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(54) Title: BAGGAGE TRANSPORT

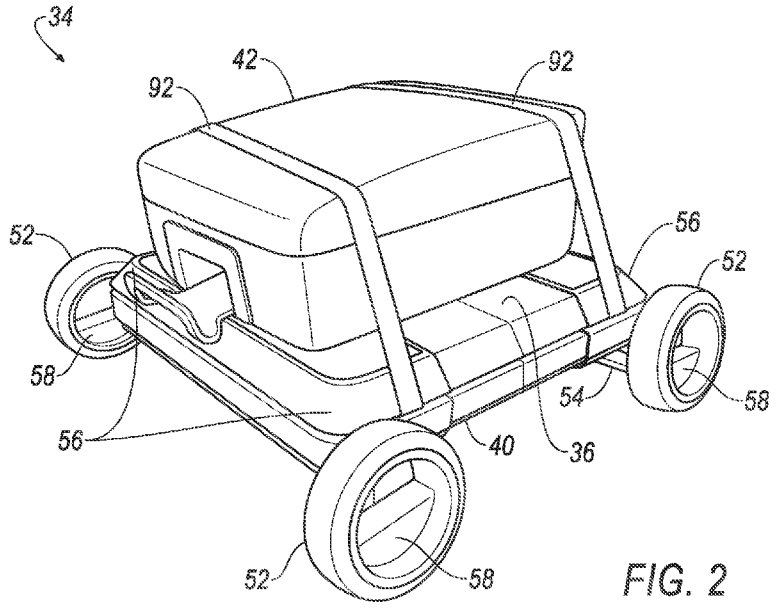


FIG. 2

(57) Abstract: A system includes a central controller and a plurality of vehicles. The central controller includes a memory and a processor. The vehicles are in communication with and separate from the central controller, and each vehicle includes a platform and a controller including a memory and a processor. The central controller is programmed to receive an input associated with an object and transmit a destination to the vehicle based on the input. The vehicle is programmed to receive an object on the platform and navigate to the destination.

[Continued on next page]

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BAGGAGE TRANSPORT

BACKGROUND

[0001] Airports move baggage checked by passengers from check-in desks to airplanes on which the passengers are booked. The passenger is responsible for moving the baggage from wherever the passenger arrived at the airport, for example, a parking garage, a bus station, a subway station, or a curbside area designated for departures, to a check-in desk. At the check-in desk, the baggage can be weighed on a scale. A tag containing identifying information, for example, a barcode, may be affixed to the baggage. Then the baggage is then typically placed on a conveyer belt that transports the baggage to a security screening area equipped with, for example, metal detectors, x-ray machines, CTX (Computer Tomography X-ray) screening machines, and so on. The baggage may be sorted using the tags by a mixture of human baggage-handling personnel and, for example, tilt-tray sorting machines on the conveyer belts equipped with barcode scanners. Sorted baggage is loaded onto trolleys that are driven to the airplanes, onto which the baggage is then loaded. Present systems including conveyors, trolleys, and the like are inefficient.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Figure 1 is a perspective view of a vehicle.

[0003] Figure 2 is a perspective view of the vehicle of Figure 1 supporting an object.

[0004] Figures 3A–D are perspective views of the vehicle of Figure 1.

[0005] Figure 4 is a block diagram of a control system of the vehicle of Figure 1.

[0006] Figure 5 is a diagram of paths at an airport.

[0007] Figure 6 is a process flow diagram of a process of transporting an object by the vehicle of Figure 1.

[0008] Figure 7 is a process flow diagram of a process of controlling the vehicle of Figure 1 by a central controller.

DETAILED DESCRIPTION

[0009] With reference to Figures 1 and 5, wherein like numerals indicate like parts throughout the several views, a system 30 includes a central controller 32 and a plurality of vehicles 34. The central controller 32 includes a memory and a processor. Each vehicle 34 includes a platform 36 and a vehicle controller 38 including a memory and a processor. The vehicles 34 may be in wireless communication with the central controller 32 as they travel, e.g., through an airport. The central controller 32 is programmed to receive an input identifying a second vehicle to receive an object, e.g., a bag 42, loaded on one of the vehicles 34 and to transmit a destination to the vehicle 34 loaded with the object based on the identified second vehicle. The vehicle 34 is programmed to, upon receipt of an object on the platform 36, navigate to the destination.

[0010] The system 30 is more scalable and less capital-intensive than airports' use of conveyer belts and trolleys. The vehicles 34 do not need conveyer belts to move around, and the vehicles 34 can travel in areas, e.g., an airport tarmac, where conveyer belts cannot go. An increase in baggage 42 passing through an airport 74 can advantageously be handled by additional vehicles 34 without installing additional or wider conveyer belts. The vehicles 34 further obviate inefficiencies in sorting the baggage 42. The vehicles 34 can accept baggage 42 as soon as passengers arrive at the airport 74 rather than requiring the passengers to transport the baggage 42 to the check-in desk 86, and no additional installations are needed to do so other than markings for the vehicles 34 to follow.

[0011] With reference to Figures 1–3D, the system 30 includes the plurality of vehicles 34 selectively in communication with the central controller 32 while travelling at locations physically remote from the central controller 32 (e.g., in an airport such locations can be 2–4 kilometers or more from the controller 32). Each vehicle 34 is configured to travel autonomously, that is, the vehicle 34 includes a motor, steering, and programming to propel itself through an environment without assistance.

[0012] Each vehicle 34 may include a body 40 supporting the platform 36. The body 40 may contain components of the vehicle 34 and provide structural support for the vehicle 34.

[0013] With reference to Figures 1–3D, each vehicle 34 may include a plurality of wheels 52 coupled to the platform 36. Each wheel 52 may be rotatably coupled to a member 54 that is coupled to and pivotable relative to the body 40 about an axis A perpendicular to the platform 36, as shown in Figure 3D. Specifically, the body 40 may have four corners 56, and four members 54 are pivotably attached at the four corners 56. Each member 54 may pivot 90° about the corresponding vertical axis A, from aligning the corresponding wheel 52 with a side of the body 40, as shown in Figure 3A, to aligning the wheel 52 with an adjacent side of the vehicle 34, as shown in Figure 3B. Alternatively, the vehicle 34 may have treads or another suitable method of locomotion.

[0014] Each wheel 52 may include a motor 58 drivably coupled to the wheel 52. The motors 58 may be electric. The motors 58 may be disposed in the wheels 52 in a known manner to drive the respective wheel 52. The motors 58 may be in communication with the controller 38 and may draw power from a battery 60.

[0015] The platform 36 is supported by the body 40 of the vehicle 34. The platform 36 can be a generally planar surface onto which an object such as baggage 42 may be placed by a passenger. The platform 36 may include skid pads 46, that is, surfaces of high friction relative to a surface of the body 40 or of the platform 36. The platform 36 is oriented generally so that the planar surface is horizontal.

[0016] The platform 36 may have an adjustable length, as seen in a comparison of Figures 3B and 3C, which can accommodate a range of sizes of baggage 42. The passenger may adjust the length of the platform 36 by, e.g., pushing a button (not shown) on the vehicle 34, using an application on a mobile phone of the passenger, etc. The length adjustment may be performed by, for example, a linear actuator (not shown) within the body 40, the wheels 52, etc. Specifically, the wheels 52 may pivot to be aligned in the direction of the length

adjustment, and the wheels 52 on one side of the body 40 may rotate one direction while the wheels 52 on the other side of the body 40 rotate the other direction.

[0017] The platform 36 may be formed of multiple panels 44. For example, while adjusting the length, one panel 44 may extend from and retract below another panel 44.

[0018] With reference to Figure 2, each vehicle 34 may include a strap 92. The strap 92 may be extendable from a retracted position with the body 40 to an extended position extending across the platform 36. The strap 92 may be formed of fabric, webbing, or the like, such as is known.

[0019] With reference to Figures 1 and 4, each vehicle 34 includes a weight sensor 48 coupled to the platform 36 and in communication with the controller 38 of the vehicle 34. The weight sensor 48 may be configured to measure a weight pressing down against the platform 36 as is known. The weight sensor 48 may be, for example, a load cell, a spring scale, a hydraulic or pneumatic scale, a digital scale, a strain gauge scale, a pressure sensor, and other sensors configured to measure a force exerted against the platform 36.

[0020] With reference to Figure 4, each vehicle 34 includes an alarm speaker 50 in communication with the controller 38. The alarm speaker 50 is capable of producing a loud sound designed to attract attention from individuals near the vehicle 34.

[0021] With reference to Figure 1, the vehicle 34 may include the battery 60. The battery 60 may be disposed in the body 40. The battery 60 may be of any suitable type for vehicular electrification, for example, lithium-ion batteries, nickel-metal hydride batteries, lead-acid batteries, or ultracapacitors.

[0022] An induction charger 62 may be connected to the battery 60. The induction charger 62 may include an induction coil provided to convert an electromagnetic field into an electric current. The electric current provided by the induction charger 62 may charge the battery 60. Alternatively or additionally, the vehicle 34 may include a power cord or electrical outlet connected to the battery 60 for charging the battery 60.

[0023] With reference to Figure 4, each vehicle 34 may include a control system 64. The control system 64 includes the controller 38 and

components connected to and selectively communicating with the controller 38, specifically, the weight sensor 48, the alarm speaker 50, the motors 58, a path sensor 66, a location sensor 68, a short-wavelength receiver 70, and a telecommunications link 72.

[0024] The vehicle controller 38 may be a microprocessor-based controller. The controller 38 may include a processor, memory, etc. The memory of the controller 38 may store instructions executable by the processor.

[0025] Each vehicle 34 includes a path sensor 66 communicatively coupled to the controller 38 of the vehicle 34. The path sensor 66 is configured to detect a line disposed on the ground. The path sensor 66 may be, for example, an array of photosensors or infrared sensors. As is known, the array of photosensors may include a series of cells, and each cell may include an emitter of visible or infrared light and a receiver. A difference between readings of the cells indicates which cells are above a line and which cells are not above a line.

[0026] The location sensor 68 is communicatively coupled to the controller 38 and provides a location of the vehicle 34. The location sensor 68 may be, for example, a global positioning system (GPS) receiver, an inertial sensor, a combination of GPS and inertial sensors, or another type of sensor. In the case of an inertial sensor, the vehicle 34 may periodically reset the location sensor 68 at a known location to prevent the accumulation of error over time.

[0027] Each vehicle 34 may include the short-wavelength receiver 70 communicatively coupled to the controller 38 of the vehicle 34. The short-wavelength receiver 70 may communicate wirelessly in accordance with Bluetooth, Wi-Fi, or any other standard appropriate for short-distance wireless transmissions.

[0028] Each vehicle 34 may include the telecommunications link 72 communicatively coupled to the controller 38 of the vehicle 34. The telecommunications link 72 may communicate wirelessly in accordance with Bluetooth, Wi-Fi, radio, or any other standard or bandwidth for wireless transmission. The telecommunications link 72 and the short-wavelength receiver 70 may be the same component or different components.

[0029] With reference to Figure 5, the plurality of vehicles 34 may operate at a facility such as an airport 74. Alternatively, the plurality of vehicles 34 may operate at a train station, bus station, or other facilities at which objects are moved from one set of locations to another set of locations.

[0030] The airport 74 may include the central controller 32. The central controller 32 may be a microprocessor-based controller. The central controller 32 may include a processor, memory, etc. The memory of the central controller 32 may store instructions executable by the processor. The central controller 32 may be communicatively coupled to a transceiver 76 that is able to communicate with the vehicles 34 via the telecommunications links 72.

[0031] The airport 74 may include a plurality of paths 78 along which the vehicles 34 can travel. The paths 78 may begin at a public transit station 80, parking garage 82, drop-off curb 84, or any other location in the airport 74 at which passengers arrive. The paths 78 may also begin at check-in desks 86. The paths 78 may run to one or more security checkpoints 88. The security checkpoints 88 may include facilities for screening baggage 42, for example, metal detectors, x-ray machines, CTX screening machines, and so on. From the security checkpoints 88, the paths 78 run to and terminate at loading areas corresponding to gates 90.

[0032] The paths 78 may include a line or lines marking the paths 78. The lines may be configured to be detected by the path sensors 66. For example, the lines may be a contrasting color with an area of the path 78 not on the lines. The paths 78 are thus marked paths.

[0033] The paths 78 may include induction chargers 62. The induction charger 62 may include an induction coil capable of converting an electric current into an electromagnetic field. The electromagnetic field provides power for the induction chargers 62 of the vehicles 34. The paths 78 are thus induction-charging paths.

[0034] Figure 6 is a process flow diagram illustrating an exemplary process 600 for transporting an object, for example, baggage 42, through a facility. The process 600 is described using the airport 74 as an example, but the process 600 could be used at other types of facilities. The process 600 begins in a

block 605, in which the vehicle 34 receives a location corresponding to a newly arrived passenger from the central controller 32. Locations may be communicated and/or stored as coordinates as used for the GPS system, as a series of waypoints along the paths 78, or by any other manner of storing locations. The newly arrived passenger may be at, for example, a designated parking spot in the parking garage 82, the public transit station 80, the drop-off curb 84, or one of the check-in desks 86.

[0035] Next, in a block 610, the vehicle 34 navigates to the passenger location. The vehicle 34 may receive a route from the central controller 32, the vehicle 34 may determine the route itself, or the central controller 32 may remotely direct the vehicle 34. The route may be based on the passenger location, the current location of the vehicle 34, the paths 78, and/or the presence of other vehicles 34 on the paths 78.

[0036] The route may follow a series of segments of the marked paths 78. Each vehicle 34 may be programmed to navigate to a destination by following the plurality of marked paths 78. The path sensor 66 may track the presence of the marked paths 78 and allow the vehicle 34 to follow the marked paths 78. The vehicle 34 may track its location and/or its progress toward the destination by using the location sensor 68. The route may be stored by the vehicle controller 38 as a series of commands to follow at intersections of the paths 78 (e.g., right-left-right-straight-left-right), as a series of paired distances and directions, as a series of intermediate locations, or any other known way of storing a route. The vehicle 34 may use known methods of autonomous navigation to follow the route to the destination.

[0037] Next, in a block 615, the vehicle 34 is programmed to receive an object on the platform 36. The object may be baggage 42 that the passenger is checking on a flight. The vehicle 34 may give an indication to the passenger that the vehicle 34 is ready to receive the object, for example, by beeping or blinking a light. Alternatively, the vehicle 34 may send a message to a mobile phone of the passenger. After the object or objects have been loaded onto the vehicle 34, the vehicle 34 may receive an indication that loading is complete. For example, the passenger may push a button or buckle the strap 92, or the

strength of a signal from the mobile phone received by the short-wavelength receiver 70 may recede by a preset amount from the passenger walking away from the vehicle 34.

[0038] Next, in a block 615, the weight sensor 48 measures the weight of the object, and the controller 38 of the vehicle 34 stores the weight. Additionally, the vehicle 34 may transmit the weight to the central controller 32 through the telecommunications link 72.

[0039] Next, in a block 620, the vehicle 34 enters a secure mode. In the secure mode, the vehicle 34 is programmed to activate the alarm speaker 50 based on a signal from the weight sensor 48 indicating a change in the weight. In other words, if the weight changes from the recorded weight by more than a predetermined threshold, the alarm speaker 50 will sound. The predetermined threshold may be determined according to a change of detected weight that is unlikely to be accounted for because of travel of the vehicle 30, shifting, bouncing, etc. of the baggage 42, etc. Further, more than one weight measurement could be used, e.g., over a period of time such as five seconds, ten seconds, etc., again to avoid momentary changes caused by movement other than an additional object or item being added to the platform 36.

[0040] Next, in a decision block 625, the vehicle 34 determines whether the passenger has already checked in to the flight at the passenger location or will check in once inside the airport 74 at the check-in desk 86. The passenger may check in using the mobile phone to the central controller 32, which will send a signal to the vehicle 34 via the telecommunications link 72. Alternatively, the passenger may check in by using the mobile phone or a keypad on the vehicle 34 to communicate with the vehicle 34, which then sends a signal through the telecommunications link 72 to the central controller 32. The system 30 may require checking in at the passenger location, require checking in at the check-in desk 86, or permit either checking in at the passenger location or the check-in desk 86.

[0041] If the passenger has not checked in, next, in a block 630, the vehicle 34 follows the passenger while the passenger walks to the check-in desk 86. Each vehicle 34 is programmed to associate with a short-wavelength

transmitter and to move within a maximum distance of the transmitter. In other words, as the passenger walks, the vehicle 34 moves to stay no more than a preset distance from the passenger, as measured by the signal sent by the mobile phone. The vehicle 34 may determine distance by using the strength of the signal from the mobile phone or by comparing a location provided by the mobile phone with the location of the vehicle 34.

[0042] Next, in a block 635, the vehicle 34 registers that the passenger has checked in. Once the passenger has checked in at the check-in desk 86, the central controller 32 sends a signal to the vehicle 34 that check-in has occurred.

[0043] Next after the block 635, or after the decision block 625 if check-in occurred at the passenger location, in a block 640, the vehicle 34 receives locations for a security checkpoint 88 and an airplane gate 90 from the central controller 32 via the telecommunications link 72.

[0044] Next, in a block 645, the vehicle 34 navigates to the location of the security checkpoint 88, navigating as described above with respect to the block 610. The route may be based on the location of the security checkpoint 88, the current location of the vehicle 34, the paths 78, and/or the presence of other vehicles 34 on the paths 78.

[0045] Next, in a block 650, the vehicle 34 exits the secure mode. The vehicle 34 may exit the secure mode upon arriving at the security checkpoint 88 or after receiving a signal from security personnel. Exiting the secure mode allows security personnel to screen the object.

[0046] Next, in a decision block 655, the vehicle 34 checks for an all-clear signal. The all-clear signal indicates that screening is complete and the object has been returned to the platform 36 of the vehicle 34. If the vehicle 34 does not receive the all-clear signal, for example, if the screening procedure raised issues with the object, then the process 600 ends, and the vehicle 34 may begin the process 600 again with a different passenger. Alternatively, personnel of the airport 74 may load bags 42 from multiple vehicles 34 for the same flight onto one vehicle 34 that continues the process 600, and the unloaded vehicles 34 may restart the process 600.

[0047] Next, if the vehicle 34 receives the all-clear signal, in a block 660, the vehicle 34 enters the secure mode, as described above with respect to the block 620.

[0048] Next, in a block 665, the vehicle 34 navigates to the location of the airplane gate 90, navigating as described above with respect to the block 610. The route may be based on the location of the airplane gate 90, the current location of the vehicle 34, the paths 78, and/or the presence of other vehicles 34 on the paths 78. Each vehicle 34 may be programmed to navigate to a second destination, e.g., the airplane gate 90, after navigating to a first destination, e.g., the security checkpoint 88.

[0049] Next, in a block 670, the vehicle 34 exits the secure mode. The vehicle 34 may exit the secure mode upon arriving at the airplane gate 90 or after receiving a signal from baggage-handling personnel. Exiting the secure mode allows baggage-handling personnel to load the object onto the airplane.

[0050] Next, in a block 675, the vehicle 34 sends a completion signal via the telecommunications link 72 to the central controller 32. After the block 675, the process 600 ends.

[0051] Figure 7 is a process flow diagram illustrating an exemplary process 700 for directing the vehicle 34 by the central controller 32. The process 700 is described using the airport 74 as an example, but the process 700 could be used at other types of facilities. The process 700 begins in a block 705, in which the central controller 32 receives a baggage request from a newly arrived passenger. The central controller 32 is programmed to receive an input identifying a second vehicle, e.g., an airplane. The airplane may be identified through the airplane gate 90 at which the airplane will onboard passengers. The input may be a check-in request or a request to have baggage 42 picked up made through an application on, e.g., a mobile phone of the passenger. The central controller 32 may be programmed to receive and send information via the application. The input may include information such as identifying information for the passenger, the flight number of the passenger's flight, the number of bags 42 that the passenger wants to check, etc. The object may be baggage 42 that the passenger is checking on a flight. The baggage request may be sent, for example, by the

passenger via a mobile phone of the passenger. Alternatively, the request may be sent via a kiosk fixed at the parking garage 82, the public transit station 80, or the drop-off curb 84, or the request may be sent from one of the check-in desks 86.

[0052] Next, in a block 710, the central controller 32 assigns one of the plurality of vehicles 34 to the passenger location.

[0053] Next, in a block 715, the central controller 32 receives a signal indicating that the vehicle 34 is loaded. The signal may include the weight of the object. If the weight of the object is above a preset threshold, the central controller 32 may adjust fees charged to the passenger and/or send a signal to baggage-handling personnel.

[0054] Next, in a block 720, the central controller 32 receives a check-in signal. The check-in signal may be sent by the passenger from the passenger location, in which case the check-in signal may arrive shortly before or after the loaded signal. Or the check-in signal may arrive from the check-in desk 86 after the passenger has walked with the vehicle 34 from the passenger location to the check-in desk 86.

[0055] Next, in a block 725, the central controller 32 determines the locations of the security checkpoint 88 and the airplane gate 90 based on the identified second vehicle, e.g., the airplane, from the check-in signal. The check-in signal may include, for example, a flight number, and the central controller 32 may access a listing of airplane gates 90 corresponding to flight numbers. The central controller 32 may determine which security checkpoint 88 to direct the vehicle 34 to based on the airplane gate 90 and the current location of the vehicle 34. The central controller 32 is programmed to determine a destination and a second destination for the vehicle 34 based on the identified second vehicle, e.g., the airplane. The central processor may determine a route for the vehicle 34 to follow, or the vehicle 34 may determine the route itself. The route may be based on the location of the airplane gate 90, the current location of the vehicle 34, the paths 78, and/or the presence of other vehicles 34 on the paths 78.

[0056] Next, in a block 730, the central controller 32 transmits the locations of the security checkpoint 88 and the airplane gate 90 to the vehicle 34. If the central controller 32 determined the routes, the central controller 32

transmits the routes to the security checkpoint 88 and the airplane gate 90. The central controller 32 is programmed to transmit a destination and a second destination to the vehicle 34 based on the input. Alternatively, the central controller 32 may transmit only the location of the security checkpoint 88, wait for a signal from the vehicle 34 indicating that the vehicle 34 has passed the security checkpoint 88, and then transmit the location of the airplane gate 90. Further alternatively, the central controller 32 may transmit directions to the vehicle 34 in response to updated current locations from the vehicle 34.

[0057] Next, in a block 735, the central controller 32 receives a completion signal from the vehicle 34, indicating that the vehicle 34 has successfully delivered the object to the airplane gate 90. After the block 735, the process 700 ends.

[0058] The disclosure has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations of the present disclosure are possible in light of the above teachings, and the disclosure may be practiced otherwise than as specifically described.

CLAIMS

What is claimed is:

1. A system comprising:

a plurality of first vehicles, each including a platform and a vehicle controller; and

a central controller programmed to receive input identifying a second vehicle to receive an object loaded on one of the first vehicles, and transmit a destination to the loaded first vehicle based on the identified second vehicle;

wherein each vehicle controller is programmed to navigate to the destination.

2. The system of claim 1, wherein each first vehicle is configured to travel autonomously.

3. The system of claim 1, wherein the central controller is further programmed to transmit a second destination to the loaded first vehicle based on the identified second vehicle, and each first vehicle is programmed to navigate to the second destination after navigating to the destination.

4. The system of claim 1, wherein each vehicle includes a weight sensor coupled to the platform and in communication with the vehicle controller.

5. The system of claim 4, wherein each first vehicle includes an alarm speaker in communication with the controller, and is programmed to activate the alarm speaker based on a signal from the weight sensor indicating a change in weight.

6. The system of claim 1, wherein the second vehicle is an airplane.

7. The system of claim 1, wherein each first vehicle includes a battery and an induction charger connected to the battery.

8. The system of claim 7, further comprising a plurality of induction-charging paths.

9. The system of claim 1, wherein each first vehicle includes a path sensor in communication with the vehicle controller.

10. The system of claim 9, wherein each first vehicle is programmed to navigate to the destination by following a plurality of marked paths.

11. The system of claim 10, further comprising the plurality of marked paths.

12. The system of claim 1, wherein the platform of each first vehicle has an adjustable length.

13. The system of claim 1, wherein each first vehicle includes a short-wavelength receiver in communication with the vehicle controller, and the vehicle controller is programmed to associate with a short-wavelength transmitter and to move within a maximum distance of the transmitter.

14. The system of claim 1, wherein each first vehicle includes a body supporting the platform and a strap extendable from a retracted position with the body to an extended position extending across the platform.

15. A controller comprising a processor and a memory storing processor-executable instructions, wherein the processor is programmed to:

receive input associated with a loaded first vehicle of a plurality of first vehicles identifying a second vehicle to receive an object loaded on the loaded first vehicle; and

transmit a destination to the loaded first vehicle based on the identified second vehicle.

16. The controller of claim 15, wherein the second vehicle is an airplane.

17. The controller of claim 15, wherein the processor is further programmed to receive a weight of the object from the loaded first vehicle.

18. The controller of claim 15, wherein the processor is further programmed to transmit a route to the destination to the loaded first vehicle.

19. The controller of claim 15, wherein the processor is further programmed to transmit a second destination to the loaded first vehicle based on the identified second vehicle.

20. The controller of claim 19, wherein the processor is further programmed to transmit a route to the destination to the loaded first vehicle and to transmit a route from the destination to the second destination to the loaded first vehicle.

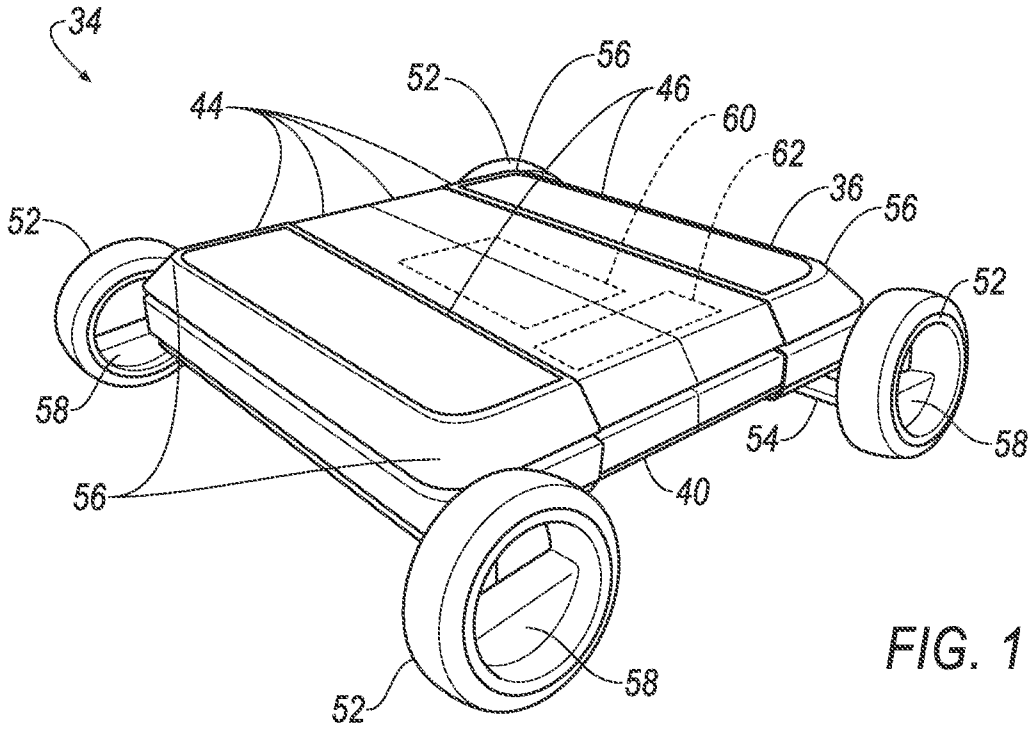

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FIG. 1

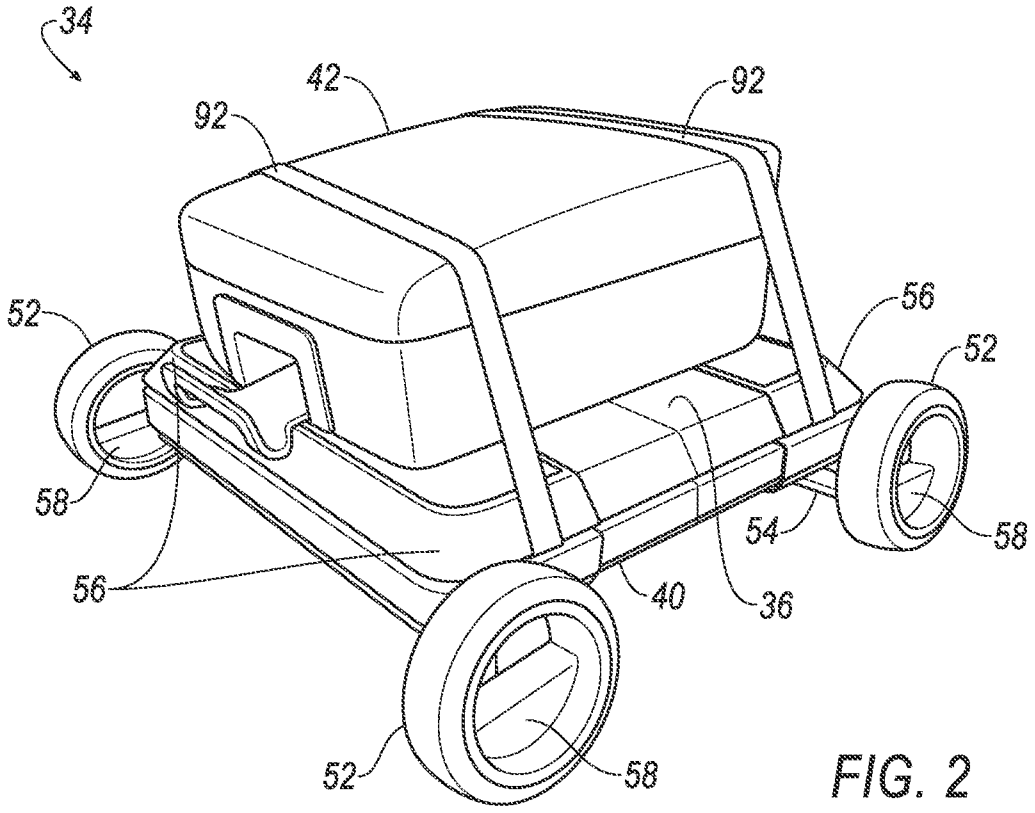

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FIG. 2

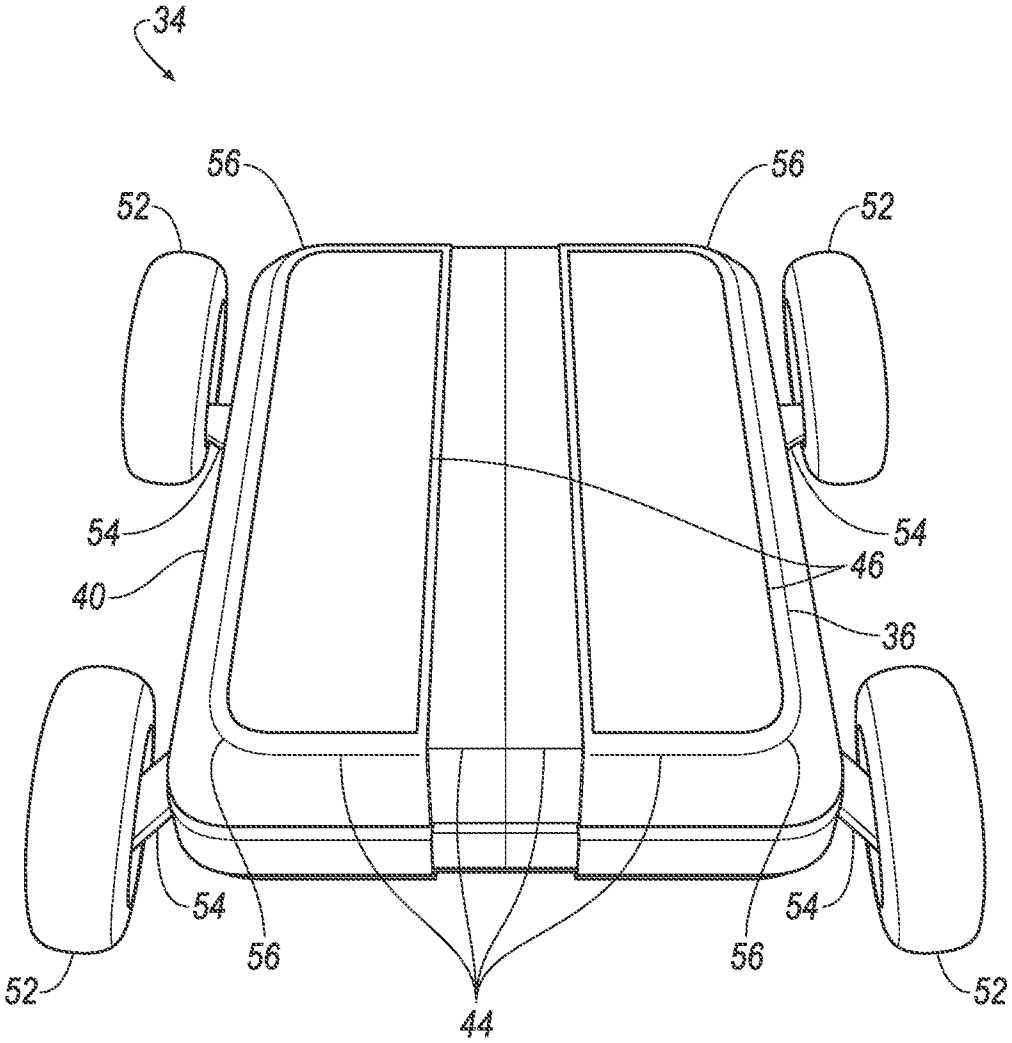


FIG. 3A

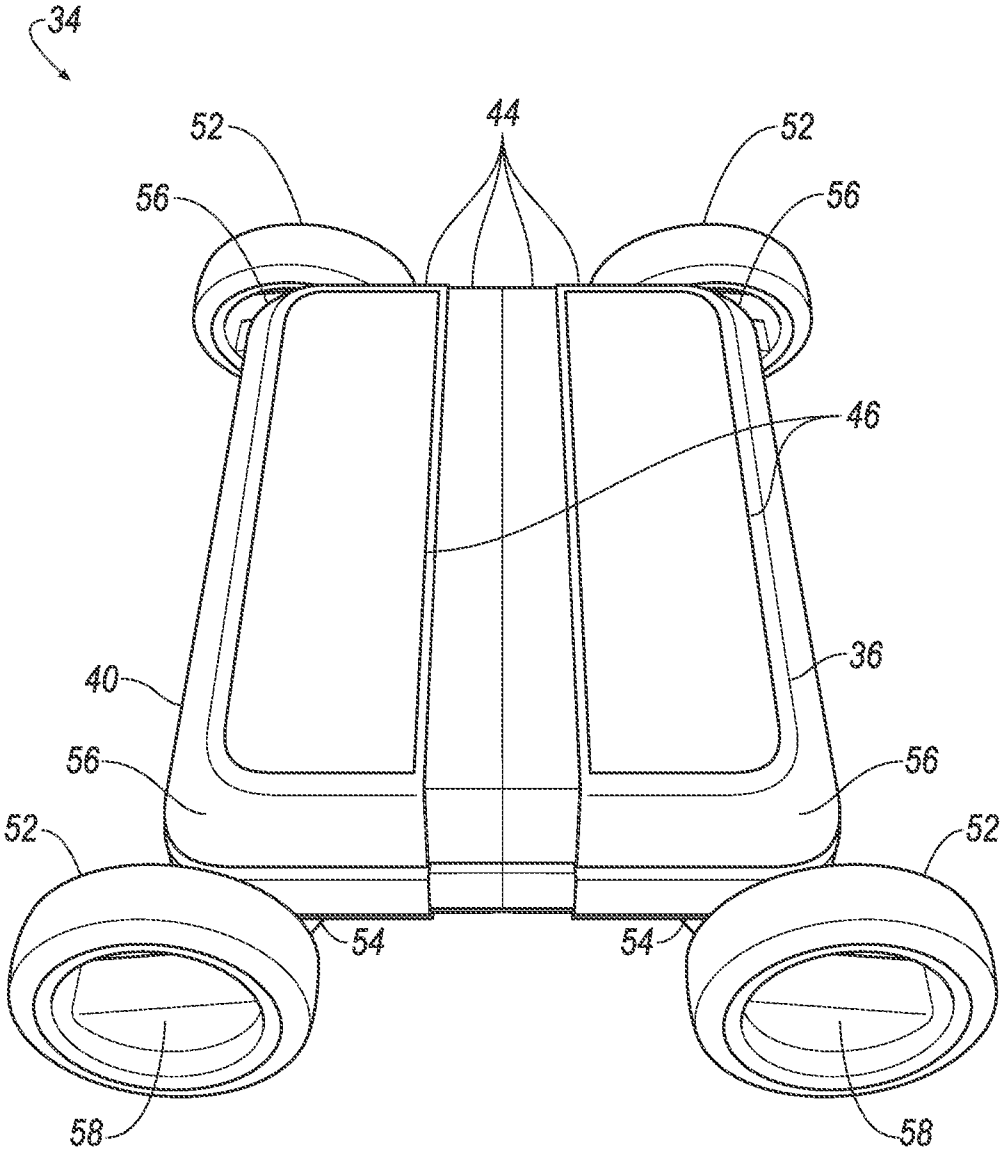


FIG. 3B

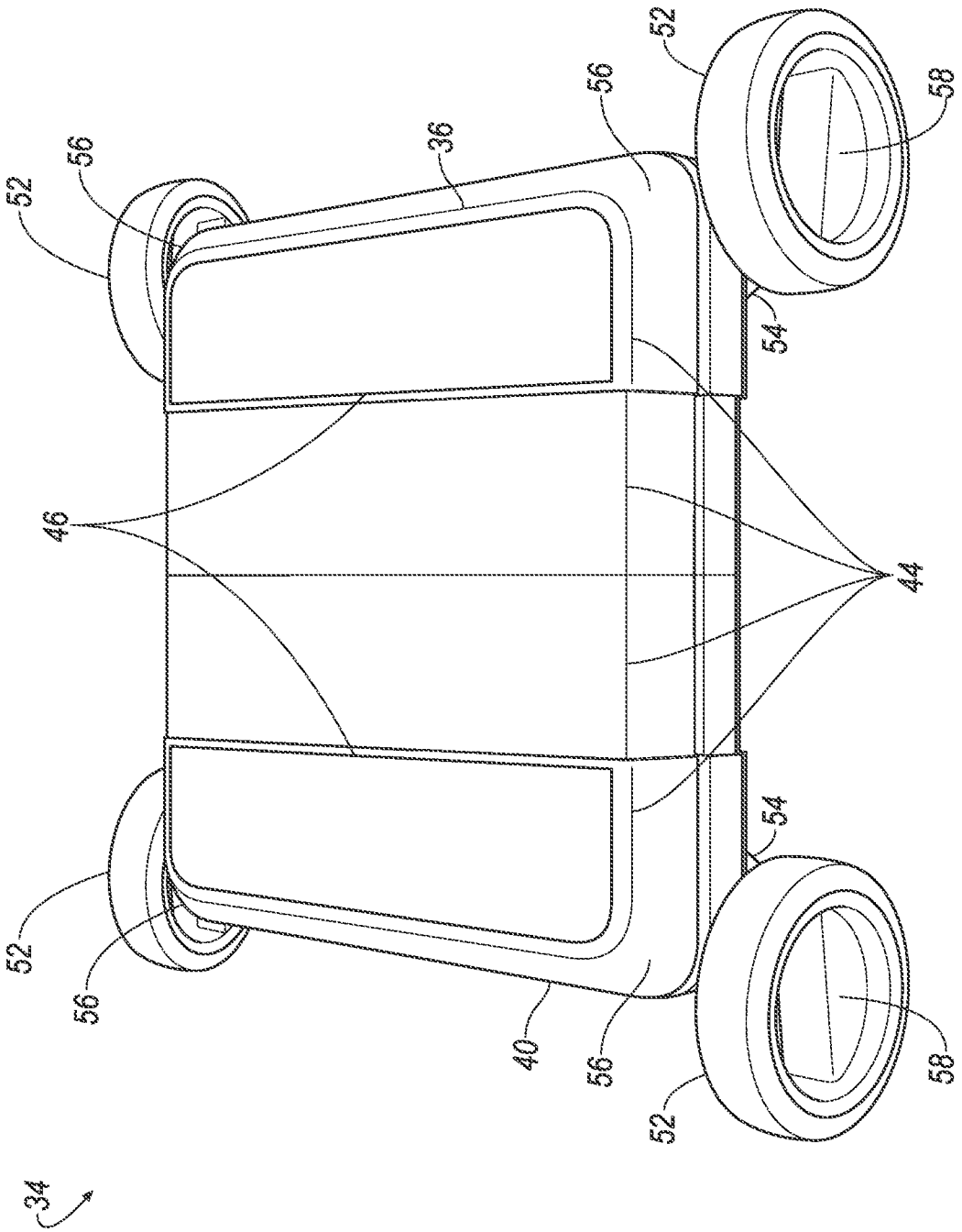


FIG. 3C

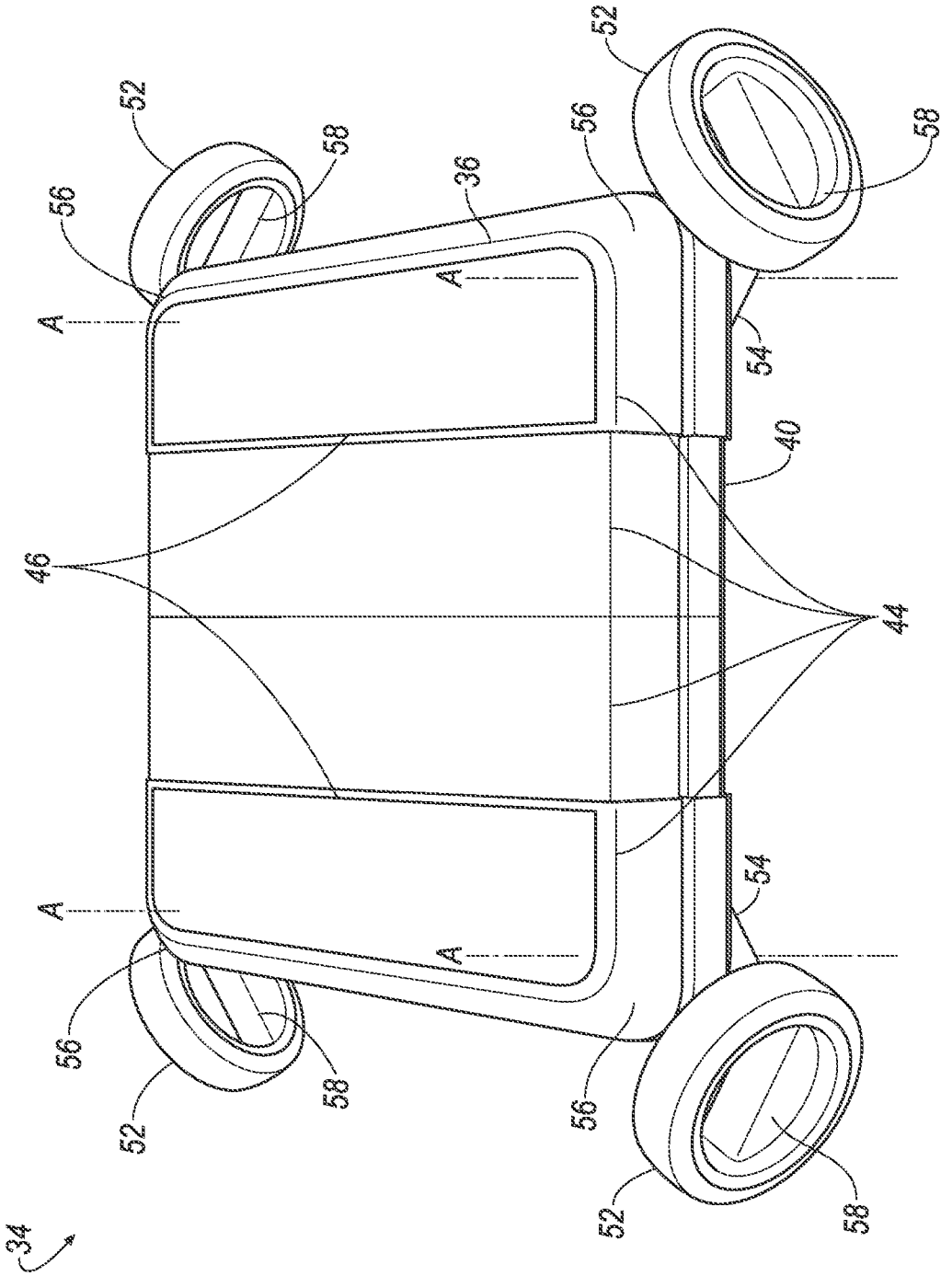


FIG. 3D

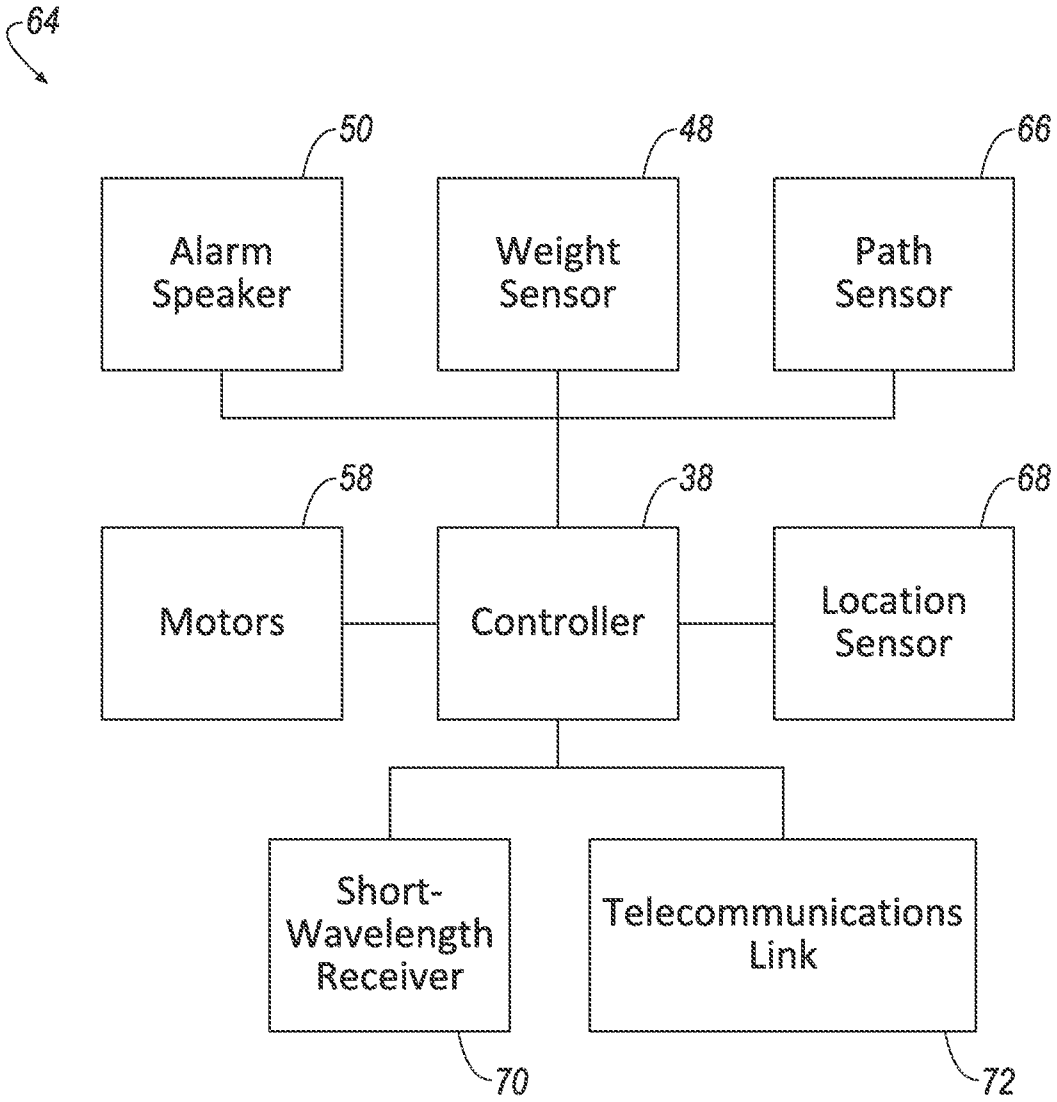

64
50
48
66
Alarm Speaker
Weight Sensor
Path Sensor
58
38
68
Motors
Controller
Location Sensor
Short-Wavelength Receiver
Telecommunications Link
70
72

FIG. 4

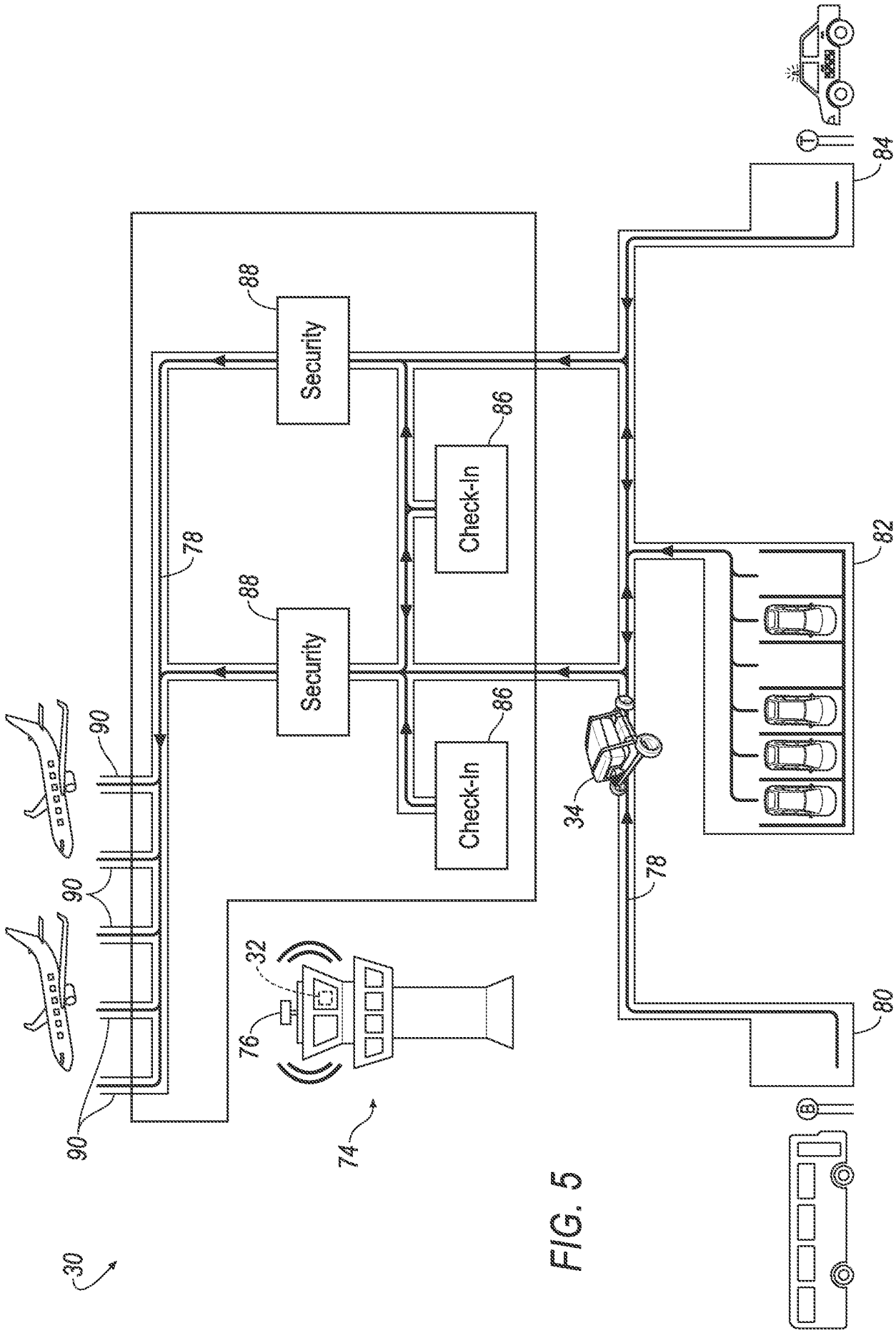

30
90
90
90
78
88
Security
88
Security
86
Check-In
86
Check-In
32
76
74
34
78
82
84
80

FIG. 5

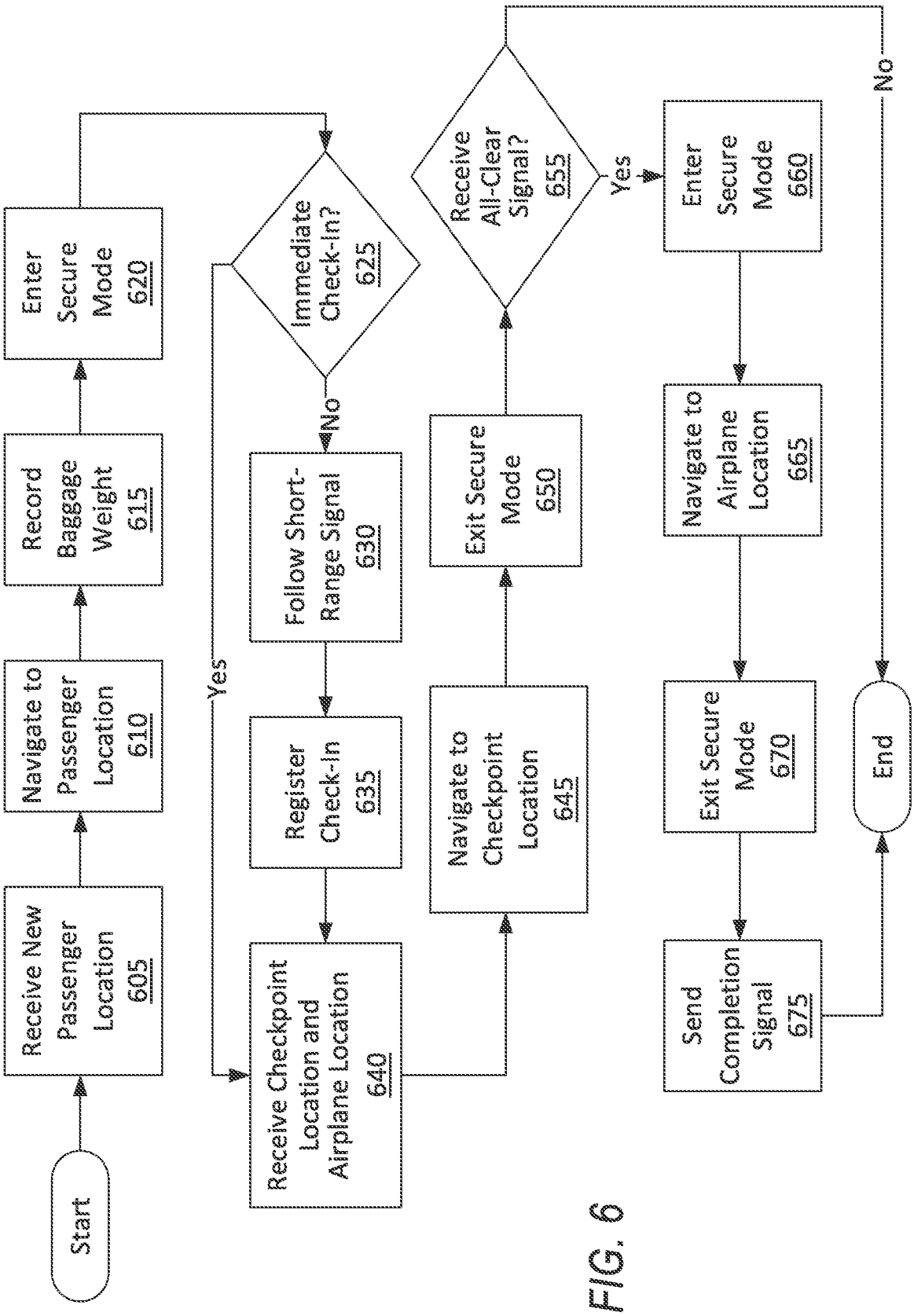

Start
Receive New Passenger Location 605
Navigate to Passenger Location 610
Record Baggage Weight 615
Enter Secure Mode 620
Immediate Check-In? 625
Yes
No
Follow Short-Range Signal 630
Register Check-In 635
Receive Checkpoint Location and Airplane Location 640
Navigate to Checkpoint Location 645
Exit Secure Mode 650
Receive All-Clear Signal? 655
Yes
No
Enter Secure Mode 660
Navigate to Airplane Location 665
Exit Secure Mode 670
Send Completion Signal 675
End

FIG. 6

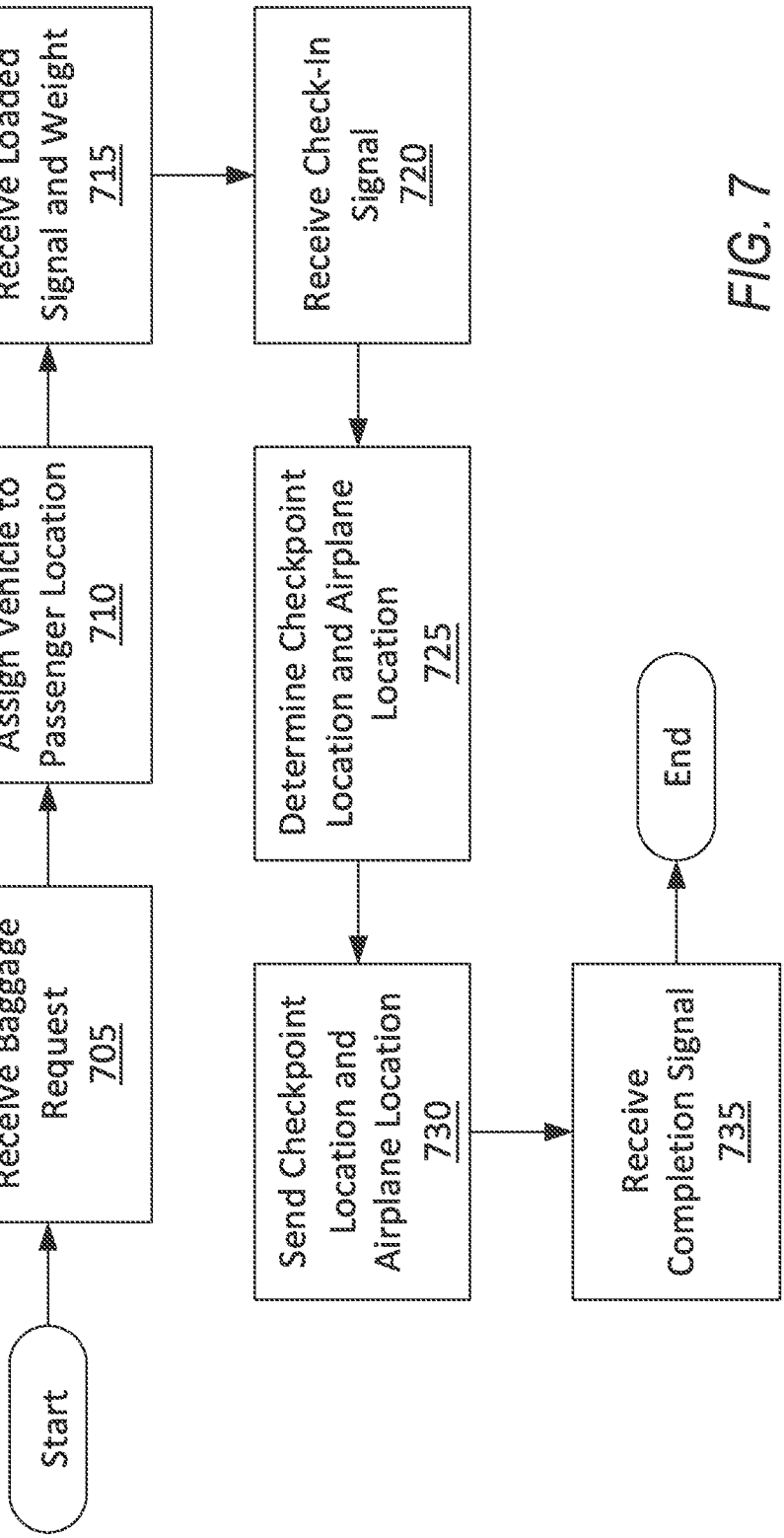

Start
Receive Baggage Request 705
Assign Vehicle to Passenger Location 710
Receive Loaded Signal and Weight 715
Receive Check-In Signal 720
Determine Checkpoint Location and Airplane Location 725
Send Checkpoint Location and Airplane Location 730
Receive Completion Signal 735
End

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/42896

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B62D 11/20; B64F 1/32, 1/36 (2016.01)
CPC - B62D 11/20; B64F 1/32, 1/36, 1/368
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classifications: B62D 11/20; B64F 1/32, 1/36; B65G 47/52 (2016.01)
CPC Classifications: B62D 11/001, 11/003, 11/20; B64F 1/32, 1/36, 1/368; B65G 47/52

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); cart, vehicle, carrier, trolley, dolly, UAV, unmanned aerial vehicle, AGV, automatically guided vehicle, aircraft, airport, airplane, luggage, baggage, suitcase, deliver, cargo, payload, load, parcel, package, strap, adjust, length, alarm, speaker, audible, weight, load, mass, load cell, sensor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	DE 102009050331 A1 (SIEMENS AG) April 28, 2011; figures 1, 2; abstract; paragraphs [0018]-[0020]	1, 2, 6-8, 15, 16, 18 --- 12, 13
X --- Y	US 6,129,026 A (LECROY D. L.) October 10, 2000; figures 1, 2; column 4, lines 25-35; claims 10, 11	1-3, 6, 15, 16, 18-20 --- 4, 5
X --- Y	US 2008/0202402 A1 (GILES D. L.) August 28, 2008; figures 8, 9; paragraphs [0042], [0048]	1, 2, 4, 9, 15, 17, 18 --- 10, 11, 14
Y	US 8,556,084 B1 (SNOOK J. D.) October 15, 2013; column 9, lines 27-31 and 45-50	4, 5
Y	US 5,341,130 A (YARDLEY J. V. et al.) August 23, 1994; abstract; claim 1	10, 11
Y	US 2007/0114742 A1 (GILBERT R. A. et al.) May 24, 2007; paragraph [0041]	12
Y	US 2016/0059875 A1 (SEGMAN Y.) March 3, 2016; paragraphs [0004], [0017], [0046]	13
Y	US 5,975,455 A (ALEGRE J. L.) November 2, 1999; abstract; figure 1; column 2, lines 43-50	14
X	US 5,801,506 A (NETZLER G.) September 1, 1998; figures 1, 2; column 1, lines 15-20; column 2, lines 25-45; column 4, lines 10-15	1, 15

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 September 2016 (15.09.2016)	30 SEP 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/42896

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2002/0159869 A1 (FUKUHARA Y. et al.) October 31, 2002; entire document	1-20
A	WO 2016/107844 A1 (BBHS A/S) July 7, 2016; entire document	1-20
A	US 2016/0167706 A1 (VANDERLANDE INDUSTRIES B.V.) June 16, 2016; entire document	1-20
A	US 2011/0084162 A1 (GOOSSEN E. et al.) April 14, 2011; entire document	1-20
A	EP 2 821 324 A1 (VANDERLANDE INDUSTRIES B.V.) July 7, 2014; entire document	1-20