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(54) **TWO-WHEELER AIRBAG SYSTEM**

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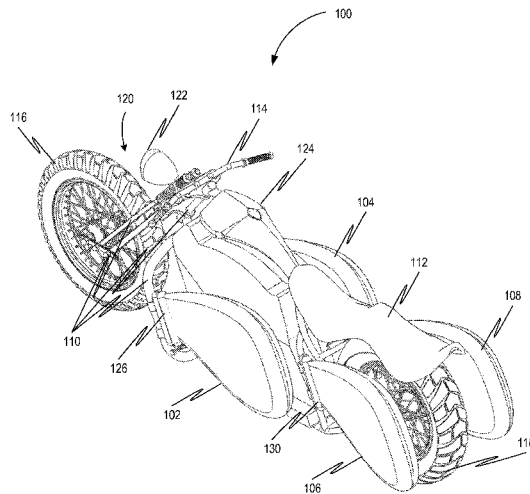
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(57) **ABSTRACT**

The present invention provides an airbag apparatus for a two-wheeler vehicle. The airbag apparatus includes at least one front airbag mounted near each leg of a rider of the two-wheeler vehicle, the at least one front airbag to be deployed and inflated for protecting the knees, legs and feet of the rider during emergency conditions. Further, the airbag apparatus includes at least one rear airbag mounted near each leg of a pillion rider of the two-wheeler vehicle, the at least one rear airbag to be deployed and inflated for protecting the knees, legs and feet of the pillion rider during emergency conditions. Yet further, the airbag apparatus includes at least one inflator configured to supply inflation gas to the at least one front airbag and the at least one rear airbag when activated. Finally, the airbag apparatus includes at least one sensor configured to track at least one safety parameter of the two-wheeler vehicle and activate the inflator, when a predetermined threshold of the at least one safety parameter is reached.

**16 Claims, 12 Drawing Sheets**



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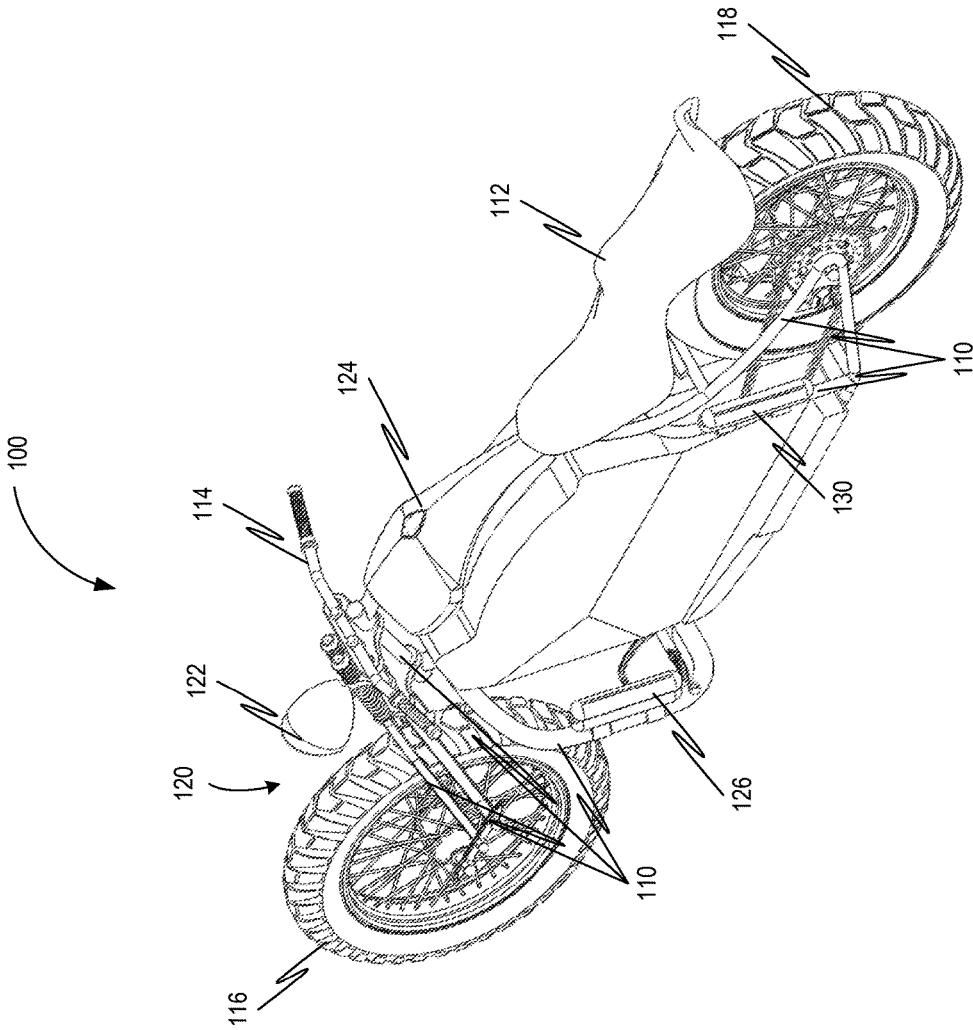


FIG. 1

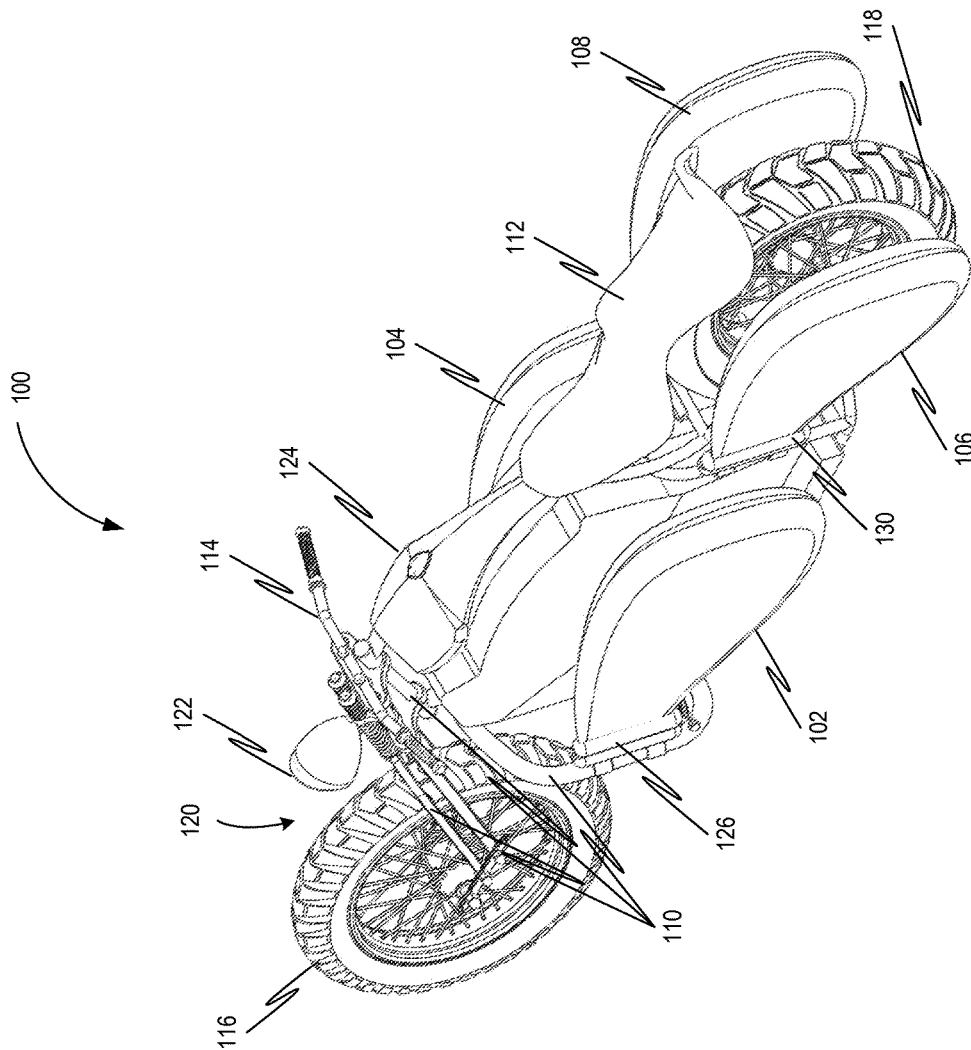


FIG. 2

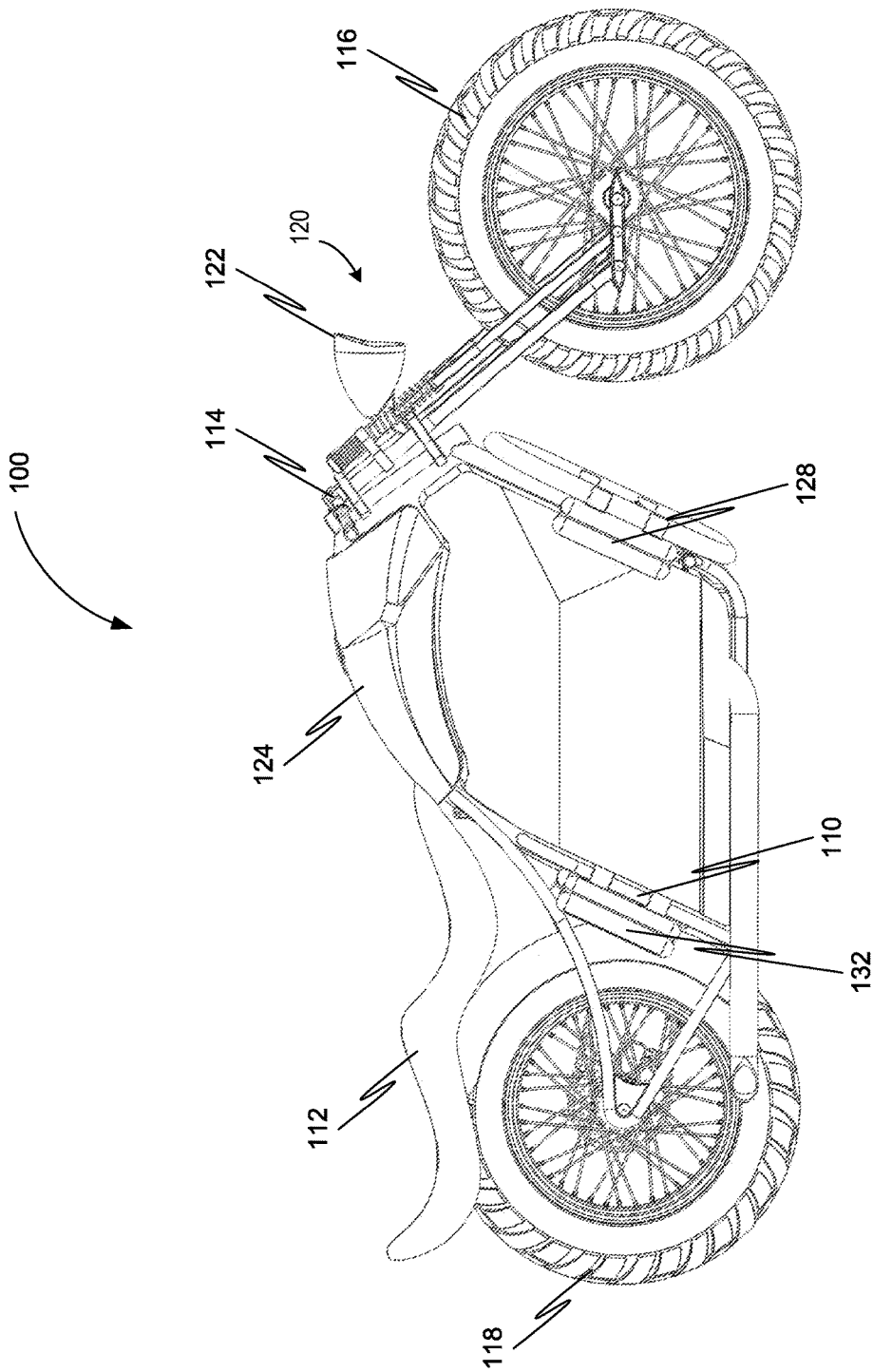


FIG. 3

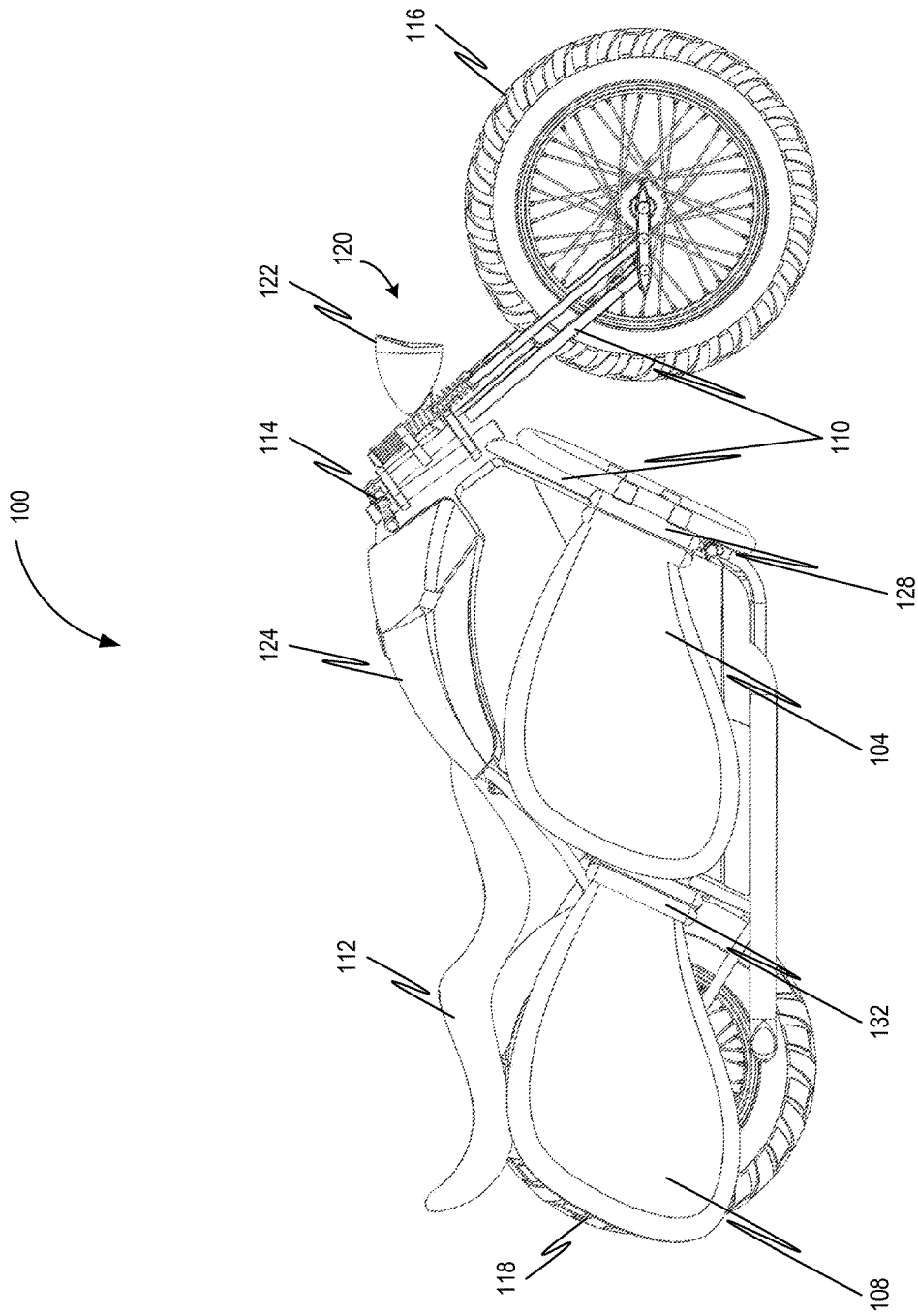


FIG. 4

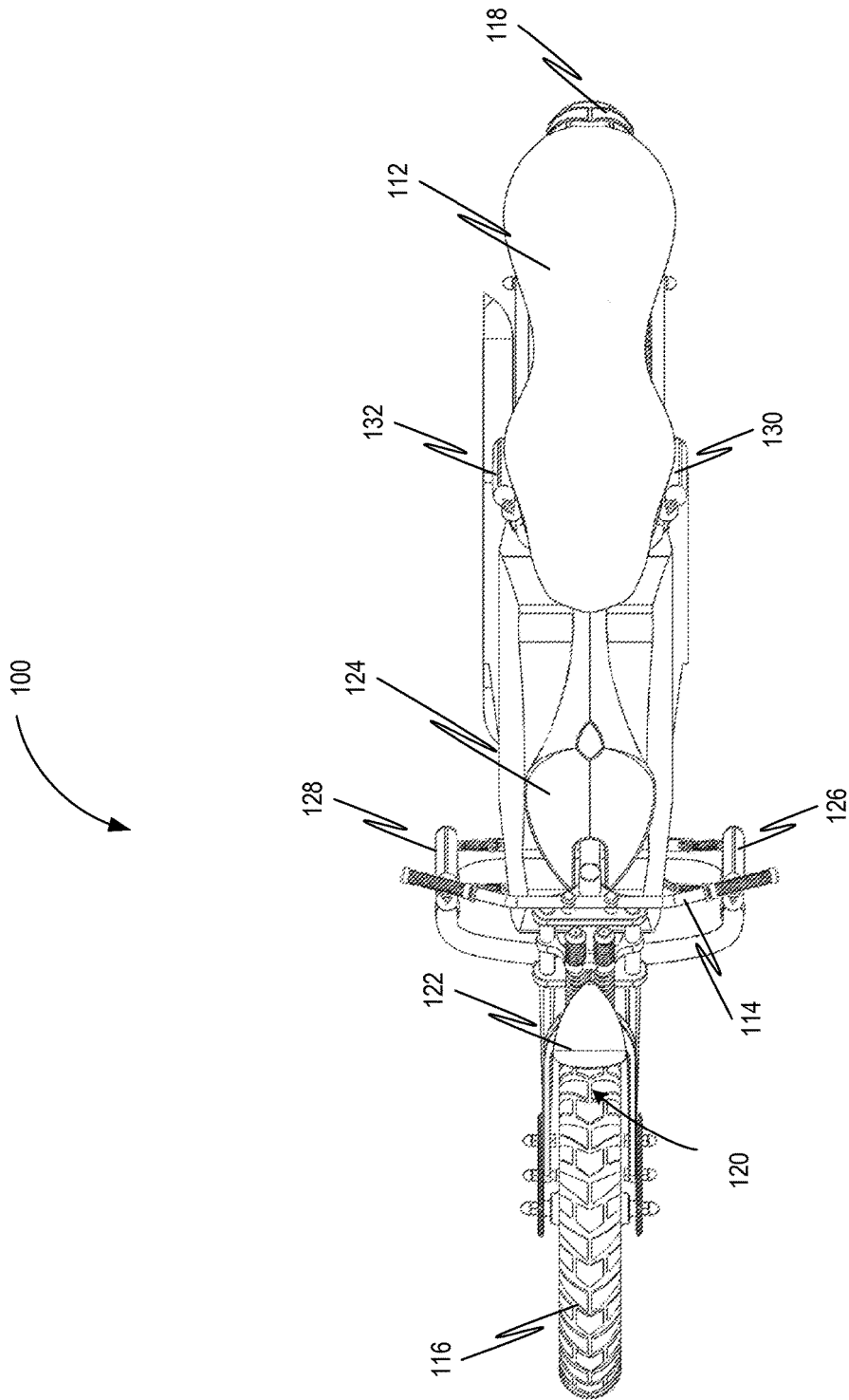


FIG. 5

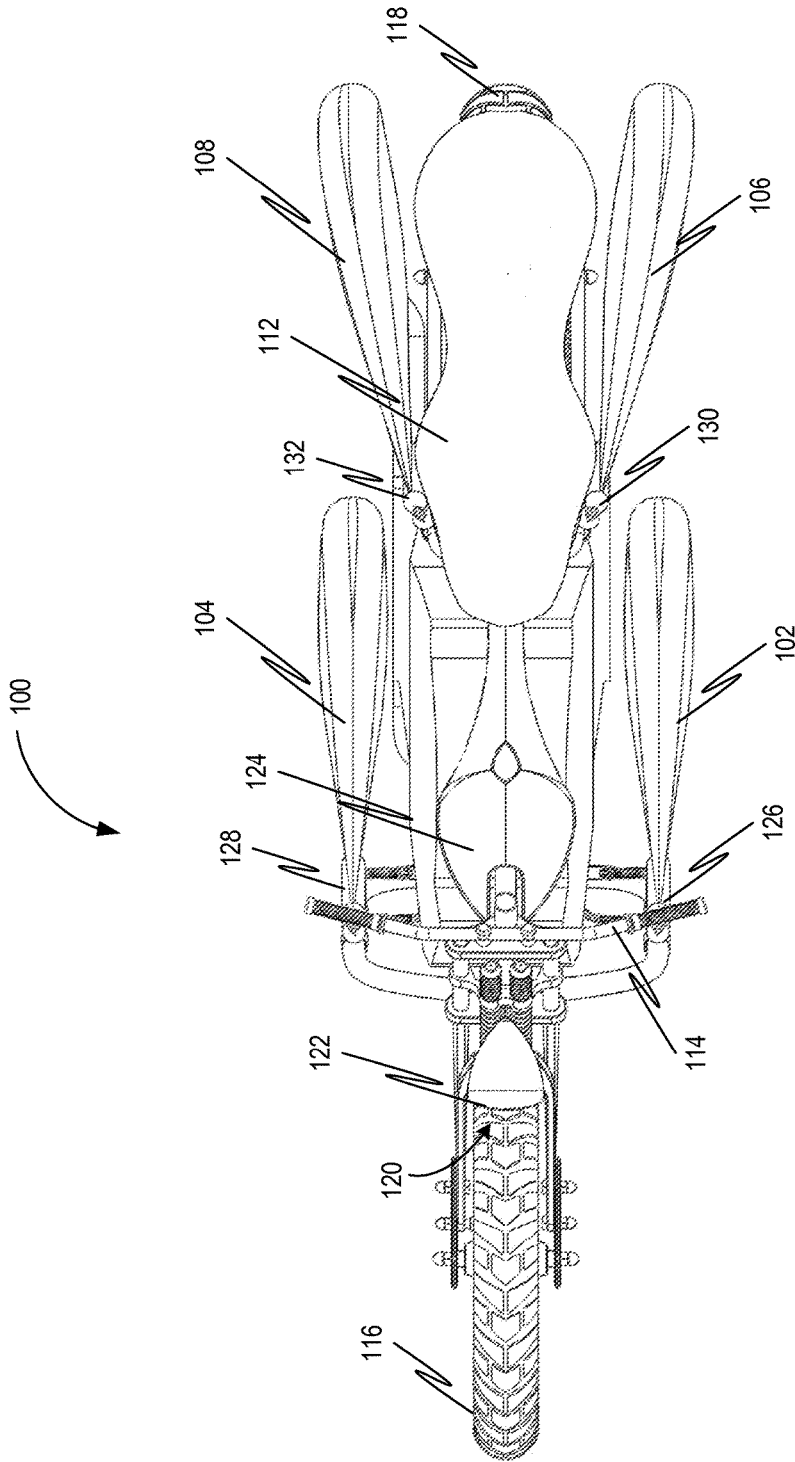


FIG. 6



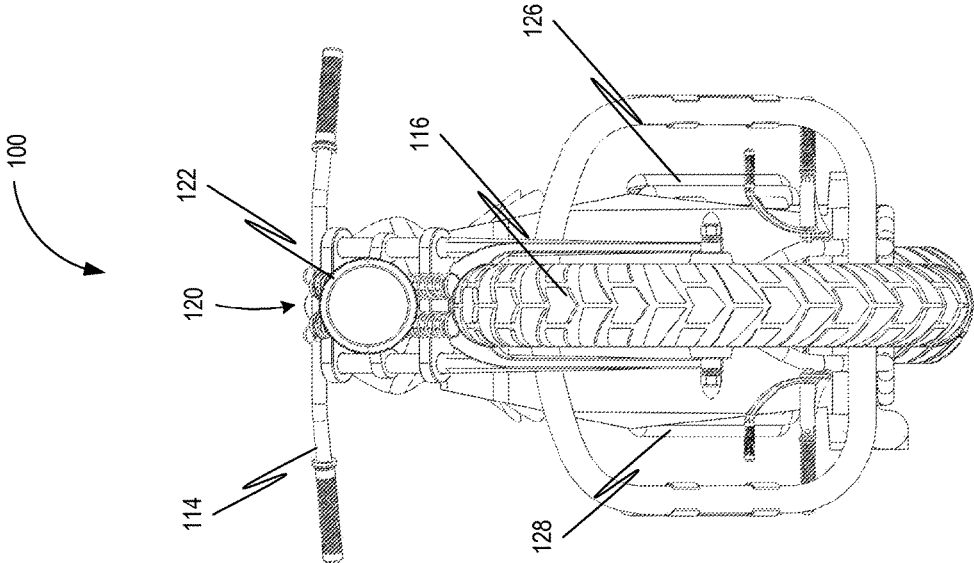


FIG. 7

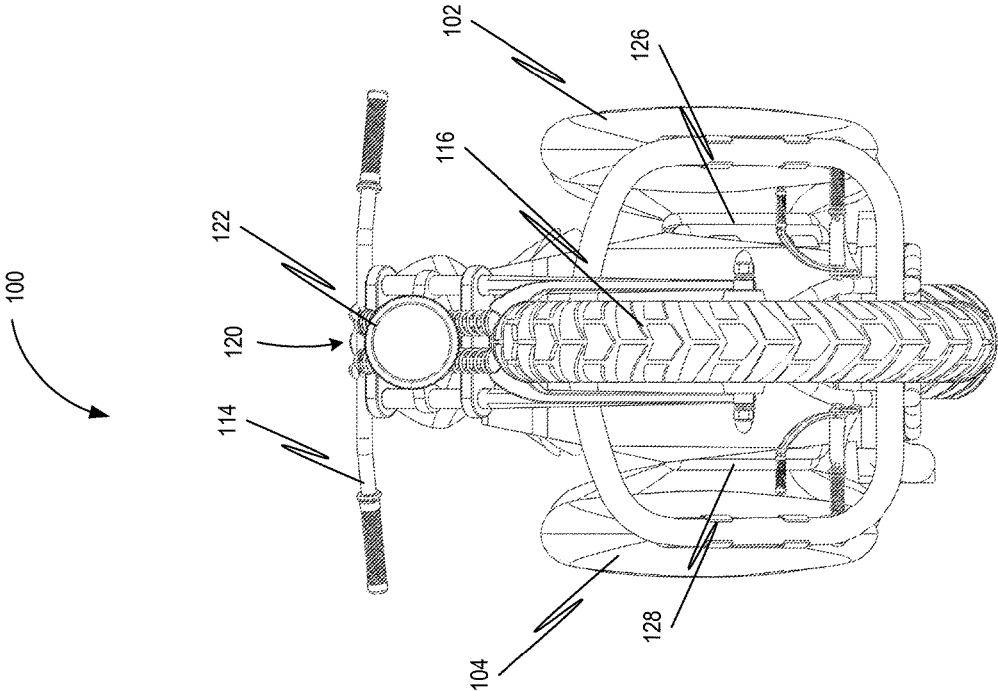


FIG. 8

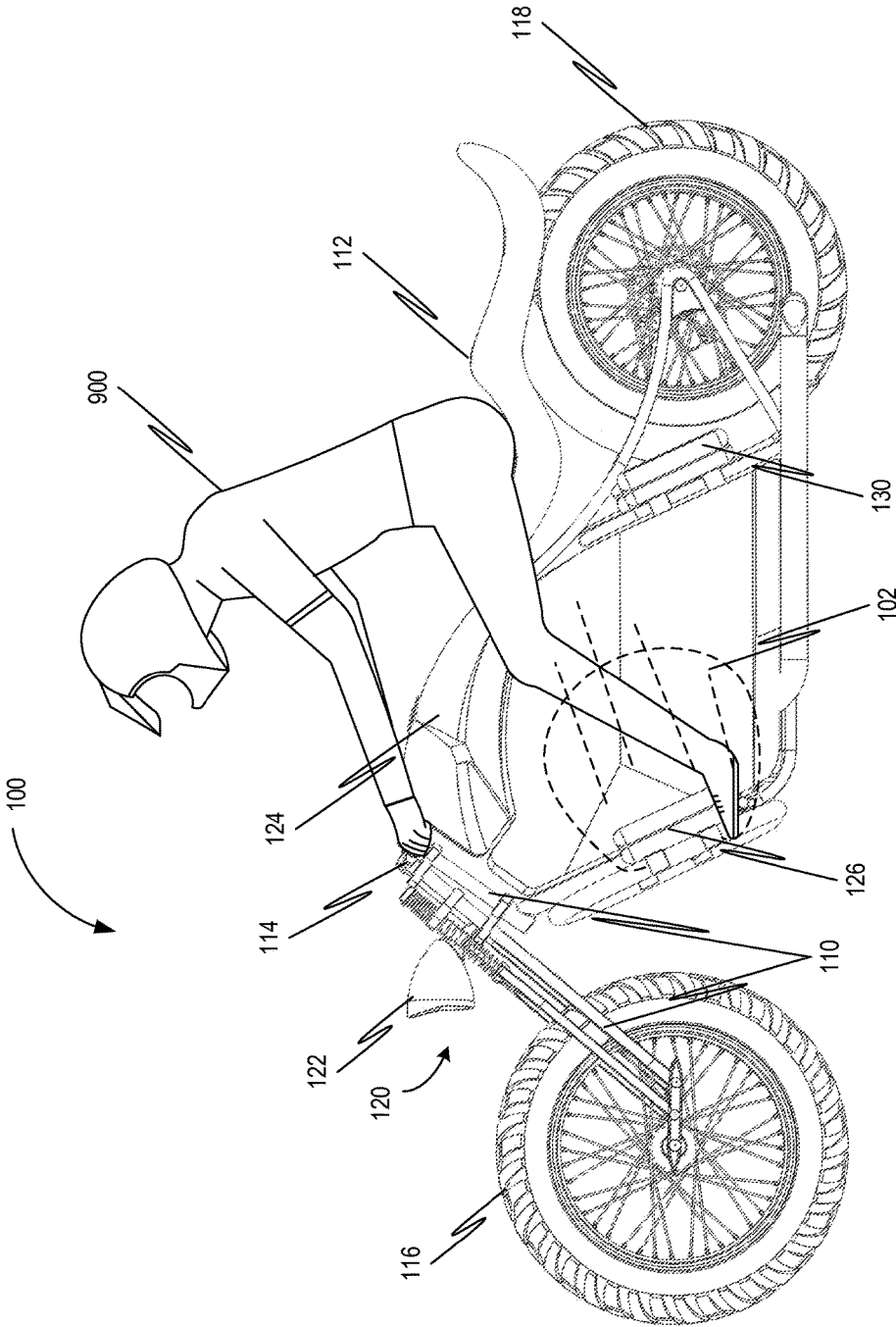


FIG. 9

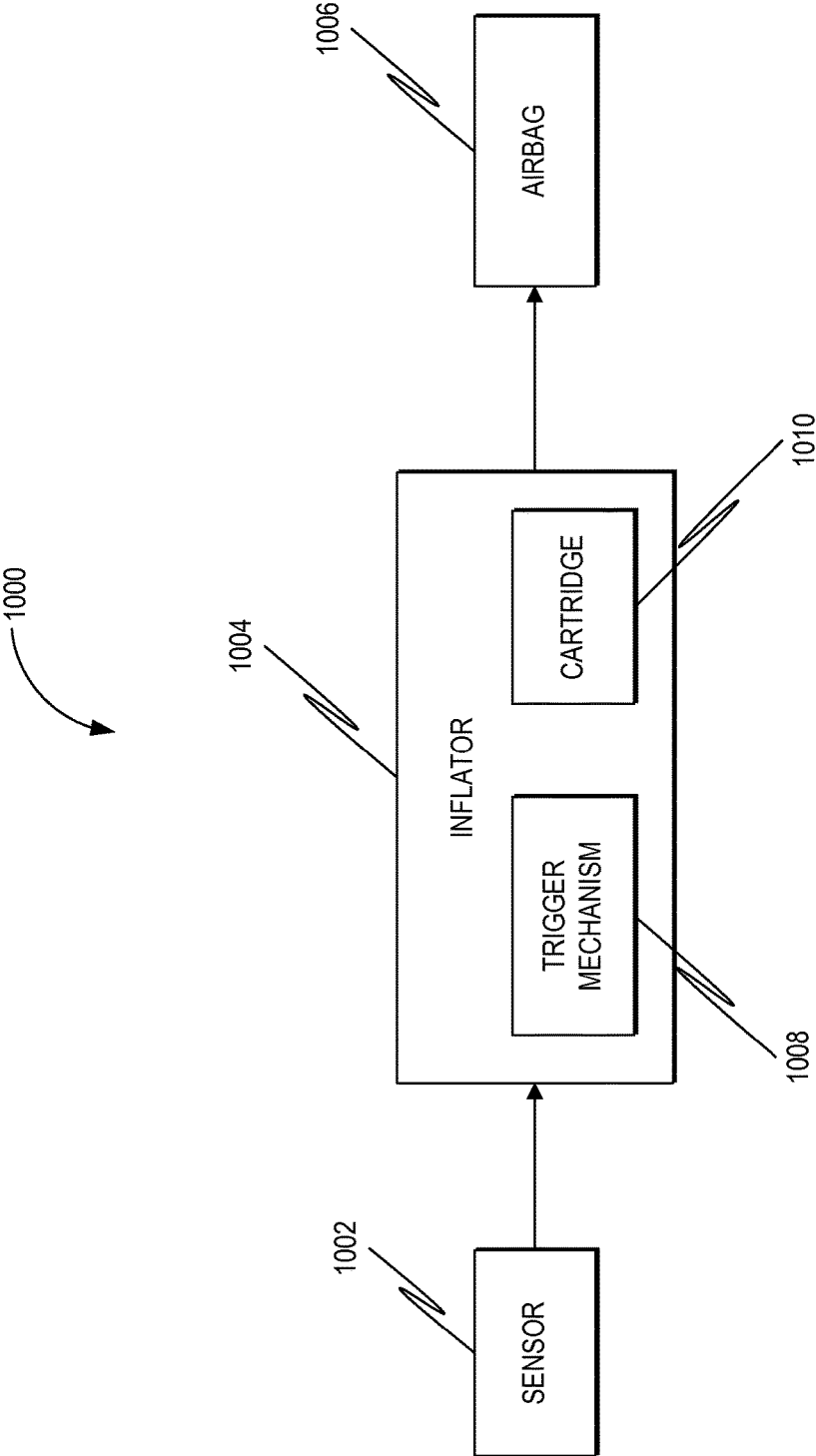


FIG. 10

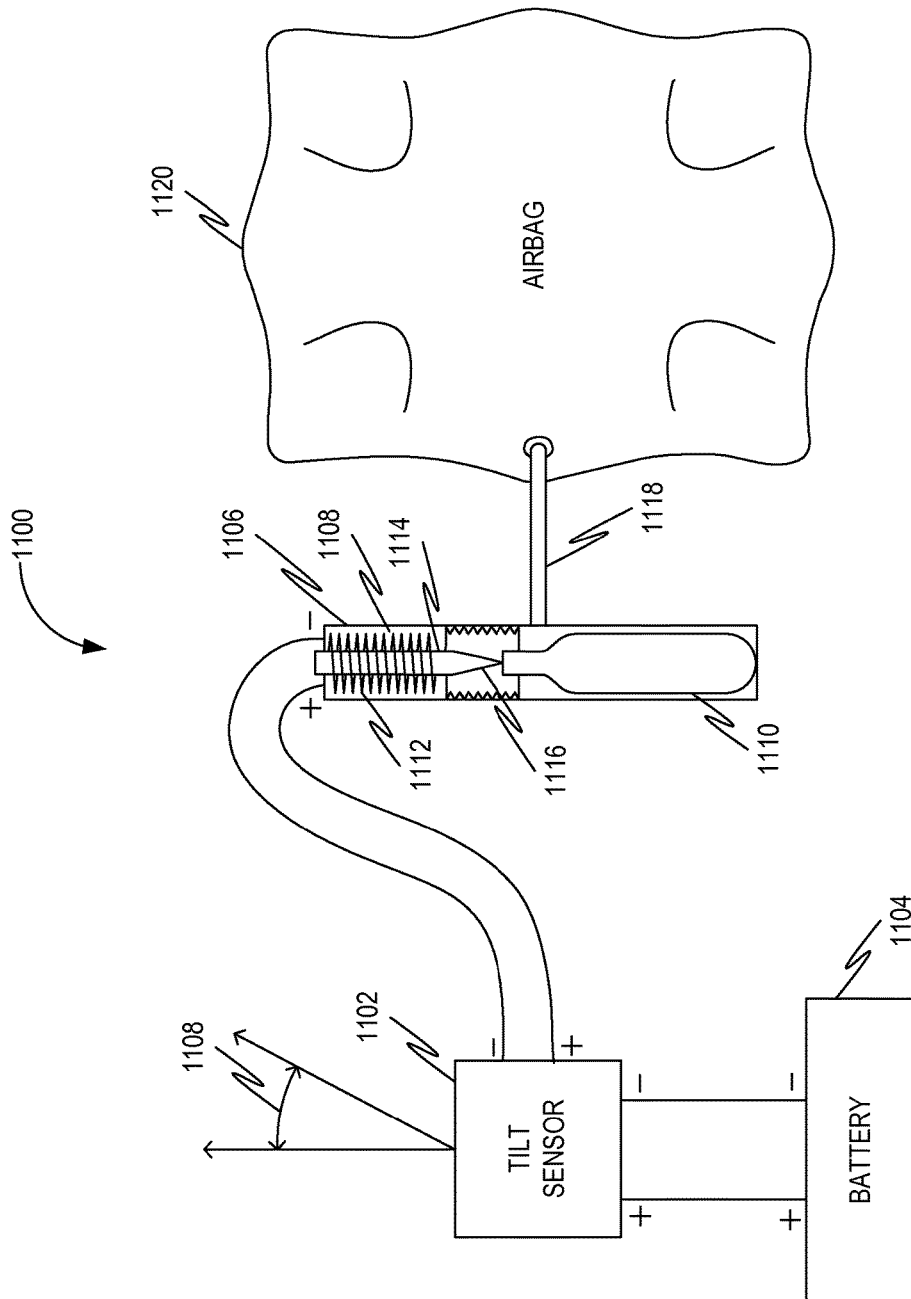


FIG. 11

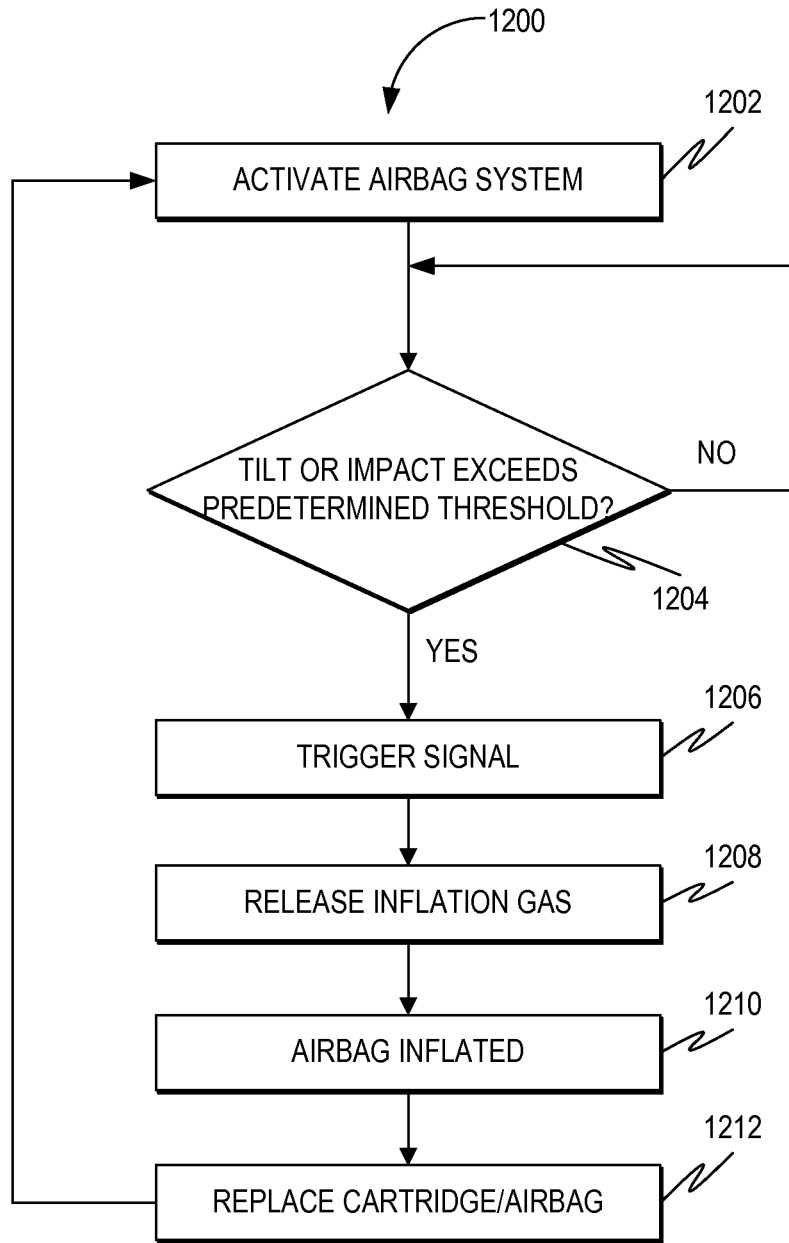


FIG. 12

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**TWO-WHEELER AIRBAG SYSTEM**

## TECHNICAL FIELD

The present invention relates to an airbag system to be mounted on a two-wheeler vehicle.

## BACKGROUND OF THE INVENTION

Airbag modules for two-wheeler vehicles have recently been developed. When it is detected that there has been an impact, the airbag module inflates and deploys an airbag, which is responsible for mitigating the impact suffered by the rider. Most of these airbags protect riders in case of front collision.

However, skidding is one of the major causes of two-wheeler accidents. The rider is not protected during skidding. The causes of skidding include sharp turns, unbanked turns, obstacle such as pebbles, water, oil spills etc., sudden side traffic and pedestrians or pets crossing the road. Most of these causes are beyond a rider's control, so many a times skidding is inevitable. In a skidding accident, the body parts that are most vulnerable to getting hurt are the legs, the feet and the knees. Apart from the impact, the rider and pillion rider also get dragged along with the two-wheeler vehicle till the vehicle and riders lose their momentum. The chances of getting leg trapped and dragged is also high in case of such an incident. This can cause severe injury to the rider. Therefore, there is a need to protect riders when two-wheeler vehicles skid.

## SUMMARY OF THE INVENTION

The present invention provides an airbag apparatus for a two-wheeler vehicle. The airbag apparatus includes at least one front airbag mounted near each leg of a rider of the two-wheeler vehicle, the at least one front airbag to be deployed and inflated for protecting the knees, legs and feet of the rider during emergency conditions. Further, the airbag apparatus includes at least one rear airbag mounted near each leg of a pillion rider of the two-wheeler vehicle, the at least one rear airbag to be deployed and inflated for protecting the knees, legs and feet of the pillion rider during emergency conditions. Yet further, the airbag apparatus includes at least one inflator configured to supply inflation gas to the at least one front airbag and the at least one rear airbag when activated. Finally, the airbag apparatus includes at least one sensor configured to track at least one safety parameter of the two-wheeler vehicle and activate the inflator, when a predetermined threshold of the at least one safety parameter is reached.

In some embodiments, the at least one inflator includes a trigger mechanism and one of a gas cartridge storing compressed gas and a chemical cartridge storing one or more chemicals capable of generating gas through a chemical reaction.

In further embodiments, the at least one sensor is a tilt sensor that activates the at least one inflator, when a tilt of the two-wheeler vehicle exceeds a predetermined threshold, wherein the at least one front airbag and the at least one rear airbag is inflated based on the direction of tilt determined by the tilt sensor.

In some further embodiments, the at least one sensor includes an impact sensor that detects a collision and activates the at least one inflator, when a detection value of the impact sensor is greater than a predetermined threshold,

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wherein all airbags in the at least one front airbag and the at least one rear airbag are inflated when the impact sensor detects a collision.

In another related aspect of the present invention, a method to deploy an airbag for a two-wheeler vehicle, the two-wheeler vehicle includes at least one front airbag mounted near each leg of a rider of the two-wheeler vehicle and at least one rear airbag mounted near each leg of a pillion rider of the two-wheeler vehicle. The method comprising first detecting an emergency condition, using at least one sensor configured to track at least one safety parameter of the two-wheeler vehicle. Next, the method includes sending a trigger signal, when a predetermined threshold of the at least one safety parameter is reached. Then, the method includes activating at least one inflator configured to supply inflation gas to the at least one front airbag and the at least one rear airbag when the trigger signal is received. Finally, the method includes deploying at least one of the at least one front airbag and the at least one rear airbag.

With these and other advantages and features of the invention that will become hereinafter apparent, the invention may be more clearly understood by reference to the following detailed description of the invention, the appended claims, and the drawings attached herein.

## BRIEF DESCRIPTION OF THE DRAWINGS

As presented herein, various embodiments of the present invention will be described, followed by some specific examples of various components that can be utilized to implement the embodiments. The following drawings facilitate the description of some embodiments of the present invention.

FIG. 1 is an isometric view of a two-wheeler vehicle, according to an embodiment of the invention.

FIG. 2 is an isometric view of the two-wheeler vehicle, when the airbag of the embodiment is fully deployed.

FIG. 3 is a side view of the two-wheeler vehicle in FIG. 1.

FIG. 4 is a side view of the two-wheeler vehicle in FIG. 1, when the airbag of the embodiment is fully deployed.

FIG. 5 is a top view of the two-wheeler vehicle in FIG. 1.

FIG. 6 is a top view of the two-wheeler vehicle in FIG. 1, when the airbag of the embodiment is fully deployed.

FIG. 7 is a front view of the two-wheeler vehicle in FIG. 1.

FIG. 8 is a front view of the two-wheeler vehicle in FIG. 1, when the airbag of the embodiment is fully deployed.

FIG. 9 is a side view of the two-wheeler vehicle in FIG. 1, when an airbag of the embodiment is fully deployed.

FIG. 10 is a block diagram an airbag system according to an embodiment of the invention.

FIG. 11 illustrates exemplary method steps for deployment of the airbag system according to an embodiment of the invention.

FIG. 12 is a flow chart of a method of the invention.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention will be further illustrated with examples below. Referring first to FIGS. 1 and 2, the entire structure of a two-wheeler vehicle **100** will be described. FIGS. 1 and 2 show an isometric view of the two-wheeler vehicle **100** according to an embodiment of the invention, to which an airbag system is mounted. FIG. 2 shows fully deployed front airbags **102-104** and rear airbags **106-108**.

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The two-wheeler vehicle **100** of the embodiment is a motorcycle. However, the two-wheeler vehicle may be a bicycle, a scooter or any similar vehicle.

As shown in FIGS. **1** and **2**, the two-wheeler vehicle **100** is composed of a body frame **110** including an engine and a main frame; a seat **112** that a rider and pillion rider can straddle; a handlebar **114**; a front wheel **116** and a rear wheel **118**. A front part **120** of the body frame **110** at the front of the vehicle has a headlight **122**, various meters, switches, a windshield and so on. A fuel tank **124** is disposed in front of a vehicle between the seat **112** and the front part **120**. When the airbag **102** is not deployed, it is housed in a retainer **126**. Similarly, the airbag **104** is housed in a retainer **128**, the airbag **106** is housed in a retainer **130** and the airbag **108** is housed in a retainer **132**. The retainers **126-132** may be part of the frame **110** of the two-wheeler vehicle **100**. Alternatively, the retainers **126-132** may be additional components mounted on the frame **110** of the two-wheeler vehicle **100**. The airbags **102-108** are made of the same material as that of car airbags. The retainers **126-132** provide housing for the airbags **102-108** respectively in a predetermined folded state. The retainers **126-132** may also house inflators to deploy the airbags **102-108**. The retainers for airbags are well known in the art.

FIGS. **3** and **4** show a side view of the two-wheeler vehicle **100**. FIGS. **5** and **6** show a top view of the two-wheeler vehicle **100**. FIGS. **7** and **8** show a front view of the two-wheeler vehicle **100**.

The retainer **126** (and the front airbag **102**) is mounted near left leg of a rider of the two-wheeler vehicle **100** and the retainer **128** (and the front airbag **104**) is mounted near right leg of a rider of the two-wheeler vehicle **100**. For example, each of the front airbags **102-104** is mounted near each shin of the rider respectively. Further, the front airbags **102-104** may be mounted on a front safety bar of the two-wheeler vehicle **100**. Similarly, the retainer **130** (and the rear airbag **106**) is mounted near left leg of a pillion rider of the two-wheeler vehicle **100** and the retainer **132** (and the rear airbag **108**) is mounted near right leg of the pillion rider of the two-wheeler vehicle **100**.

When the front airbags **102-104** are deployed they protect the knees, legs and feet of a rider **900** as shown in FIG. **9**. When the rear airbags **106-108** are deployed they protect the knees, legs and feet of a pillion rider (not shown). Accordingly, size, shape and volume of the airbags **102-108** is selected such that when the airbags are deployed the knees, legs and feet of one of the rider and the pillion rider are totally protected. For example, the airbags **102-108** may be fin shaped. Further, suitable webbings, straps, belts or like may be used to ensure that the airbags **102-108** deploy properly to restrain and protect the knees, legs and feet of the rider and the pillion rider.

The airbags **102-108** are deployed during emergency conditions, which include a collision of the two-wheeler vehicle **100** or tilt of the two-wheeler vehicle **100** exceeding a critical angle. The collision broadly includes the two-wheeler vehicle **100** colliding with an object (for example, other vehicles, pedestrians, obstacles, or guardrails). Tilting of the two-wheeler vehicle **100** includes the rider banking the two-wheeler vehicle **100** while turning the two-wheeler vehicle **100** around a corner and the rider losing the balance of the two-wheeler vehicle **100** leading to the two-wheeler vehicle **100** falling on one side. The critical angle depends on the characteristics of the two-wheeler vehicle **100** and the road surface.

Further, the two-wheeler vehicle **100** includes one or more inflators configured to supply inflation gas to the

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airbags **102-108**. The airbags **102-108** are in a folded state before deployment. The inflation gas from the one or more inflators deploys the one or more airbags **102-108**. An inflator further includes a trigger mechanism and a cartridge to release inflation gas. The cartridge is one of a gas cartridge storing compressed gas and a chemical cartridge storing one or more chemicals capable of generating gas through a chemical reaction. An inflator may be housed in each airbag, wherein the inflator supplies the inflation gas directly into the corresponding airbag. Alternatively, an inflator is connected to one or more airbags through a gas supply passage and the inflator indirectly supplies the inflation gas into the one or more airbags through the gas supply passage.

Yet further, the two-wheeler vehicle **100** includes one or more sensors that activate the one or more inflators by closing an electrical circuit, wherein an electric signal is used to ignite a chemical reaction in a chemical cartridge to generate gas or release compressed gas from a gas cartridge that inflates the one or more airbags **102-108**. The one or more sensors configured to track one or more safety parameters of the two-wheeler vehicle **100** and generate a trigger signal, when a predetermined threshold of the one or more safety parameters is reached. In an embodiment, the one or more sensors include a tilt sensor that activates the one or more inflators, when a tilt of the two-wheeler vehicle **100** exceeds a predetermined threshold (a critical angle). The one or more front airbags **102-104** and the one or more rear airbags **106-108** are inflated based on the direction of tilt determined by the tilt sensor. Further, the one or more sensors further include an impact sensor that detects a collision and activates the one or more inflators, when a detection value of the impact sensor is greater than a threshold value. All airbags **102-108** are inflated when the impact sensor detects a collision. Moreover, the one or more inflators may be deactivated to prevent any accidental activation during vehicle servicing.

System Block Diagram

Referring to FIG. **10**, the airbag system **1000** of an embodiment is mainly composed of one or more sensors **1002**, one or more inflators **1004**, and one or more airbags **1006**. The one or more sensors **1002** include a tilt sensor, an impact sensor, a pressure sensor and other similar sensors. In the event of a skidding or impact, the one or more sensors **1002** detect the emergency condition. For example, the tilt sensor detects when the tilt angle of the two-wheeler vehicle **100** is more than the critical angle and the impact sensor detects when an impact is beyond normal limits. When an emergency condition is detected, the one or more sensors **1002** send a trigger signal to the one or more inflators **1004**. Each inflator in the one or more inflators **1004** includes a trigger mechanism **1008** and a cartridge **1010**, wherein the cartridge **1010** is one of a gas cartridge storing compressed gas and a chemical cartridge storing one or more chemicals capable of generating gas through a chemical reaction. For example, a gas cartridge may store carbon dioxide (CO<sub>2</sub>) in liquid form and a chemical cartridge may store chemicals Potassium Nitrate (KNO<sub>3</sub>) and Sodium Azide (NaN<sub>3</sub>) which on chemically reacting release CO<sub>2</sub>. The one or more airbags **1006** are the airbags **102-108**.

Various configurations of the one or more sensors **1002**, the one or more inflators **1004** and the one or more airbags **1006** may be employed. In an example embodiment, there is one set of the one or more sensors **1002** and one inflator **1004** for each airbag in the one or more airbags **1006**. In this embodiment, there are four sets of the one or more sensors **1002** and four inflators. Accordingly, the one or more



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sensors **1002** send a trigger signal to the relevant inflator which then inflates the associated airbag. In an alternate embodiment, the two-wheeler vehicle **100** includes one central set of sensors **1002** and one central inflator **1004**, wherein the central set of sensors **1002** sends a trigger signal to the central inflator **1004** which then inflates the relevant airbag via a gas supply passage (a gas duct). In another embodiment, the two-wheeler vehicle **100** includes one central set of sensors **1002**. Further it includes one inflator **1004** for each airbag, wherein the central set of sensors **1002** sends a trigger signal to the relevant inflator **1004** which then inflates the corresponding airbag directly. In a yet another embodiment, the two-wheeler vehicle **100** includes one central set of sensors **1002**. Further it includes one inflator **1004** for each side of the vehicle (that is, one inflator for the left side of the vehicle and one inflator for the right side of the vehicle), wherein the central set of sensors **1002** sends a trigger signal to the relevant inflator on one of the left side and right side of the two-wheeler vehicle **100**, which then inflates the two airbags on the corresponding side of the two-wheeler vehicle **100** directly.

Further, when a tilt sensor indicates that the two-wheeler vehicle **100** has tilted more than a predetermined threshold (critical angle) towards the left side, then only the left side airbags (the airbags **102** and **106**) are deployed to protect the rider and the pillion rider. Similarly, when the tilt sensor indicates that the two-wheeler vehicle **100** has tilted more than a predetermined threshold towards the right side, then only the right side airbags (the airbags **104** and **108**) are deployed to protect the rider and the pillion rider. However, when an impact sensor detects a collision, then all airbags **102-108** are deployed. Yet further, the seat **112** may include a pressure sensor to detect a pillion rider. Accordingly, the rear airbags **106** and **108** are deployed in emergency situations only if a pillion rider is detected by the pressure sensor.

FIG. **11** shows an airbag system **1100** according to an exemplary embodiment of present disclosure. The airbag system **1100** includes a tilt sensor **1102** connected to a battery **1104**. The battery **1104** may be the main battery of the two-wheeler vehicle **100**. The tilt sensor **1102** activates an inflator **1106**, when a tilt of the two-wheeler vehicle **100** exceeds a predetermined threshold. The predetermined threshold is a critical angle **1108**. The critical angle **1108** depends on the characteristics of the vehicle and the road surface. The inflator **1106** includes a trigger mechanism **1108** and a cartridge **1110**. The trigger mechanism **1108** includes a coil **1112**, which moves a solenoid core **1114** when the trigger mechanism **1108** is activated by the tilt sensor **1102**. The solenoid core **1112** further has a punch tip **1116**, which when moved punctures the cartridge **1110**. The cartridge **1110** contains compressed carbon dioxide. The released carbon dioxide moves through an air duct **1118** to inflate the airbag **1120**.

#### Methods

Referring now to FIG. **12**, a flow chart of a method **1200** that may be incorporated into some embodiments of the present invention. The method steps are presented as exemplary and are not required to be executed in a particular order. At step **1202**, the airbag system **1000** is activated. The airbag system **1000** is activated when the ignition switch of the two-wheeler vehicle **100** is switched on. There may be an additional switch to switch on/off the airbag system **1000**. The additional switch is also used to deactivate the airbag system **1000** (or the inflator **1004**) to prevent any accidental activation during vehicle servicing.

Then, at step **1204**, the sensor **1002** is configured to detect and determine an emergency condition which includes

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detecting an impact or a tilt more than a predetermined threshold. When the sensor **1002** detects an emergency condition, the sensor **1002** sends a trigger signal that closes an electrical circuit at step **1206**. The trigger signal activates the trigger mechanism **1008** which releases inflation gas from the cartridge **1010** at step **1208**. The inflation gas inflates the airbag **1006** at step **1210**. The trigger signal is an electric signal that can be used to ignite chemical reaction when a chemical cartridge is used or to puncture a cartridge when a gas cartridge is used. The time between sending the trigger signal and the two-wheeler vehicle **100** completely falling is utilized to completely deploy the relevant airbags to provide a cushion for the leg, knee and feet of the rider and the pillion rider.

Once an airbag is inflated, the cartridge **1010** needs to be replaced. Further, airbag may be damaged as it protects the rider and the pillion rider. The cartridge **1010** and airbag are replaced at step **1212** and the method **1200** goes back to step **1202**.

A number of embodiments of the present invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. For example, various methods or equipment may be used to implement the process steps described herein or to create a device according to the inventive concepts provided above and further described in the claims. In addition, various integration of components, as well as software and firmware may be implemented. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. An airbag apparatus for a two-wheeler vehicle, the airbag apparatus comprising:
  - a. a plurality of front airbags mounted on the two-wheeler vehicle configured to be near each leg of a rider of the two-wheeler vehicle, wherein the plurality of front airbags corresponds to a left side and a right side of the vehicle, wherein at least one front airbag of the plurality of front airbags is configured to be deployed and inflated for protecting the knees, legs and feet of the rider on one of the left side and the right side of the two-wheeler vehicle during emergency conditions;
  - b. a plurality of rear airbags mounted on the two-wheeler vehicle configured to be near each leg of a pillion rider of the two-wheeler vehicle, wherein the plurality of rear airbags corresponds to the left side and the right side of the vehicle, wherein at least one rear airbag of the plurality of rear airbags is configured to be deployed and inflated for protecting the knees, legs and feet of the pillion rider on one of the left side and the right side of the two-wheeler vehicle during emergency conditions;
  - c. at least one selected inflator configured to supply inflation gas to the at least one front airbag and the at least one rear airbag when activated, wherein each of the at least one front airbag and the at least one rear airbag corresponds to only one of the left side and the right side of the two-wheeler vehicle;
  - d. at least one tilt sensor configured to determine a direction of tilt and a critical angle of tilt of the two-wheeler vehicle and produce a trigger signal to activate the at least one selected inflator selected based upon a direction of tilt registered by the tilt sensor and the tilt sensor exceeding a predetermined threshold critical angle;

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e. wherein the at least one front airbag is mounted on either sides of the two-wheeler vehicle configured to be next to the rider's shin; and  
 f. wherein the at least one rear airbag comprises a fin shape mounted on either side of the two-wheeler vehicle is configured to be next to the pillion rider's shin and configured to protect knees, legs and feet of the rider when deployed.

2. The airbag apparatus of claim 1 wherein the at least one front airbag and the at least one rear airbag is mounted on the frame of the two-wheeler vehicle.

3. The airbag apparatus of claim 1 wherein the at least one front airbag and the at least one rear airbag is shaped and sized such that a fully inflated airbag shields the knees, legs and feet of one of the rider and the pillion rider.

4. The airbag apparatus of claim 1, wherein the at least one inflator includes a trigger mechanism and one of a gas cartridge storing compressed gas and a chemical cartridge storing one or more chemicals capable of generating gas through a chemical reaction.

5. The airbag apparatus of claim 1, the at least one sensor is a tilt sensor that activates the at least one inflator, when a tilt of the two-wheeler vehicle measured by the tilt sensor exceeds a threshold dependent upon characteristics of a road surface.

6. The airbag apparatus of claim 5, wherein the at least one front airbag and the at least one rear airbag is inflated based on the direction of tilt determined by the tilt sensor that is dependent upon characteristics of the two wheeler vehicle.

7. The airbag apparatus of claim 6, the at least one sensor includes an impact sensor that detects a collision and activates the at least one inflator, when a detection value of the impact sensor is greater than a predetermined threshold indicating a collision of the two wheeler vehicle with an object comprising one of: another vehicle, a pedestrian, an obstacle and a guardrail.

8. The airbag apparatus of claim 7, wherein all airbags in the at least one front airbag and the at least one rear airbag are inflated when the impact sensor detects a collision.

9. The airbag apparatus of claim 8, wherein the at least one sensor activates the at least one inflator by sending a trigger signal, wherein the trigger signal is an electric signal used to ignite a chemical reaction in a chemical cartridge to generate gas or to release compressed gas in a gas cartridge that inflates at least one of the at least one front airbag and the at least one rear airbag.

10. The airbag apparatus of claim 9, wherein the at least one inflator may be deactivated to prevent activation during vehicle servicing.

11. A method to deploy an airbag for a two-wheeler vehicle, the two-wheeler vehicle comprising a plurality of front airbags mounted on the two-wheeler vehicle configured to be near each leg of a rider of the two-wheeler vehicle and a plurality of rear airbags mounted on the two-wheeler vehicle configured to be near each leg of a pillion rider of the two-wheeler vehicle, wherein each of the plurality of front airbags and the plurality of rear airbags corresponds to a left side and right side of the two-wheeler vehicle, the method comprising:

- a. detecting an emergency condition, using at least one sensor configured to track at least one safety parameter comprising:
  - a critical angle of the two-wheeler vehicle based upon characteristics of the two-wheeler vehicle, and a direction of tilt;

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b. sending a trigger signal, when a predetermined threshold critical angle in the direction of tilt is reached;

c. activating at least one inflator configured to supply inflation gas to at least one of at least one front airbag of the plurality of front airbags and at least one rear airbag of the plurality of rear airbags when the trigger signal is received, wherein each of the at least one front airbag and the at least one rear airbag corresponds to a direction of tilt and comprising only one of the left side and the right side of the two-wheeler vehicle;

d. deploying at least one of the at least one front airbag and the at least one rear airbag; wherein the at least one rear airbag to be deployed and inflated for protecting the knees, legs and feet of the pillion rider on one of the left side and the right side of the two-wheeler vehicle during emergency conditions, wherein the at least one front airbag to be deployed and inflated for protecting the knees, legs and feet of the rider on one of the left side and the right side of the two-wheeler vehicle during emergency conditions; and

e. forming at least one of the at least one front airbag and the at least one rear airbag is fin shaped and mounted on the frame of the two-wheeler vehicle, wherein at least one of the at least one front airbag and the at least one rear airbag is shaped and sized so that a fully inflated airbag ins configured to shield the knees, legs and feet of at least one of the rider and the pillion rider.

12. The method of claim 11, wherein the at least one inflator includes a trigger mechanism and one of a gas cartridge storing compressed gas and a chemical cartridge storing one or more chemicals capable of generating gas through a chemical reaction.

13. The method of claim 12, wherein the at least one sensor is a tilt sensor that activates the at least one inflator, when a tilt of the two-wheeler vehicle exceeds a predetermined threshold, wherein the at least one front airbag and the at least one rear airbag is inflated based on the direction of tilt determined by the tilt sensor and the characteristics of a road surface.

14. The method of claim 13, wherein the at least one sensor includes an impact sensor and the method further detecting a collision; and activating all airbags based upon the impact sensor detecting a collision.

15. The method of claim 14, wherein the at least one sensor activates the at least one inflator by sending a trigger signal, wherein the trigger signal is an electric signal used to ignite a chemical reaction in a chemical cartridge to generate gas or to release compressed gas in a gas cartridge that inflates at least one of the at least one front airbag and the at least one rear airbag.

16. An airbag apparatus for a two-wheel vehicle, the airbag apparatus comprising:

- a. a left front airbag and a right front airbag, mounted to a frame of the two-wheel vehicle, on a left side and a right side of the two-wheel vehicle respectively, and positioned to protect knees, legs and feet of a driver of the two-wheel vehicle when the left front airbag and the right front airbag are deployed;
- b. a left rear airbag and a right rear airbag, mounted to a frame of the two-wheel vehicle, each fin shaped and mounted on a left side and a right side of the two-wheel vehicle respectively, and positioned to protect knees, legs and feet of a pillion rider of the two-wheel vehicle when the left rear airbag and the right rear airbag are deployed;
- c. an inflator device configured in an activated state to supply inflation gas to one or more of the left front

- airbag, the right front airbag, the left rear airbag or the right rear airbag, the inflator device comprising one of one of: a gas cartridge storing compressed gas and a chemical cartridge storing one or more chemicals capable of generating gas through a chemical reaction; 5
- d. a tilt sensor configured to determine a direction of tilt and a critical angle of tilt of the two wheeled vehicle and produce a trigger signal to activate the inflator device and thereby supply gas to a selected airbag based upon a direction of tilt registered by the tilt 10 sensor and the tilt sensor exceeding a predetermined threshold critical angle of tilt of the two wheeled vehicle, wherein the threshold critical angle may be based upon characteristics of a road surface and the two-wheel vehicle; 15
- e. an impact sensor for detecting a collision and deploying each inflator via activation when a detection value of the impact sensor is greater than a predetermined threshold indicating a collision of the two wheel vehicle with an object comprising one of: another 20 vehicle, a pedestrian, an obstacle and a guardrail; and
- f. a deactivation device deactivating the inflator during service of the two-wheel vehicle.

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