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(56) Documents Cited
GB 2289448 A **EP 0565501 A1** **US 5437471 A**
US 5281780 A

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INT CL^6 **B60R 21/00 21/22 21/32**
EDOC, WPI

(54) Vehicle side impact sensor arrangement

(57) A sensor 16,17 is located within the vehicle adjacent to a vehicle door sill 2 and, during a side impact collision to the vehicle, movement of the outer skin 4 of the door 1 is transferred by force transmitting elements 5,8,9,11 to the sensor 16,17, causing a safety device such as a side air bag to inflate. In order to prevent the sensor being inadvertently activated by being kicked when a person enters or leaves the vehicle, a protector plate 13 is mounted in front of the sensor. The protector plate 13 defines an aperture 12 through which one force transmitting element 11 can pass to activate the sensor. The sensor may be an acceleration sensor or it may comprise a pyrotechnic charge which is responsive to a compression force.

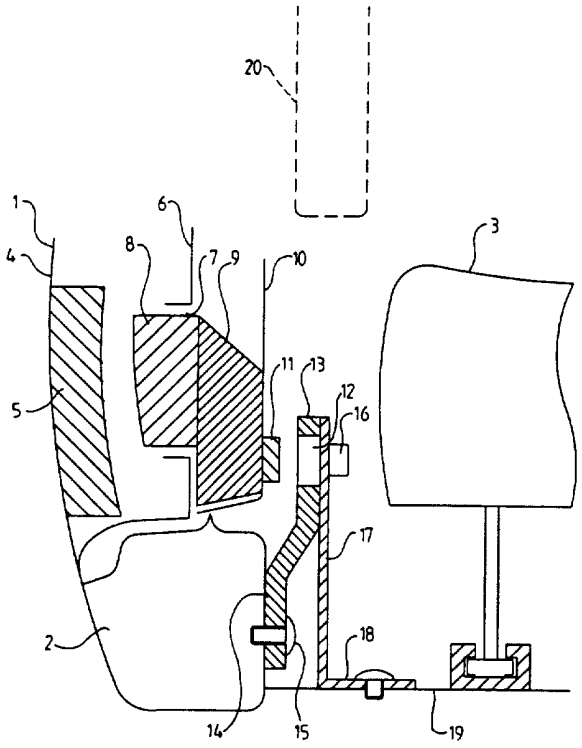

FIG 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

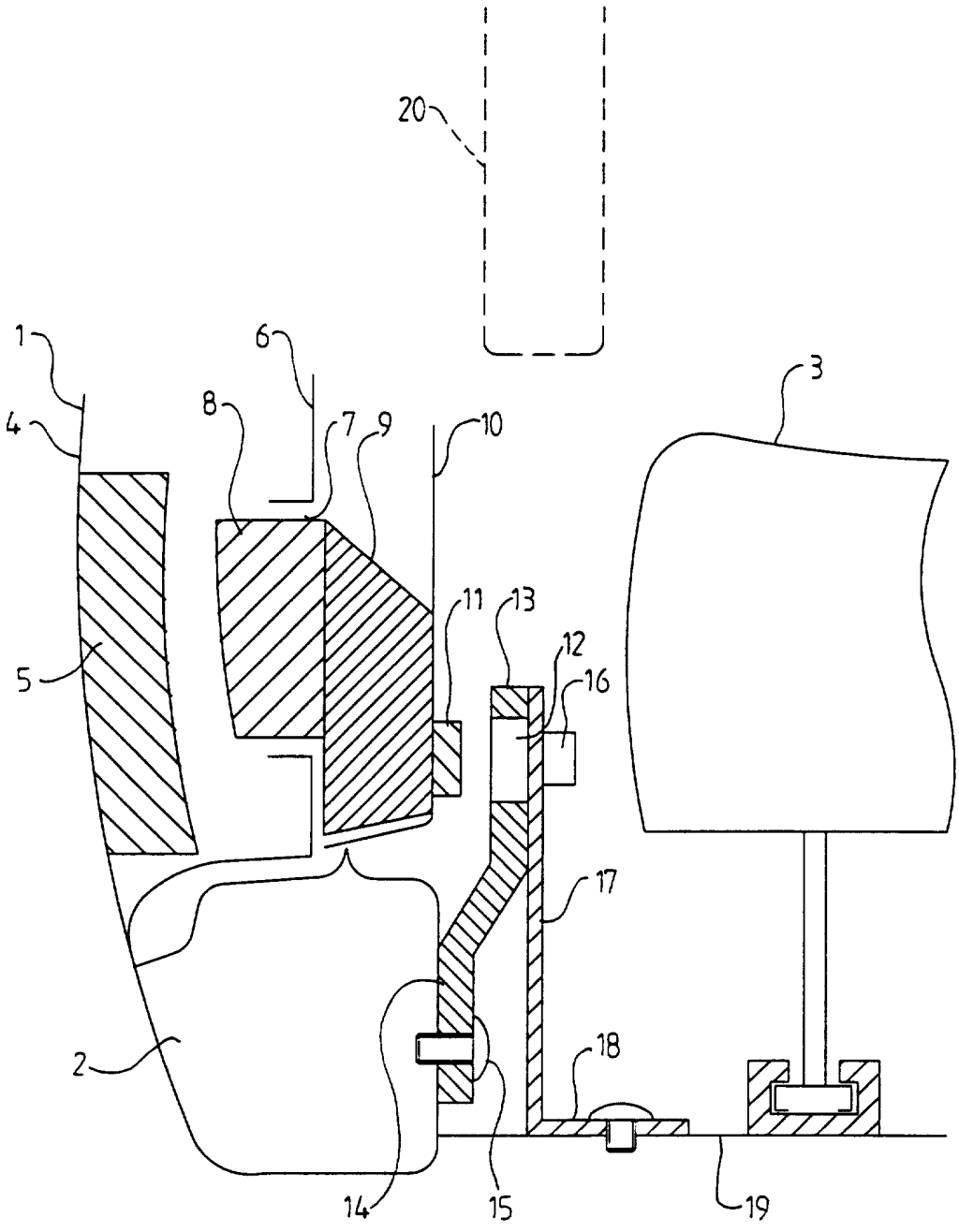

FIG 1

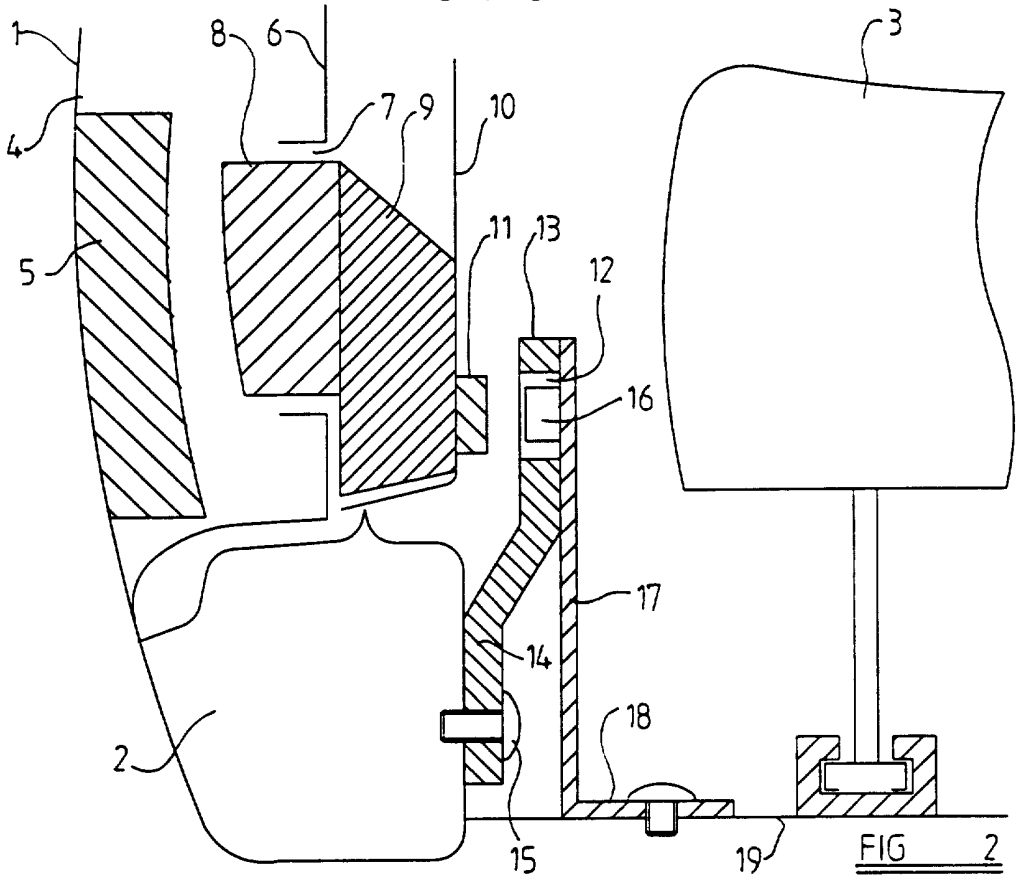

FIG 2

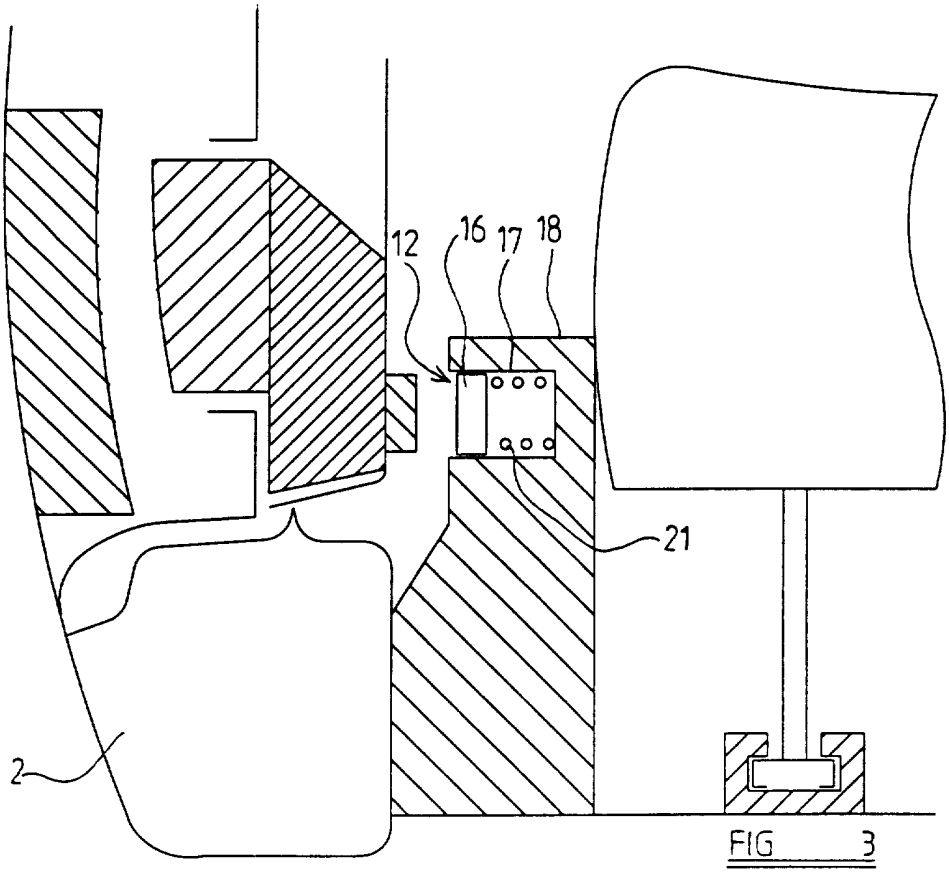

FIG 3

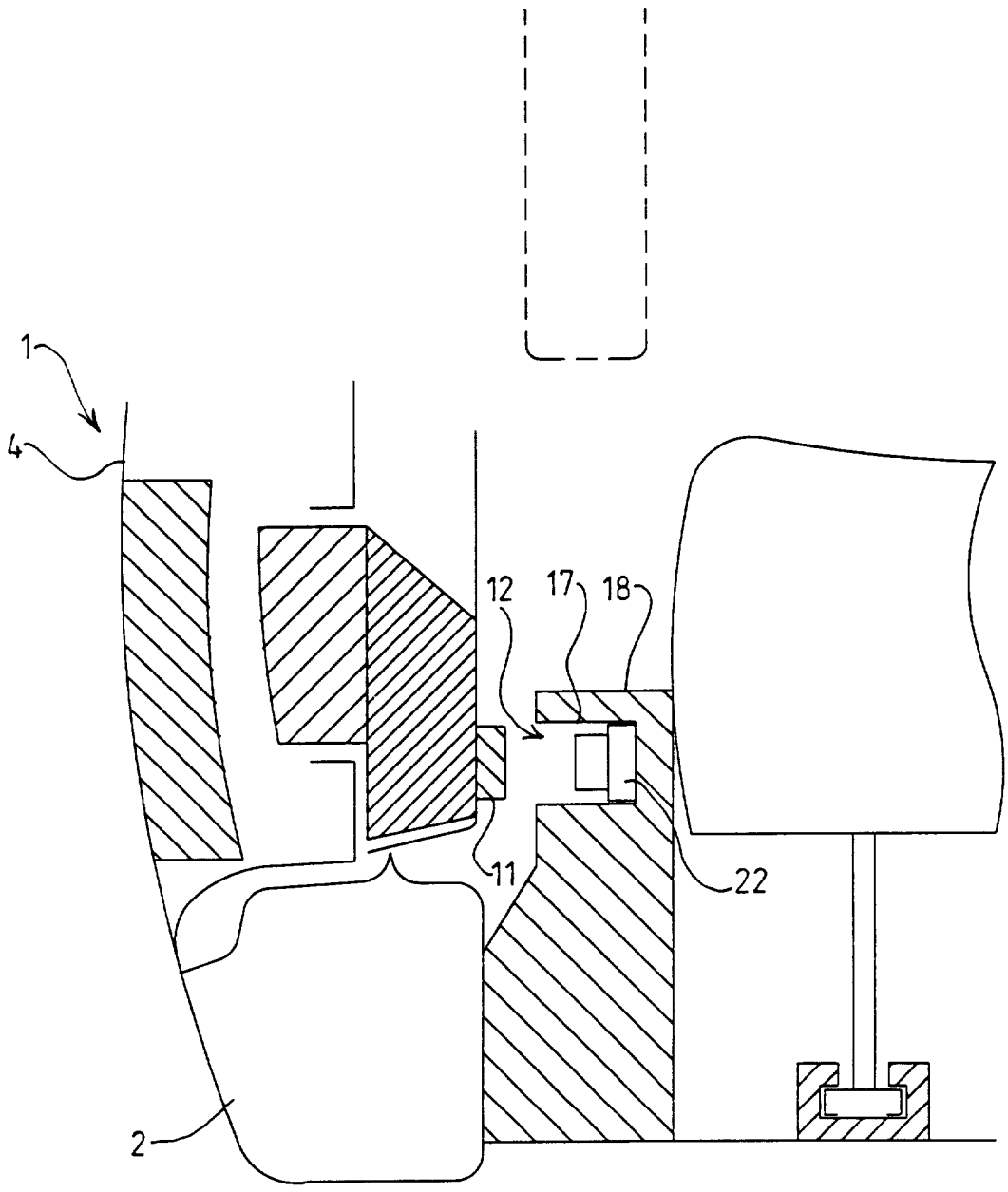

FIG 4

DESCRIPTION OF INVENTION

"IMPROVEMENTS IN OR RELATING TO A VEHICLE IMPACT SENSOR ARRANGEMENT FOR DETECTING A SIDE IMPACT"

THE PRESENT INVENTION relates to a vehicle impact sensor arrangement, and more particularly relates to a vehicle impact sensor arrangement adapted to sense an impact on a side of a vehicle and to activate a safety device within the vehicle such as an air-bag or a seat belt pre-tensioner.

When a vehicle, such as a motor car, is involved in an accident the vehicle can accelerate or decelerate rapidly. In such a situation a person travelling within the vehicle may continue to move at the original speed of the vehicle, due to inertia, and may thus impact with part of the vehicle which has accelerated or decelerated. For example, if a vehicle is subjected to a front impact, the main body of the vehicle may stop relatively rapidly, whilst the person in the vehicle continues to travel forwardly. Thus, in effect, the person travelling in the vehicle is thrown forwardly on to a fixed part of the vehicle, such as the steering wheel or the dash-board. In a side impact situation, however, a person sitting near the site of the impact may be hit by the intruding outer shell of the vehicle before the speed of the main body of the vehicle is changed and very soon after the impact is initiated. These side impact conditions demand special sensor arrangements.

If a safety device is to be activated in response to a side impact, then the sensor which senses the side impact must be able to respond to a side impact before the inside part of the door of the vehicle hits the seat or hits the person sitting on the seat. Because the total distance between the outer skin of the vehicle and the seat is very short, the sensor has to react very rapidly.

It has been proposed previously to provide a sensor, adapted to sense a side impact, which is located adjacent the lower part of the door of a motor vehicle, the sensor being moved in response to inward deformation of the lower part of the door.

In certain circumstances a sensor of this type may be activated inadvertently, especially if the sensor is kicked by a person getting into or out of the motor vehicle.

The present invention seeks to provide an improved sensor arrangement.

According to this invention there is provided a sensor arrangement adapted to sense a side impact in a motor vehicle comprising a sensor responsive to a predetermined movement, the sensor, or actuating means for the sensor, being located adjacent a door of a motor vehicle, means being provided to transfer deformation of the outer skin of the door of the vehicle to the sensor, said transfer means comprising an element adapted to engage the sensor or the actuating means for the sensor, there being rigid protector means located to protect the sensor, or the actuator, from inadvertent engagement by means other than the said transfer means, the protector means having a front face directed towards the door, the front face of the

protector means being located at a position NOT behind the front face of the sensor or the actuating means for the sensor.

Preferably the protector means define an aperture, the sensor being located within the aperture or in alignment with the aperture, said transfer means being dimensioned and located to extend into said aperture on deformation of the outer skin of the door.

Conveniently the longest dimension of the aperture is less than 3 cm.

Advantageously the area of the aperture is less than 10 cm^3.

The aperture is dimensioned so that a shoe cannot inadvertently pass into or through the aperture to apply any force to the sensor.

Preferably the sensor comprises an acceleration sensor and yieldable means to support or retain the acceleration sensor at a predetermined position, the said transfer means being adapted, as a consequence of deformation of the outer skin of the door of the vehicle, to cause the sensor to move. Whilst the acceleration sensor may be retained in position by resilient means, such as a resilient strip or spring, the sensor may be retained in position by deformable means, such as a deformable metal element or by frangible means, such as an element made of a brittle plastic or other brittle material.

In one embodiment the acceleration sensor is supported on a resilient strip, the strip abutting a

protection plate, the protection plate comprising the protection means and defining an aperture.

The protection plate is located between the resilient strip and the door, the resilient strip being aligned with an aperture formed in the protection plate. The transfer means are dimensioned and located to extend through the aperture, on deformation of the outer skin of the door, to engage the sensor. The acceleration sensor may be on the side of the resilient strip which is remote from the protection plate or, alternatively, may be located on the side of the resilient strip that is adjacent the protection plate, the acceleration sensor actually being received within the aperture.

In an alternative embodiment the sensor is located within a housing, the sensor being received within a cavity in the housing. In such an embodiment it is preferred that the sensor is retained in the predetermined position by spring means.

In a further embodiment of the invention the sensor comprises a pyrotechnic charge which is responsive to a compression force, said transfer means being adapted to apply a compression force to the pyrotechnic charge.

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 view of one embodiment of the invention,

FIGURE 2 is a view corresponding to Figure 1 showing a modified embodiment of the invention,

FIGURE 3 is a view of part of a further embodiment of the invention, and

FIGURE 4 is a view of part of yet another embodiment of the invention.

Referring initially to Figure 1, a motor vehicle is provided with a door 1, the lower edge of which is located above a door sill 2 which forms part of the monocoque shell or chassis of the motor vehicle. A seat 3 is located adjacent the door adapted to be occupied by the driver of or a passenger in the vehicle.

The door 1 has a relatively "soft" outer metal skin 4. At least the lower part of the metal skin is reinforced with a substantially rigid reinforcing element 5. The reinforcing element is located in the lower portion of the door adjacent the side of the seat 3, in the region where it is anticipated that the vehicle may be struck, for example, by the bumper of another vehicle, during a side impact. The reinforcing element 5 extends from the front part of the door to the rear part of the door.

A central part of the door is formed by an inner metal sheet 6 which defines, in the region of the reinforcing element 5, an opening 7. A force transmitting element 8 passes through the opening, the force transmitting element 8 being aligned with and slightly spaced from the reinforcing element 5. The force transmitting element 8 is connected to a further force transmitting element 9 which extends across a space defined

between the inner metal sheet 6 and a "trim" 10 which may be formed, for example, of a plastics material. A further force transmitting element 11, in the form of a small projection, may be mounted on the outside of the trim 10.

The reinforcing element 5 and the force transmitting elements 8,9 and 11 may be formed of any suitable material such as, for example, a substantially rigid foamed plastics material.

The force transmitting element 11 is substantially aligned with an aperture 12 formed in a rigid protection plate 13. The longest dimension of the aperture may be less than 3 cm. The area of the aperture is preferably less than 10 cm^2. The aperture may thus be a circular aperture with a diameter of less than 3 cm. The force transmitting element 11 is dimensioned to be able to pass into the aperture 12.

The protection plate 13 extends substantially vertically, the lower end 14 of the protection plate 13 being secured, by appropriate fastening means 15, to the inner face of the door sill 2.

It is to be appreciated that should the vehicle be subjected to a side impact, and the outer skin of the door is deformed, the force transmitting element 13 will pass through the aperture 12 formed in the protecting plate 13.

A sensor is provided which comprises an accelerometer 16 mounted on a flexible resilient strip 17, the lower end of which 18 is secured to the floor 19 of the motor vehicle. The resilient strip 17 is such that the front face of the strip is biased firmly in contact with

the rear face of the protection plate 13. The sensor is thus aligned with the aperture 12.

It is to be appreciated, therefore, that the accelerometer 16 is, ordinarily, held firmly in place against the protection plate 13 and the protection plate 13 is fixed securely to part of the monocoque shell or chassis of the motor vehicle. Consequently, the accelerometer moves together with the monocoque shell or chassis of the motor vehicle. However, in the event of a side impact of sufficient severity to deform the outer skin 4 of the door 1, the reinforcing element 5 hits the force transmitting element 8 causing the force transmitting element 8, the force transmitting element 9, the trim 10 and the force transmitting element 11 to move towards the right, as illustrated in Figure 1. The force transmitting element 11 thus engages the sensor, causing the resilient strip 17 to deflect and thus imparting an acceleration to the accelerometer 16. The accelerometer 16 senses an acceleration in excess of a predetermined limit, causing a safety device, such as an air-bag 20 which, when inflated, is located between the door 1 and the torso of a person sitting on the seat 3, to be inflated.

It is to be appreciated that the protection plate 13 is so located between the sensor and the door, that if the door is opened and a person enters the motor vehicle, even if the person is careless as to where they place their feet, the person cannot actually kick the sensor but will, at the worst, kick the protection plate 13. The aperture 12 is so dimensioned and shaped as to prevent a shoe passing through the aperture to engage the accelerometer.

In the arrangement of Figure 1, the accelerometer is located on the part of the flexible strip 17 which is substantially aligned with the aperture 12, the accelerometer being located on the face of the strip 17 that faces away from the aperture 12. In the embodiment of Figure 2, however, the arrangement is virtually identical save that the accelerometer is located on the opposite side of the strip, the accelerometer thus, in the ordinary condition of the apparatus, being accommodated within the aperture 12. However, it is to be noted that the front face of the support plate is located forwardly of the front face of the accelerometer. It is to be understood that the front face of the protector must be located at a position which is not behind the front face of the sensor if the desired degree of protection is to be achieved.

Figure 3 illustrates a further alternative embodiment of the invention in which the sensor comprises an accelerometer which is mounted within a recess 17 formed in a rigid housing 18. The recess has an opening in the front face of the housing 18 - i.e. the face directed towards the door - and the opening defines the aperture 12. The housing 18 is mounted in position adjacent the sill 2 of the motor vehicle. A resilient spring 20 is located between the accelerometer 16 and the base of the recess 17 to retain the accelerometer in a predetermined position. Other means may also be provided to retain the accelerometer in a predetermined position, such as frangible elements. In the embodiment of Figure 3 it is to be noted that the front face of the accelerometer 16 is located slightly recessed behind the front face of the protector housing. Consequently in this embodiment the front face of the protector housing is located not behind the front face of the sensor. The sensor is located within the aperture 12. The remaining components of the

arrangement of Figure 3 are equivalent to the corresponding components of the embodiments of Figures 1 and 2 and will not be re-described in detail.

Figure 4 illustrates yet another alternative embodiment of the invention which is similar to that shown in Figure 3 in that the embodiment of Figure 4 has a rigid housing 18 which defines a recess 17 which defines the aperture 12. In this embodiment, received within the recess 17, is a pyrotechnic charge 21 which is responsive to a compressive force. The force transmitting element 11 is so located that, on deformation of the outer skin 4 of the door 1, the force transmitting element 11 will extend through the aperture 12 into the recess 17 applying a compressional force to the pyrotechnic charge 21. The pyrotechnic charge, when activated, may initiate inflation of an air-bag or the like.

It is again to be appreciated that the remaining components of the arrangement of Figure 4 are equivalent to the corresponding components of the embodiments of Figures 1 and 2 and will not be re-described in detail.

Of course, it is to be appreciated that the sensor may be located at a position much more towards the centre of the motor vehicle, there being a drive rod or some other force transmitting element extending from the sensor to a position adjacent the door of the vehicle. In such a case, a protector would be provided, the front face of which is located not behind the front face of any part that moves integrally with the sensor or which moves to transmit force from the door to the sensor, but which is not mounted on the door.

CLAIMS:

1. A sensor arrangement adapted to sense a side impact in a motor vehicle comprising a sensor responsive to a predetermined movement, the sensor, or actuating means for the sensor, being located adjacent a door of a motor vehicle, means being provided to transfer deformation of the outer skin of the door of the vehicle to the sensor, said transfer means comprising an element adapted to engage the sensor or the actuating means for the sensor, there being rigid protector means located to protect the sensor, or the actuator, from inadvertent engagement by means other than the said transfer means, the protector means having a front face directed towards the door, the front face of the protector means being located at a position NOT behind the front face of the sensor or the actuating means for the sensor.

2. A sensor arrangement according to Claim 1 wherein the protector means define an aperture, the sensor being located within the aperture or in alignment with the aperture, said transfer means being dimensioned and located to extend into said aperture on deformation of the outer skin of the door.

3. A sensor arrangement according to Claim 2 wherein the largest dimension of the aperture is less than 3 cm.

4. A sensor arrangement according to Claim 2 or 3 wherein the area of the aperture is less than 10 cm^2.

5. A sensor arrangement according to any one of the preceding Claims wherein the sensor comprises an

acceleration sensor and yieldable means to support or retain the acceleration sensor at a predetermined position, the said transfer means being adapted, as a consequence of deformation of the outer skin of the door of the vehicle, to cause the sensor to move.

6. A sensor arrangement according to Claim 5 wherein the acceleration sensor is supported on a resilient strip, the strip abutting a protection plate, the protection plate comprising the protection means.

7. A sensor arrangement according to any one of Claims 1 to 4 wherein the sensor is located within a housing, the sensor being received within a cavity in the housing.

8. A sensor arrangement according to Claim 7 wherein the sensor is retained in the predetermined position by spring means.

9. A sensor arrangement according to anyone of Claims 1 to 4 wherein the sensor comprises a pyrotechnic charge which is responsive to a compression force, said transfer means being adapted to apply a compression force to the pyrotechnic charge.

10. A sensor arrangement substantially as herein described with reference to and as shown in Figure 1 of the accompanying drawings.

11. A sensor arrangement substantially as herein described with reference to and as shown in Figure 2 of the accompanying drawings.

12. A sensor arrangement substantially as herein described with reference to and as shown in Figure 3 of the accompanying drawings.

13. A sensor arrangement substantially as herein described with reference to and as shown in Figure 4 of the accompanying drawings.

14. Any novel feature or combination of features disclosed herein.

Amendments to the claims have been filed as follows

1. A sensor arrangement adapted to sense a side impact in a motor vehicle comprising a sensor responsive to a predetermined movement, the sensor, or actuating means for the sensor, being located adjacent a door of a motor vehicle, means being provided to transfer deformation of the outer skin of the door of the vehicle to the sensor, said transfer means comprising an element adapted to engage the sensor or the actuating means for the sensor, there being rigid protector means located to protect the sensor, or the actuator, from inadvertent engagement by means other than the said transfer means, the protector means having a front face directed towards the door, the front face of the protector means being located at a position NOT behind the front face of the sensor or the actuating means for the sensor, the protector means defining an aperture, the sensor being located within the aperture or in alignment with the aperture, and said transfer means being dimensioned and located to extend into said aperture on deformation of the outer skin of the door.

2. A sensor arrangement according to Claim 1 wherein the largest dimension of the aperture is less than 3 cm.

3. A sensor arrangement according to Claim 1 or 23 wherein the area of the aperture is less than 10 cm^2.

4. A sensor arrangement according to any one of the preceding Claims wherein the sensor comprises an acceleration sensor and yieldable means to support or retain the acceleration sensor at a predetermined position, the said transfer means being adapted, as a consequence of

deformation of the outer skin of the door of the vehicle, to cause the sensor to move.

5. A sensor arrangement according to Claim 4 wherein the acceleration sensor is supported on a resilient strip, the strip abutting a protection plate, the protection plate comprising the protection means.

6. A sensor arrangement according to any one of Claims 1 to 3 wherein the sensor is located within a housing, the sensor being received within a cavity in the housing.

7. A sensor arrangement according to Claim 6 wherein the sensor is retained in the predetermined position by spring means.

8. A sensor arrangement according to anyone of Claims 1 to 3 wherein the sensor comprises a pyrotechnic charge which is responsive to a compression force, said transfer means being adapted to apply a compression force to the pyrotechnic charge.

9. A sensor arrangement substantially as herein described with reference to and as shown in Figure 1 of the accompanying drawings.

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

11. A sensor arrangement substantially as herein described with reference to and as shown in Figure 3 of the accompanying drawings.

12. A sensor arrangement substantially as herein described with reference to and as shown in Figure 4 of the accompanying drawings.

The Patent Office

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Application No: GB 9607276.4
Claims searched: 1 to 13

Examiner: Robert Crowshaw
Date of search: 24 June 1996

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.O): B7B (BSB)

Int Cl (Ed.6): B60R 21/00, 21/22, 21/32

Other: EDOC, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2289448 A	(AUTOLIV) See especially sensor 16 in figure 1.	
X	EP 0565501 A1	(AB VOLVO) See especially sensor 16 within rigid protector means 18,20 in figure 2, and deformation transfer means 23 in figure 7.	1
A	US 5437471	(TAKATA) See especially deformation transfer means 42 and rigid protector means 40 in figures 1 and 2.	
A	US 5281780	(GENERAL ENGINEERING) See especially deformation transfer means 15 and rigid protector means 6 in front of sensor 16 in figure 4.	

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.