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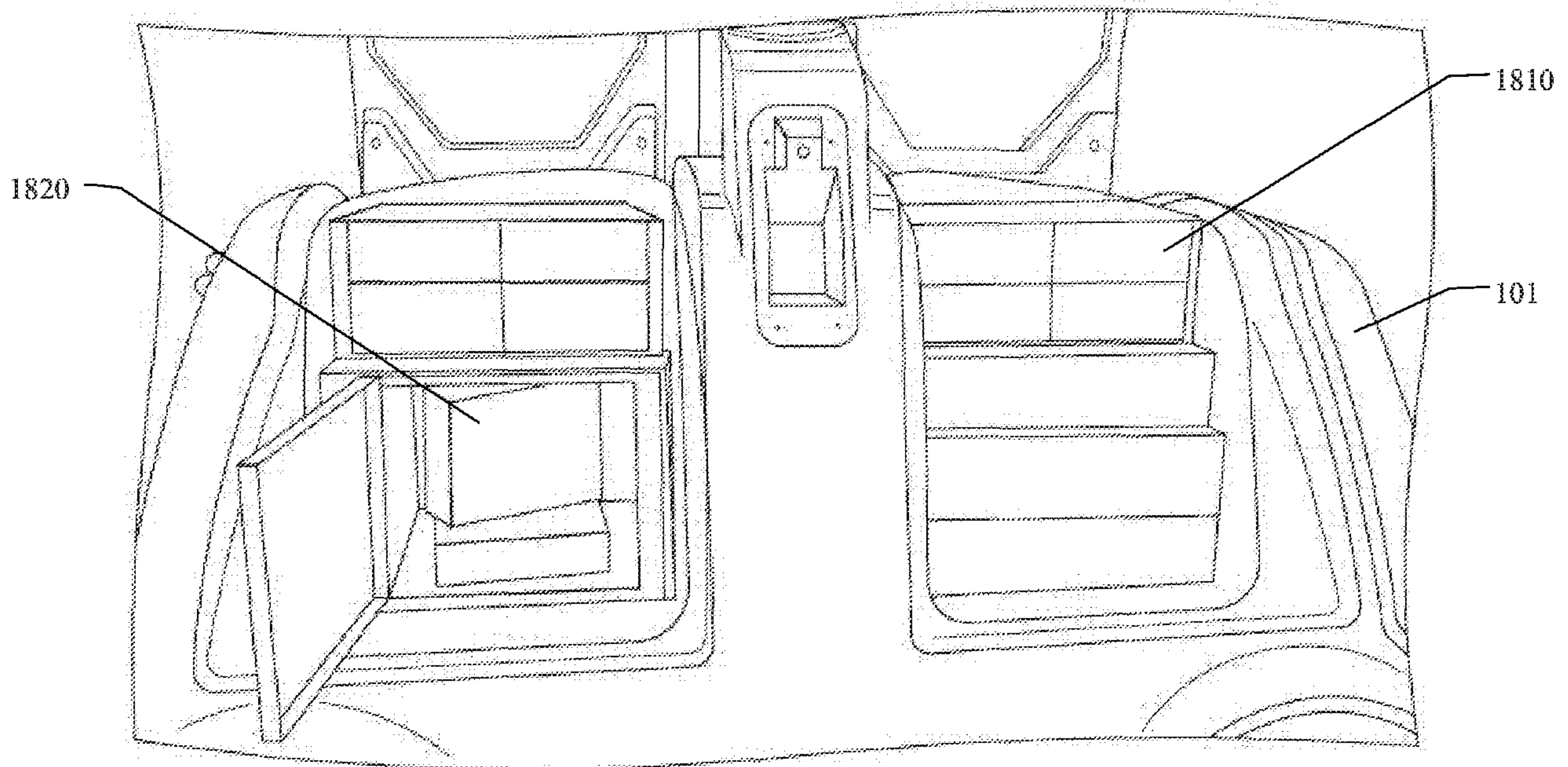
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(71) Demandeur/Applicant:  
NURO, INC., US

(72) Inventeurs/Inventors:  
FERGUSON, DAVID, US;  
ZHU, JIAJUN, US;  
JULIAN, BENJAMIN, US;  
RANSOHOFF, NAN, US

(74) Agent: SMART & BIGGAR LLP

(54) Titre : CONCEPTION DE COMPARTIMENT FLEXIBLE DANS UN VEHICULE AUTONOME OU SEMI-AUTONOME  
 (54) Title: FLEXIBLE COMPARTMENT DESIGN ON AUTONOMOUS AND SEMI-AUTONOMOUS VEHICLE



**FIG. 18**

(57) **Abrégé/Abstract:**

Provided herein is an autonomous or semi-autonomous vehicle fleet comprising a plurality of autonomous or semi-autonomous vehicles coordinated by a fleet management module. Each vehicle may be configured to receive a modular unit, wherein the modular unit is configured to secure a consumer product.

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- (71) **Applicant:** NURO, INC. [US/US]; 1300 Terra Bella Avenue, #100, Mountain View, California 94043 (US).
- (72) **Inventors:** FERGUSON, David; 1300 Terra Bella Avenue, #100, Mountain View, California 94043 (US). ZHU, Jiajun; 1300 Terra Bella Avenue, #100, Mountain View, California 94043 (US). JULIAN, Benjamin; 1300 Terra Bella Avenue, #100, Mountain View, California 94043 (US). RANSOHOFF, Nan; 1300 Terra Bella Avenue, #100, Mountain View, California 94043 (US).
- (74) **Agent:** KANG, Peter; WILSON SONSINI GOODRICH & ROSATI, 12235 El Camino Real, San Diego, California 92130 (US).
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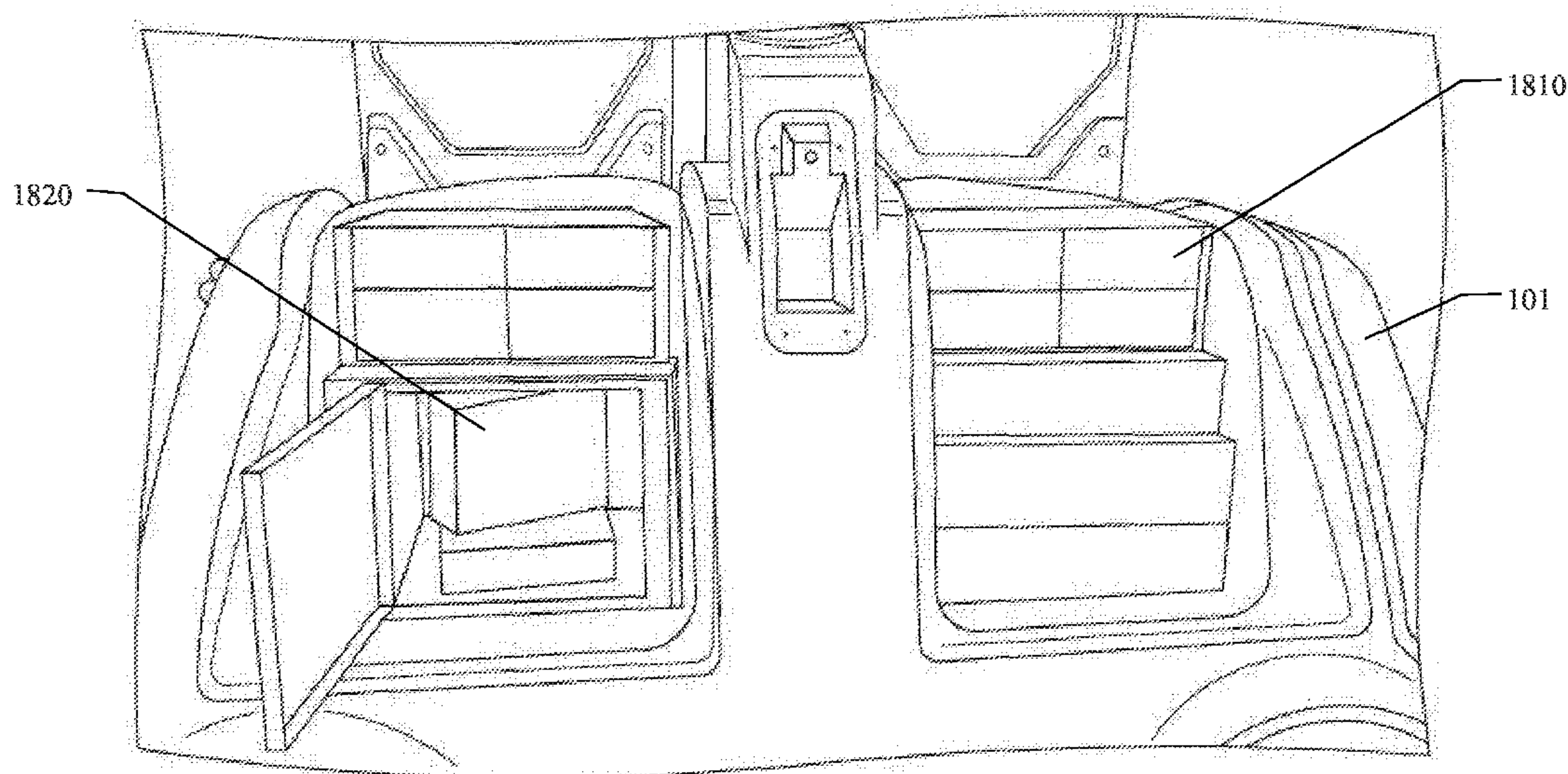
(54) **Title:** FLEXIBLE COMPARTMENT DESIGN ON AUTONOMOUS AND SEMI-AUTONOMOUS VEHICLE

FIG. 18

(57) **Abstract:** Provided herein is an autonomous or semi-autonomous vehicle fleet comprising a plurality of autonomous or semi-autonomous vehicles coordinated by a fleet management module. Each vehicle may be configured to receive a modular unit, wherein the modular unit is configured to secure a consumer product.

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## **FLEXIBLE COMPARTMENT DESIGN ON AUTONOMOUS AND SEMI-AUTONOMOUS VEHICLE**

### **CROSS REFERENCE**

[0001] This application claims priority to U.S. Provisional Application No. 62/538,538, filed on July 28, 2017, the contents of which are incorporated herein by reference in its entirety.

### **BACKGROUND OF THE INVENTION**

[0002] The field of autonomous and semi-autonomous vehicles is a growing field of innovation. Vehicles are being used for many purposes including warehouse inventory operations, household operations, hospital deliveries, sanitation, and military or defense applications.

### **SUMMARY OF THE INVENTION**

[0003] This disclosure relates to an autonomous or semi-autonomous vehicle fleet comprising a plurality of vehicles, in particular vehicles for transporting or retrieving deliveries in either unstructured outdoor environment or closed environments.

[0004] Current manned delivery systems, platforms, and methods are expensive and inefficient, mainly due to the need for human drivers. Further, many current manned delivery means are configured for delivery and preservation of a single product. Although many additional restaurants and vendors seek to provide delivery service for their customers, specialized and dedicated delivery services to sufficiently maintain the quality of a food or beverage item, is cost prohibitive. Further, without a dedicated delivery vehicle for each restaurant, current manned delivery vehicles are unable to stock additional items for on-delivery supplemental orders. Additionally, current manned delivery systems are often configured to securely hold and transport one specific item, or to hold and transport a variety of items in an unsecure fashion.

[0005] One aspect provided herein is an autonomous or semi-autonomous land vehicle configured to receive a modular unit, the vehicle comprising: an energy storage device; a communication device; an autonomous or semi-autonomous land propulsion system; a vehicle interior fastener configured to reversibly affix the modular unit to the vehicle; a non-transitory computer-readable storage media encoded with a computer program including instructions executable by a processor to create an application comprising: a navigation

module receiving at least a location via the communication device and directing the autonomous or semi-autonomous land propulsion system based at least on the location; and a transmission module transmitting an output data, receiving an input data, or both, via the communication device, to a command center; and at least one of: a vehicle power port configured to transmit power from the energy storage device to the modular unit; a vehicle data port communicatively connecting the modular unit and the transmission module; a vehicle temperature control system, a cooling port, and a heating port configured to heat the modular unit, cool the modular unit, or both; and a vehicle exhaust port configured to receive an exhaust from the modular unit.

**[0006]** In some embodiments, the communication device comprises a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, a satellite communication device, or any combination thereof. In some embodiments, the vehicle data port comprises a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof. In some embodiments, the vehicle interior fastener comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof. In some embodiments, the vehicle further comprises a plurality of vehicle interior fasteners, the plurality of vehicle interior fasteners comprising a first vehicle interior fastener configured to reversibly affix a first type of modular unit and a second vehicle interior fastener configured to reversibly affix a second type of modular unit. In some embodiments, the vehicle interior fastener comprises at least one of the vehicle power port, the vehicle data port, the vehicle cooling/heating port, and the vehicle exhaust port. In some embodiments, the vehicle further comprises a lock configured to prevent unauthorized removal of the modular unit from the vehicle. In some embodiments, the vehicle interior fastener comprises the lock. In some embodiments, the vehicle is configured to receive two or more modular units. In some embodiments, the vehicle is configured to receive 3 to 25 modular units. In some embodiments, the modular unit is configured to secure a consumer product. In some embodiments, the consumer product comprises a food item, a beverage item, an electronics item, a clothing item, or any combination thereof. In some embodiments, the vehicle data port receives data from at least one sensor configured to measure a sensed data corresponding to the modular unit. In some embodiments, the input data comprises a modular unit temperature target, a modular unit display data, a modular unit indicator data, a modular unit access data, or any combination thereof. In some embodiments, the output data comprises a presence of a consumer product secured by the modular unit, a



modular unit access status, a current modular unit temperature, a modular unit stock, a modular unit type, or any combination thereof. In some embodiments, the vehicle comprises an interior compartment, and wherein the vehicle interior fastener is configured to reversibly affix the modular unit within the interior compartment. In some embodiments, the vehicle further comprises a permanently fixed modular unit.

**[0007]** Another aspect provided herein is a modular unit configured to be removably disposed within an autonomous or semi-autonomous land vehicle comprising: a modular unit fastener configured to reversibly attach to the vehicle; and at least one of: a modular unit power port configured to receive power from the vehicle; a modular unit data port configured to receive an input data from the vehicle, transmit an output data to the vehicle, or both; a modular unit cooling/heating port configured to receive heat from the vehicle, receive cooling from the vehicle, or both; and a modular unit exhaust port configured to emit an exhaust to the vehicle.

**[0008]** In some embodiments, the modular unit fastener comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof. In some embodiments, the modular unit fastener comprises at least one of the modular unit power port, the modular unit data port, the modular unit cooling/heating port, and the modular unit exhaust port. In some embodiments, the modular unit power port comprises a jack, an outlet, a cord, a cable, a wireless power transfer unit, or any combination thereof. In some embodiments, the modular unit data port comprises a jack, an outlet, a cord, a cable, a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof.

**[0009]** Another aspect provided herein is a reconfigurable autonomous or semi-autonomous vehicle system comprising: a modular unit comprising a modular unit fastener and at least one of: a modular unit power port; a modular unit data port; a modular unit cooling/heating port; and a modular unit exhaust port; and an autonomous or semi-autonomous land vehicle comprising: an energy storage device; a communication device; an autonomous or semi-autonomous propulsion system; a vehicle interior fastener configured to reversibly affix the modular unit to the vehicle; a non-transitory computer-readable storage media encoded with a computer program including instructions executable by a processor to create an application comprising: a navigation module receiving at least a location via the communication device and directing the autonomous or semi-autonomous land propulsion system based at least on the location; and a transmission module transmitting an output data, receiving an input data,

or both, via the communication device, to a command center; and at least one of: a vehicle power port configured to transmit power to the modular unit power port; a vehicle data port communicatively connected to the modular unit data port; a vehicle temperature control system, a cooling port, and a heating port configured to heat the modular unit, cool the modular unit, or both, via the modular unit cooling/heating port; and a vehicle exhaust port configured to receive an exhaust from the modular unit exhaust port.

**[0010]** In some embodiments, the communication device comprises a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, a satellite communication device, or any combination thereof. In some embodiments, the vehicle data port comprises a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof. In some embodiments, the vehicle interior fastener comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof. In some embodiments, the vehicle further comprises a plurality of vehicle interior fasteners, the plurality of vehicle interior fasteners comprising a first vehicle interior fastener configured to reversibly affix a first type of modular unit and a second vehicle interior fastener configured to reversibly affix a second type of modular unit. In some embodiments, the vehicle interior fastener comprises at least one of the vehicle power port, the vehicle data port, the vehicle cooling/heating port, and the vehicle exhaust port. In some embodiments, the vehicle further comprises a lock configured to prevent unauthorized removal of the modular unit from the vehicle. In some embodiments, the vehicle interior fastener comprises the lock. In some embodiments, the vehicle is configured to receive two or more modular units. In some embodiments, the vehicle is configured to receive 3 to 25 modular units. In some embodiments, the modular unit is configured to secure a consumer product. In some embodiments, the consumer product comprises a food item, a beverage item, an electronics item, a clothing item, or any combination thereof. In some embodiments, the vehicle data port receives data from at least one sensor configured to measure a sensed data corresponding to the modular unit. In some embodiments, the input data comprises a modular unit temperature target, a modular unit display data, a modular unit indicator data, a modular unit access data, or any combination thereof. In some embodiments, the output data comprises a presence of a consumer product secured by the modular unit, a modular unit access status, a current modular unit temperature, a modular unit stock, a modular unit type, or any combination thereof. In some embodiments, the vehicle comprises an interior compartment, and wherein the vehicle interior fastener is configured to reversibly



affix the modular unit within the interior compartment. In some embodiments, the vehicle further comprises a permanently fixed modular unit. In some embodiments, the modular unit fastener comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof. In some embodiments, the modular unit fastener comprises at least one of the modular unit power port, the modular unit data port, the modular unit cooling/heating port, and the modular unit exhaust port. In some embodiments, the modular unit power port comprises a jack, an outlet, a cord, a cable, a wireless power transfer unit, or any combination thereof. In some embodiments, the modular unit data port comprises a jack, an outlet, a cord, a cable, a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof.

[0011] Another aspect provided herein is a vehicle fleet comprising a plurality of autonomous vehicles operating autonomously and/or semi-autonomously and a fleet management module, associated with a central server for coordination of the vehicle fleet; the fleet management module configured to coordinate the activity and positioning of each autonomous vehicle in the fleet, wherein the fleet is configured for transporting, delivering or retrieving goods or services and capable of operating in an unstructured open or closed environments; each autonomous vehicle in the fleet comprising: a power system, a conveyance system; (e.g., a drive system with a propulsion engine, wheels, treads, wings, rotors, blowers, rockets, propellers, brakes, etc.); a navigation module for navigation in the unstructured open or closed environments; (e.g., digital maps, HD maps, GPS); a communication module configurable to receive, store and send data to the fleet management module, a user, and the autonomous vehicles in the fleet, related to at least; user interactions and the vehicle fleet interactions, comprising: scheduled requests or orders, on-demand requests or orders, or a need for self-positioning of the vehicle fleet based on anticipated demand within the unstructured open or closed environments; a sensor system, at least one securable compartment or a plurality of securable compartments to hold said goods or items associated with said services; and a controller configurable to associate each one of the at least one or plurality of securable compartments to an assignable customer, or customer group in a marketplace, or provider and provide entry when authorized; at least one processor configured to manage the conveyance system, the navigation module, the sensor system, instructions from the fleet management module, the communication module, and the controller.



[0012] In some embodiments, the unstructured open environment is a non-confined geographic region accessible by navigable pathways comprising: public roads; private roads; bike paths; open fields; open public lands; open private lands; pedestrian walkways; lakes; rivers; streams; or open airspace. In some embodiments, each vehicle fleet is configured with a maximum speed range from 1.0 mph to 90.0 mph.

[0013] In some embodiments, the closed environment is a confined, enclosed or semi-enclosed structure accessible by navigable pathways comprising: open areas or rooms within commercial architecture, with or without structures or obstacles therein; airspace within open areas or rooms within commercial architecture, with or without structures or obstacles therein; public or dedicated aisles; hallways; tunnels; ramps; elevators; conveyors; or pedestrian walkways.

[0014] In some embodiments, the navigation module controls routing of the conveyance system of the autonomous vehicles in the fleet in the unstructured open or closed environments. In some embodiments, the communication to the user, to the autonomous vehicles in the fleet, between the autonomous vehicles of the fleet, and between the user and the autonomous vehicles in the fleet, occurs via wireless transmission. In some embodiments, the user comprises a fleet manager; a sub-contracting vendor; a service provider; a customer; a business entity; an individual; or a third party.

[0015] In some embodiments, the user's wireless transmission interactions and the vehicle fleet wireless transmission interactions occur via mobile application transmitted by an electronic device and forwarded to the communication module via: a central server; a fleet management module; and/or a mesh network.

[0016] In some embodiments, the electronic device comprises: a phone; a personal mobile device; a personal digital assistant (PDA); a mainframe computer; a desktop computer; a laptop computer; a tablet computer; and/or wearable computing device comprising: a communication headset; smart glasses; a contact lens or lenses; a digital watch; a bracelet; a ring; jewelry; or a combination thereof.

[0017] In some embodiments, the plurality of securable compartments is configurable for a plurality of goods. Such configurations and goods comprise: bookshelves for books; thin drawers for documents; larger box-like drawers for packages, and sized compartments for vending machines, coffee makers, pizza ovens and dispensers. In some embodiments, the plurality of securable compartments is variably configurable based on: anticipated demands; patterns of behaviors; area of service; or types of goods to be transported. In some embodiments, the plurality of securable compartments is humidity and temperature controlled



for: hot goods, cold goods, wet goods, dry goods, or combinations or variants thereof. In some embodiments, the services comprise: subscription services; prescription services; marketing services; advertising services; notification services; a mobile marketplace; or requested, ordered or scheduled delivery services. In particular embodiments, the scheduled delivery services include, by way of example, special repeat deliveries such as groceries, prescriptions, drinks, mail, documents, etc. In some embodiments, the services further comprise: the user receiving and returning the same or similar goods within the same interaction; (e.g., signed documents); the user receiving one set of goods and returning a different set of goods within the same interaction; (e.g., product replacement / returns, groceries, merchandise, books, recording, videos, movies, payment transactions, etc.); a third party user providing instruction and or authorization to a goods or service provider to prepare, transport, deliver and/or retrieve goods to a principle user in a different location. In some embodiments, the services further comprise: general services, (e.g., picking up a user's dry cleaning, dropping off a user's dry cleaning, renting goods, (such as tools, DVDs, etc.), sharing/borrowing goods from other users or businesses, etc.). Further still, it may be a general pickup service for items to be shipped, returned, or sent to other users/businesses, etc.

**[0018]** In some embodiments, at least one autonomous vehicle in the fleet is further configured to process or manufacture goods. In some embodiments, the processed or manufactured goods comprise: beverages, etc., with or without condiments; (e.g., coffee, tea, carbonated drinks, etc.); a plurality of fast foods; or microwavable foods.

**[0019]** In some embodiments, the vehicle fleet further comprises at least one autonomous vehicle having a digital display for curated content comprising: advertisements (i.e., for both specific user and general public), including; services provided, marketing / promotion, regional / location of areas served, customer details, local environment, lost, sought or detected people, public service announcements, date, time, or weather.

**[0020]** In some embodiments of the vehicle fleet, the positioning of autonomous vehicles may be customized based on: anticipated use, a pattern of historical behaviors, or specific goods being carried. In some embodiments, the vehicle fleet is fully-autonomous. In some embodiments, the vehicle fleet is semi-autonomous. In some embodiments, the vehicle fleet is controlled directly by the user. In some embodiments of the vehicle fleet, a plurality of said autonomous or semi-autonomous vehicles within the fleet is operated on behalf of third party vendor/service provider; (e.g., fleet managed by an owner, but providing a coffee service/experience for a third party vendor (i.e., Starbucks) with white label vehicles in the fleet). In some embodiments of the vehicle fleet, a plurality of said autonomous vehicles



within the fleet is further configured to be part of a sub-fleet comprising a sub-plurality of autonomous vehicles, wherein each sub-fleet is configured to operate independently or in tandem with multiple sub-fleets comprising two or more sub-fleets.

### **INCORPORATION BY REFERENCE**

[0021] All publications, patents, and patent applications mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent, or patent application was specifically and individually indicated to be incorporated by reference.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0022] The novel features of the invention are set forth with particularity in the appended claims. A better understanding of the features and advantages of the present invention will be obtained by reference to the following detailed description that sets forth illustrative embodiments, in which the principles of the invention are utilized, and the accompanying drawings of which:

[0023] **FIG. 1** is an illustration of an exemplary vehicle fleet, in accordance with some embodiments;

[0024] **FIG. 2** is a perspective view of an exemplary autonomous vehicle comprising a plurality of compartments, in accordance with some embodiments;

[0025] **FIG. 3** is a front view of an exemplary autonomous vehicle beside a walking person, in accordance with some embodiments;

[0026] **FIG. 4** is a right side view of an exemplary autonomous vehicle, in accordance with some embodiments;

[0027] **FIG. 5** is a left side view of an exemplary autonomous vehicle beside an average person, in accordance with some embodiments;

[0028] **FIG. 6** is a rear view of an exemplary autonomous vehicle in accordance with some embodiments;

[0029] **FIG. 7** is a perspective view of an exemplary food delivery autonomous vehicle, in accordance with some embodiments;

[0030] **FIG. 8** is a perspective view of an exemplary pizza delivery autonomous vehicle, in accordance with some embodiments;

[0031] **FIG. 9** is a perspective view of an exemplary coffee delivery autonomous vehicle, in accordance with some embodiments;

[0032] **FIG. 10** is a perspective view of an exemplary meal delivery autonomous vehicle comprising a lighted interior, in accordance with some embodiments;

[0033] **FIG. 11A** is a perspective view of an exemplary autonomous vehicle, in accordance with some embodiments;

[0034] **FIG. 11B** is a perspective view of another exemplary autonomous vehicle, in accordance with some embodiments;

[0035] **FIG. 12** is a flowchart of an exemplary fleet control system, in accordance with some embodiments;

[0036] **FIG. 13** is a flowchart of an exemplary fleet control module, in accordance with some embodiments;

[0037] **FIG. 14** is a non-limiting schematic diagram of a digital processing device; in this case, a device with one or more CPUs, a memory, a communication interface, and a display, in accordance with some embodiments;

[0038] **FIG. 15** is a non-limiting schematic diagram of a web/mobile application provision system; in this case, a system providing browser-based and/or native mobile user interfaces, in accordance with some embodiments;

[0039] **FIG. 16** is a non-limiting schematic diagram of a cloud-based web/mobile application provision system; in this case, a system comprising an elastically load balanced, auto-scaling web server and application server resources as well synchronously replicated databases, in accordance with some embodiments;

[0040] **FIG. 17** is a perspective view of an exemplary autonomous vehicle configured to receive a modular unit, in accordance with some embodiments;

[0041] **FIG. 18** is a perspective view of an exemplary autonomous vehicle with modular units, in accordance with some embodiments;

[0042] **FIG. 19A** is a front perspective view of an exemplary first modular unit, in accordance with some embodiments;

[0043] **FIG. 19B** is a back perspective view of an exemplary first modular unit, in accordance with some embodiments;

[0044] **FIG. 19C** is a front perspective view of an exemplary second modular unit, in accordance with some embodiments; and

[0045] **FIG. 19D** is a back perspective view of an exemplary second modular unit, in accordance with some embodiments.



## **DETAILED DESCRIPTION OF THE INVENTION**

[0046] This disclosure relates to an autonomous or semi-autonomous vehicle fleet comprising a plurality of autonomous vehicles, for transporting or retrieving deliveries in either open unstructured outdoor environments or closed environments.

[0047] Provided herein is an autonomous or semi-autonomous land vehicle configured to receive a modular unit.

[0048] Currently, dedicated custom-made manned vehicles are used for specific use cases. Manned vehicles with cooling systems have been used to deliver fresh cool produce. Such dedicated custom vehicles, however, are unable to simultaneously deliver different items. Alternatively, delivery services that use generic unmodified vehicles are able to simultaneously deliver a wide array of items, but are not configured for optimal delivery of temperature or motion sensitive items.

[0049] By contrast, the reconfigurable autonomous vehicle herein may be easily modified to carry different types of removable display cases to enable optimal transport and delivery of various items. The reconfigurable autonomous vehicle herein may be configured to provide optimal delivery of various items without interaction or maintenance by a human driver. Further, the reconfigurable autonomous vehicle may be employed for longer operating hours per day than human drivers, whereby facile reconfigurability ensures optimal utilization throughout the day and/or night.

### **Fleet of Autonomous Vehicles**

[0050] Provided herein, per **FIG. 1**, is a vehicle fleet **100**, comprising a plurality of autonomous or semi-autonomous vehicles **101**.

[0051] In some embodiments, one or more of the vehicles **101** in the vehicle fleet **100** are autonomous. In some embodiments, one or more of the vehicles **101** in the vehicle fleet **100** are autonomous. In some embodiments the semi-autonomous vehicles **101** can be manually controlled by an operator. Manual override may be required to, for example, address navigation malfunctions, provider inventory issues, or unanticipated traffic, mechanical failure, electrical failure, traffic accident, and road conditions. In some embodiments of the plurality of autonomous vehicles **101** within the fleet **100** is operated on behalf of third party vendor or service provider. The third party vendor or service provider may comprise a food and beverage provider.

[0052] In some embodiments, one or more of the vehicles **101** within the vehicle fleet **100** are configured to be part of a sub-fleet **100a** that operates independently or in tandem with

other sub-fleets **100a**. In one example, the sub-fleet **100a** of vehicles **101** may only provide a product, service, or level of service associated with a single vendor. Each of the vehicles **101** in the sub-fleet **100a** may display a logo of the vendor or an alternative indicator representing the specific product, service, or level of service associated with that vehicle **101**. Levels of service may include immediate dedicated rush service, guaranteed morning / afternoon delivery service, and general delivery service. Some sub-fleets **100a** may offer a faster or more prioritized service than other sub-fleets **100a**.

#### Autonomous and Semi-Autonomous Vehicles

**[0053]** As illustrated in **FIGS. 1 – 11**, the vehicle **101** may comprise an autonomous or semi-autonomous automobile configured for land travel. The vehicle **101** may have a width, a height, and a length, wherein the length is about 2 feet to about 5 feet. The vehicle **101** may be lightweight and have a low center of gravity for increased stability. The vehicle **101** may be configurable for land, water, or air. The vehicle **101** may comprise a land vehicle such as, for example, a car, a wagon, a van, a tricycle, a truck, a trailer, a bus, a train, or a tram. The vehicle **101** may comprise a watercraft such as, for example, a ship, a boat, a ferry, a landing craft, a barge, a rafts, a hovercraft, or any combination thereof.. Alternatively, the vehicle **101** may comprise an aircraft or a spacecraft.

**[0054]** Each vehicle **101** in the fleet may comprise an autonomous propulsion system **130** comprising a drive system, a propulsion engine, a wheel, a treads, a wing, a rotor, a blower, a rocket, a propeller, a brake, or any combination thereof.

**[0055]** In one exemplary embodiment, a vehicle **101** comprises a land vehicle configured with a traditional 4-wheeled automotive configuration comprising conventional steering and braking systems. In this embodiment, the drive train may be configurable for standard 2-wheel drive or 4-wheel all-terrain traction drive, and the propulsion system may be configurable as a gas engine, a turbine engine, an electric motor, and/or a hybrid gas/electric engine.

**[0056]** In some embodiments, the vehicle **101** is configured for water travel as a watercraft with a propulsion system comprising a gas engine, a turbine engine, an electric motor and/or a hybrid gas/electric engine, or any combination thereof. In some embodiments, the vehicle **101** is configured for hover travel as an over-land or over-water hovercraft or an air-cushion vehicle (ACV) and is configured with blowers to produce a large volume of air below the hull that is slightly above atmospheric pressure. In some embodiments, the vehicle **101** is



configured for air travel as an aerial drone or aerial hovercraft and is configured with wings, rotors, blowers, rockets, and/or propellers and an appropriate brake system.

**[0057]** The vehicle **101** may further comprise an auxiliary solar power system to provide back-up emergency power or power for minor low-power sub-systems. In some embodiments, each vehicle of the vehicle fleet is configured with one or more power sources, such as battery, solar, gasoline, or propane. In some embodiments, the vehicle **101** further comprises a digital display for curated content comprising advertisements, marketing promotions, a public service notification, an emergency notification, or any combination thereof.

**[0058]** Each vehicle **101** in the fleet **100** may comprise a sensor system comprising a plurality of onboard sensors such as, for example, a camera, a video camera, a LiDAR, a radar, an ultrasonic sensor, and a microphone. Each vehicle **101** may further comprise an internal computer for real time navigation and obstacle avoidance, based on the data received by the sensors.

**[0059]** In some embodiments, the vehicles may further comprise an autonomous propulsion system sensor configured to monitor drive mechanism performance (e.g., the propulsion engine), power system levels (e.g., battery, solar, gasoline, propane, etc.), monitor drive train performance (e.g., transmission, tires, brakes, rotors, etc.), or any combination thereof.

**[0060]** In some embodiments, the vehicle is further configured to process or manufacture a good. In some embodiments, the vehicle is configured to process or manufacture the good in-transit. In some embodiments, the processed or manufactured good comprises: a beverage with or without condiments (such as coffee, tea, carbonated drinks, etc.), a fast food, a microwavable food, a reheatable food, or a rehydratable food. In some embodiments, the vehicle is equipped for financial transactions through debit or credit card readers.

**[0061]** In some embodiments, the vehicle **101** has a driving speed of about 1 mile per hour (mph) to about 90 mph, to accommodate inner-city, residential, and intrastate or interstate driving. In some embodiments, the vehicle **101** is configured for land travel. In some embodiments, each vehicle **101** in the fleet is configured with a working speed range from 13.0 mph to 45.0 mph. In some embodiments, the vehicle **101** is configured with a maximum speed range from 13.0 mph to about 90.0 mph. In some embodiments, vehicle **101** is configured for water travel as a watercraft and is configured with a working speed range from 1.0 mph to 45.0 mph. In some embodiments, the vehicle **101** is configured for hover travel as an over-land or over-water hovercraft and is configured with a working speed range from 1.0 mph to 60.0 mph. In some embodiments, the vehicle **101** is configured for air travel as an

aerial drone or aerial hovercraft and is configured with a working speed range from 1.0 mph to 80.0 mph.

#### Primary and Secondary Compartments

[0062] Provided herein, per **FIG. 2**, is an autonomous vehicle **101** comprising a plurality of compartments **102**, **104**. In some embodiments, the autonomous vehicle **101** comprises a primary compartment **102** and a secondary compartment **104** within the primary compartment **102**. In some embodiments, the plurality of compartments are non-modular. In other embodiments, some of the compartments are modular while the other compartments are non-modular. In some embodiments, the plurality of compartments may be humidity and/or temperature controlled for: hot goods, cold goods, wet goods, dry goods, or combinations thereof. In some embodiments, the plurality of securable compartments is configurable for a plurality of goods. Exemplary compartments and goods comprise: bookshelves for books; thin drawers for documents; larger box-like drawers for packages; and sized compartments for vending machines, embedded coffee makers, pizza ovens, and dispensers. In some embodiments, the plurality of securable compartments may be configured and reconfigured based on: anticipated demands, patterns of behaviors, area of service, the types of goods to be transported, or any combination thereof. Alternately, the compartments may be configured to contain a set of goods to form a mobile marketplace (similar to a mini bar at a hotel).

[0063] As illustrated in **FIGS. 8 - 10**, the compartment may comprise various additional amenities such as lights for night deliveries, condiment dispensers, and display screens.

[0064] Provided herein, per **FIG. 11A and FIG. 11B**, is a reconfigurable autonomous vehicle **101** for displaying and vending an item **1100** to a consumer comprising a plurality of removable display cases **1110**, an autonomous propulsion system, and a non-transitory computer-readable storage media encoded with a computer program including instructions executable by a processor to create an application.

[0065] In some embodiments, each display case **1110** comprises the item **1100**, a display fastener **1120** and at least one of: a temperature control system configured to maintain a target temperature within the removable display case **1110**; a display screen **1130** configured to display a case media; and a vending device **1140** configured to vend the item **1100**. In some embodiments, the autonomous vehicle **101** further comprises a vehicle interior fastener configured to removably affix the display fastener **1120**. The autonomous vehicle **101** may further comprise an energy storage device configured to provide energy to the removable display case **1110**. In some embodiments, the energy storage device is further configured to



provide power to the autonomous propulsion system, the display, the vending device, or any combination thereof.

**[0066]** In some embodiments, the application comprises a transmission module configured to receive an instruction from a fleet management module; the instruction comprising a route, and at least one of the target temperature and the case media; and a command module configured to communicate at least one of the target temperature and the case media to the removable display case **1110**, and a navigation module configured to direct the autonomous propulsion system based on the route. In some embodiments, the command module is configured to communicate the target temperature, the media, or both to the removable case through a communication hub. In some embodiments, the communication hub comprises a Wi-Fi router, a Bluetooth router, a cellular network, a jack, an outlet, a wire, or any combination thereof. In some embodiments, the route comprises a location of the consumer.

**[0067]** In some embodiments, the display fastener **1120** comprises a hook, a ring, a shelf, a bar, a spring, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, or any combination thereof. In some embodiments, the vehicle interior fastener comprises a hook, a ring, a shelf, a bar, a spring, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, or any combination thereof.

**[0068]** In some embodiments, the case media is based on the item **1100**, the target temperature, the route, or any combination thereof. In some embodiments, the autonomous vehicle **101** further comprises a screen configured to display a vehicular media. In some embodiments, the vehicular media comprises the item, the target temperature, the media, the route, or any combination thereof.

**[0069]** In some embodiments, the autonomous vehicle **101** further comprises a lock configured to prevent unauthorized removal of the display case from the autonomous vehicle. In some embodiments, at least one of the vehicle interior fastener and the display fastener comprise the lock. In some embodiments, the autonomous vehicle **101** further comprises a strain relief configured to prevent damage to the autonomous vehicle, the display case, the energy storage device the autonomous propulsion system, or any combination thereof.

**[0070]** In some embodiments, the autonomous vehicle **101** further comprises at least one of a power outlet, a data port, and an exhaust port. The power outlet may be configured to provide one or more power ratings to removable display case **1110** to power the display screen and/or any additional electrical components within the removable display case **1110**. The data port may enable data transmission to and/or from the removable display case **1110** and transmission module and the command module. The data may comprise a stock of items

within the removable display case **1110**, a current temperature removable display case **1110**, the case media, a price associated with the item **1100**, or any combination thereof.

[0071] At least one of the autonomous vehicle and the compartment may comprise a controller configured to associate each one of the plurality of securable compartments **102**, **104** to an assigned customer or provider and provide entry to the securable compartments **102**, **104** upon authorization. Each securable compartment **102**, **104** may be secured separately to transport goods to separate sets of customers. As such, the autonomous vehicle may deliver a first good or service to a first assigned customer from within a first securable compartment **102** and then deliver a second good or service to a second assigned customer from within the second securable compartment **104**.

[0072] Upon arrival of the autonomous vehicle to the customer destination, the customer may open their respective compartment(s) by verifying their identity. In one embodiment, the customer verifies their identity by providing a PIN (e.g., 4 digit number) via a touchscreen or a keypad within the autonomous vehicle, which they received upon initial request/order. The customer may verify themselves using their mobile phone and an RFID reader on the autonomous vehicle. Alternatively, the customer is verified through voice recognition of a keyword or key-phrase, wherein the autonomous vehicle comprises a microphone and a voice recognition application for recognition thereof. Further, in another embodiment, the customer is verified through facial or identification recognition, wherein the autonomous vehicle comprises a camera and a facial recognition application for recognition thereof. Additionally or alternatively, the customer is verified through a magnetic strip, RFID key or any other computer readable form of identification. Finally, in another embodiment, the customer is verified by entering a code or identification value on their mobile device, wherein the autonomous vehicle receives a cellular signal comprising a confirmation of the user or data related to the code of identification of the user.

[0073] In some embodiments, the vehicle could be configured for water travel, providing at least one and preferably two large storage compartments, and more preferably, at least one large compartment is configured with a plurality of smaller internal secure compartments of variable configurations to carry individual items that are to be delivered to, or need to be retrieved from customers. Further still, in some embodiments, the vehicle could be configured for hover travel, providing at least one and preferably two large storage compartments, and more preferably, at least one large compartment is configured with a plurality of smaller internal secure compartments of variable configurations to carry individual items that are to be delivered to, or need to be retrieved from customers. Further



still, in some embodiments, the vehicle could be configured for aerial drone or aerial hover travel, providing at least one and preferably two large storage compartments, and more preferably, at least one large compartment is configured with a plurality of smaller internal secure compartments of variable configurations to carry individual items that are to be delivered to, or need to be retrieved from customers.

#### Fleet Management Module

[0074] Provided herein, per **FIG. 12**, is a system for fleet management comprising a fleet management module **1201**, a central server **1202**, a vehicle **1204**, a customer **1203**, and a service provider **1205**. In some embodiments, the fleet management module **1201** coordinates, assigns tasks, and monitors the position of each of the plurality of vehicles **1204** in the fleet. The fleet management module **1201** may coordinate the vehicles **1204** in the fleet to monitor and collect data regarding unstructured open or closed environments, and report to the service provider **1205**. As seen, the fleet management module **1201** may coordinate with a central server **1202**. The central server **1202** may be located in a central operating facility owned or managed by the fleet owner. The service provider **1205** may comprise a third party provider of a good or service. The service provider **1205** may comprise a vendor, a business, a restaurant, a delivery service, a retailer, or any combination thereof.

[0075] In some embodiments, the fleet management module **1201** is configured to receive, store and transmit data to and/or from the service provider **1205**. The fleet management module **1201** may receive and transmit data to and/or from the service provider **1205** via a service provider application. In some embodiments, the service provider application comprises a computer application, an internet application, a tablet application, a phone application, or any combination thereof.

[0076] In some embodiments, the central server **1202** is configured to receive, store and transmit data to and/or from the customer **1203**. The central server **1202** may receive and transmit data to and/or from the customer **1203** via a customer application. In some embodiments, the customer application comprises a computer application, an internet application, a tablet application, a phone application, or any combination thereof.

[0077] In some embodiments, the vehicle **1204** comprises a memory device to store the data for future data transfer or manual download.

[0078] In one example, an order by a customer **1203** is transmitted to a central server **1202**, which then communicates with the fleet management module **1201**, which relays the order to the service provider **1205** associated with the order and a vehicle **1204**. The fleet

management module **1201** may employ one or more vehicles **1204** or sub-fleet vehicles **1204** that are closest to the service provider **1205**, customer **1203**, or both. The assigned service provider then interacts with that vehicle **1204** through a service provider application to supply the vehicle **1204** with any goods, maps, or instructions associated with the order. The vehicle **1204** then travels to the customer **1203** and reports completion of the order to at least one of the customer **1203**, the service provider **1205**, the central server **1202**, and the fleet management module **1201**.

[0079] In some embodiments the vehicle **1204** may be operated on behalf of the service provider **1205**, wherein at least one of the central server **1202** and the fleet management module **1201** is operated by the service provider **1205**. In any one of the embodiments, the vehicle **1204** is controlled directly by the customer **1203**, the service provider **1205**, or both. In some embodiments, human interaction of the vehicle **1204** may be required to address maintenance issues such as mechanical failure, electrical failure or a traffic accident.

[0080] In one example, the fleet management module **1201** receives an instruction from the service provider **1205** to collect an item at a first location and deliver the item to a second location. Upon receipt of the instruction, the fleet management module **1201** may assign one or more of the vehicles **1204** to perform the instruction by navigating the one or more of the vehicles **1204** the first location. The one more of the vehicles **1204** may then confirm the receipt of the item and navigate to the second location. The one more of the vehicles **1204** may then deliver the item to the second location and confirm receipt of the delivery. In some embodiments, the one more of the vehicles **1204** may further receive an identification associated with the first location, the second location, or both, to enable receipt and delivery of the item.

[0081] In one example, a request by the customer **1203** is sent to the central server **1202**, which then communicates with the fleet management module **1201** to relay the request to the service provider **1205**, which instructs the vehicles **1204**. The fleet management module **1201** may select one or more of the vehicles **1204** within the geographic region and/or proximity of the customer **1203**, the service provider **1205**, or both. The vehicles **1204** may be first directed to a location associated with the service provider **1205** to receive an item associated with the request. The vehicle **1204** may then travels to a location associated with the customer **1203**. The customer **1203** may then interacts with the one or more vehicle **1204** to retrieve the item. The customer **1203** may retrieve the item by opening a compartment within the vehicle **1204**. The customer **1203** may open the compartment within the vehicle **1204** through a customer application, or a customer interface comprising, for example, an RFID



reader, a touchpad, a keypad, a voice command, or a vision-based recognition. Upon completion the vehicles **1204** may then report a completion of the request to the fleet management module **1201** and be reassigned to a subsequent request.

**[0082]** In some embodiments, the autonomous fleet may be strategically positioned throughout a geographic region in anticipation of a known demand. Demand for autonomous vehicle services may be predicted by storing historical demand data relating to the quantity, timing, and type of request received in each region. Such demand predictions may further be weighted by the cost or importance of the good or service and employ historical trends for higher efficiency and throughput. As such, the fleet management module may position the autonomous vehicles as close as possible to the expected source locations.

**[0083]** Per **FIG. 13**, the fleet management module **1301** instructs the processor **1303** of the autonomous or semi-autonomous vehicle via a communication module **1302**. The processor **1303** may be configured to send an instruction and receive a sensed data from the sensor system **1306**, and may further control at least one of the power system **1307**, the navigation module **1305**, and the conveyance system **1304**. The processor **1303** may additionally be configured to instruct a controller **1308** to open a securable compartment **1309** to release any contents associated with an order. The processor **1303** may allow manual override of the conveyance system **1304**, the navigational system **1305**, or both.

**[0084]** In some embodiments, the processor **1303** is in functional communication with the communication module **1302**. In some embodiments, the communication module **1302** is adapted to receive, store, and/or transmit data to and from the customer and the fleet management module **1301**. In some embodiments, the data comprises a schedule, a request or order, a current location, a delivery location, a service provider location, a route, an estimated time of arrival (ETA), a repositioning instruction, a vehicle condition, a vehicle speed, or any combination thereof. In some embodiments, the processor **1303** is capable of both high-level computing for processing as well as low-level safety-critical computing capacity for controlling the hardware. The processor **1303** may be configured to direct the conveyance system **1304**, the navigation module **1305**, the sensor system **1306**, the power system **1307**, the controller **1308**, or any combination thereof. The processor **1303** may reside aboard the autonomous or semi-autonomous vehicle, or at a remote location.

**[0085]** In some embodiments, the communication module **1302** is configured to receive, store and transmit data via wireless transmission (e.g., 4G, 5G, or satellite communications). In some embodiments, the wireless transmission occurs via: a central server, a fleet management module, a mesh network, or any combination thereof. In some embodiments, the

customer application is configured to send and receive data via an electronic device comprising a phone, a personal mobile device, a personal digital assistant (PDA), a mainframe computer, a desktop computer, a laptop computer, a tablet computer, and/or wearable computing device comprising: a communication headset, smart glasses, or a combination thereof.

[0086] In some embodiments, the fleet management module **1301** directs each of the vehicles **1204** through a navigation module **1305**. In some embodiments, the navigation module **1305** controls the conveyance system **1304** to translate the autonomous or semi-autonomous vehicle through the unstructured open or closed environments. In some embodiments, the navigation module **1305** comprises an HD maps, a weather condition, an elevation map, a digital map, a street view photograph, a GPS point, or any combination thereof. In some embodiments, the map is generated by a customer, a customer, a service provider, a fleet operator, an online repository, a public database, or any combination thereof. In some embodiments, the map is generated only for intended operational geography. The maps may be augmented or confirmed by data obtained by the sensor system **1306**. The navigation module **1305** may further implement data collected by the sensor system **1306** to determine the location and/or the surroundings of the autonomous or semi-autonomous vehicle. In some embodiments, the map further comprises a navigation marker comprising a lane, a road sign, an intersection, a grade, or any combination thereof. As such the navigation module **1305**, in combination with processors and/or applications vehicles **1204** enable a safe, robust navigation trajectory.

[0087] In some embodiments, the fleet management module **1301** is configured to determine and predict a geographic demand for the autonomous or semi-autonomous vehicles for strategic placement throughout a geographic region in anticipation of a known demand. The fleet management module **1301** may determine and predict a geographic demand by storing data relating the location, quantity, time, price, item, item type, service, service type, service provider, or any combination thereof of placed orders and requests. Further, the service provider may provide independently measured trends to supplement or augment the measured trends. As such, the vehicles may be strategically placed to reduce transit and idle time and to increase sales volume and efficiency.

#### Vehicle Configured to Receive a Modular Unit

[0088] Provided herein, per **FIGS. 17 to 18**, is an autonomous or semi-autonomous land vehicle **101** configured to receive a modular unit **1810**, the vehicle **101** comprising: an energy



storage device **1760**; a communication device **1750**; an autonomous or semi-autonomous land propulsion system **130**; a vehicle interior fastener **1740**; a non-transitory computer-readable storage media; and at least one of: a vehicle power port **1702**; vehicle data port **1701**; a vehicle cooling/heating port **1703**; and a vehicle exhaust port **1704**.

[0089] In some embodiments, the vehicle **101** is configured to receive two or more modular units **1810**. In some embodiments, the vehicle **101** is configured to receive 3 to 50 modular units **1810**. In some embodiments, the vehicle **101** is configured to receive 3, 4, 5, 6, 8, 10, 15, 20, 30, 40, 50 or more modular units **1810** or increments therein. In some embodiments, per **FIG. 18**, the modular unit **1810** is configured to secure a consumer product **1820**. In some embodiments, the consumer product **1820** comprises a food item, a beverage item, an electronics item, a clothing item, or any combination thereof. In some embodiments, the vehicle **101** comprises an interior compartment **102**, and wherein the vehicle interior fastener **1740** is configured to reversibly affix the modular unit **1810** within the interior compartment **102**. In some embodiments, the vehicle **101** further comprises a permanently fixed modular unit. The permanently fixed modular unit may comprise a shelf, a display, an input device, or any combination thereof.

[0090] In some embodiments, the vehicle interior fastener **1740** is configured to reversibly affix the modular unit **1810** to the vehicle **101**. In some embodiments, the vehicle interior fastener **1740** comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof. In some embodiments, the vehicle **101** further comprises a plurality of vehicle interior fasteners **1740**, the plurality of vehicle interior fasteners **1740** comprising a first vehicle interior fastener **1740** configured to reversibly affix a first type of modular unit **1810** and a second vehicle interior fastener configured to reversibly affix a second type of modular unit. In some embodiments, the vehicle interior fastener **1740** comprises at least one of the vehicle power port **1702**, the vehicle data port **1701**, the vehicle cooling/heating port **1703**, and the vehicle exhaust port **1704**. In some embodiments, the vehicle **101** further comprises a lock configured to prevent unauthorized removal of the modular unit **1810** from the vehicle **101**. In some embodiments, the vehicle interior fastener **1740** comprises the lock.

[0091] The vehicle power port **1702** may be configured to transmit power from the energy storage device **1760** to the modular unit. In some embodiments, the vehicle power port **1702** comprises a plug, a socket, a connector, a wire, a cable, a wireless power connector, or any combination thereof. The vehicle data port **1701** may communicatively connect the modular unit **1810** and the transmission module. In some embodiments, the vehicle data port **1701**

comprises a plug, a socket, a connector, a wire, a cable, a wireless connector, a Bluetooth connector, or any combination thereof. The vehicle cooling/heating port **1703** may be configured to heat the modular unit **1810**, cool the modular unit **1810**, or both. The vehicle cooling/heating port **1703** may be alternatively or further configured change the condition of air within the modular unit **1810** in temperature of any degree and in any direction. In some embodiments, vehicle cooling/heating port **1703** may also be configured to alter a humidity or any other quality of the air within the modular unit **1810**. In some embodiments, the vehicle **101** further comprises a temperature control system configured to provide heat to the modular unit **1810**, cool the modular unit **1810**, or both. In some embodiments, the vehicle **101** further comprises a humidifier configured to alter an air quality within the modular unit **1810**. The vehicle cooling/heating port **1703** may comprise a push to connect connector, a quick connector, a jack, a fitting, a duct, or any combination thereof. The vehicle exhaust port **1704** may be configured to receive an exhaust from the modular unit **1810**. The vehicle air exhaust port **1704** may comprise a push to connect connector, a quick connector, a jack, a fitting, a duct, or any combination thereof. In some embodiments, the vehicle **101** comprises two or more of the vehicle interior fastener **1740**, the non-transitory computer-readable storage media, and at least one of: the vehicle power port **1702**, vehicle data port **1701**, the vehicle cooling/heating port **1703**, or the vehicle exhaust port **1704**. In some embodiments, the temperature control system is disposed away from the vehicle.

**[0092]** In some embodiments, the non-transitory media is encoded with a computer program including instructions executable by a processor to create an application comprising a navigation module and a transmission module. In some embodiments, the navigation module receives at least a location via the communication device **1750** and directing the autonomous or semi-autonomous land propulsion system **130** based at least on the location. In some embodiments, the transmission module transmits an output data, receiving an input data, or both, via the communication device **1750**, to a command center. In some embodiments, the input data comprises a modular unit **1810** temperature target, a modular unit **1810** display data, a modular unit **1810** indicator data, a modular unit **1810** access data, or any combination thereof. In some embodiments, the output data comprises a presence of a consumer product **1820** secured by the modular unit, a modular unit **1810** access status, a current modular unit **1810** temperature, a modular unit **1810** stock, a modular unit **1810** type, or any combination thereof.

**[0093]** In some embodiments, the communication device **1750** comprises a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device,



a satellite communication device, or any combination thereof. In some embodiments, the vehicle data port **1701** comprises a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof.

[0094] In some embodiments the vehicle **101** further comprises a sensor **1730**. In some embodiments, the sensor **1730** comprises a camera, a video camera, a LiDAR, a RADAR, a microphone, a radiation sensor, a chemical sensor, a light sensor, a tactile sensor, or any combination thereof. In some embodiments, the sensor **1730** is configured to measure a sensed data corresponding to the modular unit. In some embodiments, the vehicle data port **1701** receives data from the sensor **1730**.

#### Modular Units

[0095] Another aspect provided herein, per **FIGS. 19A to 19D** is a modular unit **1810a** **1810b** configured to be removably disposed within an autonomous or semi-autonomous land vehicle comprising: a modular unit fastener **1940** and at least one of: a modular unit power port **1902**; a modular unit data port **1901**; a modular unit cooling/heating port **1903**; and a modular unit exhaust port **1904**.

[0096] The modular unit fastener **1940** may be configured to reversibly attach to the vehicle. The modular unit power port **1902** may be configured to receive power from the vehicle. The modular unit data port **1901** may be configured to receive an input data from the vehicle, transmit an output data to the vehicle, or both. The modular unit cooling/heating port **1903** may be configured to receive heat from the vehicle, receive cooling from the vehicle, or both. The modular unit exhaust port **1904** may be configured to emit an exhaust to the vehicle.

[0097] In some embodiments, the modular unit fastener **1940** comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof. In some embodiments, the modular unit fastener **1940** comprises at least one of the modular unit power port **1902**, the modular unit data port **1901**, the modular unit cooling/heating port **1903**, and the modular unit exhaust port **1904**.

[0098] In some embodiments, the modular unit power port **1902** comprises a jack, an outlet, a cord, a cable, a wireless power transfer unit, or any combination thereof. In some embodiments, the modular unit data port **1901** comprises a jack, an outlet, a cord, a cable, a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof.

[0099] In some embodiments, the modular unit **1810** is configured to secure a consumer product. In some embodiments, the consumer product **1820** comprises a food item, a beverage item, an electronics item, a clothing item, or any combination thereof. In some embodiments the modular unit **1810** further comprises a modular unit sensor. In some embodiments, the modular unit sensor comprises a camera, a video camera, a LiDAR, a RADAR, a microphone, a radiation modular unit sensor, a chemical modular unit sensor, a light modular unit sensor, a tactile modular unit sensor, or any combination thereof. In some embodiments, the modular unit sensor is configured to measure a sensed data corresponding to the consumer product **1820**. In some embodiments, the modular unit data port **1901** receives data from the modular unit sensor. In some embodiments, the modular unit **1810** further comprises a lock configured to secure the contents therein.

[0100] **FIGS. 19A** and **19B** show front perspective views of an exemplary first modular unit **1810a** comprising a shelf. In some embodiments, the first modular unit **1810a** may not comprise at least one of the modular unit power port **1902**, the modular unit data port **1901**, the modular unit cooling/heating port **1903**, and the modular unit exhaust port **1904**. **FIGS. 19C** and **19D** show front perspective views of an exemplary second modular unit **1810b** comprising a locker modular unit **1810b**.

#### Systems Comprising a Vehicle and a Modular Unit

[0101] Provided herein, per **FIGS. 17** to **19**, is a system comprising an autonomous or semi-autonomous land vehicle **101** and a modular unit **1810**.

[0102] In some embodiments, per **FIG. 17**, the vehicle **101** comprises an energy storage device **1760**. The energy storage device may comprise a battery, a capacitor, a supercapacitor, or any combination thereof. In some embodiments, the vehicle comprises a communication device **1750**, an autonomous or semi-autonomous land propulsion system **130**, a vehicle interior fastener **1740**, a non-transitory computer-readable storage media, and at least one of: a vehicle power port **1702**; vehicle data port **1701**; a vehicle cooling/heating port **1703**; and a vehicle exhaust port **1704**. In some embodiments, the vehicle interior fastener **1740** comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof. In some embodiments, the vehicle interior fastener **1740** comprises at least one of the vehicle power port **1702**, the vehicle data port **1701**, the vehicle cooling/heating port **1703**, and the vehicle exhaust port **1704**. In some embodiments, the vehicle further comprises a plurality of vehicle interior fasteners **1740**, the plurality of vehicle interior fasteners **1740** comprising a



first vehicle interior fastener configured to reversibly affix a first type of modular unit and a second vehicle interior fastener configured to reversibly affix a second type of modular unit.

**[0103]** In some embodiments, the non-transitory media is encoded with a computer program including instructions executable by a processor to create an application comprising a navigation module and a transmission module. In some embodiments, the navigation module receives at least a location via the communication device **1750** and directing the autonomous or semi-autonomous land propulsion system **130** based at least on the location. In some embodiments, the transmission module transmits an output data, receiving an input data, or both, via the communication device **1750**, to a command center. In some embodiments, the input data comprises a modular unit temperature target, a modular unit display data, a modular unit indicator data, a modular unit access data, or any combination thereof. In some embodiments, the output data comprises a presence of a consumer product **1820** secured by the modular unit, a modular unit access status, a current modular unit temperature, a modular unit stock, a modular unit type, or any combination thereof.

**[0104]** In some embodiments, the communication device **1750** comprises a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, a satellite communication device, or any combination thereof. In some embodiments, the vehicle data port **1701** comprises a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof.

**[0105]** In some embodiments the vehicle **101** further comprises a sensor **1730**. In some embodiments, the sensor **1730** comprises a camera, a video camera, a LiDAR, a RADAR, a microphone, a radiation sensor, a chemical sensor, a light sensor, a tactile sensor, or any combination thereof. In some embodiments, the sensor **1730** is configured to measure a sensed data corresponding to the modular unit. In some embodiments, the vehicle data port **1701** receives data from the sensor **1730**.

**[0106]** In some embodiments, per **FIG. 18**, the vehicle **101** is configured to receive two or more modular units **1810**. In some embodiments, the vehicle is configured to receive 3 to 25 modular units **1810**. In some embodiments, per **FIG. 18**, the modular unit **1810a 1810b** is configured to secure a consumer product. In some embodiments, the consumer product comprises a food item, a beverage item, an electronics item, a clothing item, or any combination thereof. In some embodiments, the vehicle comprises an interior compartment, and wherein the vehicle interior fastener **1740** is configured to reversibly affix the modular unit **1810** within the interior compartment . In some embodiments, the vehicle interior

fastener **1740** is configured to reversibly affix the modular unit **1810a 1810b** to the vehicle **101**. In some embodiments, the vehicle **101** further comprises a lock configured to prevent unauthorized removal of the modular unit **1810a 1810b** from the vehicle **101**. In some embodiments, the vehicle interior fastener **1740** comprises the lock. In some embodiments, the vehicle **101** further comprises a permanently fixed modular unit **1810**. The permanently fixed modular unit **1810** may comprise a shelf, a display, an input device, or any combination thereof.

[0107] The vehicle power port **1702** may be configured to transmit power from the energy storage device **1760** to the modular unit **1810**. The vehicle data port **1701** may communicatively connect the modular unit **1810** and the transmission module. The vehicle cooling/heating port **1703** may be configured to heat the modular unit **1810**, cool the modular unit **1810**, or both. The vehicle cooling/heating port **1703** may be alternatively or further configured change the condition of air within the modular unit **1810** in temperature of any degree and in any direction. In some embodiments, vehicle cooling/heating port **1703** may also be configured to alter a humidity or any other quality of the air within the modular unit **1810**. In some embodiments, the vehicle **101** further comprises a temperature control system configured to provide heat the modular unit **1810**, cool the modular unit **1810**, or both. In some embodiments, the vehicle **101** further comprises a humidifier configured to alter an air quality within the modular unit **1810**. The vehicle exhaust port **1704** may be configured to receive an exhaust from the modular unit. In some embodiments, the vehicle **101** comprises two or more of the vehicle interior fasteners **1740**, the non-transitory computer-readable storage media, and at least one of: the vehicle power port **1702**, vehicle data port **1701**, the vehicle cooling/heating port **1703**, or the vehicle exhaust port **1704**.

[0108] The modular unit **1810** may be configured to be removably disposed within an autonomous or semi-autonomous land vehicle **101** and may comprise: a modular unit fastener **1940** and at least one of: a modular unit power port **1902**; a modular unit data port **1901**; a modular unit cooling/heating port **1903**; and a modular unit exhaust port **1904**. In some embodiments, the modular unit fastener **1940** comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof.

[0109] In referring to **FIGs. 19A-19D**, the modular unit power port **1902** may be configured to receive power from the vehicle **101**. The modular unit data port **1901** may be configured to receive an input data from the vehicle **101**, transmit an output data to the vehicle **101**, or both. The modular unit cooling/heating port **1903** may be configured to receive heat from the



vehicle **101**, receive cooling from the vehicle **101**, or both. The modular unit exhaust port **1904** may be configured to emit an exhaust to the vehicle **101**.

[0110] In some embodiments, the vehicle power port **1702** is configured to connect to the modular unit power port **1902**. In some embodiments, the vehicle data port **1701** is configured to connect to the modular unit cooling/heating port **1903**. In some embodiments, the vehicle cooling/heating port **1703** is configured to connect to the modular unit data port **1901**. In some embodiments, the vehicle exhaust port **1704** is configured to connect to the modular unit exhaust port **1904**.

[0111] In some embodiments, the vehicle power port **1702** and the modular unit power port **1902** are configured to transfer power from the vehicle **101** to a display, an indicator, a light, a speaker, a temperature control system, a heater, or any combination thereof within the modular unit **1810**. In some embodiments, the vehicle data port **1701** and the modular unit data port **1901** are configured to transfer data from the vehicle **101** to a display, an indicator, a light, a speaker, a sensor, a thermometer, or any combination thereof within the modular unit **1810**. In some embodiments, the vehicle cooling/heating port **1703** and the modular unit cooling/heating port **1903** are configured to transfer heat or cold from the vehicle **101** to maintain a set temperature within the modular unit **1810**. In some embodiments, the vehicle air exhaust port **1704** and the modular unit exhaust port **1904** are configured to transfer exhaust from the modular unit **1810** emitted by any component within the modular unit **1810**. In one example, the vehicle air exhaust port **1704** and the modular unit exhaust port **1904** are configured to transfer gaseous exhaust comprising an odor to the vehicle **101** to prevent cross-contamination of smells or vapors between objects within the modular unit **1810**, or between the one or more modular units **1810**.

[0112] In some embodiments, the vehicle power port **1702** and the modular unit power port **1902** comprise a plug, a socket, a connector, a wire, a cable, a wireless power connector, or any combination thereof. In some embodiments, the vehicle data port **1701** and the modular unit data port **1901** comprise a plug, a socket, a connector, a wire, a cable, a wireless connector, a Bluetooth connector, or any combination thereof. In some embodiments, vehicle cooling/heating port **1703** and the modular unit cooling/heating port **1903** comprise a push to connect connector, a quick connector, a jack, a fitting, a duct, or any combination thereof. In some embodiments, the vehicle air exhaust port **1704** and the modular unit exhaust port **1904** comprise a push to connect connector, a quick connector, a jack, a fitting, a duct, or any combination thereof.

[0113] The modular unit fastener **1940** may be configured to reversibly attach to the vehicle **101**. In some embodiments, the modular unit fastener **1940** comprises at least one of the modular unit power port **1902**, the modular unit data port **1901**, the modular unit cooling/heating port **1903**, and the modular unit exhaust port **1904**.

[0114] In some embodiments, the modular unit power port **1902** comprises a jack, an outlet, a cord, a cable, a wireless power transfer unit, or any combination thereof. In some embodiments, the modular unit data port **1901** comprises a jack, an outlet, a cord, a cable, a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof.

[0115] In some embodiments, the modular unit **1810** is configured to secure a consumer product **1820**. In some embodiments, the consumer product **1820** comprises a food item, a beverage item, an electronics item, a clothing item, or any combination thereof. In some embodiments the modular unit **1810** further comprises a modular unit sensor. In some embodiments, the modular unit sensor comprises a camera, a video camera, a LiDAR, a RADAR, a microphone, a radiation modular unit sensor, a chemical modular unit sensor, a light modular unit sensor, a tactile modular unit sensor, or any combination thereof. In some embodiments, the modular unit sensor is configured to measure a sensed data corresponding to the consumer product **1820**. In some embodiments, the modular unit data port **1901** receives data from the modular unit sensor.

### Operating Environments

[0116] The autonomous vehicles in the fleet may be configured to operate within a variety of unstructured open operating environments to enable service to a broad range of locations. In some embodiments, the unstructured open environment is a non-confined geographic region accessible by navigable pathways comprising: public roads; private roads; bike paths; open fields, open public lands, open private lands, pedestrian walkways, lakes, rivers, or streams. In some embodiments, the closed environment is a confined, enclosed, or semi-enclosed structure accessible by navigable pathways comprising: open areas or rooms within commercial architecture, with or without structures or obstacles therein; airspace within open areas or rooms within commercial architecture, with or without structures or obstacles therein; public or dedicated aisles; hallways; tunnels; ramps; elevators; conveyors; or pedestrian walkways. In some embodiments, the unstructured open environment is a non-confined airspace or even near-space environment which includes all main layers of the Earth's atmosphere comprising the troposphere, the stratosphere, the mesosphere, the



thermosphere and the exosphere. In some embodiments, the navigation module controls routing of the conveyance system of the vehicles in the fleet in the unstructured open or closed environments.

### Goods and Services

[0117] In some embodiments, the user comprises a fleet manager, a sub-contracting vendor, a service provider, a customer, a business entity, an individual, or a third party. In some embodiments, the services comprises a subscription service, a prescription service, a marketing service, an advertising service, a notification service, a requested service, an ordered service, a scheduled delivery service, or any combination thereof. For example, the scheduled delivery services may include special repeat deliveries such as groceries, prescriptions, drinks, mail, documents, or any combination thereof.

[0118] In some embodiments, the services alternatively or further comprise a return of a good (e.g., a signed document), receiving one set of goods and returning a different set of goods (e.g., product replacement / returns, groceries, merchandise, books, recording, videos, movies, payment transactions, etc.), or a third party user providing instruction and or authorization to a goods or service provider to prepare, transport, deliver and/or retrieve goods to a principle user in a different location. In some embodiments, the services further or alternatively comprise: advertising services, land survey services, patrol services, monitoring services, traffic survey services, signage and signal survey services, architectural building, or road infrastructure survey services.

[0119] In some embodiments, the service further or alternatively comprises processing or manufacturing a good. In some embodiments, the autonomous vehicle is configured to process or manufacture the good in-transit. In some embodiments, the processed or manufactured good comprises: a beverage with or without condiments (such as coffee, tea, carbonated drinks, etc.), a fast food, a microwavable food, a reheatable food, or a rehydratable food. In some embodiments, the service comprises a financial transaction. In some embodiments, the service comprises advertising, marketing, public safety, public service, or any combination thereof.

### Digital processing device

[0120] In some embodiments, the platforms, systems, media, and methods described herein include a digital processing device, or use of the same. In further embodiments, the digital processing device includes one or more hardware central processing units (CPUs) or general

purpose graphics processing units (GPGPUs) that carry out the device's functions. In still further embodiments, the digital processing device further comprises an operating system configured to perform executable instructions. In some embodiments, the digital processing device is optionally connected a computer network. In further embodiments, the digital processing device is optionally connected to the Internet such that it accesses the World Wide Web. In still further embodiments, the digital processing device is optionally connected to a cloud computing infrastructure. In other embodiments, the digital processing device is optionally connected to an intranet. In other embodiments, the digital processing device is optionally connected to a data storage device.

**[0121]** In accordance with the description herein, suitable digital processing devices include, by way of non-limiting examples, server computers, desktop computers, laptop computers, notebook computers, sub-notebook computers, netbook computers, netpad computers, set-top computers, and media streaming devices, handheld computers, Internet appliances, mobile smartphones, tablet computers, personal digital assistants, video game consoles, and vehicles. Those of skill in the art will recognize that many smartphones are suitable for use in the system described herein. Those of skill in the art will also recognize that select televisions, video players, and digital music players with optional computer network connectivity are suitable for use in the system described herein. Suitable tablet computers include those with booklet, slate, and convertible configurations, known to those of skill in the art.

**[0122]** In some embodiments, the digital processing device includes an operating system configured to perform executable instructions. The operating system is, for example, software, including programs and data, which manages the device's hardware and provides services for execution of applications. Those of skill in the art will recognize that suitable server operating systems include, by way of non-limiting examples, FreeBSD, OpenBSD, NetBSD<sup>®</sup>, Linux, Apple<sup>®</sup> Mac OS X Server<sup>®</sup>, Oracle<sup>®</sup> Solaris<sup>®</sup>, Windows Server<sup>®</sup>, and Novell<sup>®</sup> NetWare<sup>®</sup>. Those of skill in the art will recognize that suitable personal computer operating systems include, by way of non-limiting examples, Microsoft<sup>®</sup> Windows<sup>®</sup>, Apple<sup>®</sup> Mac OS X<sup>®</sup>, UNIX<sup>®</sup>, and UNIX-like operating systems such as GNU/Linux<sup>®</sup>. In some embodiments, the operating system is provided by cloud computing. Those of skill in the art will also recognize that suitable mobile smart phone operating systems include, by way of non-limiting examples, Nokia<sup>®</sup> Symbian<sup>®</sup> OS, Apple<sup>®</sup> iOS<sup>®</sup>, Research In Motion<sup>®</sup> BlackBerry OS<sup>®</sup>, Google<sup>®</sup> Android<sup>®</sup>, Microsoft<sup>®</sup> Windows Phone<sup>®</sup> OS, Microsoft<sup>®</sup> Windows Mobile<sup>®</sup> OS, Linux<sup>®</sup>, and Palm<sup>®</sup> WebOS<sup>®</sup>. Those of skill in the art will also recognize that suitable media streaming device operating systems include, by way of non-limiting examples,



Apple TV<sup>®</sup>, Roku<sup>®</sup>, Boxee<sup>®</sup>, Google TV<sup>®</sup>, Google Chromecast<sup>®</sup>, Amazon Fire<sup>®</sup>, and Samsung<sup>®</sup> HomeSync<sup>®</sup>. Those of skill in the art will also recognize that suitable video game console operating systems include, by way of non-limiting examples, Sony<sup>®</sup> PS3<sup>®</sup>, Sony<sup>®</sup> PS4<sup>®</sup>, Microsoft<sup>®</sup> Xbox 360<sup>®</sup>, Microsoft Xbox One, Nintendo<sup>®</sup> Wii<sup>®</sup>, Nintendo<sup>®</sup> Wii U<sup>®</sup>, and Ouya<sup>®</sup>.

**[0123]** In some embodiments, the device includes a storage and/or memory device. The storage and/or memory device is one or more physical apparatuses used to store data or programs on a temporary or permanent basis. In some embodiments, the device is volatile memory and requires power to maintain stored information. In some embodiments, the device is non-volatile memory and retains stored information when the digital processing device is not powered. In further embodiments, the non-volatile memory comprises flash memory. In some embodiments, the non-volatile memory comprises dynamic random-access memory (DRAM). In some embodiments, the non-volatile memory comprises ferroelectric random access memory (FRAM). In some embodiments, the non-volatile memory comprises phase-change random access memory (PRAM). In other embodiments, the device is a storage device including, by way of non-limiting examples, CD-ROMs, DVDs, flash memory devices, magnetic disk drives, magnetic tapes drives, optical disk drives, and cloud computing based storage. In further embodiments, the storage and/or memory device is a combination of devices such as those disclosed herein.

**[0124]** In some embodiments, the digital processing device includes a display to send visual information to a user. In some embodiments, the display is a liquid crystal display (LCD). In further embodiments, the display is a thin film transistor liquid crystal display (TFT-LCD). In some embodiments, the display is an organic light emitting diode (OLED) display. In various further embodiments, on OLED display is a passive-matrix OLED (PMOLED) or active-matrix OLED (AMOLED) display. In some embodiments, the display is a plasma display. In other embodiments, the display is a video projector. In yet other embodiments, the display is a head-mounted display in communication with the digital processing device, such as a VR headset. In further embodiments, suitable VR headsets include, by way of non-limiting examples, HTC Vive, Oculus Rift, Samsung Gear VR, Microsoft HoloLens, Razer OSVR, FOVE VR, Zeiss VR One, Avegant Glyph, Freefly VR headset, and the like. In still further embodiments, the display is a combination of devices such as those disclosed herein.

**[0125]** In some embodiments, the digital processing device includes an input device to receive information from a user. In some embodiments, the input device is a keyboard. In some embodiments, the input device is a pointing device including, by way of non-limiting



examples, a mouse, trackball, track pad, joystick, game controller, or stylus. In some embodiments, the input device is a touch screen or a multi-touch screen. In other embodiments, the input device is a microphone to capture voice or other sound input. In other embodiments, the input device is a video camera or other sensor to capture motion or visual input. In further embodiments, the input device is a Kinect, Leap Motion, or the like. In still further embodiments, the input device is a combination of devices such as those disclosed herein.

[0126] Referring to **FIG. 14**, in a particular embodiment, a digital processing device **1401** is programmed or otherwise configured to managing autonomous vehicles. The device **1401** is programmed or otherwise configured to manage autonomous vehicles. In this embodiment, the digital processing device **1401** includes a central processing unit (CPU, also “processor” and “computer processor” herein) **1405**, which is optionally a single core, a multi core processor, or a plurality of processors for parallel processing. The digital processing device **1401** also includes memory or memory location **1410** (e.g., random-access memory, read-only memory, flash memory), electronic storage unit **1415** (e.g., hard disk), communication interface **1420** (e.g., network adapter) for communicating with one or more other systems, and peripheral devices **1425**, such as cache, other memory, data storage and/or electronic display adapters. The memory **1410**, storage unit **1415**, interface **1420** and peripheral devices **1425** are in communication with the CPU **1405** through a communication bus (solid lines), such as a motherboard. The storage unit **1415** comprises a data storage unit (or data repository) for storing data. The digital processing device **1401** is optionally operatively coupled to a computer network (“network”) **1430** with the aid of the communication interface **1420**. The network **1430**, in various cases, is the internet, an internet, and/or extranet, or an intranet and/or extranet that is in communication with the internet. The network **1430**, in some cases, is a telecommunication and/or data network. The network **1430** optionally includes one or more computer servers, which enable distributed computing, such as cloud computing. The network **1430**, in some cases, with the aid of the device **1401**, implements a peer-to-peer network, which enables devices coupled to the device **1401** to behave as a client or a server.

[0127] Continuing to refer to **FIG. 14**, the CPU **1405** is configured to execute a sequence of machine-readable instructions, embodied in a program, application, and/or software. The instructions are optionally stored in a memory location, such as the memory **1410**. The instructions are directed to the CPU **105**, which subsequently program or otherwise configure the CPU **1405** to implement methods of the present disclosure. Examples of operations



performed by the CPU **1405** include fetch, decode, execute, and write back. The CPU **1405** is, in some cases, part of a circuit, such as an integrated circuit. One or more other components of the device **1401** are optionally included in the circuit. In some cases, the circuit is an application specific integrated circuit (ASIC) or a field programmable gate array (FPGA).

[0128] Continuing to refer to **FIG. 14**, the storage unit **1415** optionally stores files, such as drivers, libraries and saved programs. The storage unit **1415** optionally stores user data, e.g., user preferences and user programs. The digital processing device **1401**, in some cases, includes one or more additional data storage units that are external, such as located on a remote server that is in communication through an intranet or the internet.

[0129] Continuing to refer to **FIG. 14**, the digital processing device **1401** optionally communicates with one or more remote computer systems through the network **1430**. For instance, the device **1401** optionally communicates with a remote computer system of a user. Examples of remote computer systems include personal computers (e.g., portable PC), slate or tablet PCs (e.g., Apple<sup>®</sup> iPad, Samsung<sup>®</sup> Galaxy Tab, etc.), smartphones (e.g., Apple<sup>®</sup> iPhone, Android-enabled device, Blackberry<sup>®</sup>, etc.), or personal digital assistants.

[0130] Methods as described herein are optionally implemented by way of machine (e.g., computer processor) executable code stored on an electronic storage location of the digital processing device **101**, such as, for example, on the memory **1410** or electronic storage unit **1415**. The machine executable or machine readable code is optionally provided in the form of software. During use, the code is executed by the processor **1405**. In some cases, the code is retrieved from the storage unit **1415** and stored on the memory **1410** for ready access by the processor **1405**. In some situations, the electronic storage unit **1415** is precluded, and machine-executable instructions are stored on the memory **1410**.

#### Non-transitory computer readable storage medium

[0131] In some embodiments, the platforms, systems, media, and methods disclosed herein include one or more non-transitory computer readable storage media encoded with a program including instructions executable by the operating system of an optionally networked digital processing device. In further embodiments, a computer readable storage medium is a tangible component of a digital processing device. In still further embodiments, a computer readable storage medium is optionally removable from a digital processing device. In some embodiments, a computer readable storage medium includes, by way of non-limiting examples, CD-ROMs, DVDs, flash memory devices, solid state memory, magnetic disk

drives, magnetic tape drives, optical disk drives, cloud computing systems and services, and the like. In some cases, the program and instructions are permanently, substantially permanently, semi-permanently, or non-transitorily encoded on the media.

#### Computer program

**[0132]** In some embodiments, the platforms, systems, media, and methods disclosed herein include at least one computer program, or use of the same. A computer program includes a sequence of instructions, executable in the digital processing device's CPU, written to perform a specified task. Computer readable instructions may be implemented as program modules, such as functions, objects, Application Programming Interfaces (APIs), data structures, and the like, that perform particular tasks or implement particular abstract data types. In light of the disclosure provided herein, those of skill in the art will recognize that a computer program may be written in various versions of various languages.

**[0133]** The functionality of the computer readable instructions may be combined or distributed as desired in various environments. In some embodiments, a computer program comprises one sequence of instructions. In some embodiments, a computer program comprises a plurality of sequences of instructions. In some embodiments, a computer program is provided from one location. In other embodiments, a computer program is provided from a plurality of locations. In various embodiments, a computer program includes one or more software modules. In various embodiments, a computer program includes, in part or in whole, one or more web applications, one or more mobile applications, one or more standalone applications, one or more web browser plug-ins, extensions, add-ins, or add-ons, or combinations thereof.

#### Web application

**[0134]** In some embodiments, a computer program includes a web application. In light of the disclosure provided herein, those of skill in the art will recognize that a web application, in various embodiments, utilizes one or more software frameworks and one or more database systems. In some embodiments, a web application is created upon a software framework such as Microsoft<sup>®</sup>.NET or Ruby on Rails (RoR). In some embodiments, a web application utilizes one or more database systems including, by way of non-limiting examples, relational, non-relational, object oriented, associative, and XML database systems. In further embodiments, suitable relational database systems include, by way of non-limiting examples, Microsoft<sup>®</sup> SQL Server, mySQL<sup>™</sup>, and Oracle<sup>®</sup>. Those of skill in the art will also recognize that a web



application, in various embodiments, is written in one or more versions of one or more languages. A web application may be written in one or more markup languages, presentation definition languages, client-side scripting languages, server-side coding languages, database query languages, or combinations thereof. In some embodiments, a web application is written to some extent in a markup language such as Hypertext Markup Language (HTML), Extensible Hypertext Markup Language (XHTML), or eXtensible Markup Language (XML). In some embodiments, a web application is written to some extent in a presentation definition language such as Cascading Style Sheets (CSS). In some embodiments, a web application is written to some extent in a client-side scripting language such as Asynchronous Javascript and XML (AJAX), Flash<sup>®</sup> ActionScript, JavaScript, or Silverlight<sup>®</sup>. In some embodiments, a web application is written to some extent in a server-side coding language such as Active Server Pages (ASP), ColdFusion<sup>®</sup>, Perl, Java<sup>™</sup>, JavaServer Pages (JSP), Hypertext Preprocessor (PHP), Python<sup>™</sup>, Ruby, Tcl, Smalltalk, WebDNA<sup>®</sup>, or Groovy. In some embodiments, a web application is written to some extent in a database query language such as Structured Query Language (SQL). In some embodiments, a web application integrates enterprise server products such as IBM<sup>®</sup> Lotus Domino<sup>®</sup>. In some embodiments, a web application includes a media player element. In various further embodiments, a media player element utilizes one or more of many suitable multimedia technologies including, by way of non-limiting examples, Adobe<sup>®</sup> Flash<sup>®</sup>, HTML 5, Apple<sup>®</sup> QuickTime<sup>®</sup>, Microsoft<sup>®</sup> Silverlight<sup>®</sup>, Java<sup>™</sup>, and Unity<sup>®</sup>.

**[0135]** Referring to **FIG. 15**, in a particular embodiment, an application provision system comprises one or more databases **1500** accessed by a relational database management system (RDBMS) **1510**. Suitable RDBMSs include Firebird, MySQL, PostgreSQL, SQLite, Oracle Database, Microsoft SQL Server, IBM DB2, IBM Informix, SAP Sybase, SAP Sybase, Teradata, and the like. In this embodiment, the application provision system further comprises one or more application servers **1520** (such as Java servers, .NET servers, PHP servers, and the like) and one or more web servers **1530** (such as Apache, IIS, GWS and the like). The web server(s) optionally expose one or more web services via application programming interfaces (APIs) **1540**. Via a network, such as the internet, the system provides browser-based and/or mobile native user interfaces.

**[0136]** Referring to **FIG. 16**, in a particular embodiment, an application provision system alternatively has a distributed, cloud-based architecture **1600** and comprises elastically load balanced, auto-scaling web server resources **1610**, and application server resources **1620** as well synchronously replicated databases **1630**.

### Mobile Application

[0137] In some embodiments, a computer program includes a mobile application provided to a mobile digital processing device. In some embodiments, the mobile application is provided to a mobile digital processing device at the time it is manufactured. In other embodiments, the mobile application is provided to a mobile digital processing device via the computer network described herein.

[0138] In view of the disclosure provided herein, a mobile application is created by techniques known to those of skill in the art using hardware, languages, and development environments known to the art. Those of skill in the art will recognize that mobile applications are written in several languages. Suitable programming languages include, by way of non-limiting examples, C, C++, C#, Objective-C, Java™, Javascript, Pascal, Object Pascal, Python™, Ruby, VB.NET, WML, and XHTML/HTML with or without CSS, or combinations thereof.

[0139] Suitable mobile application development environments are available from several sources. Commercially available development environments include, by way of non-limiting examples, AirplaySDK, alcheMo, Appcelerator®, Celsius, Bedrock, Flash Lite, .NET Compact Framework, Rhomobile, and WorkLight Mobile Platform. Other development environments are available without cost including, by way of non-limiting examples, Lazarus, MobiFlex, MoSync, and Phonegap. Also, mobile device manufacturers distribute software developer kits including, by way of non-limiting examples, iPhone and iPad (iOS) SDK, Android™ SDK, BlackBerry® SDK, BREW SDK, Palm® OS SDK, Symbian SDK, webOS SDK, and Windows® Mobile SDK.

[0140] Those of skill in the art will recognize that several commercial forums are available for distribution of mobile applications including, by way of non-limiting examples, Apple® App Store, Google® Play, Chrome WebStore, BlackBerry® App World, App Store for Palm devices, App Catalog for webOS, Windows® Marketplace for Mobile, Ovi Store for Nokia® devices, Samsung® Apps, and Nintendo® DSi Shop.

### Standalone Application

[0141] In some embodiments, a computer program includes a standalone application, which is a program that is run as an independent computer process, not an add-on to an existing process, e.g., not a plug-in. Those of skill in the art will recognize that standalone applications are often compiled. A compiler is a computer program(s) that transforms source code written in a programming language into binary object code such as assembly language



or machine code. Suitable compiled programming languages include, by way of non-limiting examples, C, C++, Objective-C, COBOL, Delphi, Eiffel, Java™, Lisp, Python™, Visual Basic, and VB.NET, or combinations thereof. Compilation is often performed, at least in part, to create an executable program. In some embodiments, a computer program includes one or more executable compiled applications.

### Web Browser Plug-in

[0142] In some embodiments, the computer program includes a web browser plug-in (e.g., extension, etc.). In computing, a plug-in is one or more software components that add specific functionality to a larger software application. Makers of software applications support plug-ins to enable third-party developers to create abilities which extend an application, to support easily adding new features, and to reduce the size of an application. When supported, plug-ins enable customizing the functionality of a software application. For example, plug-ins are commonly used in web browsers to play video, generate interactivity, scan for viruses, and display particular file types. Those of skill in the art will be familiar with several web browser plug-ins including, Adobe® Flash® Player, Microsoft® Silverlight®, and Apple® QuickTime®.

[0143] In view of the disclosure provided herein, those of skill in the art will recognize that several plug-in frameworks are available that enable development of plug-ins in various programming languages, including, by way of non-limiting examples, C++, Delphi, Java™, PHP, Python™, and VB.NET, or combinations thereof.

[0144] Web browsers (also called Internet browsers) are software applications, designed for use with network-connected digital processing devices, for retrieving, presenting, and traversing information resources on the World Wide Web. Suitable web browsers include, by way of non-limiting examples, Microsoft® Internet Explorer®, Mozilla® Firefox®, Google® Chrome, Apple® Safari®, Opera Software® Opera®, and KDE Konqueror. In some embodiments, the web browser is a mobile web browser. Mobile web browsers (also called microbrowsers, mini-browsers, and wireless browsers) are designed for use on mobile digital processing devices including, by way of non-limiting examples, handheld computers, tablet computers, netbook computers, subnotebook computers, smartphones, music players, personal digital assistants (PDAs), and handheld video game systems. Suitable mobile web browsers include, by way of non-limiting examples, Google® Android® browser, RIM BlackBerry® Browser, Apple® Safari®, Palm® Blazer, Palm® WebOS® Browser, Mozilla®

Firefox<sup>®</sup> for mobile, Microsoft<sup>®</sup> Internet Explorer<sup>®</sup> Mobile, Amazon<sup>®</sup> Kindle<sup>®</sup> Basic Web, Nokia<sup>®</sup> Browser, Opera Software<sup>®</sup> Opera<sup>®</sup> Mobile, and Sony<sup>®</sup> PSP<sup>™</sup> browser.

### Software Modules

[0145] In some embodiments, the platforms, systems, media, and methods disclosed herein include software, server, and/or database modules, or use of the same. In view of the disclosure provided herein, software modules are created by techniques known to those of skill in the art using machines, software, and languages known to the art. The software modules disclosed herein are implemented in a multitude of ways. In various embodiments, a software module comprises a file, a section of code, a programming object, a programming structure, or combinations thereof. In further various embodiments, a software module comprises a plurality of files, a plurality of sections of code, a plurality of programming objects, a plurality of programming structures, or combinations thereof. In various embodiments, the one or more software modules comprise, by way of non-limiting examples, a web application, a mobile application, and a standalone application. In some embodiments, software modules are in one computer program or application. In other embodiments, software modules are in more than one computer program or application. In some embodiments, software modules are hosted on one machine. In other embodiments, software modules are hosted on more than one machine. In further embodiments, software modules are hosted on cloud computing platforms. In some embodiments, software modules are hosted on one or more machines in one location. In other embodiments, software modules are hosted on one or more machines in more than one location.

### Databases

[0146] In some embodiments, the platforms, systems, media, and methods disclosed herein include one or more databases, or use of the same. In view of the disclosure provided herein, those of skill in the art will recognize that many databases are suitable for autonomous vehicles. In various embodiments, suitable databases include, by way of non-limiting examples, relational databases, non-relational databases, object oriented databases, object databases, entity-relationship model databases, associative databases, and XML databases. Further non-limiting examples include SQL, PostgreSQL, MySQL, Oracle, DB2, and Sybase. In some embodiments, a database is internet-based. In further embodiments, a database is web-based. In still further embodiments, a database is cloud computing-based. In other embodiments, a database is based on one or more local computer storage devices.



### Terms and Definitions

[0147] As used herein, the phrases “at least one,” “one or more,” and “and/or” are open-ended expressions that are both conjunctive and disjunctive in operation. For example, each of the expressions “at least one of A, B and C”, “at least one of A, B, or C”, “one or more of A, B, and C”, “one or more of A, B, or C” and “A, B, and/or C” means A alone, B alone, C alone, A and B together, A and C together, B and C together, or A, B and C together.

[0148] As used herein, the terms “fleet,” “sub-fleet,” and like terms are used to indicate a number of land vehicles, watercraft, or aircraft operating together or under the same ownership. In some embodiments the fleet or sub-fleet is engaged in the same activity. In some embodiments, the fleet or sub-fleet are engaged in similar activities. In some embodiments, the fleet, or sub-fleet are engaged in different activities.

[0149] As used herein, the terms “autonomous vehicle,” “vehicle fleet,” “vehicle,” “all-terrain vehicle,” and like terms are used to indicate a mobile machine that transports cargo. Typical vehicles include cars, wagons, vans, unmanned motor vehicles (e.g., tricycles, trucks, trailers, buses, etc.), unmanned railed vehicles (e.g., trains, trams, etc.), unmanned watercraft (e.g., ships, boats, ferries, landing craft, barges, rafts, etc.), aerial drones, unmanned hovercraft (air, land and water types) , unmanned aircraft, and even including unmanned spacecraft.

[0150] As used herein, the terms “user,” “operator,” “fleet operator,” and like terms are used to indicate the entity that owns or is responsible for managing and operating the vehicle fleet.

[0151] As used herein, the term “customer” and like terms are used to indicate the entity that requests the services provided the vehicle fleet.

[0152] As used herein, the terms “provider,” “business,” “vendor,” “third party vendor,” and like terms are used to indicate an entity that works in concert with the fleet owner or operator to utilize the services of the vehicle fleet to deliver the provider’s product from and or return the provider’s product to the provider’s place of business or staging location.

[0153] As used herein, the terms “server,” “computer server,” “central server,” “main server,” and like terms are used to indicate a computer or device on a network that manages the fleet resources, namely the autonomous vehicles.

[0154] As used herein, the term “controller” and like terms are used to indicate a device that controls the transfer of data from a computer to a peripheral device and vice versa. For example, disk drives, display screens, keyboards, and printers all require controllers. In personal computers, the controllers are often single chips. As used herein the controller is

commonly used for managing access to components of the autonomous vehicle such as the securable compartments.

**[0155]** As used herein a “mesh network” is a network topology in which each node relays data for the network. All mesh nodes cooperate in the distribution of data in the network. It may be applied to both wired and wireless networks. Wireless mesh networks may be considered a type of “Wireless *ad hoc*” network. Thus, wireless mesh networks are closely related to Mobile ad hoc networks (MANETs). Although MANETs are not restricted to a specific mesh network topology, Wireless ad hoc networks or MANETs may take any form of network topology. Mesh networks may relay messages using either a flooding technique or a routing technique. With routing, the message is propagated along a path by hopping from node to node until it reaches its destination. To ensure that all its paths are available, the network must allow for continuous connections and must reconfigure itself around broken paths, using self-healing algorithms such as Shortest Path Bridging. Self-healing allows a routing-based network to operate when a node breaks down or when a connection becomes unreliable. As a result, the network is typically quite reliable, as there is often more than one path between a source and a destination in the network. This concept may also apply to wired networks and to software interaction. A mesh network whose nodes are all connected to each other is a fully connected network.

**[0156]** As used herein, the term “module” and like terms are used to indicate a self-contained hardware component of the central server, which in turn comprises software modules. In software, a module is a part of a program. Programs are composed of one or more independently developed modules that are not combined until the program is linked. A single module may contain one or several routines, or sections of programs that perform a particular task. As used herein the fleet management module comprises software modules for managing various aspects and functions of the vehicle fleet.

**[0157]** As used herein, the terms “processor,” “digital processing device,” and like terms are used to indicate a microprocessor or central processing unit (CPU). The CPU is the electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.

**[0158]** In accordance with the description herein, suitable digital processing devices include, by way of non-limiting examples, server computers, desktop computers, laptop computers, notebook computers, sub-notebook computers, netbook computers, netpad computers, set-top computers, handheld computers, Internet appliances, mobile smartphones, tablet computers,



personal digital assistants, video game consoles, and vehicles. Those of skill in the art will recognize that many smartphones are suitable for use in the system described herein. Suitable tablet computers include those with booklet, slate, and convertible configurations, known to those of skill in the art.

**[0159]** In some embodiments, the digital processing device includes an operating system configured to perform executable instructions. The operating system is, for example, software, including programs and data, which manages the device's hardware and provides services for execution of applications. Those of skill in the art will recognize that suitable server operating systems include, by way of non-limiting examples, FreeBSD, OpenBSD, NetBSD<sup>®</sup>, Linux, Apple<sup>®</sup> Mac OS X Server<sup>®</sup>, Oracle<sup>®</sup> Solaris<sup>®</sup>, Windows Server<sup>®</sup>, and Novell<sup>®</sup> NetWare<sup>®</sup>. Those of skill in the art will recognize that suitable personal computer operating systems include, by way of non-limiting examples, Microsoft<sup>®</sup> Windows<sup>®</sup>, Apple<sup>®</sup> Mac OS X<sup>®</sup>, UNIX<sup>®</sup>, and UNIX-like operating systems such as GNU/Linux<sup>®</sup>. In some embodiments, the operating system is provided by cloud computing. Those of skill in the art will also recognize that suitable mobile smart phone operating systems include, by way of non-limiting examples, Nokia<sup>®</sup> Symbian<sup>®</sup> OS, Apple<sup>®</sup> iOS<sup>®</sup>, Research In Motion<sup>®</sup> BlackBerry OS<sup>®</sup>, Google<sup>®</sup> Android<sup>®</sup>, Microsoft<sup>®</sup> Windows Phone<sup>®</sup> OS, Microsoft<sup>®</sup> Windows Mobile<sup>®</sup> OS, Linux<sup>®</sup>, and Palm<sup>®</sup> WebOS<sup>®</sup>.

**[0160]** In some embodiments, the device includes a storage and/or memory device. The storage and/or memory device is one or more physical apparatus used to store data or programs on a temporary or permanent basis. In some embodiments, the device is volatile memory and requires power to maintain stored information. In some embodiments, the device is non-volatile memory and retains stored information when the digital processing device is not powered. In some embodiments, the non-volatile memory comprises flash memory. In some embodiments, the non-volatile memory comprises dynamic random-access memory (DRAM). In some embodiments, the non-volatile memory comprises ferroelectric random access memory (FRAM). In some embodiments, the non-volatile memory comprises phase-change random access memory (PRAM). In some embodiments, the device is a storage device including, by way of non-limiting examples, CD-ROMs, DVDs, flash memory devices, magnetic disk drives, magnetic tapes drives, optical disk drives, and cloud computing based storage. In some embodiments, the storage and/or memory device is a combination of devices such as those disclosed herein.

**[0161]** In some embodiments, the digital processing device includes a display to send visual information to a user. In some embodiments, the display is a cathode ray tube (CRT). In some

embodiments, the display is a liquid crystal display (LCD). In some embodiments, the display is a thin film transistor liquid crystal display (TFT-LCD). In some embodiments, the display is an organic light emitting diode (OLED) display. In various some embodiments, on OLED display is a passive-matrix OLED (PMOLED) or active-matrix OLED (AMOLED) display. In some embodiments, the display is a plasma display. In some embodiments, the display is a video projector. In some embodiments, the display is interactive (e.g., having a touch screen or a sensor such as a camera, a 3D sensor, a LiDAR, a radar, etc.) that may detect user interactions/gestures/responses and the like. In still some embodiments, the display is a combination of devices such as those disclosed herein.



**CLAIMS****WHAT IS CLAIMED IS:**

1. An autonomous or semi-autonomous land vehicle configured to receive a modular unit, the vehicle comprising:
  - a) an energy storage device;
  - b) a communication device;
  - c) an autonomous or semi-autonomous land propulsion system;
  - d) a vehicle interior fastener configured to reversibly affix the modular unit to the vehicle;
  - e) a non-transitory computer-readable storage media encoded with a computer program including instructions executable by a processor to create an application comprising:
    - (i) a navigation module receiving at least a location via the communication device and directing the autonomous or semi-autonomous land propulsion system based at least on the location; and
    - (ii) a transmission module transmitting an output data, receiving an input data, or both, via the communication device, to a command center; and
  - f) at least one of:
    - (i) a vehicle power port configured to transmit power from the energy storage device to the modular unit;
    - (ii) a vehicle data port communicatively connecting the modular unit and the transmission module;
    - (iii) a vehicle temperature control system, a cooling port, and a heating port configured to heat the modular unit, cool the modular unit, or both; and
    - (iv) a vehicle exhaust port configured to receive an exhaust from the modular unit.
2. The vehicle of claim 1, wherein the communication device comprises a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, a satellite communication device, or any combination thereof.

3. The vehicle of claim 1, wherein the vehicle data port comprises a wired data interface, a Wi-Fi communication device, a Bluetooth communication device, a cellular communication device, or any combination thereof.
4. The vehicle of claim 1, wherein the vehicle interior fastener comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof.
5. The vehicle of claim 1, comprising a plurality of vehicle interior fasteners, the plurality of vehicle interior fasteners comprising a first vehicle interior fastener configured to reversibly affix a first type of modular unit and a second vehicle interior fastener configured to reversibly affix a second type of modular unit.
6. The vehicle of claim 1, wherein the vehicle interior fastener comprises at least one of the vehicle power port, the vehicle data port, the vehicle cooling/heating port, and the vehicle exhaust port.
7. The vehicle of claim 1, further comprising a lock configured to prevent unauthorized removal of the modular unit from the vehicle.
8. The vehicle of claim 7, wherein the vehicle interior fastener comprises the lock.
9. The vehicle of claim 1, configured to receive two or more modular units.
10. The vehicle of claim 9, configured to receive 3 to 25 modular units.
11. The vehicle of claim 1, wherein the modular unit is configured to secure a consumer product.
12. The vehicle of claim 11, wherein the consumer product comprises a food item, a beverage item, an electronics item, a clothing item, or any combination thereof.
13. The vehicle of claim 1, wherein the vehicle data port receives data from at least one sensor configured to measure a sensed data corresponding to the modular unit.
14. The vehicle of claim 1, wherein the input data comprises a modular unit temperature target, a modular unit display data, a modular unit indicator data, a modular unit access data, or any combination thereof.



15. The vehicle of claim 1, wherein the output data comprises a presence of a consumer product secured by the modular unit, a modular unit access status, a current modular unit temperature, a modular unit stock, a modular unit type, or any combination thereof.
16. The vehicle of claim 1, wherein the vehicle comprises an interior compartment, and wherein the vehicle interior fastener is configured to reversibly affix the modular unit within the interior compartment.
17. The vehicle of claim 1, further comprising a permanently fixed modular unit.
18. A reconfigurable autonomous or semi-autonomous vehicle system comprising:
  - a) a modular unit comprising a modular unit fastener and at least one of:
    - (i) a modular unit power port;
    - (ii) a modular unit data port;
    - (iii) a modular unit cooling/heating port; and
    - (iv) a modular unit exhaust port; and
  - b) an autonomous or semi-autonomous land vehicle comprising:
    - (i) an energy storage device;
    - (ii) a communication device;
    - (iii) an autonomous or semi-autonomous propulsion system;
    - (iv) a vehicle interior fastener configured to reversibly affix the modular unit to the vehicle;
    - (v) a non-transitory computer-readable storage media encoded with a computer program including instructions executable by a processor to create an application comprising:
      - i) a navigation module receiving at least a location via the communication device and directing the autonomous or semi-autonomous land propulsion system based at least on the location; and

- ii) a transmission module transmitting an output data, receiving an input data, or both, via the communication device, to a command center; and
    - (vi) at least one of:
      - i) a vehicle power port configured to transmit power to the modular unit power port;
      - ii) a vehicle data port communicatively connected to the modular unit data port;
      - iii) a vehicle temperature control system, a cooling port, and a heating port configured to heat the modular unit, cool the modular unit, or both, via the modular unit cooling/heating port; and
      - iv) a vehicle exhaust port configured to receive an exhaust from the modular unit exhaust port.
19. A modular unit configured to be removably disposed within an autonomous or semi-autonomous land vehicle comprising:
- a) a modular unit fastener configured to reversibly attach to the vehicle; and
  - b) at least one of:
    - (i) a modular unit power port configured to receive power from the vehicle;
    - (ii) a modular unit data port configured to receive an input data from the vehicle, transmit an output data to the vehicle, or both;
    - (iii) a modular unit cooling/heating port configured to receive heat from the vehicle, receive cooling from the vehicle, or both; and
    - (iv) a modular unit exhaust port configured to emit an exhaust to the vehicle.
20. The modular unit of claim 19, wherein the modular unit fastener comprises a hook, a ring, a shelf, a bar, a spring, a rail, a slide, a bolt, a nut, a bearing, a bushing, a tie, a clip, a chain, a rack, a magnet, or any combination thereof.



21. The modular unit of claim 19, wherein the modular unit fastener comprises at least one of the modular unit power port, the modular unit data port, the modular unit cooling/heating port, and the modular unit exhaust port.

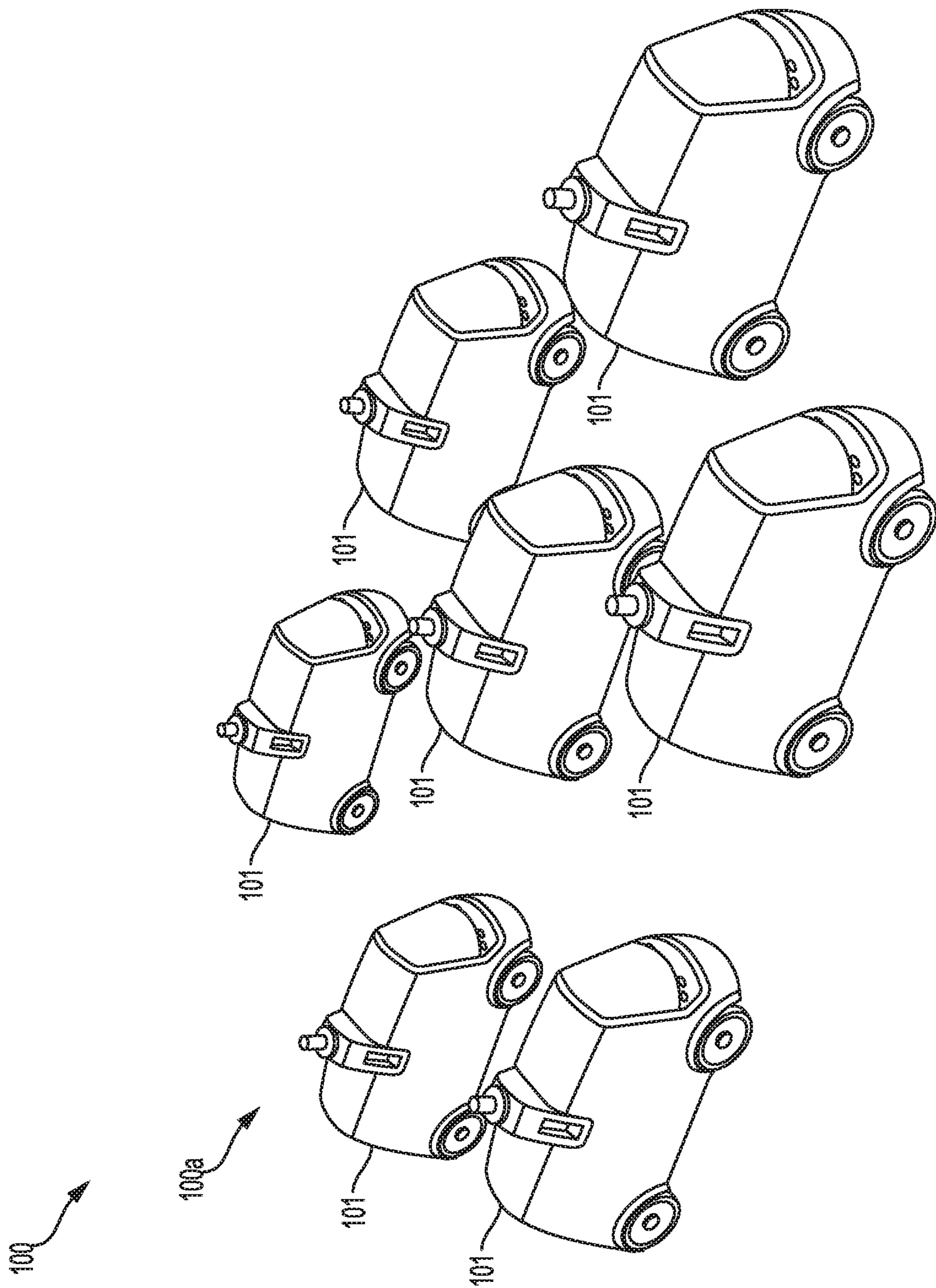


FIG. 1



[2/21]

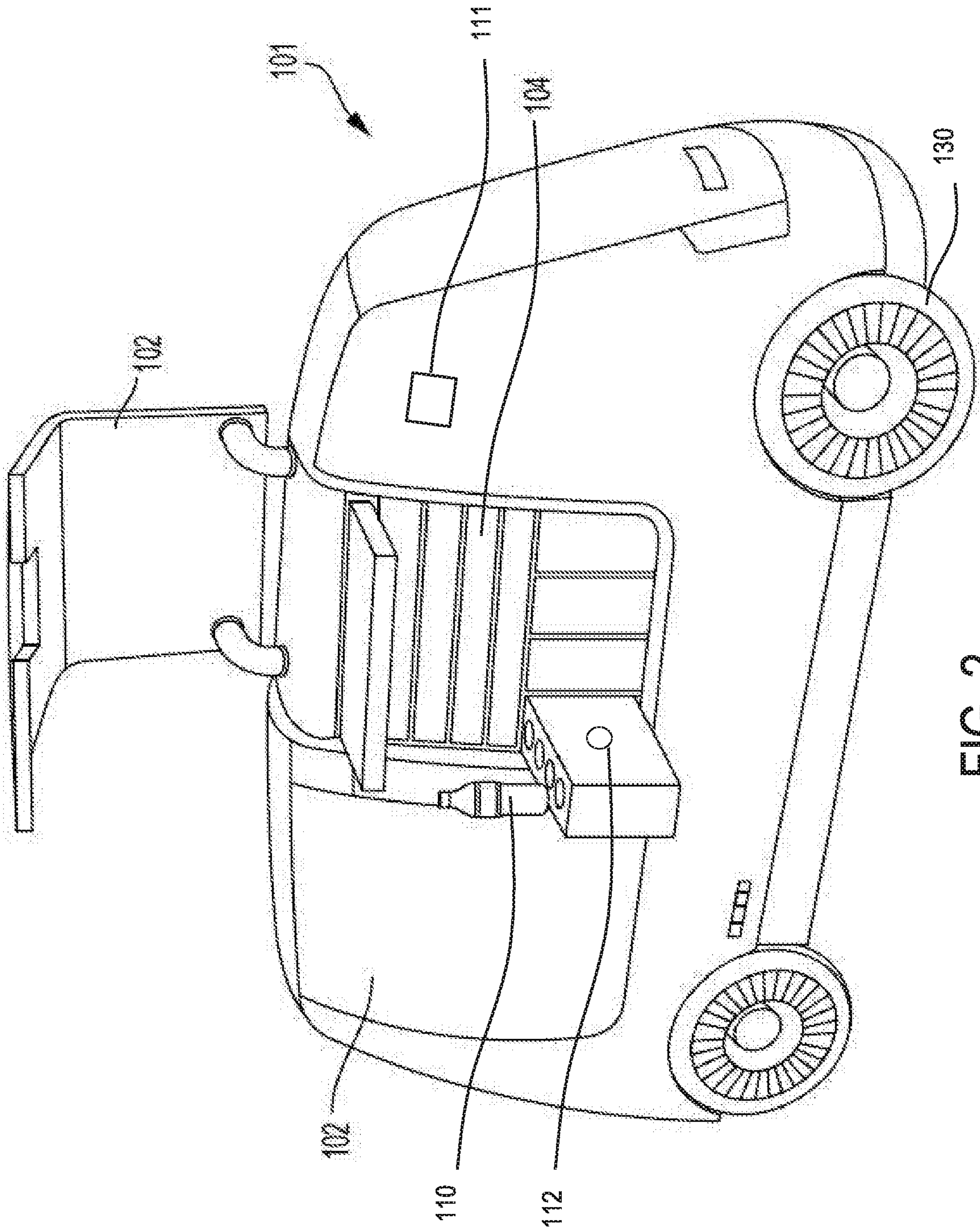


FIG. 2

[3/21]

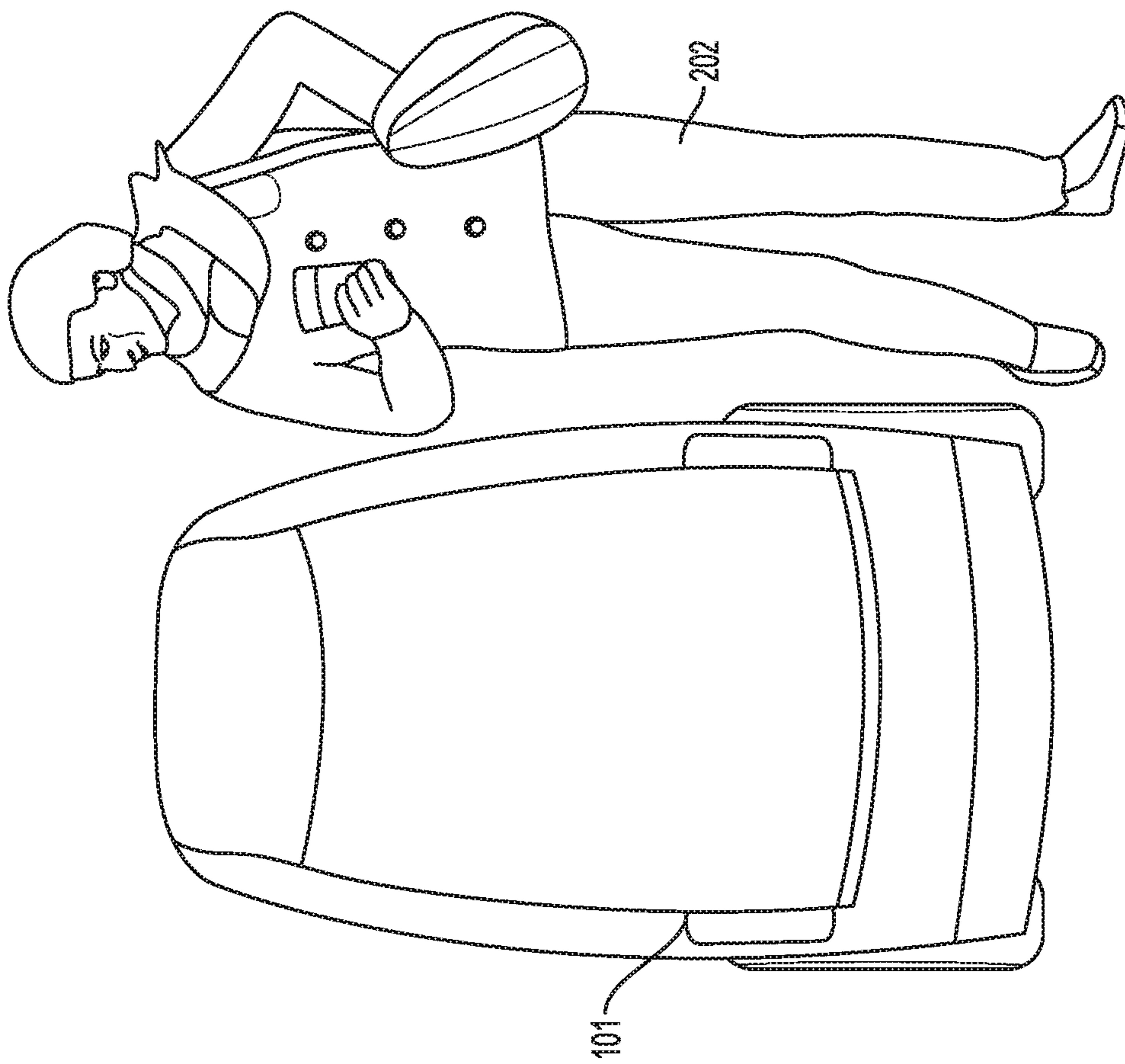


FIG. 3



[4/21]

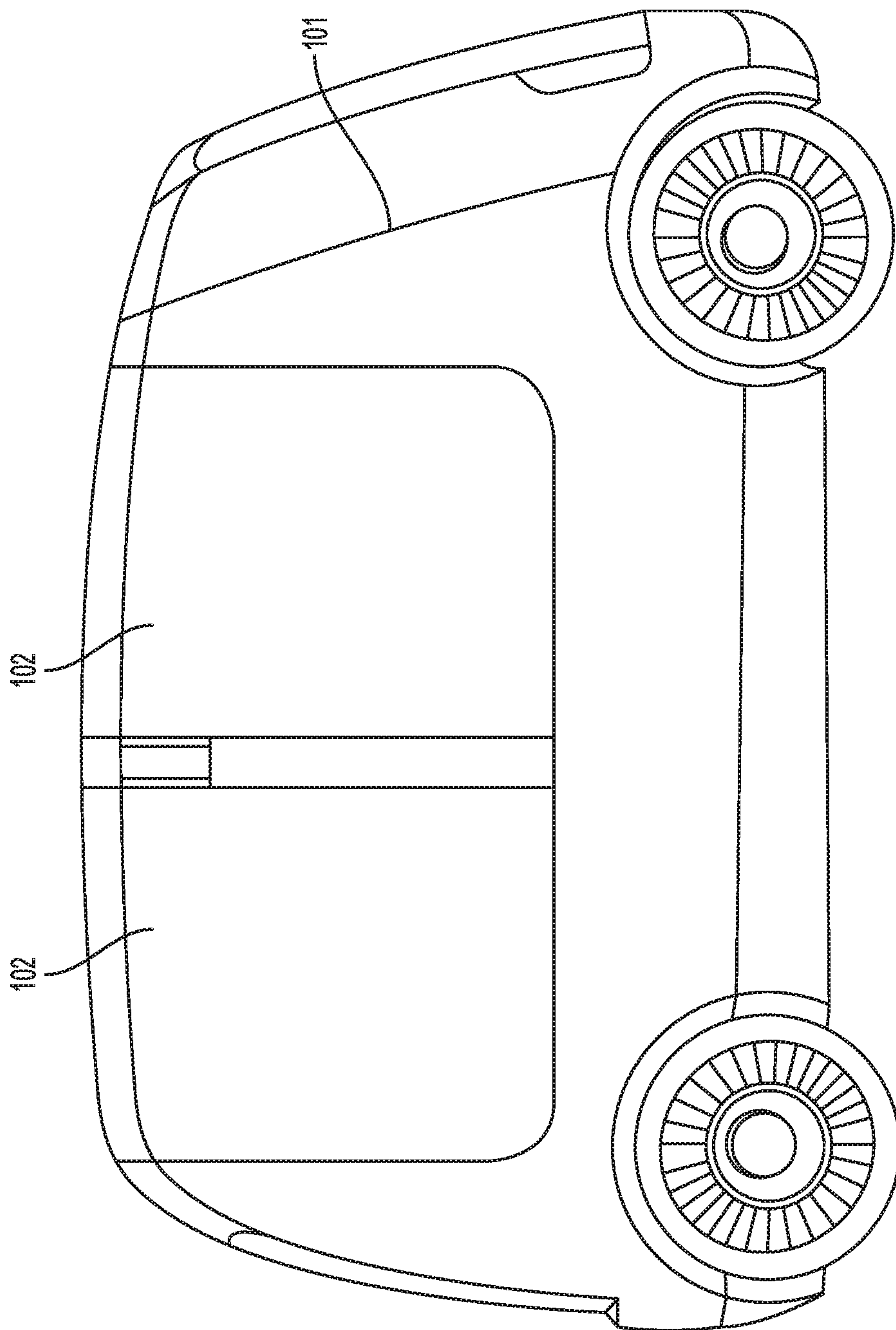


FIG. 4

[5/21]

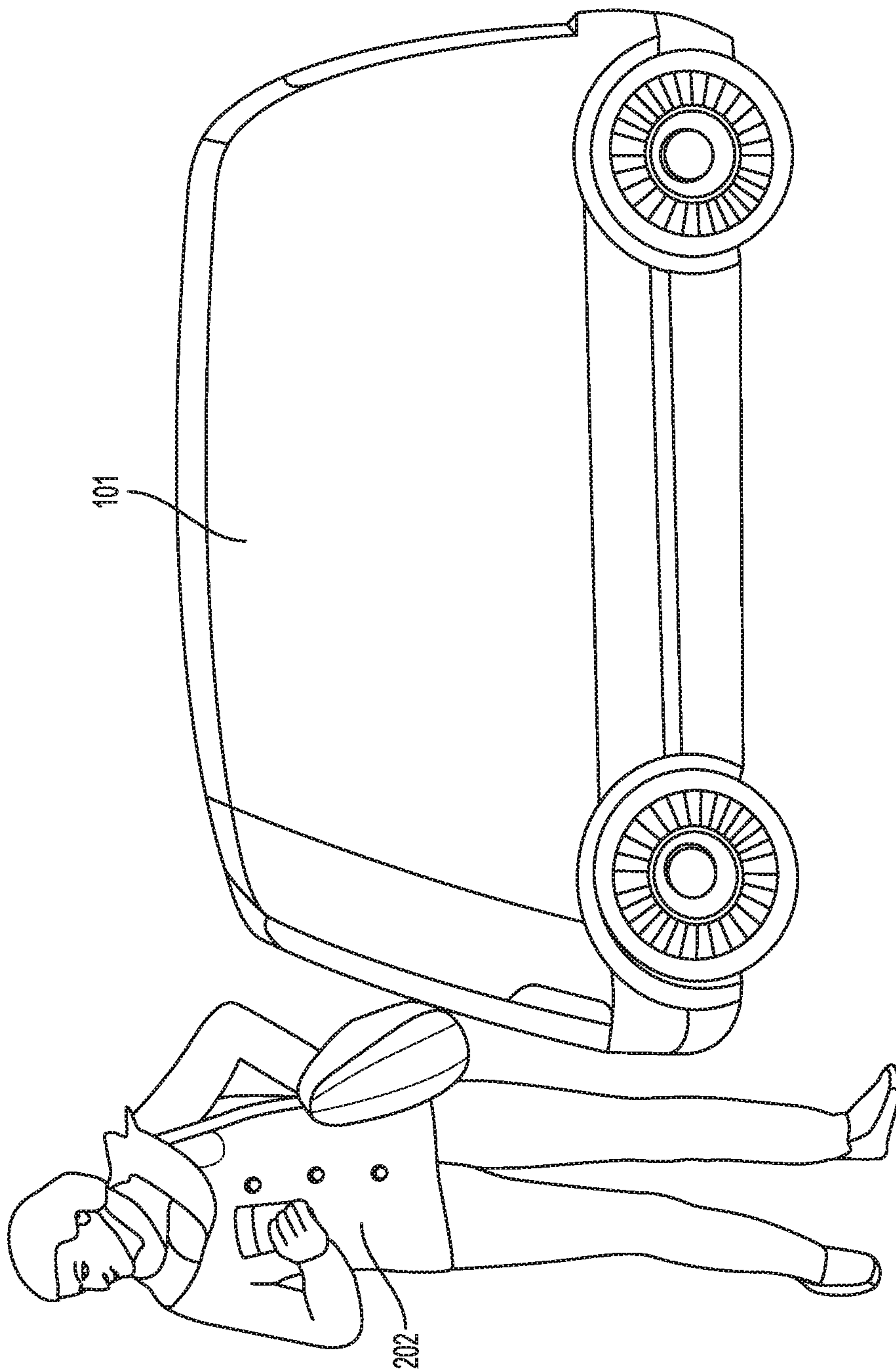


FIG. 5



[6/21]

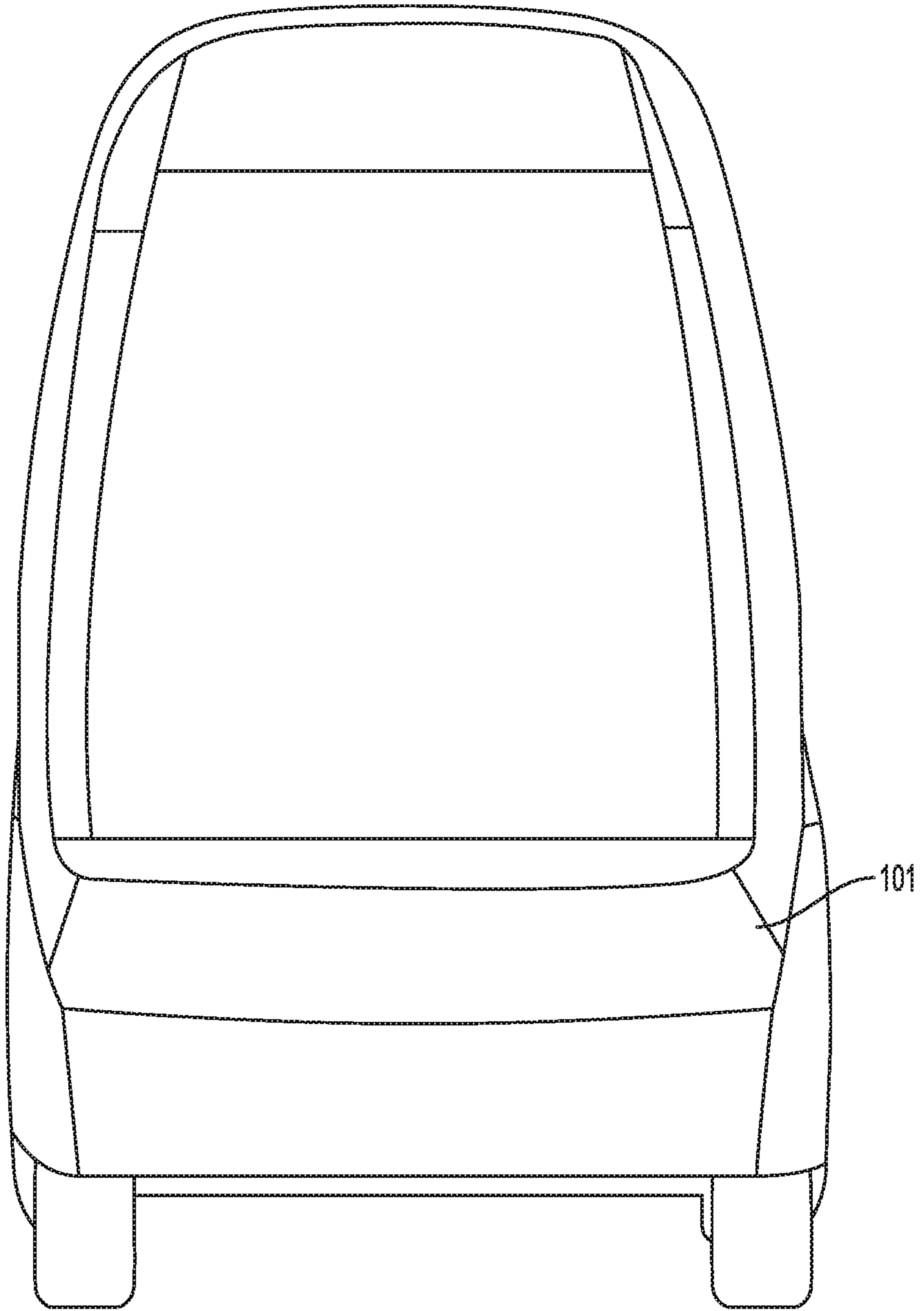


FIG. 6

[7/21]

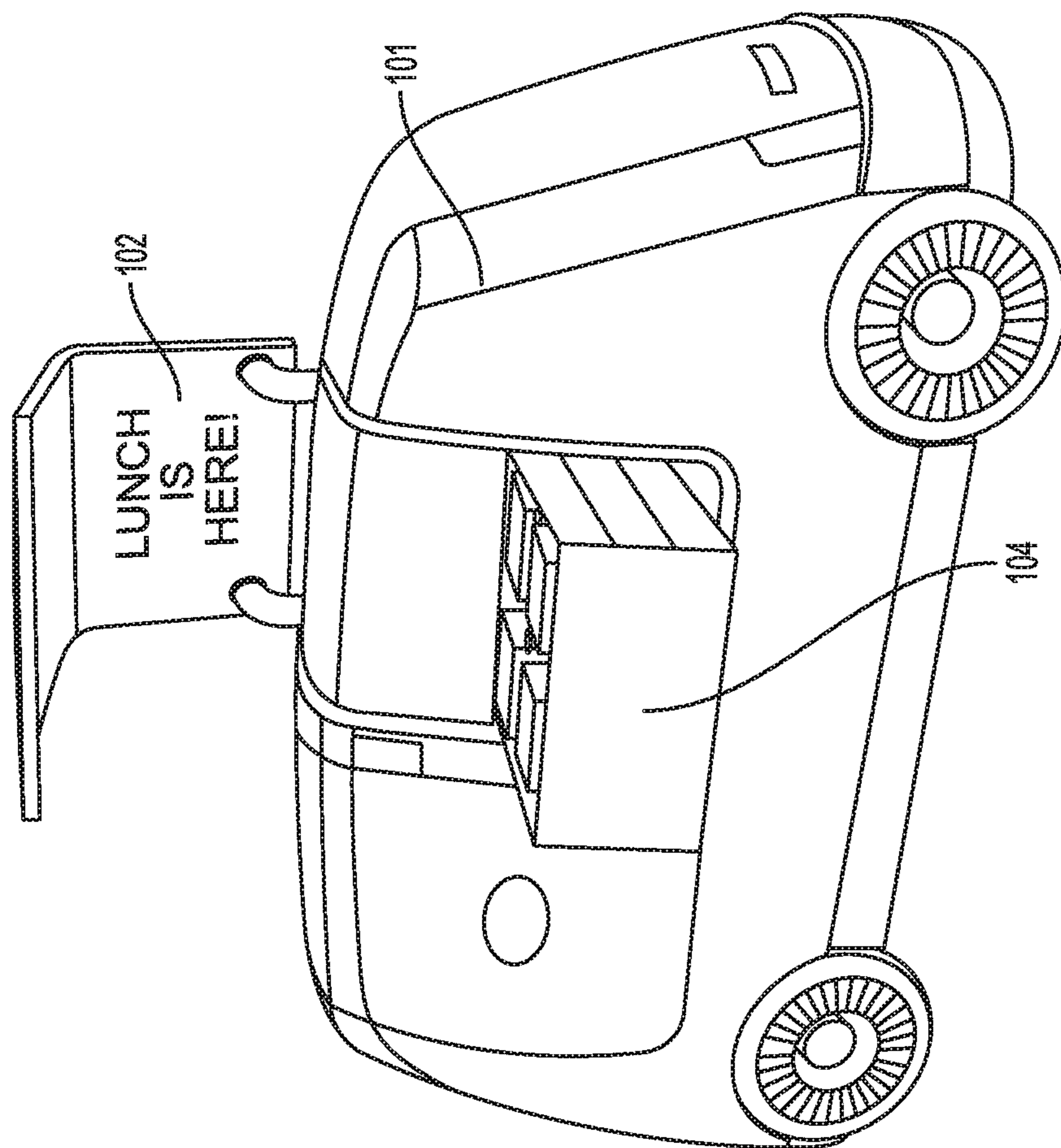


FIG. 7



[8/21]

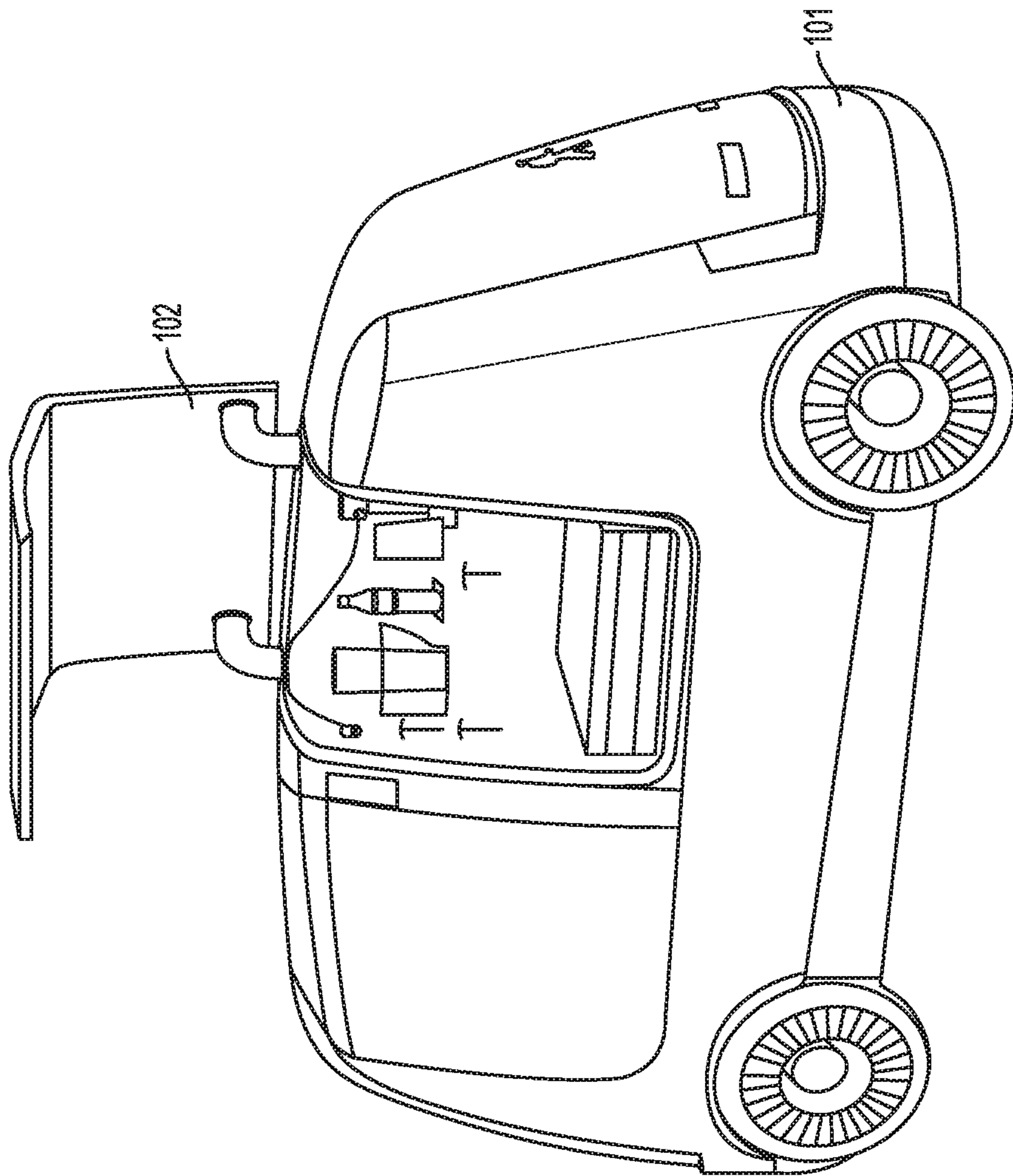


FIG. 8

[9/21]

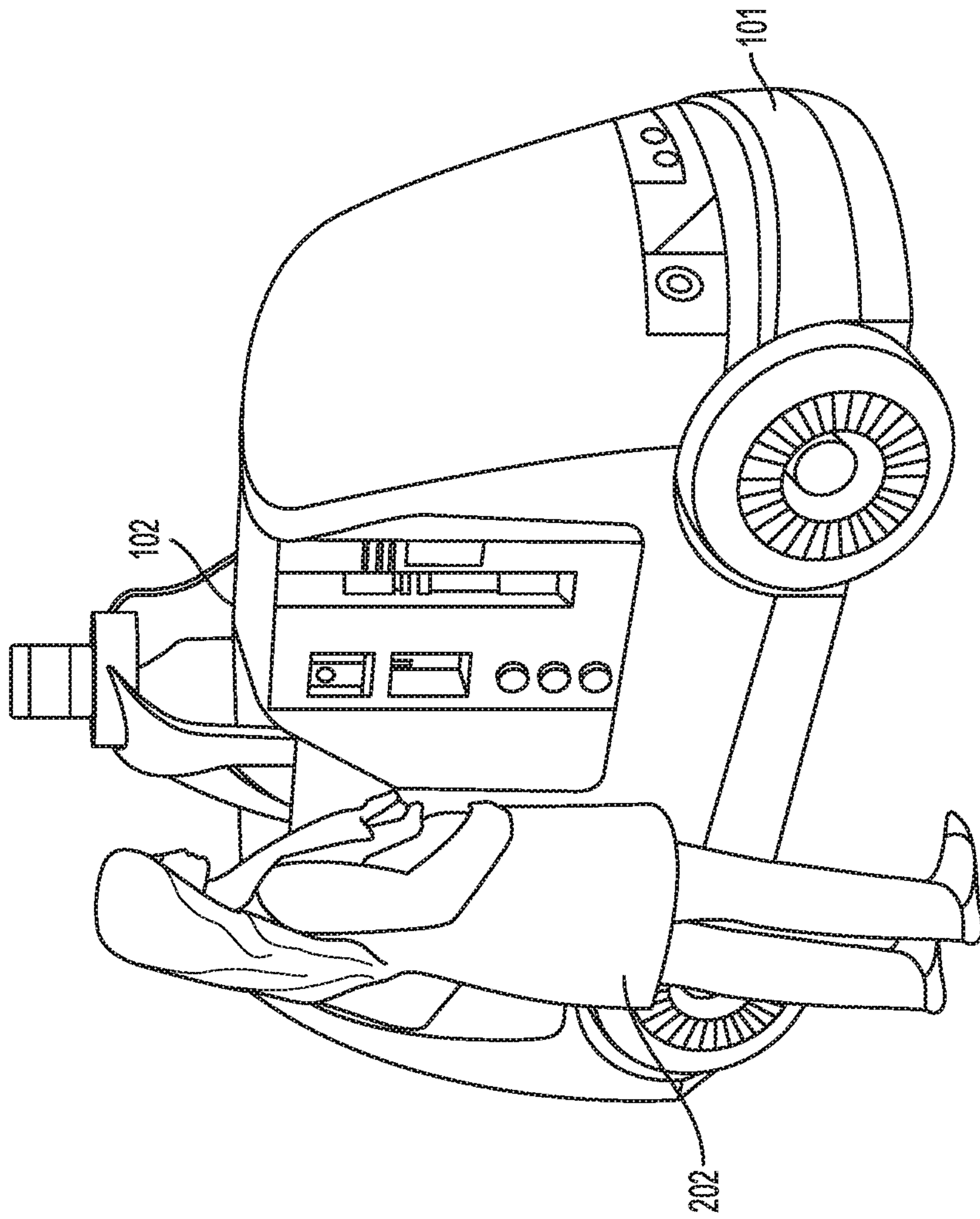


FIG. 9



[10/21]

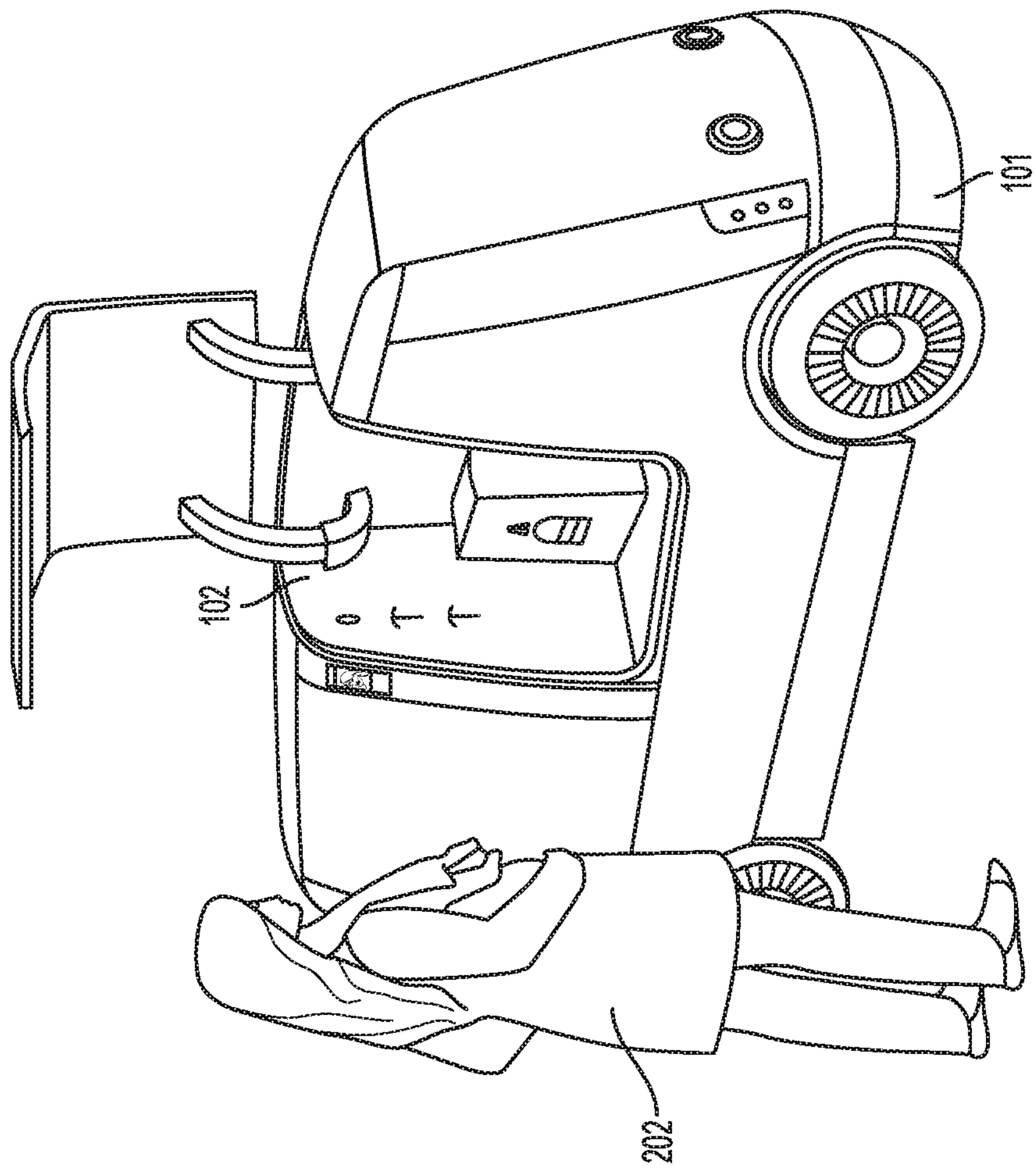


FIG. 10



[11/21]

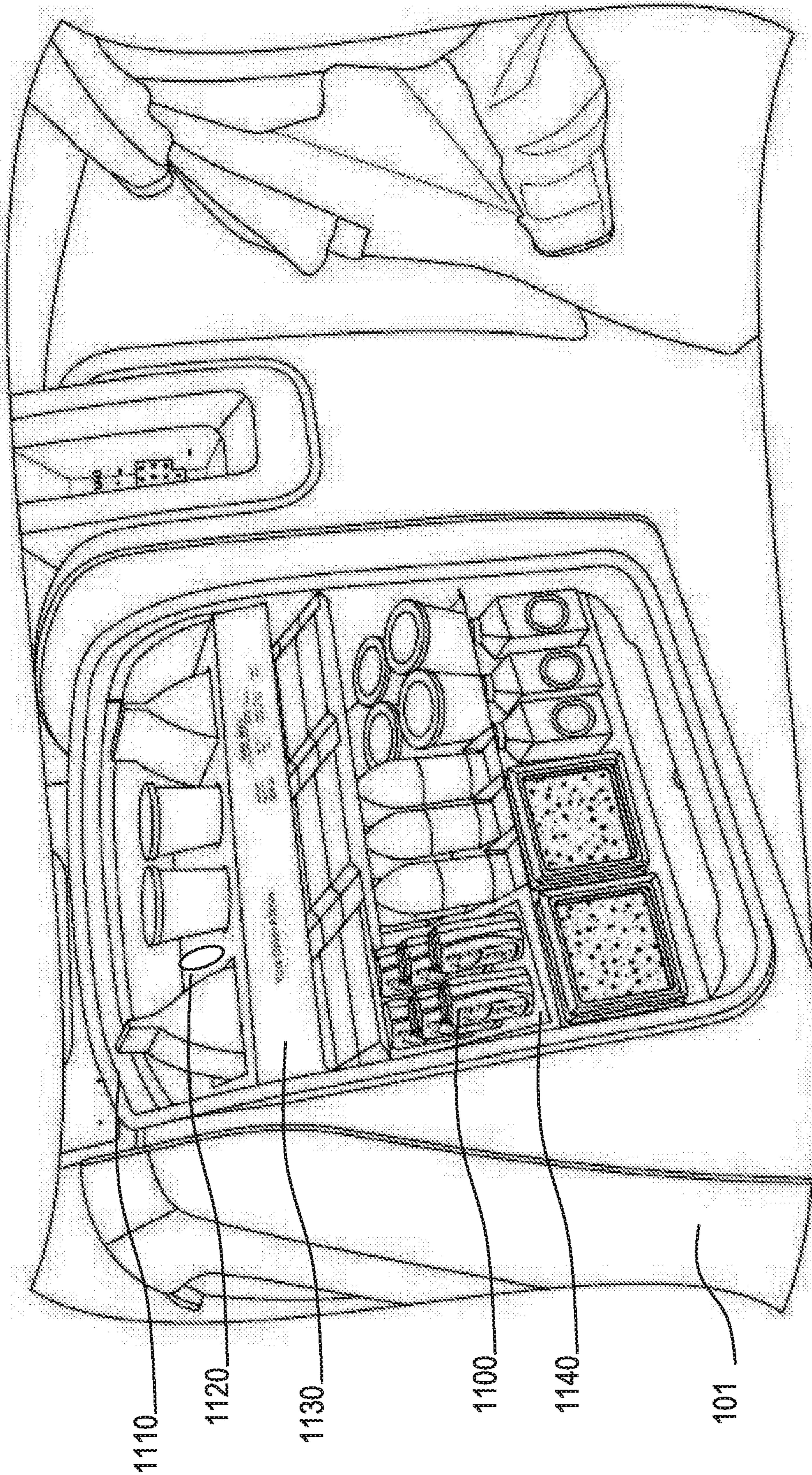


FIG. 11A



[12/21]

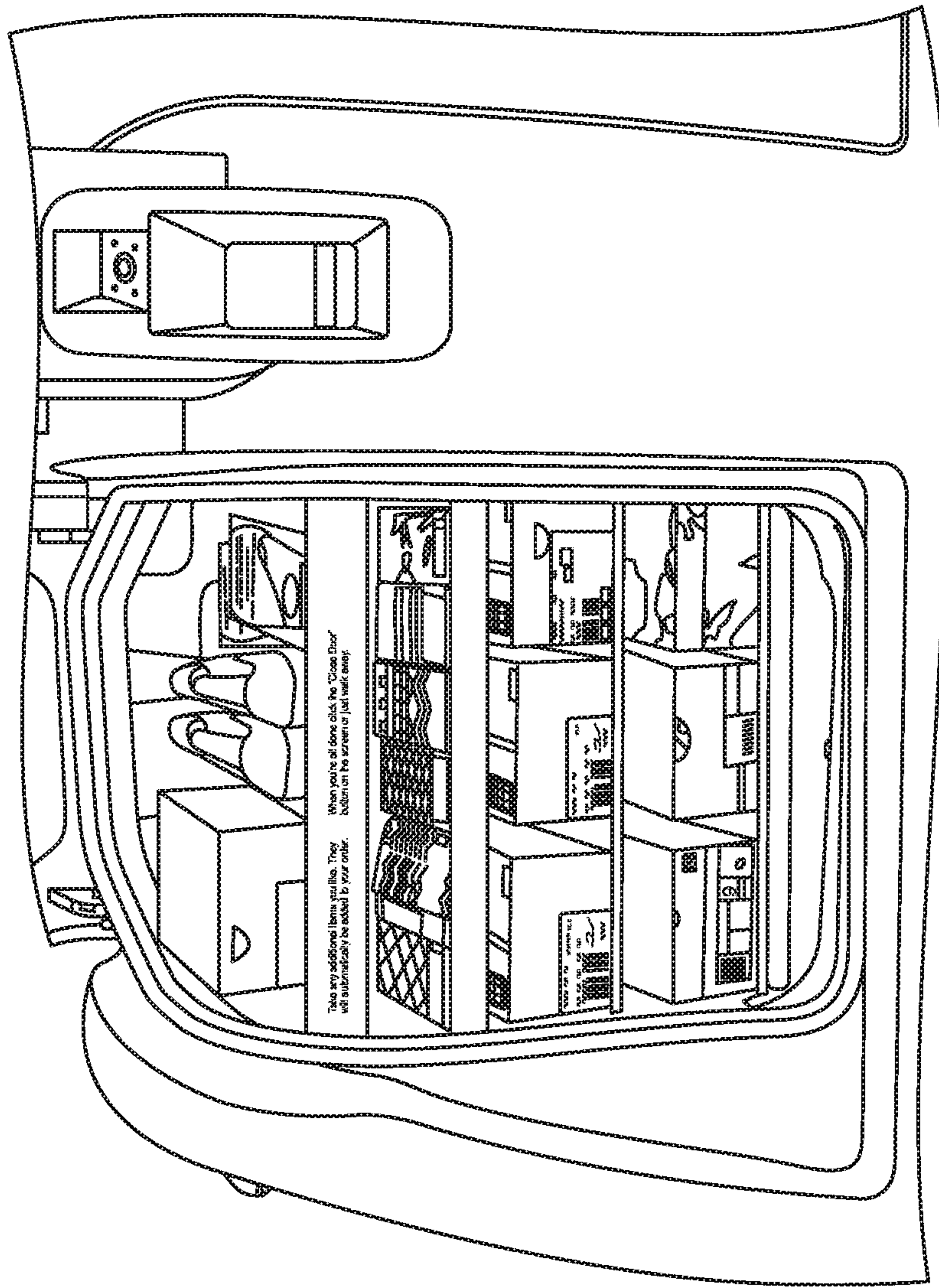


FIG. 11B

[13/21]

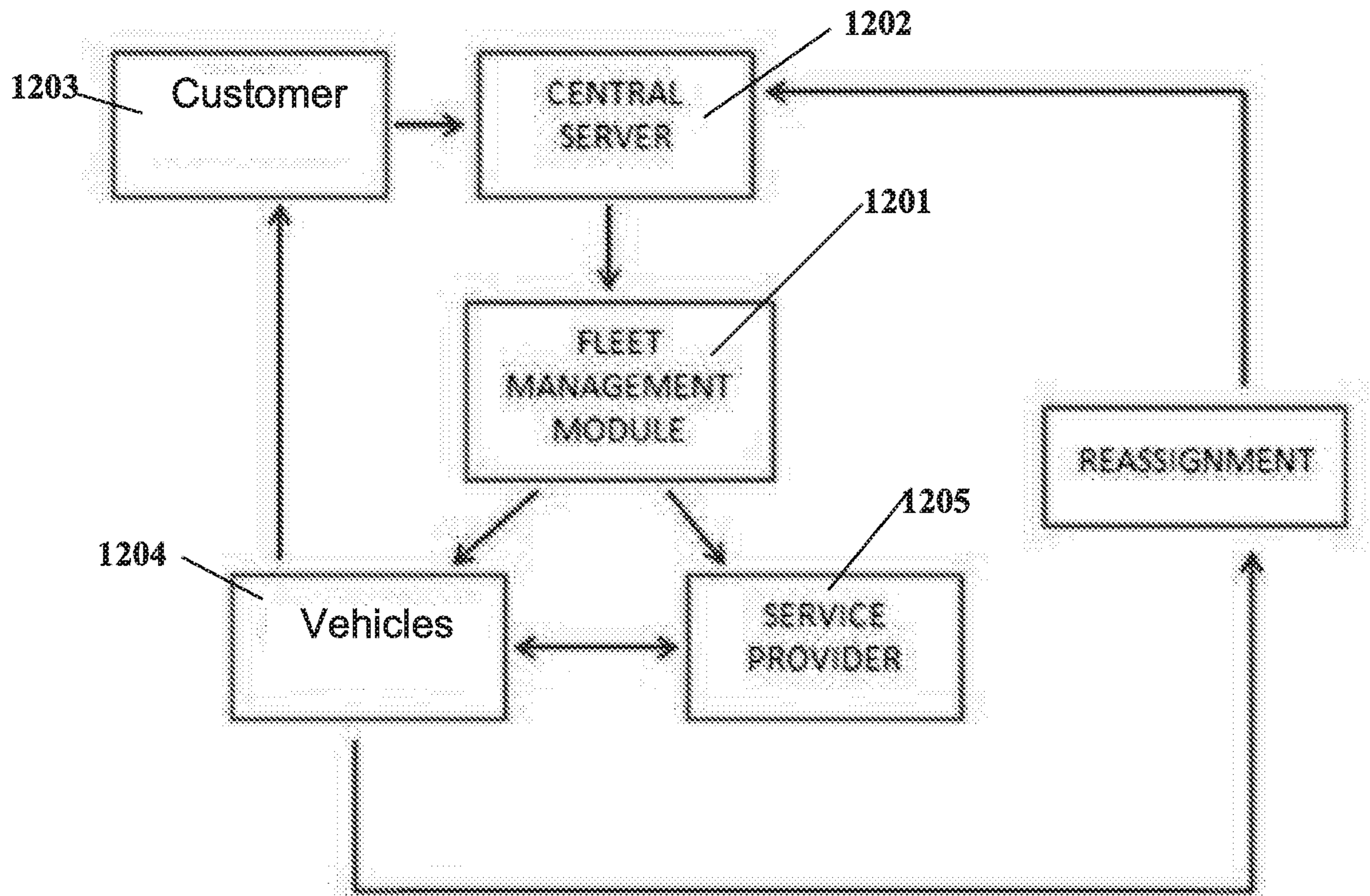


FIG. 12



[14/21]

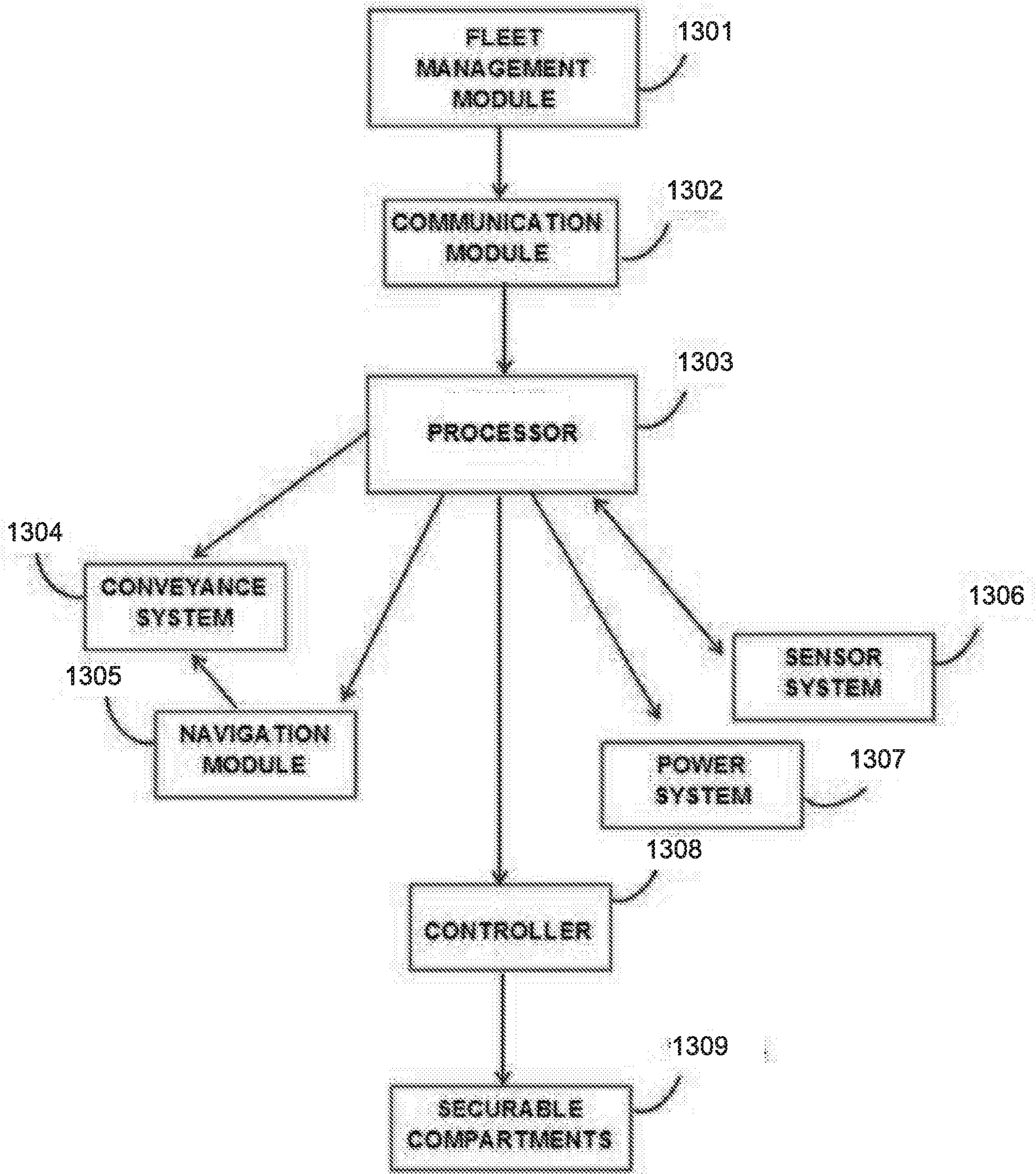


FIG. 13

[15/21]

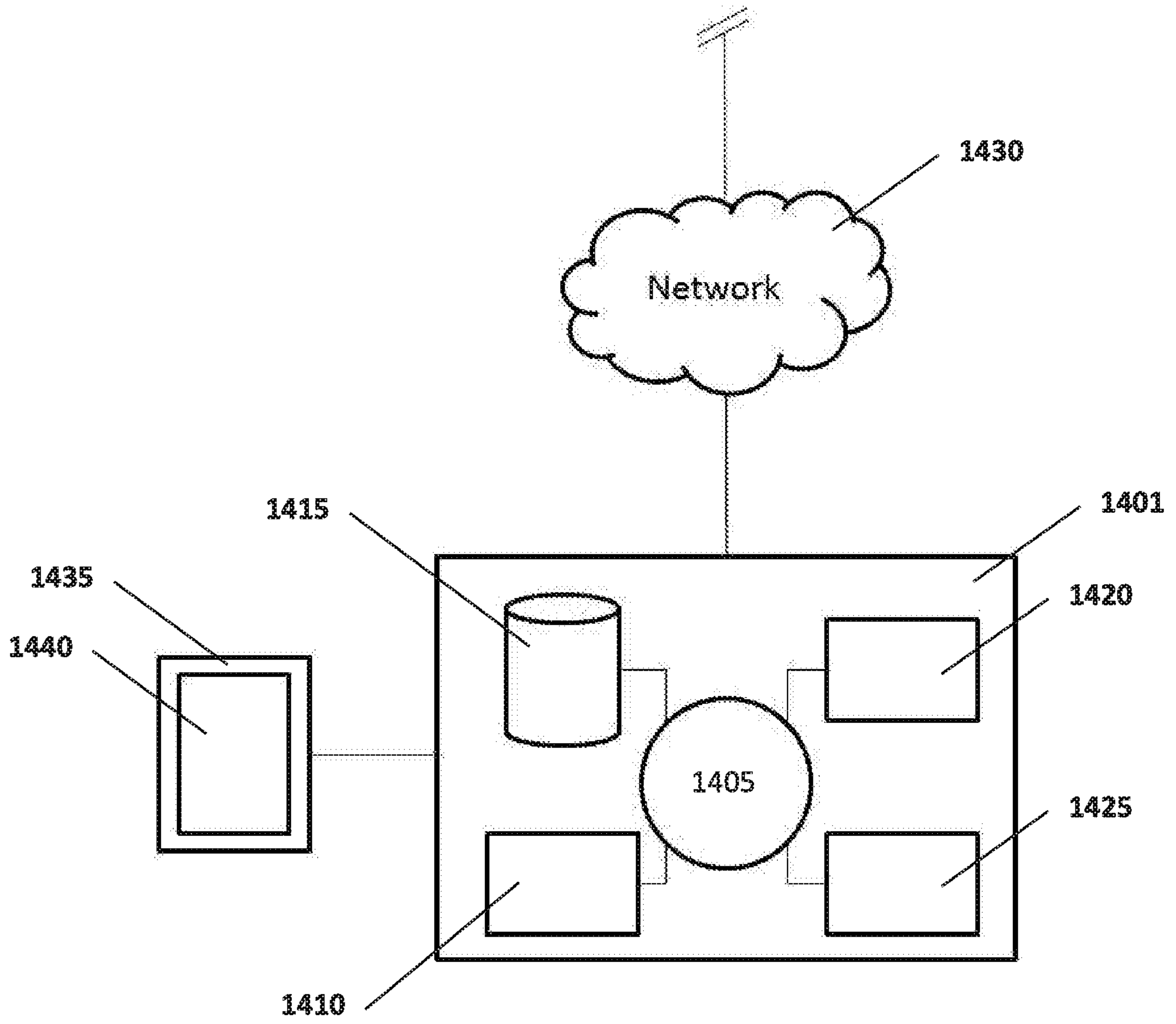


FIG. 14



[16/21]

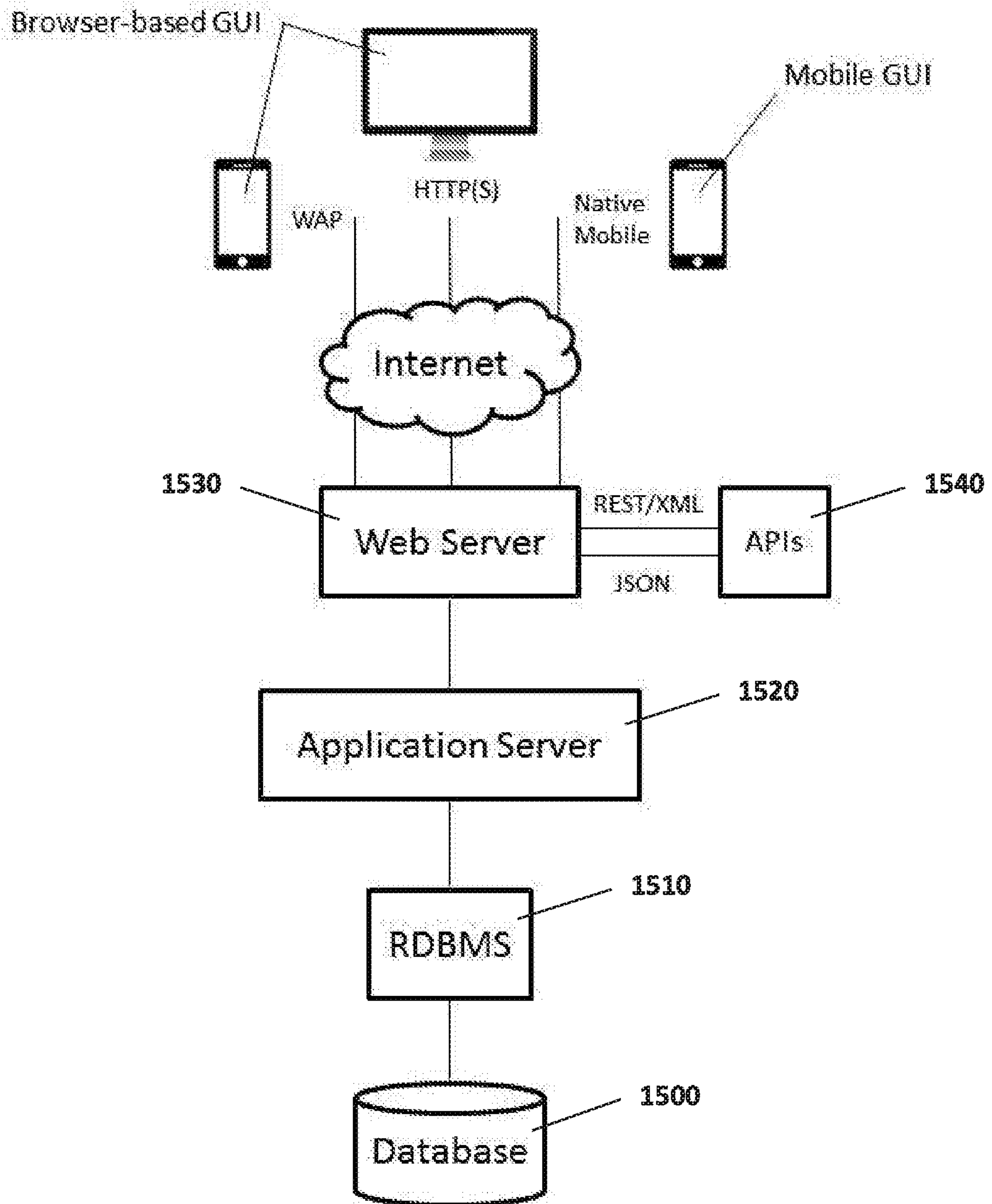


FIG. 15

[17/21]

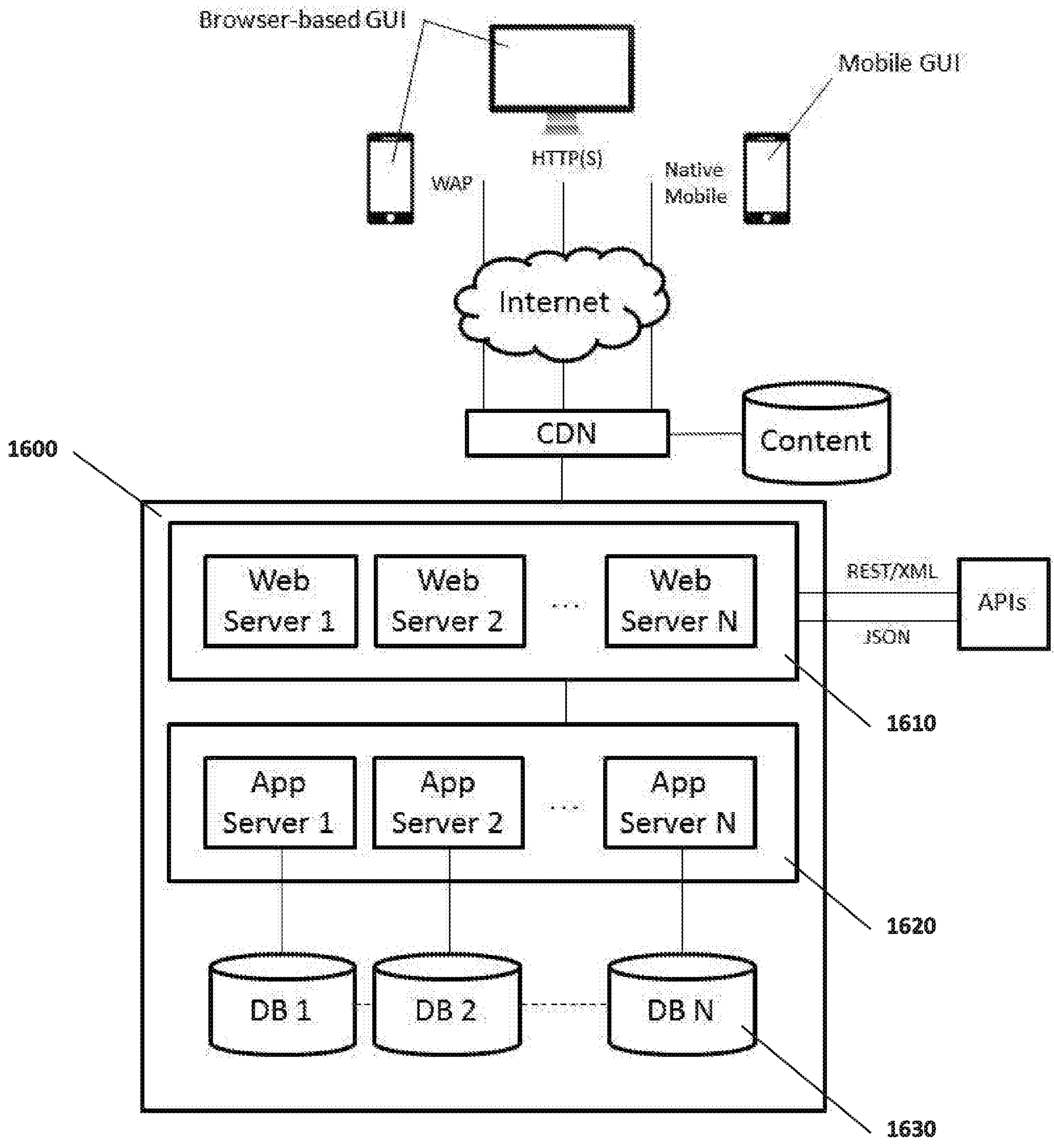


FIG. 16



[18/21]

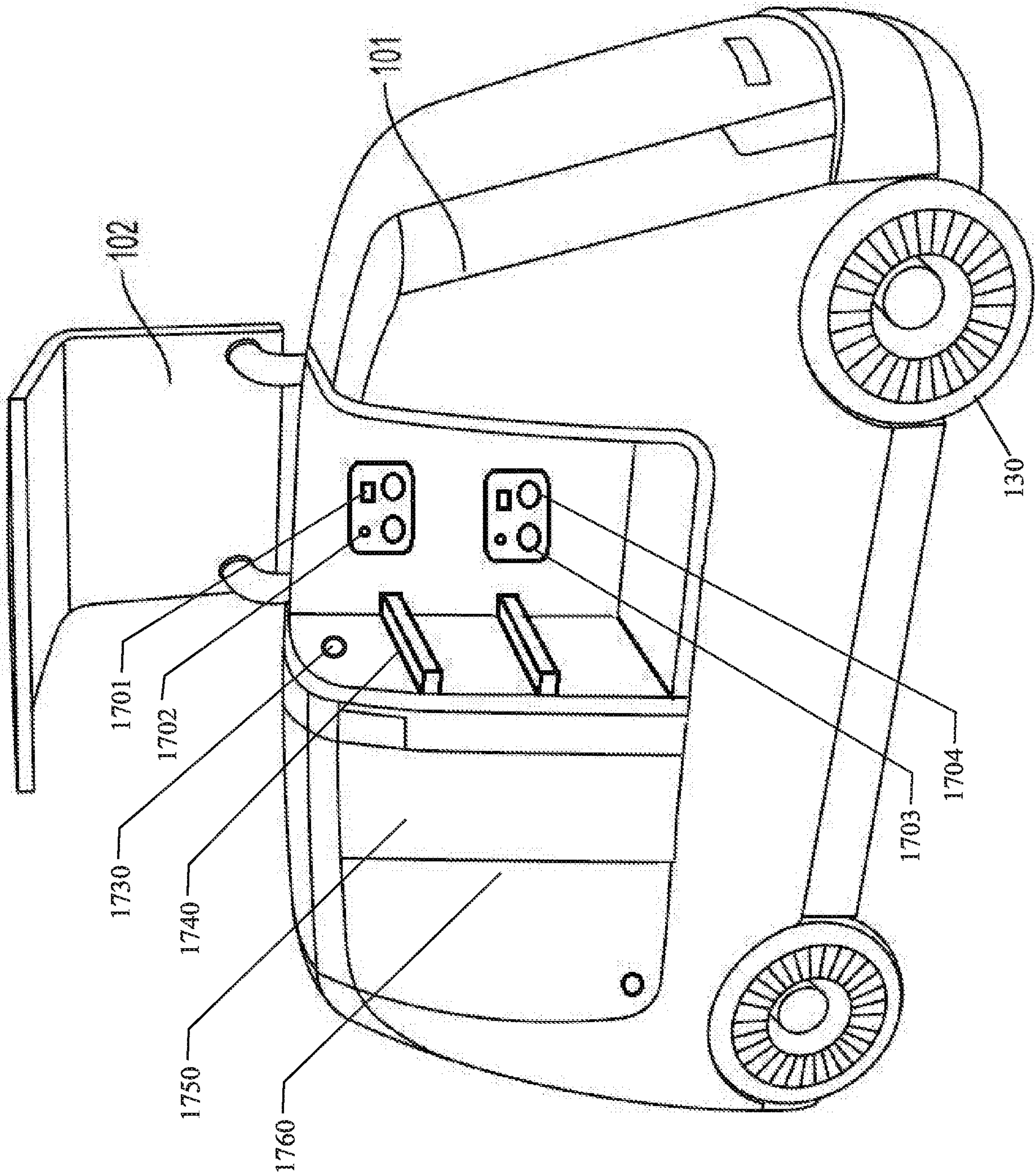


FIG. 17

[19/21]

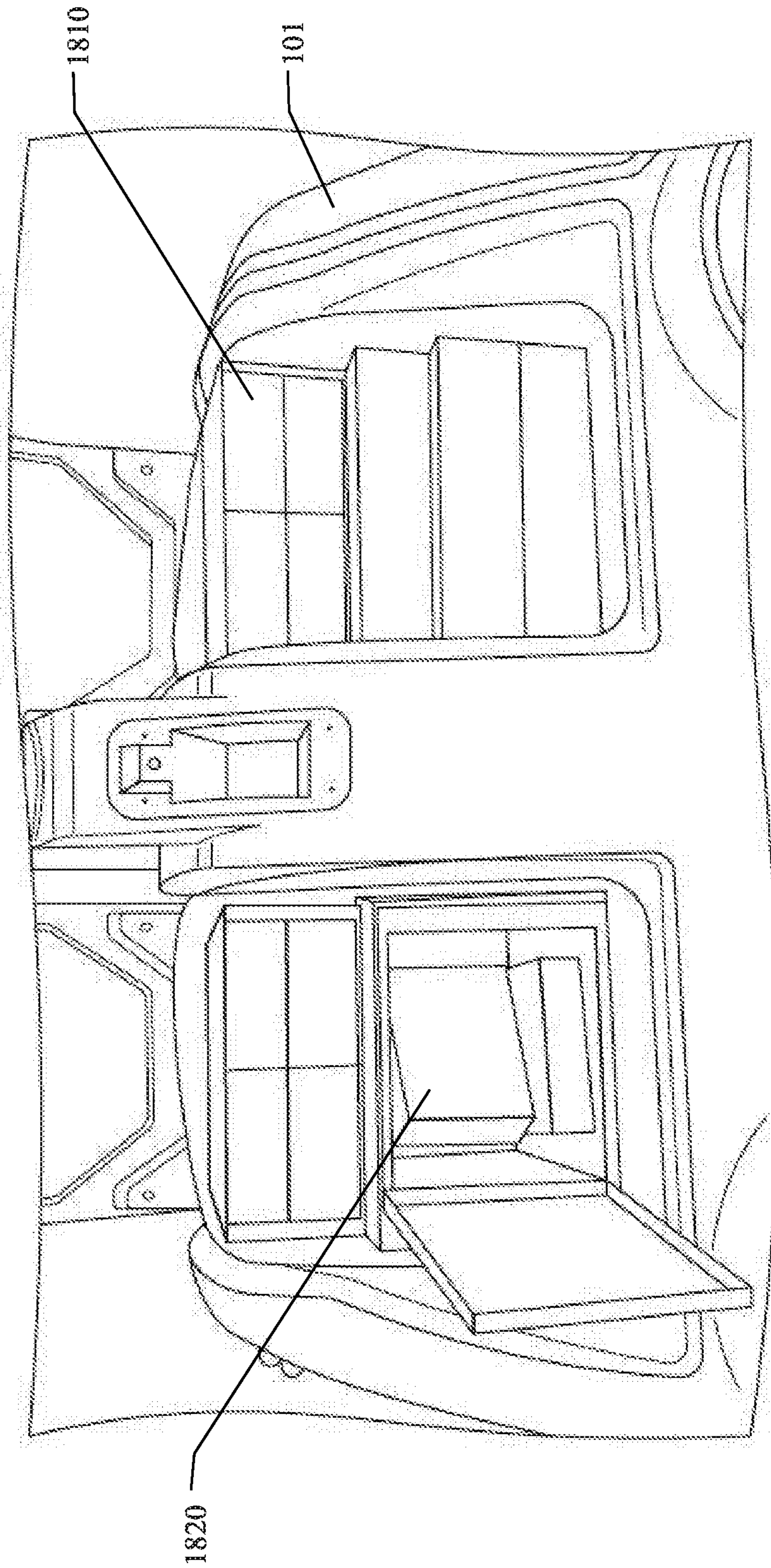


FIG. 18



[20/21]

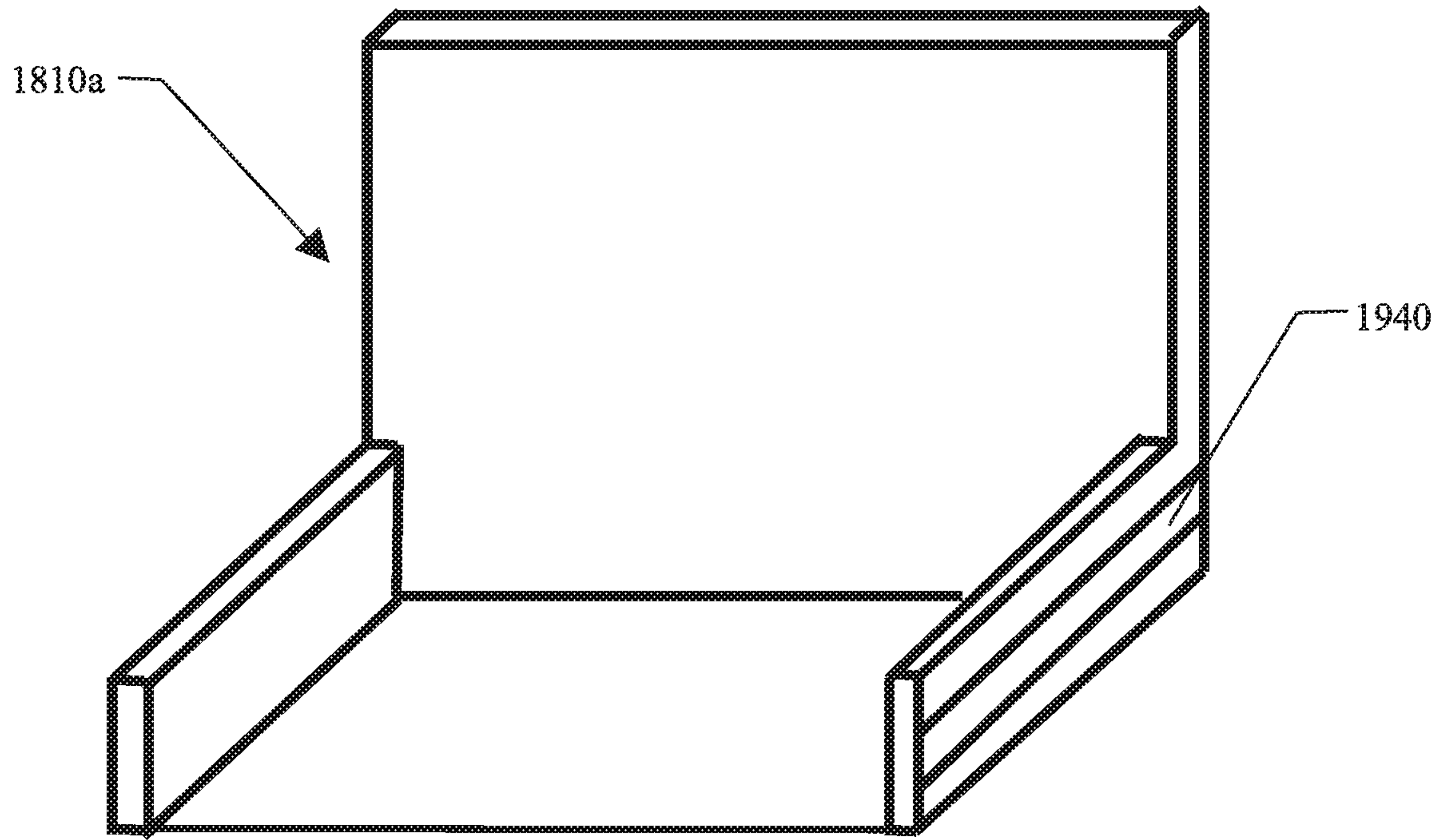


FIG. 19A

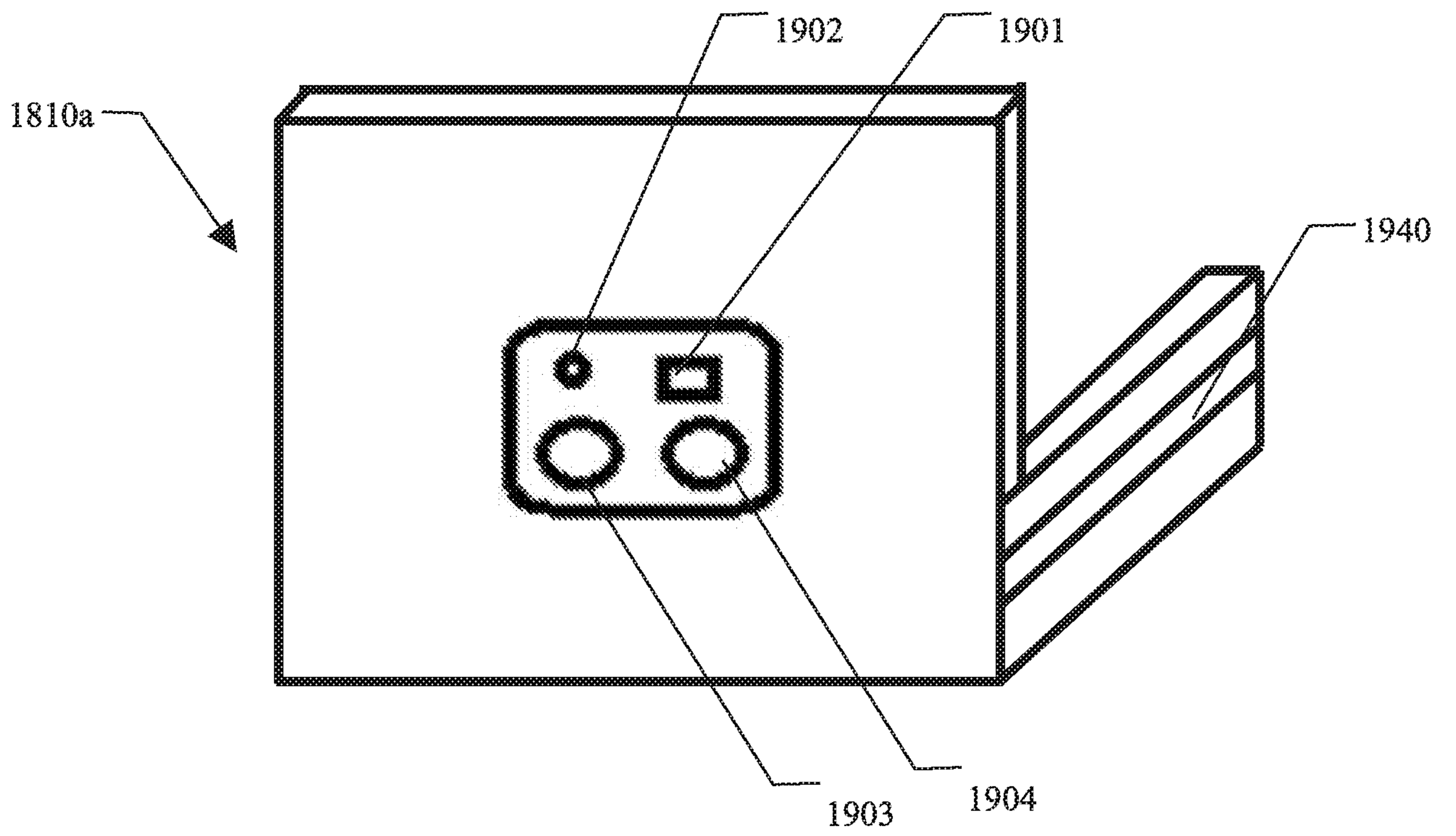


FIG. 19B

[21/21]

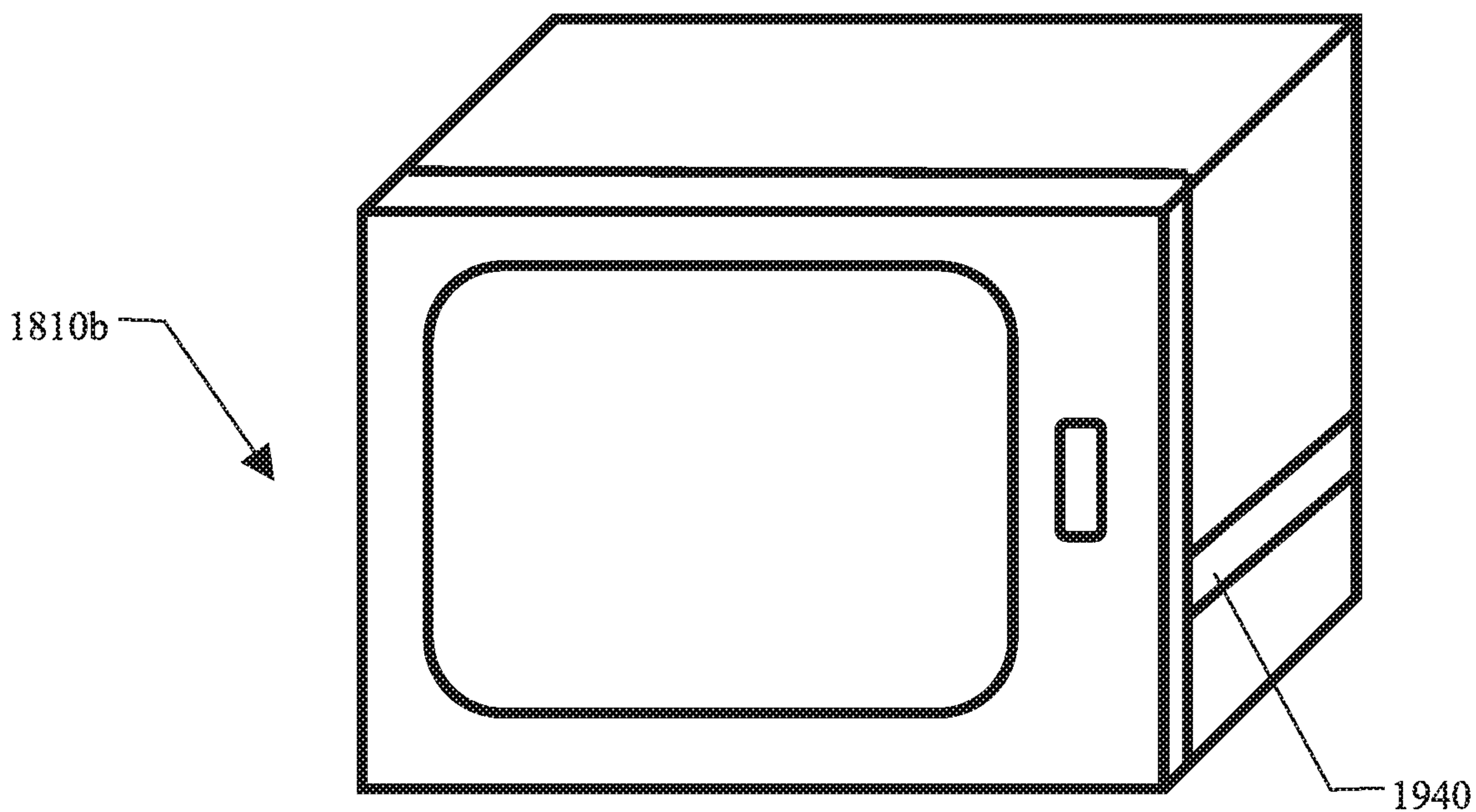


FIG. 19C

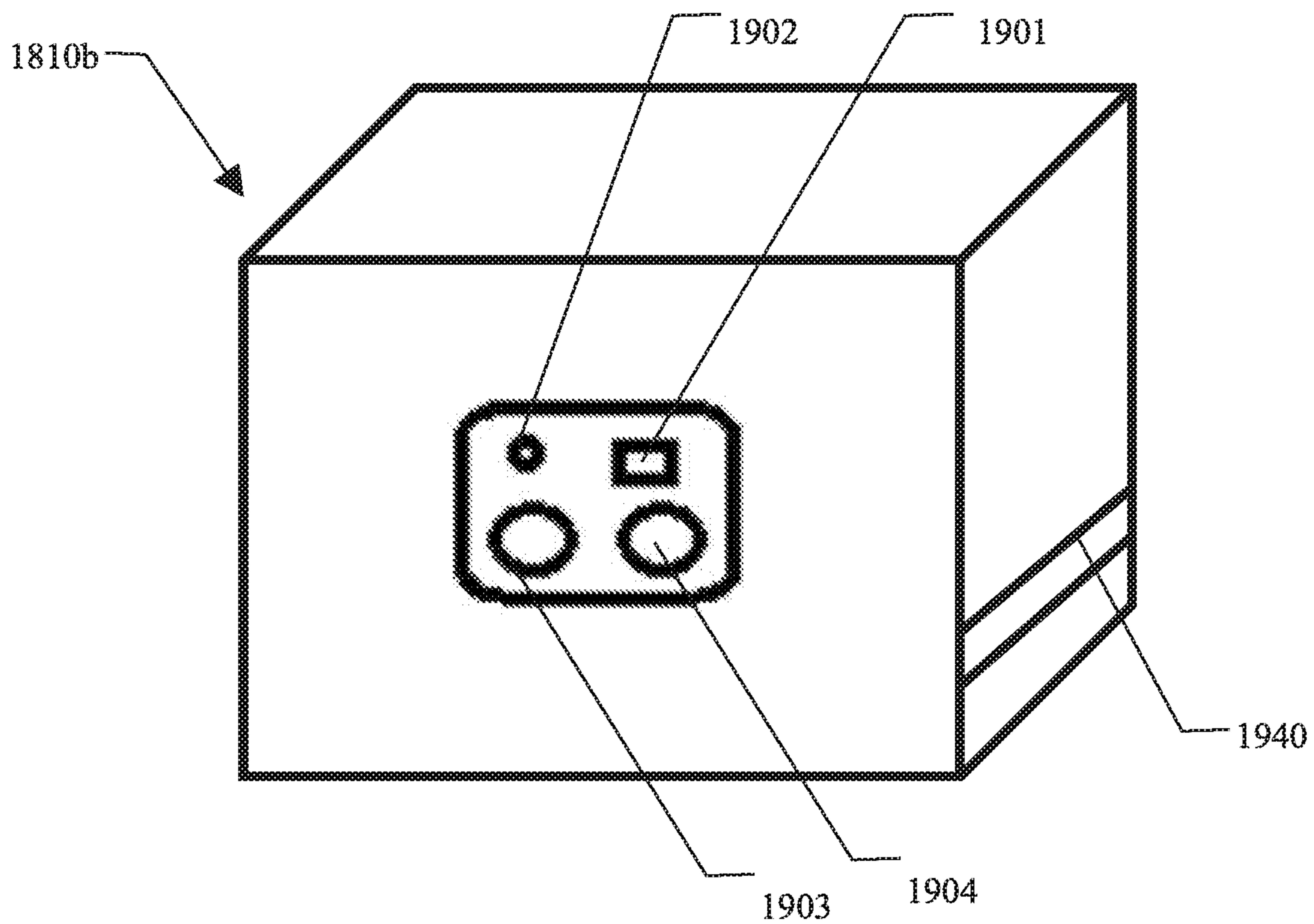


FIG. 19D



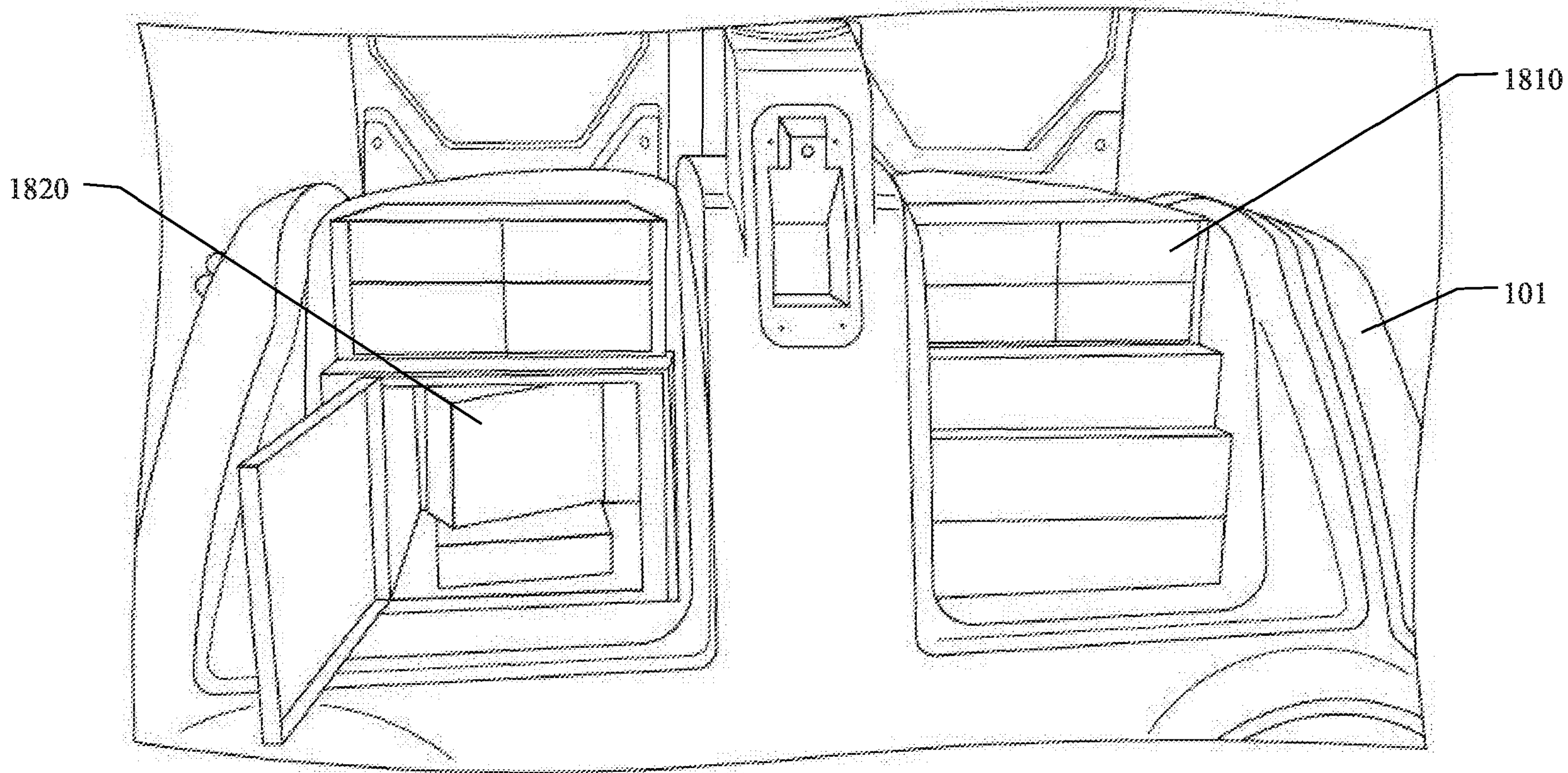


FIG. 18