**Safety system for a power-operated trunk lid**

A safety system for a power-operated trunk lid comprises an obstacle detector associated with a trunk lid for detecting an obstacle to an opening movement of the trunk lid. The obstacle detector comprises an energy emitter, which is integrated into a wiper arranged on the trunk lid. The energy emitter emits infrared light, acoustic waves or ultrasound into the opening volume of the trunk lid. The safety system further comprises an energy sensor, which is able to sense the emitted form of energy.
Description

Technical field

[0001] The present invention generally relates to a motor vehicle with a power-operated trunk lid, in particular to a safety system for such a trunk lid.

Background Art

[0002] Automotive manufacturers are faced with an increasing demand for vehicles equipped with an automated system for trunk opening. A user of such a vehicle does not need to open the trunk manually but can initiate an automated opening of the trunk lid by activating a control switch in the vehicle or by a remote control. Problems arise if the user does not consequently watch for hindering objects on the opening trajectory or in the opening volume of the trunk lid. Such obstacles may damage the trunk if they are not detected in due time.

[0003] A solution to this problem has been disclosed in DE 198 13 025 A1, wherein the trunk lid is equipped with optical or ultrasonic distance sensors. The movement of the trunk lid is automatically stopped if the distance sensors sense an obstacle within a predefined distance range from the trunk lid.

[0004] Nevertheless, several improvements to the system are recommended, notably regarding integration of the obstacle sensors into the trunk lid.

Object of the invention

[0005] It is an object of the present invention to provide a safety system for a vehicle with improved integration capabilities. This object is achieved by a safety system as claimed in claim 1.

General Description of the Invention

[0006] A safety system for a power-operated trunk lid comprises an obstacle detector associated with a trunk lid for detecting an obstacle to an opening movement of the trunk lid. The obstacle detector comprises an energy emitter, which emits energy, e.g. infrared light, acoustic waves or ultrasound, into the opening volume of the trunk lid, and an energy sensor, which is able to sense the emitted form of energy. According to an important aspect of the invention, the energy emitter is integrated into a wiper arranged on the trunk lid. Preferably, the energy sensor is integrated in the wiper together with the energy emitter. The energy emitter may, for instance, comprise an ultrasonic generator, a light source (such as e.g. a light-emitting diode, a semiconductor laser), or any other device capable of producing ultrasound or infrared radiation. The energy sensor may comprise, for instance, an ultrasonic receiver, a photodiode, a photocell, a photo-detector, or any other device capable of sensing ultrasound or infrared radiation.

[0007] Detection of an obstacle can be achieved according to two basic principles. According to the "transmission" principle, energy emitter and sensor are arranged in a facing relationship. If an obstacle intercepts energy travelling from the emitter to the sensor, the amount of sensed energy changes, which results in detection of the obstacle. According to the "reflection" principle, energy emitter and energy sensor are arranged next to each other. If emitted energy is intercepted by an obstacle, part of it is scattered back to the sensor, so that the amount of sensed energy changes and results in the obstacle being detected.

[0008] Advantageously, the energy emitter and/or the energy sensor is integrated into the axial portion of said wiper. In the present context, the term "axial portion" is to be understood as designating the portion located at the rotation axis, about which the wiper is rotated during operation.

[0009] Preferably, the energy emitter is adapted for emitting a passive energy curtain of infrared light and/or ultrasound into the opening volume of the trunk lid, i.e. the space the trunk lid moves through during its opening. The curtain can comprise one or several energy beams, which are directed from said axial portion of the wiper into an angular segment alongside the trunk lid. The energy beams can, for instance, comprise fan-shaped or pencil energy beams. As will be appreciated, the curtain can be static with respect to the lid or sweep over the latter during operation of the energy emitter. The latter operation is preferred, if the energy curtain does not cover the entire surface of the trunk lid at a time.

[0010] Sweeping movement of the curtain or selected beams of the curtain can, for instance, be achieved by operating a suitable deflector included in or associated with the energy emitter. In case of light beams, such a deflector advantageously comprises a mirror, an acousto-optical deflector or the like. According to a preferred embodiment of the invention, however, the obstacle detector comprises rotating means for rotating the energy emitter. The standard wiper axis can be replaced by a hollow axis, in the middle of which an emitter-specific axis is driven, so that the energy emitter may rotate independently from the wiper. The emitter-specific axis can be driven by the wiper motor via a small gear box; preferably, however, the emitter-specific axis is driven by a separate motor.

[0011] Advantageously, the obstacle detector comprises one or several additional energy emitters. The additional energy emitter(s) can be arranged at suitable locations of the trunk lid, preferably in such a way that any critical region that is not covered by the curtain originating from the energy emitter on the wiper is covered by an energy beam from the additional emitter(s).

[0012] According to a preferred embodiment of the invention, the energy emitter comprises a light source capable of emitting a light beam and beam shaping means for shaping said light beam. The beam shaping means may comprise, refractive optical components (e.g. such
as lenses, prisms, fibres, etc.) and/or reflective optical components (e.g. such as flat mirrors or curved mirrors, etc.).

[0013] As will be appreciated, the present invention encompasses a power-operated trunk lid opening system, comprising a safety system as exposed above. The trunk lid opening system has a mechanism (including e.g. a motor and/or a hydraulic and/or a pneumatic system) for an automated opening of the trunk lid, with which the obstacle detector operationally interacts for prohibiting opening or further opening of the trunk lid in case of an obstacle being detected.

[0014] The present invention further encompasses a wiper equipped with a safety system for a trunk lid.

Description of Preferred Embodiments

[0015] Preferred embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1: is a side schematic view of a hatchback vehicle illustrating the critical volume during opening of the trunk lid;

Fig. 2: is a flow chart of a trunk-opening event;

Fig. 3: is a schematic view of an obstacle detector operating according to the "transmission" principle;

Fig. 4: is a schematic view of an obstacle detector operating according to the "reflection" principle;

Fig. 5: is a rear view of a hatchback vehicle with a power-operated trunk lid equipped with a safety system according to a first embodiment of the invention;

Fig. 6: is a rear view of a hatchback vehicle with a safety system according to a second embodiment of the invention;

Fig. 7: is a rear view of a station wagon equipped with a safety system according to a third embodiment of the invention;

Fig. 8: is a rear view of a hatchback vehicle with a safety system according to a fourth embodiment of the invention;

Fig. 9: is a rear view of a station wagon equipped with a safety system according to a fifth embodiment of the invention;

Fig. 10: is a rear view of a hatchback vehicle with a safety system according to a sixth embodiment of the invention;

Fig. 11: is a perspective schematic view of an optical obstacle detector;

Fig. 12: is a cross-sectional view through the optical obstacle detector of Fig. 11.

Fig. 1 shows the rear part of a vehicle 10 equipped with a power-operated trunk lid opening system. For providing adequate anti-collision protection of the entire trunk lid 12, obstacles are detected in substantially the whole volume through which the trunk lid 12 is moved during opening. A convenient way to do so is to keep the space 14 adjacent to the trunk lid 12 under surveillance by an obstacle detector 16. In that way, starting just before the trunk lid 12 opens and while the trunk lid moves from its closed position 18 to its fully opened position 20, the detector 16 progressively scans the entire opening volume.

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Exemplary embodiments of safety systems for...
a power-operated trunk lid are now discussed with respect to Figs. 5 to 10. In these embodiments, the obstacle detector generally comprises one or several energy emitter(s) and associated energy sensor(s). They are arranged at different locations on the trunk lid depending on the particular embodiment. A common point to the shown embodiments is the energy emitter(s) deploying a energy curtain 40 e.g. of ultrasound and/or infrared radiation.

[0021] In the embodiment of Fig. 5, this curtain 40 is static - in the sense that its overall shape remains substantially constant in the reference system of the trunk lid 12. An ultrasonic or infrared emitter, which is arranged in the axial portion of the rear wiper 38, emits ultrasound beams, respectively infrared light beams into four directions along the trunk lid 12. An ultrasound sensor, respectively an infrared sensor, is integrated together with the emitter in the axial portion 36 of the wiper 38. If a beam hits an obstacle, an echo, respectively a reflection, is produced and sensed by the sensor.

[0022] In the embodiments of Figs. 6, 7 and 9, the obstacle detector is rotatably arranged in the axial portion 36 of the wiper 38. At least one infrared light source, comprising e.g. a LED or a miniature laser, emits one or a plurality of light beams alongside the trunk lid 12. The infrared light source is mounted on a detector support 54 that can rotate independently from the wiper 38. The wiper axis is hollow and accommodates the axis bearing the detector support. Alternatively, the axis bearing the detector may be hollow and accommodating the wiper axis. Both axes can be driven by a single motor if an appropriate gearbox is provided. Alternatively, two motors can be used. Rotation of the light source causes a sweeping movement (indicated by arrows 50, 51, 52, 53) of the beams over the surface of the trunk lid 12. Minimum recommended angular amplitude of the rotation depends on beam divergence angle \( \delta \) and beam spacing angle \( \alpha \). An infrared light sensor, comprising e.g. a photodiode, is arranged with the light source on the detector support 54. If the sensor senses back-scattered light, a logic unit connected to the sensor may conclude that there is an obstacle intercepting a light beam and stop trunk lid opening.

[0023] Depending on vehicle geometry, different obstacle detector configurations can be conceived to assure optimally safe trunk opening. Most of today’s station wagons or hatchback cars have the wiper 38 mounted centrally underneath the rear window. In particular, Fig. 7 shows a station wagon, Fig. 8 a hatchback vehicle with such a middle-mounted wiper 38. Some vehicles, however, have the rear wiper arranged above the rear window, as illustrated in Fig. 9 for a station wagon and in Fig. 10 for a hatchback vehicle.

[0024] A station wagon presents a substantially flat trunk lid 12, so that the energy curtain can be deployed essentially in a plane parallel to the trunk lid 12. In the embodiment of Fig. 7 (middle-mounted wiper), the energy emitter emits two diametrically opposed energy beams. In the embodiment of Fig. 9 (high-mounted wiper), a single energy beam is emitted.

[0025] Referring now to the case of a hatchback vehicle, the trunk lid 12 has a sloping upper portion 12a and a substantially vertical lower portion 12b - the terms upper, lower and sloping relating to the closed position of the trunk lid 12. In order to avoid a blind spot in the opening volume, the energy curtain 40 presents different configurations for the upper and the lower parts of the trunk lid 12.

[0026] In the embodiments of Figs. 8 and 10, the energy curtain 40 furthermore comprises a static component 40a and a dynamic component 40b. A first infrared light beam operationally sweeps over the upper portion of the trunk lid. The back-scattered or reflected portion of the light hits an infrared light sensor, which is mounted on the same support 54 as the light source of the first infrared beam. Regarding impact protection at the lower portion of the trunk lid, further light sources provide a number of static light beams, which extend alongside the lower portion of the trunk lid 12.

[0027] In the embodiment of Fig. 8, light sources are integrated into an immobile part of the axial wiper portion 36. These light sources emit divergent beams into different angular segments along the lower trunk lid portion 12b. Light sensors 56 are integrated into the trunk lid at its bottom edge, so that the obstacle detector operates according to the "transmission" principle as far as the lower portion of the trunk lid is concerned.

[0028] Referring now to Fig. 10, a plurality of infrared light sources 58 are arranged on the trunk lid 12 at its bottom edge. Each one of these light sources 58 emits a fan-shaped beam in such a way that a static curtain is formed for the lower trunk lid portion 12b. A plurality of infrared light sensors 56 are also arranged on the trunk lid at its bottom edge, so that the detector operates according to the reflection principle.

[0029] Figs. 11 and 12 show an optical obstacle detector 16, arranged on the detector support 54 in the axial portion of a wiper. The detector may be rotatably mounted or fixed with respect to the trunk lid. The detector 16 comprises a plurality of light-emitting/receiving units 60, each of which includes, for instance, an LED (or another light source) and a photodiode (or another light detector) operating in a same region of the infrared spectrum. As illustrated in Fig. 12, the light-emitting/receiving units 60 can be arranged circularly around the centre of the detector 16 in a ring-like configuration. The detector 16 further comprises refractive optical components 66, each of which is associated to a light-emitting/receiving unit 60. The optical components may comprise lenses arranged circularly around the light-emitting/receiving units 60. The refractive optical components 66 are preferably designed so that they expand the infrared beams emitted by the light-emitting/receiving unit 60. Most preferably, the design of the refractive optical components causes the emitted beams to expand mainly in a plane substantially parallel to the trunk lid, so that a curtain of infrared
light results. The emitted beams are represented in Fig. 11 by the arrows 62, in Fig. 12 by the hatched areas 64. Light reflected by an obstacle and scattered back towards the light-emitting/receiving units 60 is represented in Fig. 11 by the arrows 68 and in Fig. 12 by the arrows 70. The reflected light is focussed onto the light-emitting/receiving units 60 by the refractive optical components 66. The detector 16 is preferably equipped with a protection housing 72, e.g. made of polymethylmethacrylate (PMMA). In Fig. 11, the housing 72 is not shown for sake of clarity of the drawing.

[0030] Preferably, the optical obstacle detector comprises cleaning means at least for those components, though which the light beams have to pass, e.g. the optical components 66 or the protection housing 72. Such cleaning means may e.g. comprise miniature wiper blades or cleaning pads. Most preferably, the optical detector is retractable, so that it is hidden in the wiper base portion if it is not in use. This would contribute to a good optical impression of the rear of the vehicle and furthermore provide for enhanced encapsulation of the detector. For obstacle detection, the detector can be moved into its operative position, which is elevated with respect to the trunk lid. The cleaning means may be arranged in such a way that the detector is cleaned as it moves from its hidden to its operative position or vice-versa. For instance, miniature wiper blades may be arranged around the detector in such a way that, as the detector moves, its outer surface slides along the wiper blades, which remain stationary, whereby dirt or water is wiped off. It should be noted that movement of the detector may comprise rotational movement and/or translational movement.

Claims

1. A safety system for a power-operated trunk lid comprising an obstacle detector associated with a trunk lid for detecting an obstacle to an opening movement of said trunk lid, said obstacle detector comprising an energy emitter and an energy sensor, characterised in that said energy emitter is integrated into a wiper arranged on said trunk lid.

2. The safety system according to claim 1, wherein said energy sensor is, together with said energy emitter, integrated into said wiper.

3. The safety system according to claim 1 or 2, wherein said energy emitter is integrated into an axial portion of said wiper.

4. The safety system according to any one of claims 1 to 3, wherein said energy emitter is adapted for emitting infrared light and/or ultrasound and wherein said energy sensor is adapted for sensing infrared radiation and/or ultrasound.

5. The safety system according to claim 4, wherein said energy emitter is adapted for emitting a stationary curtain of infrared light and/or ultrasound.

6. The safety system according to claim 4 or 5, wherein said energy emitter is adapted for emitting a sweeping curtain of infrared light and/or ultrasound.

7. The safety system according to claim 6, wherein said obstacle detector comprises rotating means for rotating said energy emitter.

8. The safety system according to any one of claims 1 to 7, wherein said obstacle detector comprises at least one additional energy emitter.

9. The safety system according to any one of claims 1 to 8, wherein said energy emitter comprises a light source capable of emitting a light beam and beam shaping means for shaping said light beam.

10. A power-operated trunk lid opening system, comprising a safety system according to any one of the preceding claims, comprising a mechanism for an automated opening of said trunk lid, wherein said obstacle detector operationally interacts with said mechanism for prohibiting opening or further opening of said trunk lid in case of an obstacle being detected.

11. A wiper comprising a safety system for a trunk lid according to any one of claims 1 to 9.
# European Search Report

## Documents Considered to Be Relevant

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The present search report has been drawn up for all claims.

Place of search: The Hague
Date of completion of the search: 23 March 2006
Examiner: Mund, A

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