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(54) Title: LOAD CARRYING CONSTRUCTION VEHICLE

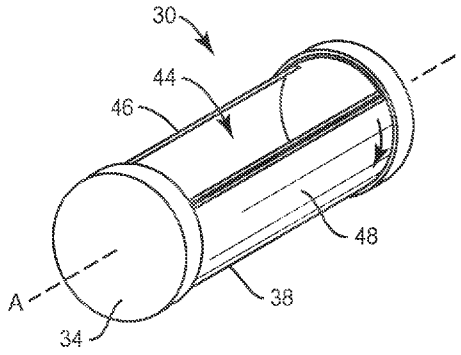

FIG. 4A

(57) Abstract: An unmanned load carrying vehicle is described. The vehicle has a pair of wheels on a rotational axis and a body providing a load receiving compartment between the pair of wheels. The body includes an opening for accessing the load receiving compartment and for allowing loading and unloading of the load receiving compartment. The vehicle also includes a propulsion system configured to propel the vehicle from a loading location to an unloading location. The body is positionable in a loading position where the opening is located above the rotational axis. The body is also positionable in an unloading position where the opening is located below the rotational axis.

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[Continued on next page]

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

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Load Carrying Construction Vehicle

Field of the Disclosure

[0001] The present disclosure relates to construction equipment, particularly construction equipment configured to accept, transport, and deliver a load of construction material or debris.

Background

[0002] Construction sites, surface mines, and other industrial, commercial and even residential operations rely upon the orchestrated movement of people, machines, and materials to operate at peak performance. Various vehicle configurations have been developed for the purpose of accepting a load of material at a first location, transporting the load of material, and releasing the load of material at a second location. A conventional dump truck has a pivoted bed that is tilted to dump material off the rear of the dump truck. Alternatively, side-dump trailers rotate their beds about a dump axis parallel with the trailer's direction of motion. Further, belly dump trailers include one or more gates along a bottom of the bed that are closed during loading and transportation of the material, but may be opened upon arrival at the dump site.

[0003] A need exists, therefore, for improved vehicles for accepting, transporting and delivering a load.

Summary

[0004] In one embodiment of the present disclosure, a load carrying construction vehicle is described. The vehicle has a pair of wheels on a rotational axis and a body providing a load

receiving compartment between the pair of wheels. The body includes an opening for accessing the load receiving compartment and for allowing loading and unloading of the load receiving compartment. The vehicle also includes a propulsion system configured to propel the vehicle from a loading location to an unloading location. The body is positionable in a loading position where the opening is located above the rotational axis. The body is also positionable in an unloading position where the opening is located below the rotational axis. When viewed along the rotational axis, the body does not extend beyond a periphery of the pair of wheels.

[0005] A further embodiment of the present disclosure includes a method of moving material. The method includes loading material, at a loading location, into a cargo compartment of a load carrying vehicle through an opening when the opening faces substantially upward. The method also includes rolling the load carrying vehicle from the loading location to an unloading location with an onboard propulsion system. The method also includes dumping material through the opening when the opening faces substantially downward.

[0006] These and other aspects of the present invention will become apparent to those skilled in the art after a reading of the following description of the preferred embodiments, when considered in conjunction with the drawings. It should be understood that both the foregoing general description and the following detailed description are explanatory only and are not restrictive of the invention as claimed.

Brief Description of the Drawings

[0007] FIG. 1 shows a load carrying vehicle according to embodiments of the present disclosure.

[0008] FIG. 2 shows a cut-away schematic of the load carrying vehicle.

[0009] FIG. 3 shows a schematic of a propulsion system according to one embodiment.

[0010] FIGs. 4A-4D illustrate the use of the load carrying vehicle according to one embodiment of the present disclosure.

Detailed Description

[0011] Exemplary embodiments of this disclosure are described below and illustrated in the accompanying figures, in which like numerals refer to like parts throughout the several views. The embodiments described provide examples and should not be interpreted as limiting the scope of the invention. Other embodiments, and modifications and improvements of the described embodiments, will occur to those skilled in the art and all such other embodiments, modifications and improvements are within the scope of the present invention. Features from one embodiment or aspect may be combined with features from any other embodiment or aspect in any appropriate combination. For example, any individual or collective features of method aspects or embodiments may be applied to apparatus, product or component aspects or embodiments and vice versa.

[0012] As shown in FIG. 1, a load carrying vehicle 30 is shown. The load carrying vehicle 30 includes a pair of wheels 34, a body 38 located axially between the pair of wheels 34, and a propulsion system 40.

[0013] The pair of wheels 34 share a center of rotation, such as rotational axis A. The pair of wheels 34 may provide two spaced apart points of contact with a surface 42 supporting the vehicle 30. As used herein, the vehicle 30 can have at least two wheels 34 even if those wheels were rotationally fixed to one another. As used herein, the vehicle 30 can have at least two wheels 34 even if the two wheels were rotationally fixed relative to an exterior of the body 38. Additional auxiliary wheels are also contemplated as optional. Alternatively, the two wheels 34 may each comprise a plurality of rollers arranged around the rotational axis A.

[0014] The body 38 is at least partially hollow to at least partially define a load carrying compartment 44. In the illustrated embodiment, the body 38 is substantially cylindrical in shape. In one embodiment, when viewed along the rotational axis A, the body 38 does not extend beyond the periphery of the pair of wheels 34. However, in other embodiments, the body 38 may extend beyond the periphery of the pair of wheels 34.

[0015] The load carrying compartment 44 is accessible through at least one opening 46, also referred to as an aperture, through the body 38. A cover 48 is preferably provided for selectively opening and closing the opening 46; however, in alternative embodiments the opening 46 may not include a cover 48.

[0016] The cover 48 may be configured to slide relative to the body 38 as shown in FIG. 1. The cover 48 may slide in a direction parallel with the rotational axis A or may slide in a circumferential direction as represented in FIG. 1. The cover 48 may be a hinged door configured to open into the compartment 44 or a hinged door configured to open out away

from the compartment. The cover 48 may be one-way or capable of swinging both into and out of the body 38. The cover 48 may have two or more sections that slide or pivot away from one another to open. The cover 48 may be supported along the exterior of the body 38 or may be substantially supported within the compartment 44. The cover 48 may have a latch mechanism. The cover 48 may have a lock mechanism.

[0017] The cover 48 may be gravity operated to be capable of opening when the opening 46 faces in a substantially downward direction. The cover 48 may be moved between a closed position and an open position manually. The cover 48 may be moved between a closed position and an open position with the assistance of a mechanical, electrical, hydraulic or pneumatic actuator. Any of these actuators may be operated through buttons or knobs on the body 38, or may be operated remotely.

[0018] The cover 48 could be a mesh screen to retain some objects, such as rocks, but allow other items through, such as water, when the cover is in a closed position. The cover 48 could be transparent or partially transparent so an operator is able to see the contents of the compartment 44 for inspection purposes. The cover 48 may come into contact with a support surface of the vehicle 30 when the cover 48 is oriented downward. The cover 48 may have a surface roughness to assist with rolling traction of the vehicle 30.

[0019] In one embodiment, schematically illustrated in FIG. 2, the body 38 may be capable of being disengaged from a chassis 50 that includes the pair of wheels 34 and a frame 52 for supporting the propulsion system. The chassis 50 may be able to accept one body 38 at an initial location, transport the body 38 and its contents, and then drop the body at a second

location. The chassis 50 may then support a second body with other contents on a return trip to the initial location or a third location.

[0020] The pair of wheels 34 and the body 38 may be propelled by any propulsion system 40 known in the art. The propulsion system 40 may include a power system 54, a drive system 56, and a control system 60 as illustrated schematically in FIG. 3.

[0021] The power system 54 may include any means known in the art, including batteries, generators, gas engines, solar power, etc.

[0022] The drive system 56 may include at least one actuator 62. At least one actuator 62 may take the form of an electric motor, a gas engine, a hydraulic system or a pneumatic system. In one embodiment, a single actuator 62, such as an electric motor, may be used to propel the vehicle 30. In the present embodiment, the pair of wheels 34 are rotationally fixed relative to one another to each rotate at the same rate, in the same direction. In the present embodiment, the body 38 may also be rotationally fixed to the pair of wheels 34. Thus, as the pair of wheels 34 rolls along a surface, the body 38 will also be rotating. In this embodiment, the at least one opening 46 would also be rotating with the pair of wheels 34 so that the direction in which the opening faces will change as the pair of wheels rotates.

[0023] In another embodiment, the example drive system 56 may include two actuators 62. Use of two actuators 62 allows for independent propulsion of two portions of the vehicle 30. For example, the pair of wheels 34 may be configured to be capable of independent rotation. A first wheel is able to rotate at a different rate and/or a different direction relative to a second wheel of the pair of wheels 34 by providing each wheel with its own actuator. In this

embodiment, the body 38 may be rotationally fixed to one of the pair of wheels 34 so that rotation of one of the wheels will result in a change in the relative position of the opening 46 relative to the rotational axis A.

[0024] In another embodiment where the drive system 56 includes two actuators 62, the pair of wheels 34 may be rotationally fixed relative to one another, driven by a first actuator, and the body 38 may be capable of rotation relative to the wheels 34, driven by a second actuator. In such an embodiment, the body 38 may remain substantially upright, i.e. having the opening 46 facing substantially upward, while the load carrying vehicle 30 is in motion across the support surface 42. Once the load carrying vehicle 30 has reached its unloading location, the body 38 may be independently operated to rotate about the rotational axis A, or another axis, so that the opening 46 is moved to face in a downward direction, all while the pair of wheels 34 remains stationary.

[0025] In yet other embodiments, the drive system 56 may include three actuators 62, used to provide independent control of the pair of wheels 34 individually, as well as separate control over the orientation of the body 38. Three actuators 62 are shown in FIG. 2.

[0026] Turning to the control system 60, the control system 60 directs operation of the drive system 56 and optionally controls the cover 48. In an embodiment the vehicle 30 is unmanned and does not itself include a cab in which a human operator would reside during operation of the vehicle. The control system 60 may be configured such that each of the vehicle's functions may be controlled by a human operator using known wireless remote control technologies linked to a wireless receiver 64. Suitable wireless technologies may include near field communications such as Bluetooth®, networked technologies such as Wi-

Fi, or long distance technologies such as cellular, radio, or satellite based communication technologies. In one example, vehicles 30 configured to travel miles between being loaded and unloaded, or vehicles configured to be operated from off-site may operate with satellite technology, while vehicles that are wirelessly controlled by an operator at the job site may operate using Wi-Fi technology.

[0027] Alternatively, the control system 60 may be programmed for autonomous operation of the vehicles 30. By using various marker or reference technologies, such as the global positioning system (GPS), the vehicles 30 may be programmed to travel from a predetermined loading location to a predetermined unloading location without additional human intervention. The vehicles 30 may be programmed to automatically allow access to the compartment 44 at the loading location and automatically open the cover 48 at the unloading location to dump the material contents of the compartment. Position sensors 66, such as accelerometers, may be used to confirm proper orientation of the body 38 to confirm or control whether the opening 46 is in the substantially upward, loading position, or in the substantially downward, unloading position.

[0028] The optional autonomous control of the load carrying vehicle 30 may be supplemented with communication technologies, networked technologies, or anti-collision technologies such that a plurality of the load carrying vehicles 30 can operate in close proximity on a job site without colliding with one another. The vehicles 30 may be configured as part of the internet of things (IoT), enabling the vehicles to communicate directly or indirectly with one another. Various anti-collision sensors 68 may be used to help each load carrying vehicle 30 avoid the other vehicles or obstacles. The anti-collision sensors 68 may be optical, magnetic, electrical, or of other known types. By networking the load

carrying vehicles 30 and allowing them to communicate directly or indirectly with one another, the load carrying vehicles may be able to stagger their location, and time their movements, to reduce downtime that could result if several empty vehicles are waiting idle at the loading location.

[0029] The control system 60 may also provide for feedback. Each load carrying vehicle 30 may be outfit with a plurality of smart feedback sensors 70 that allow each vehicle to monitor its own location, orientation, or position. The contents of the compartment 44 may be monitored for characteristics such as weight, volume, remaining capacity, etc. Other aspects of the vehicles 30 may also be monitored with onboard technologies, including the level of remaining power, or system analytics for maintaining a proper maintenance schedule.

[0030] The load carrying vehicle 30 of the various embodiments described above provide for a new method of loading, transporting, and unloading materials. Example materials for transportation by the vehicle 30 include loose construction materials such as soil, wet concrete, or waste materials. The process may begin by loading the vehicle 30. To load the vehicle 30, the body 38 is often oriented such that the opening 46 faces substantially upward and the cover 48 is provided in an open position, which allows access to the compartment 44. This state for loading the vehicle 30 is shown in FIG. 4A. External persons or equipment may be used to load material into the compartment 44 via the opening 46. When the compartment 44 has received a load within the compartment, the cover 48 is moved to a closed position. The closed position is shown in FIG. 4B.

[0031] The propulsion system may then activate the vehicle 30 to travel from the loading location to an unloading location by rolling at least one of the pair of wheels 34. Upon

arriving at the unloading location, if the body 38 is not already in an unloading position, the body 38 may be activated to assume the unloading position, where the opening 46 is oriented to face a substantially downward direction as shown in FIG. 4C. When the vehicle 30 has arrived at the unloading location and assumed the unloading position, the cover 48 may be returned to the open position, as shown in FIG. 4D, at which time gravity may act upon the load of material to allow the material to self-dump through the opening 46. The vehicle 30 may be programmed or otherwise operated to shake or vibrate to assist with emptying of the compartment 44. Once empty, the propulsion system may propel the vehicle 30 back to the loading location with or without reclosing the cover 48.

[0032] In one embodiment, the unloading location is where the material leaves the vehicle 30. In some embodiments, the unloading location may include a raised bridge structure or a ramp such that the material leaving the vehicle 30 may further travel to a third location using gravity. In another example, the material may be unloaded onto a conveyor where the material is moved to a third location. Use of the bridge structure, or the presence of a gap between the support surface 42 and the body 38, may allow the vehicle 30 to unload the material while moving, resulting in the ability to spread the material leaving the compartment 44.

[0033] Although the above disclosure has been presented in the context of exemplary embodiments, it is to be understood that modifications and variations may be utilized without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the appended claims and their equivalents.

Claims

1. A load carrying construction vehicle, comprising:

a pair of wheels on a rotational axis;

a body providing a load receiving compartment between the pair of wheels, the body having an opening for accessing the load receiving compartment and for allowing loading and unloading of the load receiving compartment; and

a propulsion system configured to propel the vehicle from a loading location to an unloading location,

wherein the body is positionable in a loading position where the opening is located above the rotational axis, and the body is positionable in an unloading position where the opening is located below the rotational axis.

2. The vehicle of claim 1, wherein the pair of wheels and the body are rotationally fixed to one another and the body is rotated between the loading position at the loading location and the unloading position at the unloading location by rolling the vehicle such that the opening rotates relative to the rotational axis as the vehicle rolls from the loading location to the unloading location.

3. The vehicle of claim 1, wherein,

the body is capable of rotating relative to the rotational axis while the pair of wheels remain stationary relative to one another.

4. The vehicle of claim 3, wherein the propulsion system is capable of driving a first wheel of the pair of wheels independent of the rotation of a second wheel of the pair of wheels.

5. The vehicle of claim 4, wherein the propulsion system comprises a first actuator for rotating the first wheel and a second actuator for rotating the second wheel.

6. The vehicle of claim 5, wherein the vehicle comprises a third actuator for causing the body to rotate between the loading position and the unloading position.

7. The vehicle of claim 1, further comprising a cover for the opening that is openable and closable.

8. The vehicle of claim 1, wherein the vehicle is controlled remotely.

9. The vehicle of claim 1, wherein the vehicle is programmable to operate autonomously.

10. A method of moving material, comprising:

loading material, at a loading location, into a cargo compartment of a load carrying vehicle through an opening when the opening faces substantially upward;

rolling the load carrying vehicle from the loading location to an unloading location with an onboard propulsion system; and

dumping material through the opening when the opening faces substantially downward.

11. The method of claim 10, wherein the load carrying vehicle comprises a pair of wheels rotationally fixed to the cargo compartment.

12. The method of claim 10, wherein the load carrying vehicle comprises a pair of wheels rotationally independent of the cargo compartment.

13. The method of claim 10, wherein opening includes a cover that is moveable relative to the opening.

14. The method of claim 10, wherein rolling the load carrying vehicle includes remotely controlling the load carrying vehicle.

15. The method of claim 10, wherein rolling the load carrying vehicle includes programming the load carrying vehicle to function autonomously.

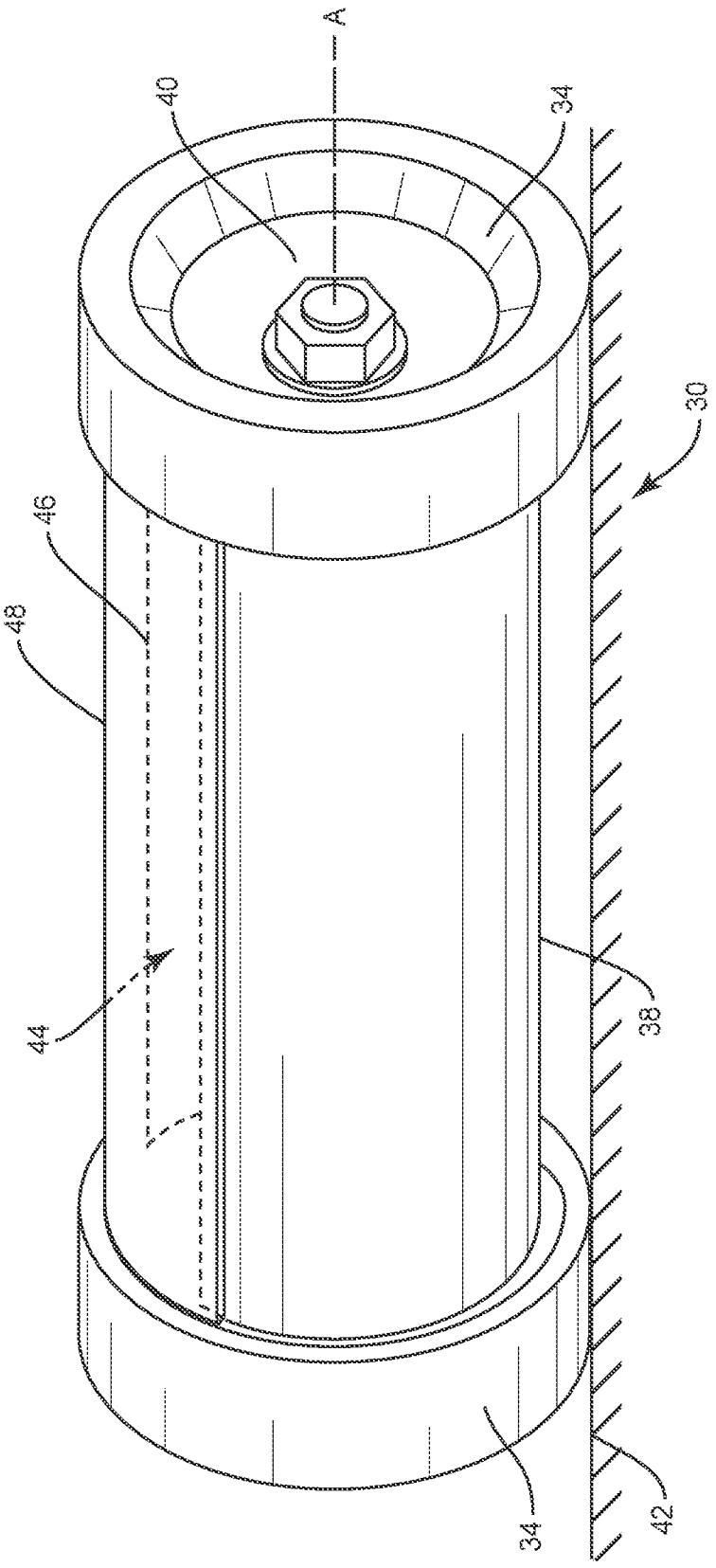

FIG. 1

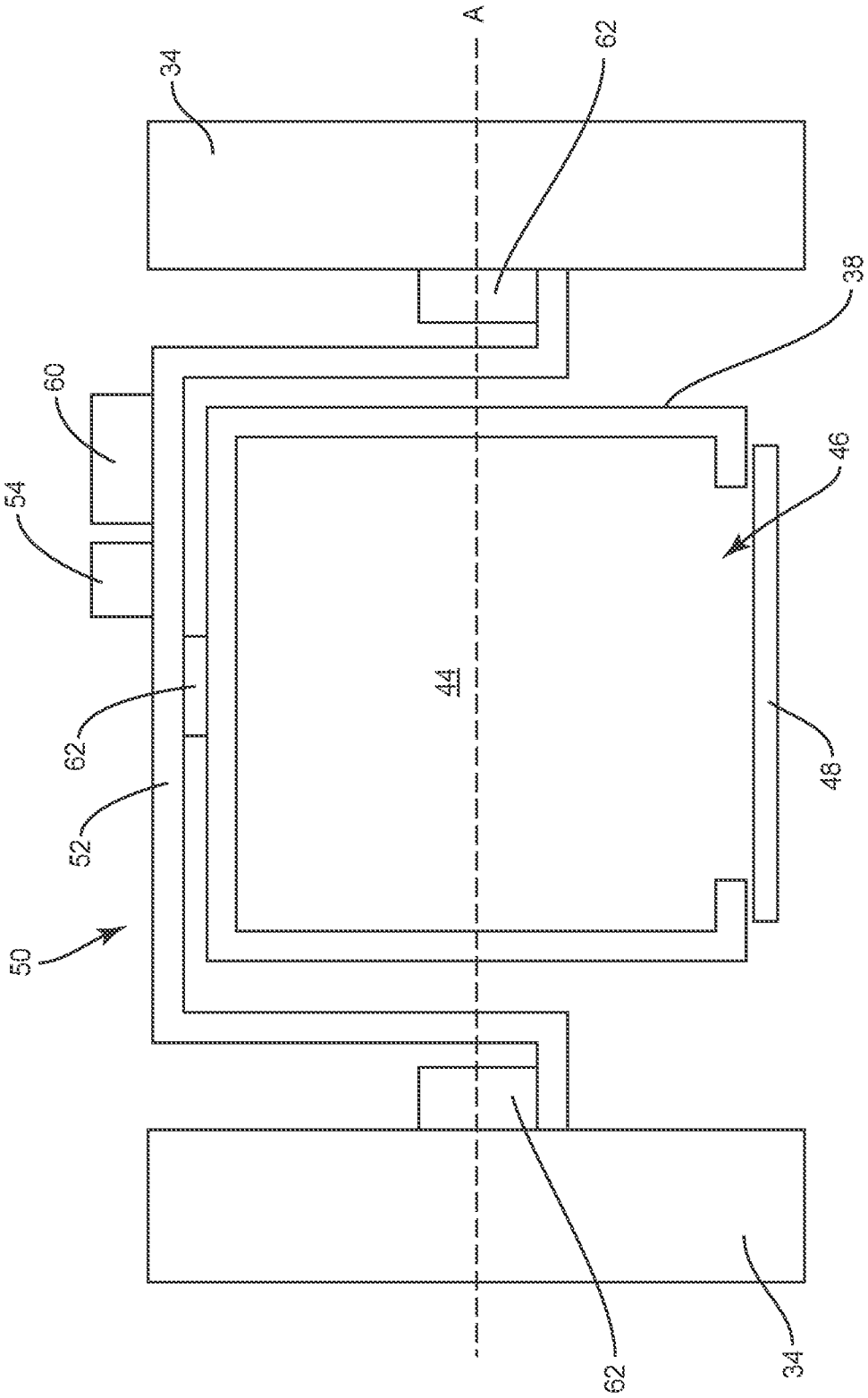

FIG. 2

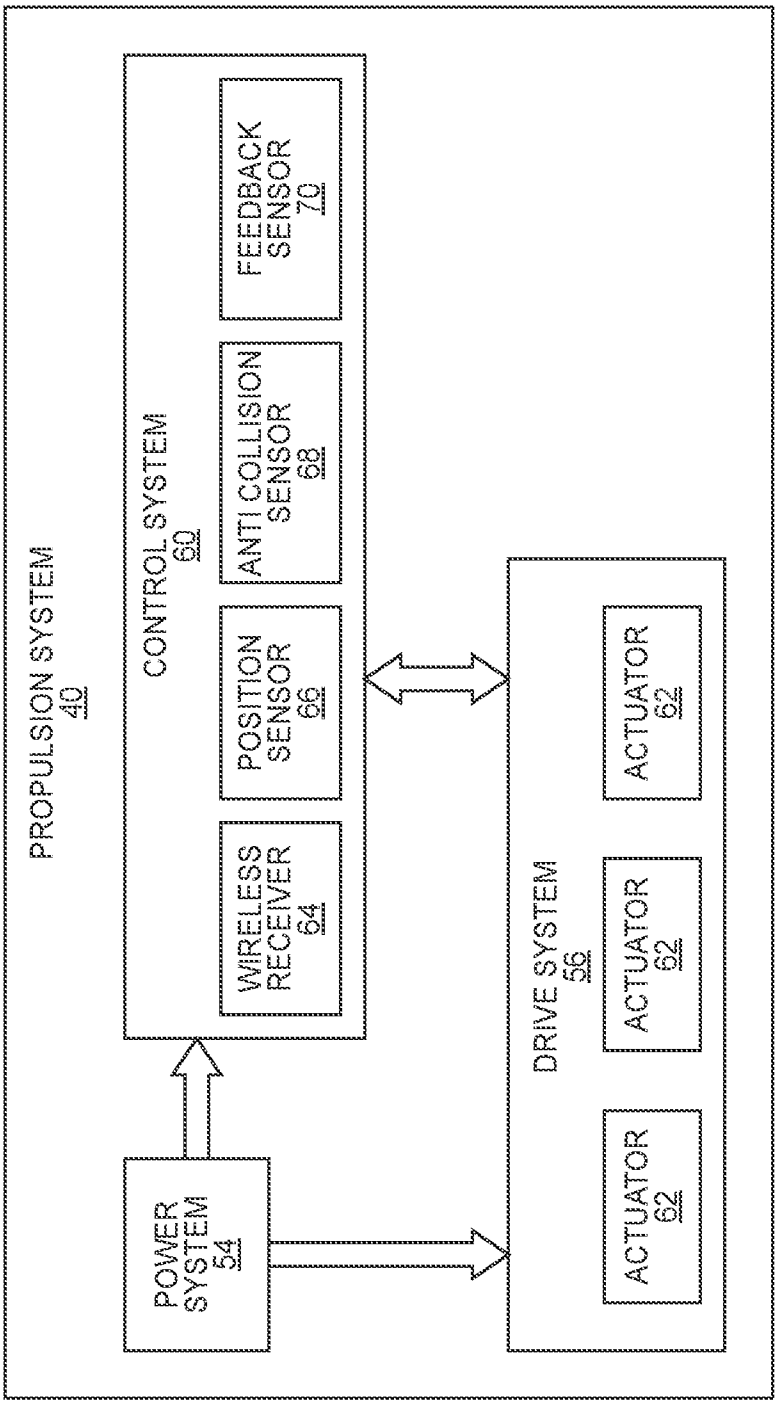
PROPULSION SYSTEM
40
CONTROL SYSTEM
60
WIRELESS RECEIVER
64
POSITION SENSOR
66
ANTI COLLISION SENSOR
68
FEEDBACK SENSOR
70
POWER SYSTEM
54
DRIVE SYSTEM
56
ACTUATOR
62
ACTUATOR
62
ACTUATOR
62

FIG. 3

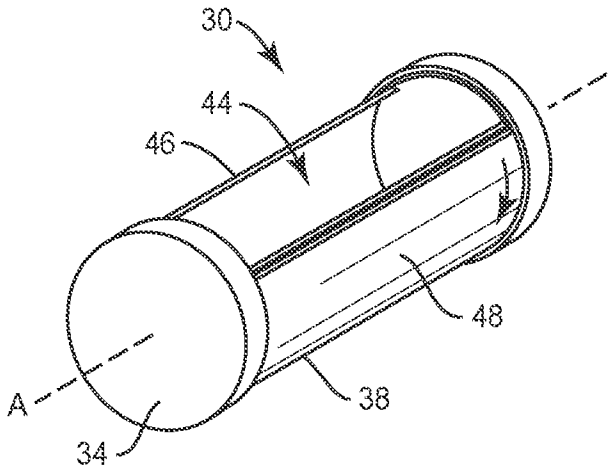

FIG. 4A

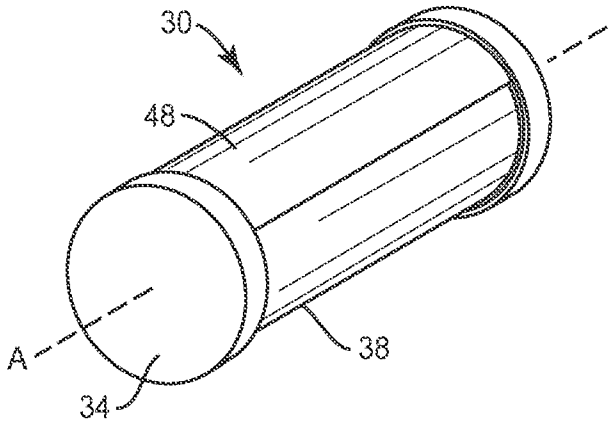

FIG. 4B

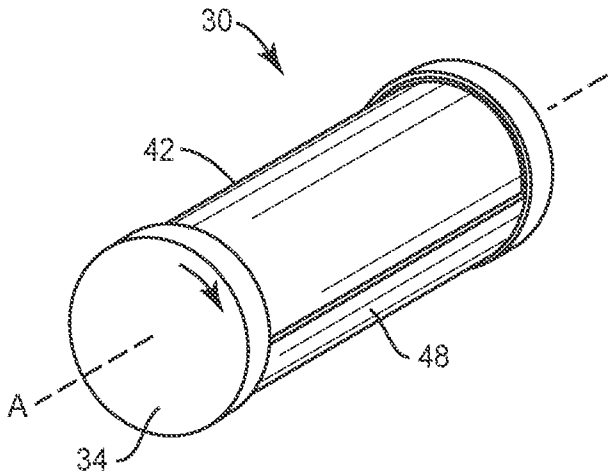

FIG. 4C

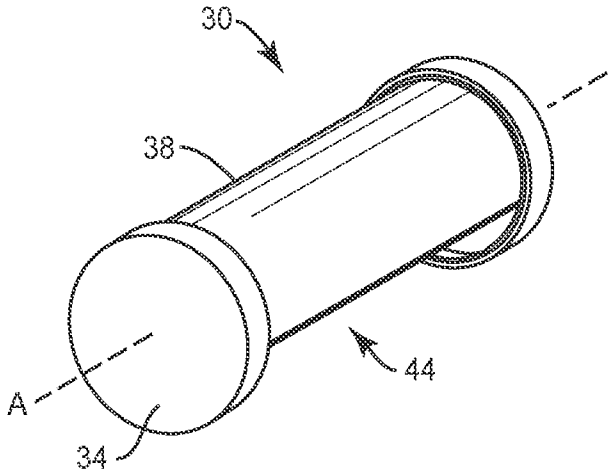

FIG. 4D

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/015742

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B60P 1/04; B60L 15/00; B60L 15/40; B60P 1/00; B62D 33/04; B62D 51/00; B62D 61/00 (2017.01)
CPC - B60P 1/04; B60L 15/00; B60L 15/40; B60L 2200/40; B60P 1/00; B62D 51/00; B62D 61/00; G05D 1/0011; G05D 1/021 (2017.02)

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)
See Search History document

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 499,740 A (JONES et al.) 20 June 1893 (20.06.1893) entire document	1-10, 12-15
Y	US 2003/0193234 A1 (BAKER et al) 16 October 2003 (16.10.2003) entire document	1-10, 12-15
Y	US 525,379 A (WOOD) 04 September 1894 (04.09.1894) entire document	2
A	US 2012/0273284 A1 (NESNAS ISSA A D et al) 01 November 2012 (01.11.2012) entire document	1-15

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

* Special categories of cited documents:
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"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
24 March 2017	10 APR 2017
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774