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(56) Documents Cited
EP 0785112 A1
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(54) Abstract Title
Control system for vehicle safety device

(57) A control system for a safety device such as an air-bag unit 11 in a motor vehicle has three sensors. First and third sensors 21, 22 are sensitive to acceleration having a principal component perpendicular to the longitudinal axis of the vehicle, and are associated with evaluation means 23, 24, 25 adapted to close a first switch 3. The second sensor 4 senses acceleration along the longitudinal axis of the vehicle and is associated with evaluating means 5, 6 which generate a signal to close a second switch 7. When both switches are closed a current is supplied to the unit 11 to deploy the air-bag. Sensors 21, 22 are located at the sides of the vehicle and indicate the risk of a frontal impact.

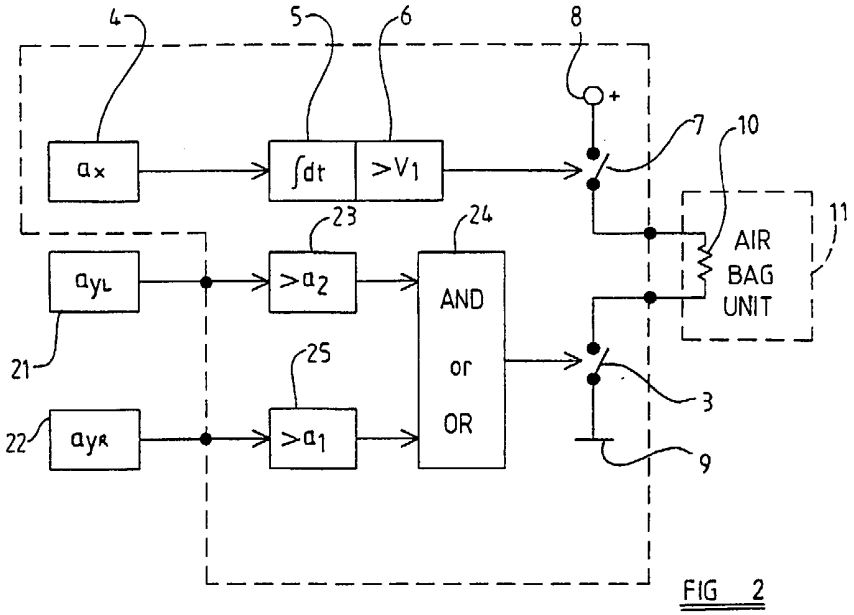

FIG 2

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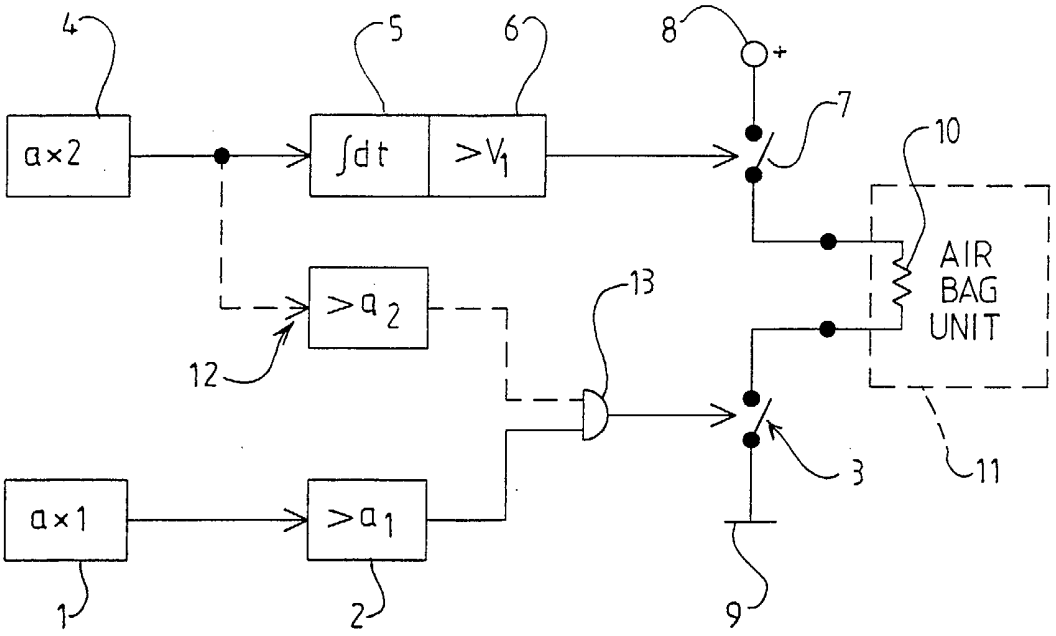

FIG 1 (PRIOR ART)

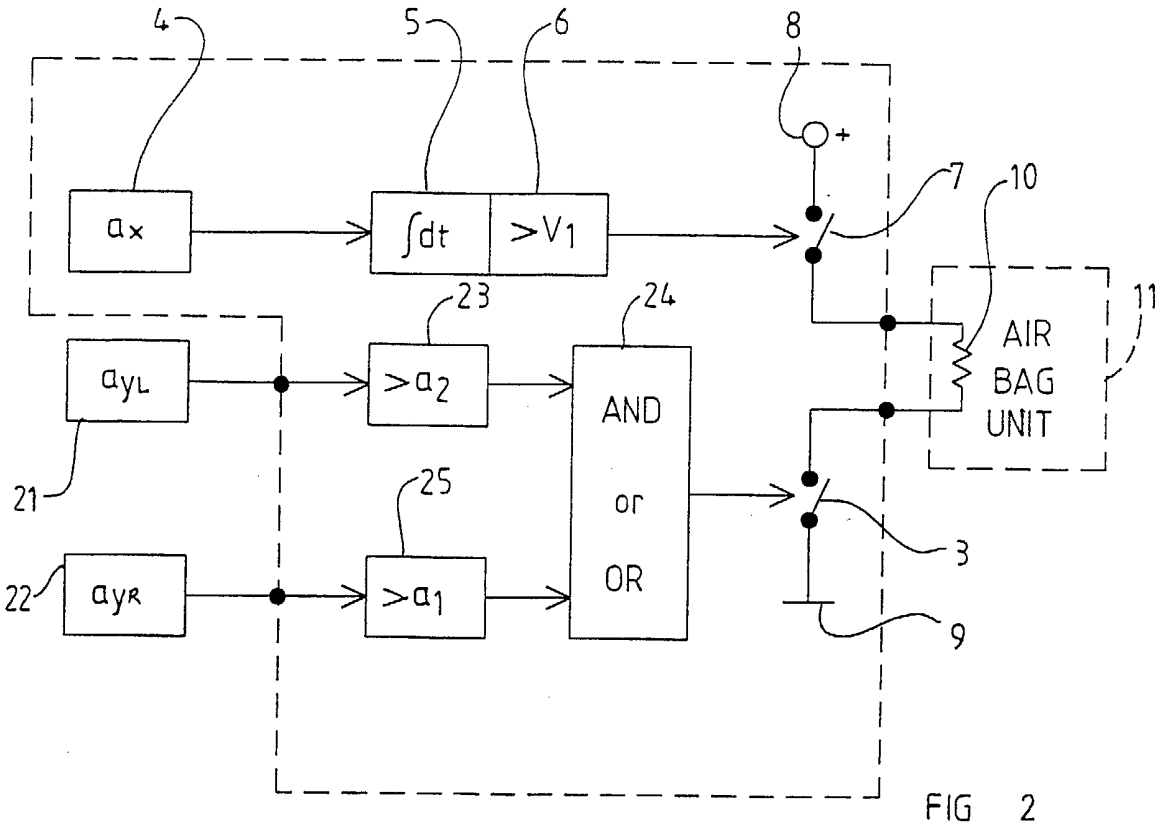
4
5
6
8
+
7
10
a_x
$\int dt$
$>V_1$
11
AIR
BAG
UNIT
23
24
a_{yL}
$>a_2$
AND
or
OR
21
25
3
22
a_{yR}
$>a_1$
9

FIG 2

PATENTS ACT 1977

Q13833GB-NF/jsd

DESCRIPTION OF INVENTION

"IMPROVEMENTS IN OR RELATING TO A CONTROL SYSTEM"

THE PRESENT INVENTION relates to a control system, and more particularly relates to a control system for the deployment of a safety device in a motor vehicle.

It has been proposed to provide safety devices in a motor vehicle which are deployed in the event that an accident should occur. An example of such a safety device is an air-bag which is inflated if the vehicle is involved in an impact.

In order to minimise the risk of the safety device being deployed inadvertently, the triggering arrangement that is utilised to deploy the safety device typically includes two switches, both of which must be closed before the triggering device will deploy the air-bag. One switch performs an arming function or an enabling function, and is closed in response to an appropriate signal from an arming function sensor. The arming function sensor may be a relatively cheap sensor responsive to axial deceleration. The second switch is closed in response to an appropriate signal from a crash sensor. The crash sensor may comprise a more accurate, and thus more expensive, accelerometer responsive to acceleration in the axial direction of the vehicle.

The present invention seeks to provide an improved control system.

According to this invention there is provided a control system for a vehicle safety device, the control system comprising at least a first acceleration sensitive sensor, and a second acceleration sensitive sensor, and a third acceleration sensitive sensor, wherein the first and third sensors are respectively located adjacent the left and right side of a vehicle, the system further incorporating first evaluation means adapted to evaluate a signal from the first sensor, and the third sensor to evaluate a risk of a frontal impact, and to provide an output signal when a risk of a frontal impact exists, and a second evaluating means using a signal from the second sensor for evaluating the existence of a frontal impact, and providing an output when a frontal impact occurs, the control system further incorporating a triggering circuit for actuating the safety device in response to the signals from both said first evaluating means and said second evaluating means, wherein the first and third sensors are sensitive only to acceleration having a principal component perpendicular to the longitudinal axis of the vehicle, and the second sensor is an accelerometer for sensing acceleration substantially along the longitudinal axis of the vehicle.

Preferably the first sensor senses lateral acceleration.

Conveniently the vehicle safety device is a device adapted to provide protection in a frontal impact of the vehicle and wherein the first sensor is utilised to detect a lateral crash, and to deploy a further safety device adapted to provide protection in a lateral crash situation.

Alternatively the first sensor senses vertical acceleration.

Conveniently the vehicle safety device is adapted to provide protection in a frontal impact of the vehicle, and wherein the first sensor is responsive to a roll-over situation to deploy a further safety device adapted to provide protection in a roll-over situation. A sensor responsive to a roll-over situation may incorporate a sensing mechanism which determines angular velocity or angular acceleration and provides an output when the measured valve exceeds a threshold. Such a sensor may also measure velocity or acceleration in the Z- (or vertical) direction.

Conveniently the first evaluating means include a gate, the output of which provides the said output signal when a risk of frontal impact exists, the gate receiving input signals derived from the first and third sensors.

Preferably the outputs of the first and third sensors each pass to a respective comparator where the signal is compared with a threshold value, the outputs of the comparators providing the said input signals to the gate.

In one embodiment the gate is an **AND**-gate, and in an alternative arrangement the gate is an **OR**-gate.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a block diagram of a prior art control system in association with an air-bag unit, and

FIGURE 2 is a block diagram corresponding to Figure 1 illustrating a first embodiment of the present invention.

Referring initially to Figure 1 of the accompanying drawings, a prior art control system for a vehicle safety device comprises a first accelerometer 1, responsive to acceleration in the axial or "X" direction of the vehicle. The accelerometer may be located in alignment with the axis of the vehicle. The accelerometer 1 need not be a very accurate accelerometer and consequently can be relatively cheap. The accelerometer 1 has an output connected to a comparator 2 which acts as an evaluating means to evaluate the risk of a front impact. The comparator compares the output of the accelerometer with a predetermined threshold value and provides an output when the threshold is exceeded. The output of the comparator 2 is utilised to control a switch 3.

The control arrangement incorporates a second accelerometer 4, again adapted to sense acceleration in the axial direction. The accelerometer 4 may be a relatively accurate accelerometer. The output of the accelerometer 4 is supplied to an integrator 5 where the output is integrated, and the output of the integrator is connected to a comparator 6. The comparator 6 acts as an evaluating means to evaluate the existence of a frontal impact and compares the output of the accelerometer with a predetermined threshold. The comparator provides an output when the signal from the integrator exceeds the predetermined threshold. The output of the comparator controls a second switch 7.

The switches 3 and 7 are connected in a series connection between a first high source of potential 8 and a second source of potential 9, the series connection incorporating a squib resistor 10 that is present within an air-bag

unit. It is to be appreciated that when both of the switches 3 and 7 have been closed, current will flow through the series connection and the squib resistor 10 will initiate the generation of gas from a gas generator unit present within the air-bag unit 11.

An optional additional feature shown in Figure 1 is the presence of a further comparator 12 which receives a signal from the second relatively accurate accelerometer 4, and compares that signal with a predetermined value, the output of the comparator 12 being forwarded as one input to an AND-gate 13. The second input of the AND-gate 13 is the output of the first comparator 12, and the output of the AND-gate is connected to control the switch 3.

The prior art arrangements discussed above therefore provide two accelerometers which are sensitive to acceleration in the axial direction of the vehicle.

Some vehicles are now provided with air-bag arrangements which are specifically adapted to be inflated in the event that a side impact or roll-over should occur. In order to sense such a side impact, many vehicles are provided with side impact sensors, and such side impact sensors typically comprise accelerometers which are responsive to an acceleration which has a very substantial component in a direction which is perpendicular to the longitudinal direction of the vehicle. Thus, a typical sensor used to sense a side impact may be sensitive to a horizontal acceleration transverse to the longitudinal direction of the vehicle, that is to say acceleration on the "Y" axis. However, it is also to be appreciated that in some cases a sensor may be utilised to sense a roll-over situation, and such a sensor may be responsive to an acceleration in the vertical

direction, that is to say acceleration which is perpendicular to the longitudinal axis of the vehicle substantially in alignment with the "Z" axis.

In the control system of the present invention, as will be described with reference to Figure 2, accelerometers are utilised which are responsive to acceleration having a substantial component perpendicular to the longitudinal direction of the vehicle. Consequently, in using the embodiments described with reference to Figure 2, it is possible to utilise one accelerometer which is specifically responsive to acceleration in the longitudinal direction of the vehicle, and also to use other accelerometers which have been provided primarily in use for deploying safety devices which are to be activated in response to a side impact, or roll-over, meaning that the overall costs incurred are minimised. It has been found possible to utilise an arrangement of this type since, in a frontal impact of a motor vehicle there is still substantial acceleration at specific points of the vehicle which has a substantial component perpendicular to the longitudinal direction of the vehicle. It is believed that such acceleration is caused by vibrations within the chassis or body shell of the vehicle.

Figure 2 illustrates an embodiment of the invention. In this embodiment of the invention the relatively accurate sensitive accelerometer 4 of Figure 1 is provided together with the associated integrator 5 and comparator 6 to control the switch 7 in the series connection between the two sources of potential 8 and 9.

However, in the embodiment of Figure 2, two separate accelerometers 21, 22 are provided, which are located on the left side of the vehicle and the right side of the vehicle respectively. Both of these accelerometers may be responsive to acceleration in the horizontal plane with a

substantial component extending perpendicularly to the longitudinal (or "X") axis of the vehicle, that is to say acceleration along the "Y" axis of the vehicle. These accelerometers may be provided primarily to be responsive to a side impact on the left side of the vehicle and a side impact on the right side of the vehicle respectively. Thus the sensors are located on the left side and the right side of the vehicle. The output of the accelerometer 21 is supplied to a comparator 23 where the output is compared with a predetermined value, and the output of the comparator 23 is supplied to a gate 24 which may be an AND-gate or which alternatively may be an OR-gate.

The output of the accelerometer 22 is forwarded to a comparator 25 where the output of the accelerometer is compared with a threshold value. If the output exceeds the threshold value, a signal is passed from the comparator 25, the output from the comparator 25 is passed as a second input to the gate 24.

The output of the gate 24 is utilised to control the switch 3.

It is to be appreciated that in use of the embodiment of Figure 3, if the gate 24 is an AND-gate, both of the sensors 21 and 22 must sense an acceleration having a substantial component in the "Y" axis in excess of a predetermined threshold before the switch 3 is closed, whereas if the gate 24 is an OR-gate, only one of the accelerometers 21 or 22 need sense an acceleration in excess of a predetermined threshold for the switch 3 to be closed. The output of the accelerometer 4 must be such that the integrated output, as integrated by the integrator 5 exceeds a predetermined threshold, as determined by the comparison of the output of the integrator 5 with a predetermined threshold within the comparator 6, before the switch 7 is closed. When both the switch 3 and the switch 7 have been closed, an electrical current will flow

through the resistive squib 10, thus initiating the generation of gas from a gas generator within the air-bag unit, consequently deploying the air-bag.

Whilst the invention has been described with particular reference to a control system for controlling the deployment of an air-bag, it is to be appreciated that the control system may be utilised to control other safety devices within a motor vehicle such as, for example, a seat-belt pre-tensioner.

In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A control system for a vehicle safety device, the control system comprising at least a first acceleration sensitive sensor, and a second acceleration sensitive sensor, and a third acceleration sensitive sensor, wherein the first and third sensors are respectively located adjacent the left and right side of a vehicle, the system further incorporating first evaluation means adapted to evaluate a signal from the first sensor, and the third sensor to evaluate a risk of a frontal impact, and to provide an output signal when a risk of a frontal impact exists, and a second evaluating means using a signal from the second sensor for evaluating the existence of a frontal impact, and providing an output when a frontal impact occurs, the control system further incorporating a triggering circuit for actuating the safety device in response to the signals from both said first evaluating means and said second evaluating means, wherein the first and third sensors are sensitive only to acceleration having a principal component perpendicular to the longitudinal axis of the vehicle, and the second sensor is an accelerometer for sensing acceleration substantially along the longitudinal axis of the vehicle.

2. A system according to Claim 1 wherein the first sensor senses lateral acceleration.

3. A system according to Claim 2 wherein the vehicle safety device is a device adapted to provide protection in a frontal impact of the vehicle and wherein the first sensor is utilised to detect a lateral crash, and to deploy a further safety device adapted to provide protection in a lateral crash situation.

4. A system according to Claim 1 wherein the first sensor senses vertical acceleration.

5. A system according to Claim 4 wherein the vehicle safety device is adapted to provide protection in a frontal impact of the vehicle, and wherein the first sensor is responsive to a roll-over situation to deploy a further safety device adapted to provide protection in a roll-over situation.

6. A system according to any one of the preceding Claims wherein the first evaluating means include a gate, the output of which provides the said output signal when a risk of frontal impact exists, the gate receiving input signals derived from the first and third sensors.

7. A system according to Claim 6 wherein the outputs of the first and third sensors each pass to a respective comparator where the signal is compared with a threshold value, the outputs of the comparators providing the said input signals to the gate.

8. A system according to Claim 6 or 7 wherein the gate is an **AND**-gate.

9. A system according to Claim 6 or 7 wherein the gate is an **OR**-gate.

10. A control system substantially as herein described with reference to and as shown in Figure 2 of the accompanying drawings.

INVESTOR IN PEOPLE

Application No:	GB 0203914.7	**Examiner:**	David Brunt
Claims searched:	1-10	**Date of search:**	27 March 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): G4N (NHVSC)

Int Cl (Ed.7): B60R (21/01)

Other: Online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0785112 A1	(TRW) see Fig.5	-
A	WO 98/50256 A1	(SIEMENS) see Figs.2-4	-
A	US 5746444	(FOO) see Fig.3	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.