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(54) Title of the Invention: **Debris impact protection system**
Abstract Title: **Debris impact protection system**

(57) A debris impact protection system 100 for a vehicle (1, Figure 1) has first and second sill impact guards 105, 107 respectively connectable to first and second sills 5, 7 of the vehicle, an underbody impact guard 113 and a brace 103 for bracing laterally between first and second sill impact guards 105, 107 and fastened to a chassis 3 of the vehicle, where brace 103 also couples underbody impact guard 113 to chassis 3. Underbody impact guard 113 may comprise a plurality of guard panels each respectively below a fuel tank, a transmission and an engine. An alternative system has a bullbar attached to chassis rails, an underbody impact guard attached to a front subframe and a skidplate attached to the bullbar and to the front subframe through the underbody impact guard. A vehicle and installation method are also provided.

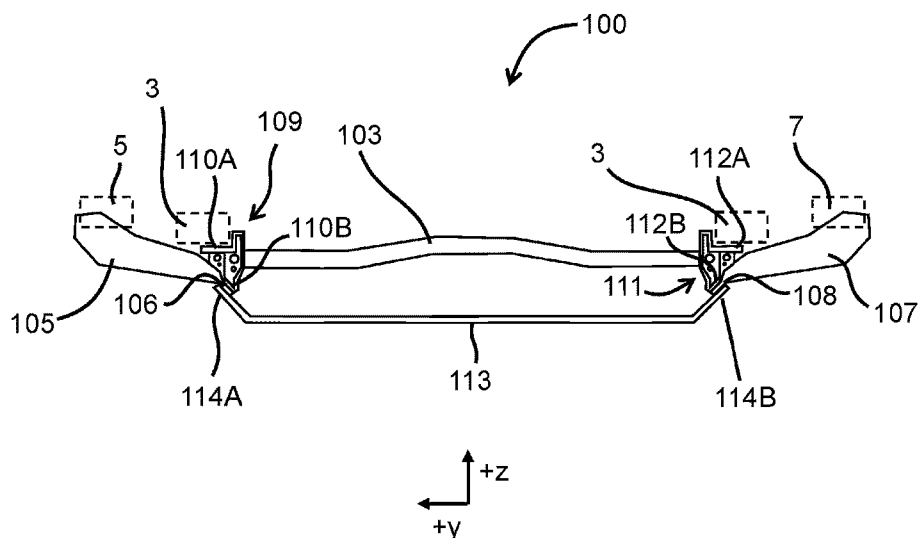


FIG 2

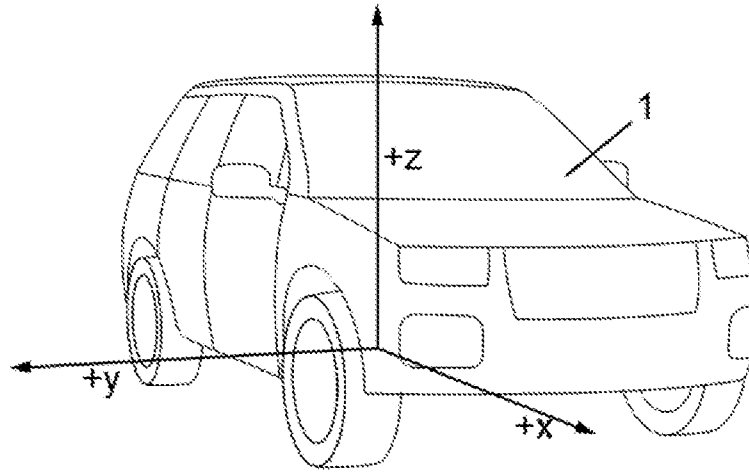


FIG 1

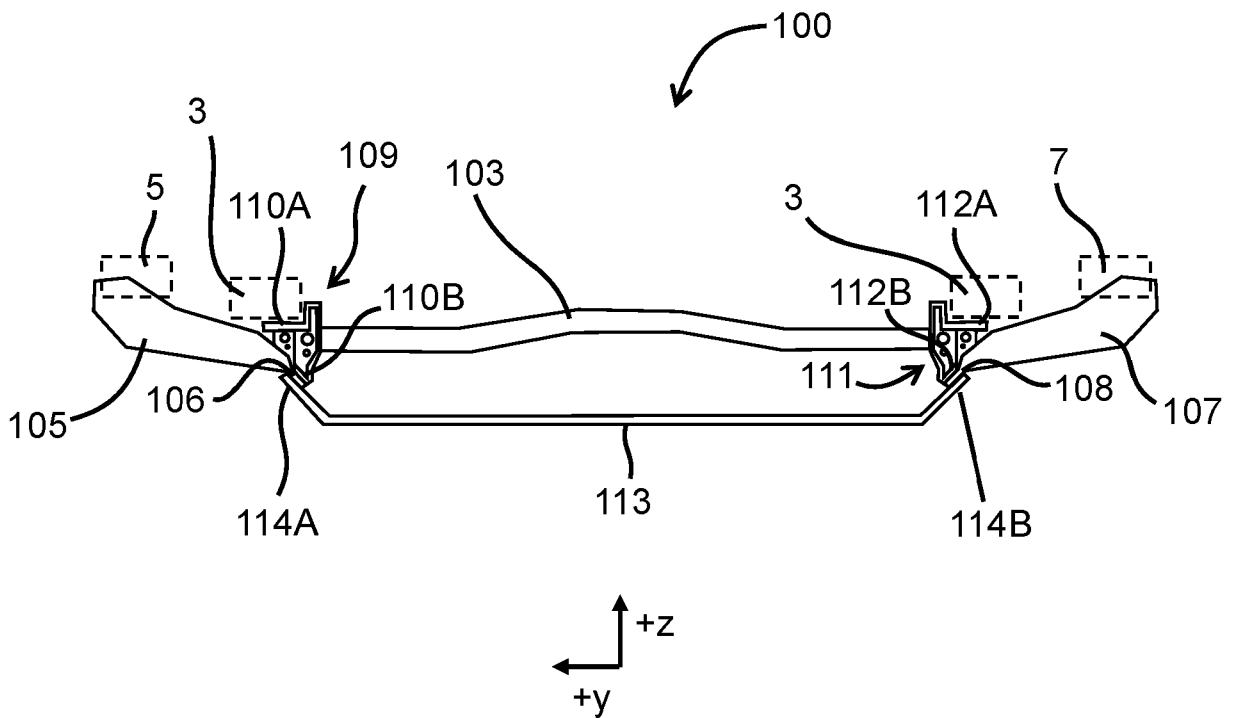


FIG 2

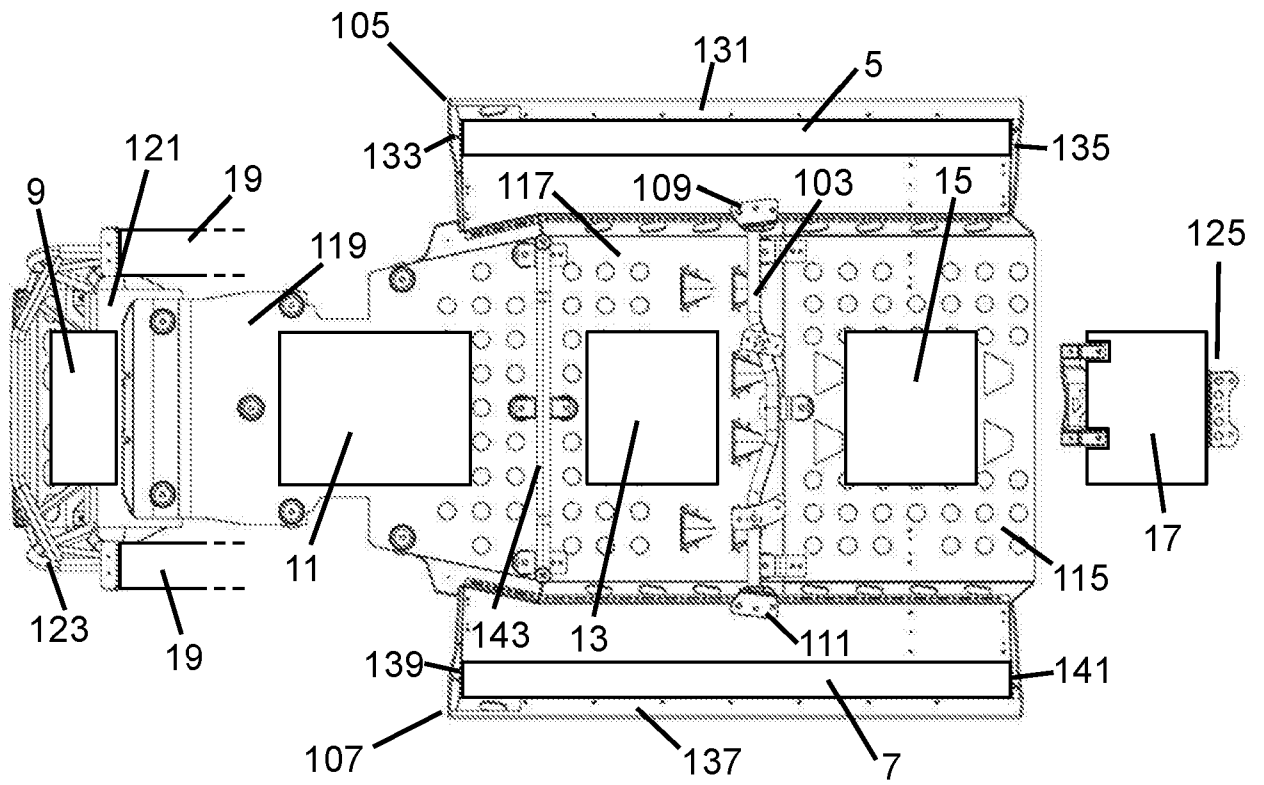


FIG 3A

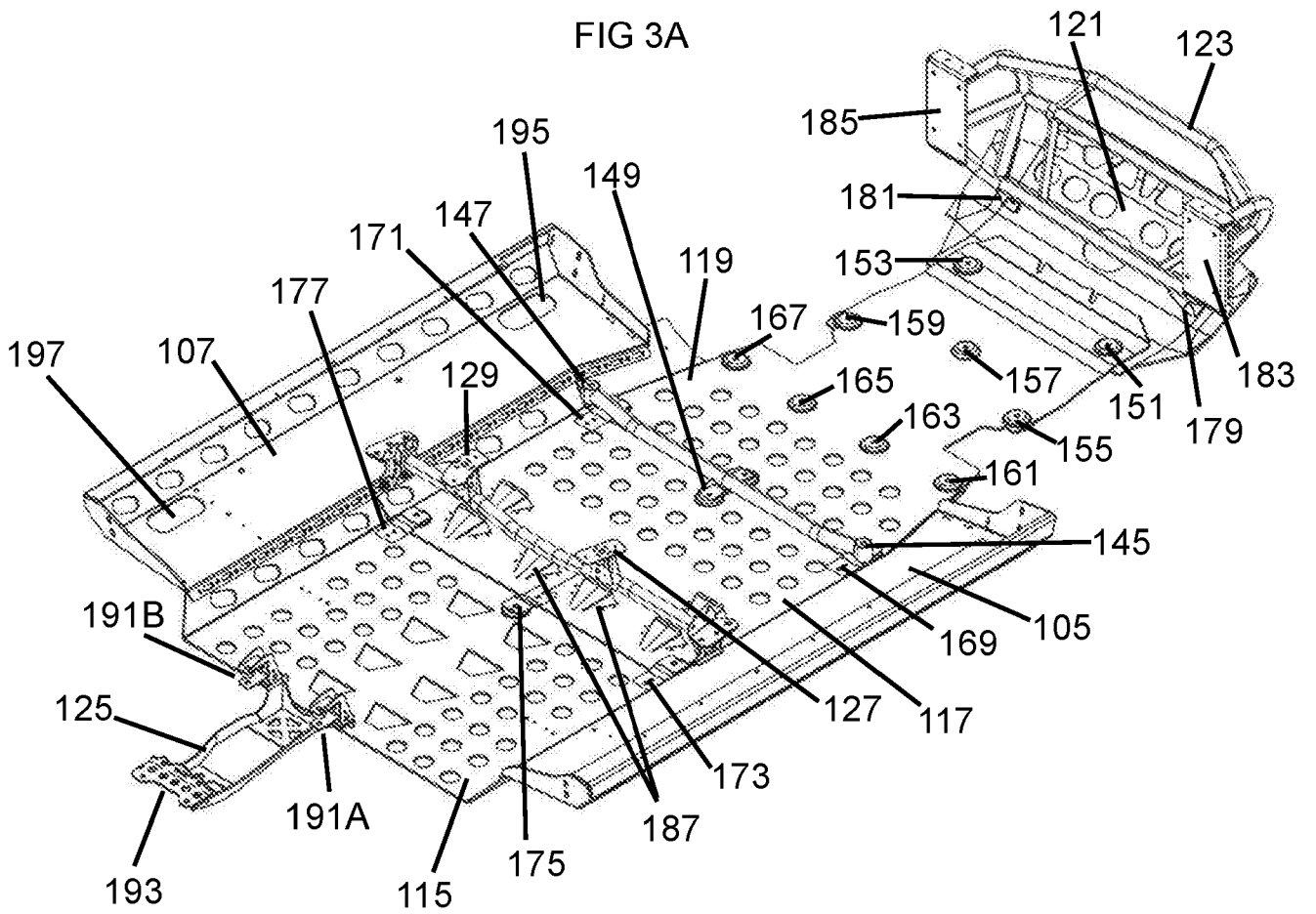


FIG 3B

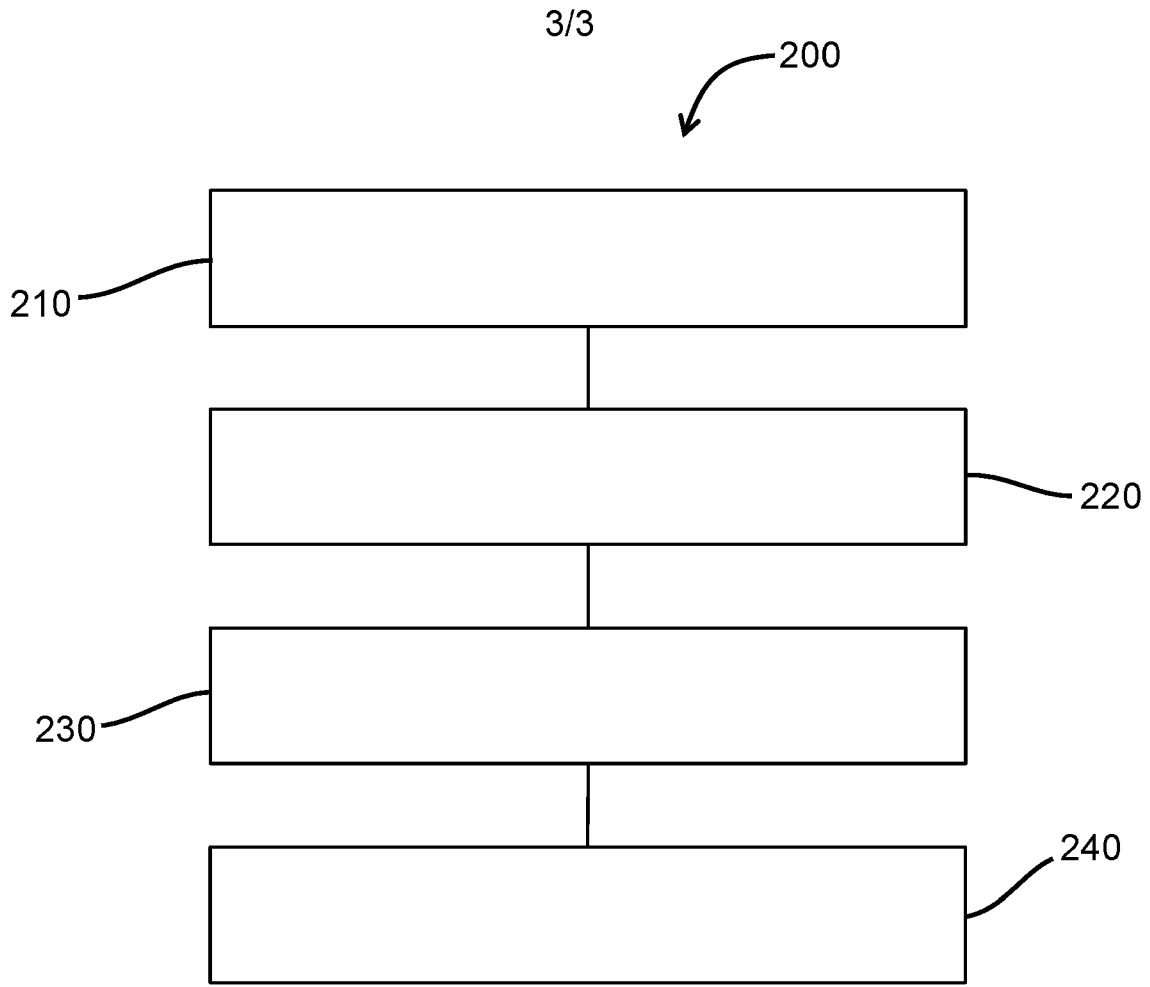


FIG 4

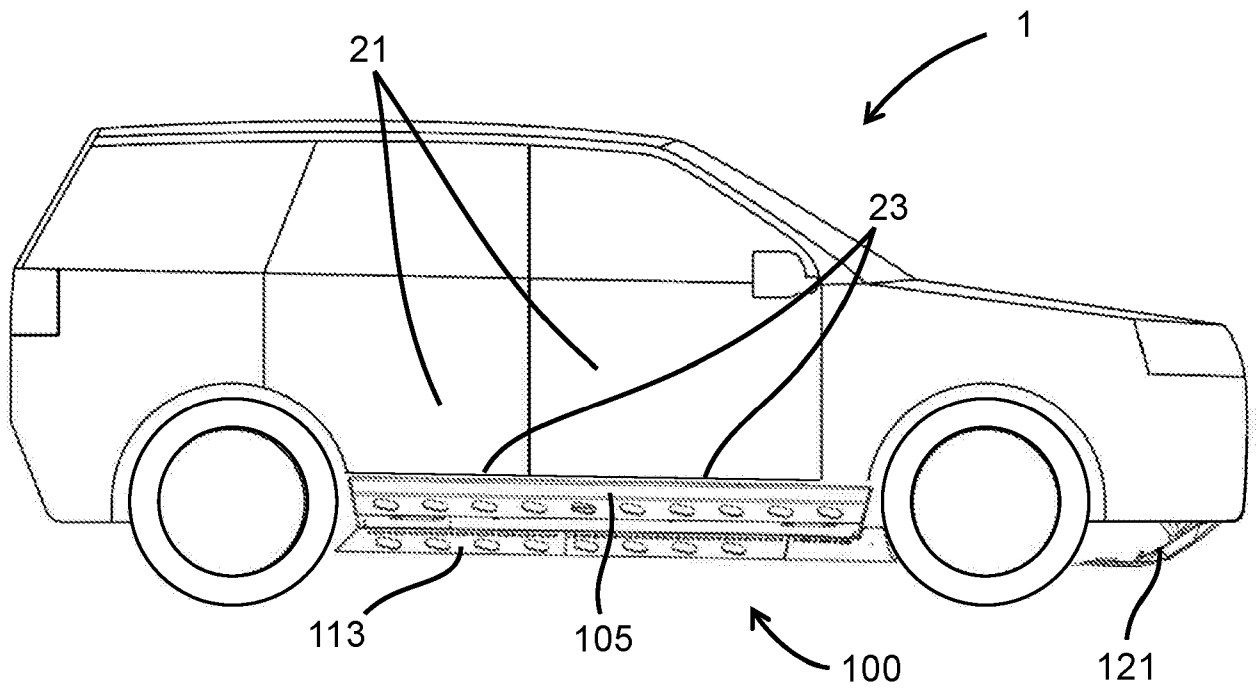


FIG 5

DEBRIS IMPACT PROTECTION SYSTEM

TECHNICAL FIELD

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The present disclosure relates to a debris impact protection system. In particular, but not exclusively it relates to a debris impact protection system for use in protecting the sills and underbody of a vehicle.

10 BACKGROUND

Some vehicles include skid plates, bullbars, and tree/rock sliders. The present invention seeks to improve such components.

15 SUMMARY OF THE INVENTION

Aspects and embodiments of the invention provide a debris impact protection system, a vehicle, and a method of installing the debris impact protection system to a vehicle as claimed in the appended claims.

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According to an aspect of the invention there is provided a debris impact protection system for a vehicle comprising:

a first sill impact guard configured to fasten to a first sill of the vehicle;

a second sill impact guard configured to fasten to a second sill of the vehicle;

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an underbody impact guard; and

a brace for bracing laterally between the first sill impact guard and the second sill impact guard, wherein the brace is configured to fasten to a chassis of the vehicle and is further configured to couple the underbody impact guard to the chassis.

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This provides the advantage of both increased resistance to impacts and supports increased coverage of vulnerable components of the vehicle.

Optionally, the brace may comprise:

a first mount configured to facilitate fastening of the first sill impact guard and the

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underbody impact guard to the chassis; and

a second mount configured to facilitate fastening of the second sill impact guard and the underbody impact guard to the chassis.

5 Optionally, the first and second mounts may be located along the brace to enable fastening to the chassis on either side of a longitudinal powertrain of the vehicle.

Optionally, the first and second mounts may be configured to locate the underbody impact guard below a transmission of the vehicle when fastened to the chassis.

10 Optionally, the underbody impact guard may comprise a plurality of impact guard panels.

Optionally, the debris impact protection system may be configured, upon fastening of the brace to the chassis, to locate a first impact guard panel below a fuel tank of the vehicle, a second impact guard panel below a transmission of the vehicle, and a third impact guard panel below an engine of the vehicle.

15 Optionally, the third impact guard panel may be configured to fasten to a front subframe of the vehicle.

20 Optionally, the debris impact protection system may further comprise an elongate support member configured to couple the second and third impact guard panels together and to fasten to the front subframe on either side of a longitudinal powertrain of the vehicle.

25 Optionally, forward of a fuel tank location, the underbody impact guard may comprise deflectors cooperating with outlets for debris to direct debris moving backwards in a space defined between the vehicle underbody and the underbody impact guard out of this space.

Optionally, the debris impact protection system may further comprise a bullbar configured to fasten to the front of longitudinal chassis rails of the vehicle.

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Optionally, the debris impact protection system may further comprise a skid plate configured as an impact guard and to fasten to the bullbar and to a front subframe of the vehicle through the underbody impact guard.

Optionally, the debris impact protection system may further comprise an underbody rear differential impact guard configured to fasten to a rear subframe of the vehicle via one or more fixing points in common with a rear differential of the vehicle.

- 5 According to an aspect of the invention there is provided a method of installing the debris impact protection system to a vehicle, the method comprising:
- fastening the first sill impact guard to a first sill of the vehicle;
 - fastening the second sill impact guard to a second sill of the vehicle;
 - fastening the brace between the first sill impact guard and the second sill impact
- 10 guard to a chassis of the vehicle;
- coupling the underbody impact guard to the chassis via the brace.

Optionally, the method may further comprise removing portions of door panels of the vehicle which overlap the first and second sills to enable fastening of the first and second sill impact

15 guards to the first and second sills.

According to an aspect of the invention there is provided a debris impact protection system for a vehicle comprising:

- a bullbar configured to fasten to the front of longitudinal chassis rails of the vehicle;
 - 20 an underbody impact guard configured to fasten to a front subframe of the vehicle;
- and
- a skid plate configured as an impact guard and to fasten to the bulbar and to the front subframe through the underbody impact guard.

- 25 According to an aspect of the invention there is provided a vehicle comprising:
- a first sill impact guard fastened to a first sill of the vehicle;
 - a second sill impact guard fastened to a second sill of the vehicle;
 - an underbody impact guard located below one or more of: a fuel tank of the vehicle, a transmission of the vehicle, an engine of the vehicle; and
- 30 a lateral brace between the first sill impact guard and the second sill impact guard, fastened to a chassis of the vehicle and coupling the underbody impact guard to the chassis.

Optionally, doors of the vehicle may terminate above the level of the first and second sill impact guards.

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Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

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BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

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FIG 1 depicts an example vehicle;

FIG 2 depicts an example underbody protections system;

FIGS 3A and 3B depict another example underbody protection system;

FIG 4 depicts an example method; and

FIG 5 depicts an example vehicle comprising an example underbody protection system.

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DETAILED DESCRIPTION

FIG 1 illustrates an example of a vehicle 1 in which embodiments of the invention can be implemented. In some, but not necessarily all examples, the vehicle 1 is a passenger vehicle, also referred to as a passenger car or as an automobile. In other examples, embodiments of the invention can be implemented for other applications, such as commercial vehicles.

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FIG 1 is a front perspective view and illustrates a longitudinal x-axis between the front and rear of the vehicle 1 representing a centreline, an orthogonal lateral y-axis between left and right lateral sides of the vehicle 1, and a vertical z-axis. A forward direction typically faced by a driver's seat is in the positive x-direction; rearward is -x. A rightward direction as seen from the driver's seat is in the positive y-direction; leftward is -y. These are a first lateral direction and a second lateral direction.

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The vehicle 1 can comprise any appropriate torque source for delivering tractive torque to vehicle wheels. For example, the vehicle 1 can comprise an electric traction motor. Additionally, or alternatively, the vehicle 1 can comprise an internal combustion engine. The vehicle 1 may be an electric vehicle, a hybrid electric vehicle, an internal combustion engine vehicle, or similar.

FIG 2 schematically depicts an example of a debris impact protection system 100 for a vehicle 1. The debris impact protection system 100 is depicted in cross section, specifically a lateral cross section, adopting the directional naming convention used in respect of FIG 1.

The debris impact protection system 100 comprises first and second sill impact guards 105, 107. The first sill impact guard 105 is configured to fasten to a first sill 5 of the vehicle 1. The second sill impact guard 107 is configured to fasten to a second sill 7 of the vehicle 1.

The first and second sill impact guards 105, 107 guard against (that is, protect against damage which could result from) impact on the respective sills 5, 7. Impacts guarded against include impacts from debris, for example surface debris such as pebbles, rocks, stones, boulders, sticks, branches, tree roots, tree stumps, or other solid objects including those spread over the surface as a result of human activity.

The first and second sill impact guards 105, 107 may be configured to guard against greater impacts such as intervehicle collisions or collisions with other bodies of substantially greater inertia than debris. In this sense, by guard it is meant that damage resulting from an impact is reduced as compared to the result of impact directly on the sills.

Damage that may be mitigated by the sill impact guards 105, 107 includes deformation of the sills 5, 7 which would inhibit or obstruct the opening and/or closing of one or more of the vehicle's doors 21 (depicted in FIG 5).

Fastening the sill impact guards 105, 107 to the sills 5, 7 Interposed the guards between sills and the environment external to vehicle 1.

The debris impact protection system 100 comprises a brace 103 for bracing laterally between the first sill impact guard 105 and the second sill impact guard 107. The brace 103 may be a rigid body functioning as a strut to resist changes in the separation of the sill

impact guards 105, 107 under compression and/or as a tie to resist changes in the separation of the sill impact guards 105, 107 under tension. As such, the brace 103 reinforces the sill impact guards 105, 107, improving their ability to guard against impact on respective sills 5, 7.

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The brace 103 is configured to fasten to a chassis 3 of the vehicle 1. Accordingly, via the brace 103, the sill impact guards 105, 107 are supported in their guarding against impacts by both a body of the vehicle 1, of which the sills 5, 7 are constituent parts, and the chassis 3 of the vehicle 1 which are either fixed together or form a single structure in the case of the vehicle 1 having a unibody construction. In this later case, the sill impact guards 105, 107 are supported by a plurality of different parts of the same structure.

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In FIG 2, the brace 103 is depicted as being fastenable to two different parts of the chassis 3; however, it is to be appreciated that the brace 103 may be configured to fasten to just a single part of the chassis 3 or to more than two different parts of the chassis 3.

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The brace 103 is depicted with a bend in it. This can enable contact with components of a longitudinal powertrain to be avoided when the brace 103 is fastened to the chassis; however, it is to be appreciated that in some examples a straight brace 103 can be fastened to the chassis 3 without it coming into contact with such components. Accordingly, the depicted bend is only provided in some examples of the brace 103.

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The brace 103 is further configured to couple the underbody impact guard 113 to the chassis 3. The underbody impact guard 113 is also comprised in the debris impact protection system 100. It guards against impacts on vehicle components which are situated under the body of the vehicle 1. Such components may include, without limitation, an engine 11, transmission 13, and fuel tank 15, each of which are depicted in FIG 3A. In order to guard against impacts on vehicle components which are situated under the body of the vehicle 1, the underbody impact guard 113 is suspended below those components, interposed between these components and the surface on which the vehicle 1 is resting or over which it is travelling, when the debris impact protection system 100 is installed on the vehicle 1. It is suspended at least in part from the brace 103 and thus from the chassis 3. Such impacts that it guards against include impacts from debris, for example surface debris such as pebbles, rocks, stones, boulders, sticks, branches, tree roots, tree stumps, or other solid objects including those spread over the surface as a result of human activity.

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In some examples the brace 103 comprises two mounts 109, 111 to facilitate fastening to the chassis 3. The mounts 109, 111 provide fixed points for attaching the brace 103 to the chassis 3. The mounts 109, 111 may each comprise a mating surface 110A, 112A to be brought into contact with the chassis 3 and one or more aligning holes, at least some of which are configured to receive bolts or other suitable fasteners for fastening the brace 103 to the chassis 3.

The brace 103 may terminate at the mounts 109, 111 as depicted in FIG 2; however, it is to be appreciated that the mounts 109, 111 may otherwise be located at other positions along the brace 103 which enable fastening to the chassis 3 on either side of a longitudinal powertrain. For example, they may be positioned to fasten onto two outer chassis longitudinal members.

The mounts 109, 111 are further configured to facilitate fastening to the underbody impact guard 113.

In some examples the mounts 109, 111 are configured to facilitate fastening to the sill impact guards 105, 107 too. In the example depicted in FIG 2, the underbody impact guard 113 is fastened to the brace 103 through the sill impact guards 105, 107.

Accordingly, the first mount 109 can be configured to facilitate fastening of the first sill impact guard 105 and the underbody impact guard 113 to the chassis 3 and the second mount 111 configured to facilitate fastening of the second sill impact guard 107 and the underbody impact guard 113 to the chassis 3.

It is, however, to be appreciated that the sill impact guards 105, 107 may be fastened to the brace 103 separately from the underbody impact guard 113. It is also to be appreciated that the brace 103 can provide lateral bracing between the sill impact guards 105, 107 by means of unfastened contact with surfaces of the sill impact guards 105, 107.

The mounts 109, 111 may, in addition to comprising a mating surface 110A, 112A for the chassis 3, each comprise a mating surface 110B, 112B to be brought into contact with the underbody impact guard 113 (or a sill impact guard 105/107 respectively if the underbody impact guard 113 is fastened to the brace 103 through the sill impact guards 105, 107) and

one or more aligning holes, at least some of which are configured to receive bolts or other suitable fasteners for fastening the brace 103 to the underbody impact guard 113.

In examples where the underbody impact guard 113 is fastened to the brace 103 through the sill impact guards 105, 107, a mating portion 106 of the first sill impact guard 105 is pressed between the mating surface 114A of the underbody impact guard 113 on one side and the mating surface 110B on the other by the fastener. Likewise, a mating portion 108 of the second sill impact guard 107 is pressed between the mating surface 114B of the underbody impact guard 113 on one side and the mating surface 112B on the other by the fastener.

In some examples the mounts 109, 111 facilitate fastening to the chassis 3 which locates the underbody impact guard 113 below the vehicle's transmission 13. In some examples the mounts 109, 111 facilitate fastening to the chassis 3 which locates the underbody impact guard 113 below the vehicle's transmission 13 as it would be arranged in a longitudinal powertrain. This is shown in more detail in FIGS 3A and 3B.

FIG 3A depicts an example of a debris impact protection system 100 in plan view and FIG 3B depicts the same system 100 from a viewpoint to the rear (-x), right (+y) and from above (+z). In FIG 3A, examples of approximate positions of vehicle components which may be guarded against impact are also depicted.

In this example, the first sill impact guard 105 fastens to a first sill 5 via an L-bracket attached to the longitudinal retainer strip 131 of the first sill impact guard 105 which projects slightly inwards and, when installed, may overlie the first sill 5. The first sill impact guard 105 may additionally be fastened to the first sill 5 via brackets attached to front and rear surfaces 133, 135 of the first sill impact guard 105.

Likewise, in this example, the second sill impact guard 107 fastens to a second sill 7 via an L-bracket attached to the longitudinal retainer strip 137 of the second sill impact guard 107 which projects slightly inwards and, when installed, may overlie the second sill 7. The second sill impact guard 107 may additionally be fastened to the second sill 7 via brackets attached to front and rear surfaces 139, 141 of the second sill impact guard 107.

The first and second sill impact guards 105, 107 comprise holes 195, 197 (and corresponding ones obscured in the depiction of the first sill impact guard 105 in FIG 3B)

that allow for the jacking points fixed to the body or chassis 3 of the vehicle 1 to be accessible for workshop or field/onsite use and thus enabling jacking or lifting on the sill impact guards 105, 107 to be avoided.

5 In this example the underbody impact guard 113 comprises a plurality of impact guard panels 115, 117, 119. When the debris impact protection system 100 is installed on the vehicle 100 (including, fastening the brace 103 to the chassis 3 using the first and second mounts 109, 111), the first and second mounts 109, 111 are configured to locate a first impact guard panel 115 below the vehicle's fuel tank 15, a second impact guard panel 117 below the vehicle's transmission 13 (for example, one comprised in a longitudinal powertrain), and a third impact guard panel 119 below the vehicle's engine 11 (for example, one comprised in a longitudinal powertrain).

15 In some examples the brace 103 is fastened directly to second impact guard panel 117, whether through the sill impact guards 105, 107 or not.

In the depicted example, but not necessarily all examples, the brace 103 further comprises third and fourth mounts 127, 129 configured to facilitate additional fastening to different parts of the chassis 3 such as inner/centre chassis longitudinal members or a cross-vehicle beam. This can provide more secure mounting of the brace 103 to the chassis 3.

20 Brackets 173, 175, 177 may be used to attach the second impact guard panel 117 to the first impact guard panel 115. The brace 103 therefore indirectly supports the first impact guard panel 115 via the second impact guard panel 117.

25 In some examples the debris impact protection system 100 comprises an elongate support member 143 configured to couple the second and third impact guard panels 117, 119 together. The elongate support member 143 can comprise an integrally formed bracket 149 which in the depicted example is reinforced with corner bracing. The elongate support member 143 is configured to enable coupling of second and third impact guard panels 117, 30 119 when each are fastened to the integrally formed bracket 149.

In some examples, the elongate support member 143 is configured to fasten to the vehicle's front subframe (not shown) on either side of a longitudinal powertrain of the vehicle 1. The elongate support member 143 can have mounts 145, 147 which are located to align with 35 locations on the vehicle's front subframe. In some examples the locations on the vehicle's

front subframe comprise existing mounting points. They may for example be separated by approximately 950-1000 mm, such as 975 mm, in the y-direction. The mounts 145, 147 comprise a through hole for receiving a fastener such as a bolt or rivet to fasten the elongate support member 143 to the front subframe.

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Brackets 169, 171 may also be used to attach the second impact guard panel 117 to the third impact guard panel 119.

10 In some examples the third impact guard panel 119 is configured to fasten to the front subframe. The third impact guard panel 119 comprises fixing points 151-167 in the form of aligning holes, at least some of which are configured to receive bolts or other suitable fasteners for fastening the third impact guard panel 119 to the front subframe. The fixing points 151-167 have a spatial distribution which align with locations on the vehicle's front subframe. In some examples the locations on the vehicle's front subframe comprise existing
15 mounting points.

In some examples the debris impact protection system 100 comprises a bullbar 123 configured to fasten to the front of longitudinal chassis rails 19.

20 The bulbar 123 comprises mounts 183, 185 which comprise a plurality of aligning holes, at least some of which are configured to receive bolts or other suitable fasteners for fastening the bulbar 123 on to the front of longitudinal chassis rails 19.

The aligning holes of the mount 183 may be distributed over a range of approximately 90
25 mm in the y-direction and approximately 175 mm in the z-direction. The aligning holes of the mount 185 may be distributed over a range of approximately 90 mm in the y-direction and approximately 175 mm in the z-direction. The aligning holes of the mount 183 and the aligning holes of the mount 185 may be separated by approximately 800-1000 mm in the y-direction.

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In the depicted example, but not necessarily all examples, the bullbar 123 is a rigid three-dimensional framework comprises three substantially lateral bars, each separately connected to both of the mounts 183, 185. Cross bracing is provided between these three substantially lateral bars.

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The debris impact protection system 100 may also comprise a skid plate 121 configured as an impact guard and configured to fasten to the bullbar 123 and to the front subframe through the underbody impact guard 113. Accordingly, the skid plate 121 partially overlaps the underbody impact guard 113. In the depicted example, the skid plate 121 partially underlies the third impact guard panel 119.

In the depicted example brackets 179, 181 are used to facilitate the fastening of the lower one of the three substantially lateral bars of the bullbar 123 to the skid plate 121. The skid plate 121 fastens to the front subframe through the fixing points 151, 153 of the third impact guard panel 119.

The combination of:

- the bullbar 123 which is configured to fasten to the front of longitudinal chassis rails 19;
 - the third impact guard panel 119 (or underbody impact guard 113 as a whole) which is configured to fasten to a front subframe; and
 - a skid plate 121 which is configured as an impact guard and to fasten to the bullbar 123 and to the front subframe through the third impact guard 119 (or underbody impact guard 113 as a whole),
- may be installed on some vehicles in isolation from other components (including other impact guard panels 115, 117 which have above been described as being comprised in the underbody impact guard 113) of the debris impact protection system 100. This combination still functions as a debris impact protection system.

In some examples the debris impact protection system 100 comprises an underbody rear differential impact guard 125 configured to fasten to the vehicle's rear subframe (not shown) via one or more fixing points in common with a rear differential 17 of the vehicle 1.

The depicted example of the underbody rear differential impact guard 125 comprises three mounts 191A, 191B, 193.

Two of these mounts 191A, 191B share with the rear differential 17 fixing points to the rear subframe. The mounts 191A, 191B can each comprise upper and lower aligning holes, between which the rear differential 17 can be positioned when fastening it to the rear subframe. The lower of these aligning holes can be placed over the rear subframe and a

fastener located through the upper aligning hole, rear differential 17 and lower aligning hole and into the rear subframe to fix the position of both the rear differential 17 and the underbody rear differential impact guard 125 with respect to the vehicle 1.

- 5 The aligning holes of the mounts 191A, 191B may be separated by approximately 250-260 mm in the y-direction.

The other mount 193 comprises a plurality of aligning holes, at least some of which are configured to receive fasteners for fastening the underbody rear differential impact guard
10 125 to the rear subframe.

The separation in the x-direction between aligning holes of the mounts 191A, 191B and aligning holes of the mount 193 may be approximately 390-400 mm.

- 15 In some examples components of the debris impact protection system 100 comprise a plurality of holes. These enable egress of debris, sand and water from a space defined between the vehicle underbody and the underbody impact guard 113, though ingress of debris and water through these same holes may not be prevented. In some example the holes are sized to filter ingress of debris with sufficient inertia to damage vehicle components
20 which are situated under the body of the vehicle 1 and to exclude such debris from ingress.

The skid plate 121 can comprise holes functioning as vents to allow for the cooling of a radiator 9 located at least partially behind the skid plate 121.

- 25 The front portion of the third impact guard panel 119 comprises a lower density distribution of holes (other than for fixing points 151-167) than a rear portion of this panel 119. As installed on the vehicle 1, this portion of the panel 119 may function as a sump protection area. The lower distribution of holes in this portion reduces the chances of stones or sharp objects getting between the impact guard panel 119 and the sump. If such objects were to
30 be in this space when there was an impact on the panel 119, the objects may be pushed through the sump resulting in engine failure once the oil was lost.

Forward of the fuel tank 15 location, the underbody impact guard 113 can comprises deflectors 187 cooperating with holes functioning as outlets for debris. The deflectors 187
35 are configured to direct debris moving backwards (for example, towards the fuel tank 15) in

the space between the vehicle underbody and the underbody impact guard 113 out of this space. The deflectors 187 can also repel debris on a trajectory to enter the space through the outlets they are cooperating with. The deflectors 187 may be formed as part of second impact guard panel 117.

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FIG 4 depicts a method 200 of installing the debris impact protection system 100 as described in relation to FIG 2 or in relation to FIGS 3A and 3B to the vehicle 1.

10 Block 210 of the method 200 comprises fastening the first sill impact guard 105 to the first sill 5 of the vehicle 1. As described in the foregoing, the first sill impact guard 105 may be fastened to the first sill 5 via an L-bracket attached to the longitudinal retainer strip 131 and/or additionally via brackets attached to front and rear surfaces 133, 135 of the first sill impact guard 105.

15 Block 220 of the method 200 comprises fastening the second sill impact guard 107 to the second sill 7 of the vehicle 1. As described in the foregoing, the second sill impact guard 107 may be fastened to the second sill 7 via an L-bracket attached to the longitudinal retainer strip 137 and/or additionally via brackets attached to front and rear surfaces 139, 141 of the second sill impact guard 107.

20

Block 230 comprises fastening the brace 103 between the first sill impact guard 105 and the second sill impact guard 107 to the chassis 3 of the vehicle 1. As described in the foregoing, the brace 103 may be fastened to the chassis 3 using the two mounts 109, 111 to suitably locate the underbody impact guard 113, which is (or will be) coupled to the brace 103, with
25 respect to the vehicle components situated under the body of the vehicle 1.

In some examples block 230 comprises fastening the brace 103 onto two outer chassis longitudinals via first and second mounts 109, 111 and, optionally, onto inner/centre chassis longitudinals via third and fourth mounts 127, 129.

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Block 240 comprises coupling the underbody impact guard 113 to the chassis 3 via the brace 103. This may be achieved by block 230 if the underbody impact guard 113 is pre-emptively fastened to the brace 103.

The illustration of a particular order to the blocks does not necessarily imply that there is a required or preferred order for the blocks and the order and arrangement of the block may be varied.

5 An example of the resultant vehicle 1 is depicted in FIG 5.

FIG 5 depicts an example of a vehicle 1. As can be seen, a first sill impact guard 105 is fastened to a first sill 5 of the vehicle 1. Though it cannot be seen, obscured in FIG 5 by the body of the vehicle 1, the second sill impact guard 107 is fastened to the second sill 7 of the vehicle 1. The underbody impact guard 113 is located below one or more of: the fuel tank 15, transmission 13, engine 11 or other of the components situated under the vehicle's body. Obscured by the first sill impact guard 105 and underbody impact guard 113 in FIG 5, the lateral brace 103 between the first sill impact guard 105 and the second sill impact guard 107 and is nevertheless fastened to the chassis 3 of the vehicle 1 and couples the underbody impact guard 113 to the chassis 3 in the manner described in the foregoing. Also in FIG 5 it can be observed where, in some examples, skid plate 121 is fastened to the vehicle 1. The bullbar 123 may be confined within the bumper structure of the vehicle 1 and is thus obscured in FIG 5. In some examples the skid plate 121 is fitted to align with the bumper. Though not depicted, they are fastened to the vehicle in the manner described in the foregoing.

In some examples the method 200 further comprises adapting one or more of the vehicle's doors 21. Adapting one or more of the vehicle's doors 21 in accordance with some examples of the method 200 can comprise removing portions of door panels which overlap the first and/or second sills 5, 7 to enable fastening of the first and second sill impact guards 105, 107 to the first and second sills 5, 7, particularly in a manner which does not obstruct the opening and closing of the doors 21. In the resultant vehicle 1, as depicted in FIG 5, the doors 21 terminate above the level of the first and second sill impact guards 105, 107. Accordingly, the lower edge 23 of each door 21 can pass above the first and second sill impact guards 105, 107 when the door is opened and closed.

It will be appreciated that various changes and modifications can be made to the present invention without departing from the scope of the present application.

Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed.

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Features described in the preceding description may be used in combinations other than the combinations explicitly described.

Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

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Although features have been described with reference to certain embodiments, those features may also be present in other embodiments whether described or not.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

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CLAIMS

1. A debris impact protection system for a vehicle comprising:
5 a first sill impact guard configured to fasten to a first sill of the vehicle;
a second sill impact guard configured to fasten to a second sill of the vehicle;
an underbody impact guard; and
a brace for bracing laterally between the first sill impact guard and the second sill
impact guard, wherein the brace is configured to fasten to a chassis of the vehicle and is
10 further configured to couple the underbody impact guard to the chassis.
2. The debris impact protection system of claim 1 wherein the brace comprises:
a first mount configured to facilitate fastening of the first sill impact guard and the
underbody impact guard to the chassis; and
15 a second mount configured to facilitate fastening of the second sill impact guard and
the underbody impact guard to the chassis.
3. The debris impact protection system of claim 2 wherein the first and second mounts
are located along the brace to enable fastening to the chassis on either side of a longitudinal
20 powertrain of the vehicle.
4. The debris impact protection system of claims 2 or 3 wherein the first and second
mounts are configured to locate the underbody impact guard below a transmission of the
vehicle when fastened to the chassis.
25
5. The debris impact protection system of any preceding claim wherein the underbody
impact guard comprises a plurality of impact guard panels.
6. The debris impact protection system of claim 5 configured, upon fastening of the
30 brace to the chassis, to locate a first impact guard panel below a fuel tank of the vehicle, a
second impact guard panel below a transmission of the vehicle, and a third impact guard
panel below an engine of the vehicle.
7. The debris impact protection system of claim 6 wherein the third impact guard panel
35 is configured to fasten to a front subframe of the vehicle.

8. The debris impact protection system of claim 6 or claim 7 further comprising an elongate support member configured to couple the second and third impact guard panels together and to fasten to the front subframe on either side of a longitudinal powertrain of the vehicle.
9. The debris impact protection system of any preceding claim wherein forward of a fuel tank location, the underbody impact guard comprises deflectors cooperating with outlets for debris to direct debris moving backwards in a space defined between the vehicle underbody and the underbody impact guard out of this space.
10. The debris impact protection system of any preceding claim further comprising a bullbar configured to fasten to the front of longitudinal chassis rails of the vehicle.
11. The debris impact protection system of claim 10 further comprising a skid plate configured as an impact guard and to fasten to the bullbar and to a front subframe of the vehicle through the underbody impact guard.
12. The debris impact protection system of any preceding claim further comprising an underbody rear differential impact guard configured to fasten to a rear subframe of the vehicle via one or more fixing points in common with a rear differential of the vehicle.
13. A debris impact protection system for a vehicle comprising:
a bullbar configured to fasten to the front of longitudinal chassis rails of the vehicle
(1);
an underbody impact guard configured to fasten to a front subframe of the vehicle;
and
a skid plate configured as an impact guard and to fasten to the bulbar and to the front subframe through the underbody impact guard.
14. A vehicle comprising:
a first sill impact guard fastened to a first sill of the vehicle;
a second sill impact guard fastened to a second sill of the vehicle;
an underbody impact guard located below one or more of: a fuel tank of the vehicle,
a transmission of the vehicle, an engine of the vehicle; and

a lateral brace between the first sill impact guard and the second sill impact guard, fastened to a chassis of the vehicle and coupling the underbody impact guard to the chassis.

5 15. The vehicle of claim 14 wherein doors of the vehicle terminate above the level of the first and second sill impact guards.

16. A method of installing the debris impact protection system of any of claims 1 to 12 to a vehicle, the method comprising:

- 10 fastening the first sill impact guard to a first sill of the vehicle;
fastening the second sill impact guard to a second sill of the vehicle;
fastening the brace between the first sill impact guard and the second sill impact guard to a chassis of the vehicle;
coupling the underbody impact guard to the chassis via the brace.

15 17. The method of claim 16 further comprising removing portions of door panels of the vehicle which overlap the first and second sills to enable fastening of the first and second sill impact guards to the first and second sills.

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Application No: GB2110776.8

Examiner: Simon Rose

Claims searched: 1-12, 14-17

Date of search: 5 January 2022

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	US 2020/0398896 A1 (GRATTAN) See particularly Figure 2, undersills 14a, reinforcement brace 16
A	-	US 2016/0121688 A1 (HICKS) See particularly Figures 1, 3 and 4, mounting arrangement 40, pivot arrangements 56, 60, and paragraphs 17-19
A	-	CN 210454718 U (JIANGSU ZHIYA) See particularly Figure 1

Categories:

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.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

Worldwide search of patent documents classified in the following areas of the IPC

B60R; B62D

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, Patent Fulltext

International Classification:

Subclass	Subgroup	Valid From
B62D	0021/15	01/01/2006
B60R	0019/42	01/01/2006



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Claims searched: 13

Date of search: 20 May 2022

**Patents Act 1977
Further Search Report under Section 17**

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	13	WO 2020/169908 A1 (PSA AUTOMOBILES) See particularly Figure 1
A	-	US 2019/0337476 A1 (HARE et al) See particularly Figure 1
A	-	US 2017/0182873 A1 (BACCOUCHE) See particularly Figures 2 and 3

Categories:

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