US 20160189115A1

(19) United States
(12) Patent Application Publication
Cattone
(10) Pub. No.: US 2016/0189115 A1
(43) Pub. Date: Jun. 30, 2016

(54) SYSTEMS AND METHODS TO UTILIZE SMART COMPONENTS

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(21) Appl. No.: **14/588,272**

(22) Filed: **Dec. 31, 2014**

**Publication Classification**

(51) **Int. Cl.**

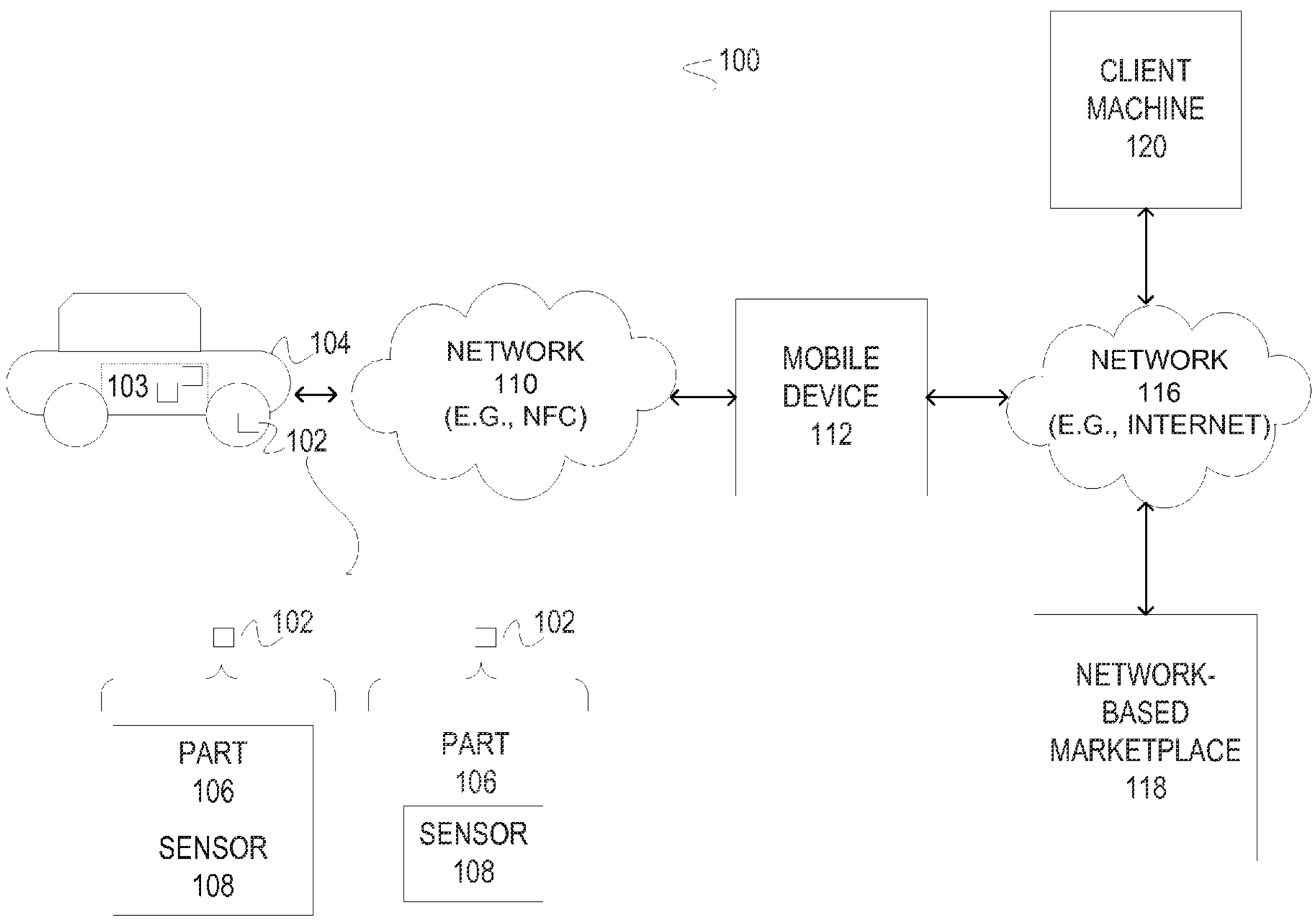
| | |
|---|---|
| ***G06Q 10/00*** | (2006.01) |
| ***G06Q 10/08*** | (2006.01) |
| ***G07C 5/00*** | (2006.01) |
| ***G06Q 30/06*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***G06Q 10/20*** (2013.01); ***G06Q 30/0633*** (2013.01); ***G06Q 10/087*** (2013.01); ***G07C 5/008*** (2013.01)

(57) **ABSTRACT**

Systems and methods to utilize smart components are described. The system receives a maintenance message from a mobile device at a network-based marketplace. The maintenance message includes part log information including a timestamp and characterization information. The characterization information is received by the mobile device from a component in a vehicle that includes a sensor that senses a first part that is assembled into the vehicle and generates the characterization information based on the sense of the sensor. The component communicates the characterization information to the mobile device that, in turn, communicates the maintenance message to network-based marketplace. The system identifies user profile information based on the maintenance message and stores the part log information in the user profile information at the network-based marketplace. The system compares the part log information with part maintenance information and receives a triggering event to initiate an electronic commerce activity.



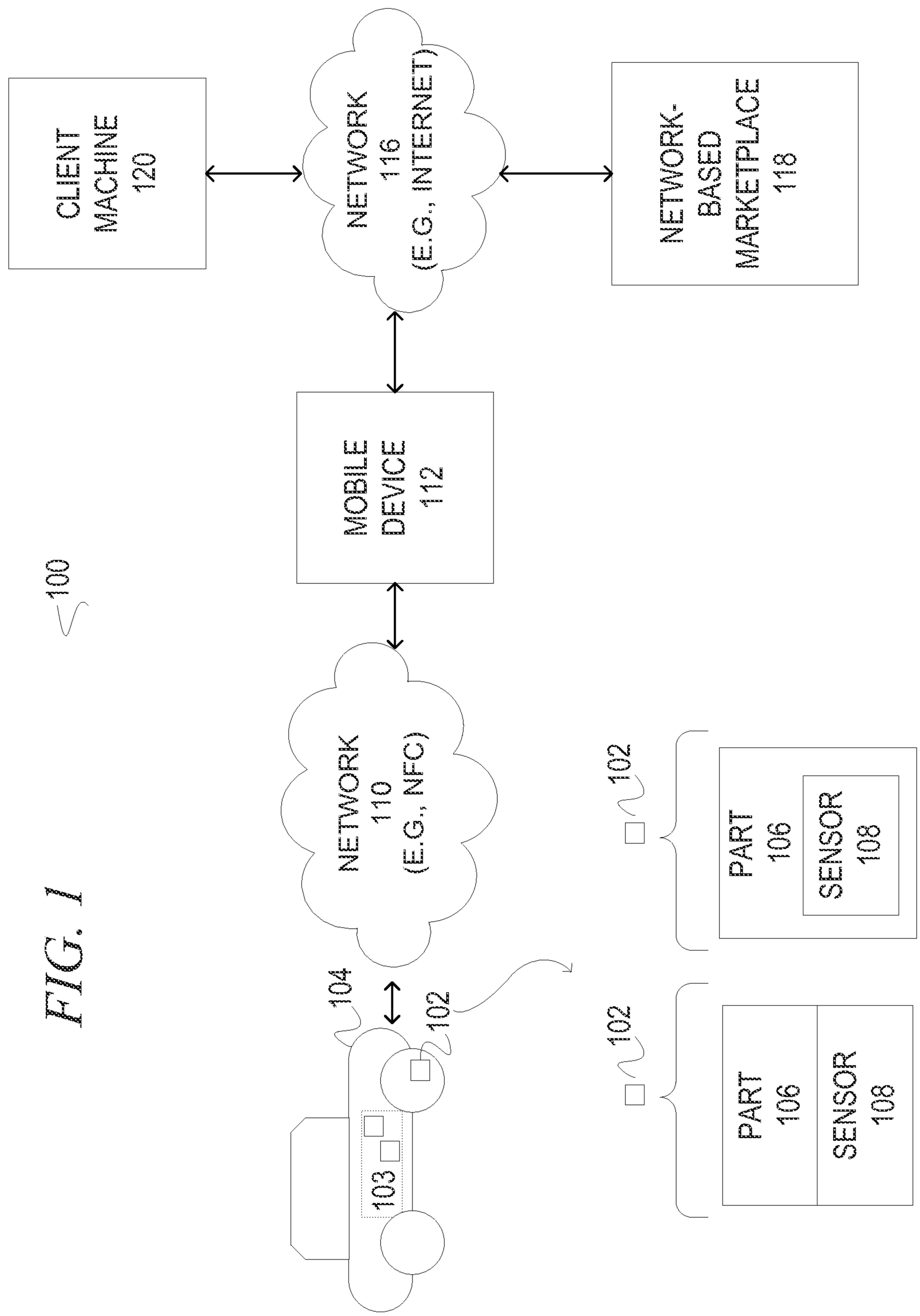

100
CLIENT MACHINE 120
NETWORK 116 (E.G., INTERNET)
NETWORK-BASED MARKETPLACE 118
MOBILE DEVICE 112
NETWORK 110 (E.G., NFC)
104
102
103
102
PART 106
SENSOR 108
102
PART 106
SENSOR 108

FIG. 1

*FIG. 2*

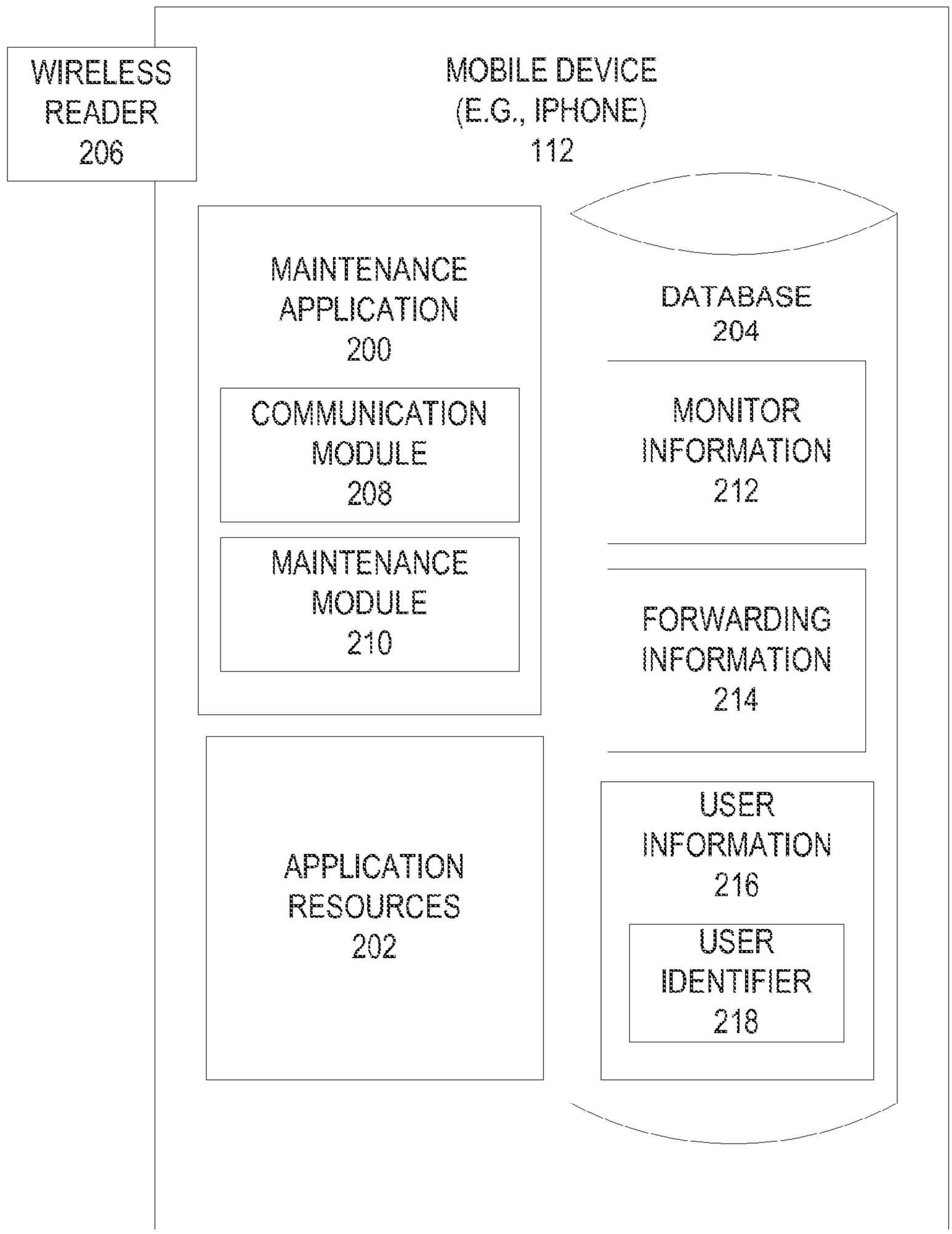

WIRELESS READER 206
MOBILE DEVICE (E.G., IPHONE) 112
MAINTENANCE APPLICATION 200
COMMUNICATION MODULE 208
MAINTENANCE MODULE 210
DATABASE 204
MONITOR INFORMATION 212
FORWARDING INFORMATION 214
APPLICATION RESOURCES 202
USER INFORMATION 216
USER IDENTIFIER 218

*FIG.3A*

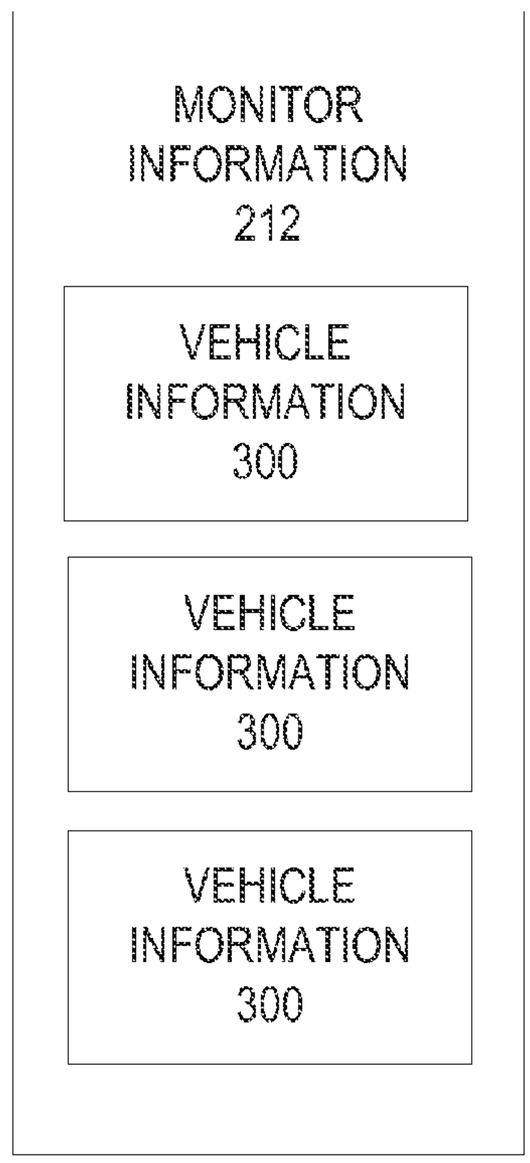

MONITOR INFORMATION 212
VEHICLE INFORMATION 300
VEHICLE INFORMATION 300
VEHICLE INFORMATION 300

*FIG.3B*

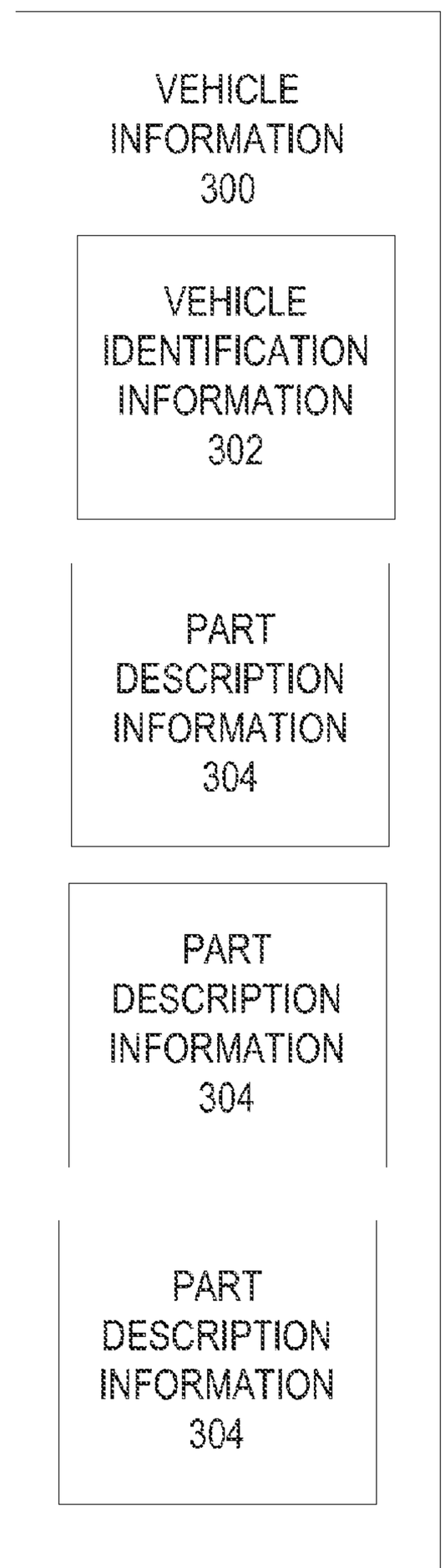

VEHICLE INFORMATION 300
VEHICLE IDENTIFICATION INFORMATION 302
PART DESCRIPTION INFORMATION 304
PART DESCRIPTION INFORMATION 304
PART DESCRIPTION INFORMATION 304

*FIG.3C*

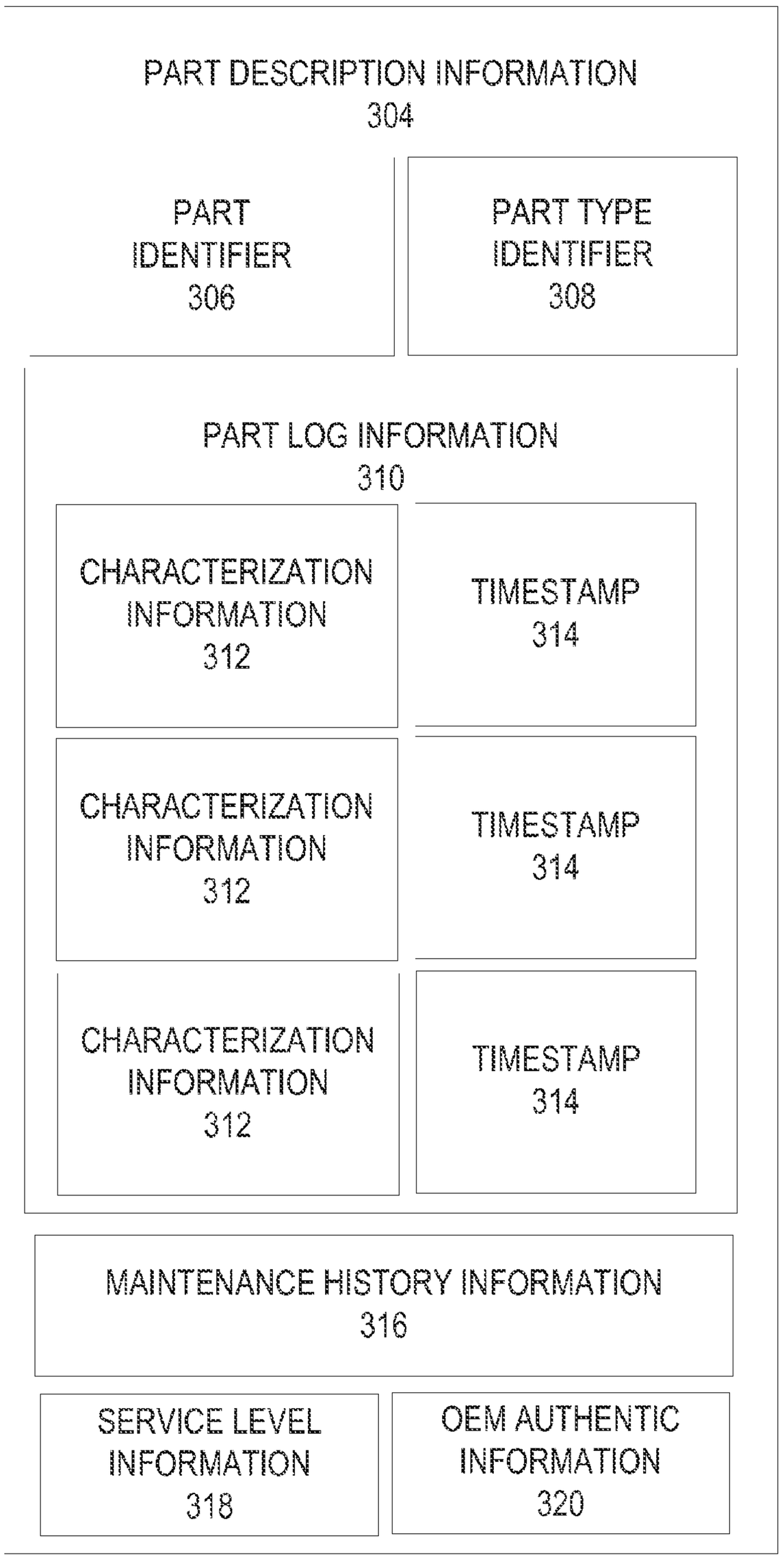

PART DESCRIPTION INFORMATION
304
PART
IDENTIFIER
306
PART TYPE
IDENTIFIER
308
PART LOG INFORMATION
310
CHARACTERIZATION
INFORMATION
312
TIMESTAMP
314
CHARACTERIZATION
INFORMATION
312
TIMESTAMP
314
CHARACTERIZATION
INFORMATION
312
TIMESTAMP
314
MAINTENANCE HISTORY INFORMATION
316
SERVICE LEVEL
INFORMATION
318
OEM AUTHENTIC
INFORMATION
320

*FIG.4A*

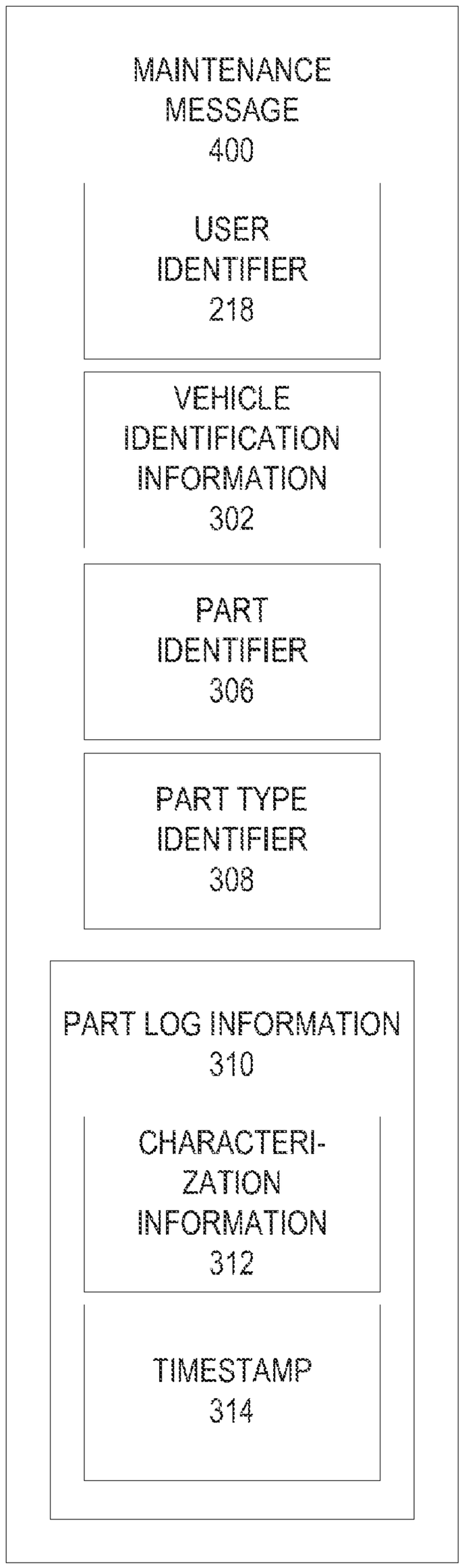

MAINTENANCE MESSAGE 400
USER IDENTIFIER 218
VEHICLE IDENTIFICATION INFORMATION 302
PART IDENTIFIER 306
PART TYPE IDENTIFIER 308
PART LOG INFORMATION 310
CHARACTERI-ZATION INFORMATION 312
TIMESTAMP 314

*FIG.4B*

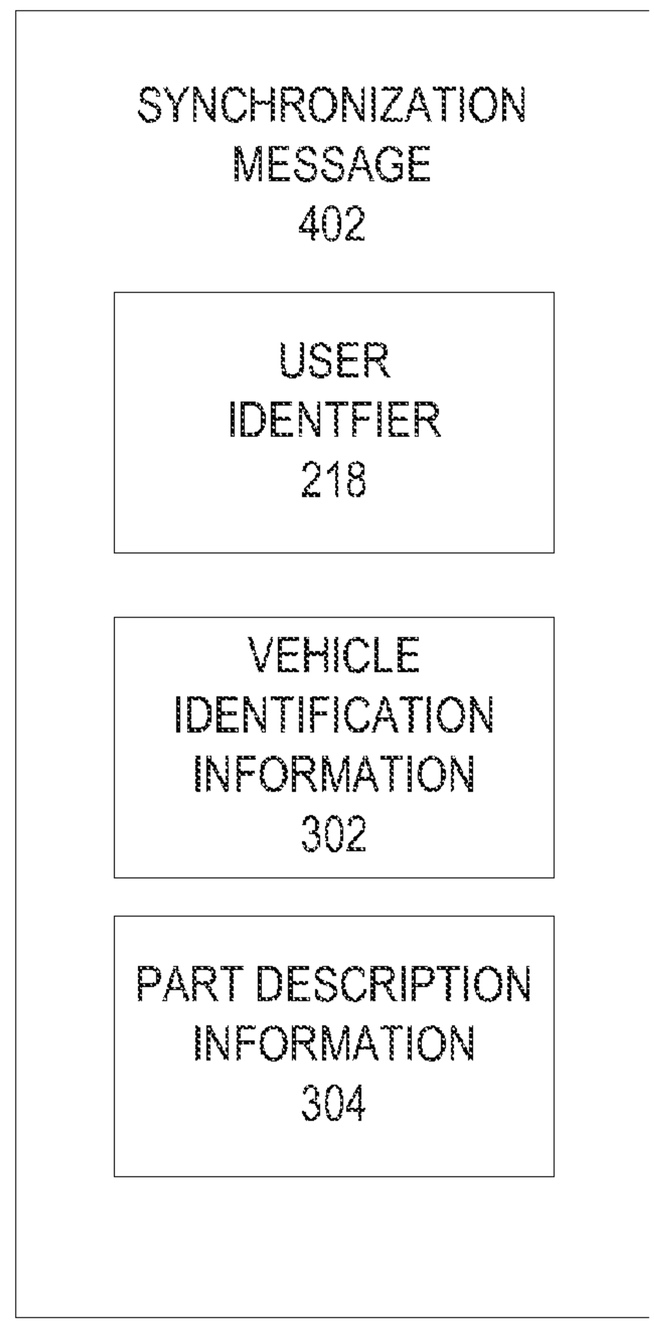

SYNCHRONIZATION MESSAGE 402
USER IDENTFIER 218
VEHICLE IDENTIFICATION INFORMATION 302
PART DESCRIPTION INFORMATION 304

*FIG. 5*

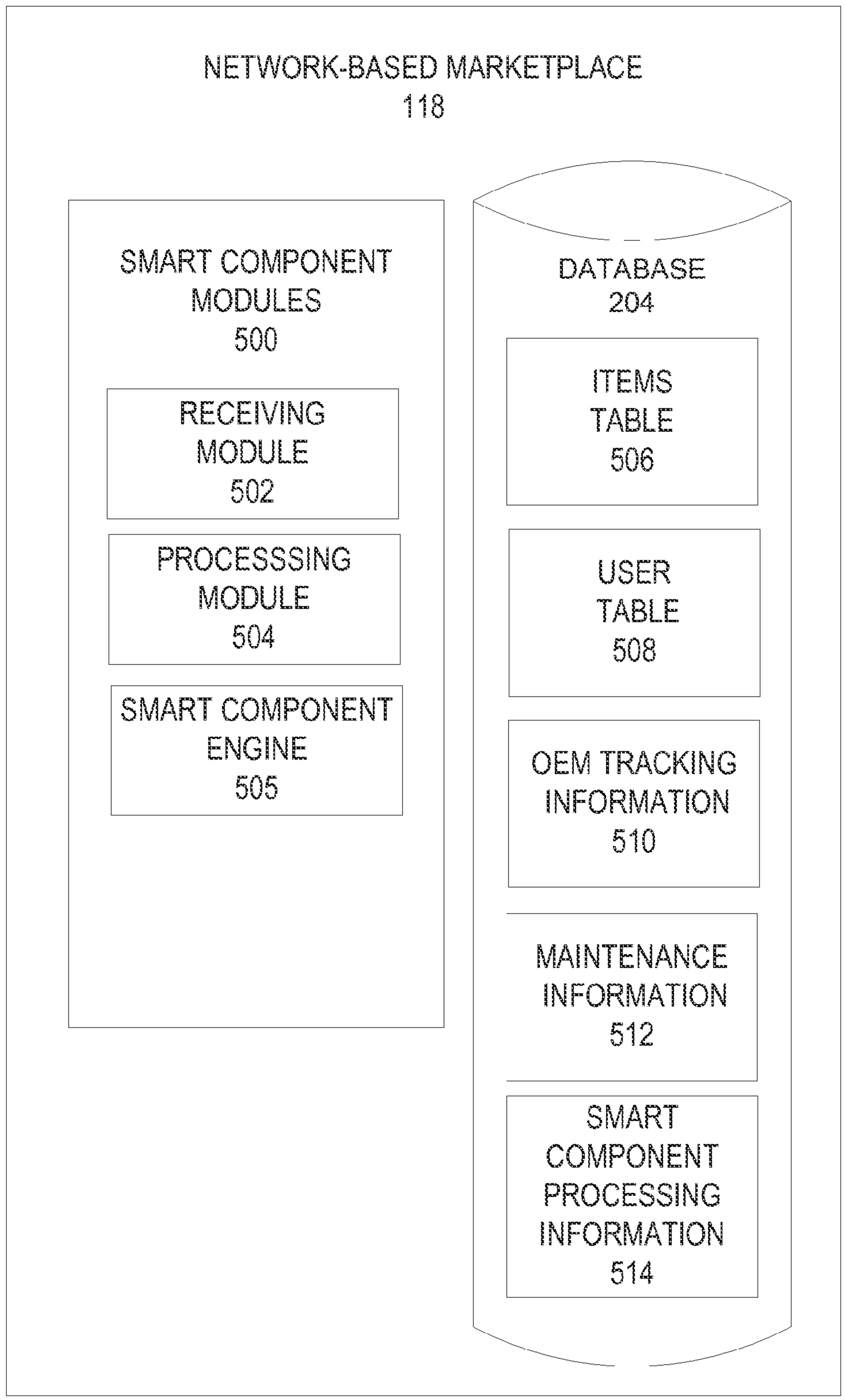

NETWORK-BASED MARKETPLACE
118
SMART COMPONENT MODULES
500
RECEIVING MODULE
502
PROCESSSING MODULE
504
SMART COMPONENT ENGINE
505
DATABASE
204
ITEMS TABLE
506
USER TABLE
508
OEM TRACKING INFORMATION
510
MAINTENANCE INFORMATION
512
SMART COMPONENT PROCESSING INFORMATION
514

*FIG. 6A*

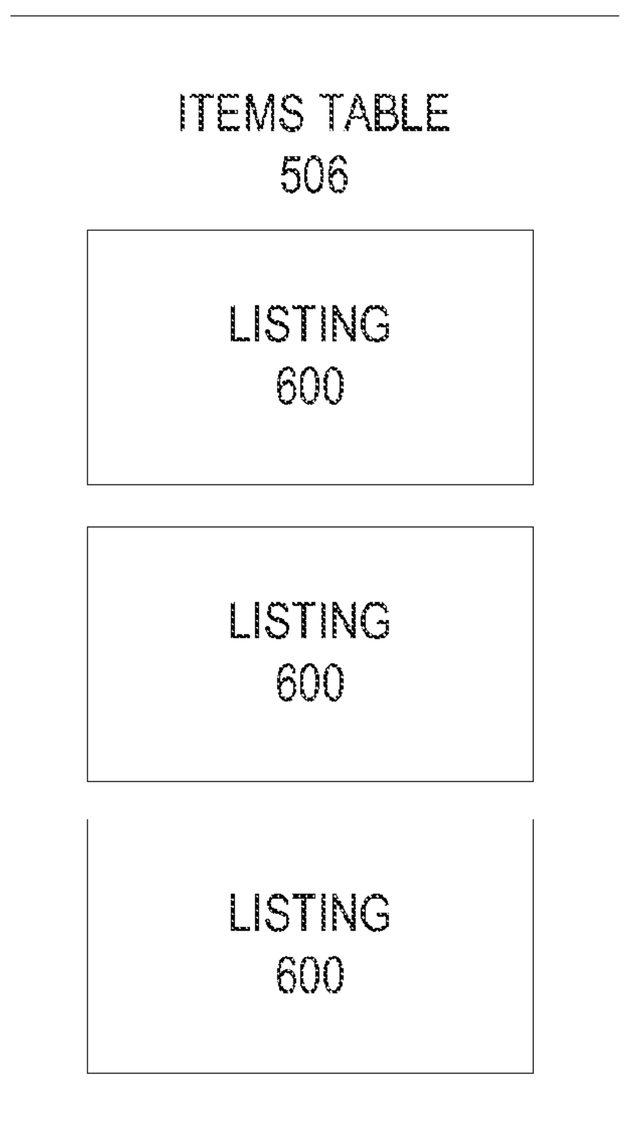

ITEMS TABLE
506
LISTING
600
LISTING
600
LISTING
600

*FIG. 6B*

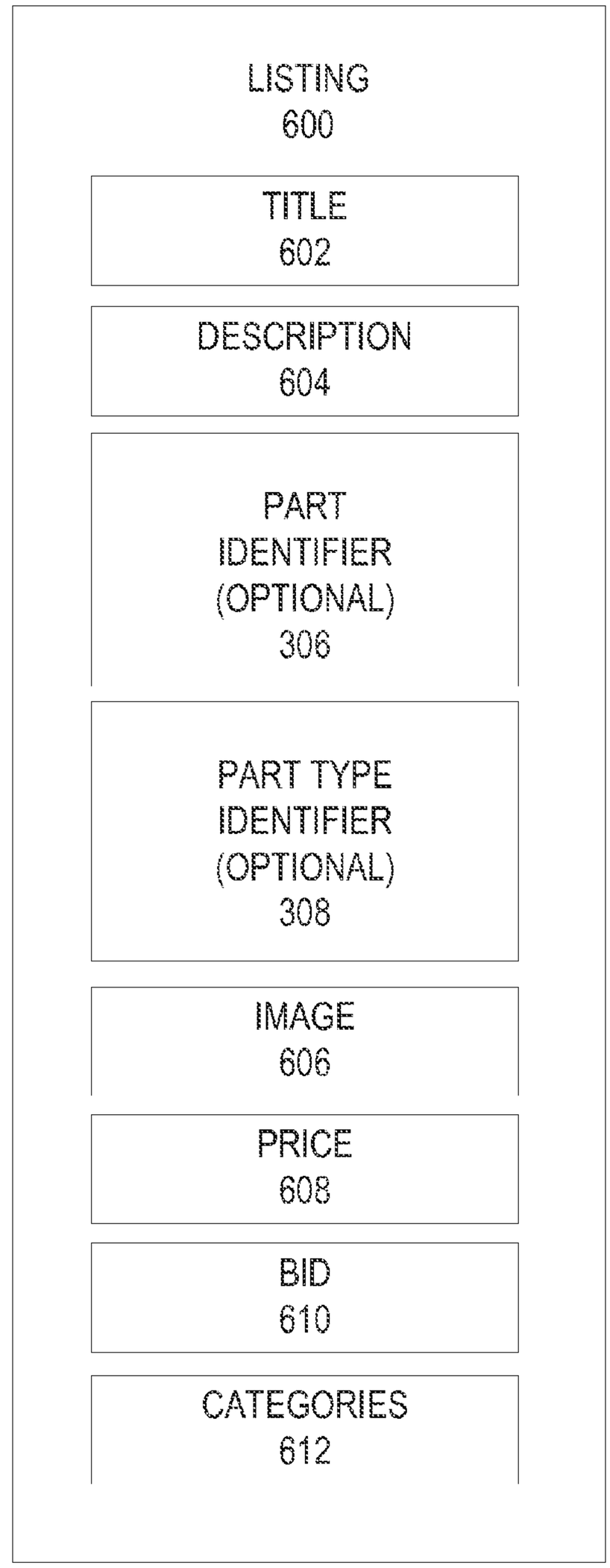

LISTING
600
TITLE
602
DESCRIPTION
604
PART
IDENTIFIER
(OPTIONAL)
306
PART TYPE
IDENTIFIER
(OPTIONAL)
308
IMAGE
606
PRICE
608
BID
610
CATEGORIES
612

*FIG. 7A*

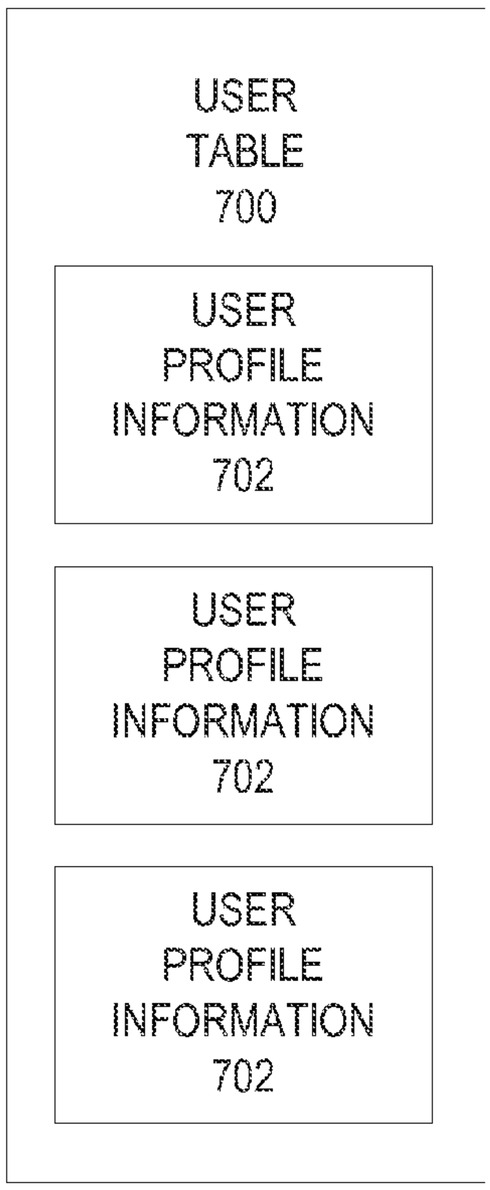



*FIG. 7B*

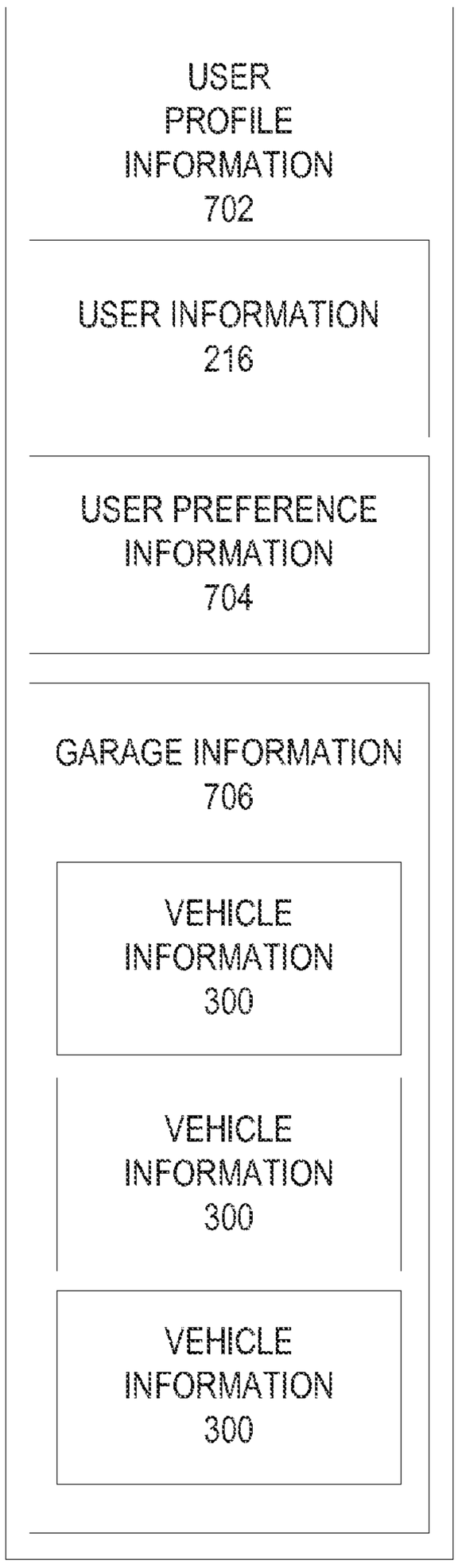



*FIG. 7C*

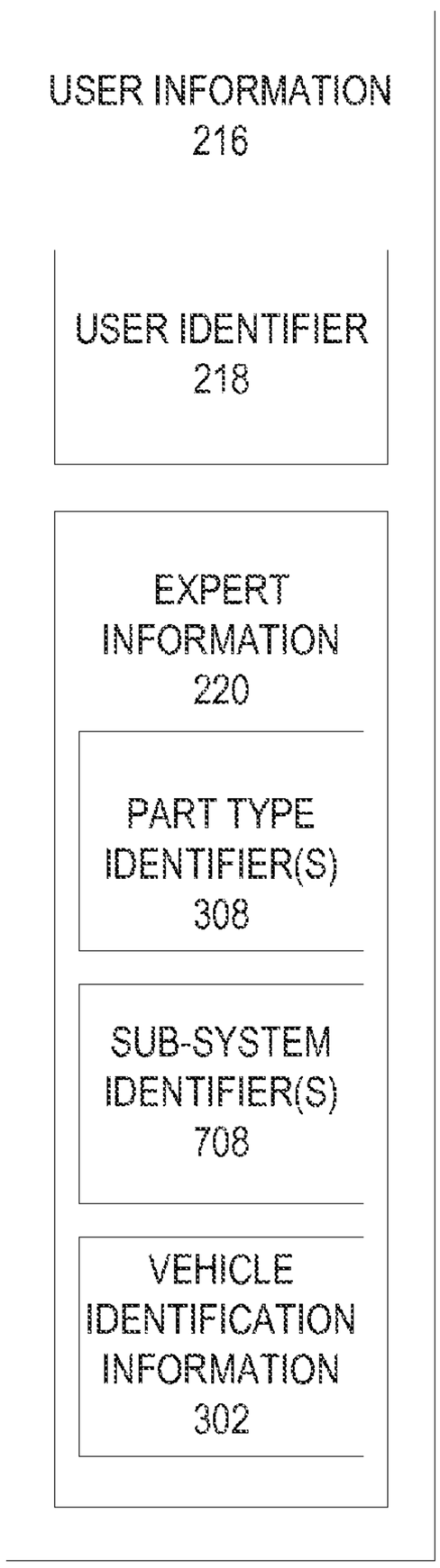


*FIG. 7D*

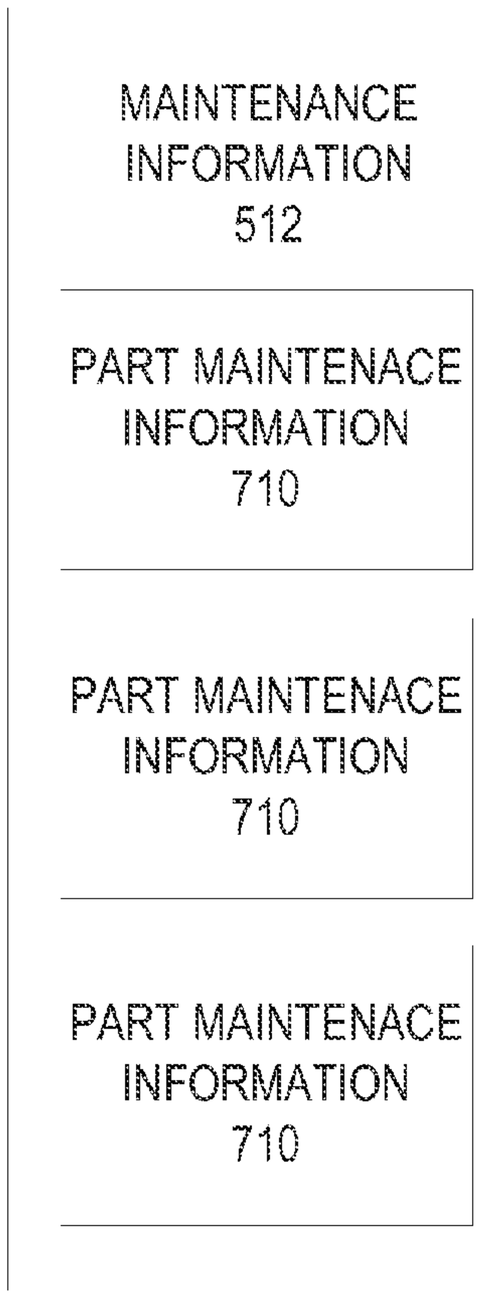

MAINTENANCE INFORMATION 512
PART MAINTENACE INFORMATION 710
PART MAINTENACE INFORMATION 710
PART MAINTENACE INFORMATION 710

*FIG. 7E*

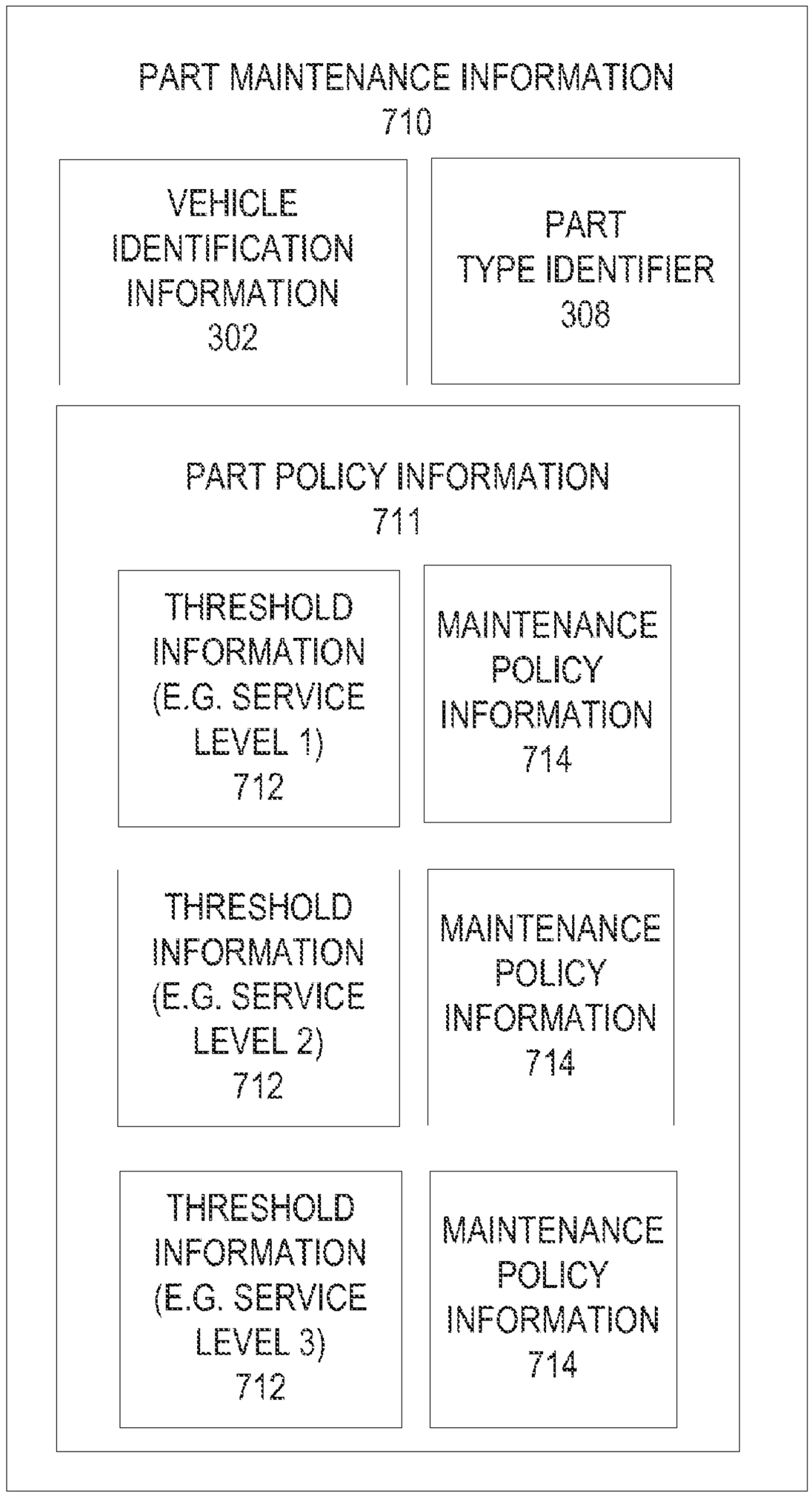
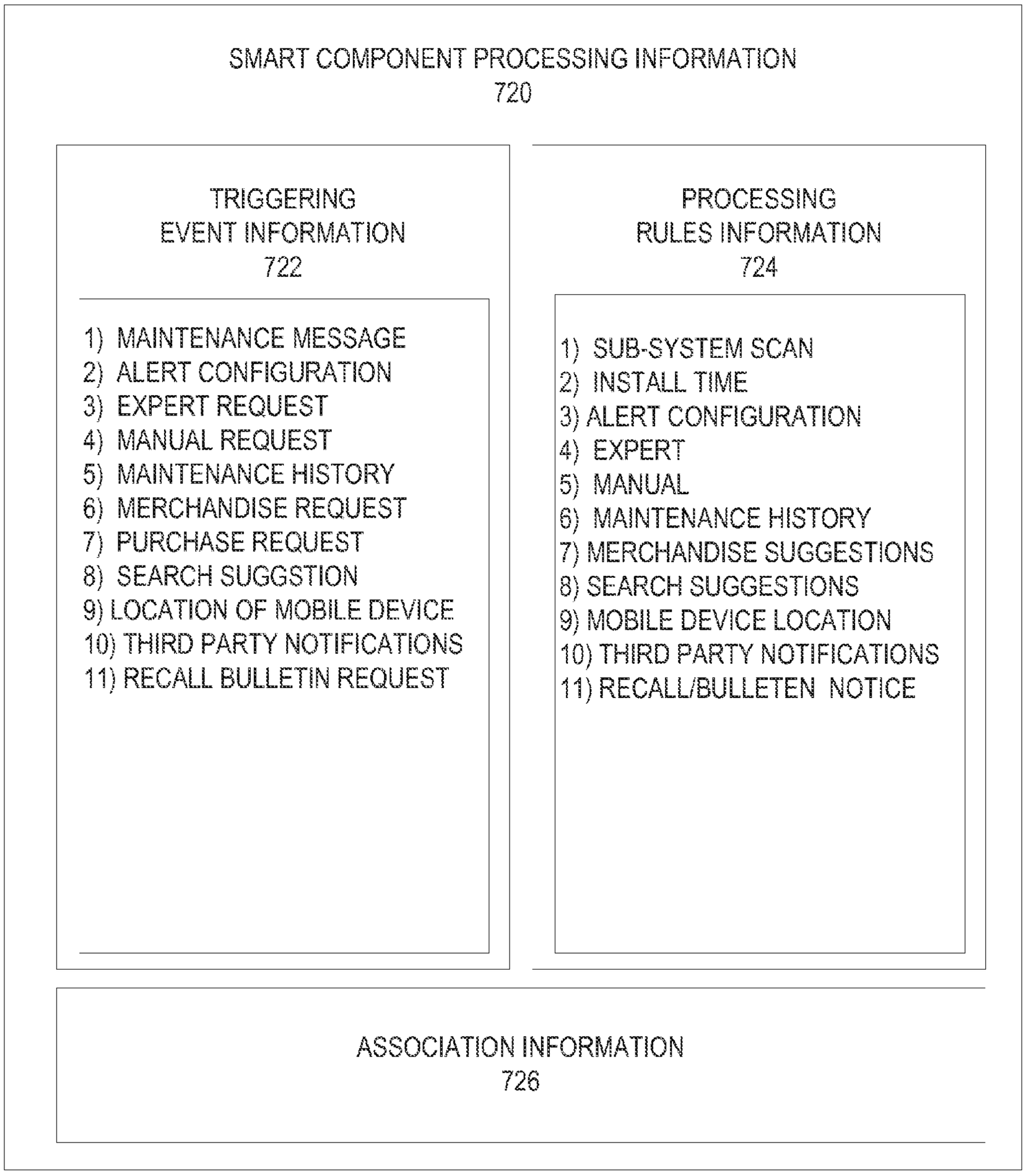

PART MAINTENANCE INFORMATION 710
VEHICLE IDENTIFICATION INFORMATION 302
PART TYPE IDENTIFIER 308
PART POLICY INFORMATION 711
THRESHOLD INFORMATION (E.G. SERVICE LEVEL 1) 712
MAINTENANCE POLICY INFORMATION 714
THRESHOLD INFORMATION (E.G. SERVICE LEVEL 2) 712
MAINTENANCE POLICY INFORMATION 714
THRESHOLD INFORMATION (E.G. SERVICE LEVEL 3) 712
MAINTENANCE POLICY INFORMATION 714

*FIG. 7F*


SMART COMPONENT PROCESSING INFORMATION
720
TRIGGERING
EVENT INFORMATION
722
1) MAINTENANCE MESSAGE
2) ALERT CONFIGURATION
3) EXPERT REQUEST
4) MANUAL REQUEST
5) MAINTENANCE HISTORY
6) MERCHANDISE REQUEST
7) PURCHASE REQUEST
8) SEARCH SUGGSTION
9) LOCATION OF MOBILE DEVICE
10) THIRD PARTY NOTIFICATIONS
11) RECALL BULLETIN REQUEST
PROCESSING
RULES INFORMATION
724
1) SUB-SYSTEM SCAN
2) INSTALL TIME
3) ALERT CONFIGURATION
4) EXPERT
5) MANUAL
6) MAINTENANCE HISTORY
7) MERCHANDISE SUGGESTIONS
8) SEARCH SUGGESTIONS
9) MOBILE DEVICE LOCATION
10) THIRD PARTY NOTIFICATIONS
11) RECALL/BULLETEN NOTICE
ASSOCIATION INFORMATION
726

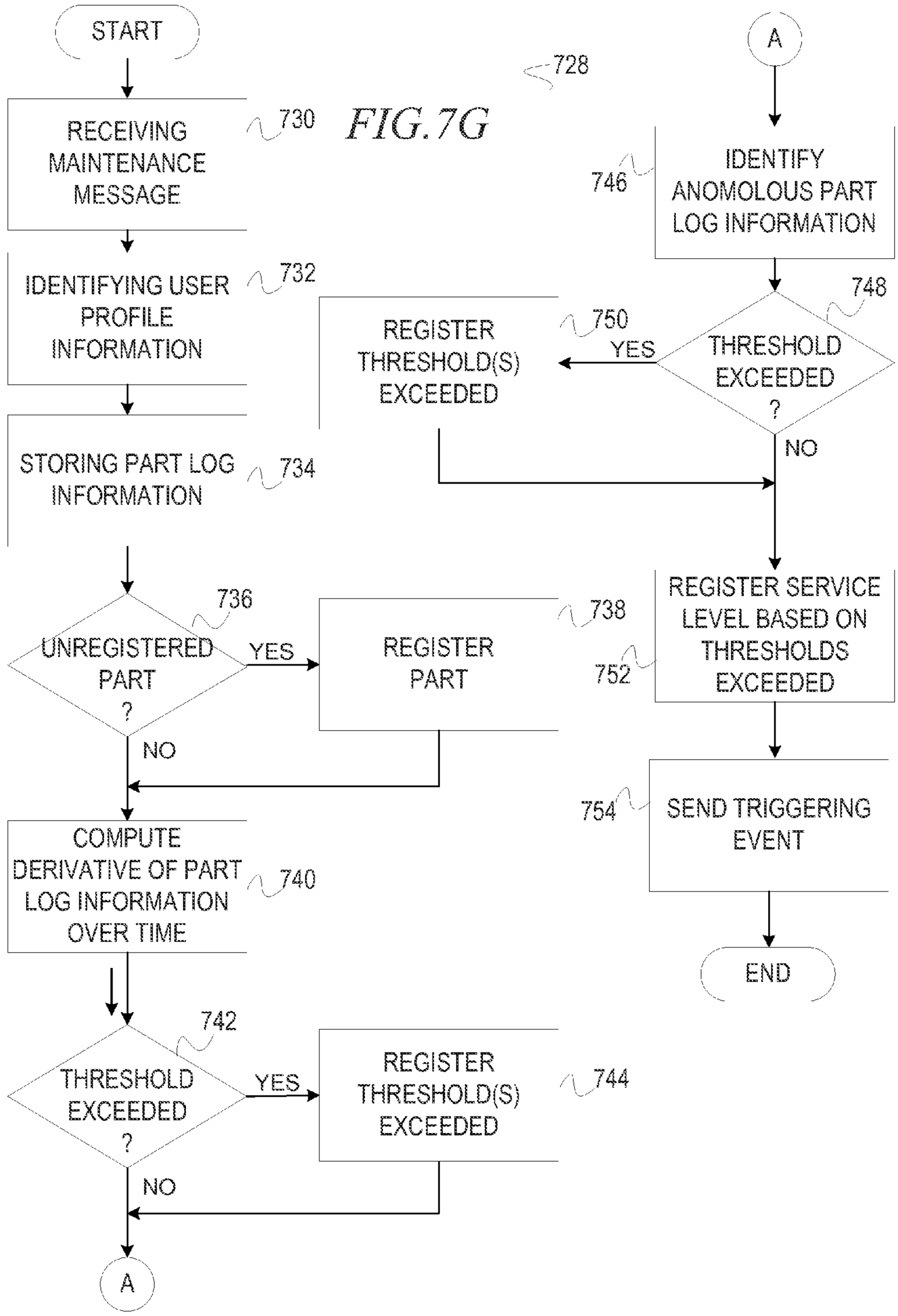

START
RECEIVING MAINTENANCE MESSAGE
730
FIG. 7G
728
IDENTIFYING USER PROFILE INFORMATION
732
STORING PART LOG INFORMATION
734
UNREGISTERED PART ?
736
YES
NO
REGISTER PART
738
COMPUTE DERIVATIVE OF PART LOG INFORMATION OVER TIME
740
THRESHOLD EXCEEDED ?
742
YES
NO
REGISTER THRESHOLD(S) EXCEEDED
744
A
A
IDENTIFY ANOMOLOUS PART LOG INFORMATION
746
THRESHOLD EXCEEDED ?
748
YES
NO
REGISTER THRESHOLD(S) EXCEEDED
750
REGISTER SERVICE LEVEL BASED ON THRESHOLDS EXCEEDED
752
SEND TRIGGERING EVENT
754
END

*FIG. 7H*

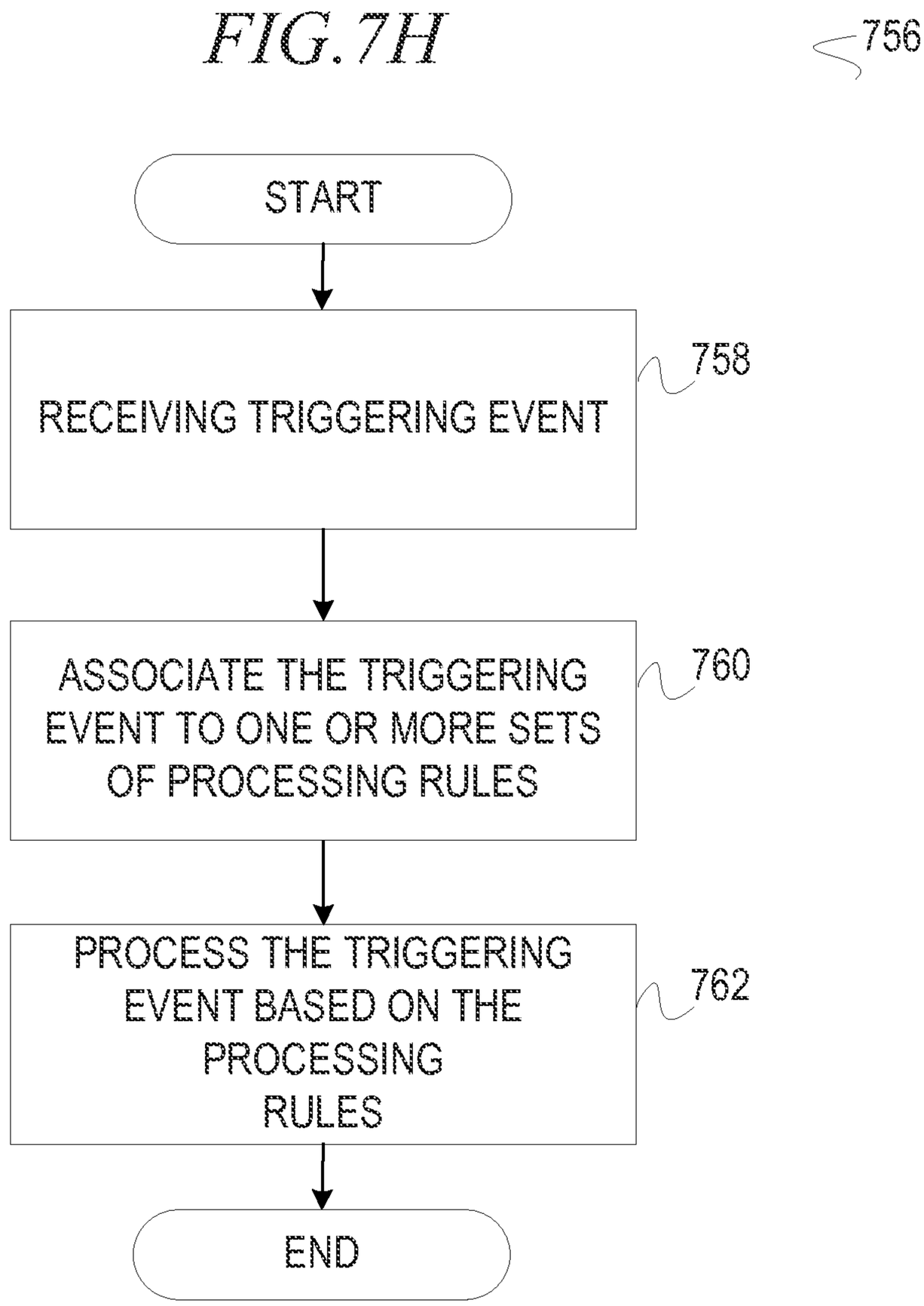

756
START
RECEIVING TRIGGERING EVENT
758
ASSOCIATE THE TRIGGERING EVENT TO ONE OR MORE SETS OF PROCESSING RULES
760
PROCESS THE TRIGGERING EVENT BASED ON THE PROCESSING RULES
762
END

FIG. 7I

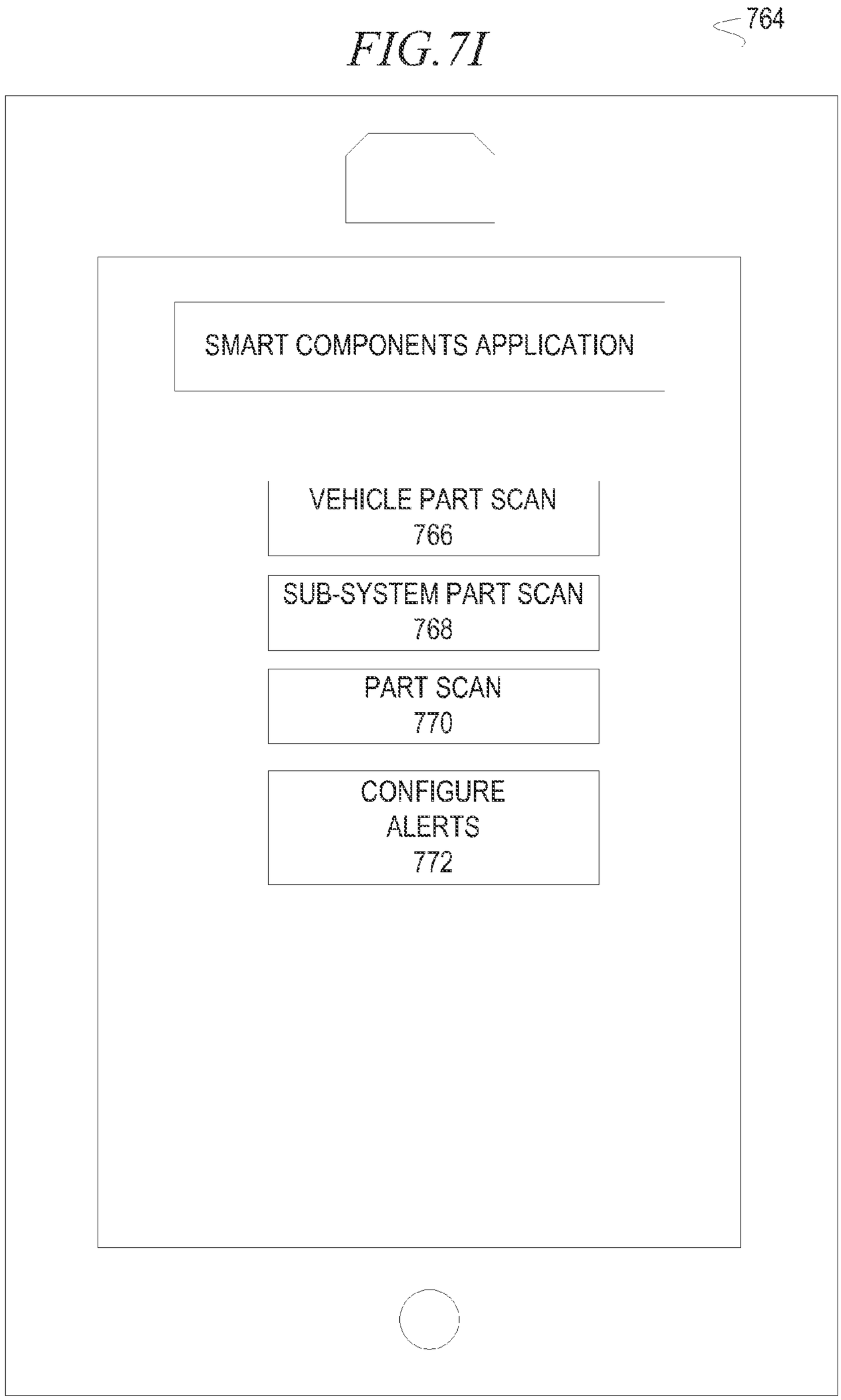
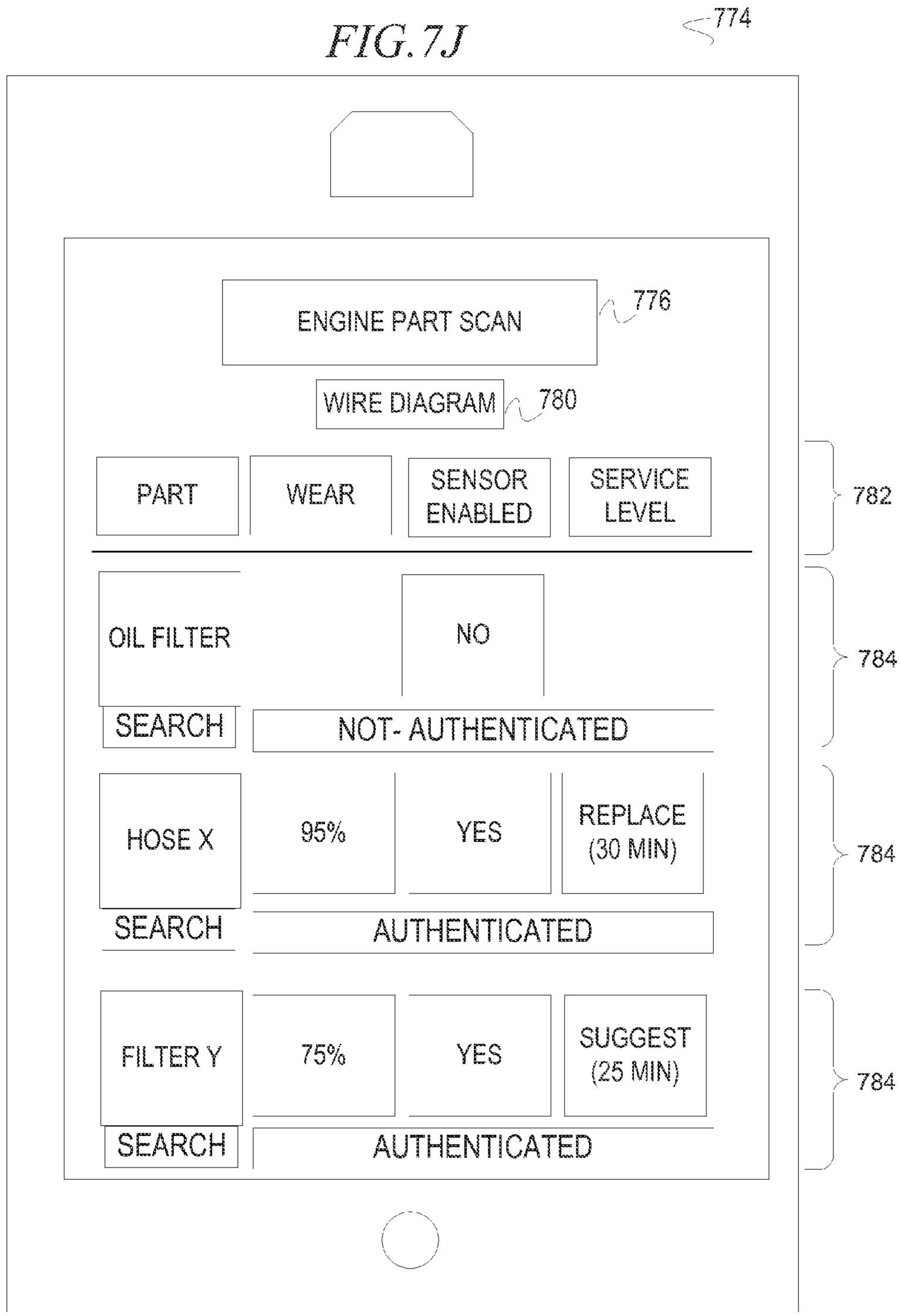

764
SMART COMPONENTS APPLICATION
VEHICLE PART SCAN
766
SUB-SYSTEM PART SCAN
768
PART SCAN
770
CONFIGURE
ALERTS
772

FIG. 7J


774
ENGINE PART SCAN
776
WIRE DIAGRAM
780
PART
WEAR
SENSOR ENABLED
SERVICE LEVEL
782
OIL FILTER
NO
SEARCH
NOT- AUTHENTICATED
784
HOSE X
95%
YES
REPLACE (30 MIN)
SEARCH
AUTHENTICATED
784
FILTER Y
75%
YES
SUGGEST (25 MIN)
SEARCH
AUTHENTICATED
784

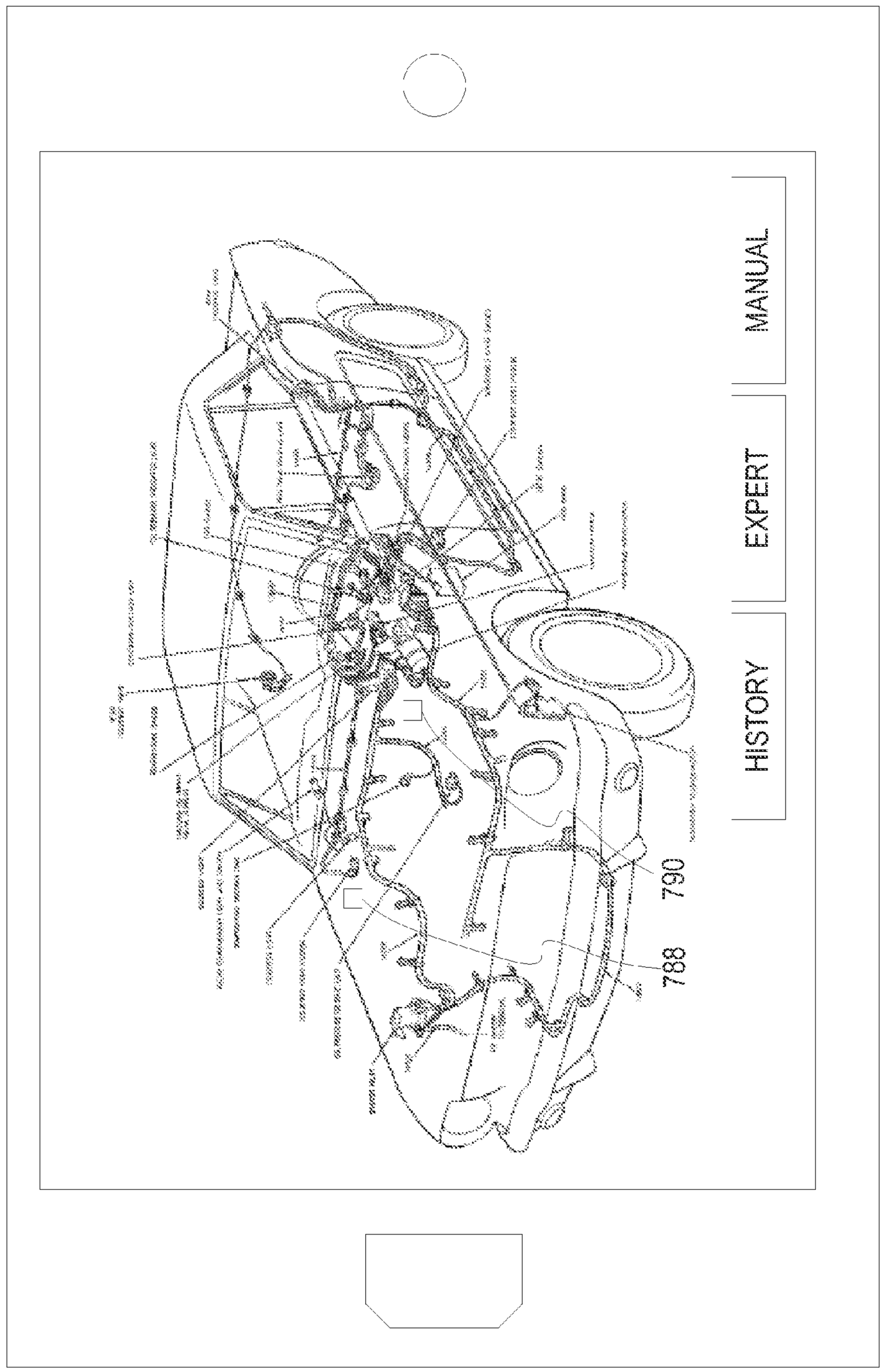



FIG. 7K

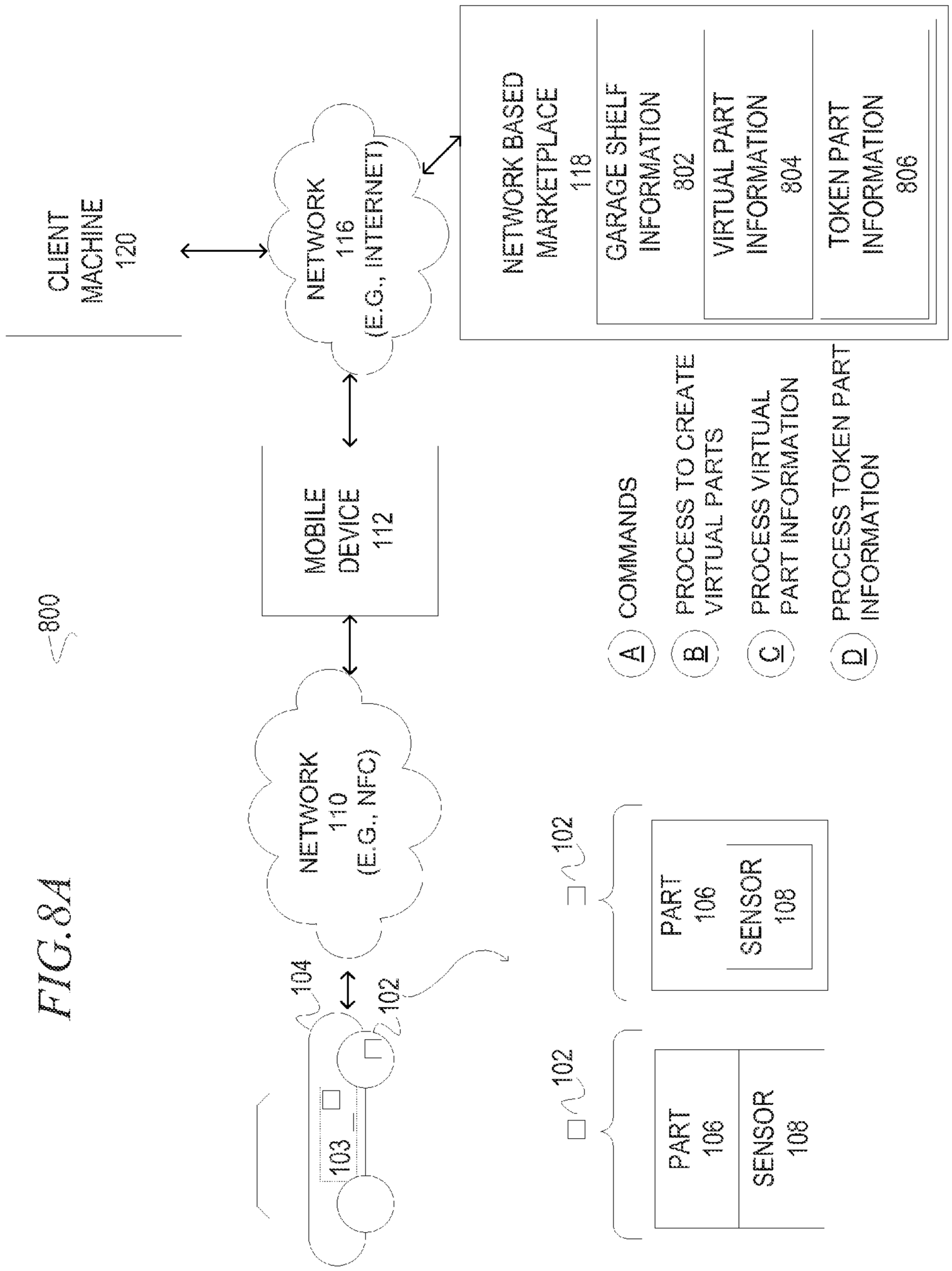

800
CLIENT MACHINE 120
NETWORK 116 (E.G., INTERNET)
NETWORK BASED MARKETPLACE 118
GARAGE SHELF INFORMATION 802
VIRTUAL PART INFORMATION 804
TOKEN PART INFORMATION 806
MOBILE DEVICE 112
A COMMANDS
B PROCESS TO CREATE VIRTUAL PARTS
C PROCESS VIRTUAL PART INFORMATION
D PROCESS TOKEN PART INFORMATION
NETWORK 110 (E.G., NFC)
104
102
103
102
PART 106
SENSOR 108
102
PART 106
SENSOR 108

FIG. 8A

*FIG.8B*

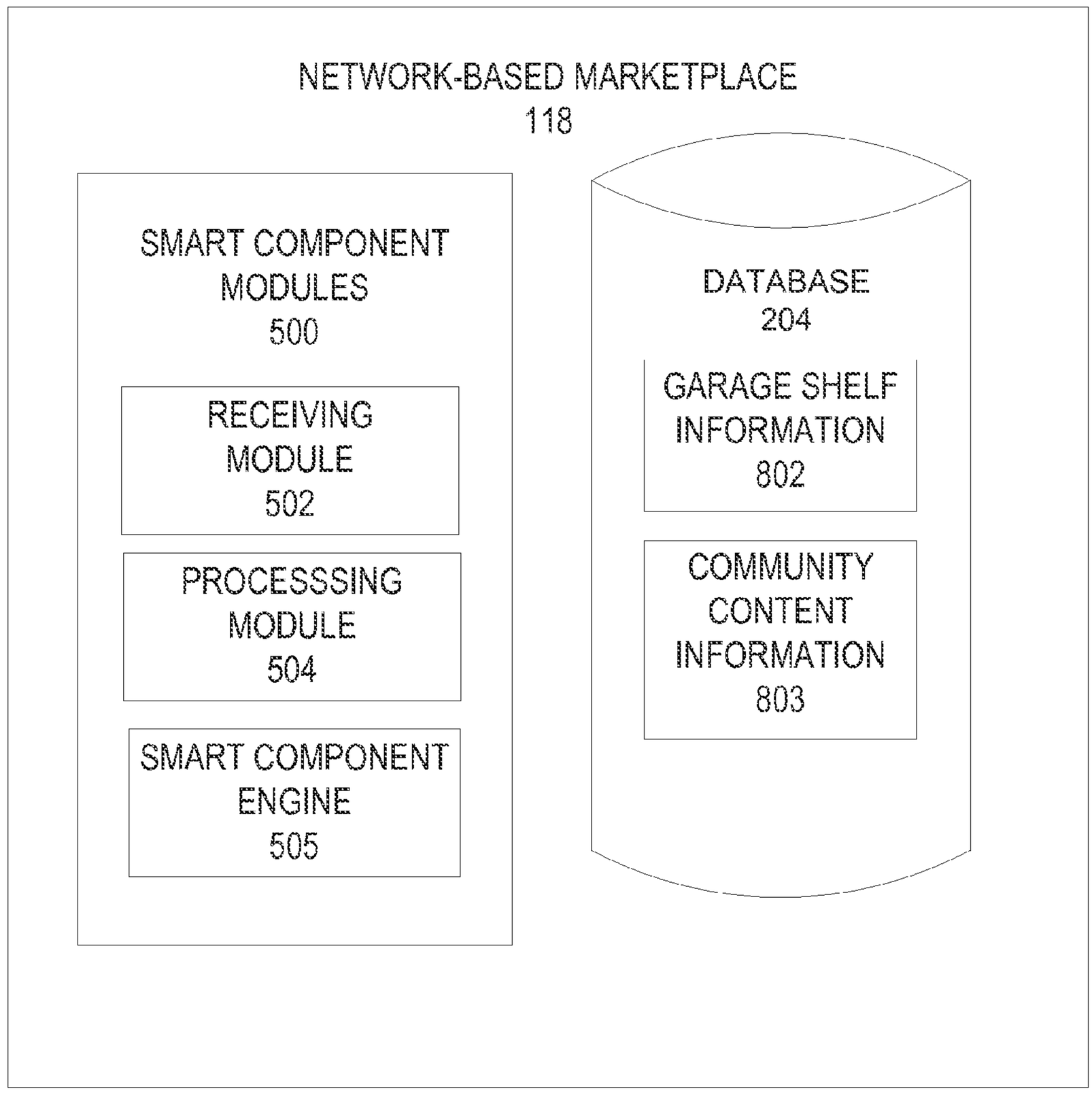
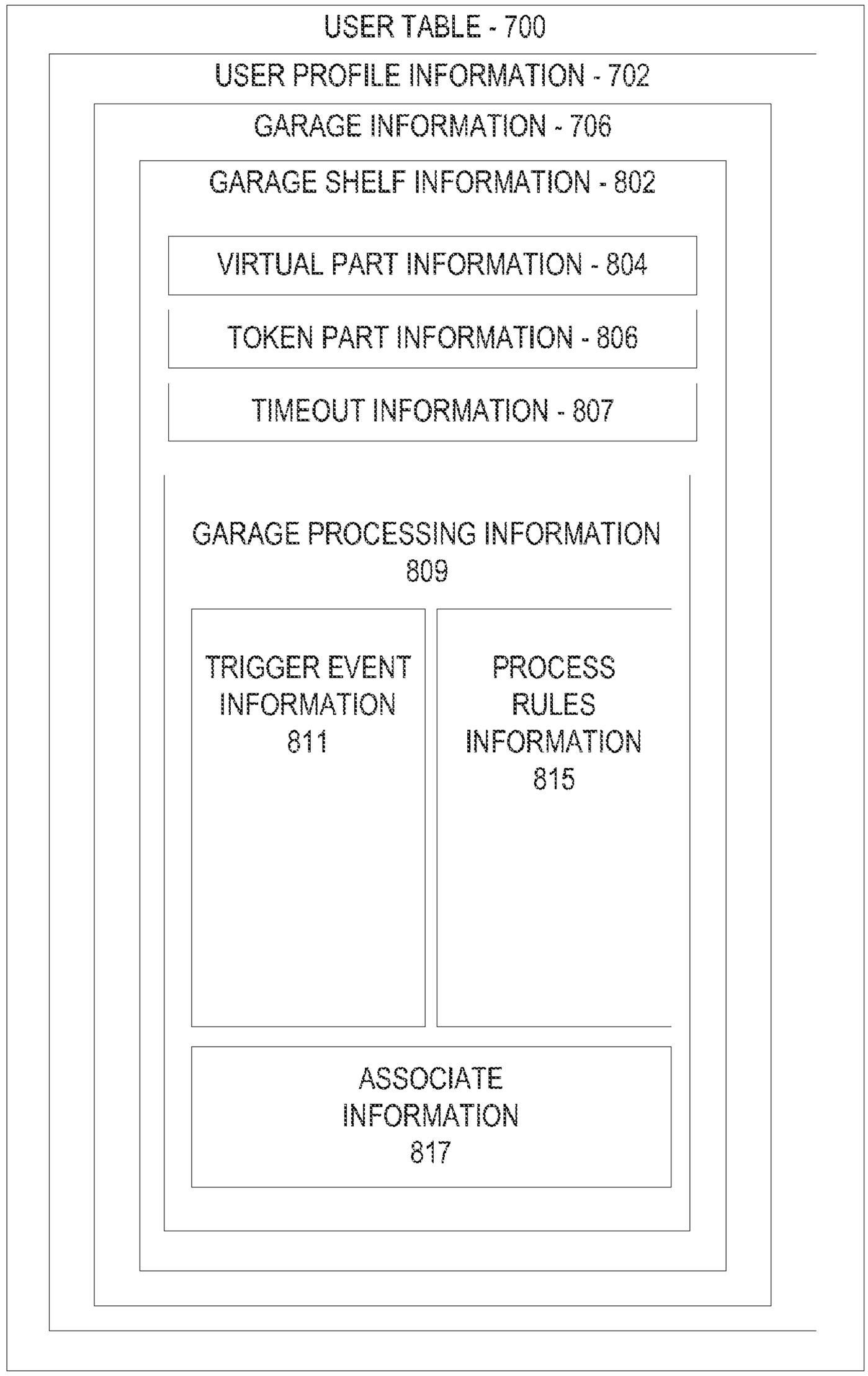

NETWORK-BASED MARKETPLACE
118
SMART COMPONENT MODULES
500
RECEIVING MODULE
502
PROCESSSING MODULE
504
SMART COMPONENT ENGINE
505
DATABASE
204
GARAGE SHELF INFORMATION
802
COMMUNITY CONTENT INFORMATION
803

*FIG.8C*


USER TABLE - 700
USER PROFILE INFORMATION - 702
GARAGE INFORMATION - 706
GARAGE SHELF INFORMATION - 802
VIRTUAL PART INFORMATION - 804
TOKEN PART INFORMATION - 806
TIMEOUT INFORMATION - 807
GARAGE PROCESSING INFORMATION 809
TRIGGER EVENT INFORMATION 811
PROCESS RULES INFORMATION 815
ASSOCIATE INFORMATION 817

808

*FIG. 8D*

| Command | Input Parameters | Description |
|---|---|---|
| Add virtual part (VP) | Vehicle identifier<br>Part type identifier<br>Part identifier | Add VP |
| Delete VP | VP identifier | Delete VP |
| Configure VP | VP identifier<br>Preferred brand(s)<br>Alert (On/Off)<br>Timeout period | |
| Add token part (TP) | Vehicle identifier<br>Part type identifier<br>Part identifier | Add TP |
| Delete TP | TP identifier | Delete TP |
| Configure TP | TP identifier<br>Preferred brand(s)<br>Alert (On/Off)<br>Timeout period | |
| Change VP to TP | VP identifier | Change VP to TP |
| Search VP | Part type identifier or other criteria | Searches garage shelf information for virtual part |
| Search TP | Part type identifier or other criteria | Searches garage shelf information for token part |

*FIG.8E*

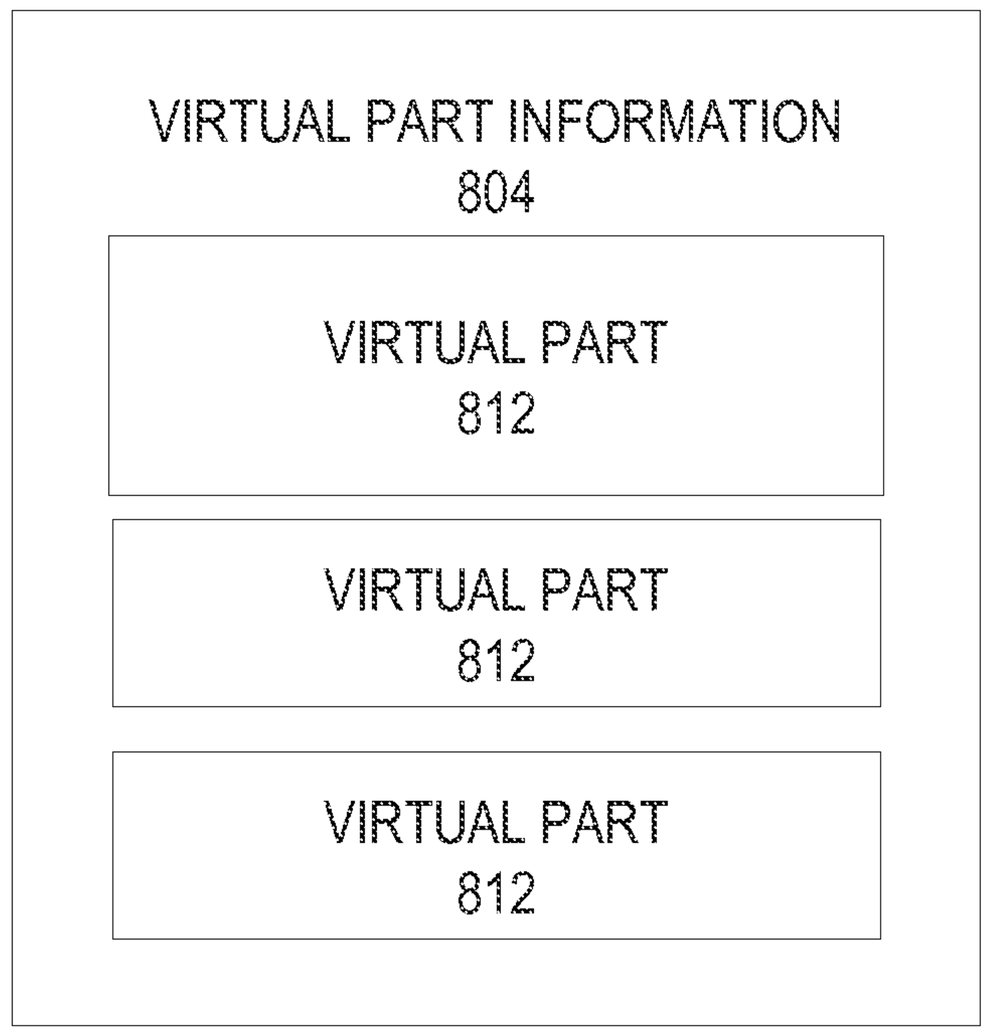

VIRTUAL PART INFORMATION
804
VIRTUAL PART
812
VIRTUAL PART
812
VIRTUAL PART
812

*FIG.8F*

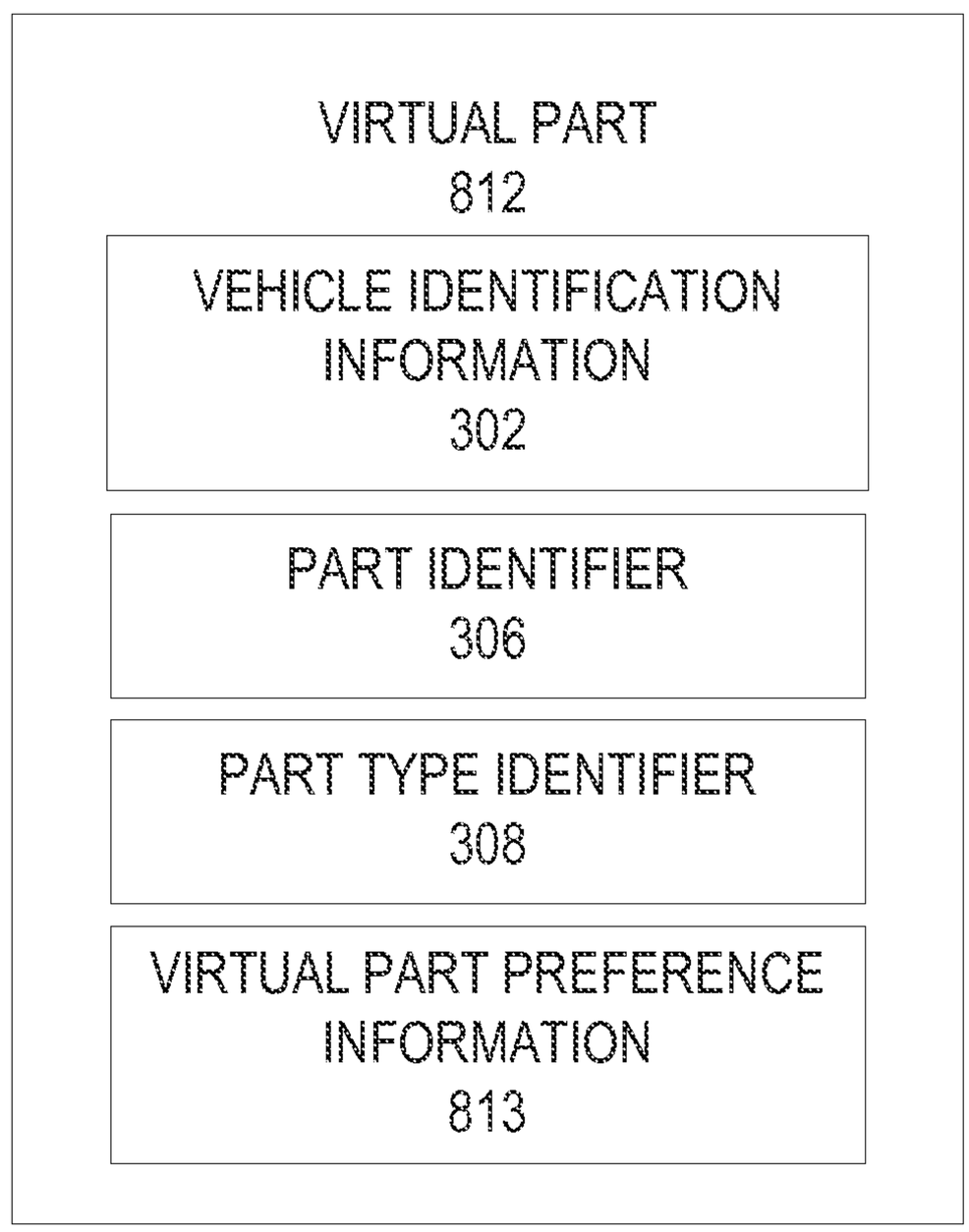

VIRTUAL PART
812
VEHICLE IDENTIFICATION
INFORMATION
302
PART IDENTIFIER
306
PART TYPE IDENTIFIER
308
VIRTUAL PART PREFERENCE
INFORMATION
813

*FIG.8G*

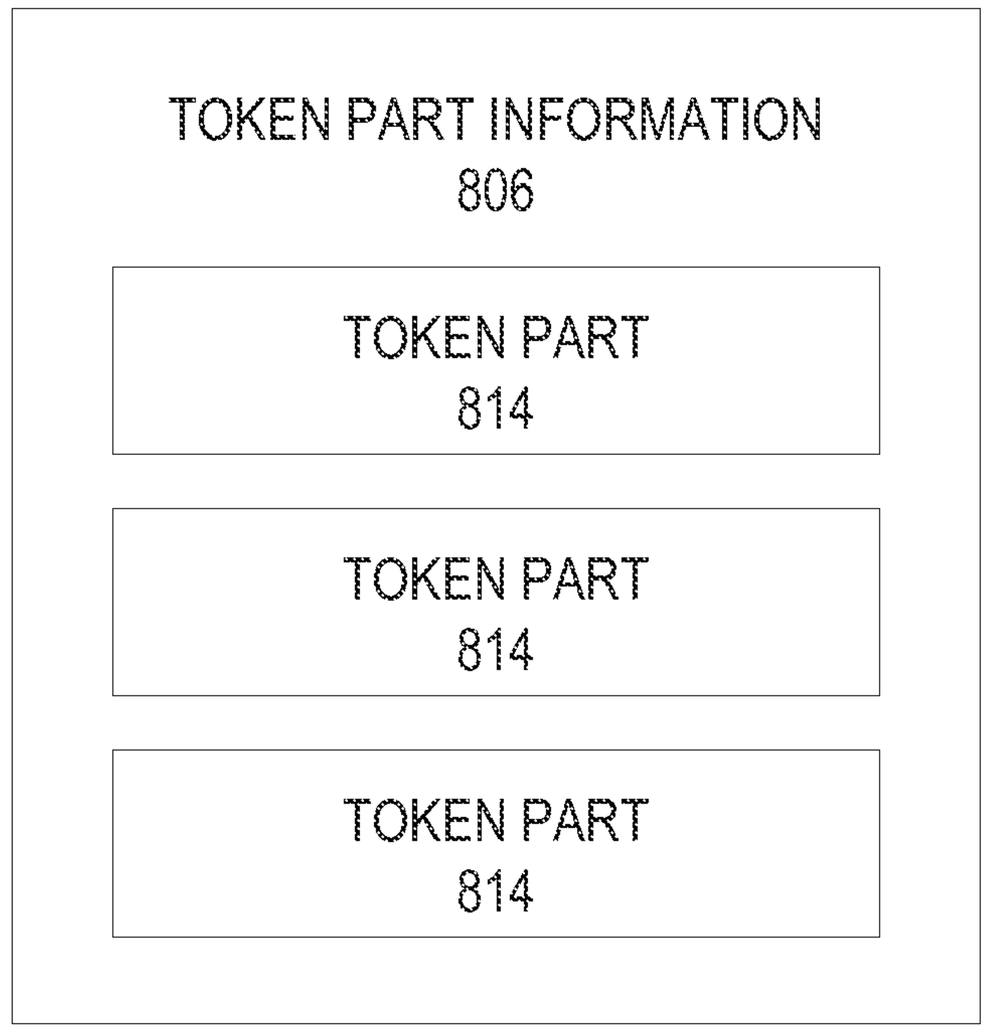

TOKEN PART INFORMATION
806
TOKEN PART
814
TOKEN PART
814
TOKEN PART
814

*FIG.8H*

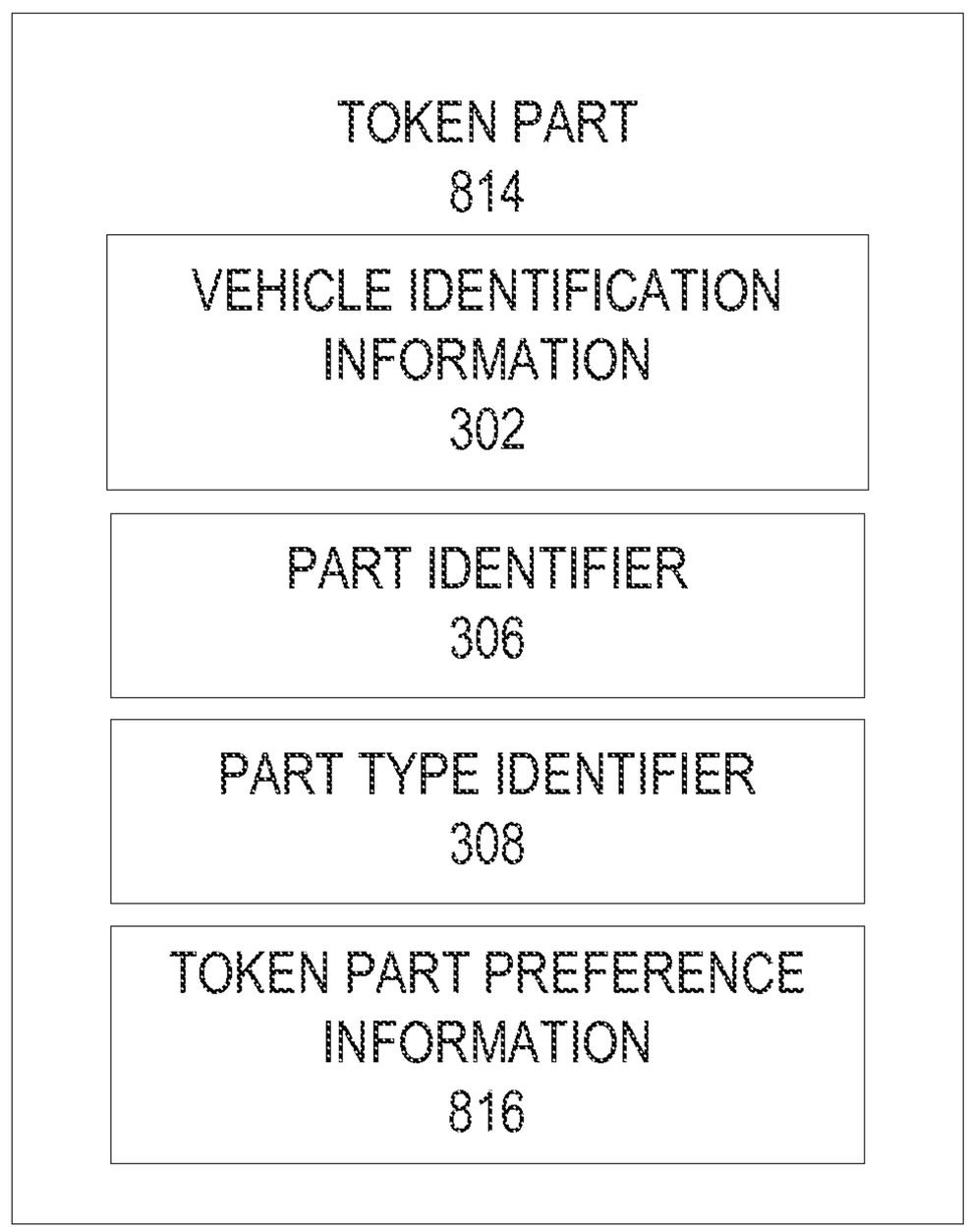
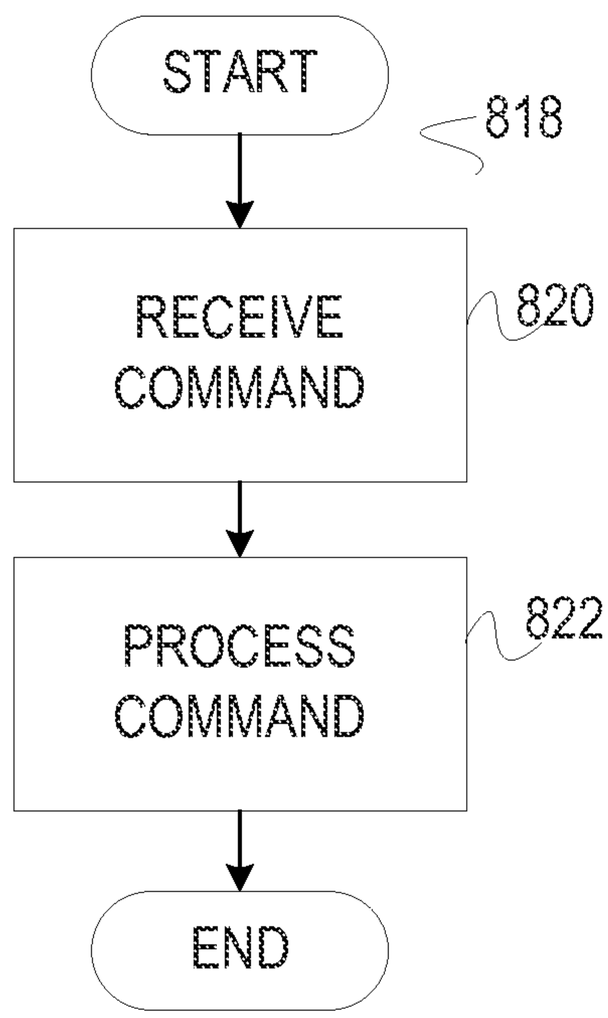
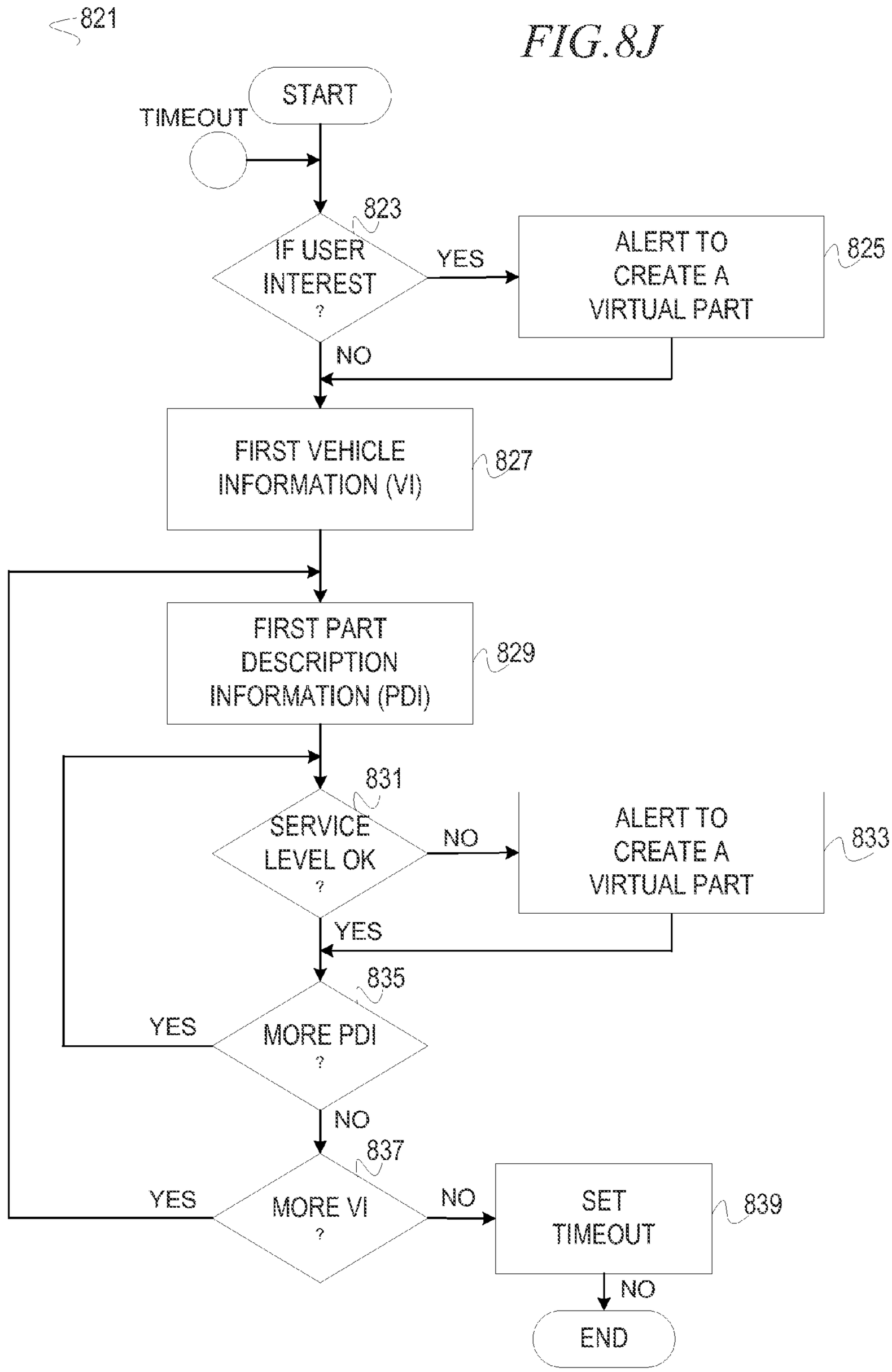

TOKEN PART
814
VEHICLE IDENTIFICATION INFORMATION
302
PART IDENTIFIER
306
PART TYPE IDENTIFIER
308
TOKEN PART PREFERENCE INFORMATION
816

*FIG. 8I*




821
FIG.8J
START
TIMEOUT
823
IF USER INTEREST ?
YES
ALERT TO CREATE A VIRTUAL PART
825
NO
FIRST VEHICLE INFORMATION (VI)
827
FIRST PART DESCRIPTION INFORMATION (PDI)
829
831
SERVICE LEVEL OK ?
NO
ALERT TO CREATE A VIRTUAL PART
833
YES
835
YES
MORE PDI ?
NO
837
YES
MORE VI ?
NO
SET TIMEOUT
839
NO
END

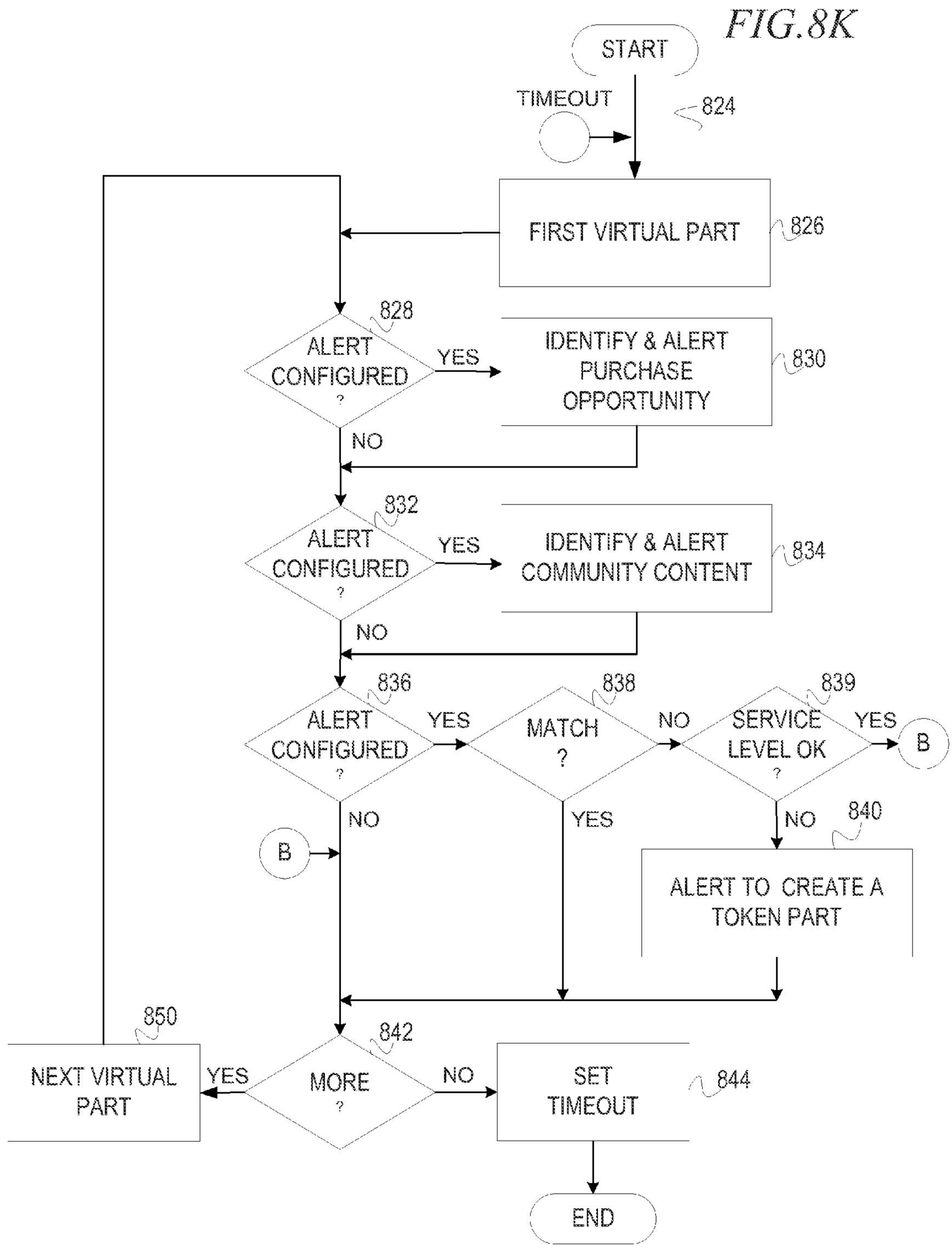


FIG.8K
START
TIMEOUT
824
FIRST VIRTUAL PART
826
828
ALERT CONFIGURED ?
YES
IDENTIFY & ALERT PURCHASE OPPORTUNITY
830
NO
832
ALERT CONFIGURED ?
YES
IDENTIFY & ALERT COMMUNITY CONTENT
834
NO
836
ALERT CONFIGURED ?
YES
838
MATCH ?
NO
839
SERVICE LEVEL OK ?
YES
B
NO
B
YES
NO
840
ALERT TO CREATE A TOKEN PART
850
NEXT VIRTUAL PART
YES
842
MORE ?
NO
SET TIMEOUT
844
END

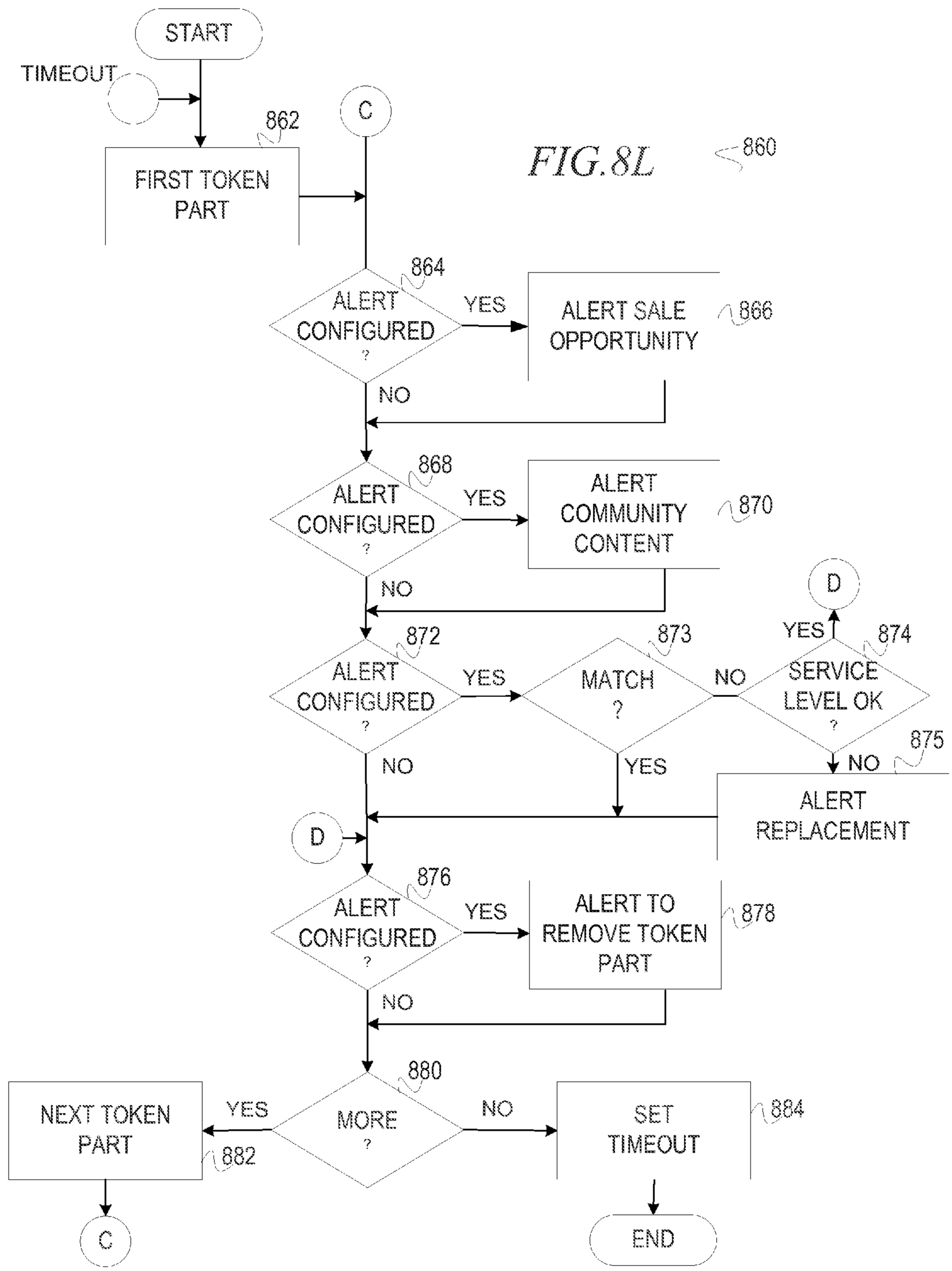

START
TIMEOUT
862
FIRST TOKEN PART
C
FIG.8L
860
864
ALERT CONFIGURED ?
YES
ALERT SALE OPPORTUNITY
866
NO
868
ALERT CONFIGURED ?
YES
ALERT COMMUNITY CONTENT
870
NO
D
872
ALERT CONFIGURED ?
YES
873
MATCH ?
NO
YES
874
SERVICE LEVEL OK ?
NO
875
ALERT REPLACEMENT
NO
YES
D
876
ALERT CONFIGURED ?
YES
ALERT TO REMOVE TOKEN PART
878
NO
880
MORE ?
YES
NEXT TOKEN PART
882
C
NO
SET TIMEOUT
884
END

*FIG. 8M*

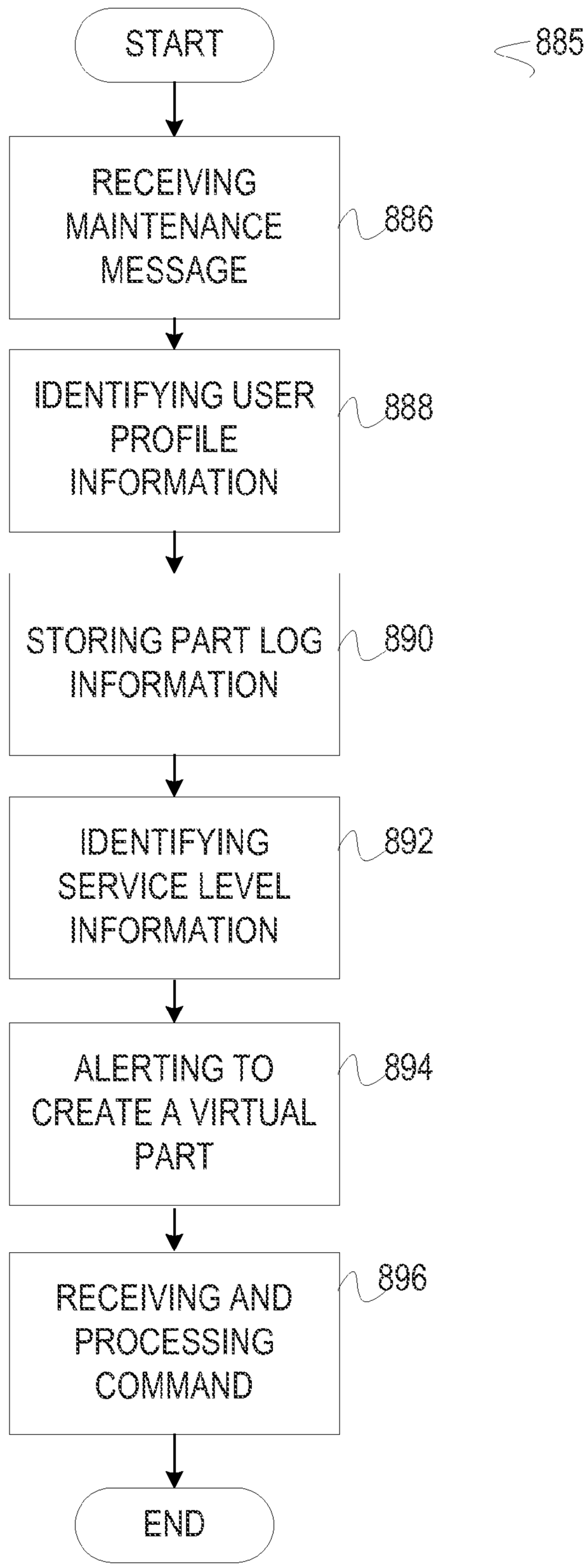
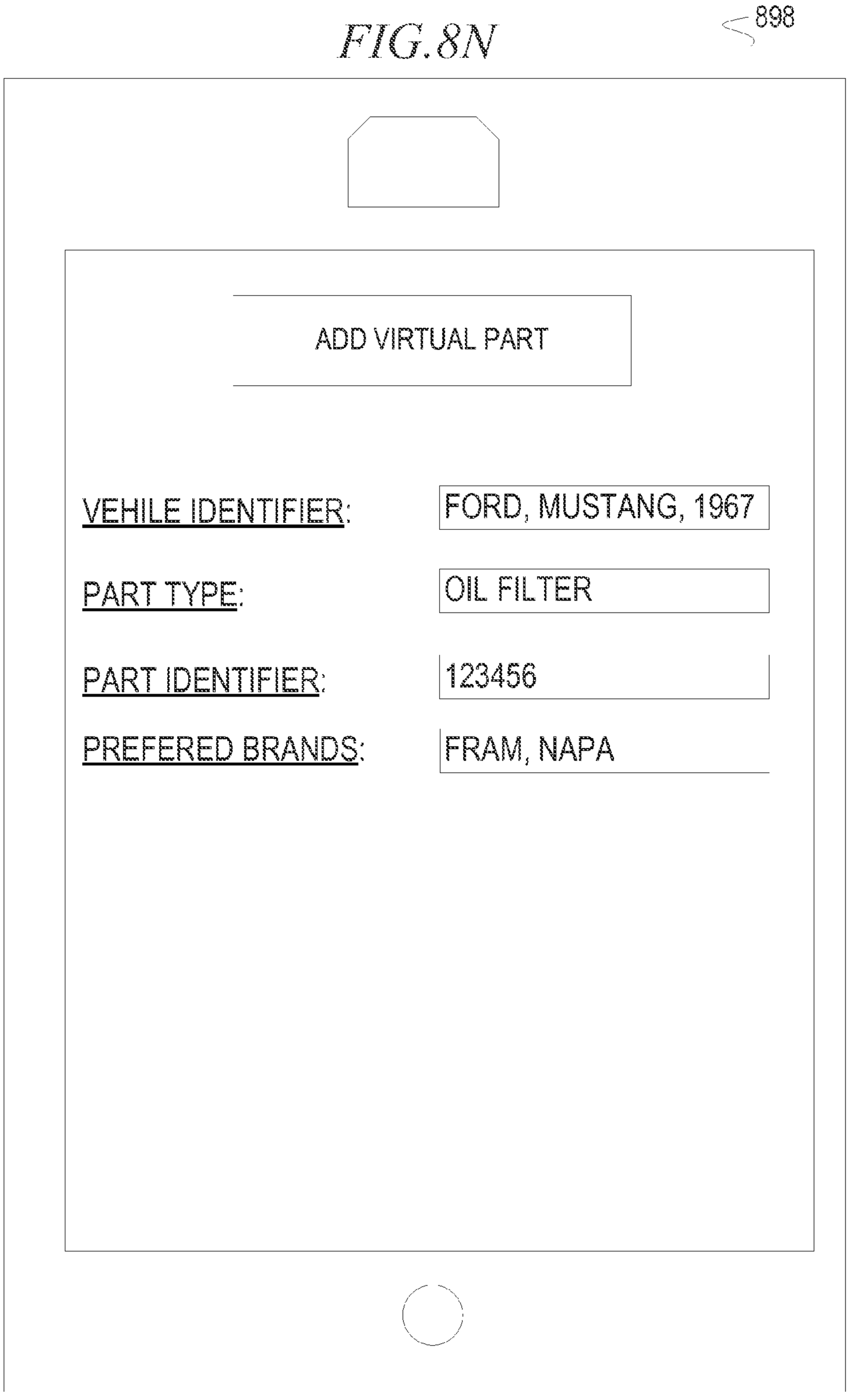

START
885
RECEIVING MAINTENANCE MESSAGE
886
IDENTIFYING USER PROFILE INFORMATION
888
STORING PART LOG INFORMATION
890
IDENTIFYING SERVICE LEVEL INFORMATION
892
ALERTING TO CREATE A VIRTUAL PART
894
RECEIVING AND PROCESSING COMMAND
896
END

FIG.8N


898
ADD VIRTUAL PART
VEHILE IDENTIFIER:
FORD, MUSTANG, 1967
PART TYPE:
OIL FILTER
PART IDENTIFIER:
123456
PREFERED BRANDS:
FRAM, NAPA

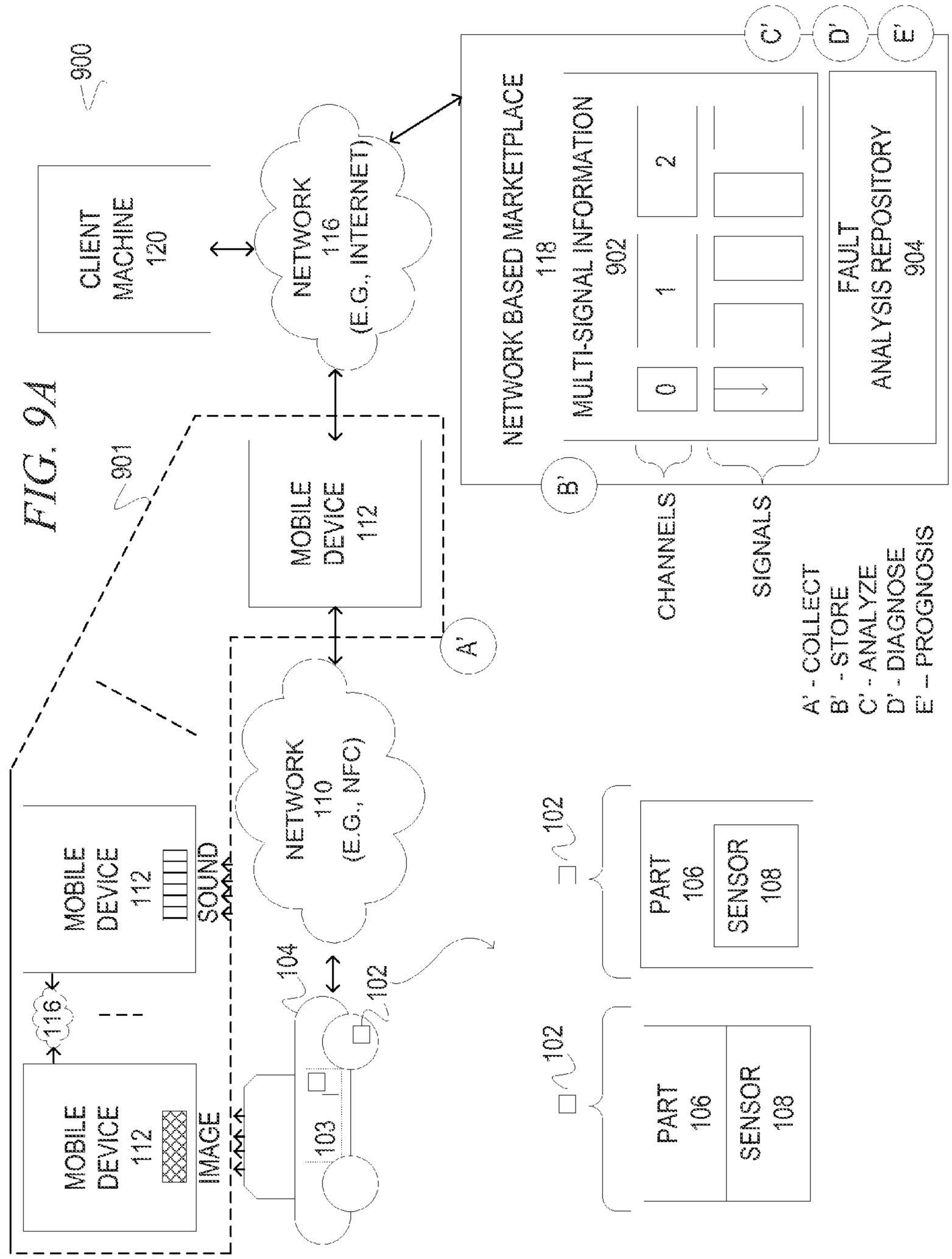

900
CLIENT MACHINE 120
NETWORK 116 (E.G., INTERNET)
NETWORK BASED MARKETPLACE 118
MULTI-SIGNAL INFORMATION 902
0
1
2
FAULT ANALYSIS REPOSITORY 904
C'
D'
E'
B'
CHANNELS
SIGNALS
A' - COLLECT
B' - STORE
C' - ANALYZE
D' - DIAGNOSE
E' – PROGNOSIS
901
MOBILE DEVICE 112
A'
NETWORK 110 (E.G., NFC)
MOBILE DEVICE 112
SOUND
116
MOBILE DEVICE 112
IMAGE
104
102
103
102
PART 106
SENSOR 108
102
PART 106
SENSOR 108

FIG. 9A

*FIG. 9B*

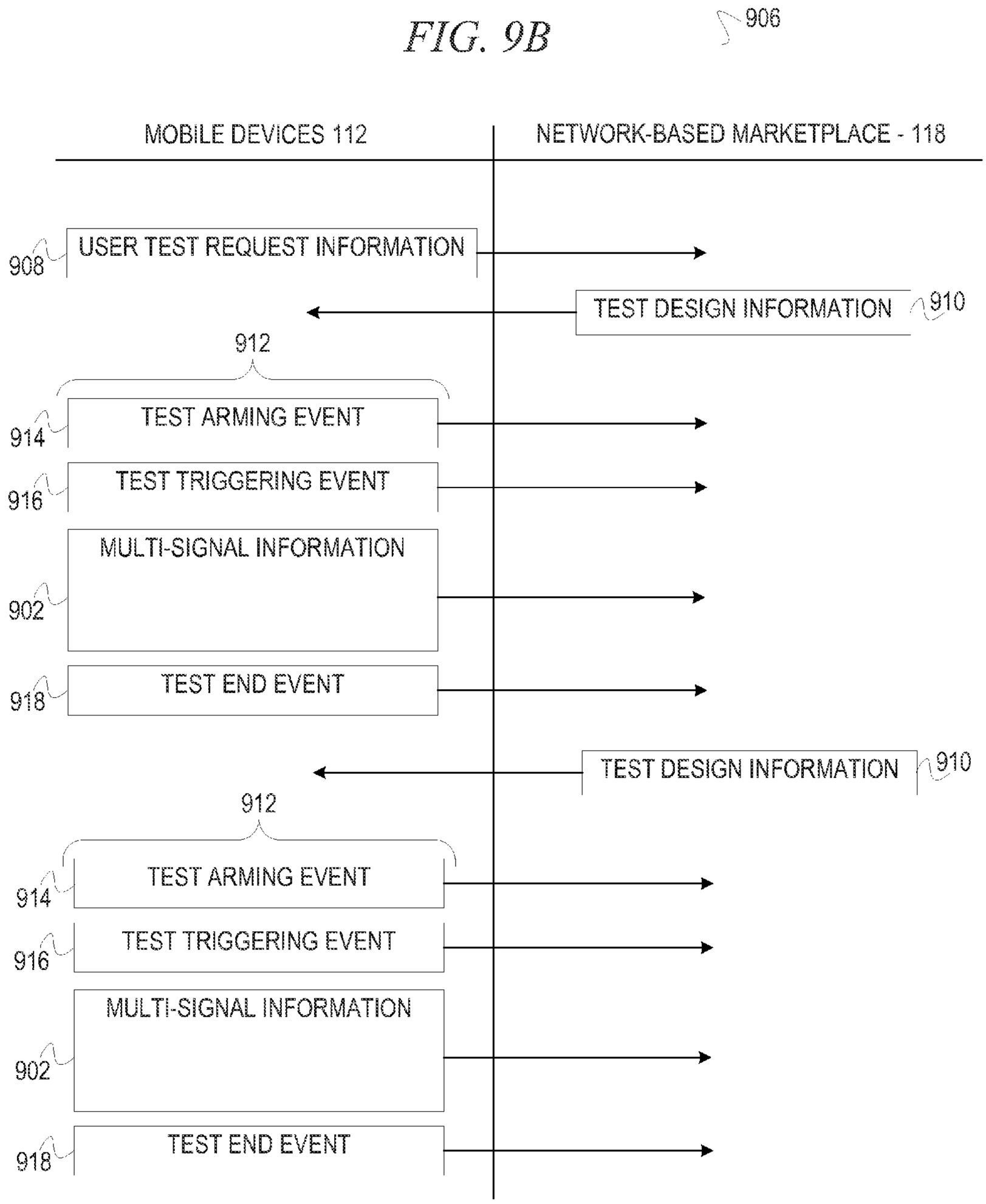

906
MOBILE DEVICES 112
NETWORK-BASED MARKETPLACE - 118
908
USER TEST REQUEST INFORMATION
TEST DESIGN INFORMATION
910
912
914
TEST ARMING EVENT
916
TEST TRIGGERING EVENT
MULTI-SIGNAL INFORMATION
902
918
TEST END EVENT
TEST DESIGN INFORMATION
910
912
914
TEST ARMING EVENT
916
TEST TRIGGERING EVENT
MULTI-SIGNAL INFORMATION
902
918
TEST END EVENT

*FIG. 9C*

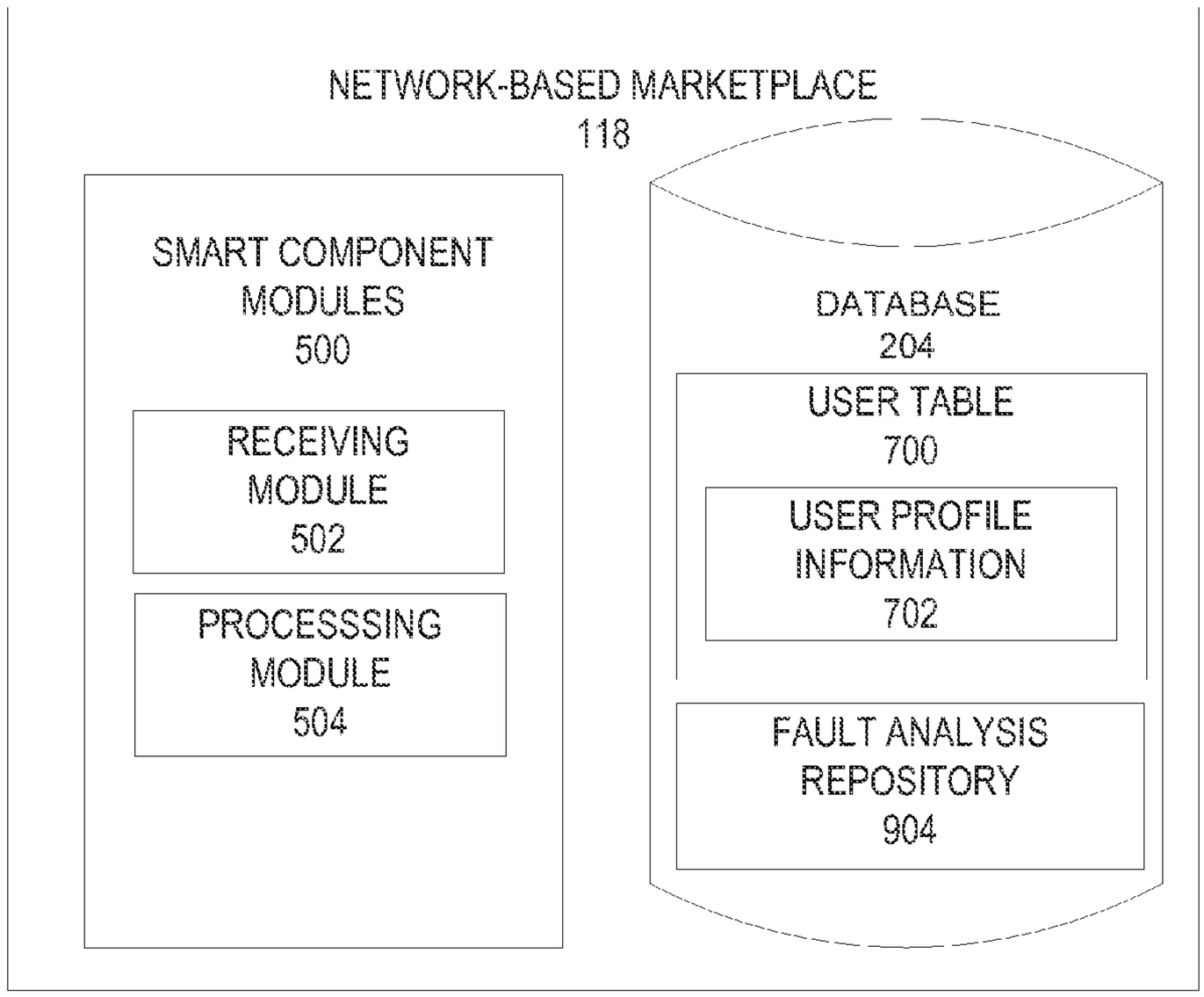



*FIG. 9D*

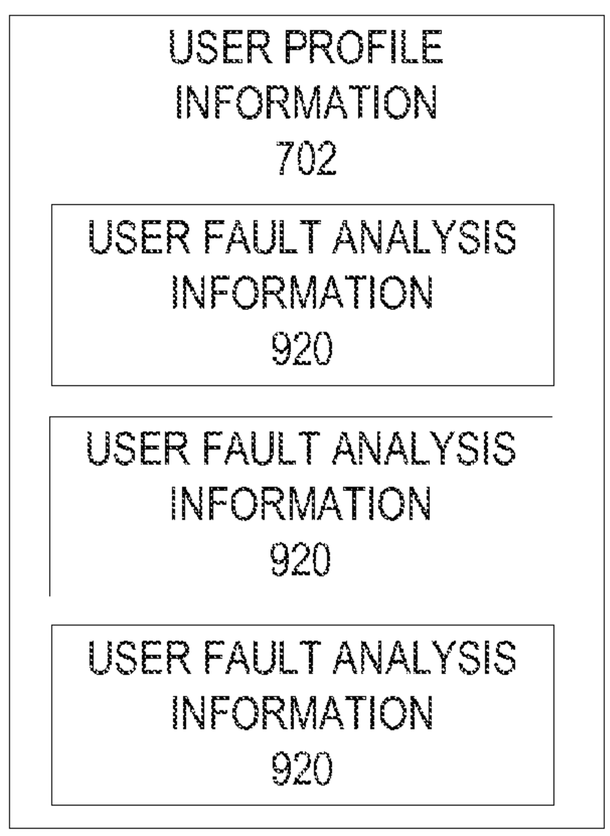



*FIG. 9E*

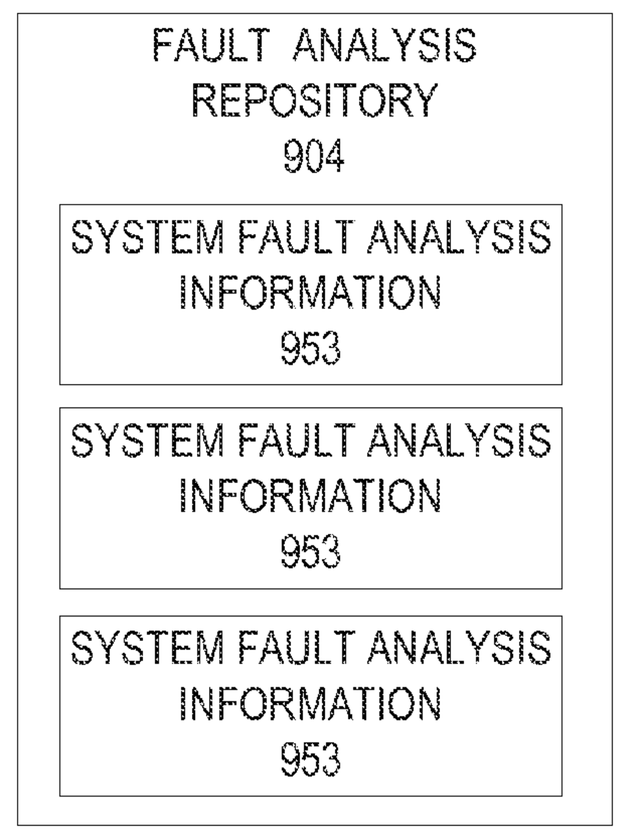


*FIG. 9F*

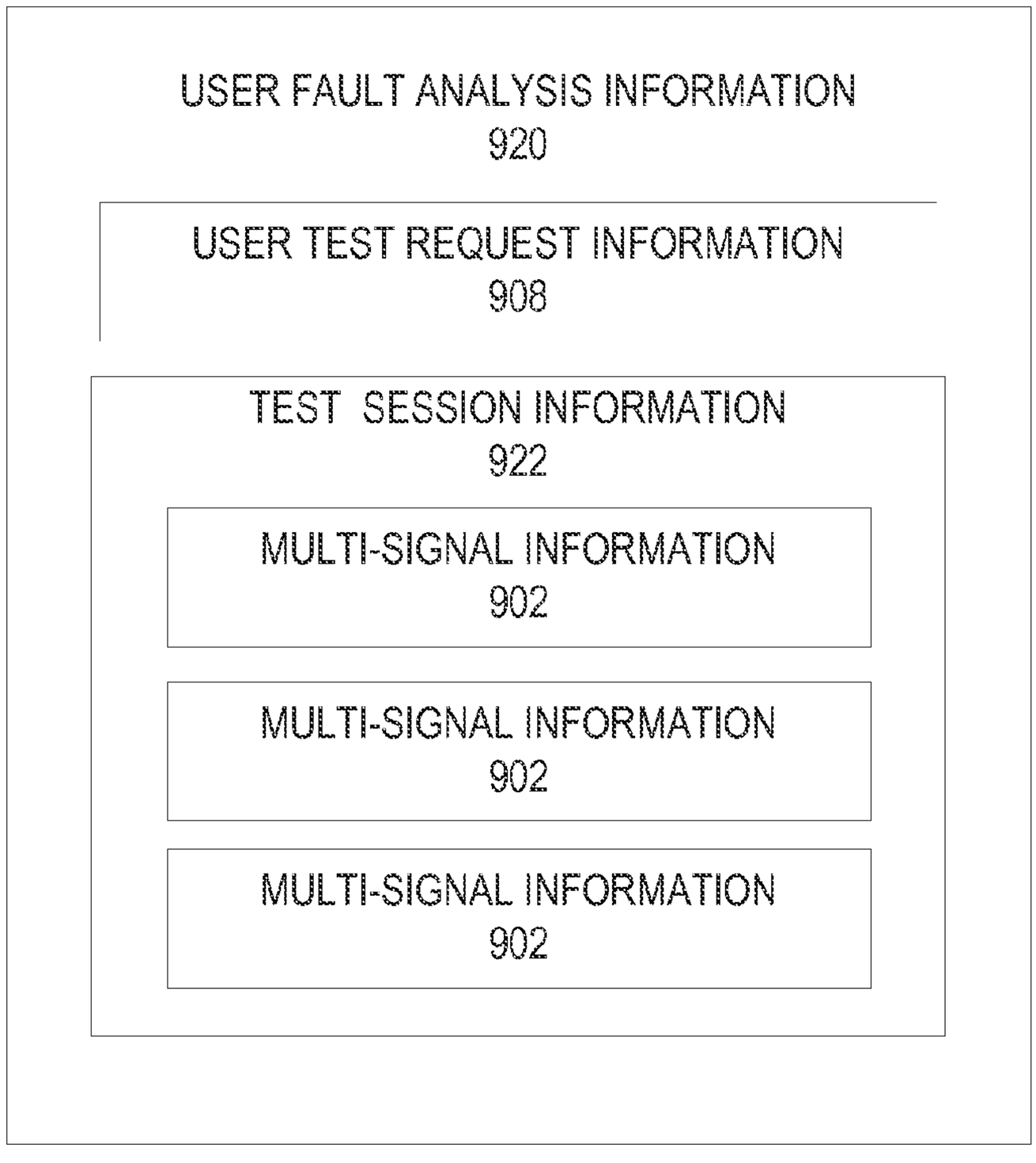



*FIG. 9FF*

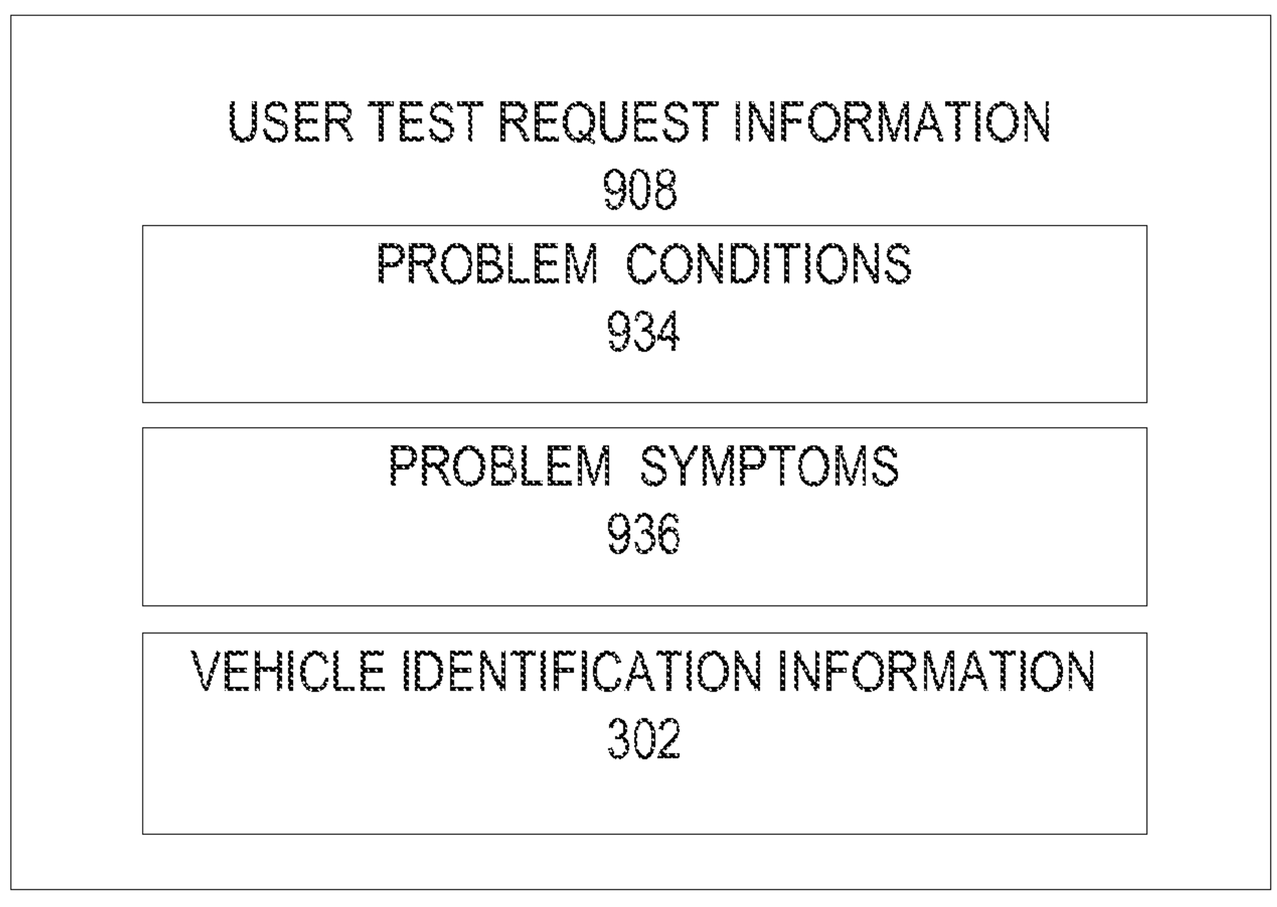


*FIG. 9G*

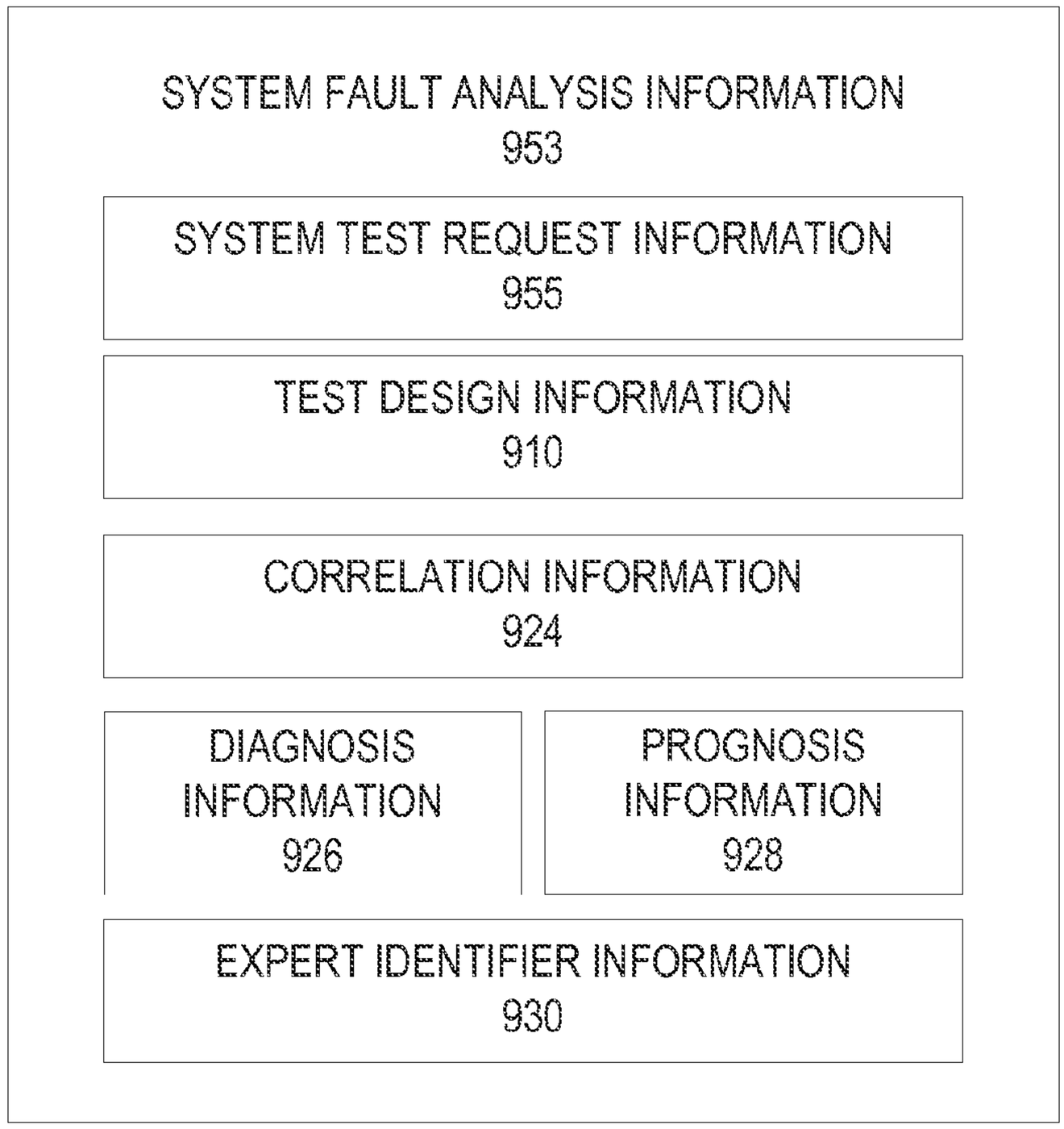



*FIG. 9GG*

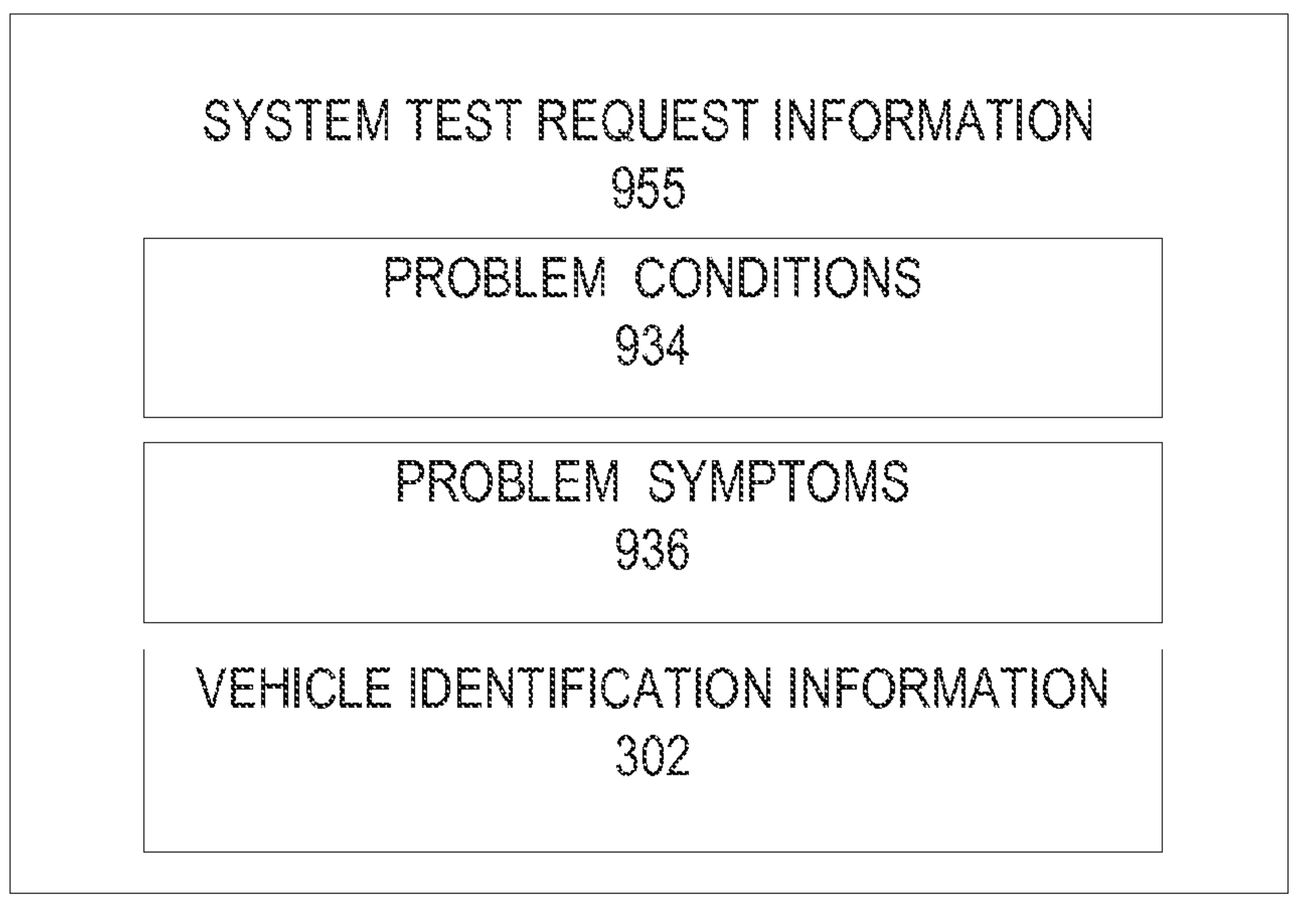


*FIG. 9H*

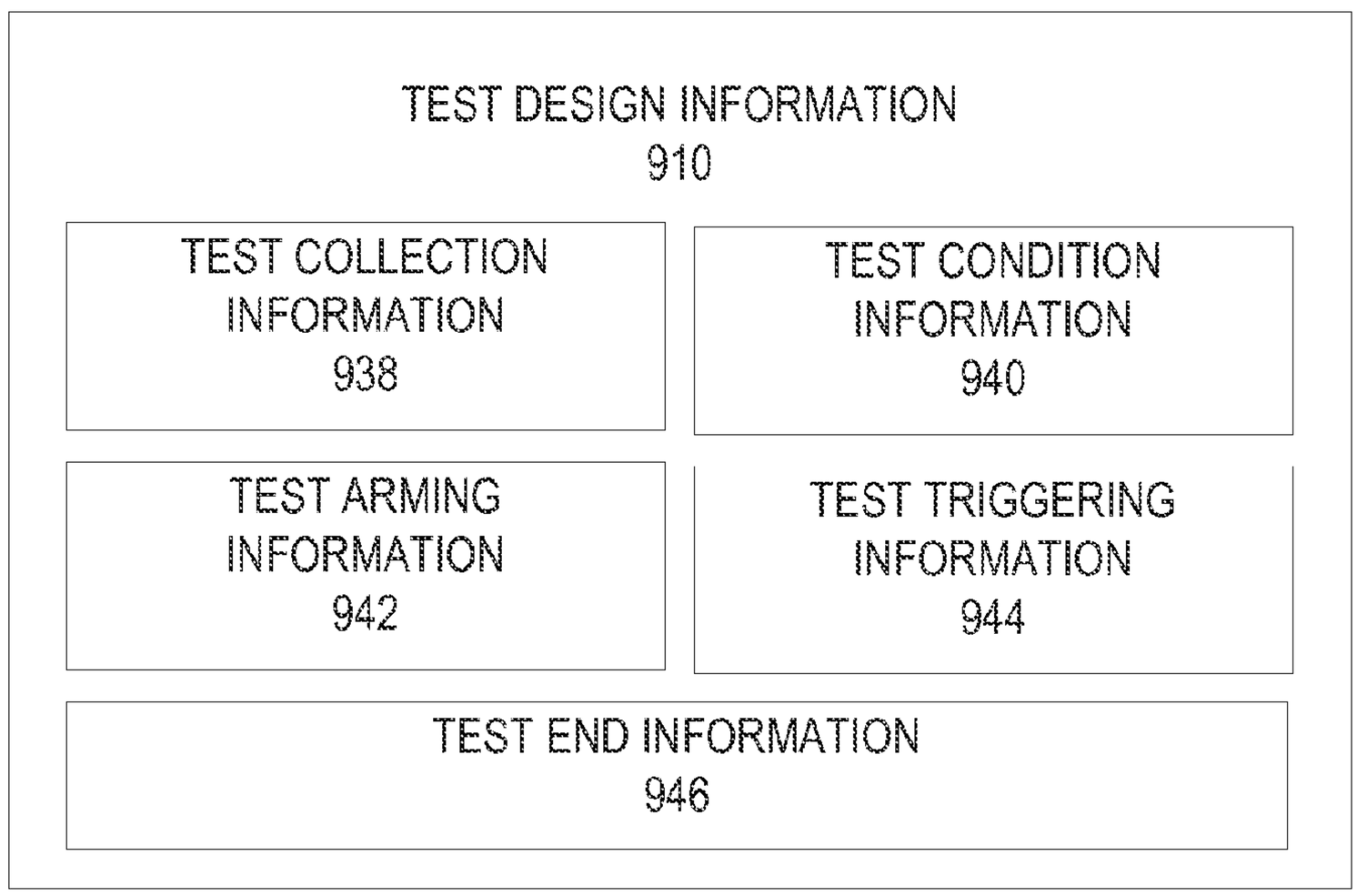

TEST DESIGN INFORMATION
910
TEST COLLECTION INFORMATION
938
TEST CONDITION INFORMATION
940
TEST ARMING INFORMATION
942
TEST TRIGGERING INFORMATION
944
TEST END INFORMATION
946

*FIG. 9I*

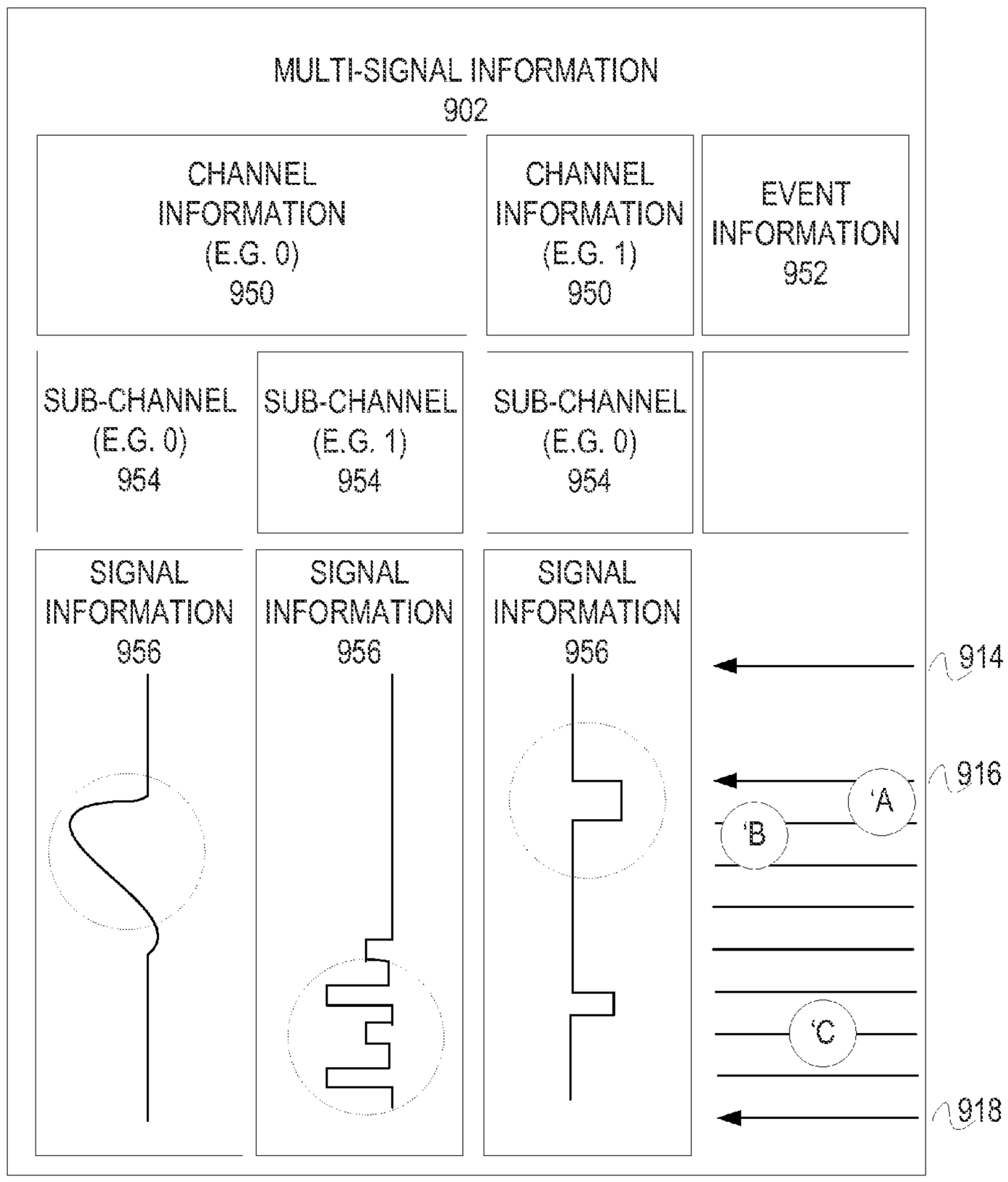

MULTI-SIGNAL INFORMATION
902
CHANNEL INFORMATION (E.G. 0)
950
CHANNEL INFORMATION (E.G. 1)
950
EVENT INFORMATION
952
SUB-CHANNEL (E.G. 0)
954
SUB-CHANNEL (E.G. 1)
954
SUB-CHANNEL (E.G. 0)
954
SIGNAL INFORMATION
956
SIGNAL INFORMATION
956
SIGNAL INFORMATION
956
914
916
'A
'B
'C
918

*FIG. 9J*

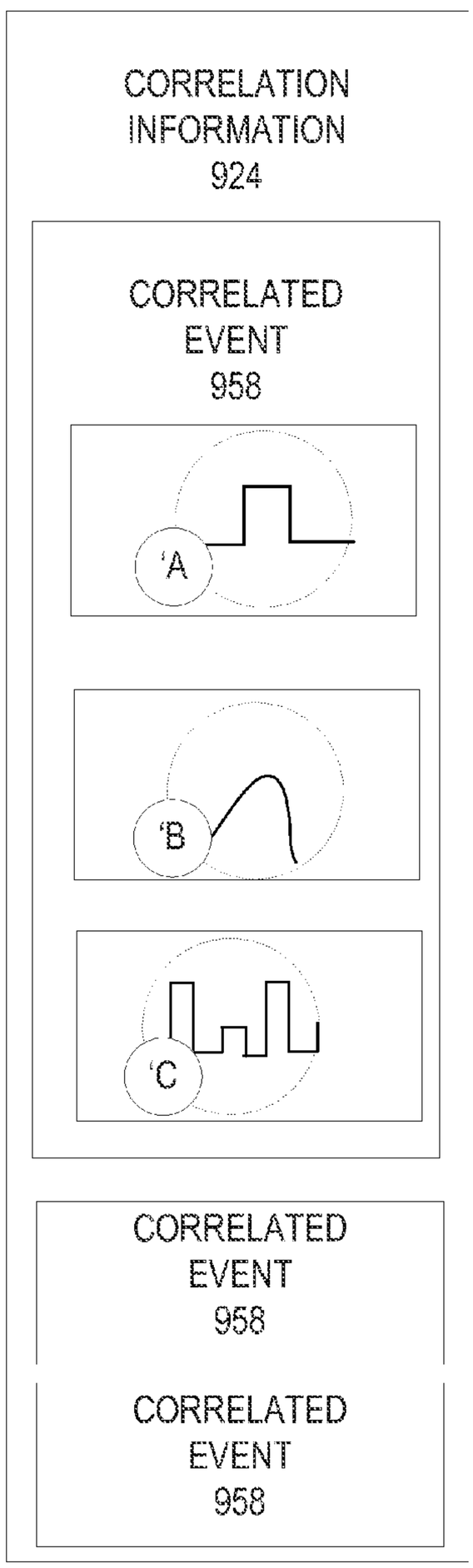



*FIG. 9K*

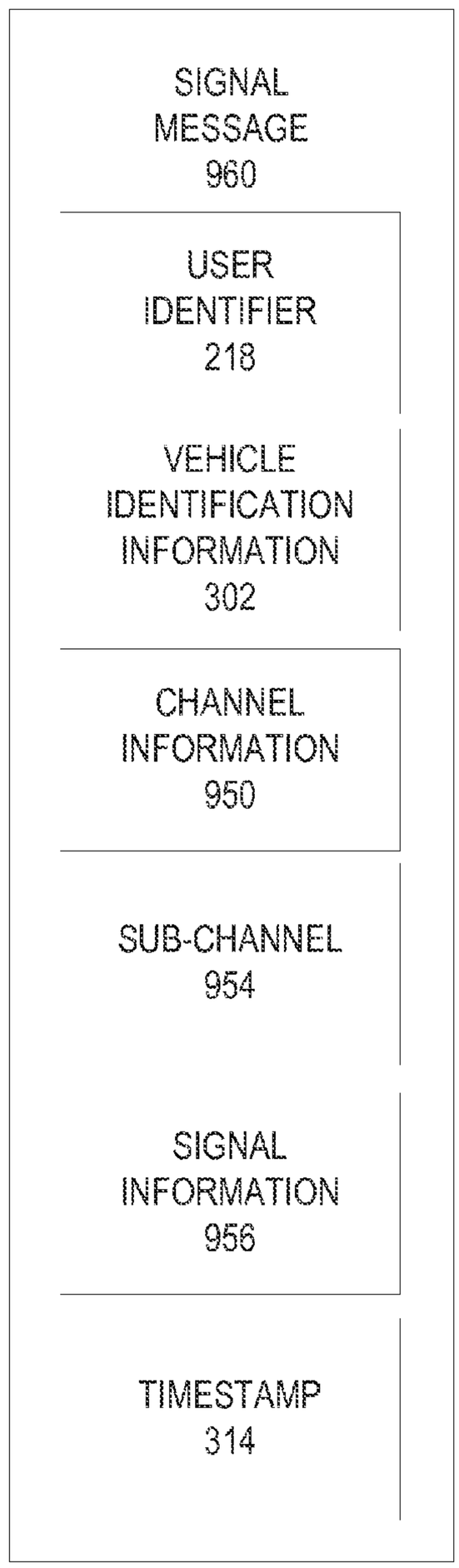
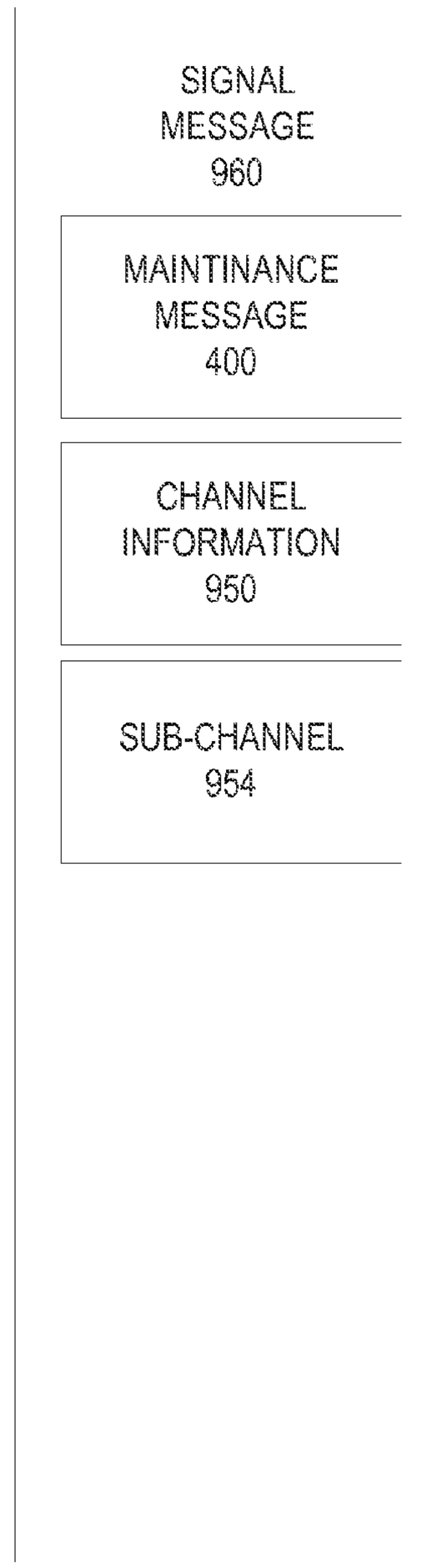



*FIG. 9L*



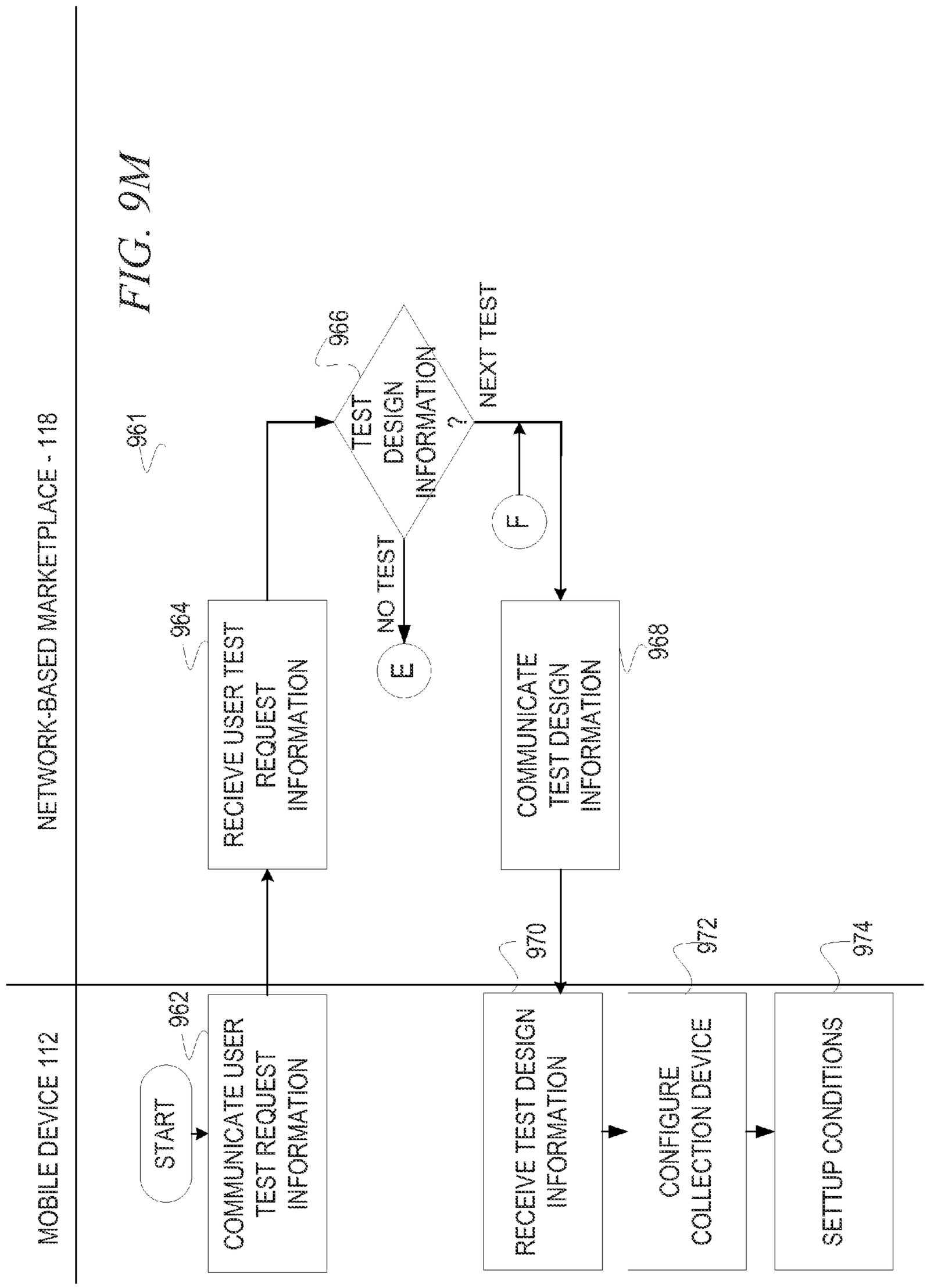

NETWORK-BASED MARKETPLACE - 118
MOBILE DEVICE 112
961
962
START
COMMUNICATE USER TEST REQUEST INFORMATION
964
RECIEVE USER TEST REQUEST INFORMATION
966
TEST DESIGN INFORMATION ?
NO TEST
E
NEXT TEST
F
968
COMMUNICATE TEST DESIGN INFORMATION
970
RECEIVE TEST DESIGN INFORMATION
972
CONFIGURE COLLECTION DEVICE
974
SETTUP CONDITIONS

FIG. 9M

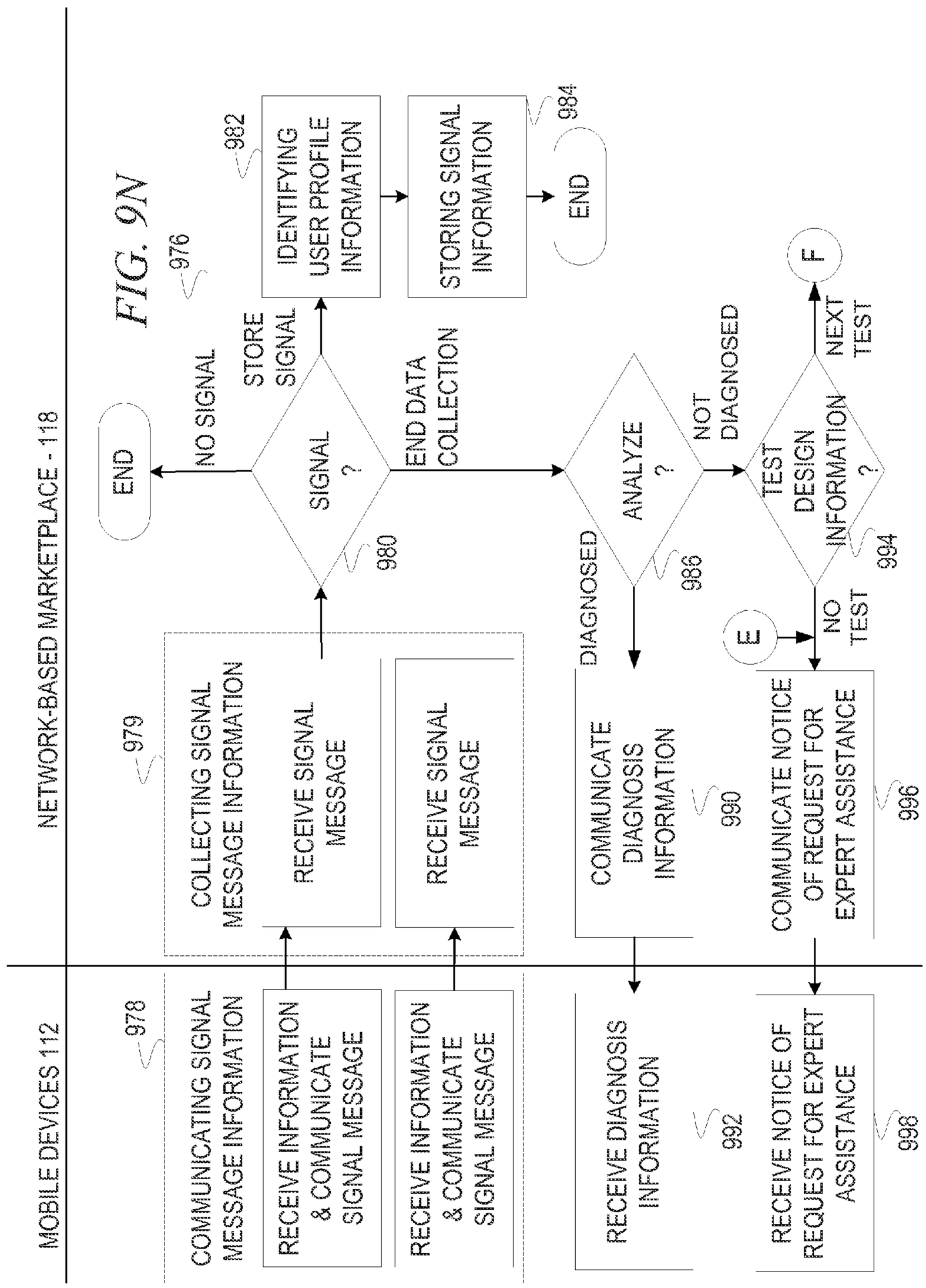

NETWORK-BASED MARKETPLACE - 118
MOBILE DEVICES 112
978
COMMUNICATING SIGNAL MESSAGE INFORMATION
979
COLLECTING SIGNAL MESSAGE INFORMATION
RECEIVE INFORMATION & COMMUNICATE SIGNAL MESSAGE
RECEIVE SIGNAL MESSAGE
RECEIVE INFORMATION & COMMUNICATE SIGNAL MESSAGE
RECEIVE SIGNAL MESSAGE
980
SIGNAL ?
NO SIGNAL
END
STORE SIGNAL
982
IDENTIFYING USER PROFILE INFORMATION
STORING SIGNAL INFORMATION
984
END
END DATA COLLECTION
986
ANALYZE ?
DIAGNOSED
NOT DIAGNOSED
990
COMMUNICATE DIAGNOSIS INFORMATION
992
RECEIVE DIAGNOSIS INFORMATION
994
TEST DESIGN INFORMATION ?
NO TEST
NEXT TEST
E
F
996
COMMUNICATE NOTICE OF REQUEST FOR EXPERT ASSISTANCE
998
RECEIVE NOTICE OF REQUEST FOR EXPERT ASSISTANCE

FIG. 9N

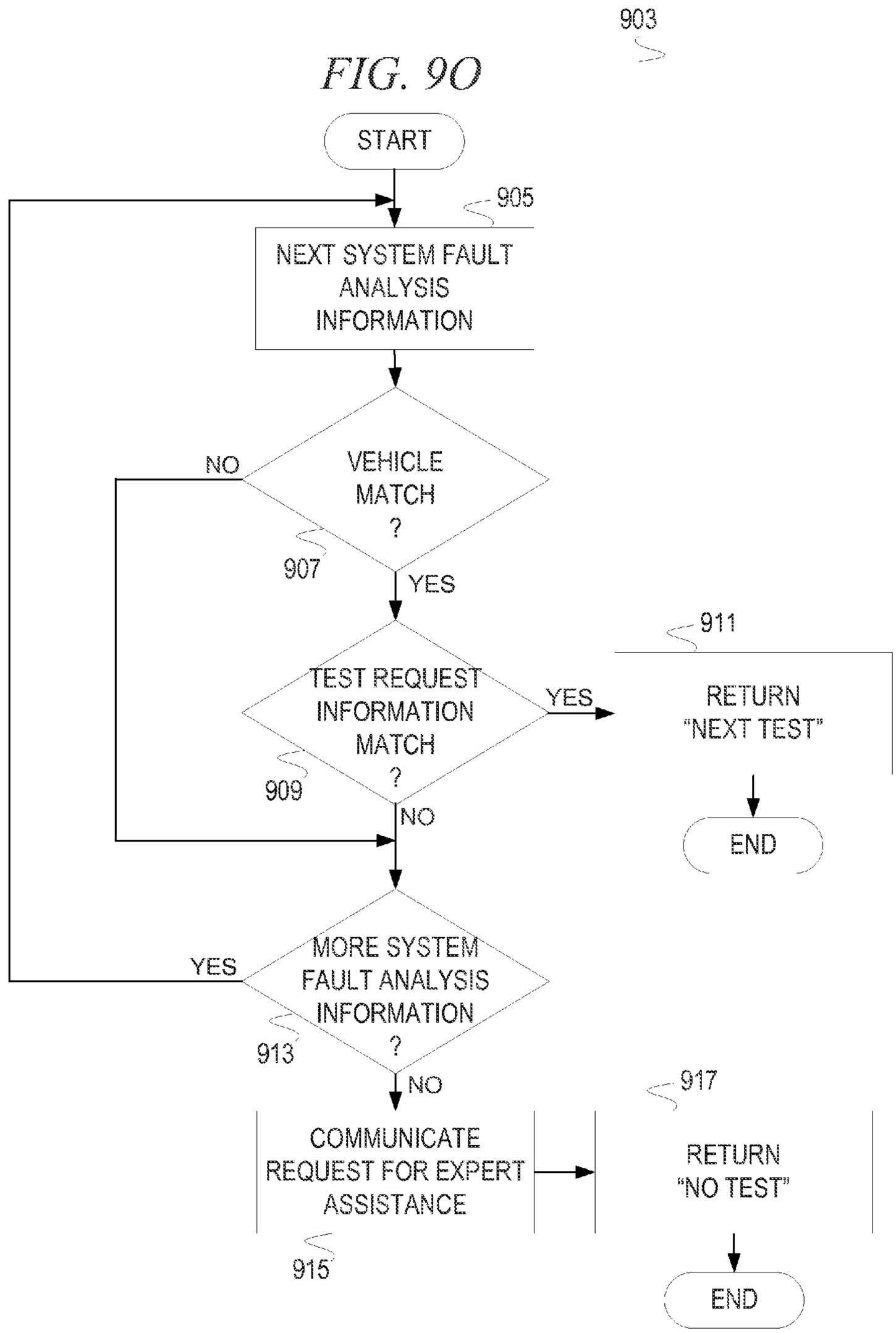

903
FIG. 9O
START
905
NEXT SYSTEM FAULT ANALYSIS INFORMATION
VEHICLE MATCH ?
NO
907
YES
911
TEST REQUEST INFORMATION MATCH ?
YES
RETURN "NEXT TEST"
909
NO
END
MORE SYSTEM FAULT ANALYSIS INFORMATION ?
YES
913
NO
917
COMMUNICATE REQUEST FOR EXPERT ASSISTANCE
RETURN "NO TEST"
915
END

*FIG. 9P*

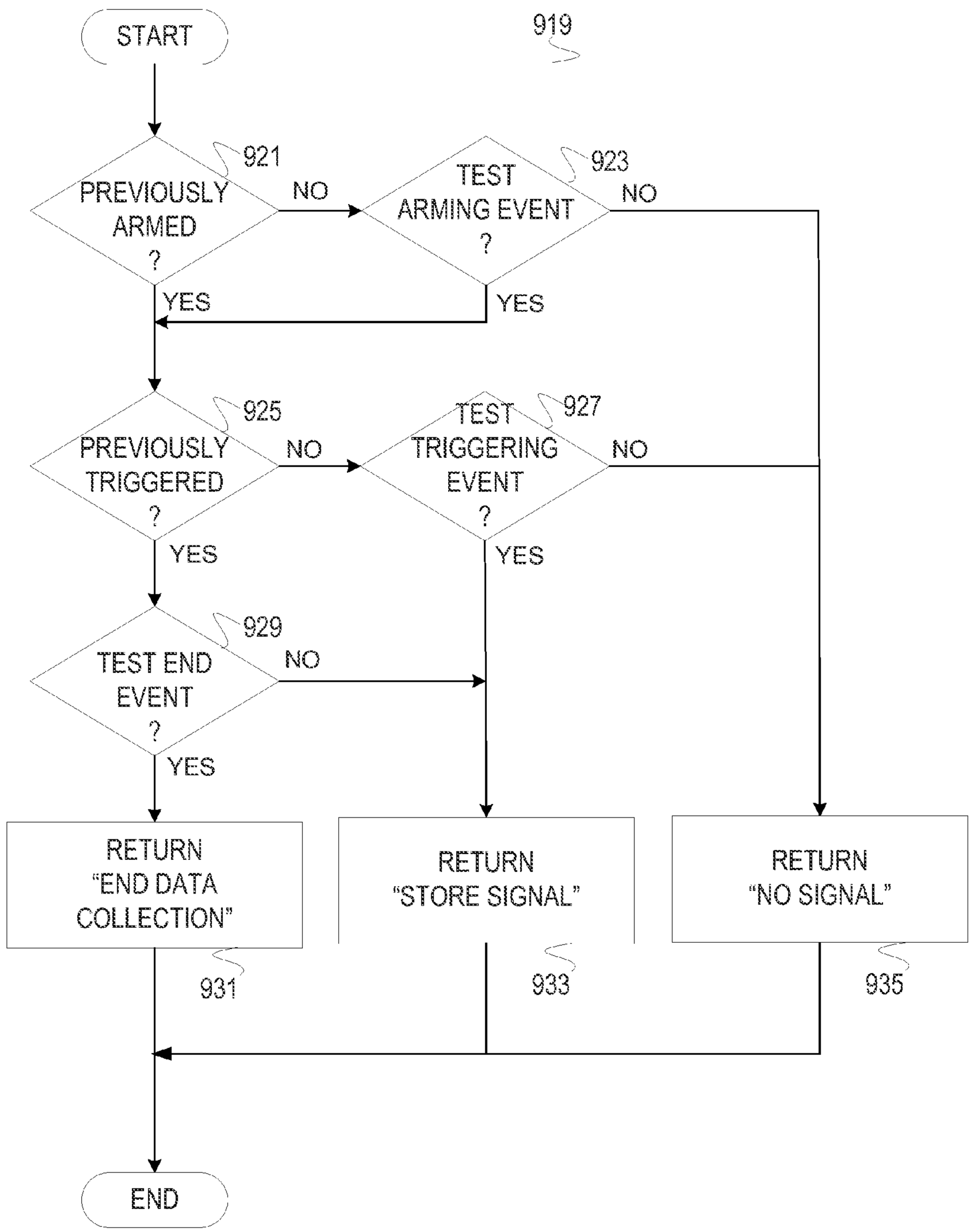

START
919
921
PREVIOUSLY ARMED ?
NO
923
TEST ARMING EVENT ?
NO
YES
YES
925
PREVIOUSLY TRIGGERED ?
NO
927
TEST TRIGGERING EVENT ?
NO
YES
YES
929
TEST END EVENT ?
NO
YES
RETURN "END DATA COLLECTION"
RETURN "STORE SIGNAL"
RETURN "NO SIGNAL"
931
933
935
END

*FIG. 9Q*

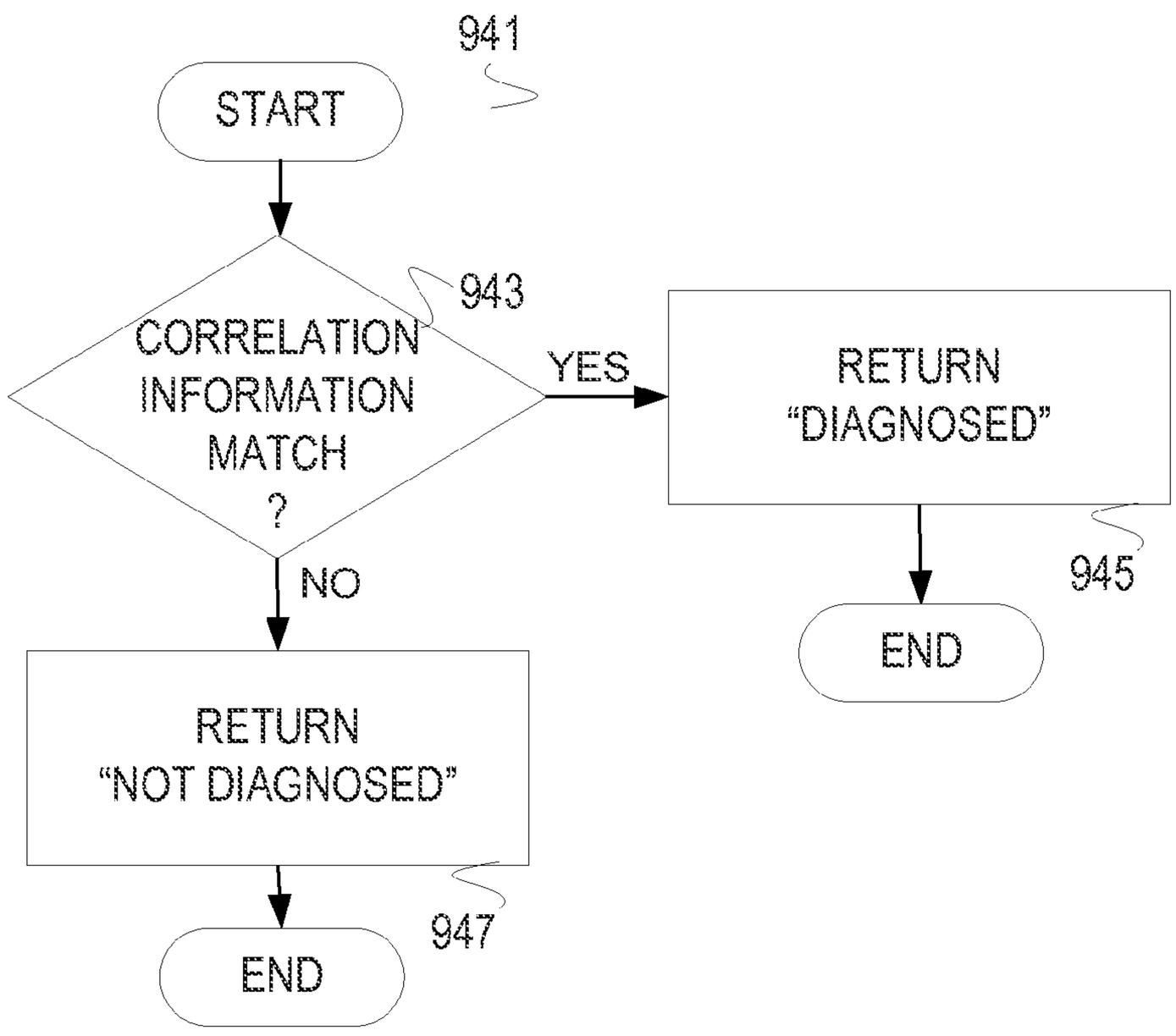

941
START
943
CORRELATION INFORMATION MATCH ?
YES
RETURN "DIAGNOSED"
945
END
NO
RETURN "NOT DIAGNOSED"
947
END

*FIG. 9R*

949

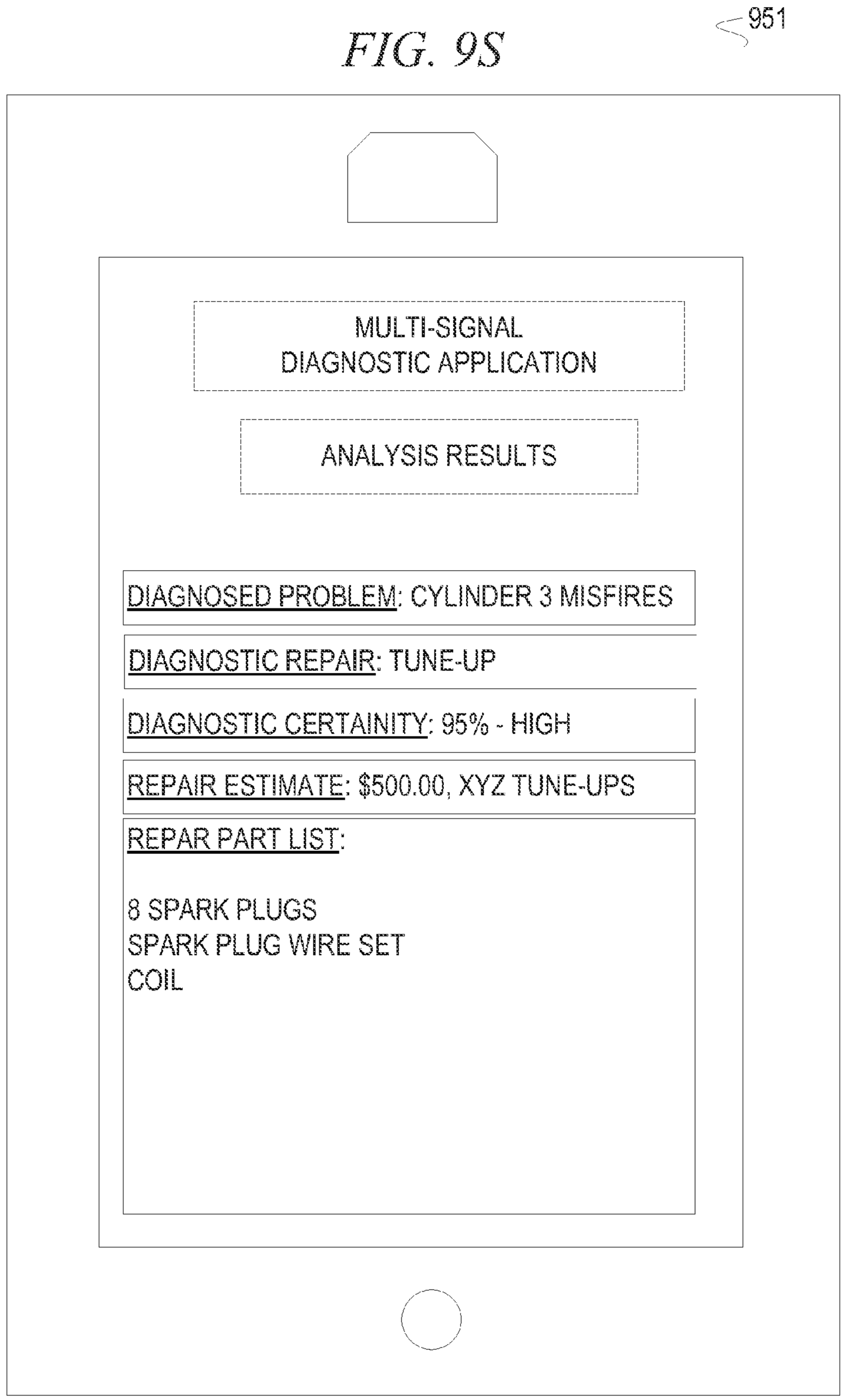
MULTI-SIGNAL FAULT ANALYSIS APPLICATION

CONFIGURATION USER INTERFACE

COLLECTION DEVICE - CHANNEL 0

| CHAN | SUB | SIGNAL | TELEPHONE |
|---|---|---|---|
| 0 | 0 | AUDIO | 408 876-2221 |
| 0 | 1 | VISUAL | |
| 1 | 0 | SMART COMPONENTS | 408 876-1234 |
| 2 | 0 | TEMP | 408 888-1234 |
| 3 | 0 | ACCEL | 408 123-1234 |

*FIG. 9S*


951
MULTI-SIGNAL
DIAGNOSTIC APPLICATION
ANALYSIS RESULTS
DIAGNOSED PROBLEM: CYLINDER 3 MISFIRES
DIAGNOSTIC REPAIR: TUNE-UP
DIAGNOSTIC CERTAINITY: 95% - HIGH
REPAIR ESTIMATE: $500.00, XYZ TUNE-UPS
REPAR PART LIST:
8 SPARK PLUGS
SPARK PLUG WIRE SET
COIL

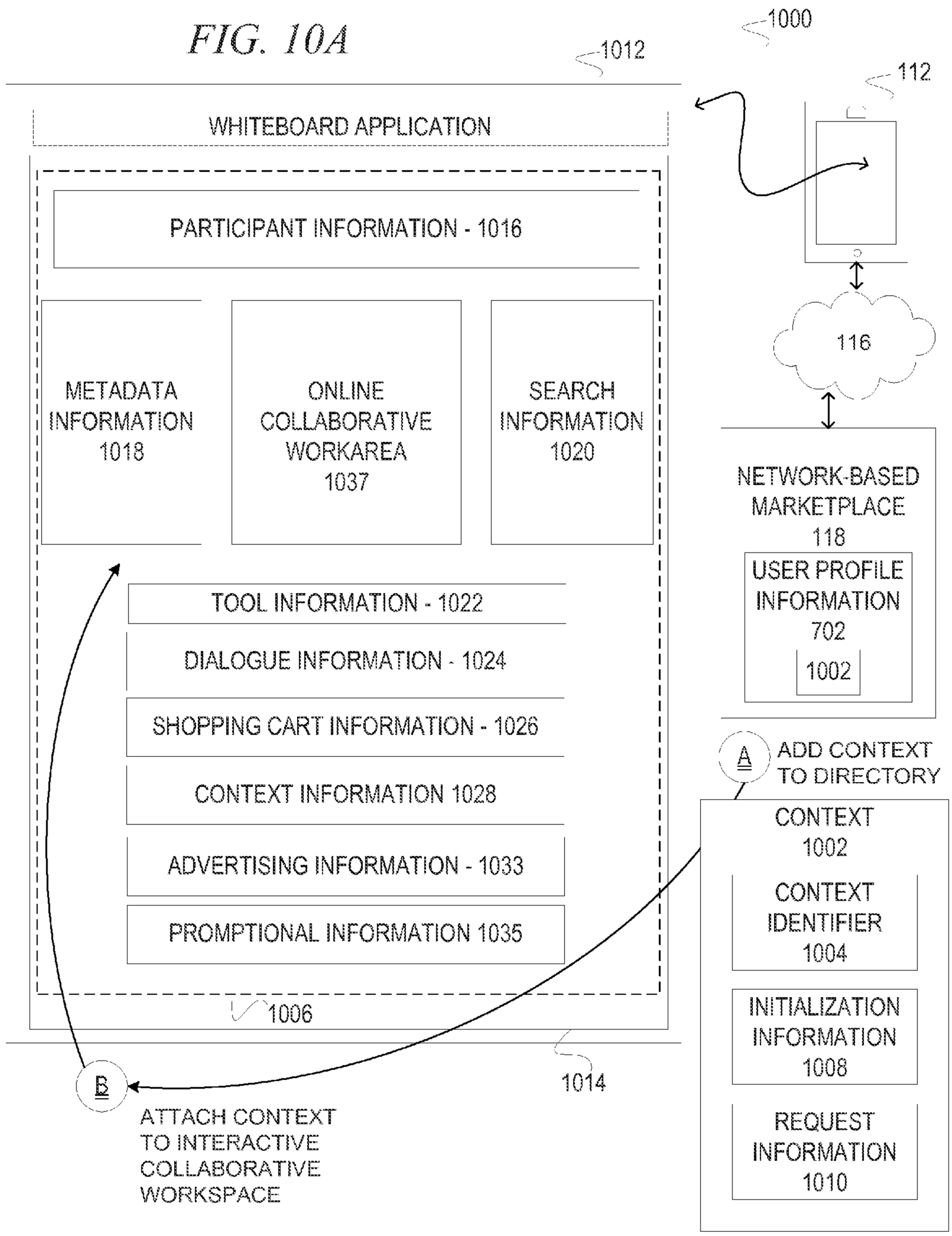


FIG. 10A
1000
1012
112
WHITEBOARD APPLICATION
PARTICIPANT INFORMATION - 1016
METADATA INFORMATION 1018
ONLINE COLLABORATIVE WORKAREA 1037
SEARCH INFORMATION 1020
TOOL INFORMATION - 1022
DIALOGUE INFORMATION - 1024
SHOPPING CART INFORMATION - 1026
CONTEXT INFORMATION 1028
ADVERTISING INFORMATION - 1033
PROMPTIONAL INFORMATION 1035
1006
1014
116
NETWORK-BASED MARKETPLACE 118
USER PROFILE INFORMATION 702
1002
A
ADD CONTEXT TO DIRECTORY
CONTEXT 1002
CONTEXT IDENTIFIER 1004
INITIALIZATION INFORMATION 1008
REQUEST INFORMATION 1010
B
ATTACH CONTEXT TO INTERACTIVE COLLABORATIVE WORKSPACE

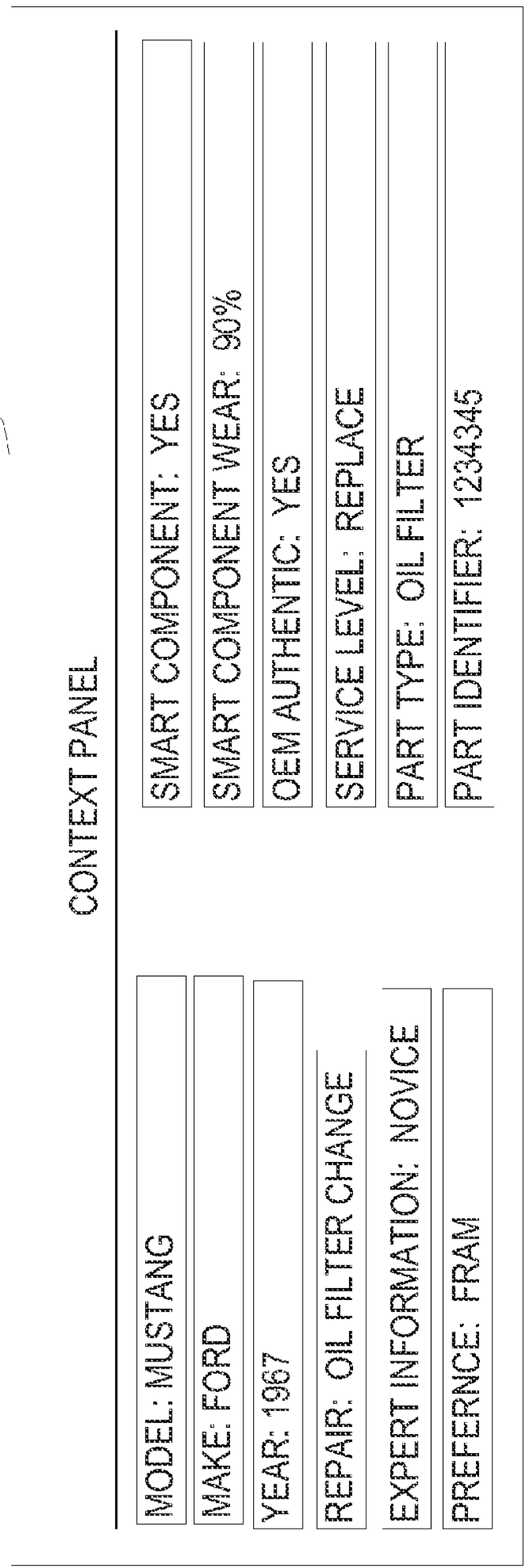



FIG. 10B

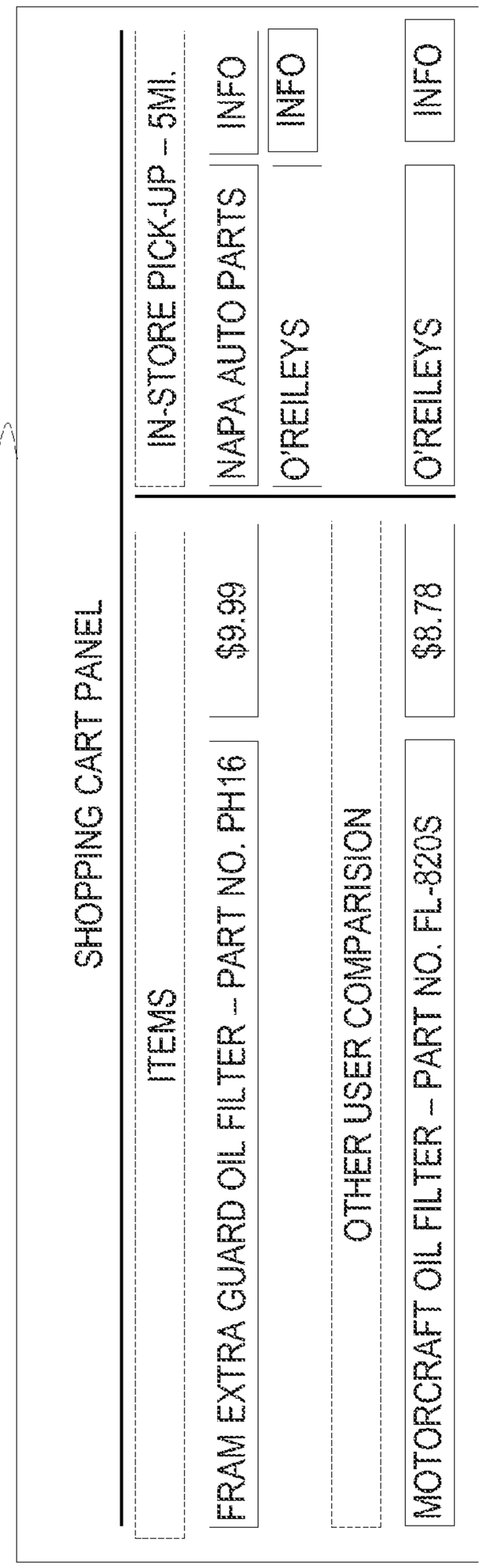



FIG. 10C

FIG. 10D

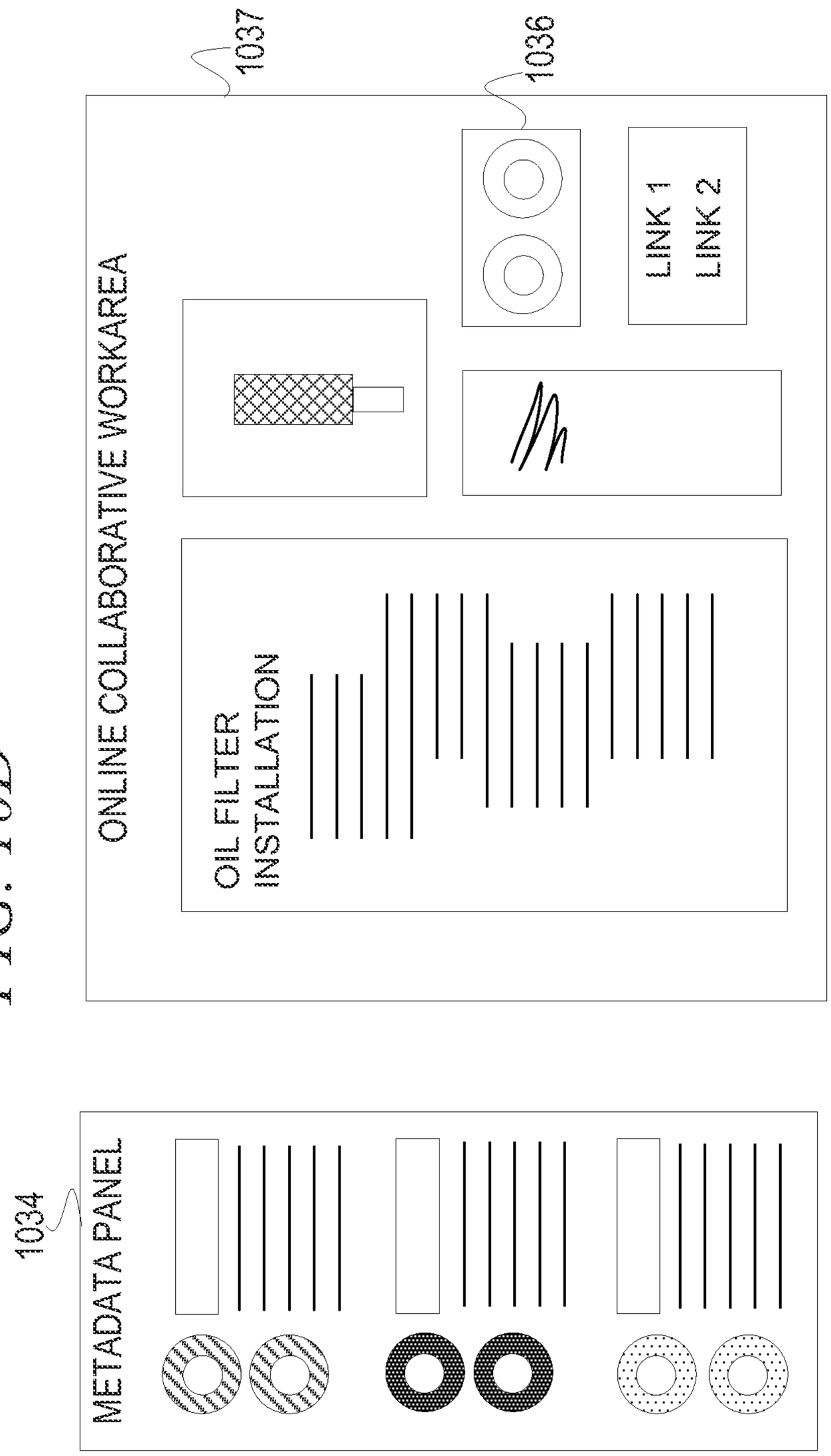
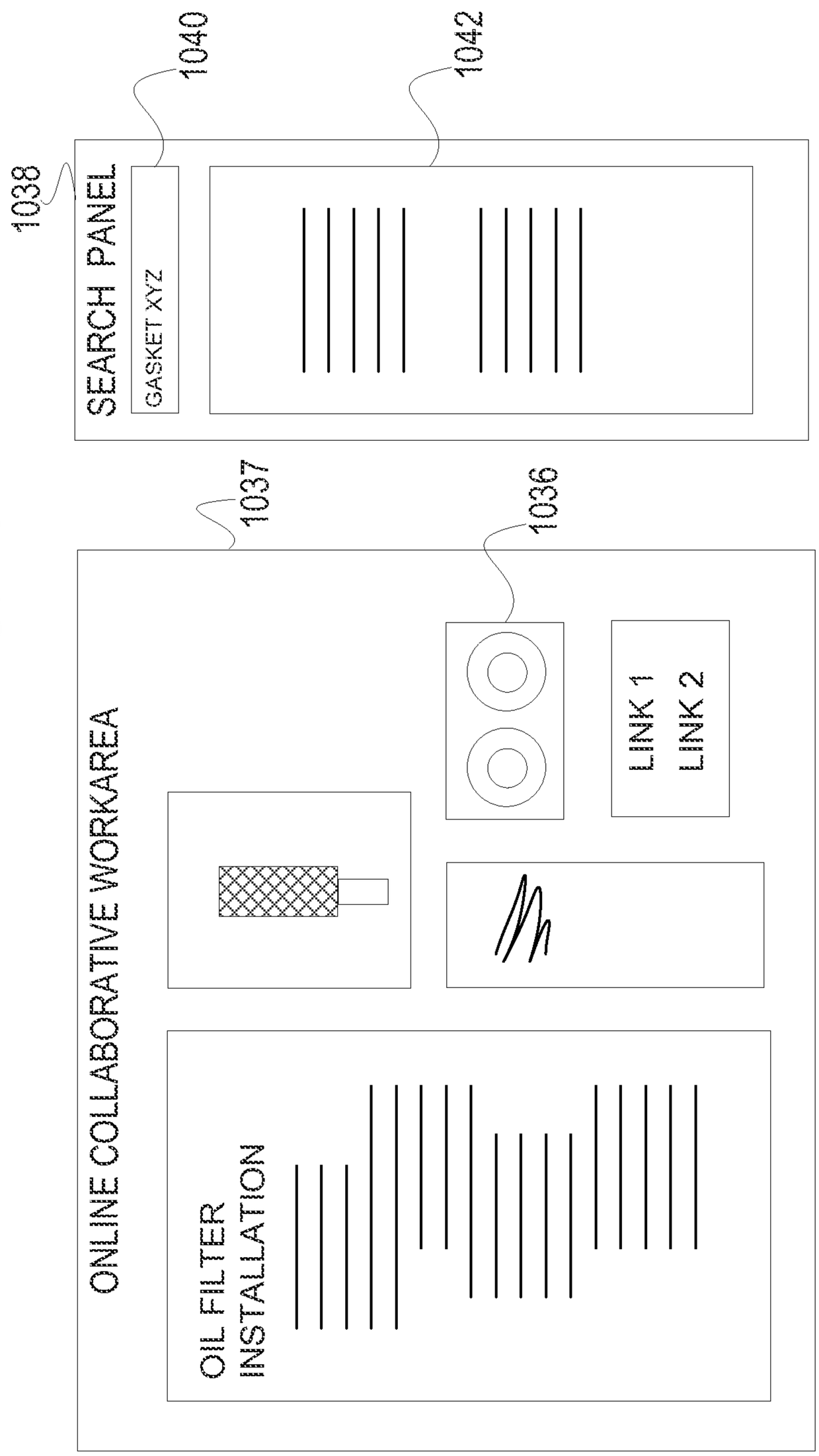

1037
1036
ONLINE COLLABORATIVE WORKAREA
LINK 1
LINK 2
OIL FILTER
INSTALLATION
1034
METADATA PANEL

FIG. 10E


1038
SEARCH PANEL
GASKET XYZ
1040
1042
ONLINE COLLABORATIVE WORKAREA
1037
1036
LINK 1
LINK 2
OIL FILTER
INSTALLATION

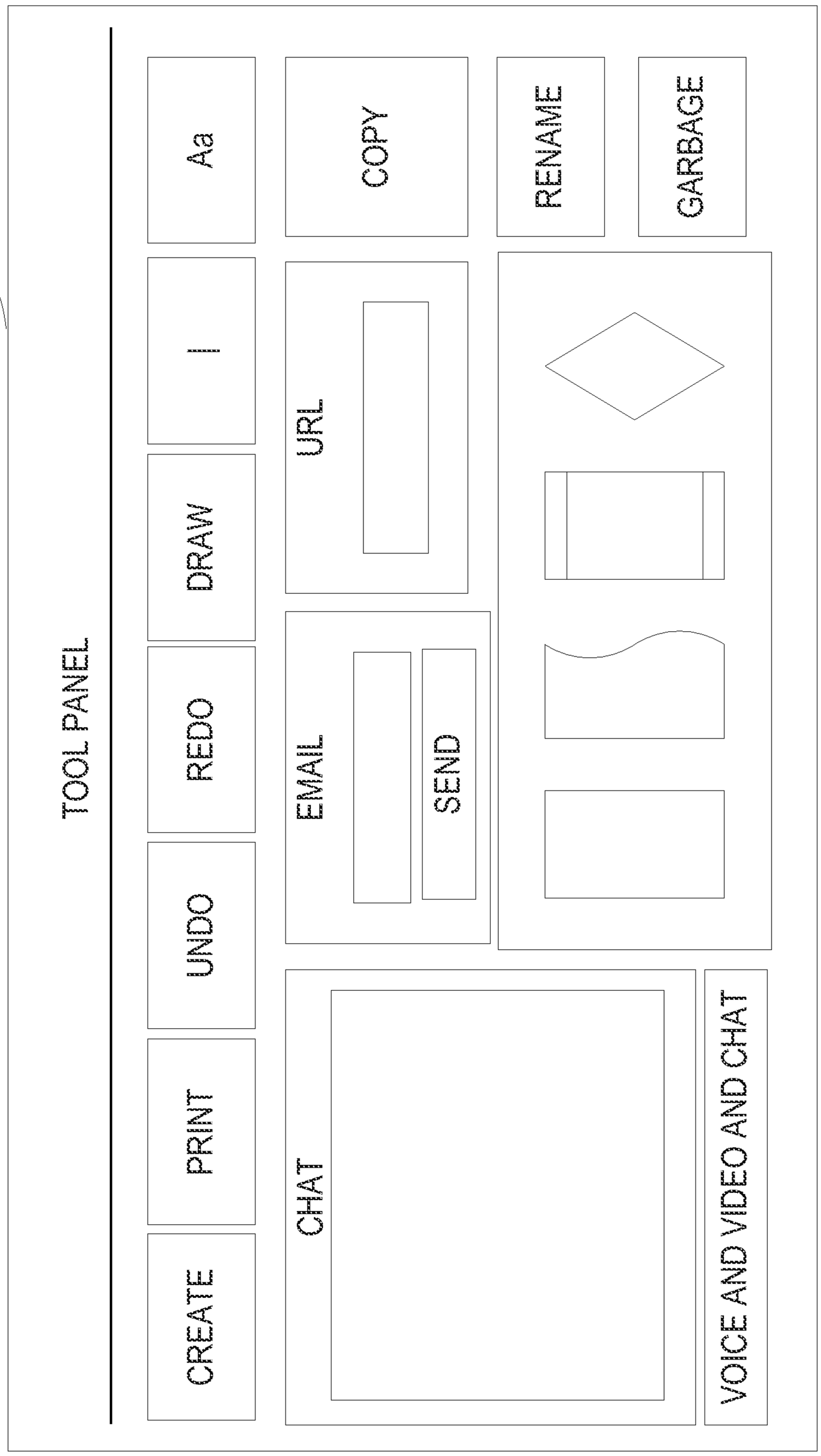

1043
TOOL PANEL
CREATE
PRINT
UNDO
REDO
DRAW
Aa
COPY
RENAME
GARBAGE
URL
EMAIL
SEND
CHAT
VOICE AND VIDEO AND CHAT

FIG. 10F

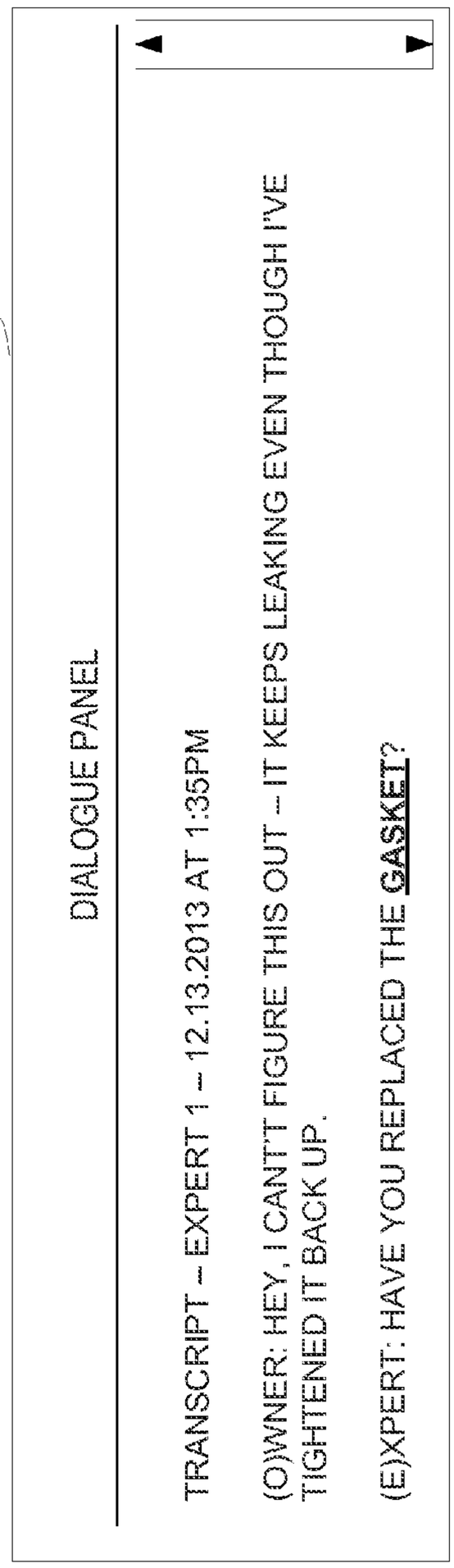



FIG. 10G

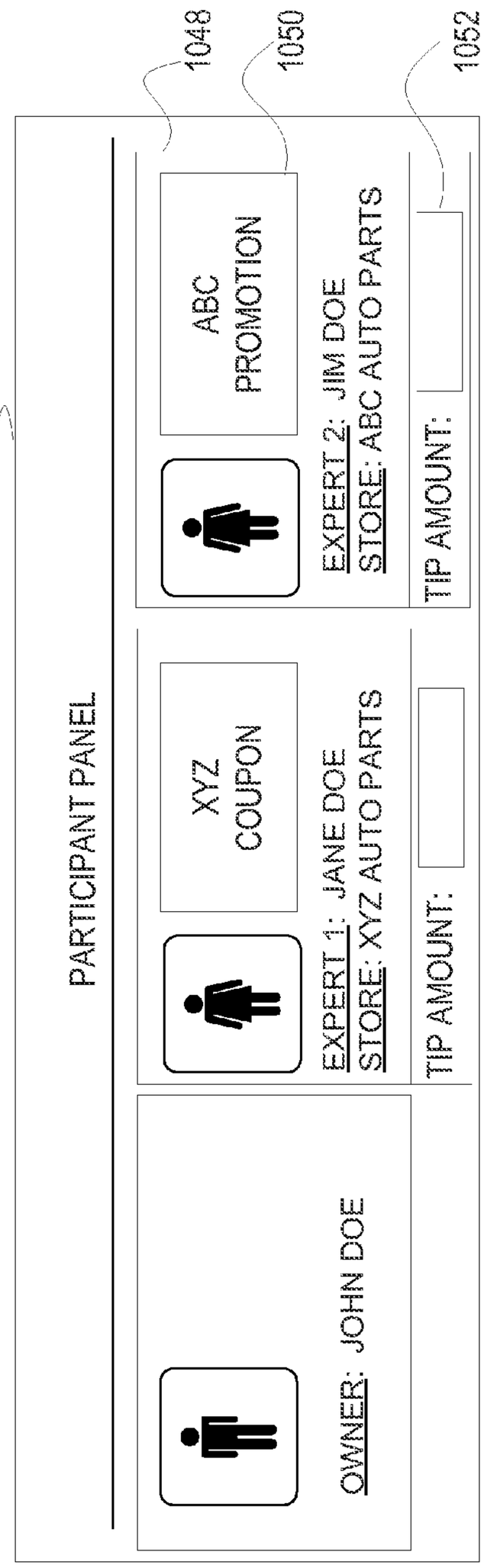



FIG. 10H

*FIG. 10I*

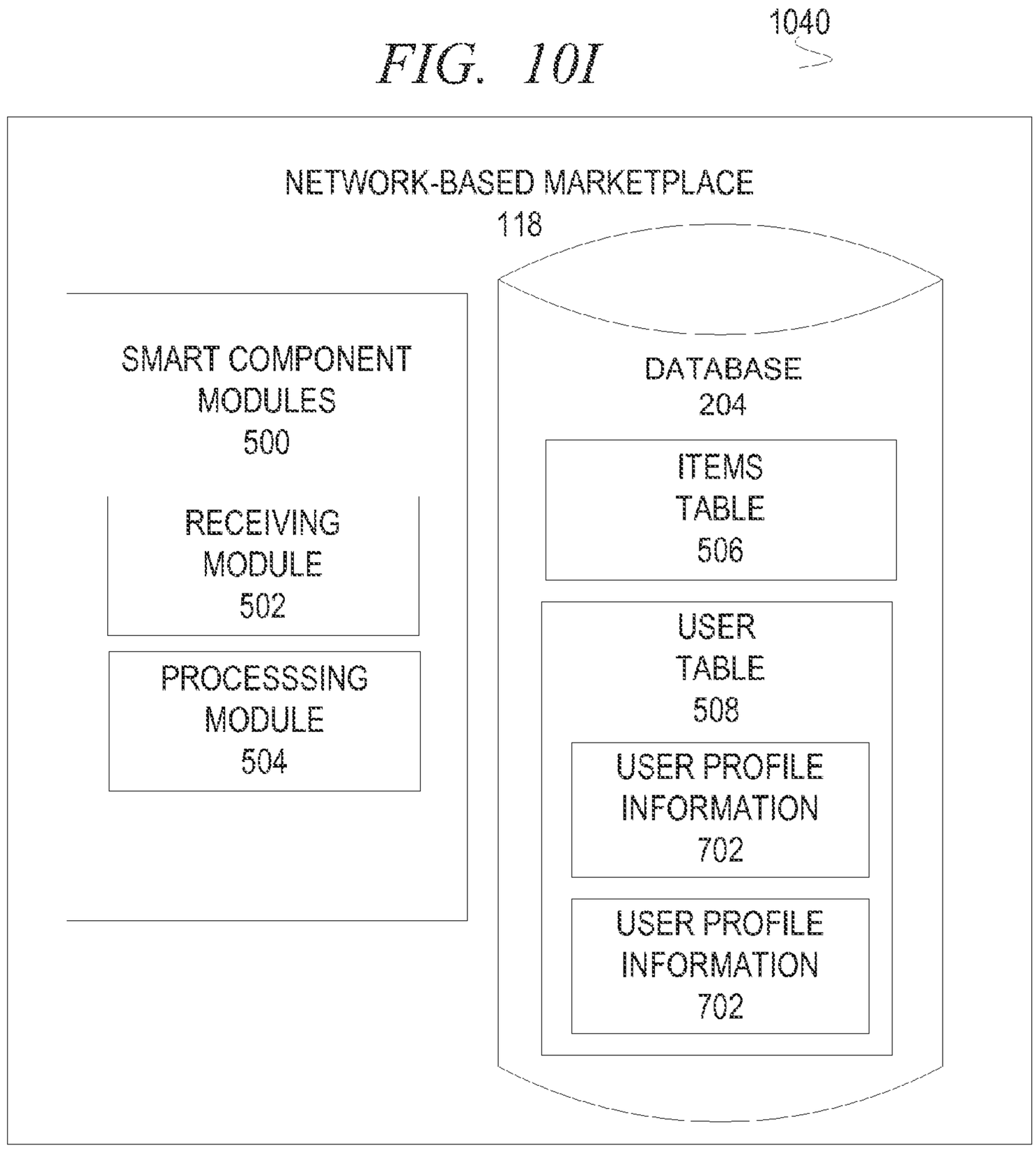

1040
NETWORK-BASED MARKETPLACE
118
SMART COMPONENT MODULES
500
RECEIVING MODULE
502
PROCESSSING MODULE
504
DATABASE
204
ITEMS TABLE
506
USER TABLE
508
USER PROFILE INFORMATION
702
USER PROFILE INFORMATION
702

*FIG. 10J*

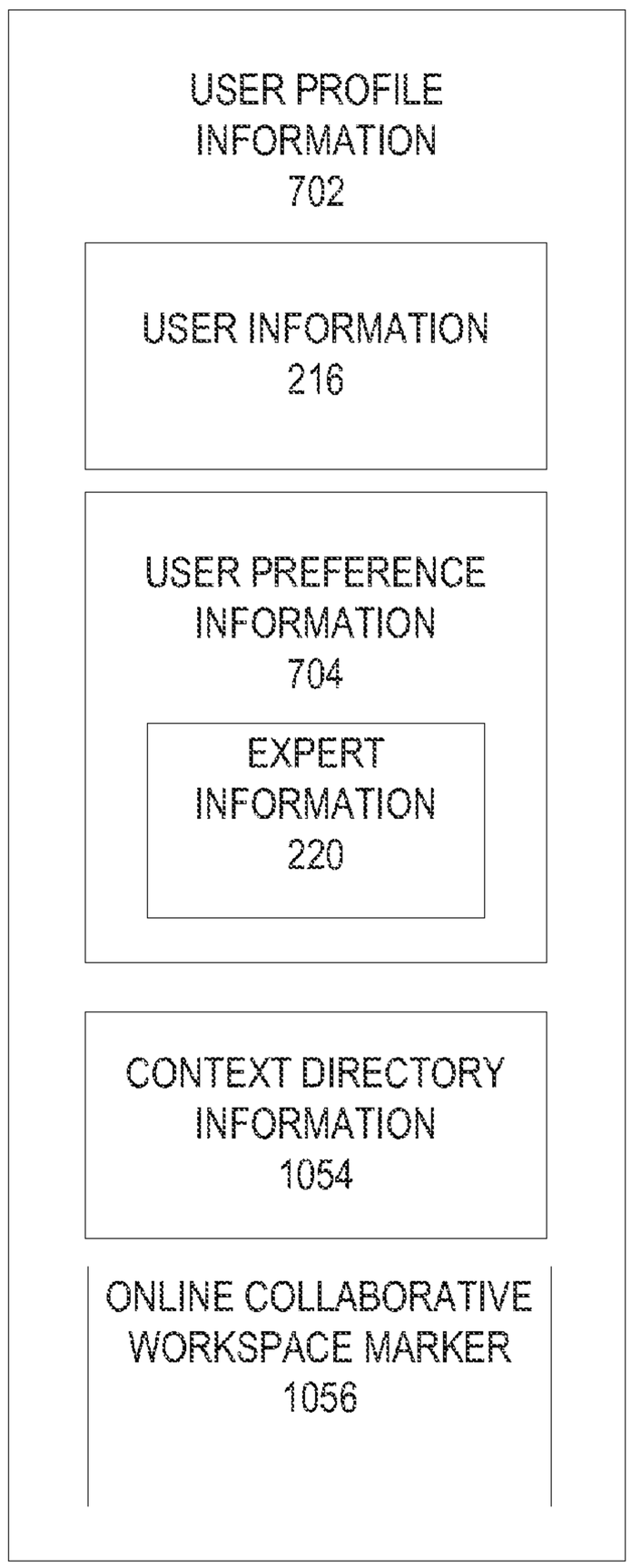



*FIG. 10K*

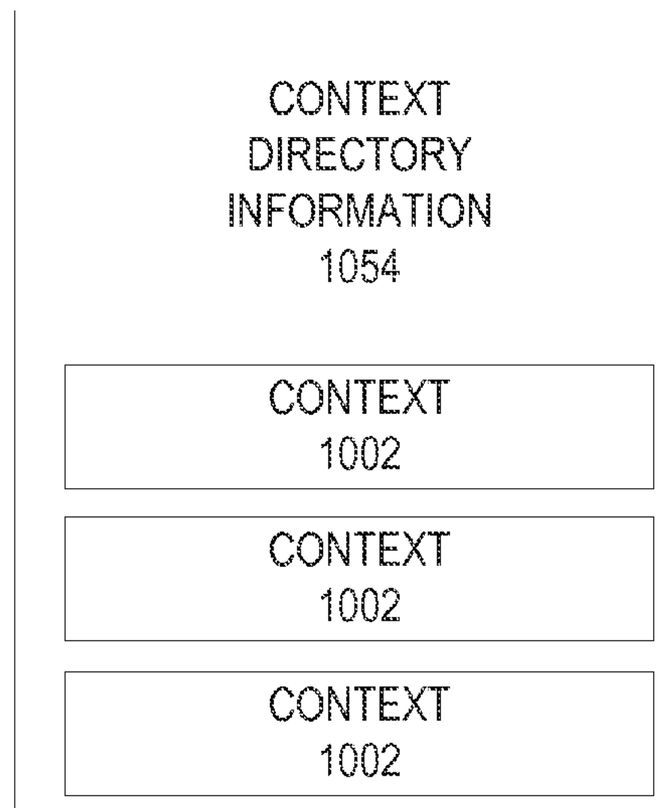


*FIG. 10L*

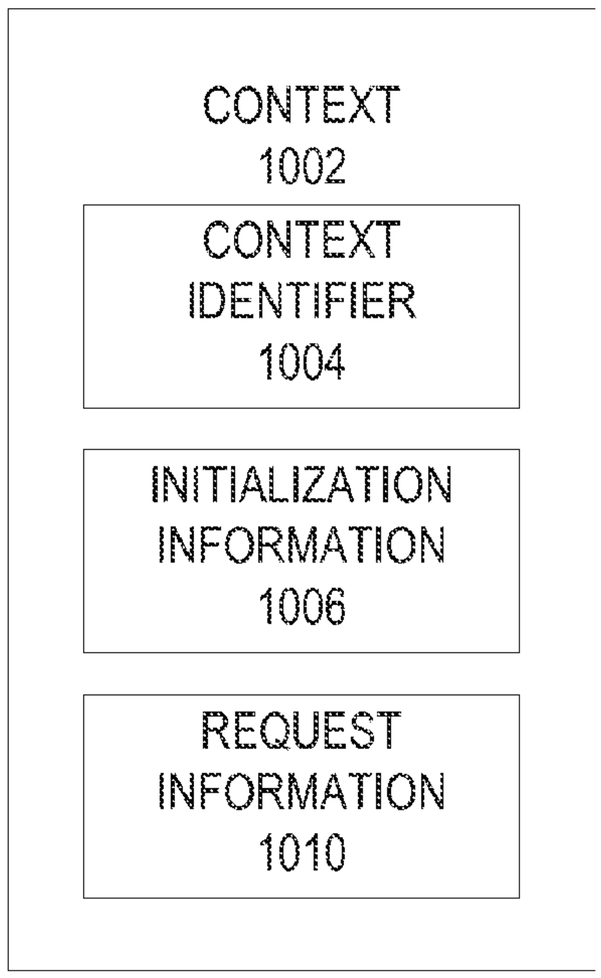



*FIG. 10M*

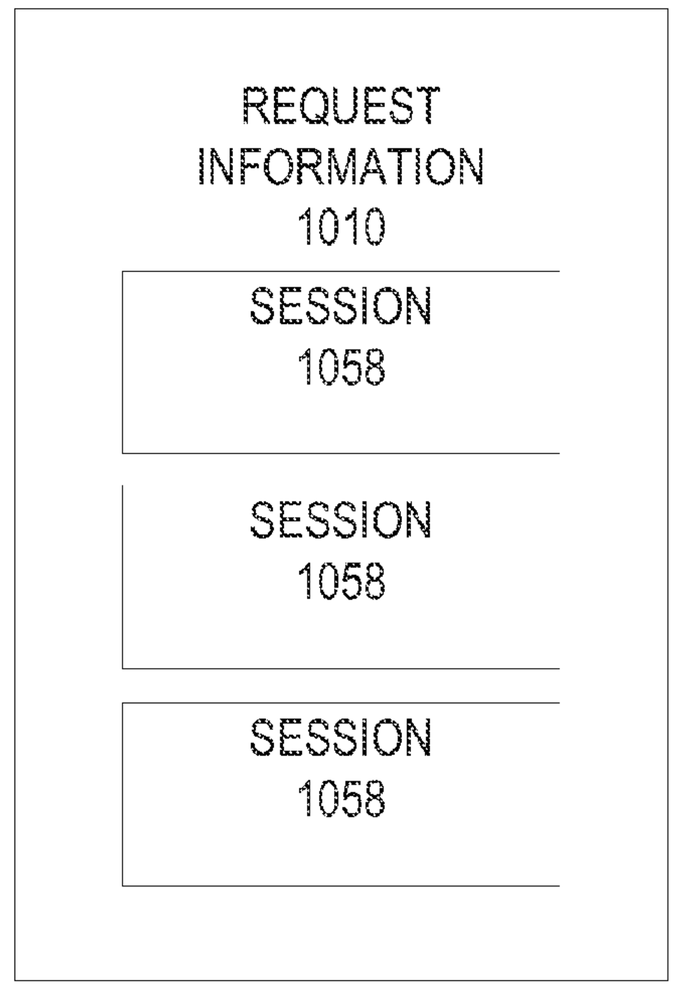



*FIG. 10N*

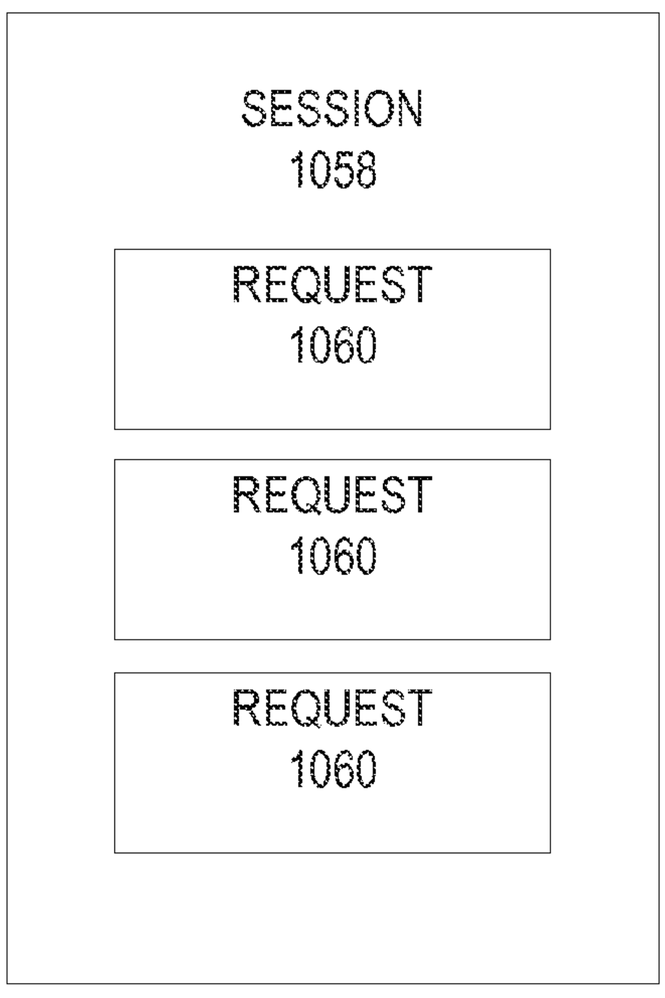


*FIG. 10O*

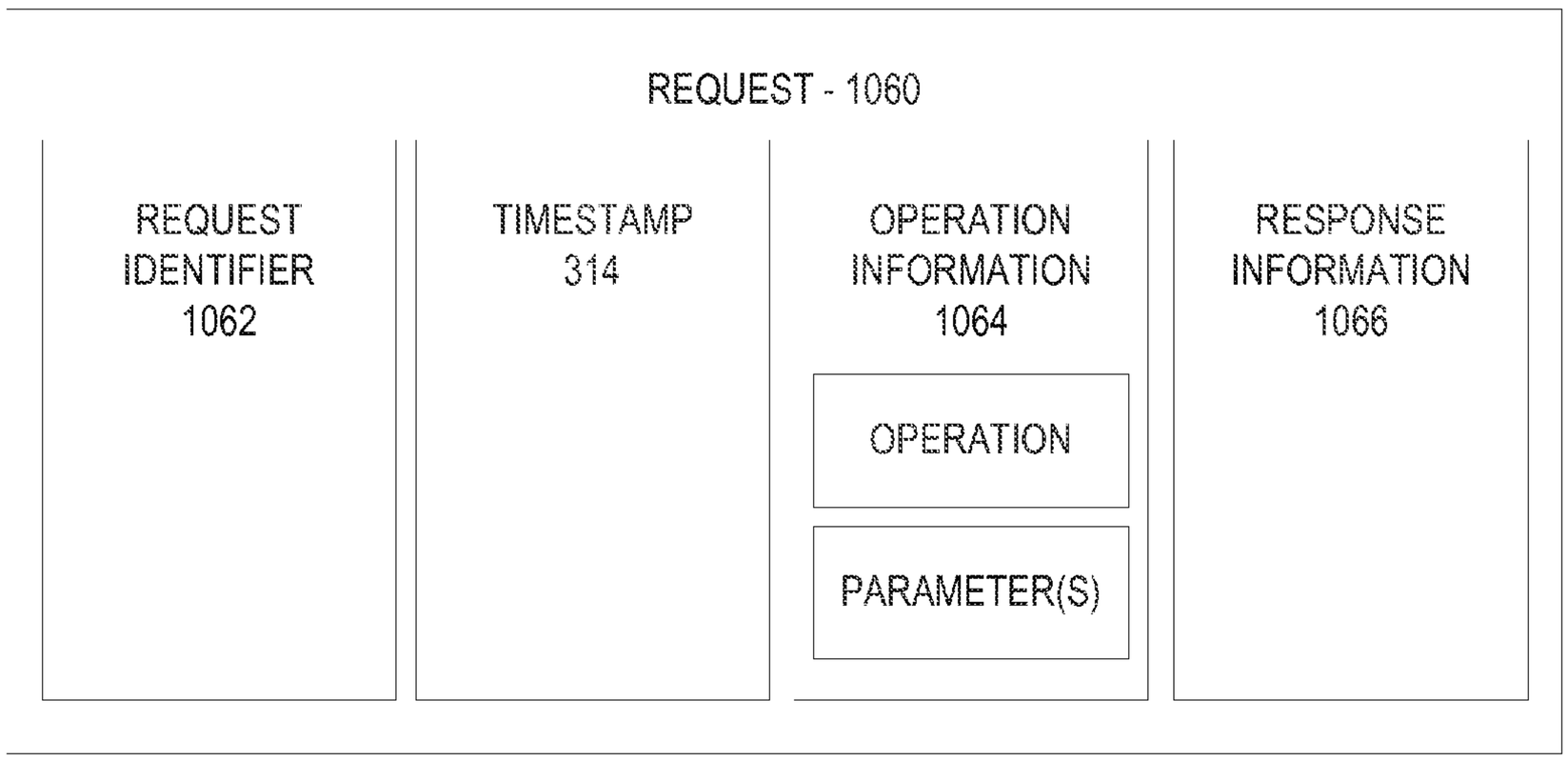



*FIG. 10P*

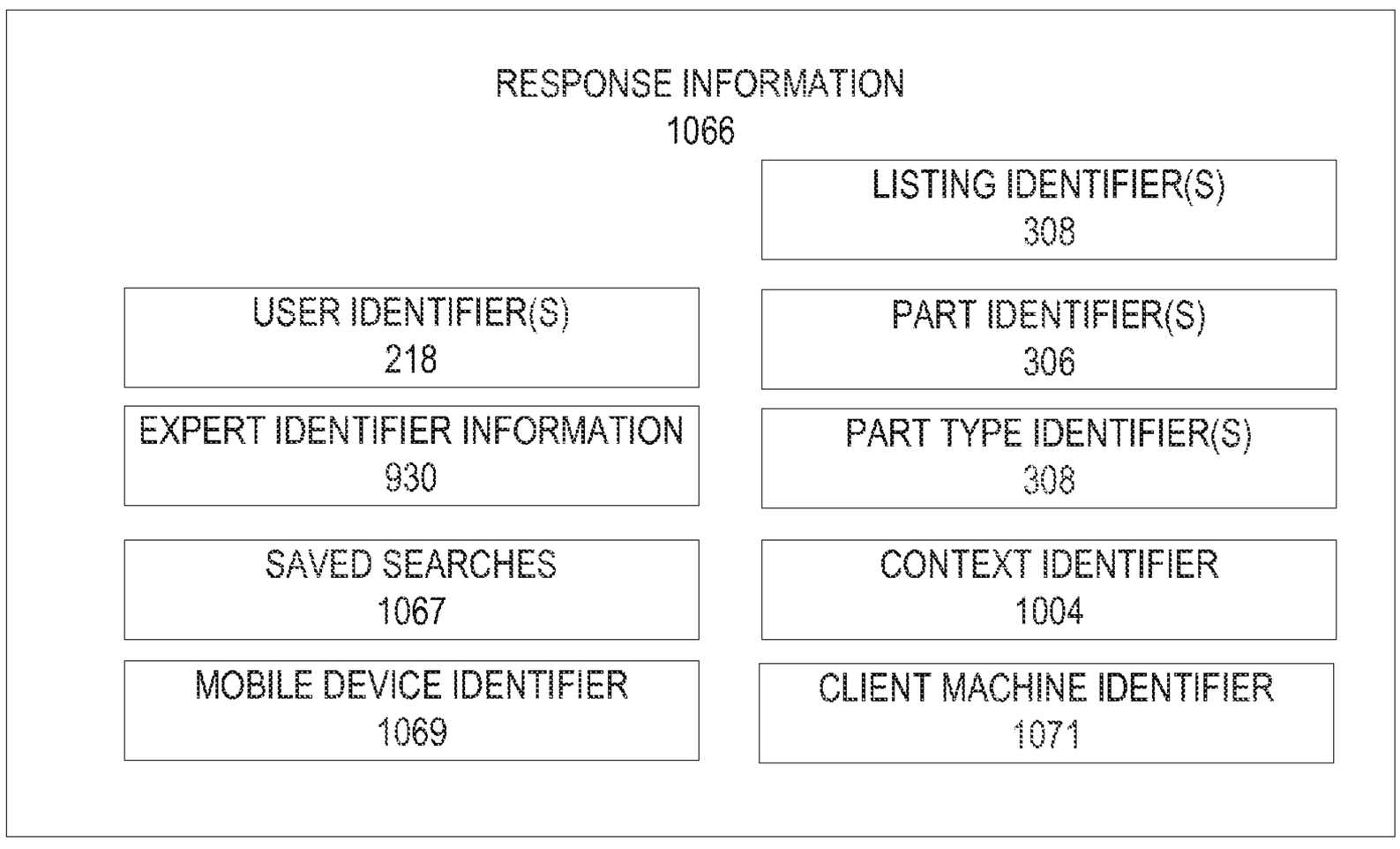


*FIG. 10Q*

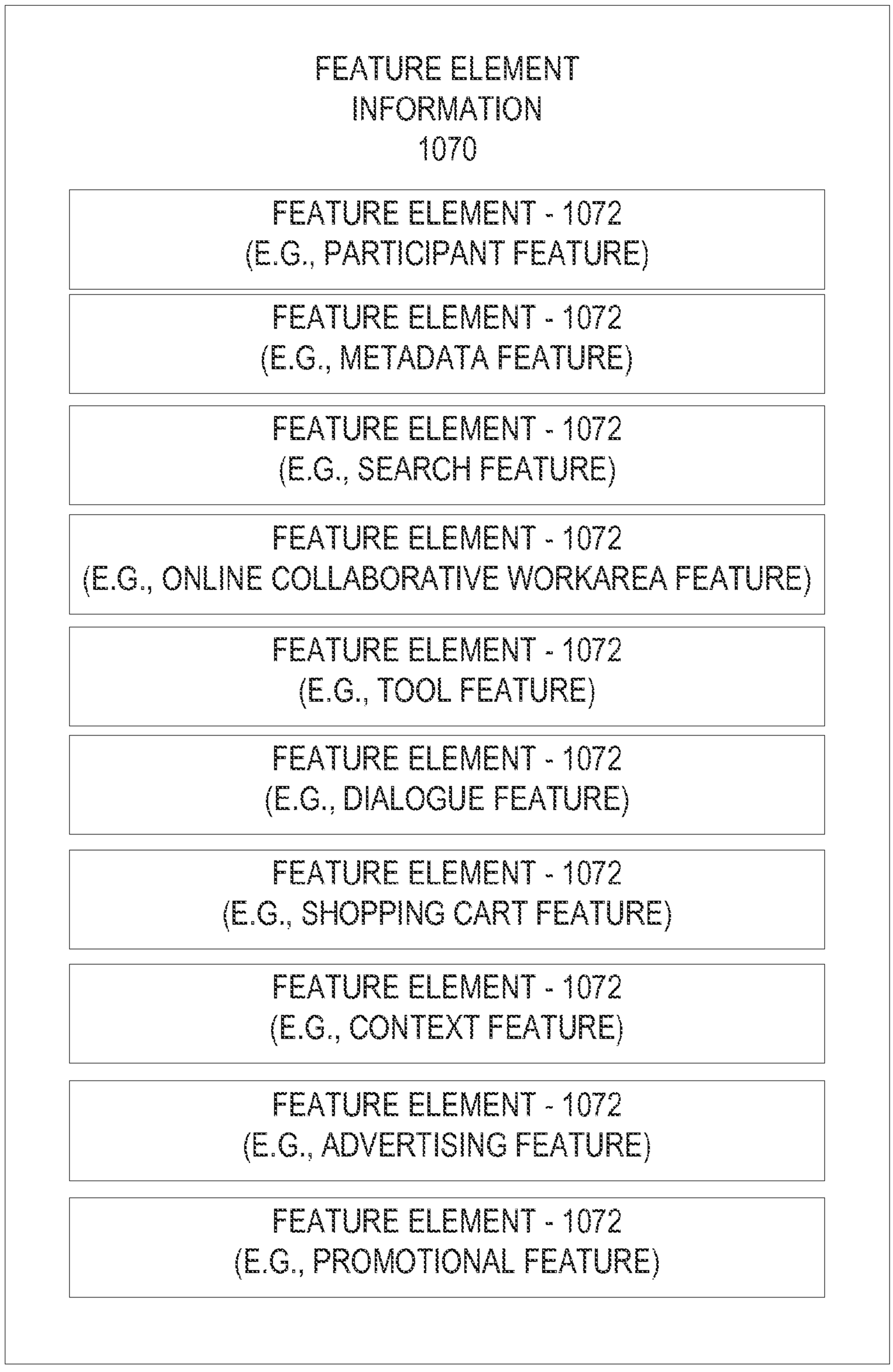

FEATURE ELEMENT INFORMATION 1070
FEATURE ELEMENT - 1072 (E.G., PARTICIPANT FEATURE)
FEATURE ELEMENT - 1072 (E.G., METADATA FEATURE)
FEATURE ELEMENT - 1072 (E.G., SEARCH FEATURE)
FEATURE ELEMENT - 1072 (E.G., ONLINE COLLABORATIVE WORKAREA FEATURE)
FEATURE ELEMENT - 1072 (E.G., TOOL FEATURE)
FEATURE ELEMENT - 1072 (E.G., DIALOGUE FEATURE)
FEATURE ELEMENT - 1072 (E.G., SHOPPING CART FEATURE)
FEATURE ELEMENT - 1072 (E.G., CONTEXT FEATURE)
FEATURE ELEMENT - 1072 (E.G., ADVERTISING FEATURE)
FEATURE ELEMENT - 1072 (E.G., PROMOTIONAL FEATURE)

*FIG. 10R*

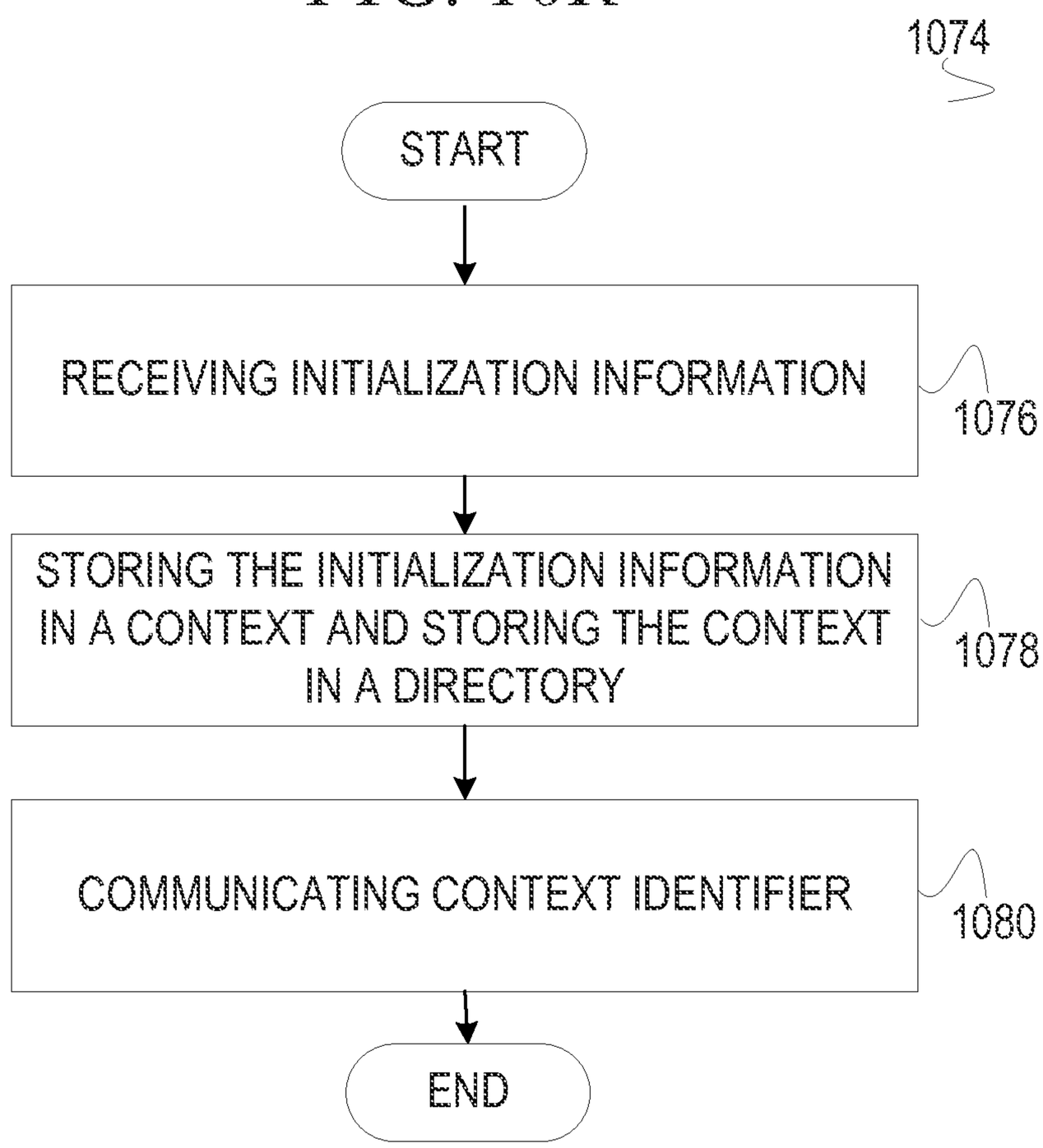

1074
START
RECEIVING INITIALIZATION INFORMATION
1076
STORING THE INITIALIZATION INFORMATION IN A CONTEXT AND STORING THE CONTEXT IN A DIRECTORY
1078
COMMUNICATING CONTEXT IDENTIFIER
1080
END

*FIG. 10S*

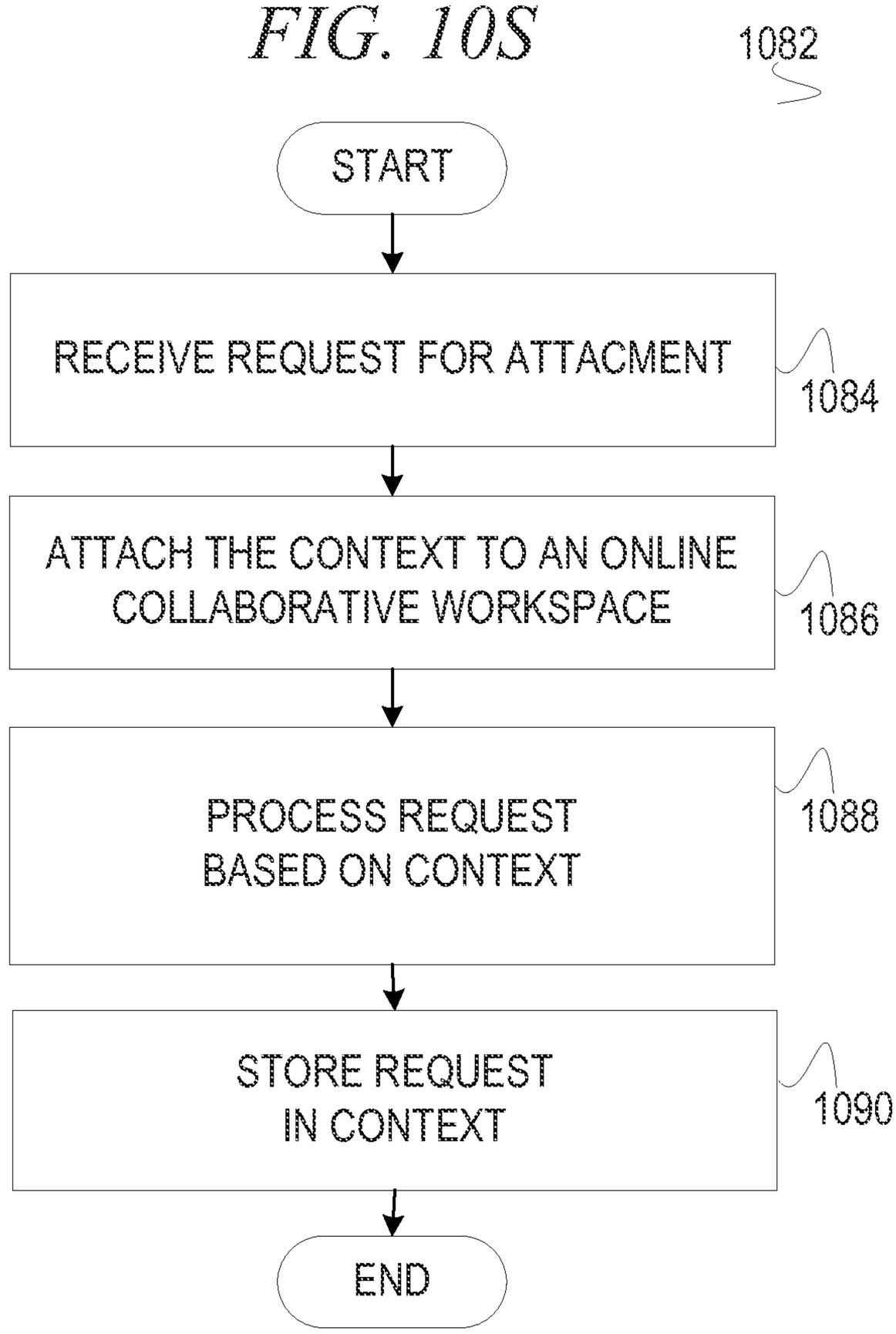
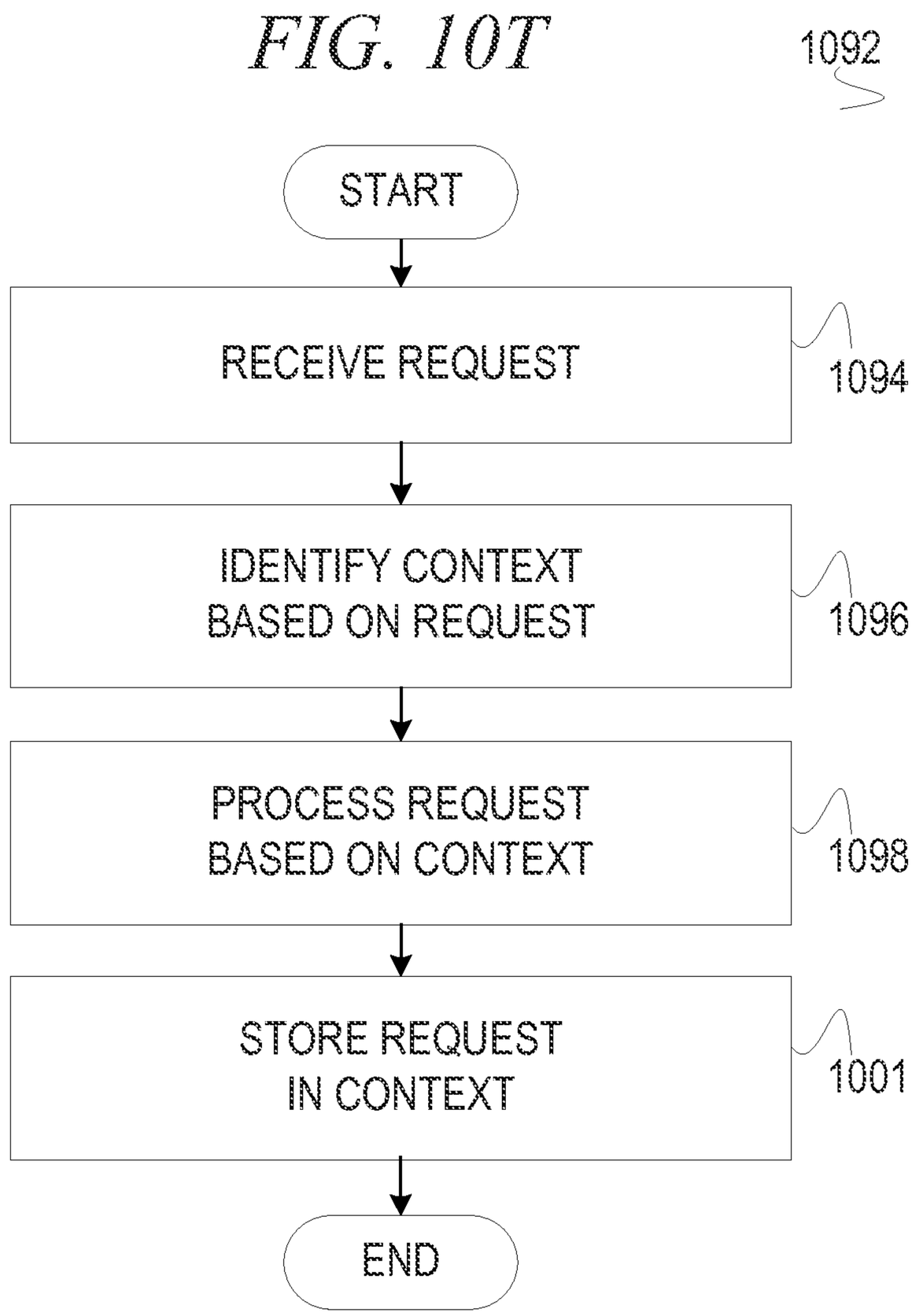

1082
START
RECEIVE REQUEST FOR ATTACMENT
1084
ATTACH THE CONTEXT TO AN ONLINE COLLABORATIVE WORKSPACE
1086
PROCESS REQUEST BASED ON CONTEXT
1088
STORE REQUEST IN CONTEXT
1090
END

*FIG. 10T*


1092
START
RECEIVE REQUEST
1094
IDENTIFY CONTEXT BASED ON REQUEST
1096
PROCESS REQUEST BASED ON CONTEXT
1098
STORE REQUEST IN CONTEXT
1001
END

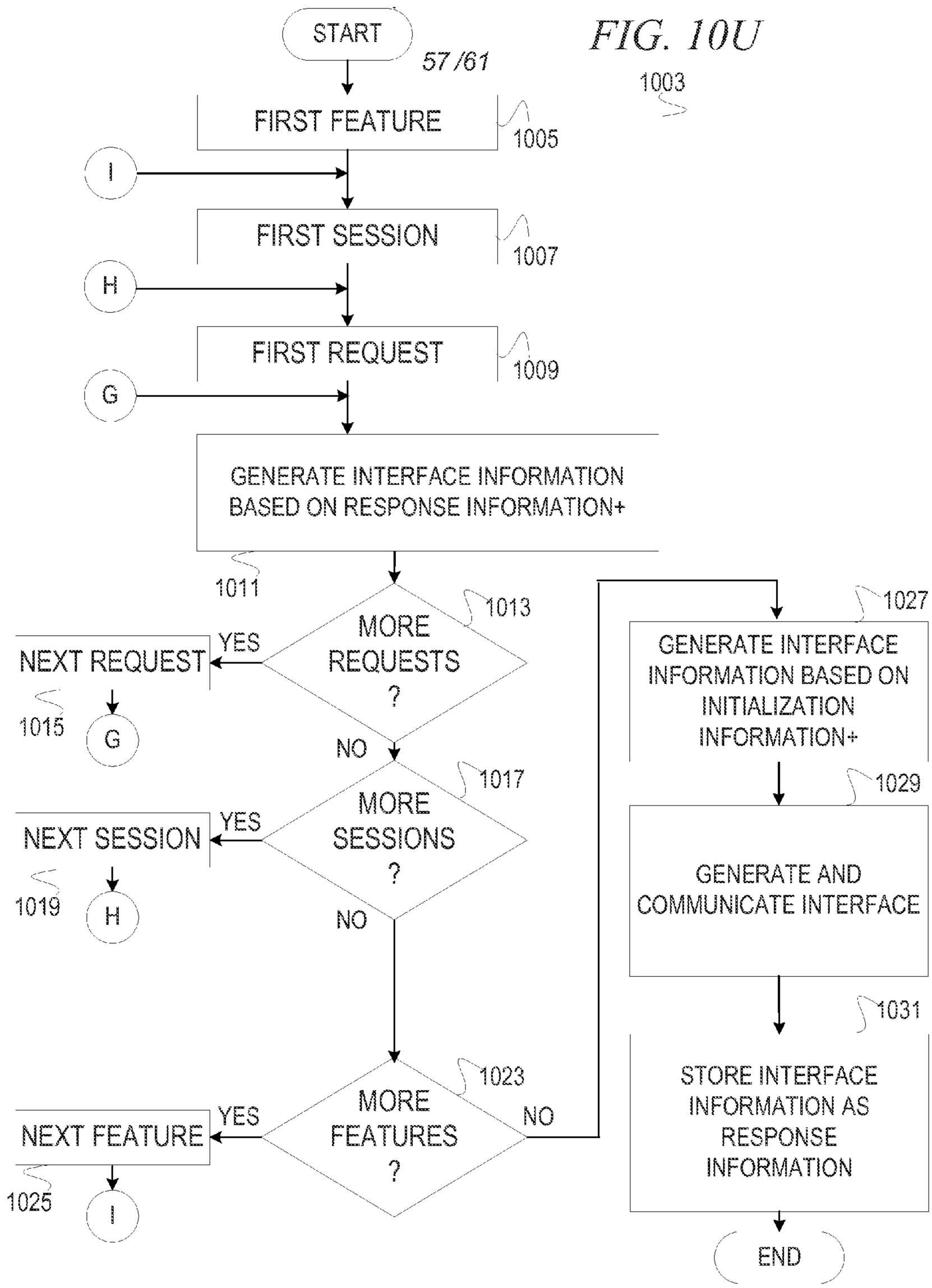


FIG. 10U
1003
START
57 /61
FIRST FEATURE
1005
I
FIRST SESSION
1007
H
FIRST REQUEST
1009
G
GENERATE INTERFACE INFORMATION BASED ON RESPONSE INFORMATION+
1011
MORE REQUESTS ?
1013
YES
NEXT REQUEST
1015
G
NO
MORE SESSIONS ?
1017
YES
NEXT SESSION
1019
H
NO
MORE FEATURES ?
1023
YES
NEXT FEATURE
1025
I
NO
GENERATE INTERFACE INFORMATION BASED ON INITIALIZATION INFORMATION+
1027
GENERATE AND COMMUNICATE INTERFACE
1029
STORE INTERFACE INFORMATION AS RESPONSE INFORMATION
1031
END

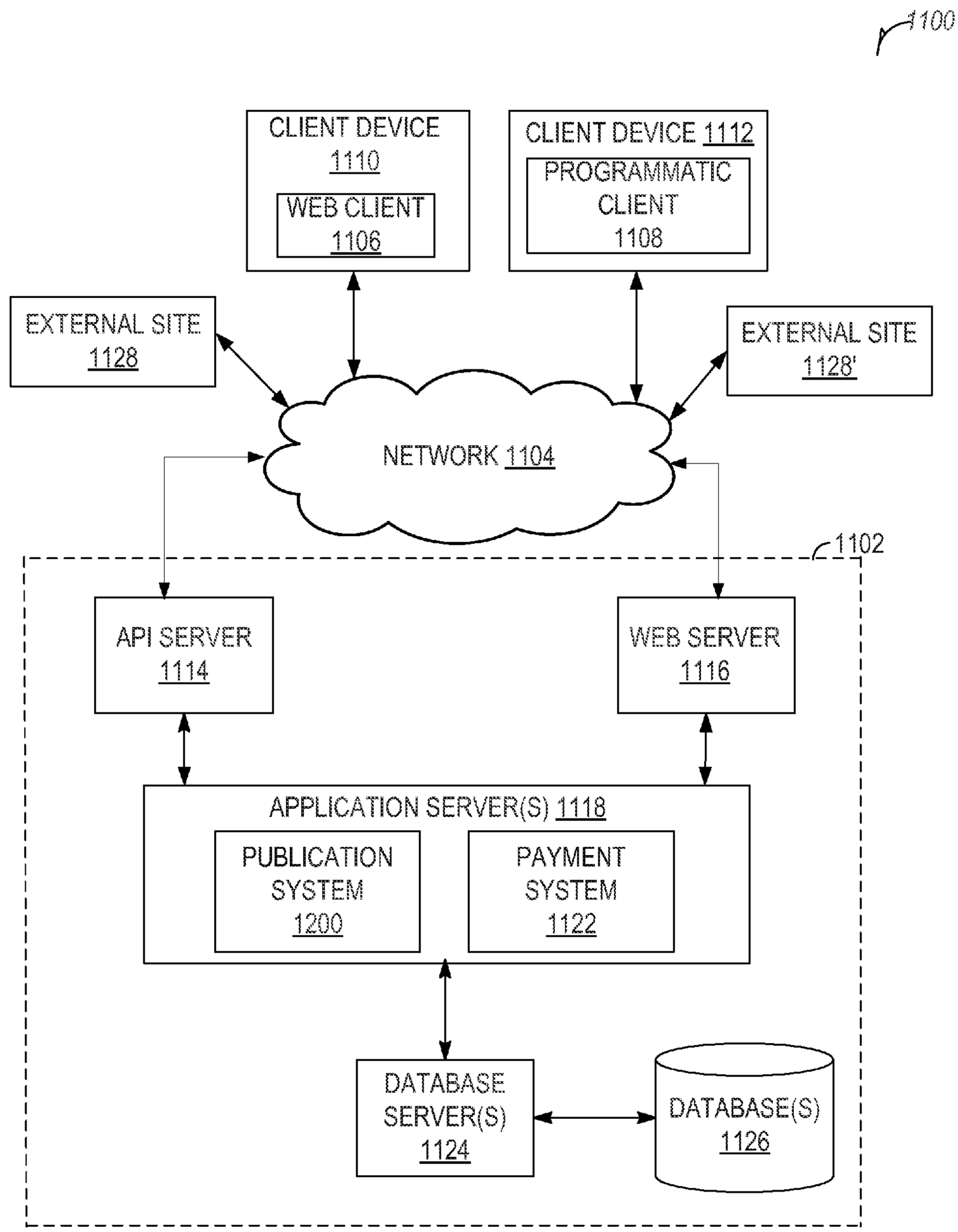

1100
CLIENT DEVICE 1110
WEB CLIENT 1106
CLIENT DEVICE 1112
PROGRAMMATIC CLIENT 1108
EXTERNAL SITE 1128
EXTERNAL SITE 1128'
NETWORK 1104
1102
API SERVER 1114
WEB SERVER 1116
APPLICATION SERVER(S) 1118
PUBLICATION SYSTEM 1200
PAYMENT SYSTEM 1122
DATABASE SERVER(S) 1124
DATABASE(S) 1126

*FIG. 11*

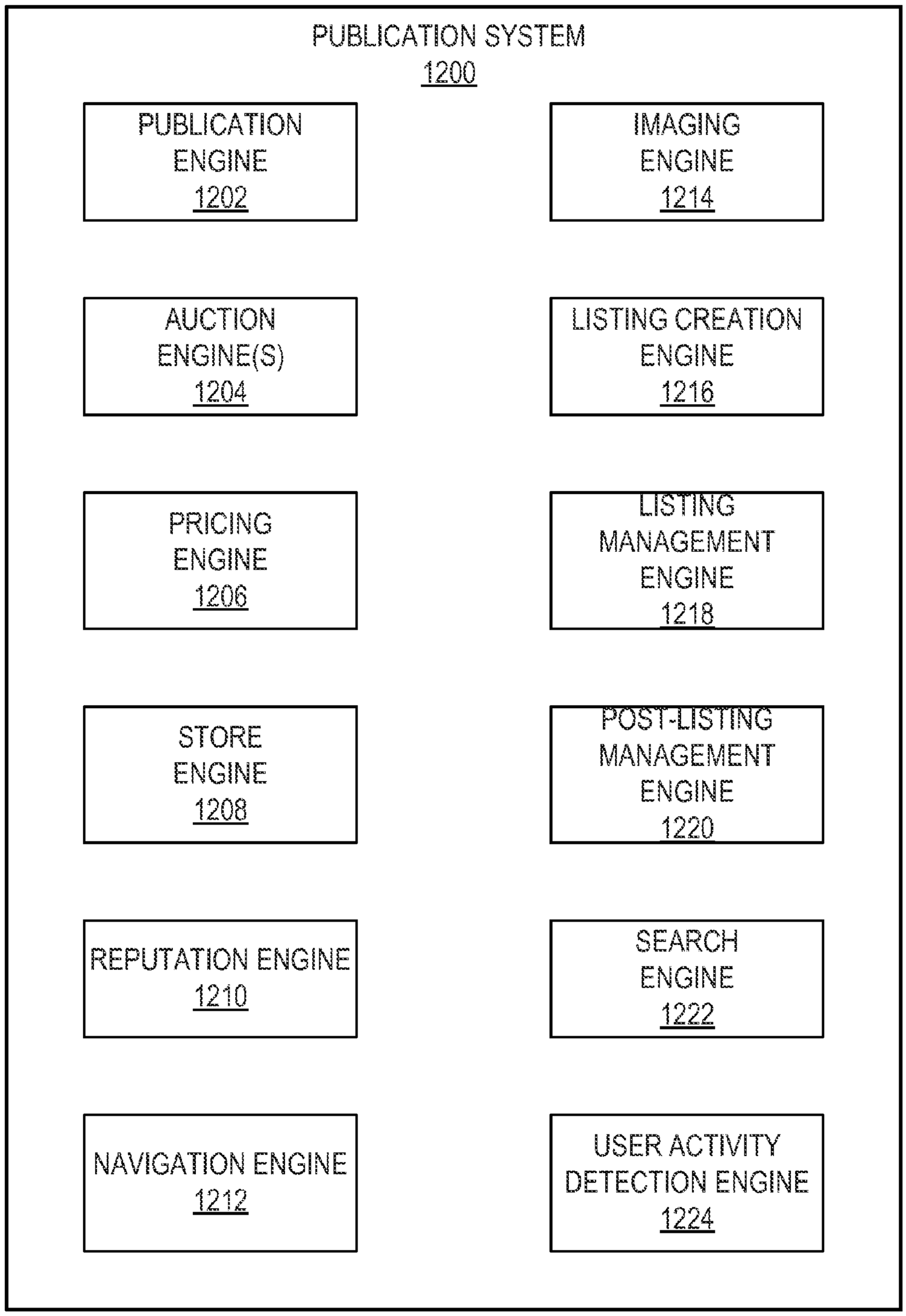
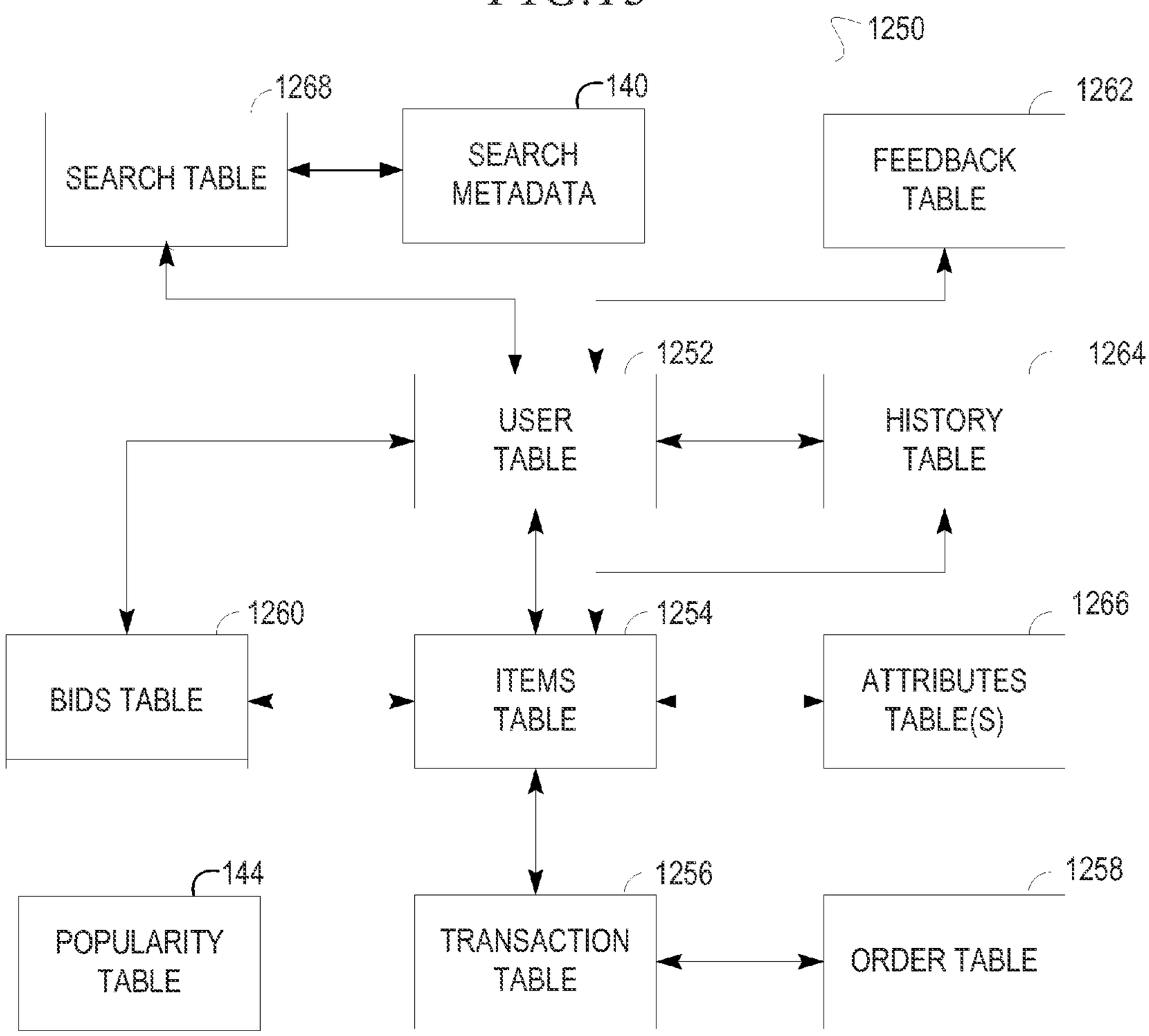

PUBLICATION SYSTEM
1200
PUBLICATION ENGINE 1202
IMAGING ENGINE 1214
AUCTION ENGINE(S) 1204
LISTING CREATION ENGINE 1216
PRICING ENGINE 1206
LISTING MANAGEMENT ENGINE 1218
STORE ENGINE 1208
POST-LISTING MANAGEMENT ENGINE 1220
REPUTATION ENGINE 1210
SEARCH ENGINE 1222
NAVIGATION ENGINE 1212
USER ACTIVITY DETECTION ENGINE 1224

*FIG. 12*

*FIG. 13*


1250
1268
SEARCH TABLE
140
SEARCH METADATA
1262
FEEDBACK TABLE
1252
USER TABLE
1264
HISTORY TABLE
1260
BIDS TABLE
1254
ITEMS TABLE
1266
ATTRIBUTES TABLE(S)
144
POPULARITY TABLE
1256
TRANSACTION TABLE
1258
ORDER TABLE

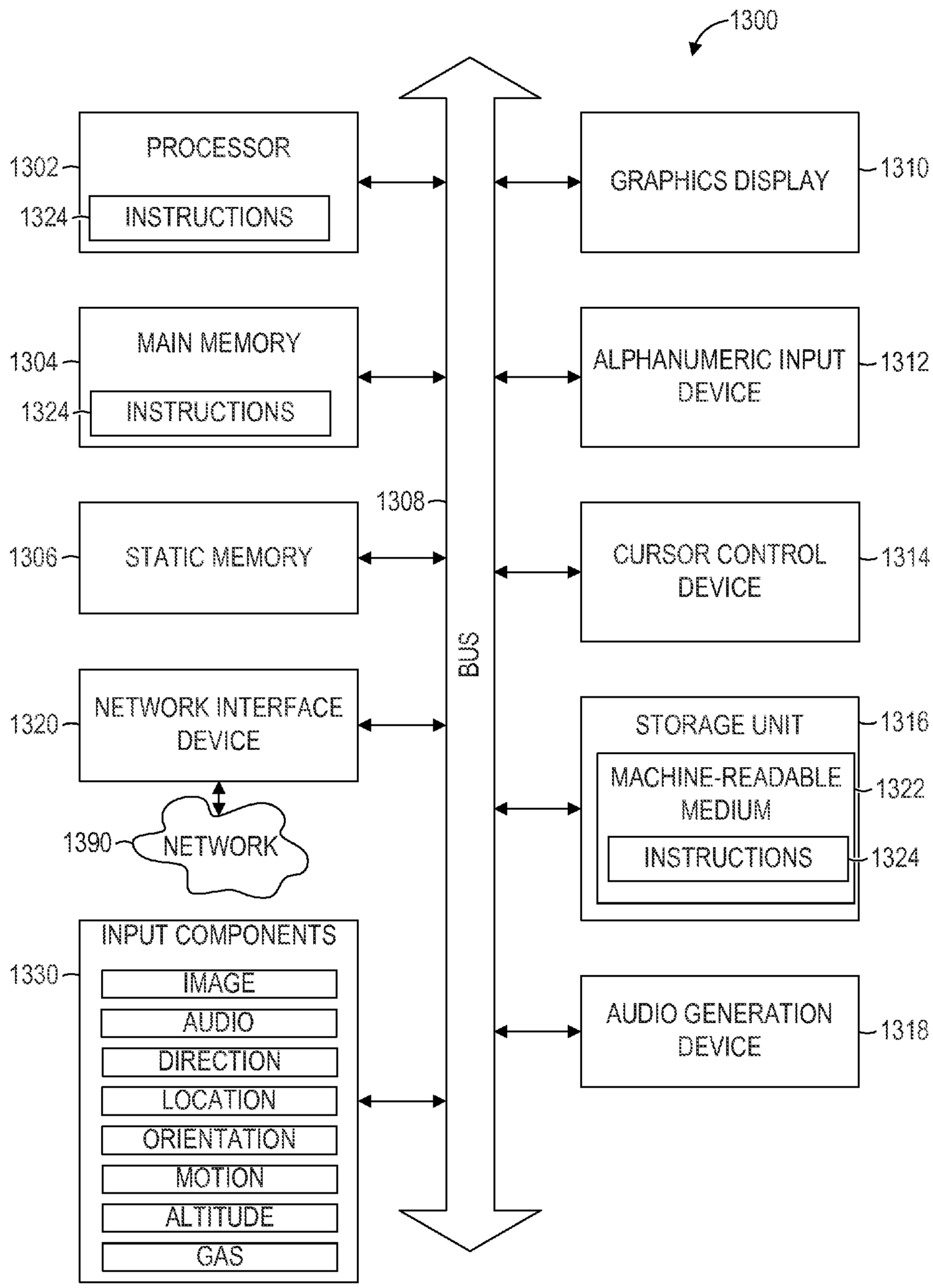

1300
PROCESSOR
1302
INSTRUCTIONS
1324
MAIN MEMORY
1304
INSTRUCTIONS
1324
1308
STATIC MEMORY
1306
NETWORK INTERFACE DEVICE
1320
NETWORK
1390
INPUT COMPONENTS
1330
IMAGE
AUDIO
DIRECTION
LOCATION
ORIENTATION
MOTION
ALTITUDE
GAS
BUS
GRAPHICS DISPLAY
1310
ALPHANUMERIC INPUT DEVICE
1312
CURSOR CONTROL DEVICE
1314
STORAGE UNIT
1316
MACHINE-READABLE MEDIUM
1322
INSTRUCTIONS
1324
AUDIO GENERATION DEVICE
1318

*FIG. 14*

# SYSTEMS AND METHODS TO UTILIZE SMART COMPONENTS

## TECHNICAL FIELD

**[0001]** This disclosure relates to computing and data processing systems. More particularly, systems and methods to utilize smart components are described.

## RELATED

**[0002]** Vehicle repair involves identifying parts that have failed, utilizing procedures or employing services to make a repair and economizing the costs that are often incurred to implement these activities. Today, most vehicle owners wait for a part to fail before considering the above described activities.

**[0003]** A portion of the disclosure of this patent document contains material that is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent files or records, but otherwise reserves all copyright rights whatsoever. The following notice applies to the software and data as described below and in the drawings that form a part of this document: Copyright eBay, Inc. 2014, All Rights Reserved.

## BRIEF DESCRIPTION OF DRAWINGS

**[0004]** Various ones of the appended drawings merely illustrate example embodiments of the present invention and cannot be considered as limiting its scope.

**[0005]** FIG. **1** illustrates a system to utilize smart components, according to an embodiment;

**[0006]** FIG. **2** illustrates a mobile device, according to an embodiment;

**[0007]** FIG. **3**A illustrates monitor information, according to an embodiment;

**[0008]** FIG. **3**B illustrates vehicle information, according to an embodiment;

**[0009]** FIG. **3**C illustrates part description information, according to an embodiment;

**[0010]** FIG. **4**A illustrates a maintenance message, according to an embodiment:

**[0011]** FIG. **4**B illustrates a synchronization message, according to an embodiment;

**[0012]** FIG. **5** illustrates a network-based marketplace, according to an embodiment;

**[0013]** FIG. **6**A illustrates an items table, according to an embodiment;

**[0014]** FIG. **6**B illustrates a listing, according to an embodiment;

**[0015]** FIG. **7**A illustrates a user table, according to an embodiment;

**[0016]** FIG. **7**B illustrates user profile information, according to an embodiment:

**[0017]** FIG. **7**C illustrates user information, according to an embodiment;

**[0018]** FIG. **7**D illustrates maintenance information, according to an embodiment;

**[0019]** FIG. **7**E illustrates part maintenance information, according to an embodiment;

**[0020]** FIG. **7**F illustrates smart component processing information, according to an embodiment;

**[0021]** FIG. **7**G illustrates a method to utilize a smart component, according to an embodiment;

**[0022]** FIG. **7**H illustrates a method to utilize a smart component, according to an embodiment;

**[0023]** FIG. **7**I illustrates a user interface, according to an embodiment;

**[0024]** FIG. **7**J illustrates user interface, according to an embodiment;

**[0025]** FIG. **7**K illustrates user interface, according to an embodiment;

**[0026]** FIG. **8**A illustrates a system to utilize an electronic garage shelf, according to an embodiment;

**[0027]** FIG. **8**B illustrates a network-based marketplace, according to an embodiment;

**[0028]** FIG. **8**C illustrates a user table, according to an embodiment;

**[0029]** FIG. **8**D illustrates garage shelf commands, according to an embodiment;

**[0030]** FIG. **8**E illustrates virtual part information, according to an embodiment;

**[0031]** FIG. **8**F illustrates a virtual part, according to an embodiment;

**[0032]** FIG. **8**G illustrates token part information, according to an embodiment;

**[0033]** FIG. **8**H illustrates a token part, according to an embodiment;

**[0034]** FIG. **8**I illustrates a method to process commands, according to an embodiment;

**[0035]** FIG. **8**J illustrates a method to alert a creation of a virtual part, according to an embodiment;

**[0036]** FIG. **8**K illustrates a method to process virtual parts, according to an embodiment;

**[0037]** FIG. **8**L illustrates a method to process token parts, according to an embodiment;

**[0038]** FIG. **8**M illustrates a method to utilize an electronic garage shelf, according to an embodiment;

**[0039]** FIG. **8**N illustrates a user interface, according to an embodiment;

**[0040]** FIG. **9**A illustrates a system for multi-signal fault analysis, according to an embodiment;

**[0041]** FIG. **9**B illustrates a test protocol, according to an embodiment;

**[0042]** FIG. **9**C illustrates a network-based marketplace, according to an embodiment;

**[0043]** FIG. **9**D illustrates user profile information, according to an embodiment;

**[0044]** FIG. **9**E illustrates a fault analysis repository, according to an embodiment;

**[0045]** FIG. **9**F illustrates user fault analysis information, according to an embodiment;

**[0046]** FIG. **9**FF illustrates user test request information, according to an embodiment:

**[0047]** FIG. **9**G illustrates system fault analysis information, according to an embodiment;

**[0048]** FIG. **9**GG illustrates system test request information, according to an embodiment;

**[0049]** FIG. **9**H illustrates test design information, according to an embodiment;

**[0050]** FIG. **9**I illustrates multi-signal information, according to an embodiment;

**[0051]** FIG. **9**J illustrates correlation information, according to an embodiment;

**[0052]** FIG. **9**K illustrates a signal message, according to an embodiment;

**[0053]** FIG. **9**L illustrates a signal message, according to an embodiment;

**[0054]** FIG. **9**M illustrates a method to process a test request, according to an embodiment;

**[0055]** FIG. **9**N illustrates a method for multi-signal fault automated analysis, according to an embodiment;

**[0056]** FIG. **9**O illustrates a method to identify test design information, according to an embodiment;

**[0057]** FIG. **9**P illustrates a method to identify signal processing, according to an embodiment;

**[0058]** FIG. **9**Q illustrates a method to analyze multi-signal information, according to an embodiment;

**[0059]** FIGS. **9**R-**9**S illustrate user interfaces, according to an embodiment;

**[0060]** FIG. **10**A illustrates a system for an e-commerce enabled digital whiteboard, according to an embodiment;

**[0061]** FIG. **10**B illustrates a context panel, according to an embodiment;

**[0062]** FIG. **10**C illustrates a shopping cart panel, according to an embodiment;

**[0063]** FIG. **10**D illustrates a metadata panel, according to an embodiment;

**[0064]** FIG. **10**E illustrates a search panel, according to an embodiment;

**[0065]** FIG. **10**F illustrates a tool panel, according to an embodiment;

**[0066]** FIG. **10**G illustrates a dialogue panel, according to an embodiment;

**[0067]** FIG. **10**H illustrates a participant panel, according to an embodiment;

**[0068]** FIG. **10**I illustrates a network-based marketplace, according to an embodiment;

**[0069]** FIG. **10**J illustrates user profile information, according to an embodiment;

**[0070]** FIG. **10**K illustrates context directory information, according to an embodiment;

**[0071]** FIG. **10**L illustrates a context, according to an embodiment;

**[0072]** FIG. **10**M illustrates request information, according to an embodiment;

**[0073]** FIG. **10**N illustrates a session, according to an embodiment;

**[0074]** FIG. **10**O illustrates a request, according to an embodiment;

**[0075]** FIG. **10**P illustrates response information, according to an embodiment;

**[0076]** FIG. **10**Q illustrates feature element information, according to an embodiment.

**[0077]** FIG. **10**R illustrates a method, according to an embodiment, to add a context;

**[0078]** FIG. **10**S illustrates a method, according to an embodiment, to attach a context;

**[0079]** FIG. **10**T illustrates a method, according to an embodiment, to receive and process a request;

**[0080]** FIG. **10**U illustrates a method, according to an embodiment, to process a request based on a context;

**[0081]** FIG. **11** is a block diagram illustrating an example embodiment of a high-level client-server-based network architecture;

**[0082]** FIG. **12** is a block diagram illustrating an example embodiment of a publication system;

**[0083]** FIG. **13** is a block diagram illustrating tables that are utilized by the publication system, according to an embodiment; and

**[0084]** FIG. **14** is a block diagram of a machine in an example form of a computing system within which a set of instructions for causing the machine to perform any one or more of the methodologies discussed herein may be executed.

## DETAILED DESCRIPTION

**[0085]** The description that follows includes systems, methods, techniques, instruction sequences, and computing machine program products that embody illustrative embodiments of the present invention. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide an understanding of an embodiment of the inventive subject matter. It will be evident, however, to those skilled in the art that embodiments of the inventive subject matter may be practiced without these specific details. In general, well-known instruction instances, protocols, structures, and techniques have not been shown in detail.

### Systems and Methods to Utilize Smart Components

**[0086]** FIG. **1** illustrates a system **100**, according to an embodiment, utilizing smart components **102**. The system **100** may include a vehicle **104** that includes smart components **102** that are grouped into sub-systems **103** (e.g., chassis, engine, suspension, etc.). While the vehicle **104** is illustrated as an automobile, it will be appreciated that trucks, all-terrain vehicles, jeeps, aircraft, water-born vessels, space vessels, and the like may embody the illustrated vehicle **104**. Each smart component **102** may include a part **106** and a sensor **108**. Broadly, the smart component **102** may utilize the sensor **108** to sense the part **106** to receive information (e.g., a sense of the part) that is utilized by the smart component **102** to generate characterization information and communicate the characterization information (e.g., percentage wear) over a network **110** (e.g., nearfield communication (NFC)) to a mobile device **112** (e.g., smart phone. Apple iPhone, etc.) that, in turn, communicates a maintenance message that includes the characterization information over a network **116** (e.g., cellular, WiFi, Internet, telephone, etc., combinations thereof) to a network-based marketplace **118** that, in turn, stores the characterization information and other information and processes the characterization information to initiate electronic commerce activity. Merely for example, a smart component **102** in a Ford Mustang may include a sensor **108** for a brake pad that senses wear (e.g., ninety percent) for the brake-pad, the smart component **102** to generate the characterization information based on the sensing of the sensor and to communicate the characterization information over the network **110** (e.g., NFC) to an iPhone that, in turn, communicates the maintenance message over a network **116** (e.g., cellular and Internet) to a network-based marketplace **118** that, in turn, stores the characterization information in an electronic garage for the Ford Mustang in the user profile associated with the iPhone, identifies a service level for the brake-pad, and generates a triggering event that is processed to initiate electronic commerce activity. For example, the network-based marketplace **118** may identify one or more sets of processing rules based on the triggering event, and execute the one or more sets of processing rules to initiate electronic commerce and other related activities. In one embodiment, one set of processing rules may identify the location of the iPhone that originated the maintenance message to initiate electronic commerce activity. For example, if the location of the iPhone is identified to be in the vicinity of

a brake shop, the network-based marketplace **118** may respond to the maintenance message by generating and sending a user interface to the iPhone that provides an estimated time for the brake shop to install the brake pad.

**[0087]** The smart components **102**, network **110**, mobile device **112**, network **116**, and network-based marketplace **118** are further described. Each smart component **102** may include a sensor **108** that senses an associated part **106**. The smart component **102** may generate characterization information based on the sensing of the part **106** and communicate the characterization information that characterizes the current state of the part **106**. For example, the characterization information may include performance information, percentage wear information, state information or the like. In accordance with one embodiment, the smart component **102** illustrated on the lower left of FIG. **1** is illustrated as including a part **106** that is adapted to receive a sensor **108** and the smart component **102** to its immediate right is manufactured to include the sensor **108**. For example, the smart component **102** on the left includes a sensor **108** that is affixed to the part **106** as a subsequent assembly rather than being designed and manufactured as such (e.g., factory embedded). Smart components **102** may be manufactured and adapted for brake systems, filters, suspension systems, belts, bulbs sparks, batteries, tire walls, etc. Merely for example, smart components **102** for the brake system may sense and communicate characterization information for pads and rotors. Smart components **102** for filters may sense and communicate characterization information for oil filters, fuel filters and air filters. Smart components **102** for a suspension system may sense and communicate characterization information for springs, leafs and shocks. Sensors **108** may sense and report information that characterizes different aspects of the part **106**. For example, a sensor **108** may characterize acceleration, separation, deformation, impact/shock, water/moisture, temperature, pressure, fluid flow, fluid levels or any other quantifiable natural phenomena. In the case of separation, a gap may be sensed between paired sensors **108** and characterized by one or both of the sensors **108**. In the case of deformation, damage may be sensed on a part **106** in a package before the package is opened. Further in the case of deformation, one or more sensors **108** may sense and characterize vibration, bend, flex, strain, and weight.

**[0088]** The network **110** may be embodied as a wireless network, near frequency network (NFC), radio frequency network (e.g., RFID)) or some other type of network capable of supporting communication between a smart component **102** and the mobile device **112**. The mobile device **112** may include a smart phone such as an iPhone, Nokia, or BlackBerry. Further, the mobile device **112** may utilize the Android mobile operating system to provide services described in this document. It will be appreciated by one having ordinary skill in the art that the Android mobile operating system is gaining public acceptance as an automotive operating system. The mobile device **112** may further include software in the form of an operating system (e.g., open or proprietary) and one or more applications (e.g., apps) that may be uploaded to the mobile device **112** to provide one or more functions that are described in this document. The network **116** may include a wireless network, near frequency network (NFC), radio frequency network (RFID), LAN, WAN, Internet, telephone, or any other type of network capable of supporting communication between the mobile device **112** and the network-based marketplace **118**. In another embodiment, the mobile device **112** may include any paired device, such as Google Glass, a smartwatch, etc.

**[0089]** The network-based marketplace **118** may be an electronic marketplace for purchasing and selling items and services such as eBay of San Jose, Calif., "The Worlds Online Marketplace." The items sold or purchased on the network-based marketplace **118** may include the parts **106**, the vehicle **104**, and other items and services related to the parts **106** and vehicle **104**. The network-based marketplace **118** supports electronic commerce services (e.g., search, browse, merchandise, expert services, etc.) to facilitate the replacement and repair of the parts **106** for the vehicle **104**, as is described in this document. The client machine **120** may include a mobile device **112**, desktop computer, laptop computer or any other device from which a user (e.g., buyer, seller, etc.) may access and utilize the services of the network-based marketplace **118**.

**[0090]** FIG. **2** illustrates a mobile device **112**, according to an embodiment. The mobile device **112** may include a maintenance application **200**, application resources **202**, database **204** and a wireless reader **206**. The maintenance application **200** may include a communication module **208**, a maintenance module **210**, and other apps (not shown) that may be loaded onto the mobile device **112**. The communication module **208** may receive and communicate information. For example, the communication module **208** may receive commands from the operator of the mobile device **112** and information that originates from outside of the mobile device **112**. The commands from the user may include a "system part scan" command to scan for smart components **102** in a vehicle **104** in the immediate vicinity of the mobile device **112**, a "sub-system part scan" command to scan for smart components **102** in a sub-system (e.g., engine, chassis, brakes, etc.) of the vehicle **104**, a "configure alerts" command to configure an alert that notifies the user of mobile device **112** (e.g., responsive to thresholds being exceeded), and other commands. For example, the user of the mobile device **112** may configure an audible, haptic or visual alert on the mobile device **112** responsive to an identification of a threshold being exceeded. In addition, mobile device **112** may be associated with a user profile on the network-based marketplace **118**, and alerts may be configured to be communicated to any devices associated with the user profile such as the client machine **120**, as described in this document. In addition, the communication module **208** may receive characterization information from smart components **102**. For example, the characterization information may include performance information, a percentage wear, state information or the like, as previously described. The maintenance module **210** may process the commands and the characterization information received via the communication module **208**. For example, the maintenance module **210** may update the database **204** with configuration information, cause the communication module **208** to send a command to the network-based marketplace **118** (as shown in FIG. **1**), or timestamp characterization information that was reported by a smart component **102** with the current time before storing the characterization information in the database **204** and causing the communication module **208** to send a maintenance message to the network-based marketplace **118**. The application resources **202** may include static bulk data definitions and other static con-

tent (e.g., bitmaps, layout definitions, user interface strings, animation instructions, etc.) that may be utilized by the maintenance application **200**.

**[0091]** The database **204** may include monitor information **212**, forwarding information **214**, and user information **216**. The monitor information **212** may store characterization information received from smart components **102** and metadata related to the characterization information. The forwarding information **214** may store information that describes other systems or network-entities that are utilized for processing related to smart components **102**. For example, the forwarding information **214** may include one or more entries that correspond to one or more entries of user profile information on the network-based marketplace **118**. For example, the forwarding information **214** may be utilized to identify other user profile information based on a vehicle **104** (e.g., via vehicle identification number (VIN), possibly in combination with a shared 'family' or 'sharing' code). The user information **216** may include information related to the user associated with the mobile device **112** including a user name, a user telephone number, and password for authentication by the network-based marketplace **118**. Further, the user information **216** may include a user identifier **218** that uniquely identifies the user on the network-based marketplace **118**. The wireless reader **206** may be attached to the mobile device **112** to receive the characterization information from the smart components **102**.

**[0092]** FIG. **3**A illustrates monitor information **212**, according to an embodiment. The monitor information **212** may store information for vehicles **104**. For example, a first entry of vehicle information **300** may store information for a Ford Mustang and a second entry of vehicle information **300** may store information for a Chevrolet Camaro. In one embodiment, an entry of vehicle information **300** may be automatically stored in the monitor information **212** responsive to receiving characterization information from a particular vehicle **104** for the first time. According to one embodiment, the vehicle information **300** may be stored in a provisional state until association with a particular vehicle **104** has been corroborated through repeated recognition over time and location, possibly in conjunction with other already-associated or reliably-coincidental signals.

**[0093]** FIG. **3**B illustrates vehicle information **300**, according to an embodiment. The vehicle information **300** may store information for a vehicle **104**. The vehicle information **300** may include vehicle identification information **302** that identifies a vehicle **104** and one or more entries of part description information **304** that describes part(s) **106** in the vehicle **104**. The vehicle identification information **302** may include a vehicle identification number (VIN), make, model, and year for the vehicle **104**. Each entry of part description information **304** corresponds to a part **106**. In one embodiment, an entry of part description information **304** may be automatically stored in the vehicle information **300** responsive to receiving characterization information for a part **106** for the first time from the vehicle **104**.

**[0094]** FIG. **3**C illustrates part description information **304**, according to an embodiment. The part description information **304** may include a part identifier **306**, a part type identifier **308**, part log information **310**, maintenance history information **316**, service level information **318**, and original equipment manufacturer (OEM) authentic information **320**. The part identifier **306** may include an alphanumeric identifier or some other identifier that uniquely identifies the part **106**. In accordance with one embodiment, the part identifier **306** may include a range of part identifiers **306**. The part identifier **306** may be assigned by a manufacturer or the network-based marketplace **118**. The part identifier **306** may include a standard product identifier (e.g., Universal Product Code (UPC), Electronic Product Code (EPC), etc.). The part type identifier **308** may identify a part type (e.g., hose, filter, bulb, belt, etc.). A particular part type identifier **308** may be associated with one or more part identifiers **306**. The part log information **310** may include one or more entries of characterization information **312** for the part **106**. Each entry of characterization information **312** may be associated with a timestamp **314** that is generated by the mobile device **112** and stored with the corresponding characterization information **312** that is received from a smart component **102**. In one embodiment, the part log information **310** may be embodied as a circular buffer with a size that is configurable. The characterization information **312** was previously described. The timestamp **314** may include the current time as identified by the mobile device **112** responsive to the mobile device **112** receiving the characterization information **312**. In one embodiment, the mobile device **112** may receive characterization information **312** for a part **106** that signals a replacement of the part.

**[0095]** Responsive to receiving the characterization information **312**, the mobile device **112** may purge an entry of part description information **304** for the part **106** that is being replaced from the vehicle information **300** and create an entry of part description information **304** in the vehicle information **300** for the part **106** that is new. The maintenance history information **316** may store a history for the part type identifier **308** and survive a replacement operation in conjunction with the part type identifier **308**. The maintenance history information **316** may associate each replacement of the part **106** with a timestamp **314** that includes a date and time of replacement, an odometer reading sampled at the time of replacement, a percentage wear of the part **106** replaced (e.g., 80% wear), the manufacturer of the part **106**, the part identifier **306** and other information.

**[0096]** The service level information **318** may store the current service level for the part **106**. In one embodiment, four service levels may be defined including "OK," "SUGGEST," "WARN", and "REPLACE" in accordance with thresholds, as described later in this document. The first level, "OK," may be utilized to indicate no thresholds have been exceeded. The second level, "SUGGEST," may be utilized to indicate at least one threshold was exceeded causing the sending of an alert to the user that includes a suggestion. For example, the network-based marketplace **118** may send an alert to the user including a suggestion to repair or purchase a part **106**. The third level, "WARN," may be utilized to indicate at least one threshold was exceeded causing the network-based marketplace **118** to send an alert to the user including a suggestion to repair or purchase a part **106** and a warning. For example, the alert may suggest to the user to repair or purchase a part **106** and warn the user that the current part **106** is in need of repair. The fourth level, "REPLACE," may be utilized to indicate at least one threshold was exceeded causing the sending of an alert to the user that includes a suggestion to repair or purchase a part **106** and an urgent warning. For example, the alert may suggest to the user to repair or purchase a part **106** urgently warn the user that the part **106** may fail because a likelihood of failure has exceeded a threshold (e.g., fifty-percent).

**[0097]** The OEM authentic information **320** may include a flag that is asserted to signify the part **106** is manufactured by an original equipment manufacturer (OEM) and not asserted to indicate otherwise (e.g., knockoff—authentication failed). For example, the OEM authentic information **320** may be updated based on characterization information **312** that is received from a smart component **102**, the characterization information **312** including results from a test that is performed on the part **106** while it is in place in the vehicle **104**. In one embodiment, the test may generate characterization information **312** that includes a part identifier **306** that, in turn, is compared with OEM tracking information stored at the network-based marketplace **118** to identify whether the part **106** in the smart component **102** was manufactured by any one of multiple manufacturers. According to one embodiment, the mobile device **112** may perform the comparison. According to one embodiment, the mobile device **112** or the network-based marketplace **118** may identify (indirectly or otherwise) a certifiable cryptographic public key that is used to decrypt parts of the characterization information **312** (e.g., dynamic) where identification of characterization information **312** that is not encrypted or cannot be decrypted based on the public key causes the mobile device **112** and/or network-based marketplace **118** to not assert the OEM authentic information **320** (e.g., the part **106** is fake because the fraudulent manufacturer does not possess the corresponding private key to encrypt the part type identifier **308** in the characterization information).

**[0098]** FIG. **4**A illustrates a maintenance message **400**, according to an embodiment. The maintenance message **400** may be communicated by the mobile device **112** to the network-based marketplace **118**. The maintenance message **400** may be sent by the mobile device **112** to the network-based marketplace **118** responsive to the mobile device **112** receiving characterization information **312** from a smart component **102**. The maintenance message **400** may include the user identifier **218**, vehicle identification information **302**, part identifier **306**, part type identifier **308**, characterization information **312**, and a timestamp **314**, all as previously described. In other embodiments, the maintenance message **400** may include multiple entries of characterization information **312** respectively paired with timestamps **314**.

**[0099]** FIG. **4**B illustrates a synchronization message **402**, according to an embodiment. The synchronization message **402** may be utilized by the mobile device **112** to synchronize the network-based marketplace **118** with the mobile device **112** in accordance with the information included in the synchronization message **402**. The synchronization message **402** may include the user identifier **218**, the vehicle identification information **302**, and part description information **304**, all as previously described. The synchronization message **402** may be utilized to synchronize the network-based marketplace **118** with the mobile device **112** with regard to a part **106**. In other embodiments, the synchronization message **402** may include multiple entries of part description information **304** to synchronize the network-based marketplace **118** with the mobile device **112** with regard to a vehicle **104**.

**[0100]** FIG. **5** illustrates the network-based marketplace **118**, according to an embodiment. The network-based marketplace **118** may include smart component modules **500** and a database **204**. The smart component modules **500** may receive and process communications from the mobile device **112** and the network-based marketplace **118**. The communications from the mobile device **112** may include the previously described maintenance message **400** and synchronization message **402**. The communications from the network-based marketplace **118** may include triggering events that are generated by the network-based marketplace **118**. The smart component modules **500** may include a receiving module **502**, a processing module **504**, and a smart component engine **505**. The receiving module **502** may receive the communications and the processing module **504** may process the communications. In some instances, the processing module **504** may further generate a triggering event based on the communication and communicate the triggering event to the smart component engine **505** for further processing although other processes may generate and communicate a triggering event to the smart component engine **505**. The database **204** may include an items table **506**, a user table **508**, original equipment manufacturing (OEM) tracking information **510**, maintenance information **512**, and smart component processing information **514**. The items table **506** may include multiple entries of listings with each listing describing an item (e.g., part **106** or service) that is being offered for sale and/or for auction on the network-based marketplace **118**. The user table **508** may include multiple entries of user profile information where each entry of user profile information may be utilized to describe a user (e.g., buyer, seller, both) on the network-based marketplace **118**. The OEM tracking information **510** may be utilized by the network-based marketplace **118** to perform a validation on a part **106** to identify whether it is authentically supplied by a manufacturer. For example, the mobile device **112** may be used to scan a part identifier **306** and/or part type identifier **308** for a part **106** prior to installation in the vehicle **104** to authenticate whether the part **106** is supplied by a particular manufacturer. The maintenance information **512** may be utilized to identify and execute a maintenance policy responsive to identifying characterization information **312** or a time derivative of one or more entries of characterization information **312** as exceeding or dropping below a threshold. For example, traversing a threshold may cause an implementation of a maintenance policy by communicating one or more triggering events to the smart component engine **505**. The smart component processing information **514** may be utilized to define triggering events that are received by the smart component engine **505**, define processing rules that are executed by the smart component engine **505** responsive to receiving a triggering event, and define associations between the triggering events and the processing rules.

**[0101]** FIG. **6**A illustrates the items table **506**, according to an embodiment. The items table **506** may include entries of listings **600** that are published by sellers on the network-based marketplace **118**.

**[0102]** FIG. **6**B illustrates the listing **600**, according to an embodiment. The listing **600** may describe an item that is offered for sale on the network-based marketplace **118**. The listing **600** may include a title **602**, a part identifier **306** (optional), a part type identifier **308** (optional), a description **604**, an image **606** of the item (e.g., part **106**) that may be uploaded by the seller, a price **608** to purchase the item that may be configured by the seller, a bid **610** (e.g., the current highest bid for the item), one or more categories **612** which may be navigated to locate and view the listing **600**. The title **602** may briefly describe the item and the description **604** may further describe the item. The title **602** and the description **604** may be received from the seller. The part identifier **306** may include a component/part identifier that identifies the part

**106**. The part identifier **306** may be assigned by a manufacturer. The part identifier **306** may include a global trade number (GTIN), a universal product code (UPC), a manufacture part number (MPN) or some other standard product identifier that identifies the item being described.

**[0103]** FIG. **7**A illustrates a user table **700**, according to an embodiment. The user table **700** may include multiple entries of user profile information **702** that respectively correspond to a user who utilizes the network-based marketplace **118** to buy and/or sell items (e.g., smart components **102**, parts **106**, sensors **108**, etc.).

**[0104]** FIG. **7**B illustrates the user profile information **702**, according to an embodiment. The user profile information **702** may include user information **216**, user preference information **704**, and garage information **706**. The user information **216** may store the name, address, telephone number, and other information, as described in FIG. **7**C. The user preference information **704** may store thresholds, values, and other preferences manually configured by the user or automatically configured based on behaviors or actions of the user. For example, the user preference information **704** may store preferences for a particular brand of parts **106** that were identified based on user behavior including purchases, search queries, browsing values and the like that implicated the brand of a part **106**. The garage information **706** may store vehicle information **300** for vehicles **104** that are associated with the user. An entry of vehicle information **300** may be created or generated responsive to a manual configuration by the user. In addition, an entry of vehicle information **300** may be automatically created or generated responsive to receipt of a maintenance message **400** or synchronization message **402** based on the content of the respective message.

**[0105]** FIG. **7**C illustrates the user information **216**, according to an embodiment. The user information **216** may include information that describes the user, as mentioned above, such as a user identifier **218** and expert information **220**. The user identifier **218** may uniquely identify the user from other users on the network-based marketplace **118**. The expert information **220** may include one or more part type identifiers **308**, one or more sub-system identifiers **708**, and vehicle identification information **302** that may identify one or more vehicles **104**. For example, the expert information **220** may include an expertise level indicating the user has an ability to provide "expert" or "qualified" advice for a particular part **106**, in a particular sub-system **103**, in a particular vehicle **104**, or some combination thereof. For example, the expertise level may indicate the user is a general expert who is qualified to provide advice for Fords by including vehicle identification information **302** that identifies Ford while specifying neither a part type identifier **308** nor a sub-system identifier **708**. Further for example, the expertise level may indicate the user is an expert for a specific type of hoses, in an engine sub-system for Fords.

**[0106]** FIG. **7**D illustrates maintenance information **512**, according to an embodiment. The maintenance information **512** may be used to facilitate the maintenance of parts **106** on vehicles **104**. The maintenance information **512** may include one or more entries of part maintenance information **710** that define thresholds and maintenance policies for a particular part(s) **106**.

**[0107]** FIG. **7**E illustrates part maintenance information **710**, according to an embodiment. The part maintenance information **710** may include vehicle identification information **302** that identifies a vehicle **104**, the part type identifier **308** that identifies a type of a part **106** and part policy information **711**. In some embodiments, the part maintenance information **710** may further include a part identifier **306**. The part policy information **711** may include threshold information **712** that includes a threshold in association with maintenance policy information **714** that defines maintenance for the associated threshold. For example, the part log information **310** (FIG. **3**C) for a smart component **102** may be processed to identify a computed value as exceeding threshold information **712** of 75% (e.g., Level 1) to cause the associated maintenance policy information **714** to be implemented. In one embodiment, the maintenance policy information **714** may include a triggering event that is communicated to the smart component engine **505** for processing (e.g., communicate alerts to mobile device **112**). The part policy information **711** may include multiple levels of threshold information **712** paired with maintenance policy information **714** (e.g., "LEVEL 1," "LEVEL 2," "LEVEL 3"). For example, the levels may be graduated based on the level of wear (e.g., 75%—"SUGGEST," 85% —"WARN," 95%—"REPLACE").

**[0108]** FIG. **7**F illustrates smart component processing information **720**, according to an embodiment. The smart component processing information **720** may include triggering event information **722** that defines triggering events, processing rules information **724** that includes sets of processing rules, and association information **726** to associate each triggering event to one or more sets of processing rules. The smart component processing information **720** may be utilized by the smart component engine **505** to associate a triggering event with one or more sets of processing rules based on the association information **726**, load the one or more sets of processing rules into the smart component engine **505** and execute the one or more sets of processing rules.

Maintenance Message Triggering Event

**[0109]** The triggering event information **722** may include a maintenance message triggering event. The maintenance message triggering event may be communicated by the processing module **504** to the smart component engine **505** responsive to receipt of the maintenance message **400** at the network-based marketplace **118**. Recall that the mobile device **112** may receive characterization information **312** from a smart component **102** (e.g., part **106** and sensor **108**), the mobile device **112**, in turn, communicating a maintenance message **400**, including the characterization information **312**, to the network-based marketplace **118** including the processing module **504** that, in turn, processes the maintenance message **400** to communicate the maintenance message triggering event to the smart component engine **505**. For example, the processing module **504** may process the maintenance message **400** for the part **106** (e.g., engine hose) to identify a new service level (e.g., "REPLACE," "WARN," "SUGGEST") in the service level information **318** for the part **106**. Further, the association information **726** may be utilized by the smart component engine **505** to associate the maintenance message triggering event with sub-system scan rules, and install time processing rules, according to one embodiment. According to another embodiment, additional or fewer sets of processing rules may be associated with the maintenance message triggering event. The sub-system processing rules may be executed by the smart component engine **505** to identify a service level (e.g., "REPLACE," "WARN," "SUGGEST") other than "OK" in the service level information **318**

for the part **106**. If a service level other than "OK" is identified then the sub-system processing rules may further be executed to identify a sub-system that includes the part **106**, and communicate a message to the mobile device **112** that causes the mobile device **112** to scan all of the smart components **102** in the identified sub-system. For example, an engine hose in an engine that is identified with a service level other than "OK" may be identified by the smart component engine **505** that causes a message to be communicated to the mobile device **112** that causes the mobile device **112** to scan all the parts **106** in the identified engine sub-system. In one embodiment, related sub-systems may be scanned responsive to identification of a service level other than "OK" for a part **106**. In one embodiment, the scan of the sub-system is not performed if the engine-sub system or the entire vehicle **104** was scanned in a predetermined period of time (e.g., five minutes) prior to receipt of the maintenance message **400** by the network-based marketplace **118**. In one embodiment the period of time may be configured. In another embodiment, a part scan, sub-system part scan, or vehicle part scan may optionally or automatically be delayed to enable the car to warm up, or otherwise reach a stable operating condition.

**[0110]** The install time processing rules may be utilized by the smart component engine **505** to identify a service level (e.g., "REPLACE," "WARN," "SUGGEST") other than "OK" in the service level information **318** for the part **106**. If a service level other than "OK" is identified the sub-system processing rules may further be executed to generate an estimated replacement time for the part **106**, and communicate an alert to the mobile device **112** that includes the replacement time. In one embodiment, the replacement time may be computed based on the location of the mobile device **112**. For example, responsive to the smart component engine **505** identifying the mobile device **112** as being located in a geographic circle that includes the garage of the user, the smart component engine **505** may compute the replacement time for the part **106** based on the assumption that the user is performing the replacement and the competence level of the user. Further, for example, responsive to the smart component engine **505** identifying the mobile device **112** as being located within a geographic circle that includes a vehicle repair shop, the smart component engine **505** may compute the replacement time based on the competence level of the repair shop. In one embodiment, the center of the circle is the location of the mobile device **112** and the radius of the circle is a predetermined length. In one embodiment the length of the radius may be configured. In another embodiment, a geographic area may further include an irregular region or set of regions that are determined from navigation route information, calculated travel paths between common destinations (e.g., home-to-work), or historical location information (with or without respect to any specific travel path).

Alert Configuration Triggering Event

**[0111]** The triggering event information **722** may include an alert configuration triggering event. The alert configuration triggering event may be communicated by the mobile device **112** or client machine **120** to the smart component engine **505**, via the network-based marketplace **118**, responsive to receipt of one or more selections at the respective mobile device **112** or client machine **120**. The alert configuration triggering event may include configuration information that is used to configure threshold information **712** and maintenance policy information **714** for a particular part **106**. The association information **726** may be utilized by the smart component engine **505** to associate the alert configuration triggering event with the alert configuration processing rules that, in turn, are executed by the smart component engine **505** to receive the configuration information, process the configuration information to generate the threshold information **712** and maintenance policy information **714**, store the threshold information **712** in the part policy information **711** that is identified for the part **106**, and store the maintenance policy information **714** in the part policy information **711** that is identified for the part **106**.

Expert Request Triggering Event

**[0112]** The triggering event information **722** may include an expert request triggering event. The expert request triggering event may be sent by the mobile device **112** or client machine **120** to the smart component engine **505**, via the network-based marketplace **118**, responsive to receipt of a selection at the respective mobile device **112** or client machine **120**. The expert request triggering event may include a part type identifier **308** and/or sub-system identifier **708** and/or vehicle identification information **302**. The association information **726** may be utilized by the smart component engine **505** to associate the expert request triggering event with the alert expert processing rules that, in turn, are executed by the smart component engine **505** to identify experts in the user information **216** based on the expert information **220**. For example, the smart component engine **505** may execute the alert expert processing rules to identify experts in the user information **216** by matching the part type identifier **308** and/or sub-system identifier **708** and/or vehicle identification information **302** in the expert request triggering event with the expert information **220** in the user information **216** and communicating the results back to the respective mobile device **112** or client machine **120** that initiated the request.

Manual Request Triggering Event

**[0113]** The triggering event information **722** may include a manual request triggering event. The manual request triggering event may be sent by the mobile device **112** or client machine **120** via the network-based marketplace **118**, in response to receipt of a selection at the respective mobile device **112** or client machine **120**. For example, a user who is operating his mobile device **112** may be attempting to replace a part **106** in his vehicle **104** in his garage at home and make a selection on his mobile device **112** to request a manual to repair a particular part **106**. The manual request triggering event may include a part identifier **306** and/or, a part type identifier **308** and/or sub-system identifier **708** and/or vehicle identification information **302**. The association information **726** may be utilized by the smart component engine **505** to associate the manual request triggering event with the manual processing rules which are executed by the smart component engine **505** to identify and communicate the appropriate manual(s) to the mobile device **112** or client machine **120**.

Maintenance History Triggering Event

**[0114]** The triggering event information **722** may include a maintenance history triggering event. The maintenance history triggering event may be sent by the mobile device **112** or client machine **120** to the smart component engine **505**, at the network-based marketplace **118**, responsive to receipt of a

selection at the mobile device **112** of the client machine **120**. For example, a user who is operating his mobile device **112** may want to know the maintenance history of one or more parts **106** in his vehicle **104** and make one or more selections on his mobile device **112** which causes the mobile device **112** to communicate the maintenance history triggering event to the network-based marketplace **118**. The maintenance history triggering event may include a part identifier **306** and/or, a part type identifier **308** and/or sub-system identifier **708** and/or vehicle identification information **302**. The association information **726** may be used by the smart component engine **505** to associate the maintenance history triggering event with the maintenance history processing rules which, in turn, are executed by the smart component engine **505** to retrieve one or more entries of maintenance history information **316** from the corresponding entries part description information **304** for one or more parts **106**, parts **106** included in one or more sub-systems and parts **106** included in one or more vehicles **104** and to communicate the maintenance history information **316** that was retrieved to the mobile device **112** or client machine **120**.

Merchandise Request Triggering Event

**[0115]** The triggering event information **722** may include an entry for a merchandise request triggering event. The merchandise request triggering event may be sent by a process in the network-based marketplace **118** to the smart component engine **505** responsive to an identification of a presentation of merchandising information. For example, a user who is operating his mobile device **112** or the client machine **120** may be targeted for a presentation of merchandising information (e.g., presentation of purchase opportunities) that is updated or modified by the smart component engine **505** to include purchase opportunities for parts **106** that are identified by the smart component engine **505**. Responsive to receipt of the merchandise request triggering event, the smart component engine **505** may utilize the association information **726** to associate the merchandise request triggering event with the merchandise suggestion processing rules which, in turn, are executed by the smart component engine **505** to identify service level information **318** in the vehicle information **300** of the garage information **706** that is associated with the user of the mobile device **112** or client machine **120**. Responsive to identifying service level information **318** that is not "OK" (e.g., "SUGGEST," "WARN," "REPLACE") for parts **106** of vehicles **104** in the garage information **706** at the network-based marketplace **118**, the smart component engine **505** may utilize the associated maintenance history information **316** to modify the merchandising information. For example, the smart component engine **505** may identify parts **106** with service level information **318** that are not "OK" and modify the merchandising information to include merchandising content for one or more of the identified parts **106** where the merchandising content is modified to include buying opportunities for the identified parts **106** that are filtered according to the brands that are preferred by the user as determined by the corresponding maintenance history information **316**. For example, the smart component engine **505** may modify merchandising content to push unsolicited content to a user, realize an intra-purchase opportunity with a suggestion (e.g., "Do you also need X" or "Other users often purchase Y" or "Purchase Z at the same time and save XX %"), realize a post-purchase opportunity with a suggestion (e.g., "You might also like"). For example, the smart component engine **505** may modify merchandising content to present a wish list of parts **106** and send alerts to any device associated with the current user (e.g., another device on which the user is running and signed-into a marketplace-connected app) (e.g., any device that has been indirectly associated with the user's profile—for example, given an operating system or environment in which the user profile information **702** is associated with a cloud account).

Purchase Request Triggering Event

**[0116]** The triggering event information **722** may include an entry for a purchase request triggering event. The purchase request triggering event may be sent by a process in the network-based marketplace **118** to the smart component engine **505** responsive to an identification of a presentation of merchandising information at the time of purchase. The purchase request triggering event operates similar to the merchandise request triggering event.

Search Suggestion Triggering Event

**[0117]** The triggering event information **722** may include an entry for a search suggestion triggering event. The search suggestion triggering event may be sent by a process in the network-based marketplace **118** to the smart component engine **505** responsive to an identification of a user entering a query from a mobile device **112** or the client machine **120**. In one embodiment, an input box that receives a query from the user may include a drop-down box immediately below the input box. The drop-down box may contain search suggestions that may be selected by the user to overwrite the current query. Responsive to receiving a search suggestion triggering event, the smart component engine **505** may utilize the association information **726** to associate the search suggestion triggering event to search suggestions processing rules that, when executed by the smart component engine **505**, identify parts **106** with service level information **318** that is not "OK" (e.g., "SUGGEST," "WARN," "REPLACE") for vehicles **104** in the garage information **706** or the user, and modify the search suggestions in the drop-down box to include search suggestions that target the identified parts **106**. For example, the smart component engine **505** may modify the search suggestions to include categories, brands, performance characteristics, and compatibility attributes based on the identified parts **106**.

Location of Mobile Device Triggering Event

**[0118]** The triggering event information **722** may include an entry for a location of mobile device triggering event. The location of mobile device triggering event may be sent by a scheduling process in the network-based marketplace **118** to the smart component engine **505** responsive to the expiration of a mobile device timer. The mobile device triggering event may be sent to identify the location of the mobile device **112** and initiate ecommerce activity. In one embodiment, the mobile device timer may be reinitialized with a predetermined timeout of five minutes each time the triggering event is processed. In one embodiment, the predetermined timeout may be configured by a user. Responsive to receiving a location of mobile device triggering event, the smart component engine **505** may utilize the association information **726** to associate the mobile device triggering event with mobile device location rules that, when executed by the smart component engine **505**, identify the current location of the mobile

device **112**, identify parts **106** with service level information **318** that is, respectively not "OK" (e.g., "SUGGEST," "WARN," "REPLACE") for vehicles **104** in the garage information **706** of the user associated with a particular mobile device **112**, identify whether the current location of the mobile device **112** is within a geographic area (e.g., geographic circle) that includes a facility that may repair the identified part(s) **106**, identify a wait time for the facility to perform the service, identify an estimated repair time to repair the part **106**, communicate a message to the mobile device **112** that prompts the user of the opportunity to repair the part **106** at the facility including an estimated wait time for the facility to perform the service and an estimated repair time for the facility to repair the part **106**, and initialize the mobile device timer with the predetermined timeout. In one embodiment, the center of the circle is the location of the mobile device **112** and the radius of the circle is a predetermined length from the location of the mobile device **112**. In one embodiment the length of the radius may be configured.

Third Party Notification Triggering Event

**[0119]** The triggering event information **722** may include an entry for a third party notification triggering event. Information may be communicated to a third party responsive to receiving this event. Responsive to receiving a third party triggering event, the smart component engine **505** may utilize the association information **726** to associate the third party notification triggering event with third party triggering event rules that, when executed by the smart component engine **505**, generate third party information and communicate the third party information, over a network (e.g., network **116**), to a third party (e.g., fleet management). For example, the third party information may include service level information **318** for a part **106**, maintenance history information **316** for a part **106**, or any other information for a part **106**, subsystem **103**, or vehicle **104**.

Recall/Bulletin Triggering Event

**[0120]** The triggering event information **722** may include an entry for recall/bulletin triggering event. A recall/bulletin for one or more parts **106** may be communicated to the mobile device **112** or client machine **120** responsive to receiving a request from one of these devices for such information. Responsive to receiving a recall/bulletin triggering event, the smart component engine **505** may utilize the association information **726** to associate the recall/bulletin triggering event with recall/bulletin rules that, when executed by the smart component engine **505** cause the smart component engine **505** to identify garage information **706** associated with a user associated with the client machine **120** or mobile device **112**, identify one or more entries of vehicle information **300** in the garage information **706** associated with the user, identify part type identifiers **308** in the respective vehicle information **300** for which recall/bulletins have been published, and communicate the recall/bulletins to the mobile device **112** or client machine **120**.

**[0121]** FIG. **7**G illustrates a method **728** to utilize smart components, according to an embodiment. The method **728** may commence at operation **730**, at the network-based marketplace **118**, with the receiving module **502** receiving a maintenance message **400** from a mobile device **112**. For example, the mobile device **112** may have received a selection to execute a part scan, sub-system scan part scan, or a vehicle scan for a vehicle **104**. Responsive to execution of one of the aforementioned scans, the mobile device may receive characterization information **312** from a smart component **102** on the vehicle **104** and communicate a maintenance message **400** including the characterization information **312** and timestamp **314** to the network-based marketplace **118**.

**[0122]** At operation **732**, the processing module **504** may identify the user profile information **702** in the user table **700** based on the maintenance message **400**.

**[0123]** At operation **734**, the processing module **504** may store the characterization information **312** and the timestamp **314** as part log information **310** in the appropriate part description information **304** (e.g., part **106**). For example, the processing module **504** may identify the vehicle information **300** in the garage information **706** in the user profile information **702** based on the vehicle identification information **302** in the maintenance message **400**. In addition, the processing module **504** may identify the appropriate part description information **304** in the identified vehicle information **300** based on the part identifier **306** or part type identifier **308** in the maintenance message **400**. Finally, the processing module **504** may copy the characterization information **312** and the timestamp **314** from the maintenance message **400** to next available location in the part log information **310** in the identified part description information **304**. In one embodiment, the processing module **504** may create the vehicle information **300** in the garage information **706** responsive to receipt of the maintenance message **400**.

**[0124]** At decision operation **736**, the processing module **504** may identify whether a part **106** has not previously been registered in the garage information **706**. For example, a part **106** that is not registered in the garage information **706** may include replacing a part **106** that is old with a part **106** that is new for a particular part type identifier **308**. If the part identifier **306** in the maintenance message **400** is not found in the garage information **706** then processing continues at operation **738**. Otherwise, processing continues at operation **740**.

**[0125]** At operation **738**, the processing module performs multiple steps to register the part **106**. First, the processing module **504** may identify an existing part **106** in the garage information **706** with a part type identifier **308** that matches the part type identifier **308** in the maintenance message **400**. If found, the processing module **504** may utilize the existing entry by overwriting the part identifier **306** that is old with the part identifier **306** that is new. Otherwise, the processing module **504** may create a new entry of part description information **304** in the vehicle information **300**. Second, the processing module **504** may update the maintenance history information **316** for the part type identifier **308** by recording an entry chronicling the replacement of the part **106** that is old with the part **106** that is new. For example, the brand names of the two parts **106**, the part identifiers **306**, the part type identifier **308**, the current date, odometer reading, vehicle identification information **302**, and part log information **310** for the part **106** that is old may be stored in the maintenance history information **316**. Third, the part identifier **306** for the part **106** that is being registered may be compared with the part identifiers **306** in the OEM tracking information. If a match is found, then the part **106** is validated as an authentic OEM part. Otherwise the part is not validated as an authentic OEM part. In either instance, at operation **738**, the processing module **504** may store the appropriate status in the OEM authentic information **320** in the part description information **304** for the part **106** and communicate the status to the associated

client machine **120** or mobile device **112**. Fourth, the processing module **504** may communicate a recall/bulletin triggering event to the smart component engine **505** to identify whether recall/bulletin notices are available for the part **106** and, responsive to such an identification communicate an alert to the mobile device **112** or client machine **120** that includes a notice of the recall/bulleting for the part **106**.

**[0126]** At operation **740**, the processing module **504** may compute a derivative of part log information **310** over time. The processing module **504** may compute multiple derivatives of the part log information **310** including a first-derivative to generate first-derivative information (e.g., a simple change over time (e.g., the average wear rate)), a second derivative to generate second derivative information (e.g., an acceleration over time (e.g., the rate at which the rate is changing—acceleration may indicate partial failure, failure in related parts, conditions exceeding some 'elastic' threshold, etc.)), and/or a third derivative to generate third derivative information (e.g., a 'jerk'—the rate at which the acceleration is changing—a sudden 'jerk' possibly indicating a catastrophic failure or other transient but significant change not following the 'usual' degradation). For example, processing module **504** may generate first-derivative information for an aggregate often entries of characterization information **312**. The quantity of time may be computed by subtracting a timestamp **314** associated with the first entry (e.g., earliest) in the aggregate from the timestamp **314** associated with the last entry (e.g., latest) in the aggregate. Further, the quantity of wear may be computed by subtracting the characterization information **312** associated with the first entry (e.g., earliest) in the aggregate from the characterization information **312** associated with the last entry in the aggregate. Further, where the first-derivative is computed by dividing the quantity of wear by the quantity of time and, optionally, by smoothing the resulting derivative.

**[0127]** At decision operation **742**, the processing module **504** may compare the first derivative information and/or the second derivative information and/or the third derivative information with respective threshold information **712** in the part maintenance information **710** associated with the part type identifier **308** to identify whether a threshold has been exceeded. If a threshold is exceeded then processing continues at operation **744**. Otherwise, processing continues at operation **746**. In one embodiment, the threshold may be calculated dynamically at the time operation **742** is executed by the processing module **504**. At operation **744**, the processing module **504**, may register the one or more thresholds that have been exceeded.

**[0128]** At operation **746**, the processing module **504** may interrogate the part log information **310** to identify anomalous part log information **310**. The processing module **504** may identify anomalous part log information **310** in many different ways. For some part types (e.g., part type identifier (s) **308**), the processing module **504** may expect the part log information **310** to represent a discrete approximation or sampling of a continuous set whose ideal trend is expected to progress in one direction, after accounting for measurement noise due to sensor **108** and extreme environmental conditions. For example, brake wear is ideally expected to trend smoothly from 0% to 100% wear. In this instance it is reasonable to apply averaging or outlier elimination to obtain a more accurate approximation of actual wear level. Consequently, a single anomalous reading may not be considered actionable. In contrast, other parts **106** may supply measurements that result in part log information **310** that is largely uncorrelated to other measurements except in very close temporal proximity. For example, the part log information **310** for boost pressure is expected to vary rapidly with no intrinsic trend. While for some measurement error is still expected, a single reading that falls out of expected range by more than some value can indicate a gasket failure, blowoff malfunction, etc. The processing module **504** may evaluate these measurements individually for such characteristics. According to another embodiment the processing module **504** may evaluate the part log information **310** for boost pressure relative to a continuous function derived from other contemporaneous readings such as throttle, engine speed, gear ratio, etc. Yet according to another embodiment, the processing module **504** may identify sequences or combinations of individually-valid values that are recognized as aberrant when evaluated together (e.g., correlation of simultaneous or sequential signals vs. covariance models). For an example of a sequence of values that might be recognized as aberrant, consider a leaf spring capable of reporting the apparent load on the spring as determined by the degree of deformation. Values may range freely between some well-known extremes, but are expected to maintain a constant average given a constant load. While the vehicle **104** is in motion, deflections in the spring should return (via damped motion) to a reasonable and stable center-point. If an extreme (but normal) inflection returns to a stable center significantly different than the center prior to the inflection, it may be an indication that a crack in the leaf spring has reduced the ability of the spring to hold a load. For an example of a sequence of values that might be recognized as aberrant, when correlated to other values, consider deflection/compression measurements as reported by brake calipers. If a hydraulic line is faulty, one caliper may experience considerably less deflection than the opposed caliper, even though both deflection measurements are individually within tolerance. Similarly, various signals could be correlated with those from related smart components **102**, with engine speed, etc. . . . . In one embodiment, the processing module **504** may identify the lack or unexpected rate of appearance of an expected signal. For example, if a previously-recorded sensor **108** fails to report a signal altogether, the processing module **504** may determine the part **106** has failed catastrophically, but may more plausibly be a signal that the sensor **108** itself has failed, or the part **106** was replaced.

**[0129]** At decision operation **748**, the processing module **504** may compare the anomalies in the part log information **310** with threshold information **712** in the part maintenance information **710**, as described above, to identify whether any thresholds have been exceeded. If a threshold is exceeded, then processing continues at operation **750**. Otherwise, processing continues at operation **752**. In another embodiment, the processing module **504** may branch to operation **750** based on an identification of one or more anomalies without making a comparison with the threshold information **712**. At operation **750**, the processing module **504**, may register threshold(s) that have been exceeded. In another embodiment, the processing module **504** may register one or more anomalies that were identified notwithstanding the threshold information **712**.

**[0130]** At operation **752**, the processing module **504**, may register the service level (e.g., "OK," "SUGGEST," "WARN," "REPLACE") for the part **106** in the service level information **318**. For example, the processing module **504**

may generate the service level based on identifying the one or more thresholds that were registered as exceeded in operations **744** and **750**. In one embodiment, the processing module **504** may identify the service level based on one or more thresholds that have been exceeded as registered in operation **744** and/or based on the identification anomalous part log information **310**.

**[0131]** At operation **754**, the processing module **504** may send a triggering event to the smart component engine **505**. For example, the processing module **504** may send the maintenance message triggering event to the smart component engine **505**. In one embodiment, the maintenance message triggering event may include the maintenance message **400**. The method **728** ends.

**[0132]** FIG. **7**H illustrates a method **756** to utilize smart components, according to an embodiment. The method **756** may commence at operation **758**, at the network-based marketplace **118**, with the smart component engine **505** receiving a triggering event. At operation **758**, the smart component engine **505** may associate the triggering event with processing rules, as described further in this document, and load the processing rules in the smart component engine **505**. At operation **760**, the smart component engine **505** may execute the processing rules.

**[0133]** FIG. **7**I illustrates a user interface **764**, according to an embodiment. The user interface **764** is illustrated as being displayed on a mobile device **112** (e.g., Apple iPhone). The user interface **764** includes the string, "Smart Components Application" indicating the name of an "app" that is displaying the user interface **764**. For example, the "Smart Components Application" may embody the maintenance application **200** illustrated in FIG. **1** to execute any of the methods described in this document. According to one embodiment, the "Smart Components Application" "app" may be loaded from the "app store" provided by Apple, Inc. of Cupertino, Calif. The user interface **764** may include a vehicle part scan user interface element **766**, a sub-system part scan user interface element **768**, a part scan user interface element **770**, and a configure alerts user interface element **772**. The vehicle part scan user interface element **766** may be selected to scan all smart components **102** on one or more a vehicles **104** included within a geographic circle where the center of the circle is identified as the location of the mobile device **112** and the radius of the circle is a predetermined length measured from the location of the mobile device **112**. In one embodiment, the radius is configurable. According to one embodiment, the range of a signal for a smart component **102** (not shown) may be a determining factor (e.g., sending or receiving signal). However, a third party (e.g., the vehicle **104** or shop environment) could conceivably provide area-effect 'power' for the sensors **108** (e.g., via inductive or RF wireless power transmission) upon instigation by a triggering signal originating in the mobile device **112**. In these scenarios, the range of the signal may be configurable based upon the power of the output signal, strength of the return signal, sensitivity of the receiver, or a selection of which of the localized third-party power transmitters were activated. The sub-system part scan user interface element **768** may be selected to scan a sub-system (e.g., smart components **102** in an engine, chassis, electrical, trunk, etc.) that is identified by the user and included within a geographic circle, as previously described. The part scan user interface element **770** may be selected to scan a part type that is identified by the user and included within a geographic circle, as previously described. It will be observed that proximity-based scans (e.g., vehicle part scan user interface element **766**, sub-system part scan user interface element **768**, or part scan user interface element **770**) may pick up parts **106** from neighboring vehicles **104**. According to one embodiment, the system **100** (as shown in FIG. **1**) may eliminate false positives from nearby vehicles **104** by correlating smart components **102** identified in multiple scans varied in time & location, and then 'recognizing' only those smart components **102** that have been consistently identified across multiple scans for a particular vehicle **104**.

**[0134]** The configure alerts user interface element **772** may be selected to enter a set of user interfaces that enable configuring of threshold information **712** (e.g., threshold) and maintenance policy information **714** for a particular part type, as identified by the network-based marketplace **118** with a part type identifier **308**, and vehicle **104**, as identified by the network-based marketplace **118** with vehicle identification information **302**. In one embodiment, the threshold information **712** may be configured to enable the dynamic calculation of a threshold responsive to receiving characterization information **312**.

**[0135]** FIG. **7**J illustrates a user interface **774**, according to an embodiment. The user interface **774** is illustrated as being displayed on a mobile device **112** (e.g., Apple iPhone). The user interface **774** displays a string, "Engine Part Scan" indicating the results of a sub-system part scan. The user interface **774** may include a user interface element **780**, column titles **782** for a "Part," "Wear," "Sensor Enabled," and "Service Level. The user interface **774** may further include rows **784** of part information, one for each part **106**. The user interface element **780** may be selected to display a wire diagram including the results of a vehicle **104** that was scanned, as illustrated in FIG. **7**L. The "Part column displays the name that is associated with the part identifier **306** and/or part type identifier **308** for the part **106**. The name of the part **106** is further associated with a user interface element "SEARCH" that may be selected to initiate a search for listings **600** that respectively describe an offering of the part **106** for sale or auction on the network-based marketplace **118**. The "Wear" column displays a percentage wear as indicated by the most recent characterization information **312** for the part **106** or an average of a window of recent characterization information **312** for the part **106**. The "Sensor Enabled" column displays "YES" for a smart component **102** with its sensor **108** enabled and "NO" for a smart component **102** with its sensor **108** disabled (e.g., not working, turned off, etc.). The "Service Level" column indicates the current service level information **318** (e.g., "OK," "SUGGEST," "WARN," or "REPLACE") and an estimated replace time based on the location of mobile device **112**, as previously described. For each row **784**, the part **106** is associated with an indication whether the part **106** was authenticated (e.g., "AUTHENTICATED") or not authenticated (e.g., "NOT-AUTHENTICATED"), as previously described.

**[0136]** FIG. **7**K illustrates a user interface **786**, according to an embodiment. The user interface **786** is illustrated as being displayed on a mobile device **112** (e.g., Apple iPhone). The user interface **786** includes user interface elements **788** and **790** respectively representing smart components **102**. The user interface element **788** represents a smart component **102** including a courtesy light bulb part **106** and the user interface element **790** represents a smart component **102** including an ignition switch part **106**. Recall, the smart components **102** are each associated with a part type identifier **308**. The user

interface elements (e.g., "HISTORY," "EXPERTS," or "MANUALS") may be selected in conjunction with a selection of one of the user interface elements **788** or **790** to display the selected type of information. For example, the user interface element for "HISTORY" may be selected after selecting the user interface elements **788** or **790** to display the maintenance history information **316** for the smart component **102** that was selected. Similarly, the user interface element "EXPERT" may be selected after selecting the user interface elements **788** or **790** to identify an expert for the part **106** included in the respective smart component **102** and/or enter a chat room that includes the identified expert and/or initiate a communication with the identified expert. For example, the expert may be identified based on the part type identifier **308** for the part **106** and the expert information **220**, as shown on FIG. **7**C, in the user table **700**, as shown on FIG. **7**A. The user interface element, "MANUAL," may be selected after selecting the user interface elements **788** or **790** to identify a manual to replace the smart component **102** that was selected. In one embodiment, the manual may be identified based an expertise level (e.g., novice, casual fixer, expert) of the user associated with the mobile device **112**.

Systems and Methods to Utilize an Electronic Garage Shelf

**[0137]** FIG. **8**A illustrates a system **800** to utilize an electronic garage shelf, according to an embodiment. The electronic garage shelf may be a metaphor for a shelf in a garage that is used to store parts **106**. Merely for example, the electronic garage shelf may store token parts that respectively represent parts **106** or smart components **102** including oil filters, carburetors, spark plugs, and fuses that are stored on a garage shelf in the user's garage. Further, the metaphor for a shelf in the garage may be expanded to include virtual parts that represent parts **106** or smart components **102** of interest to the user. Accordingly, the system **800** may include garage shelf information **802** comprising virtual part information **804** and token part information **806**. The virtual part information **804** may store virtual parts signifying parts **106** that are desirable for acquisition and the token part information **806** may store token parts signifying parts **106** that are in the user's possession.

**[0138]** Broadly, the system **800** may include: "A") a set of commands to add, delete, and configure the virtual parts and token parts; "B") processing to create virtual parts; "C") processing of the virtual parts; and "D") processing of the token parts. Processing to create virtual parts may include alerting a particular user to create a virtual part. For example, an alert to create a virtual part may be sent to a user who has expressed interest in a part **106**/smart component **102** by searching for the part **106**. Further for example, an alert to create a virtual part may be sent to a user for a smart component **102** that reports excessive wear. Processing virtual parts may be proactive or reactive. Processing that is proactive may include alerting a particular user of a purchase opportunity related to the virtual part, community content related to the virtual part, and creating a token part based on the virtual part to prompt the acquisition of the part **106** or smart component **102**. Processing that is reactive may include modifying dynamically selected content based on a virtual part. For example, the virtual parts for a particular user may be input to a mechanism that dynamically selects and ranks content. For example, a search mechanism executing a search on behalf of a user is configured to receive virtual parts as input to select and rank listings that are returned in a search result to the user. Further, for example, an automatically invoked merchandising mechanism (e.g., shopping cart being displayed) is configured to receive virtual parts as input to select and rank listings that are merchandised in association with the shopping cart to the user. In both instances a user's implicit interest in a part **106** is accommodated by utilizing the corresponding virtual part. Processing token parts may be proactive or reactive. Processing token parts that is proactive may include alerting a particular user of a sales opportunity to sell the part **106** or smart component **102** signified by the token part, alerting a particular user of community content related to the token part, alerting a particular user of installation of the part **106** or smart component **102** signified by the token part, and alerting a particular user of deleting the token part. Processing of token parts that is reactive may include evaluating whether token parts are compatible with a vehicle **104** that is added to a garage that is associated with a user. For example, a vehicle **104** may be added to vehicle garage information **706** (not shown) that is associated with a user and responsive to the addition of the vehicle **104** an analysis is performed to identify whether any of the token parts are compatible with the vehicle (e.g., for repair). For example, a token part that is identified as compatible signifies a part **106** in the real world that is suitable to replace the corresponding part **106** and/or smart component **102** in the vehicle **104**.

**[0139]** The system **800** may operate in conjunction with smart components **102** as previously described with respect to the system **100** in FIG. **1**. Accordingly, the same or similar references have been used to indicate the same or similar features unless otherwise indicated. While the vehicle **104** is illustrated as an automobile, it will be appreciated that trucks, all-terrain vehicles, jeeps, aircraft, water-born vessels, space vessels, and the like may embody the illustrated vehicle **104**. Merely for example, a smart component **102** in a Ford Mustang may include a sensor **108** for a brake pad that senses information **312** and communicates the characterization information **312** over the network **110** (e.g., NFC) to an iPhone that, in turn, communicates a maintenance message **400** including the characterization information **312** and a timestamp **314** to the network-based marketplace **118** that, in turn, stores the characterization information **312** and the timestamp **314** in garage information **706** for the Ford Mustang in user profile information **702** associated with a user and processes the characterization information **312** to identify a "REPLACE" service level for the brake-pad. Responsive to identifying a service level for the brake pad that is not "OK" (e.g., "REPLACE"), the network-based marketplace **118** may communicate an alert to the mobile device **112** or the client machine **120** to create a virtual part for the brake pad. The user may respond by entering a command to create a virtual part for the brake pad in the virtual part information **804**. Next, the network-based marketplace **118** may process the virtual part for the brake pad in the virtual part information **804** to identify a purchase opportunity on the network-based marketplace **118**. For example, an electronic storefront may be advertising a sale on the brake pad and the user may be alerted of the sale. Next, the user may purchase the brake pad and enter a command to change the virtual part that was previously created into a token part signifying acquisition the brake pad. In some embodiments, the virtual part may be changed automatically by the network-based marketplace **115**. For example, in one embodiment, the network-based marketplace **118** change the virtual part to the token part responsive to identifying the purchase as concluding an online transaction that was initi-

ated with a search based on the virtual part. Further for example, in one embodiment, the network-based marketplace **118** may change the virtual part to the token part responsive to identifying the purchase as concluding an online transaction that was initiated with a search based on an alert that described the virtual part. Next, the network-based marketplace **118** may process the virtual part for the brake pad in the garage shelf information **802** to communicate an alert to the user to prompt the user to install the brake pad as the corresponding smart component **102** for the break pad is now reporting 99% wear. Further details and features are described below.

**[0140]** FIG. **8**B illustrates the network-based marketplace **118**, according to an embodiment. The network-based marketplace **118** may include smart component modules **500** and the database **204**. The network-based marketplace **118**, smart component modules **500** and database **204** operate as previously described and as follows. The smart component modules **500** may include a receiving module **502** and a processing module **504** and a smart component engine **505**. The receiving module **502** may receive the commands from the mobile device **112** or the client machine **120** and the processing module **504** may process the commands to update the database **204**. Further, the processing module **504** may communicate responses to the commands, periodically identify and communicate alerts to create virtual parts, process the virtual parts and process the token parts. The processing module **504** may process the virtual parts to communicate alerts and perform other operations and process the token parts to communicate alerts and to perform other operations, both as described below. In some instances, the processing module **504** may further generate a triggering event and communicate the triggering event to the smart component engine **505** for further processing although other processes on the network-based marketplace **118** may generate and communicate a triggering event to the smart component engine **505**. The database **204** may include the garage shelf information **802** and community content information **803** in addition to the other data structures previously described in this document though not presently shown. The community content information **803** may include bulletin, recalls, service manuals, installation guides, pricing guides, recommendations, and any other community sourced content that may be used to maintain, fix, repair, price, acquire, evaluate, etc. a part **106** or smart component **102**, sub-system **103**, vehicle **104** or fleet of vehicles, etc.

**[0141]** FIG. **8**C illustrates a user table **700** including the garage shelf information **802**, according to an embodiment. The garage shelf information **802** is stored in the garage information **706** that, in turn, is stored in user profile information **702** that, in turn, is stored in the user table **700**. The garage shelf information **802** may include virtual part information **804** and token part information **806**, as previously described. The garage shelf information **802** may further include timeout information **807** and garage processing information **809**. The timeout information **807** may include three timeouts including a timeout to process an alert to create a virtual part, a timeout to process virtual parts and a timeout to process token parts. Responsive to an expiration of one of the timeouts a corresponding method is executed. For example responsive to the expiration of a timeout to process an alert to create a virtual part a corresponding method is executed, as described below. Responsive to an expiration of a timeout to process virtual parts a corresponding method is executed, as described below and responsive to an expiration of a timeout to process token parts a corresponding method is executed, as described below. The garage processing information **809** may include trigger event information **811** that defines triggering events, process rules information **815** that stores multiple sets of processing rules, and associate information **817** to associate each triggering event to one or more sets of processing rules. The garage processing information **809** may be utilized by the smart component engine **505** to associate a triggering event with one or more sets of processing rules based on the associate information **817**, load the one or more sets of processing rules into the smart component engine **505** and execute the one or more sets of processing rules.

**[0142]** Search Triggering Event—The trigger event information **811** may include the "search triggering event." The "search triggering event" may be communicated by a search mechanism including a search algorithm to the smart component engine **505**. The "search triggering event" may be communicated responsive to an execution of a search by a user associated with the garage shelf information **802**. For example, the network-based marketplace may receive a request for search that is initiated by selecting a virtual part or a token part that is registered in garage shelf information **802** associated with the user. Responsive to a search that is initiated by selecting a virtual part, the smart component engine **505** may utilize the associate information **817** to associate the "search triggering event" with "get virtual parts process rules" and retrieve the "get virtual parts process rules" from the process rules information **815**. Responsive to a search that is initiated by selecting a token part, the smart component engine **505** may utilize the associate information **817** to associate the "search triggering event" with "get token parts processing rules" and retrieve the "get token parts processing rules" from the process rules information **815**. The smart component engine **505** may execute the "get virtual parts processing rules" to identify the virtual parts in the virtual part information associated with the user and communicate a list of the virtual parts to the search algorithm that, in turn, selects and ranks listings **600** based on the contents of the list and other factors. The smart component engine **505** may execute the "get token parts processing rules" to identify the token parts in the token part information **806** associated with the user and communicate a list of the token parts to the search algorithm that, in turn, selects and ranks listings **600** based on the contents of the list and other factors. The search algorithm includes the selected listings **600** in search results that are communicated to the user.

**[0143]** Merchandise Triggering Event—The trigger event information **811** may include the "merchandise triggering event." The "merchandise triggering event" may be communicated by a merchandising algorithm to the smart component engine **505** responsive to a user performing a predetermined activity that suggests the user is receptive to a suggestion (e.g., making a purchase, browsing for a predetermined period of time, searching for a predetermined period of time, etc.) regarding merchandise (e.g., an item described by a listing **600**). The merchandising algorithm may select content in the form of listings **600** that describe items to merchandise to the user. Responsive to receiving the "merchandise triggering event," the smart component engine **505** may utilize the associate information **817** to associate the "merchandise triggering event" with "get virtual parts process rules," retrieve the "get virtual parts processing rules" from the process rules information **815**, associate the "merchandise triggering

event" with "get token parts processing rules" and retrieve the "get token parts processing rules" from the process rules information **81**. The smart component engine **505** may execute the "get virtual parts processing rules" to identify the virtual parts in the virtual part information associated with the user based on the interest of the user matching a virtual part interest profile associated with a virtual part. The smart component engine **505** may execute the "get token parts processing rules" to identify the token parts in the token part information associated with the user based on the expressed interest of the user matching a token part interest profile associated with a token part. The smart component engine **505** may execute the "get virtual parts processing rules" based on the expressed interest of the user to identify a list of virtual parts and communicate the list of virtual parts to the merchandising algorithm. The smart component engine **505** may execute the "get token parts processing rules" based on the expressed interest of the user to identify a list of token parts and communicate the list of token parts to the merchandising algorithm. The merchandising algorithm may receive one or both of the lists and process the respective lists to select and rank the listings **600** based on the contents of the list(s), in addition to other factors. The merchandising algorithm may merchandise one or more of the selected listings **600** to the user based on the ranking.

Completed Transaction Triggering Event

**[0144]** The trigger event information **811** may include the "completed transaction triggering event." The "completed transaction triggering event" may be communicated by a transaction mechanism including a transaction algorithm to the smart component engine **505**. The "completed transaction triggering event" may be communicated to the smart component engine **505** responsive to a user completing a transaction (e.g., payment for an item) for an item that was initiated based on a virtual part. For example, the user may initiate a search for listings **600** based on a virtual part by selecting the virtual part in an alert that is communicated to the user. Responsive to receiving the "completed transaction triggering event," the smart component engine **505** may utilize the associate information **817** to associate the "completed transaction triggering event" with "completed transaction processing rules" and retrieve the "completed transaction processing rules" from the process rules information **815**. The smart component engine **505** may execute the "completed transaction processing rules" to change the virtual part to a token part. For example, the smart component engine **505** may execute the "completed transaction processing rules" to change the virtual part that was utilized to initiate the transaction to a token part.

Vehicle Registration Triggering Event

**[0145]** The trigger event information **811** may include the "vehicle registration triggering event." The "vehicle registration triggering event" may be communicated by the processing module **504** to the smart component engine **505** responsive to vehicle information **300** being registered in the garage information **706**, as previously described. Recall that registration of vehicle information **300** in association with the user signifies a physical possession of a vehicle **104** associated with the user. Responsive to receiving the "vehicle registration triggering event," the smart component engine **505** may utilize the associate information **817** to associate the "vehicle registration triggering event" with "alert compatible parts processing rules" and retrieve the "alert compatible token parts processing rules" from the process rules information **815**. The smart component engine **505** may execute the "alert compatible parts processing rules" to identify token parts in the token part information **806** that are compatible with the vehicle **104** that is being registered and, responsive to the identification, communicate an alert to the user that includes a message that indicates possession of a part **106** that is compatible with the vehicle **104**. For example, the part **106** that is identified as compatible with the vehicle **104** may be utilized to fix the vehicle **104**.

Vehicle Registration Spare Parts Triggering Event

**[0146]** The trigger event information **811** may include the "vehicle registration spare parts triggering event." The "vehicle registration spare parts triggering event" may be communicated by the processing module **504** to the smart component engine **505** responsive to vehicle information **300** being registered in the garage information **706** as spare parts. For example, the user may intend to cannibalize the vehicle **104** to use/and or sell its parts **106** and indicate as much in the registration of the vehicle **104** on the network-based marketplace **118**. Responsive to receipt of the "vehicle registration spare parts triggering event," the smart component engine **505** may associate the "vehicle registration spare parts triggering event" with "generate virtual parts for vehicle processing rules." The smart component engine **505** may execute the "generate virtual parts processing rules" to identify the parts **106** included in the vehicle **104** based on the community content information **803** and generate virtual parts **814** for all of the parts **106** identified for the registered vehicle **104**.

Search Virtual Part—Sale Triggering Event

**[0147]** The trigger event information **811** may include the "search virtual part—sale triggering event." The "search virtual part—sale triggering" event may be communicated by a sales algorithm to the smart component engine **505** responsive to a sales algorithm identifying a purchase of an item as concluding an online transaction that was initiated with a search for a virtual part. For example, a user may execute a "Search VP command" (described later) to identify one or more matching virtual parts in the garage shelf information **802** on the network-based marketplace **118**, select a particular virtual part from the search results, contact the user (e.g., owner), and purchase the corresponding part **106** or win the part **106** in an auction. Recall the virtual part signifies a part **106** that may be acquired from the user associated with the garage shelf information that includes the virtual part. Responsive to receiving the "search virtual part—sale triggering event," the smart component engine **505** may utilize the associate information **817** to associate the "search virtual part—sale triggering event" with "change virtual part processing rules" and retrieve the "change virtual part processing rules" from the process rules information **815**. The smart component engine **505** may execute the "change virtual part processing rules" to change the virtual part corresponding to the part **106** that was purchased to a token part. For example, the smart component engine **505** may execute "Change VP to TP" command, as described later, to change the virtual part to a token part.

Bar Code Scan Triggering Event

**[0148]** The trigger event information **811** may include the "bar code scan triggering event." The "bar code scan trigger-

ing event" may be communicated by the smart component engine **505** responsive to a user scanning a bar code on a part **106** and identifying the part **106** based on the bar code. Responsive to receiving the "bar code scan triggering event," the smart component engine **505** may utilize the associate information **817** to associate the "bar code scan triggering event" with "change virtual part processing rules" and retrieve the "change virtual part processing rules" from the process rules information **815**. The smart component engine **505** may execute the "change virtual part processing rules" to identify a virtual part that corresponds to the scanned part **106** and change the virtual part to a token part. For example, the smart component engine may execute "Change VP to TP" command, as described later, to change the virtual part to a token part.

**[0149]** FIG. **8**D illustrates a table **808** of garage shelf commands, according to an embodiment. The table **808** includes an "add virtual part command," a "delete virtual part command," a "configure virtual part command," an "add token part command," a "delete token part command," a "configure token part command," a "change virtual part to token part command," a ", search virtual part command," and a "search token part command."

**[0150]** The "add virtual part command" may be utilized to add a virtual part to the virtual part information **804**. The "add virtual part command" may receive input parameters including a vehicle identifier (e.g., year, make, model, vehicle identification number, etc.), a part type identifier **308** (e.g., oil filter), and a part identifier **306** (e.g., unique identifier or range of unique identifiers) and process the input parameters to add an a virtual part to the virtual part virtual part information **804** in the garage shelf information **802** associated with the user who entered the command.

**[0151]** The "delete virtual part command" may be utilized to delete a virtual part from the virtual part information **804** in the garage shelf information **802** associated with the user who entered the command. The "delete virtual part command" may receive an input parameter including a virtual part identifier and process the virtual part identifier to delete the identified virtual part.

**[0152]** The "configure virtual part command" may receive input parameters including a virtual part identifier and other parameters and process the input parameters to configure the virtual part in the garage shelf information **802** associated with the user who entered the command. For example, the virtual part information **804** may include user-preferred brands, YES/NO alert configuration settings, and a timeout period to process the virtual part.

**[0153]** The "add token part command" may receive input parameters including a vehicle identifier (e.g., year, make, model, vehicle identification number, etc.), a part type identifier **308** (e.g., oil filter), and a part identifier **306** (e.g., unique identifier or range of unique identifiers) and process the input parameters to add one token part to the token part information **806** in the garage shelf information **802** associated with the user who entered the command.

**[0154]** The "delete token part command" may be utilized to delete a token part from the token part information **806** in the garage shelf information **802** associated with the user who entered the command. The "delete token part command" may receive a token part identifier and be process the token part identifier to delete the identified token part.

**[0155]** The "configure token part command" may receive input parameters including a token part identifier and other parameters and process the input parameters to configure the token part in the token part information **806** in the garage shelf information **802** of the user who entered the command. For example, the token part information **806** may include user-preferred brands, YES/NO alert configuration settings, and a timeout period to process the token part.

**[0156]** The "change virtual part to token part command" may receive a virtual part identifier and change the identified virtual part to a token part. According to one embodiment, the "change virtual part to token part command" may be automatically executed responsive to scanning a bar code or part identifier on a part **106** or smart component **102**, as previously described. For example, a user may utilize their mobile device **112** to scan a part identifier on a part **106** or smart component **102** and communicate a message to the network-based marketplace **118** that, in turn, causes the smart component modules **500** to receive the message, identify a virtual part with a matching part identifier **306** or part type identifier **308** and responsive to the identification, communicate the "bar code can triggering event" to the smart component engine **505** to change the virtual part to a corresponding token part.

**[0157]** The "search virtual part command" may be utilized to identify a virtual part in the virtual part information **804** in the garage shelf information **802**. For example, the "search virtual part command" may receive input parameters including a part type identifier **308** or part identifier **306** or some other search criteria (e.g., alphanumeric string) and process the input parameters to search all of the virtual part information **804** in the network-based marketplace **118**. For example, a user may want to make an offer to another user to sell a part **106** to a user who is associated with a corresponding virtual part.

**[0158]** The "search token part command" may be utilized to identify a token part in garage shelf information **802**. For example, the "search token part command" may receive input parameters including a part type identifier **308** or part identifier **306** or some other search criteria (e.g., alphanumeric string) and process the input parameters to search all of the token part information **806** in the network-based marketplace **118**. For example, a user may want to make an offer to another user to purchase a part **106** a part from user who is associated with a corresponding token part.

**[0159]** In one embodiment, a virtual part or token part may be utilized to search the items table **506** for matching listings **600**. For example, the input parameter for the search may include a virtual part or a token part. In one embodiment, the search parameters may further include a vehicle **104** to limit the scope of the search to the vehicle **104**. For example, that input parameters may specify one more elements of the vehicle information **300** including the make, model and year of the vehicle. In one embodiment, the input parameters may further include a brand preference that describe brands and other preferences that limit the scope of the search to the brands and other preferences. For example, the search parameters may include one or more elements of user preference information **704** including a brand preference.

**[0160]** In one embodiment, a virtual part or token part may be utilized to search the items table **506** for compatible listings **600**. For example, a compatible listing **600** may describe an item that is compatible with the virtual part or the token part. For example, an item that is compatible may be an accessory to the virtual part or the token part. Further, an item that is compatible may be assembled with the virtual part or token part. Further, an item that is compatible may be inserted

into the virtual part or token part. Further, an item that is compatible may be contained by the virtual part or token part.

**[0161]** FIG. **8**E illustrates virtual part information **804**, according to an embodiment. The virtual part information **804** may store one or more virtual parts **812**. The virtual parts **812** may be created with the "add virtual part command" and deleted with the "delete virtual part command."

**[0162]** FIG. **8**F illustrates a virtual part **812**, according to an embodiment. The virtual part **812** may include vehicle identification information **302**, as previously described; a part identifier **306**, as previously described; a part type identifier **308**, as previously described; virtual part preference information **813** and other content for describing, illustrating or imaging the virtual part **812**. The virtual part preference information **813** may store user-preferred brands and other preferences, as configured by the user.

**[0163]** FIG. **8**G illustrates token part information **806**, according to an embodiment. The token part information **806** may store one or more token parts **814**. The token parts **814** may be created with the "add token part command" and the "change virtual part to token part command." The token parts **814** may further be deleted with the "delete token part command."

**[0164]** FIG. **8**H illustrates a token part **814**, according to an embodiment. The token part **814** may include vehicle identification information **302**, as previously described; a part identifier **306**, as previously described; a part type identifier **308**, as previously described, token part preference information **816** and other content for describing, illustrating or imaging the token part **814**. The token part preference information **816** may store user-preferred brands and other preferences, as configured by the user.

**[0165]** FIG. **8**I illustrates a method **818** to process commands, according to an embodiment. The method **818** describes processing commands for controlling the electronic garage including the commands in table **808**, as shown in FIG. **8**D. The method **818** may commence, at operation **820**, with the receiving module **502** receiving the command and its corresponding input parameters. Merely for example, a user may enter the input parameters into an input box on the mobile device **112** or the client machine **120**. In another embodiment, the receiving module **502** may utilize a menu-driven interface to interact with the user operating the mobile device **112** to receive the command and input parameters. At operation **822**, the processing module **504** may process the command. For example, the processing module **504** may process the commands related to a virtual part to store user-preferred brands, YES/NO alert configuration settings, and a timeout period. Further for example, the processing module **504** may process the commands related to a token part to store user-preferred brands, YES/NO alert configuration settings, and a timeout period.

**[0166]** FIG. **8**J illustrates a method **821** to alert a creation of a virtual part, according to an embodiment. The method **821** commences, at operation **823**, for a particular user on the network-based marketplace **118** responsive to the expiration of a timeout for the method **821** in the timeout information **807** in garage shelf information **802** associated with the user. The timeout may be configured to periodically expire (e.g., once per day) by the user or an administrator.

**[0167]** At decision operation **823**, the processing module **504** may identify whether the user has expressed an interest in one or more parts **106**. For example, the user may express an interest in a part **106** by searching for the part **106**, browsing to the part **106**, or watching the part **106**. If the user has expressed interest then a branch is made to operation **825**. Otherwise the processing module **504** branches to operation **827**. At operation **825**, the processing module **504** may communicate an alert to the user to create a virtual part **812**. For example, the alert may include a message indicating that the user expressed interest in a part **106** or smart component **102** and a question asking the user whether they would like to create a virtual part **812** that corresponds to the part **106** or smart component **102**.

**[0168]** At operation **827**, the processing module **504** may advance to the first entry of vehicle information **300** (e.g., vehicle **104**) in the garage information **707** in the user profile information **702**. At operation **829**, the processing module **504** may advance to the first entry of part description information **304** (e.g., smart component **102**) for the particular vehicle **104**.

**[0169]** At decision operation **831**, the processing module **504** may identify whether the smart component **102** has a service level that is not "OK." For example, the processing module **504** may identify service level information **318** that includes a service level that is "SUGGEST," "WARN", or "REPLACE." If the service level is "OK," then the processing module **504** branches to decision operation **835**. Otherwise the processing module **504** branches to operation **833**.

**[0170]** At operation **833**, the processing module **504** may communicate an alert to the user including a message to create a virtual part **812** corresponding to the identified smart component **102** in the vehicle **104** associated with the user. For example, the alert may include a question that asks the user whether they would like to create a virtual part **812** based on the identified smart component **102**. In some embodiments, the alert may further include the service level for the smart component **102** and a warning that is appropriate for the service level, as previously described.

**[0171]** At decision operation **835**, the processing module **504** identifies whether more part description information **304** in the current vehicle information **300** is to be processed. If more part description information **304** is to be processed then the processing module **504** advances to the next part description information **304** in the current vehicle information **300** and then branches to decision operation **831**. Otherwise the processing module **504** branches to decision operation **837**.

**[0172]** At decision operation **837**, the processing module **504** may identify whether more vehicle information **300** (e.g., for a vehicle **104**) in the garage information **706** that is associated with the current user is to be processed. If more vehicle information **300** is to be processed then the processing module **504** advances to the next vehicle information **300** in the garage information **706** and then branches to operation **829**. Otherwise the processing module **504** branches to operation **839**. At operation **839**, the processing module **504** sets the timeout for the method **821** in the timeout information **807**. For example the processing module **504** sets the timeout for the method **821** in the timeout information **807** in garage shelf information **802** associated with the particular user on the network-based marketplace **118**.

**[0173]** FIG. **8**K illustrates a method **824** to process virtual parts, according to an embodiment. The method **824** commences, at operation **826**, responsive to the expiration of a timeout for the method **824** in the timeout information **807** in garage shelf information **802** associated with a particular user on the network-based marketplace **118**. The timeout may be configured (e.g., once a day) by the user with the "configure

virtual part command." At operation **826**, the processing module **504** may advance to the first virtual part **812** in the virtual part information **804** in the garage information **706** associated with the user.

**[0174]** At decision operation **828**, the processing module **504** may identify whether an alert is configured for purchase opportunities. For example, an alert may be configured "YES" by the user with the "configure virtual part command." If the alert is configured "YES," then processing continues at operation **830**. Otherwise processing continues at decision operation **832**. At operation **830**, the processing module **504** may identify whether any purchase opportunities are available based on the current virtual part **812**. For example, the processing module **504** may execute a search of the items table **506** utilizing information in the current virtual part **812** including the part identifier **306** and/or the part type identifier **308** and/or virtual part preference information (e.g., favorite brands, style, discounted items, etc.) and communicate an alert to the current user responsive to identifying one or more listings **600** that match. For example, the processing module **504** may communicate an alert that includes links to the listings **600** describing items being offered for sale that match the current virtual part **812**. Further, for example, the processing module **504** may execute a search of token part information **806** on the network-based marketplace **118** utilizing information in the current virtual part **812** including the part identifier **306** and/or the part type identifier **308** and/or virtual part preference information (e.g., favorite brands, style, discounted items, etc.) and communicate an alert to the current user responsive to identifying one or more listings **600** that match. For example, the processing module **504** may communicate an alert that includes links to the token parts **814** describing items being offered for sale that match the current virtual part **812** and the identity of the users respectively associated with the token parts **814**. Other embodiments of the alert do not disclose the identity of the users. Further for example, the alert may include links that invoke a search for compatible listings **600** on the network-based marketplace **118**. Compatible listings **600** describe an item that is related to the virtual part **812**. For example, the item may be an accessory to the virtual part **812** or an element that is assembled with the virtual part **812** or an element that is inserted into the virtual part **812**.

**[0175]** At decision operation **832**, the processing module **504** may identify whether an alert is configured for community content. For example, the alert may be configured "YES" by the user with the "configure virtual part command." If the alert is configured "YES," then processing continues at operation **834**. Otherwise processing continues at decision operation **836**. At operation **834**, the processing module **504** may identify whether new community content is available based on the current virtual part **812** and, if so, communicate an alert to the user. For example, the processing module **504** may execute a search of the community content information **803** utilizing information in the current virtual part **812** including the part identifier **306** and/or the part type identifier **308** and/or virtual part preference information (e.g., favorite brands, style, discounted items, etc.) and communicate an alert to the user responsive to identifying one or more new elements of community content information **803** that match. Further for example, the processing module **504** may communicate an alert including links to the elements of community content information **803** (e.g., installation guide).

**[0176]** At decision operation **836**, the processing module **504** may identify whether an alert is configured to alert the creation of a token part **814** based on the current virtual part **812**. For example, the alert may be configured "YES" by the user with the "configure virtual part command." If the alert is configured "YES," then processing continues at decision operation **838**. Otherwise processing continues at decision operation **842**. At decision operation **838**, the processing module **504** may identify whether the current virtual part **812** corresponds to a smart component **102** that is registered in the user's garage information **706**. For example, the processing module **504** may identify the smart component **102** by respectively matching the vehicle identification information **302** in the virtual part **812** with the vehicle identification information **302** in any of the entries of vehicle information **300** in the same user profile information **702** and further respectively matching the part type identifier **308** and the part identifier **306** in the virtual part **812** with the part type identifier **308** and the part identifier **306** in any of the entries of part description information **304** in the identified vehicle information **300**. In some embodiments, a fuzzy match may be sufficient to register a match (e.g., part identifier **306** is not included to register a match, a range of part identifiers **306** sufficient to register a match, a range of vehicle identification information **302** is sufficient to register a match, or any combination thereof). At decision operation **839**, the processing module **504** may identify whether the service level information **318** includes a service level for the identified smart component **102** that is registered as "OK." If the service level information **318** for the identified smart component **102** is registered as "OK" then processing continues at decision operation **842**. Otherwise processing continues at operation **840** (e.g., service level is "SUGGEST," "WARN", or "REPLACE"). At operation **840**, the processing module **504** may communicate an alert to the user to create a token part **814** based on the current virtual part **812**. Recall that the token part **814** is a proxy for actual possession of the part **106**. Accordingly, the alert provides a notice to the user to acquire the part **106** because the corresponding smart component **102** in a vehicle **104** has a service level that registers not "OK." In some embodiments, the alert may include the service level of the identified smart component **102**.

**[0177]** At decision operation **842**, the processing module **504** may identify whether more virtual parts **812** are in the virtual part information **804**. If more virtual parts **812** are included in the virtual part information **804** then processing continues at operation **850**. Otherwise the processing module **504** branches to operation **844**. At operation **850**, the processing module **504** advances to the next virtual part **812** and then continues processing at decision operation **828**. At operation **844**, the processing module **504** sets the timeout that, upon expiration, initiates the method **824** for the user. For example the processing module **504** sets the timeout for the method **824** in the timeout information **807** in garage shelf information **802** associated with the particular user on the network-based marketplace **118**.

**[0178]** FIG. **8**L illustrates a method **860** to process token parts, according to an embodiment. The method **860** commences at operation **862** responsive to the expiration of a timeout for the method **860** in the timeout information **807** in garage shelf information **802** associated with a particular user on the network-based marketplace **118**. The timeout may be configured (e.g., once a day) by the user with the "configure token part command." At operation **862**, the processing mod-

ule **504** may advance to the first token part **814** in the token part information **806** in the garage information **706** associated with the user.

**[0179]** At decision operation **864**, the processing module **504** may identify whether an alert is configured for sales opportunities. For example, the alert may be configured "YES" by the user with the "configure token part command." If the alert is configured "YES," then processing continues at operation **866**. Otherwise processing continues at decision operation **868**. At operation **866**, the processing module **504** may communicate an alert indicating a part **106** that corresponds to the present virtual part **812** is being offered for sale. For example, the processing module **504** may communicate the alert to users on the network-based marketplace **118** who are looking for the part **106** that corresponds to the current token part **814** (e.g., operation **830** on FIG. **8**K, users who are "watching" for the part **106**, etc.).

**[0180]** At decision operation **868**, the processing module **504** may identify whether an alert is configured for community content. For example, the alert may be configured "YES" by the user with the "configure token part command." If the alert is configured "YES," then processing continues at operation **870**. Otherwise processing continues at decision operation **872**. At operation **870**, the processing module **504** may identify whether new community content is available based on the current token part **814** and, if so, communicate an alert to the user. For example, the processing module **504** may execute a search of the community content information **803** utilizing information in the current token part **814** including the vehicle identification information **302**, the part identifier **306** and/or the part type identifier **308** and/or virtual part preference information (e.g., favorite brands, style, discounted items, etc.) and communicate an alert to the user responsive to identifying one or more new elements of community content information **803** that match. For example, the processing module **504** may communicate an alert that includes one or more links to elements of community content information **803** (e.g., installation guide).

**[0181]** At decision operation **872**, the processing module **504** may identify whether an alert is configured to replace a smart component **102** in a vehicle **104**. For example, the alert may be configured "YES" by the user with the "configure token part command." Recall that the current token part **814** is a proxy for a real part **106** or smart component **102** on a shelf in the user's garage. If the alert is configured "YES," then processing continues at decision operation **873**. Otherwise processing continues at decision operation **876**.

**[0182]** At decision operation **873**, the processing module **504** may identify whether the current token part **814** corresponds to a smart component **102** that is registered in user's garage information **706**. For example, the processing module **504** may identify a smart component **102** in user's garage information **706** by matching the vehicle identification information **302**, the part type identifier **308** and/or the part identifier **306** of the current token part **814** with the respective information in a smart component **102** that is registered in user's garage information **706**. In some embodiments, a fuzzy match may be sufficient to register a match (e.g., part identifier **306** is not included to register a match, a range of part identifiers **306** is sufficient to register a match, a range of vehicle identification information **302** is sufficient to register a match, or any combination thereof). At decision operation **874**, the processing module **504** may identify whether the service level information **318** for the smart component **102** includes a service level that is registered as "OK." If the service level for the identified smart component **102** is registered "OK" then processing continues at decision operation **876** and the user is not alerted. Otherwise processing continues at operation **875** (e.g., service level is "SUGGEST," "WARN", or "REPLACE") and the user is alerted. At operation **875**, the processing module **504** may communicate an alert to the user to replace the smart component **102** with the part **106** or smart component **102** corresponding to the current token part **814**. In some embodiments, the alert may include the service level.

**[0183]** At decision operation **876**, the processing module **504** may identify whether to alert the user to remove the current token part **814**. For example, the processing module **504** may identify a smart component **102** that is being reported by a vehicle **104** that is registered with vehicle information **300** in the garage information **706** for the user with a part identifier **306** that matches the part identifier of the current token part **814**. If the processing module **504** identifies a match then processing continues at operation **878**. Otherwise processing continues at decision operation **880**. At operation **878**, the processing module **504** may communicate an alert to the user to delete the current token part **814**. In some embodiments, the current token part **814** may be automatically deleted responsive to receiving a maintenance message or some other message reporting a matching vehicle identification information **302**, part type identifier **308** and part identifier **306**.

**[0184]** At decision operation **880**, the processing module **504** may identify whether more token parts **814** are in the token part information **806**. If the token part information **806** includes more token parts **814**, then processing continues at operation **882**. Otherwise processing continues at operation **844**. At operation **882**, the processing module **504** advances to the next token part **814** and processing continues at decision operation **864**. At operation **884**, the processing module **504** sets the timeout that, upon expiration, initiates the method **860**. For example the processing module **504** sets the timeout for the method **860** in the timeout information **807** in garage shelf information **802** associated with the particular user on the network-based marketplace **118**.

**[0185]** FIG. **8**M illustrates a method **885** to utilize an electronic garage shelf, according to an embodiment. The method **885** may commence at operation **886** with the receiving module **502**, at the network-based marketplace **118**, receiving a maintenance message **400**, as described in operation **730** in FIG. **7**G. The maintenance message **400** is communicated by the mobile device **112** to the network-based marketplace **118** responsive the mobile device **112** receiving characterization information **312** from a smart component **102** that operates in a vehicle **104**. For example, the smart component **102** may include a sensor **108** that senses the wear of a brake pad that provides braking for the front left wheel of a 1999 Ford Explorer.

**[0186]** At operation **888**, the processing module **504** may identify user profile information **702** (e.g., John Doe) in a user table **700** based on a user identifier **218** in the maintenance message **400**, as described in operation **732** in FIG. **7**G.

**[0187]** At operation **890**, the processing module **504** may store the characterization information **312** and the timestamp **314** for the brake pad, as part log information **310**, in the appropriate part description information **304** (e.g., part **106**—brake pad) in the appropriate vehicle information **300** (e.g., vehicle **104**—**199** Ford Explorer) in the garage information

**706** (e.g., garage) in the user profile information **702** (e.g., user—John Doe), as described in operation **734** in FIG. **7**G.

**[0188]** At operation **892**, the processing module **504** may register a service level for the smart component **102** in the vehicle **104**, as described in operations **740-752** in FIG. **7**G. For example, the processing module **504** may register a service level of "REPLACE" for the brake pad.

**[0189]** At operation **894**, the processing module **504** may communicate an alert to the user (e.g., John Doe) to create a virtual part **812**, as described in operations **831** and **833** in FIG. **8**J. For example, the processing module **504** may communicate an alert to create a virtual part **812** for the brake pad responsive to identifying a service level that is not "OK" (e.g., "REPLACE").

**[0190]** At operation **896**, the receiving module **502** may receive an "add virtual part" command for the brake pad from the user, as described in operation **820** in FIG. **8**I. Further at operation **896**, the processing module **504** may add the virtual part **812** to the virtual part information **804** in the garage information **706** of the user profile information **702** of the user, as described in operation **822** in FIG. **8**I.

**[0191]** FIG. **8**N illustrates a user interface **898**, according to an embodiment. The user interface **774** is one example of the "add a virtual part" command.

Systems and Methods for Multi-Signal Automated Fault Analysis

**[0192]** FIG. **9**A illustrates a system **900**, according to an embodiment, for multi-signal fault analysis. The system **900** may include a collection device **901** that utilizes a network **110** to collect multiple signals from a vehicle **104**, communicate the signals, over a network **116** to a network-based marketplace **118** that, in turn, stores the multiple signals as multi-signal information **902**, analyzes the multi-signal information **902** to identify a diagnosis of the fault and communicates the diagnosis back over the network **116** to one of the mobile devices **112** or a client machine **120**. The collection device **901** may be comprised of one or more mobile devices **112**. The collection device **901** may further be configured using one of the mobile devices **112** or the client machine **120**. Each mobile device **112** may be utilized to sense one or more physical phenomena and communicate signal messages including signal information that represents the physical phenomena, over the network **116**, to the network-based marketplace **118**. The sensed phenomena, at the mobile device **112**, may include optical phenomena, motion phenomena, orientation phenomena. geolocation phenomena, temperature phenomena, humidity phenomena, weather phenomena including atmospheric pressure phenomena, and any other physical phenomena that are representable as signal information. Further, each mobile device **112** may be used to receive characterization information **312** from one or more smart components **102** in the vehicle **104** and communicate the characterization information **312** (e.g., signal information) in a signal message, over the network **116**, to the network-based marketplace **118**, as previously described. Accordingly, a single mobile device **112** may be configured to sense and communicate one or more types of physical phenomena that are sensed by the mobile device **112** and/or relay one or more types of characterization information **312** that are sensed by smart components **102** that communicate the characterization information **312** to the mobile device **112**. The signal information may be stored at the network-based marketplace **118** as multi-signal information **902** according to channels that respectively correspond to the mobile devices **112** and sub-channels that are utilized to distinguish different streams of signal information at the same mobile device **112**. The network-based marketplace **118** may analyze the multi-signal information **902** to identify a correlated event that is defined in the fault analysis repository **904** as one or more sets of signal information or derived characteristics that, when combined together, characterize a diagnosis. For example, a squeaking sound and a smart component **102** reporting 90% brake wear that are both received as signal information within five seconds of applying brakes in a 1967 Ford Mustang are received and analyzed as multi-signal information **902** to identify a correlated event corresponding to a diagnosis of a brake failure. Further, the network-based marketplace **118** may associate the diagnosis with a prognosis to facilitate a repair of the identified fault. It will be appreciated by one skilled in the art that the system **900** may operate in conjunction with smart components **102**, as described in this document. Accordingly, the same or similar references have been used to indicate the same or similar features unless otherwise indicated. While the vehicle **104** is illustrated as an automobile, it will be appreciated that trucks, all-terrain vehicles, jeeps, aircraft, water-born vessels, space vessels, and the like may embody the illustrated vehicle **104**. Further, one skilled will appreciate that a ruggedized form of multi-signal fault analysis may be performed on entities other than the vehicle **104** and in environments that are deemed too difficult to access (e.g., desert, mountain, cliff, top of a structure, etc.) or too hazardous to access (e.g., military/combat). For example, in an environment where direct human placement of the mobile devices **112** is too hazardous, one or more mobile devices **112** may be mounted on one or more drones, configured as a collection device **901**, and flown into the hazardous environment to collect signal information from the test object. Accordingly, the collection device **901** may be flown to a recently destroyed bridge in a combat zone to collect signal information in an otherwise too hazardous environment. Further for example, in an environment where direct human placement of the mobile devices **112** is too difficult to access, one or more mobile devices **112** may be mounted on one or more drones, configured as a collection device **901**, and flown to the difficult to access environment to collect signal information from the test object. For example, the collection device **901** may be flown to a turbine in a wind tower to collect signal information in an otherwise too hazardous environment.

**[0193]** In a more typical example, a user may perform a fault analysis on a 1967 Ford Mustang by configuring the collection device **901** to collect (operation "A'") signal information from a first mobile device **112** that receives signal information from a smart component **102** that includes a sensor **108** that senses a brake pad that is mounted on the front right wheel of the Mustang and signal information from a second mobile device **112** that includes a microphone that receives audio. Further, the user may operate wearable technology such as an optical head-mounted receiver and display (e.g., Google Glass) that may be tapped by the user to arm the collection device **901** to monitor for receipt of signaling information for the squeaking sound to initiate the capture and storage of multi-signal information **902** including the above described audio signal information and signal information from a smart component **102**. For a particular test, the user follows test design information including instructions to rest the second mobile device **112** on a passenger seat of the

Mustang, accelerate to a speed of five mph, tap on the Google Glass to arm the collection device **901**, and apply the brakes to achieve a dead stop. Accordingly, the network-based marketplace **118** may respond to the tap on the Google Glass by monitoring the signal message information from the second mobile device for receipt of the squeaking sound and responsive to receipt of the squeaking sound store (operation "B"') multiple instances of the signal message information from the first and second mobile devices. Further, the network-based marketplace **118** may respond to an end of the test event by initiating an analysis (operation "C"') of the multi-signal information **902** that was collected to diagnose (operation "D"') the fault (e.g., right front brake is worn out) and communicate a message including the diagnosis of the fault to the first mobile device. In some embodiments, the message may further include a prognosis (operation "E"') including an estimated cost for repair at a local service shop and a list of parts.

**[0194]** The collection device **901** may be comprised of one or more mobile devices **112** including mobile devices **112** that are carried (e.g., smart phones and other devices that are carried), mobile devices **112** that are worn (e.g., smart glasses, smart watches, and other smart devices that are worn), and mobile devices **112** that are purpose built. The mobile devices **112** that are purpose built are now further described. Mobile devices **112** that are purpose built are designed for a particular purpose and location. Mobile devices **112** that are purpose built may be designed to include a magnetic attachment or fastener attachment for attachment to target location (e.g., engine compartment, wheel well, etc.). Mobile devices **112** that are purpose built may provide in-operation monitoring from the target locations that not accessible to a human-held or consumer-grade device. Mobile devices **112** that are purpose built may be different in appearance from a consumer device (e.g., no display, ruggedized exterior, hermetically sealed, etc. . . . ), nevertheless, implement the same functions as other mobile devices **112** that operate in the collection device **901**. For example, mobile devices **112** that are purpose built may operate as general-purpose single or multi-channel signal devices. Further, mobile devices **112** that are purpose built may operate to capture one or more specific types of signals and/or in specific use cases (e.g., including a monitor designed to diagnose engine noise with an optional rigid temperature resistant module containing only noise/vibration sensors **108**) (e.g., including a monitor designed to diagnose engine noise with an optional rigid temperature resistant module containing only an adhesive single-use temperature and flexion monitor) (e.g., including a monitor designed to capture belt timing via a strobe & camera).

**[0195]** FIG. **9**B illustrates a test protocol **906**, according to an embodiment. Illustrated on the left are operations performed by one or more mobile devices **112** and illustrated on the right are operations performed by the network-based marketplace **118**. The test protocol **906** may include communications originating from the mobile devices **112** including the user test request information **908** and fault analysis test session **912** and a communication originating from the network-based marketplace **118** including the test design information **910**.

**[0196]** The user test request information **908** may include a request for a fault analysis. For example, the user test request information **908** may include information typically communicated to a mechanic who is skilled in fixing vehicles **104** including symptoms, sounds, failures, conditions, etc. Responsive to receipt of the user test request information **908**, the network-based marketplace **118** may match the user test request information **908** to corresponding system test request information in the fault analysis repository **904** (not shown) to identify the appropriate test design information **910** and communicate the test design information **910** back to the mobile device **112**.

**[0197]** The test design information **910** may include instructions to configure the collection device **901**, instructions to establish conditions for performing the data collection (e.g., drive at a specific speed and apply brakes), and instructions to arm the collection device **901** (e.g., tap on the Google Glass) to collect signal information. For example, the user may follow the instructions in the test design information **910** to register mobile devices **112** and the type of signal information being received by each of the mobile devices **112** with one or more commands that are entered from the mobile device **112**. Further for example, the user may follow the instructions in the test design information **910** to register a wearable device by pairing the wearable device (e.g., Google Glass, smart watch, etc.) with a particular mobile device **112**.

**[0198]** The fault analysis test session **912** is comprised of a test arming event **914**, a test triggering event **916**, multi-signal information **902**, and a test end event **918**. The test arming event **914** may be received from one of the mobile devices **112** as signal information to signal the network-based marketplace **118** to begin monitoring signal information for a test triggering event **916**. For example, the test arming event **914** may be a tap on Google Glass. The test triggering event **916** may further be received as signal information to signal the network-based marketplace **118** to begin collecting and storing the multi-signal information **902**. For example, the test triggering event **916** may be a squeaking sound that is sensed after the test arming event **914** has been received. In some cases, the test design information **910** may describe the test arming event **914** and the test triggering event **916** as the same event. The test end event **918** may be received as signal information or a system timeout that signals to the network-based marketplace **118** that the fault analysis test session **912** has completed and to begin an analysis of the multi-signal information **902** that was collected. For example, responsive to receipt of the test end event **918**, the network-based marketplace **118** may register the end of the fault analysis test session **912** and analyze the multi-signal information **902** to identify whether the fault identified with the user test request information **908** was diagnosed. The network-based marketplace **118** may analyze the multi-signal information **902** by comparing it with the multi-signal information **902** in the fault analysis repository **904** to identify a one or more correlated events. Identification of one or more correlated events constitutes a diagnosis of the problem. On the other hand, if the problem is not diagnosed, the fault analysis test session **912** may be repeated with a new set of test design information **910**. For example, the network-based marketplace **118** may alter the test conditions or add a new mobile device **112** to collect additional signal information or add more signal information (e.g., speed, sound, image, motion picture, etc.) to an existing mobile device **112**. The process described above may be iterated until the problem is diagnosed or until all available tests are exhausted. In some embodiments, the network-based marketplace **118** may request expert manual intervention in response to identifying all available tests is exhausted.

**[0199]** FIG. **9**C illustrates a network-based marketplace **118**, according to an embodiment. The network-based mar-

ketplace **118** may include smart component modules **500** and a database **204**. The network-based marketplace **118**, smart component modules **500** and database **204** operate as previously described and further as follows. The smart component modules **500** may include a receiving module **502** and a processing module **504**. The receiving module **502** may receive commands from the mobile device **112** or the client machine **120**. Further, the receiving module **502** may receive the user test request information **908** (not shown), events included in the fault analysis test session **912** (not shown) and the signaling messages from the mobile devices **112** (not shown) including signal information that is collectively stored as multi-signal information **902** (not shown) in the appropriate user profile information **702**. The processing module **504** may process the aforementioned information, events, and messages including the signal information to update the database **204**, and respond to the mobile devices **112** and client machine **120**. The database **204** may include the user profile information **702** in the user table **700** and fault analysis repository **904** in addition to other data structures previously described though not presently shown. The user profile information **702** may be used to store the multi-signal information **902** for one or more fault analysis according to users on the network-based marketplace **118**. The fault analysis repository **904** may be used to store multiple entries of system fault analysis information **953** that are used to diagnose the problems/faults described by the user fault analysis information **920**.

**[0200]** FIG. **9**D illustrates user profile information **702**, according to an embodiment. The user profile information **702** has been previously described. With respect to the current feature, the user profile information **702** may store one or more entries of user fault analysis information **920** for a particular user on the network-based marketplace **118**. For example, each fault analysis that is initiated by a user with the user test request information **908** may be associated with one entry of user fault analysis information **920**.

**[0201]** FIG. **9**E illustrates a fault analysis repository **904**, according to an embodiment. The fault analysis repository **904** may be used to store system fault analysis information **953** entries that are used for fault/problem diagnosis. For example, multiple system fault analysis information **953** entries may be stored in the fault analysis repository **904** for diagnosing a front brake failure for a 1967 Ford Mustang and other types of failures. Accordingly, a user fault analysis information **920** entry in the user profile information **702** that is being utilized to perform a fault analysis for a particular user may be compared with relevant entries of system fault analysis information **953** in the fault analysis repository **904** to identify and communicate test design information **910**, diagnose a fault, identify a prognosis of a fault and identify one or more experts. Accordingly, each of the system fault analysis information **953** entries may be considered signatures for a particular problem diagnosis, as described further below. The fault analysis repository **904** may be generated based on different sources of information. For example, an entry of system fault analysis information **953** may be generated based on a bulletin or a recall notice. According to one embodiment, an entry of system fault analysis information **953** that is generated based on a bulletin or a recall notice may be utilized to confirm or pre-qualify a particular vehicle **104** as exhibiting symptoms associated with the bulletin or recall.

**[0202]** FIG. **9**F illustrates user fault analysis information **920**, according to an embodiment. The user fault analysis information **920** may include user test request information **908** and test session information **922**. The user test request information **908** may be received from the user or the network-based marketplace **118** and stored in the user fault analysis information **920**. Receipt of user test request information **908** initiates a fault analysis. The user test request information **908** in the user fault analysis information **920** may be compared with the system test request information in system fault analysis information **953** to identify a match. Responsive to identification of the match, the test design information **910** and other information from the system fault analysis information **953** may be utilized to perform a fault analysis, as described further below. The test session information **922** includes one or more entries of multi-signal information **902** that are collected with the collection device **901**. Each entry of multi-signal information **902** corresponds to one fault analysis test session **912**.

**[0203]** FIG. **9**FF illustrates user test request information **908**, according to an embodiment. The user test request information **908** may be received from a user or from the network-based marketplace **118** to initiate multi-signal fault analysis. For example, a user may interact with a set of user interfaces to make selections that are utilized to generate the user test request information **908** for storage in the user fault analysis information **920** in the user profile information **702**. Further, for example, the network-based marketplace **118** may automatically generate the user test request information **908** based on a recall or service bulletin that identifies a part **106** and vehicle **104**, the user test request information **908** being communicated to a mobile device **112** that, in turn, receives an affirmation from the user that is communicated with the user test request information **908** back to the network-based marketplace **118** to initiate multi-signal fault analysis for a particular vehicle **104**. In another embodiment, the processing module **504** may automatically generate the user test request information **908** responsive to receiving characterization information **312** from smart component **102** that is stored in part description information **304** (e.g., part **106**) associated with a user. For example, responsive to receipt of characterization information **312**, the processing module **504** may identify the characterization information **312** for the particular part **106** and vehicle **104** as being associated with a particular type of user test request information **908** by performing a mapping operation (e.g., identifying an predetermined association between (part **106**, vehicle **104**, identified characterization information **312**) and the user test request information **908**), communicating the user test request information **908** to a mobile device **112** that, in turn, receives an affirmation from the user that is communicated with the user test request information **908** back to the network-based marketplace **118** to initiate multi-signal fault analysis for a particular vehicle **104**. In another embodiment, the user test request information **908** may be communicated directly to the network-based marketplace **118** to initiate multi-signal fault analysis and a notice of test initiation may be communicated to the user. In another embodiment, the processing module **504** may automatically generate the user test request information **908** responsive to identifying a level of service in service level information **318** in part description information **304** (e.g., part **106**) associated with a user. For example, responsive to identification of service level information **318** that is not "OK," the processing module **504** may identify the identification of a service level in service level information **318** that is not "OK" for the particular part **106** and vehicle

**104** as being associated with a particular type of user test request information **908** by performing a mapping operation (e.g., identifying an predetermined association between (part **106**, vehicle **104**, identified service level information **318**) and the user test request information **908**), communicating the user test request information **908** to a mobile device **112** that, in turn, receives an affirmation from the user that is communicated with the user test request information **908** back to the network-based marketplace **118** to initiate multi-signal fault analysis for a particular vehicle **104**. In another embodiment, the user test request information **908** may be communicated directly to the network-based marketplace **118** to initiate multi-signal fault analysis and a notice of test initiation may be communicated to the user.

**[0204]** The user test request information **908** may include problem conditions **934**, problem symptoms **936** and vehicle identification information **302**. The problem conditions **934** may describe conditions that are associated with the problem symptoms **936**. For example, the problem conditions **934** may include a particular range of speed and/or motion such as turning right, turning left, backing up, etc. The problem symptoms **936** may include some discretely observable phenomena such as a high pitched sound, a low rumbling sound, a loss of power, a vibration, etc. that occurs in association with the problem conditions **934**. The vehicle identification information **302** describes a make, model, and year of a vehicle **104**, as previously described. All or part of the vehicle identification information **302** may be optionally entered.

**[0205]** FIG. **9**G illustrates system fault analysis information **953**, according to an embodiment. The system fault analysis information **953** may be utilized to identify and communicate test design information **910** and analyze the test session information **922** in the user fault analysis information **920** (not shown) to diagnose a fault. The system fault analysis information **953** may include the system test request information **955**, test design information **910**, correlation information **924**, diagnosis information **926**, prognosis information **928**, and expert identifier information **930**. The system test request information **955** may be utilized to associate a particular entry of system fault analysis information **953** with user test request information **908** to initiate a fault analysis test session **912** (not shown). The test design information **910** was previously described. The correlation information **924** may be utilized to analyze the multi-signal information **902** in the user fault analysis information **920** (not shown). The diagnosis information **926** may include diagnostic problem information, diagnostic repair information and diagnostic certainty information. The diagnostic problem information includes a diagnosis of the problem described by the associated system test request information **955**. For example, the diagnostic problem information may include "front left tire is low on air," "spark plug in number **4** cylinder is misfiring," "engine is running roughly," "battery low." The diagnostic repair information may include a remedy to the diagnosed problem such as "replace front left tire," "replace spark plug in number four cylinder," "perform tune-up," "replace battery." The diagnostic certainty information may include a quantified certainty that the diagnosis of the problem is correct. For example, the diagnostic certainty information may include 90%. The prognosis information **928** may include information related to fixing the fault that is diagnosed. For example, the prognosis information **928** may include repair estimate information and repair list information. The repair estimate information may be utilized to generate estimates for repair based on a user performing their own work or based on a local shop performing the work. The repair estimate information utilized to generate estimates for repair based on a local shop performing the work may include a monetary estimate to fix the vehicle **104**, an estimate of time to perform the work, a likelihood that the repair will address the problem (e.g., a percentage), and an estimate of urgency to fix the problem including a level of risk (e.g., YELLOW, ORANGE, or RED) or a cascading failure description describing other failures likely to occur if the current problem is not fixed. The repair list information may be utilized to generate a list of parts that are needed to repair the problem described by the associated user test request information **908**. The list may further include an estimated cost for each of the parts from a supplier. The expert identifier information **930** may include user identifiers **218** that identify users on the network-based marketplace **118** that are qualified experts to diagnose or fix the problem described by the associated system test request information **955**.

**[0206]** FIG. **9**GG illustrates system test request information **955**, according to an embodiment. The system test request information **955** may be initialized by a system administrator. The system test request information **955** may include problem conditions **934**, problem symptoms **936** and vehicle identification information **302**, as previously described. The system test request information **955** may be compared with user test request information **908** to identify a match. A fuzzy match may constitute a match. For example, overlapping ranges of problem conditions **934** and/or overlapping ranges of problem symptoms **936** and/or overlapping ranges of vehicle identification information **302** or parts of the vehicle identification information **302** may constitute a match.

**[0207]** FIG. **9**H illustrates test design information **910**, according to an embodiment. The test design information **910** may include test collection information **938**, test condition information **940**, test arming information **942**, test triggering information **944** and test end information **946**. Recall that the test design information **910** is communicated to a user responsive to receiving from the user the user test request information **908** that includes a description of a problem with a vehicle **104**. The test design information **910** provides instructions for the user to perform a fault analysis test session **912** (not shown). The test collection information **938** may provide specifications for configuring the collection device **901**. For example, the test collection information **938** may specify the number of mobile devices **112** and the type of signaling information that is collected at each of the mobile devices **112**. Further, the test collection information **938** may specify whether one or more wearable devices are included in the collection device **901** and other information related to the wearable devices including the type of signaling information to collect and the identity of the mobile device **112** to pair with the wearable device. Further the test collection information **938** may instruct the user to perform multiple fault analysis test sessions **912** as prompted by the network-based marketplace **118** with a notice that includes a reminder. For example, the network-based marketplace **118** may communicate a notice to the user including a reminder for the user to perform the next multiple fault analysis test session **912**. In one embodiment, the network-based marketplace **118** may communicate the notice for the next fault analysis test session **912** based on a schedule (e.g., date and time). In one embodiment, the network-based marketplace **118** may communicate the

notice for the next fault analysis test sessions **912** to be performed based on the network-based marketplace **118** identifying one or more conditions (e.g., time and/or date and/or presence in the car and/or driving condition) that maximize the value of the fault analysis test sessions **912**. The test condition information **940** may specify the conditions under which to perform the fault analysis test session **912**. For example, the test condition information **940** may specify the position (e.g., on the dashboard, under the hood, back seat, front seat, etc.) of the mobile device(s) **112**, the driving activities (e.g., speed, motion, activity, etc.), and the driving conditions (e.g., rain, snow, up a hill, down a hill, etc.) for the fault analysis test session **912**. The test arming information **942** may specify a test arming event **914** that is received by a mobile device **112** or wearable device to arm the collection device **901**. For example, the test arming event **914** may include a tap, a push of a button, a waving motion, or some other signal that is sensed. The test triggering information **944** may specify a test triggering event **916** that is received by a mobile device **112** to initiate collection and storage of signal information. For example, the test triggering event **916** may include signaling information for a discrete phenomenon that is received as signal information by one of the mobile devices **112** in the collection device **901**. For example, the test triggering event **916** may include one of the problem symptoms **936** included in the user test request information **908**. The test end information **946** may specify a test end event **918** that terminates the fault analysis test session **912**. For example, the test end event **918** may include a timeout that expires a period of time after the test triggering event **916** is received. Further for example, the test end event **918** may include a discrete phenomenon that is received as signal information by one of the mobile devices **112** in the collection device **901**.

**[0208]** FIG. **9**I illustrates multi-signal information **902**, according to an embodiment. The multi-signal information **902** may include channel information **950**, event information **952**, sub-channels **954**, and signal information **856**. All channel information **950** in the multi-signal information **902** is associated with a single collection device **901** and fault analysis test session **912**. Each entry of channel information **950** is associated a mobile device **112** that may receive one or more entries of signal information **956** respectively identified according to sub-channels **954**. Two sub-channels **954** are illustrated on the left as associated with one channel information **950** (e.g., channel zero), however, more or fewer sub-channels **954** may be configured. The signal information **956** may be received from a mobile device **112** in signal messages and stored in the multi-signal information **902** in chronological order according to the timestamps **314**. The signal information **956** is illustrated as being received with earlier timestamps **314** towards the top. Signal information **965** may be compressed without loss, compressed with acceptable loss with acceptable lossiness as defined by a system administrator or user, sparsely represented (e.g., omitting "uninteresting" data leaving resulting signal information **965** that is discontinuous according to timestamps **314** and optionally annotated), represented as a processed or derived form (e.g., frequency-domain transform), annotated as sequence of interpreted events (e.g., ["time 1:05: event **85**C", "time 1:10: event **85**C"]), annotated with an indirect reference (e.g., stored signal information **965** is equivalent to reference (or previously-delivered) signal ABC **123** within specified tolerances). In addition, the signal information **965** may not be anomalous. In these instances the signal information **965** may be annotated "not anomalous," "existing," "no-anomaly," "provided upon request," "folded," or "delta." The "folded" annotation signifies signal information **965** is based upon a fixed periodicity where a repeating signal is treated as a series of many measurement windows with only the averaged measurement of one or more windows being reported. The "delta" annotation signifies signal information **965** that is being reported as the difference of a reference signal (e.g., natural, synthetic, modeled, etc.). The "phase" annotation signifies a shift of one instance of signal information **965**, in time, relative to another instance of signal information **965**. The "delta" and "phase" annotations may be used in conjunction. For example, if a sample of signal information **965** is slightly delayed relative to a reference sample of signal information **965**, and also contains a small amount of 'interesting' noise, then the time shift can be represented by a single phase measurement, with the remaining noise being represented efficiently by delta measurements between the phase-corrected signals.

**[0209]** Each of the signal information **956** is further illustrated as representing different phenomena over time with different characteristics (e.g., hill, little ratchet, big ratchet). The event information **952** may store a registration of the test arming event **914**, a registration of the test triggering event **916**, a registration of correlated events (e.g., "'A," "'B," "'C") a registration of the test end event **918**, and annotations as described above though not shown. The correlated events are registered, as such, in the event information **952** for a fault analysis test session **912** responsive to an analysis that identifies a match with correlation information **924** in the fault analysis repository **904** (not shown), as described further below. A fuzzy match may be sufficient to constitute a match. For example, the correlated event may be registered in the event information **952** in the multi-signal information **902** responsive to correlated events (e.g., "'A," "'B," "'C") that differ in time, magnitude, periodicity, etc. within respective and specified ranges as specified by correlation information **924** in the user fault analysis information **920** in the fault analysis repository **904**.

**[0210]** FIG. **9**J illustrates correlation information **924**, according to an embodiment. The correlation information **924** may store one or more correlated events **958**, as previously described. A particular correlated event **958** is a signature to diagnose a failure. The correlation information **924** may include multiple and different correlated events **958** and each correlated event **958** may be sufficient to diagnose the same failure (e.g., brake failure). Each correlated event **958** may be compared with multi-signal information **902** in the user profile information **702** to identify whether the multi-signal information **902** matches the correlated event **958** signifying diagnosis of the failure. For example, the correlated event **958** that is presently illustrated is comprised of an event "'A" that was identified in first signal information **956**, an event "'B" that was identified in second signal information **956**, and an event "'C" that was identified in third signal information **956** to constitute a single correlated event **958**. Further, the events "'A," "'B" and "'C" in the user profile information **702** may be identified to constitute a match with the events "'A," "'B" and "'C" in the correlation information **924** according to predetermined ranges of variability in the shape, timing, amplitude, and periodicity of the respective events. Further, the events "'A," "'B" and "'C" in the user profile information **702** may be identified to constitute a match with the events "'A," "'B" and "'C" in the correlation

information **924** according to predetermined ranges of variability in relation to each other. For example, a predetermined range of variability between event "'A" and "'B" may include their occurrence in time within a predetermined range (e.g., two minutes). Further, the number of events in one correlated event **958** may be more or fewer than the number of events in another correlated event **958**.

**[0211]** FIG. **9**K illustrates a signal message **960**, according to first embodiment. The signal message **960** may be communicated by a mobile device **112** to the network-based marketplace **118** responsive the mobile device **112** being configured to sense and report a type of physical phenomena (e.g., image, motion image, sound, pressure, temperature, etc.) at the mobile device **112**. The signal message **960** may include a user identifier **218**, vehicle identification information **302**, channel information **950**, sub-channel **954**, signal information **956** and the timestamp **314**, all as previously described.

**[0212]** FIG. **9**L illustrates a signal message **960**, according to a second embodiment. The signal message **960** may be communicated by a mobile device **112** to the network-based marketplace **118** in response to the mobile device **112** being configured to receive characterization information **312** from a smart component **102** and communicate the characterization information **312** in the signal message **960** to the network-based marketplace **118**. The signal message **960** may include a maintenance message **400**, as previously described. The signal message **960** may further include channel information **950** and the sub-channel **954** both as previously described. The characterization information **312** may be received as signal information **956** at the network-based marketplace **118**.

**[0213]** FIG. **9**M illustrates a method **961** to process a test request, according to an embodiment. Illustrated on the left are operations performed at the mobile device **112** and illustrated on the right are operations performed at the network-based marketplace **118**. The method **961** may commence at operation **962**, at the mobile device **112**, with a user entering user test request information **908** that is communicated to the network-based marketplace **118**. For example, the user may navigate a series of screens to generate user test request information **908** including problem symptoms **936** describing a squeaking sound emanating from the right front wheel under problem conditions **934** describing brakes that are applied at a specified speed for vehicle identification information **302** describing a 1967 Ford Mustang with a vehicle identification number of XYZ123245 and odometer reading of 1234567.

**[0214]** At operation **964**, at the network-based marketplace **118**, the receiving module **502** may receive the user test request information **908** and at decision operation **966** the processing module **504** may identify whether the test design information **910** is identified in the fault analysis repository **904** for the user test request information **908** that was received. The decision operation **966** is described more fully with reference to FIG. **9**O as a method **903** to identify test design information **910**. If the test design information **910** is identified (e.g., "NEXT TEST"), at decision operation **966**, then a branch is made to operation **968**. Otherwise a branch is made to connector "E" (e.g., "NO TEST") which corresponds to connector "E" on FIG. **9**N. At operation **968**, the processing module **504** may communicate the test design information **910** to the mobile device **112**.

**[0215]** At operation **970**, at the mobile device **112**, the user may receive the test design information **910**. At operation **972** the user may configure the collection device **901** based on the test collection information **938** in the test design information **910**. For example, the user may configure a first mobile device **112** to receive characterization information **312** from a smart component **102** that senses brake wear on the front right brake in the Mustang, configure a second mobile device **112** to sense audio, and execute a pairing operation to pair the Google Glass with the second mobile device **112**. At operation **974**, the user may setup test conditions based on based on the test condition information **940** in the test design information **910**. For example, the user may set the first mobile device **112** and the second mobile device **112** on the passenger's seat in the Mustang, accelerate to five mph, tap the Google Glass and apply the brakes to achieve a dead stop.

**[0216]** FIG. **9**N illustrates a method **976** for multi-signal automated fault analysis, according to an embodiment. Illustrated on the left are operations performed at the mobile devices **112** and illustrated on the right are operations performed at the network-based marketplace **118**. The method **976** may commence, at operation **978**, with the mobile devices **112** in the collection device **901** communicating signal messages **960** to the network-based marketplace **118**. According to one embodiment, the mobile devices **112** may commence communicating signal messages **960** responsive to being configured as part of the collection device **901** by the user. According to another embodiment, the mobile devices **112** may commence communicating signal messages **960** responsive to receipt of the test arming event **914**. For example, the network-based marketplace **118** may receive a message from the Google Glass via the paired first mobile device **112** and communicate commands to the first mobile device **112** and the second mobile device **112**. For example, the network-based marketplace **118** may communicate a command to the first mobile device **112** to enable signal messages **960** to report characterization information **312** by the smart component **102** and to the second mobile device **112** to enable signal messages **960** to report the sensing of audio. According to yet another embodiment, the first mobile device **112** may commence communicating signal messages **960** responsive to receipt of the tap on the Google Glass and the second mobile device **112** may be enabled to commence communicating signal messages **960** responsive to receipt of the test triggering event **916** (e.g., squeaking sound) at the first mobile device **112**.

**[0217]** At operation **979**, at the network-based marketplace **118**, the signal messages **960** are received by the receiving module **502** and at decision operation **980** the processing module **504** processes the signal messages **960** to identify a type of signal processing. The decision operation **980** is described more fully on FIG. **9**P as a method **919** to identify signal processing. If the signal information **956** is identified as "NO SIGNAL" then processing ends until another signal message **960** is received. If the signal information **956** is identified as "STORE SIGNAL," then processing continues at operation **982** and if the signal information **956** is identified as "END DATA COLLECTION," then processing continues at decision operation **986**. At operation **982**, the processing module **504** may identify user profile information **702** based on the user identifier **218** in the signal message **960**. At operation **984**, the processing module **504** may store the signal information **956** from the signal message **960** in the appropriate user fault analysis information **920** in the user profile information **702**. For example, the processing module **504** may utilize the vehicle identification information **302**, chan-

nel information **950**, sub-channel **954**, and timestamp **314** in the signal message **960** to identify the appropriate location in the user fault analysis information **920** for storage. Note that the characterization information **312** in the embodiment of the signal message **960** including the maintenance message **400** is stored as signal information **956** in the user fault analysis information **920**.

**[0218]** At decision operation **986** the processing module **504** analyzes the multi-signal information **902** in the user fault analysis information **920** based on the current system fault analysis information **953** (e.g., identified previously with the decision operation **966** in FIG. **9**M based on matching the user test request information **908** with system test request information **955**) to identify whether the fault is diagnosed. The decision operation **986** is illustrated more fully in FIG. **9**Q as a method **941** to analyze multiple signals. If the multi-signal information **902** is identified as "DIAGNOSED," then processing continues at operation **990**. If the multi-signal information **902** is identified as "NOT DIAGNOSED" then processing continues at decision operation **994**.

**[0219]** At decision operation **994** the processing module **504** may identify whether additional test design information **910** is available. The decision operation **994** is described more fully in FIG. **9**O as a method **903** to identify test design information **910**. If the processing module **504**, at decision operation **994**, identifies additional test design information **910** is available then a branch is made to connector "F" which corresponds to connector "F" on FIG. **9**M. Otherwise a branch is made to operation **996**.

**[0220]** At operation **990**, the processing module **504** may communicate a message including diagnosis information **926** to the mobile device **112** that initiated the fault analysis. In some embodiments, the client machine **120** may initiate the fault analysis. For example, the message may include diagnosis information **926** that indicates the front right brake pad needs to be replaced. In another embodiment, the message may further include prognosis information **928**, as previously described. At operation **998**, the mobile device **112** may display the message including the diagnosis information **926** and/or the prognosis information **928**.

**[0221]** At operation **996**, the processing module **504** may communicate a notice to the mobile device that initiated the fault analysis indicating expert assistance has been requested. For example, the processing module **504** may identify a qualified expert to assist the user based on the expert identifier information **930** in the system fault analysis information **953**, communicate a request the expert including a request for their assistance in diagnosing the problem, and communicate a notice to the user that initiated the test indicating that an expert is expected contact the user momentarily to assist the user in diagnosing the problem. At operation **998**, the mobile device **112** may receive and display the message including the above described notice.

**[0222]** FIG. **9**O illustrates a method **903**, according to an embodiment, to identify test design information **910**. The method may receive and utilize user test request information **908** and an index, described more fully below, to identify test design information **910**. The method **903** may identify test design information **910** by matching the user test request information **908** with system test request information **955** in an entry of system fault analysis information **953** in the fault analysis repository **904**. More specifically, the method **903** may be entered multiple times to initiate multiple fault analysis test sessions **912**. Each entry of the method **903** includes an index that is passed to the method **903** and designated by the method **903** as the current system fault analysis information **953** (e.g., the place to begin searching the fault analysis repository **904**). The method **903** utilizes the current system fault analysis information **953** to begin a search for the next entry of matching system fault analysis information **953**. The method **903** may return "NEXT TEST" and an index corresponding to the identified entry of system fault analysis information **953** responsive to identifying a match or "NO TEST" responsive to identifying the fault analysis repository **904** is exhausted. The method **903** may commence, at operation **905**, with the processing module **504** receiving an index and designating the index as the "next system fault analysis information **953**. Entry of the method **903** from decision operation **966** of FIG. **9**M initializes the "next system fault analysis information" to the first entry of system fault analysis information **953**. That is, entry of the method **903** from decision operation **966** of FIG. **9**M is for initiating execution of the first fault analysis test session **912**. Entry of the method **903** from decision operation **994** of FIG. **9**N is for execution of a successive fault analysis test session **912**. Accordingly, the entry of the method **903** from decision operation **994** of FIG. **9**N initializes the "next system fault analysis information" with an index corresponding to the entry of system fault analysis information **953** following the entry of system fault analysis information **953** that was utilized for the previous fault analysis test session **912**. For example, the method **903** may be entered from decision operation **994** of FIG. **9**N three times to initialize the "next system fault analysis information" with the twentieth, twenty-fifth, and ninetieth entries of the system fault analysis information **953** in the fault analysis repository **904**. At decision operation **907**, the processing module **504** may identify whether vehicles **104** match. For example, the processing module **504** may compare vehicle identification information **302** in the user fault analysis information **920** in the user profile information **702** with vehicle identification information **302** in the current system fault analysis information **953** in the fault analysis repository **904**. If vehicles **104** match, then processing continues at decision operation **909**. Otherwise processing continues at decision operation **913**. A fuzzy match may constitute a match. For example, an overlapping range of years and/or overlapping range of makes and/or overlapping range of models may constitute a match. Further, the entirety of the vehicle identification information **302** may not be utilized for a particular comparison. For example, the vehicle identification number may not be utilized for a particular comparison.

**[0223]** At decision operation **909**, the processing module **504** may identify whether user test request information **908** matches the current system test request information **955**. For example, the processing module **504** may compare user test request information **908** in the user fault analysis information **920** in the user profile information **702** with system test request information **955** in the current system fault analysis information **953** in the fault analysis repository **904**. If a match is identified then processing continues at operation **911**. Otherwise processing continues at decision operation **913**. A fuzzy match may constitute a match. For example, overlapping ranges of problem conditions **934** and/or overlapping ranges of problem symptoms **936** may constitute a match. At operation **911**, the processing module **504** may

return the value "NEXT TEST" to decision operation **994** on FIG. **9**N or decision operation **966** on FIG. **9**M. The method **903** would then end.

**[0224]** At decision operation **913**, the processing module **504** may identify whether more entries of system fault analysis information **953** are present in the fault analysis repository **904** for processing. If more entries are available for processing, then a branch is made to operation **905**. Otherwise processing continues at decision operation **915**.

**[0225]** At operation **915**, the processing module **504** may communicate a message to an expert requesting their assistance in designing a test to diagnose the current problem. For example, the processing module **504** may identify the expert based on the expert identifier information **930** in the current system fault analysis information **953**. At operation **917**, the processing module **504** may return the value "NO TEST" to decision operation **994** of FIG. **9**N or decision operation **966** of FIG. **9**M. The method **903** then ends.

**[0226]** FIG. **9**P illustrates a method **919**, according to an embodiment, to identify signal processing. The method **919** is entered from decision operation **980** on FIG. **9**N to process signal information **956** in a signal message **960** that was received from a mobile device **112**. The method **919** commences at decision operation **921** with the processing module **504** identifying whether the collection device **901** was previously armed. If the processing module **504** identifies the collection device **901** as previously armed then processing continues at decision operation **925**. Otherwise processing continues at decision operation **923**.

**[0227]** At decision operation **923**, the processing module **504** identifies whether the signal information **956** in the signal message **960** that is presently being processed includes a test arming event **914**. For example, the processing module **504** may utilize the test arming information **942** in the test design information **910** in the current system fault analysis information **953** to identify whether the signal message **960** includes the test arming event **914**. If the processing module **504** identifies the test arming event **914** then processing continues at decision operation **925**. Otherwise processing continues at operation **935**.

**[0228]** At decision operation **925**, the processing module **504** identifies whether the collection device **901** was previously triggered. If the processing module **504** identifies the collection device **901** as previously triggered, then processing continues at decision operation **929**. Otherwise processing continues at decision operation **927**.

**[0229]** At decision operation **927**, the processing module **504** identifies whether the signal information **956** in the signal message **960** that is presently being processed includes a test triggering event **916**. For example, the processing module **504** may utilize the test triggering information **944** in the test design information **910** in the current system fault analysis information **953** to identify whether the signal message **960** includes the test triggering event **916**. If the processing module identifies the test triggering event **916** then processing continues at operation **933**. Otherwise processing continues at operation **935**.

**[0230]** At decision operation **929**, the processing module **504** identifies whether the signal information **956** in the signal message **960** that is presently being processed includes a test end event **918**. For example, the processing module **504** may utilize the test end information **946** in the test design information **910** in the current system fault analysis information **953** to identify whether the signal message **960** includes the test end event **918**. If the processing module **504** identifies the test end event **918** then processing continues at operation **931**. Otherwise processing continues at operation **933**. In some embodiments an expired timeout may be utilized to simulate the test end event **918**. In other embodiments, the signal message **960** that is presently being processed may be combined with an expired timeout to constitute the test end event **918**.

**[0231]** At operation **931**, the processing module **504** may return "END DATA COLLECTION" to decision operation **980** of FIG. **9**N. At operation **933**, the processing module **504** may return "STORE SIGNAL" to decision operation **980** of FIG. **9**N. At operation **935**, the processing module **504** may return "NO SIGNAL" to decision operation **980** of FIG. **9**N.

**[0232]** FIG. **9**Q illustrates a method **941**, according to an embodiment, to analyze multi-signal information **902**. The method **941** is entered from decision operation **986** of FIG. **9**N to analyze signal information **956** in multi-signal information **902** in user profile information **702** that was received from a collection device **901**. The method **941** commences, at decision operation **943**, with the processing module **504** identifying whether the multi-signal information **902** matches at least one correlated event **958** in the correlation information **924** of the current system fault analysis information **953** in the fault analysis repository **904**. A fuzzy match may constitute a match, as previously described. At operation **947**, the processing module **504** may return "NOT DIAGNOSED" to decision operation **986** on FIG. **9**N. At operation **945**, the processing module **504** may return "DIAGNOSED" to decision operation **986** on FIG. **9**N.

**[0233]** FIG. **9**R illustrates a user interface **949**, according to an embodiment, to configure a collection device **901**. The user interface **949** illustrates a collection device including four mobile devices **112** respectively operating on channels zero, one, two, and three and respectively associated with different telephone numbers. Channel zero includes two sub-channels including a first sub-channel that captures signal information **956** that represents audio phenomena and a second sub-channel that captures signal information **956** that represents visual phenomena. Other embodiments may include additional sub-channels **954**. Channel one captures signal information **956** that represents characterization information **312** reported by a smart component **102**. Channel two captures signal information **956** that represents temperature phenomena. Channel three captures signal information **956** that represents acceleration phenomena. The user interface **949** further illustrates the mobile device **112** associated with channel zero as being utilized to configure the collection device **901**. In some embodiments, the same mobile device **112** may be paired with one or more mobile devices **112** that are wearable (e.g., Google Glasses, smart watch, etc.). Any of the mobile devices **112** may be utilized to capture a test arming event **914** or a test triggering event **916**.

**[0234]** FIG. **9**S illustrates a user interface **951**, according to an embodiment, to display partial results for a multi-signal automated fault analysis including aspects of the diagnosis information **926** and prognosis information **928**.

## Systems and Methods for an E-Commerce Enabled Digital Whiteboard

**[0235]** FIG. **10**A illustrates a system **1000**, according to an embodiment, for an e-commerce enabled digital whiteboard. The system **1000** is generally described in the present disclosure to process interactions between a vehicle owner who is

collaborating with other users (e.g., experts) to repair a vehicle **104** (not shown), however, other collaborations may include management personnel who collaborate to plan a budget, engineers who collaborate to build a software system, publishers who collaborate to identify whether to publish a book, shoppers who collaborate to make a purchase (e.g., online shopping assistance) and the like.

**[0236]** Broadly, the system **1000** may include a network-based marketplace **118** that utilizes a context **1002**, including a context identifier **1004**, initialization information **1008** and request information **1010** to process interactions between users who are collaborating online, the interactions being received as requests via a user interface **1012**. For example, the network-based marketplace **118** may utilize the context **1002** to process interactions in an online collaborative workspace **1014** to expose feature information **1006** and/or augment feature information **1006** and/or remove feature information **1006** from the user interface **1012** in addition to improving the relevancy and/or enabling ecommerce activities that are presented via the user interface **1012**.

**[0237]** The network-based marketplace **118** may utilize the context **1002** to process interface information. Interface information may include information that is exposed or received via the user interface **1012**. For example the interface information may include requests/interactions that are received via the online collaborative workspace **1014**. The interactions may include manipulating objects including documents, videos, illustrations, wire frame diagrams and the like, hosting real-time audio/visual online collaborative workspace sessions with other users and the like, and facilitating general drop and drag facilities for links, objects, etc. and other typical digital whiteboard facilities and the like. The interface information may further include feature information **1006**. For example, the feature information may include participant information **1016**, metadata information **1018**, search information **1020**, tool information **1022**, dialogue information **1024**, shopping cart information **1026**, context information **1028** including the context **1002**, advertising information **1033** and promotional information **1035**. The feature information **1006** may be displayed as interface information according to panels on the user interface **1012** or as discrete user interface elements or as groups of user interface elements on the user interface **1012**.

**[0238]** As briefly mentioned above but now discussed, the feature information **1006** may be hidden or exposed. For example, the participant information **1016** may be added or removed to interact with expert users. Further for example, the metadata information **1018** may be added or removed to manipulate objects in a separate workspace. Specifically, the metadata information **1018** may be used to manipulate instances of objects presently displayed on another part of the user interface **1012**. Further, the metadata information **1018** may be used to display instantiations of an archetypical object. For example, the metadata information **1018** may display user interface elements rendering Fram or Napa oil filters for parallel viewing with an archetypical oil filter that is being displayed in a repair schematic in the online collaborative workspace **1014**. The search information **1020** may include search results, queries, saved searches, and other search related information. Further the search information **1020** may be generated based on searches being performed for listings **600** (not shown) on the network-based marketplace **118**. The tool information **1022** may include tools to operate the user interface **1012** and manipulate the contents of the user interface **1012**. The dialogue information **1024** may include scripts representing spoken words, typed words, messaged words, etc. and generally any statement (e.g., declarative, question, etc.) submitted by any user from present and previous online collaborative sessions. The shopping cart information **1026** may include listings **600** (not shown) and other elements supporting sales and other e-commerce activity including merchandising activities. The context information **1028** may include the context **1002**, as previously described. The advertising information **1033** may include advertisement elements, merchandising elements (e.g., listings) and other elements supporting sales and other e-commerce activity. The promotional information **1035** may include promotion elements (e.g., discounts, games, etc.), merchandising elements and other elements supporting sales and other e-commerce activity.

**[0239]** More specifically, the system **1000** may include a mobile device **112** (e.g., smart phone) operated by a first user who enters an "add context" command (operation "A") on the mobile device **112** to add the context **1002**. The mobile device **112** may communicate the context **1002**, over a network **116**, to a network-based marketplace **118** that, in turn, processes the "add context" command and the context **1002** to store the context **1002** in a directory in user profile information **702** that is associated with the first user on the network-based marketplace **118**. Responsive to processing the "add context" command, the network-based marketplace **118** may communicate a context identifier **1004** back to the mobile device **112**. Further, the first user may enter an "attach context" command (operation "B") and the context identifier **1004** with the mobile device **112** to attach the context **1002** to the online collaborative workspace **1014**. To this end, the mobile device **112** may communicate the command and the context identifier **1004**, over the network **116**, to the network-based marketplace **118** that, in turn, processes the command and the context identifier **1004** to attach the context **1002** to the online collaborative workspace **1014**, generate the user interface **1012** by utilizing the context **1002** and communicate the user interface **1012**, back over the network **116**, to the mobile device **112**. Further, one or more other users who are remotely located to the user may enter a request by touch or another activity that is received via the one or more instances of the, touch sensitive, user interface **1012**. The network-based marketplace **118** may receive the requests, process the requests based on the context **1002** including the initialization information **1008** and all of the request information **1010** including the present and previous requests. Responsive to processing the requests, the network-based marketplace **118** may (re)generate the user interface **1012** or parts of the user interface **1012** and communicate the user interface **1012** or parts thereof back over the network **116** to the one or more mobile devices **112**.

**[0240]** In one example, the initialization information **1008** may include a description of vehicle **104** (not shown) and a description of a repair for the vehicle. For example, the initialization information **1008** may describe a 1967 Ford Mustang that needs a repair in the form of an oil filter replacement. Continuing with the example, the context **1002** may be attached to the online collaborative workspace **1014**, as previously described, and the online collaborative workspace **1014** may be generated based on the initialization information **1008** in the context **1002** to include a repair schematic for replacing the oil filter. Subsequent to displaying the repair schematic, requests may be received from the first, second,

and other users, who are collaborating to replace the oil filter, and stored in the context **1002** as request information **1010**. For example, the requests may include a request to invite a third user (e.g., expert) to collaborate, a screen touch that selects an object (e.g., gaskets) in a repair schematic that is displayed in an online collaborative workarea **1037**, spoken statements, typed statements, etc. Requests may be stored as request information **1010** in the context **1002** corresponding to communications received via the user interface **1012** from the mobile device **112**.

Example

**[0241]** A vehicle **104** owner is changing an oil filter using their electronic tablet (e.g., iPad) to view maintenance instructions provided by online marketplace XYZ Motors. The user is experiencing problems. The user opens the whiteboard app ("WHITEBOARD APPLICATION") provided by XYZ Motors on their tablet, A) adds a context **1002** describing the vehicle (e.g., 1967 Ford Mustang) and describing the repair ("OIL FILTER CHANGE") to initiate a collaborative workspace session; and B) attaches the context **1002** to the online collaborative workspace **1014**.

<whiteboard initializes w/ vehicle make/model/year and repair schematic>

<collaborative workspace session begins>

<user requests assistance via the user interface **1012**>

<expert who responds via the user interface **1012**>

(O)wner: "Hey—I can't figure this out—it keeps leaking even though I've tightened it up"

(E)xpert: "Have you replaced the gaskets?"

O: "Ummm . . . What gaskets?"

E: <taps on the gaskets within the repair schematic>

<automatic display of set of gaskets (e.g., Fram) in metadata on user interface **1012** that may be utilized to complete the repair described by the repair schematic>

<drags one of the item images to the online collaborative workarea **1037**>

<schematic automatically highlights the gasket location tapped by the expert>

"They look like this . . . "

O: "Huh!no—thought I could reuse the old one . . . "

<drags the link to a shopping cart on the user interface **1012**>

"I'll grab one of those tomorrow. Thanks!"

<tips the expert an 'eBuck' for his time>

<collaborative workspace session ends>

**[0242]** Later that evening, the user again launches the whiteboard app ("WHITEBOARD APPLICATION"), identifies the above mentioned context **1002** in the directory and reattaches the context **1002** by executing the "add context" command to initiate a second session for the same context **1002**. The user returns to the item in their shopping cart which is accessible via the user interface **1012** and selects a user interface element invoking an "IN-STORE PICK UP" to purchase the item from a store that is located within a predetermined distance of the mobile device **112**. The network-based marketplace **118** utilizes the context **1002** to suggest a different item (e.g., second item) (e.g., another brand that is preferred by the user) based on the context **1002**. For example, the context **1002** may be accessed to identify a second item and present the second item as being available through a local merchant's "IN-STORE PICK-UP" feature of XYZ motors (e.g., network-based marketplace **118**), or directly from XYZ motors (e.g., network-based marketplace **118**). The user purchases the second item via the shopping cart that is accessed via the user interface **1012** that is accessed via the whiteboard app.

**[0243]** In another embodiment, the user does not re-launch the whiteboard app but, instead, opens their shopping cart directly and is presented with the item and a presentation of a second item that is selected based on the context **1002** being associated with the user who opens the shopping cart (e.g., a brand preferred by the user who opens the shopping cart). The user completes the purchase after selecting the IN-STORE PICK-UP feature, picks up the part along their bus ride home the next day, and receives a 'continue my repair' notification on their tablet after the purchase is completed.

**[0244]** Returning to the general discussion, further examples may include utilization of the "add context" command to create other contexts **1002** for different repairs of the same vehicle or for repairing other vehicles. Further examples may also include, re-launching the whiteboard application and reattaching a context **1002** that was previously initialized and/or utilized. It will be appreciated by one skilled in the art that a user may, at any time, open one or more instances of the whiteboard application on multiple devices including a mobile device **112** and/or a client machine **120**. Further, each device may display a different type of information (e.g., participant information, metadata information **1018**, etc.) in the user interface **1012** and receive different information. For example, a first device (e.g., mobile) device **112** may be utilized for camera, voice, and sensor **108** functionality, a second device (e.g., laptop) may be utilized for interactive chat and shopping cart information and a third device (e.g., tablet or Google Glass) may be utilized to view and interact with a repair schematic or document. It will further be appreciated by one skilled in the art that the interface information described above may be embodied in interfaces other than the user interface **1012**. For example, the interface information may be embodied in an audio interface, a machine interface, application programming interface (API), a haptic interface or any other boundary across which two or more systems meet and act on each other or two or more users communicate with each other or any combination thereof.

**[0245]** FIG. **10**B illustrates a context panel **1030**, according to an embodiment. The context panel **1030** may be utilized to display context information **1028**. The context information **1028** may include the context **1002** including the initialization information **1008** and other information utilized to characterize a context **1002** for a particular online whiteboard collaboration. The initialization information **1008** may include the year, make, model and repair for which the user desires to collaborate. Other information may include part description information **304** that is displayed responsive to the network-based marketplace **118** comparing the initialization information **1008** with vehicle information **300** in the garage information **706** in the user profile information **702** associated with the user who attached the context **1002** and identifying a match according to vehicle **104** (e.g., Ford Mustang 1967) and part **106** (e.g., oil filter). For example, the part description information **304** in the identified vehicle information **300** may include an indicator ("YES') indicating a smart component **102** (e.g., oil filter) was reported in a scan of 1967 Ford Mustang. The part description information **304** that is displayed may further include characterization information **312** to indicate a percentage of wear (e.g., 90%) or multiple samples of characterization information **312** that are pro-

cessed (e.g., averaged) to indicate a percentage of wear (e.g., 90%) that is further associated with service level information **318** that registers a service level (e.g., "REPLACE"), the OEM authentic information **320** (e.g., original equipment manufacturer (OEM)) including a flag that is asserted to signify the part **106** is manufactured by an original equipment manufacturer, the part type identifier **308** ("OIL FILTER"), and the part identifier **306** all as previously described. Further, portions of the user profile information **702** for the user who attached the context **1002** may be displayed including an expertise level included in the expert information **220** ("NOVICE") indicating the present user is a novice with regard to installing oil filters and user preference information **704** indicating the user has expressed an interest in a particular brand of the oil filter (e.g., "FRAM").

**[0246]** Other embodiments may not utilize the context panel **1030** to display the context information **1028**. For example, other embodiments may display all or part of the context information **1028** as discrete user interface elements on the user interface **1012** or as groups of user interface elements on the user interface **1012**. Further, other embodiments of the present disclosure may display other types of information in the context panel **1030**. For example, other embodiments of the present disclosure may display discrete user interface elements or groups of user interface elements of participant information **1016**, metadata information **1018**, elements from the online collaborative workarea **1037**, search information **1020**, tool information **1022**, dialogue information **1024**, shopping cart information **1026**, advertising information **1033** and promotional information **1035** in the context panel **1030**.

**[0247]** FIG. **10**C illustrates a shopping cart panel **1032**, according to an embodiment. The shopping cart panel **1032** may be utilized to display shopping cart information **1026**. The shopping cart information **1026** may include items the user intends to purchase (e.g., "FRAM EXTRAT GUARD . . . "). For example, the shopping cart information **1026** may include items the user intends to purchase that were selected from other parts of the user interface **1012** (e.g., other panels) and dragged to the shopping cart panel **1032**. The shopping cart information **1026** may include items other users purchased for similar repairs for similar vehicles ("MOTORCRAFT OIL . . . "). The shopping cart information **1026** may further include in-store pick-up availability for items within a predetermined distance (e.g., five miles) of the current location of the mobile device **112**. For example, the "FRAM EXTRA GUARD . . . " oil filter may be picked up at a Napa Auto Parts store or an O'Reilly's Auto Parts store both within five miles of the current location of the mobile device **112**. Further illustrated are buttons ("INFO") respectively corresponding to the stores that may be selected for in-store pick-up. The buttons may be selected to display store information including a map including driving instructions to the store, open hours for the store, and contact information for the store including a link to a website for the store. Other embodiments may not utilize the shopping cart panel **1032** to display the shopping cart information **1026**. For example, other embodiments may display all or part of the shopping cart information **1026** as discrete user interface elements on the user interface **1012** or as groups of user interface elements on the user interface **1012**. Further, other embodiments may display other types of information in the shopping cart panel **1032**. For example, other embodiments may display discrete user interface elements or groups of user interface elements of participant information **1016**, metadata information **1018**, elements from the online collaborative workarea **1037**, search information **1020**, tool information **1022**, dialogue information **1024**, advertising information **1033** and promotional information **1035** in the shopping cart panel **1032**.

**[0248]** FIG. **10**D illustrates a metadata panel **1034**, according to an embodiment. The metadata panel **1034** may be utilized to display metadata information **1018**. The metadata panel **1034** may be used as an additional and separate workspace. The metadata panel **1034** may be used to display and manipulate instances of objects that are presently being displayed on another part of the user interface **1012** such as the online collaborative workarea **1037**. For example, the online collaborative workarea **1037** illustrates a repair schematic including a user interface element **1036** representing an object in the form of an archetypical set of gaskets used in the replacement of an oil filter. Selection of the user interface element **1036** by one of the users (e.g., an expert) may cause the user interface element **1036** to be highlighted, an automatic initiation of a search for listings **600** describing gaskets that are being offered for sale on the network-based marketplace **118** that match the selected archetypical set of gaskets and display of three sets of gaskets in the metadata panel **1034** that match the description of archetypical set of gaskets as well as the user-preferred brands of the user in accordance with user preference information **704** in the user profile information **702** associated with the user who attached the context **1002**. In another example, the gasket sets may be matched in accordance with the user-preferred brands of the user who selected user interface element **1036**. For example, the user who selected the user interface element **1036** may be a user other than the user who attached the context **1002** and the gasket sets may be matched in accordance with the user-preferred brands included in the user preference information **704** in the user profile information **702** of that user. Other user interface elements (e.g., text box, links, and illustrations) representing objects on the online collaborative workspace **1014** may be dragged to the metadata panel **1034**. Further, a gasket set may be selected from the metadata panel **1034** and dragged to the shopping cart panel **1032** (not shown) for purchase. Other embodiments may not utilize the metadata panel **1034** to display the metadata information **1018**. For example, other embodiments may display all or part of the metadata information **1018** as discrete user interface elements on the user interface **1012** or as groups of user interface elements on the user interface **1012**. Further, other embodiments may display other types of information in the metadata panel **1034**. For example, other embodiments may display discrete user interface elements or groups of user interface elements of participant information **1016**, elements from the online collaborative workarea **1037**, search information **1020**, tool information **1022**, dialogue information **1024**, advertising information **1033** and promotional information **1035** in the metadata panel **1034**.

**[0249]** FIG. **10**E illustrates a search panel **1038**, according to an embodiment. The search panel **1038** may be utilized to display search information **1020**. The search panel **1038** may be used to automatically or manually search for listings **600** on the network-based marketplace **118**. To this end, the search panel **1038** may include an input box **1040** to receive a query to initiate a manual search and a search result box **1042** to display the search result including descriptions of listings **600** of items being offered for sale on the network-based marketplace **118** and links to the listings **600**. An automatic search

may be initiated by selecting an object from the user interface **1012** (not shown) corresponding to an item that may be offered for sale on the network-based marketplace **118**. For example, the online collaborative workarea **1037** illustrates a repair schematic including a user interface element **1036** representing an object in the form of an archetypical set of gaskets used in the replacement of an oil filter. Selection of the user interface element **1036** by one of the users (e.g., expert) may cause the user interface element **1036** to be highlighted and an automatic initiation of a search for listings **600** describing gaskets that are being offered for sale on the network-based marketplace **118**. The search result box **1042** may include a search result including listings **600** that match the selected archetypical set of gaskets. The search result may be sorted and displayed in the search result box **1042**. The search result may be sorted based on the brand preferences of the user that initiated the search. In another embodiment, the search result may be sorted based on the preferences of the user that attached the context **1002**. In both instances the user-preferred brands of the user may be found in the user preference information **704** in the user profile information **702** for the user. Selections of other objects from other panels may also automatically initiate a search. Further, a listing **600** (not shown) in the search result box **1042** may be selected and dragged to the shopping cart panel **1032** (not shown) for purchase or to another panel. Other embodiments may not utilize the search panel **1038** to display the search information **1020**. For example, other embodiments may display all or part of the search information **1020** as discrete user interface elements on the user interface **1012** or as groups of user interface elements on the user interface **1012**. Further, other embodiments may display other types of information in the search panel **1038**. For example, other embodiments may display discrete user interface elements or groups of user interface elements of participant information **1016**, elements from the online collaborative workarea **1037**, tool information **1022**, dialogue information **1024**, search information **1020**, advertising information **1033** and promotional information **1035** in the search panel **1038**.

**[0250]** FIG. **10**F illustrates a tool panel **1043**, according to an embodiment. The tool panel **1043** may be utilized to display tool information **1022**. The tool information **1022** may include tools to control the user interface **1012**. For example, the tools may be utilized to open and close panels on the user interface **1012**. Further, the tool information **1022** may include tools to control the contents of the user interface **1012**. For example tool information **1022** may include tools to create, delete, modify, or manipulate text, illustrations, objects, or user interface elements on the user interface **1012**. Other embodiments may not utilize the tool panel **1043** to display the tool information **1022**. For example, other embodiments may display all or part of the tool information **1022** as discrete user interface elements on the user interface **1012** or as groups of user interface elements on the user interface **1012**. Further, other embodiments may display other types of information in the tool panel **1043**. For example, other embodiments may display discrete user interface elements or groups of user interface elements of participant information **1016**, elements from the online collaborative workarea **1037**, dialogue information **1024**, and search information **1020** in the tool panel **1043**.

**[0251]** FIG. **10**G illustrates a dialogue panel **1044**, according to an embodiment. The dialogue panel **1044** may be utilized to display dialogue information **1024**. The dialogue information **1024** may include scripts representing spoken words, typed words, messaged words, etc. and generally any statement (e.g., declarative, question, etc.) submitted by any user whether in the present or previous online collaborative session. The dialogue information **1024** may be analyzed based on the context **1002** to identify words as relevant. Merely for example, the network-based marketplace may parse the dialogue information **1024** based on the context **1002** to generate a parse result including words that register at a high frequency of occurrence in the dialogue information **1024** and filtered using a dictionary of parts **102** (e.g., Chilton's Automotive Repair Manual for repair of automobiles) to identify a parsed result including words in the dialogue information **1024** for highlighting and hyperlinking to automatically initiate searches on the network-based marketplace **118**. For example, the highlighted word or phrase may be selected to initiate a search query for listings **600** on the network-based marketplace **118** by utilizing the highlighted word or phrase as a query for the search. Other embodiments may not utilize the dialogue panel **1044** to display the dialogue information **1024**. For example, other embodiments may display all or part of the dialogue information **1024** as discrete user interface elements on the user interface **1012** or as groups of user interface elements on the user interface **1012**. Further, other embodiments may display other types of information in the dialogue panel **1044**. For example, other embodiments may display discrete user interface elements or groups of user interface elements of participant information **1016**, elements from the online collaborative workarea **1037**, tool information **1022**, search information **1020**, advertising information **1033** and promotional information **1035** in the dialogue panel **1044**.

**[0252]** FIG. **10**H illustrates a participant panel **1046**, according to an embodiment. The participant panel **1046** may include one or more user panels **1048** to display participant information **1016**. Each user panel **1048** may present a user on the network-based marketplace **118** (not shown). The user panel **1048** may present the user who attached the context **1002** (e.g., "JOHN DOE") and one or more other users (e.g., experts, "EXPERT 1: JANE DOE") who participate in a session. The experts may be selected for presentation based on expert information **220** (not shown) in the user profile information **702** (not shown) associated with the user, as described later. The presentation of the user in the user panel **1048** may include an image of the user (e.g., expert), a user name, a user affiliated electronic storefront, a merchandising element **1050**, and a tip box **1052**. Selection of the user name or image may communicate a notice to the user (e.g., expert) including an inquiry asking the user to join a session. The merchandising element **1050** may be updated by the associated user to present a featured promotion, discount, or coupon (s) that may be selected to participate in the featured promotion (e.g., print the coupon, buy an item to obtain a discount, etc.). The tip box **1052** may receive a tip for the associated user. For example, the tip box **1052** may receive five USD that is credited to the associated user's PayPal account (e.g., "EXPERT 2: JIM DOE") and debited from the tipping user's PayPal account (e.g., "OWNER: JOHN DOE"). Other embodiments may not utilize the participant panel **1046** to display the participant information **1016**. For example, other embodiments may display all or part of the participant information **1016** as discrete user interface elements on the user interface **1012** or as groups of user interface elements on the user interface **1012**. Further, other embodiments may display

other types of information in the participant panel **1046**. For example, other embodiments may display discrete user interface elements or groups of user interface elements of search information **1020**, elements from the online collaborative workarea **1037**, tool information **1022**, search information **1020**, advertising information **1033** and promotional information **1035** in the participant panel **1046**.

**[0253]** FIG. **10**I illustrates the network-based marketplace **118**, according to an embodiment. The network-based marketplace **118** may include smart component modules **500** and a database **204**. The network-based marketplace **118**, smart component modules **500** and database **204** operate as previously described and further as follows. The smart component modules **500** may include a receiving module **502** and a processing module **504**. The receiving module **502** may receive commands, requests and other information from the mobile device **112** (not shown) or a client machine **120** (not shown). For example, the commands may include the "add context" command, the "attach context" command or other commands, as previously described. Further for example, the receiving module **502** may receive requests describing interactions received via the user interface **1012** (not shown). The processing module **504** may process the commands, requests and other information to update the database **204** and respond to the aforementioned commands, requests and other information by communicating the user interface **1012**, updates to the user interface **1012**, or portions of the user interface **1012** to the mobile device(s) **112** or the client machine(s) **120** in accordance with the one or more participants of a session. The database **204** may include the items table **506**. the user table **508** and other data structures previously described though not presently shown. The user table **508** may include user profile information **702**. Each entry of user profile information **702** may store one or more contexts **1002** (not shown) for a particular user.

**[0254]** FIG. **10**J illustrates user profile information **702**, according to an embodiment. The user profile information **702** operates as previously described and as described below. The user profile information **702** may include user information **216** and user preference information **704** including expert information **220**. Recall the expert information **220** may include one or more part type identifiers **308**, one or more sub-system identifiers **708** and vehicle identification information **302** that may identify one or more vehicles **104** for which the user is ranked. The user ranking may be utilized to identify content for consumption by a user or to identify a source of content for consumption by a user. For example, the expert information **220** may indicate that a user has the ability to source content for another user by providing "expert" or "qualified" advice (e.g., verbal content) for a particular part **106** (not shown), in a particular sub-system **103** (not shown), in a particular vehicle **104** (not shown), or some combination thereof. The processing module **504** (not shown) may identify a user who is qualified as an expert to work on the repair and vehicle **104** (not shown) specified in the context **1002** by comparing the initialization information **1008** in the context **1002** with the expert information **220** to identify a match. For example, portions of the expert information **220** may be compared with the initialization information **1008** in the context **1002** (not shown) to identify a match. A fuzzy match may constitute a match. For example, overlapping part type identifiers **308** and/or overlapping vehicle identification information **302** may constitute a match. The processing module **504** (not shown) may further utilize the expert information **220** to select content for consumption by a user who attaches the context **1002** to the online collaborative workspace **1014**. Merely for example, the expert information **220** may include an expertise level that ranks the ability of the user to consume content with four levels of qualification information including "NOVICE." "INTERMEDIATE," "SENIOR," and "EXPERT" that may be utilized to select content for the user for the indicated field of expertise (e.g., part type, sub-system, vehicle). For example, the processing module **504** may select repair schematics with brief and terse instructions for a user at the "EXPERT" level and repair schematics that are exhaustive for a user at the "NOVICE" level. Continuing with the example, the schematics that are exhaustive may include additional and/or more detailed illustrations and additional or more detailed description. Further, the processing module **504** may upgrade or downgrade the expertise level in the expert information **220** for the user based on the amount of assistance provided to perform a repair or the quality of assistance provided to perform a repair.

**[0255]** The user profile information **702** further includes context directory information **1054** and an online collaborative workplace marker **1056**. The content directory information **1054** may store the context **1002** for the user. For example, the contexts **1002** created by the user with the "add context" command are stored in the user profile information **702** until removed with a "delete context" command. The online collaborative workplace marker **1056** may be used to store a context identifier **1004** for a particular context **1002**. Responsive to execution of the "attach context" command, the context identifier **1004** that is being received by the "attach context" command is stored in the online collaborative workplace marker **1056** constituting attachment of the context **1002** to the online collaborative workspace **1014**. Subsequent executions of the "attach context" command overwrite the context identifier **1004** stored by the previous execution of the "attach context" command. That is, only a single context identifier **1004** is utilized by the network-based marketplace **118** for the whiteboard application.

**[0256]** FIG. **10**K illustrates context directory information **1054**, according to an embodiment. The context directory information **1054** may include one or more entries of context **1002**. An entry of context **1002** may be added to the context directory information **1054** with the "add context" command and removed from the content directory information **1054** with the "delete context" command

**[0257]** FIG. **10**L illustrates the context **1002**, according to an embodiment. The context **1002** may include the context identifier **1004**, the initialization information **1008**, and the request information **1010**, as previously described.

**[0258]** FIG. **10**M illustrates the request information **1010**, according to an embodiment. The request information **1010** may include one or more sessions **1058**, as previously described. A session **1058** may be initiated with execution of an "attach context" command. A session **1058** may be terminated by closing the whiteboard app. Reattachment initiates a new session **1058** for a particular context **1002**.

**[0259]** FIG. **10**N illustrates a session **1058**, according to an embodiment. The session **1058** may include one or more requests **1060**, as previously described. The request **1060** may be stored in the session **1058** responsive to the request **1060** being received at the network-based marketplace **118**.

**[0260]** FIG. **10**O illustrates the request **1060**, according to an embodiment. The request **1060** may include a request identifier **1062**, a timestamp **314**, operation information

**1064**, and response information **1066**. The request identifier **1062** may be sequentially allocated and assigned to the request **1060** responsive to receiving the request **1060**. The request identifier **1062** may uniquely identify the request **1060** for the particular session **1058**. The timestamp **314** is stored in the request **1060** responsive to receipt of the request **1060** via the user interface **1012** (not shown) at the mobile device **112** (not shown) or client machine **120** (not shown). The operation information **1064** may include an operation (e.g., operation code) describing the type of operation requested and one or more parameters. For example, operations may include attaching a context **1002**, adding an expert to the session **1058**, selecting an object (e.g., user interface element for a part **106**), moving a part **106** from the metadata panel **1034** (not shown) to the shopping cart panel **1032** (not shown), scroll dialogue information **1024**, etc. Further each operation may be associated with one or more parameters that are received as input for the operation. For example, one or more parameters may be received via the user interface **1012** from the mobile device **112** or the client machine **120**. The response information **1066** may store information utilized to respond to the request **1060** including interface information. For example, the request **1060** may indicate the user selected a user interface element representing an item that triggered a search and the response information **1066** may include interface information including search information **1020** including the search results that were identified based on the search executed.

**[0261]** FIG. **10**P illustrates response information **1066**, according to an embodiment. The response information **1066** may include information utilized to respond to the operation in the request **1060**. For example the response information may include interface information including participant information **1016**, metadata information **1018**, search information **1020**, tool information **1022**, dialogue information **1024**, shopping cart information **1026**, and information generated for display in the online collaborative workarea **1037** or any other part of the user interface **1012**. Further, the response information may include information that is generated based on the request **1060** but not accessed via the user interface **1012** (e.g., search results generated in response to a request **1060** but not displayed on the user interface **1012**). Merely for example, the response information **1066** may include one or more user identifiers **218**, expert identifier information **930**, one or more saved searches **1067** including query and search results, one or more listing identifiers **308**, one or more part identifiers **306**, one or more part type identifiers **308**, and the context identifier **1004**, as previously described. The user identifiers **218** may include and distinguish the user identifier **218** associated with the mobile device **112** that is currently executing the whiteboard application and other use identifiers (e.g., expert 1, expert 2, etc.). The mobile device identifier **1069** may identify the mobile device **112** from which the request **1060** originated. The client machine identifier **1071** may identify the client machine **120** from which the request **1060** originated.

**[0262]** FIG. **10**Q illustrates feature element information **1070**, according to an embodiment. The feature element information **1070** may include one or more feature elements **1072**. Each feature element **1072** corresponds to a feature that is supported by the online collaborative workspace **1014**. The processing module **505** may utilize the feature element information **1070** to process corresponding feature information **1006**. For example, a participant feature corresponds to the participant information **1016**, a metadata feature corresponds to the metadata information **1018**, an online collaborative workarea feature corresponds to information processed in the online collaborative workarea **1037**, a search feature corresponds to the search information **1020**, a tool feature corresponds to tool information **1022**, a dialogue feature corresponds to dialogue information **1024**, a shopping cart feature corresponds to shopping cart information **1026**, a context feature corresponds to context information **1028**, an advertising feature corresponds to advertising information **1033** and a promotional feature corresponds to promotional information **1035**. Other embodiments may include additional or fewer features.

**[0263]** FIG. **10**R illustrates a method **1074**, according to an embodiment, to add a context **1002**. The method **1074** may commence at operation **1076**, at the network-based marketplace **118**, with the receiving module **502** receiving the initialization information **1008**. The message may be received from a mobile device **112** or a client machine **120**. The message may include user identifier **218**, an indication to add the context **1002**, and the initialization information **1008**. For example, the user may have interacted with a set of screens that were displayed at the mobile device **112** that, in turn, communicated the message over the network **116** to the network-based marketplace **118**. At operation **1078**, the processing module **504** may allocate the context **1002**, allocated by the context identifier **1004**, store the initialization information **1008** in the context **1102**, and store the context identifier **1004** in the context **1002**. Further, the processing module **504** may store the context **1002** in the context directory information **1054** in the user profile information **702** that is identified based on the user identifier **218**. At operation **1080**, the processing module **504** may communicate the context identifier **1004** over the network **116** to the mobile device **112** or the client machine **120** that executed the "add context" command.

**[0264]** FIG. **10**S illustrates a method **1082**, according to an embodiment, to attach a context **1002**. The method **1082** may commence at operation **1084**, at the network-based marketplace **118**, with the receiving module **502** receiving a request **1060** to attach a context **1002**. The request may include the context identifier **1004**. For example, the receiving module **502** may receive the request **1060** from over a network **116** from the mobile device **112** or the client machine **120**. The request **1060** may include the user identifier **218** to identify the user making the request **1060**, and an operation **1068** to attach the context **1002**, and the context identifier **1004**. For example, the user may have selected a user interface element representing the context **1002** from a screen displayed at the mobile device **112** that, in turn, communicated the request **1060** over the network **116** to the network-based marketplace **118**. At operation **1086**, the processing module **504** may attach the context **1002** to the online collaborative workspace **1014** in the whiteboard application. For example, the processing module **504** may store the context identifier **1004** in the online collaborative workspace marker **1056** in the user profile information **702** that is identified based on the user identifier **218** in the request **1060**. Other embodiments may utilize the mobile device identifier **1069** and/or the client machine identifier **1071** in the request **1060** to identify the appropriate user profile information **702** with a mapping operation. The processing module **504** overwrites the context identifier **1004** previously stored in the online collaborative workspace marker **1056** with the context identifier **1004** received in the

request **1060** and creates a new session in the request information **1010**. Further, the processing module **504** may indicate an end of session **1058** for the context identifier **1004** previously stored in the online collaborative workspace marker **1056**. At operation **1088**, the processing module **504** may processes the request **1060** based on the context **1002**. For example, the processing module **504** may utilize the context identifier **1004** and the request **1060** to update the user interface **1012** at the mobile device **112** or generate a new user interface **1012** at the mobile device **112**. The operation **1088** is described further as the method **1003** in FIG. **10**U. At operation **1090**, the processing module **504** stores the request **1060** in the session **1058** in the request information **1010** in the context **1002**.

**[0265]** FIG. **10**T illustrates a method **1092**, according to an embodiment, to receive and process a request. The method **1092** may commence at operation **1094**, at the network-based marketplace **118**, with the receiving module **502** receiving a request **1060**. For example, a mobile device **112** may initially receive the request **1060** responsive to sensing a touch on a user interface **1012** and communicate the request **1060** over the network **116** to the network-based marketplace **118** that, in turn, includes the receiving module **502** that, in turn, receives the request.

**[0266]** At operation **1096**, the processing module **504** may identify the context **1002** based on the request **1060**. For example, the processing module **504** may utilize the user identifier **218** in the operation information **1064** in the request **1060** to identify the corresponding user profile information **702** including the appropriate online collaborative workspace marker **1056**. It will be appreciated that the processing module **504** may map a request **1060** that is received from an expert to the user who initiated the session **1058** and the session **1058** to properly identify the appropriate online collaborative workspace marker **1056**. Other embodiments may utilize the mobile device identifier **1069** or the client machine identifier **1071** in the request **1060** to identify the appropriate user profile information **702** with a mapping operation that identifies the user based on the device identifier **1069** or the client machine identifier **1071**. Further, at operation **1096**, the processing module **504** may read the context identifier **1004** from the collaborative workspace marker **1056**.

**[0267]** At operation **1098**, the processing module **504** may process the request **1060** based on the context **1002**. For example, the processing module **504** may utilize the context identifier **1004** and the request **1060** to update the user interface **1012** or generate a new user interface **1012** and communicate the update or new user interface **1012** to the mobile device **112**. The operation **1098** is described further as the method **1003** in FIG. **10**U. At operation **1001**, the processing module **504** may store the request **1060** in the most recent session **1058** in the request information **1010** in the context **1002**.

**[0268]** FIG. **10**U illustrates a method **1003**, according to an embodiment, to process a request **1060** based on a context **1002**. The method **1003** may be entered from operation **1088** of FIG. **10**S or from operation **1098** of FIG. **10**T. Recall that a request **1060** (e.g., received request) was received over the network **116**, the received request **1060** originating from the whiteboard app at a mobile device **112** (though the app may also be executed on the client machine **120**). Broadly, the method **1003** may generate response information **1066** for the received request **1060** based on context **1002** including the initialization information **1008** and the request information **1010**. The method **1003** may generate interface information in at least two ways. First, the method **1003** may generate interface information based on the response information **1066** respectively stored in all of the previous requests **1060**, the initialization information **1008**, and the received request **1060** for every feature (e.g., participating feature, shopping cart feature, etc.) presently supported by the whiteboard app. Further, the method **1003** may generate interface information based on the initialization information **1008** and the received request **1060** for every feature (e.g., participating feature, shopping cart feature, etc.) presently supported by the whiteboard app. Accordingly, the entire context **1002** is reviewed over time (e.g., all previous requests **1060**) for every feature (e.g., participating feature, shopping cart feature, etc.) to generate the interface information that, in turn, may be utilized to generate the user interface **1012** that, in turn, is communicated over the network **116** to the mobile device **112** or client machine **120**.

**[0269]** At operation **1005**, the processing module **504** may advance to the first feature element **1072** (e.g., current feature) in the feature element information **1070** (e.g., participant feature, metadata feature, etc.). At operation **1007**, the processing module **504** may advance to the first session **1058** (e.g., current session) in the request information **1010** in the context **1002** in the user profile information **702** identified based on the received request **1060**. At operation **1009**, the processing module **504** may advance to the first request **1060** (e.g., current request) in the current session **1058**.

**[0270]** At operation **1011**, the processing module **504** may generate interface information based on the response information **1066** in the current request **1060**, the received request **1060** and the current feature (e.g., participant feature). For example, the processing module **504** may generate interface information including a list of user identifiers **218** that identify expert users responsive to identifying the current request **1060** as including operation information including an operation (e.g., op code) that describes a request for expert assistance and identifying the response information **1066** for the current request **1060** as including a list of user identifiers **218** that identify expert users (e.g., previously consulted experts). Further for example, the processing module **504** may generate the interface information to open, close, or augment a panel (e.g., dialogue panel **1044**) corresponding to the current feature (e.g., dialogue feature). Further for example, the processing module **504** may generate interface information to add (e.g., expert), remove, or augment user interface elements for corresponding to the current feature (e.g., participant feature).

**[0271]** At decision operation **1013**, the processing module **504** may identify whether more requests **1060** are in the current session **1058**. If more requests **1060** are in the current session **1058** then processing continues at operation **1015**. Otherwise, processing continues at decision operation **1017**. At operation **1015**, the processing module **504** advances to the next request **1060** and continues processing at operation **1011**.

**[0272]** At decision operation **1017**, the processing module **504** may identify whether more sessions **1058** are in the request information **1010** associated with the received request **1060**. If more sessions **1058** are in the request information **1010** then processing continues at operation **1019**. Otherwise, processing continues at decision operation **1023**. At operation **1019**, the processing module **504** may advance to the next session **1058** and continue processing at operation **1009**.

**[0273]** At decision operation **1023**, the processing module **504** may identify whether more features elements **1072** are present in the feature element information **1070**. If more features elements **1072** are present in the feature element information **1070** then processing continues at operation **1025**. Otherwise, processing continues at operation **1027**. At operation **1025**, the processing module **504** may advance to the next feature element **1072** and continue processing at operation **1007**.

**[0274]** At operation **1027**, the processing module **504** may generate interface information based on the initialization information **1008** in the context **1002**, the received request **1060** and all features (e.g., participant feature). For example, the processing module **504** may generate interface information to open, close, or augment any of the aforementioned panels including a context panel, the shopping cart panel **1032**, the metadata panel **1034**, the search panel **1038**, the dialogue panel **1044** and the participant panel **1046**. Further for example, the processing module **504** may generate interface information to add, remove, or augment user interface elements for participant information **1016**, metadata information **1018**, the online collaborative workarea **1037**, the search information **1020** the tool information **1022**, the dialogue information **1024**, the shopping cart information **1026** the context information **1028**, advertising information **1033** and promotional information **1035**. Further for example, the processing module **504** may utilize service level information **318** and other information in the part description information **304** of vehicle information **300** in the garage information **706** of the user for smart components **102** that match or fuzzy match the initialization information **1008** in the context **1002** and update the context panel **1030** display "SMART COMPONENT WEAR: 90%" based on the identified match.

**[0275]** At operation **1029**, the processing module **504** may generate the user interface **1012** based on the interface information that was generated in operations **1011** and **1027** and communicate the user interface **1012** over the network **116** to the mobile device **112** or the client machine **120** that originated the request **1060**. In another example, the processing module **504** may communicate the interface information over the network **116** to update the user interface **1012** or a portion of the user interface **1012** that is being displayed on mobile device **112** or the client machine **120**.

**[0276]** At operation **1031**, the processing module **504** may store the interface information that was generated in operations **1011** and **1027** in the response information **1066** for the received request **1060**.

**[0277]** FIG. **11** illustrates network architecture **1100**, according to an embodiment. A networked system **1102**, in an example form of a network-server-side functionality, is coupled via a communication network **1104** (e.g., the Internet, wireless network, cellular network, or a Wide Area Network (WAN)) to one or more client devices **1110** and **1112**. The networked system **1102** corresponds to the system **100** in FIG. **1**, the network-based marketplace **118** in FIG. **5**, the system **800** in FIG. **8**A, the system **900** in FIG. **9**A, and the system **1000** in FIG. **10**A, accordingly, the same or similar references have been used to indicate the same or similar features unless otherwise indicated. FIG. **11** illustrates, for example, a web client **1106** operating via a browser (e.g., such as the INTERNET EXPLORERS browser developed by Microsoft's Corporation of Redmond, Wash. State), and a programmatic client **1108** executing on respective client devices **1110** and **1112**.

**[0278]** The network architecture **1100** may be utilized to execute any of the methods described in this document. The client devices **1110** and **1112** may comprise a mobile phone, desktop computer, laptop, or any other communication device that a user may utilize to access the networked system **1102**. In some embodiments, the client device **1110** may comprise a display module (not shown) to display information (e.g., in the form of user interfaces). In further embodiments, the client device **1110** may comprise one or more of a touch screen, accelerometer, camera, microphone, and GPS device. The client devices **1110** and **1112** may be a device of a user that is used to perform a transaction involving digital goods within the networked system **1102**. In one embodiment, the networked system **1102** is a network-based marketplace that manages digital goods, publishes publications comprising item listings of products available on the network-based marketplace, and manages payments for these marketplace transactions. Additionally, external sites **1128**, **1128'** may be sites coupled to networked system **1102** via network **1104**. External sites may be any desired system, including ecommerce systems.

**[0279]** An Application Program Interface (API) server **1114** and a web server **1116** are coupled to, and provide programmatic and web interfaces respectively to, one or more application servers **1118**. The application server(s) **1118** host a publication system **1200** and a payment system **1122**, each of which may comprise one or more modules, applications, or engines, and each of which may be embodied as hardware, software, firmware, or any combination thereof. The application servers **1118** are, in turn, coupled to one or more database servers **1124** facilitating access to one or more information storage repositories or database(s) **1126**. In one embodiment, the databases **1126** are storage devices that store information to be posted (e.g., publications or listings) to the publication system **1200**. The databases **1126** may also store digital goods information in accordance with example embodiments.

**[0280]** In example embodiments, the publication system **1200** publishes content on a network (e.g., Internet). As such, the publication system **1200** provides a number of publication and marketplace functions and services to users that access the networked system **1102**. The publication system **1200** is discussed in more detail in connection with FIG. **12**. In example embodiments, the publication system **1200** is discussed in terms of an online marketplace environment. However, it is noted that the publication system **1200** may be associated with a non-marketplace environment such as an informational (e.g., search engine) or social networking environment.

**[0281]** The payment system **1122** provides a number of payment services and functions to users. The payment system **1122** allows users to accumulate value (e.g., in a commercial currency, such as the U.S. dollar, or a proprietary currency, such as points, miles, or other forms of currency provide by a private entity) in their accounts, and then later to redeem the accumulated value for products (e.g., goods or services) that are made available via the publication system **1200** or elsewhere on the network **1104**. The payment system **1122** also facilitates payments from a payment mechanism (e.g., a bank account, PayPal, or credit card) for purchases of items via any type and form of a network-based marketplace.

**[0282]** While the publication system **1200** and the payment system **1122** are shown in FIG. **11** to both form part of the networked system **1102**, it will be appreciated that, in alternative embodiments, the payment system **1122** may form part

of a payment service that is separate and distinct from the networked system **1102**. Additionally, while the example network architecture **1100** of FIG. **11** employs a client-server architecture, a skilled artisan will recognize that the present disclosure is not limited to such an architecture. The example network architecture **1100** can equally well find application in, for example, a distributed or peer-to-peer architecture system. The publication system **1200** and payment system **1122** may also be implemented as standalone systems or standalone software programs operating under separate hardware platforms, which do not necessarily have networking capabilities.

**[0283]** Referring now to FIG. **12**, an example block diagram illustrating multiple components that, in one embodiment, are provided within the publication system **1200** of the networked system **1102** is shown. In this embodiment, the publication system **1200** is a marketplace system where items (e.g., goods or services) may be offered for sale and that further implements the features described herein for interactive query generation and refinement. The items may comprise digital goods (e.g., currency, license rights). The publication system **1200** may be hosted on dedicated or shared server machines (not shown) that are communicatively coupled to enable communications between the server machines. The multiple components themselves are communicatively coupled (e.g., via appropriate interfaces), either directly or indirectly, to each other and to various data sources, to allow information to be passed between the components or to allow the components to share and access common data. Furthermore, the components may access the one or more databases **1126** via the one or more database servers **1124**, as shown in FIG. **11**.

**[0284]** Returning to FIG. **12**, the publication system **1200** provides a number of publishing, listing, and price-setting mechanisms whereby a buyer may list (or publish information concerning) goods or services for sale, a buyer can express interest in or indicate a desire to purchase such goods or services, and a price can be set for a transaction pertaining to the goods or services. To this end, the publication system **1200** may comprise at least one publication engine **1202** and one or more auction engines **1204** that support auction-format listing and price setting mechanisms (e.g., English, Dutch, Chinese, Double, Reverse auctions, etc.).

**[0285]** A pricing engine **1206** supports various price listing formats. One such format is a fixed-price listing format (e.g., the traditional classified advertisement-type listing or a catalog listing). Another format comprises a buyout-type listing. Buyout-type listings (e.g., the Buy-It-Now (BIN) technology developed by eBay Inc., of San Jose, Calif.) may be offered in conjunction with auction-format listings and allow a buyer to purchase goods or services, which are also being offered for sale via an auction, for a fixed price that is typically higher than a starting price of an auction for an item.

**[0286]** A store engine **1208** allows a buyer to group listings within a "virtual" store, which may be branded and otherwise personalized by and for the buyer. Such a virtual store may also offer promotions, incentives, and features that are specific and personalized to the buyer. In one example, the buyer may offer a plurality of items as Buy-It-Now items in the virtual store, offer a plurality of items for auction, or a combination of both.

**[0287]** A reputation engine **1210** allows users that transact, utilizing the networked system **1102**, to establish, build, and maintain reputations. These reputations may be made available and published to potential trading partners. Because the publication system **1200** supports person-to-person trading between unknown entities, in accordance with one embodiment, users may otherwise have no history or other reference information whereby the trustworthiness and credibility of potential trading partners may be assessed. The reputation engine **1210** allows a user, for example through feedback provided by one or more other transaction partners, to establish a reputation within the network-based marketplace over time. Other potential trading partners may then reference the reputation for purposes of assessing credibility and trustworthiness.

**[0288]** Navigation of the network-based marketplace may be facilitated by a navigation engine **1212**. For example, a browse module (not shown) of the navigation engine **1212** allows users to browse various category, catalog, or inventory data structures according to which listings may be classified within the publication system **1200**. Various other navigation applications within the navigation engine **1212** may be provided to supplement the browsing applications.

**[0289]** In order to make listings available via the networked system **1102** as visually informing and attractive as possible, the publication system **1200** may include an imaging engine **1214** that enables users to upload images for inclusion within publications and to incorporate images within viewed listings. The imaging engine **1214** may also receive image data from a user as a search query and utilize the image data to identify an item depicted or described by the image data.

**[0290]** A listing creation engine **1216** allows users (e.g., buyers) to conveniently author listings of items. In one embodiment, the listings pertain to goods or services that a user (e.g., a buyer) wishes to transact via the publication system **1200**. In other embodiments, a user may create a listing that is an advertisement or other form of publication.

**[0291]** A listing management engine **1218** allows the users to manage such listings. Specifically, where a particular user has authored or published a large number of listings, the management of such listings may present a challenge. The listing management engine **1218** provides a number of features (e.g., auto-relisting, inventory level monitors, etc.) to assist the user in managing such listings.

**[0292]** A post-listing management engine **1220** also assists users with a number of activities that typically occur post-listing. For example, upon completion of a transaction facilitated by the one or more auction engines **1204**, a buyer may wish to leave feedback regarding a particular seller. To this end, the post-listing management engine **1220** provides an interface to the reputation engine **1210** allowing the buyer to conveniently provide feedback regarding multiple sellers to the reputation engine **1210**. Another post-listing action may be shipping of sold items whereby the post-listing management engine **1220** may assist in printing shipping labels, estimating shipping costs, and suggesting shipping carriers.

**[0293]** A search engine **1222** performs searches for publications in the networked system **1102** that match a query. In example embodiments, the search engine **1222** comprises a search module (not shown) that enables keyword searches of publications published via the publication system **1200**. Further, for example, the search engine **1222** may perform the functions previously described in reference to the search engine **121**. In a further embodiment, the search engine **1222** may take an image received by the imaging engine **1214** as an input for conducting a search. The search engine **1222** takes the query input and determines a plurality of matches from the

networked system **1102** (e.g., publications stored in the database **1126**). It is noted that the functions of the search engine **1222** may be combined with the navigation engine **1212**. The search engine **1222**, in the publication system **1200**, may perform the functionality previously described with respect to the search engine **121**.

**[0294]** A user activity detection engine **1224** in FIG. **12** may monitor user activity during user sessions and detect a change in the level of user activity that, as discussed in more detail below, may predict that a user is about to make a purchase. The exact amount of change in the level of user activity may vary. A general guideline may be to monitor across multiple sessions and detect any significant increase over time (for example the activity level doubling or tripling in a short span). In one embodiment, when the user activity detection engine **1224** detects such a condition, the ecommerce system may make an intervention to provide content for display to the user in an effort to improve the probability that the user will make a purchase, and/or also to motive the user to make the purchase on the ecommerce system site instead of moving to a competitor site in search of a better purchase. Stated another way, activity over time and at different times before a purchase action provides an opportunity to personalize marketing to a user, based on time, by intervention as discussed above. Additional examples of including a temporal frame in that marketing personalization are discussed below. The publication system **1200** may further include the smart component modules **500**, as previously described.

**[0295]** Although the various components of the publication system **1200** have been defined in terms of a variety of individual modules and engines, a skilled artisan will recognize that many of the items can be combined or organized in other ways and that not all modules or engines need to be present or implemented in accordance with example embodiments. Furthermore, not all components of the publication system **1200** have been included in FIG. **12**. In general, components, protocols, structures, and techniques not directly related to functions of exemplary embodiments (e.g., dispute resolution engine, loyalty promotion engine, personalization engines) have not been shown or discussed in detail. The description given herein simply provides a variety of exemplary embodiments to aid the reader in an understanding of the systems and methods used herein.

Data Structures

**[0296]** FIG. **13** is a high-level entity-relationship diagram, illustrating various tables **1250** that may be maintained within the databases **1126** of FIG. **11**, and that are utilized by and support the publication system **1200** and payment system **1122**, both of FIG. **11**. A user table **1252** may contain a record for each of the registered users of the networked system **1102**. A user may operate as a seller, a buyer, or both, within the network-based marketplace. In one example embodiment, a buyer may be a user that has accumulated value (e.g., commercial or proprietary currency), and is accordingly able to exchange the accumulated value for items that are offered for sale by the network-based marketplace.

**[0297]** The tables **1250** may also include an items table **1254** (e.g., items table **506**) in which item records (e.g., listings) are maintained for goods and services (e.g., items) that are available to be, or have been, transacted via the network-based marketplace. Item records (e.g., listings) within the items table **1254** may furthermore be linked to one or more user records within the user table **1252**, so as to associate a seller and one or more actual or potential buyers with an item record (e.g., listing).

**[0298]** A transaction table **1256** may contain a record for each transaction (e.g., a purchase or sale transaction or auction) pertaining to items for which records exist within the items table **1254**.

**[0299]** An order table **1258** may be populated with order records, with each order record being associated with an order. Each order, in turn, may be associated with one or more transactions for which records exist within the transaction table **1256**.

Bid records within a bids table **1260** may relate to a bid received at the network-based marketplace **118** in connection with an auction-format listing supported by the auction engine(s) **1204** of FIG. **12**. A feedback table **1262** may be utilized by one or more reputation engines **1210** of FIG. **12**, in one example embodiment, to construct and maintain reputation information concerning users in the form of a feedback score. A history table **1264** may maintain a history of transactions to which a user has been a party. One or more attributes tables **1266** may record attribute information that pertains to items for which records exist within the items table **1254**. Considering only a single example of such an attribute, the attributes tables **1266** may indicate a currency attribute associated with a particular item, with the currency attribute identifying the currency of a price for the relevant item as specified by a seller. Another example of an attribute may include 'fitment' (compatibility) information, which facilitates an identification of compatibility of a part **106** relative to other parts **106** described in other listings, smart component information and characterization, and garage vehicle metadata.

**[0300]** A search table **1268** may store search information that has been entered by a user (e.g., a buyer) who is looking for a specific type of listing. The tables **1250** may include the OEM tracking information **510**, the maintenance information **512**, and the smart component processing information **514**, as previously described.

Machine

**[0301]** FIG. **15** is a block diagram illustrating components of a machine **1300**, according to some example embodiments, able to read instructions **1324** from a machine-readable medium **1322** (e.g., a non-transitory machine-readable medium, a machine-readable storage medium, a computer-readable storage medium, or any suitable combination thereof) and perform any one or more of the methodologies discussed herein, in whole or in part. Specifically, FIG. **15** shows the machine **1300** in the example form of a computer system (e.g., a computer) within which the instructions **1324** (e.g., software, a program, an application, an applet, an app, or other executable code) for causing the machine **1300** to perform any one or more of the methodologies discussed herein may be executed, in whole or in part. In alternative embodiments, the machine **1300** operates as a standalone device or may be connected (e.g., networked) to other machines. In a networked deployment, the machine **1300** may operate in the capacity of a server machine or a client machine in a server-client network environment, or as a peer machine in a distributed (e.g., peer-to-peer) network environment. The machine **1300** may be a server computer, a client computer, a personal computer (PC), a tablet computer, a laptop computer, a netbook, a cellular telephone, a smartphone, a set-top

box (STB), a personal digital assistant (PDA), a web appliance, a network router, a network switch, a network bridge, an engine control unit, integrated vehicle entertainment and information system (e.g., in-dash navigation+information+radio controller), or any machine capable of executing the instructions **1324**, sequentially or otherwise, that specify actions to be taken by that machine. Further, while only a single machine is illustrated, the term "machine" shall also be taken to include any collection of machines that individually or jointly execute the instructions **1324** to perform all or part of any one or more of the methodologies discussed herein.

**[0302]** The machine **1300** includes a processor **1302** (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), an application specific integrated circuit (ASIC), a radio-frequency integrated circuit (RFIC), or any suitable combination thereof), a main memory **1304**, and a static memory **1306**, which are configured to communicate with each other via a bus **1308**. The processor **1302** may contain microcircuits that are configurable, temporarily or permanently, by some or all of the instructions **1324** such that the processor **1302** is configurable to perform any one or more of the methodologies described herein, in whole or in part. For example, a set of one or more microcircuits of the processor **1302** may be configurable to execute one or more modules (e.g., software modules) described herein.

**[0303]** The machine **1300** may further include a graphics display **1310** (e.g., a plasma display panel (PDP), a light emitting diode (LED) display, a liquid crystal display (LCD), a projector, a cathode ray tube (CRT), or any other display capable of displaying graphics or video). The machine **1300** may also include an alphanumeric input device **1312** (e.g., a keyboard or keypad), a cursor control device **1314** (e.g., a mouse, a touchpad, a trackball, a joystick, a motion sensor, an eye tracking device, or other pointing instrument), a storage unit **1316**, an audio generation device **1318** (e.g., a sound card, an amplifier, a speaker, a headphone jack, or any suitable combination thereof), and a network interface device **1320**.

**[0304]** The storage unit **1316** includes the machine-readable medium **1322** (e.g., a tangible and non-transitory machine-readable storage medium) on which are stored the instructions **1324** embodying any one or more of the methodologies or functions described herein. The instructions **1324** may also reside, completely or at least partially, within the main memory **1304**, within the processor **1302** (e.g., within the processor's cache memory), or both, before or during execution thereof by the machine **1300**. Accordingly, the main memory **1304** and the processor **1302** may be considered machine-readable media (e.g., tangible and non-transitory machine-readable media). The instructions **1324** may be transmitted or received over the network **1390** via the network interface device **1320**. For example, the network interface device **1320** may communicate the instructions **1324** using any one or more transfer protocols (e.g., hypertext transfer protocol (HTTP)).

**[0305]** In some example embodiments, the machine **1300** may be a portable computing device, such as a smart phone, tablet computer, or wearable device (e.g., Google Glass), and have one or more additional input components **1330** (e.g., sensors or gauges). Examples of such input components **1330** include an image input component (e.g., one or more cameras), an audio input component (e.g., a microphone), a direction input component (e.g., a compass), a location input component (e.g., a global positioning system (GPS) receiver), an orientation component (e.g., a gyroscope), a motion detection component (e.g., one or more accelerometers), an altitude detection component (e.g., an altimeter), and a gas detection component (e.g., a gas sensor). Inputs harvested by any one or more of these input components **1330** may be accessible and available for use by any of the modules described herein.

**[0306]** As used herein, the term "memory" refers to a machine-readable medium able to store data temporarily or permanently and may be taken to include, but not be limited to, random-access memory (RAM), read-only memory (ROM), buffer memory, flash memory, and cache memory. While the machine-readable medium **1322** is shown in an example embodiment to be a single medium, the term "machine-readable medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, or associated caches and servers) able to store instructions **1324**. The term "machine-readable medium" shall also be taken to include any medium, or combination of multiple media, that is capable of storing the instructions **1324** for execution by the machine **1300**, such that the instructions **1324**, when executed by one or more processors of the machine **1300** (e.g., processor **1302**), cause the machine **1300** to perform any one or more of the methodologies described herein, in whole or in part. Accordingly, a "machine-readable medium" refers to a single storage apparatus or device, as well as cloud-based storage systems or storage networks that include multiple storage apparatus or devices. The term "machine-readable medium" shall accordingly be taken to include, but not be limited to, one or more tangible (e.g., non-transitory) data repositories in the form of a solid-state memory, an optical medium, a magnetic medium, or any suitable combination thereof.

**[0307]** Furthermore, the machine-readable medium is non-transitory in that it does not embody a propagating signal. However, labeling the tangible machine-readable medium as "non-transitory" should not be construed to mean that the medium is incapable of movement—the medium should be considered as being transportable from one physical location to another. Additionally, since the machine-readable medium is tangible, the medium may be considered to be a machine-readable device.

**[0308]** Throughout this specification, plural instances may implement components, operations, or structures described as a single instance. Although individual operations of one or more methods are illustrated and described as separate operations, one or more of the individual operations may be performed concurrently, and nothing requires that the operations be performed in the order illustrated. Structures and functionality presented as separate components in example configurations may be implemented as a combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements fall within the scope of the subject matter herein.

**[0309]** Certain embodiments are described herein as including logic or a number of components, modules, or mechanisms. Modules may constitute software modules (e.g., code stored or otherwise embodied on a machine-readable medium or in a transmission medium), hardware modules, or any suitable combination thereof. A "hardware module" is a tangible (e.g., non-transitory) unit capable of performing certain operations and may be configured or arranged in a certain physical manner. In various example

embodiments, one or more computer systems (e.g., a standalone computer system, a client computer system, or a server computer system) or one or more hardware modules of a computer system (e.g., a processor or a group of processors) may be configured by software (e.g., an application or application portion) as a hardware module that operates to perform certain operations as described herein.

**[0310]** In some embodiments, a hardware module may be implemented mechanically, electronically, or any suitable combination thereof. For example, a hardware module may include dedicated circuitry or logic that is permanently configured to perform certain operations. For example, a hardware module may be a special-purpose processor, such as a field programmable gate array (FPGA) or an ASIC. A hardware module may also include programmable logic or circuitry that is temporarily configured by software to perform certain operations. For example, a hardware module may include software encompassed within a general-purpose processor or other programmable processor. It will be appreciated that the decision to implement a hardware module mechanically, in dedicated and permanently configured circuitry, or in temporarily configured circuitry (e.g., configured by software) may be driven by cost and time considerations.

**[0311]** Accordingly, the phrase "hardware module" should be understood to encompass a tangible entity, and such a tangible entity may be physically constructed, permanently configured (e.g., hardwired), or temporarily configured (e.g., programmed) to operate in a certain manner or to perform certain operations described herein. As used herein, "hardware-implemented module" refers to a hardware module. Considering embodiments in which hardware modules are temporarily configured (e.g., programmed), each of the hardware modules need not be configured or instantiated at any one instance in time. For example, where a hardware module comprises a general-purpose processor configured by software to become a special-purpose processor, the general-purpose processor may be configured as respectively different special-purpose processors (e.g., comprising different hardware modules) at different times. Software (e.g., a software module) may accordingly configure one or more processors, for example, to constitute a particular hardware module at one instance of time and to constitute a different hardware module at a different instance of time.

**[0312]** Hardware modules can provide information to, and receive information from, other hardware modules. Accordingly, the described hardware modules may be regarded as being communicatively coupled. Where multiple hardware modules exist contemporaneously, communications may be achieved through signal transmission (e.g., over appropriate circuits and buses) between or among two or more of the hardware modules. In embodiments in which multiple hardware modules are configured or instantiated at different times, communications between such hardware modules may be achieved, for example, through the storage and retrieval of information in memory structures to which the multiple hardware modules have access. For example, one hardware module may perform an operation and store the output of that operation in a memory device to which it is communicatively coupled. A further hardware module may then, at a later time, access the memory device to retrieve and process the stored output. Hardware modules may also initiate communications with input or output devices, and can operate on a resource (e.g., a collection of information).

**[0313]** The various operations of example methods described herein may be performed, at least partially, by one or more processors that are temporarily configured (e.g., by software) or permanently configured to perform the relevant operations. Whether temporarily or permanently configured, such processors may constitute processor-implemented modules that operate to perform one or more operations or functions described herein. As used herein, "processor-implemented module" refers to a hardware module implemented using one or more processors.

**[0314]** Similarly, the methods described herein may be at least partially processor-implemented, a processor being an example of hardware. For example, at least some of the operations of a method may be performed by one or more processors or processor-implemented modules. As used herein, "processor-implemented module" refers to a hardware module in which the hardware includes one or more processors. Moreover, the one or more processors may also operate to support performance of the relevant operations in a "cloud computing" environment or as a "software as a service" (SaaS). For example, at least some of the operations may be performed by a group of computers (as examples of machines including processors), with these operations being accessible via a network (e.g., the Internet) and via one or more appropriate interfaces (e.g., an application program interface (API)).

**[0315]** The performance of certain operations may be distributed among the one or more processors, not only residing within a single machine, but deployed across a number of machines. In some example embodiments, the one or more processors or processor-implemented modules may be located in a single geographic location (e.g., within a home environment, an office environment, or a server farm). In other example embodiments, the one or more processors or processor-implemented modules may be distributed across a number of geographic locations.

**[0316]** Some portions of the subject matter discussed herein may be presented in terms of algorithms or symbolic representations of operations on data stored as bits or binary digital signals within a machine memory (e.g., a computer memory). Such algorithms or symbolic representations are examples of techniques used by those of ordinary skill in the data processing arts to convey the substance of their work to others skilled in the art. As used herein, an "algorithm" is a self-consistent sequence of operations or similar processing leading to a desired result. In this context, algorithms and operations involve physical manipulation of physical quantities. Typically, but not necessarily, such quantities may take the form of electrical, magnetic, or optical signals capable of being stored, accessed, transferred, combined, compared, or otherwise manipulated by a machine. It is convenient at times, principally for reasons of common usage, to refer to such signals using words such as "data," "content," "bits," "values." "elements," "symbols," "characters." "terms," "numbers," "numerals," or the like. These words, however, are merely convenient labels and are to be associated with appropriate physical quantities.

**[0317]** Unless specifically stated otherwise, discussions herein using words such as "processing," "computing," "calculating," "determining," "presenting," "displaying," or the like may refer to actions or processes of a machine (e.g., a computer) that manipulates or transforms data represented as physical (e.g., electronic, magnetic, or optical) quantities within one or more memories (e.g., volatile memory, non-

volatile memory, or any suitable combination thereof), registers, or other machine components that receive, store, transmit, or display information. Furthermore, unless specifically stated otherwise, the terms "a" or "an" are herein used, as is common in patent documents, to include one or more than one instance. Finally, as used herein, the conjunction "or" refers to a non-exclusive "or," unless specifically stated otherwise.

We claim:

**1**. A system comprising:

a receiving module, implemented using one or more processors, configured to receive a maintenance message, over a network, from a mobile device, the maintenance message is received by a network-based marketplace and is associated with a first user, the maintenance message further including part log information including a timestamp and characterization information, the characterization information is received by the mobile device from a component in a vehicle, the component including a sensor that senses a first part that is assembled into the vehicle, the component to generate the characterization information based on a sense of the first part, as sensed by the sensor, and to communicate the characterization information to the mobile device;

a processing module, implemented using one or more processors, configured to identify user profile information, at the network-based marketplace, based on the maintenance message, the user profile information being associated with the first user on the network-based marketplace and the mobile device, the processing module configured to store the part log information in the user profile information at the network-based marketplace, the processing module configured to compare the part log information that corresponds to the first part in the user profile information, at the network based marketplace, with corresponding part maintenance information to generate a service level for the first part; and

a smart component engine, implemented using one or more processors, configured to receive a triggering event, at the network-based marketplace, the triggering event being associated with the first user, the smart component engine configured to process the triggering event responsive to receipt of the triggering event, the smart component engine configured to process the triggering event to initiate an electronic commerce activity based on the service level for the first part.

**2**. The method of claim **1**, wherein the processing module is configured to identify whether a derivative of the part log information, with respect to time, exceeds a threshold.

**3**. The system of claim **2**, wherein the threshold is dynamically calculated.

**4**. The system of claim **2**, wherein the threshold is predetermined.

**5**. The system of claim **1**, wherein the characterization information includes a percentage of wear of the first part and wherein the processing module is configured to identify whether an aggregate of the percentage of wear of the first part is greater than a predetermined threshold.

**6**. The system of claim **1**, wherein the processing module is configured to identify a second part on the vehicle and to register the second part in the user profile information, wherein the second part was manufactured to include a sensor.

**7**. The system of claim **6**, wherein the sensor on the second part operates to sense an elasticity of the second part, and wherein the second part is an engine belt.

**8**. The system of claim **1**, wherein the processing module is configured to authenticate the second part as authentic part based on original equipment manufacturer tracking information.

**9**. The system of claim **1**, wherein the maintenance message includes vehicle identification information that identifies a make and model of the vehicle and wherein the processing of the triggering event includes processing a particular subsystem that is identified based on the first part being identified as requiring a replacement in the vehicle.

**10**. A method comprising:

receiving a maintenance message, over a network, from a mobile device, the maintenance message being received by a network-based marketplace, the maintenance message being associated with a first user and including part log information including a timestamp and characterization information, the characterization information is received by the mobile device from a component in a vehicle, the component including a sensor that senses a first part that is assembled into the vehicle, the component to generate the characterization information based on a sense of the first part, as sensed by the sensor, and to communicate the characterization information to the mobile device;

identifying user profile information, at the network-based marketplace, based on the maintenance message, the user profile information being associated with the first user on the network-based marketplace and the mobile device;

storing the part log information in the user profile information at the network-based marketplace;

comparing the part log information corresponding to the first part in the user profile information, at the network-based marketplace, with corresponding part maintenance information to generate a service level for the first part;

receiving a triggering event, at the network-based marketplace, the triggering event being associated with the first user; and

processing the triggering event responsive to receiving the triggering event, the processing including initiating an electronic commerce activity based on the service level for the first part.

**11**. The method of claim **10**, wherein the comparing the part log information corresponding to the first part in the user profile information with corresponding part maintenance information includes identifying whether a derivative of the part log information, with respect to time, exceeds a threshold.

**12**. The method of claim **11**, wherein the threshold is dynamically calculated.

**13**. The method of claim **11**, wherein the threshold is predetermined.

**14**. The method of claim **10**, wherein the characterization information includes a percentage of wear of the first part and wherein the comparing the part log information corresponding to the first part in the user profile information with corresponding part maintenance information includes identifying whether an aggregate of the percentage of wear of the first part is greater than a predetermined threshold.

**15**. The method of claim **10**, further comprising identifying whether a second part is installed on the vehicle, and registering the second part in the user profile information, wherein the second part was manufactured to include a sensor.

**16**. The method of claim **15**, wherein the sensor of the second part operates to sense an elasticity of the second part and wherein the second part is an engine belt.

**17**. The method of claim **15**, further comprising authenticating the second part as an authentic part based on original equipment manufacturer tracking information.

**18**. The method of claim **10**, wherein the maintenance message includes vehicle identification information that identifies a make and model of the vehicle and wherein the processing of the triggering event includes processing a particular subsystem that is identified based on the first part being identified as requiring a replacement in the vehicle.

**19**. A machine-readable hardware storage device having no transitory signals storing a set of instructions that, when executed by a processor of a machine, cause the machine to perform operations comprising:

receiving a maintenance message, over a network, from a mobile device, the maintenance message being received by a network-based marketplace, the maintenance message being associated with a first user and including part log information including a timestamp and characterization information, the characterization information is received by the mobile device from a component in a vehicle, the component including a sensor that senses a first part that is assembled into the vehicle, the component to generate the characterization information based on a sense of the first part, as sensed by the sensor, and to communicate the characterization information to the mobile device;

identifying user profile information, at the network-based marketplace, based on the maintenance message, the user profile information being associated with the first user on the network-based marketplace and the mobile device;

storing the part log information in the user profile information at the network-based marketplace;

comparing the part log information corresponding to the first part in the user profile information, at the network-based marketplace, with corresponding part maintenance information to generate a service level for the first part;

receiving a triggering event, at the network-based marketplace, the triggering event being associated with the first user; and

processing the triggering event responsive to receiving the triggering event, the processing including initiating an electronic commerce activity based on the service level for the first part.

**20**. The machine-readable hardware storage device of claim **19**, wherein the comparing the part log information corresponding to the first part in the user profile information with corresponding part maintenance information includes identifying

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