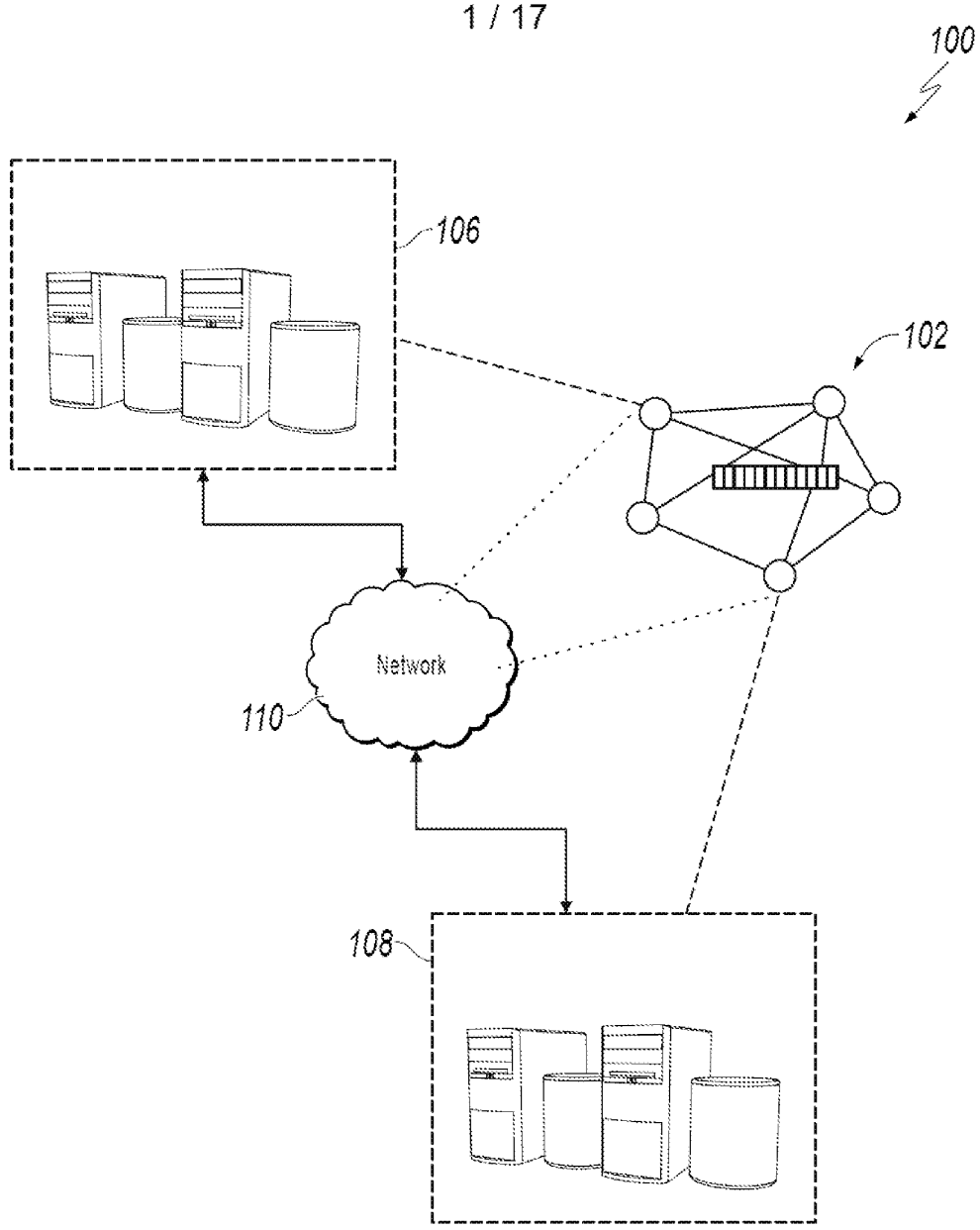

FIG. 1

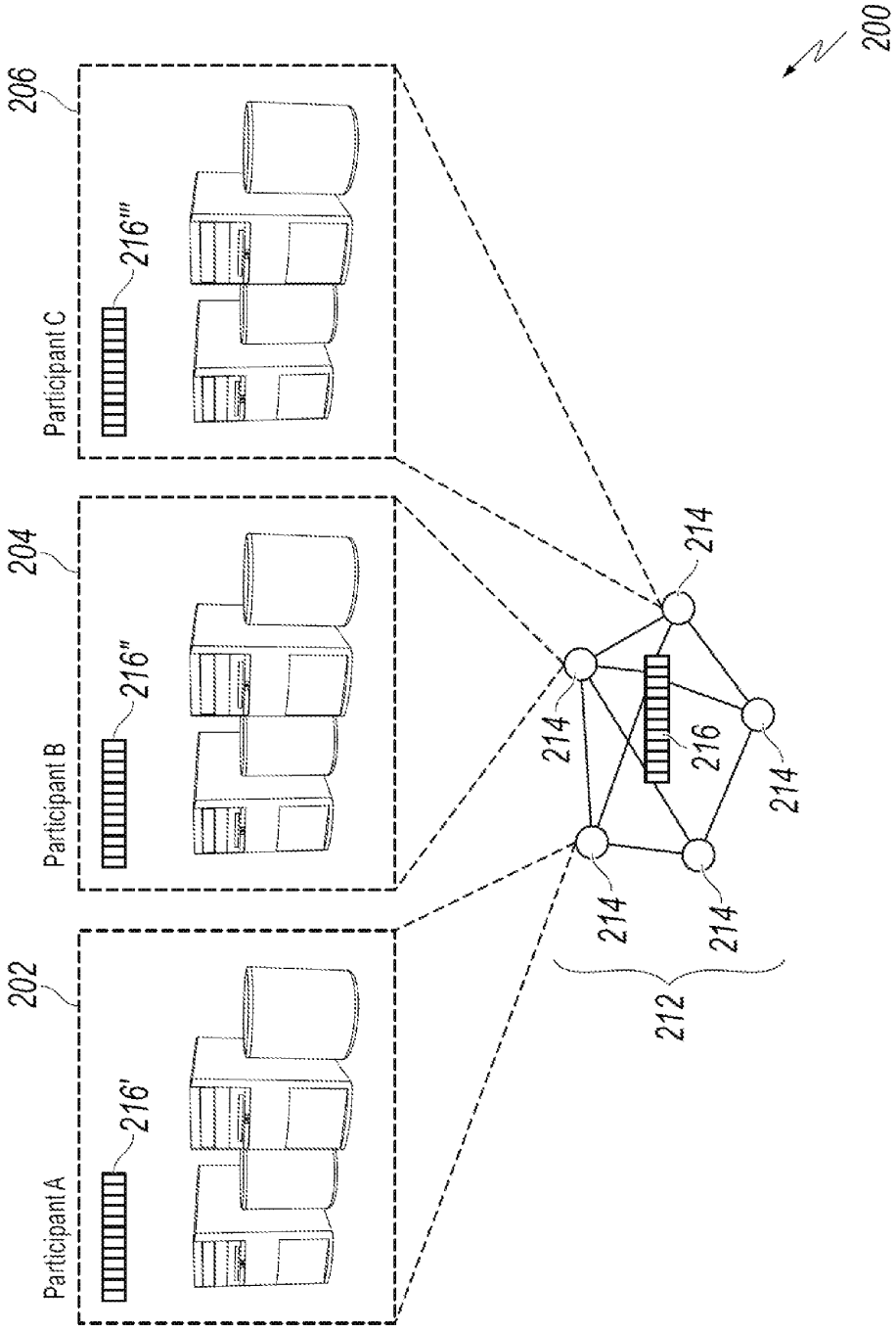
200
206
216'''
Participant C
204
216''
Participant B
202
216'
Participant A
214
214
216
214
214
214
212

FIG. 2

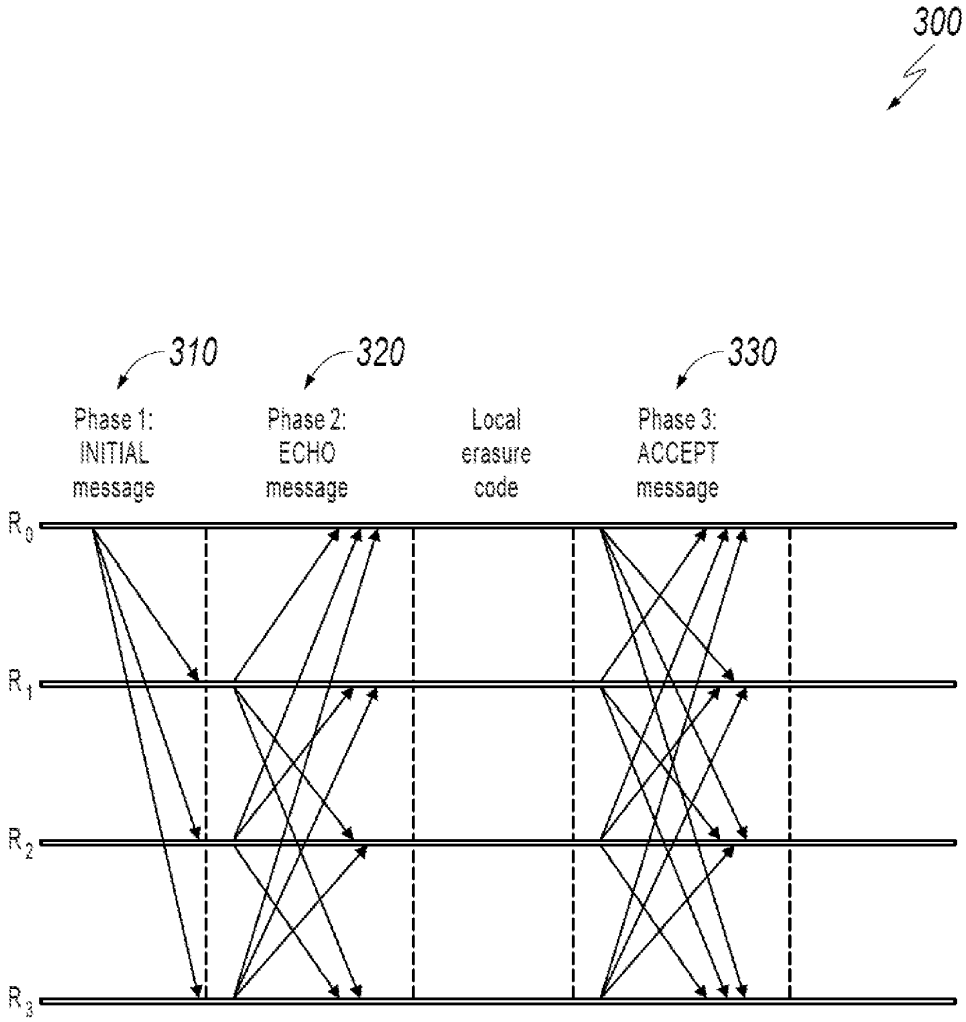
300
310
320
330
Phase 1: INITIAL message
Phase 2: ECHO message
Local erasure code
Phase 3: ACCEPT message
R_0
R_1
R_2
R_3

FIG. 3

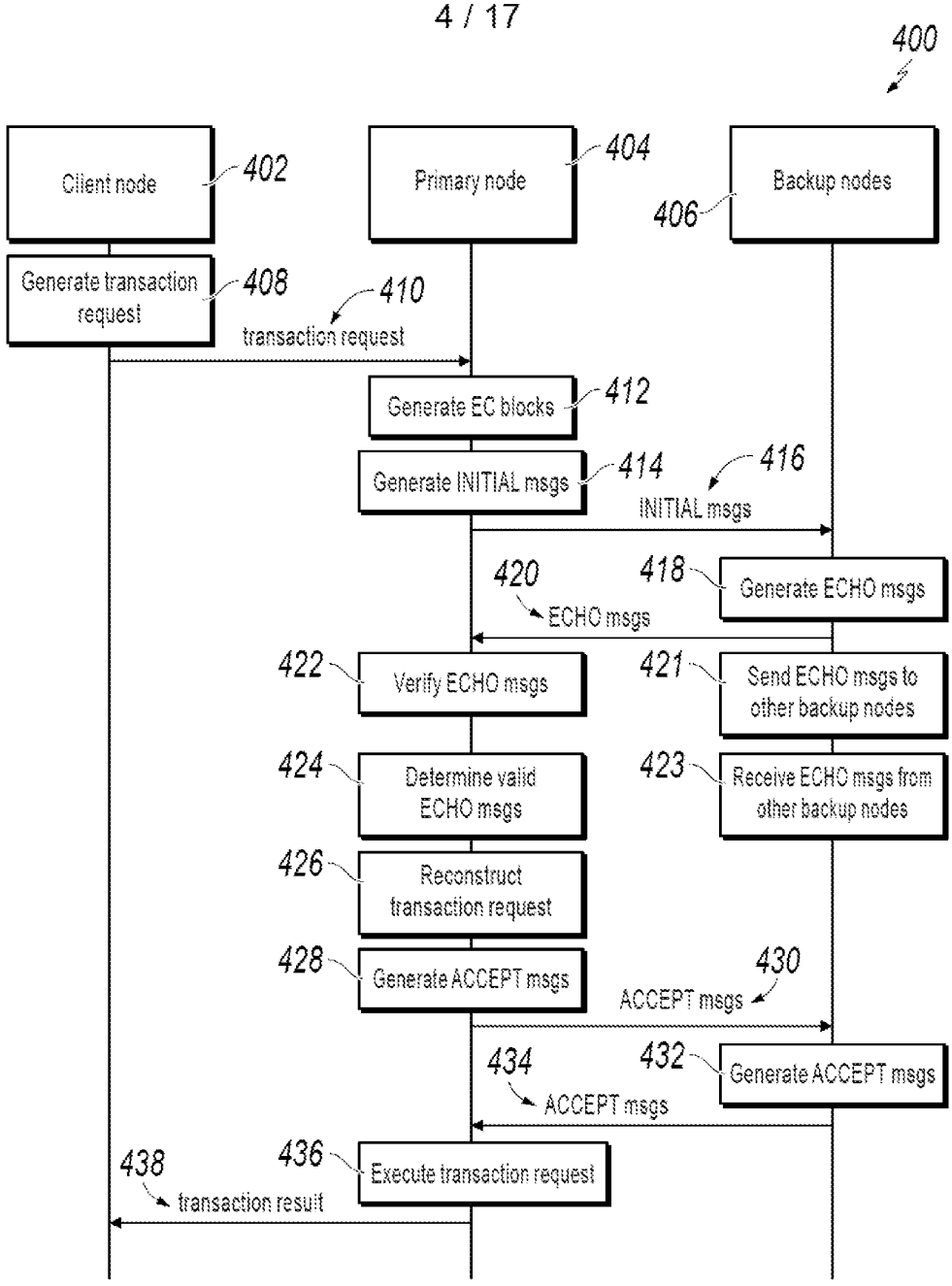
400
Client node
402
Primary node
404
Backup nodes
406
Generate transaction request
408
410
transaction request
Generate EC blocks
412
Generate INITIAL msgs
414
416
INITIAL msgs
420
ECHO msgs
418
Generate ECHO msgs
422
Verify ECHO msgs
421
Send ECHO msgs to other backup nodes
424
Determine valid ECHO msgs
423
Receive ECHO msgs from other backup nodes
426
Reconstruct transaction request
428
Generate ACCEPT msgs
430
ACCEPT msgs
434
ACCEPT msgs
432
Generate ACCEPT msgs
438
transaction result
436
Execute transaction request

FIG. 4

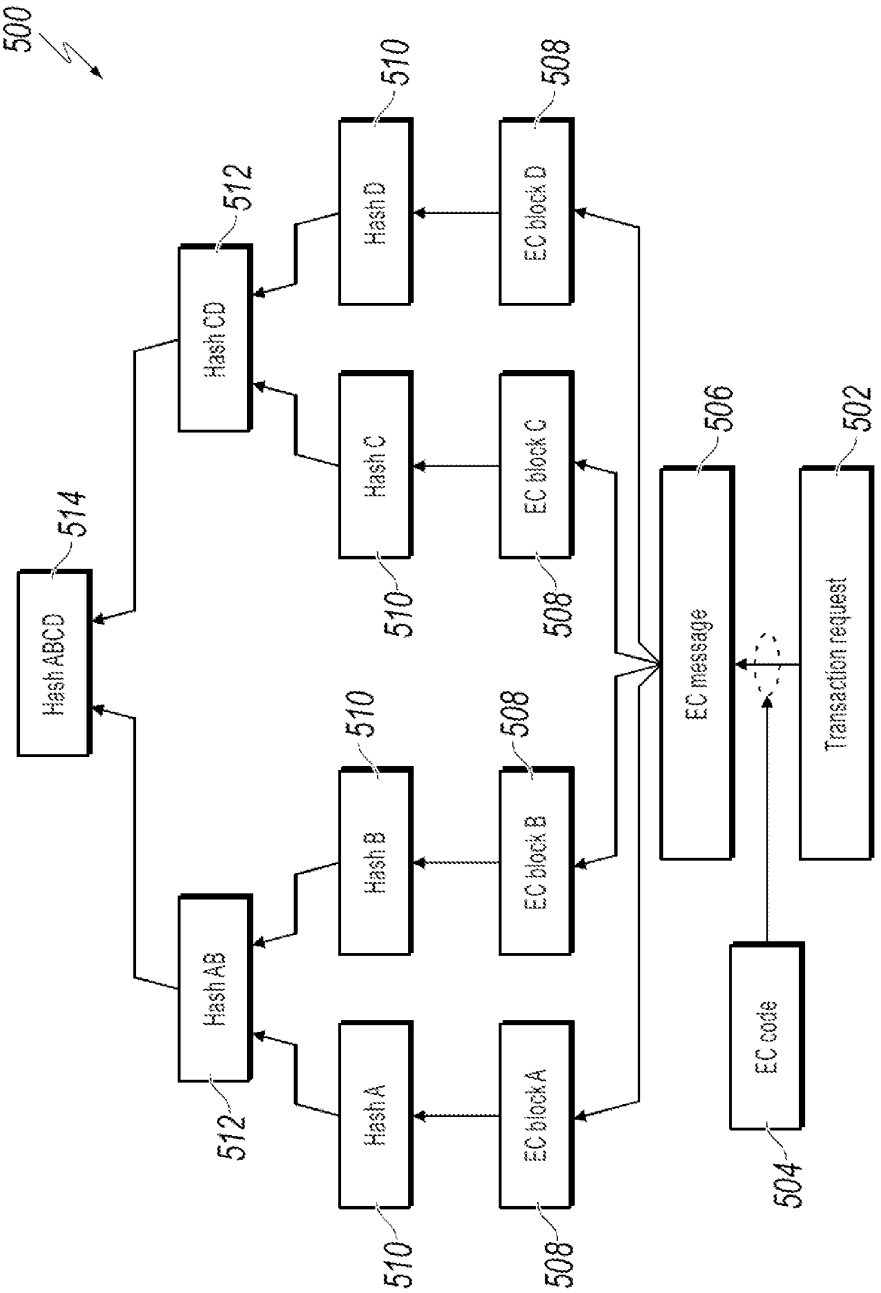
500
Hash ABCD
514
Hash CD
512
Hash AB
512
Hash D
510
Hash C
510
Hash B
510
Hash A
510
EC block D
508
EC block C
508
EC block B
508
EC block A
508
EC message
506
Transaction request
502
EC code
504

FIG. 5

Initial<epoch, tx_root_hash, ec_block_hash, ec_block, seq, j>
Echo<epoch, tx_root_hash, ec_block_hash, ec_block, seq, sign_proof, j>
Accept<epoch, tx_root_hash, seq, sign_proofs, j>

FIG. 6


700

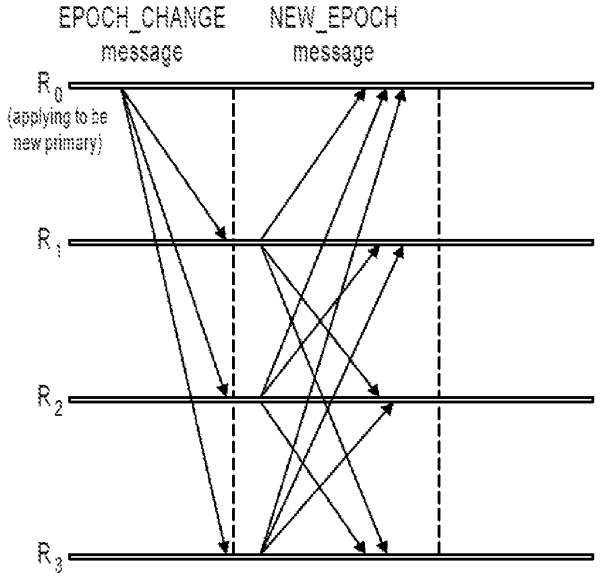
EPOCH_CHANGE message
NEW_EPOCH message
R0
(applying to be new primary)
R1
R2
R3

FIG. 7

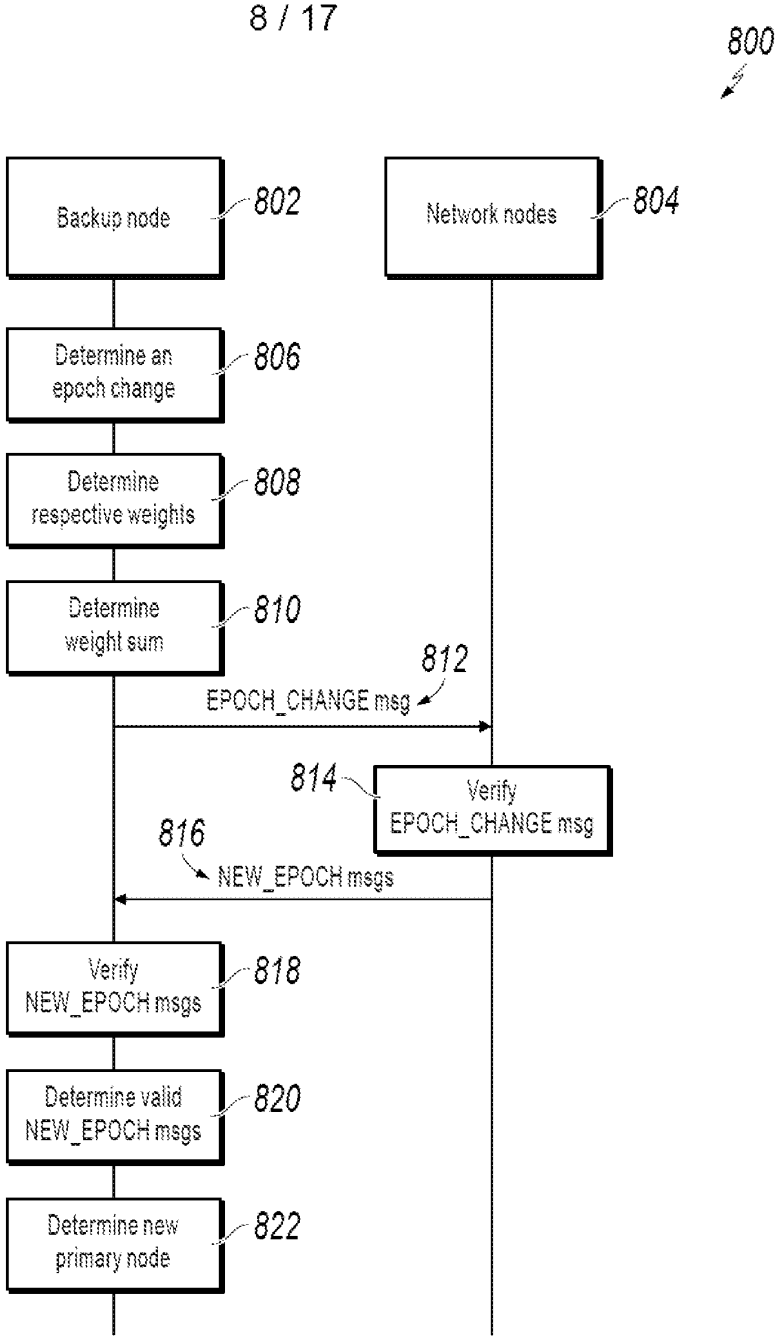
800
Backup node
802
Network nodes
804
Determine an epoch change
806
Determine respective weights
808
Determine weight sum
810
812
EPOCH_CHANGE msg
814
Verify EPOCH_CHANGE msg
816
NEW_EPOCH msgs
Verify NEW_EPOCH msgs
818
Determine valid NEW_EPOCH msgs
820
Determine new primary node
822

FIG. 8

Epoch_change <weight, epoch+1, Echo{}, Accept{}, j>
Echo {<epoch, seq, sign_proof, j>}
Accept {<epoch, tx_root_hash, sign_proofs, seq, j>}
New_epoch <epoch+1, i, j, seq, ec_digest>

FIG. 9

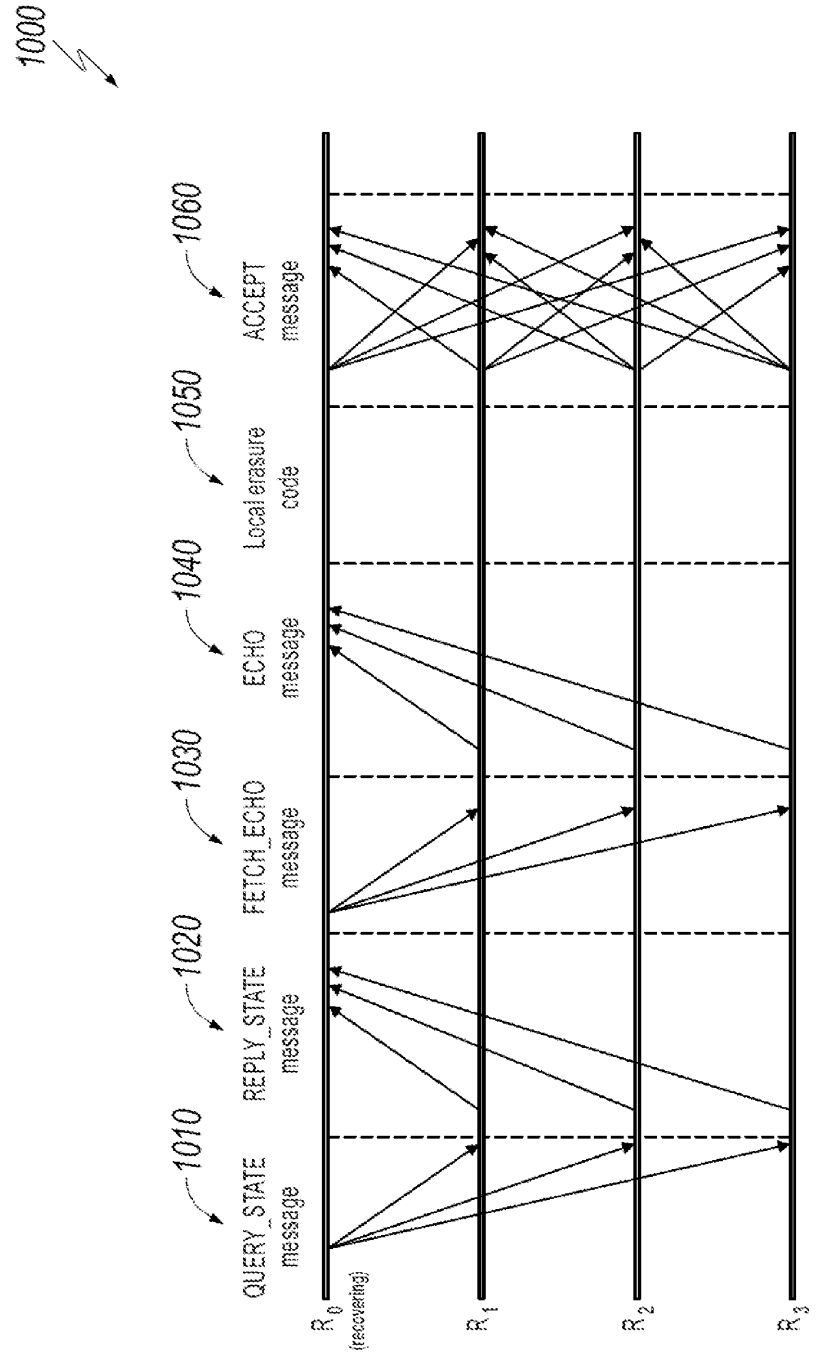
1000
1010
QUERY_STATE message
1020
REPLY_STATE message
1030
FETCH_ECHO message
1040
ECHO message
1050
Local erasure code
1060
ACCEPT message
R0 (recovering)
R1
R2
R3

FIG. 10

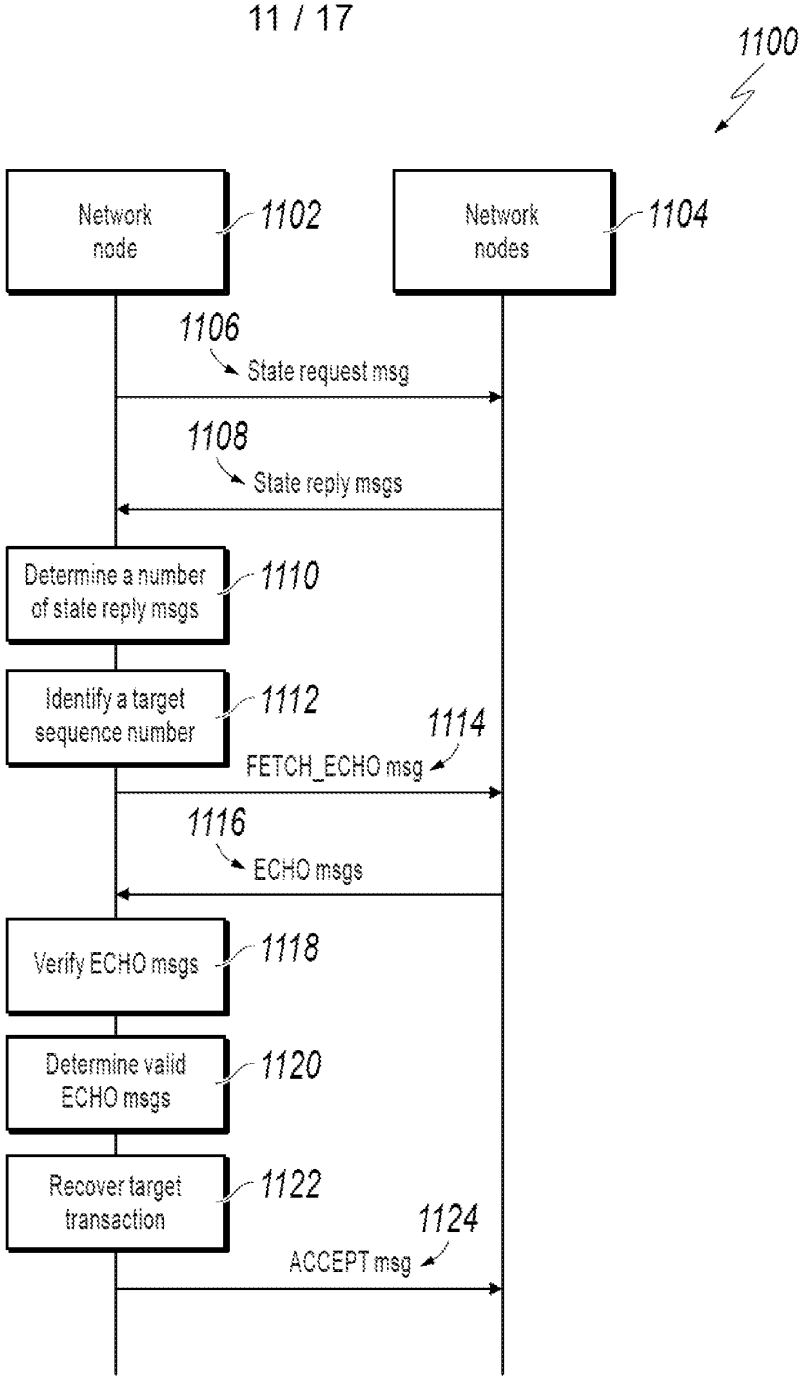
1100
Network node
1102
Network nodes
1104
1106
State request msg
1108
State reply msgs
Determine a number of state reply msgs
1110
Identify a target sequence number
1112
1114
FETCH_ECHO msg
1116
ECHO msgs
Verify ECHO msgs
1118
Determine valid ECHO msgs
1120
Recover target transaction
1122
1124
ACCEPT msg

FIG. 11

Query_state <j, seq>
Reply_state <j, last_seq>
Fetch_echo <j, last_seq+1>

FIG. 12

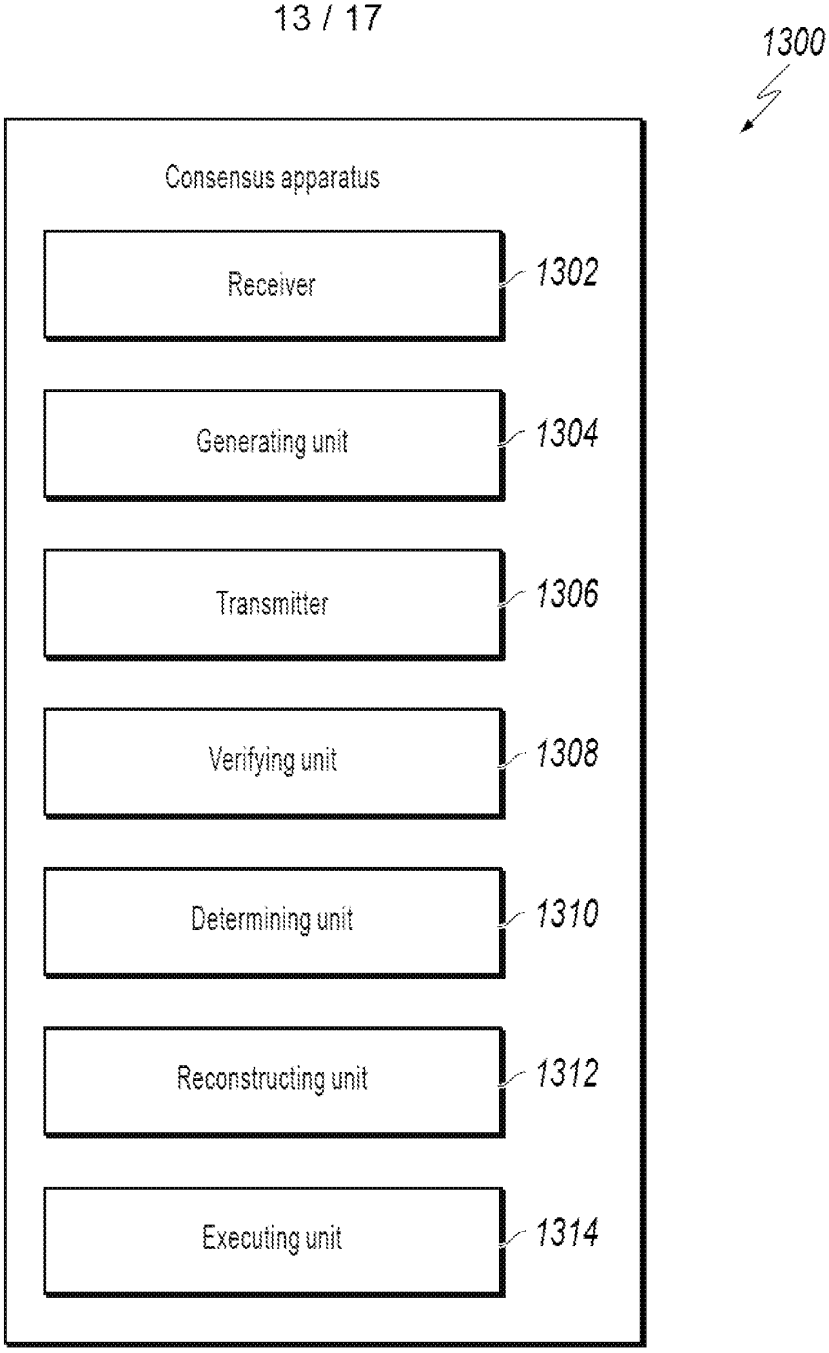
1300
Consensus apparatus
Receiver
1302
Generating unit
1304
Transmitter
1306
Verifying unit
1308
Determining unit
1310
Reconstructing unit
1312
Executing unit
1314

FIG. 13

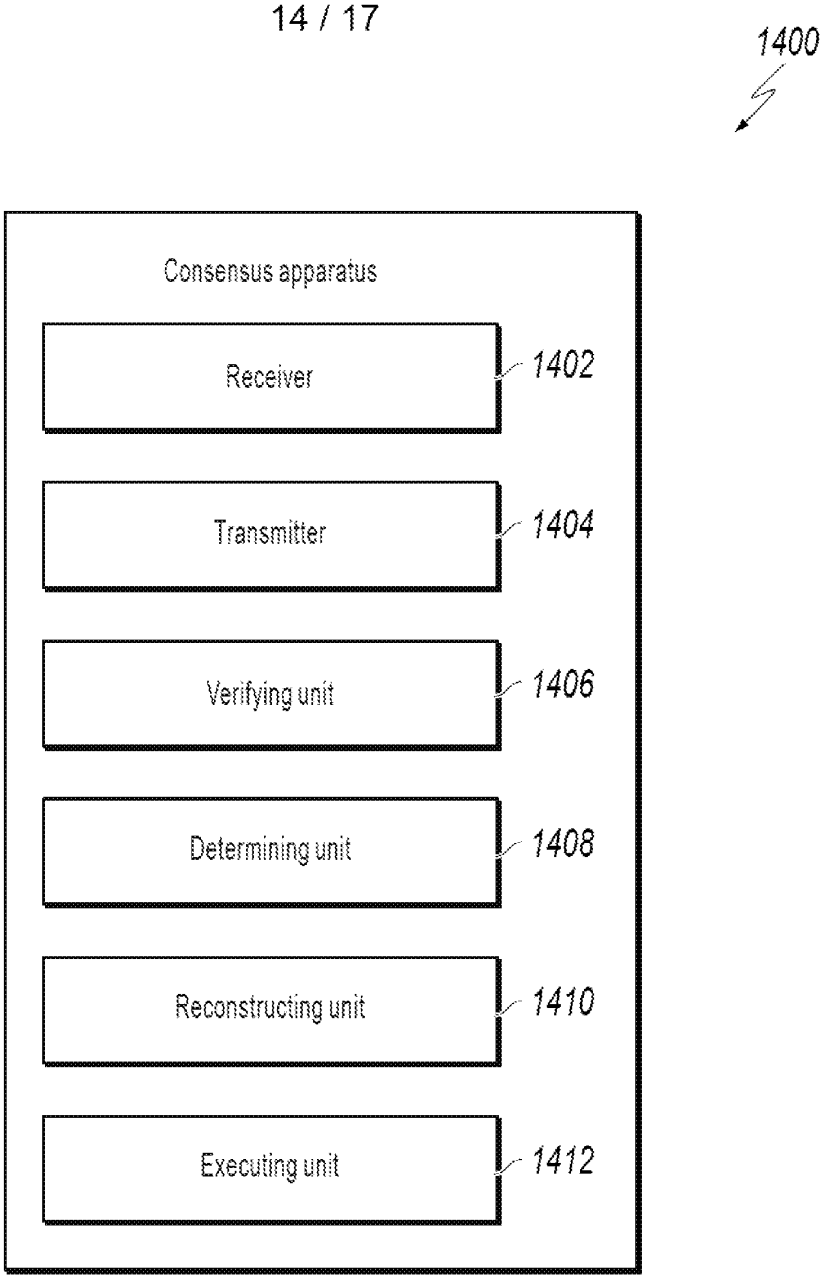
1400
Consensus apparatus
Receiver
1402
Transmitter
1404
Verifying unit
1406
Determining unit
1408
Reconstructing unit
1410
Executing unit
1412

FIG. 14

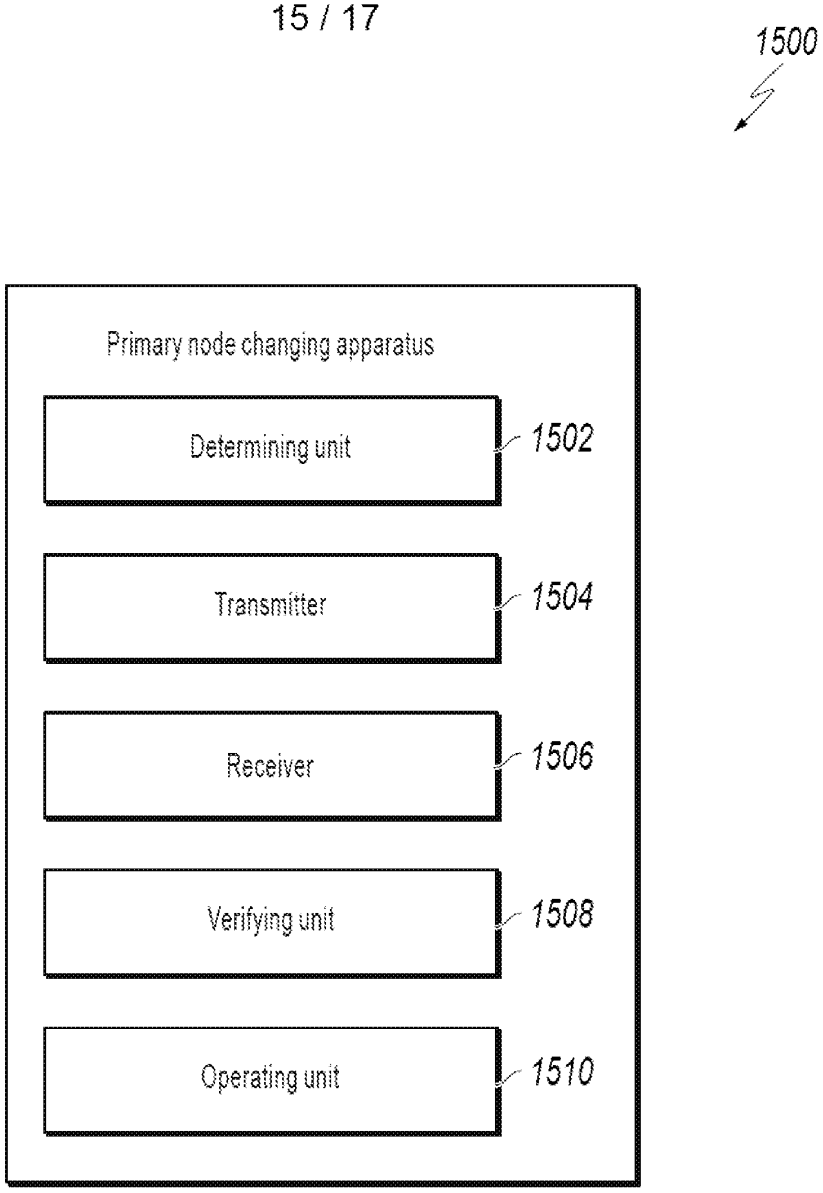
1500
Primary node changing apparatus
Determining unit
1502
Transmitter
1504
Receiver
1506
Verifying unit
1508
Operating unit
1510

FIG. 15

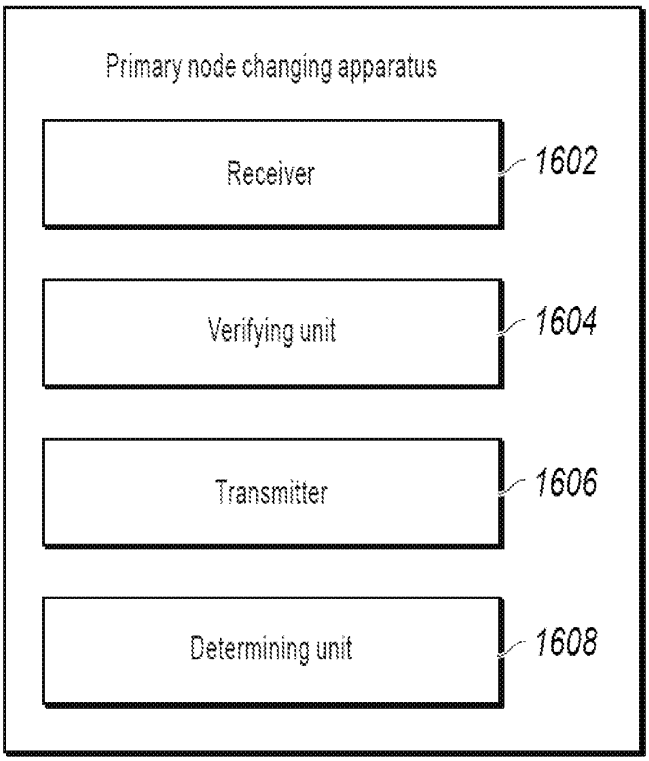
1600
Primary node changing apparatus
Receiver
1602
Verifying unit
1604
Transmitter
1606
Determining unit
1608

FIG. 16

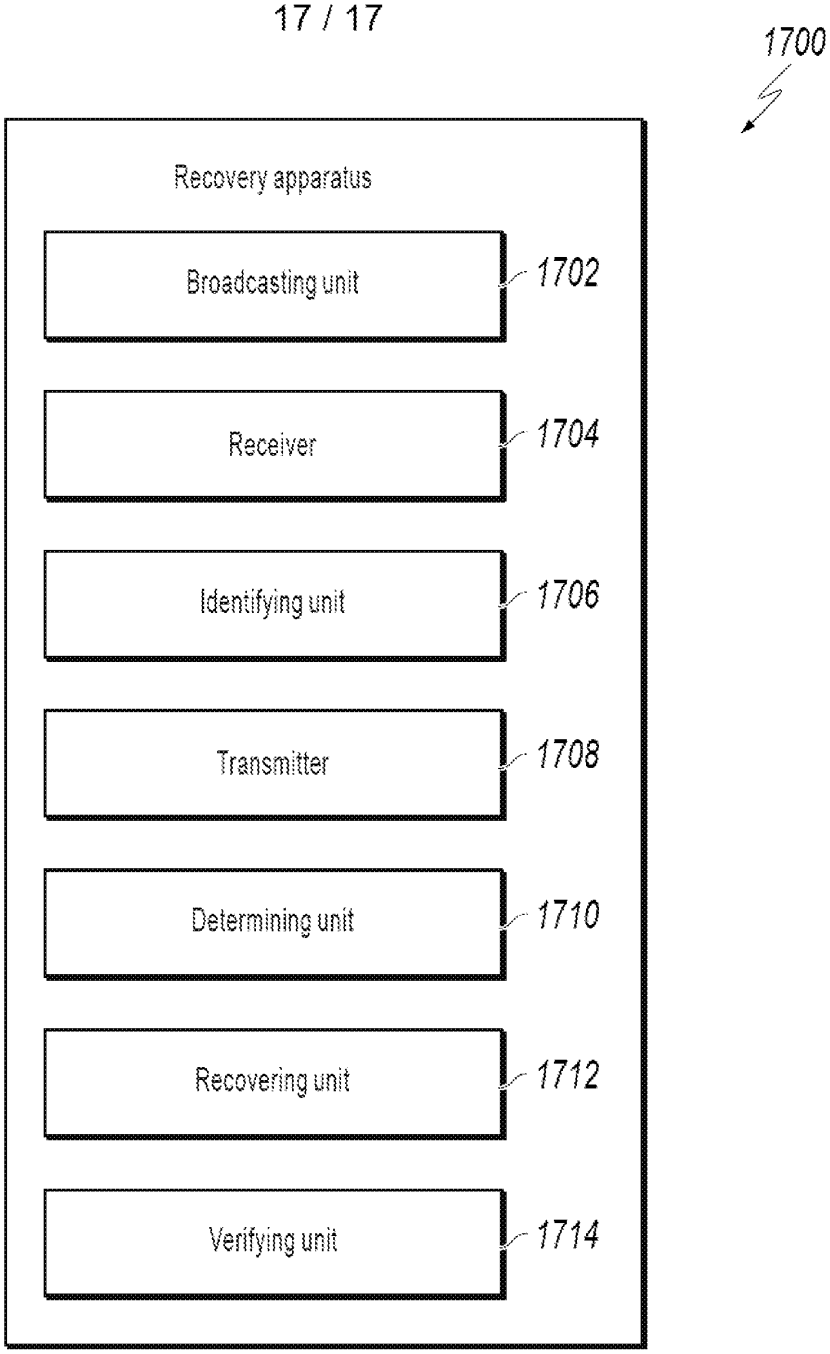
1700
Recovery apparatus
Broadcasting unit
1702
Receiver
1704
Identifying unit
1706
Transmitter
1708
Determining unit
1710
Recovering unit
1712
Verifying unit
1714

FIG. 17