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(54) **Titre** : SYSTEMES ET PROCEDES DE GESTION DE LA FLOTTABILITE D'UN DIRIGEABLE
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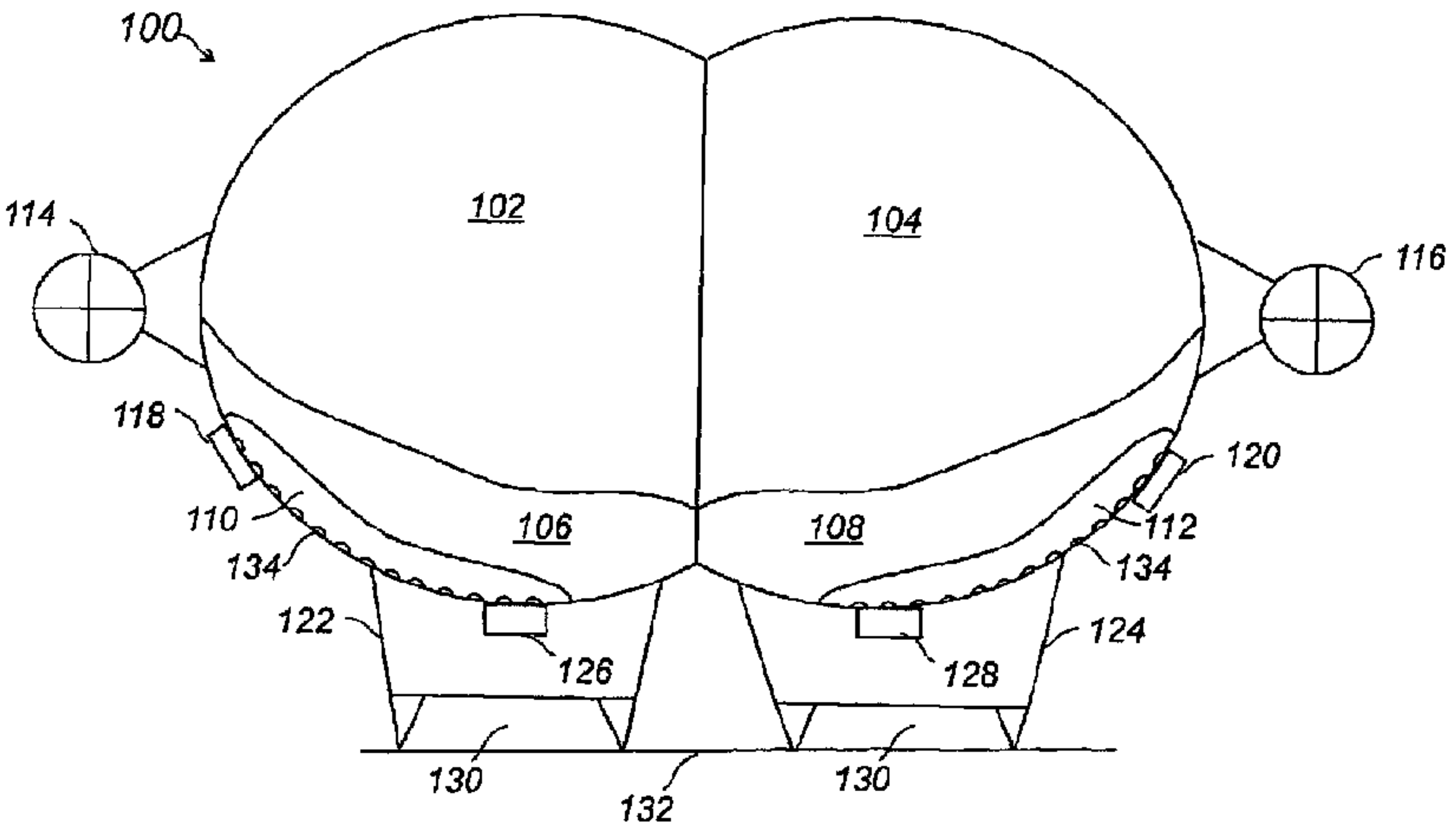

(57) **Abrégé/Abstract**:

An airship comprising a hull configured to be inflated with a first gas; a ballonet in the hull, the ballonet configured to be inflated with a second gas that is heavier than the first gas; a fan configured to draw the second gas into the ballonet; an inflatable landing system; a duct configured in the ballonet to allow access to components in the airship; and a valve coupled to the ballonet. The valve provides a pathway for air to flow between the ballonet and a plenum chamber, the plenum chamber is formed by the airship, a landing surface, and the inflatable landing system when the inflatable landing system is in contact with the landing surface.

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System and Methods for Buoyancy Management in an Airship

ABSTRACT

An airship comprising a hull configured to be inflated with a first gas; a ballonet in the hull, the ballonet configured to be inflated with a second gas that is heavier than the first gas; a fan configured to draw the second gas into the ballonet; an inflatable landing system; a duct configured in the ballonet to allow access to components in the airship; and a valve coupled to the ballonet. The valve provides a pathway for air to flow between the ballonet and a plenum chamber, the plenum chamber is formed by the airship, a landing surface, and the inflatable landing system when the inflatable landing system is in contact with the landing surface.

Systems And Methods For Buoyancy Management In An Airship

BACKGROUND

[0001] A hybrid airship can combine the characteristics of different aviation technologies such as heavier-than-air (HTA) aircraft, lighter-than-air (LTA) vehicles, fixed wing aircraft, helicopter, hovercraft, and others, to perform desired functions. Hybrid airships are currently being developed that combine the advantages of an aerodynamic shape with the cargo capacity, simplicity, and low operating costs of airships. Uses for such vehicles include cargo transport, telecommunications platforms, surveillance, emergency response, advertising platforms, and tourism, among others.

[0002] LTA vehicles are typically slow and difficult to maneuver. Yet, it is desirable to develop a hybrid airship capable of take off and landing in a minimum amount of space. Traditional LTA vehicles with an air cushioned landing system (ACLS) have been proposed to reduce the take off and landing space requirement. However, many traditional ACLS systems have fixed configurations during take off and landing and also during the flight. This increases drag and reduces fuel efficiency. More recently, some LTA vehicles include an ACLS system that is operable in dual modes including a take off and landing mode that is suitable for landing and take off, and a flight mode that is suitable for operation during the flight of the vehicle. However, traditional tools and techniques that are used for enabling the dual mode ACLS system to transition between the flight mode and the take off and landing mode are often impractical, inefficient, and prone to frequent failures.

SUMMARY

[0003] In some embodiments, an airship comprising a hull configured to be inflated with a first gas; a ballonet in the hull, the ballonet configured to be inflated with a second gas that is heavier than the first gas; a fan configured to draw the second gas into the ballonet; an inflatable landing system; a duct configured in the ballonet to allow access to components in the airship; and a valve coupled to the ballonet. The valve provides a pathway for air to flow between the ballonet and a plenum chamber, the plenum chamber is formed by the airship, a landing surface, and the inflatable landing system when the inflatable landing system is in contact with the landing surface.

[0003a] In one aspect, there is provided a system for controlling an operating mode of an airship, comprising: a sensor system configured to determine an altitude of a bottom of a hull of the airship, the hull configured to be inflated with a lighter-than-air gas; a computer processor configured to execute logic instructions to: determine the altitude of the airship based on information from the sensor system; determine an operating mode of the airship; determine whether to increase, decrease or maintain the altitude and airspeed of the airship based on the operating mode; and generate signals to open or close a valve and operate a ballonet fan to control gas pressure within a hull and a ballonet enclosed in the hull of the airship based on a desired airspeed, altitude, and operating mode, the valve coupled between a plenum chamber of an air cushion landing system (ACLS) and the ballonet, the plenum chamber formed by a landing surface and the ACLS when the ACLS is in contact with the landing surface, the generated signals controlling the valve to selectively allow air to flow from the plenum chamber into the ballonet while the ACLS is in contact with the landing surface, the generated signals further controlling the ballonet fan to draw air into the ballonet.

[0003b] In another aspect, there is provided a method of operating an airship, the airship including an inflatable hull and a ballonet in the hull, the method comprising: determining a flight mode of the airship to be one of the group of: takeoff, climb, cruise, initial ground contact, ground settling, stop, initial hover, and hover; adjusting gas pressures in the hull and the ballonet according to the flight mode by controlling pressure within a plenum chamber and the ballonet, the plenum chamber being formed by a bottom of the hull, a landing surface, and an inflatable landing system when the inflatable landing system is in contact with the landing surface.

BRIEF DESCRIPTION OF THE FIGURES

[0004] Embodiments of the present invention can be better understood, and their numerous objects, features, and advantages made apparent to those skilled in the art by referencing the accompanying drawings. The use of the same reference symbols in different drawings indicates similar or identical items.

FIG. **1** is a front view of an embodiment of an airship in accordance with the present invention.

FIG. **2** is a cross-sectional view of an embodiment of a portion of the duct shown in FIG. **1**.

FIG. **3** is a cross-sectional view of an embodiment of the portion of the duct shown in FIG. **2**.

FIG. **4** is a top view of an embodiment of the portion of the duct shown in FIG. **2**.

FIG. **5** is a flow chart of an embodiment of operating modes of the airship of FIG. **1**.

FIG. **6** is a perspective view of an embodiment of a pressure maintenance system for the airship of FIG. **1**.

FIG. **7** is a block diagram of an embodiment of a processing system to control a valve, motor, hull pressure and/or ballonet pressure in the airship of FIG. **1**.

DETAILED DESCRIPTION

[0005] FIG. **1** is a front view of an embodiment of airship **100** including first and second hulls **102**, **104**, ballonets **106**, **108**, ducts **110**, **112**, propulsion systems **114**, **116**, fans **118**, **120**, air cushion landing systems (ACLS) **122**, **124**, and valves **126**, **128**. Hulls **102**, **104** provide the main structure of the airship **100** and are typically filled with lighter-than-air gas such as helium. Ballonets **106**, **108** and ducts **110**, **112** can be positioned within hulls **102**, **104** and are typically filled with air. Propulsion systems **114**, **116** can include a propellor-driven engines mounted external to the sides of hulls **102**, **104** although other suitable propulsion systems can be used. Propulsion systems **114**, **116** can be gimballed to help steer airship **100** in up to three dimensions. Although airship **100** is shown with **2** hulls **102**, **104**, airship **100** may be configured with one or more hulls **102**, **104**, ballonets **106**, **108**, ducts **110**, **112**, propulsion systems **114**, **116**, fans **118**, **120**, air cushion landing systems (ACLS) **122**, **124**, and valves **126**, **128**.

[0006] An airship **100** equipped with ACLS **122**, **124** offers considerable lifting capacity, operational flexibility, and cost effectiveness as well as the ability to operate from unimproved landing sites on both land and water. ACLS **122**, **124**

can be configured in accordance with a flight mode of the airship **100**, for example, ACLS **122**, **124** is typically fully inflated during landing, touchdown, and take-off, but deflated into a stowed position to reduce drag during up and away flight. An air cushion pad of the ACLS **122**, **124** can be formed around an open center to create plenum chambers **130** when ACLS **122**, **124** touches the ground. Valves **126**, **128** can operate to form suction within the plenum chambers **130** to stabilize and retain airship **100** on the ground.

[0007] Ducts **110**, **112** can be large enough to allow maintenance personnel to access various components such as propulsion systems **114**, **116**, fans **118**, **120**, and valves **126**, **128**. Ducts **110**, **112** may also provide a route for electric cables, hydraulic lines, and other components internal to airship **100** with sufficient space to separate components such as electric cables and hydraulic or fuel lines from one another as required. Fans **118**, **120** can supply air to ballonets **106**, **108** and ACLS **122**, **124**. Valves **126**, **128** can control airflow from fans **118**, **120** to ACLS **122**, **124**. When ACLS **122**, **124** are inflated, plenum chambers **130** are formed by the ACLS **122**, **124** and landing surface **132**. In some embodiments, fans **118**, **120** are induction fans that draw air into ballonets **106**, **108** through air vents **134** in the outer surface of airship **100**.

[0008] Airship **100** can be equipped with an on-board source of lighter-than-air gas (not shown), such as compressed helium tanks or other suitable gas that are configured to supply hulls **102**, **104**. An onboard processing system, such as a computerized controller as further described in FIG. **7**, can also be included in airship **100** and configured to monitor data from subsystems in airship **100** and issue appropriate commands to adjust subsystem operation to achieve desired operational status.

[0009] FIG. **2** depicts a side view of an embodiment of a portion of duct **110** including spine baton **204** and rib batons **206**. Batons **204**, **206** provide structural support for duct **110** when ballonet **108** is deflated, at which point, ballonet **108** is draped over batons **204**, **206**. Rib baton **206** typically extends along the length of duct **110** at a distance from the inner surface of airship **100** that is sufficient to allow a person and equipment to traverse the length of duct **110**. The length and position of duct **110** can be selected to allow access to various components of airship **100**, such as fans **118**, **120**, propulsion systems **114**, **116**, ACLS **122**, **124**, and valves **126**, **128** for maintenance and other purposes.

[00010] FIG. **3** depicts an end view cross-section of a portion of duct **110** including components that can be routed through duct **110** such as static line(s) **302**, ladder **304**, electrical cables **306**, hydraulic lines **308**, duct lighting **310**, and air monitoring equipment **312**. Static line **302** and ladder **304** may facilitate access by maintenance personnel through the duct. Electrical and hydraulic cables **306** are routed within duct **110** according to specifications for separating various types of cables from one another.

[00011] FIG. **4** shows a top view of a portion of duct **110** including ladder **304**, air vents **134**, spine baton **204**, and rib batons **206**. Ladder **304** can extend either fully or only partially through duct, and is especially useful to access components such as fans **118**, **120** that may be positioned in sloped portions of airship **100**. Rib batons **206** can extend from side to side of duct and provide support for rib baton **204** as well as deflated material from ballonet **108**. Other suitable structure for forming duct **110** can be used, however.

[00012] Referring to FIGS. **1** and **5**, FIG. **5** is a chart **500** of an embodiment of operating modes of airship **100** including takeoff/climb/cruise modes **502**, initial ground contact mode **510**, ground settling mode **518**, stop mode **530**, initial hover mode **538**, and hover mode **548**. Note that fans **118**, **120** are not always needed to pressurize the plenum chambers **130** since excess pressure inside the hulls **102**, **104** may be used to momentarily pressurize the plenum chambers **130**. In this way the hulls **102**, **104** and ballonets **106**, **108** act as an accumulator to assist the fans **118**, **120** when needed. This reduces the installed fan power required, thus leading to a more efficient vehicle configuration.

[00013] In takeoff, climb and/or cruise mode **502**, the pressure of hull **102** is nominal (**504**), plenum pressure is unimportant (**506**), and the flow rate of fans **118**, **120** is typically zero (**508**).

[00014] During initial ground contact mode (**510**), the altitude of the bottom of hulls **102**, **104** is approximately equal to the height of ACLS **122**, **124**. The hull/ballonet pressures may be nominal (**512**), the pressure of plenum chambers **132** is nominal (**514**), and the flow rate of fans **118**, **120** may be zero (**516**).

[00015] During ground settling mode **518**, the altitude of the bottom of hulls **102**, **104** is less than the height of ACLS **122**, **124**, and the downward velocity of the airship **100** is less than a predetermined value. The hull/ballonet pressure increases to greater than nominal (**520**), and the flow rate of fans **118**, **120** is zero (**522**). Valves **126**, **128** open so that air flows from plenum chambers **132** to ballonets **106**, **108** as the weight of airship **100** compresses ACLS **122**, **124** (**524**) as airship **100** comes to a stop (**526**).

[00016] During stop mode **530**, the weight of airship **100** has settled and the altitude of the bottom of hulls **102**, **104** is less than the fully-inflated height of the ACLS **122**, **124**. The pressure of ballonets **106**, **108** is much greater than the nominal ballonet pressure as high pressure air from plenum chambers **132** flows into the ballonets **106**, **108** (**532**). The over-inflation of ballonets **106**, **108** causes the pressure of hulls **102**, **104** to be greater than the nominal pressure (**534**). Fans **118**, **120** are started to pressurize plenum chambers **132** (**536**).

[00017] Once airship **100** comes to a stop, airship **100** enters initial hover mode **538**. During initial hover mode **538**, the altitude of the bottom of hulls **102**, **104** approximately equals the height of ACLS **122**, **124** as the excess air pressure from hulls **102**, **104** and ballonets **106**, **108** is used to inflate plenum chambers **132**. Fans **118**, **120** can also operate to pressurize the plenum chambers **132** for hover (**544**). Valves **126**, **128** between the plenum chambers **132** and the ballonets **106**, **108** are open (**546**).

[00018] Once the pressure in hulls **102**, **104**, ballonets **106**, **108**, and plenum chambers **132** equalizes in initial hover mode **538**, airship **100** enters hover mode **548**. The altitude of the bottom of hulls **102**, **104** approximately equals the height of ACLS **122**, **124**. The pressures in hulls **102**, **104**, ballonets **106**, **108**, and plenum chambers **132** are nominal (**550**, **552**). Fans **118**, **120** operate to maintain the plenum and ballonet pressure (**554**).

[00019] Referring again to FIG. **1**, the outer surface of airship **1 00** can be fabricated of a non-rigid sheet material, including composite and/or laminated fabric material. Hulls **102**, **104** are typically pressurized, thereby eliminating the need for internal structure or bracing. Such a design provides a vehicle **100** with resilient external surfaces that is low cost and low weight. The relatively low height to length profile of hulls **102**, **104** provide improved stability and ground handling compared to conventional lighter-than-airships of equal gas volume. The inflated hulls **102**, **104** of airship **100** typically carry the primary loads of control surfaces, engines, and other components. Therefore the pressure in the airship **100** generally needs to be maintained even when the vehicle is parked on the ground or stored in a hangar.

[00020] Referring to FIGs. **1** and **6**, FIG. **6** shows a perspective view of an embodiment of pressure management system **600** that can be used to maintain the pressure of airship **100** at a desired level while airship **100** is parked on the ground. The embodiment of pressure management system **600** shown includes valve **601**, fan/fan duct **602**, controller **604**, pressure switches **606**, outlet duct **608**, power supply **610**, back up power supply **612**, fan override switch **614**, circuit breaker switch **616**, and vehicle pressure line **618**. Pressure management system **600** can adjust and maintain pressure in hull **102**, ballonet **106**, and plenum chamber **132**. Note that while each hull **102**, **104** and ballonet **106**, **108** can accommodate a pressure management system **600**, a single pressure management system **600** can be configured to manage the pressure in two or more hulls **102**, **104**, ballonets **106**, **108**, and plenum chambers **130**. Pressure management system **600** can be connected to airship **100** by connecting a fan duct **602** to a plug in airship **100**. One or more clamps, straps, and/or other suitable device can be used to secure the duct to the airship **100**.

[00021] Valve **601** can be opened to release air and closed to retain air in airship **100** manually or under automatic operation by controller **604**.

[00022] A fan **602** provides an air pressure source with pressure sensors **606** that can adjust fan operation to accommodate gas volume expansion and contraction caused by atmospheric conditions (temperature and pressure) and leakage.

[00023] Controller **604** controls operation of pressure management system **600** to achieve a desired pressure according to the flight mode, as described with respect to FIG. **5** hereinabove. Controller **604** can communicate with another processing system on board airship **100** to coordinate operation of pressure management system **600** and other subsystems based on flight mode, subsystem status, and other relevant information.

[00024] A number of switches **606** can be configured to send control commands to the controller **604** for various functions including a valve switch, high pressure alarm switch, low pressure alarm switch, high pressure switch, and low pressure switch, as shown for example in Table **1** below. Note that the numbers shown are for example only and may be varied depending on a particular vehicle's requirements/configuration.

TABLE **1**: Pressure Switch Settings

VALVE SWITCH	HIGH PRESSURE ALARM SWITCH
Open: **4.0** inH$_2$0	Open: **4.1** inH$_2$0
Close: **4.2** inH$_2$0	Close: **4.3** inH$_2$0
Wired: normally closed	Wired: normally closed

HIGH PRESSURE SWITCH

Open: **3.7** inH$_2$**0**

Close: **3.5** inH$_2$**0**

Wired: normally open

LOW PRESSURE SWITCH

Open: **2.6** inH$_2$**0**

Close: **2.4** inH$_2$**0**

Wired: normally Open

LOW PRESSURE ALARM SWITCH

Open: **2.4** inH$_2$**0**

Close: **2.2** inH$_2$**0**

Wired: normally open

[00025] If the vehicle is to be left unattended, low and high pressure alarm switches can be connected to an alarm system that provides alerts when high or low pressure conditions are detected. For example, the alarm system can be configured to make phone calls and play a message indicating the nature of the problem. The alarm system can be equipped with battery backup. Lights can also be connected to and operated by controller **604** to indicate status. For example, one light may indicate that the pressure maintenance system **600** has power. Another light may indicate that the fan has been commanded to run. Visual indicators can be located within view of a video camera or other visual monitoring system for remote monitoring.

[00026] Controller **604** can include mode switches (not shown) that set the mode of the controller **604** and status lights (not shown). The mode switches can include, for example, a valve switch, a fan switch, and a fan mode switch, as shown for example in Table **2** below:

Table **2**: Mode Switches

Fan switch	provides on-off-automatic control settings for the fan **602**
Valve switch (three position)	provides on-off-automatic control settings for the valve **601**

Fan mode switch	selects pressure to control to low pressure, high pressure, or off position

[00027] In normal operation the fan switch and valve switch are typically left in automatic mode. Fan mode switch **624** can be set to low pressure, unless full vehicle pressure is required for maintenance or operational reasons. For example, fan mode switch may be set to HIGH as required to stretch hulls **102**, **104** to full flight pressure to tighten lacing. A programmable relay can be used to delay fan shut-off to eliminate excessive cycling of fan **602** thereby preventing chatter and vibration.

[00028] Outlet duct **608** can be used to connect pressure maintenance system **600** to a ground pressurization port.

[00029] Power supply **610** provides suitable power to the components of pressure management system **600**, such as thirty (**30**) amp, twenty-eight (**28**) volt direct current. Back up power supply **612** can provide an alternate power source using any suitable power supply, such as one or more batteries.

[00030] Fan override switch **614** bypasses the controller **604** to manually operate fan **602**.

[00031] Circuit breaker switch **616** removes power and/or backup power from controller **604** in the event an overcurrent condition is detected.

[00032] Vehicle pressure line **618** can be coupled to a pressure manifold switch and pressure gage to control the pressure in hulls **102**, **104** and/or ballonets **106**, **108**.

[00033] Note that when operating on battery power alone, fan **602** may not be able to produce the pressure required to maintain the airship **100** at the desired

minimum pressure. Therefore, in the event of a power failure, the fan mode switch can be set to low pressure.

[00034] Referring to FIG. **7**, a block diagram of a processing system **700** that can be included in airship **100** (FIG. **1**) is shown including processor **702**, memory device **704**, and logic instructions **706**. Processing system **700** can interface with a variety of subsystems and sensors that provide information about the operational state of airship **100** such as pressure maintenance system **600**, engines **114**, **116**, fans **118**, **120**, satellite positioning system **708**, hydraulic system **710**, and lighter-than-air (LTA) gas source **712**. For example, positioning system **708** can provide the latitude, longitude, and altitude of the airship **100**. Other sensor information regarding the electrical systems, engine, throttle position, fuel system, pressure of hulls **102**, **104**, ballonets **106**, **108**, ACLS **122**, **124**, and hydraulic system **710** can be provided for use by logic instructions **706**.

[00035] Processor **702** can be any suitable computer-processing device that communicates with memory device **704** to access and execute logic instructions, such as logic instructions **706** to receive input from sensors and issue control commands to subsystems to transition to, establish and maintain desired flight modes of airship **100**, such as the flight modes shown in FIG. **5** for example. Processor **702** can interface with various input/output devices, such as a keyboard, touchscreen, buttons, knobs, switches, and/or other suitable input/output devices that allow a user to interact with components internal and external to processing system **700**.

[00036] Logic instructions **706** can be executed by processor **702** and configured to operate airship **100** automatically as well as allow manual inputs from crewmembers. Logic instructions **706** can determine whether the modes requested by the crewmembers are permitted based on the current mode of airship **100**, and issue alerts if desired operational modes cannot be achieved. Mode control and option selections can also be transmitted from crewmembers processor **702** to various subsystems to control operational modes of various subsystems. As shown, logic instructions **706** as executed by processor **702** send outputs to open and close valves **126**, **128**, control propulsion systems **114**, **116** and fans **118**, **120**, and inflate and deflate hulls **102**, **104**, ballonets **106**, **108**, and ACLS **122**, **124**.

[00037] Logic instructions **706** executed by processor **702** can be stored in memory device **706**, on computer readable medium, or accessed by processor **702** in the form of electronic signals. Processor **702** can be configured to interface with other processors, and to connect to an external network via a suitable communication link such as any one or combination of T1, ISDN, or cable line, a wireless connection through a cellular or satellite network, or a local data transport system such as Ethernet or token ring over a local area network.

[00038] Additionally, processor **702** can be embodied in any suitable computing device, and so include embedded computers, desktop computers, laptop computers, or other suitable computing devices. Processor **702** and corresponding logic instructions can be implemented using any suitable combination of hardware, software, and/or firmware, such as microprocessors, Field Programmable Gate Arrays (FPGAs), Application Specific Integrated Circuit (ASICs), or other suitable devices.

[00039] While the present disclosure describes various embodiments, these embodiments are to be understood as illustrative and do not limit the claim scope. Many variations, modifications, additions and improvements of the described embodiments are possible. For example, those having ordinary skill in the art will readily implement the processes necessary to provide the structures and methods disclosed herein. Variations and modifications of the embodiments disclosed herein can also be made while remaining within the scope of the following claims. The functionality and combinations of functionality of the individual modules can be any appropriate functionality. Additionally, limitations set forth in publications incorporated by reference herein are not intended to limit the scope of the claims. In the claims, unless otherwise indicated the article "a" is to refer to "one or more than one".

CLAIMS

1. A system for controlling an operating mode of an airship, comprising:

a sensor system configured to determine an altitude of a bottom of a hull of the airship, the hull configured to be inflated with a lighter-than-air gas;

a computer processor configured to execute logic instructions to:

determine the altitude of the airship based on information from the sensor system;

determine an operating mode of the airship;

determine whether to increase, decrease or maintain the altitude and airspeed of the airship based on the operating mode; and

generate signals to open or close a valve and operate a ballonet fan to control gas pressure within a hull and a ballonet enclosed in the hull of the airship based on a desired airspeed, altitude, and operating mode, the valve coupled between a plenum chamber of an air cushion landing system (ACLS) and the ballonet, the plenum chamber formed by a landing surface and the ACLS when the ACLS is in contact with the landing surface, the generated signals controlling the valve to selectively allow air to flow from the plenum chamber into the ballonet while the ACLS is in contact with the landing surface, the generated signals further controlling the ballonet fan to draw air into the ballonet.

2. The system of claim 1, wherein when the operating mode is takeoff, climb, or cruise, the processor is further configured to:

generate signals to adjust hull and ballonet gas pressures to be nominal and a ballonet fan speed to be zero.

3. The system of claim 1, wherein the processor is further configured to:

detect initial ground contact mode when the altitude of the bottom of the hull approximately equals a nominal height of the ACLS coupled to the hull;

maintain the hull and ballonet pressures at a nominal value;

maintain a plenum chamber pressure at a nominal value, the plenum chamber being formed by an outer portion of the airship, the landing surface, and the ACLS when the ACLS is in contact with the landing surface;

generate a signal to maintain a ballonet fan flow rate at zero.

4. The system of claim 1, wherein the processor is further configured to:

detect ground settling mode when the altitude of the bottom of the hull is less than a nominal height of the ACLS coupled to the hull;

maintain the hull pressure at a nominal value;

maintain a plenum chamber pressure at a nominal value, the plenum chamber being formed by the bottom of the airship, the landing surface, and the ACLS when the ACLS is in contact with the landing surface;

generate a signal to maintain a ballonet fan flow rate at zero;

generate a signal to open a valve allowing plenum chamber air to flow into the ballonet;

determine that the airship has come to a stop when the altitude of the bottom of the hull is less than the nominal height of the ACLS.

5. The system of any one of claims 1, wherein the processor is further configured to:

detect stop mode when the altitude of the bottom of the hull is less than a nominal height of the ACLS coupled to the hull;

allow the hull and ballonet pressures to be much greater than nominal hull and ballonet pressures;

generate a signal controlling the ballonet fan to produce a flow to pressurize a plenum chamber, the plenum chamber being formed by the bottom of the airship, the landing surface, and the ACLS when the ACLS is in contact with the landing surface.

6. The system of claim 1, wherein the processor is further configured to:

detect initial hover mode when the altitude of the bottom of the hull is approximately equal to a nominal height of the ACLS coupled to the hull;

maintain the hull and ballonet gas pressures at values greater than nominal hull and ballonet gas pressures;

maintain a plenum chamber pressure greater than nominal plenum chamber pressure;

generate a signal to close a valve to prevent air from flowing from the plenum chamber into the ballonet.

7. The system of claim 1, wherein the processor is further configured to:

detect hover mode when the altitude of the bottom of the hull is approximately equal to a nominal height of the ACLS coupled to the hull;

maintain the hull gas pressure approximately equal to nominal hull gas pressure;

maintain a plenum chamber pressure equal to nominal plenum chamber pressure;

generate a signal to operate the ballonet fan to maintain pressure in the plenum chamber and the ballonet.

8. A method of operating an airship, the airship including an inflatable hull and a ballonet in the hull, the method comprising:

determining a flight mode of the airship to be one of the group of: takeoff, climb, cruise, initial ground contact, ground settling, stop, initial hover, and hover;

adjusting gas pressures in the hull and the ballonet according to the flight mode by controlling pressure within a plenum chamber and the ballonet, the plenum chamber being formed by a bottom of the hull, a landing surface, and an inflatable landing system when the inflatable landing system is in contact with the landing surface.

9. The method of claim 8, further comprising:

when the flight mode is takeoff, climb, or cruise:

adjusting a ballonet fan speed to be zero;

adjusting the hull gas pressure to be nominal.

10. The method of claim 8, further comprising:

determining the flight mode to be initial ground contact when the altitude of the bottom of the hull decreases until approximately equal to nominal height of an inflatable landing system coupled to the airship;

when the flight mode is initial ground contact:

maintaining hull and ballonet gas pressures to be nominal;

maintaining plenum chamber gas pressure to be nominal, the plenum chamber being formed by an outer portion of the airship, a landing surface, and the inflatable landing system when the inflatable landing system is in contact with the landing surface; and

maintaining a ballonet fan flow rate at zero.

11. The method of claim 8, further comprising:

determining the flight mode to be ground settling when the current flight mode of the airship is initial ground contact mode and the downward velocity of the airship is less than a predetermined value and the altitude of the bottom of the hull is less than the nominal height of an inflatable landing system coupled to the airship;

when the flight mode of the airship is ground settling:

increasing the hull gas pressure to be greater than nominal;

increasing the ballonet gas pressure to be greater than nominal;

opening a valve to allow plenum air flow into the ballonet.

12. The method of claim 8, further comprising:

determining the flight mode of the airship to be stop when the current flight mode is ground settling and the altitude of the bottom of the hull is less than nominal height of an inflatable landing system coupled to the airship and the forward velocity of the airship is below a predetermined threshold;

when the flight mode of the airship is stopped:

allowing the hull and ballonet gas pressures to be much greater than nominal hull and ballonet pressures;

starting a fan to pressurize the plenum chamber, the plenum chamber being formed by the bottom of the ballonet, a landing surface, and an inflatable landing system when the inflatable landing system is in contact with the landing surface.

13. The method of claim 8, further comprising:

determining the flight mode of the airship to be an initial hover mode when the current flight mode is stop and the altitude of the bottom of the hull is approximately equal to the nominal height of the inflatable landing system;

when the flight mode of the airship is initial hover:

maintaining the hull and ballonet gas pressures greater than nominal hull and ballonet gas pressures;

maintaining plenum chamber gas pressure greater than nominal plenum chamber pressure;

starting a fan to pressurize a plenum for hover;

closing a valve between the plenum chamber and the ballonet, the plenum chamber being formed by the bottom of the hull, a landing surface, and an inflatable landing system when the inflatable landing system is in contact with the landing surface.

14. The method of claim 8, further comprising:

determining the flight mode of the airship to be hover when the current mode is an initial hover mode and the altitude of the bottom of the hull is approximately equal to the nominal height of the inflatable landing system;

when the flight mode of the airship is hover:

maintaining the hull and ballonet pressures equal to nominal hull and ballonet pressures;

maintaining plenum chamber pressure approximately equal to nominal plenum chamber pressure;

starting a fan to maintain the plenum chamber and ballonet pressures.

15. The system of claim 1, wherein the processor is further configured to:

adjust the speed of the ballonet fan, when in an initial hover mode, to increase the altitude of the airship to approximately the nominal height of the ACLS.

16. The system of claim 1, wherein the processor is further configured to:

operate the ballonet fan, when in a stop mode, to increase the pressure within the ballonet and the plenum chamber, thereby stopping a descent of the airship at a minimum altitude that is less than the nominal height of the ACLS.

17. The system of claim 1, wherein the processor is further configured to:

stop a flow of air between the plenum chamber and the ballonet after the airship stops descending;

allow the airship to rise thereby reducing an air pressure within the plenum chamber and forming a suction within the plenum chamber thereby stabilizing and retaining the airship on the landing surface.

18. The system of claim 1, wherein the processor is further configured to close the valve to stop a flow of air between the plenum chamber and the ballonet.

19. The system of claim 1, wherein the processor is configured to reduce air pressure within the plenum chamber by adjusting the speed of the ballonet fan.

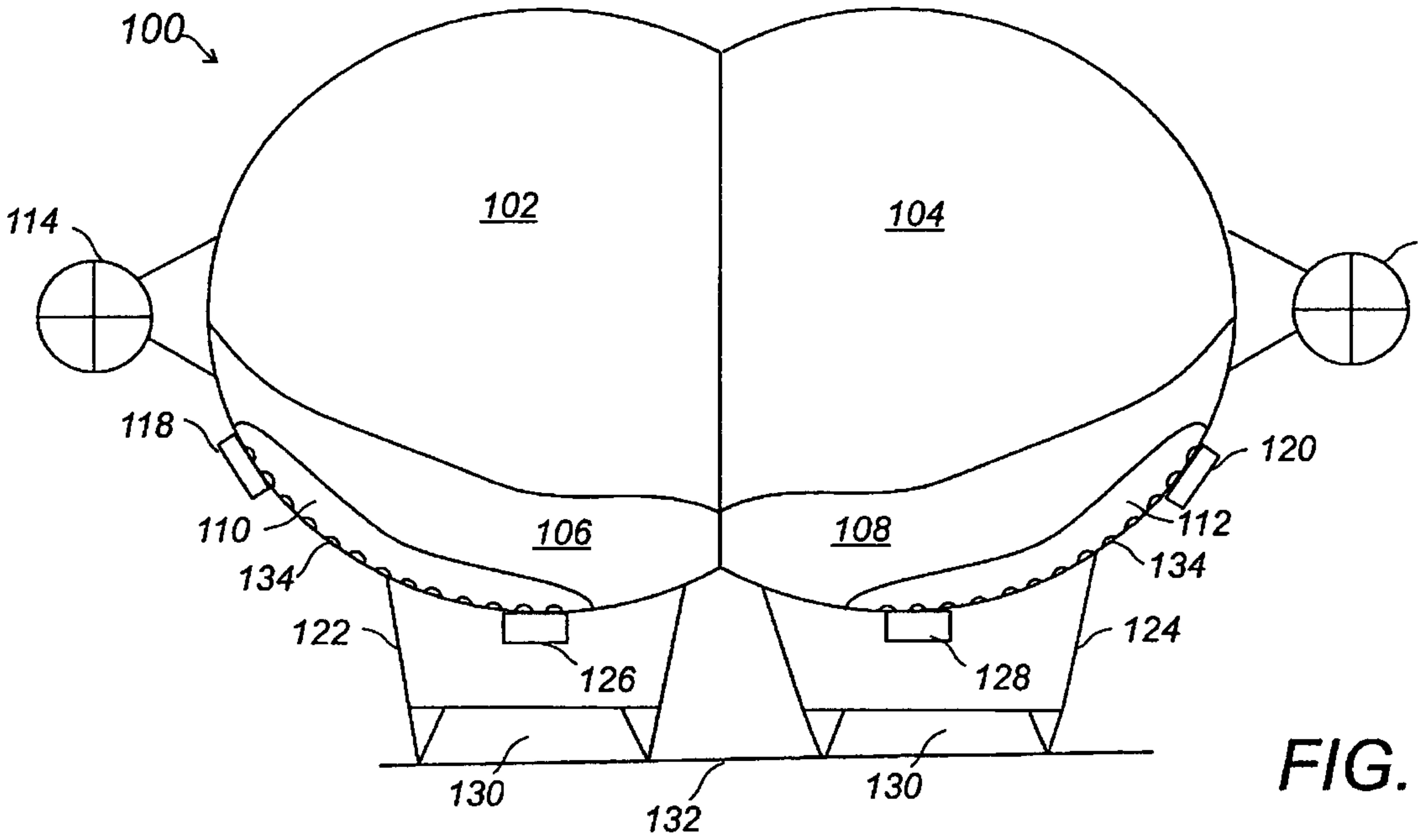


FIG. 1

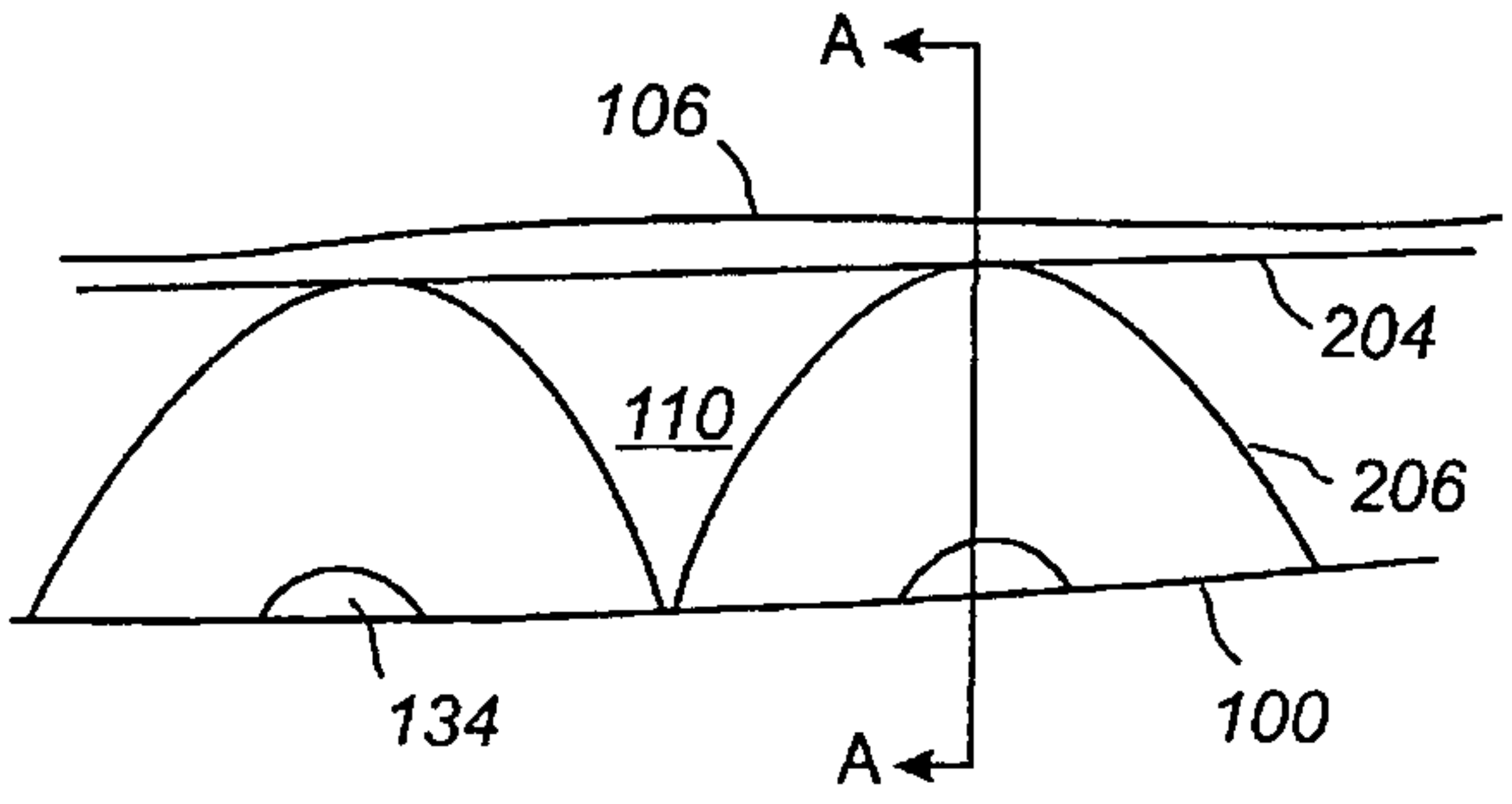
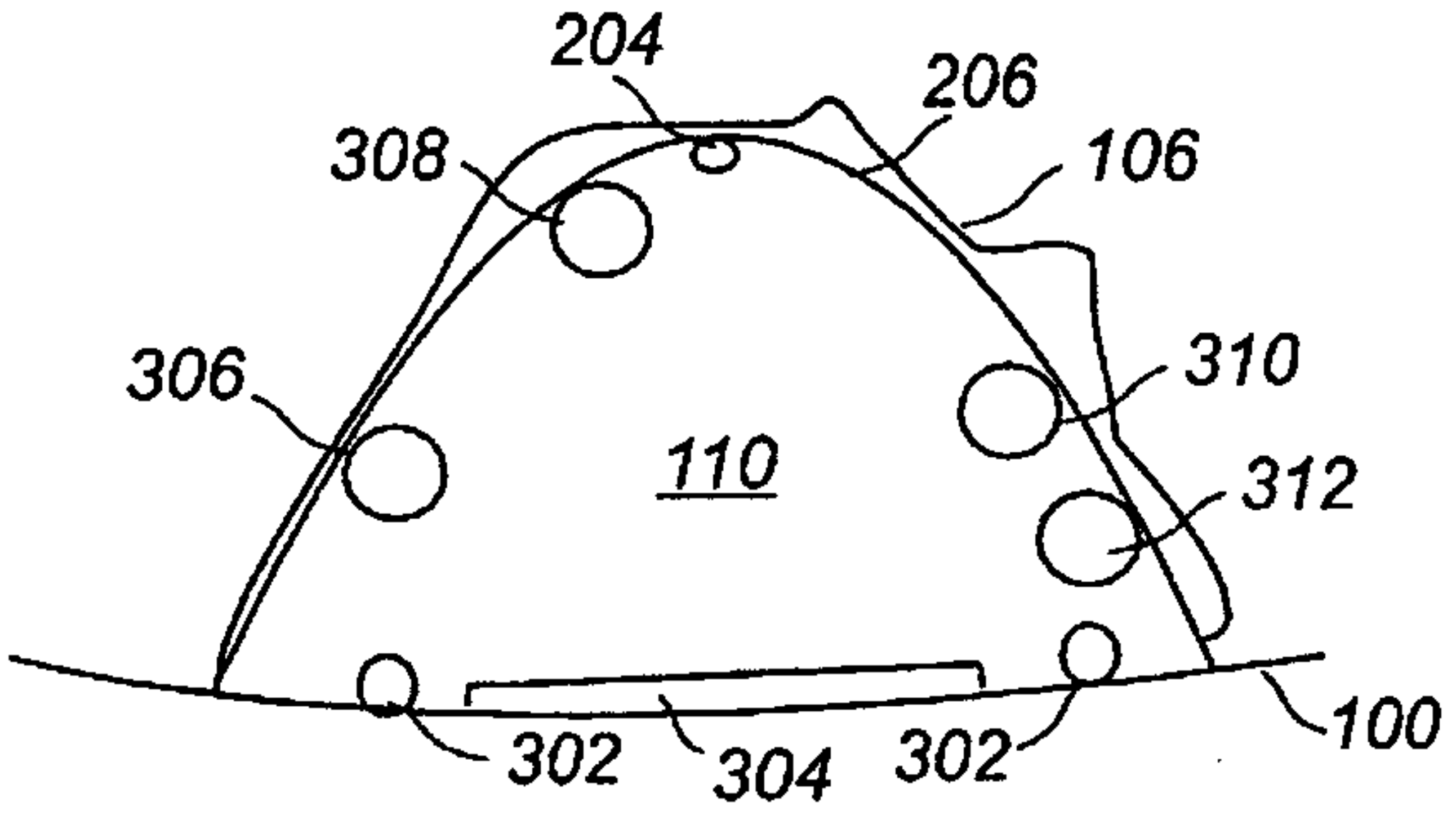


FIG. 2



Cross section A-A

FIG. 3

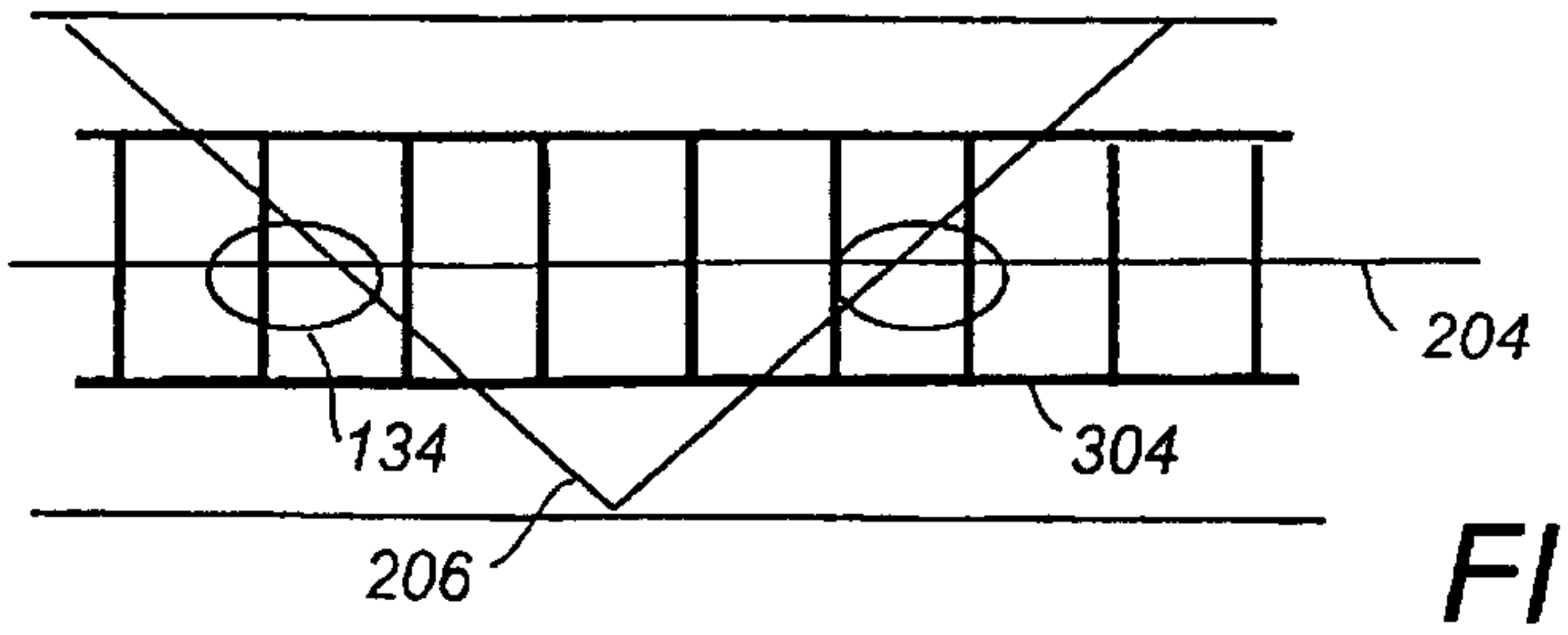


FIG. 4

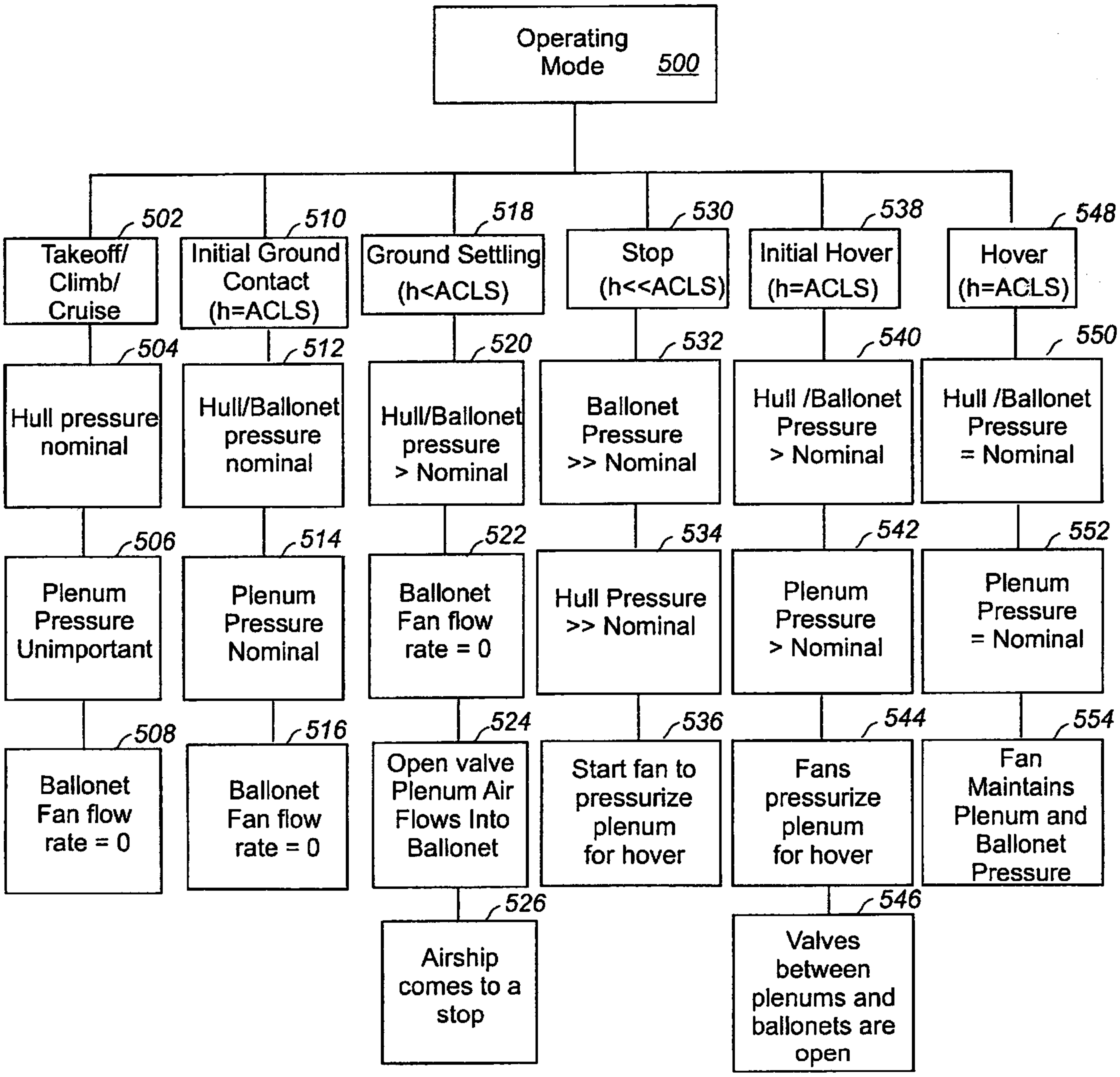

Operating Mode 500
502
Takeoff/ Climb/ Cruise
504
Hull pressure nominal
506
Plenum Pressure Unimportant
508
Ballonet Fan flow rate = 0
510
Initial Ground Contact (h=ACLS)
512
Hull/Ballonet pressure nominal
514
Plenum Pressure Nominal
516
Ballonet Fan flow rate = 0
518
Ground Settling (h<ACLS)
520
Hull/Ballonet pressure > Nominal
522
Ballonet Fan flow rate = 0
524
Open valve Plenum Air Flows Into Ballonet
526
Airship comes to a stop
530
Stop (h<<ACLS)
532
Ballonet Pressure >> Nominal
534
Hull Pressure >> Nominal
536
Start fan to pressurize plenum for hover
538
Initial Hover (h=ACLS)
540
Hull /Ballonet Pressure > Nominal
542
Plenum Pressure > Nominal
544
Fans pressurize plenum for hover
546
Valves between plenums and ballonets are open
548
Hover (h=ACLS)
550
Hull /Ballonet Pressure = Nominal
552
Plenum Pressure = Nominal
554
Fan Maintains Plenum and Ballonet Pressure

FIG. 5

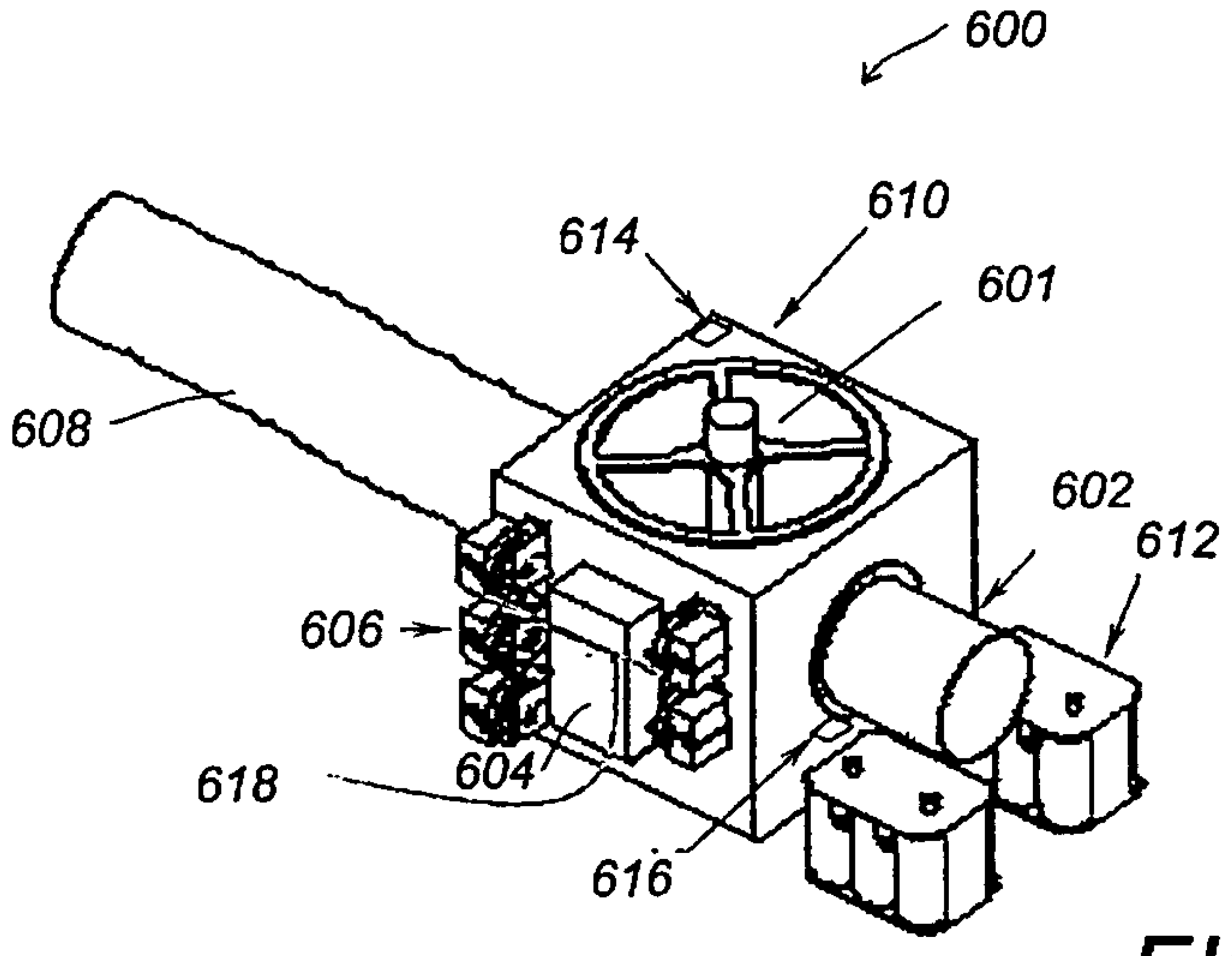

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FIG. 6

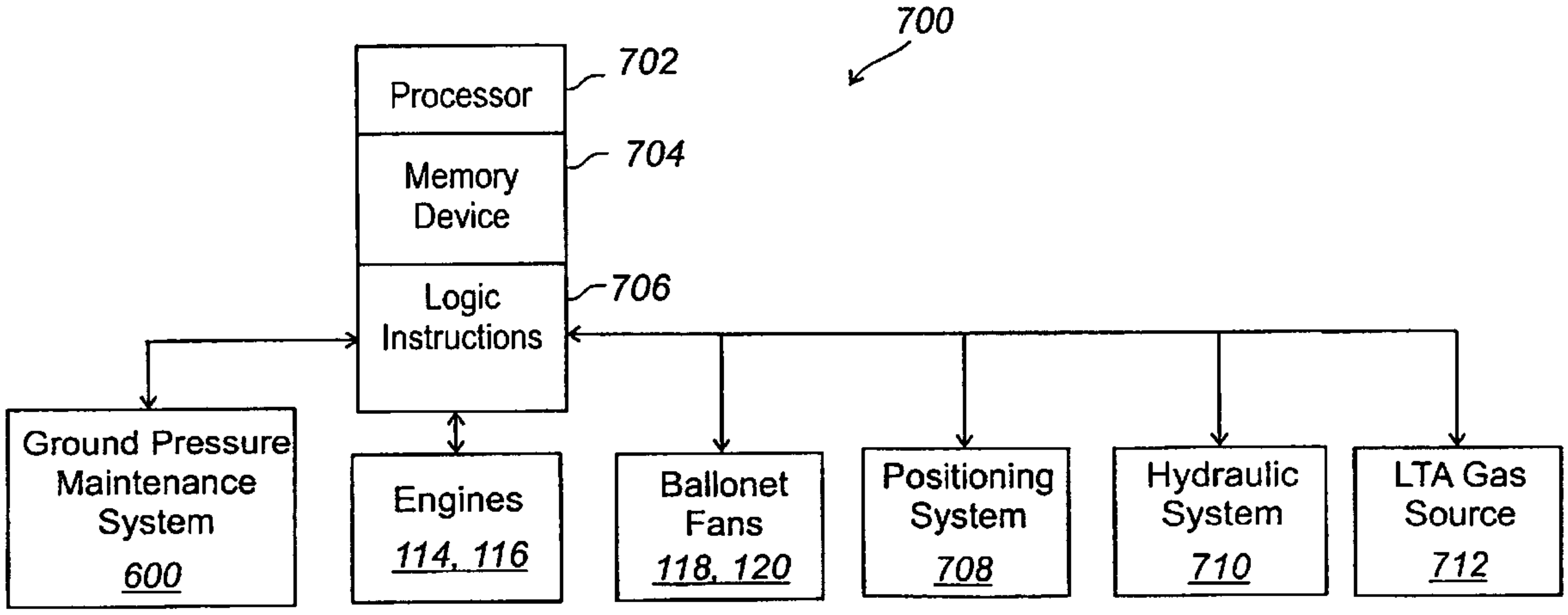
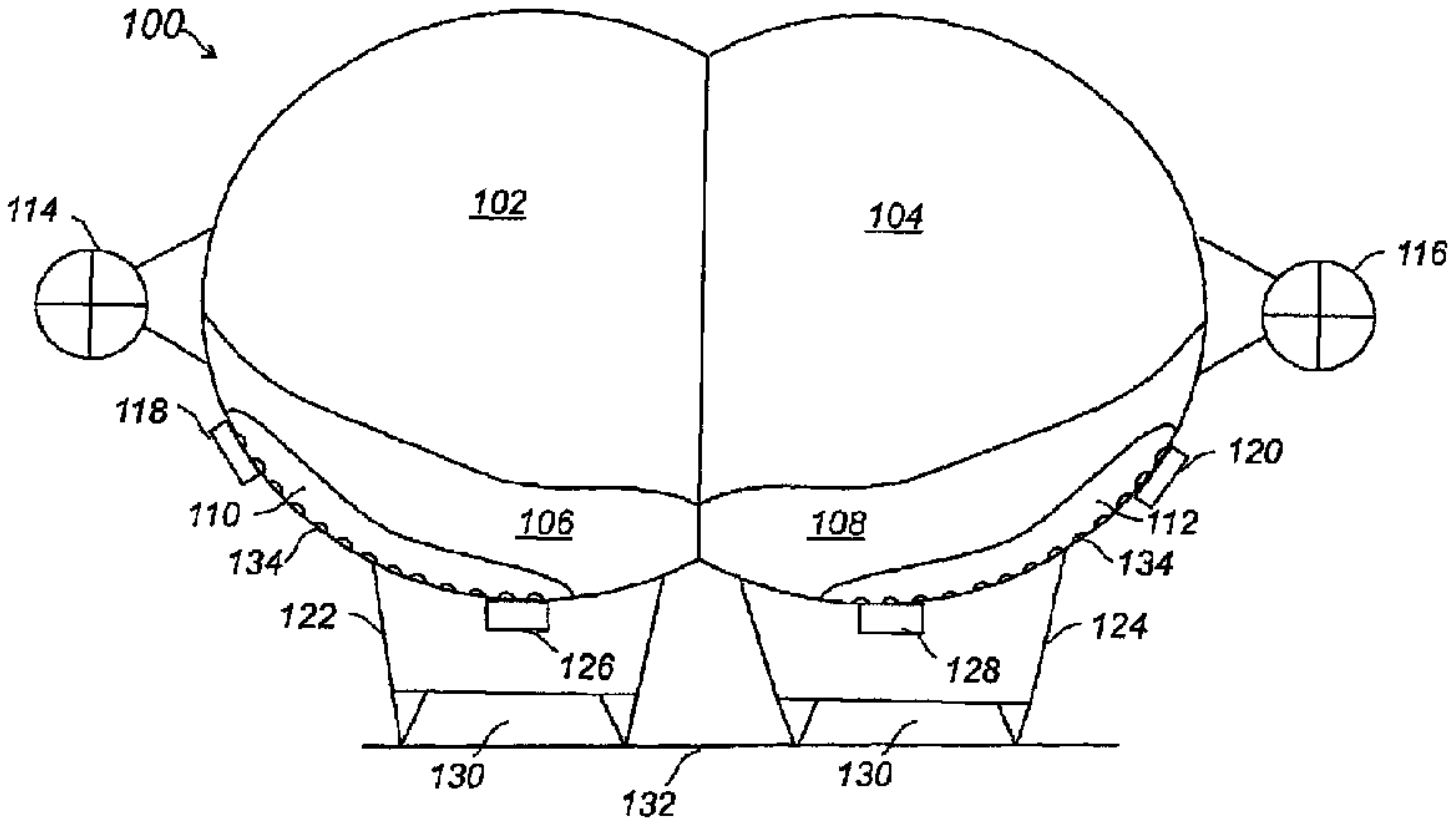

700
Processor
702
Memory Device
704
Logic Instructions
706
Ground Pressure Maintenance System 600
Engines 114, 116
Ballonet Fans 118, 120
Positioning System 708
Hydraulic System 710
LTA Gas Source 712

FIG. 7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