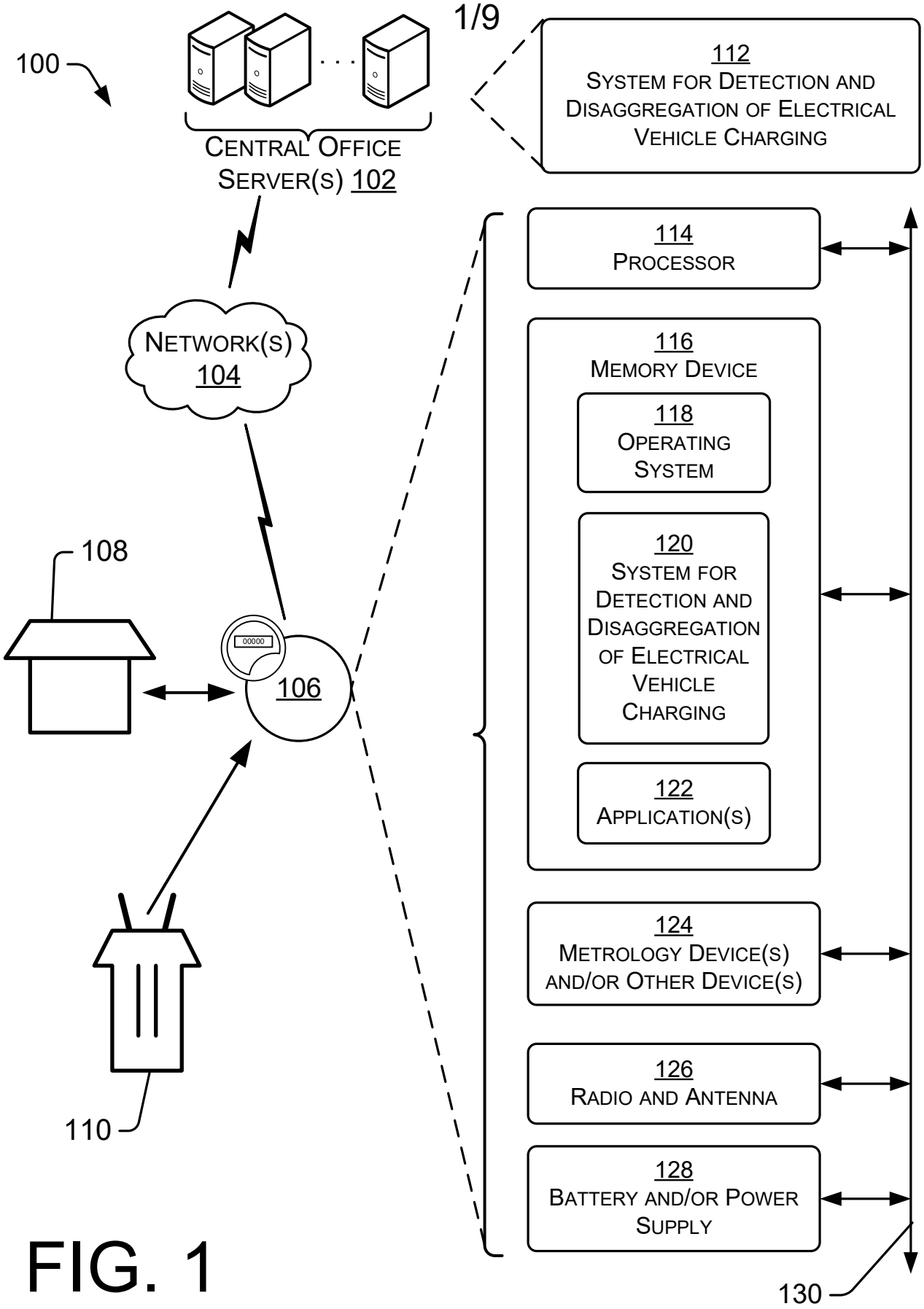
100
CENTRAL OFFICE SERVER(S) 102
112
SYSTEM FOR DETECTION AND DISAGGREGATION OF ELECTRICAL VEHICLE CHARGING
NETWORK(S) 104
108
106
110
114
PROCESSOR
116
MEMORY DEVICE
118
OPERATING SYSTEM
120
SYSTEM FOR DETECTION AND DISAGGREGATION OF ELECTRICAL VEHICLE CHARGING
122
APPLICATION(S)
124
METROLOGY DEVICE(S) AND/OR OTHER DEVICE(S)
126
RADIO AND ANTENNA
128
BATTERY AND/OR POWER SUPPLY
130

FIG. 1

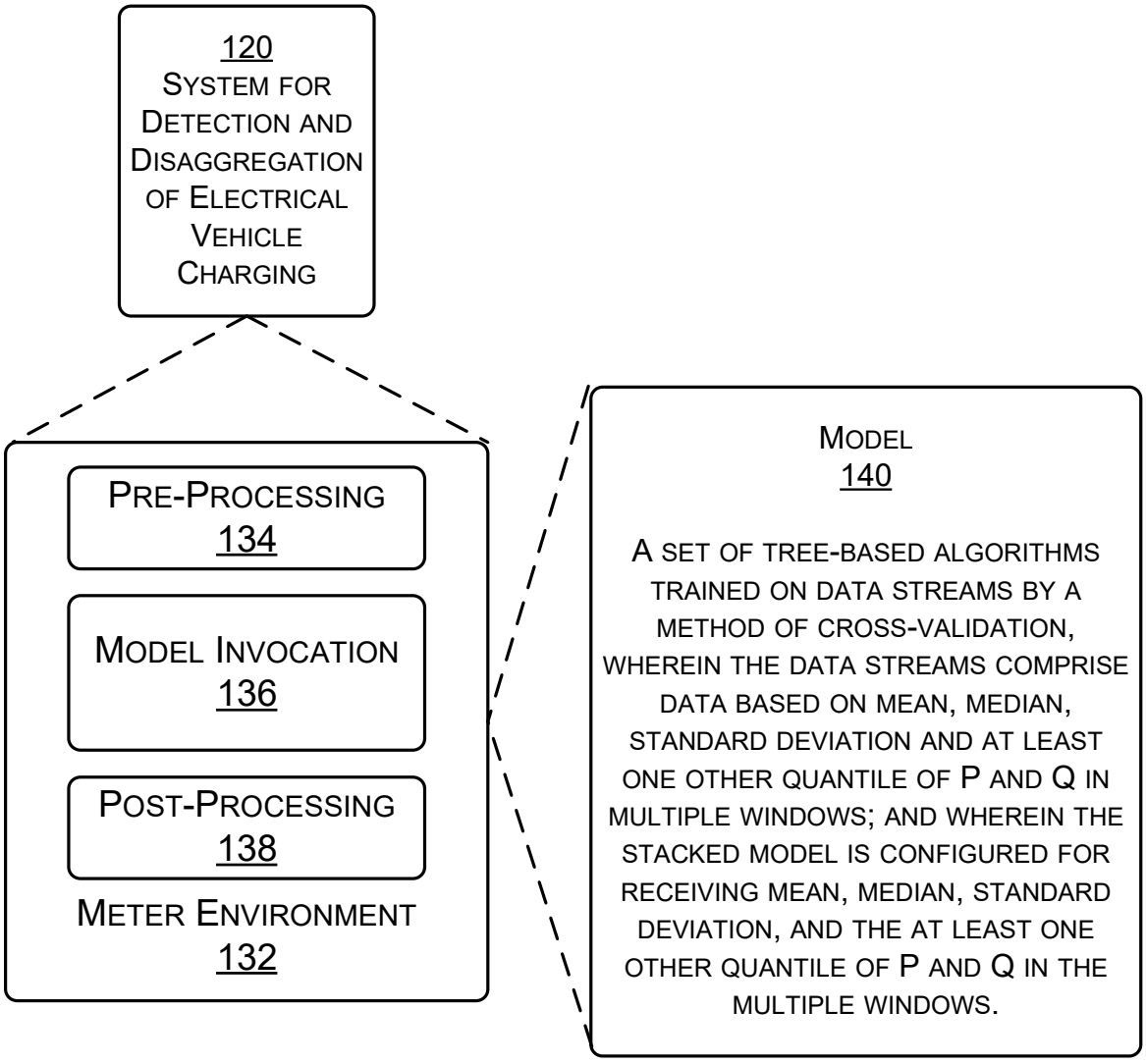
120
System for Detection and Disaggregation of Electrical Vehicle Charging
Pre-Processing
134
Model Invocation
136
Post-Processing
138
Meter Environment
132
Model
140
A set of tree-based algorithms trained on data streams by a method of cross-validation, wherein the data streams comprise data based on mean, median, standard deviation and at least one other quantile of P and Q in multiple windows; and wherein the stacked model is configured for receiving mean, median, standard deviation, and the at least one other quantile of P and Q in the multiple windows.

FIG. 1A

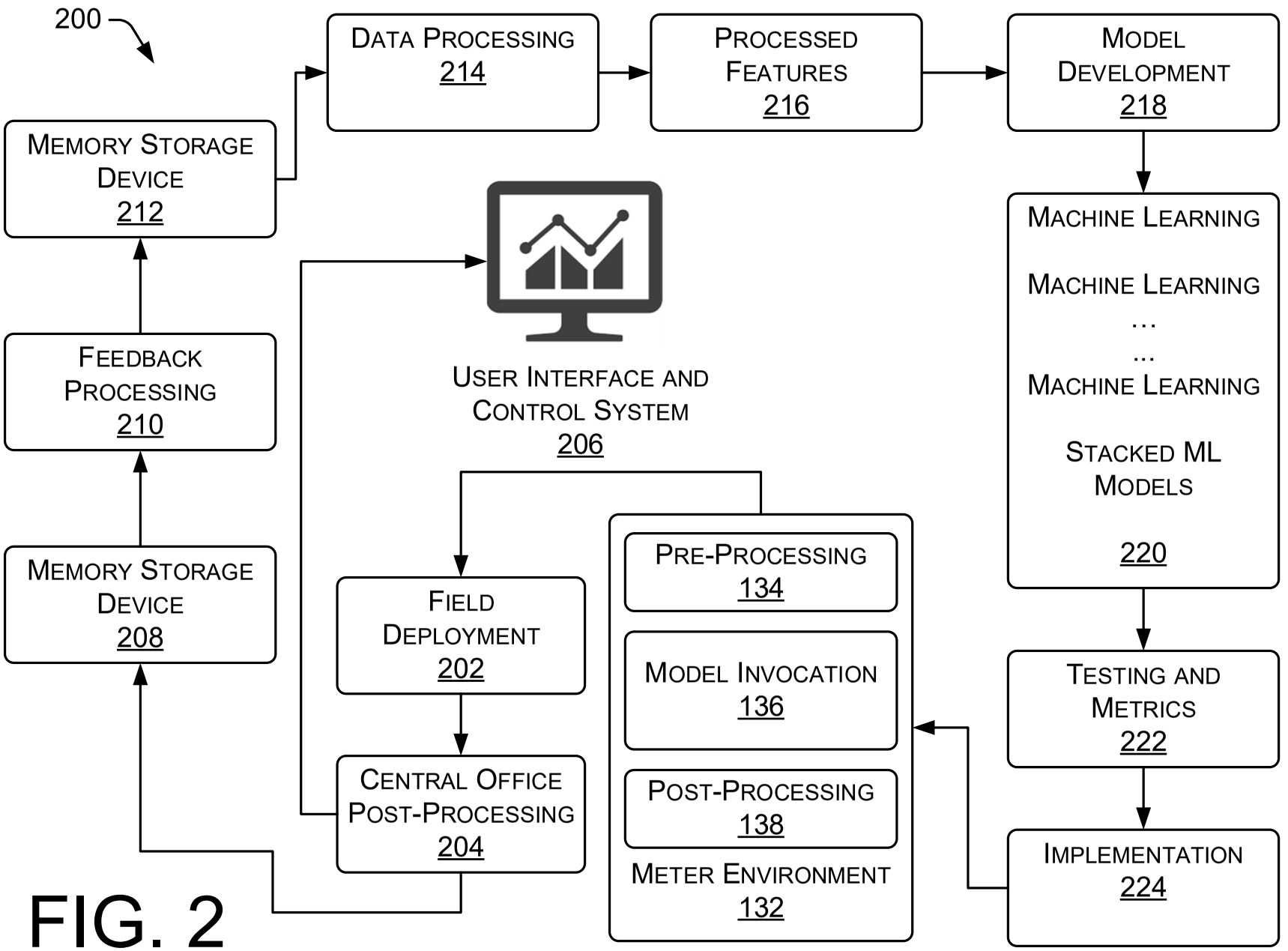
200
Data Processing
214
Processed
Features
216
Model
Development
218
Memory Storage
Device
212
Machine Learning
Machine Learning
...
...
Machine Learning
Stacked ML
Models
220
Feedback
Processing
210
User Interface and
Control System
206
Memory Storage
Device
208
Field
Deployment
202
Pre-Processing
134
Model Invocation
136
Post-Processing
138
Meter Environment
132
Testing and
Metrics
222
Central Office
Post-Processing
204
Implementation
224

FIG. 2

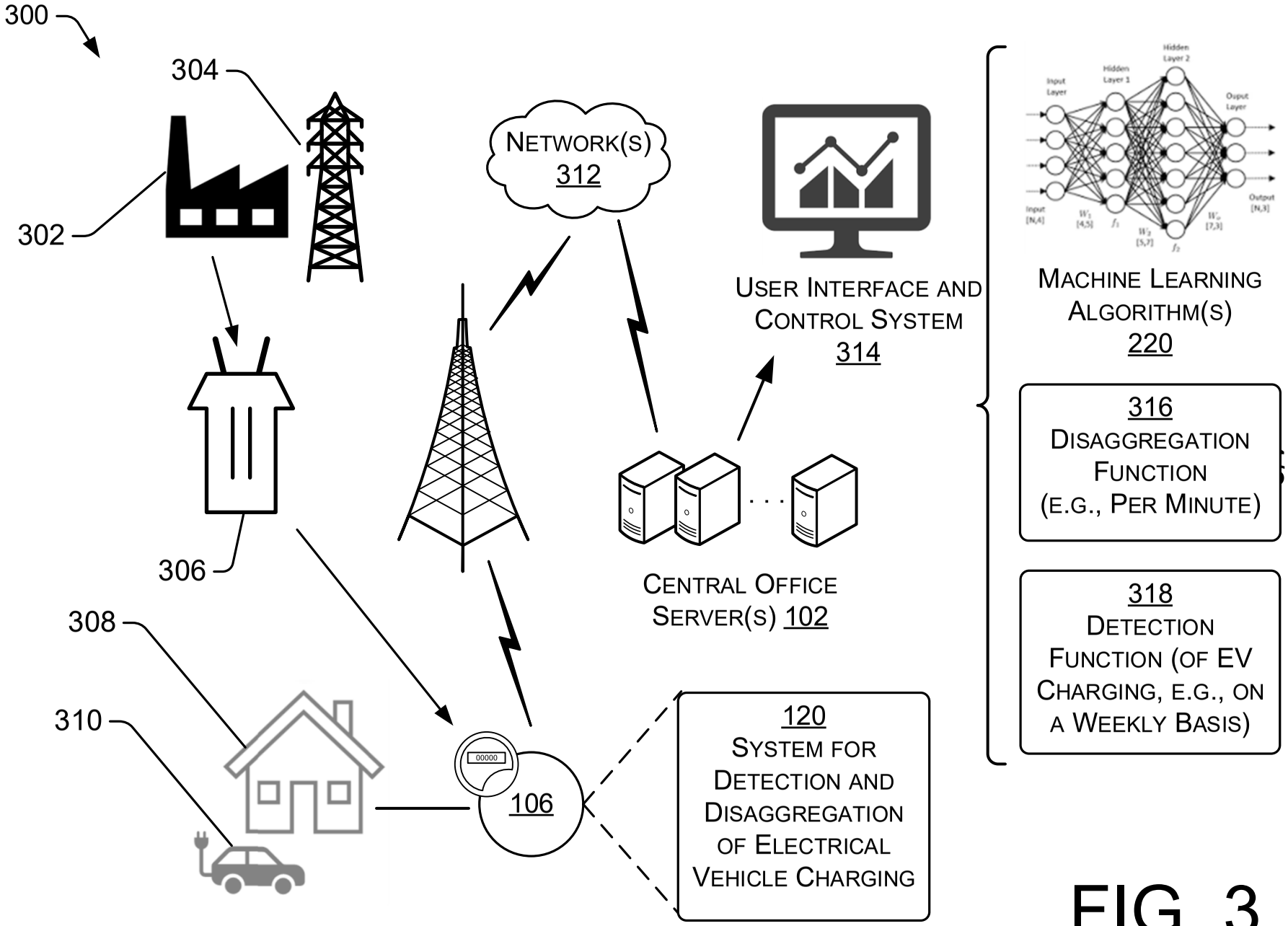
300
304
302
306
308
310
NETWORK(S)
312
USER INTERFACE AND
CONTROL SYSTEM
314
CENTRAL OFFICE
SERVER(S) 102
106
120
SYSTEM FOR
DETECTION AND
DISAGGREGATION
OF ELECTRICAL
VEHICLE CHARGING
MACHINE LEARNING
ALGORITHM(S)
220
316
DISAGGREGATION
FUNCTION
(E.G., PER MINUTE)
318
DETECTION
FUNCTION (OF EV
CHARGING, E.G., ON
A WEEKLY BASIS)

FIG. 3

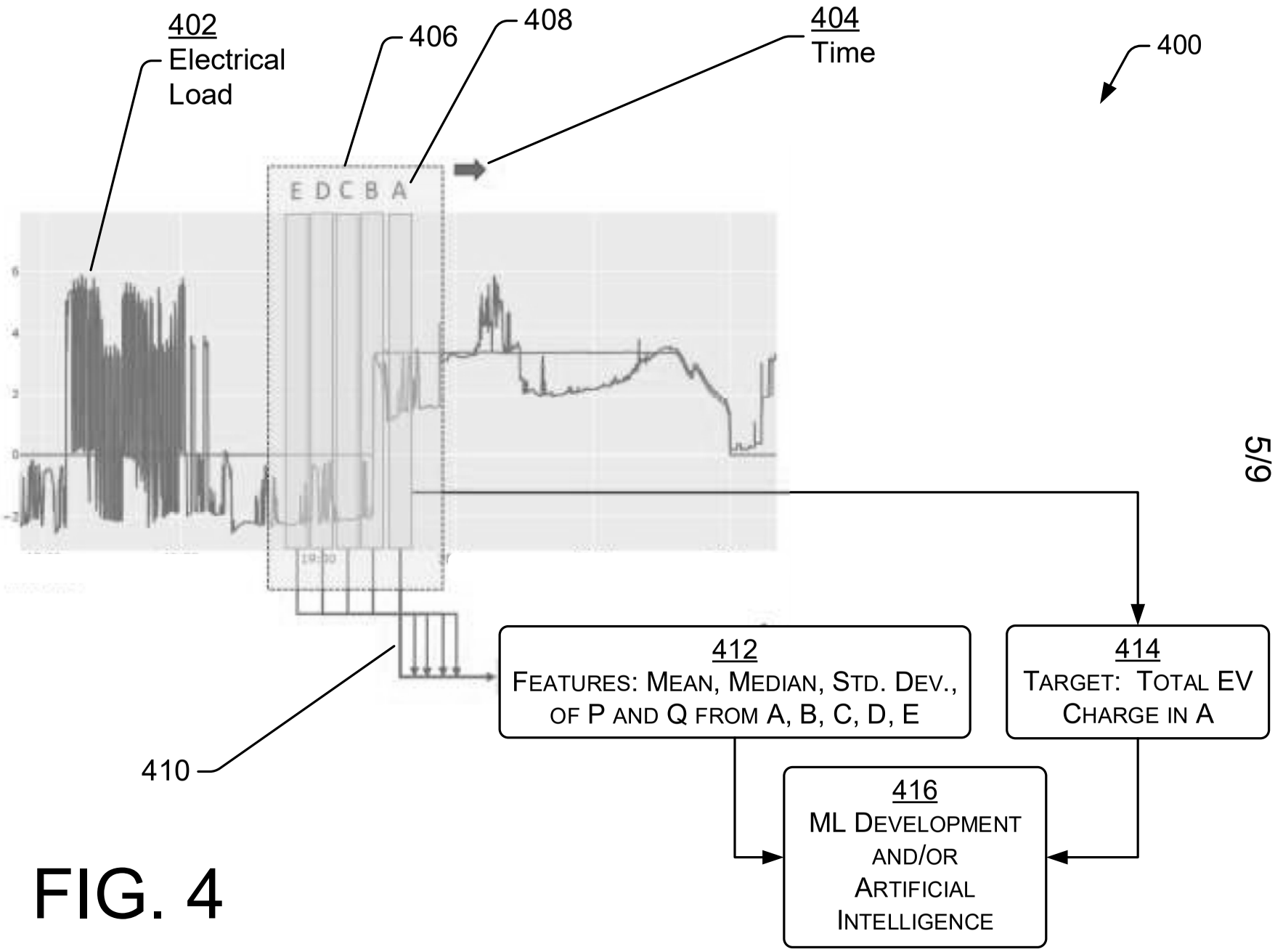
402
Electrical
Load
406
408
404
Time
400
E D C B A
410
412
FEATURES: MEAN, MEDIAN, STD. DEV., OF P AND Q FROM A, B, C, D, E
414
TARGET: TOTAL EV CHARGE IN A
416
ML DEVELOPMENT AND/OR ARTIFICIAL INTELLIGENCE

FIG. 4

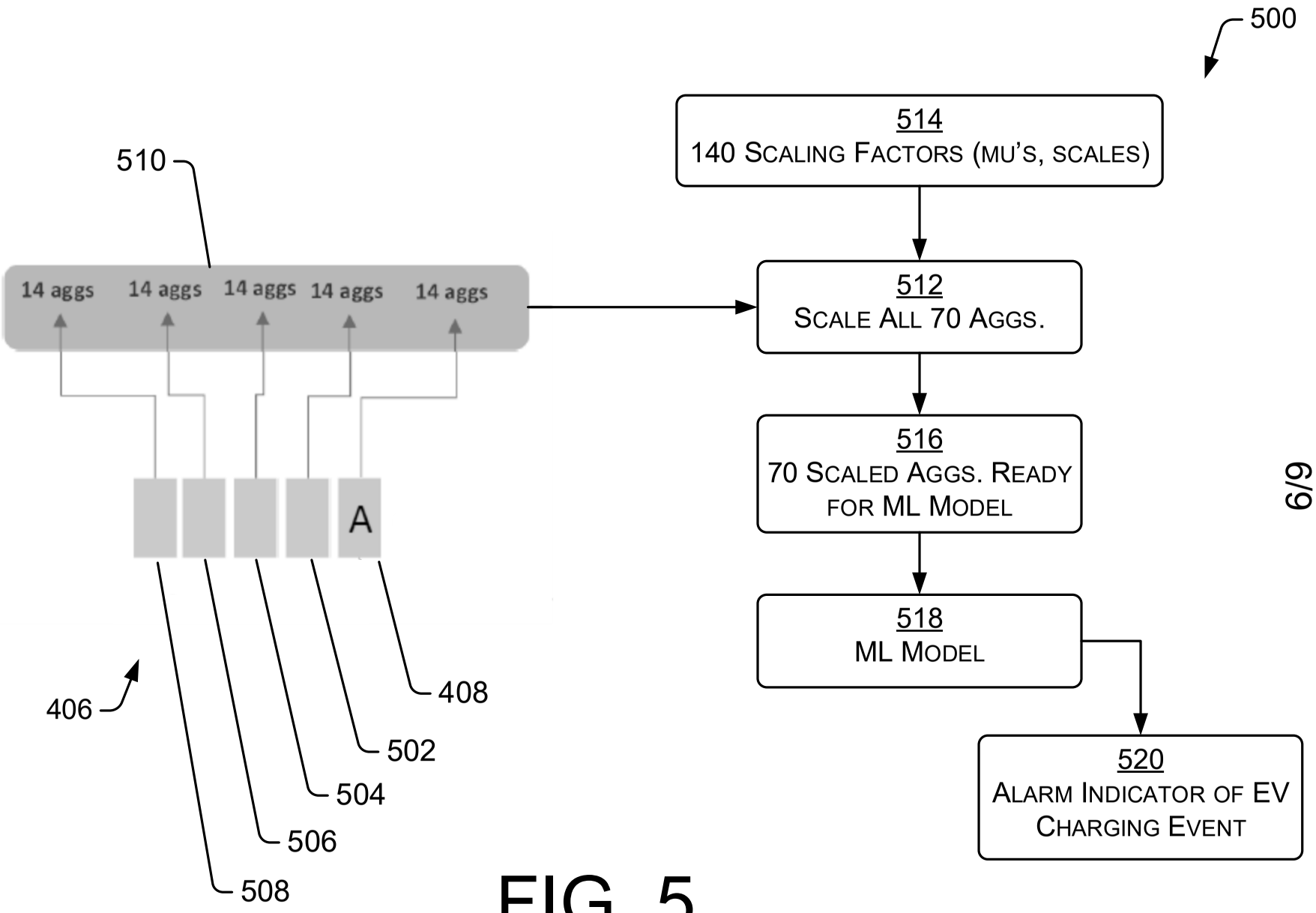
500
514
140 SCALING FACTORS (MU'S, SCALES)
510
14 aggs
14 aggs
14 aggs
14 aggs
14 aggs
512
SCALE ALL 70 AGGS.
516
70 SCALED AGGS. READY FOR ML MODEL
A
518
ML MODEL
520
ALARM INDICATOR OF EV CHARGING EVENT
406
408
502
504
506
508

FIG. 5

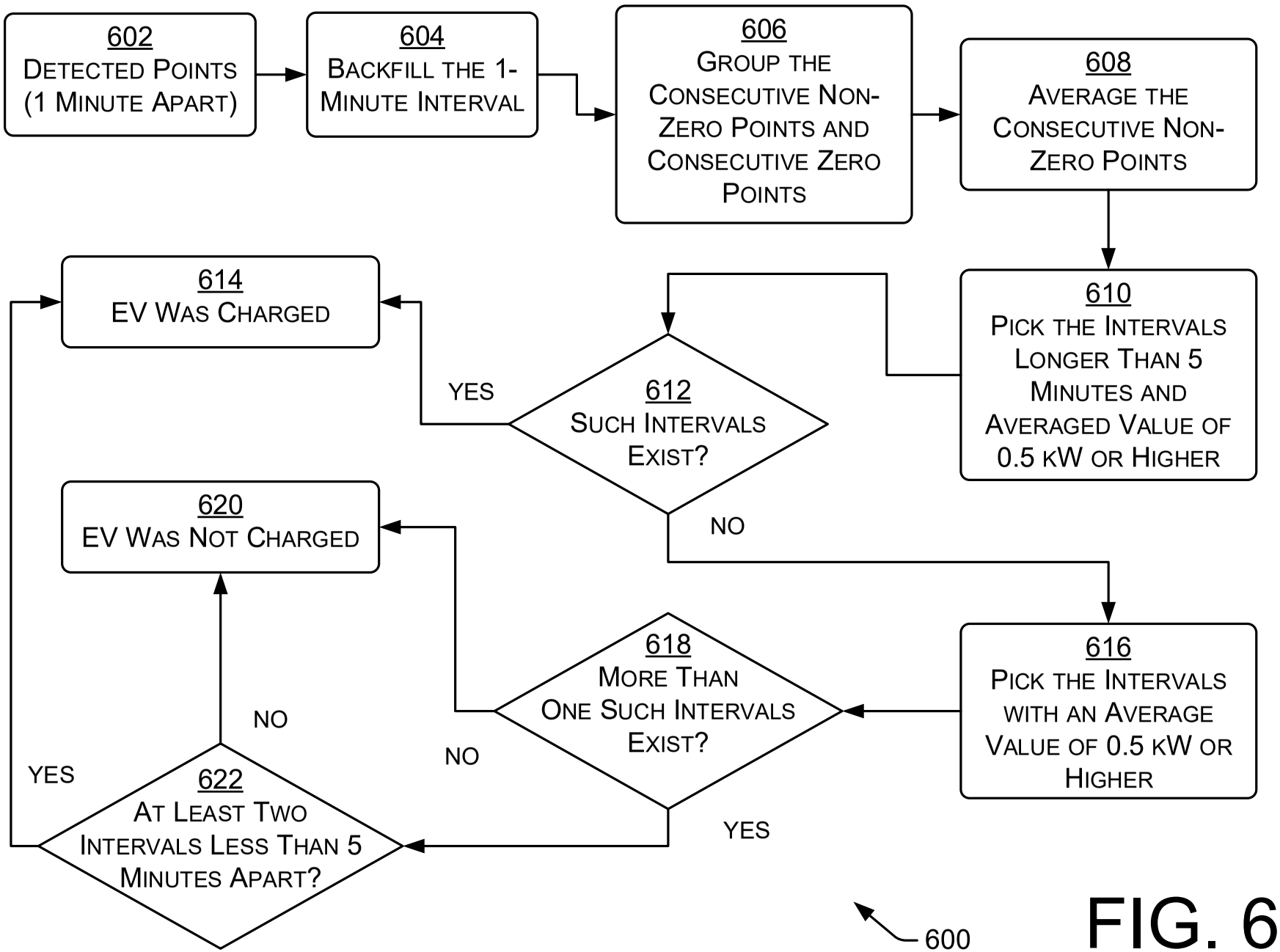
602
DETECTED POINTS (1 MINUTE APART)
604
BACKFILL THE 1-MINUTE INTERVAL
606
GROUP THE CONSECUTIVE NON-ZERO POINTS AND CONSECUTIVE ZERO POINTS
608
AVERAGE THE CONSECUTIVE NON-ZERO POINTS
610
PICK THE INTERVALS LONGER THAN 5 MINUTES AND AVERAGED VALUE OF 0.5 KW OR HIGHER
612
SUCH INTERVALS EXIST?
YES
NO
614
EV WAS CHARGED
616
PICK THE INTERVALS WITH AN AVERAGE VALUE OF 0.5 KW OR HIGHER
618
MORE THAN ONE SUCH INTERVALS EXIST?
YES
NO
620
EV WAS NOT CHARGED
622
AT LEAST TWO INTERVALS LESS THAN 5 MINUTES APART?
YES
NO
600

FIG. 6

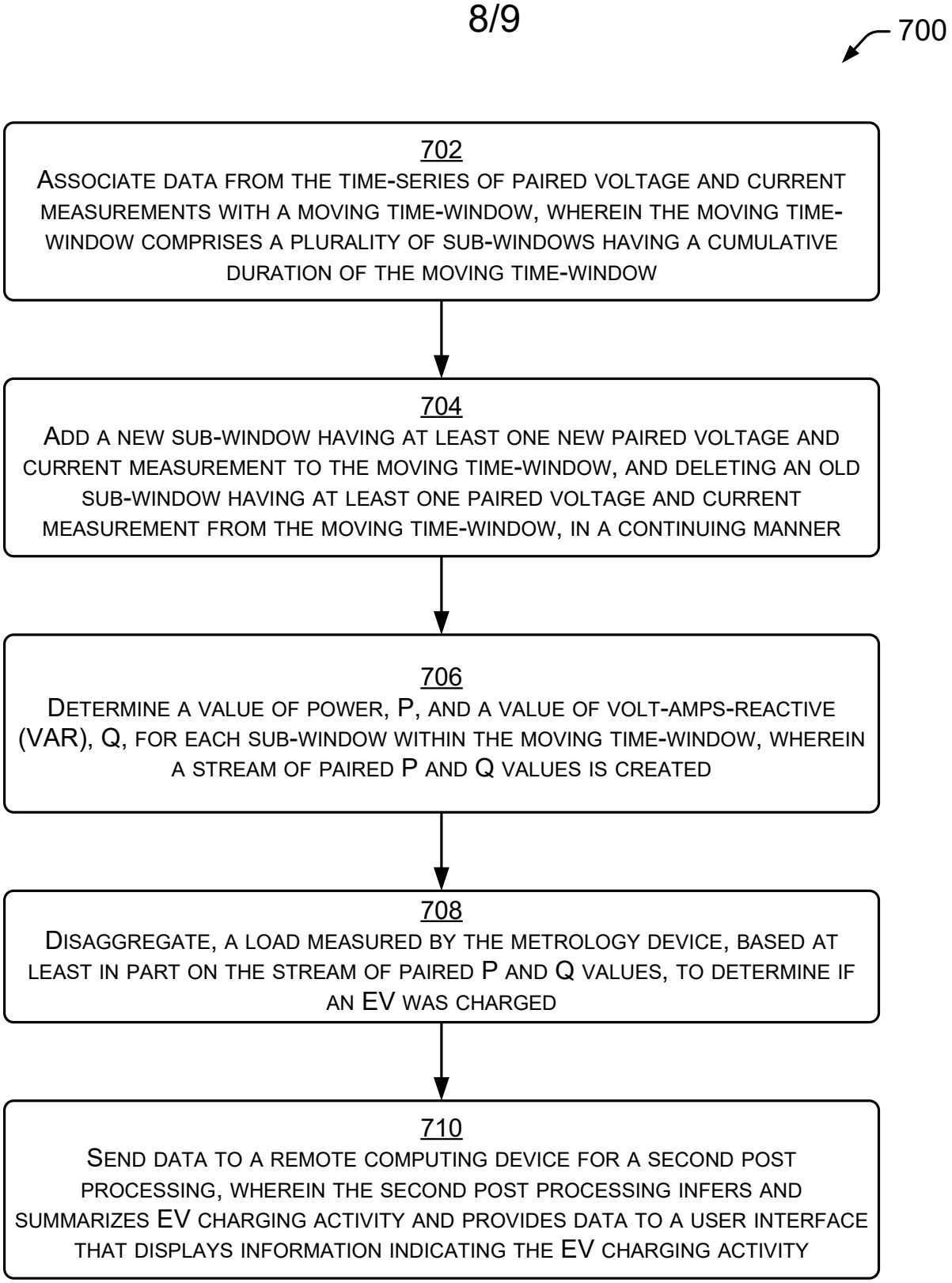
700
702
ASSOCIATE DATA FROM THE TIME-SERIES OF PAIRED VOLTAGE AND CURRENT MEASUREMENTS WITH A MOVING TIME-WINDOW, WHEREIN THE MOVING TIME-WINDOW COMPRISES A PLURALITY OF SUB-WINDOWS HAVING A CUMULATIVE DURATION OF THE MOVING TIME-WINDOW
704
ADD A NEW SUB-WINDOW HAVING AT LEAST ONE NEW PAIRED VOLTAGE AND CURRENT MEASUREMENT TO THE MOVING TIME-WINDOW, AND DELETING AN OLD SUB-WINDOW HAVING AT LEAST ONE PAIRED VOLTAGE AND CURRENT MEASUREMENT FROM THE MOVING TIME-WINDOW, IN A CONTINUING MANNER
706
DETERMINE A VALUE OF POWER, P, AND A VALUE OF VOLT-AMPS-REACTIVE (VAR), Q, FOR EACH SUB-WINDOW WITHIN THE MOVING TIME-WINDOW, WHEREIN A STREAM OF PAIRED P AND Q VALUES IS CREATED
708
DISAGGREGATE, A LOAD MEASURED BY THE METROLOGY DEVICE, BASED AT LEAST IN PART ON THE STREAM OF PAIRED P AND Q VALUES, TO DETERMINE IF AN EV WAS CHARGED
710
SEND DATA TO A REMOTE COMPUTING DEVICE FOR A SECOND POST PROCESSING, WHEREIN THE SECOND POST PROCESSING INFERS AND SUMMARIZES EV CHARGING ACTIVITY AND PROVIDES DATA TO A USER INTERFACE THAT DISPLAYS INFORMATION INDICATING THE EV CHARGING ACTIVITY

FIG. 7

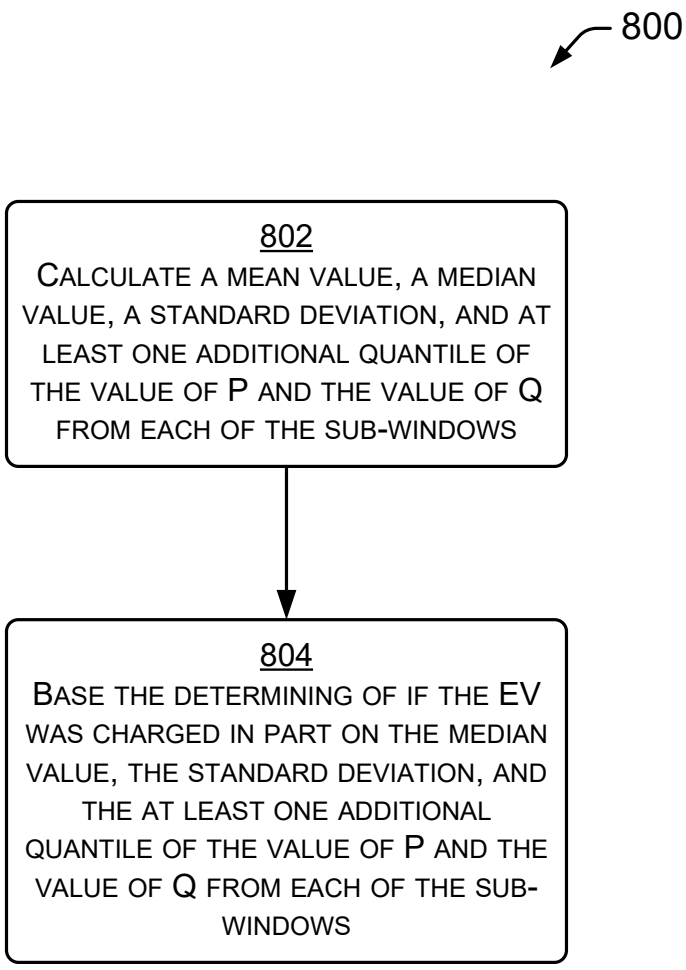
800
802
CALCULATE A MEAN VALUE, A MEDIAN VALUE, A STANDARD DEVIATION, AND AT LEAST ONE ADDITIONAL QUANTILE OF THE VALUE OF P AND THE VALUE OF Q FROM EACH OF THE SUB-WINDOWS
804
BASE THE DETERMINING OF IF THE EV WAS CHARGED IN PART ON THE MEDIAN VALUE, THE STANDARD DEVIATION, AND THE AT LEAST ONE ADDITIONAL QUANTILE OF THE VALUE OF P AND THE VALUE OF Q FROM EACH OF THE SUB-WINDOWS

FIG. 8