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(54) **VEHICLE SEAT SYSTEM**

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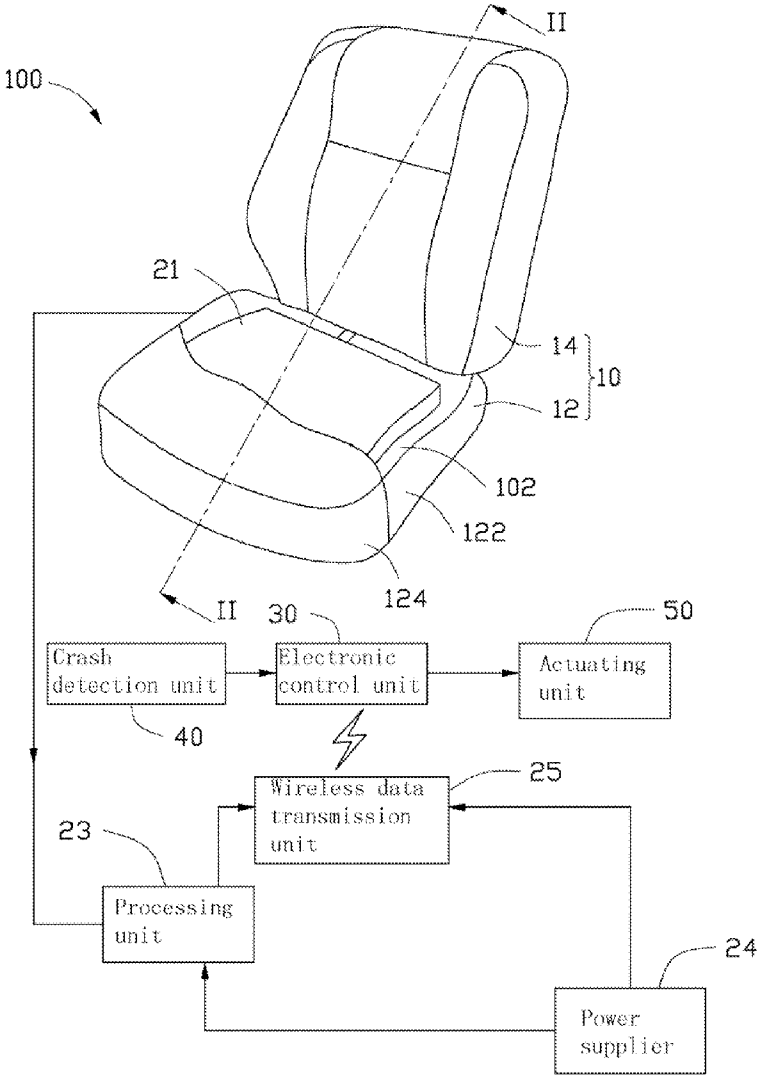
(57) **ABSTRACT**

An exemplary vehicle seat system includes a vehicle seat, an electronic control unit, a crash detection unit connected with the control unit, a seat occupancy sensing module configured for sensing an occupancy of the seat and generating a digital signal associated therewith, an airbag, and an airbag inflating module. The detection unit detects a crash and sends a crash signal associated therewith to the control unit. The inflating module is selectively operable in an activated mode where the inflating module is configured to inflate the airbag in response to the crash signal and an inactivated mode where the inflating module is deactivated and irresponsive to the crash signal. The control unit analyzes the digital signal and determining if the vehicle seat is occupied, and switches the inflating module either in the activated mode if the seat is occupied or in the inactivated mode if the seat is not occupied.



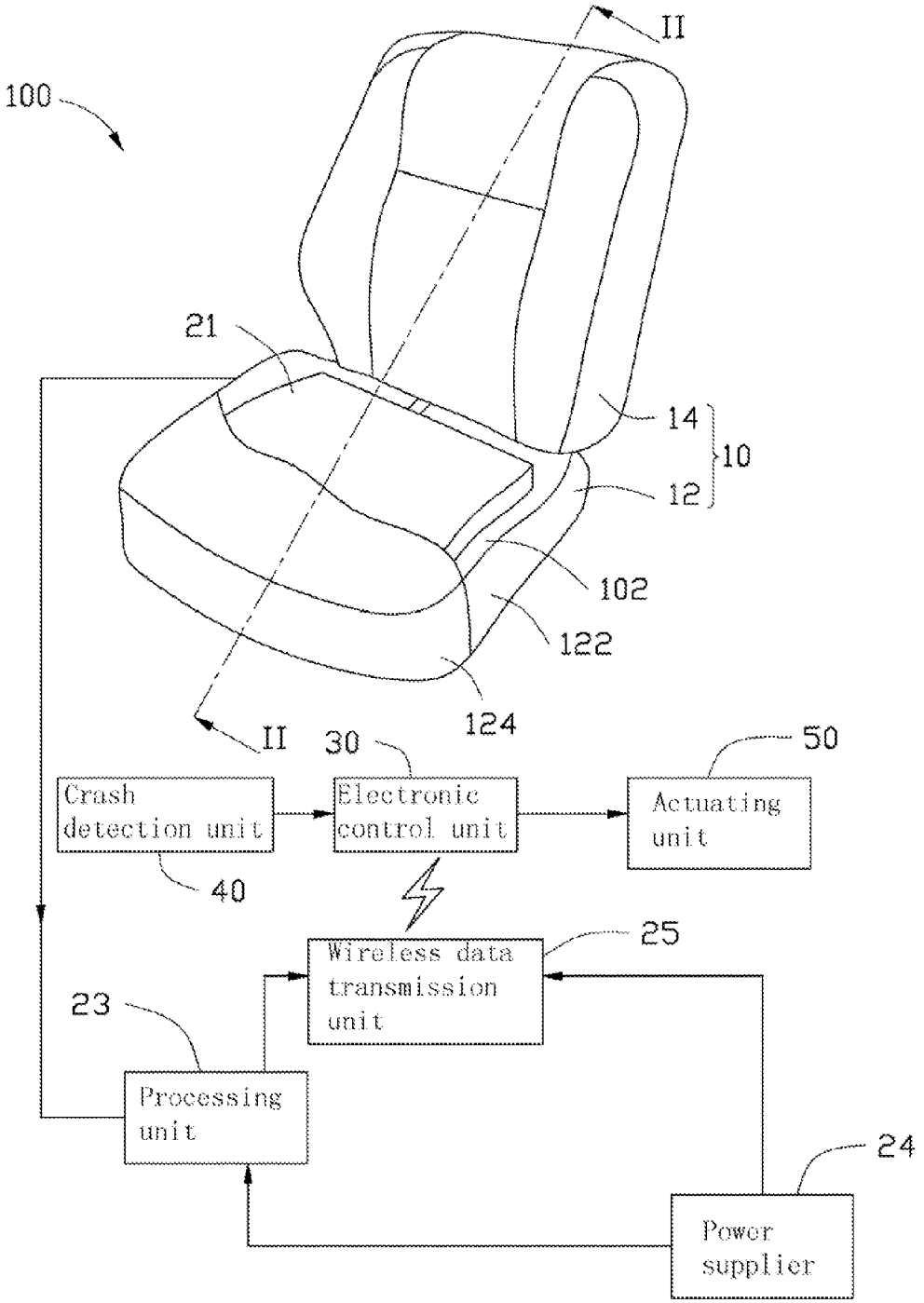

100
II
21
14
10
12
102
122
124
II
30
50
Crash detection unit
Electronic control unit
Actuating unit
40
25
Wireless data transmission unit
23
Processing unit
24
Power supplier

FIG. 1

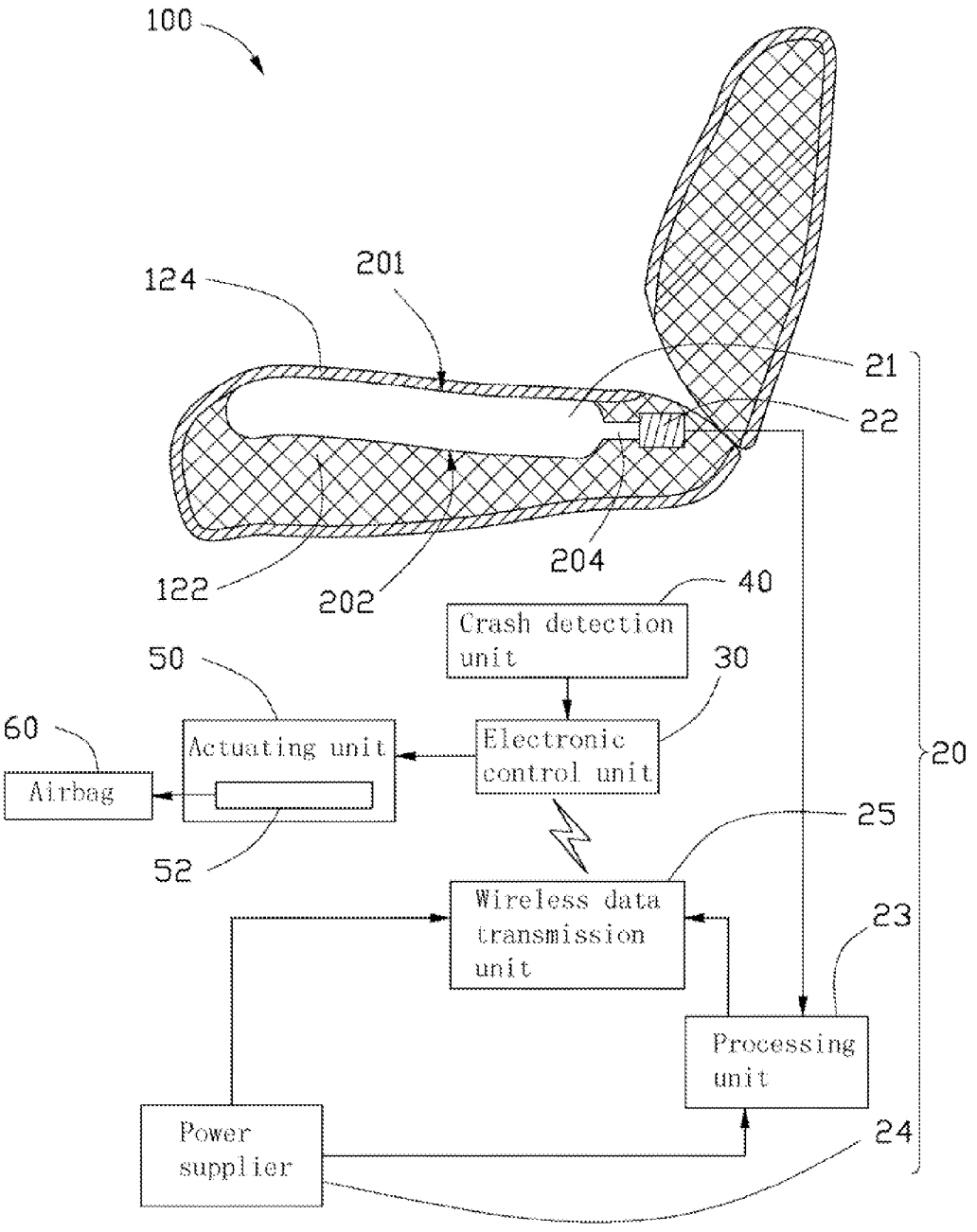

100
124
201
21
22
204
122
202
40
Crash detection unit
50
30
60
Actuating unit
Electronic control unit
Airbag
20
52
25
Wireless data transmission unit
23
Processing unit
Power supplier
24

FIG. 2

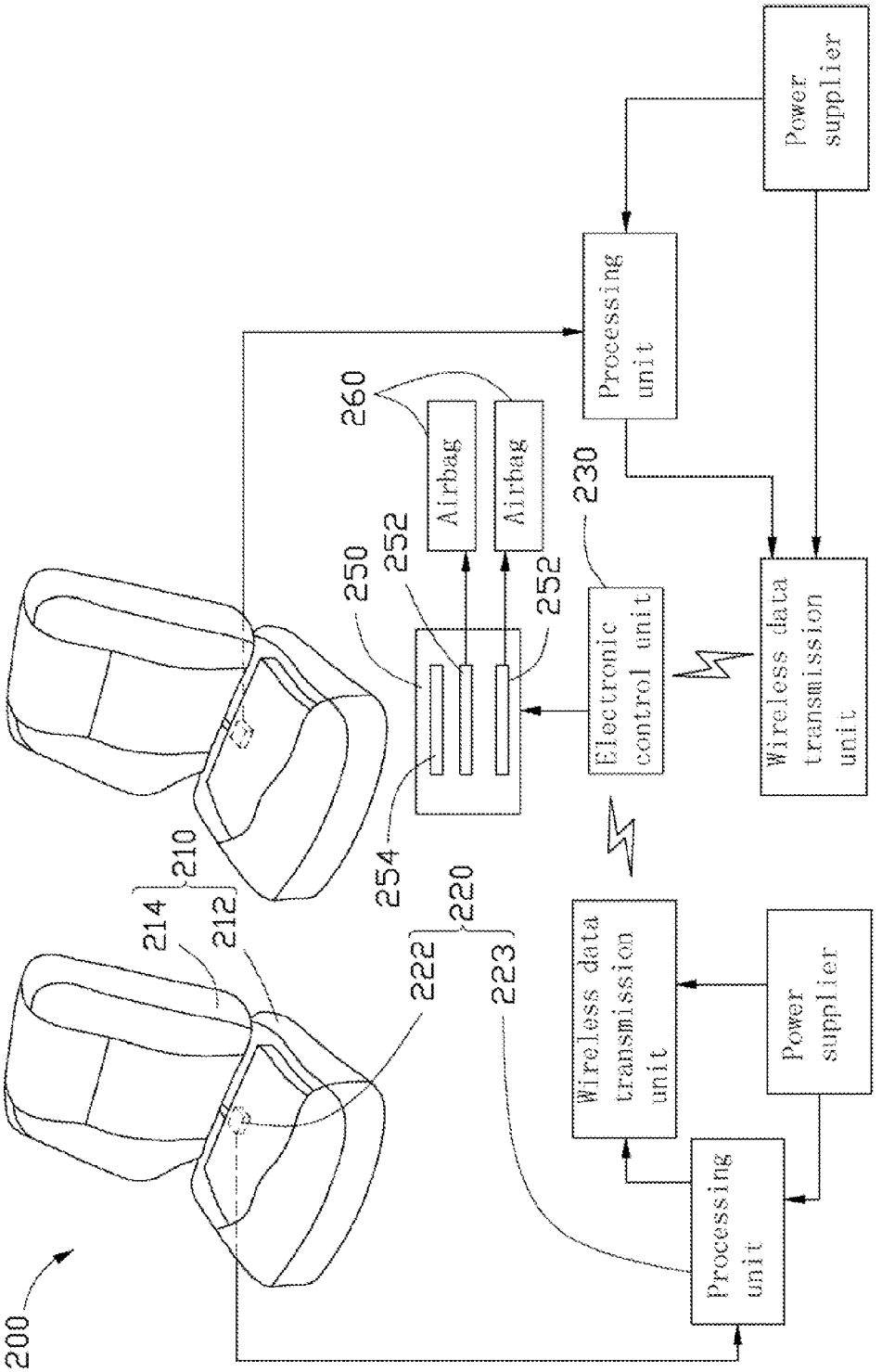

Power supplier
Processing unit
260
Airbag
Airbag
230
250
252
252
Electronic control unit
Wireless data transmission unit
254
210
214
212
220
222
223
Wireless data transmission unit
Power supplier
Processing unit
200

FIG. 3

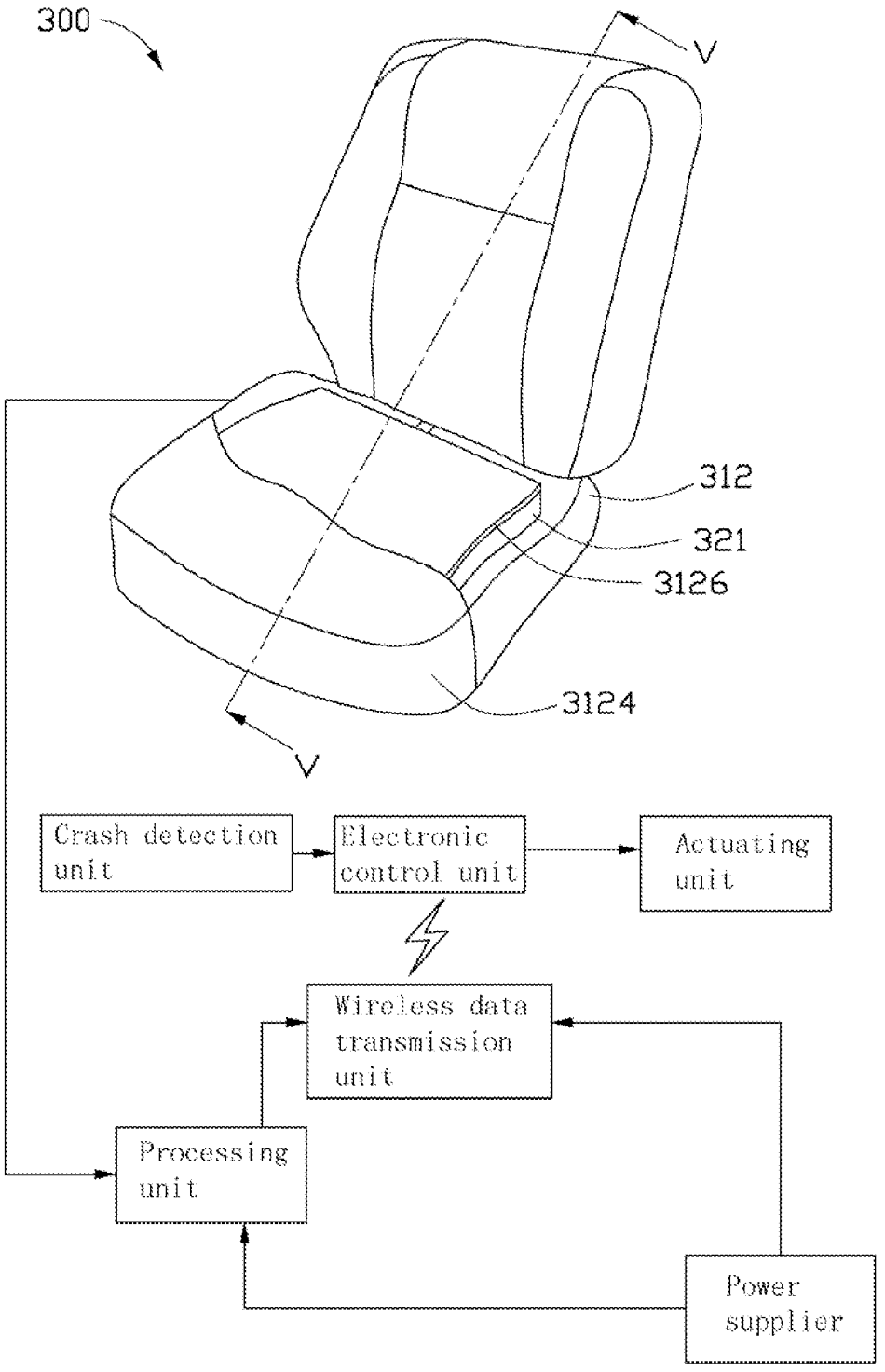

300
V
312
321
3126
3124
V
Crash detection unit
Electronic control unit
Actuating unit
Wireless data transmission unit
Processing unit
Power supplier

FIG. 4

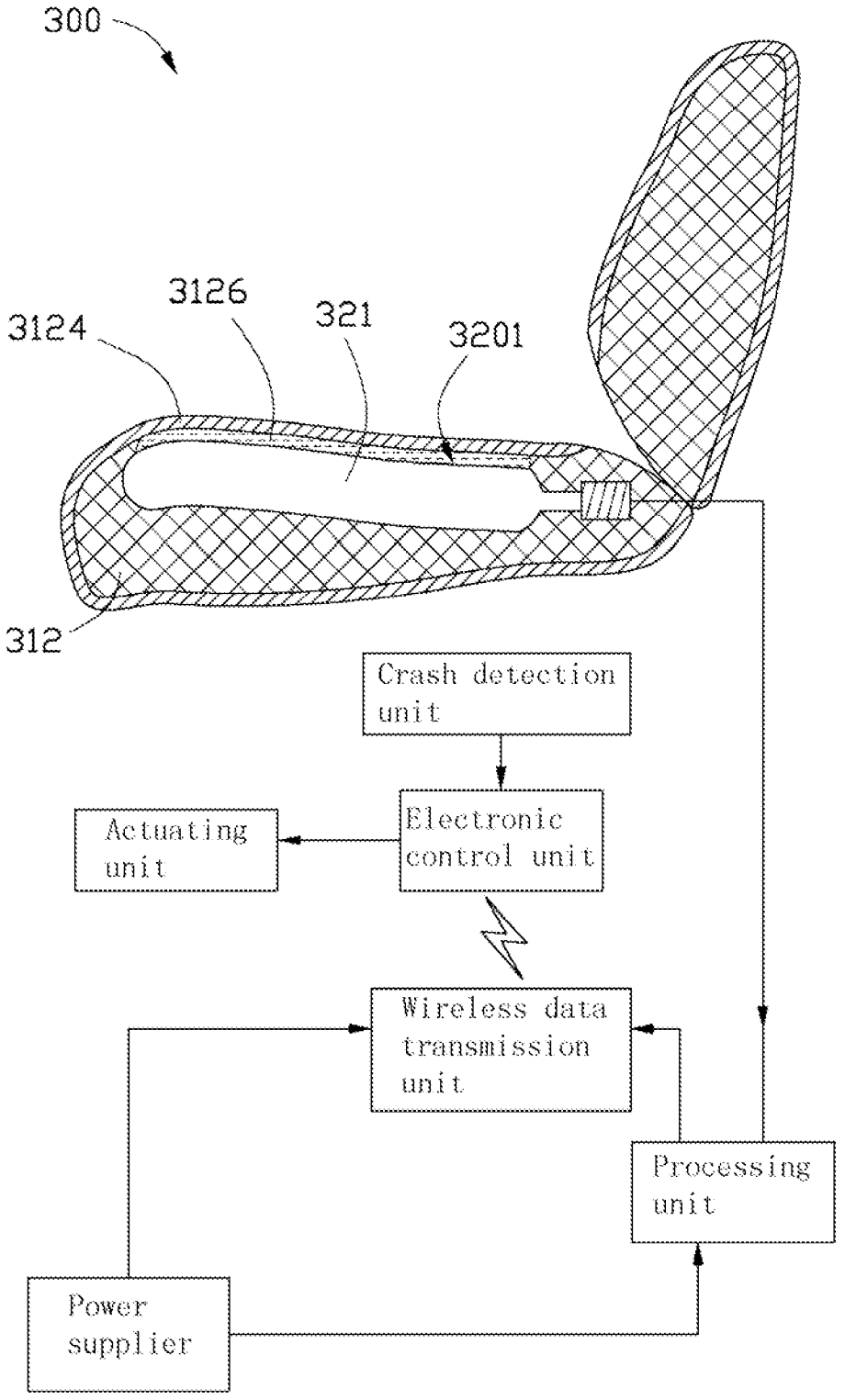

300
3124
3126
321
3201
312
Crash detection unit
Electronic control unit
Actuating unit
Wireless data transmission unit
Processing unit
Power supplier

FIG. 5

VEHICLE SEAT SYSTEM

BACKGROUND

[0001] 1. Technical Field

[0002] The present disclosure relates to automotive technology, and particularly, to a seat system with airbag deployment control for a vehicle.

[0003] 2. Description of Related Art

[0004] Generally, vehicles employ airbags for protecting occupants in a car crash. However, because all bags deploy no matter whether there are occupants to protect or not, great expense is incurred.

[0005] Therefore, it is desirable to provide a vehicle seat system, which can overcome the above mentioned limitations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a schematic view of a vehicle seat system according to a first embodiment.

[0007] FIG. **2** is a schematic cross-section view of the vehicle seat system of

[0008] FIG. **1**, taken along the line II-II thereof.

[0009] FIG. **3** is a schematic view of a vehicle seat system according to a second embodiment.

[0010] FIG. **4** is a schematic view of a vehicle seat system according to a third embodiment.

[0011] FIG. **5** is a schematic cross-section view of the vehicle seat system of FIG. **4**, taken along the line V-V thereof.

DETAILED DESCRIPTION

[0012] Embodiments will now be described in detail below with reference to drawings. In this description, unless the context indicates otherwise, it is accepted that a micro-electro-mechanical-system (MEMS) means an integrative micro-device system that consists of micro-sensor, micro-actuator, controlling and signal processing circuit, interface circuit, communication interface and electrical source. Similarly, unless the context indicates otherwise, a MEMS pressure sensor means a pressure sensor that measures pressure by MEMS. The MEMS pressure sensor can be a resistance MEMS pressure sensor, a capacitive MEMS pressure sensor, and etc.

[0013] Referring to FIGS. **1-2**, a vehicle seat system **100**, in accordance with a first embodiment, is shown. The vehicle seat system **100** includes a vehicle seat **10**, a seat occupancy sensing module **20**, an electronic control unit **30**, a crash detection unit **40**, an actuating unit **50**, and an airbag **60**.

[0014] The vehicle seat **10** includes a horizontally situated bottom seat portion **12**, and a vertically oriented back portion **14** connected with the seat portion **12**. The seat portion **12** includes a cushion **122**, and a packaging layer **124** packaging the cushion **122**. A receiving cavity **102** is cooperatively defined by the cushion **122** and the packaging layer **124**.

[0015] The seat occupancy sensing module **20** is configured for sensing an occupancy of the seat portion **12** of the vehicle seat **10** and generating a digital signal associated therewith. The seat occupancy sensing module **20** includes a pressure sensing bag **21**, and a MEMS pressure sensor **22**, a processor unit **23**, and a power supplier **24** for supplying electrical power to the processor unit **23**.

[0016] The pressure sensing bag **21** is disposed in the seat portion **12**. In the present embodiment, the pressure sensing bag **21** is received in the receiving cavity **102** of the seat portion **12**. The pressure sensing bag **21** includes an upper surface **201**, and a lower surface **202** opposite to the upper surface **201**. The upper surface **201** is adjacent to the packaging layer **124**. The lower surface **202** is adjacent to the upper surface of the cushion **122**. The pressure sensing bag **21** also includes a neck portion **204** with a width less than that of other portions thereof. The pressure sensing bag **21** is made of a material capable of elastic distortion. In the present embodiment, the pressure sensing bag **21** is made of rubber. The pressure sensing bag **21** is filled with gas or fluid. If the seat portion **12** is occupied by an occupant (not shown), the pressure sensing bag **21** compresses, and then generates pressure at the neck portion **204**. On the contrary, if the occupant leaves the seat portion **12**, the pressure sensing bag **21** returns to its original state.

[0017] The MEMS pressure sensor **22** is disposed at the neck portion **204** of the pressure sensing bag **21**. The MEMS pressure sensor **22** is configured for sensing pressure applied to the pressure sensing bag **21** by the occupant (i.e., the weight of the occupant), and providing a pressure sensing output signal in response to the sensed pressure.

[0018] The processing unit **23** is electrically connected with the MEMS pressure sensor **22**. The processing unit **23** is configured for processing (e.g. demodulating, correcting, compensating) the pressure sensing output signal from the MEMS pressure sensor **22**, and finally generating and outputting a digital signal associated with the occupancy of the seat portion **12**. That is, the processing unit **23** finally outputs the digital signal based on a pressure condition on the seat portion **12**. In the present embodiment, the processing unit **23** is electrically connected with the MEMS pressure sensor **22** by data transmission channel (not shown), and is a micro processing integrated circuit. The digital signal is transmitted to the processing unit **23** by the data transmission channel.

[0019] The crash detection unit **40** is connected to the electronic control unit **30**. The crash detection unit **40** includes, for example, crash detection sensors on a vehicle, an acceleration sensor, and the like. The crash detection unit **40** detects a crash of the vehicle and sends a crash signal associated therewith to the electronic control unit **30**.

[0020] The actuating unit **50** is electrically connected with the electronic control unit **30**, and includes an airbag inflator module **52**. The inflator module **52** is selectively operable in an activated mode where the airbag inflating module **52** is configured to inflate an airbag **60** in response to the crash signal and an inactivated mode where the airbag inflating module **52** is deactivated and irresponsive to the crash signal.

[0021] The electronic control unit **30** analyzes the digital signal, and determines if the seat portion **12** of the vehicle seat **10** is occupied. The electronic control unit **30** is configured for switching the airbag inflating module **52** to the activated mode if the seat portion **12** of the vehicle seat **10** is occupied and switching the airbag inflating module **52** to the inactivated mode if the seat portion **12** of the vehicle seat **10** is not occupied.

[0022] When the vehicle seat system **100** experiences a crash, and there is no occupant in the vehicle seat **10** sensed by the seat occupancy sensing module **20**, the electronic control unit **30** prevents the airbag **60** from being inflated, thereby reducing the cost of the vehicle seat system **100**. In addition, no matter whether an occupant sits at the center of the cushion **122** or not, the MEMS pressure sensor **22** can sense the

pressure applied to the pressure sensing bag **21**. The sensitivity and the reliability of the pressure sensing are thus improved.

[0023] The seat occupancy sensing module **20** may also includes a wireless data transmission unit **25**. The wireless data transmission unit **25** is electronically connected with the processing unit **23**, thereby receiving the digital signal from the processing unit **23**, and transmitting the digital signal to the electronic control unit **30**. In the present embodiment, the wireless data transmission unit **25** is a BLUETOOTH transmission unit **25**; the power supplier **24** may be a battery pack. The power supplier **24** supplies electrical power to the wireless data transmission unit **25** and the processing unit **23**. In other embodiments, the wireless data transmission unit **25** may be a Wi-Fi transmission unit.

[0024] Referring to FIG. **3**, a vehicle seat system **200**, in accordance with a second embodiment, is shown. The vehicle seat system **200** is similar to the vehicle seat system **100**, and includes a plurality of vehicle seats **210**, a plurality of seat occupancy sensing modules **220** mounted to the respective vehicle seats **210**, an electronic control unit **230**, a crash detection unit (not shown), an actuating unit **250**, and a plurality of airbag **260**.

[0025] Each of the vehicle seats **210** includes a seat portion **212** and a back portion **214**. The actuating unit **250** includes a plurality of airbag inflator modules **252** corresponding to the respective MEMS pressure sensing modules **220**, and a suspension system **254** for stabilizing the vehicle seat system **200**.

[0026] Each seat occupancy sensing module **200** is configured for sensing an occupancy of the seat portion **212** of the responding vehicle seat **210** and generating a digital signal associated therewith. Each seat occupancy sensing module **220** includes a MEMS pressure sensor **222**, and a processing unit **223**. The MEMS pressure sensor **222** is configured for sensing the pressure applied to the seat portion **212**, and providing a pressure sensing output signal proportional to the sensed pressure. The processing unit **223** receives the pressure sensing output signal, processes the pressure sensing output signal, and generates and outputs a digital signal.

[0027] The crash detection unit is the same as the crash detection unit **40**, and detects a crash of the vehicle and sends a crash signal associated therewith to the electronic control unit **230**.

[0028] Each actuating unit **250** includes an airbag inflating module **252**. The airbag inflating modules **252** are coupled to the corresponding airbags **260**. Each airbag inflating module **252** is selectively operable in an activated mode where the airbag inflating module **252** is configured to inflate the corresponding airbag **260** in response to the crash signal and an inactivated mode where the airbag inflating module **252** is deactivated and irresponsive to the crash signal.

[0029] The electronic control unit **230** analyzes the digital signals and determines which the seat portion **212** of the vehicle seat **210** is occupied. The electronic control unit **230** can switch the corresponding airbag inflating module **252** to the activated mode if the corresponding seat portion **212** is occupied, and switch the corresponding airbag inflating module **252** to the inactivated mode if the corresponding seat portion **212** is not occupied. In addition, the electronic control unit **230** can determine a pressure distribution according to from the digital signals, and generate a stabilization signal in response to the pressure distribution for the suspension system **254**.

[0030] According to the stabilization signal for the suspension system **254**, the suspension system **254** stabilizes the vehicular system **200** to make the occupants more comfortable. In the present embodiment, the suspension system **254** stabilizes the vehicular system **200** by adjusting hydraulic equilibrium system (not shown) of the suspension system **254**.

[0031] Referring to FIGS. **4-5**, a vehicle seat system **300**, in accordance with a third embodiment, is shown. The vehicle seat system **300** is similar to the vehicle seat system **100**, and includes a seat portion **321** with a package layer **3124**, and a pressure sensing bag **321** with an upper surface **3201**. In addition, the vehicle seat system **300** also includes a medium layer **3126** disposed between the package layer **3124** of the seat portion **312** and the upper surface **3201** of the pressure sensing bag **321**. The medium layer **3126** is configured for transmitting pressure to the pressure sensing bag **321**, and protecting the pressure sensing bag **321** from being damaged. In the present embodiment, the medium layer **3126** is a liquid cushion. In other embodiments, the medium layer **3126** may be an air cushion, a silica gel cushion, a spring cushion, etc.

[0032] While certain embodiments have been described and exemplified above, various other embodiments will be apparent to those skilled in the art from the foregoing disclosure. The disclosure is not limited to the particular embodiments described and exemplified but is capable of considerable variation and modification without departure from the scope and spirit of the appended claims.

What is claimed is:

1. A vehicle seat system comprising:
a vehicle seat having a seat portion;
an electronic control unit;
a crash detection unit connected with the electronic control unit, the crash detection unit configured for detecting a crash and sending a crash signal associated therewith to the electronic control unit;
a seat occupancy sensing module configured for sensing an occupancy of the vehicle seat and generating a digital signal associated therewith;
an airbag, and an airbag inflating module selectively operable in an activated mode where the airbag inflating module is configured to inflate the airbag in response to the crash signal and an inactivated mode where the airbag inflating module is deactivated and irresponsive to the crash signal; the electronic control unit configured for analyzing the digital signal and determining if the vehicle seat is occupied, and switching the airbag inflating module to the activated mode if the seat is occupied and switching the airbag inflating module to the inactivated mode if the seat is not occupied.

2. The vehicle seat system of claim **1**, wherein the seat occupancy sensing module comprises a pressure sensing bag, a MEMS pressure sensor connected with the pressure sensing bag, and a processing unit connected with the MEMS pressure sensor, the pressure sensing bag is disposed in the seat portion, and is compressible when the seat portion is occupied, the MEMS pressure sensor is configured for sensing a pressure applied to the pressure sensing bag, and providing a pressure sensing output signal in response to the sensed pressure, the processing unit is configured for receiving and processing the pressure sensing output signal, and generating and outputting the digital signal.

3. The vehicle seat system of claim **2**, wherein the seat portion comprises a cushion, a packaging layer packaging the

cushion, and a receiving cavity cooperatively defined by the cushion and the packaging layer, the pressure sensing bag is received in the receiving cavity.

4. The vehicle seat system of claim **3**, wherein the pressure sensing bag comprises an upper surface, and a lower surface opposite to the upper surface, the upper surface is adjacent to the packaging layer, and the lower surface is adjacent to an upper surface of the cushion.

5. The vehicle seat system of claim **4**, further comprising a medium layer, the medium layer is disposed between the package layer of the seat portion and the upper surface of the pressure sensing bag.

6. The vehicle seat system of claim **2**, wherein the pressure sensing bag comprises a neck portion with a width less than that of other portions thereof, and the MEMS pressure sensor disposed at the neck portion.

7. The vehicle seat system of claim **2**, wherein the seat occupancy sensing module further comprise a wireless data transmission unit, the wireless data transmission unit is electrically connected with the processing unit, thereby receiving the digital signal from the processing unit, and transmitting the digital signal to the electronic control unit.

8. The vehicle seat system of claim **2**, wherein the MEMS pressure sensor is a resistance MEMS pressure sensor or a capacitive MEMS pressure sensor.

9. The vehicle seat system of claim **2**, wherein the processing unit is a micro processing integrated circuit.

10. A vehicle seat system comprising:

a plurality of vehicle seats, each of the vehicle seats having a seat portion;

an electronic control unit; and

a crash detection unit connected with the electronic control unit, the crash detection unit configured for detecting a crash and outputting a crash signal associated with the crash to the electronic control unit;

a plurality of seat occupancy sensing modules mounted to the respective vehicle seats, each seat occupancy sensing module configured for sensing an occupancy of the vehicle seat and generating a digital signal associated therewith;

a plurality of airbags, and

a plurality of airbag inflating modules coupled to the corresponding airbags, each airbag inflating module being selectively operable in an activated mode where the airbag inflating module is configured to inflate the corresponding airbag in response to the crash signal and an inactivated mode where the airbag inflating module is deactivated and irresponsive to the crash signal; the electronic control unit configured for analyzing the digital signals and determining which vehicle seat is occupied, the electronic control unit configured for switching the corresponding airbag inflating module to the activated mode if the corresponding seat is occupied, the electronic control unit configured for switching the airbag inflating module to the inactivated mode if the corresponding seat is not occupied.

11. The vehicle seat system of claim **10**, wherein each of seat occupancy sensing modules comprises a pressure sensing bag, a MEMS pressure sensor connected with the pressure sensing bag, and a processing unit connected with the MEMS pressure sensor, each of the pressure sensing bags is disposed in the corresponding seat portion, and is compressible when the corresponding seat portion is occupied, each of the MEMS pressure sensors is configured for sensing a pressure applied to the corresponding pressure sensing bag, and providing a pressure sensing output signal in response to the corresponding sensed pressure, each of the processing unit is configured for receiving and processing the corresponding pressure sensing output signal, and generating the digital signal.

12. The vehicle seat system of claim **11**, wherein each of the seat portions comprises a cushion, a packaging layer packaging the cushion, and a receiving cavity cooperatively defined by the cushion and the packaging layer, the pressure sensing bags are received in the corresponding receiving cavities.

13. The vehicle seat system of claim **12**, wherein each of the pressure sensing bags comprises an upper surface, and a lower surface opposite to the upper surface, each of the upper surfaces is adjacent to the corresponding packaging layer, each of the lower surfaces is adjacent to the upper surface of the corresponding cushion.

14. The vehicle seat system of claim **13**, further comprising a plurality of medium layers, each of the medium layers is disposed between the package layer of the corresponding seat portion and the upper surface of the corresponding pressure sensing bag.

15. The vehicle seat system of claim **11**, wherein each of the pressure sensing bags comprises a neck portion with a width less than that of other portions thereof, and each of the MEMS pressure sensors disposed at the corresponding neck portion.

16. The vehicle seat system of claim **11**, wherein each of the MEMS pressure sensing modules further comprise a wireless data transmission unit, each of the wireless data transmission units is electrically connected with the corresponding processing unit, thereby receiving the corresponding digital signal from the corresponding processing unit, and transmitting the corresponding digital signal to the electronic control unit.

17. The vehicle seat system of claim **11**, wherein each of the MEMS pressure sensors is a resistance MEMS pressure sensor or a capacitive MEMS pressure sensor.

18. The vehicle seat system of claim **11**, further comprising a suspension system, the electronic control unit is configured for determining a pressure distribution according to the digital signals, and generates a stabilization signal in response to the pressure distribution for the suspension system, the suspension system is configured for stabilizing the vehicle seat system in response to the stabilization signal.

* * * * *