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GRILLE SHUTTERS WITH ACTIVE UPPER LOAD PATH AND VEHICLES INCLUDING SAME

Abstract

A vehicle includes an active grille shutter system including an actuation frame and grille fins that extend between opposite sides of the actuation frame. The grille fins each include a fin body rotatably connected to the actuation frame and a fin extension movably connected to the fin body such that the fin extension moves from a stowed configuration to a deployed configuration relative to the fin body. An actuation device is configured to move the fin extension from the stowed configuration to the deployed position thereby adding to a length of the fin body.

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Background/Summary

TECHNICAL FIELD

[0001] The present specification generally relates to vehicles with grill shutters, and more specifically, grille shutters with an active load path for improved pedestrian leg impact test results.

BACKGROUND

[0002] Vehicles may be equipped with bumper assemblies and impact protection structures that elastically and plastically deform to absorb energy in the event of an impact. A number of standards and tests currently exist. Various organizations have introduced a number of pedestrian regulations and rating criteria for automotive vehicles. As one example, test methods have been developed to assess the protection of an adult pedestrian by simulating leg-impact conditions during a car-to-pedestrian impact.

[0003] Accordingly, vehicle front end structures are desired that provide improved energy absorption under pedestrian leg impact testing conditions.

SUMMARY

[0004] In one embodiment, a vehicle includes an active grille shutter system including an actuation frame and grille fins that extend between opposite sides of the actuation frame. The grille fins each include a fin body rotatably connected to the actuation frame and a fin extension movably connected to the fin body such that the fin extension moves from a stowed configuration to a deployed configuration relative to the fin body. An actuation device is configured to move the fin extension from the stowed configuration to the deployed position thereby adding to a length of the fin body.

[0005] In another embodiment, an active grille shutter system includes an actuation frame and grille fins that extend between opposite sides of the actuation frame. The grille fins each include a fin body that is rotatably connected to the actuation frame and a fin extension movably connected to the fin body such that the fin extension moves from a stowed configuration to a deployed configuration relative to the fin body. An actuation device is configured to move the fin extension from the stowed configuration to the deployed position thereby adding to a length of the fin body.

[0006] In another embodiment, a method of increasing a load path between an active grille shutter system and a front of a vehicle is provided. The method includes moving a plurality of grille fins from a closed configuration to an open configuration using a motor. A fin extension of at least one of the plurality of grille fins is moved from a stowed configuration to a deployed configuration to add to a length of a fin body of the at least one of the plurality of grille fins.

[0007] These and additional features provided by the embodiments described herein will be more fully understood in view of the following detailed description, in conjunction with the drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The embodiments set forth in the drawings are illustrative and exemplary in nature and not intended to limit the subject matter defined by the claims. The following detailed description of the illustrative embodiments can be understood when read in conjunction with the following drawings, where like structure is indicated with like reference numerals and in which:

[0009] FIG. **1** schematically depicts a perspective view of a vehicle, according to one or more embodiments shown or described herein;

[0010] FIG. **2** illustrates a side section view of a front portion of the vehicle of FIG. **1**, according to one or more embodiments shown or described herein;

[0011] FIG. **3** schematically depicts an embodiment of an active grille shutter system including grille fins with extension portions, according to one or more embodiments shown and described herein;

[0012] FIG. **4** schematically illustrates an embodiment of a grille fin including fin extension, according to one or more embodiments shown and described herein;
[0013] FIG. **5** schematically illustrates an embodiment of a grille fin including fin extension, according to one or more embodiments shown and described herein;
[0014] FIG. **6** schematically illustrates an embodiment of a grille fin including fin extension, according to one or more embodiments shown and described herein;
[0015] FIG. **7** schematically illustrates an embodiment of a fin extension, according to one or more embodiments shown and described herein; and
[0016] FIG. **8** schematically illustrates an embodiment of a fin extension, according to one or more embodiments shown and described herein.

DETAILED DESCRIPTION

[0017] Vehicles according to the present specification include active grille shutter systems that include an actuation frame and grille fins that extend between opposite sides of the actuation frame. An active grille shutter system, as used herein, refers to a system that is disposed in a front grille area of the vehicles that is used to adjust the amount of outside air that is introduced into an engine compartment of the vehicles by automatically moving the grille fins to control air flow. The grille fins each include a fin body rotatably connected to the actuation frame and a fin extension movably connected to the fin body such that the fin extension moves from a stowed configuration to a deployed configuration relative to the fin body. An actuation device is configured to move the fin extension from the stowed configuration to the deployed position thereby adding to a length of the fin body.

[0018] It has been observed that high bumper vehicles, such as trucks and SUVs, can provide reduced reaction force during leg impact testing in the femur and/or tibia regions. The grill shutter systems described herein may be used to increase an upper and/or lower longitudinal load path to provide increased reaction forces in the femur and/or tibia regions of the vehicle.

[0019] As used herein, the term “vehicle longitudinal direction” refers to the forward-rearward direction of the vehicle (i.e., in the +/− vehicle X-direction depicted in FIG. **1**). The term “vehicle lateral direction” refers to the cross-vehicle direction (i.e., in the +/− vehicle Y-direction depicted in FIG. **1**), and is transverse to the vehicle longitudinal direction. The term “vehicle vertical direction” refers to the upward-downward direction of the vehicle (i.e., in the +/− vehicle Z-direction depicted in FIG. **1**). Further, the terms “inboard,” “inward,” “outboard” and “outward” are used to describe the relative positioning of various components of the vehicle. Referring to FIG. **1**, the terms “outboard” or “outward” as used herein refers to the relative location of an outward component away from a vehicle centerline. The term “inboard” or “inward” as used herein refers to the relative location of an inward component toward the vehicle centerline. Because the vehicle structures may be generally symmetrical about the vehicle centerline, the direction to which use of terms “inboard,” “inward,” “outboard” and “outward” refer may be mirrored about the vehicle centerline when evaluating components positioned along opposite sides of the vehicle **10**.

[0020] Referring initially to FIG. **1**, a vehicle **10** includes a vehicle body **12** and a cabin **13** that is integral with the vehicle body **12**. The cabin **13** generally defines a passenger cabin of the vehicle **10**. The vehicle **10** includes a front end assembly **16** that includes a hood **18**, front fenders **20** and **22**, an upper grille assembly **24**, a front bumper assembly **26** and a lower grille assembly **28** extending between the front fenders **20** and **22**. Generally, the upper grille assembly **24** includes a covering portion **30** with a number of grille deflectors **32**, a mesh or other suitable covering that protects a radiator behind the covering portion **30**, while allowing air to flow past the covering and over the radiator. The front end assembly **16** includes an outer covering or front fascia **34**, an upper projecting bumper portion **36** and a lower projecting bumper portion **38** that under hangs the upper projecting bumper portion **36**. The lower grille assembly **28** may include a covering portion **41** with a number of grille deflectors **43** and be located between the upper projecting bumper portion **36** and the lower projecting bumper portion **38**.

[0021] Referring to FIG. **2**, a diagram schematically illustrating the vehicle **10** is shown and includes the front end assembly **16** that includes the hood **18**, the upper grille assembly **24**, the lower grille assembly **28** and the front bumper assembly **26** located between the upper and lower grille assemblies **24** and **28**. An active grille shutter system **50** includes a fin actuation frame **52** and a plurality of grille fins **54** that is rotatably connected to the fin actuation frame **52**. The fin actuation frame **52** and associated grille fins **54** are located between the upper and lower grille assemblies **24** and **28** and a radiator **56** of the vehicle **10**. A motor **58** may be operatively connected to the fin actuation frame **52** for providing power to actuate the grille fins **54** between open and closed configurations. The motor **58** may be driven based on control by an electronic control unit (ECU) **60** of the vehicle **10**. The ECU **60** may be connected to one or more sensors **62** that provide a signal that is indicative of an operating condition of the vehicle **10**, such as engine temperature, environmental temperature, velocity of the vehicle **10**, state of charge of a vehicle battery (SOC), coolant temperature, etc.

[0022] As can be seen in FIG. **2**, a space **66** is provided in a front area of the vehicle **10** between the front end assembly **16** and the radiator **56**, above and below where the front bumper assembly **26** (FIG. **1**) is located. This space **66** can provide a relatively low reaction forces in the femur and/or tibia regions of the vehicle **10** during leg impact testing compared to the bumper region. To reduce the space **66** and provide increased reaction forces during leg impact testing, the grille fins **54** may be provided with fin extensions that extend a length of a fin body **68** of the grille fins **54**.

[0023] Referring to FIG. **3**, an active grille shutter system **70** configured for use in the vehicle **10** includes a fin actuation frame **72** and a plurality of grille fins **74** that is rotatably connected to the fin actuation frame **72** at pivot locations **75**. A motor **80** may be operatively connected to the fin actuation frame **72** for providing power to actuate the grille fins **74** between open and closed configurations. The motor **80** may be driven based on control by an electronic control unit (ECU) **82** of the vehicle. The ECU **82** may be connected to one or more sensors **84** that provide a signal that is indicative of an operating condition of the vehicle, such as engine temperature, environmental temperature, velocity of the vehicle, state of charge of a vehicle battery (SOC), coolant temperature, etc.

[0024] One or more, such as all the grille fins **74** includes a fin body **86** and a fin extension **88** that is movably connected to the fin body **86**. The fin extension **88** may be formed out of any suitable material, such as metal, plastic, or combinations thereof. The fin extension **88** may be movably connected to the fin body **86** using any suitable connection, such as a pivot location, track, etc. such that the fin extension **88** can move relative to the fin body **86** between stowed and deployed configurations. For example, grille fin **74***a* is illustrated in the deployed configuration to provide a grille fin **74***a* of extended length and grille fin **74***b* is illustrated in the stowed configuration to provide a grille fin **74***b* of reduced length. An actuation device **76** is provided to actuate the fin extension **88**. Any suitable actuation device **76** may be used, such as a hinge-motor, rail-motor combinations, etc. The actuation device **76** may be controlled by the ECU **82** based on a signal from a sensor **89** configured to detect presence of an obstacle, such as a pedestrian, such as LIDAR, RADAR or other types of motion/object detection sensors. Image recognition may be used to determine the type of obstacle and whether or not to deploy the fin extensions **88**. For example, if the image recognition system determines that a detected object is a person, the ECU **82** may instruct the actuation devices **76** to deploy their respective fin extensions **88**. If the detected object is determined to be something other than a person, the ECU **82** may not instruct the actuation devices **76** to deploy their respective fin extensions **88**. Depending on characteristics of the detected object, the ECU **82** may instruct which ones of the actuation devices **76** to deploy their respective fin extensions **88**.

[0025] FIGS. **4** and **5** illustrates an example of a grille fin **90** with a fin body **92** and a fin extension **94** that rests alongside the fin body **92** when in the stowed configuration. As above, an actuation device **96** can be used to move the fin extension **94** relative to the fin body **92** from the stowed

configuration to the deployed configuration. For example, in one embodiment shown in FIG. **5**, a grille shutter **100** includes a fin body **102** and a fin extension **104**. In this embodiment, an actuation device **106** moves the fin extension **104** forward and then upward into the deployed configuration. In another example shown by FIG. **6**, an actuation device **116** rotates a fin extension **114** of the grille shutter **110** relative to a fin body **112** into a deployed configuration. It should be noted that the actuation devices may be used to move the fin extensions from the deployed configuration back to the stowed configuration, resetting for their continued use. However, the fin extensions and fin bodies may need replaced after the fin extensions are deployed and used.

[0026] The fin extensions may have any suitable shape. As one example, referring to FIG. **7**, a fin extension **120** is provided of varying thickness including a narrow portion **124** and a thicker portion **122**. As another example, FIG. **8** shows a fin extension **130** that includes an extension portion **132** and an end arm portion **134** that extends outward from the extension portion **132**.

[0027] The above-described active grill shutter systems include a fin actuation frame and a plurality of grille fins that include fin extensions that can be used to extend lengths of the grille fins. Extending the lengths of the grille fins can help to reduce a space between a front end of a vehicle and the fin actuation system, which can increase a load path during leg impact testing and reduce bending in the tibia and femur test regions.

[0028] It is noted that the terms “substantially” and “about” may be utilized herein to represent the inherent degree of uncertainty that may be attributed to any quantitative comparison, value, measurement, or other representation. These terms are also utilized herein to represent the degree by which a quantitative representation may vary from a stated reference without resulting in a change in the basic function of the subject matter at issue.

[0029] While particular embodiments have been illustrated and described herein, it should be understood that various other changes and modifications may be made without departing from the spirit and scope of the claimed subject matter. Moreover, although various aspects of the claimed subject matter have been described herein, such aspects need not be utilized in combination. It is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the claimed subject matter.

Claims

1. A vehicle comprising: an active grille shutter system comprising: an actuation frame; grille fins that extend between opposite sides of the actuation frame, the grille fins each include a fin body rotatably connected to the actuation frame and a fin extension movably connected to the fin body such that the fin extension moves from a stowed configuration to a deployed configuration relative to the fin body; and an actuation device that is configured to move the fin extension from the stowed configuration to the deployed position thereby adding to a length of the fin body.

2. The vehicle of claim 1, wherein the actuation device comprises a motor.

3. The vehicle of claim 2, wherein the motor is controlled by an electronic control unit (ECU).

4. The vehicle of claim 3 further comprising a sensor that is configured to provide a signal to the ECU based on an operating condition of the vehicle.

5. The vehicle of claim 3, wherein the ECU controls operation of the actuation device based on input from a sensor.

6. The vehicle of claim 5, wherein the sensor comprises an object detection sensor.

7. The vehicle of claim 1, wherein the active grille shutter system comprises a motor configured to open and close the grille fins.

8. The vehicle of claim 1, wherein the fin extension if configured to slide relative to the fin body from the stowed configuration to the deployed configuration.

9. The vehicle of claim 1, wherein the fin extension is configured to rotate relative to the fin body from the stowed configuration to the deployed configuration.

10. The vehicle of claim 1, wherein the fin extension comprises an end portion that is greater in thickness than a second end portion.
11. The vehicle of claim 1, wherein the fin extension comprises an extension portion and an arm portion that extends outward from the extension portion.
12. An active grille shutter system comprising: an actuation frame; grille fins that extend between opposite sides of the actuation frame, the grille fins each include a fin body rotatably connected to the actuation frame and a fin extension movably connected to the fin body such that the fin extension moves from a stowed configuration to a deployed configuration relative to the fin body; and an actuation device that is configured to move the fin extension from the stowed configuration to the deployed position thereby adding to a length of the fin body.
13. The active grille shutter system of claim 12, wherein the actuation device comprises a motor.
14. The active grille shutter system of claim 12, wherein the active grille shutter system comprises a motor configured to open and close the grille fins.
15. The active grille shutter system of claim 12, wherein the fin extension if configured to slide relative to the fin body from the stowed configuration to the deployed configuration.
16. The vehicle of claim 12, wherein the fin extension is configured to rotate relative to the fin body from the stowed configuration to the deployed configuration.
17. The active grille shutter system of claim 12, wherein the fin extension comprises an end portion that is greater in thickness than a second end portion.
18. The active grille shutter system of claim 12, wherein the fin extension comprises an extension portion and an arm portion that extends outward from the extension portion.
19. A method of increasing a load path between an active grille shutter system and a front of a vehicle, the method comprising: moving a plurality of grille fins from a closed configuration to an open configuration using a motor; and moving a fin extension of at least one of the plurality of grille fins from a stowed configuration to a deployed configuration to add to a length of a fin body of the at least one of the plurality of grille fins.
20. The method of claim 19, wherein the step of moving the fin extension includes moving the fin extension using an actuation device.