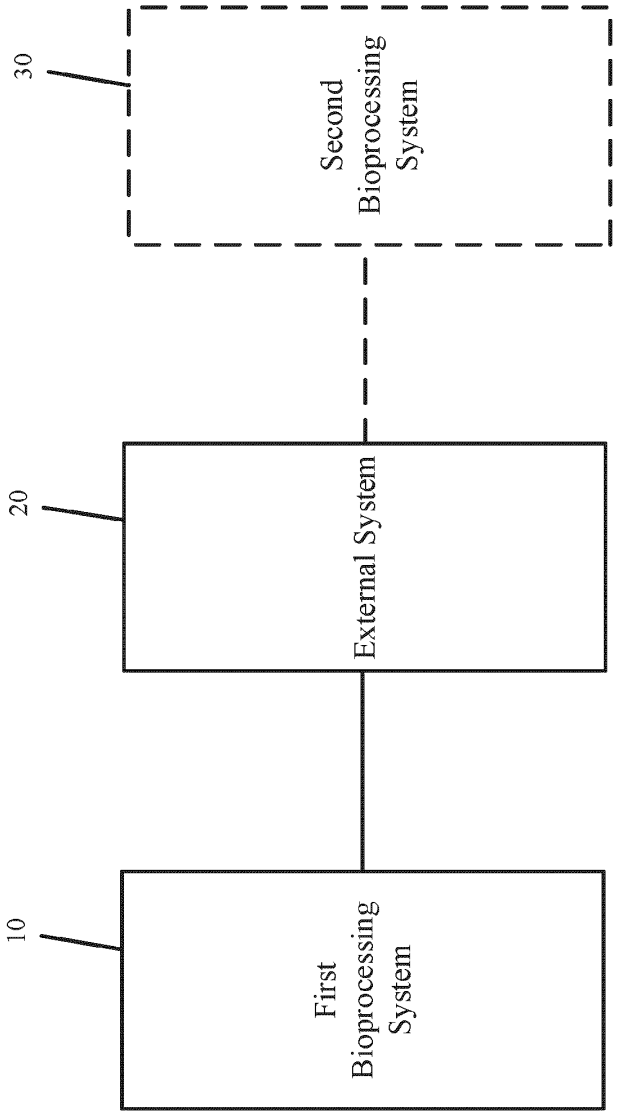

30
Second Bioprocessing System
20
External System
10
First Bioprocessing System

100

FIG. 1A

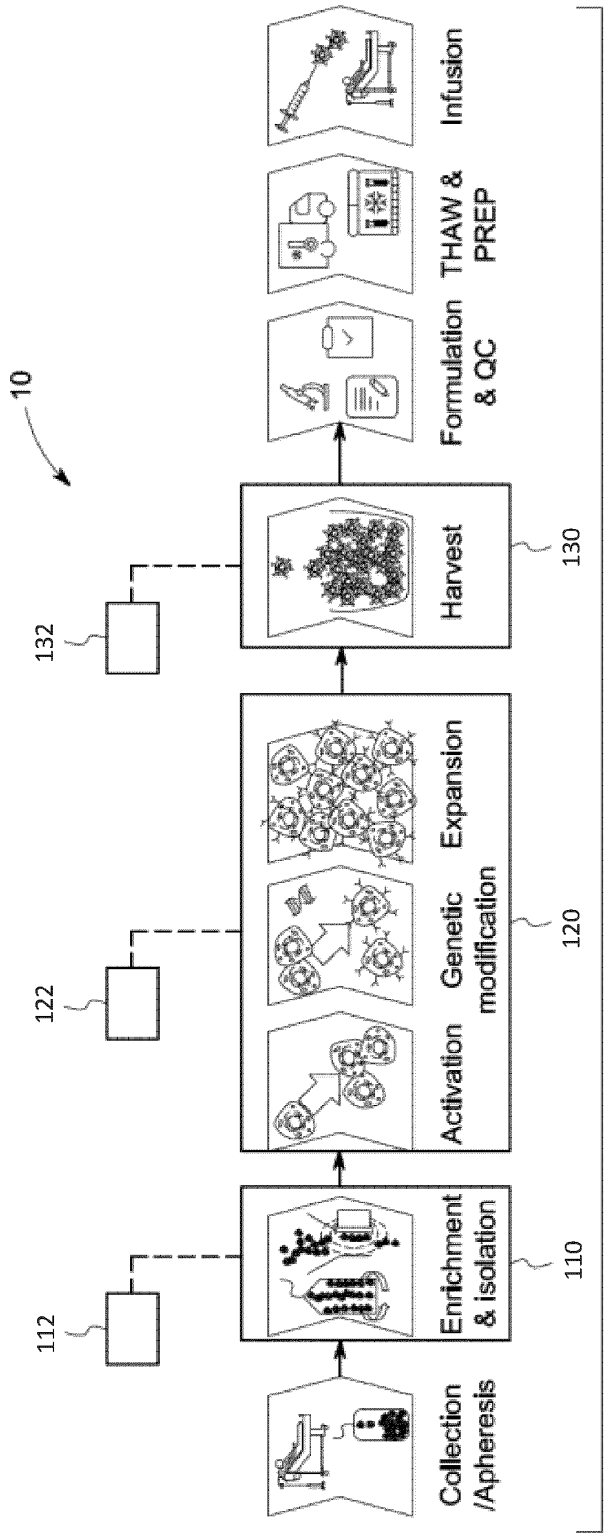
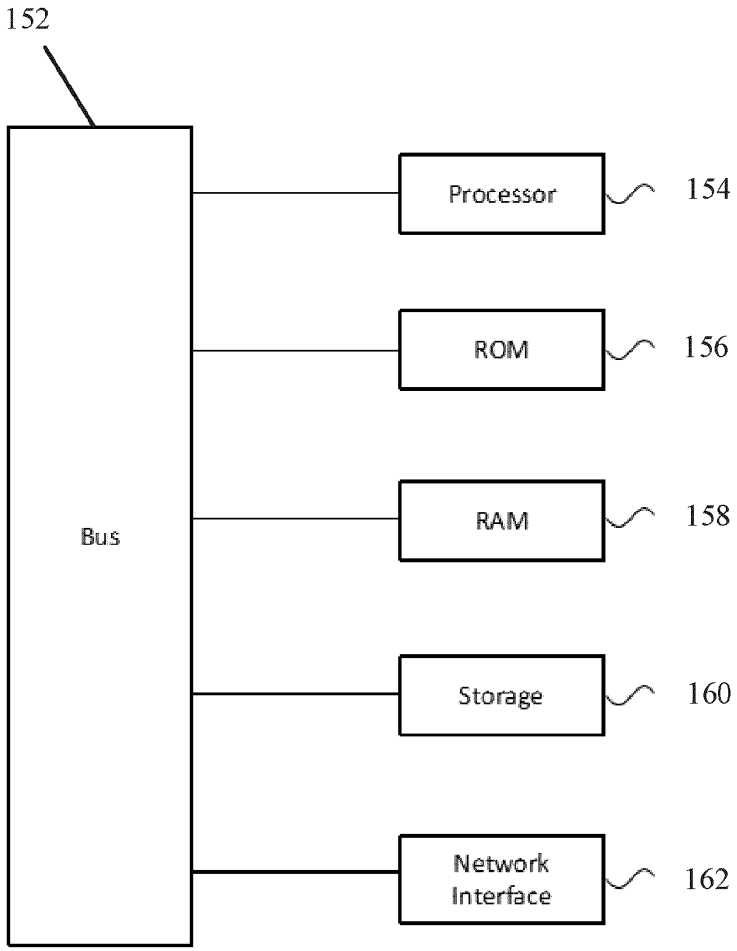
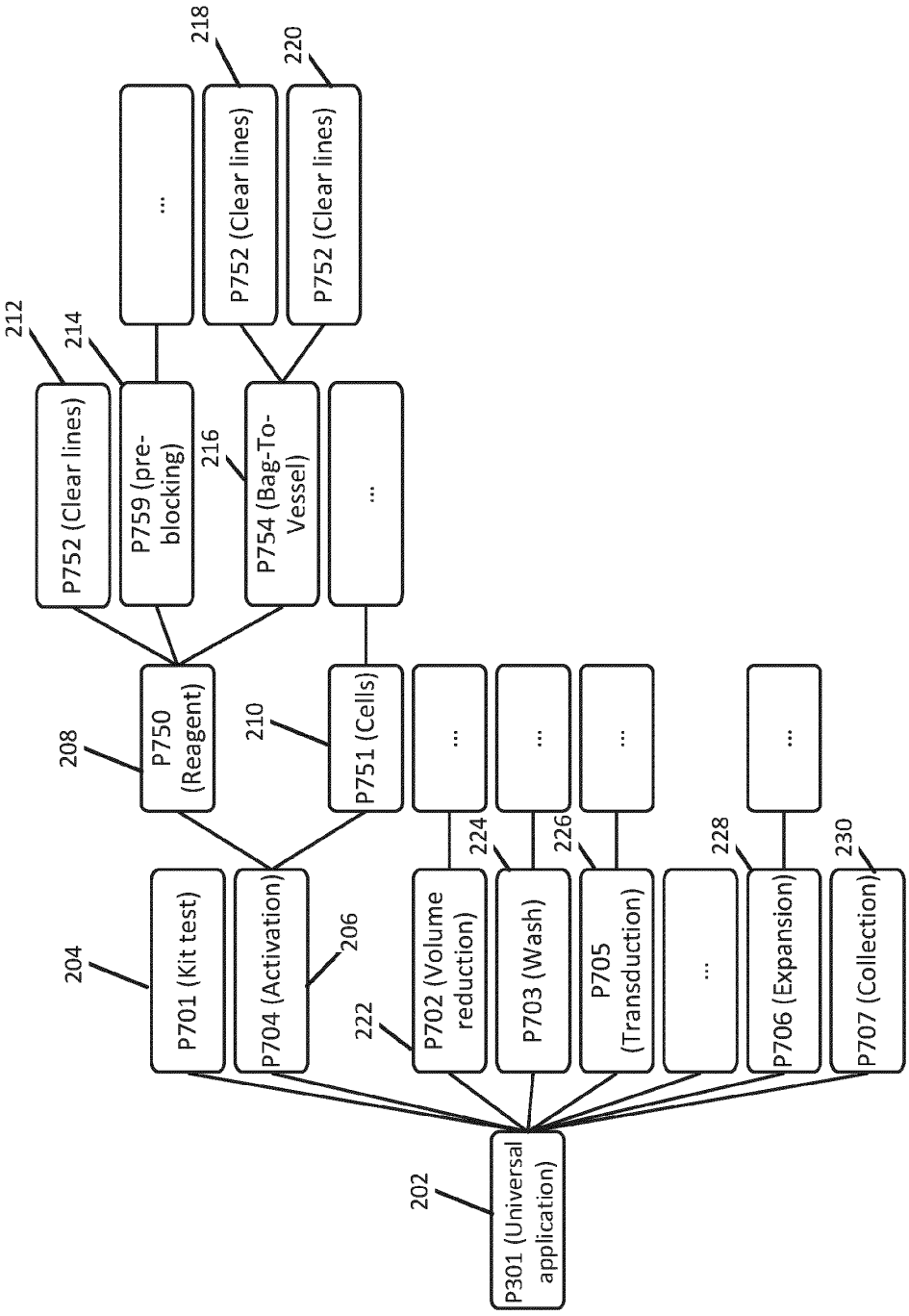

10
112
122
132
Collection /Apheresis
Enrichment & isolation
110
Activation
Genetic modification
Expansion
120
Harvest
130
Formulation & QC
THAW & PREP
Infusion

FIG. 1B


152
Bus
Processor
154
ROM
156
RAM
158
Storage
160
Network Interface
162

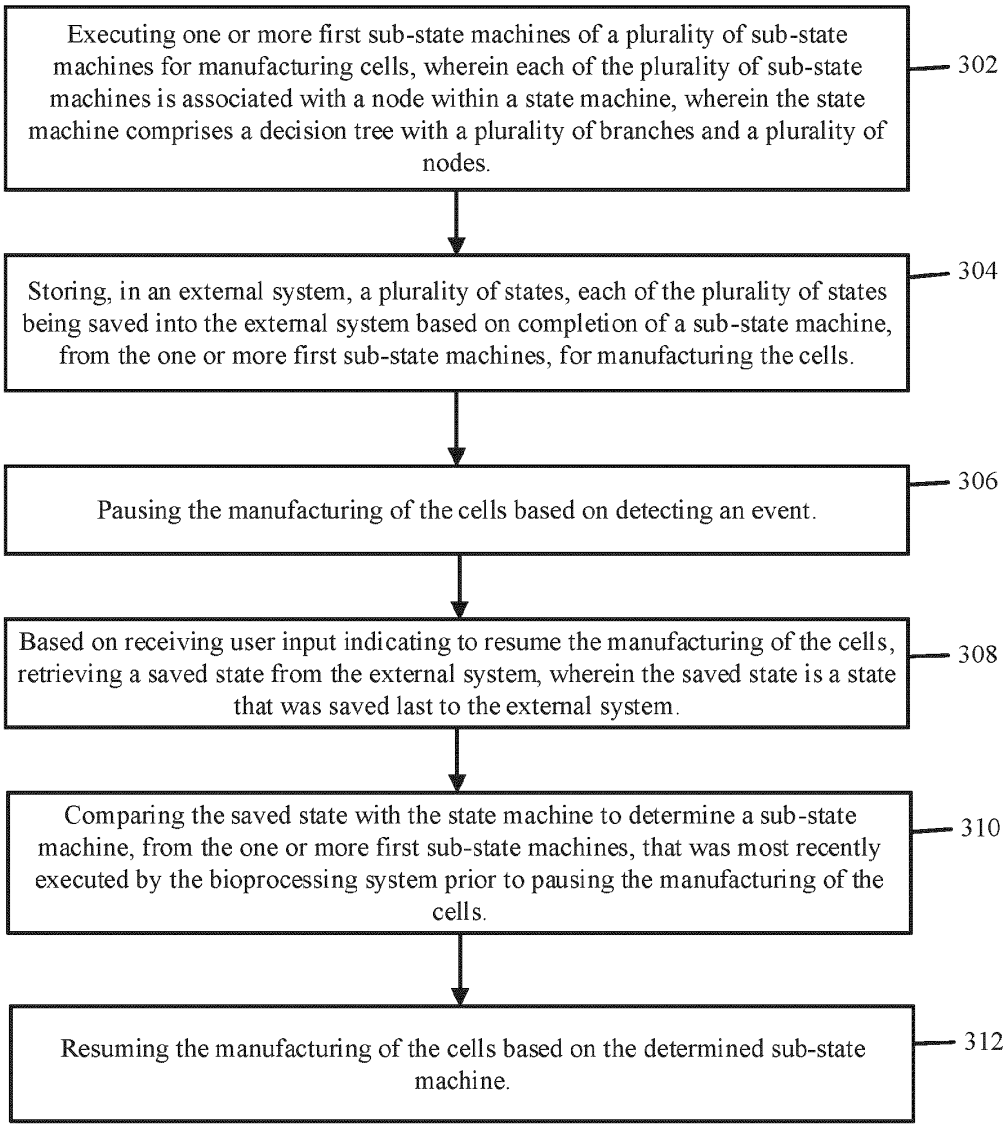
150

FIG. 1C


P301 (Universal application)
202
P701 (Kit test)
204
P704 (Activation)
206
P750 (Reagent)
208
P751 (Cells)
210
P752 (Clear lines)
212
P759 (pre-blocking)
214
P754 (Bag-To-Vessel)
216
...
218
P752 (Clear lines)
220
P752 (Clear lines)
222
P702 (Volume reduction)
224
P703 (Wash)
226
P705 (Transduction)
228
...
P706 (Expansion)
230
P707 (Collection)
...
...
...
...

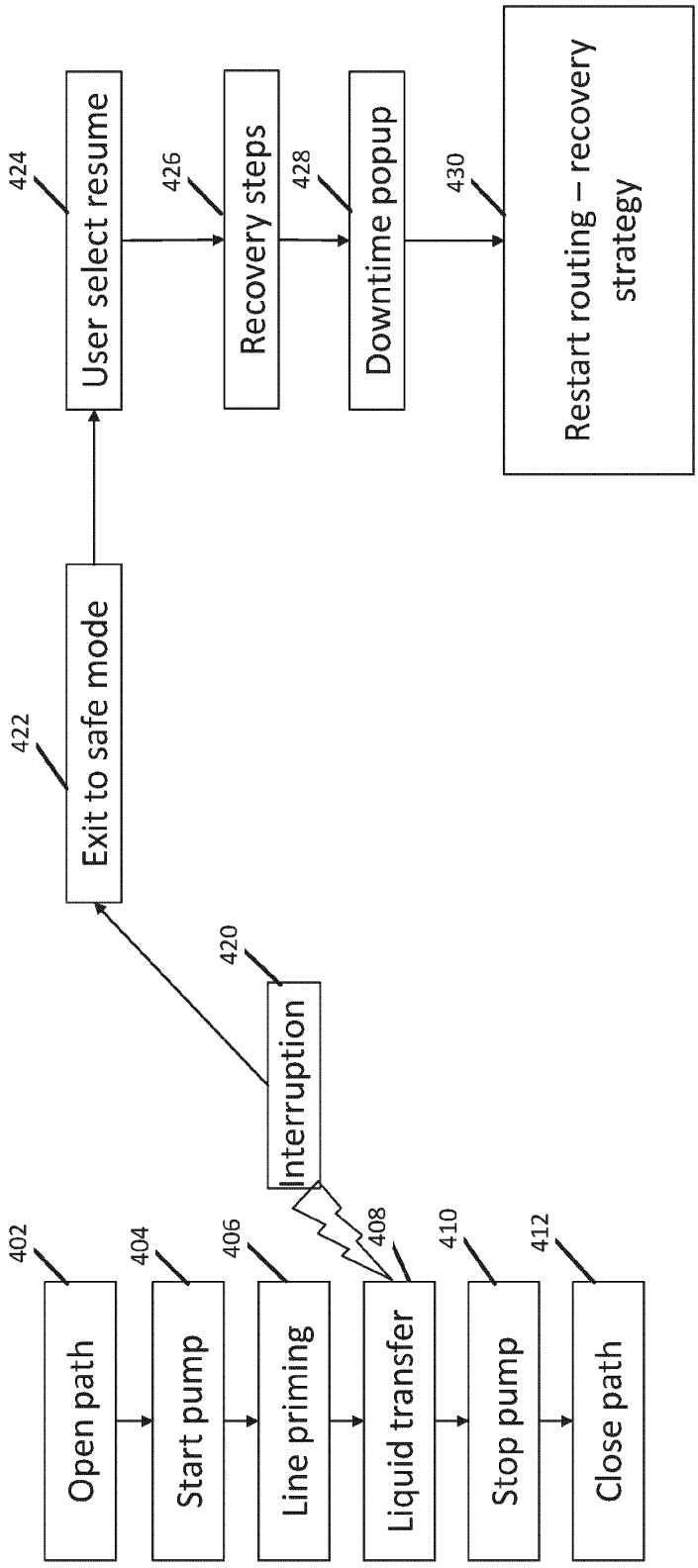
200

FIG. 2


Executing one or more first sub-state machines of a plurality of sub-state machines for manufacturing cells, wherein each of the plurality of sub-state machines is associated with a node within a state machine, wherein the state machine comprises a decision tree with a plurality of branches and a plurality of nodes.
302
Storing, in an external system, a plurality of states, each of the plurality of states being saved into the external system based on completion of a sub-state machine, from the one or more first sub-state machines, for manufacturing the cells.
304
Pausing the manufacturing of the cells based on detecting an event.
306
Based on receiving user input indicating to resume the manufacturing of the cells, retrieving a saved state from the external system, wherein the saved state is a state that was saved last to the external system.
308
Comparing the saved state with the state machine to determine a sub-state machine, from the one or more first sub-state machines, that was most recently executed by the bioprocessing system prior to pausing the manufacturing of the cells.
310
Resuming the manufacturing of the cells based on the determined sub-state machine.
312

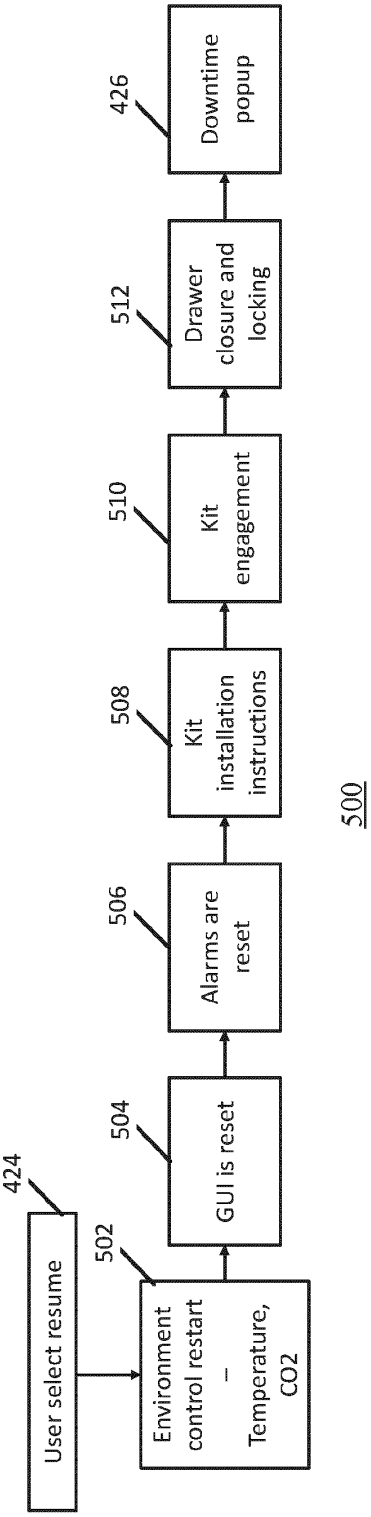
300

FIG. 3


Open path
Start pump
Line priming
Liquid transfer
Stop pump
Close path
402
404
406
408
410
412
Interruption
420
Exit to safe mode
422
User select resume
424
Recovery steps
426
Downtime popup
428
Restart routing – recovery strategy
430

400

FIG. 4


424
User select resume
502
Environment control restart – Temperature, CO2
504
GUI is reset
506
Alarms are reset
508
Kit installation instructions
510
Kit engagement
512
Drawer closure and locking
426
Downtime popup
500

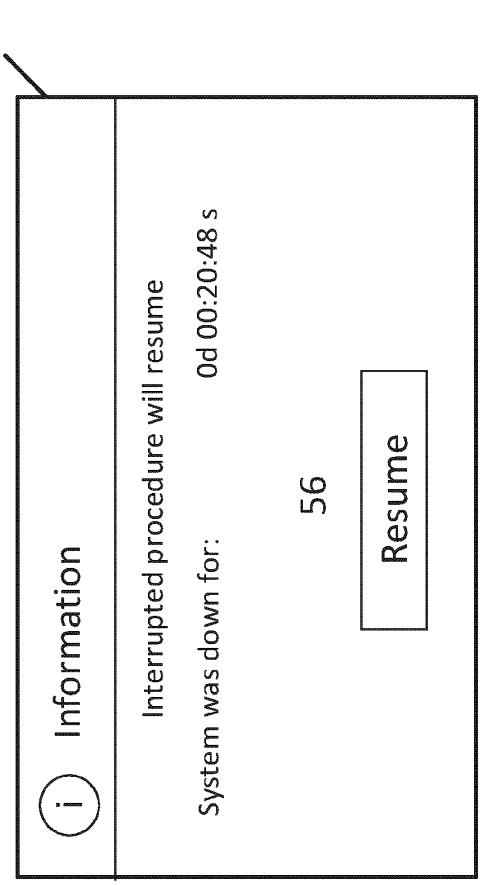
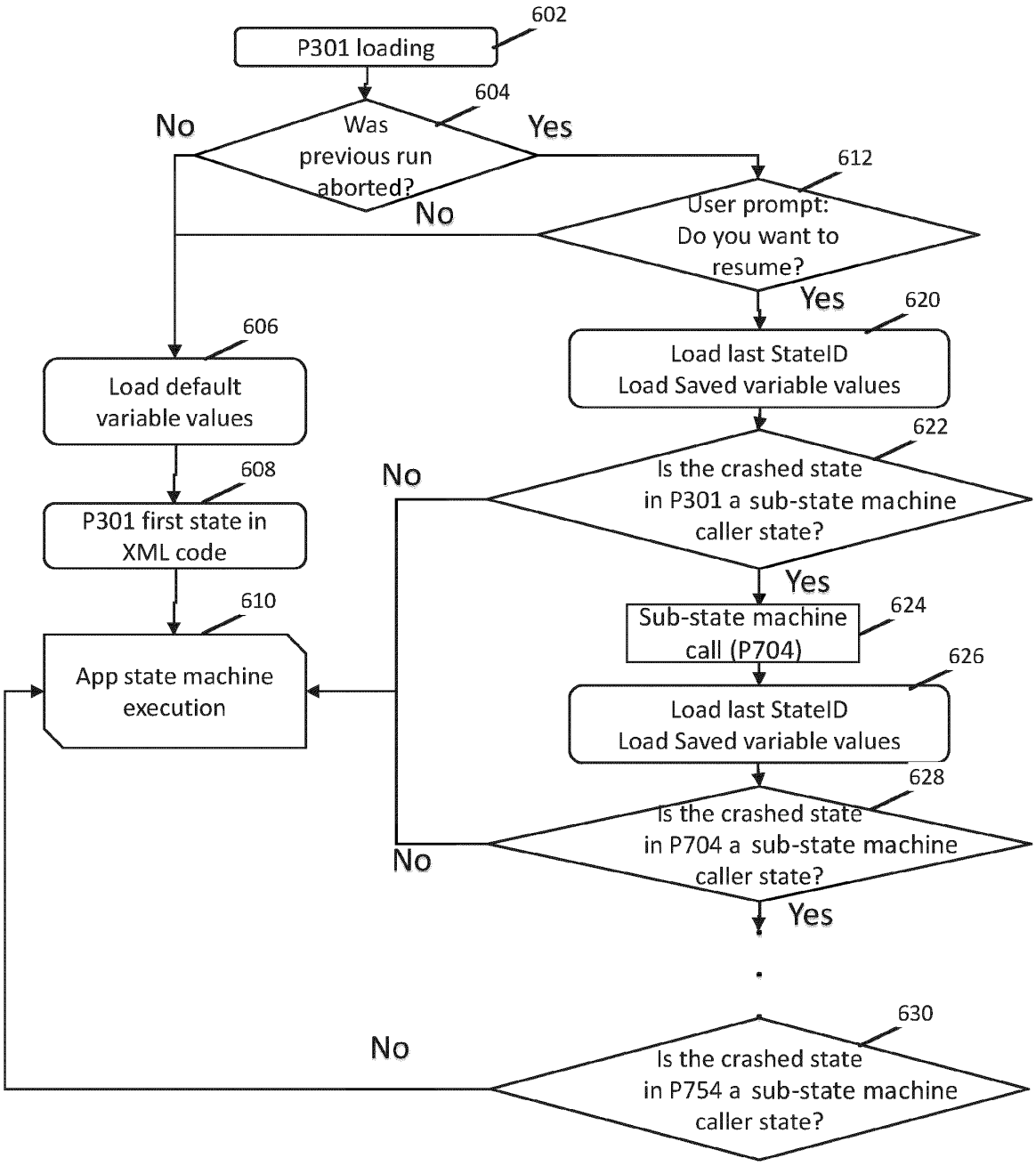

520
Information
Interrupted procedure will resume
System was down for:
0d 00:20:48 s
56
Resume

FIG. 5


602
P301 loading
604
Was previous run aborted?
No
Yes
612
User prompt: Do you want to resume?
No
Yes
620
Load last StateID
Load Saved variable values
606
Load default variable values
608
P301 first state in XML code
610
App state machine execution
622
Is the crashed state in P301 a sub-state machine caller state?
No
Yes
624
Sub-state machine call (P704)
626
Load last StateID
Load Saved variable values
628
Is the crashed state in P704 a sub-state machine caller state?
No
Yes
630
Is the crashed state in P754 a sub-state machine caller state?
No

600

FIG. 6

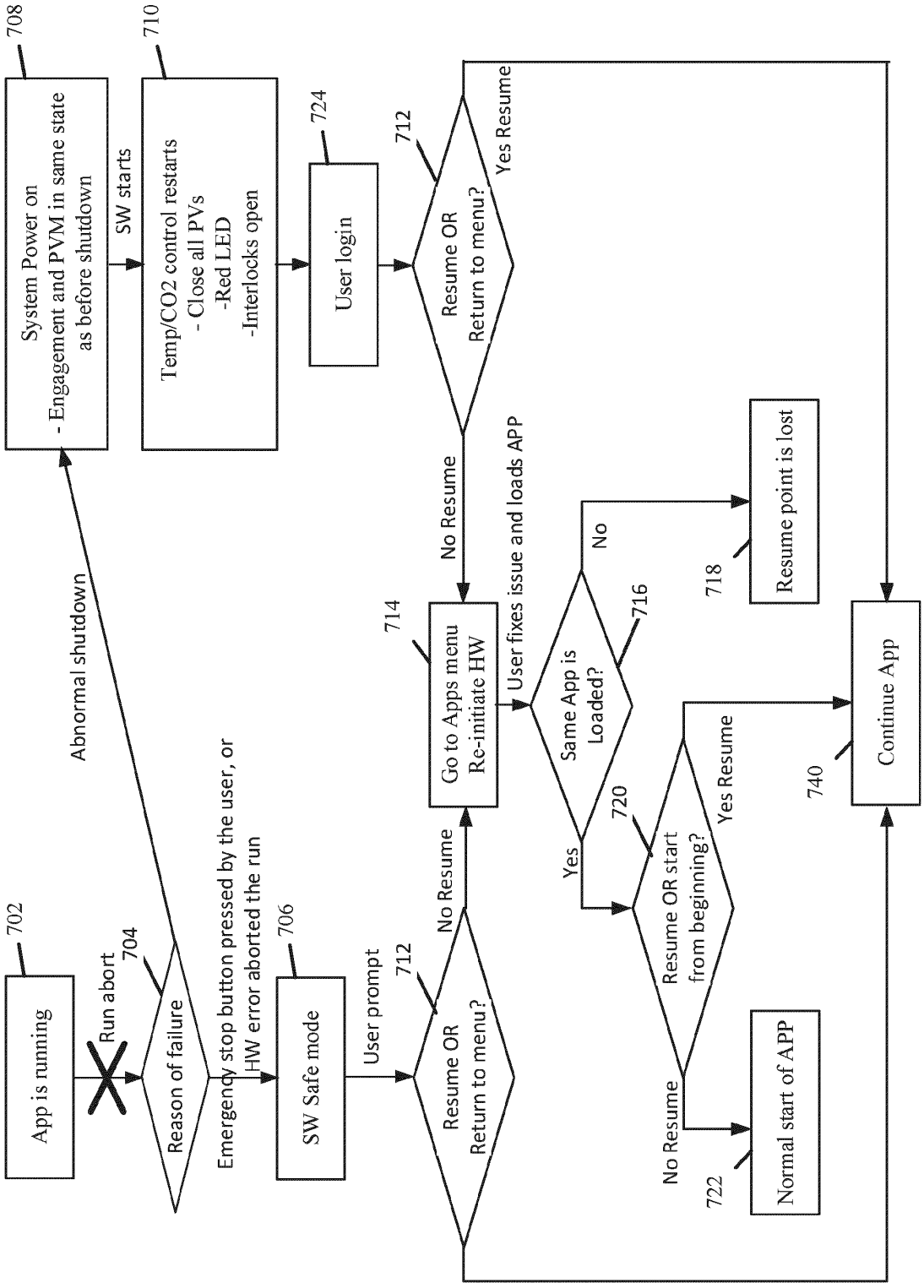
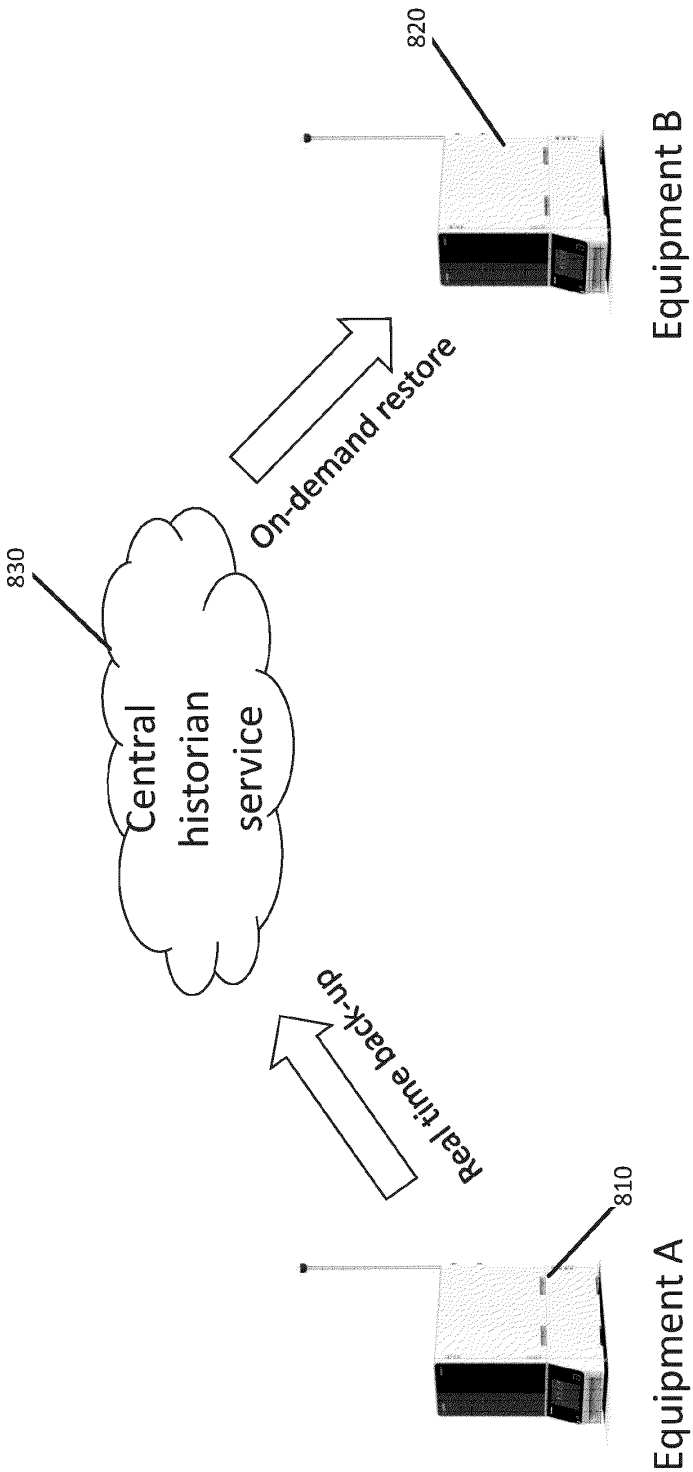

App is running
Run abort
Reason of failure
Abnormal shutdown
Emergency stop button pressed by the user, or
HW error aborted the run
SW Safe mode
User prompt
Resume OR
Return to menu?
No Resume
Yes Resume
Go to Apps menu
Re-initiate HW
User fixes issue and loads APP
Same App is
Loaded?
No
Yes
Resume point is lost
Resume OR start
from beginning?
Yes Resume
No Resume
Normal start of APP
Continue App
System Power on
- Engagement and PVM in same state
as before shutdown
SW starts
Temp/CO2 control restarts
- Close all PVs
-Red LED
-Interlocks open
User login
Resume OR
Return to menu?
Yes Resume
No Resume
702
704
706
708
710
712
714
716
718
720
722
724
740
700

FIG. 7


820
Equipment B
On-demand restore
830
Central historian service
Real time back-up
810
Equipment A

800

FIG. 8A

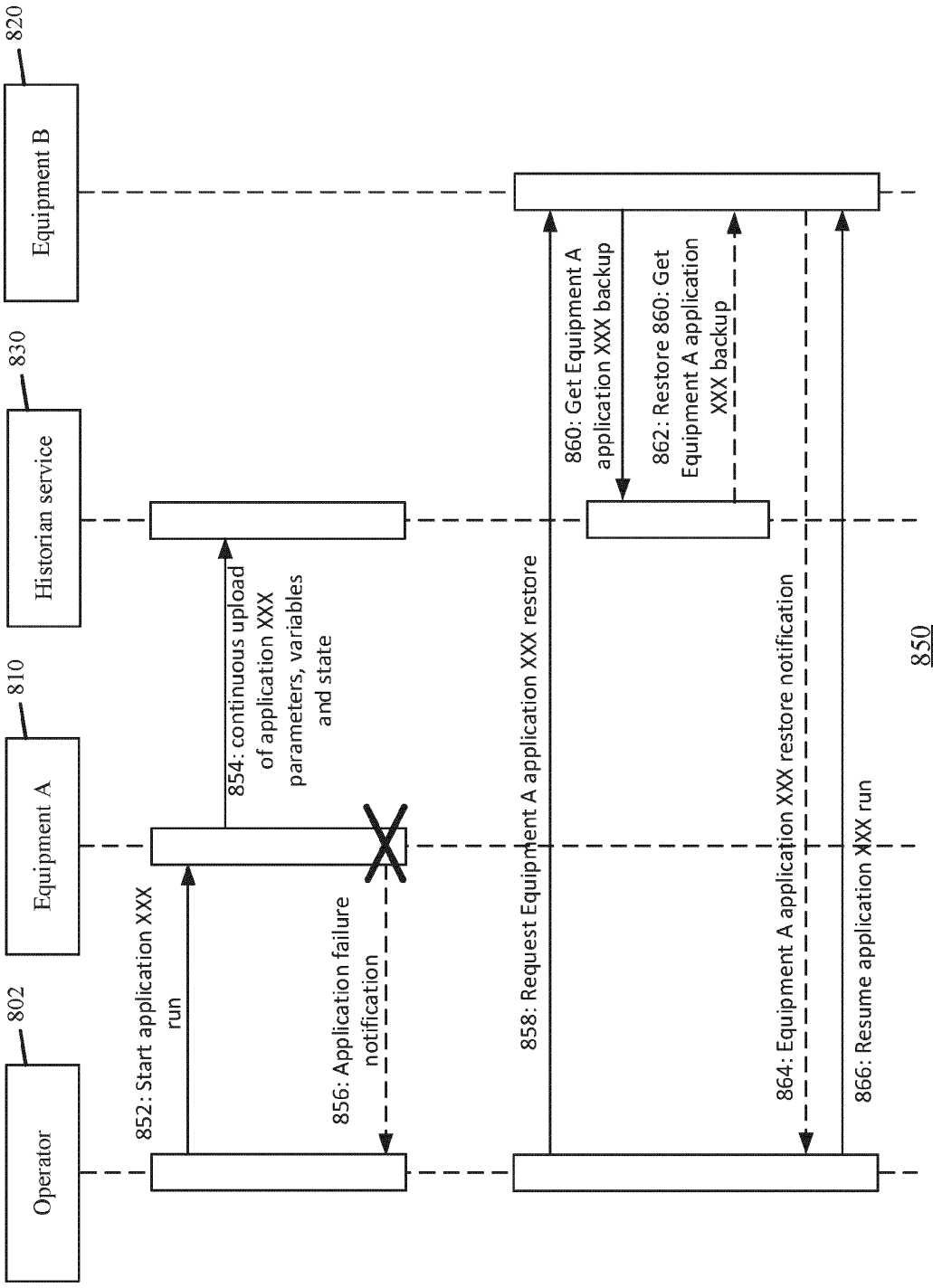
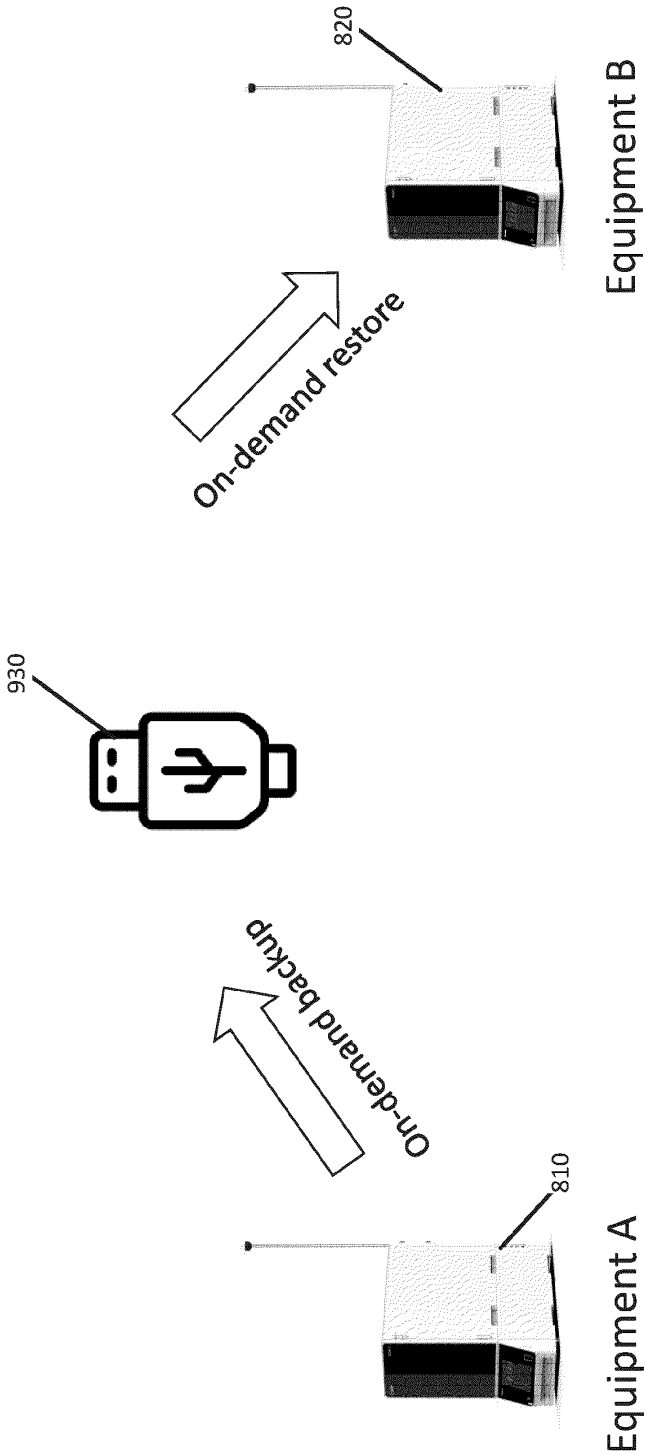

820
Equipment B
830
Historian service
810
Equipment A
802
Operator
852: Start application XXX run
854: continuous upload of application XXX parameters, variables and state
856: Application failure notification
858: Request Equipment A application XXX restore
860: Get Equipment A application XXX backup
862: Restore 860: Get Equipment A application XXX backup
864: Equipment A application XXX restore notification
866: Resume application XXX run
850

FIG. 8B


820
Equipment B
On-demand restore
930
On-demand backup
810
Equipment A

900

FIG. 9A

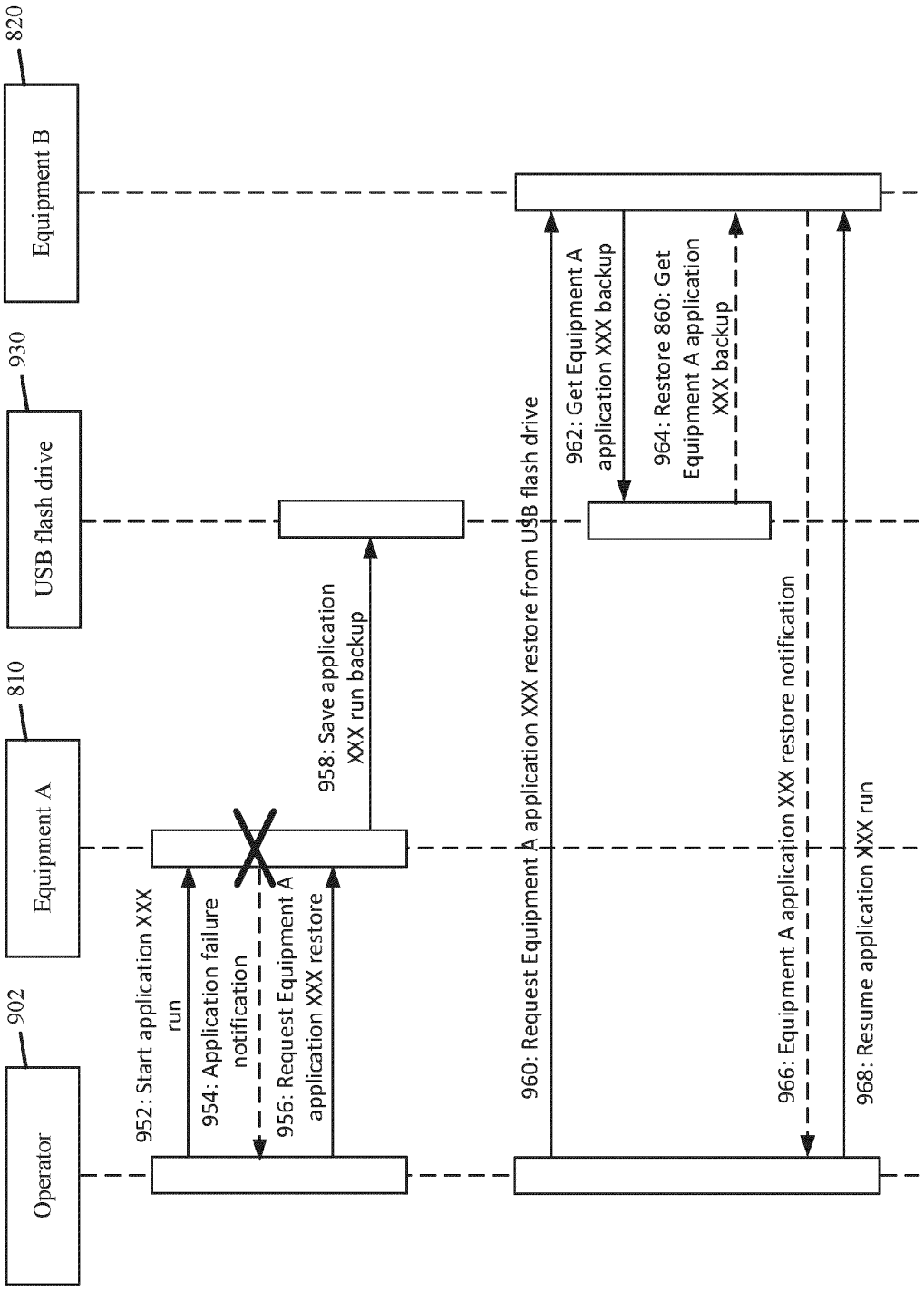

820
Equipment B
930
USB flash drive
810
Equipment A
902
Operator
952: Start application XXX run
954: Application failure notification
956: Request Equipment A application XXX restore
958: Save application XXX run backup
960: Request Equipment A application XXX restore from USB flash drive
962: Get Equipment A application XXX backup
964: Restore 860: Get Equipment A application XXX backup
966: Equipment A application XXX restore notification
968: Resume application XXX run
950

FIG. 9B