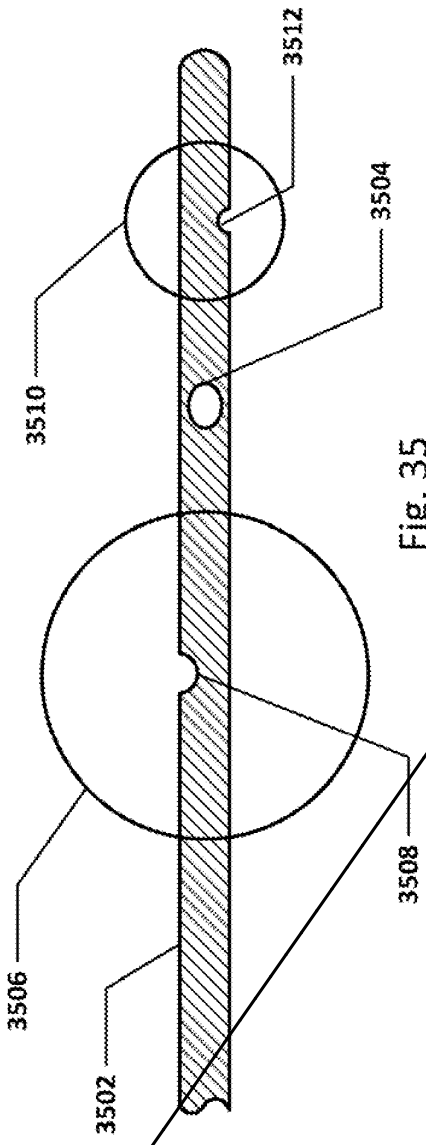


Fig. 35

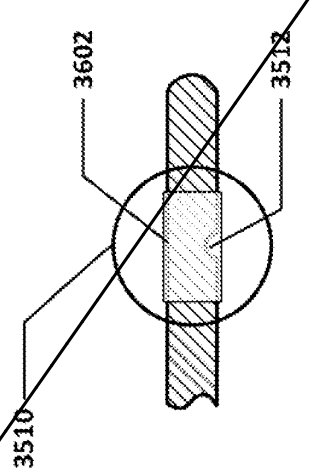


Fig. 36

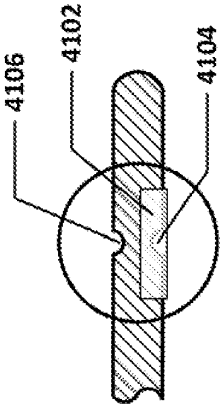


Fig. 41

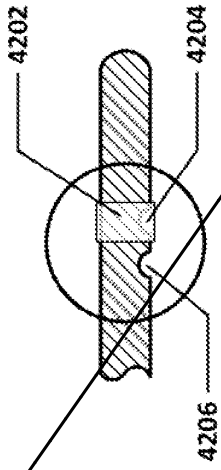


Fig. 42

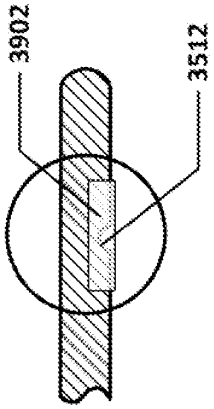


Fig. 39

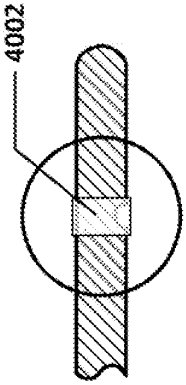


Fig. 40

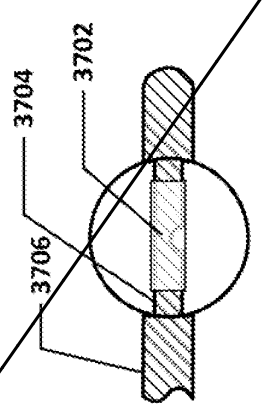


Fig. 37

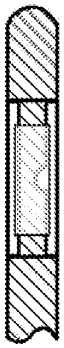


Fig. 38

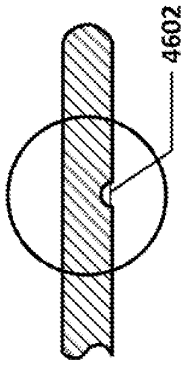


Fig. 46

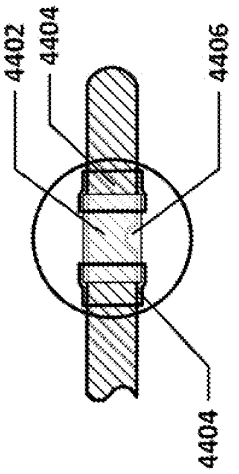


Fig. 44

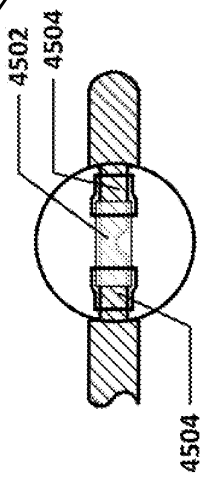


Fig. 45

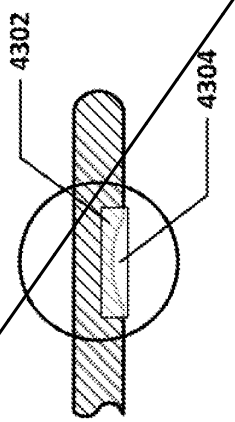


Fig. 43

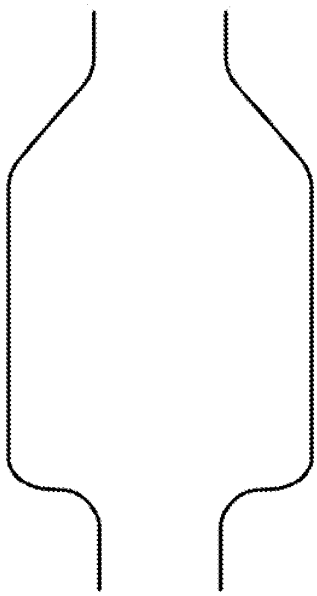


Fig. 48

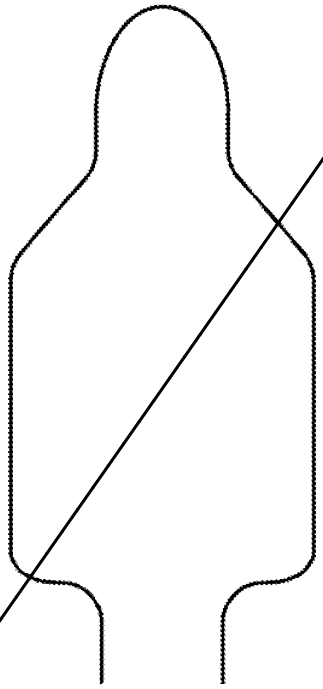


Fig. 49

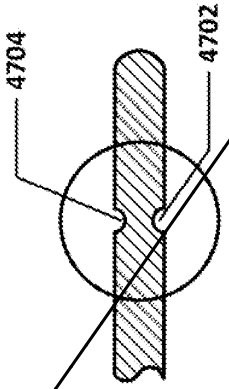


Fig. 47

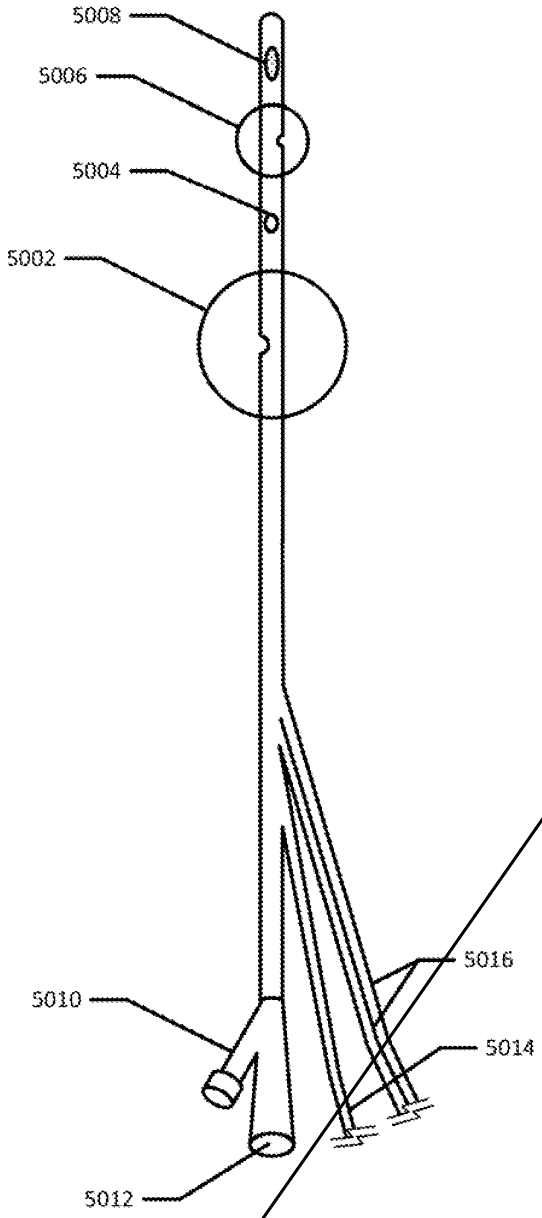


Fig. 50

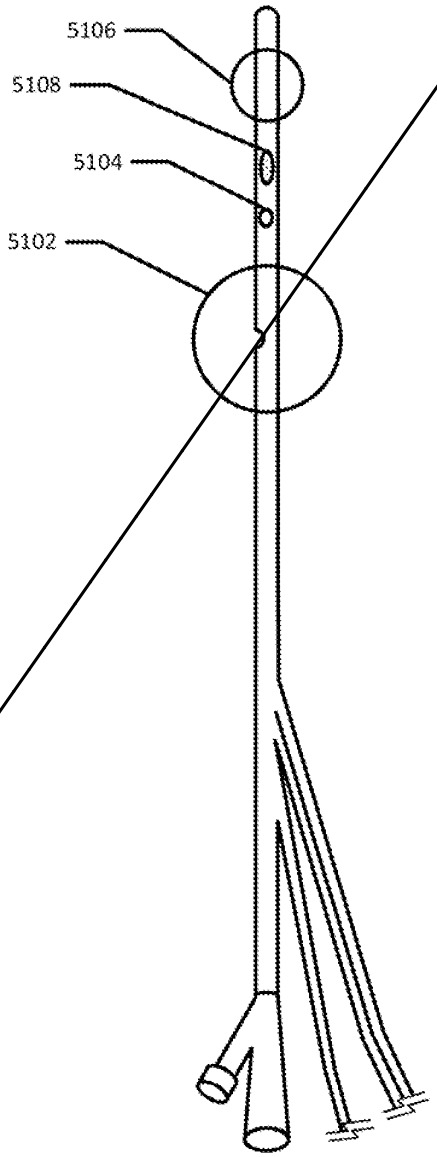


Fig. 51

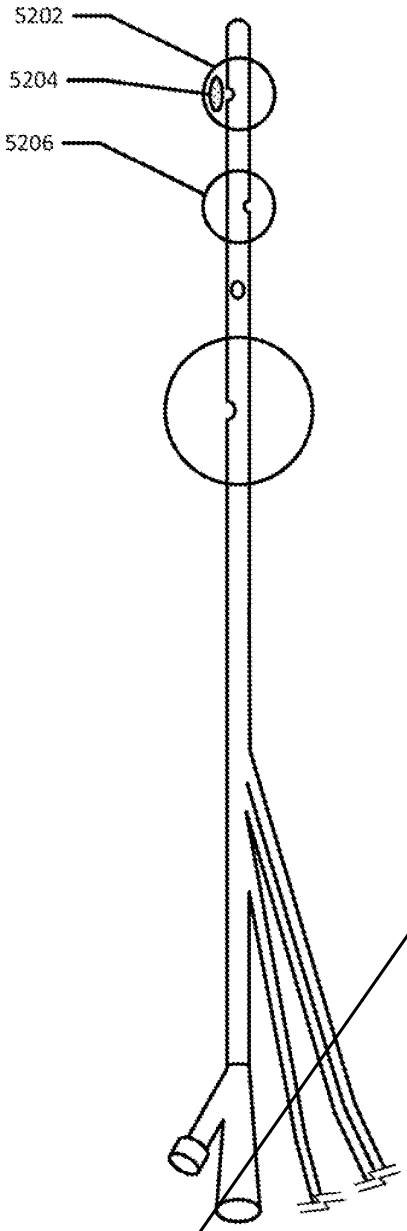


Fig. 52

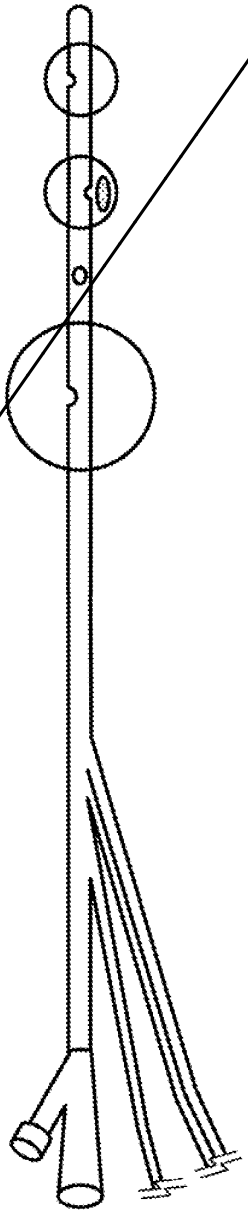


Fig. 53

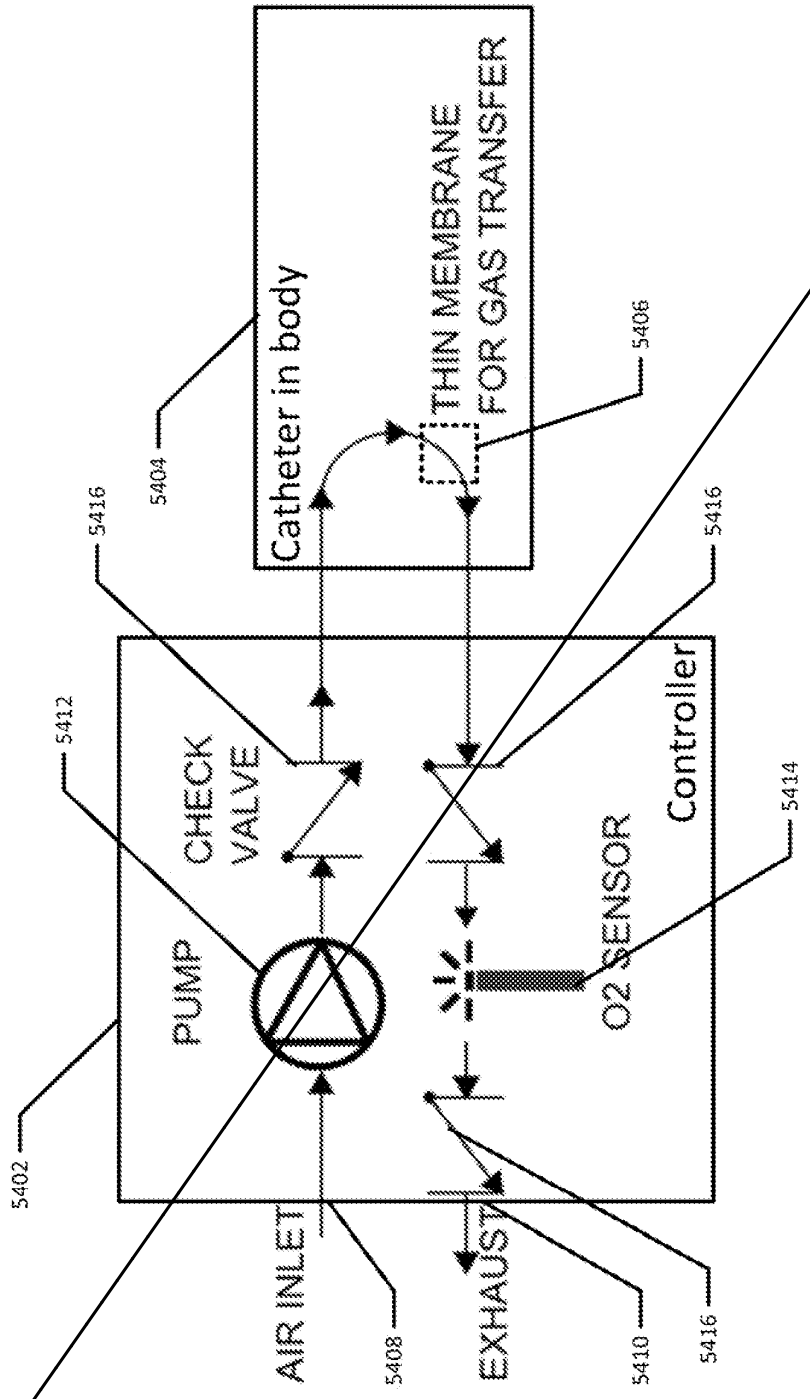

Catheter in body
THIN MEMBRANE FOR GAS TRANSFER
PUMP
CHECK VALVE
O2 SENSOR
Controller
AIR INLET
EXHAUST
5402
5404
5406
5408
5410
5412
5414
5416

Fig. 54

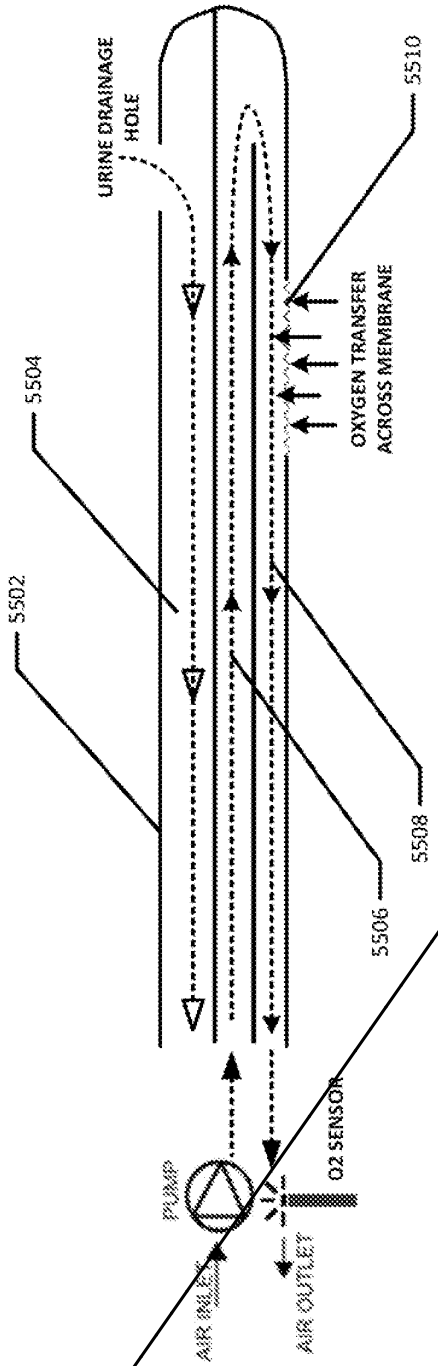

URINE DRAINAGE HOLE
5510
OXYGEN TRANSFER ACROSS MEMBRANE
5504
5502
5508
5506
PUMP
O2 SENSOR
AIR INLET
AIR OUTLET

Fig. 55

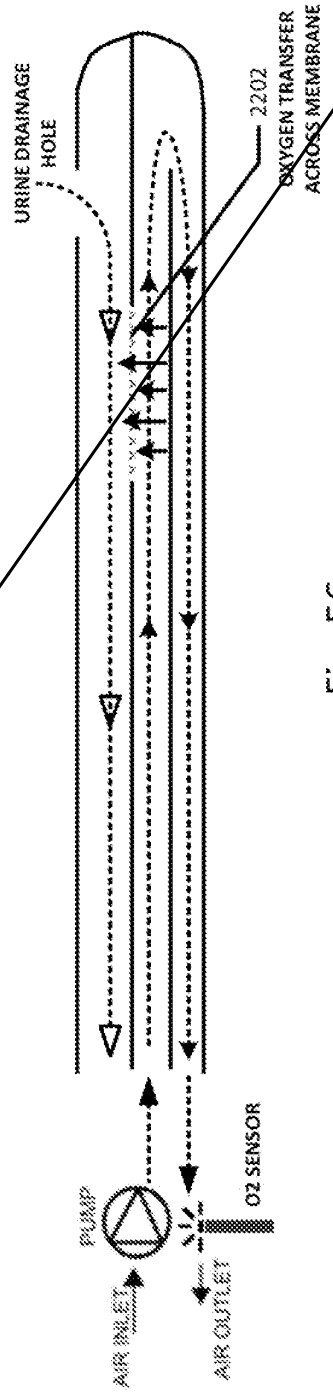

URINE DRAINAGE HOLE
2202
OXYGEN TRANSFER ACROSS MEMBRANE
PUMP
O2 SENSOR
AIR INLET
AIR OUTLET

Fig. 56

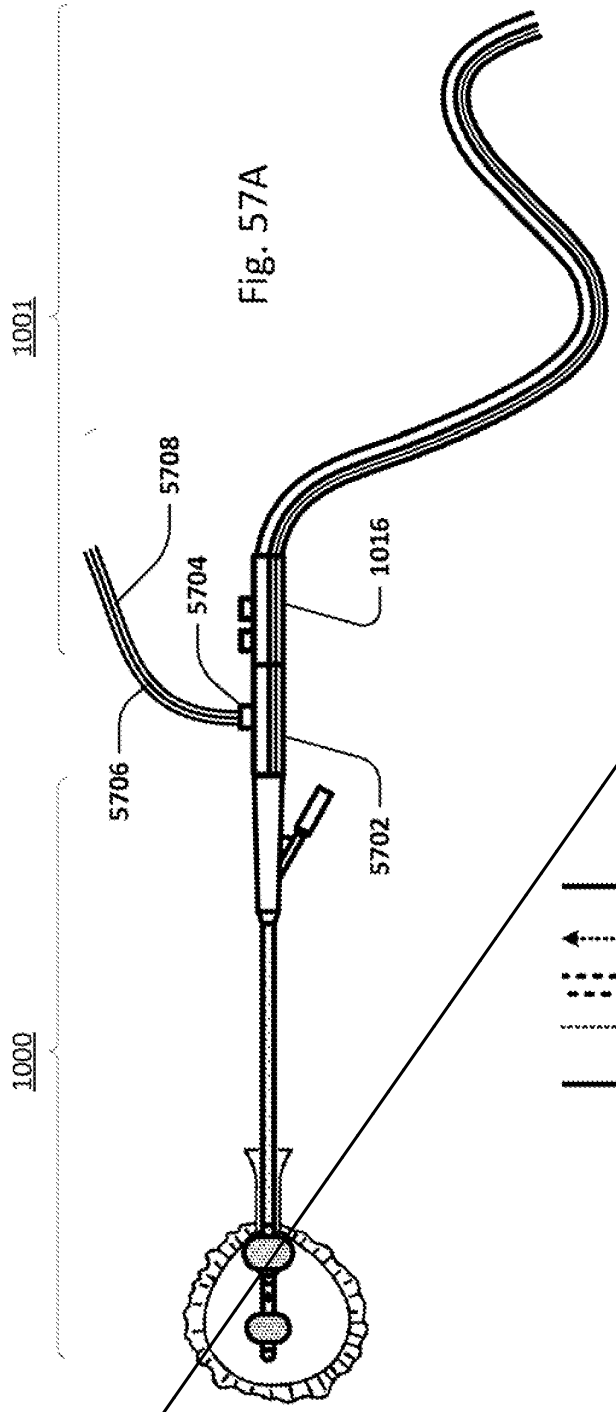


Fig. 57A

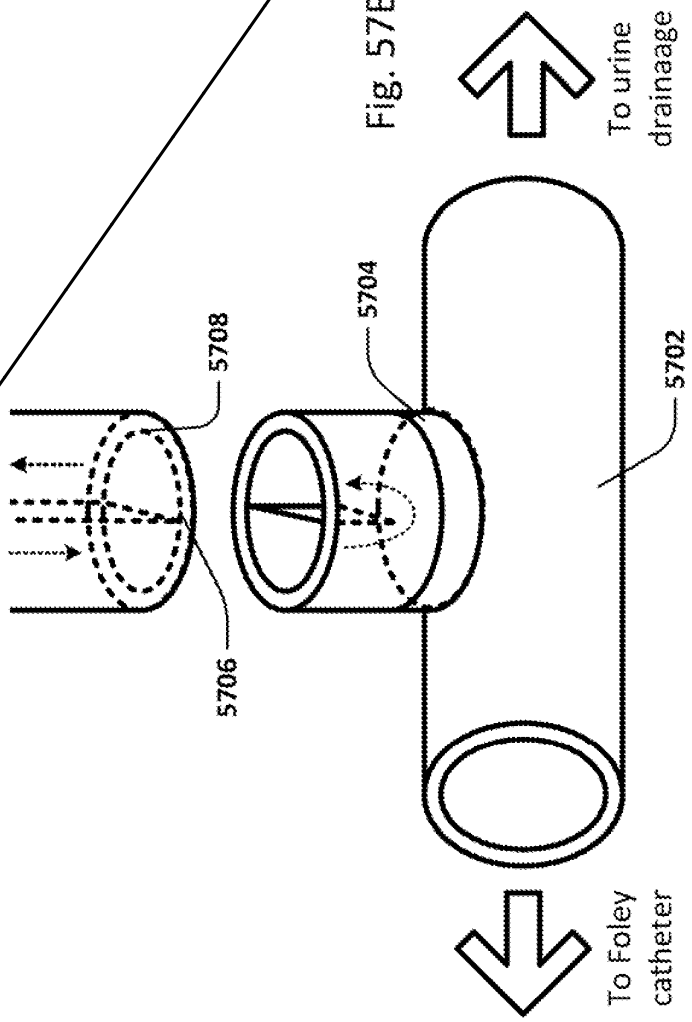


Fig. 57B

Parameter	Condition			
	AKI			UTI
	Prerenal	Intrinsic	Postrenal	
Urine Oxygen Tension	↓ then ↑	↓ then ↑	-	↓↓
Urine Output	↓↓	↓↓	↓↓↓	-
Urine Conductance	↓	↑	↑↑	-
Specific Gravity	↑	↓	-	↑

Fig. 58A

Parameter	Condition		
	Sepsis	AKI	ARDS
Urine Output	↓	↓	↑ or ↓
Heart Rate	↑ then ↓	↓	↑
Respiratory Rate	↑	↑ or ↓	↑
Temperature	↑ then ↓	-	-
Stroke Volume/Cardiac Output	↑ then ↓	↑ or ↓	↑
Abdominal Perfusion Pressure	↑ then ↓	↓	↓

Fig. 58B

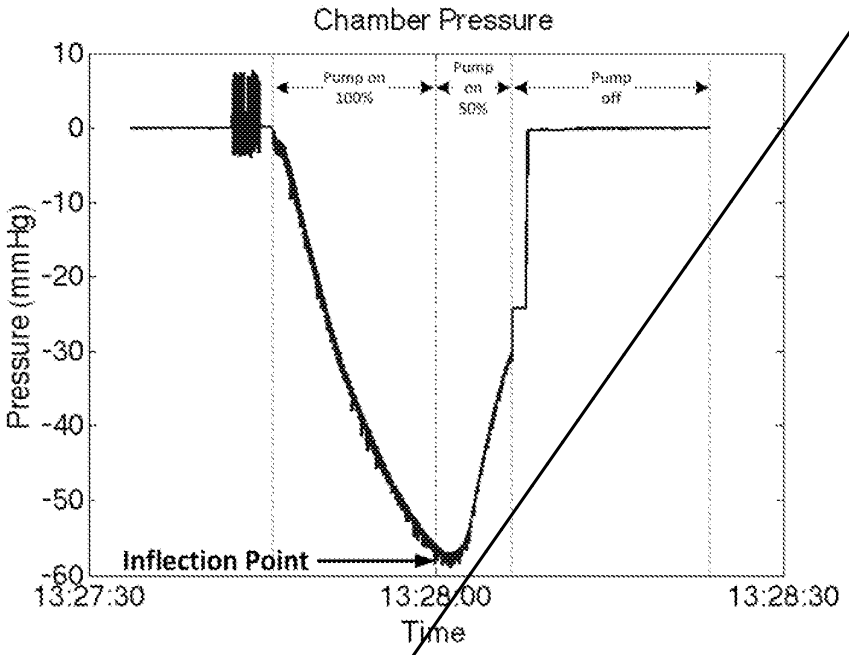

Chamber Pressure
Pump on 100%
Pump on 50%
Pump off
Pressure (mmHg)
10
0
-10
-20
-30
-40
-50
-60
Inflection Point
13:27:30
13:28:00
13:28:30
Time

Fig. 59

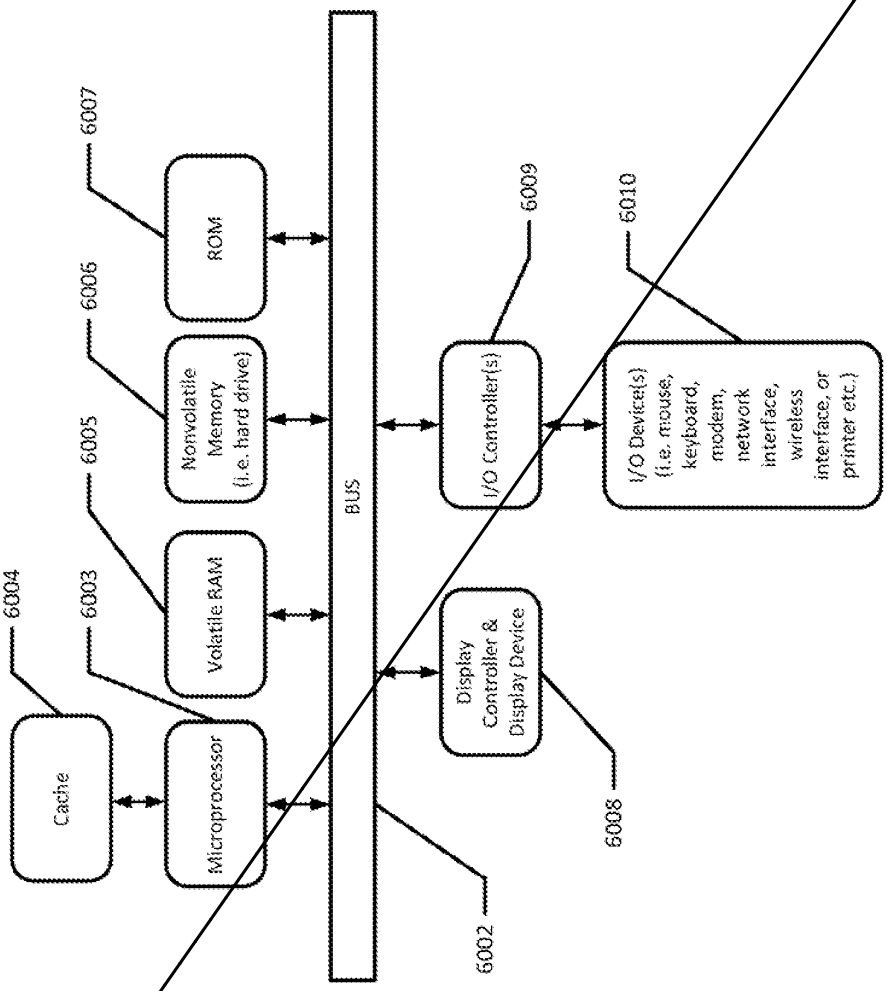

6000
Cache
6004
Microprocessor
6003
Volatile RAM
6005
Nonvolatile Memory (i.e. hard drive)
6006
ROM
6007
BUS
6002
Display Controller & Display Device
6008
I/O Controller(s)
6009
I/O Device(s) (i.e. mouse, keyboard, modem, network interface, wireless interface, or printer etc.)
6010

Fig. 60

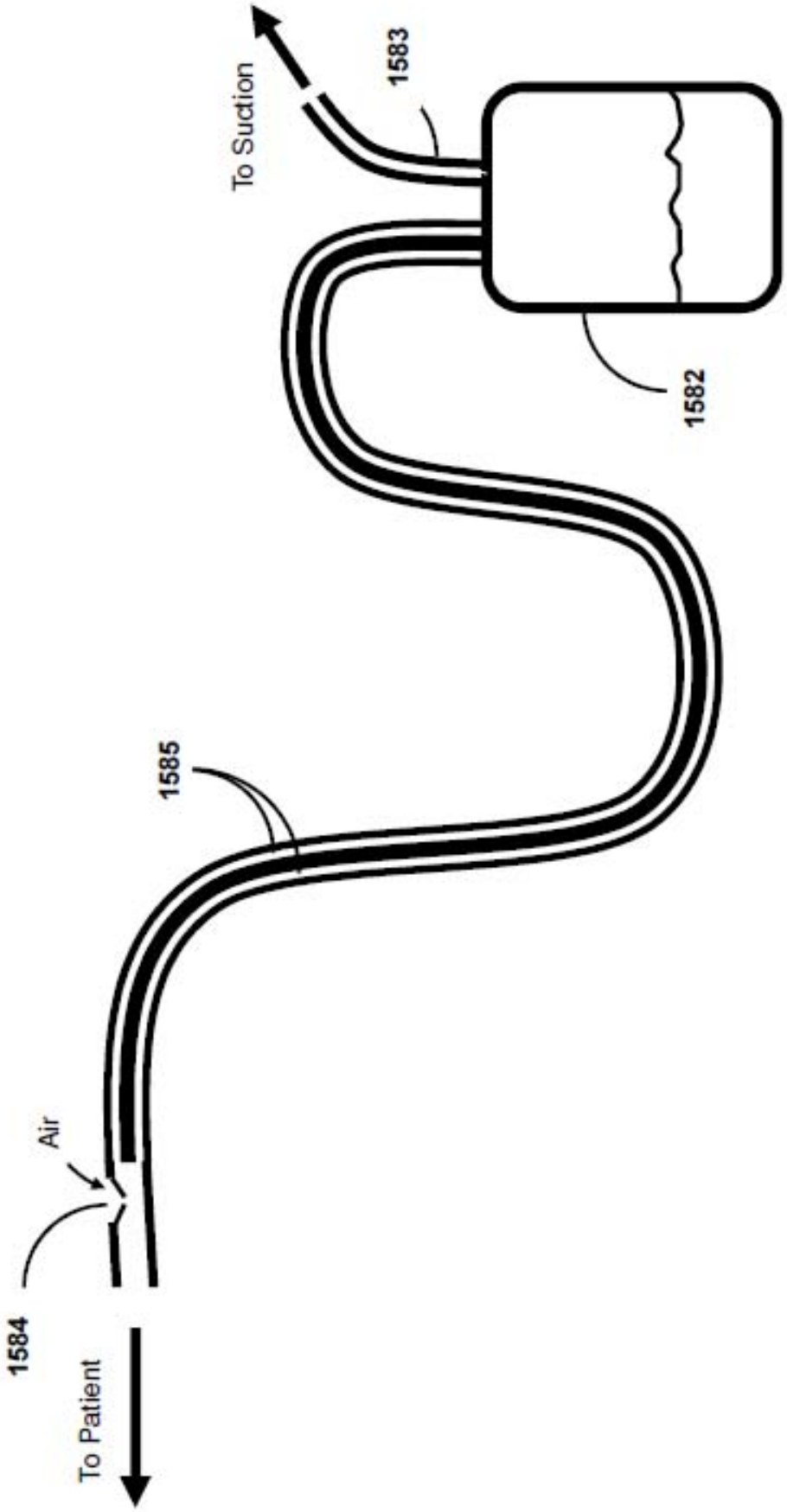


Fig. 14

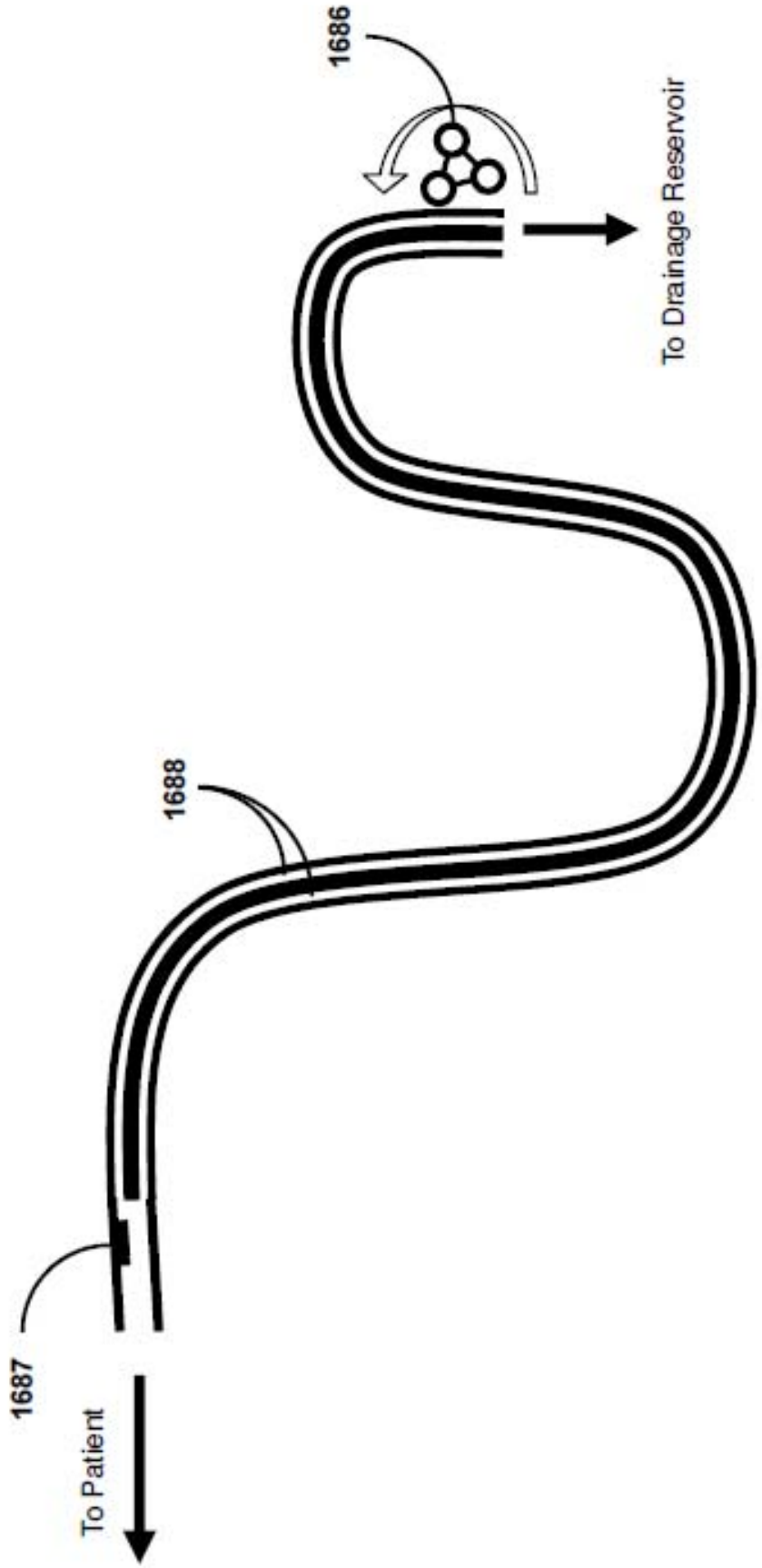


Fig. 15

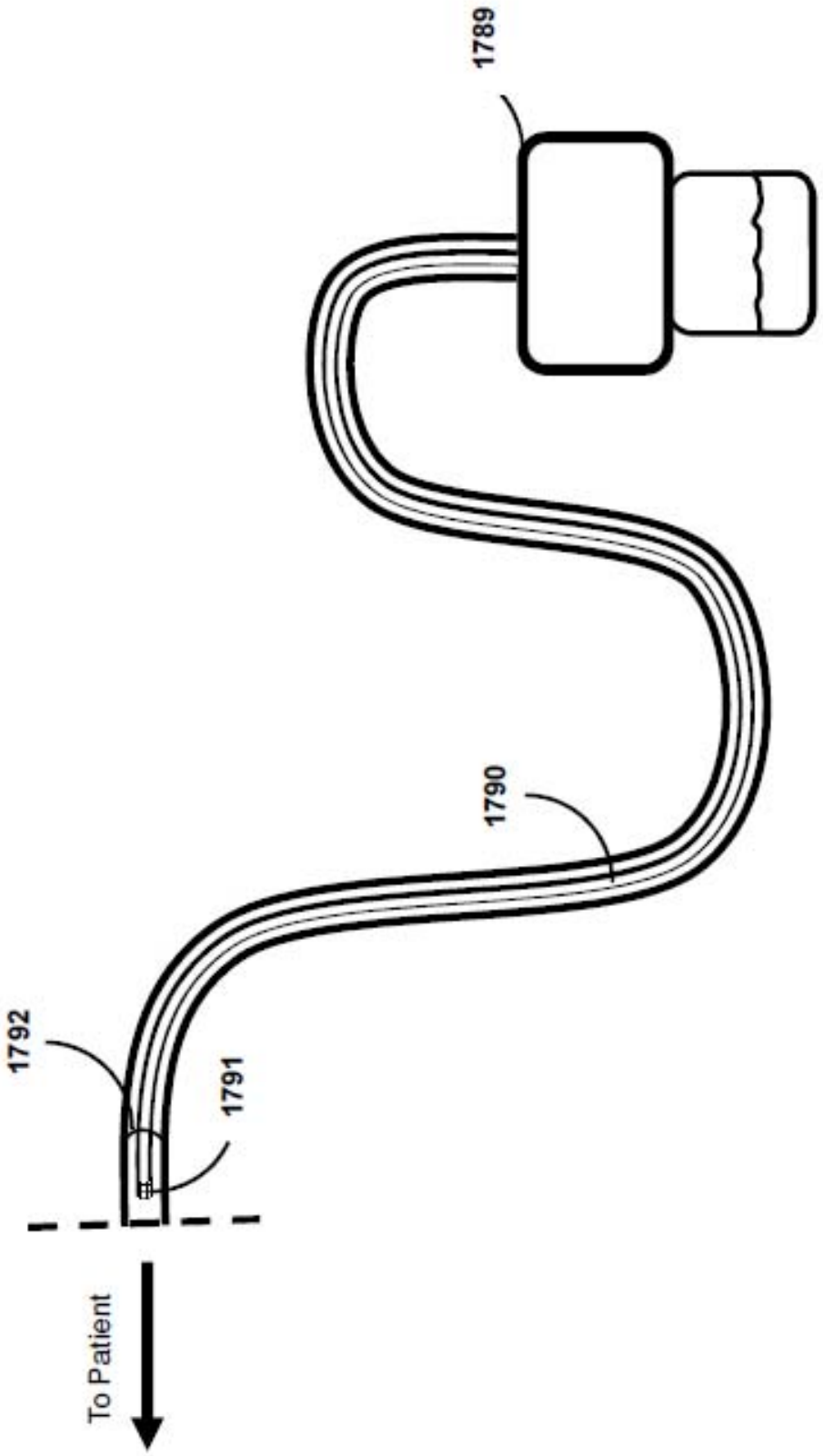


Fig. 16

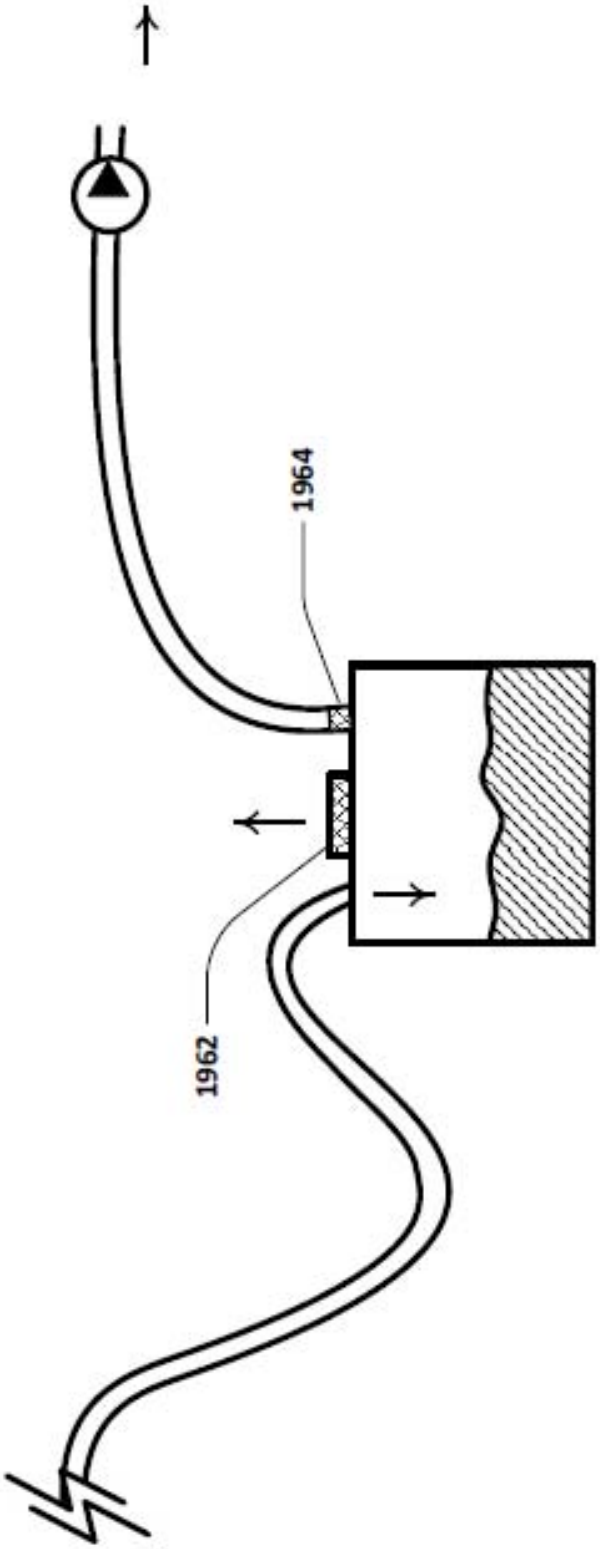


Fig. 17

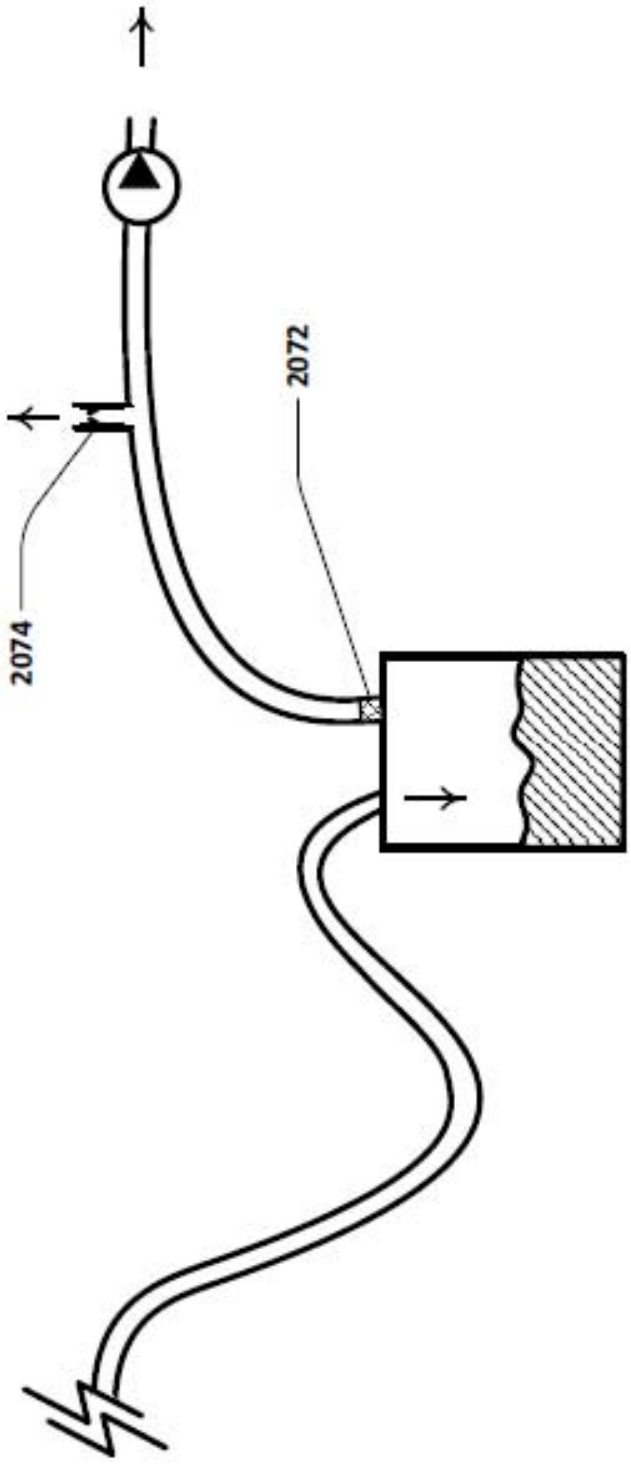


Fig. 18

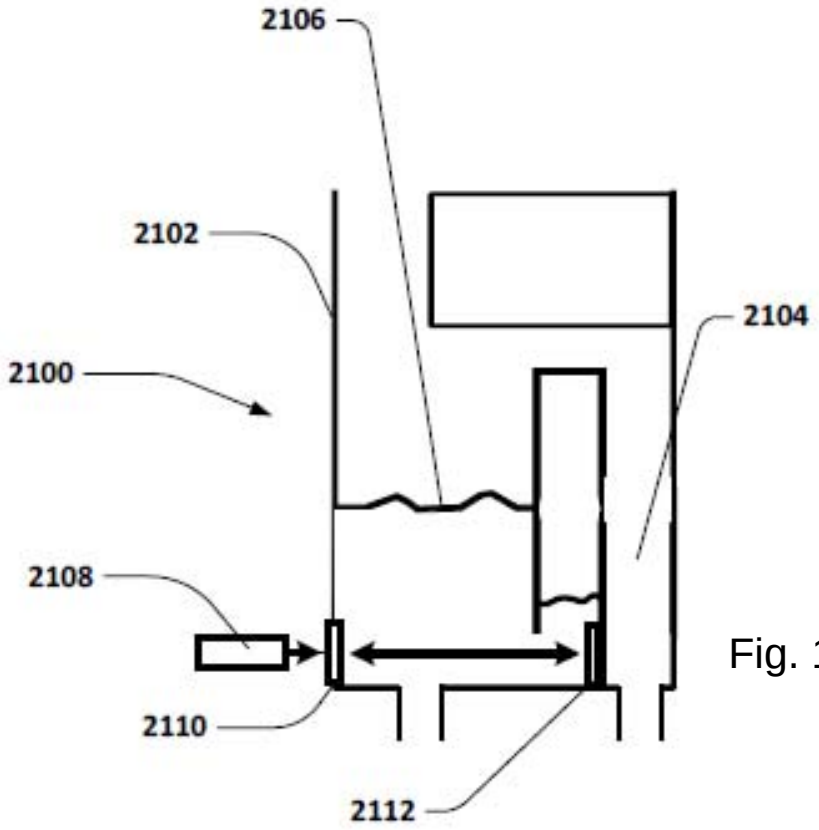

2106
2102
2104
2100
2108
2110
2112

Fig. 19

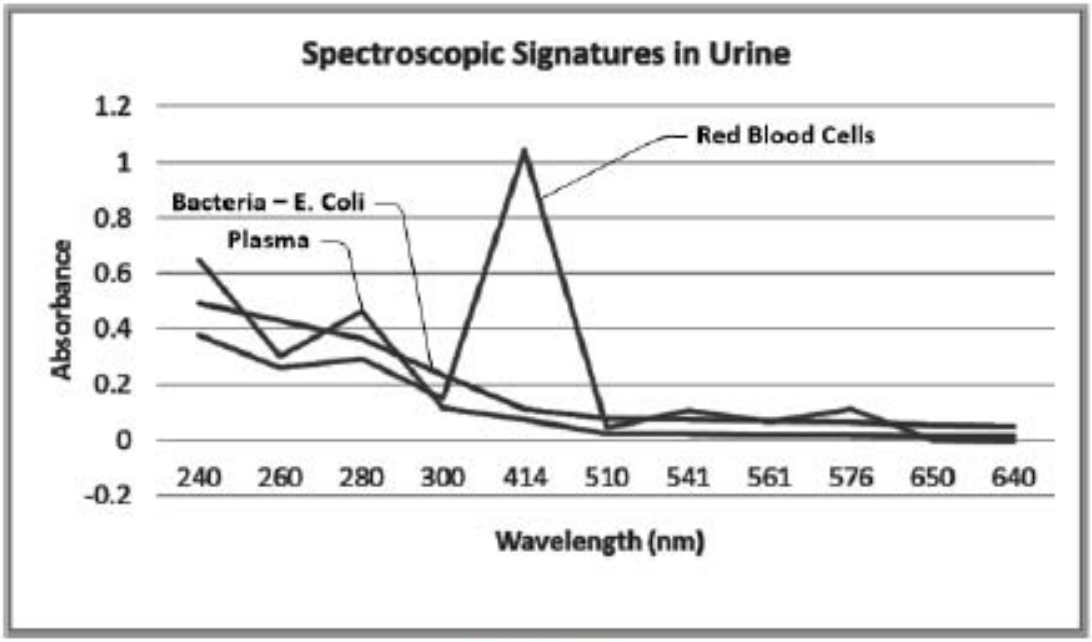

Spectroscopic Signatures in Urine
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
Absorbance
Red Blood Cells
Bacteria – E. Coli
Plasma
240
260
280
300
414
510
541
561
576
650
640
Wavelength (nm)

Fig. 20

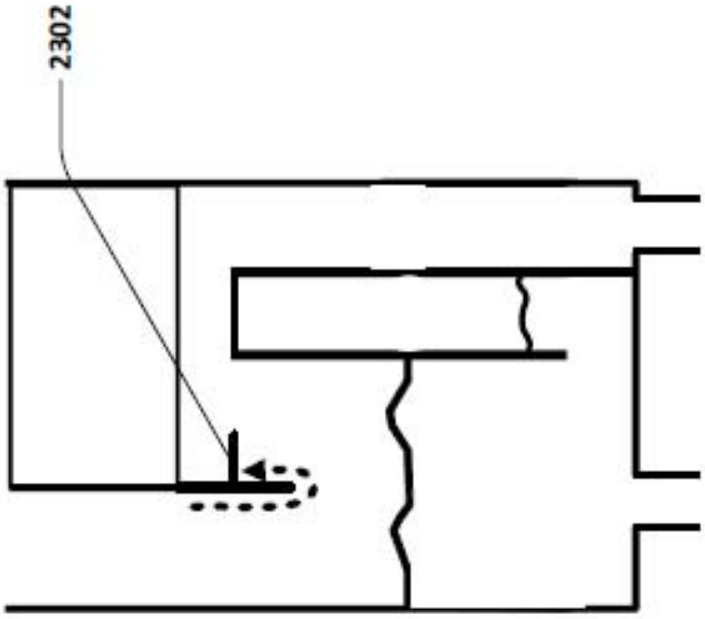


Fig. 21

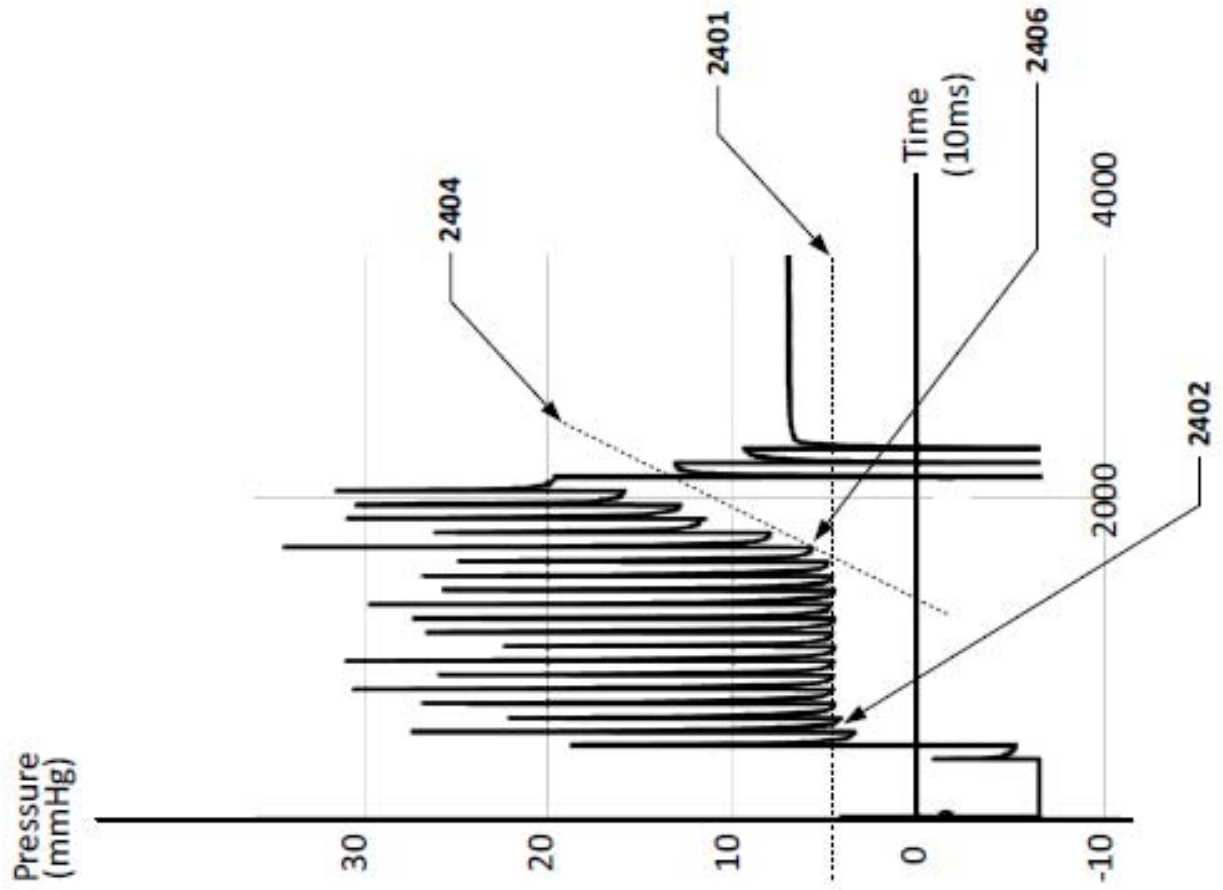

Pressure (mmHg)
30
20
10
0
-10
2000
4000
Time (10ms)
2401
2406
2404
2402

Fig. 22

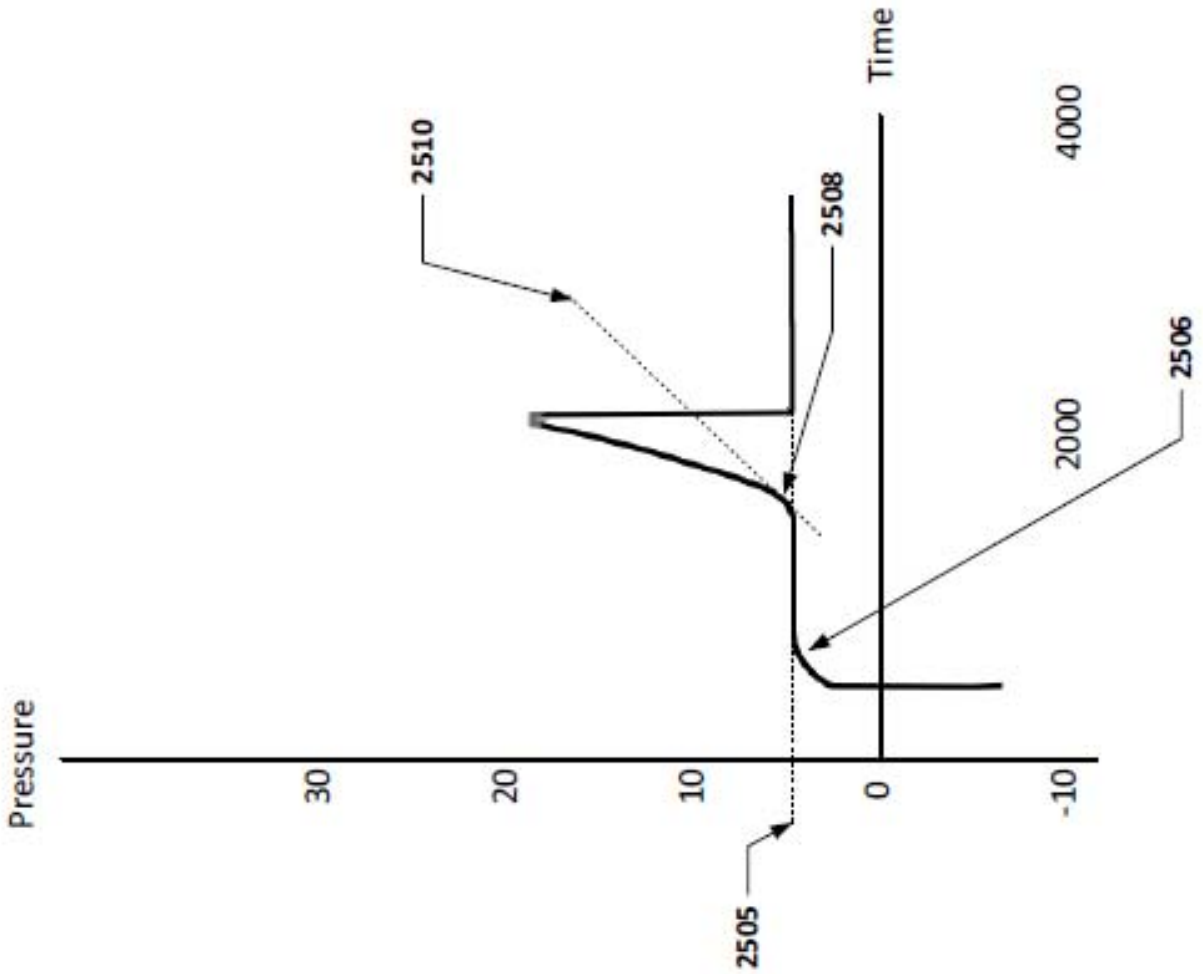


Fig. 23

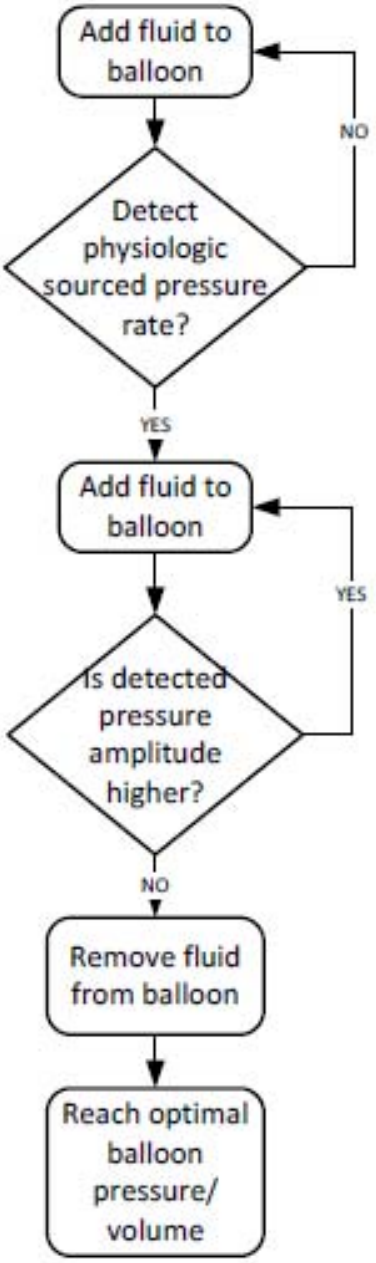

Add fluid to balloon
NO
Detect physiologic sourced pressure rate?
YES
Add fluid to balloon
YES
Is detected pressure amplitude higher?
NO
Remove fluid from balloon
Reach optimal balloon pressure/ volume

Fig. 24

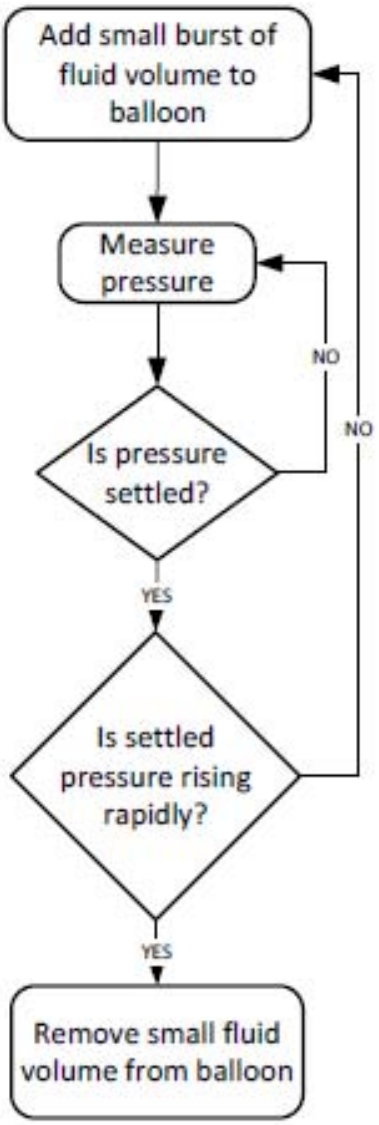

Add small burst of fluid volume to balloon
Measure pressure
NO
Is pressure settled?
NO
YES
Is settled pressure rising rapidly?
YES
Remove small fluid volume from balloon

Fig. 25

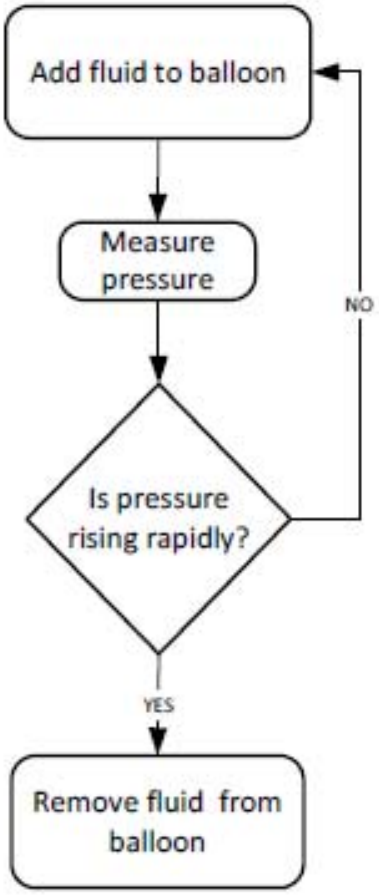

Add fluid to balloon
Measure pressure
NO
Is pressure rising rapidly?
YES
Remove fluid from balloon

Fig. 26

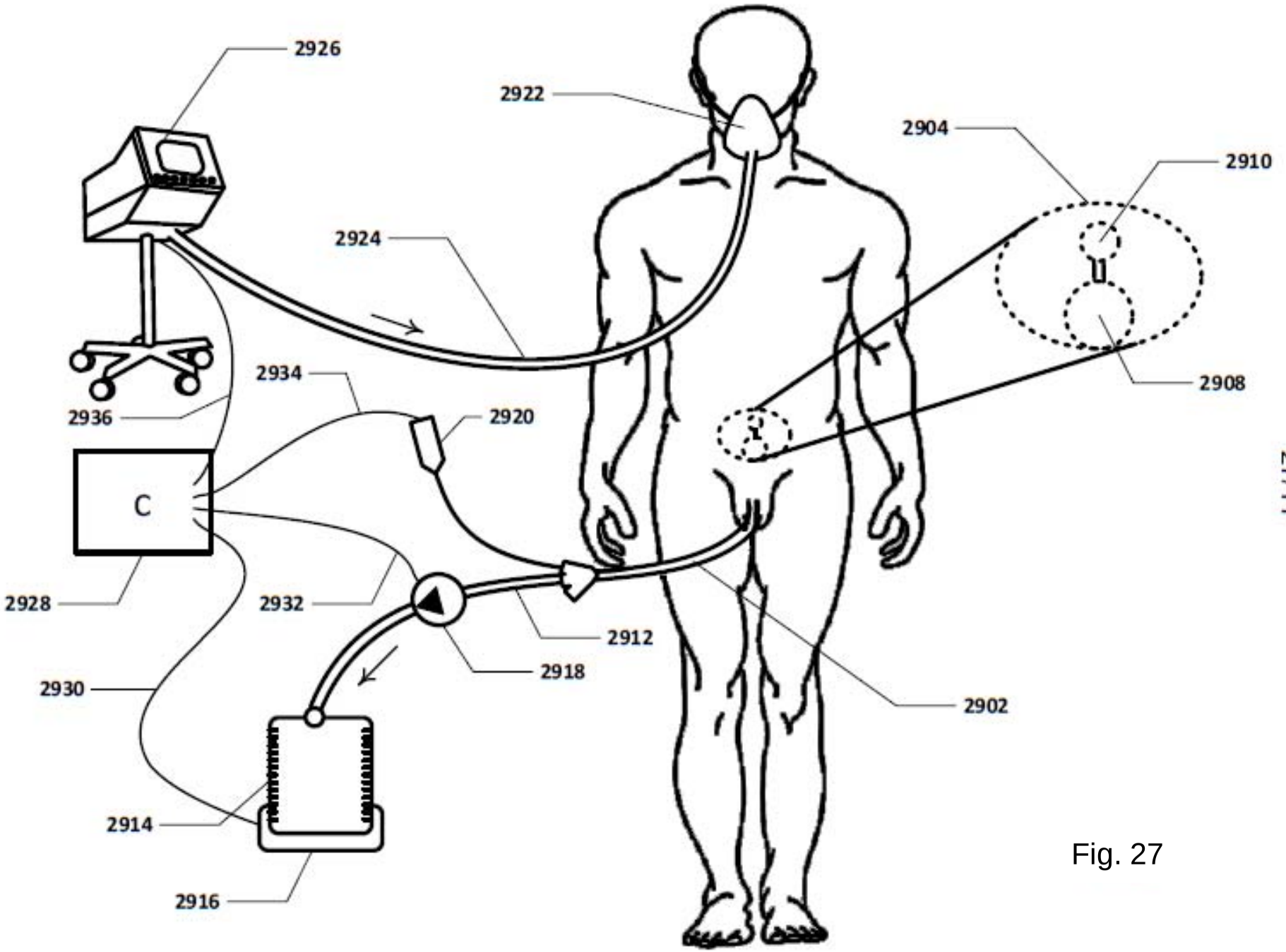

2926
2922
2904
2910
2924
2934
2936
2920
2908
C
2928
2932
2912
2918
2930
2902
2914
2916

Fig. 27

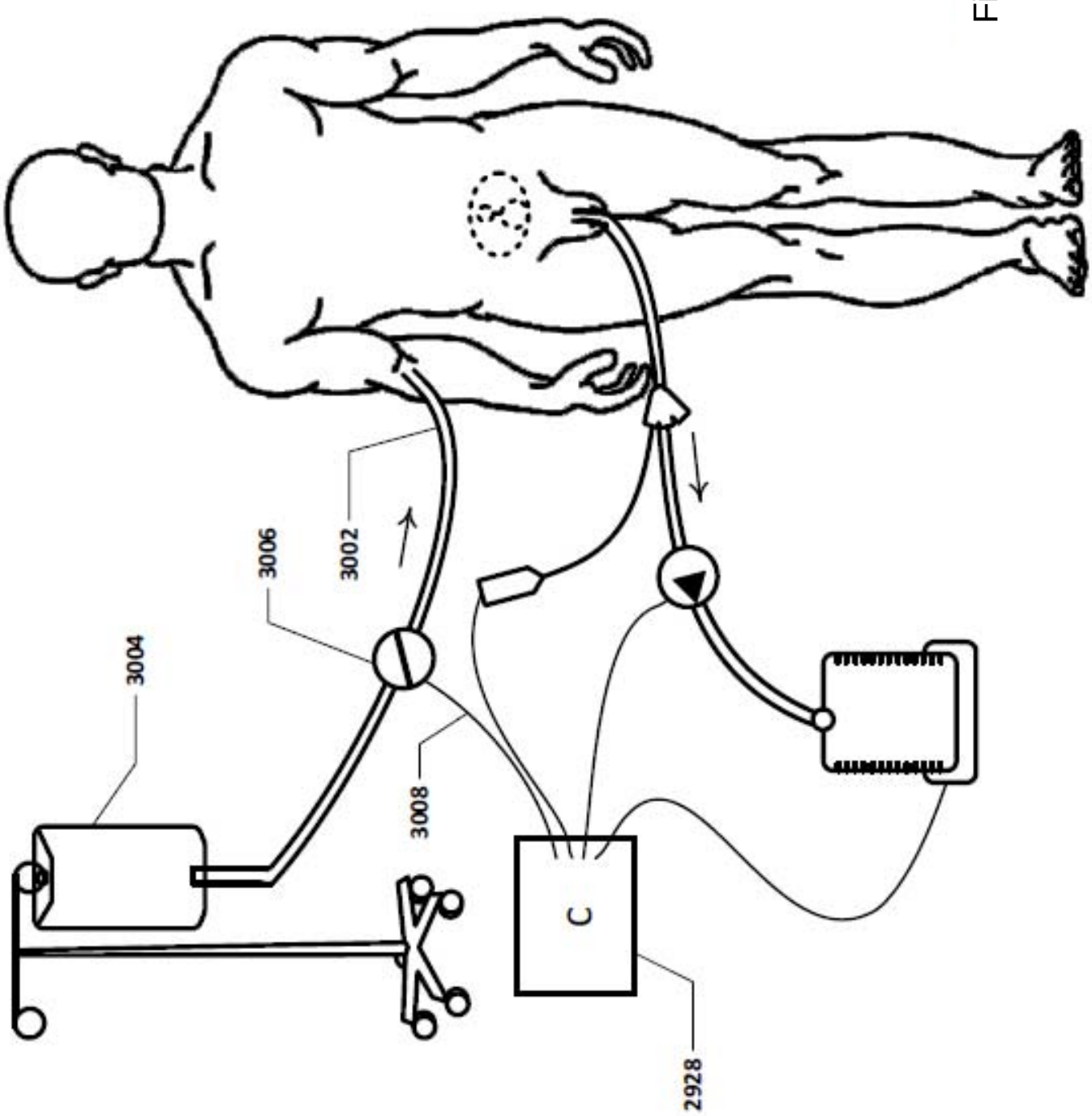
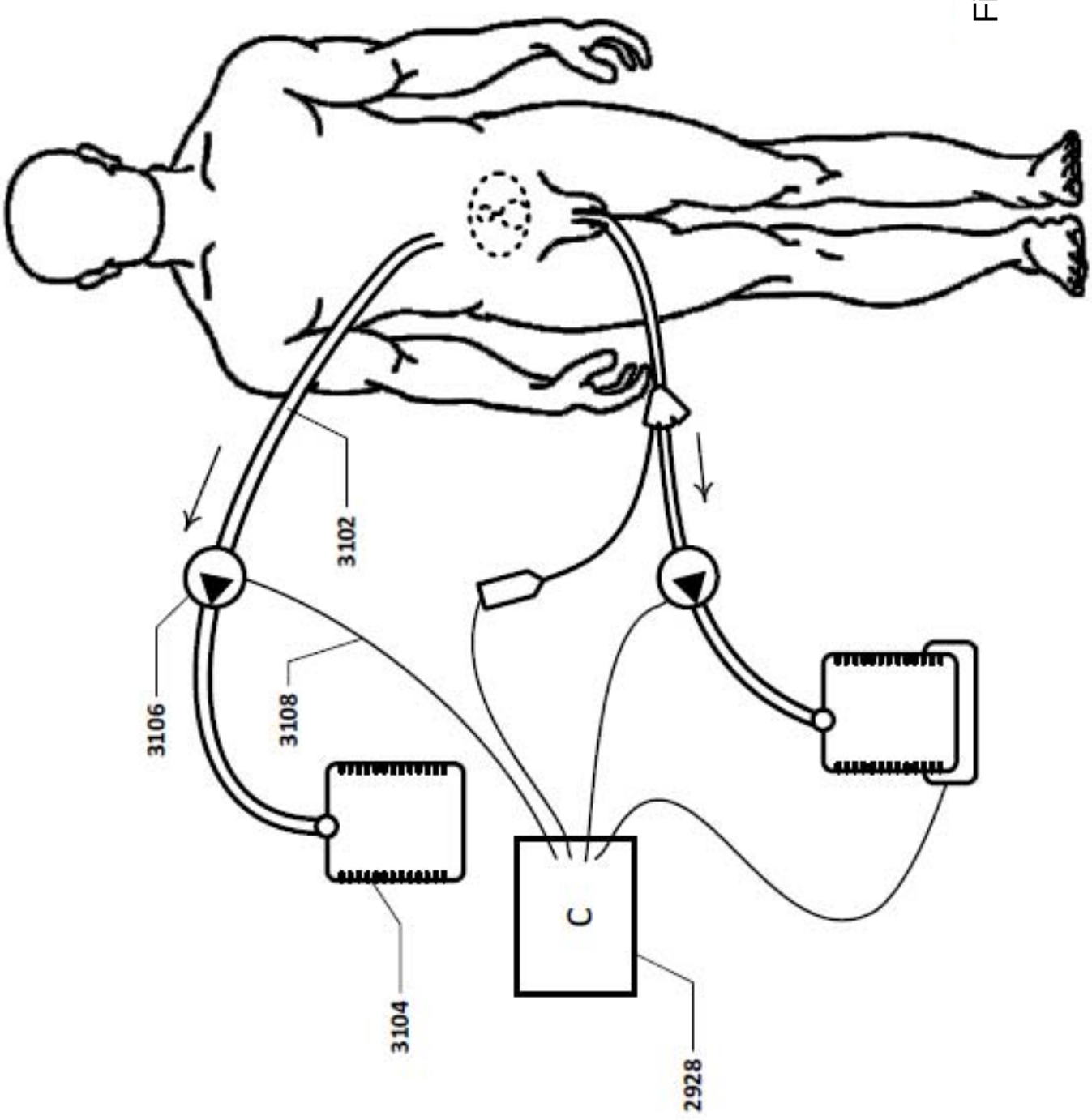


Fig. 28

Fig. 29



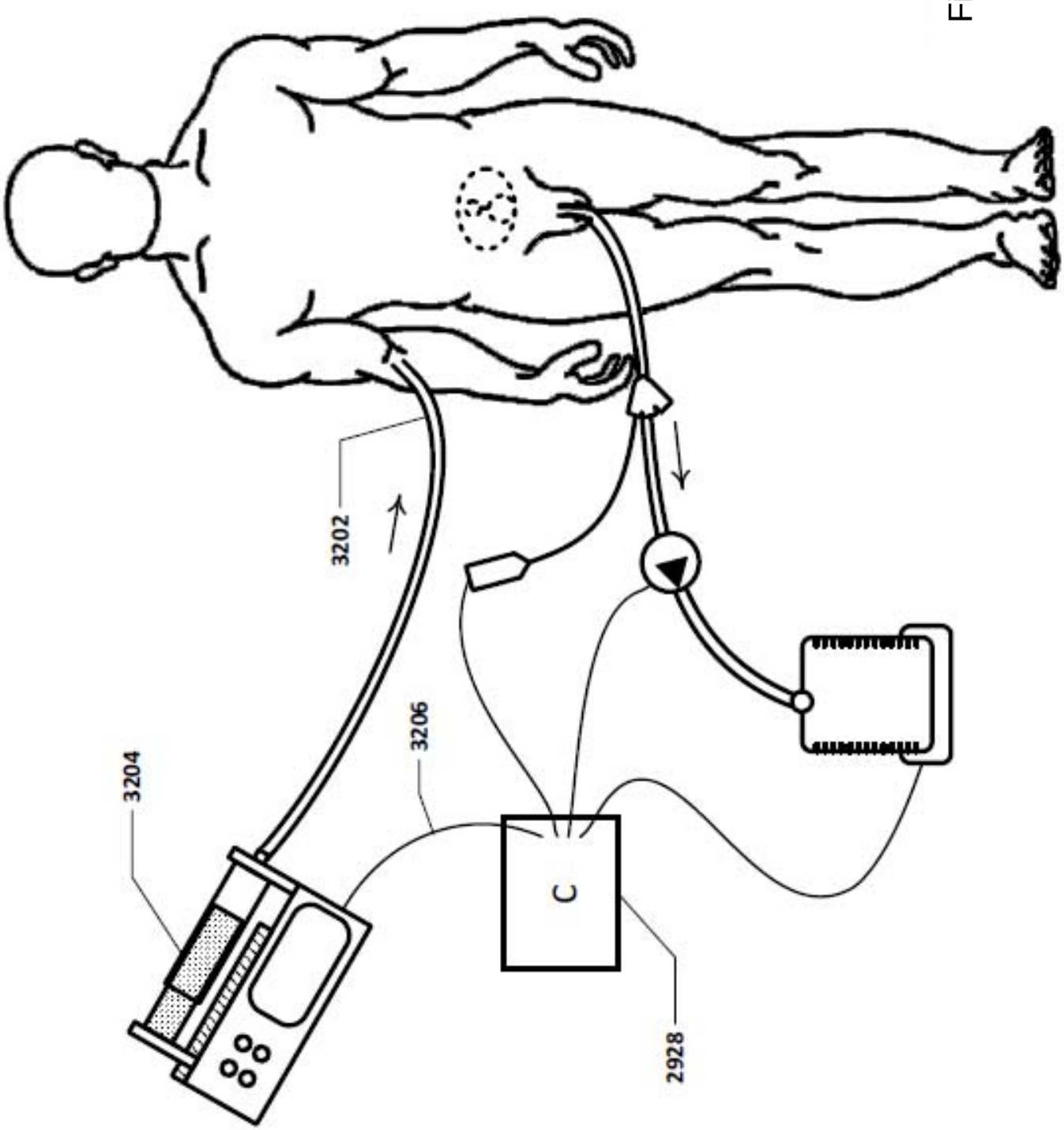


Fig. 30

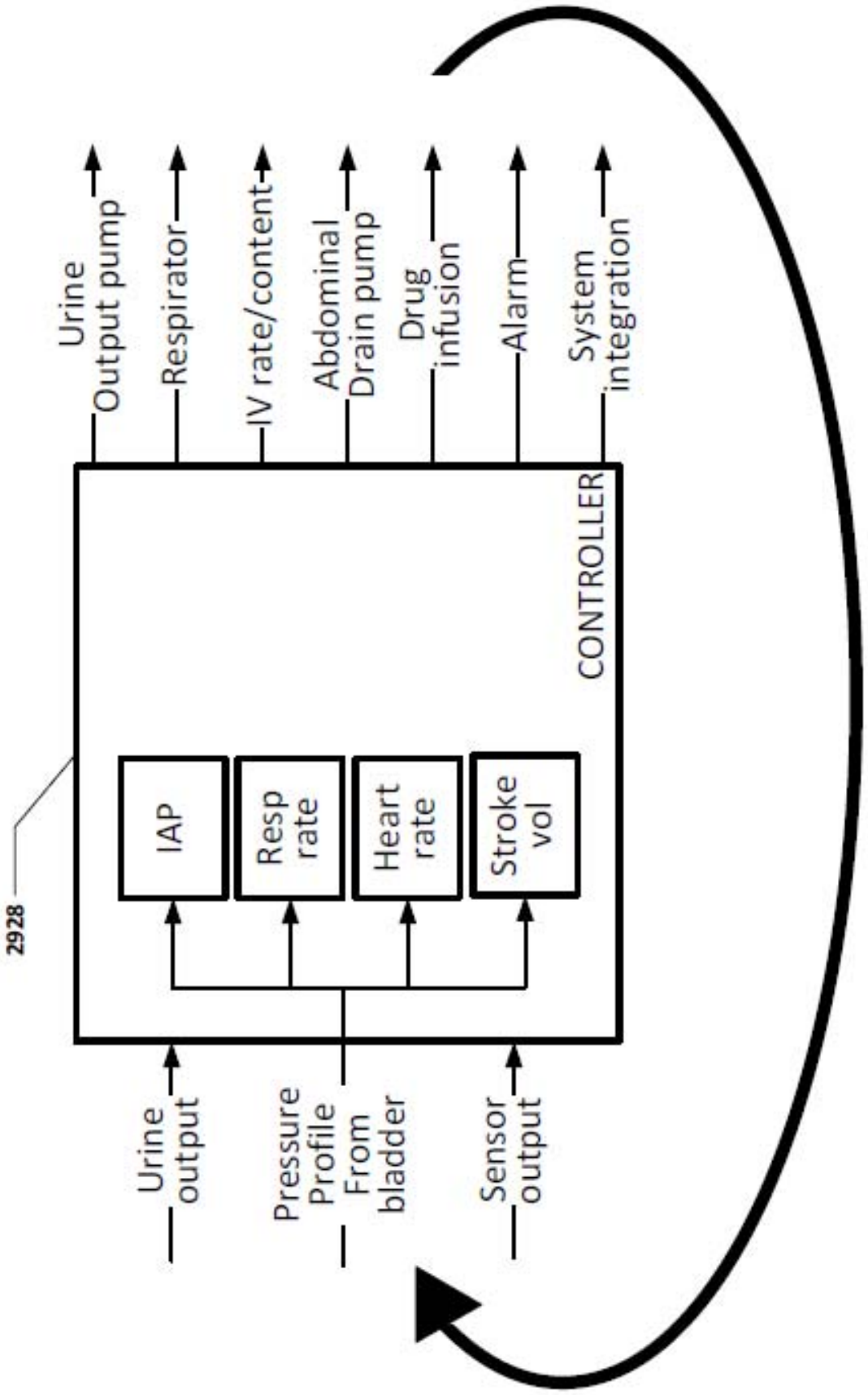

Urine
Output pump
Respirator
IV rate/content
Abdominal
Drain pump
Drug
infusion
Alarm
System
integration
CONTROLLER
2928
IAP
Resp
rate
Heart
rate
Stroke
vol
Urine
output
Pressure
Profile
From
bladder
Sensor
output

Fig. 31

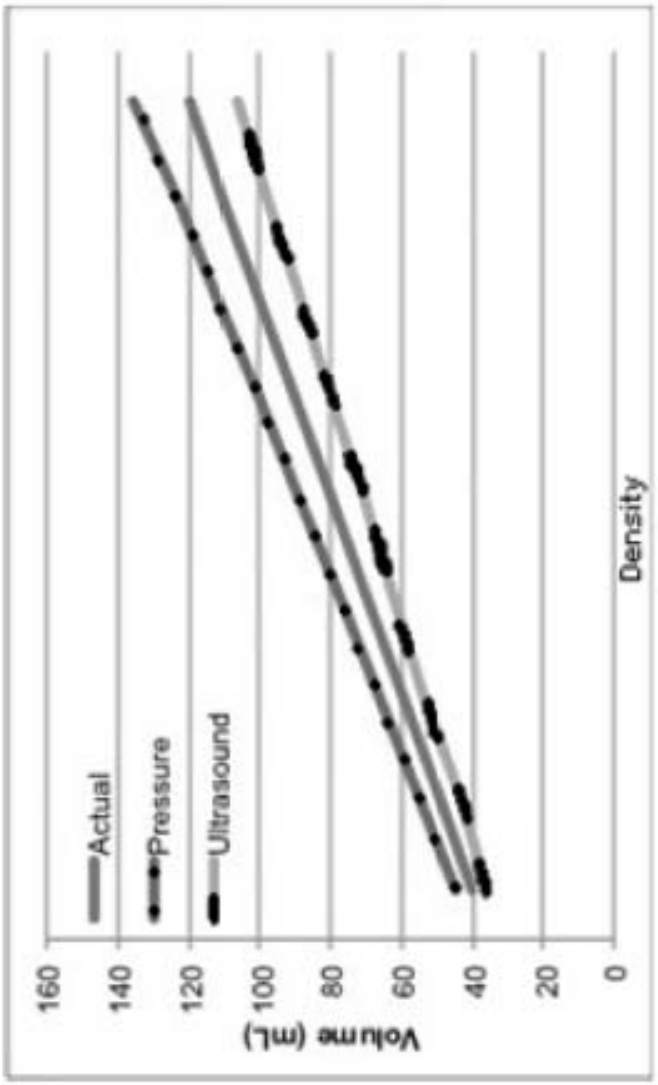

Actual
Pressure
Ultrasound
Volume (mL)
160
140
120
100
80
60
40
20
0
Density

Fig. 32

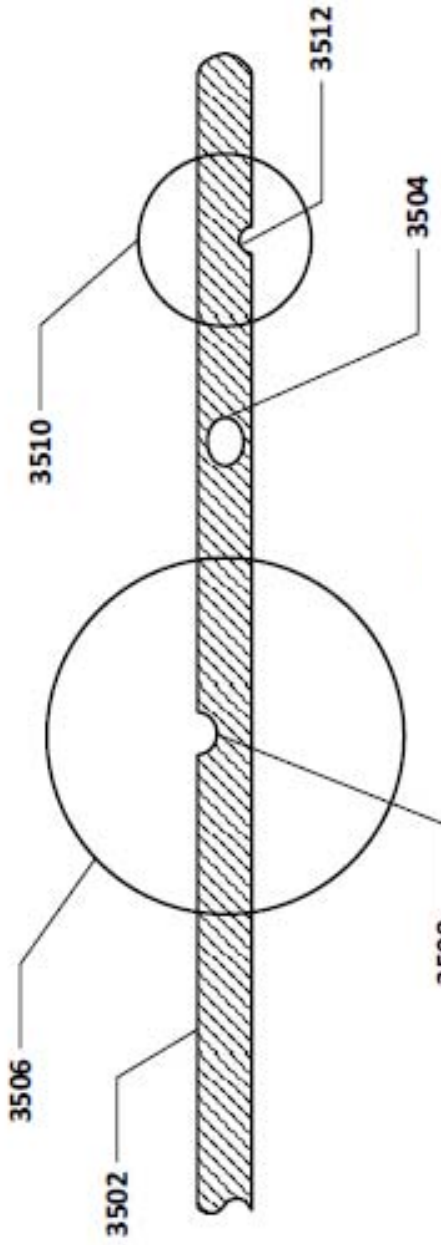


Fig. 33

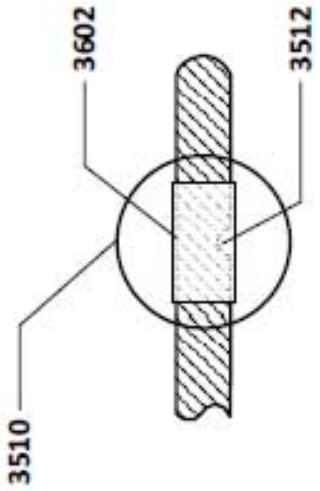


Fig. 34

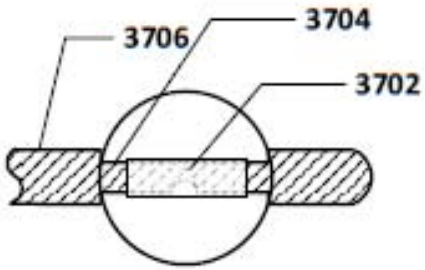


Fig. 35



Fig. 36

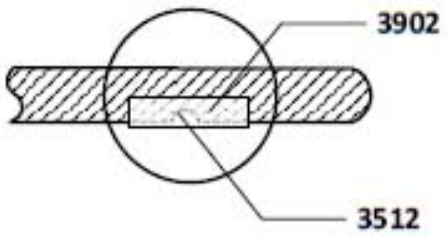


Fig. 37

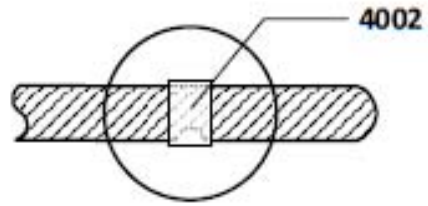


Fig. 38

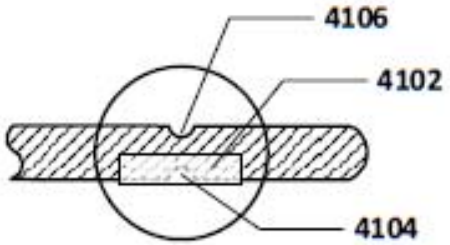


Fig. 39

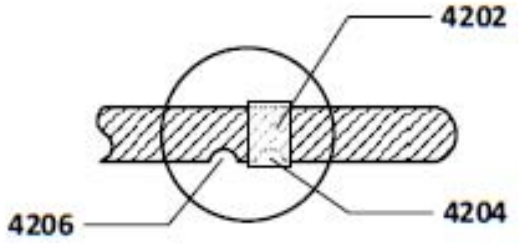


Fig. 40

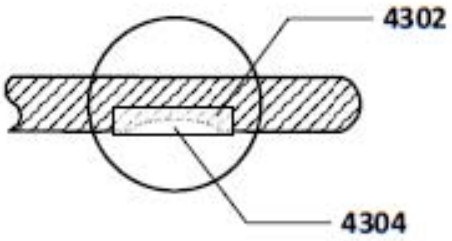


Fig. 41

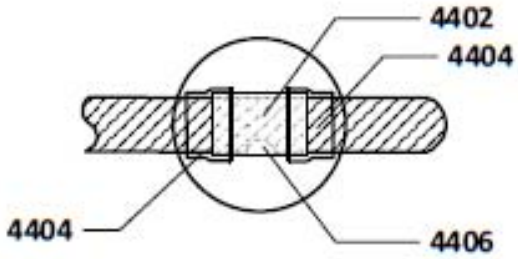


Fig. 42

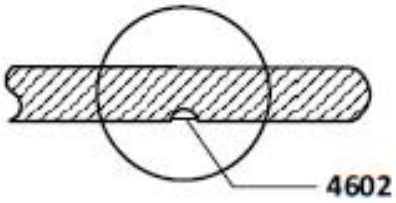


Fig. 44

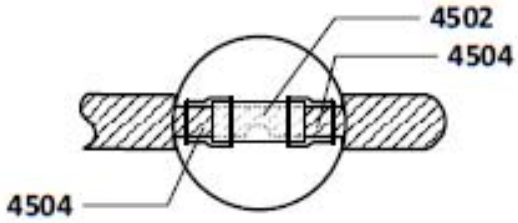


Fig. 43

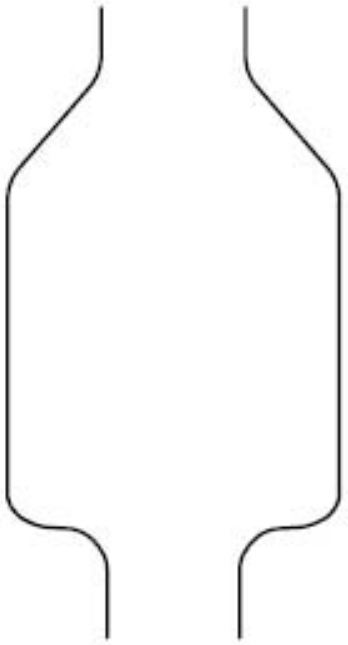


Fig. 46

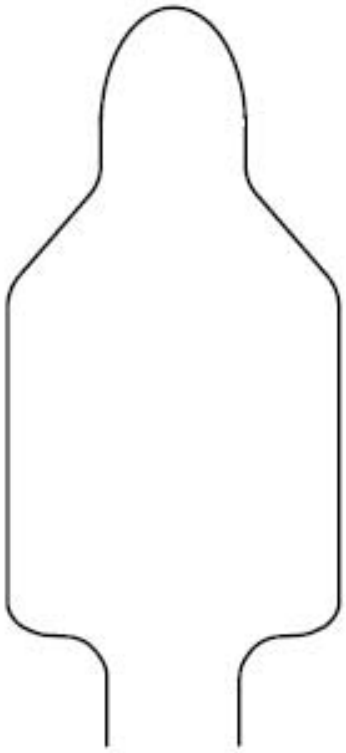


Fig. 47

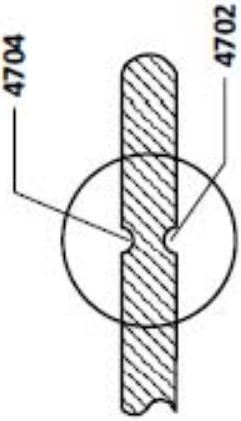


Fig. 45

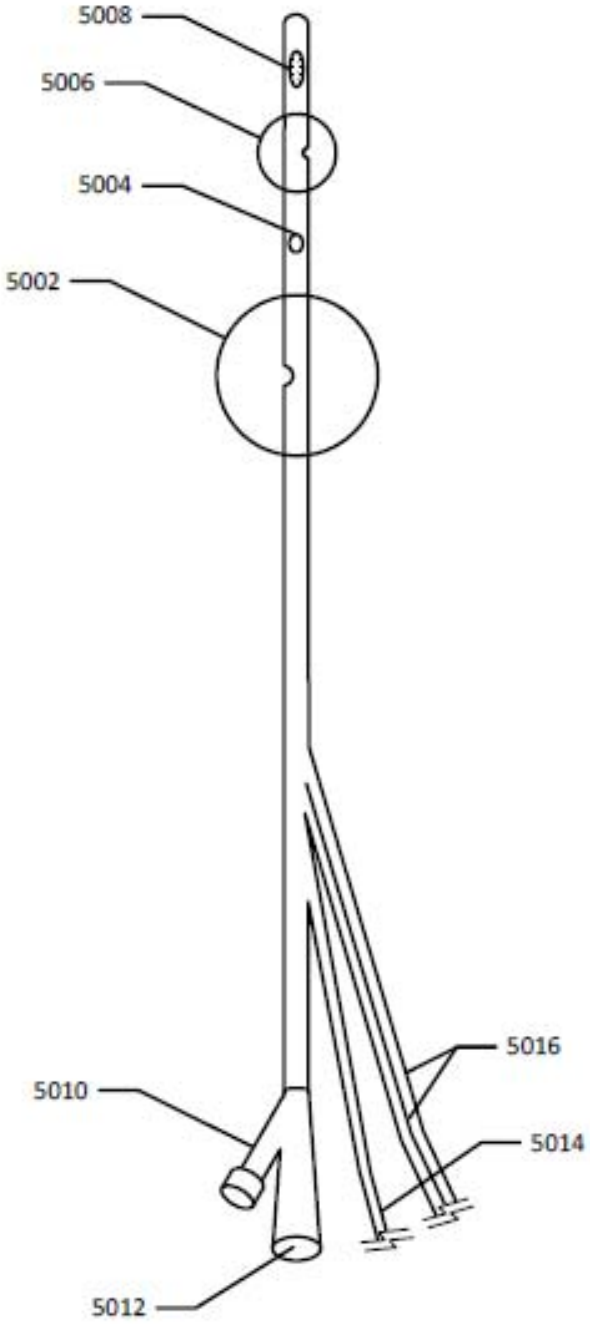


Fig. 48

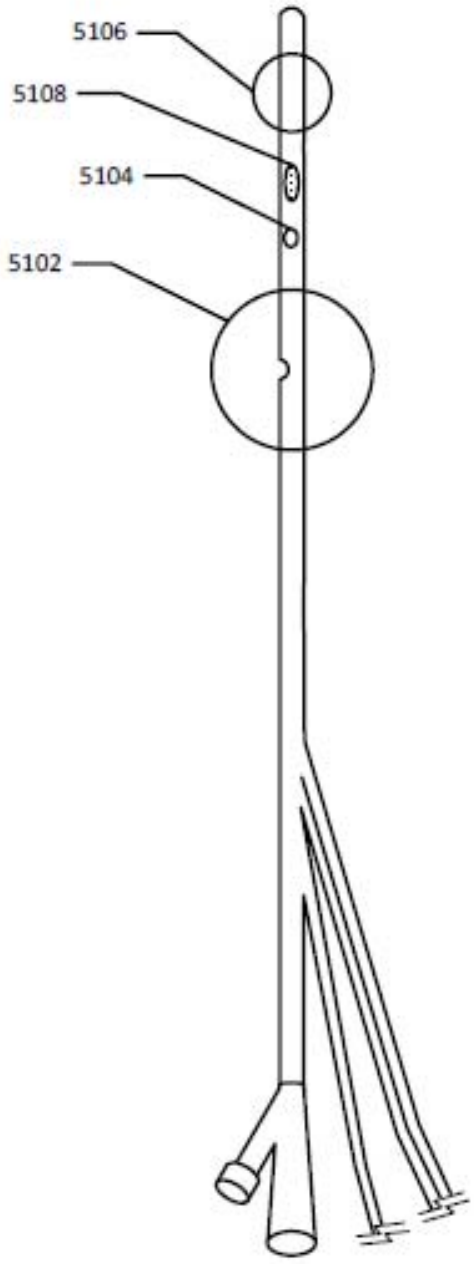


Fig. 49

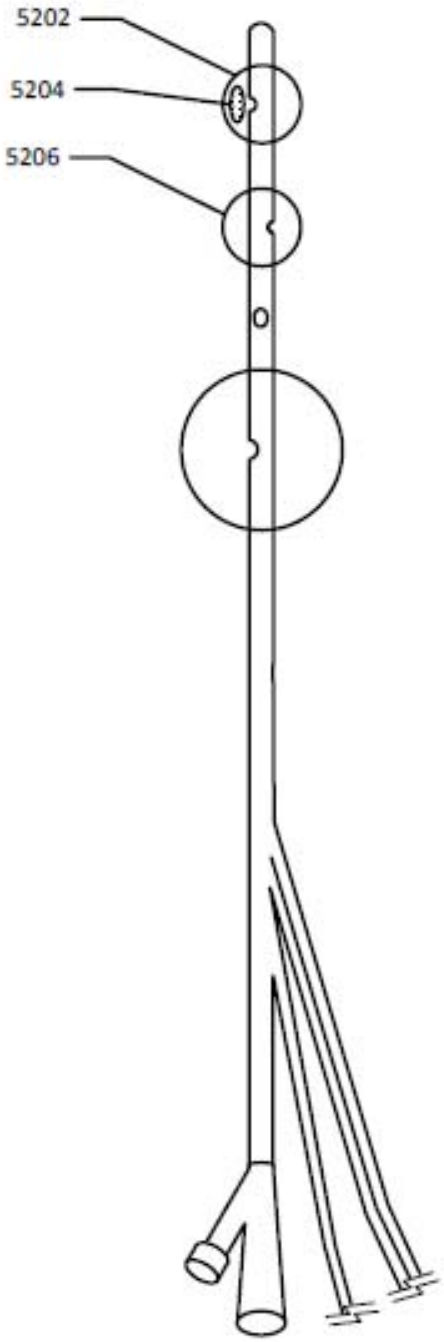


Fig. 50

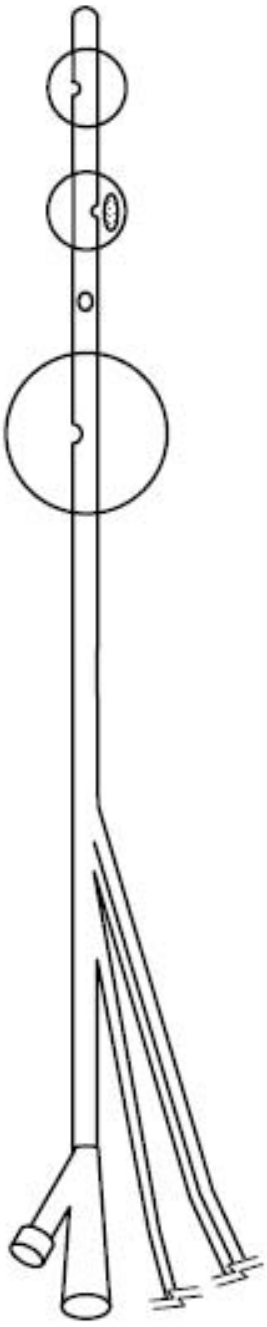


Fig. 51

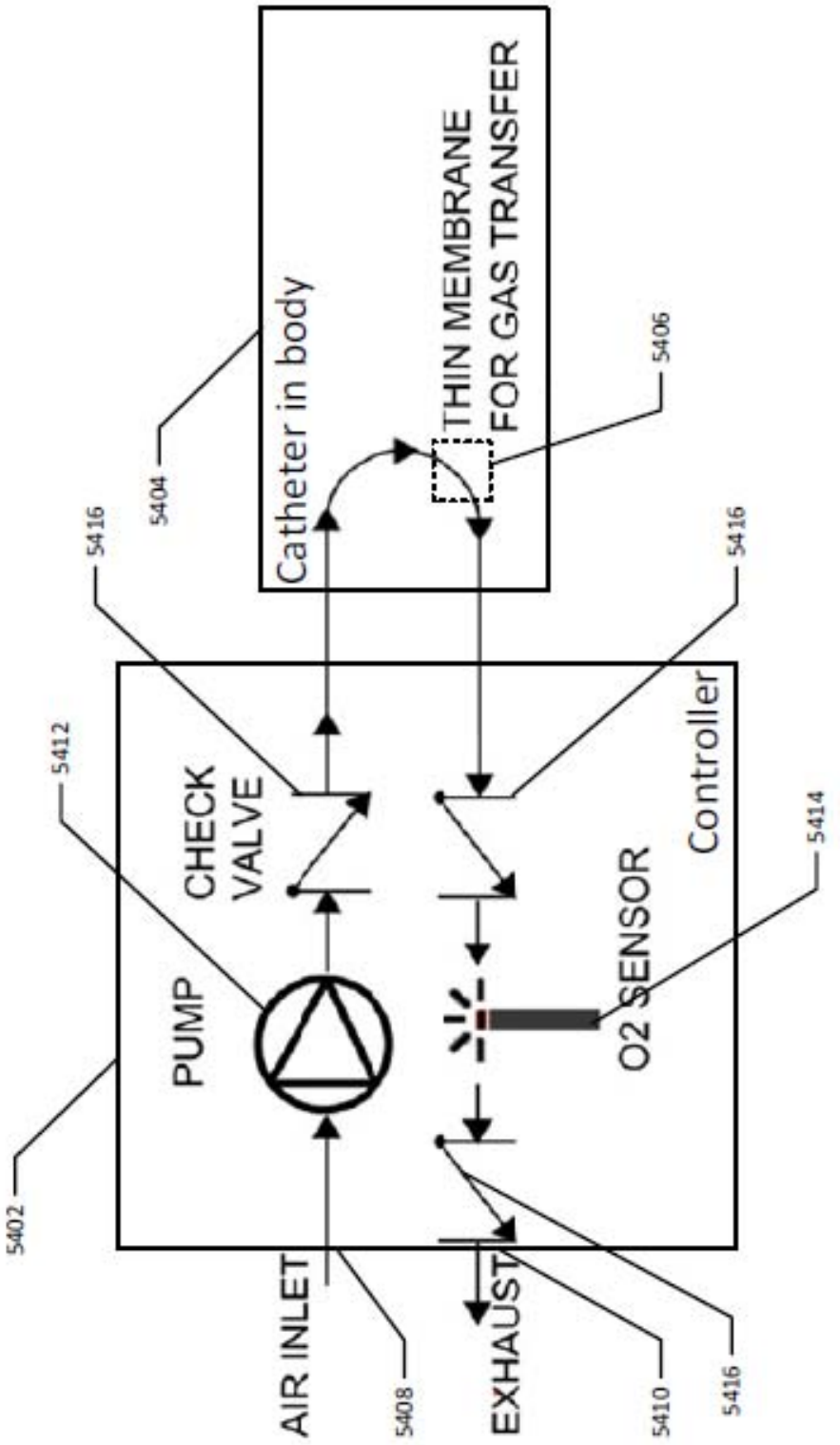

Catheter in body
THIN MEMBRANE FOR GAS TRANSFER
CHECK VALVE
PUMP
O2 SENSOR
Controller
AIR INLET
EXHAUST
5402
5404
5406
5408
5410
5412
5414
5416
5416
5416

Fig. 52

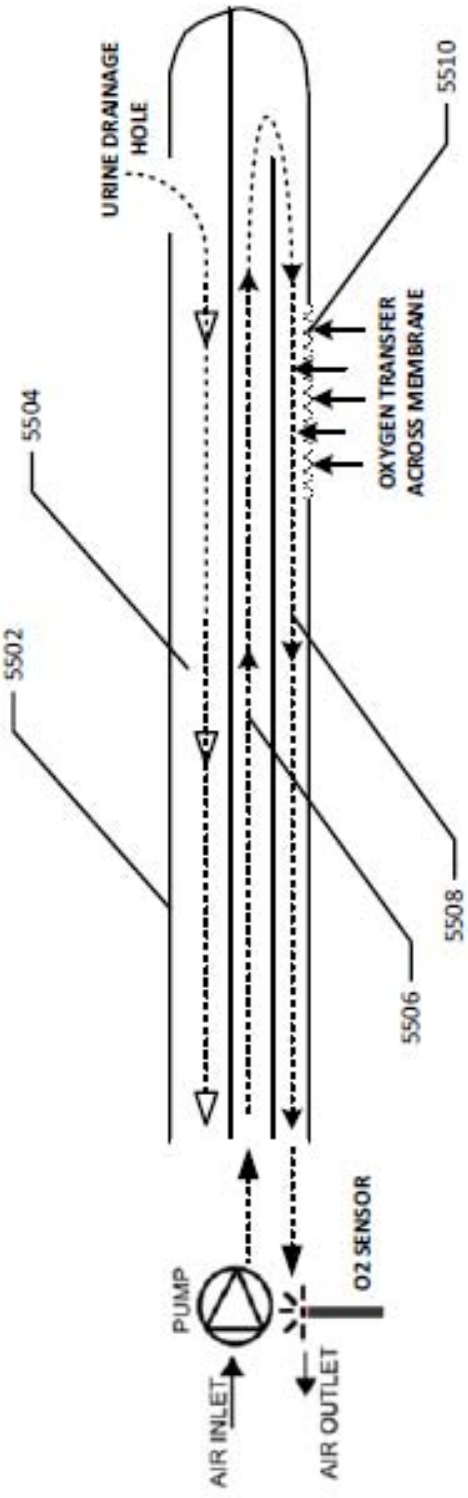

URINE DRAINAGE HOLE
5510
5504
OXYGEN TRANSFER ACROSS MEMBRANE
5502
5508
5506
PUMP
O2 SENSOR
AIR INLET
AIR OUTLET

Fig. 53

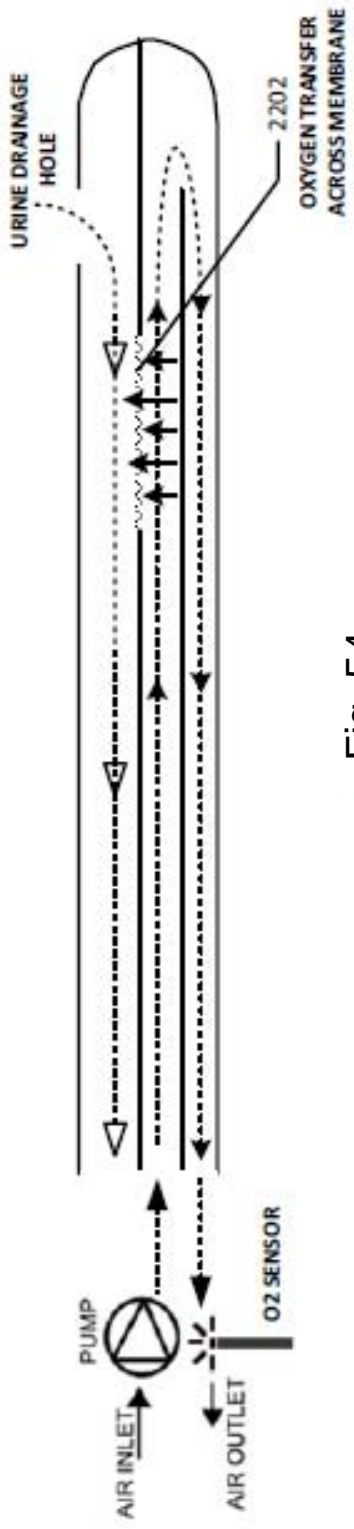

URINE DRAINAGE HOLE
2202
OXYGEN TRANSFER ACROSS MEMBRANE
PUMP
O2 SENSOR
AIR INLET
AIR OUTLET

Fig. 54

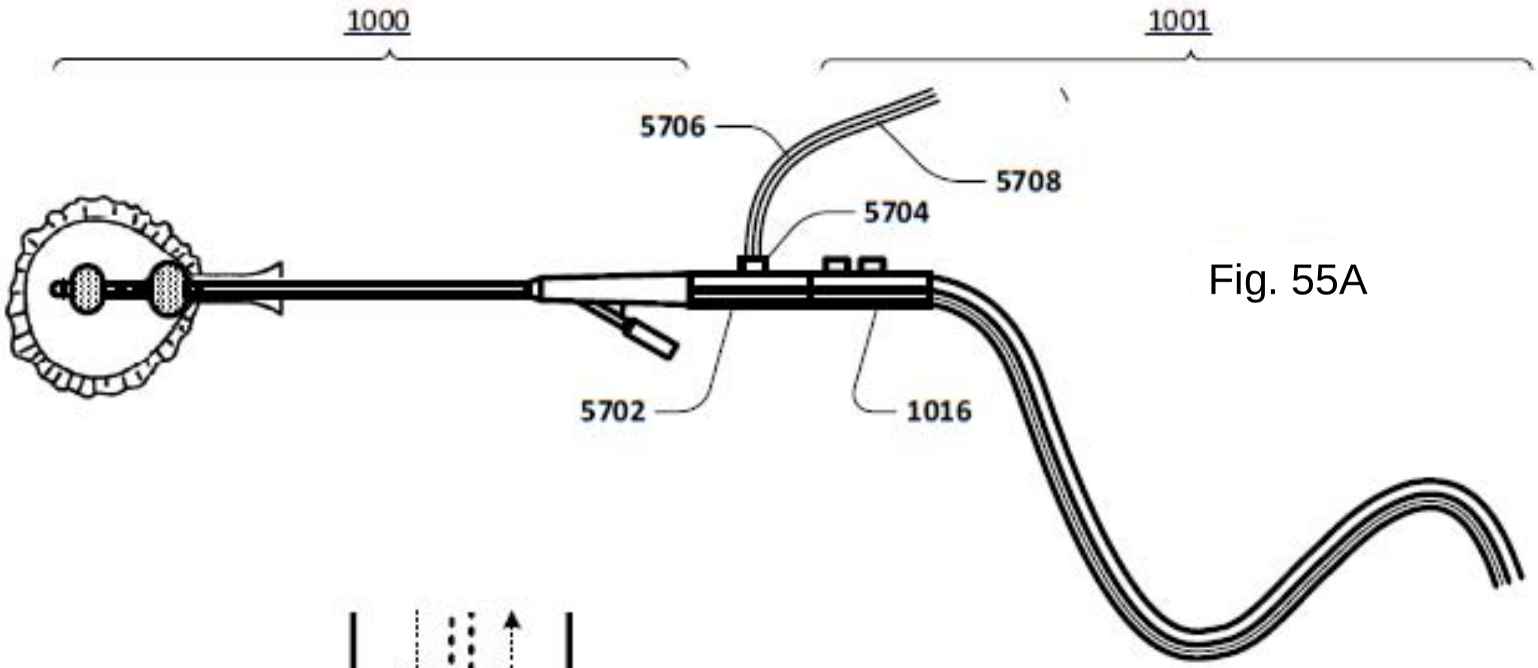


Fig. 55A

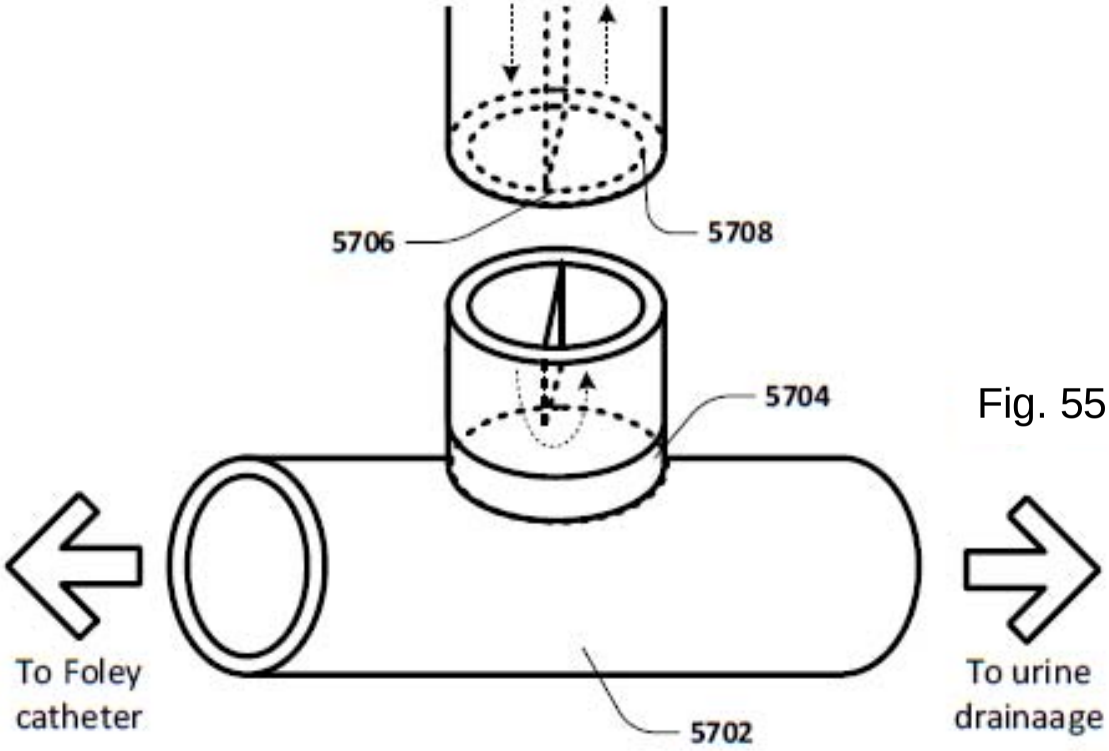


Fig. 55B

Parameter	Condition			
	AKI			UTI
	Prerenal	Intrinsic	Postrenal	
Urine Oxygen Tension	↓ then ↑	↓ then ↑	-	↓↓
Urine Output	↓↓	↓↓	↓↓↓	-
Urine Conductance	↓	↑	↑↑	-
Specific Gravity	↑	↓	-	↑

Fig. 56A

Parameter	Condition		
	Sepsis	AKI	ARDS
Urine Output	↓	↓	↑ or ↓
Heart Rate	↑ then ↓	↓	↑
Respiratory Rate	↑	↑ or ↓	↑
Temperature	↑ then ↓	-	-
Stroke Volume/Cardiac Output	↑ then ↓	↑ or ↓	↑
Abdominal Perfusion Pressure	↑ then ↓	↓	↓

Fig. 56B

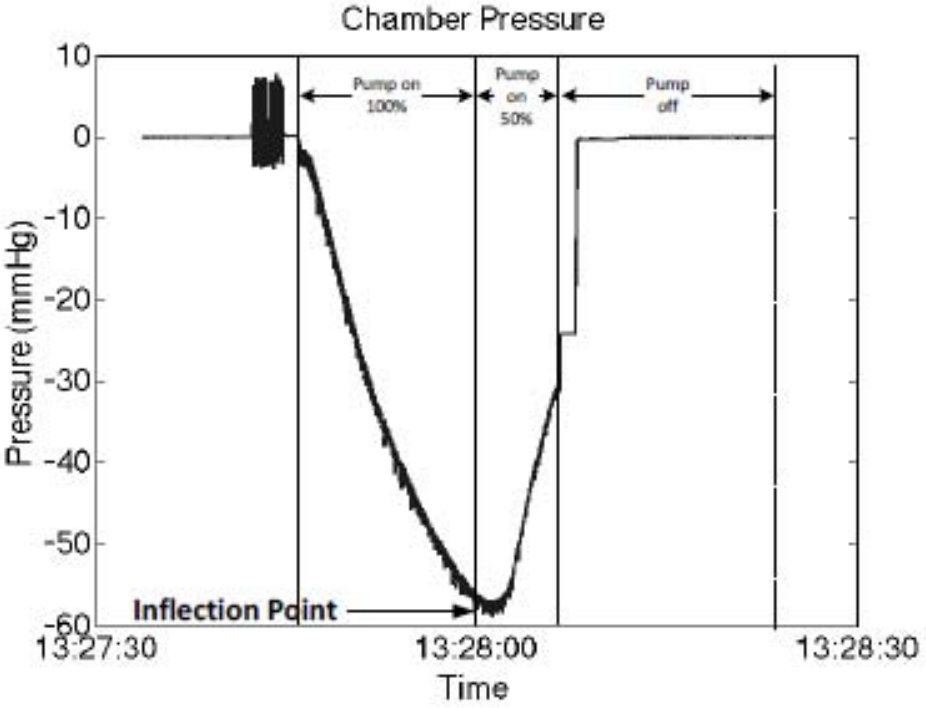

Chamber Pressure
Pump on 100%
Pump on 50%
Pump off
Inflection Point
Pressure (mmHg)
10
0
-10
-20
-30
-40
-50
-60
13:27:30
13:28:00
13:28:30
Time

Fig. 57

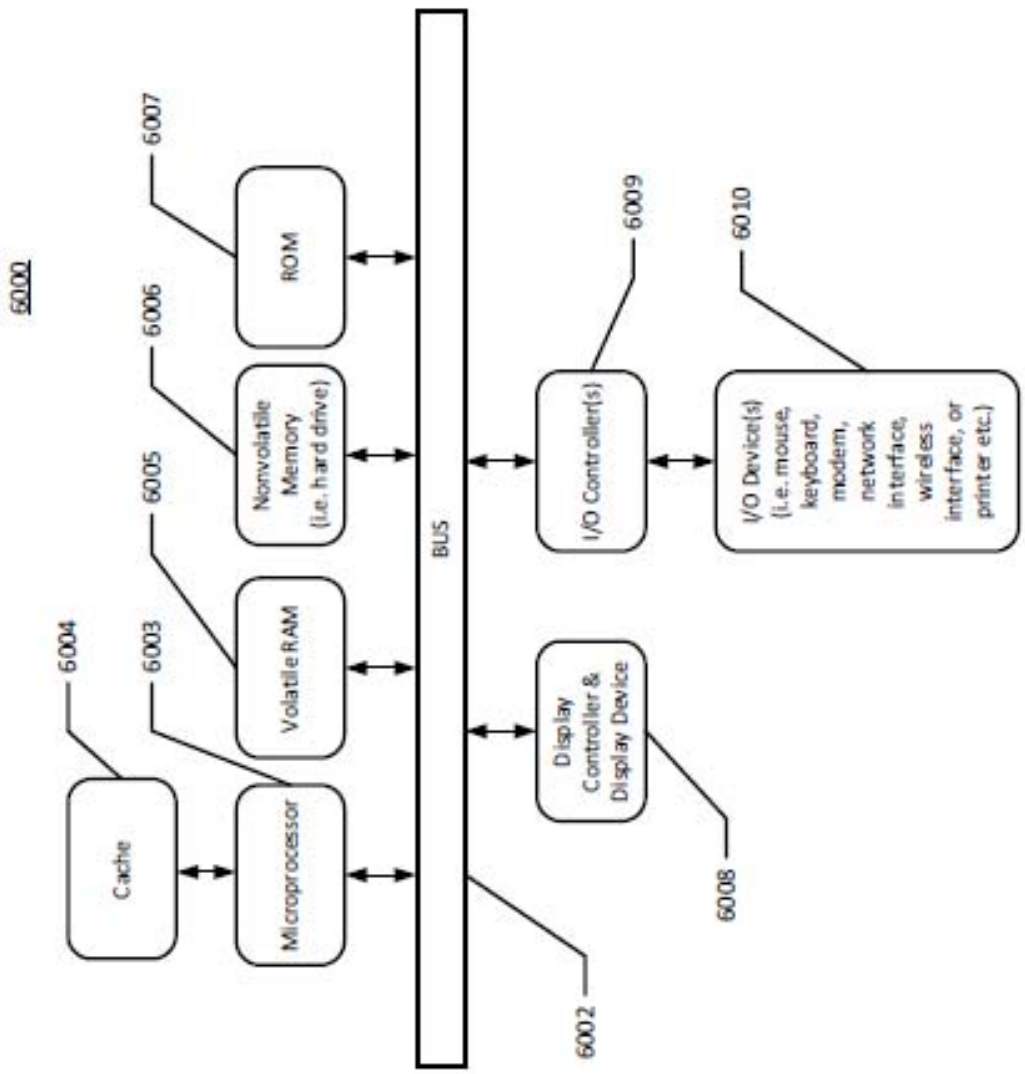

6000
Cache
6004
Microprocessor
6003
Volatile RAM
6005
Nonvolatile Memory (i.e. hard drive)
6006
ROM
6007
BUS
6002
Display Controller & Display Device
6008
I/O Controller(s)
6009
I/O Device(s) (i.e. mouse, keyboard, modem, network interface, wireless interface, or printer etc.)
6010

Fig. 58