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(54) **SYSTEM AND METHOD FOR PROVIDING POWER TO A CUP HOLDER**

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

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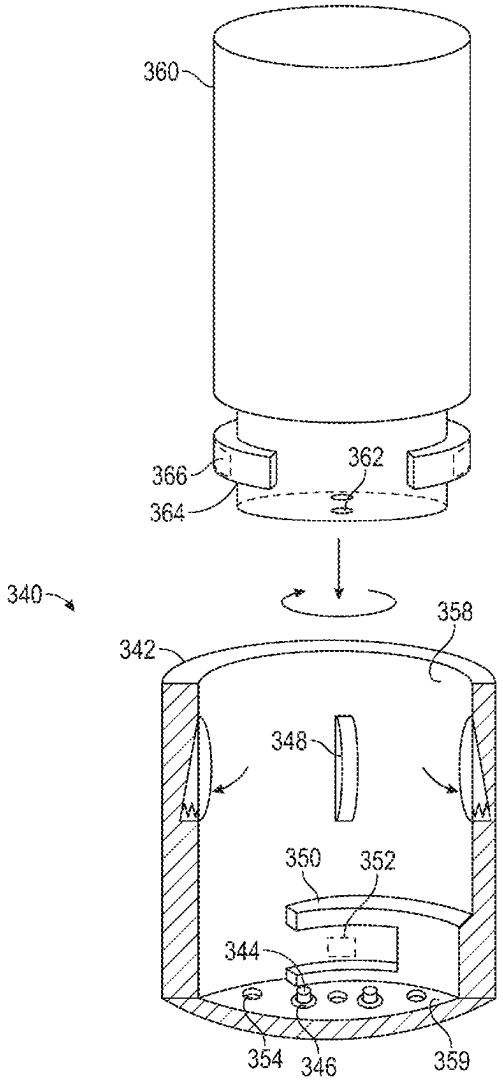
(57) **ABSTRACT**

A system includes a cupholder of a vehicle that receives and provides power to an accessory device. The cupholder includes electrical contacts to engage electrical contacts of the accessory device. The system further includes control circuitry configured to determine whether to provide the power to the electrical contacts of the cupholder. In some embodiments, the cupholder further includes a retaining mechanism to retain the accessory device in the cupholder. In some embodiments, the cupholder includes a retaining frame forming a cup well to secure sides of the accessory device and a movable base to support the bottom of the accessory device. The movable base is movable in relation to the retaining frame. The electrical contacts of the cupholder are disposed in the movable base.



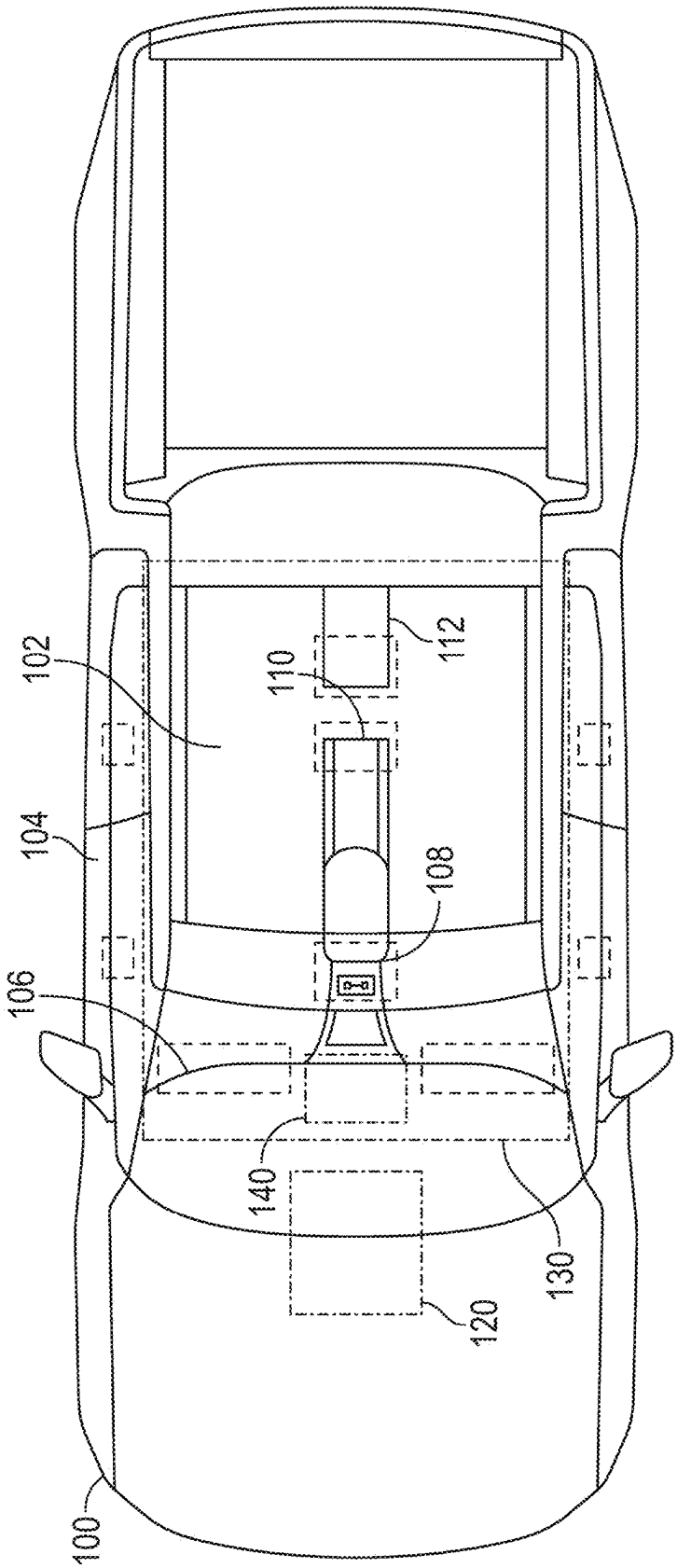


FIG. 1

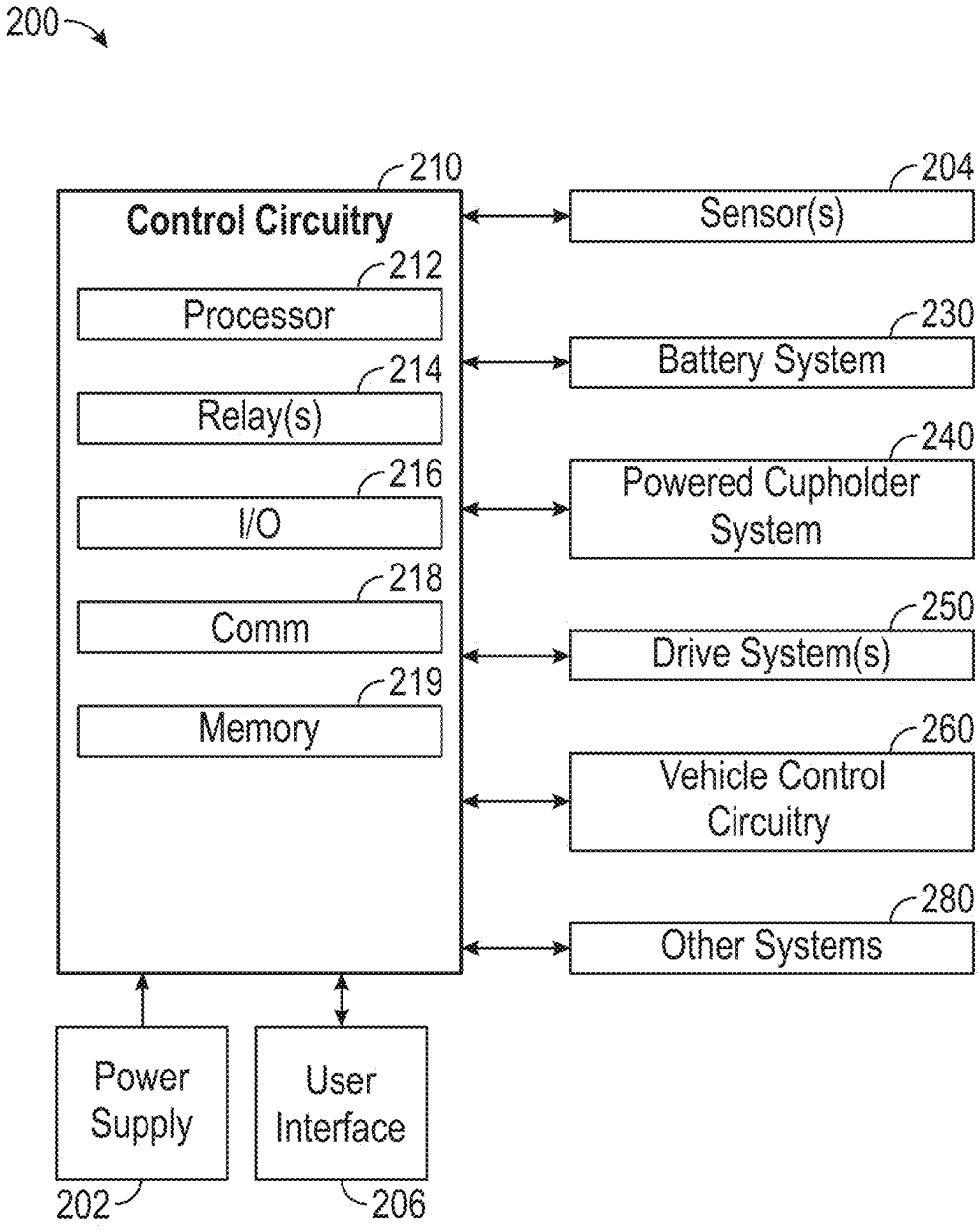

200
210
Control Circuitry
212
Processor
214
Relay(s)
216
I/O
218
Comm
219
Memory
204
Sensor(s)
230
Battery System
240
Powered Cupholder System
250
Drive System(s)
260
Vehicle Control Circuitry
280
Other Systems
Power Supply
202
User Interface
206

FIG. 2

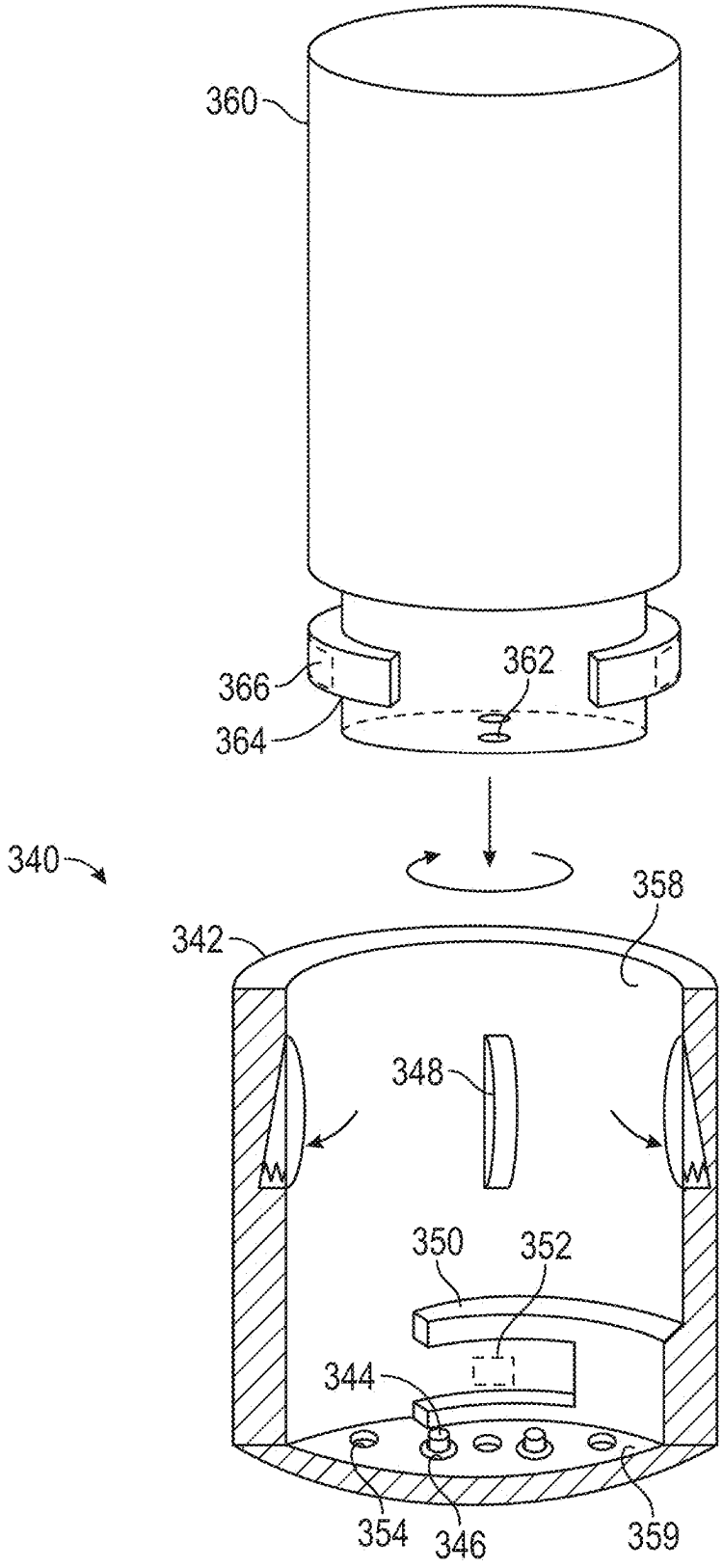


FIG. 3A

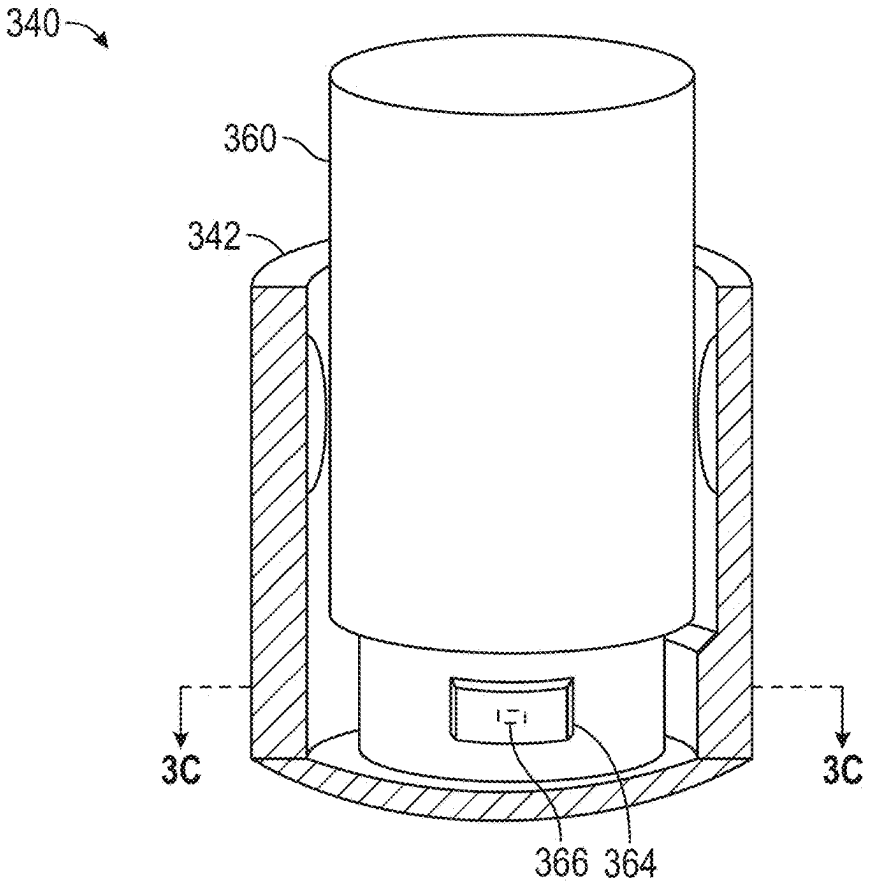


FIG. 3B

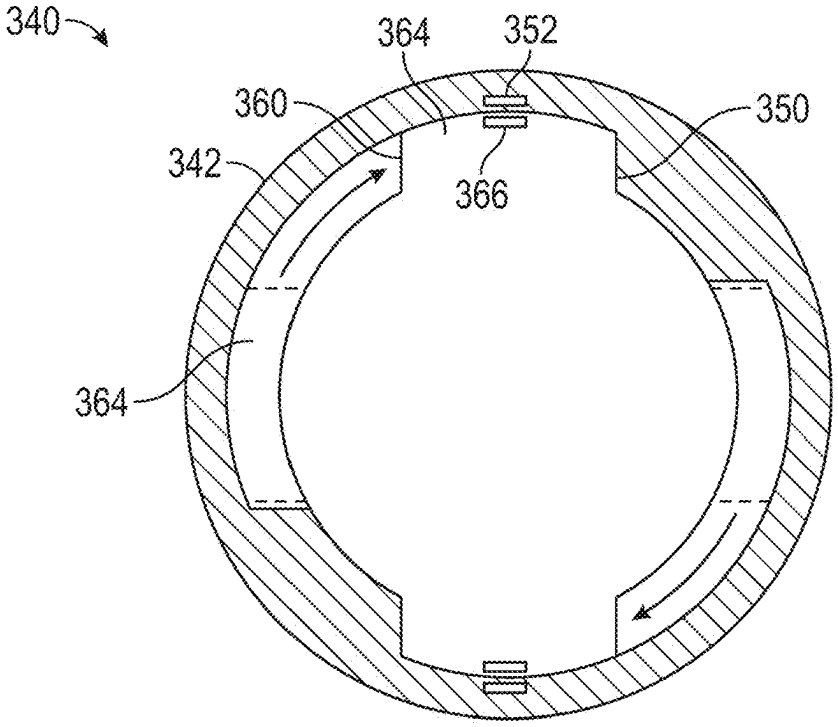


FIG. 3C

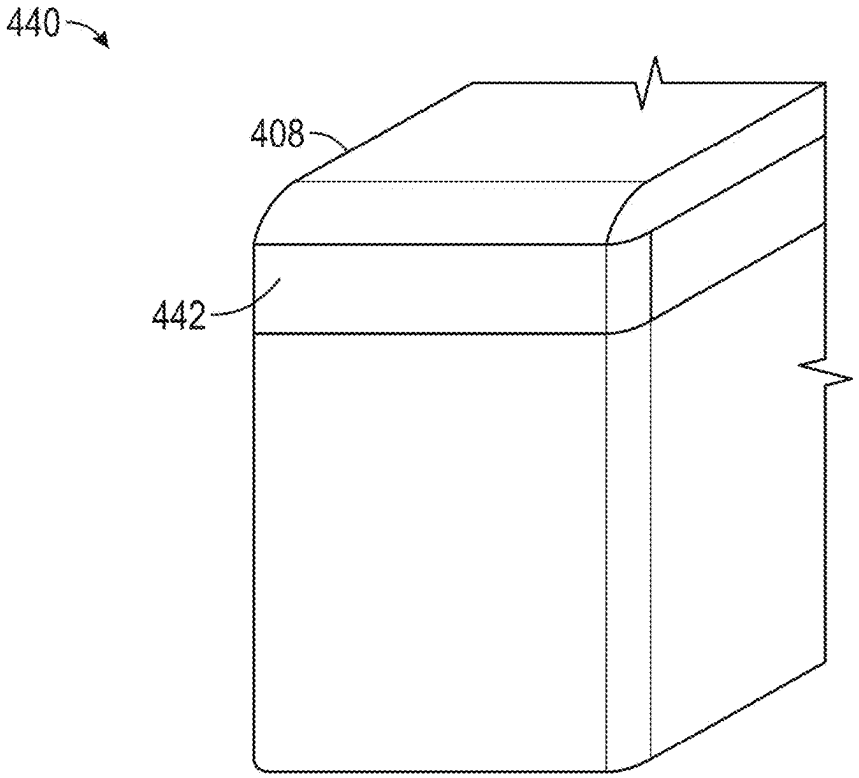


FIG. 4A

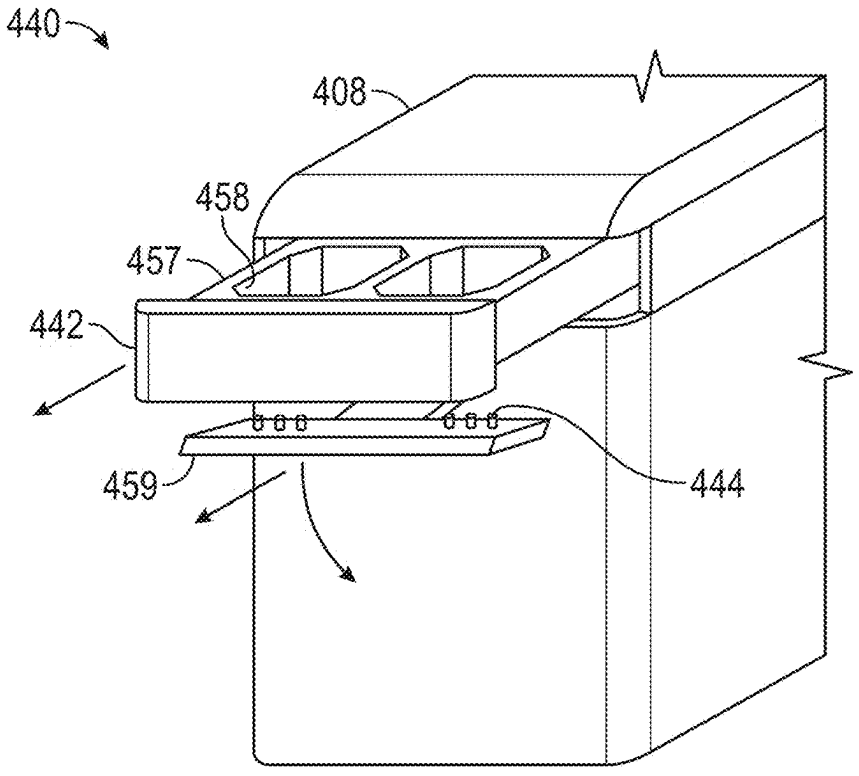


FIG. 4B

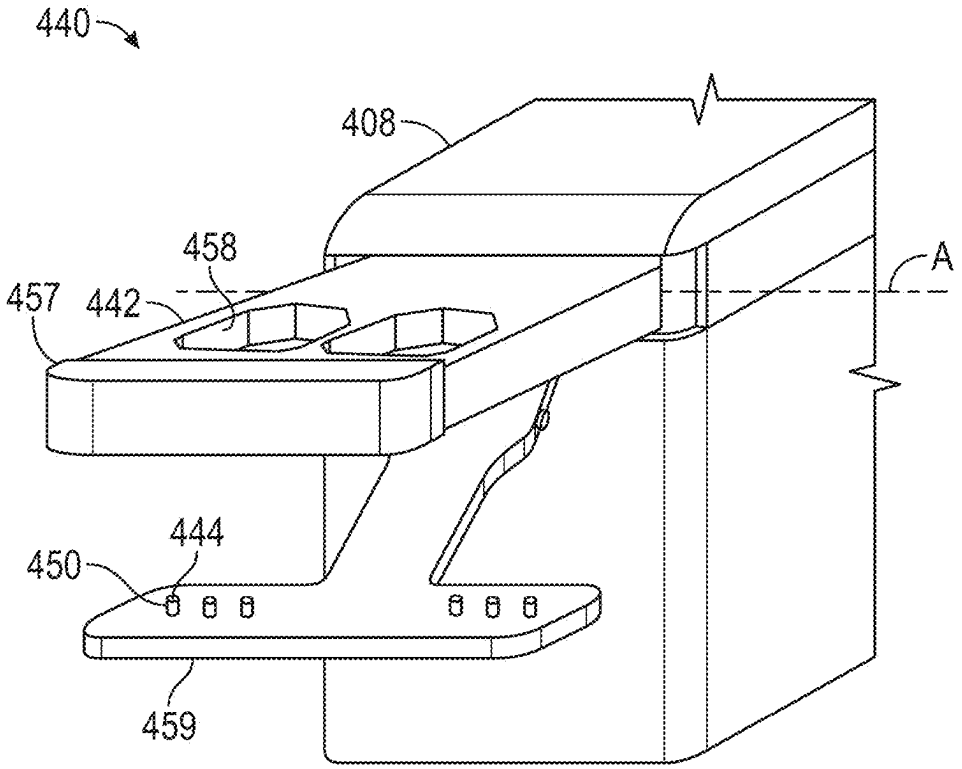

440
408
458
457
442
A
444
450
459

FIG. 4C

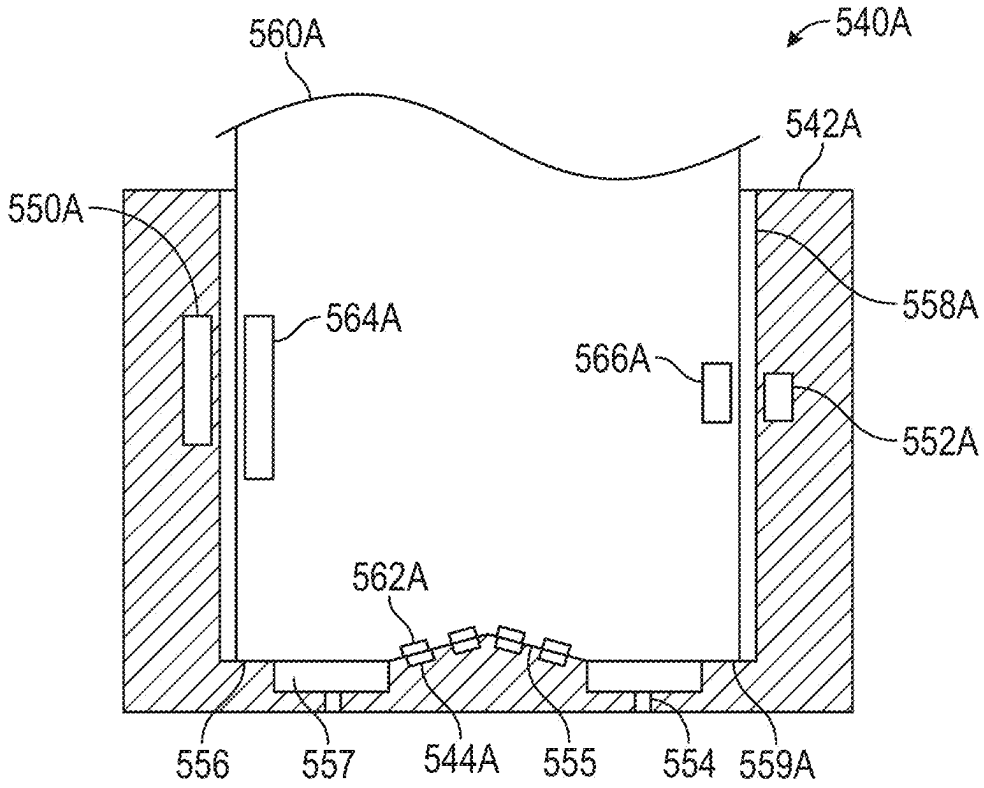

560A
540A
542A
550A
564A
558A
566A
552A
562A
556
557
544A
555
554
559A

FIG. 5A

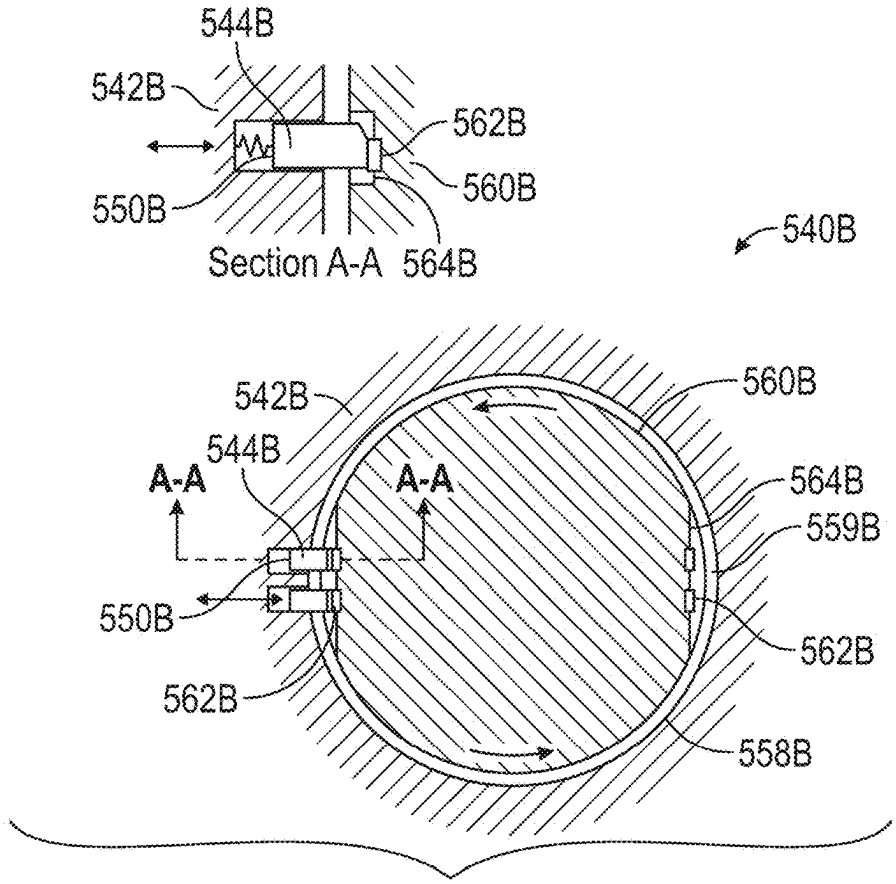
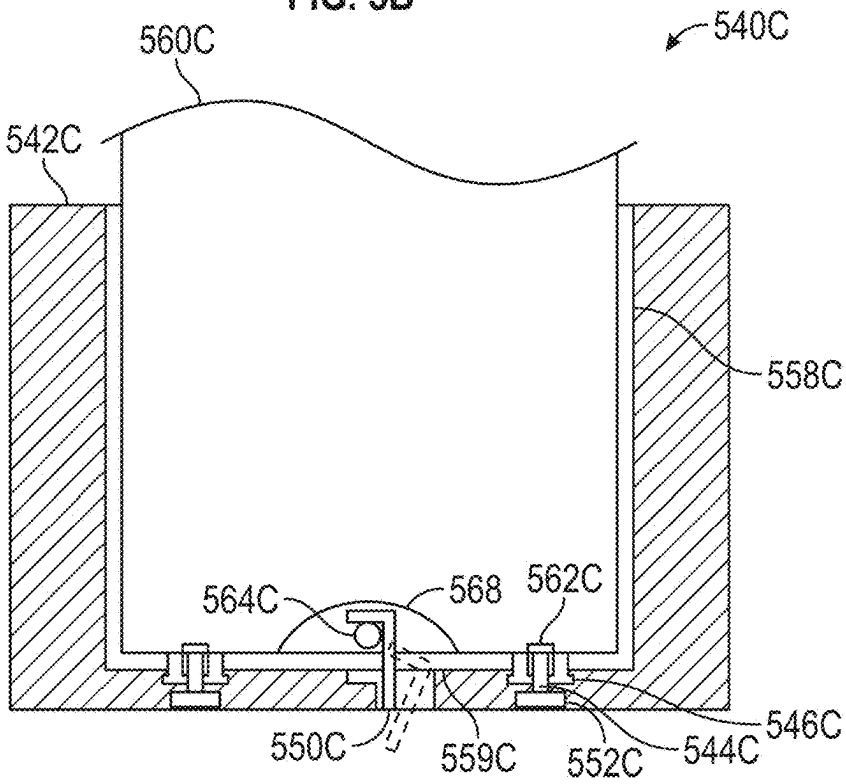

544B
542B
562B
560B
550B
Section A-A
564B
540B
542B
560B
544B
A-A
A-A
564B
559B
550B
562B
562B
558B

FIG. 5B


540C
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564C
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562C
546C
550C
559C
552C
544C

FIG. 5C

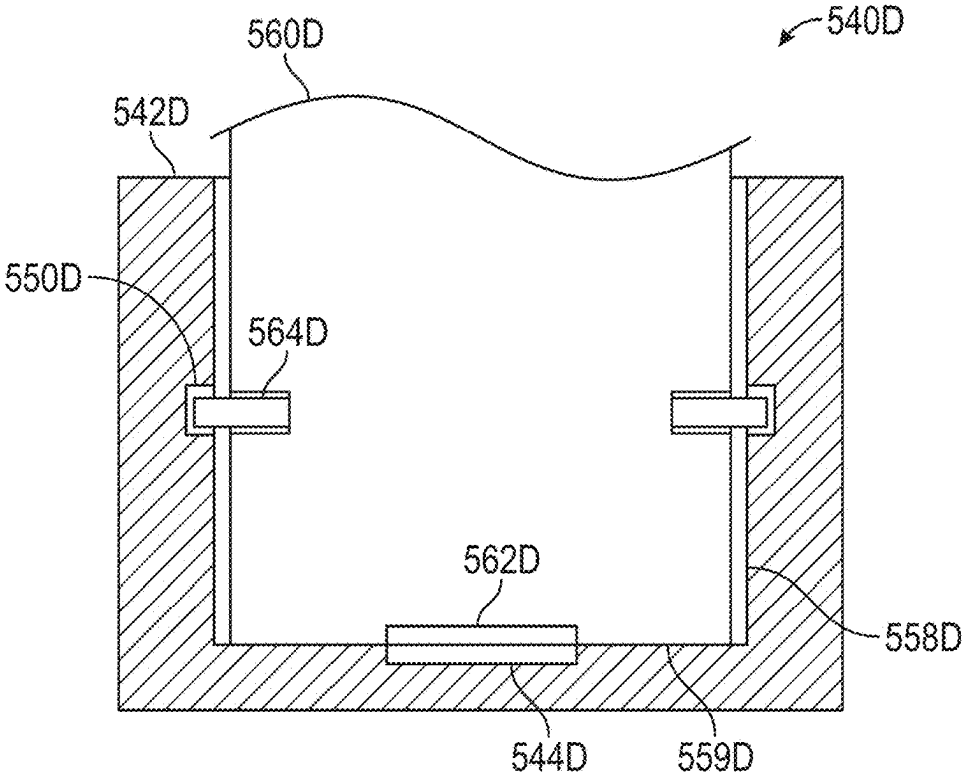
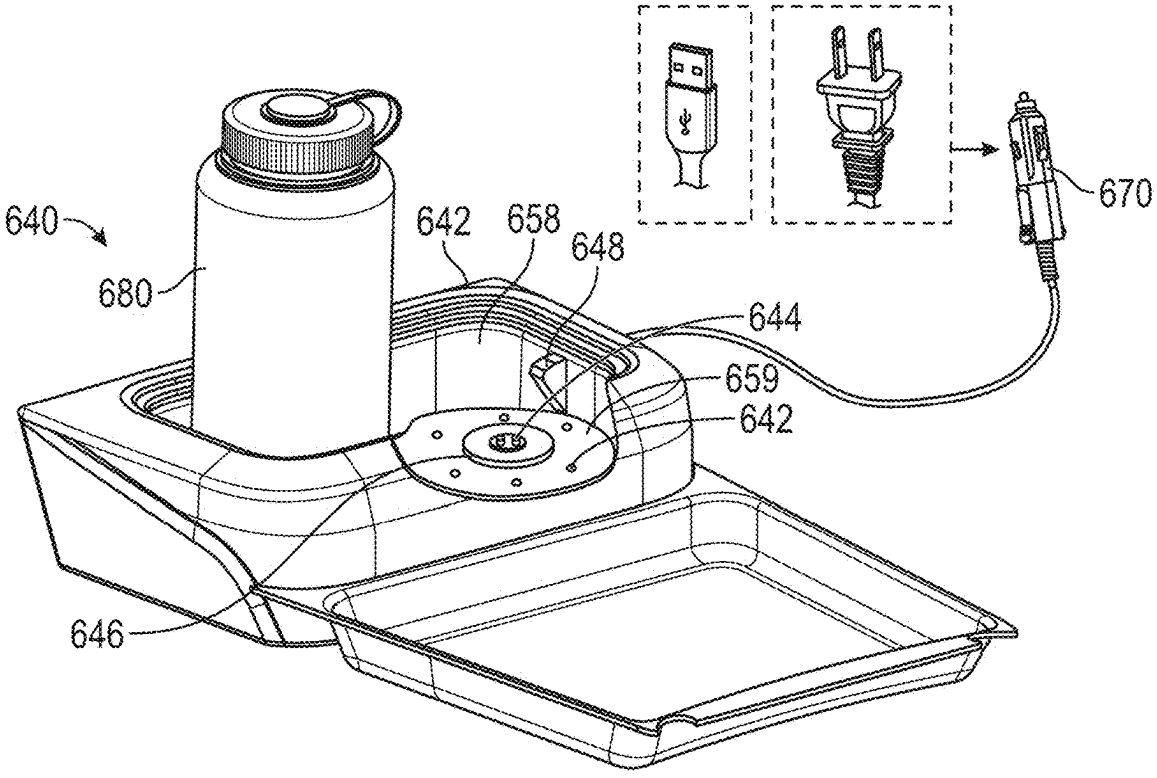

560D
540D
542D
550D
564D
562D
558D
544D
559D

FIG. 5D


640
680
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658
648
644
659
642
670
646

FIG. 6

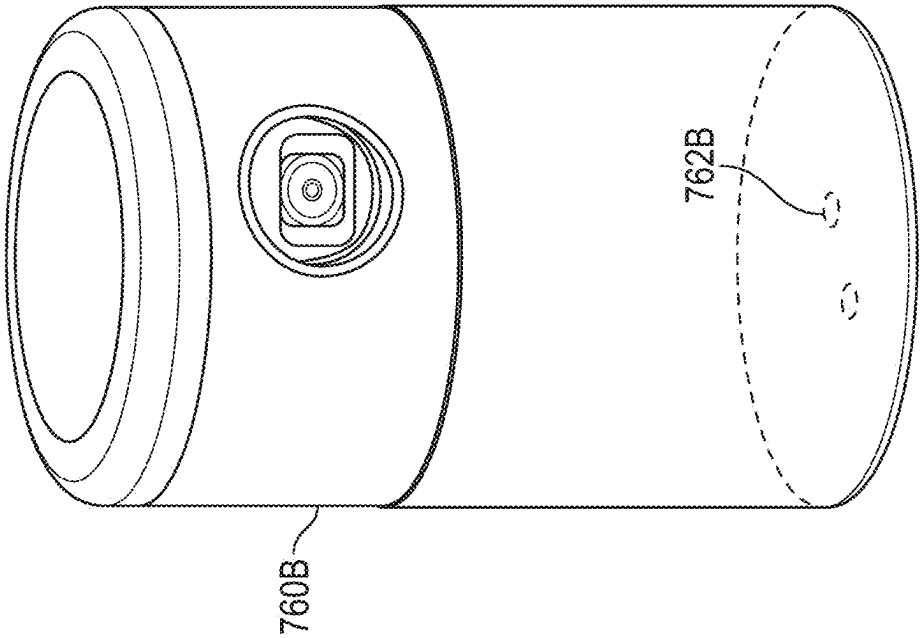

FIG. 7B

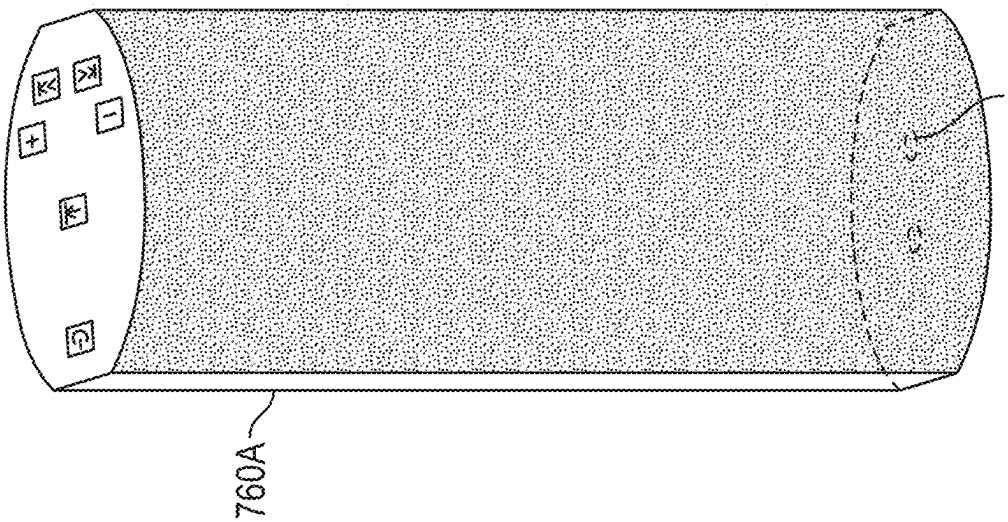

FIG. 7A

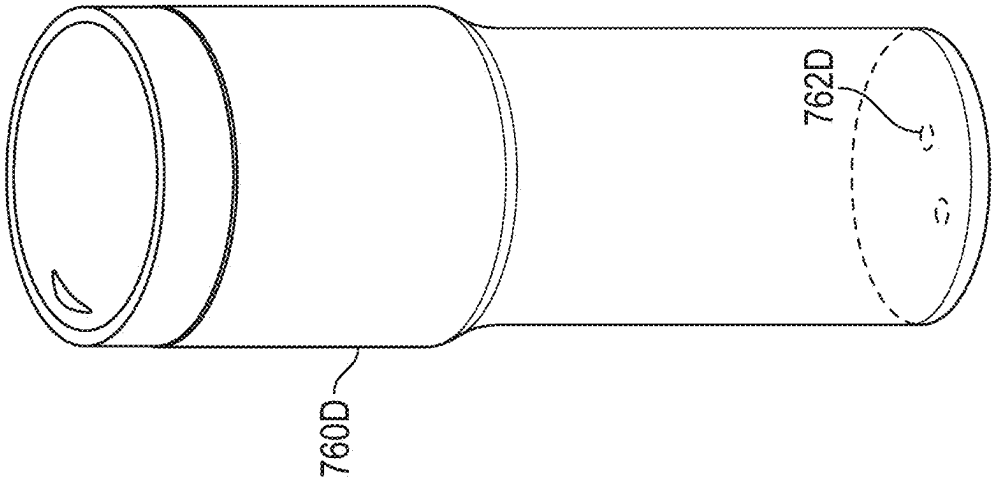

FIG. 7D

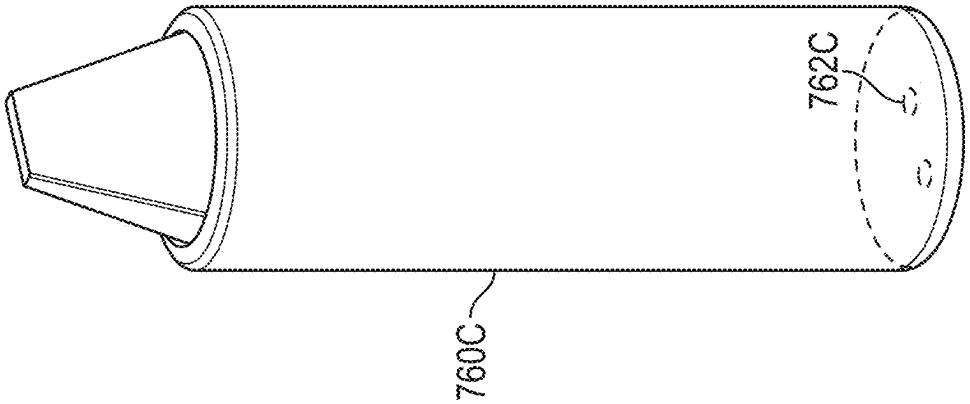

FIG. 7C

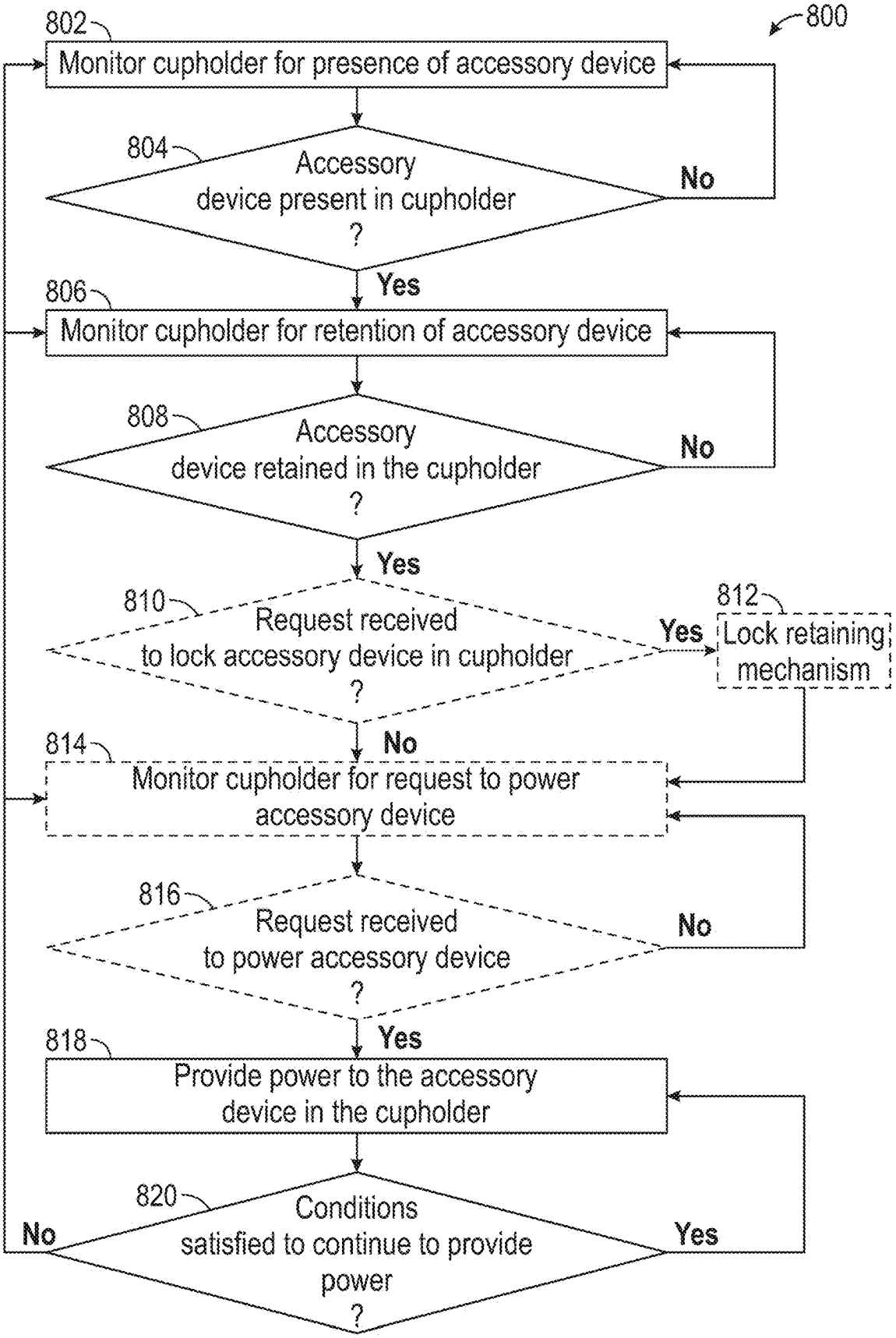
800
802
Monitor cupholder for presence of accessory device
804
Accessory device present in cupholder ?
No
Yes
806
Monitor cupholder for retention of accessory device
808
Accessory device retained in the cupholder ?
No
Yes
810
Request received to lock accessory device in cupholder ?
Yes
812
Lock retaining mechanism
No
814
Monitor cupholder for request to power accessory device
816
Request received to power accessory device ?
No
Yes
818
Provide power to the accessory device in the cupholder
820
Conditions satisfied to continue to provide power ?
No
Yes

FIG. 8

SYSTEM AND METHOD FOR PROVIDING POWER TO A CUP HOLDER

INTRODUCTION

[0001] The present disclosure is directed to a system and method for providing power to a cupholder of a vehicle, and more particularly to a system and method for providing power to an accessory device disposed in the cupholder.

SUMMARY

[0002] A vehicle may include a device for holding cups, which may be a cupholder. The cupholder may be used to hold cups, such as refillable beverage containers, water bottles, and soft drink cups, to name a few examples. The cupholder may also be used as a receptacle to hold personal items such as a cellular phone, wallet, or sunglasses.

[0003] In some embodiments, the present disclosure is directed to a system comprising a cupholder of a vehicle configured to receive and provide power to an accessory device and control circuitry. The cupholder comprises electrical contacts configured to engage electrical contacts of the accessory device. The control circuitry is configured to determine whether to provide the power to the electrical contacts of the cupholder. In some embodiments, the cupholder further comprises a retaining mechanism configured to retain the accessory device in the cupholder. In some embodiments, the cupholder further comprises a retaining frame forming a cup well and a movable base. The cup well secures sides of the accessory device. The movable base supports the bottom of the accessory device. The movable base is movable in relation to the retaining frame. The electrical contacts of the cupholder are disposed in the movable base.

[0004] In some embodiments, the present disclosure is directed to a method comprising identifying a presence of an accessory device in a cupholder and determining whether to provide power to the accessory device. In some embodiments, determining whether to provide the power to the accessory device comprises determining the accessory device is retained in the cupholder. In some embodiments, the method further comprises locking the accessory device in the cupholder.

[0005] In some embodiments, the present disclosure is directed to a system comprising a cupholder of a vehicle and control circuitry. The cupholder is configured to receive an accessory device and provide power to the accessory device. The cupholder comprising a retaining frame forming a cup well to secure sides of the accessory device. The cupholder further comprises a movable base to support the bottom of the accessory device. The movable base is movable in relation to the retaining frame. The cupholder further comprises electrical contacts disposed in the movable base configured to engage electrical contacts of the accessory device. The control circuitry is configured to provide the power to the electrical contacts of the cupholder to charge the accessory device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The present disclosure, in accordance with one or more various embodiments, is described in detail with reference to the following figures. The drawings are provided for purposes of illustration only and merely depict typical or example embodiments. These drawings are provided to facilitate an understanding of the concepts disclosed herein and shall not be considered limiting of the breadth, scope, or applicability of these concepts. It should be noted that for clarity and ease of illustration these drawings are not necessarily made to scale.

[0007] FIG. **1** shows a block diagram of an illustrative vehicle having a powered cupholder system, in accordance with some embodiments of the present disclosure;

[0008] FIG. **2** shows a block diagram of an illustrative system for providing power to a cupholder, in accordance with some embodiments of the present disclosure;

[0009] FIG. **3**A is a schematic cutaway illustration of a powered cupholder system, in accordance with some embodiments of the present disclosure;

[0010] FIG. **3**B is a schematic assembly illustration of the powered cupholder system of FIG. **3**A, in accordance with some embodiments of the present disclosure;

[0011] FIG. **3**C is a schematic sectional view of the powered cupholder system of FIG. **3**B, in accordance with some embodiments of the present disclosure;

[0012] FIGS. **4**A-**4**C are schematic assembly illustrations of another powered cupholder system, in accordance with some embodiments of the present disclosure;

[0013] FIGS. **5**A-**5**D are schematic illustrations of different retaining mechanisms for a powered cupholder system, in accordance with some embodiments of the present disclosure;

[0014] FIG. **6** is a schematic illustration of a powered cupholder system, in accordance with some embodiments of the present disclosure;

[0015] FIGS. **7**A-**7**D are schematic illustrations of accessory devices, in accordance with some embodiments of the present disclosure; and

[0016] FIG. **8** is a flowchart of an illustrative process for providing power to a cupholder, in accordance with some embodiments of the present disclosure.

DETAILED DESCRIPTION

[0017] A vehicle may include a holder, storage receptacle, or location for placing beverage containers or personal items of a user. In some situations, the user may want to hold or store one or more powered accessory devices in the vehicle. Such devices require power to use and may include a battery. Over time, the battery may discharge from use or during storage. In some situations, the user may want to provide power to the accessory device, such as to use the accessory device or to charge the battery of the accessory device. In some embodiments, the present disclosure is directed to methods and systems for providing power to an accessory device contained within the holder, storage receptacle, or location. In some embodiments, the holder, storage receptacle, or location is a cupholder of the vehicle. In some embodiments, the cupholder includes electrical contacts to engage electrical contacts of the accessory device.

[0018] FIG. **1** shows a block diagram of an illustrative vehicle **100** having a powered cupholder system **140**, in accordance with some embodiments of the present disclosure. As illustrated, the vehicle **100** includes control system **120**, battery system **130**, and the powered cupholder system **140**. The powered cupholder system **140** provides power to a cupholder (e.g., cupholder **342**, **442**, **542**A-D, **642**, discussed below in relation to FIGS. **3**A-**3**C, **4**, **5**A-**5**D, and **6**) of the vehicle **100**. The powered cupholder system **140** may provide power to an accessory device (e.g., accessory device

360, 560A-D, 760A-D discussed below in relation to FIGS. 3A-3C, 5A-5D, and 7) through the cupholder, such as to power the accessory device or charge a battery of the accessory device.

[0019] The control system 120 includes control circuitry (e.g., control circuitry 210, discussed below in relation to FIG. 2) that is coupled to sensors, actuators, interfaces, and any other suitable components to control one or more systems such as powered cupholder system 140. The control system 120 may include control circuitry for monitoring sensor signals, generating control signals, executing computer readable instructions, receiving inputs, or a combination thereof. In some embodiments, the powered cupholder system 140 includes a power delivery system such as, for example, a system having controllable electrical contacts for providing power. The battery system 130 (e.g., also referred to as an energy storage system or ESS) may include a plurality of battery cells, enclosures, and power electronics (e.g., a DC-DC converter, switches, alternator). The battery system 130 provides power to the powered cupholder system 140. The vehicle 100 may include drive units that may include motors, gearing, bearings, hubs, shafts, gearbox housings, any other suitable components, or any combination thereof. For example, each drive unit may include an inverter, electric motor, and a gearbox for providing torque to a respective wheel or drive axis of the electric vehicle via a half-shaft and constant-velocity (CV) joint.

[0020] The vehicle 100 includes an interior 102 to accommodate passengers. Powered cupholders are positioned throughout the interior 102. In the embodiment depicted in FIG. 1, one or more powered cupholders may be present in each area marked by the dashed outlines. The vehicle 100 includes doors 104, such as a front and rear driver-side and passenger-side doors 104, to access the interior 102. The doors 104 have an interior side that faces the interior 102 and an opposite exterior side. The interior side of the door 104 may include a powered cupholder. The interior includes a driver's seat, front passenger seat, and rear passenger seat or seats (not shown). The interior includes a dashboard 106, front console 108, rear console 110, and rear armrest 112. The dashboard may include indicators, such a speedometer and tachometer, air vents, an entertainment or infotainment system screen, vehicle controls, and a powered cupholder. The front console 108 may include a storage compartment between the driver's seat and front passenger seat and a powered cupholder. The rear console 110 may include air vents and a powered cupholder. In some embodiments, such as discussed below in relation to FIGS. 4A-4C, the powered cupholder may be stowed inside any of the dashboard 106, front console 108, rear console 110, or rear armrest 112.

[0021] Although the embodiment depicted in FIG. 1 shows powered cupholders in particular locations of the vehicle 100, in some embodiments the powered cupholders may be located in different locations. For example, a powered cupholder may be located on a floor of the vehicle, such as near the front or rear consoles 108, 110, or in a bed or trunk of the vehicle 100. In some embodiments, the vehicle 100 may include more or less powered cupholders than discussed in relation to FIG. 1.

[0022] FIG. 2 shows a block diagram of an illustrative system 200 for providing power to a cupholder (e.g., cupholder 342, 442, 542A-D, 642, discussed below in relation to FIGS. 3A-3C, 4, 5A-5D, and 6), in accordance with some embodiments of the present disclosure. The system 200 includes control circuitry 210, a sensor(s) 204, battery system 230, powered cupholder system 240, a drive system (s) 250, vehicle control circuitry 260, and other systems 280. For example, system 200 may be included as part of the vehicle 100 of FIG. 1, where control circuitry 210 may correspond to the control system 120, the battery system 230 corresponds to the battery system 130, and powered cupholder system 240 may correspond to the powered cupholder system 140.

[0023] In an illustrative example, control circuitry 210 may monitor and control powered cupholder system 240, and determine when and if power is needed (e.g., based on a presence of an accessory device, moisture, sensor signals, reference information, preference information, and/or user input). Vehicle control circuitry 260 may be configured to manage providing power for any or all cupholders of a vehicle (e.g., vehicle 100). In an illustrative example, drive system(s) 250 may include drivetrain components such as a plurality of drive units, a plurality of electric motors (e.g., four electric motors, corresponding to a respective wheel of a vehicle), or otherwise one or more systems for generating torque at wheels of the vehicle. Powered cupholder system 240, as illustrated, may include one or sensors, electrical contacts, and controls for managing power to and from the cupholders.

[0024] Although illustrated as separate, powered cupholder system 240 and control circuitry 210 may overlap, be interfaced to each other via one or more components (e.g., wires, circuit boards, dies, chips, vias, connectors, resistors, transformers, capacitors), or otherwise be modified from system 200 as illustrated. Further, the boundary delineating each system is merely illustrative. Accordingly, system delineations illustrated herein are merely exemplary for purposes of discussion.

[0025] Illustrative control circuitry 210 includes processor 212, one or more relays 214 (hereinafter referred to as relay(s) 214), input/output 216 (hereinafter referred to as I/O 216), communication hardware 218 (hereinafter referred to as COMM 218), and memory 219. Control circuitry 210 may include hardware, software, or both, implemented on one or more modules configured to provide control of the powered cupholder system 240. In some embodiments, processor 212 includes one or more microprocessors, microcontrollers, digital signal processors, programmable logic devices, field-programmable gate arrays (FPGAs), application-specific integrated circuits (ASICs), or any suitable combination thereof. In some embodiments, processor 212 is distributed across more than one processor or processing units. In some embodiments, control circuitry 210 executes instructions stored in memory (e.g., non-transitory computer readable media) for managing power to the cupholder. In some embodiments, memory 219 is an electronic storage device that is part of control circuitry 210. For example, memory 219 may be configured to store electronic data, computer instructions, applications, firmware, or any other suitable information. In some embodiments, memory 219 includes random-access memory, read-only memory, hard drives, optical drives, solid state devices, or any other suitable memory storage devices, or any combination thereof. For example, memory 219 may be used to launch a start-up routine, diagnostic routine, or power-management routine. In some embodiments, memory 219 includes non-transitory computer-readable media that includes computer

executable instructions for controlling power (e.g., process **800**, discussed below in relation to FIG. **8**).

[0026] In some embodiments, the control circuitry **210** is powered by power supply **202**. In some embodiments, the power supply **202** includes a car battery (e.g., a 12 V lead acid battery), a DC-DC converter, an AC power supply (e.g., generated by suitably inverting a DC power supply), any other power supply, any corresponding components (e.g., terminals, switches, fuses, and cables), or any combination thereof. In some embodiments, power supply **202** may be same as or otherwise included as part of battery system **230**.

[0027] In some embodiments, user interface **206** includes a push button, a toggle switch, a turnable knob, a display screen (e.g., a touch screen), a key fob, a key-lock combination, any other suitable system or component for receiving input from a user or providing output to a user, or any combination thereof. In some embodiments, user interface **206** includes a touchscreen on the dashboard (e.g., dashboard **106** in FIG. **1**) of a vehicle, configured to receive input from the user, and provide a display to the user. In some embodiments, user interface **206** includes one or more buttons that are selectable by a user. For example, the one or more buttons may include a button coupled to a switch, a button on a touchpad, any other suitable button that may be used by a user to make a selection, or any combination thereof. In some embodiments, user interface **206** includes one or more turnable knobs that a user may turn to adjust a drive mode, power options for the powered cupholder, or another suitable setting.

[0028] Sensor(s) **204** include one or more of pressure sensors (e.g., piezo or strain-based transducers, capacitive sensor, or optical pressure sensor), proximity sensors or switches (e.g., a capacitive, photoelectric, magnetic, optical, ultrasonic, or inductive proximity sensor), wireless sensors (e.g., radio frequency identification), current sensors, any other suitable sensors, or any combination thereof. For example, sensor(s) **204** may be used to measure pressure or a difference in pressure over time of a surface of the cupholder. In a further example, sensor(s) **204** may be used to identify presence of an object, such as the accessory device, in the cupholder. In a further example, sensor(s) **204** may be used to determine whether an accessory device is retained in the cupholder. In a further example, sensor(s) **204** may be used to determine whether electrical contacts of the cupholder contact electrical contacts of the accessory device. Sensor(s) **204** is also referred to herein as sensors **204**, and accordingly may include one or more sensors of any suitable type or types.

[0029] Powered cupholder system **240** may be the same as or similar to, or included as part of, system **140** of FIG. **1**. Powered cupholder system **240** may include sensors (e.g., sensor(s) **204**), voltage regulators or other components to control power, fittings, electrical contacts, or components designed to direct and meter voltage or current to electrical contacts of the cupholder, any other suitable components, or any combination thereof. In some embodiments, powered cupholder system **240** includes control circuitry such as a controller, module, FPGA, or any other suitable circuitry to provide monitoring, control, communication, or a combination thereof.

[0030] Drive system(s) **250** may include one or more front drive units, rear drive units, or both, which may each include a motor coupled via a gearset to an output shaft that corresponds to a wheel or a drive axis of the vehicle. To illustrate, each drive unit may include a motor coupled to a gearbox having a lubricating oil system and cooling passages (e.g., for interfacing to a coolant system), wherein the motor is electrically coupled to an inverter or otherwise power electronics (e.g., a motor drive).

[0031] The vehicle control circuitry **260** performs vehicle functions. For example, the vehicle control circuitry **260** may control power between the battery system **230** and the drive system(s) **250** to control the vehicle's speed and acceleration. For example, the vehicle control circuitry **260** may control an amount of torque to the wheels of the vehicle. In some embodiments, the vehicle control circuitry **260** controls the drive train and drive train components of the vehicle. In some embodiments, the vehicle controller controls the braking system. The vehicle control circuitry **260** may receive input from a user, such as through accelerator and brake pedals.

[0032] Other systems **280** may include controllers or modules (e.g., having processors), electronics, display devices, or other suitable systems that may interface to the powered cupholder system **240** or vehicle control circuitry **260**. In some embodiments, the other systems **280** include a fault diagnosis management unit, a steering motor and corresponding controller, air conditioning motor and corresponding controller, heater and corresponding controller braking system, and DC-DC converters, to name a few examples. The vehicle control circuitry may be communicatively coupled to the other systems **280** to control their functionality, or to communicate information to their controllers relating to their functionality.

[0033] Illustrative system **200** of FIG. **2**, or aspects thereof, may be used to control any suitable system disclosed herein and implement any suitable method disclosed herein, in accordance with the present disclosure. In some embodiments, not all components shown in FIG. **2** need be included in system **200**. In some embodiments, control circuitry **210** is configured to determine an operation mode such as off-road, wet-road, highway, city street, eco, or any other suitable mode (e.g., which defines how the system operates). For example, control circuitry **210** may execute computer readable instructions stored on non-transitory computer readable media to select from among operating modes (e.g., based on input from user interface **206**), retrieve reference information (e.g., from memory), generate and transmit control signals to any system of system **200**, receive and process sensor signals, or a combination thereof. System **200**, or control circuitry **210** thereof, may be referred to herein as a control system (e.g., for controlling power provided to the cupholder). It will be understood that a mode, as referred to herein, corresponds to any suitable form of operation for providing power to the cupholder, controlling power to the cupholder, or a combination thereof.

[0034] FIG. **3**A is a schematic cutaway illustration of a powered cupholder system **340**, in accordance with some embodiments of the present disclosure. FIG. **3**B is a schematic assembly illustration of the system **340**, in accordance with some embodiments of the present disclosure. FIG. **3**C is a schematic sectional view of the system **340** from the perspective noted in FIG. **3**B, in accordance with some embodiments of the present disclosure. FIGS. **3**A-**3**C show different views of the system **340** and an accessory device **360**, and are herein described together for clarity.

[0035] Referring to FIG. **3**A, the system **340** includes a cupholder **342**, electrical contacts **344**, sealing elements **346**,

grippers **348**, retaining mechanism **350**, and sensor **352**. The cupholder **342** includes a cup well **358** having sidewalls and a base **359** at the bottom of the cup well **358**. The cupholder **342** accommodates the accessory device **360**, which may be disposed in the cup well **358** such as depicted in FIG. **3**B. The accessory device **360** includes electrical contacts **362**, retention elements **364**, and sensed objects **366**.

[0036] The electrical contacts **344** of the cupholder **342** are pogo pins or spring-loaded pins that protrude from the base **359**. The electrical contacts **344** are electrically and communicatively coupled to control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210** in FIG. **2**). The control circuitry may provide power to the electrical contacts **344** of the cupholder **342**, which in turn may provide power to the accessory device **360**. In one example, when the accessory device **360** is retained by the cupholder, such as depicted in FIG. **3**B, the electrical contacts **362** of the accessory device **360** contact and push against the electrical contacts **344** of the cupholder **342** and the control circuitry provides power to the accessory device **360** through the electrical contacts **362**. In some embodiments, the electrical contacts **344** comprise a corrosion-resistant material. In some embodiments, the electrical contacts **344** comprise gold. In some embodiments, the electrical contacts **344** are gold-plated. In some embodiments, the electrical contacts **344** are flush with the base or recessed to the base and the electrical contacts **362** of the accessory device **360** extend to contact the electrical contacts **344**. In some embodiments, the electrical contacts **344** of the cupholder **342**, are located on sidewalls of the cup well **358** and the electrical contacts **362** are located on sides of the accessory device **360**.

[0037] Each sealing element **346** surrounds an electrical contact **344** to prevent liquids on the base **359** from contacting the electrical contacts **344**. The sealing elements **346** may be placed on the base **359** or partially placed in a recess of the base **359**. In one example, when the accessory device **360** is retained by the cupholder, such as depicted in FIG. **3**B, the bottom surface of the accessory device **360** compresses the sealing elements **346** against the cupholder **342** to form a seal around the electrical contacts **344**, such as a water-tight seal. The sealing elements **346** may include any one of O-rings, gaskets, or sealants. The sealing elements **346** may comprise any compressible material that forms a seal between the cupholder **342** and the accessory device **360**, such as neoprene, rubber, nitrile, fluoroelastomer, graphite, cork, or styrene butadiene rubber, to name a few examples. In some embodiment, the sealing elements **346** may be attached to the base **359**, such as through an adhesive or a friction fit.

[0038] The grippers **348** protrude from the sidewalls of the cup well **358** and engage sides of the accessory device **360** to secure the accessory device **360** in the cupholder **342**. The grippers **348** provide stability when the accessory device is secured while allowing some movement or adjustment within the cup well **358**. The grippers **348** allow the cupholder **342** to accommodate accessory devices **360** of different sizes or diameters. In the embodiment depicted in FIGS. **3**A and **3**B, the grippers **348** have an arc-like shape where the peak of the arc contacts a side of the accessory device **360**. As the accessory device **360** is inserted into the cupholder **342**, the grippers **348** each pivot into the sidewalls of the cup well **358** and against compliant mechanisms or elastic members, such as a spring or elastic loop, while maintaining contact with the accessory device **360**. When the accessory device **360** is removed, the compliant mechanisms or elastic members pivot the grippers **348** away from the sidewalls and into the cup well **358**. In some embodiments, the grippers **348** may be an elastic material that contacts the accessory device **360** and deforms and stretches to secure the accessory device **360**. The deformable material returns to its original shape when the accessory device **360** is removed. In some embodiments, the grippers **348** may be any mechanism known to one skilled in the art that secure the accessory device **360** in the cupholder **342**.

[0039] The retaining mechanism **350** retains the accessory device **360** in the cupholder **342** by holding the accessory device **360** in an engaged position such that the electrical contacts **344** of the cupholder **342** remain in contact with the electrical contacts **362** of the accessory device **360**. In some embodiments, the seal formed by the sealing elements **346** remains intact while the accessory device **360** is retained. In some embodiments, the retaining mechanism **350** engages the retention element **364** and fixes the accessory device **360** in cupholder **342** until the retaining mechanism **350** is disengaged.

[0040] In the embodiment depicted in FIG. **3**A, the retaining mechanism **350** includes a receiver or strike that forms a channel or groove to receive a retention element **364** of the accessory device. The retention element **364** is a protrusion or lever that protrudes from a side(s) of the accessory device **360**. The retaining mechanism **350** is attached to, or integrally formed with, the sidewall of the cup well **358**. Referring to FIGS. **3**A and **3**C, the accessory device **360** is inserted into the cupholder **342** such that the retention elements **364** do not engage the retaining mechanism **350**. The dashed retention elements **364** in FIG. **3**C show the non-engaged position. The accessory device **360** is rotated clockwise and the protrusions of the retention elements **364** enter the channel of the receiver to engage the retaining mechanism **350**. The retaining mechanism **350** includes a stop at the end of the channel to contact the retention element **364** and prevent further rotation past the engaged position. The accessory device **360** is rotated counterclockwise to the non-engaged position to stop retention of the accessory device **360**. In some embodiments, the channel of the retaining mechanism **350** is configured such that the accessory device **360** is rotated counterclockwise to from the non-engaged position to the engaged position. In some embodiments, the retaining mechanism **350** is attached to, or integrally formed with, the base **359**. Although only one receiver of the retaining mechanism **350** is depicted in cutaway schematic of FIG. **3**A, the retaining mechanism **350** may include another receiver on an opposite side of the sidewall. The another receiver is rotated 180 degrees in relation to the receiver, such as shown in FIG. **3**C. In some embodiments, the receivers of the retaining mechanism **350** are positioned at a different angle in relation to one another. In some embodiments, more or less receivers may be used.

[0041] Sensors **352** of the system **340** are disposed in or on the sidewall of the cup well **358** and in the channel of the retaining mechanism **350**. The sensors **352** are positioned such that when the accessory device **360** is in the engaged position, the sensed objects **366** of the accessory device **360** align with or contact the sensors **352**, and are detected by the sensors **352**. The control circuitry uses the sensors **352** to determine whether the accessory device **360** is retained by the retaining mechanism **350**. The control circuitry further

determines whether to provide power to the electrical contacts **344** of the cupholder **342** based on whether the accessory device **360** is retained by the retaining mechanism **350**. For example, the control circuitry may not provide the power to the electrical contacts **344** when the accessory device **360** is determined to not be retained by the retaining mechanism **350**. The sensors **352** may correspond to the sensors **204** discussed in relation to FIG. **2**. In some embodiments, the sensors **352** transmit a frequency that is reflected back from the sensed objects **366** to the sensors **352**. In some embodiments, the sensors **352** receive a transmission or reflection from the sensed objects **366**. In some embodiments, the sensors **352** and the sensed objects **366** both transmit and receive to one another.

[0042] In some embodiments, the sensors **352** are disposed in other parts of the sidewall, in the retaining mechanism, or in the base **359**. In such embodiments, the corresponding sensed objects **366** of the accessory device are placed such that they align with the sensors **352** when in the engaged position.

[0043] In some embodiments, sensors **352** may include pressure sensors disposed in the base **359**, such as sensors **552**C discussed in relation to FIG. **5**C. In such embodiments, the pressure sensors may identify the presence of the accessory device **360** in the cupholder **342**. For example, the pressure sensors may detect an increase in pressure on the base **359**. In some embodiments, at least a portion of the electrical contacts **344** move perpendicular or orthogonal to the base **359**, such as when compressed by the accessory device **360**, and the pressure sensors detect the movement.

[0044] In some embodiments, the electrical contacts **344** provide a data connection to the accessory device **360**. The data connection allows the control circuitry to determine the accessory device **360** is retained. In some embodiments, the data connection allows the control circuitry to identify the type of accessory device **360** and determine the power requirements. In some embodiments, the data connection allows the control circuitry to determine a current state of charge (SOC) of the accessory device **360**. In such embodiments, the control circuitry may determine a charging profile for the accessory device **360** (e.g., constant amperage or amperage that varies based on time or the SOC).

[0045] Drain paths **354** or holes are formed in the base to allow fluids, such as liquids that may be spilled in the cupholder **342**, to drain away from the electrical contacts **344**. In some embodiments, the drain paths **354** are fluidly connected to a drain receptacle or container.

[0046] FIGS. **4**A-**4**C are schematic assembly illustrations of another powered cupholder system **440**, in accordance with some embodiments of the present disclosure. In particular, FIG. **4**A shows the system **440** in a retracted position, FIG. **4**B shows the system **440** in a partially extended position, and FIG. **4**C shows the system **440** in a fully extended position. FIGS. **4**A-**4**C are herein described together for clarity. The system **440** is part of a front console **408** of a vehicle (e.g., vehicle **100** in FIG. **1**), although in other embodiments the system **440** may be in a different location (e.g., dashboard **106**, rear console **110**, or rear armrest **112** in FIG. **1**) of the vehicle.

[0047] The system **440** includes a cupholder **442**, retaining mechanism **450**, and electrical contacts **444**. The cupholder **442** includes a retaining frame **457** and a movable base **459**. The retaining frame **457** forms a cup well **458** to secure sides of an accessory device (e.g., accessory device **360** in FIGS. **3**A-**3**C and accessory device **560**A-D, **760**A-D, discussed below in relation to FIGS. **5**A-**5**D, and **7**). In the embodiment depicted in FIGS. **4**A-**4**C, the cupholder **442** includes two cup wells **458** separated by material of the retaining frame **457**. The cupholder **442** can receive one accessory device per cup well **458**.

[0048] The movable base **459** is movable in relation to the retaining frame **457**. For example, the movable base **459** pivots about an axis A (e.g., shown in FIG. **4**C) located where the movable base **459** connects to the retaining frame **457**. The cupholder **442** is retractable into and out of the front console **408**. The movable base **459** moves away from the retaining frame **457** when the cupholder **442** is extended from the front console **408** (e.g., transitioning from FIG. **4**A to FIG. **4**B to FIG. **4**C). The movable base **459** moves towards the retaining frame **457** when the cupholder **442** is retracted into the front console **408** (e.g., transitioning from FIG. **4**C to FIG. **4**B to FIG. **4**A). In some embodiments, the movable base **459** is configured to stow inside the retaining frame **457** when the cupholder **442** is stowed in the compartment (e.g., as shown in FIG. **4**A). A compliant mechanism or elastic member (not shown) may bias the movable base **459** to move away from the retaining frame **457**. For example, when the cupholder **442** is retracted, a spring is deformed and stores energy in the form of elastic potential energy. When the cupholder is extended, the spring releases the elastic potential energy and exerts a force on the movable base **459** to pivot the movable base **459** about the axis A away from the retaining frame **457**. In some embodiments, the compliant mechanism or elastic member is not used and gravity is used to pivot the movable base **459** away from the retaining frame **457**. When the cupholder **442** is extended, the movable base **459** may support the bottom of the accessory device or a cup that is disposed in the cup well **458**.

[0049] The electrical contacts **444** are disposed in the movable base **459**. In the embodiment depicted in FIGS. **4**A-**4**C, six electrical contacts **444** protrude from the movable base **459** such that there are three electrical contacts **444** per accessory device. In some embodiments, more or less electrical contacts **444** may be used. The electrical contacts **444** are electrically and communicatively coupled to control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210** in FIG. **2**). The control circuitry may provide power to the accessory device using two of the electrical contacts **444**. The control circuitry may communicate with the accessory device, such as by exchanging data, using the remaining third electrical contact **444**. For example, the control circuitry may communicate with the accessory device to confirm the accessory device can receive power before providing power to the two electrical contacts **444**. In some embodiments, the control circuitry may communicate with the accessory device to identify what type of accessory device is connected (e.g., one of accessory devices **760**A-D, described below in relation to FIGS. **7**A-**7**D). In some embodiments, the control circuitry may communicate with the accessory device to determine how much voltage or current to provide, which may vary with time as in adaptive charging. In some embodiments, the control circuitry may communicate with the accessory device to determine a current SOC of the accessory device.

[0050] The retaining mechanism **450** includes the electrical contacts **444**. When the accessory device is placed in the cupholder **442**, the electrical contacts **444** are disposed in

recesses of the bottom of the accessory device and prevent the accessory device from shifting on the movable base **459**. In some embodiments, the electrical contacts **444** are stationary in relation to the movable base **459** such that the accessory device rests on the electrical contacts **444** when not aligned with the recesses. In some embodiments, the electrical contacts **444** are retractable (e.g., pogo pins or spring-loaded pins). In such embodiments, the accessory device pushes the electrical contacts **444** towards the movable base **459** when not aligned with the recesses and the electrical contacts **444** extend into the recesses when aligned.

[0051] In some embodiments, the cup wells **458** are formed by a continuous opening in the retaining frame **457** such that the cup wells **458** are not completely separated by material of the retaining frame **457**.

[0052] FIGS. **5**A-**5**D are schematic illustrations of different retaining mechanisms **550**A-D for a powered cupholder system **540**A-D, in accordance with some embodiments of the present disclosure. FIGS. **5**A-**5**D are herein described together for brevity.

[0053] FIGS. **5**A-**5**D show an accessory device **560**A-D disposed in a cupholder **542**A-D of the system **540**A-D. The cupholder **542**A-D includes a cup well **558**A-D and a base **559**A-D. The system **540**A-D includes a retaining mechanism **550**A-D and electrical contacts **544**A-D. The accessory device **560**A-D includes a retention element(s) **564**A-D and electrical contacts **562**A-D.

[0054] In FIG. **5**A, the retaining mechanism **550**A comprises a magnetic feature on or in a sidewall of the cup well **558**A. The retention element **564**A comprises a magnetic feature on or in a side of the accessory device **560**A. The magnet feature of the retaining mechanism **550**A engages the magnetic feature of the accessory device **560**A to retain accessory device **560**A in the cupholder **542**A. The magnetic feature of the retaining mechanism **550**A may be a permanent magnet, electromagnet, or material that comprises a magnetic material (e.g., a ferromagnetic material) attracted to a magnet. The magnetic feature of the accessory device **560**A may be a magnet or magnetic material that is attracted to the magnetic feature of the retaining mechanism **550**A. In some embodiments, the magnetic feature of the accessory device **560**A may be a permanent magnet, electromagnet, or material that comprises a magnetic material and the magnetic feature of the retaining mechanism **550**A may be attracted to the magnetic feature of the accessory device **560**A.

[0055] The system **540**A includes sensor(s) **552**A and the accessory device **560**A includes a sensed object(s) **566**A. The sensor **552**A comprises a magnetic sensor, such as a Hall effect sensor, and the sensed object **566**A comprises a magnetic material. The magnetic sensor detects a change in voltage when placed in the magnetic field of the magnetic material. The sensor **552**A is used by control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210** in FIG. **2**) to determine if the accessory device is retained by the system **540**A. For example, sensor **552**A will detect the sensed object **566**A when the retaining mechanism **550**A engages the retention element **564**A and the electrical contacts **544**A of the system **540**A contact the electrical contacts **562**A of the accessory device **560**A.

[0056] In some embodiments, the sensor **552**A is an RFID reader and the sensed object **566**A is an RFID tag. In some embodiments, the sensor **552**A is a camera or emitter and detector and the sensed object **566**A is a visual identifier such as a QR code or a bar code. In some embodiments, the sensor **552**A is an emitter and detector and the sensed object **566**A is reflective surface. In some embodiments, the sensor **552**A and the sensed object **566**A are transceivers, such as one of an NFC, Bluetooth, or Wi-Fi transceiver, to name a few examples.

[0057] The base **559**A includes an aligning feature **555** in its center, ledges **556** where the base meets the cup well **558**A, and a channel **557** formed therebetween. The aligning feature **555** is shown as a wedge or chevron shape protruding outward from the base **559**A into the cup well **558**A and extending between sidewalls of the cup well **558**A. The wedge is formed by two flat surfaces. The electrical contacts **544**A are disposed on or in the retaining feature **555**. The accessory device **560**A forms a corresponding mating feature (e.g., an inverted wedge) in its bottom. The electrical contacts **562**A of the accessory device **560**A are disposed in or on the corresponding mating feature. The wedge of the aligning feature **555** aligns the accessory device **560**A with the retaining mechanism **550**A and the electrical contacts **544**A. The ledges **556** may be along the entire sidewall of the cup well **558**A or at discrete locations along the sidewall. The ledges **556** may support an outer area of the bottom of the accessory device **560**A. The channel **557** may entirely or partially surround the aligning feature **555**. The channel **557** is fluidly coupled to the drain paths **554**. The sloped surfaces of the wedge resist standing liquids, and may direct liquids spilled on the aligning feature **555** into the channel **557** and to the drain paths **554**. The drain paths **554** drain liquids away from the electrical contacts **544**A of the cupholder **542**A. In some embodiments, the aligning feature **555** has a conical or frustoconical shape. In some embodiments, the aligning feature **555** may be any shape that results in alignment of the electrical contacts **544**A with the electrical contacts **562**A.

[0058] In FIG. **5**B, the retaining mechanism **550**B of the system **540**B comprises a lever formed by a compliant mechanism or elastic member that is part of or attached to each electrical contact **562**B. In some embodiments, the electrical contact **562**B may include the compliant mechanism, such as in pogo pins or spring-loaded pins. The retention element **564**B comprises a receiver or strike having a slot or notch formed in opposing sides of the accessory device **560**B. The electrical contacts **562**B are disposed in the slot on the opposing sides. The compliant mechanism biases the electrical contacts **544**B to protrude from a recess in a sidewall of the cup well **558**B. When the accessory device **560**B is inserted into the cupholder **542**B, a side(s) of the accessory device **560**B contacts a chamfered or rounded portion of the electrical contacts **544**B and moves the electrical contacts **544**B towards the sidewall as the accessory device **560**B is inserted into the cup well **558**B. Once the accessory device **560**B rests in the cupholder **542**B (e.g., the bottom of the accessory device **560**B contacts the base **559**B of the cupholder **542**B), the accessory device **560**B is rotated and the electrical contacts **544**B of the system **540**A-D move away from the sidewall and toward the accessory device **560**B to engage the slot to retain the accessory device **560**B. When properly seated, the electrical contacts **544**B contact the electrical contacts **562**B of the accessory device **560**B. In some embodiments, the electrical contacts **544**B are flexible or elastically deformable such that they form the compliant mechanism. The accessory

device **560**B may be removed from the cupholder **542**B by rotating the accessory device **560**B to push the electrical contacts **544**B into the sidewall of the cup well **558**B until the electrical contacts **544**B are no longer disposed in the slot of the retention element **564**B. The accessory device **560**B may then be lifted out of the cupholder **542**B.

[0059] In FIG. **5**C, the retaining mechanism **550**C comprises a latch on or in the base **559**C of the cupholder **542**C. The retention element **564**C comprises a receiver or strike having a bar or peg spanning a recess **568** formed in the bottom of the accessory device **560**B. The electrical contacts **544**C of the system **540**C protrude outwardly from the base **559**C into the cup well **558**C. Sealing elements **546**C are partially disposed in and secured in the base **559**C and surround the electrical contacts **544**C. Control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210** in FIG. **2**) moves the retaining mechanism **550**C (e.g., such as from a position shown as a dashed outline) through the recess **568** to engage the retention element **564**C when the electrical contacts **544**C contact the electrical contacts **562**C of the accessory device **560**C. The control circuitry locks the accessory device **560**C in the cupholder **542**C by pulling the accessory device **560**C towards the base **559**C and locking the retaining mechanism **550**C. The control circuitry locks the accessory device **560**C in the cupholder **542**C by fixing the accessory device in cupholder **542**C such that it cannot be removed until unlocked. When the accessory device **560**C is pulled towards the base **559**C, the sealing elements **546**C are compressed and form a seal around the electrical contacts **544**C.

[0060] The system **540**C includes sensors **552**C. Each electrical contact **544**C protrudes from the base **559**C at a first end and may contact a sensor **552**C at an opposite second end. The electrical contacts **544**C are pogo pins and the sensors **552**C are pressure sensors. The pressure detected by the sensors **552**C increases when the accessory device **560**C rests on the electrical contacts **544**C. Control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210** in FIG. **2**) may use the sensors **552**C to determine if the accessory device **560**C is present in the cupholder **542**C.

[0061] In some embodiments, the weight of the accessory device **560**C is known and the control circuitry uses the pressures detected by the sensors **552**C to determine if an object present in the cupholder **542**C is the accessory device **560**C. For example, if the detected pressures are outside of an expected pressure range, then the control circuitry determines the accessory device **560**C is not present and does not provide power to the electrical contacts **544**C.

[0062] In some embodiments, the system **540**C receives an input from a user through a button or switch (not shown) to activate the latch of the retaining mechanism **550**C.

[0063] In some embodiments, the sensors **552**C may further comprise a sensor for checking continuity, a conductivity sensor, or a resistance sensor that is electrically or communicatively coupled to at least one electrical contact **544**C. The control circuitry compares the measurements of the sensors **552**C, which may be taken using the electrical contacts **544**C, to a predetermined value or range to determine if the electrical contacts **544**C contact the electrical contacts **562**C of the accessory device **560**C. For example, the reading from such sensors may differ when the electrical contacts **544**C contact the bottom of the accessory device **560**C and contact the electrical contacts **562**C of the accessory device **560**C.

[0064] In some embodiments, the electrical contacts **544**C move vertically (as shown on the page) and the sensors **552**C provide readings when the electrical contacts **544**C move downward and contact the sensors **552**C. In such embodiments, the sensors **552**C may be contact or conductivity sensors. The control circuitry may not provide power when the sensors **552**C do not detect contact with the electrical contacts **544**C.

[0065] In FIG. **5**D, the retaining mechanism **550**D comprises a recess(es) (e.g., a slot, hole, or notch) formed in the sidewall of the cup well **558**D. The retention element **564**D comprises a lever on or in a side(s) of the accessory device **560**D. Once the accessory device **560**D rests in the cupholder **542**D and is positioned to be retained, the retention element **564**D is moved into the retaining mechanism **550**D to engage the recess and retain the accessory device **560**D. In some embodiments, the control circuitry communicates with and/or sends power to the retention element **564**D to move the retention element **564**D to engage the retaining mechanism **550**D. In some embodiments, the control circuitry communicates with and/or sends power to the retention element **564**D through the electrical contacts **544**D, **562**D. In some embodiments, the accessory device **560**D comprises control circuitry and the control circuitry of the system **540**D communicates with the control circuitry of the accessory device **560**D (e.g., through I/O circuitry or through I/O **216**) to move the retention element **564**D. In some embodiments, the control circuitry may use the retaining mechanism **550**D to lock the accessory device **560**D in the cupholder **542**D.

[0066] The electrical contacts **544**D of the system **540**D provide wireless power to the electrical contacts **562**D of the accessory device **560**D. The electrical contacts **544**D may include a receiver coil(s) and the electrical contacts **562**D include a transmitter coil(s). The control circuitry searches for the receiver coil, and when detected, provides electrons to the transmitter coil to generate a magnetic field. The magnetic field induces an electrical current in the receiver coil to provide the power. In some embodiments, the wireless power is provided using induction wireless charging. In some embodiments, the wireless power is provided using resonant wireless charging. In some embodiments, the electrical contacts **544**D may include a plurality of receiver coils that may be used to detect an orientation of the accessory device **560**D. In such embodiments, the retention element **564**D engages the retaining mechanism **550**D when the two are properly aligned.

[0067] Although FIGS. **5**A-**5**D provide examples of different retaining mechanisms **550**A-D, they are not to be considered limiting. In some embodiments, the retaining mechanisms **550**A-D may include any features or combination of features that retain an accessory device in a cupholder.

[0068] FIG. **6** is a schematic illustration of a powered cupholder system **640**, in accordance with some embodiments of the present disclosure. The system **640** may be used with a vehicle that that does not have powered cupholders, and may be placed on the vehicle floor between the center console and the front console. The system **640** includes a cupholder **642**, electrical contacts **644**, sealing elements **646**, grippers **648**, plug **670**, and control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210** in FIG. **2**). The cupholder **642** includes cup wells **658** and a base **659**. The cup wells **658** are formed by a continuous opening in the

cupholder **642** such that the cup wells **658** are not separated by a sidewall. In the embodiment depicted in FIG. **6**, a non-powered, refillable water bottle **680** is disposed in one of the cup wells **658**.

[0069] The plug **670** provides power to the system **640** and the control circuitry may provide power to the electrical contacts **644**. The control circuitry may recognize the refillable water bottle **680** is not an accessory device and cannot receive power. As a result, the control circuitry may refrain from providing power to the electrical contacts **644**.

[0070] In the embodiment depicted in FIG. **6**, the plug **670** comprises a vehicle cigarette lighter plug that may plug into a cigarette lighter outlet of the vehicle. In some embodiments, the plug **670** is a NEMA 1-15P (two-pole, no ground) or NEMA 5-15P (two-pole with ground pin) plug. In such embodiments, the plug **670** may be plugged into an outlet of the vehicle or another outlet, such as in a home. In some embodiments, the plug **670** may be a USB plug or other data and/or power connector. In such embodiments, the plug **670** may further provide an I/O path (e.g., via I/O **216**) that communicatively couples the control circuitry of the system **640** to another control circuitry, such as the vehicle control circuitry **260** discussed in relation to FIG. **2**. Although a few examples of plug types are discussed, they are not to be considered limiting.

[0071] In some embodiments, the system **640** may use a retaining mechanism (e.g., retaining mechanism **350**, **450**, **550**A-D in FIG. **3**A, FIG. **4**, and FIGS. **5**A-**5**D) to retain an accessory device in the cupholder **642**. In some embodiments, the system **640** may use sensors (e.g., sensors **204**, **352**, **552**A and **552**C in FIGS. **2**, **3**A, **5**A, and **5**C) to determine if the accessory device is present or retained in the cupholder **642**.

[0072] FIGS. **7**A-**7**D are schematic illustrations of powered cupholder system, in accordance with some embodiments of the present disclosure. The accessory devices **760**A-D include electrical contacts **762**A-D to receive power from a powered cupholder system (e.g., powered cupholder system **240**, **340**, **440**, **540**A-D, **640** in FIGS. **2**, **3**A-C, **4**, **5**A-**5**D, and **6**). The accessory devices **760**A-D may contain a battery that is charged by the powered cupholder system. The accessory devices **760**A-D may be removed from the vehicle when used.

[0073] In FIG. **7**A, the accessory device **760**A is a speaker. The speaker includes a power button, input button, volume buttons, and previous/next song buttons. The speaker may receive input wirelessly (e.g., Bluetooth, Wi-Fi, etc.) and/or may include input ports to receive a wired input (e.g., 3.5 mm auxiliary, RCE, optical audio, speaker wire, etc.). In some embodiments, the speaker may include more, less, or no buttons. In FIG. **7**B, the accessory device **760**B is a projector. The projector may include a speaker(s). The projector may receive input wirelessly and/or may include input ports to receive a wired input (e.g., HDMI, VGA, DVI, DisplayPort, USB, BNC, SMA, RCE, component video, etc.). In some embodiments, the projector may receive input from control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210**, **260** in FIG. **2**). In FIG. **7**C, the accessory device **760**C is a vacuum. The vacuum may include an on-off switch or button. In FIG. **7**D, the accessory device **760**D is a cup that may heat and/or cool a liquid inside the cup. The cup includes a heating and/or cooling element to heat and or/cool a liquid disposed therein. The cup may be insulated to maintain a temperature of a liquid disposed therein and/or to limit a temperature of an exterior of the cup to be held by a hand. In some embodiments, the control circuitry may control power provided to the cup. For example, the control circuitry may limit an amount of power or a duration of power provided to prevent over heating or cooling. In some embodiments, the cup includes a temperature sensor and the control circuitry uses readings from the temperature sensor to control power to the cup.

[0074] In some embodiments, the accessory device may include any one of a ultraviolet (UV) sanitizer, water bottle with a UV sanitizer, power bank, power inverter, coffee or espresso maker, coffee bean grinder, battery-powered lantern, flashlight, soap or sanitizer dispenser, hand warmer, air compressor, self-priming pump for portable sink faucet, air purifier, scent diffuser, or a camera, to name a few examples.

[0075] In some embodiments, the accessory devices **760**A-D contain a port or outlet to receive a charging cable to connect to another power source (e.g., an electrical outlet). In some embodiments, an adapter may be used to connect the electrical contacts **762**A-D to another power source. For example, the adapter may be a charging station or docking station located outside the vehicle.

[0076] FIG. **8** is a flowchart of an illustrative process **800** for providing power to a cupholder (e.g., cupholder **342**, **442**, **542**A-D, **642** in FIGS. **3**A-**3**C, **4**, **5**A-**5**D, and **6**), in accordance with some embodiments of the present disclosure.

[0077] The process **800** starts at operation **802** with control circuitry (e.g., control system **120** in FIG. **1** and control circuitry **210** in FIG. **2**) monitoring the cupholder for the presence of an accessory device (e.g., accessory device **360**, **560**A-D, **760**A-D in FIGS. **3**A-**3**C, **5**A-**5**D, and **7**).

[0078] The process **800** continues to operation **804** with the control circuitry determining if an accessory device is present in cupholder, such as described above with respect to FIGS. **2**, **3**A-**3**C, and **5**C. In some embodiments, a sensor (e.g., sensors **204**, **352**, **552**A and **552**C in FIGS. **2**, **3**A, **5**A, and **5**C) is used by the control circuitry to detect if the accessory device is present. In some implementations, the control circuitry determines the accessory device is present when the data from the sensor exceeds a threshold. In some embodiments, the sensor may be any of a pressure continuity, conductivity, or resistance sensor. If the determination at operation **804** is no, then the process **800** continues to operation **802**.

[0079] If the determination at operation **804** is yes, then the process **800** continues to operation **806** with the control circuitry monitoring the cupholder for the retention of the accessory device.

[0080] The process **800** continues to operation **808** with the control circuitry determining if the accessory device is retained in the cupholder, such as described above with respect to FIGS. **2**, **3**A-**3**C, **5**A, and **6**. In some embodiments, a retaining mechanism (e.g., retaining mechanism **350**, **450**, **550**A-D in FIG. **3**A, FIG. **4**, and FIGS. **5**A-**5**D) is used to retain the accessory device in the cupholder. In some embodiments, the control circuitry determines the accessory device is retained when the data from the sensor exceeds a threshold. In some embodiments, the accessory device includes a sensed object (e.g., sensed object **366** and **566**A in FIGS. **3**A-**3**C and **5**A) that is positioned be the sensor when the accessory device is retained. In such embodiments, the sensor may be any of an RFID reader, camera, or transceiver that reads, senses, or communicates with the

sensed object when the accessory device is retained. If the determination at operation **808** is no, then the process **800** continues to operation **806**. For example, the control circuitry determines to not provide the power to electrical contacts (e.g., electrical contacts **344**, **444**, **544**A-D, **644** in FIGS. **3**A, **4**, **5**A-**5**D, and **6**) of the cupholder when the accessory device is determined to not be retained by the retaining mechanism.

[0081] If the determination at operation **808** is yes, then the process **800** continues to operation **810** with the control circuitry determining if a request was received to lock the accessory device in the cupholder. If the determination at operation **810** is yes, then the process **800** continues to operation **812** with the control circuitry locking the retaining mechanism. The process **800** continues to operation **814** with the control circuitry monitoring the cupholder for a request to power the accessory device. If the determination at operation **810** is no, then the process **800** continues to operation **814**.

[0082] The process **800** continues to operation **816** with the control circuitry determining if a request was received to provide power to the accessory device. In some embodiments, the sensor sends the request. For example, the control circuitry may determine to provide power when the sensor data indicates the accessory device is retained by the cupholder. In some embodiments, the accessory device is communicatively coupled to the control circuitry and the accessory device sends the request. In some embodiments, the accessory device comprises an interactive control or button that when activated or pressed, sends a signal to the control circuitry to request power. In some embodiments, control circuitry of the accessory device may send the request to the control circuitry of the system (e.g., via I/O circuitry). If the determination at operation **816** is no, then the process **800** continues to operation **814**.

[0083] If the determination at operation **816** is yes, then the process **800** continues to operation **818** with the control circuitry providing power to the accessory device in the cupholder. In some embodiments, the control circuitry provides the power to the electrical contacts of the cupholder for a predetermined amount of time. In some embodiments, the control circuitry provides the power until the accessory device is fully charged. In some embodiments, the control circuitry provides power until the accessory achieves a target temperature (e.g., of a beverage). In some embodiments, the control circuitry is communicatively coupled to vehicle control circuitry that performs vehicle functions and the vehicle control circuitry provides the power from the vehicle to the electrical contacts. In such embodiments, the control circuitry may request the vehicle control circuitry provide the power based on any one of the determinations that the accessory device is retained in the cupholder, that the retaining mechanism is locked, or that the control circuitry either received a request or provided a request to power the accessory device.

[0084] The process **800** continues to operation **820** with the control circuitry determining if conditions are satisfied to continue providing power to the accessory device in the cupholder. If the determination at operation **820** is yes, the process **800** continues to operation **818**. If the determination at operation **820** is no, then the process **800** continues to one of operations **802**, **806**, or **814** based on what conditions were not satisfied. For example, if the control circuitry determines the accessory device is not present in the cupholder, the process continues to operation **802**. If the control circuitry determines the accessory device is present in the cupholder and is not retained, then the process **800** continues to operation **806**. In some embodiments, if the control circuitry determines the accessory device is retained in the cupholder and power is no longer provided to the cupholder, then the process **800** continues to operation **814**.

[0085] In some embodiments, operations **802** and **804** are optional. In such embodiments, the process **800** may start at operation **806**.

[0086] In some embodiments, when the decision at operation **808** is yes, the process **800** continues to operation **814** and does not determine whether to lock the accessory device in the cupholder. In some embodiments, when the decision at operation **808** is yes, the process **800** continues to operation **818** and does not determine if a request was received to provide power to the accessory device.

[0087] In some embodiments, the determination at operation **820** is no when a user leaves the vehicle and/or the vehicle is locked. In some embodiments, the determination at operation **820** is no when power is not provided to accessories. In some embodiments, the determination at operation **820** is no when the engine is off or not running.

[0088] In some embodiments, power is always provided when the vehicle is being operated. In some embodiments, power is always provided when power is provided to accessories and the engine is off. In some embodiments, power is always provided when the engine is on or running.

[0089] The foregoing is merely illustrative of the principles of this disclosure and various modifications may be made by those skilled in the art without departing from the scope of this disclosure. The above-described embodiments are presented for purposes of illustration and not of limitation. The present disclosure also can take many forms other than those explicitly described herein. Accordingly, it is emphasized that this disclosure is not limited to the explicitly disclosed methods, systems, and apparatuses, but is intended to include variations to and modifications thereof, which are within the spirit of the following claims.

What is claimed is:

1. A system comprising:

a cupholder of a vehicle configured to receive and provide power to an accessory device, the cupholder comprising electrical contacts configured to engage electrical contacts of the accessory device; and

control circuitry configured to:

determine whether to provide the power to the electrical contacts of the cupholder.

2. The system of claim **1**, the cupholder further comprises a retaining mechanism configured to retain the accessory device in the cupholder.

3. The system of claim **2**, the control circuitry is further configured to:

determine whether the accessory device is retained by the retaining mechanism; and

determine whether to provide the power to the electrical contacts of the cupholder based on whether the accessory device is determined to be retained by the retaining mechanism.

4. The system of claim **3**, the control circuitry is further configured to not provide the power to the electrical contacts when the accessory device is determined to not be retained by the retaining mechanism.

5. The system of claim 2, wherein the retaining mechanism forms a channel configured to engage the accessory device when the accessory device is rotated in the cupholder.

6. The system of claim 2, wherein the retaining mechanism comprises a first magnetic feature configured to engage a second magnetic feature on the accessory device.

7. The system of claim 2, wherein the control circuitry is further configured to lock and unlock the retaining mechanism.

8. The system of claim 1, the cupholder further comprises:
- a retaining frame forming a cup well to secure sides of the accessory device; and
- a movable base to support the bottom of the accessory device, wherein:
  - the movable base is movable in relation to the retaining frame; and
  - the electrical contacts of the cupholder are disposed in the movable base.

9. The system of claim 8, wherein:
- the cupholder is retractable; and
- the movable base is configured to:
  - move towards the retaining frame when the cupholder is retracted into a compartment of the vehicle; and
  - move away from the retaining frame when the cupholder is extended from the compartment.

10. The system of claim 9, wherein the movable base is configured to stow inside the retaining frame when stowed in the compartment.

11. The system of claim 1, the cupholder further comprising a sealing element surrounding at least one electrical contact of the cupholder, wherein the sealing element is configured to form a seal between the cupholder and the accessory device when the accessory device is retained.

12. The system of claim 1, wherein a base of the cupholder forms drain paths configured to drain liquids away from the electrical contacts of the cupholder.

13. The system of claim 1, wherein the control circuitry is configured to provide the power to the electrical contacts of the cupholder for a predetermined amount of time.

14. The system of claim 1, wherein the control circuitry is configured to provide the power to the electrical contacts of the cupholder until the accessory device is fully charged.

15. The system of claim 1, wherein the accessory device is a speaker, vacuum, or projector.

16. The system of claim 1, wherein:
- the control circuitry of the system is communicatively coupled to vehicle control circuitry that performs vehicle functions; and
- the vehicle control circuitry provides the power from the vehicle to the electrical contacts.

17. A method comprising:
- identifying a presence of an accessory device in a cupholder; and
- determining whether to provide power to the accessory device.

18. The method of claim 17, wherein the determining whether to provide the power to the accessory device comprises determining the accessory device is retained in the cupholder.

19. The method of claim 17, further comprising locking the accessory device in the cupholder.

20. A system comprising:
- a cupholder of a vehicle configured to receive an accessory device and provide power to the accessory device, the cupholder comprising:
  - a retaining frame forming a cup well to secure sides of the accessory device;
  - a movable base to support the bottom of the accessory device, wherein the movable base is movable in relation to the retaining frame; and
  - electrical contacts disposed in the movable base configured to engage electrical contacts of the accessory device; and
- control circuitry configured to provide the power to the electrical contacts of the cupholder to charge the accessory device.

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