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HINGE FOR MITIGATING FORCE TRANSFER

Abstract

Hinges for mitigating force transfer are disclosed. A hinge coupling a tailgate to a support structure of a vehicle includes a first portion, a second portion, and one or more crumple features. The second portion rotations relative to the first portion to move the tailgate between an open position and a closed position. The one or more crumple features cause a length of the hinge to be reduced when a threshold force is applied to the hinge while the tailgate is in the closed position.

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Background/Summary

INTRODUCTION

[0001] Events that are external to a vehicle, such as a collision with another vehicle, can cause one or more components of the vehicle to interact in an unexpected manner. For example, in the event of a collision, forces applied to one vehicle component can be translated to one or more other vehicle components, resulting in damage to multiple vehicle components.

SUMMARY OF THE INVENTION

[0002] The present disclosure relates to vehicles, and more specifically, to a hinge for mitigating force transfer.

[0003] In one or more embodiments, a vehicle is disclosed. The vehicle includes a support structure, a tailgate, and a hinge coupling the tailgate to the support structure. The hinge includes a first portion, a second portion, and one or more crumple features. The second portion rotates relative to the first portion to move the tailgate between an open position and a closed position. The one or more crumple features cause a length of the hinge to be reduced when a threshold force is applied to the hinge while the tailgate is in the closed position.

[0004] In one or more embodiments, a tailgate system is disclosed. The tailgate system includes a tailgate and a hinge configured to couple the tailgate to a support structure of a vehicle. The hinge includes a first portion, a second portion, and one or more crumple features. The second portion rotates relative to the first portion to move the tailgate between an open position and a closed position. The one or more crumple features are configured to reduce a transfer of a threshold force to the support structure when the threshold force is applied to the hinge while the tailgate is in the closed position.

[0005] In one or more embodiments, a hinge is disclosed. The hinge includes a first portion and a second portion. The first portion is configured to couple the hinge to a support structure of a vehicle. The second portion is configured to couple the hinge to a tailgate of the vehicle. The second portion is coupled to the first portion, and the second portion rotates relative to the first portion to move the tailgate between an open position and a closed position. At least one of the first portion or the second portion include one or more crumple features are configured to cause a length of the hinge to be reduced when a threshold force is applied to the hinge.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only exemplary embodiments and are therefore not to be considered limiting in scope, and may admit to other equally effective embodiments.

[0007] FIG. **1** illustrates an example vehicle, in accordance with embodiments of the present disclosure.

[0008] FIG. **2** illustrates a cross-sectional view of a tailgate in a closed position including a first portion and a second portion of a hinge, in accordance with embodiments of the present disclosure.

[0009] FIG. **3** illustrates an orientation of a hinge when a tailgate is in an open position, in accordance with embodiments of the present disclosure.

[0010] FIG. **4** illustrates a hinge extending a first distance beyond a rear bumper of a vehicle, in accordance with embodiments of the present disclosure.

[0011] FIG. **5** illustrates an example of a hinge having crumple features including one or more apertures and one or more pins configured to shear, in accordance with embodiments of the present disclosure.

[0012] FIG. **6** illustrates an example of a hinge having crumple features including an inner bore and one or more pins configured to shear, in accordance with embodiments of the present disclosure.
[0013] FIG. **7** illustrates an example of a crumple zone of a hinge, in accordance with embodiments of the present disclosure.
[0014] FIG. **8** illustrates an example of a crumpled hinge, in accordance with embodiments of the present disclosure.
[0015] FIG. **9** illustrates an example of a hinge having crumple features including a pin configured to shear, in accordance with embodiments of the present disclosure.
[0016] FIG. **10** illustrates an example of a hinge having a reduced length, in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

[0017] It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the disclosure. These are, of course, merely examples and are not intended to be limiting. The section headings used herein are for organizational purposes and are not to be construed as limiting the subject matter described.
[0018] A vehicle with a tailgate includes a hinge that is coupled to the tailgate and also coupled to a portion of the vehicle. The hinge facilitates movement of the tailgate between a closed position and an open position. When the tailgate is in the closed position, a force applied to the hinge may be transferred to the portion of the vehicle to which the hinge is coupled, causing deformation of that portion of the vehicle and potentially requiring costly repairs. Certain embodiments described herein provide systems that mitigate transfer of the force to the portion of the vehicle.
[0019] In particular, embodiments herein describe a vehicle including a support structure, a tailgate, and a hinge coupling the tailgate to the support structure. In some embodiments, the hinge includes a first portion, a second portion, where one or both of the first portion and the second portion include one or more crumple features. The second portion can rotate relative to the first portion to move the tailgate between an open position and a closed position. In various embodiments, if the tailgate is in the closed position, the one or more crumple features cause a length of the hinge to be reduced when a threshold force is applied to the hinge. In certain embodiments, reducing the length of the hinge can mitigate transfer of the threshold force to the support structure.
[0020] Among other advantages, the embodiments described herein provide for forces to be applied to the hinge (e.g., in the event of a rear end collision) without substantial deformation of the support structure to which the hinge is coupled.
[0021] FIG. **1** illustrates an example vehicle **100**, in accordance with embodiments of the present disclosure. Vehicle **100** is illustrated to include tailgate **102**, support structure **104**, and hinge **106** coupling tailgate **102** to support structure **104**. Cable assembly **108** includes one or more cables with one end fixed to a portion of cable assembly **108** and the other end fixed to a portion of tailgate **102**. In FIG. **1**, tailgate **102** is illustrated in a closed position. In various embodiments, hinge **106** facilitates movement of tailgate **102** between the closed position and an open position. In the open position, one or more cables of cable assembly **108** may support tailgate **102** and objects/cargo resting on tailgate **102**.
[0022] In some embodiments, hinge **106** may be manufactured from a variety of different materials, such as a polymer, stainless steel, aluminum alloy, titanium alloy, and/or the like. In one or more embodiments, hinge **106** can be manufactured from multiple different materials. In certain embodiments, hinge **106** may comprise a gooseneck hinge which is disposed below tailgate **102**. In various embodiments, the gooseneck hinge has a wider range of motion relative to other types of hinges, which may facilitate a lower ending position of tailgate **102** (e.g., relative to a rear end bumper of vehicle **100**) when tailgate **102** is in the open position. However, the techniques described herein may be implemented with any type of hinge or other vehicle component.

[0023] FIG. **2** illustrates a cross-sectional view of a tailgate **102** in a closed position **200** including a first portion **202** and a second portion **204** of a hinge **106**, in accordance with embodiments of the present disclosure. As shown, first portion **202** is coupled to support structure **104**, and second portion **204** is coupled to tailgate **102**.

[0024] In one or more embodiments, first portion **202** and second portion **204** are connected by pivot joint **206**. In some embodiments, second portion **204** rotates relative to first portion **202** about pivot joint **206** in a clockwise direction (as viewed in FIG. **2**) to move tailgate **102** from closed position **200** to the open position. In some embodiments, second portion **204** rotates relative to first portion **202** about pivot joint **206** in a counter-clockwise direction (as viewed in FIG. **2**) to move tailgate **102** from the open position to closed position **200**.

[0025] FIG. **3** illustrates an orientation **300** of a hinge **106** when a tailgate **102** is in an open position, in accordance with embodiments of the present disclosure. When tailgate **102** is in the open position, one or more cables of cable assembly **108** cause forces applied to tailgate **102** (e.g., by objects/cargo resting on tailgate **102**) to be applied to first portion **202** of hinge **106** in a direction approximated by vector **302**. For example, a force vector **304** applied to tailgate **102** (based on a mass of objects/cargo disposed on tailgate **102** when tailgate **102** is in the open position) is directed towards first portion **202** in the direction approximated by vector **302** by the one or more cables which connect tailgate **102** to vehicle **100**.

[0026] FIG. **4** illustrates a hinge **106** extending a first distance **400** beyond a rear bumper **402** of a vehicle **100**, in accordance with embodiments of the present disclosure. In various embodiments, length **404** of hinge **106** extends beyond rear bumper **402** in a rearward direction such that rear portion **406** of hinge **106** extends beyond rear end **408** of rear bumper **402** by first distance **400**. In some embodiments, force vector **410** is representative of a threshold force applied to hinge **106** when tailgate **102** is in closed position **200** (e.g., due to a rear end collision). Notably, since rear portion **406** of hinge **106** extends beyond rear end **408** of rear bumper **402**, force vector **410** is applied to hinge **106** before force vector **410** is applied to, and at least partially absorbed by, rear bumper **402**.

[0027] FIG. **5** illustrates an example of a hinge **106** having crumple features including one or more apertures **502**, **504**, **506**, **508** and one or more pins **516**, **518** configured to shear, in accordance with embodiments of the present disclosure. In some embodiments, apertures **502**, **504**, **506**, **508** and solid portions of first portion **202** between apertures **502**, **504**, **506**, **508** are configured to absorb and/or distribute kinetic energy in response to an application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**. In certain embodiments, absorbing and/or distributing kinetic energy in response to the application of force vector **410** to hinge **106** may reduce a magnitude of force vector **410** that is transferred to another vehicle component by hinge **106**, and can also cause hinge **106** to deform in a controlled and predictable manner. In one or more embodiments, when hinge **106** deforms in a controlled and predictable manner, length **404** of hinge **106** may be reduced by at least first distance **400** such that rear bumper **402** absorbs the remaining/reduced force of force vector **410**.

[0028] In various embodiments, pivot pin **512** may be configured to shear in response to the application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**. In some embodiments, pivot pin **512** may comprise asymmetric geometry **514**. In one or more examples, when tailgate **102** is in the open position, asymmetric geometry **514** is reinforced such that applied forces to pivot pin **512** in the direction approximated by vector **302** are insufficient to cause shearing of pivot pin **512**. In certain examples, when tailgate **102** is in closed position **200**, asymmetric geometry **514** is not reinforced such that the application of force vector **410** to hinge **106** is sufficient/configured to shear pivot pin **512**. In one or more embodiments, shearing pivot pin **512** may be configured to reduce length **404** by at least first distance **400** such that rear bumper **402** receives and absorbs force vector **410** (e.g., mitigating transfer of force vector **410** to support structure **104**).

[0029] In certain embodiments, pins **516**, **518** may be configured to shear in response to the application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**. In some embodiments, shearing pins **516**, **518** may be configured to reduce length **404** by at least first distance **400** such that rear bumper **402** receives and absorbs force vector **410**. In various examples, receiving and absorbing force vector **410** by rear bumper **402** substantially reduces or prevents transfer of force vector **410** to support structure **104**.

[0030] FIG. **6** illustrates an example of a hinge **106** having crumple features including an inner bore **602** and one or more pins **516**, **518** configured to shear, in accordance with embodiments of the present disclosure. In certain embodiments, the presence of the hollow region defining inner bore **602** enables hinge **106** to absorb and/or distribute kinetic energy in response to an application of force vector **410** to hinge **106** (e.g., by causing hinge **106** to crumple) when tailgate **102** is in closed position **200**. In various embodiments, absorbing and/or distributing kinetic energy in response to the application of force vector **410** to hinge **106** may reduce a magnitude of force vector **410** and also cause second portion **204** to deform in a controlled and predictable manner. In one or more embodiments, causing second portion **204** to deform in the controlled and predictable manner may be configured to reduce length **404** by at least first distance **400** such that rear bumper **402** absorbs the remaining/reduced force of force vector **410**.

[0031] In some embodiments, stamped portion **604** may be configured to absorb and/or distribute kinetic energy in response to the application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**. In various examples, stamped portion **604** can be manufactured using a stamping process or another manufacturing process (e.g., additive manufacturing, machining, etc.). In one or more examples, stamped portion **604** can be configured to fold/buckle in response to the application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**. In certain embodiments, a folding/buckling of stamped portion **604** may be configured to reduce length **404** by at least first distance **400** such that rear bumper **402** receives and absorbs force vector **410**. However, due to the upward-facing orientation of the hollow region of inner bore **602**, first portion **202** is able to withstand significant forces applied in the direction approximated by vector **302** (e.g., due to a load applied to tailgate **102** when tailgate **102** is in the open position) without crumpling.

[0032] In various embodiments, pins **516**, **518** may be configured to shear in response to the application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200** in addition or alternative to stamped portion **604** being configured to fold/buckle in response to the application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**. In one or more examples, shearing pins **516**, **518** can be configured to cause stamped portion **604** to fold/buckle. In some examples, folding/buckling of stamped portion **604** may be configured to cause pins **516**, **518** to shear.

[0033] FIG. **7** illustrates an example of a crumple zone **700** of a hinge **106**, in accordance with embodiments of the present disclosure. In one or more embodiments, crumple zone **700** includes multiple apertures **702**. As shown in FIG. **7**, crumple zone **700** is included in both first portion **202** and second portion **204** of hinge **106**. In various embodiments, multiple apertures **702** are configured to cause crumple zone **700** to crumple in response to an application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**.

[0034] FIG. **8** illustrates an example of a crumpled hinge **800**, in accordance with embodiments of the present disclosure. As shown, an application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200** causes crumple zone **700** to crumple and compresses hinge **106** into crumpled hinge **800** in some examples. In certain embodiments, length **404** is reduced by at least first distance **400** to reduced length **802** such that rear bumper **402** receives and absorbs force vector **410**. Since rear bumper **402** receives and absorbs force vector **410**, a magnitude of force vector **410** transferred to support structure **104** is minimal and insufficient to significantly deform support structure **104**.

[0035] FIG. **9** illustrates an example of a hinge **106** having crumple features including a pin **906**

configured to shear, in accordance with embodiments of the present disclosure.
[0036] In some embodiments, first portion **202** includes front component **902** and rear component **904** which may be coupled together by pin **906**. As shown, front end **908** of rear component **904** is separated from interface **910** of front component **902** by at least first distance **400**. In certain embodiments, pin **906** may be configured to shear in response to the application of force vector **410** to hinge **106** when tailgate **102** is in closed position **200**. In one or more embodiments, shearing pin **906** may be configured to reduce length **404** by at least first distance **400** such that rear bumper **402** receives and absorbs force vector **410**.
[0037] FIG. **10** illustrates an example of a hinge **106** having a reduced length **802**, in accordance with embodiments of the present disclosure. In various embodiments, when pin **906** is sheared (e.g., in response to the application of force vector **410** to hinge **106**), front component **902** and rear component **904** are no longer coupled together which allows front end **908** to actuate towards interface **910**. In certain embodiments, when front end **908** contacts interface **910**, length **404** is reduced by at least first distance **400** such that hinge **106** has reduced length **802** and rear bumper **402** receives and absorbs force vector **410**. Because rear bumper **402** receives and absorbs force vector **410**, the magnitude of force vector **410** transferred to support structure **104** is minimal and insufficient to significantly deform support structure **104**.
[0038] Although various embodiments of the present disclosure have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the present disclosure is not limited to the embodiments disclosed herein, but is capable of numerous rearrangements, modifications, and substitutions without departing from the spirit of the disclosure as set forth herein.
[0039] The term “substantially” is defined as largely but not necessarily wholly what is specified, as understood by a person of ordinary skill in the art. In any disclosed embodiment, the terms “substantially,” “approximately,” “generally,” and “about” may be substituted with “within [a percentage] of” what is specified, where the percentage includes 0.1, 1, 5, and 10 percent.
[0040] The foregoing outlines features of several embodiments so that those skilled in the art may better understand the aspects of the disclosure. Those skilled in the art should appreciate that they may readily use the disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the disclosure, and that they may make various changes, substitutions, and alterations herein without departing from the spirit and scope of the disclosure. The scope of the invention should be determined only by the language of the claims that follow. The term “comprising” within the claims is intended to mean “including at least” such that the recited listing of elements in a claim are an open group. The terms “a,” “an,” and other singular terms are intended to include the plural forms thereof unless specifically excluded.
[0041] Depending on the embodiment, certain acts, events, or functions of any of the algorithms described herein can be performed in a different sequence, can be added, merged, or left out altogether (e.g., not all described acts or events are necessary for the practice of the algorithms). Moreover, in certain embodiments, acts or events can be performed concurrently, e.g., through multi-threaded processing, interrupt processing, or multiple processors or processor cores or on other parallel architectures, rather than sequentially. Although certain computer-implemented tasks are described as being performed by a particular entity, other embodiments are possible in which these tasks are performed by a different entity.
[0042] Conditional language used herein, such as, among others, “can,” “might,” “may,” “e.g.,” and the like, unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or states. Thus, such conditional language is not generally intended to imply that features, elements and/or states are in any way required for one or

more embodiments or that one or more embodiments necessarily include logic for deciding, with or without author input or prompting, whether these features, elements and/or states are included or are to be performed in any particular embodiment.
[0043] While the above detailed description has shown, described, and pointed out novel features as applied to various embodiments, it will be understood that various omissions, substitutions, and changes in the form and details of the devices or algorithms illustrated can be made without departing from the spirit of the disclosure. As will be recognized, the processes described herein can be embodied within a form that does not provide all of the features and benefits set forth herein, as some features can be used or practiced separately from others. The scope of protection is defined by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.
[0044] Although various embodiments of the method and apparatus of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth herein.

Claims

1. A vehicle, comprising: a support structure; a tailgate; and a hinge coupling the tailgate to the support structure, the hinge comprising a first portion, a second portion, and one or more crumple features, wherein the second portion rotates relative to the first portion to move the tailgate between an open position and a closed position, and the one or more crumple features cause a length of the hinge to be reduced when a threshold force is applied to the hinge while the tailgate is in the closed position.
2. The vehicle of claim 1, wherein the first portion of the hinge is configured to receive the threshold force being applied to the hinge while the tailgate is in the closed position without substantial deformation of the support structure.
3. The vehicle of claim 2, further comprising a rear bumper, wherein, while the tailgate is in the closed position, the hinge extends a first distance beyond the rear bumper in a rearward direction, and the length of the hinge is reduced by at least the first distance in response to the threshold force.
4. The vehicle of claim 3, wherein the one or more crumple features comprise one or more crumple zones included in the first portion of the hinge.
5. The vehicle of claim 3, wherein the one or more crumple features comprise a pin coupling the first portion and the second portion, the pin configured to shear in response to the threshold force.
6. The vehicle of claim 3, wherein the one or more crumple features comprise an inner bore of the hinge.
7. The vehicle of claim 3, wherein the one or more crumple features comprise one or more apertures of the hinge.
8. The vehicle of claim 3, wherein the one or more crumple features comprise a pin coupling the second portion and the tailgate, the pin configured to shear in response to the threshold force.
9. The vehicle of claim 1, wherein the hinge comprises a gooseneck hinge.
10. A tailgate system comprising: a tailgate; and a hinge configured to couple the tailgate to a support structure of a vehicle, the hinge comprising a first portion, a second portion, and one or more crumple features, wherein the second portion rotates relative to the first portion to move the tailgate between an open position and a closed position, the one or more crumple features configured to reduce a transfer of a threshold force to the support structure when the threshold force is applied to the hinge while the tailgate is in the closed position.
11. The tailgate system of claim 10, wherein, while the tailgate is in the closed position, the hinge is

configured to extend a first distance beyond a rear bumper of a vehicle in a rearward direction, and the one or more crumple features are configured to reduce a length of the hinge by at least the first distance in response to the threshold force.

12. The tailgate system of claim 10, wherein the one or more crumple features comprise an inner bore of the hinge.

13. The tailgate system of claim 10, wherein the one or more crumple features comprise one or more apertures of the hinge.

14. The tailgate system of claim 10, wherein the one or more crumple features comprise a pin configured to shear in response to the threshold force.

15. The tailgate system of claim 14, wherein the pin couples the second portion to at least one of the first portion or the tailgate.

16. A hinge comprising: a first portion configured to couple the hinge to a support structure of a vehicle; and a second portion configured to couple the hinge to a tailgate of the vehicle, the second portion coupled to the first portion, wherein the second portion rotates relative to the first portion to move the tailgate between an open position and a closed position, at least one of the first portion or the second portion comprising one or more crumple features configured to cause a length of the hinge to be reduced when a threshold force is applied to the hinge.

17. The hinge of claim 16, wherein the hinge comprises a gooseneck hinge.

18. The hinge of claim 16, wherein the one or more crumple features comprise an inner bore of the hinge.

19. The hinge of claim 16, wherein the one or more crumple features are further configured to reduce a transfer of the threshold force to the support structure of the vehicle.

20. The hinge of claim 16, wherein the one or more crumple features comprise a pin configured to shear in response to the threshold force.