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Office de la Propriété Intellectuelle du Canada

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Canadian Intellectual Property Office

CA 2994561 C 2023/12/12

(11)(21) 2 994 561

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) **Date de dépôt PCT/PCT Filing Date:** 2016/09/08
(87) **Date publication PCT/PCT Publication Date:** 2017/02/09
(45) **Date de délivrance/Issue Date:** 2023/12/12
(85) **Entrée phase nationale/National Entry:** 2018/02/01
(86) **N° demande PCT/PCT Application No.:** US 2016/050730
(87) **N° publication PCT/PCT Publication No.:** 2017/024320
(30) **Priorités/Priorities:** 2015/08/05 (US62/201,462); 2016/08/04 (US15/228,926)

(51) **Cl.Int./Int.Cl.** ***G06F 8/65*** (2018.01), ***B60R 16/02*** (2006.01), ***H04W 4/00*** (2018.01)

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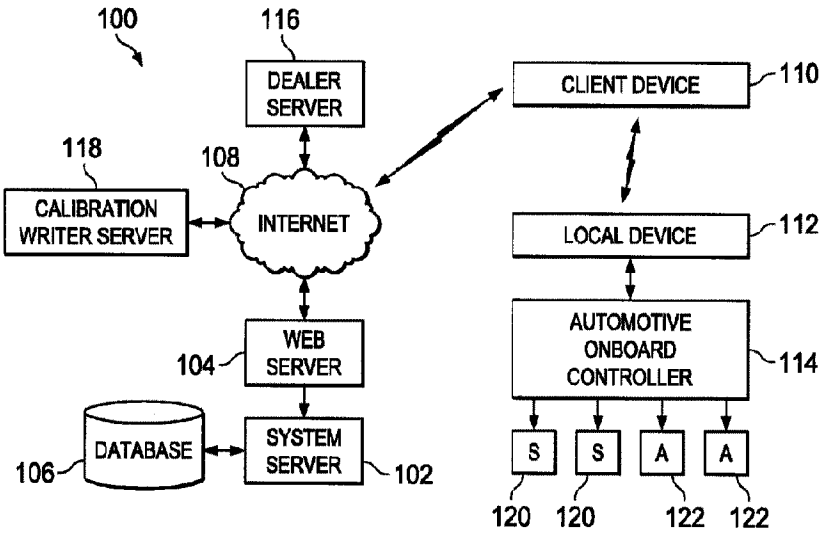
(54) **Titre : SYSTEME ET PROCEDE POUR SURVEILLER ET REPROGRAMMER UNE ECU SANS FIL EN TEMPS REEL**
(54) **Title: SYSTEM AND METHOD FOR REAL TIME WIRELESS ECU MONITORING AND REPROGRAMMING**



(57) **Abrégé/Abstract:**
Disclosed are methods, systems, and apparatus for managing firmware, settings, and parameters of an automotive controller using a local device, a client device, and a system server. The local device is connected to the automotive controller and is wirelessly connected to the client device. The client device is connected to the system server. The client device receives engine data from the local device that receives the engine data from the automotive controller and the client device sends the engine data to the server system. Firmware, settings, and parameter updates are selected with the client device, sent to the local device, and then sent to the automotive controller.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 February 2017 (09.02.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/024320 A1

(51) International Patent Classification:
G06F 19/00 (2011.01)

(21) International Application Number:
PCT/US2016/050730

(22) International Filing Date:
8 September 2016 (08.09.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/201,462 5 August 2015 (05.08.2015) US
15/228,926 4 August 2016 (04.08.2016) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR REAL TIME WIRELESS ECU MONITORING AND REPROGRAMMING

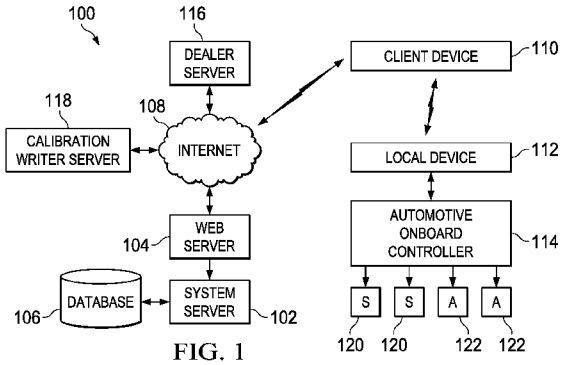

FIG. 1

(57) Abstract: Disclosed are methods, systems, and apparatus for managing firmware, settings, and parameters of an automotive controller using a local device, a client device, and a system server. The local device is connected to the automotive controller and is wirelessly connected to the client device. The client device is connected to the system server. The client device receives engine data from the local device that receives the engine data from the automotive controller and the client device sends the engine data to the server system. Firmware, settings, and parameter updates are selected with the client device, sent to the local device, and then sent to the automotive controller.

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— *with information concerning request for restoration of the right of priority in respect of one or more priority claims (Rules 26bis.3 and 48.2(b)(vii))*

SYSTEM AND METHOD FOR REAL TIME WIRELESS ECU MONITORING AND REPROGRAMMING

BACKGROUND

[0001] An engine control unit or an "ECU" is a widely used type of electronic controller that controls a series of actuators on an internal combustion engine to ensure optimal engine performance. It does this by reading values of a multitude of sensors in the engine bay and interpreting the data it receives using lookup tables which adjust engine actuators appropriately.

[0002] The ECU monitors various sensors on the automobile such as sensors for oxygen level, coolant temperature, mass air flow, air intake temperature, crank shaft angle, throttle position, cam shaft angle and engine knock. Lookup tables provide feedback information for adjustment and control of ignition timing, cam shaft position, fuel injector input, fuel pump input, fuel pump pressure, cooling fan speed, admission control systems, forced air induction controls, traction controls and transmission gear selections. In many situations, ECUs also send error codes to the vehicle dashboard to indicate immediate problems, such as overheating, or maintenance requirements, like oil changes. In some cases, the error codes activate warning lights which must be deactivated by the dealer.

[0003] Certain classes of ECUs are programmable. Modern ECUs incorporate a microprocessor which can process inputs from engine sensors in real time. The microprocessor stores its programming in firmware which is resident in flash memory or e-proms attached to the CPU of the microprocessor.

[0004] Programmable ECUs are required, for example, where significant aftermarket performance enhancing modifications have been made. Such modifications often include the addition of a turbo charger, intercooler or modified exhaust system. Programmable ECU's are

also used for several vehicle systems, such as engine control module (ECM), transmission control module (TCM), body control module, anti-lock brake system (ABS), airbag control module, and so on, that each receive routine updates from the manufacturer of the vehicle. Each ECU is remapped or reprogrammed to adapt the performance of the involved system to match the required modifications and/or to update the software and parameters of the ECU. Other changes for high performance engines which can be remapped in an ECU include ignition timing, maximum RPM, water temperature correction, transient fueling, low fuel pressure modifiers and a closed loop lambda (in order to modify a target air/fuel ratio), turbo charger waste gate control, staged fuel injection, variable cam timing, gear control and turbo charger anti-lag.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Figure 1 is a system diagram of a cloud based automotive technician system.

[0006] Figure 2A is a sequence diagram of a method for updating parameters on an automotive controller.

[0007] Figure 2B is a sequence diagram of a method for interaction with an automotive controller and a client device.

[0008] Figure 3 is a block diagram of a cloud based automotive technician system.

[0009] Figures 4A and 4B are a sequence diagrams of a method for updating an automotive controller based on data from the automotive controller.

[0010] Figure 5A is a diagram of a user interface of a preferred embodiment for a multiple gauge view with eight gauges.

[0011] Figure 5B is a diagram of a user interface of a preferred embodiment for dragging and dropping a gauge.

[0012] Figures 6A, 6B, and 6C are diagrams of a user interface of a preferred embodiment for a multiple gauge view with four sliding gauges.

[0013] Figures 7A, 7B, and 7C are diagrams of a user interface of a preferred embodiment for selecting a gauge.

[0014] Figures 8A and 8B are diagrams of a user interface of a preferred embodiment for selecting a first gauge style.

[0015] Figures 9A and 9B are diagrams of a user interface of a preferred embodiment for selecting a second gauge style.

[0016] Figures 10A and 10B are diagrams of a user interface of a preferred embodiment for selecting a third gauge style.

[0017] Figures 11A and 11B are diagrams of a user interface of a preferred embodiment for selecting a fourth gauge style.

[0018] Figures 12A through 12I are diagrams of a user interface of a preferred embodiment for adjusting parameters.

[0019] Figures 13A and 13B are diagrams of a user interface of a preferred embodiment for selecting units of a gauge.

[0020] Figures 14A through 14E are diagrams of a user interface of a preferred embodiment for a multiple gauge view with five gauges.

[0021] Figures 15A through 15D are diagrams of a user interface of a preferred embodiment for selecting gauges for a multiple gauge view.

[0022] Figures 16A through 16E are diagrams of a user interface of a preferred embodiment for vehicle management.

[0023] Figures 17A through 17C are diagrams of a user interface of a preferred embodiment for displaying diagnostics.

[0024] Figures 18A and 18B are diagrams of a user interface of a preferred embodiment for data log management.

[0025] Figures 19A through 19D are diagrams of a user interface of a preferred embodiment for settings management.

[0026] Figures 20A through 20D are diagrams of databases and records of a preferred embodiment.

[0027] Figure 21 is a block diagram of a local device of a preferred embodiment.

DETAILED DESCRIPTION

[0028] Referring to Figure 1, system **100** is provided. System **100** includes system server **102** connected to Internet **108** through web server **104**. The system server also includes database **106**.

[0029] Client device **110** is connected through a mobile network to Internet **108**. Client device **110** is also connected to local device **112**. In a preferred embodiment the local device establishes a Wi-Fi or Bluetooth connection between the client device and the automobile. Local device **112** is hardwired to the automotive controller **114**. Automotive controller **114** is connected to sensors **120** and actuators **122** resident on the vehicle. The sensors and actuators communicate with the onboard controller through a CAN BUS (also known as a controller area network (CAN) bus) as is known in the art.

[0030] Client device **110**, acts as a client of system server **102**, and as a client of local device **112**. Embodiments of client device **110** include any handheld wireless device, such as, a smart phone, a tablet computer, a notebook computer, a netbook computer, and so on.

[0031] Dealer server **116** is also connected to Internet **108** and communicates through the Internet to both the system server and the local device. Similarly, calibration writer server **118** is connected through the Internet to system server **102** and client device **110**.

[0032] Referring to Figure 2A, operation of a preferred embodiment **200** will be described. In use, the device allows recording and viewing of automobile information, diagnostics, automobile updates for onboard computers, and data logging to allow study of driving habits to research fuel economy.

[0033] At step **201**, the client device opens the application and sets up an account by entering certain demographic information. At step **202**, the application uploads the account

information to system server **102**.

[0034] At step **203**, the calibration writer server sets up an account through a form served up through the Internet from the system server. The calibration writer server includes account information such as name, address, email address, and submit computer Cal/Pid. At step **204**, calibration writer server inputs a set of operating system parameters which include programming information and look up tables for the onboard controller. At step **206**, the parameters are submitted to system server **102**. At step **208**, system server **102** stores the parameters and the account implementation. At step **210**, the database is updated by the system server with the new parameters and associated with the calibration writer server. At step **212**, the system server uploads the parameters to client device **110** via a wireless network.

[0035] In an alternative embodiment, a technician downloads the parameters or firmware from calibration writer server **118** via a web browser. The technician then uses system server **102** to download the updated parameters or firmware to smart phone **110**.

[0036] At step **214**, a client device stores the parameters. At step **215**, client device opens an application (or "App") which displays the parameters and certain options to the user. At step **216**, the client device receives options from the user as to which parameters to implement. At step **218**, the chosen parameters are uploaded to the local device via a Wi-Fi or Bluetooth connection. At step **220**, the local device stores the parameters and initiates certain timing functions such as onboard recording and storage of data.

[0037] At step **222**, the chosen parameters are uploaded to the automotive controller. At step **224**, the automotive controller stores the new parameters and lookup tables. At step **226** the automotive controller implements the new parameters and lookup tables. At step **228**, the automotive controller generates an acknowledge signal. At step **230**, the acknowledge signal is

sent to the local device. At step **231**, the local device stores the acknowledge signal. At step **232**, the local device reports the acknowledge signal to client device **110** via the WiFi or Bluetooth connection. At step **233**, the client device stores the acknowledge signal and the App displays the status of the local device and the uploaded parameters.

[0038] Referring to Figure 2B, an alternate preferred embodiment **238** is described. At step **243**, the client device chooses a target for a feed of live data from the automotive controller. Step **244**, the client device transmits the request to the local device. At step **245**, the local device stores live data request. At step **248**, the local device sends a request for live data to automotive controller **114**. At step **252**, the system status is sent to the local device. At step **256**, the local device stores the system status. At step **258**, the local device uploads the system status to client device **110**. At step **250**, the automotive controller uploads the system status from the automobile to the local device. At step **260**, client device stores the system status. At step **262**, the App displays the system status. The display is refreshed as updated system status is received from the local device. At step **261**, the local device enters a loop to repeatedly request system status from the automotive controller.

[0039] At step **263**, client device **110** chooses an option on the application to clear error codes. At step **264**, the request is uploaded to the local device. At step **265**, the request is stored in memory on the local device. At step **266**, the request is uploaded to the automotive controller. At step **267**, the automotive controller acknowledges the request and clears the error code.

[0040] At step **268**, the client device chooses an option on the application to request a diagnostic report. At step **269**, the request is uploaded to the local device. At step **270**, the local device stores the request. At step **266**, the local device uploads the request to the automotive

controller. At step **271**, the automotive controller generates the diagnostic report. At step **272**, the diagnostic report is sent to the local device. At step **273**, the local device stores the diagnostic report, according to date and time, in memory. At step **274**, the diagnostic report is sent to the client device. At step **275**, the diagnostic report is displayed according to the request of the user.

[0041] At step **276**, the client device, through use of the application requests a calibration report. At step **277**, the calibration request is uploaded to the local device. At step **278**, the local device stores the request for calibration. At step **279**, the local device forwards the request to the automotive controller. At step **280**, the automotive controller accesses the currently stored parameters and the calibration. At step **281**, the parameters are sent to the local device. At step **282**, the local device stores the current set of parameters according a date and time stamp. At step **283**, the local device sends the parameters to the client device. At step **284**, the application on the client device displays the requested calibration parameters.

[0042] Referring to Figure 3, a schematic map **300** of the setup of system server **102** and certain functions of a preferred embodiment will be described.

[0043] System server **102** presents a set of webpages for the various users of the system through web server **104** using a user/password interface. At **302**, **304**, and **306** a schematic of the local home page is shown. Local home page provides options for a choice of a user type for each of calibration writer server, a dealer, and a customer or "end user." The database includes records for each vehicle **310** and each computer profile ID number **312**. Each record **310** includes vehicle identification number, ECU serial number, make, model, engine, fuel tank number, gear ratio, tire size and vehicle modification categories. Each record is associated with a particular vehicle entered into the system. Computer profile ID number **312** is a

database entry including vehicle, calibration, PID configuration, and warning type. Computer profile ID number **312** also includes vehicle options and datalog recordings for each vehicle.

[0044] Calibration writers webpage **304** includes forms for entry of a data record for users who input engine control parameters. Each data record includes entries for photos or logos, name, phone, address, start date, email and computer Cal/Pid. When the form is complete, upon entry, system server **102** enters the data from the data form into a record into the database. The system server then copies the data record into computer profiles ID number **312**. All reports generated by the automotive controller at the request of the local device are associated with current calibration of the vehicle when stored in memory. In a preferred embodiment, the data in the record is then copied directly into memory at vehicles **310**.

[0045] The dealers webpage **306** serves up a form for data entry including data related to photo/logo, name, phone, address, start date and email address. The "dealers" in a preferred embodiment are typically maintenance shops which service vehicles but do not write calibrations.

[0046] The customers webpage **308** includes a form for entry of data regarding photo, phone number, start date and email address. The web form also enables the customer to request download of an application to be locally installed. The APP GUI provides access to the functions of the local device. In a preferred embodiment, the functions include requesting a report of a current calibration, requesting a live report of engine status, requesting a diagnosis report, requesting that an error code be cleared and uploading a calibration update from a dealer or manufacturer.

[0047]

[0048] A preferred embodiment of local device **112** includes the Freescale IMX28 Microcontroller, a UART for translation between parallel and serial data forms, Wi-Fi connectivity employing the IEEE 802.11 standard or other wireless protocol for communication between client device **110** and the local device **112** and provisions for a local interconnect network LIN for communication between vehicle components and a CAN BUS for communication between microcontrollers and other devices.

[0049] Referring to Figures 4A and 4B, method **400** updates engine parameters in response to a check engine code (also referred to as a diagnostic trouble code (DTC)) being generated by automotive controller **114**. The method includes one or more messages passed between calibration writer server **118**, system server **102**, client device **110**, local device **112**, and automotive controller **114**.

[0050] At step **411**, automotive controller **114** generates a check engine code and freezes a frame of data. The check engine code identifies a problem with the vehicle. The frozen data indicates the status of the vehicle at the time when the problem that caused the check engine code to be generated occurred.

[0051] At step **412**, a data connection is established between local device **112** and automotive controller **114**. In one embodiment, the data connection is established by connecting local device **112** to an onboard diagnostics port that is connected to a CAN BUS to which automotive controller **114** is connected.

[0052] At step **413**, a wireless connection is established between client device **110** and local device **112**. In one embodiment, local device **112** acts as a wireless local area network (WLAN) access point to which client device **110** can connect. In establishing the wireless

connection, transmission control protocol (TCP) socket is opened between client device **110** and local device **112** so that data can be passed back and forth between client device **110** and local device **112** using JavaScript Object Notation (JSON) messages.

[0053] At step **414**, a request for gauge data is sent from client device **110** and is received by local device **112**. In one embodiment, the request is sent using JSON using the TCP socket. For each of the one or more gauges displayed by client device **110**, a gauge data request is sent. After receiving the request from client device **110** by local device **112**, client device **110** is subscribed to and receives notifications from local device **112** that include updated data to be displayed on the gauge associated with the gauge data request.

[0054] At step **415**, a data request is sent from local device **112** and is received by automotive controller **114**.

[0055] At step **416**, automotive controller **114** retrieves the gauge data. In one embodiment, automotive controller **114** retrieves parameter identifier (PID) data that is associated with the gauge data.

[0056] At step **417**, the data is sent from automotive controller **114** and is received by local device **112**.

[0057] Optionally at step **418**, local device **112** records the data received from automotive controller **114** in a log file on local device **112**.

[0058] At step **419**, the requested data is sent from local device **112** and is received by client device **110**. In one embodiment, client device **110** is subscribed to local device **112** so as to receive a notification from local device **112** each time local device **112** receives updated data from automotive controller **114**.

[0059] At step **420**, the data is displayed by client device **110**. The layout settings

that describe the look and feel of the gauge are stored on client device **110** and the data is displayed in accordance to the layout settings.

[0060] At step **421**, a request for the engine code, the frozen data, and optionally the log data is sent from client device **110** and is received by local device **112**.

[0061] At step **422**, a request for the engine code and the frozen data is sent from local device **112** and is received by automotive controller **114**.

[0062] At step **423**, automotive controller **114** retrieves the engine code and frozen data that were generated in step **411**.

[0063] At step **424**, the engine code and frozen data are sent from automotive controller **114** and are received by local device **112**.

[0064] At step **425**, the engine code, frozen data, and optional log are sent from local device **112** and are received by client device **110**.

[0065] At step **426**, client device **110** stores the engine code, frozen data, and optional log.

[0066] At step **427**, client device **110** displays the engine code.

[0067] At step **428**, the engine code, frozen data, and optional log is sent from client device **110** and is received by system server **102**.

[0068] At step **429**, a request for updated engine parameters is sent from client device **110** and is received by system server **102**.

[0069] At step **430**, a request for updated engine parameters is sent from system server **102** and is received by calibration writer server **118**.

[0070] At step **431**, updated parameters and/or firmware are sent from calibration writer server **118**, and are received by system server **102**.

[0071] At step **432**, the updated parameters and firmware are sent from system server **102** and are received by client device **110**.

[0072] At step **433**, the updated parameters and firmware are stored on client device **110**.

[0073] At step **434**, the technician selects one or more parameters and firmware with which to update the vehicle.

[0074] At step **435**, the selected parameters and firmware are sent from client device **110** and are received by local device **112**. One or more parameters and the firmware may be selected to be updated and are sent.

[0075] At step **436**, reprogramming instructions are sent from local device **112** and are received by automotive controller **114**. In one embodiment, the instructions cause automotive controller **114** to be flashed with the updated firmware when the firmware is selected to be updated. Additionally, parameters can be changed beyond what was included with the updated firmware. The updated firmware may be the latest default firmware from the vehicle manufacturer that does not have every parameter tuned for the specific configuration of the vehicle. In one embodiment, the reprogramming instructions of local device **112** first reflashes automotive controller **114** with the updated firmware and then updates specific engine tuning parameters.

[0076] At step **437**, automotive controller **114** updates the firmware and parameters to the values received from local device **112**.

[0077] Referring to Figures 5A and 5B, user interface **502** includes menu button **504** on title bar **506**, which is above multiple gauge view **508**. Multiple gauge view **508** includes eight (8) mini gauge views **510**, **512**, **514**, **516**, **518**, **520**, **522**, and **524**.

[0078] User interface **502** is displayed on a client device via an app running on the client device. The name, value, and units of each respective mini gauge **510**, **512**, **514**, **516**, **518**, **520**, **522**, and **524** are displayed on user interface **502** on a client device. Values **542**, **544**, **546**, **548**, **550**, **552**, **554**, and **556** respectively of each mini gauge **510**, **512**, **514**, **516**, **518**, **520**, **522**, and **524** are continuously updated as new PID values are received from the automotive controller. In the embodiment of Figure 5A, ten (10) PIDs are named with the units indicated in the table below. PID values, names, and units may be different for different vehicles and the table below is merely one example

PID	Mini Gauge View	Name	Units
0	**510**	Engine Coolant Temperature	Degrees Fahrenheit (°F)
1	**512**	Speed	Miles per Hour (MPH)
2	**530**	Revolutions per Minute	Revolutions per Minute (RPM)
3	**532**	Battery Voltage	Voltage (V)
4	**518**	Transmission Temperature	Degrees Fahrenheit (°F)
5	(not shown)	Boost	Pounds per Square Inch (PSI)
6	**522**	Calculated Load	Percent of Max (%)
7	**524**	Injector Pressure	Thousand Pounds per Square Inch (kPSI)
8	(not shown)	Injector Pulse Width	Milliseconds (ms)
9	**520**	Throttle Position Sensor	Percent of Max (%)

[0079] Mini gauge view **510** includes name **526**, value **542**, and units **558** and is associated with a PID. Name **526** indicates that mini gauge **510** displays the engine coolant temperature, which value **542** indicates is at **156**.0, which units **558** indicates are in degrees Fahrenheit. Mini gauge view **510** is shaded in a green color to indicate that value **542** is within a desired range for the engine coolant temperature.

[0080] Mini gauge view **512** includes name **528**, value **544**, and units **560** and is

associated with a PID. Name **528** indicates that mini gauge **512** displays the speed, which value **544** indicates is at 31.0, which units **560** indicates are in miles per hour. Mini gauge view **512** is not shaded green, which would indicate that value **544** is in a desired range, and is not shaded red, which would indicate that value **544** is in a warning range.

[0081] Mini gauge view **514** includes name **530**, value **546**, and units **562** and is associated with a PID. Name **530** indicates that mini gauge **514** displays the revolutions per minute (RPM) of the engine, which value **546** indicates is at 31.0, which units **562** indicates are in revolutions per minute. Mini gauge view **514** is not shaded green, which would indicate that value **546** is in a desired range, and is not shaded red, which would indicate that value **546** is in a warning range.

[0082] Mini gauge view **516** includes name **532**, value **548**, and units **564** and is associated with a PID. Name **532** indicates that mini gauge **516** displays the battery voltage of the engine, which value **548** indicates is at 2.00, which units **564** indicates are in Volts (V). Mini gauge view **516** is shaded red to indicate that value **548** is within a warning range for the battery voltage.

[0083] Mini gauge view **518** includes name **534**, value **550**, and units **566** and is associated with a PID. Name **534** indicates that mini gauge **518** displays the transmission temperature of the engine, which value **550** indicates is at **219**.0, which units **566** indicates are in degrees Fahrenheit. Mini gauge view **518** is shaded red to indicate that value **550** is within a warning range for the transmission temperature.

[0084] Mini gauge view **520** includes name **536**, value **552**, and units **568** and is associated with a PID. Name **536** indicates that mini gauge **520** displays the throttle position sensor, which value **552** indicates is at 35, which units **568** indicates is a percentage value. Mini

gauge view **520** is not shaded green, which would indicate that value **552** is in a desired range, and is not shaded red, which would indicate that value **552** is in a warning range.

[0085] Mini gauge view **522** includes name **538**, value **554**, and units **570** and is associated with a PID. Name **538** indicates that mini gauge **522** displays the calculated load on the engine, which value **554** indicates is at 35, which units **570** indicates is a percentage value. Mini gauge view **522** is not shaded green, which would indicate that value **554** is in a desired range, and is not shaded red, which would indicate that value **554** is in a warning range.

[0086] Mini gauge view **524** includes name **540**, value **556**, and units **572** and is associated with a PID. Name **540** indicates that mini gauge **524** displays the injector pressure of the engine, which value **556** indicates is at 25.0, which units **572** indicates is in thousand pounds per square inch (kPSI). Mini gauge view **524** is shaded green to indicate that value **556** is in a desired range.

[0087] Figure 5B shows a drag and drop operation used to swap the location of two mini gauges on multiple gauge view **508**. The location of mini gauge **514** is swapped with the location of mini gauge **524** within multiple gauge view **508** by dragging mini gauge **514** from its original location towards the original location of mini gauge **524**.

[0088] Referring to Figure 6A, user interface **502** is updated to display multiple gauge view **604**. Multiple gauge view **604** includes four (4) mini gauge views (**512**, **530**, **518**, and **520**) and one selected gauge view **606**. Mini gauge **530** is updated to have its display be highlighted to indicate that gauge **530** is associated with, and has the same PID as, selected gauge **606**. User interface **502** transitions from multiple gauge view **508** (eight gauge view **508**) to multiple gauge view **604** (four gauge view **604**) when gauge **530** is selected from multiple gauge view **508** via a touch or click event.

[0089] Upper row **608** includes mini gauges **510** and **512**. Lower row **610** includes mini gauges **518** and **520**.

[0090] Referring to Figure 6B, upper row **608** is slid or dragged to the left to reveal mini gauge **516**. Any two adjacent mini gauge views **510**, **512**, **514**, and **516** can be displayed in upper row **608** by sliding or dragging upper row **608** left or right. During a drag or slide event, up to three mini gauge views may be displayed. After the drag or slide event, two mini gauge views are displayed, which need not include the mini gauge that has been selected (which in Figure 6B is mini gauge **512**).

[0091] Referring to Figure 6C, lower row **610** is slid or dragged to the left. Any two adjacent mini gauge views **518**, **520**, **522**, and **524** can be displayed in lower row **610** by sliding or dragging lower row **610** left or right. During a drag or slide event, up to three mini gauge views may be displayed. After the drag or slide event, two mini gauge views are displayed, which need not include the mini gauge that has been selected.

[0092] Referring to Figure 7A, 7B, and 7C, user interface **502** is manipulated to change the PID of mini gauge view **530**.

[0093] At Figure 7A, multiple gauge view **604** is displayed on user interface **502**. Mini gauge view **530** has been selected and selected gauge view **606** is shown on user interface **502**.

[0094] At Figure 7B, selected gauge view is slid or dragged up to reveal second selected gauge view **706**.

[0095] At Figure 7C, mini gauge view **512** is updated to become mini gauge view **712**. In on embodiment, mini gauge view **712** duplicates the information from mini gauge view **532** so that when mini gauge view **712** is unselected and user interface **502** transitions back to

multiple gauge view **508**, both mini gauge view **532** and mini gauge view **712** are displayed and both show the battery voltage.

[0096] Referring to Figures 8A and 8B, circular gauge style **802** from settings view **804** is selected for selected gauge view **606**. Settings view **802** of Figure 8A is displayed after user interface element **806** is selected from selected gauge view **606** of Figure 8B.

[0097] Settings view **804** includes name **808** and units **810** that identify the name and units of the PID that is associated with selected view **606**. Settings view **804** includes user interface element **812** that, when selected, transitions user interface **502** from displaying settings view **804** (Figure 8A) to displaying settings view **606** (Figure 8B). With the selection of circular gauge style **802**, circular gauge view **814** will be shown on selected gauge **606**.

[0098] On selected gauge view **606**, name **816** and units **818** that identify the name and units of the PID that is associated with selected view **606**. Value **820** indicates the current value of the PID associated with selected gauge view **606**. Units **822** indicates the current value of the PID associated with selected gauge view **606**. User interface element **824** indicates what gear is being reported by the automotive controller as the current gear of the vehicle.

[0099] Circular gauge view **814** includes warning section **824**. In one embodiment, warning section **824** is shaded in red and indicates that the RPM level is too low.

[0100] Circular gauge view **814** includes desired section **826**. In one embodiment, desired section **826** is shaded in green and indicates that the RPM level is in a desired operating range for the vehicle.

[0101] Referring to Figures 9A and 9B, arc gauge style **902** from settings view **804** is selected for gauge view **606**. When arc gauge style **902** is selected, selected gauge view **606** shows arc gauge view **904**. Arc gauge view **904** includes warning section **906**. In one

embodiment, warning section **906** is shaded in red and indicates that PID values that are within warning section **906** are too low.

[0102] Arc gauge view **904** includes desired section **908**. In one embodiment, desired section **908** is shaded in green and indicates that PID values that are within desired section **908** are in a preferred range for one of maximum torque or horsepower.

[0103] Referring to Figures 10A and 10B, bar gauge style **1002** from settings view **804** is selected for gauge view **606**. When bar gauge style **1002** is selected, selected gauge view **606** shows bar gauge view **1004**. Bar gauge view **1004** includes warning section **1006**. In one embodiment, warning section **1006** is shaded in red and indicates that PID values that are within warning section **1006** are too low.

[0104] Bar gauge view **1004** includes desired section **1008**. In one embodiment, desired section **1008** is shaded in green and indicates that PID values that are within desired section **1008** are in a preferred range for one of maximum torque or horsepower.

[0105] Referring to Figures 11A and 11B, line history gauge style **1102** from settings view **804** is selected for gauge view **606**. When line history gauge style **1102** is selected, selected gauge view **606** shows line history gauge view **1104**. Line history gauge view **1104** is a graph that shows recent values for the selected gauge as a function of time. The recent values are stored on the client device. Line history gauge view **1104** shows the most recent data on the right-hand-side of the chart.

[0106] Referring to Figures 12A through 12I, user interface **502** comprises multiple gauge view **604** with selected gauge view **606**. Selected gauge view **606** includes warning section **824**, desired section **826**, and warning section **1202** that are each adjustable. Warning section **824** identifies when the PID value is too low and warning section **1202** identifies when

the PID value is too high.

[0107] To adjust the settings for warning section **824**, desired section **826**, and warning section **1202**, user interface element **806** is selected to display settings view **804** (Figure 12B) and then user interface element **1204** is selected from settings view **804** to display view **1206** (Figure 12C) on user interface **502**. View **1206** is also referred to as parameter adjustment view **1206**.

[0108] Parameter adjustment view **1206** includes user interface element **1208**, user interface element **1210**, name **1212**, and units **1214**

[0109] User interface element **1208** is a cancel button that, when selected, undoes changes that were made in parameter adjustment view **1206**. After selecting user interface element **1208**, user interface **502** returns to multiple gauge view **604** with settings view **804**, as in Figure 12B.

[0110] User interface element **1210** is a button that, when selected, accepts changes that were made in parameter adjustment view **1206**. After selecting user interface element **1210**, user interface **502** returns to multiple gauge view **604** with settings view **804**, as in Figure 12B.

[0111] Name **1212** and units **1214** identify the type and units of the PID information that is displayed on view **1206**. In one embodiment, name **1212** is revolutions per minute (RPM) and units **1214** are RPM.

[0112] User interface element **1216** is a checkbox that indicates whether desired section **826** is shown on selected gauge view **606**. The range of desired section **826** is controlled by the range between minimum desired threshold **1218** and maximum desired threshold **1220**. When the PID value is between minimum desired threshold **1218** and maximum desired threshold **1220**, then the PID value is in a desired or preferred range.

[0113] The display of warning section **824** and warning section **1202** are controlled by user interface element **1222**. The range of the gap between warning section **824** and warning section **1202** is controlled by the range between minimum warning threshold **1224** and maximum warning threshold **1226**. When the PID value is below minimum desired threshold **1224** or above maximum desired threshold **1226**, then the PID value is in a warning range that could lead to engine fault, damage, or failure.

[0114] User interface element **1228** identifies whether the defuel settings are active. When the PID value is below minimum defuel threshold **1224** or above maximum defuel threshold **1226**, then the PID value is in a defuel range where the fuel supply to the engine will reduced in order to protect the engine.

[0115] In one embodiment, the relationships shown below are maintained by the thresholds displayed on parameter adjustment view **1206**.

minimum defuel threshold **1230** $\leq$ minimum warning threshold **1224** Rel.1

minimum warning threshold **1224** $\leq$ minimum desired threshold **1218** Rel.2

minimum desired threshold **1218** $\leq$ maximum desired threshold **1220** Rel.3

maximum desired threshold **1220** $\leq$ maximum warning threshold **1226** Rel.4

maximum warning threshold **1226** $\leq$ maximum defuel threshold **1232** Rel.5

[0116] Referring to Figure 12D, when minimum desired threshold **1218** is dragged to the left, minimum warning threshold **1224** and minimum defuel threshold **1230** may also move to the left so that both minimum warning threshold **1224** and minimum defuel threshold **1230** remain less than or equal to minimum desired threshold **1218**.

[0117] When maximum desired threshold **1220** is dragged to the right, maximum warning threshold **1226** and maximum defuel threshold **1232** may also move to the right so that

both maximum warning threshold **1226** and maximum defuel threshold **1232** remain greater than or equal to maximum desired threshold **1220**.

[0118] Referring to Figure 12E, when minimum warning threshold **1224** is dragged to the right , minimum desired threshold **1218** may also move to the right so that minimum desired threshold **1218** remains greater than or equal to minimum warning threshold **1224**.

[0119] When maximum warning threshold **1226** is dragged to the left, maximum desired threshold **1220** may also move to the left so that maximum desired threshold **1220** remains less than or equal to maximum warning threshold **1226**.

[0120] Referring to Figure 12F, when minimum warning threshold **1224** is dragged to the left, minimum defuel threshold **1230** may also move to the left so that minimum defuel threshold **1230** remains less than or equal to minimum warning threshold **1224**.

[0121] When maximum warning threshold **1226** is dragged to the right, maximum defuel threshold **1232** may also move to the right so that maximum defuel threshold **1232** remains greater than or equal to maximum warning threshold **1226**.

[0122] Referring to Figure 12G, when minimum defuel threshold **1230** is dragged to the right, minimum warning threshold **1224** and minimum desired threshold **1218** may also move to the right so that both minimum warning threshold **1224** and minimum desired threshold **1218** remain greater than or equal to minimum defuel threshold **1230**.

[0123] When maximum defuel threshold **1232** is dragged to the left, maximum warning threshold **1226** and maximum desired threshold **1220** may also move to the left so that both maximum warning threshold **1226** and maximum desired threshold **1220** remain less than or equal to maximum defuel threshold **1232**.

[0124] Referring to Figures 12H and 12I, when user interface element (checkbox)

1216 is unselected and user interface element (done button) **1210** is selected, then the desired section is not displayed on the selected gauge view **606**, as shown in Figure 12I.

[0125] Referring to Figures 13A and 13B, user interface **502** displays multiple gauge view **604**, mini gauge **518** has been selected, and settings view **804** is displayed. Settings view **804** includes user interface element **1302** and user interface element **1304**.

[0126] User interface element **1302** and user interface element **1304** allow for the selection between different units for the PID values associated with mini gauge **518**. In one embodiment, mini gauge **518** is associated with transmission temperature and can be displayed in degrees Celsius (°C) upon the selection of user interface element **1302** or in degrees Fahrenheit (°F) upon the selection of user interface element **1304**.

[0127] Referring to Figures 14A through 14E, user interface **502** transitions from multiple (eight) gauge view **508** to multiple gauge view **1401**. Multiple gauge view **1401** may also be referred to as five gauge view **1401**. The transition from eight gauge view **508** to five gauge view **1401** occurs when there is a slide or drag event that drags eight gauge view **508** up to reveal five gauge view **1401**. Additionally, the transition from five gauge view **1401** to eight gauge view **508** occurs when there is a slide or drag event that drags five gauge view **1401** down to reveal eight gauge view **508**.

[0128] Referring to figure 14B, five gauge view **14101** includes gauge views **14202**, **14203**, **14204**, **14205**, and **14206**, which may be referred to as large center gauge view **14202**, top left gauge view **14203**, bottom left gauge view **14204**, top right gauge view **14205**, and bottom left gauge view **14206**.

[0129] Large center gauge view **14204** includes name **14207**, value **14208**, units **14209**, gear **14210**, and circular gauge view **14211**. Circular gauge view **14211** includes lower

warning section **14212**, desired section **14213**, and upper warning section **14214**. Large center gauge view **14204** indicates that the vehicle is in reverse and that the transmission temperature is 274.0 °F and is in a warning range that is above the desired range.

[0130] Top left gauge view **14203** includes name **14215**, units **14216**, value **14217**, and arc gauge view **14218**. Arc gauge view **14218** includes lower warning section **14219**, desired section **14220**, and upper warning section **14221**. Top left gauge view **14203** indicates that the RPM of the motor is 4328 RPM, which is just above the desired range an in the upper warning range.

[0131] Bottom left gauge view **14204** includes name **14223**, units **14224**, value **14225**, and arc gauge view **14226**. Arc gauge view **14226** includes lower warning section **14227**, desired section **14228**, and upper warning section **14229**. Bottom left gauge **14204** indicates that the battery voltage is 15.00 V and is in the upper warning range.

[0132] Top right gauge view **14205** includes name **14230**, units **14231**, value **14232**, and arc gauge view **14233**. Arc gauge view **14233** includes lower warning section **14234**, desired section **14235**, and upper section **14236**. Top right gauge **14205** indicates that the engine coolant temperature is 240.0 °F and is in the upper warning section above the desired level.

[0133] Bottom right gauge view **14206** includes name **14237**, units **14238**, value **14239**, and arc gauge view **14240**. Arc gauge view **14240** includes warning section **14241** that indicates which values are too high. Bottom right gauge **14206** indicates that the speed of the vehicle is 299.0 MPH and is in the upper warning range.

[0134] The names, units, and values displayed on the gauges in large five gauge view **14101** are each shaded in red to indicate that each of the values of each of the gauges is in a warning section

[0135] When any one of gauge views **14202**, **14203**, **14204**, **14205**, and **14206** are selected from large five gauge view **14101**, user interface **502** transitions from displaying large five gauge view **14101** to multiple gauge view **14301** and selected gauge view **14302**, shown in Figure 14C. Multiple gauge view **14301** may also be referred to as small five gauge view **14301**.

[0136] Referring to Figure 14C, small five gauge view **14301** includes gauge views **14303**, **14304**, **14305**, **14306**, and **14307**, which may be referred to as small center gauge view **14303**, top left gauge view **14304**, bottom left gauge view **14305**, top right gauge view **14306** and bottom right gauge view **14307**. Gauge views **14303**, **14304**, **14305**, **14306**, and **14307** from small five gauge view **14301** are associated with the same PIDs as gauge views **14202**, **14203**, **14204**, **14205**, and **14206** from large five gauge view **14101** of Figure 14B respectively. The values for gauge views **14303**, **14304**, **14305**, **14306**, and **14307** are continuously updated to reflect the current state of the engine.

[0137] Selected gauge view **14302** of Figure 14C is similar to selected gauge view **606** of Figure 6 and is associated with small center gauge **14303**. Small center gauge view **14303** includes outline **14308** to indicate that small center gauge view **14303** is the gauge view that is linked to or associated with selected gauge view **14302** and that large center gauge view **14202** may have been selected from multiple gauge view **14101** of Figure 14B.

[0138] When user interface element **14309** of Figure 14C is selected, user interface **502** transitions from displaying selected gauge view **14302** of Figure 14C to displaying settings view **14401** of Figure 14D. Settings view **14401** of Figure 14D is similar to settings view **804** of Figure 8.

[0139] Referring to Figure 14D, degrees Fahrenheit (°F) were originally selected and displayed on small center gauge view **14303**. Upon selection of user interface element **14310**,

degrees Celsius (°C) are selected and displayed on small center gauge view **14303**.

[0140] Referring to Figures 15A to 15D, when selected gauge view **14302** is slid or dragged up, second selected gauge view **1502** is revealed. Additionally, small center gauge view **14303** that is associated with transmission temperature is updated to second small center gauge view **1504**. Second small center gauge view **1504** is a Boost value that is 29.0 pounds per square inch (PSI).

[0141] Upon selection of small top right gauge view **14306** in Figure 15D, selected gauge view **1502** of Figure 15C is updated to selected gauge view **1504** of Figure 15D. Selected gauge view **1504** shows the same PID information as small top right gauge view **14306**. Small top right gauge view **14306** is updated to include outline **1510** and outline **1506** around small center gauge view **1504** is removed.

[0142] Referring to Figure 16A, menu button **504** is selected. Eight gauge view **508** slides partially to the right and down and is made more transparent to enhance the display of menu **1602**. Menu **1602** includes user interface elements **1604**, **1606**, **1608**, **1010**, **1012**, and **1614**, which may also be referred to as "My Gauges" button **1604**, "My Vehicles" button **1606**, "Program" button **1608**, "Diagnostics" button **1610**, "Datalog" button **1612**, and "Settings" button **1614**.

[0143] Selecting button **1604** removes menu **1602** and brings back the most recent gauge view, which in Figure 16A is eight gauge view **508**.

[0144] Selecting button **1606** removes menu **1602** and transitions user interface **502** to view **1616** of Figure 16B. View **1616** may also be referred to as "My Vehicles" view **1616**, includes a user interface element for each vehicle that has been associated with the client device app. User interface element **1618** includes the year, make, and model of the vehicle and

indicates that the local device is attached to the vehicle associated with user interface

[0145] Upon selecting user interface element **1618**, user interface **502** transitions to view **1620** of Figure 16C. View **1620** may also be referred to as vehicle view **1620**, includes user interface elements **1622** and **1624**, identifies the number of technicians to which the vehicle has been shared and identifies the current ECU profile.

[0146] Upon selecting user interface element **1622**, user interface **502** transitions to view **1626** of Figure 16D. View **1626** may also be referred to as Manage Shares view **1626**, includes user interface element **1628**, and lists the technicians to which the vehicle has been shared in one or more user interface elements. As shown, in Figure 16D, the vehicle has not been shared with any technicians.

[0147] Selecting user interface element **1624** brings up a different view (not shown) that allows for the management of ECU profiles. The management of ECU profiles includes: updating one or more parameters within a profile and deleting a profile from the client device.

[0148] Upon selecting user interface element **1628**, user interface **502** transitions to view **1630** of Figure 16E. View **1630** may also be referred to as Manage Shares view **1630**, includes user interface element **1632**, keyboard **1634**, and user interface element **1636**. User interface element **1632** is an edit box that receives a technician's email address that acts as the login information to access a system server, such as system server **102** of Figure 1.

[0149] In one embodiment, view **1630** of user interface **502** is displayed on a client device that is used by a technician that is diagnosing the car to allow the technician to log into the server. Upon selection of the "Done" button on keyboard **1634** or user interface element **1636**, the client device app will attempt to login to the system server and associated (or share) the vehicle with the technician's client device.

[0150] In an alternative embodiment, view **1630** of user interface **502** is displayed on a client device that is used by the owner of the vehicle that is being diagnosed. Upon selection of the "Done" button on keyboard **1634** or user interface element **1636**, the client device app will send the technician's email address to the server, which will then allow the technician to log in and will then allow the vehicle information from the ODB2 port of the vehicle to be shared with a second client device that is operated by a technician. Sharing the vehicle information with the technician's client device allow the technician to diagnose the vehicle, even when the vehicle and the technician are remotely located.

[0151] Referring to Figures 17A, 17B, 17C, upon selection of user interface element **1610** from menu **1602**, user interface **502** displays view **1702**. View **1702** may be referred to as diagnostics view **1702** and displays list **1704** of diagnostic codes with a text description of the code. List **1704** is a list that can be scrolled up and down to show more than one page of information. Figure 17B shows the top of list **1704** and Figure 17C shows the bottom of list **1704**.

[0152] Referring to figures 18A and 18B, upon selection of user interface element **1612** from menu **1602**, user interface **502** displays view **1802**. View **1802**, which may be referred to as "Datalog" view **1802**, displays list **1804** of data logs, below which is user interface element **1806**. List **1804** is a scrollable list that shows the data logs that can be sent to the system server. The data logs store information received by the client device from the local device that the local device received from the automotive controller. Selecting user interface element **1806** sends a data log that has been selected from list **1804** to the system server.

[0153] Referring to Figures 19A, 19B, 19C, and 19D, upon selection of user interface element **1614**, user interface **502** displays view **1902**. View **1902**, which may also be referred to

as "Settings" view **1902**, displays one or more user interface elements that allow the user of the app to view and control various settings related to the app.

[0154] User interface element **1904** displays contact information including a name and an email address. When user interface element **1904** is selected, user interface **502** displays another view (not shown) that allows the user to view and manipulate the contact information, which also includes a phone number and a birthday. The contact information is used by the technician to contact the owner of the vehicle that the local device is connected to.

[0155] When selected, user interface element **1906** displays one or more videos that show how to use the client device app.

[0156] User interface element **1908** is for the development of the client device application itself. When user interface element **1908** selected, the client device app will send the log of information recorded by the client device app via an email to the contact identified in user interface element **1904**.

[0157] User interface element **1910** displays the version of the client device app that is currently running.

[0158] User interface element **1912** displays the version of the firmware running on the local device that is currently running.

[0159] User interface element **1914** displays a receive signal strength indicator (RSSI) that indicates the strength of the wireless signal that is sent by the local device and received by the client device.

[0160] User interface element **1916** is an edit box that contains the internet protocol (IP) address that the client device will use to connect to the server running on the local device.

[0161] User interface element **1918** is a binary selector switch that, when enabled,

allows the app to connect to the server running on the local device.

[0162] User interface element **1920** is a multiple position single selector switch that is used to select which protocol version that the client device app will use to communicate with the server running on the local device.

[0163] Referring to figure 20A, server database **20100** is an embodiment of database **106** that is accessed by system server **102** of Figure 1. Server database **20100** comprises one or more records, which may themselves be databases. The records can be stored on any device of the system. In one embodiment, server database **20100** includes records for vehicles **20102**, technicians **20104**, and engine control unit (ECU) profiles **20106**.

[0164] Vehicles **20102** comprise vehicle records **20200** of Figure 20B that are each associated with a vehicle. Technicians **20104** comprise technician records **20300** that are each associated with a technician. ECU profiles **20106** comprise ECU profile records **20400** that are each associated with an ECU profile.

[0165] Referring to Figure 20B, vehicle record **20200** comprises data and information related to a vehicle. Vehicle identification number (VIN) **20202** is a unique that is assigned to the vehicle by the manufacturer of the vehicle in accordance with international standard ISO 3833. Year **20204** is the model year of the vehicle, which in one embodiment is stored as an unsigned integer. Make **20206** identifies the manufacturer of the vehicle, which in one embodiment is stored as a string of characters in accordance with either the American Standard Code for Information Interchange (ASCII) or Unicode. Model **20208** identifies the model of the vehicle, which in one embodiment is stored as a string of characters. Technicians **20210** are links to technician records **20300** for each technician that has been associated with the vehicle. ECU profiles **20212** are links to ECU profile records **20400** for each ECU profile that has been

associated with the vehicle.

[0166] Referring to Figure 20C, technician record **20300** comprises data and information associated with a technician. Name **20302** is the name of the technician, which in one embodiment is stored as a string of characters. Email **20304** is an email address of the technician that may also serve as a login identifier for the technician and which, in one embodiment, is stored as a string of characters. Vehicles **20308** are links to vehicle records **20200** that are associated with the technician. Client device data **20310** includes data and information about the device that the technician uses to access the system, including: a unique device identifier, operating system (OS) version, client application version, and so on.

[0167] Referring to Figure 20D, ECU profile record **20400** comprises data and information associated with an ECU profile. ECU profile record **20400** includes firmware **20402** and parameters **20408**.

[0168] Firmware **20402** is the firmware that runs on an automotive controller, such as automotive controller **114** of Figure 1. Firmware **20402** includes code **20404** and settings **20406**. Code **20404** are the computer code instructions that allow the automotive controller to operate. Settings **20406** are the settings used to tune the engine for efficiency or performance, including settings for ignition timing advance, spark timing, fuel injection, electronic throttle control, poppet valve timing, boost control, an anti-lock braking system, an automatic transmission, a speed governor, an electronic stability control system, and so forth.

[0169] Parameters **20408** are the parameters for the gauges displayed on a client device, such as client device **110** of Figure 1. Parameter identifier (PID) **20410** is a numeric identifier that uniquely identifies the type of data from the automotive controller associated with the parameter. Name **20412** identifies the name of the parameter, which can include: engine

coolant temperature, speed, revolutions per minute, battery voltage, transmission temperature, boost, calculated load, injector pressure, injector pulse width, throttle position sensor, and so on. Desired max **20414** is a numerical value that indicates a maximum desired value for the parameter. Desired min **20416** is a numerical value that indicates a minimum desired value for the parameter.

[0170] Warning max **20418** is a numerical value that indicates the beginning of an upper warning range. Warning min **20420** is a numerical value that indicates the end of a lower warning range. Continued operation of the vehicle with the values associated with the parameter above warning max **20418** or below warning min **20420** could lead to a breakdown of the engine.

[0171] Defuel max **20422** is a numerical value that indicates the threshold above which the vehicle will be defueled to prevent a breakdown. Defuel min **20424** is a numerical value that indicates the threshold below which the vehicle will be defueled to prevent a breakdown.

[0172] Gauge style **20426** identifies the style of the gauge that will be used to display the parameter values on the client device.

[0173] Available units **20428** is a list of units that can be used to display the values related to parameter **20408**. Selected units **20430** identifies which units of available units **20428** will be used to display the values of parameter **20408**.

[0174] Referring to Figure 21, system **2102** is a system within local device **112** of Figure 1. System **2102** includes application processor **2104** that controls local device **112**. System **2102** includes: external memory interface (EMI) **2106**, general-purpose media interface (GPMI) **2108**, synchronous serial port (SSP) **2110** and controller area network (CAN) interfaces

2112 and **2114**.

[0175] EMI **2106** is connected to memory **2116** and GPMI **2108** is connected to memory **2118**. In one embodiment, memory **2118** is lower speed persistent memory that stores the programs and data run by application processor **2104** using memory **2116.**

[0176] SSP **2110** is connected to Wi-Fi module **2120** to allow for wireless communication. In one embodiment, program instructions stored in one or more of memory **2116** and memory **2118** are executed by application processor **2104** so that local device **112** may function as an access point to which a client device can connect.

[0177] CAN0 interface **2112** is connected to a first CAN transceiver 2124 of a vehicle via the CAN0_HI/LOW link to connector **2122.** CAN1 interface **2114** is connected to a second CAN transceiver **2126** through analog multiplexer **2128** and connector **2122**. Analog multiplexer **2128** is connected to connecter **2122** through two CAN1_HI_B/LOW_B lines. Input/Output multiplexor control **2113** is also connected to analog multiplexer **2128**. In one embodiment, connector **2122** is an RJ45 connector and an adapter (not shown) is connected between connector **2122** and the on-board diagnostics (OBD) port on the vehicle.

[0178] Although embodiments of the present disclosure have been described in detail, those skilled in the art should understand that they may make various changes, substitutions and alterations herein without departing from the spirit and scope of the present disclosure. Accordingly, all such changes, substitutions and alterations are intended to be included within the scope of the present disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures.

CLAIMS:

1. A method of updating an engine control unit (ECU) of a vehicle connected to a network, the network including a local device that is electrically connected to the ECU, a client device connected to the local device, and a server connected to the client device, the method comprising:

establishing a data connection between the local device and the ECU using a diagnostic port;

establishing a wireless network connection between the local device and the client device;

sending a first vehicle data request from the client device to the local device;

retrieving, by the local device, first vehicle data from the ECU based on the first vehicle data request;

transmitting, by the local device, the first vehicle data to the client device;

sending a second vehicle data request from the client device to the local device;

retrieving, by the local device, second vehicle data from the ECU based on the second vehicle data request, wherein the second vehicle data includes at least one parameter for the ECU;

transmitting, by the local device, the second vehicle data to the client device;

transmitting, by the client device, a request for updated firmware, to the server;

receiving, at the client device, updated firmware from the server including a list of a plurality of sets of preconfigured parameters for the ECU;

displaying, at the client device, the list of the plurality of sets of preconfigured parameters for the ECU;

making, at the client device, a selection of a set of preconfigured parameters for the ECU from the list of the plurality of sets of preconfigured parameters for the ECU;

receiving, at the local device, the updated firmware from the client device including the selected set of preconfigured parameters for the ECU; and,

loading, from the local device, the updated firmware onto the ECU, wherein loading the updated firmware reconfigures at least one parameter for the ECU and the second vehicle data.

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2. The method of claim 1, further comprising:

receiving, at the local device, a parameter identifier (PID) request from the client device;

recording the PID request in the local device; and,

receiving, at the local device, PID data from the ECU in response to the PID request.

3. The method of claim 2, wherein the PID request relates to one of engine coolant temperature, speed, revolutions per minute, battery voltage, transmission temperature, boost, calculated load, injector pressure, injector pulse width, and throttle position sensor.

4. The method of claim 3, further comprising:

sending, from the local device, the PID data to the client device, in response to the PID request; and

displaying, at the client device, one or more gauges based on the PID data.

5. The method of claim 4, further comprising:

receiving, at the local device, an engine check request from the client device.

6. The method of claim 5, further comprising:

retrieving, by the local device, an engine code from the ECU; and,

retrieving, by the local device, frozen data associated with the engine code from the ECU.

7. The method of claim 6, further comprising:

sending, from the local device, a check engine response to the client device that includes the engine code and the frozen data.

8. The method of claim 7, further comprising:

sending, from the client device, the engine code and the frozen data to the server;

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sending, from the client device, a request for corrective firmware for the ECU to the server based on the engine code;

storing the corrective firmware for the ECU on the client device;

sending, by the client device, the corrective firmware for the ECU to the local device; and,

sending, by the local device, the corrective firmware for the ECU to the ECU.

9. A method of updating an engine control unit (ECU) of a vehicle connected to a network, the network including a local device connected to the ECU, a client device connected to the local device, and a system server connected to the client device, the method comprising:

establishing a data connection between the local device and the ECU;

establishing a wireless network connection between the client device and the local device;

sending a first vehicle data request from the client device to the local device;

retrieving, by the local device, first vehicle data, from the ECU based on the first vehicle data request, wherein the first vehicle data includes parameter identifier (PID) data;

transmitting, by the local device, the PID data to the client device;

displaying, on the client device, the PID data received from the local device on a gauge view of a multiple gauge view in a user interface;

sending a second vehicle data request from the client device to the local device;

retrieving, by the local device, second vehicle data, from the ECU based on the second vehicle data request, wherein the second vehicle data includes a parameter for the ECU;

transmitting, by the local device, the second vehicle data, to the client device;

transmitting, by the client device, a request for updated parameters for the ECU, to the system server;

transmitting, from the system server, updated firmware for the ECU including a plurality of sets of preconfigured operating system (OS) parameters for the ECU;

receiving, at the client device, a response from the system server that includes

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the updated firmware for the ECU;

displaying, at the client device, a list of the one or more sets of preconfigured OS parameters for the ECU;

making, at the client device, a selection of a set of preconfigured OS parameters for the ECU from the list of the one or more sets of preconfigured OS parameters for the ECU;

sending, by the client device, the updated firmware for the ECU to the local device including the selected set of preconfigured OS parameters for the ECU; and,

loading, from the local device, the updated firmware for the ECU onto the ECU, wherein loading the updated firmware for the ECU reconfigures at least one of the OS parameters for the ECU and the second vehicle data.

10. The method of claim 9, further comprising:

sending, by the client device, a PID request to the local device for the PID data.

11. The method of claim 10, further comprising:

receiving, at the client device, the PID data from the local device, in response to the PID request and after the PID request is recorded by the local device.

12. The method of claim 11, further comprising:

sending, from the client device, an engine check request to the local device.

13. The method of claim 12, further comprising:

receiving, at the client device, an engine check response from the local device.

14. The method of claim 13, wherein the engine check response comprises an engine code and frozen data associated with the engine code.

15. The method of claim 14, further comprising:

displaying, on the client device, the engine code.

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16. The method of claim 15, further comprising:

sending, from the client device, the engine code and the frozen data to the system server;

sending, from the client device, a request for corrective firmware for the ECU to the system server based on the engine code;

storing the corrective firmware for the ECU on the client device;

sending, by the client device, the corrective firmware for the ECU to the local device; and,

sending, by the local device, the corrective firmware for the ECU to the ECU.

17. A method of updating an engine control unit (ECU) of a vehicle connected to a network, the network including a local device connected to the ECU, a client device connected to the local device, a first server connected to the client device, and a second server connected to the first server, the method comprising:

establishing a network connection between the local device and the ECU;

establishing a network connection between the local device and the client device;

sending a first vehicle data request from the client device to the local device;

retrieving, by the local device, first vehicle data from the ECU based on the first vehicle data request;

transmitting, by the local device, the first vehicle data to the client device;

sending a second vehicle data request from the client device to the local device;

retrieving, by the local device, second vehicle data from the ECU based on the second vehicle data request, wherein the second vehicle data includes at least one parameter for the ECU;

transmitting, by the local device, the second vehicle data to the client device;

transmitting, by the client device, a request for one of updated parameters for the ECU and updated firmware for the ECU, to the first server;

receiving, at the first server, the request from the client device for the one of the updated parameters for the ECU and the updated firmware for the ECU;

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receiving, at the second server, the request for the one of the updated parameters for the ECU and the updated firmware for the ECU, from the first server;

receiving, at the first server, the one of the updated parameters for the ECU and the updated firmware for the ECU, from the second server;

sending, from the first server, the one of the updated parameters for the ECU and the updated firmware for the ECU, to the client device;

displaying, at the client device, a list of a plurality of sets of updated parameters for the ECU;

making, at the client device, a selection of a set of updated parameters for the ECU from the list of a plurality of sets of updated parameters for the ECU;

sending, from the client device, one of the selected set of updated parameters for the ECU and the updated firmware for the ECU to the local device; and,

loading, from the local device, the one of the selected set of updated parameters for the ECU and the updated firmware for the ECU, onto the ECU, wherein loading the one of the selected set of updated parameters for the ECU and the updated firmware for the ECU reconfigures at least one of the parameters for the ECU and the second vehicle data.

18. The method of claim 17, further comprising:

sending, from the first server, a request to the second server for the updated firmware for the ECU.

19. The method of claim 18, wherein the client device comprises a first client device, further comprising:

receiving, at the local device, an updated engine setting from the first client device.

20. The method of claim 19, wherein the network further includes a second client device connected to the first client device, further comprising:

receiving, at the second client device, engine data from the first client device

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after the updated engine setting is loaded to the ECU.

21. The method of claim 17, further comprising:

receiving, at the local device, an engine check request from the client device;

retrieving, by the local device, an engine code from the ECU;

retrieving, by the local device, frozen data associated with the engine code from the ECU;

sending, from the local device, a check engine response to the client device that includes the engine code and the frozen data;

sending, from the client device, the engine code and the frozen data to the first server;

sending, from the client device, a request for corrective firmware for the ECU to the first server based on the engine code;

storing the corrective firmware for the ECU on the client device;

sending, by the client device, the corrective firmware for the ECU to the local device; and,

sending, by the local device, the corrective firmware for the ECU to the ECU.

22. A method of updating an engine control unit (ECU) of a vehicle connected to a network, the network including a local device connected to the ECU, a client device connected to the local device, and a system server connected to the client device, the method comprising:

establishing a data connection between the local device and the ECU;

establishing a wireless network connection between the client device and the local device;

sending a first vehicle data request from the client device to the local device;

retrieving, by the local device, first vehicle data, from the ECU based on the first vehicle data request, wherein the first vehicle data includes parameter identifier (PID) data;

transmitting, by the local device, the PID data to the client device;

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displaying, on the client device, the PID data received from the local device on a gauge view of a multiple gauge view in a user interface;

sending a second vehicle data request from the client device to the local device;

retrieving, by the local device, second vehicle data, from the ECU based on the second vehicle data request, wherein the second vehicle data includes an ECU parameter;

transmitting, by the local device, the second vehicle data, to the client device;

transmitting, by the client device, a request for updated parameters, to the system server;

transmitting, from the system server, updated firmware including one or more sets of preconfigured ECU operating system (OS) parameters;

receiving, at the client device, a response from the system server that includes the updated firmware;

displaying, at the client device, a list of the one or more sets of preconfigured ECU OS parameters;

making, at the client device, a selection of a set of preconfigured ECU OS parameters from the list of the one or more sets of preconfigured ECU OS parameters;

sending, by the client device, the updated firmware to the local device including the selected set of preconfigured ECU OS parameters;

loading, from the local device, the updated firmware onto the ECU, wherein loading the updated firmware reconfigures at least one of the ECU parameters and the second vehicle data;

sending, by the client device, a PID request to the local device for the PID data;

receiving, at the client device, the PID data from the local device after the PID request is recorded by the local device;

sending, from the client device, an engine check request to the local device;

receiving, at the client device, an engine check response from the local device wherein the engine check response comprises an engine code and frozen data associated with the engine code;

displaying, on the client device, the engine code;

sending, from the client device, the engine code and the frozen data to the

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system server;

sending, from the client device, a request for corrective firmware to the system server based on the engine code;

storing the corrective firmware on the client device;

sending, by the client device, the corrective firmware to the local device;

sending, by the local device, the corrective firmware to the ECU;

linking to a plurality of technician records for each technician that has been associated with the vehicle;

sending, by a client device app, a log of information recorded by the client device to a contact identified in a user interface element;

updating specific engine tuning parameters to values received from the local device tuned for a specific configuration of the vehicle; and,

reducing fuel supply to an engine of the vehicle to protect the engine when a revolutions per minute PID is below a minimum desired threshold or above a maximum desired threshold.

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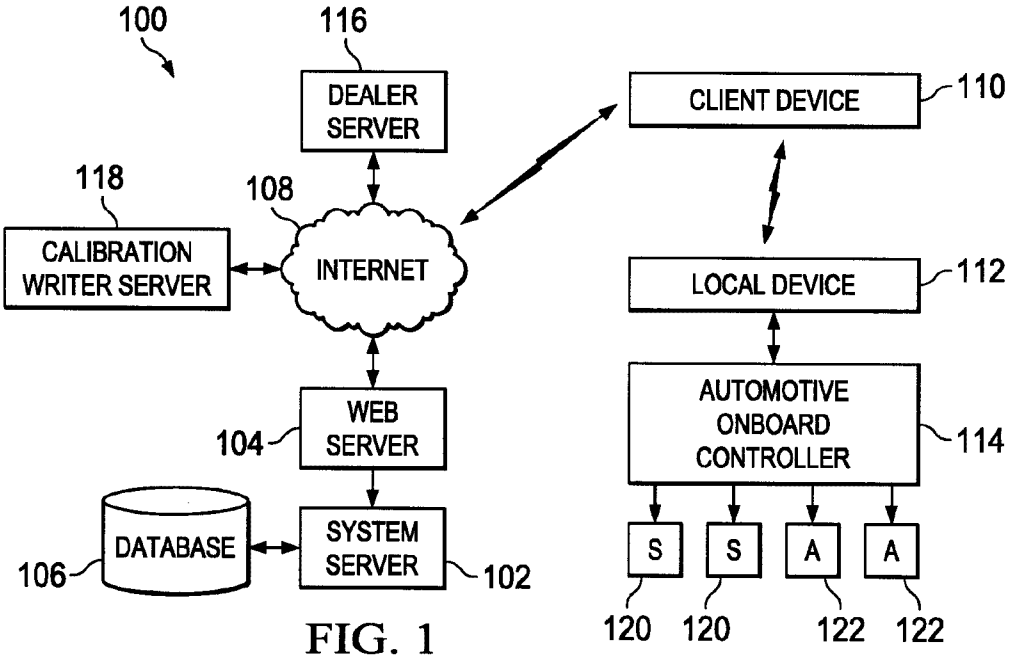

100
116
DEALER SERVER
CLIENT DEVICE
110
118
108
CALIBRATION WRITER SERVER
INTERNET
LOCAL DEVICE
112
WEB SERVER
104
AUTOMOTIVE ONBOARD CONTROLLER
114
DATABASE
106
SYSTEM SERVER
102
S
S
A
A
120
120
122
122

FIG. 1

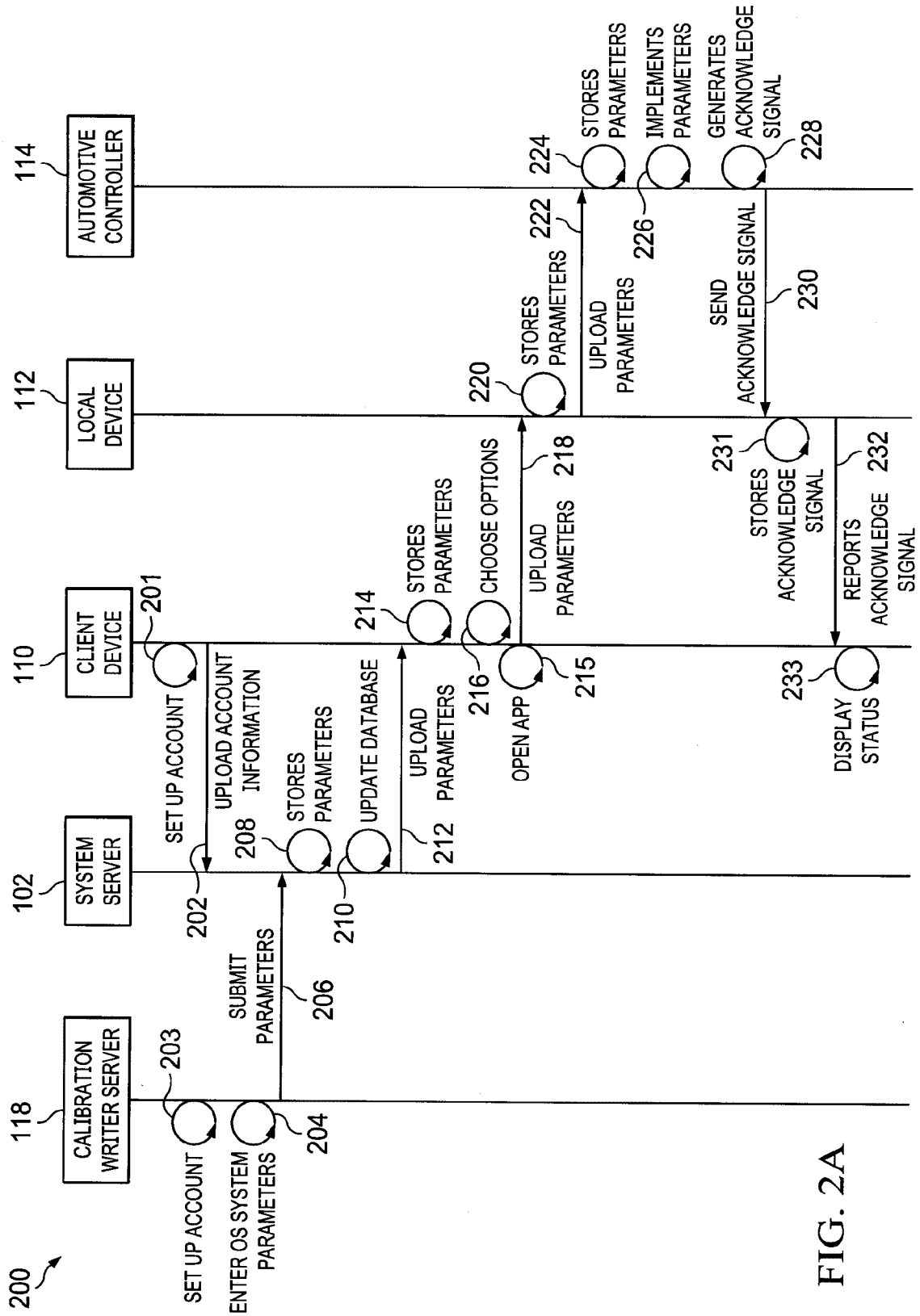

200
118
CALIBRATION WRITER SERVER
102
SYSTEM SERVER
110
CLIENT DEVICE
112
LOCAL DEVICE
114
AUTOMOTIVE CONTROLLER
SET UP ACCOUNT
203
ENTER OS SYSTEM PARAMETERS
204
SUBMIT PARAMETERS
206
SET UP ACCOUNT
202
UPLOAD ACCOUNT INFORMATION
201
STORES PARAMETERS
208
UPDATE DATABASE
210
UPLOAD PARAMETERS
212
STORES PARAMETERS
214
CHOOSE OPTIONS
216
OPEN APP
215
UPLOAD PARAMETERS
218
STORES PARAMETERS
220
UPLOAD PARAMETERS
222
STORES PARAMETERS
224
IMPLEMENTS PARAMETERS
226
GENERATES ACKNOWLEDGE SIGNAL
228
SEND ACKNOWLEDGE SIGNAL
230
STORES ACKNOWLEDGE SIGNAL
231
REPORTS ACKNOWLEDGE SIGNAL
232
DISPLAY STATUS
233

FIG. 2A

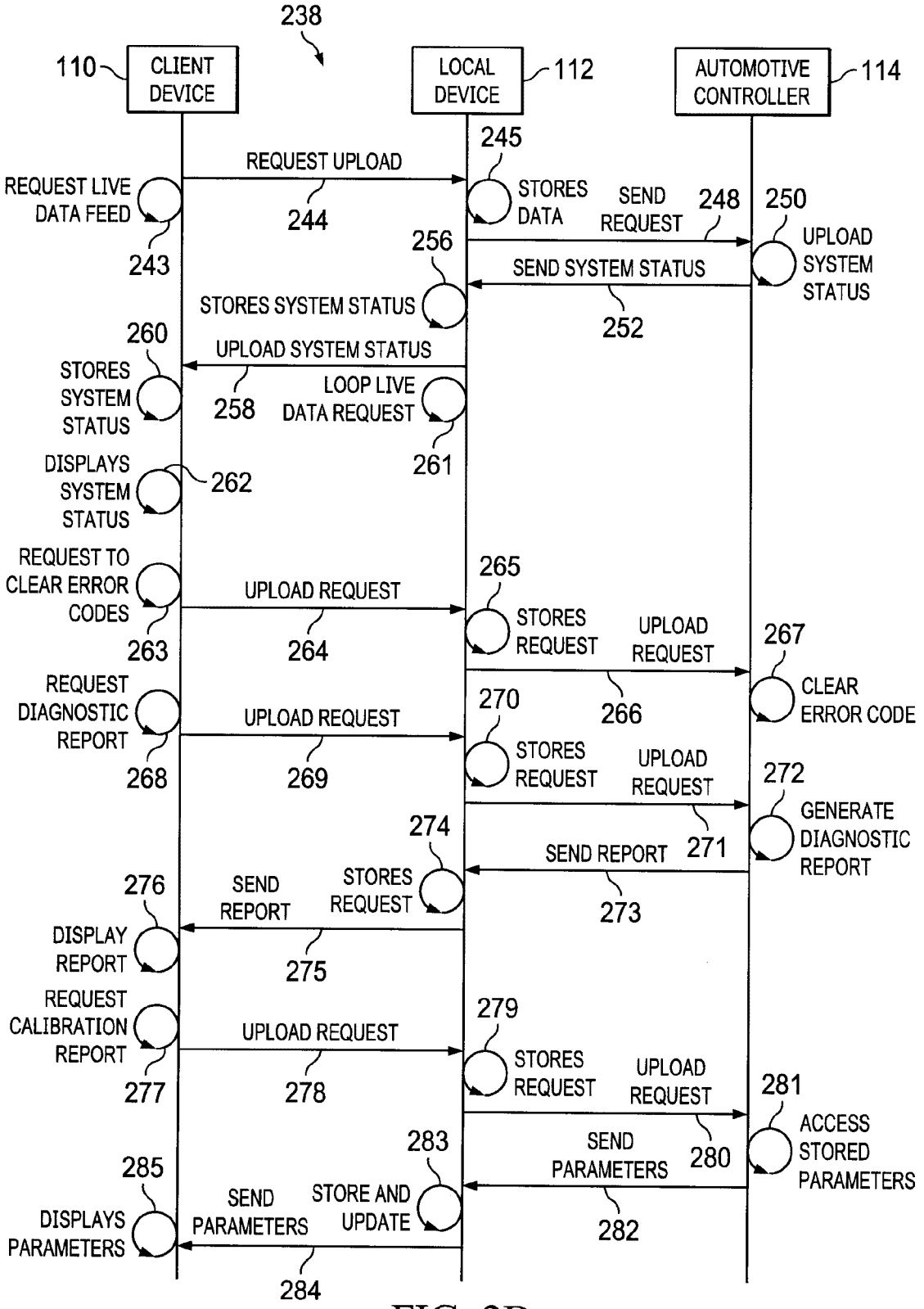

238
110
CLIENT DEVICE
LOCAL DEVICE
112
AUTOMOTIVE CONTROLLER
114
245
REQUEST UPLOAD
REQUEST LIVE DATA FEED
244
STORES DATA
SEND REQUEST
248
250
UPLOAD SYSTEM STATUS
243
256
SEND SYSTEM STATUS
STORES SYSTEM STATUS
252
260
UPLOAD SYSTEM STATUS
STORES SYSTEM STATUS
258
LOOP LIVE DATA REQUEST
261
DISPLAYS SYSTEM STATUS
262
REQUEST TO CLEAR ERROR CODES
265
UPLOAD REQUEST
263
264
STORES REQUEST
UPLOAD REQUEST
267
266
CLEAR ERROR CODE
REQUEST DIAGNOSTIC REPORT
270
UPLOAD REQUEST
STORES REQUEST
UPLOAD REQUEST
272
268
269
GENERATE DIAGNOSTIC REPORT
274
SEND REPORT
271
276
SEND REPORT
STORES REQUEST
273
DISPLAY REPORT
275
REQUEST CALIBRATION REPORT
279
UPLOAD REQUEST
STORES REQUEST
UPLOAD REQUEST
281
277
278
ACCESS STORED PARAMETERS
283
SEND PARAMETERS
280
285
SEND PARAMETERS
STORE AND UPDATE
DISPLAYS PARAMETERS
282
284

FIG. 2B

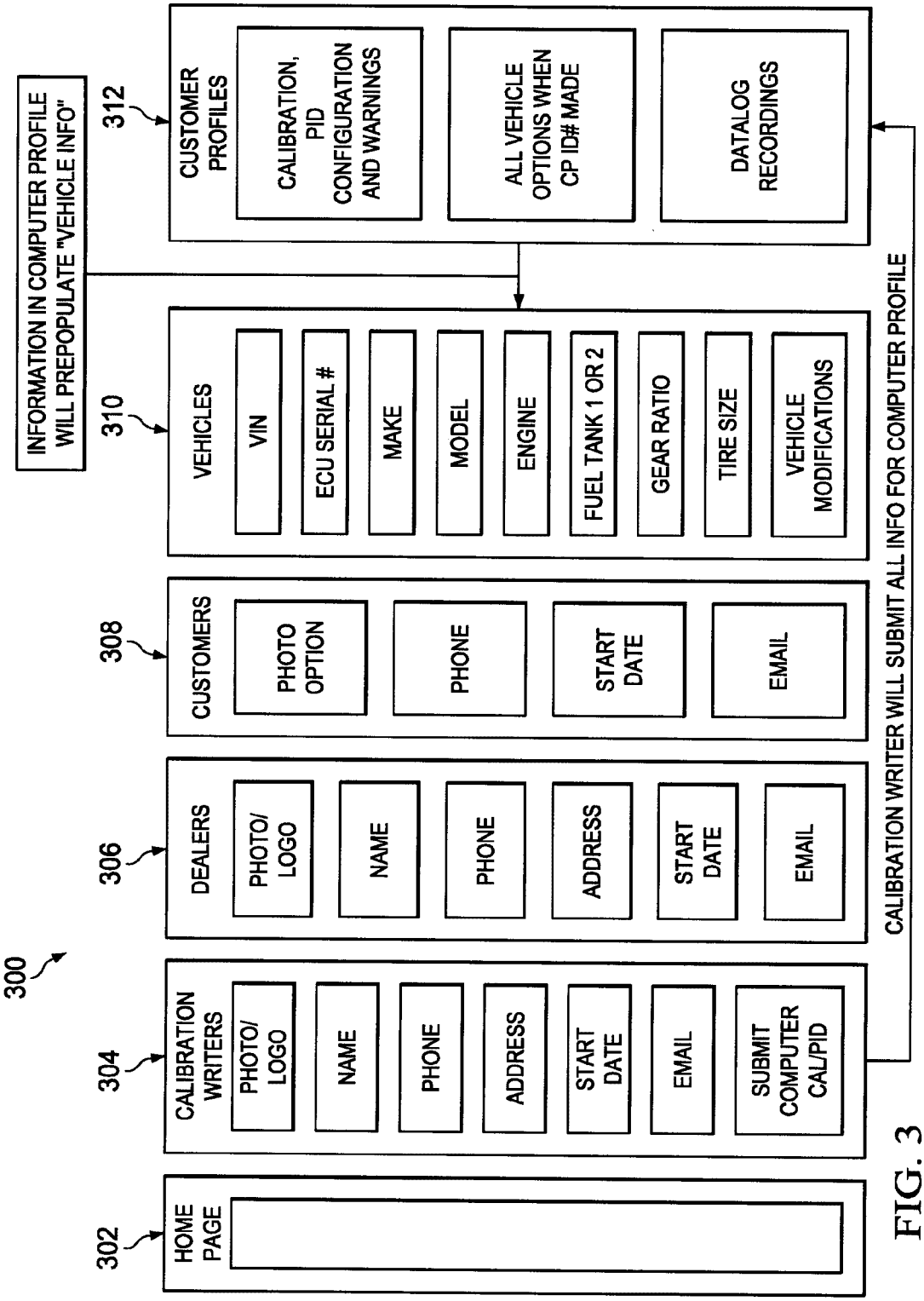

300
302
HOME PAGE
304
CALIBRATION WRITERS
PHOTO/ LOGO
NAME
PHONE
ADDRESS
START DATE
EMAIL
SUBMIT COMPUTER CAL/PID
306
DEALERS
PHOTO/ LOGO
NAME
PHONE
ADDRESS
START DATE
EMAIL
308
CUSTOMERS
PHOTO OPTION
PHONE
START DATE
EMAIL
310
VEHICLES
VIN
ECU SERIAL #
MAKE
MODEL
ENGINE
FUEL TANK 1 OR 2
GEAR RATIO
TIRE SIZE
VEHICLE MODIFICATIONS
312
CUSTOMER PROFILES
CALIBRATION, PID CONFIGURATION AND WARNINGS
ALL VEHICLE OPTIONS WHEN CP ID# MADE
DATALOG RECORDINGS
INFORMATION IN COMPUTER PROFILE WILL PREPOPULATE "VEHICLE INFO"
CALIBRATION WRITER WILL SUBMIT ALL INFO FOR COMPUTER PROFILE

FIG. 3

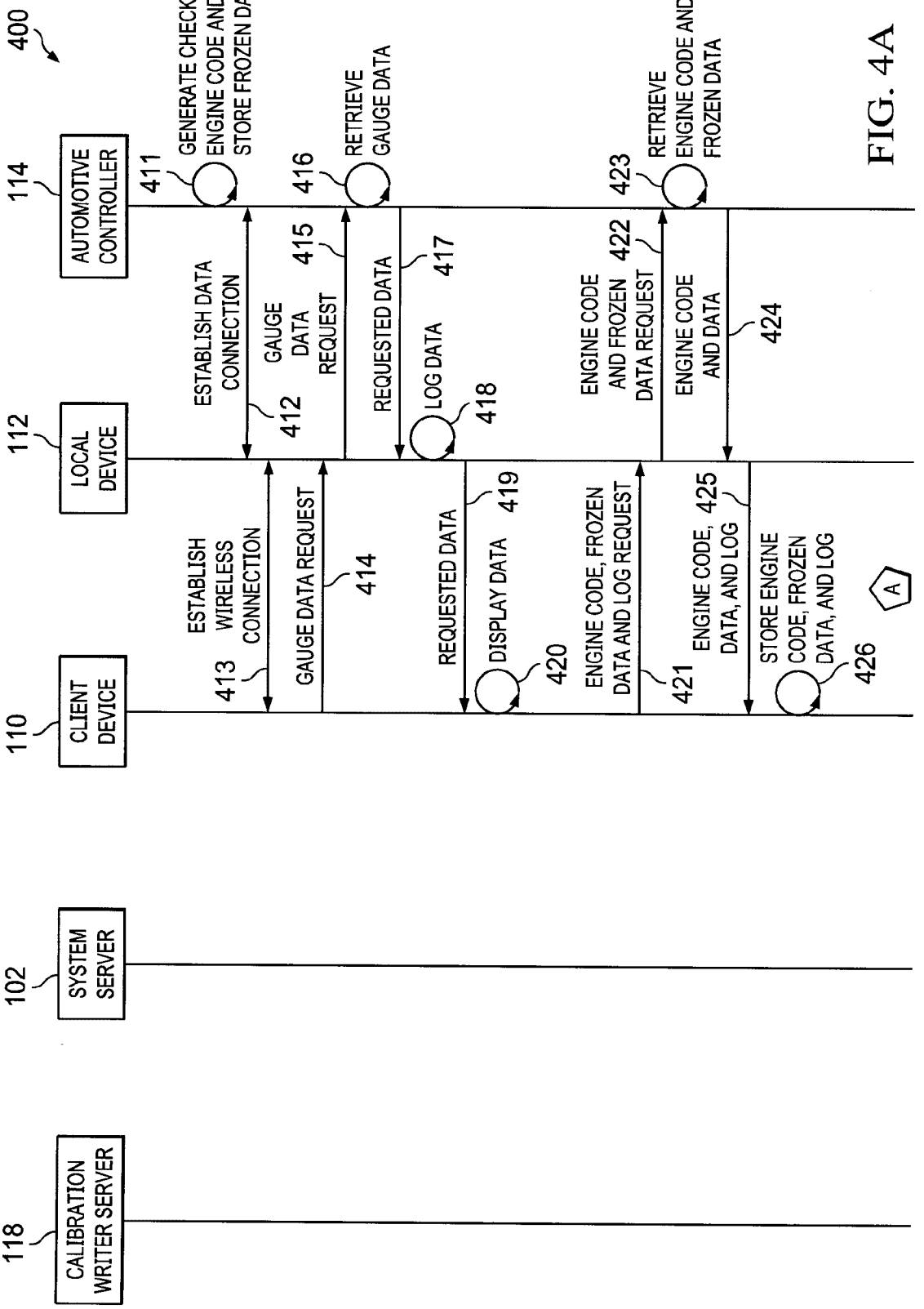

400
114
AUTOMOTIVE CONTROLLER
112
LOCAL DEVICE
110
CLIENT DEVICE
102
SYSTEM SERVER
118
CALIBRATION WRITER SERVER
411
GENERATE CHECK ENGINE CODE AND STORE FROZEN DATA
412
ESTABLISH DATA CONNECTION
413
ESTABLISH WIRELESS CONNECTION
414
GAUGE DATA REQUEST
415
GAUGE DATA REQUEST
416
RETRIEVE GAUGE DATA
417
REQUESTED DATA
418
LOG DATA
419
REQUESTED DATA
420
DISPLAY DATA
421
ENGINE CODE, FROZEN DATA AND LOG REQUEST
422
ENGINE CODE AND FROZEN DATA REQUEST
423
RETRIEVE ENGINE CODE AND FROZEN DATA
424
ENGINE CODE AND DATA
425
ENGINE CODE, DATA, AND LOG
426
STORE ENGINE CODE, FROZEN DATA, AND LOG
A

FIG. 4A

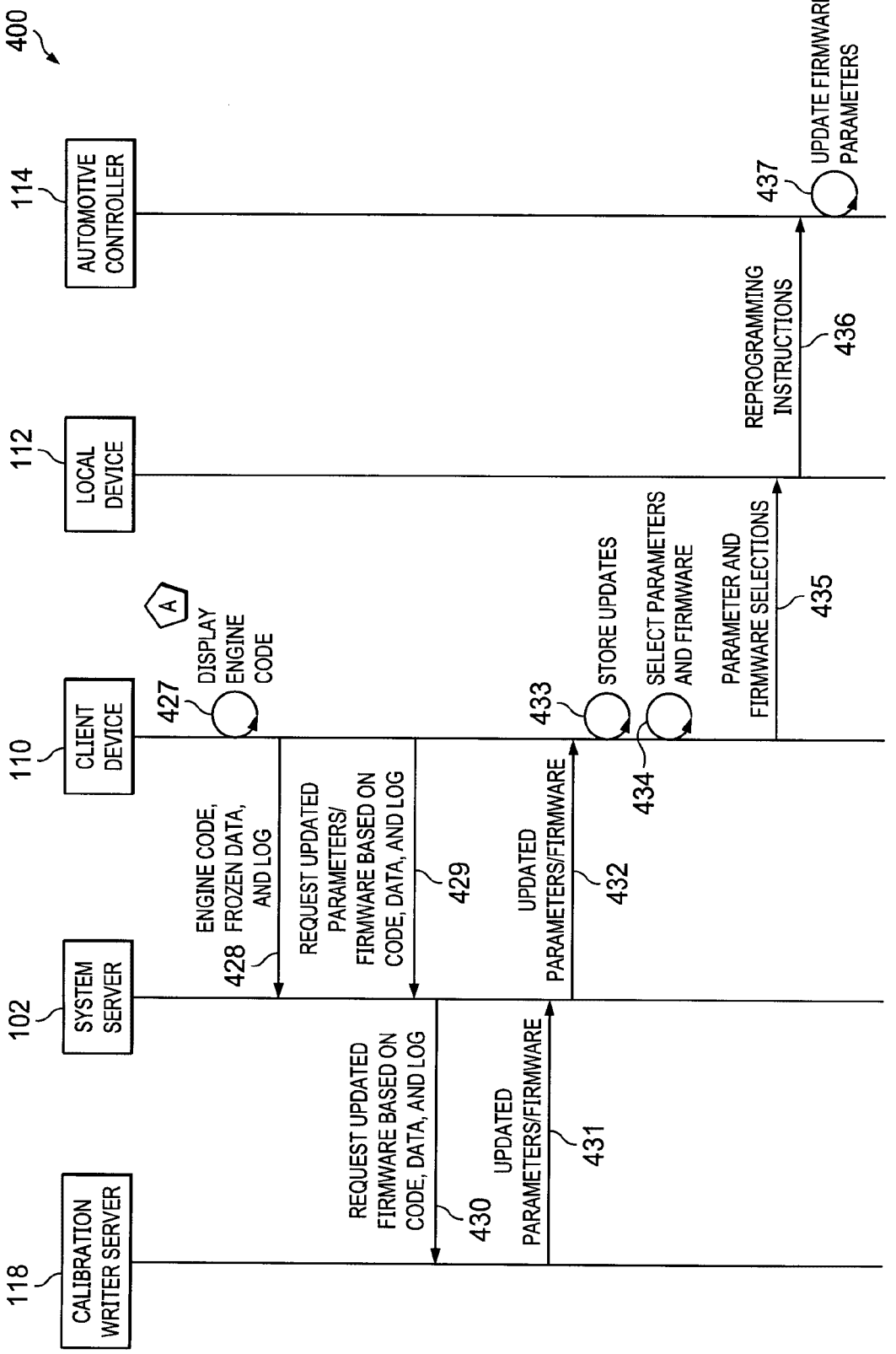

400
118
CALIBRATION WRITER SERVER
102
SYSTEM SERVER
110
CLIENT DEVICE
112
LOCAL DEVICE
114
AUTOMOTIVE CONTROLLER
A
427
DISPLAY ENGINE CODE
428
ENGINE CODE, FROZEN DATA, AND LOG
429
REQUEST UPDATED PARAMETERS/ FIRMWARE BASED ON CODE, DATA, AND LOG
430
REQUEST UPDATED FIRMWARE BASED ON CODE, DATA, AND LOG
431
UPDATED PARAMETERS/FIRMWARE
432
UPDATED PARAMETERS/FIRMWARE
433
STORE UPDATES
434
SELECT PARAMETERS AND FIRMWARE
435
PARAMETER AND FIRMWARE SELECTIONS
436
REPROGRAMMING INSTRUCTIONS
437
UPDATE FIRMWARE/ PARAMETERS

FIG. 4B

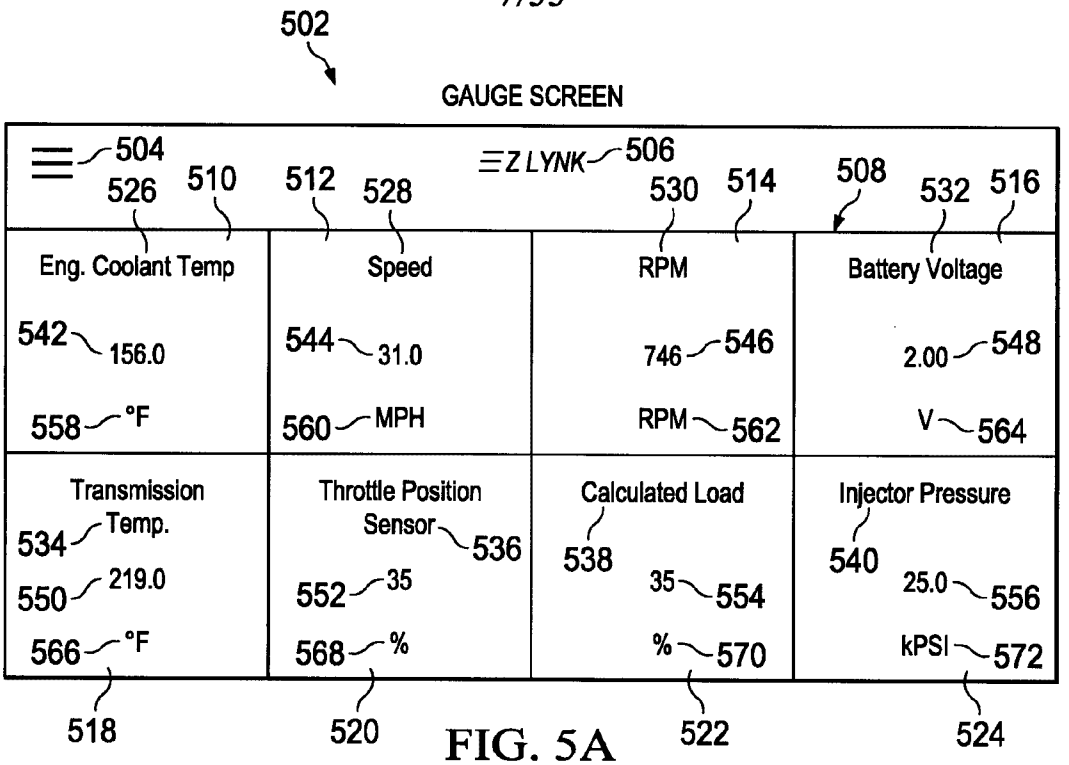

502
GAUGE SCREEN
504
526
510
512
528
ZLYNK
506
530
514
508
532
516
Eng. Coolant Temp
Speed
RPM
Battery Voltage
542
156.0
544
31.0
746
546
2.00
548
558
°F
560
MPH
RPM
562
V
564
Transmission Temp.
534
Throttle Position Sensor
536
Calculated Load
538
Injector Pressure
540
550
219.0
552
35
35
554
25.0
556
566
°F
568
%
%
570
kPSI
572
518
520
522
524

FIG. 5A

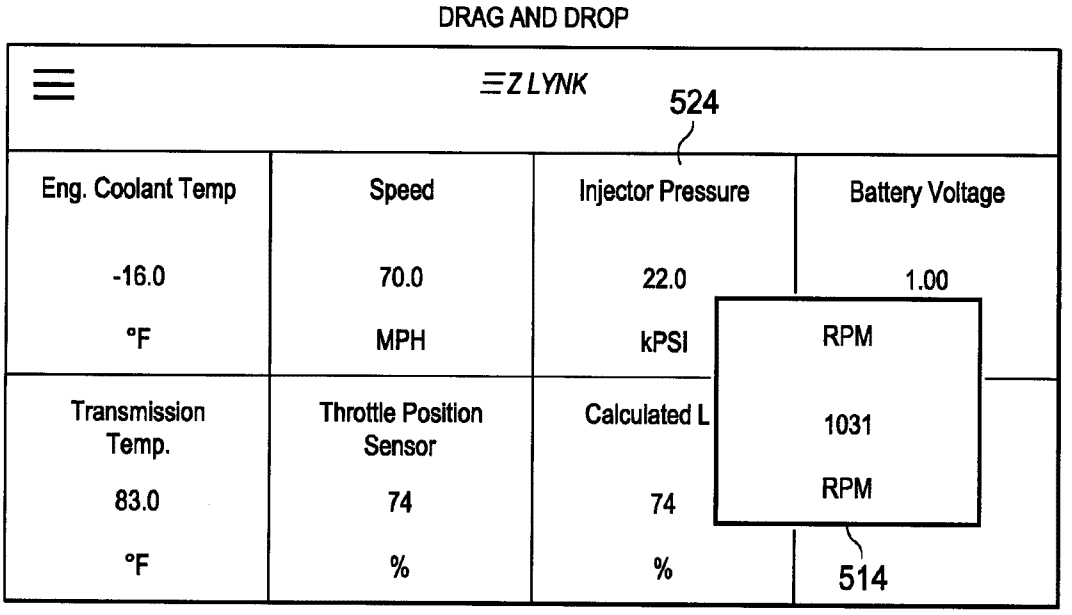

DRAG AND DROP
ZLYNK
524
Eng. Coolant Temp
Speed
Injector Pressure
Battery Voltage
-16.0
70.0
22.0
1.00
°F
MPH
kPSI
RPM
Transmission Temp.
Throttle Position Sensor
Calculated L
1031
83.0
74
74
RPM
°F
%
%
514

FIG. 5B

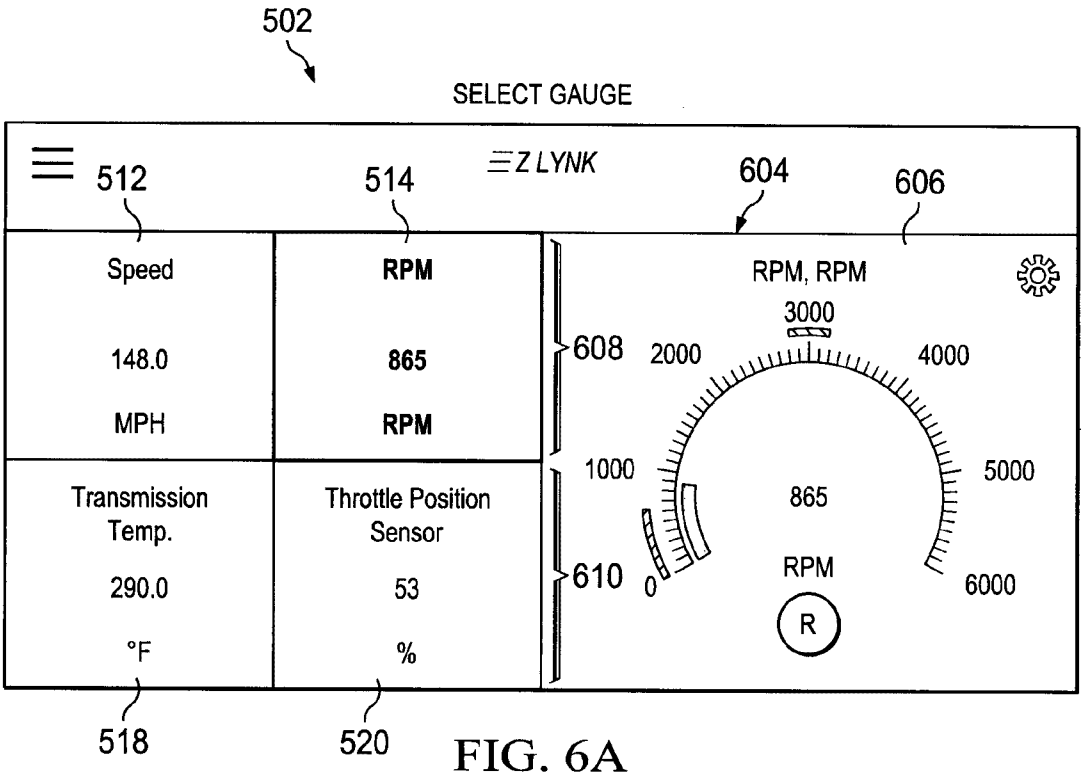

502
SELECT GAUGE
512
514
Z LYNK
604
606
Speed
148.0
MPH
RPM
865
RPM
608
610
RPM, RPM
3000
2000
4000
1000
5000
865
0
RPM
6000
R
Transmission Temp.
290.0
°F
Throttle Position Sensor
53
%
518
520

FIG. 6A

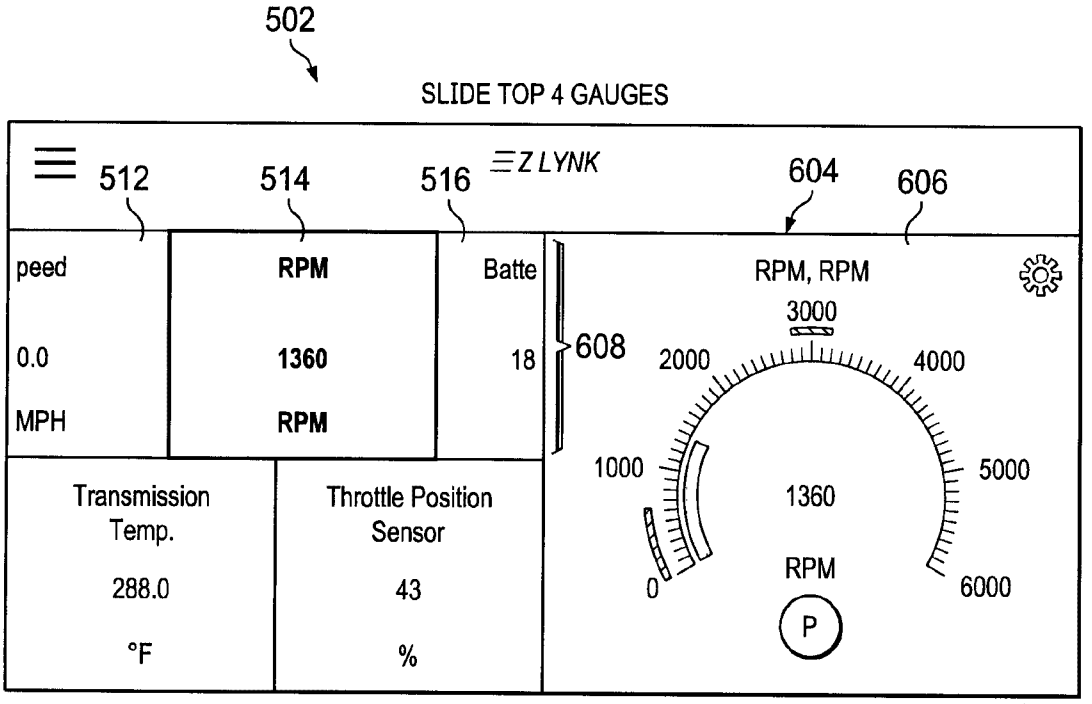

502
SLIDE TOP 4 GAUGES
512
514
516
Z LYNK
604
606
peed
0.0
MPH
RPM
1360
RPM
Batte
18
608
RPM, RPM
3000
2000
4000
1000
5000
1360
0
RPM
6000
P
Transmission Temp.
288.0
°F
Throttle Position Sensor
43
%

FIG. 6B

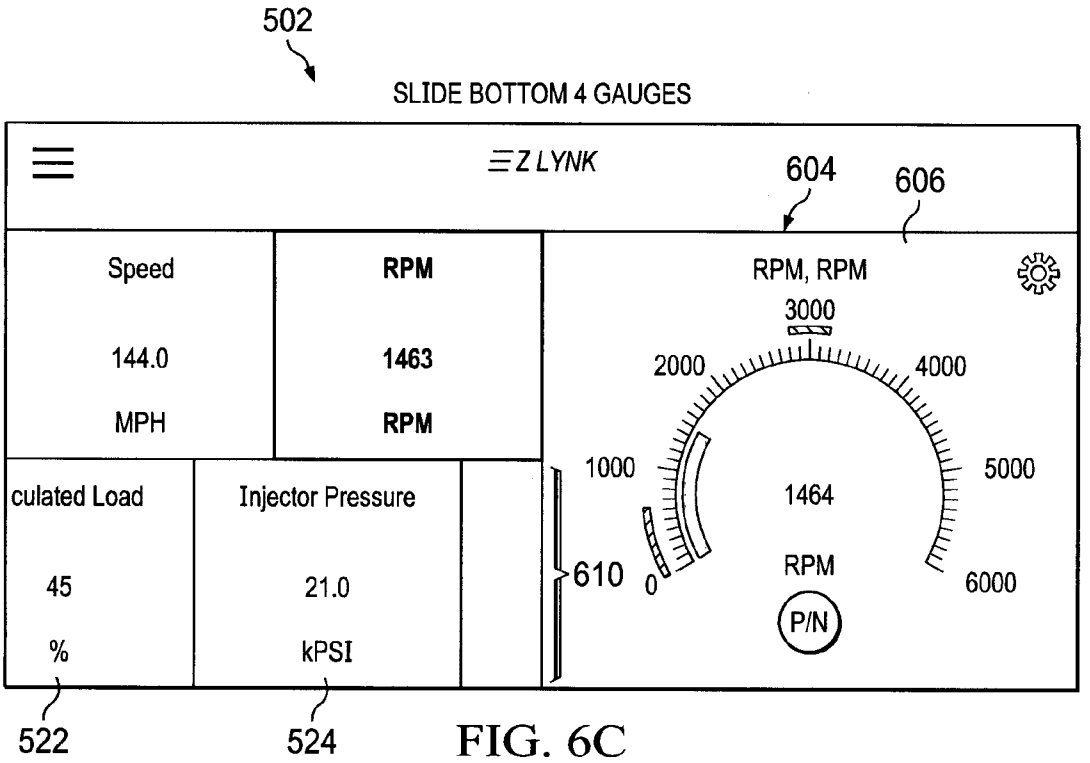

502
SLIDE BOTTOM 4 GAUGES
EZ LYNK
604
606
Speed
144.0
MPH
RPM
1463
RPM
culated Load
45
%
Injector Pressure
21.0
kPSI
610
RPM, RPM
3000
2000
4000
1000
5000
1464
RPM
0
6000
P/N
522
524

FIG. 6C

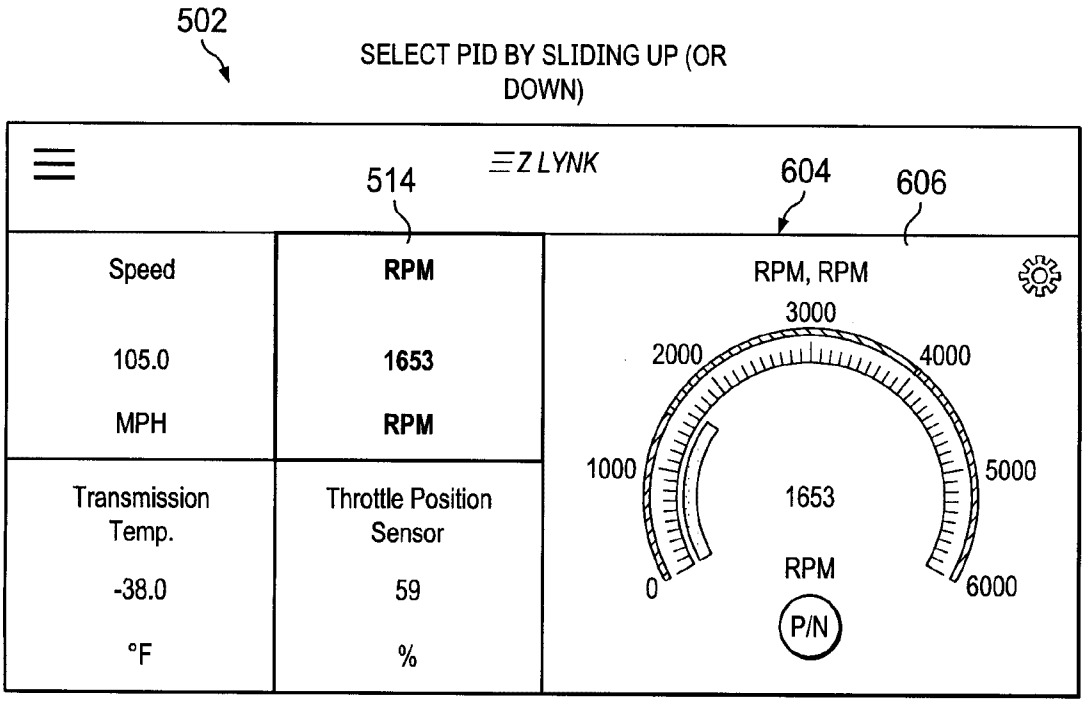

502
SELECT PID BY SLIDING UP (OR DOWN)
EZ LYNK
514
604
606
Speed
105.0
MPH
RPM
1653
RPM
Transmission Temp.
-38.0
°F
Throttle Position Sensor
59
%
RPM, RPM
3000
2000
4000
1000
5000
1653
RPM
0
6000
P/N

FIG. 7A

SELECT PID BY SLIDING UP (OR DOWN)

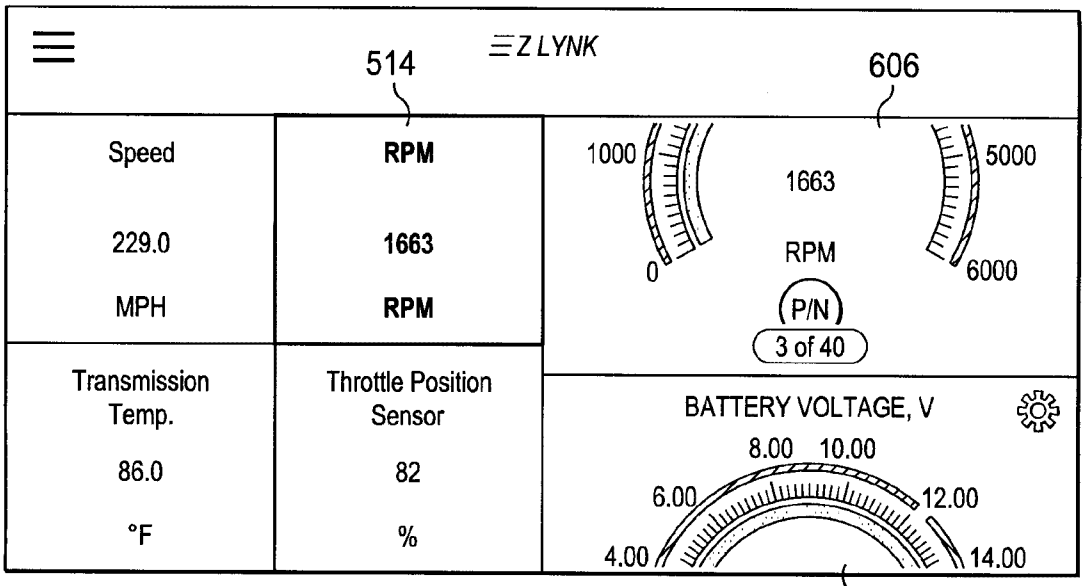


FIG. 7B

SELECT PID BY SLIDING UP (OR DOWN)

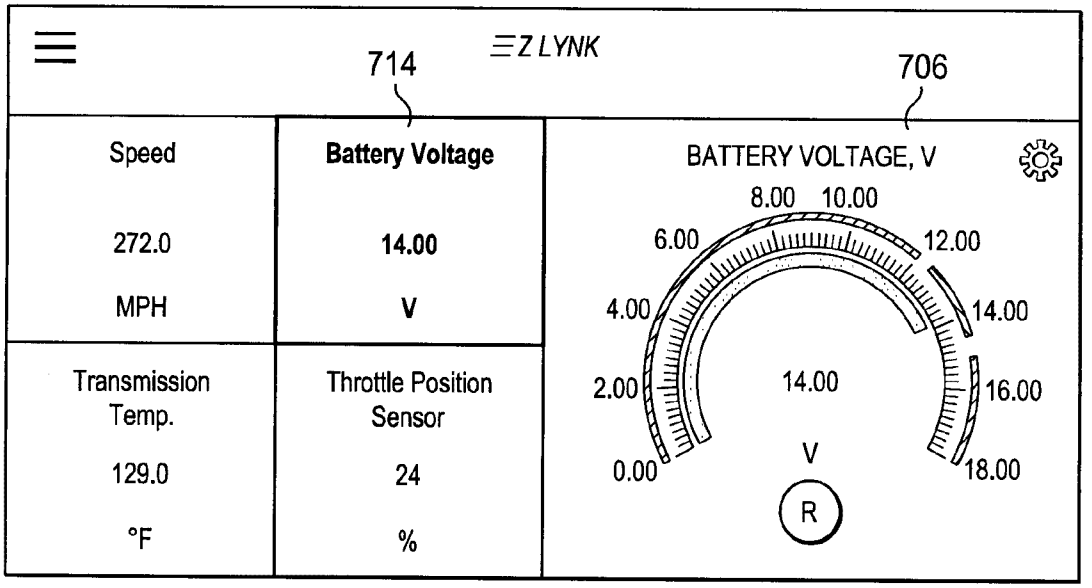


FIG. 7C

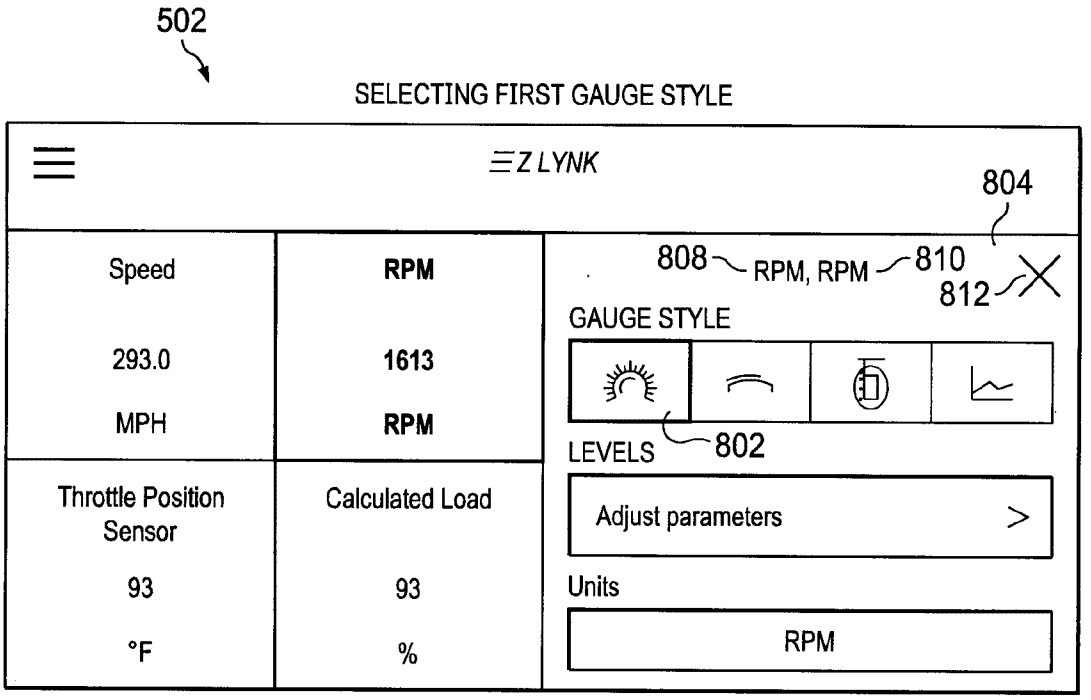

502
SELECTING FIRST GAUGE STYLE
EZ LYNK
804
Speed
RPM
808
RPM, RPM
810
812
293.0
1613
MPH
RPM
GAUGE STYLE
LEVELS
802
Throttle Position Sensor
Calculated Load
Adjust parameters
93
93
Units
°F
%
RPM

FIG. 8A

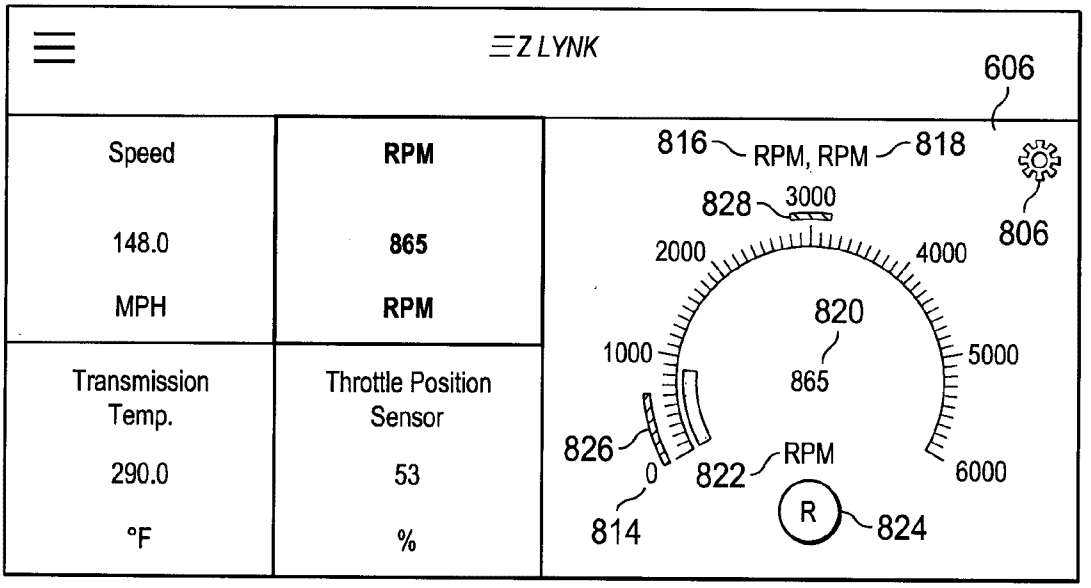

SELECTING FIRST GAUGE STYLE
EZ LYNK
606
Speed
RPM
816
RPM, RPM
818
828
3000
806
148.0
865
2000
4000
MPH
RPM
820
1000
5000
865
Transmission Temp.
Throttle Position Sensor
826
RPM
822
6000
290.0
53
0
814
R
824
°F
%

FIG. 8B

SELECTING SECOND GAUGE STYLE

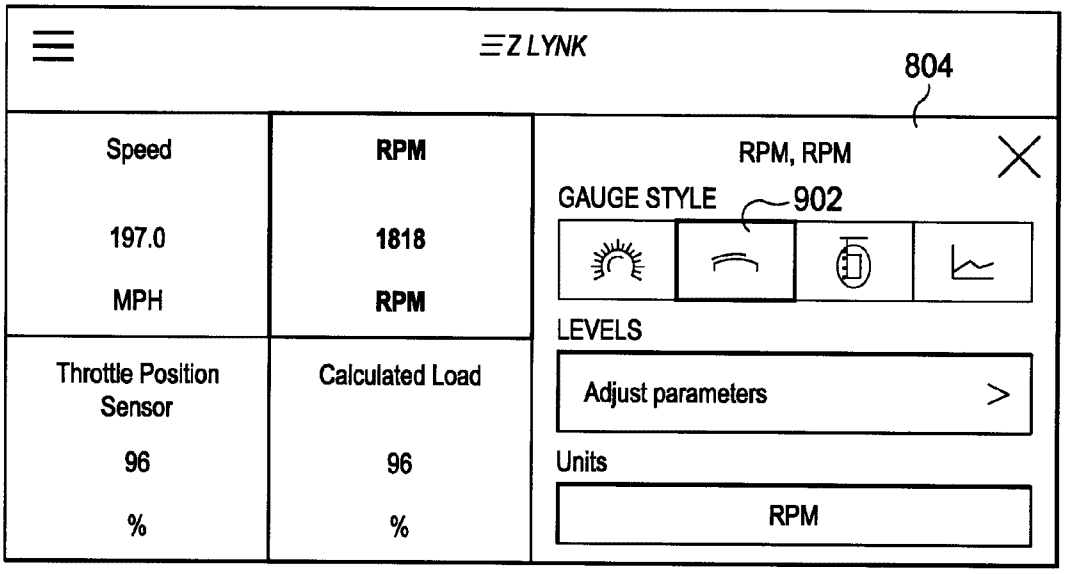


FIG. 9A

SELECTING SECOND GAUGE STYLE

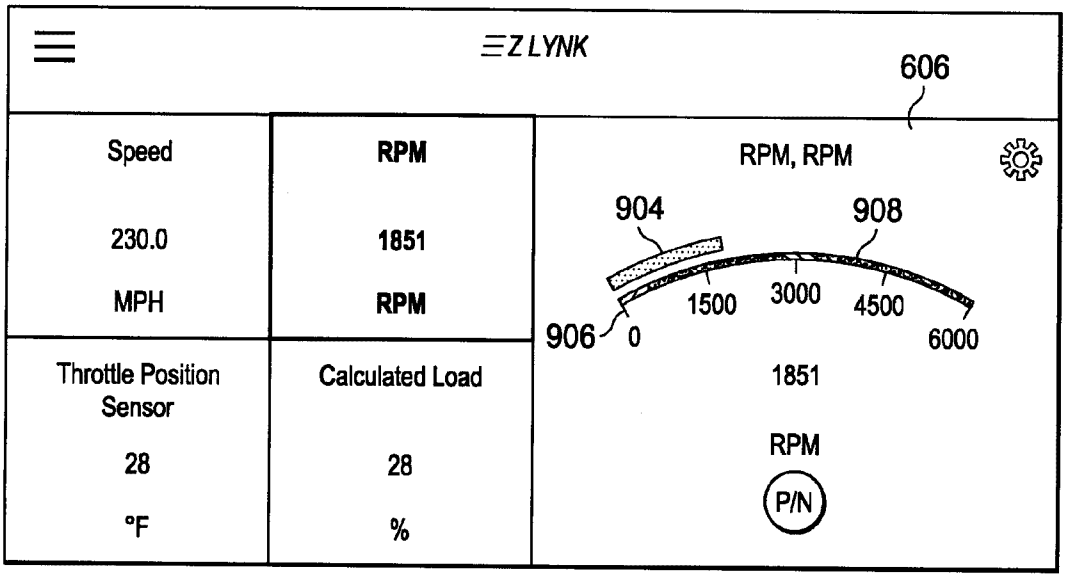


FIG. 9B

SELECTING THIRD GAUGE STYLE

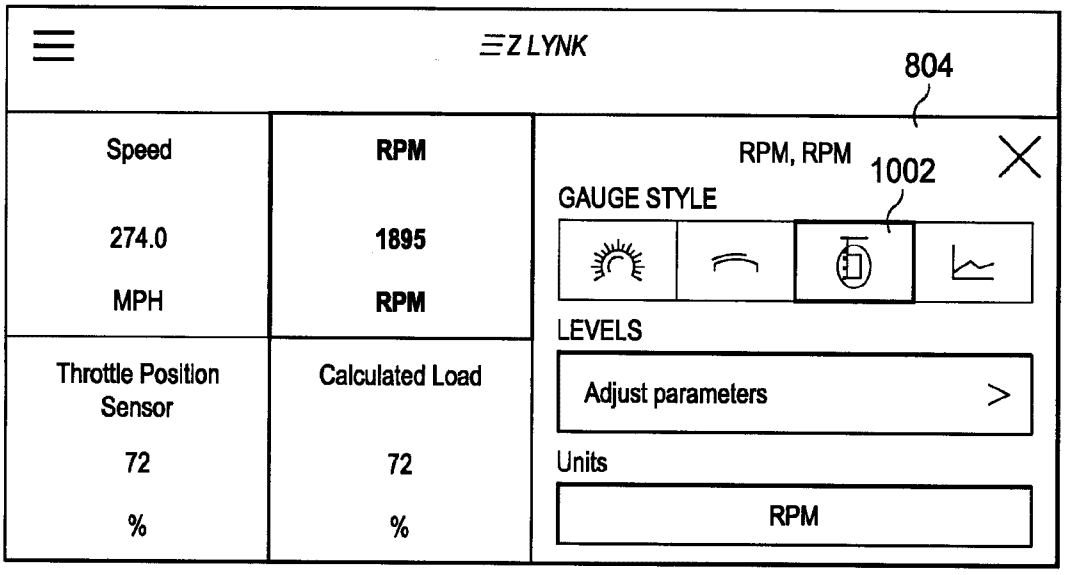


FIG. 10A

SELECTING THIRD GAUGE STYLE

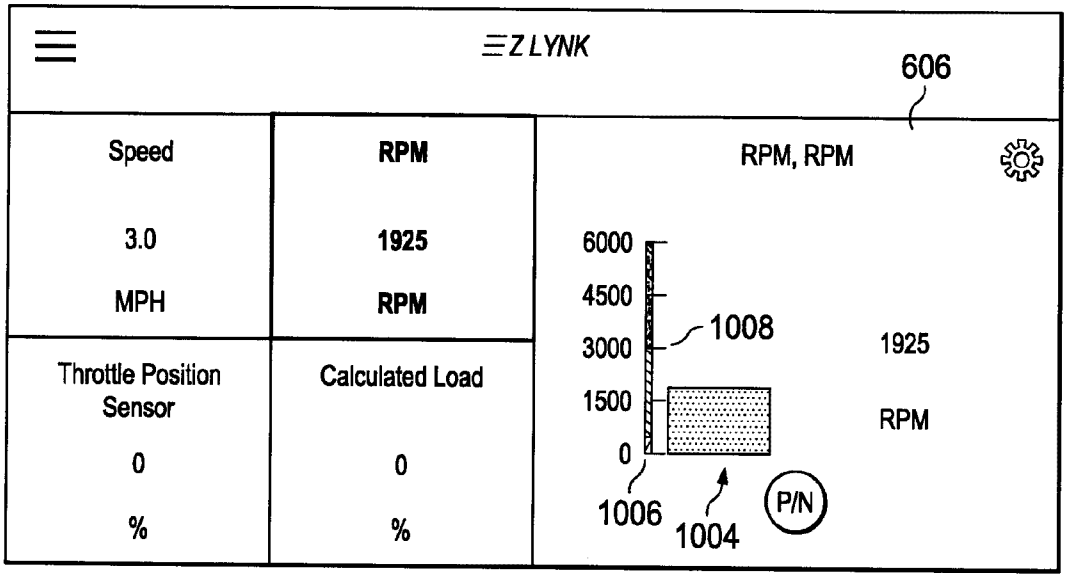


FIG. 10B

SELECTING FOURTH GAUGE STYLE

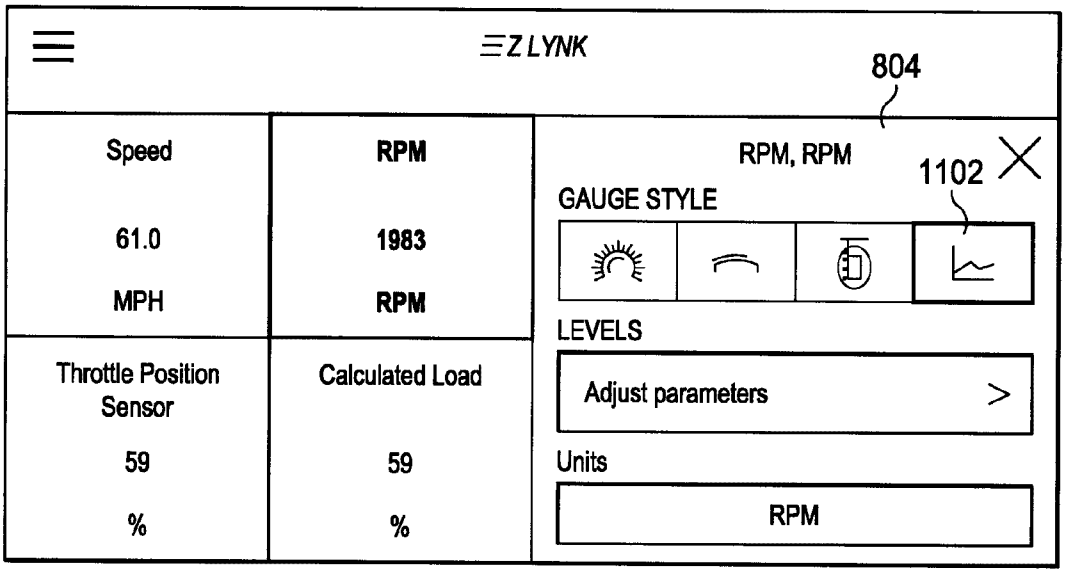


FIG. 11A

SELECTING FOURTH GAUGE STYLE

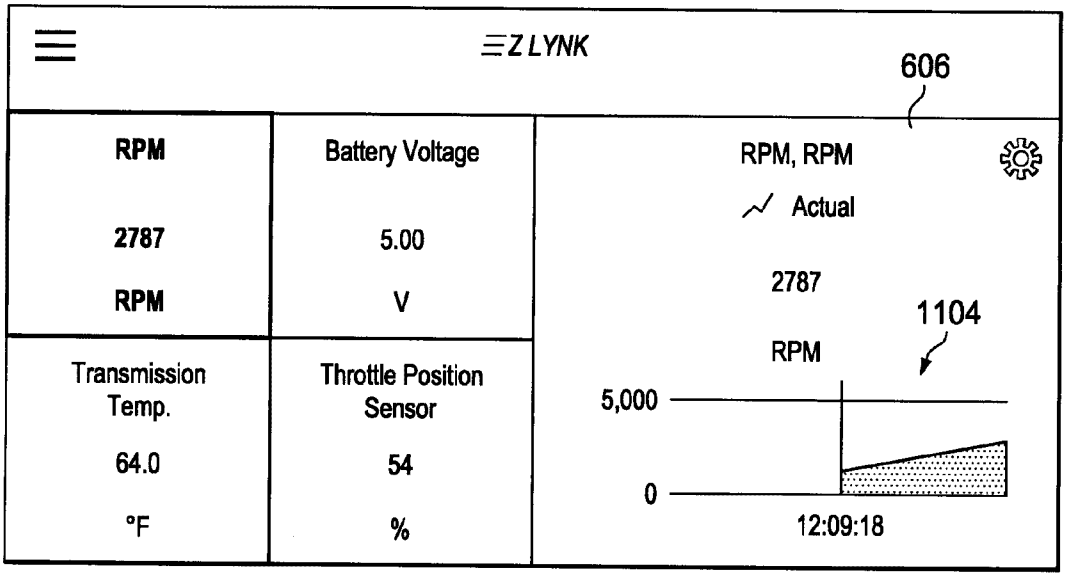


FIG. 11B

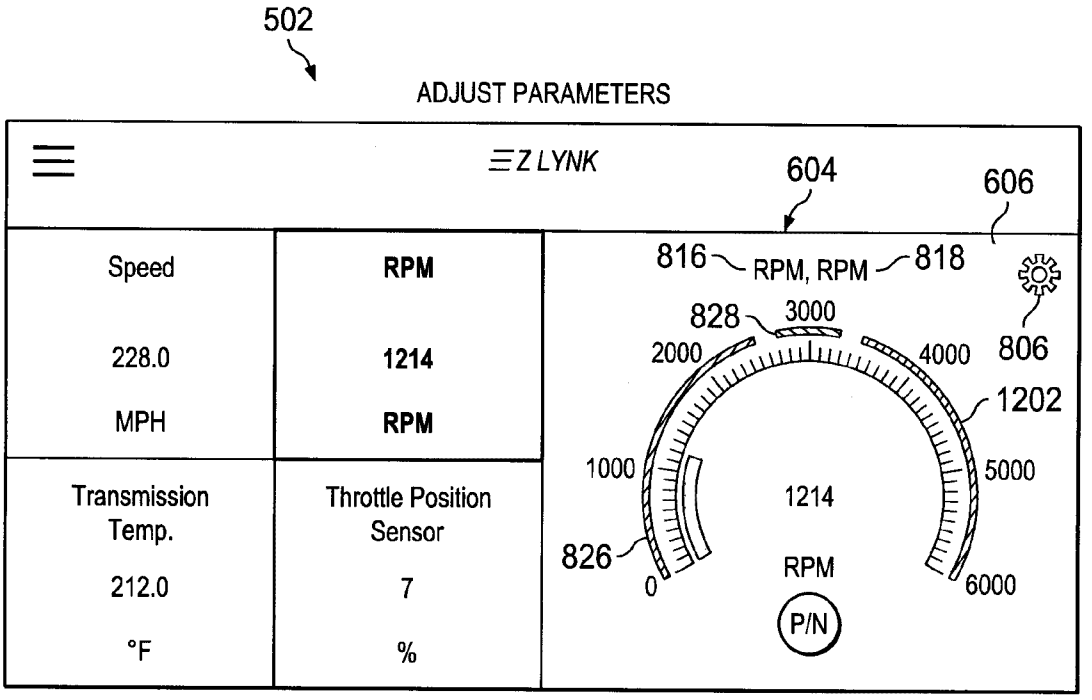


FIG. 12A

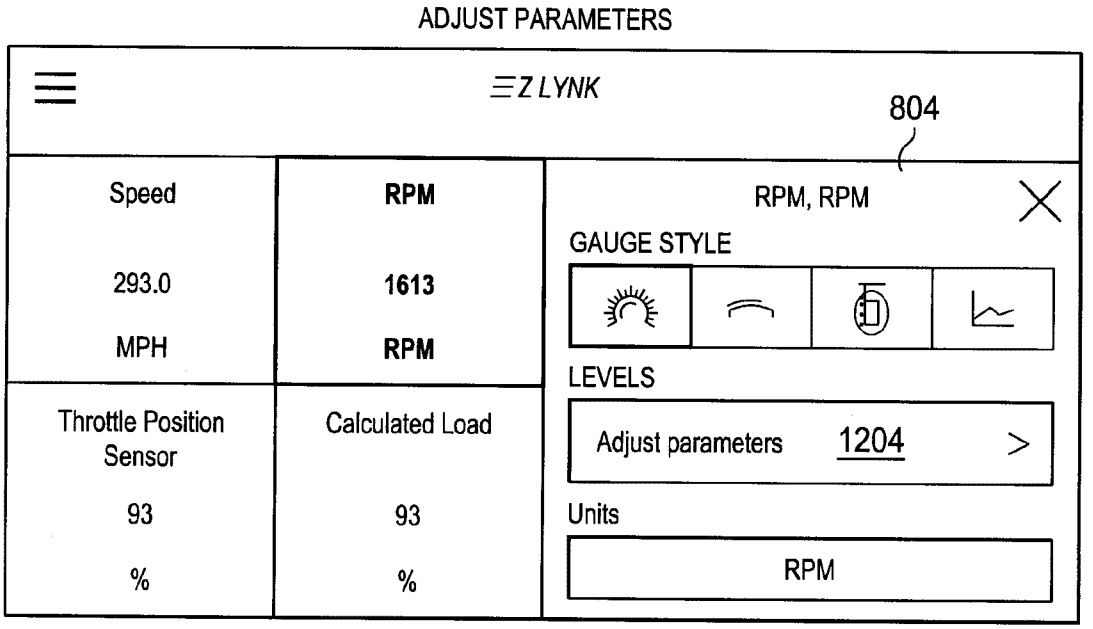


FIG. 12B

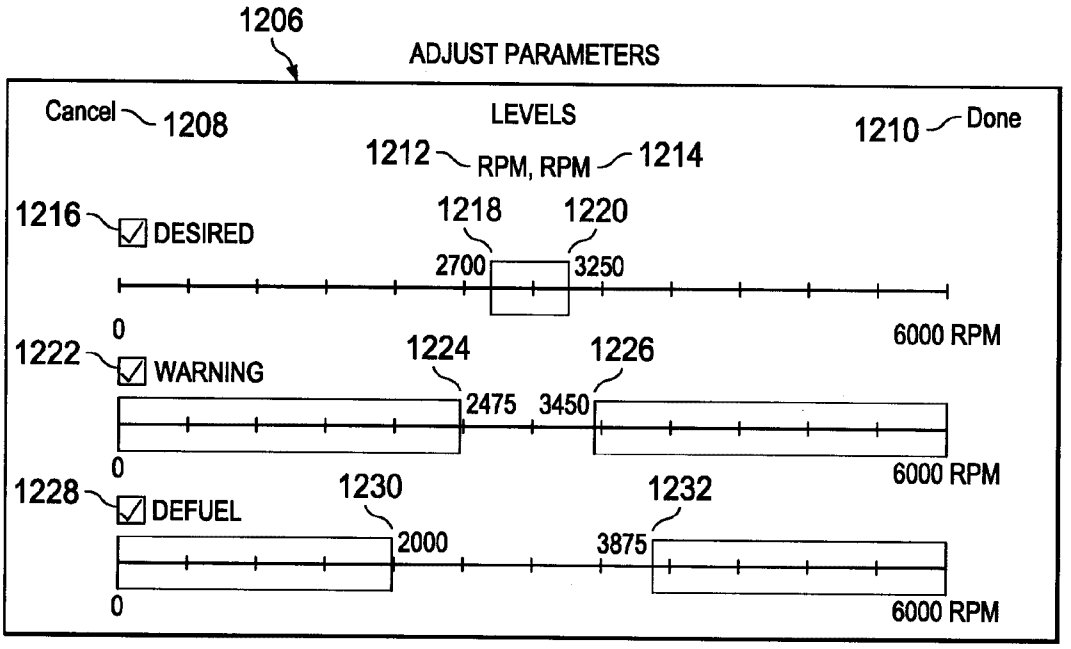


FIG. 12C

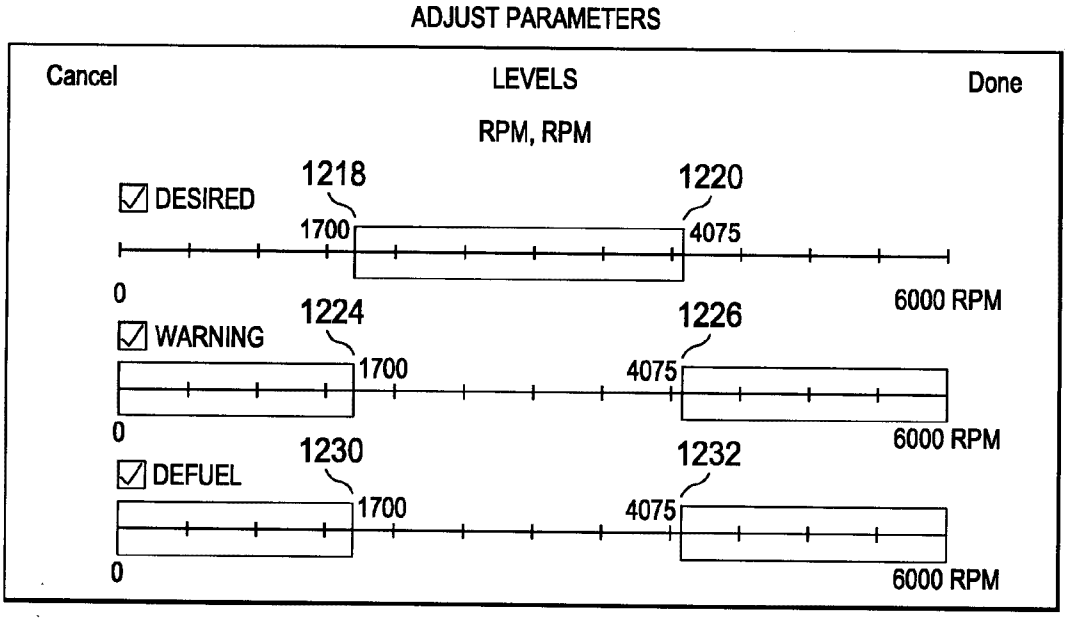


FIG. 12D

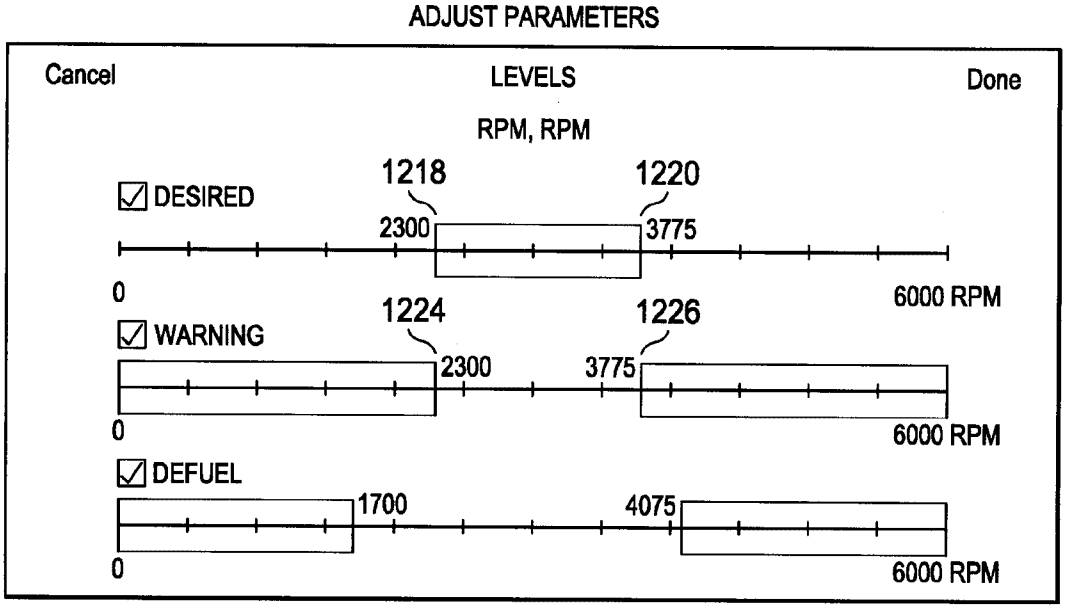


FIG. 12E

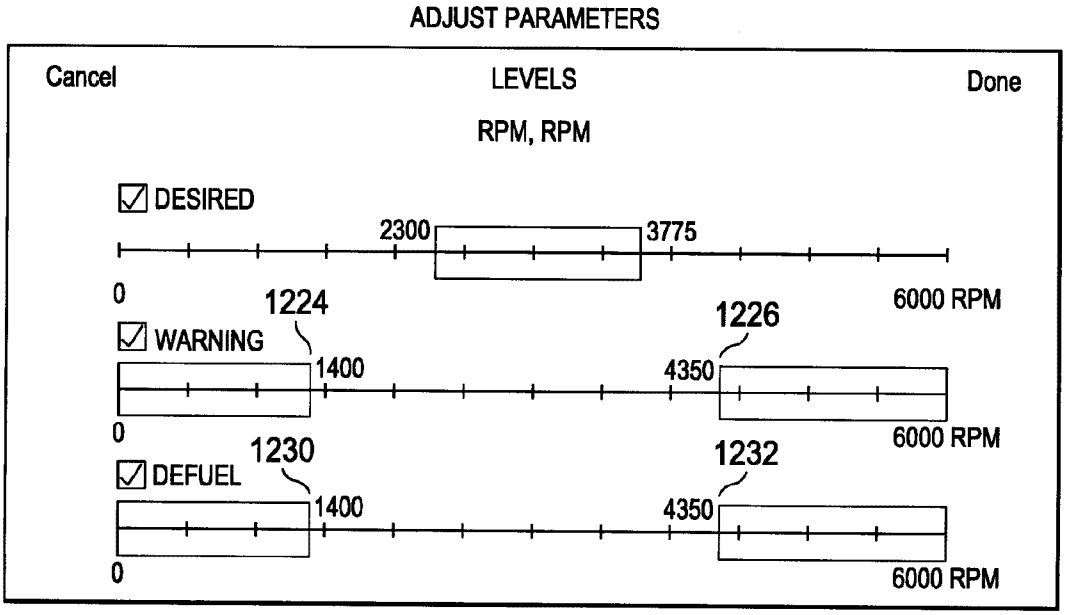


FIG. 12F

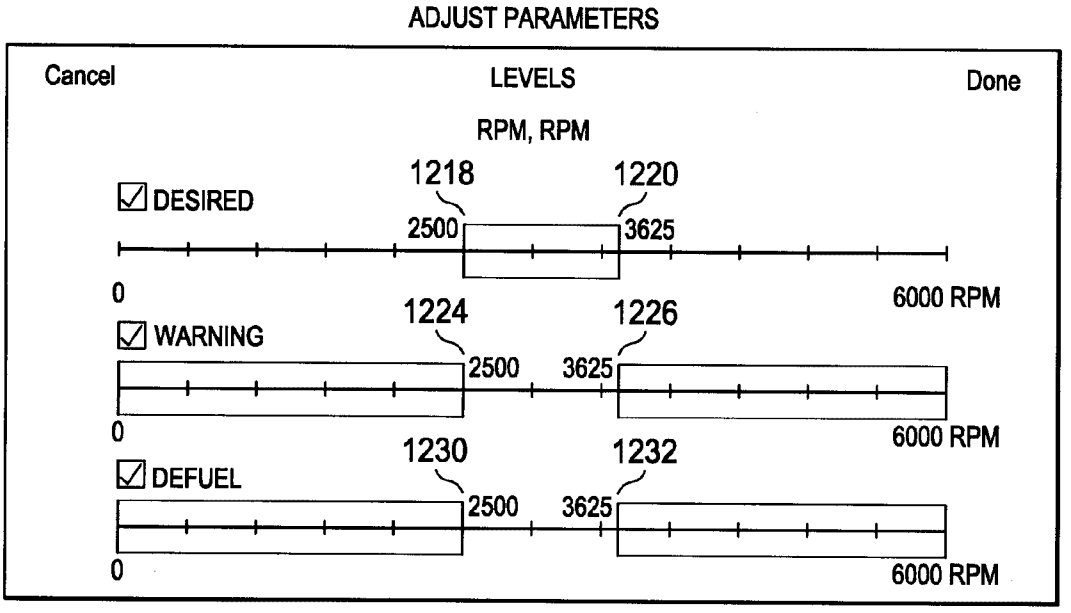


FIG. 12G

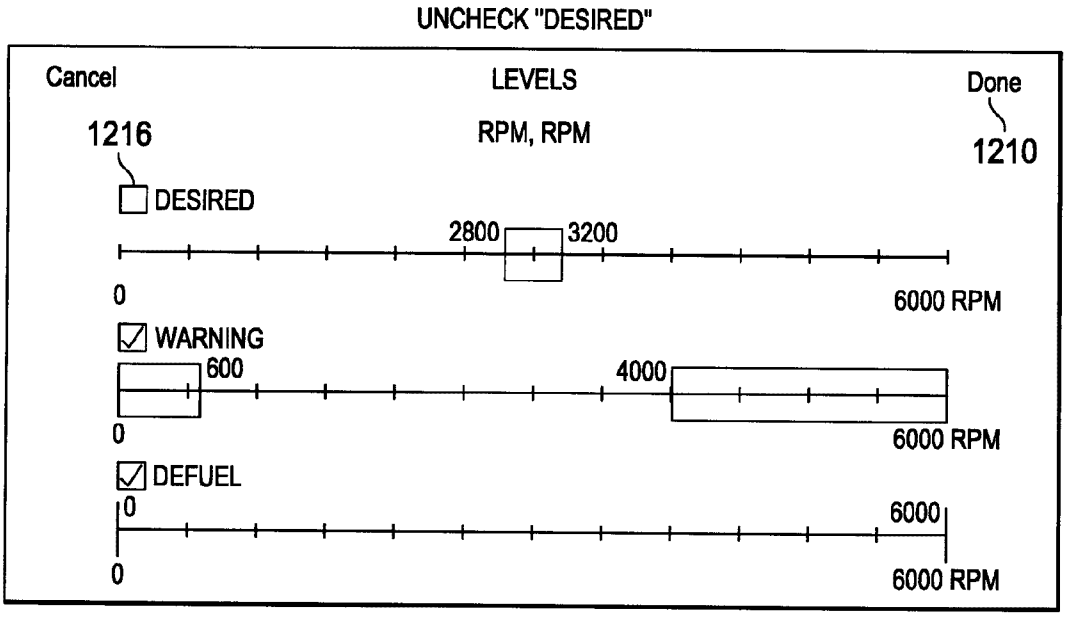


FIG. 12H

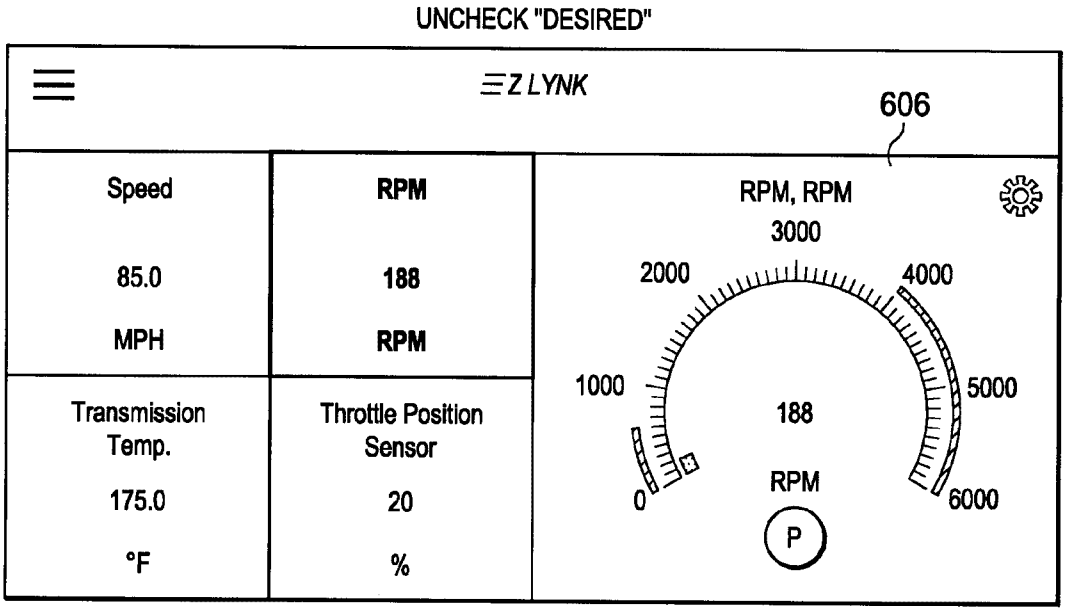


FIG. 12I

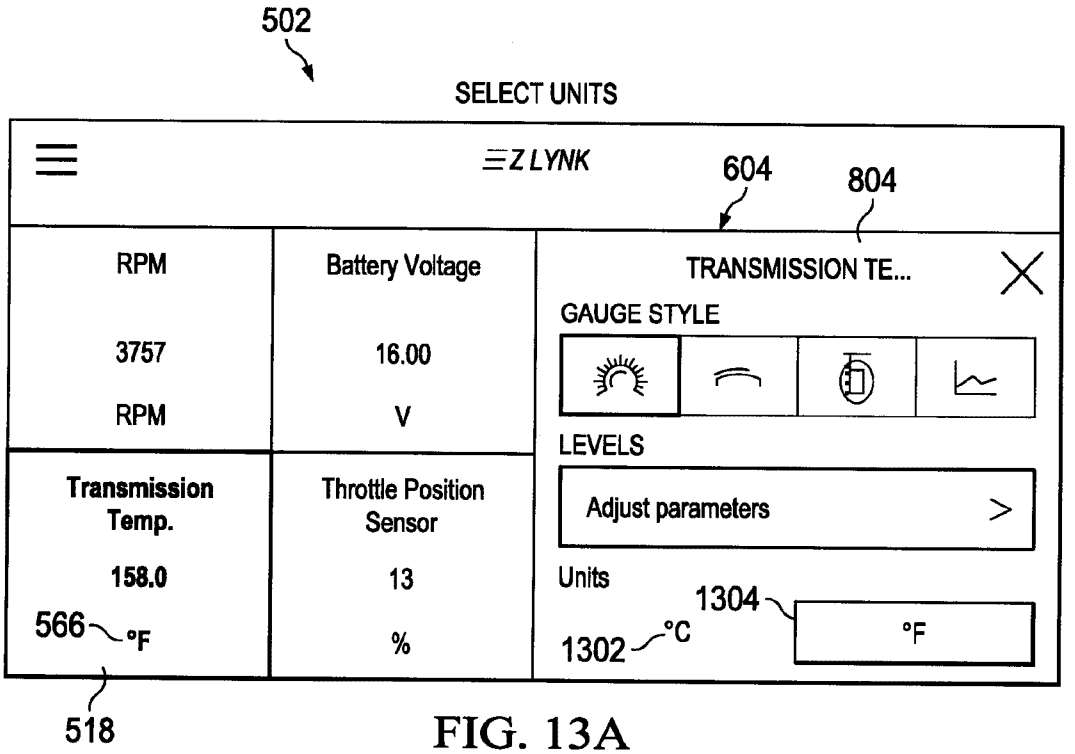


FIG. 13A

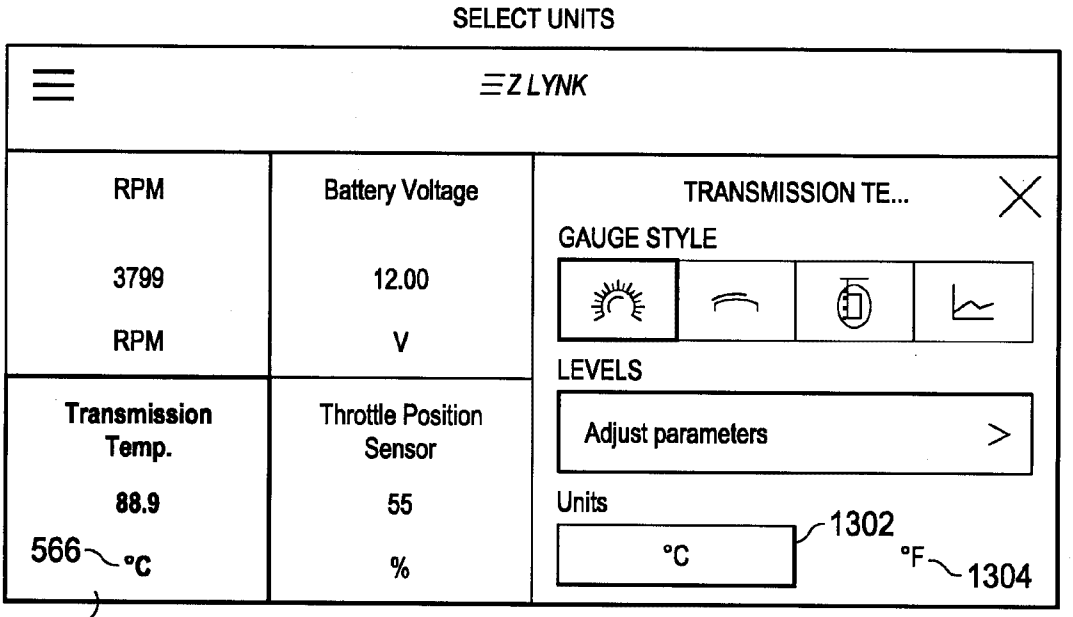


FIG. 13B

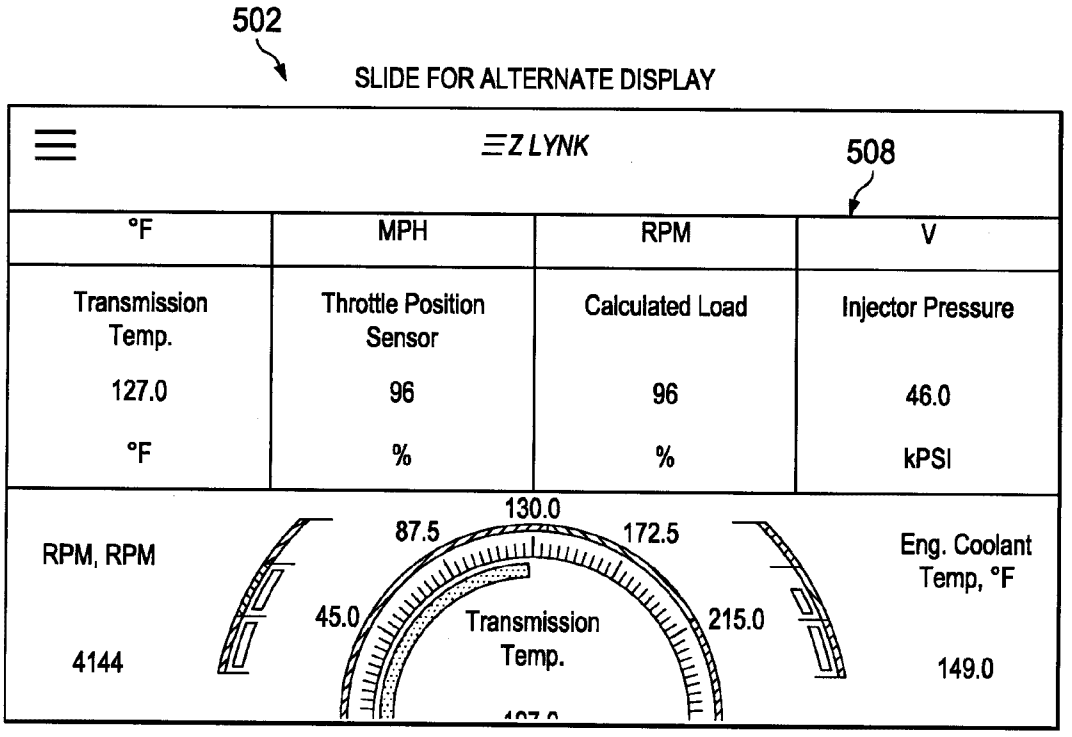


FIG. 14A

14101

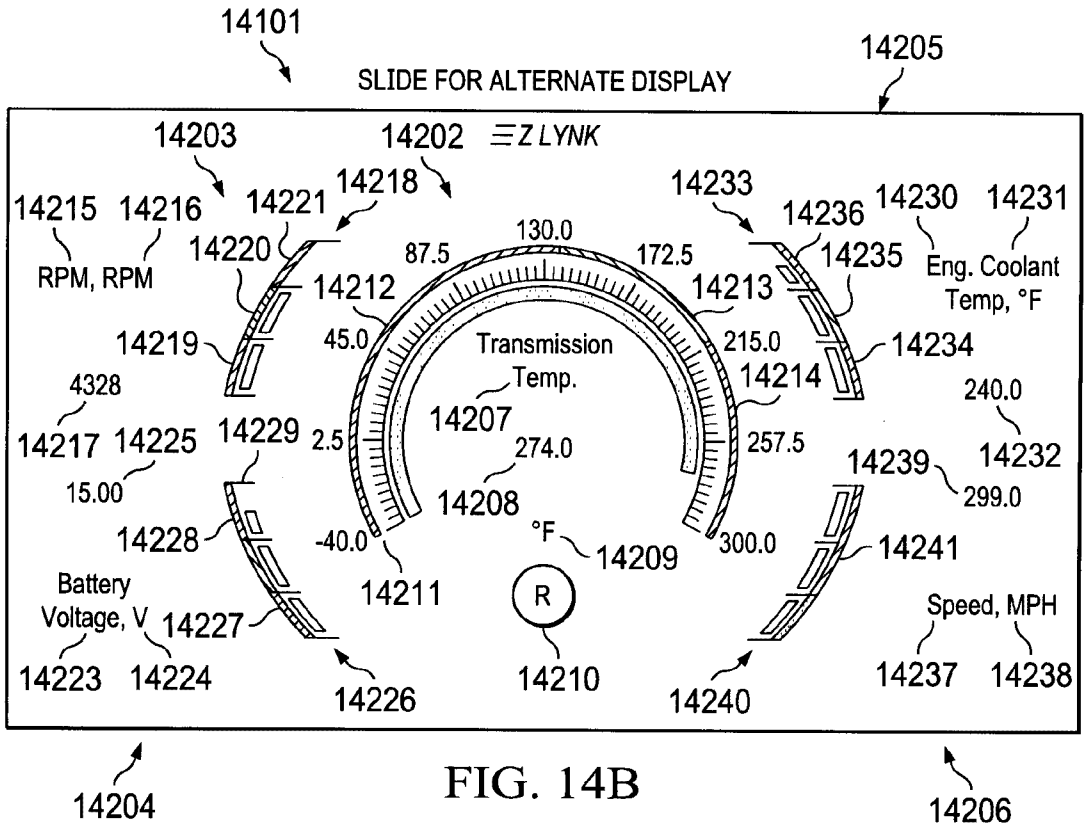


FIG. 14B

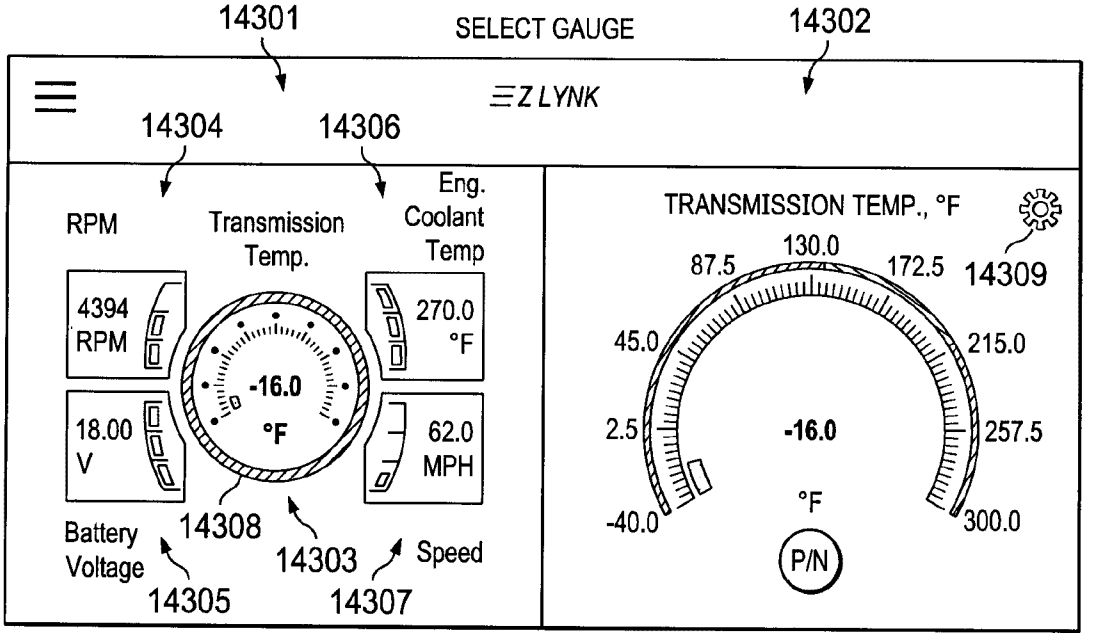


FIG. 14C

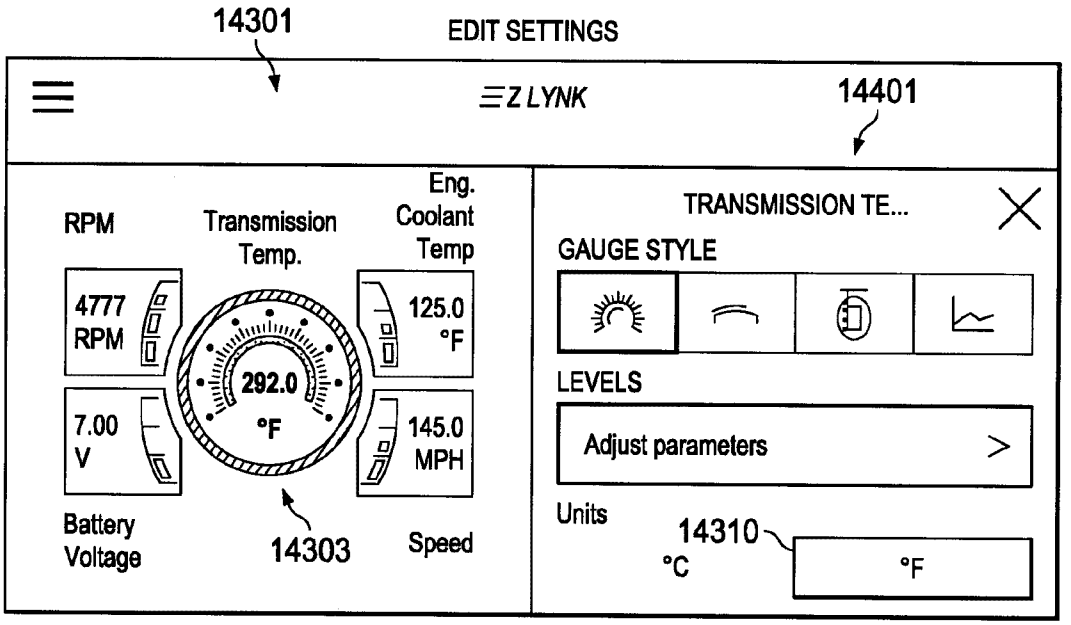


FIG. 14D

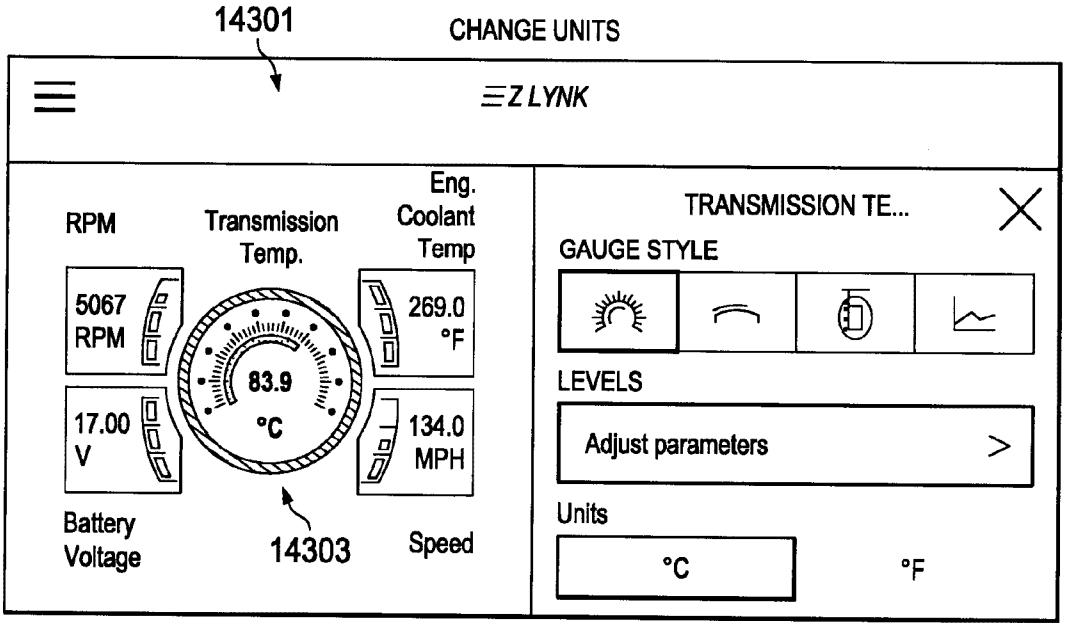


FIG. 14E

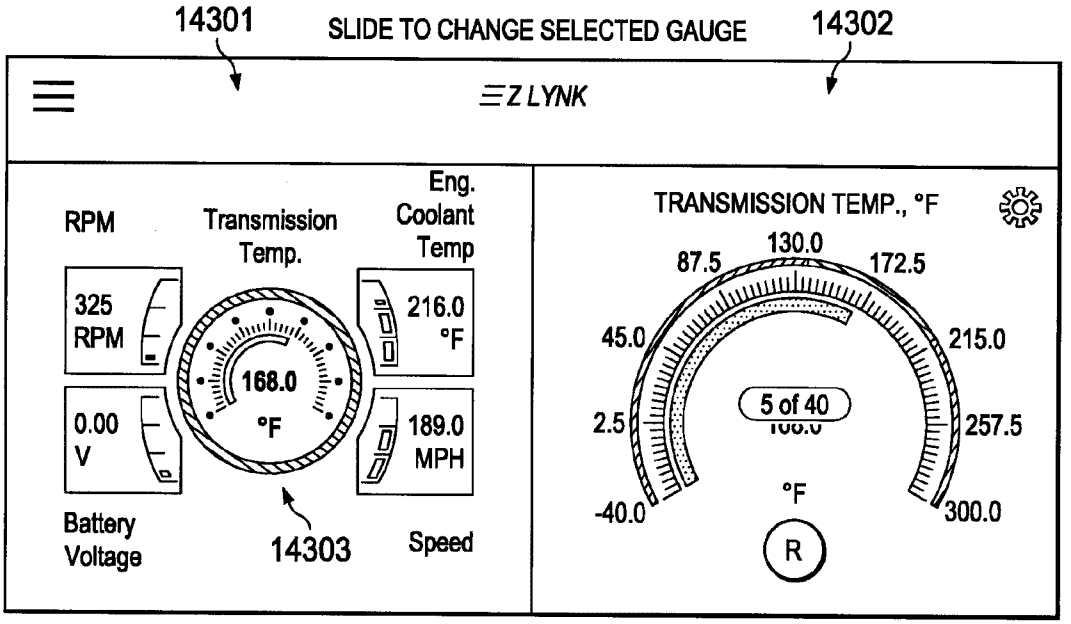


FIG. 15A

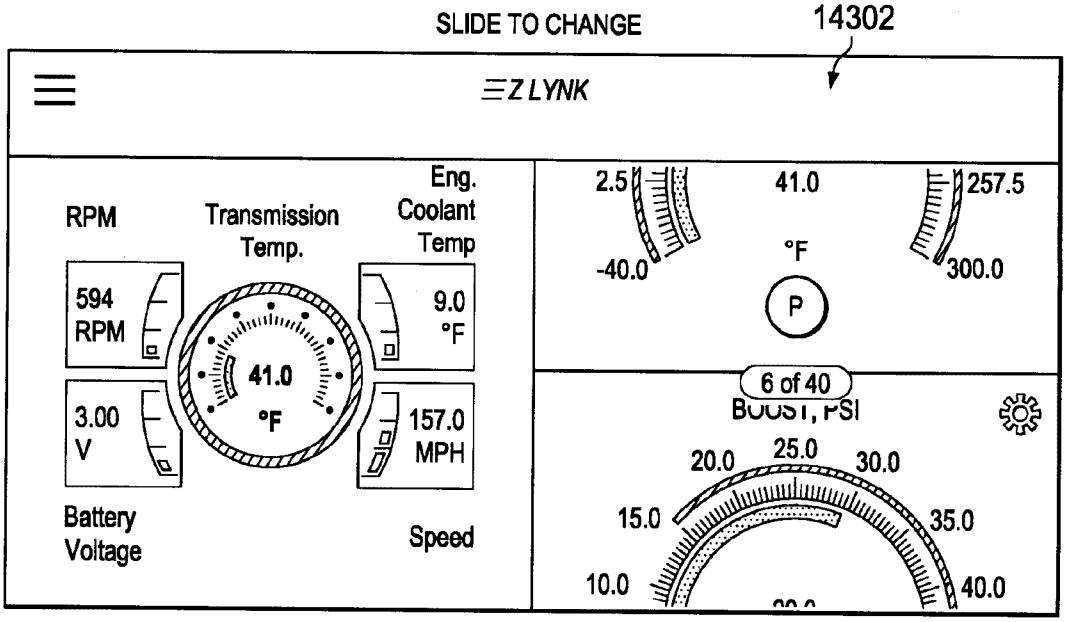


FIG. 15B

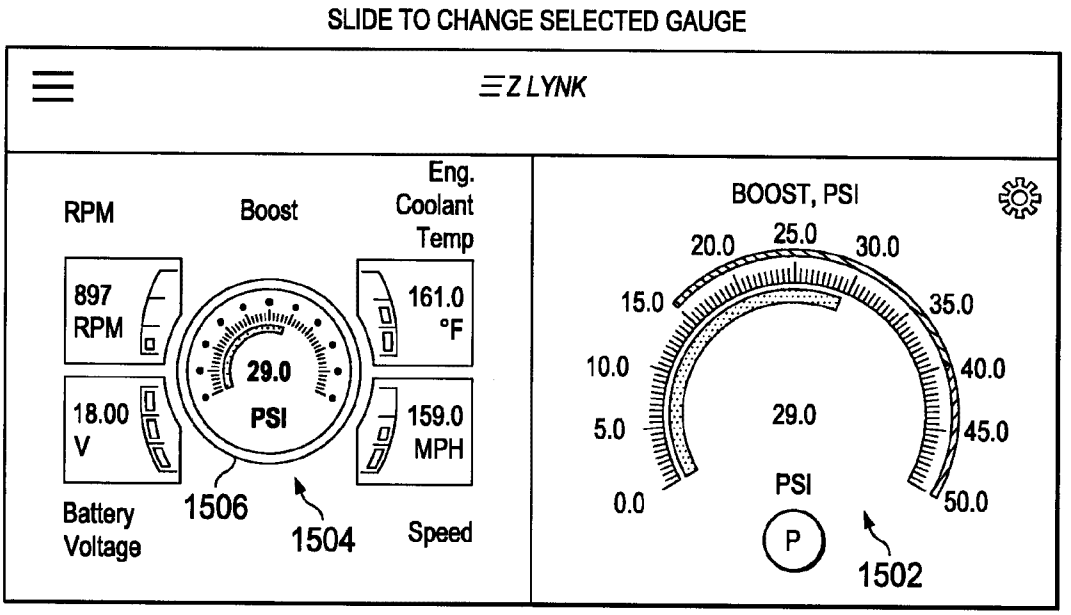


FIG. 15C

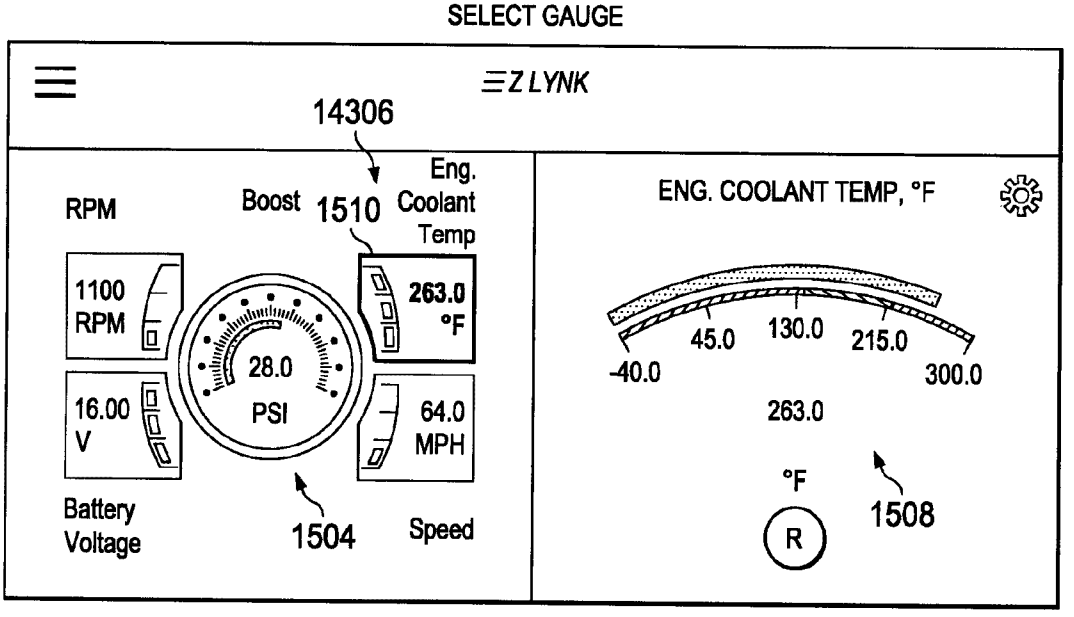


FIG. 15D

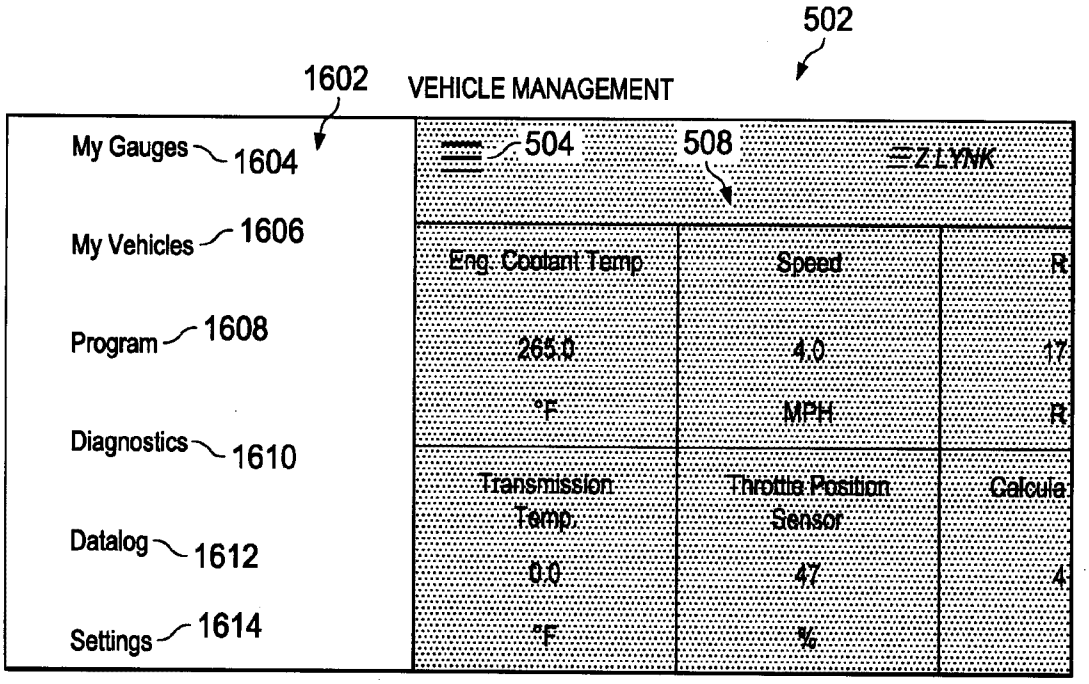


FIG. 16A

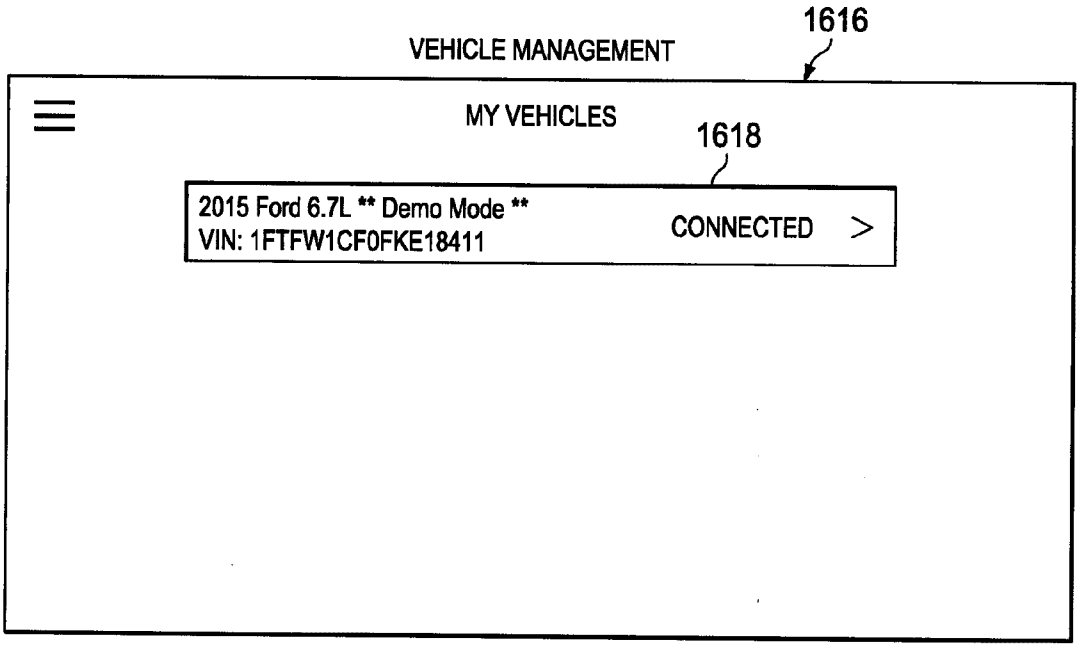


FIG. 16B

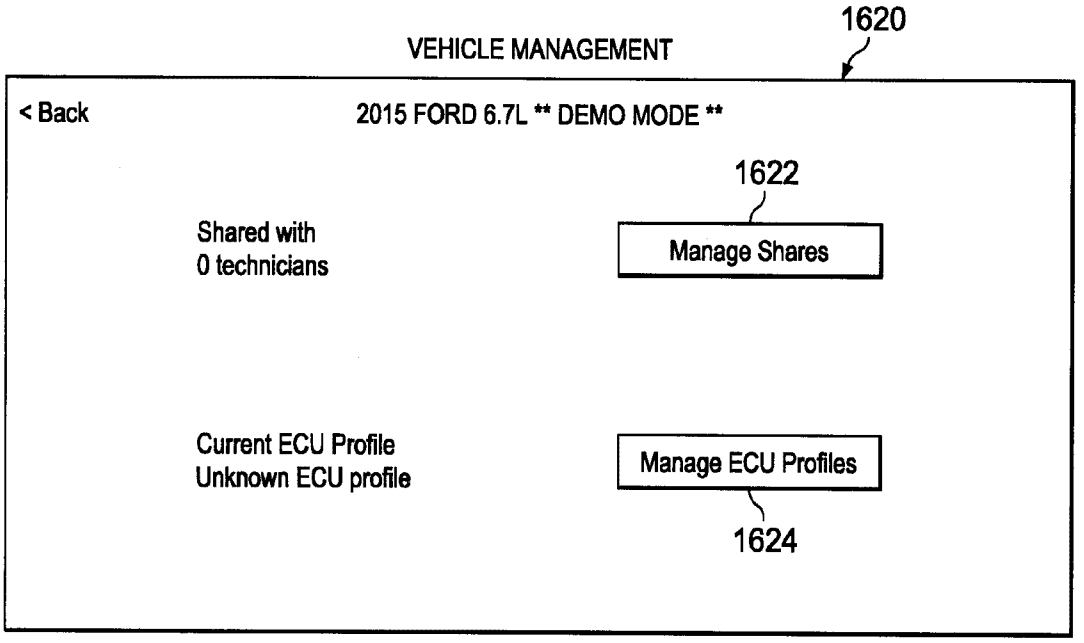


FIG. 16C

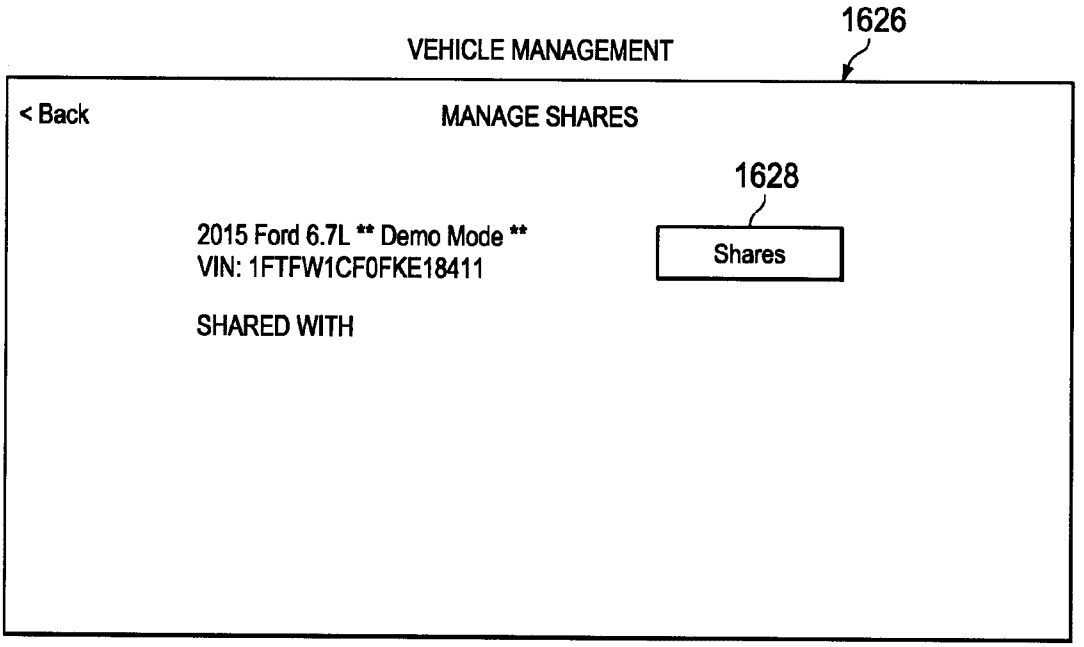


FIG. 16D

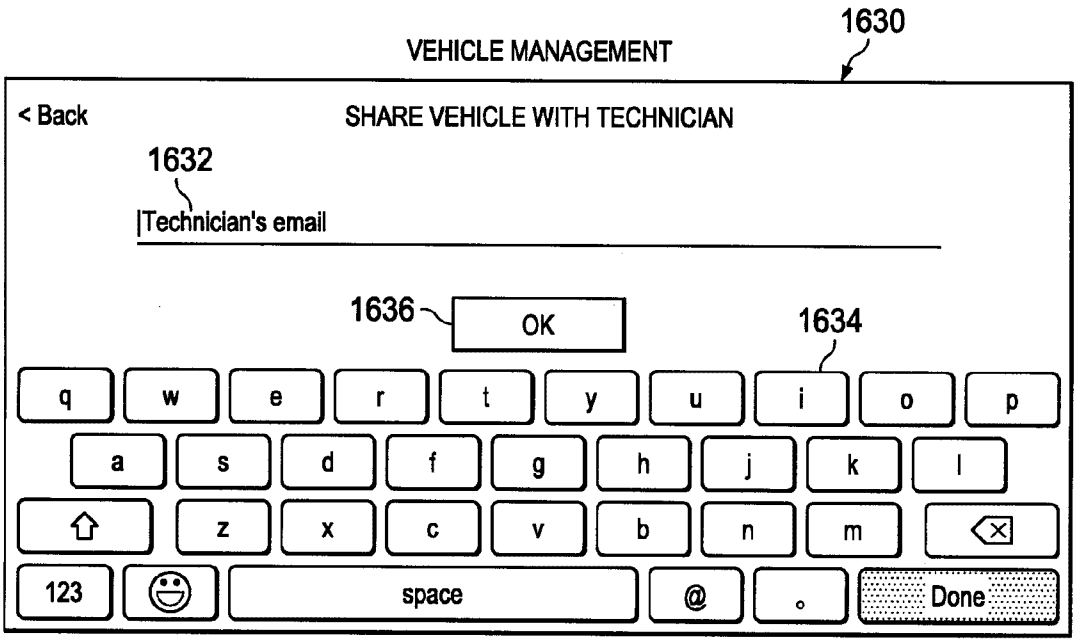


FIG. 16E

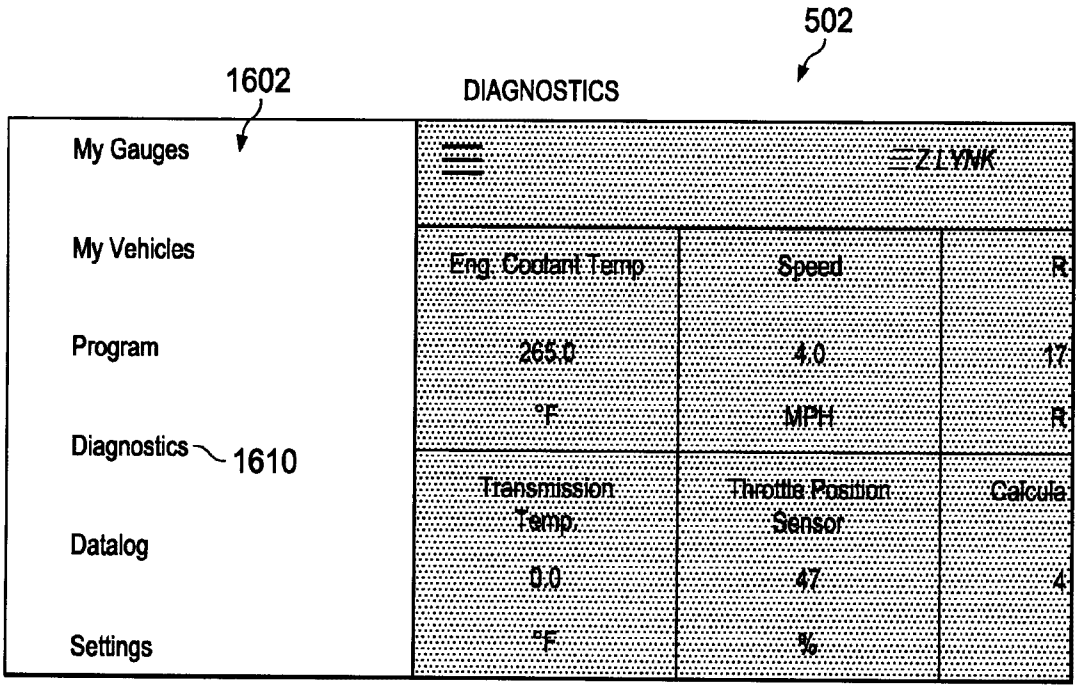


FIG. 17A

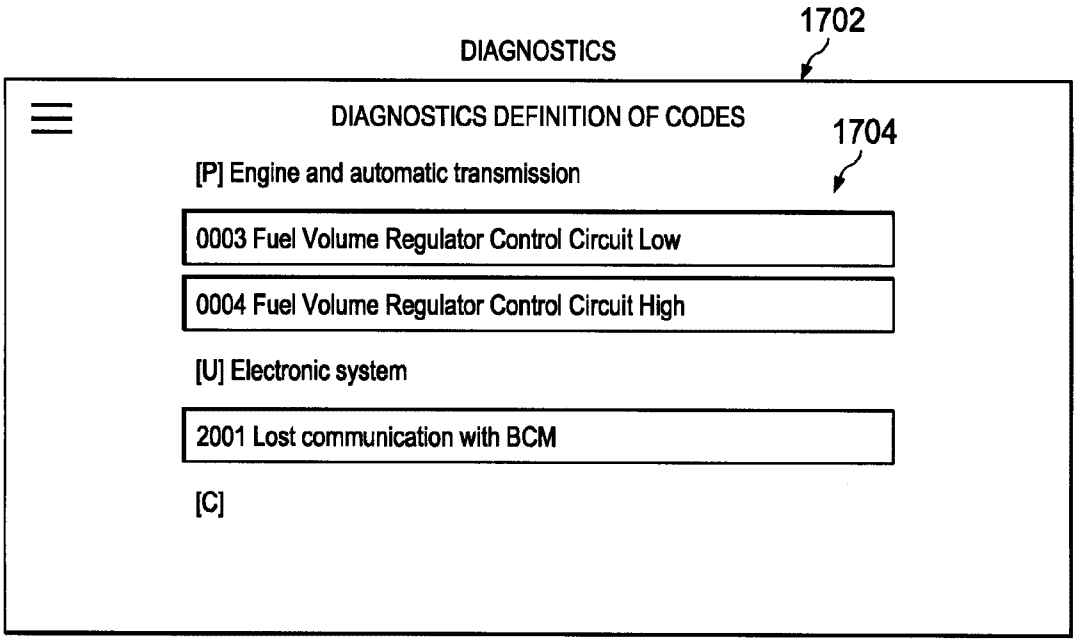


FIG. 17B

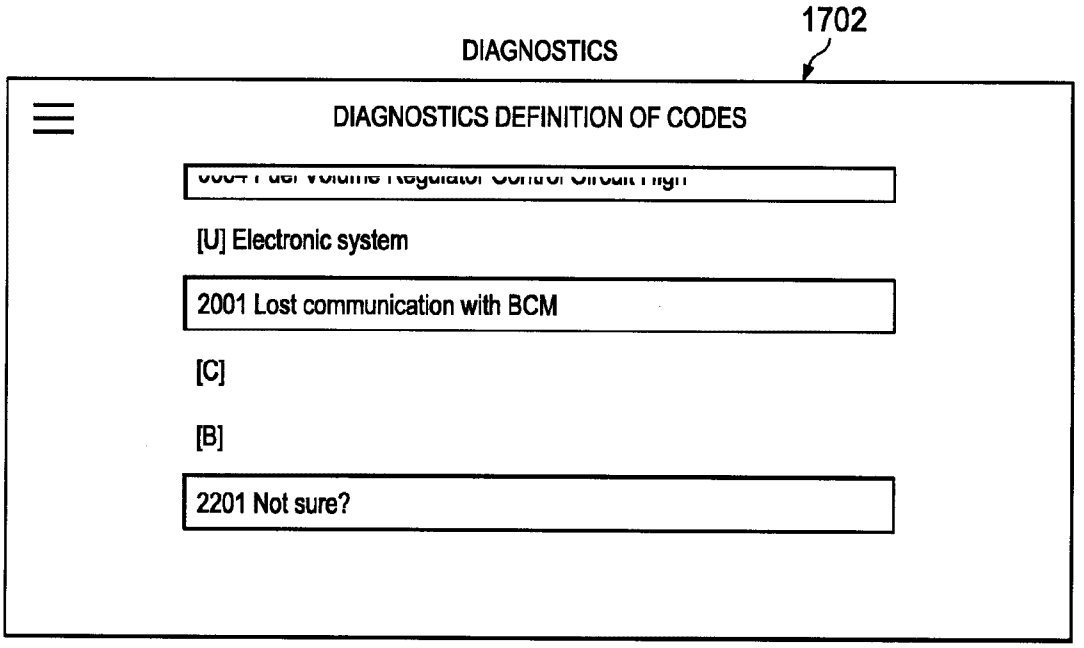


FIG. 17C

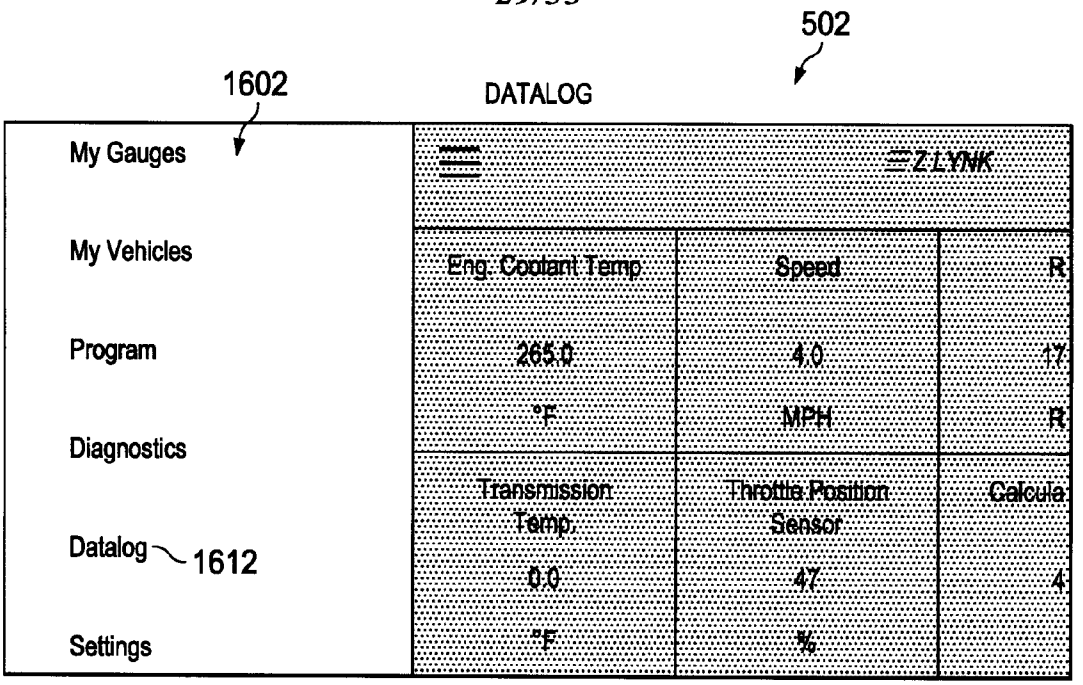


FIG. 18A

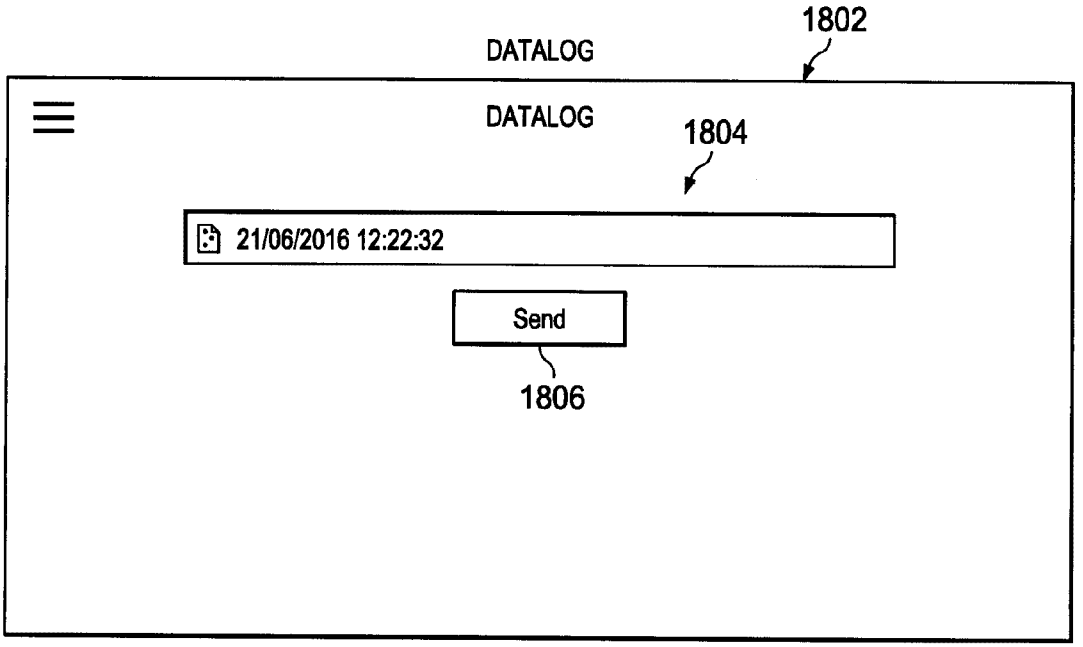


FIG. 18B

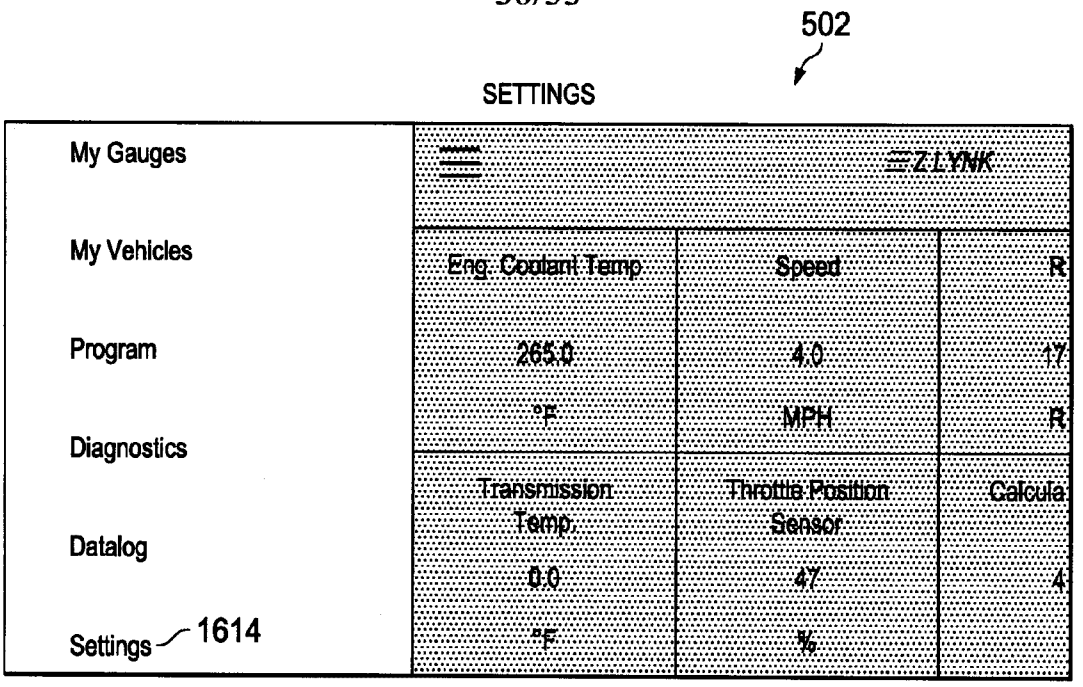


FIG. 19A

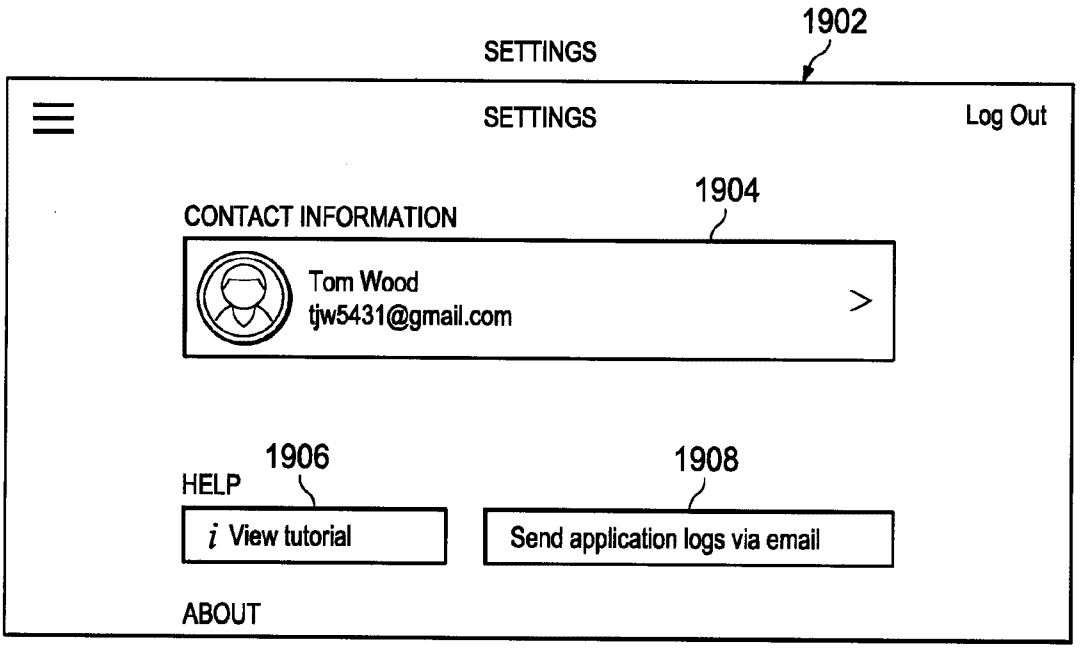


FIG. 19B

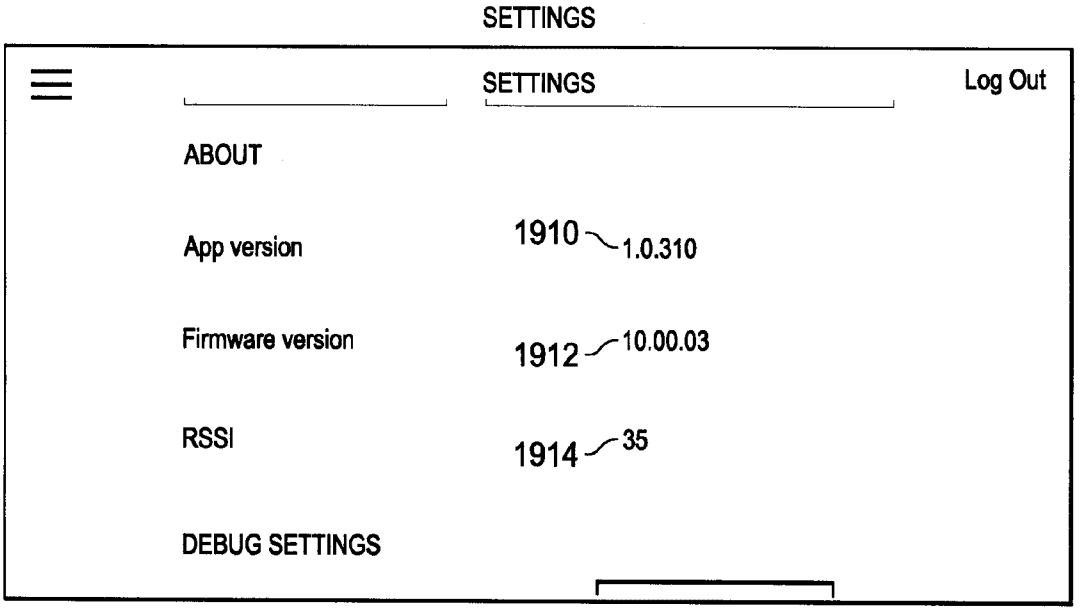


FIG. 19C

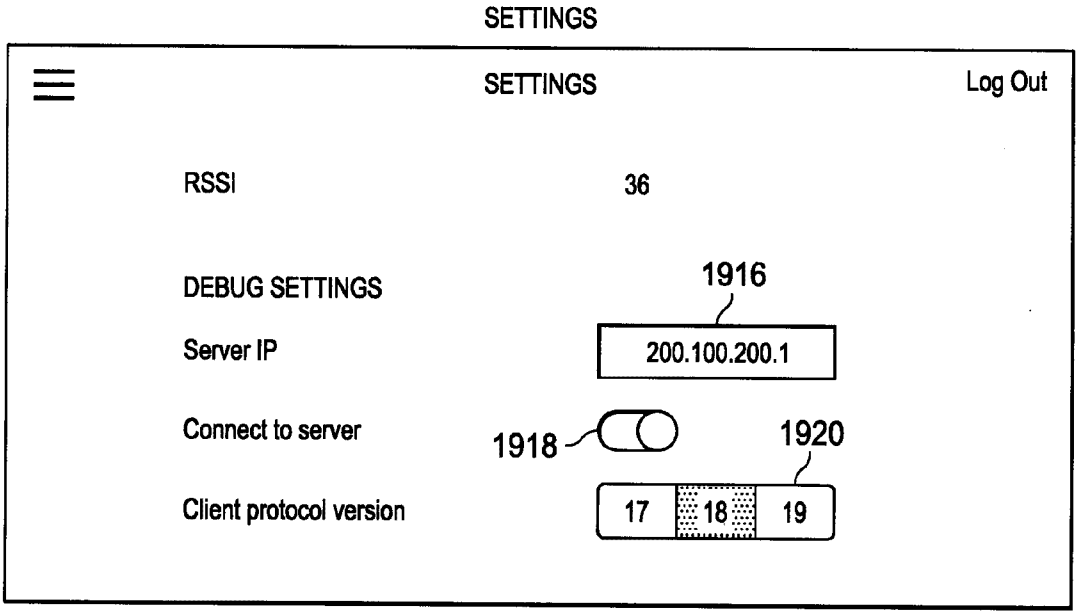


FIG. 19D

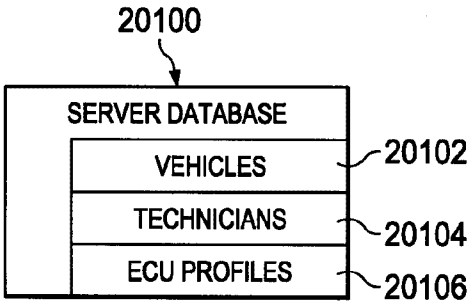


FIG. 20A

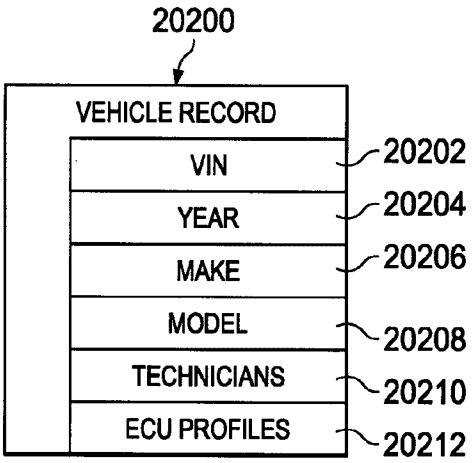


FIG. 20B

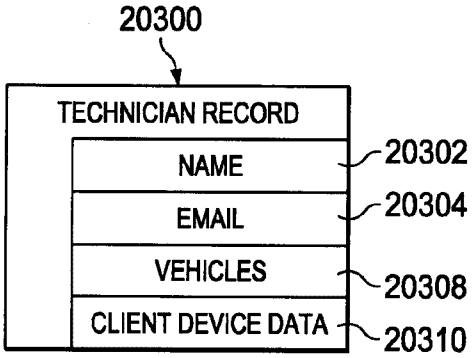


FIG. 20C

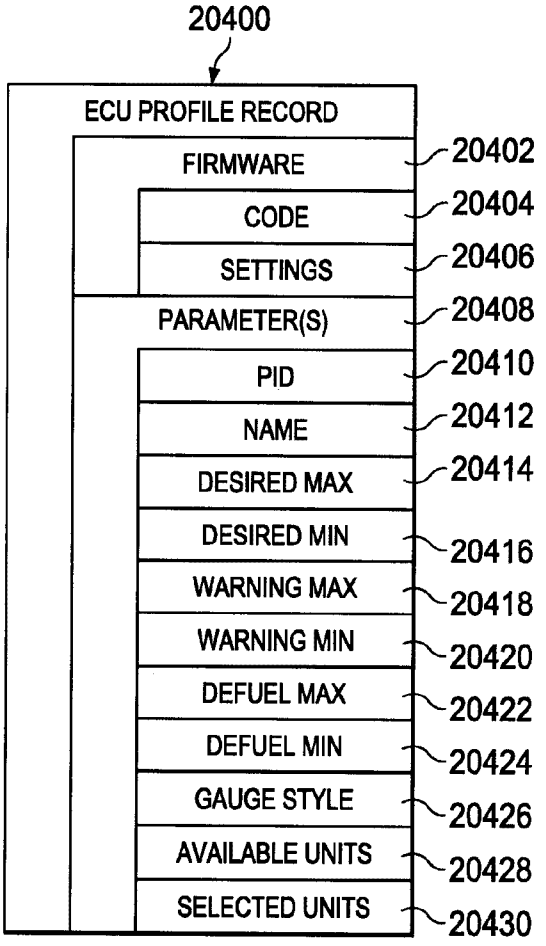


FIG. 20D

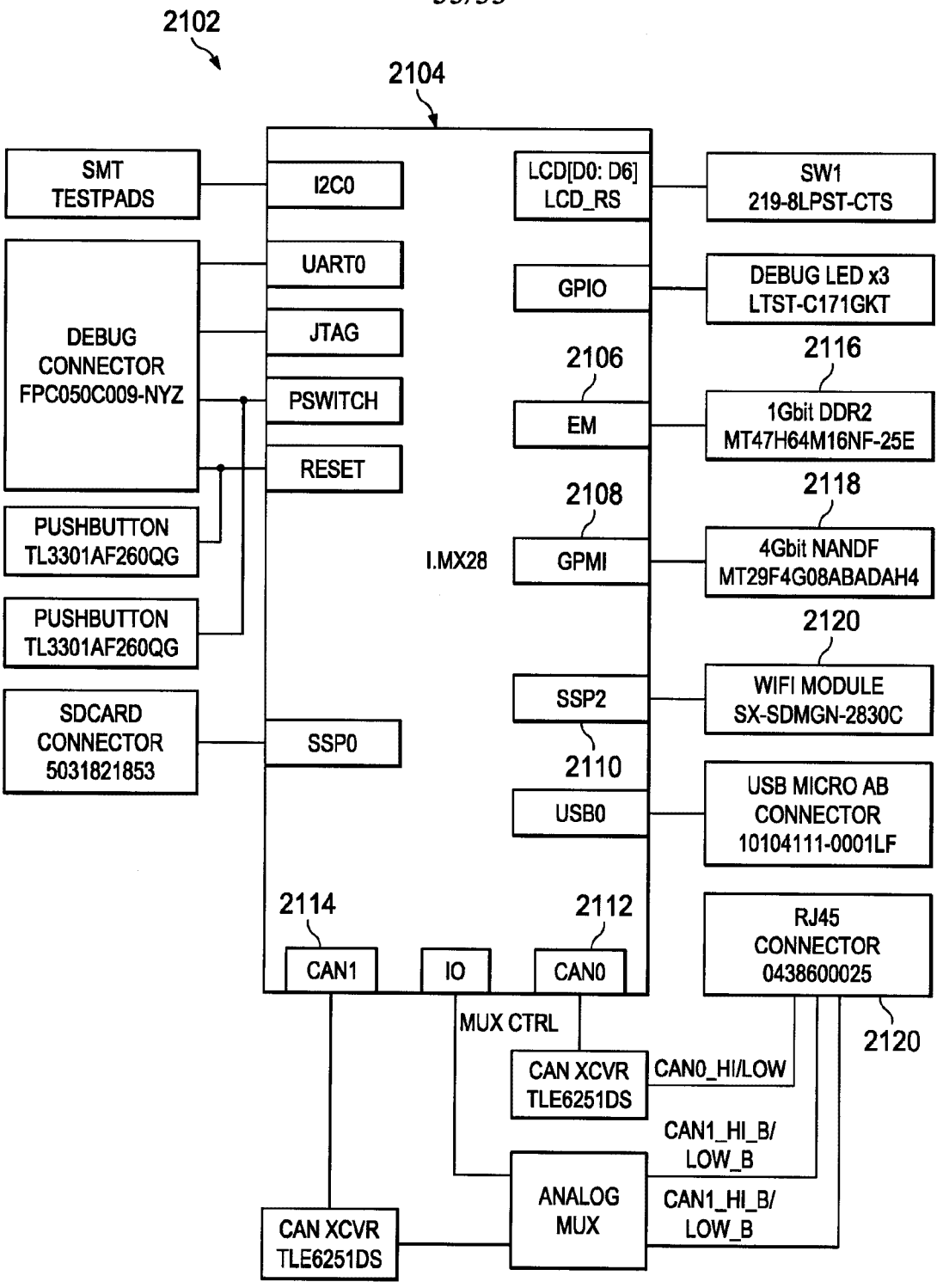
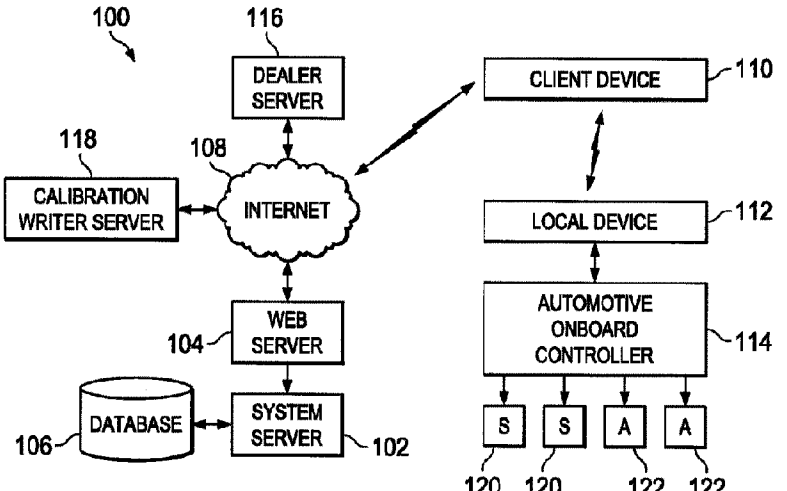

2102
2104
SMT TESTPADS
I2C0
DEBUG CONNECTOR FPC050C009-NYZ
UART0
JTAG
PSWITCH
RESET
PUSHBUTTON TL3301AF260QG
PUSHBUTTON TL3301AF260QG
SDCARD CONNECTOR 5031821853
SSP0
I.MX28
LCD[D0: D6] LCD_RS
GPIO
2106
EM
2108
GPMI
SSP2
2110
USB0
2114
CAN1
IO
2112
CAN0
MUX CTRL
CAN XCVR TLE6251DS
ANALOG MUX
CAN XCVR TLE6251DS
SW1 219-8LPST-CTS
DEBUG LED x3 LTST-C171GKT
2116
1Gbit DDR2 MT47H64M16NF-25E
2118
4Gbit NANDF MT29F4G08ABADAH4
2120
WIFI MODULE SX-SDMGN-2830C
USB MICRO AB CONNECTOR 10104111-0001LF
RJ45 CONNECTOR 0438600025
2120
CAN0_HI/LOW
CAN1_HI_B/ LOW_B
CAN1_HI_B/ LOW_B

FIG. 21


100
116
DEALER SERVER
CLIENT DEVICE
110
118
108
CALIBRATION WRITER SERVER
INTERNET
LOCAL DEVICE
112
AUTOMOTIVE ONBOARD CONTROLLER
114
WEB SERVER
104
DATABASE
SYSTEM SERVER
106
102
S
S
A
A
120
120
122
122