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(54) Title: GLAZING HAVING SENSORS

(57) Abstract: Glazing having sensors The present invention concerns an automotive glazing comprising a laminated glazing, comprising at least a first and a second glass sheets laminated with at least on thermoplastic interlayer, the glazing having at least one sensor selected from the group of a sensor for detecting impacts to, or vibration of, the glazing; a sensor for detecting a fracture in one or more of the sheets; or a combination thereof. According to the present invention, the sensor is mounted to monitor modification of physical properties and to generate a signal representative of the said modification of physical properties, the sensor being connected to an electrical connector, to provide external access to the signal generated by the sensors.



Glazing having sensors

This invention relates to a glazing, e.g. a window, having sensors responsive to physical changes, e.g. responsive to physical impact, and more particularly, to an automotive window, e.g. an automotive windshield having sensors to monitor the breakage in real time.

5 Automotive glazing, e.g. automotive windshields include a laminate of plastic layers or sheets, glass layers or sheets and combinations thereof. The layers of an inner part of the windshield face the interior of the automotive and provide structural stability to the windshield. The outer part of the windshield faces the exterior of the automotive and usually includes a laminate of
10 glass sheets. The outer part of the windshield, which can also provide structural stability is usually provided with accessories for visual acuity. For example and not limiting to the discussion, the accessories can included an electrically conductive coating, or a plurality of electrically conductive wires, between and connected to a pair of spaced bus bars to heat the windshield to prevent the
15 formation of, and/or remove fog and ice on and/or from, respectively, the outer surface of the windshield.

As is appreciated by those skilled in the art, as the service time of the automotive windshield increases, the operating efficiency of the windshield decreases until such time that the accessories of the windshield become non-
20 functional, and the windshield needs to be replaced or repaired. It particularly the case when the glazing has undergone an impact. Untimely response to repair defects when they begin, decreases the operating efficiency of the glazing and can result in the need for emergency maintenance, e.g. repair or replacement. It would be advantageous, therefore, to provide a glazing having sensors to monitor
25 physical changes such as impact so that the repair, or replacement.

This invention relates to an automotive glazing comprising a laminated glazing, comprising at least a first and a second glass sheets laminated with at least on thermoplastic interlayer, the glazing having at least one sensor selected from the group of a sensor for detecting impacts to, or vibration of, the glazing; a sensor for detecting a fracture in one or more of the sheets; or a combination thereof, wherein the sensor is mounted to monitor modification of physical properties and to generate a signal representative of the said modification of physical properties, the sensor being connected to an electrical connector, to provide external access to the signal generated by the sensors.

10 According to one non-limiting embodiment, the at least one sensor selected from the group of a sensor for detecting impacts to, or vibration of, the glazing; a sensor for detecting a fracture in one or more of the sheets; or a combination thereof is mounted on a surface of one of the glass sheets between the first and the second surfaces of the glazing.

15 According to another non-limiting embodiment, the at least one sensor selected from the group of a sensor for detecting impacts to, or vibration of, the glazing; a sensor for detecting a fracture in one or more of the sheets; or a combination thereof is mounted on an edge of the glazing mounted on a surface of one of the glass sheets between the first and the second surfaces of the glazing.

20 As used herein, spatial or directional terms such as "inner", "outer", "left", "right", "up", "down", "horizontal", "vertical", and the like, relate to the invention as it is shown in the drawing on the figures. However, it is to be understood that the invention can assume various alternative orientations and, accordingly, such terms are not to be considered as limiting. Further, all numbers expressing dimensions, physical characteristics, and so forth, used in the specification and claims are to be understood as being modified in all instances by the term "about". Accordingly, unless indicated to the contrary, the numerical values set forth in the following specification and claims can vary depending upon the property desired and/or sought to be obtained by the present invention. At the

very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claims, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Moreover, all ranges disclosed herein are to be understood to encompass any and all subranges subsumed therein. Also, as used herein, the term "positioned over" or "mounted over" means positioned on or mounted over but not necessarily in surface contact with. For example, one article or component of an article "mounted over" or "positioned over" another article or component of an article does not preclude the presence of materials between the articles, or between components of the article, respectively.

Before discussing several non-limiting embodiments of the invention, it is understood that the invention is not limited in its application to the details of the particular non-limiting embodiments shown and discussed herein since the invention is capable of other embodiments. Further, the terminology used herein to discuss the invention is for the purpose of description and is not of limitation. Still further, unless indicated otherwise, in the following discussion like numbers refer to like elements.

Non-limiting embodiments of the invention will be directed to an automotive laminated transparent glazing, and in particular to an automotive windshield. The invention, however, is not limited to any particular type of automotive glazing. Still further, the invention is not limited to the material of the layers or sheets of the glazing, and the layers or sheets can be made of, but not limited to, cured and uncured plastic sheets; annealed, heat strengthened, and heat and chemically strengthened, clear, colored, coated and uncoated glass sheets. Still further the invention can be practiced on windows having opaque sheets, e.g. glass sheets having an opaque coating, and combinations thereof.

The windshield may include a first glass sheet laminated to a second glass sheet by a first interlayer.

The windshield or the glazing may be provided with heat to remove fog from, and/or to melt ice on, the outer surface of the windshield or the glazing.

Generally the glass sheets of the windshield are clear may be chemically strengthened glass sheets; however, the invention is not limited thereto, and the glass sheets can be heat strengthened or heat tempered glass sheets. Further as is appreciated, the invention is not limited to the number of glass sheets, thermoplastic interlayers that make up the windshield and the windshield can have any number of sheets and/or interlayers.

The invention is not limited to the design and/or construction of the heatable member, and any electrically conductive heatable member used in the art to heat a surface of a sheet to melt ice on, and/or remove fog from the surface of the sheet can be used in the practice of the invention. The heatable member may include a glass sheet having a conductive coating applied to surface of the glass sheet, and a pair of spaced bus bars in electrical contact with the conductive coating. The invention is not limited to the composition of the conductive coating, for example and not limiting to the invention the conductive coating can be made from any suitable electrically conductive material.

The discussion is now directed to the placement of sensors or detectors on selected components of the windshield, to monitor the breakage and/or performance of the selected components of the windshield, in accordance to the teachings of the invention.

In one non-limiting embodiment of the invention, the windshield is provided with an impact sensor or detector that generates a signal when an object hits or impacts the windshield, e.g. but not limiting to the invention, hits the outer surface of the windshield. For example and not limiting to the invention, as the automotive foreign objects, e.g. stones are propelled through the air and can hit the outer surface of the windshield. The impact detector mounted a sheet of the windshield can be used to indicate that one or more foreign objects have hit the windshield, and optionally the location on the outer surface where the hit or

impact occurred and the relative energy of the impact on the surface of the windshield. Furthermore, a software may be linked to the impact sensor thus, if an stone or an object hits the glazing, the importance of the shock may be monitored in order to detect if the glazing have to be replaced or just repaired. The software
5 may for example offers a list of glazing advantageous for the car's owner for example to enhance performances of the glazing (weight, thermic comfort, save energy consumption...).

In one non-limiting embodiment of the invention, one or more impact sensors or detectors are mounted adjacent each one of the sides of the glass
10 sheet. In this non-limiting embodiment of the invention, each of the impact detectors include a piezoelectric material, e.g. but not limited to a piezoelectric crystal. When the piezoelectric material is exposed to vibration, e.g. vibration of the glass sheet caused by a stone hitting the outer surface of the glass sheet, the piezoelectric material undergoes a compression or distortion and, as a result,
15 produces an electric field, which can be used to activate or to cause an alarm and/or a recorder to be activated to announce and/or record the hit or impact. Further, using three or more impact detectors the location of the impact on the surface of the windshield can be identified, as discussed below.

In one preferred embodiment of the invention, one or more sensors
20 or detectors are resisting to a temperature above 140°C and preferably are resisting to a temperature of 150°C or more.

In one preferred embodiment of the invention, one or more sensors or detectors are microphone sensors or detectors.

The heatable member may have one of the impact detectors
25 mounted adjacent one of the sides, respectively of the glass sheet. The detectors are mounted on the conductive coating and may have electrical contact of the detectors electrical connected to the conductive coating and to the console and the positive pole of the power supply by way of wires, respectively. In this manner, the power to the detectors is provided by the power supply monitored by

the comparator in the console. As can be appreciated, the invention is not limited to the manner in which power is provided to the detectors and any circuit arrangement can be used in the practice of the invention, e.g. and not limiting to the invention one electrical contact of the detectors can be mounted on any one or more of the sheets of the windshield and directly connected to one pole of a power supply dedicated to providing electrical power to the detectors and the other contact of the detectors connected to the other pole of the dedicated power supply. As can be appreciated, the invention is not limited to the type of power supply used in the practice of the invention and the power supply can generate alternating or direct current.

The piezoelectric material of the detectors undergoes a compression or distortion when the windshield is vibrated, e.g. an object hits the outer surface of the windshield. The vibration of the piezoelectric crystal of the detectors produces an electric field or current which is sent along one or more of wires of the detectors, respectively to the console. The console is provided with data processing equipment, e.g. software which analysis the signal forwarded along the glazing to determine the location of the impact by triangulation of the signals from selected ones or all of the detectors, and the magnitude of the impact, e.g. by the magnitude of the electric field, and stores the information and use it as previously mentioned. Electronic circuitry for electric file of impact detectors, e.g. piezoelectric crystal is well known in the art, and no further discussion is deemed necessary. In another non-limiting embodiment of the invention, signals from the detectors that exceed a predetermined amount of current are displayed on the console to indicate that a visual inspection of the outer surface of the windshield should be made, and/or the windshield repaired, e.g. at the next scheduled stop of the automotive, and optionally can be forwarded to a control center in a manner discussed below to schedule any needed repairs. The information may be forwarded directly to our smartphone in order for example to inform the driver of the nearest center to replace the glazing or which kind of glazing will be more adapted to the automotive regarding the energy consumption, thermic comfort....

In the following discussion, the rupture or crack detector, or sensor, will be used in the practice of the invention, however, as is appreciated, the invention is not limited thereto and any of the crack sensors or detectors known in the art can be used in the practice of the invention. The crack sensor may include
5 an electrically conductive strip extending along or around substantially the entire outer periphery of a major surface of one of the sheets of the windshield. The conductive strip may be mounted over the electrically conductive layer of the glass sheet, surrounds the bus bars, and electrically isolated from the conductive coating by an electrically insulating layer, e.g. an electrically non-conductive
10 coating layer.

The conductive strip can be embedded in the interlayers between the sheets as long as the conductive strip is in contact with its respective one of the sheets in a manner that will break or disrupt the conductive strip in the event the surface of the glass sheet having the conductive strip cracks. In order to
15 enhance identifying the rupture location on the surface, multiple conductive strips can be placed in a grid or array pattern over the major surface of the sheets, or optionally an array pattern can be used adjacent the periphery of the sheets so as not to minimize reducing the vision area of windshield.

One non-limiting embodiment of the invention is to monitor the
20 performance of the transparency of the invention and to timely schedule maintenance of, e.g. repairs to, or replacement of, transparencies, e.g. automotive windshields that are performing outside acceptable limits. The windshield of the invention can have one or more of the impact, rupture, temperature and/or moisture sensors or detectors, e.g. but not limited to the types discussed above.
25 The wires from the sensors having signals carrying data regarding the performance of components of the windshield are connected to one part of a connector, e.g. an electrical output connector. The output connector is not limiting to the invention and can be any of the types used in the art to provide external electrical access to an electric device embedded within a laminate. The output
30 connector is connected to an input electrical connector, e.g. other part of the

connector, connected to the console by a cable. In one non-limiting embodiment of the invention, the console includes a computer having software to read and analyze the signals from the sensors or detectors to monitor and/or determine the performance of the components of the windshield. Monitor provides visual display, and speaker provides audible information regarding the performance of the windshield, and/or individual components of the windshield. The console can include an alarm to bring attention to the monitor. Placing the console in the automotive provides the personnel within the automotive with real time performance of the windshield. The information may advantageously be transfer to driver's smartphone.

In another non-limiting embodiment of the invention, the console has a wireless transmitter and receiver; the transmitter transmits signals to a transmitting tower. The signals carry data on the performance of the windshield. The tower transmits a signal carrying the data on the performance of the windshield to a satellite. The satellite transmits a signal carrying the data on the performance of the windshield to a control center. The data received is studied and the appropriate action to be taken is scheduled. In one non-limiting embodiment of the invention, based on the information received, personnel at the control center determine what action, if any, is needed. If action such as repairs to the windshield or replacement of the windshield, is needed, a signal providing a repair schedule is transmitted to the satellite. The satellite transmits a signal having the repair schedule to the tower. The tower transmits a signal having the repair schedule to the console and to a maintenance center geographically close to the designated repair location usually the next scheduled stop for the automotive to arrange to have all parts, equipment and personal need at the designated repair location.

In one non-limiting embodiment of the invention, if the data from the sensors indicate that the windshield has to be replaced, the repair schedule can include shipment of the windshield to the next scheduled stop of the automotive; if the windshield has to be replaced with some urgency.

The invention is not limited to the embodiments of the invention presented and discussed above which are presented for illustration purposes only, and the scope of the invention is only limited by the scope of the following claims and any additional claims that are added to applications having direct or indirect
5 lineage to this application.

Claims

1. An automotive glazing comprising a laminated glazing, comprising at least a first and a second glass sheets laminated with at least on thermoplastic interlayer, the glazing having at least one sensor selected from the group of a sensor for detecting impacts to, or vibration of, the glazing; a sensor for
5 detecting a fracture in one or more of the sheets; or a combination thereof, wherein the sensor is mounted to monitor modification of physical properties and to generate a signal representative of the said modification of physical properties, the sensor being connected to an electrical connector, to provide external access to the signal generated by the sensors.
- 10 2. The glazing according to claim 1 wherein the sensor is mounted on a surface of one of the glass sheets between the first and the second surfaces of the glazing, to monitor modification of physical properties and to generate a signal representative of the said modification of physical properties, wherein the sensor is connected to an electrical connector, to provide external access to the
15 signal generated by the sensors.
3. The glazing according to claim 1 wherein the sensor is mounted on an edge of the glazing to monitor modification of physical properties and to generate a signal representative of the said modification of physical properties, wherein the sensor is connected to an electrical connector, to provide external
20 access to the signal generated by the sensors.
4. The glazing according to claim 1 or 2 wherein the sensor is mounted on the internal face of the laminated glazing to monitor modification of physical properties and to generate a signal representative of the performance of the at least one of the properties, wherein the sensor is connected to an electrical
25 connector, to provide external access to the signal generated by the sensors.
5. The glazing according to anyone of preceding claims wherein

the windshield comprises a heating arrangement comprising an electrically conductive member and a pair of spaced bus bars in electrical contact with the conductive member, wherein a portion of the conductive member is one of the electrodes of the sensor.

5 6. The glazing according to claim 1 comprising a sensor for detecting impacts to, or vibration of, the glazing being defined as an impact sensor, wherein the impact sensor is mounted on a first major surface of one of the sheets of the glazing, wherein the impact sensor comprises a first electrode and a second electrode wherein the first electrode and the second electrode is connected
10 to the connector.

7. A vehicle, comprising:

- the glazing according to any one of claims 1 to 6 mounted in the body of the vehicle, and

- a system positioned in the vehicle to receive the signal from the
15 combination of sensors, to determine modification of physical properties of the glazing, and to generate an alert signal when the glazing has to be repaired or replaced.

8. The vehicle according to claim 7, wherein the system receiving the signal from the sensors transmits a signal to a smartphone..

20 9. The vehicle according to claim 8, wherein the system receiving the signal from the sensors transmits a signal to a system outside of the vehicle.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/163675 A1 (RASHID ALI N [US] ET AL) 1 July 2010 (2010-07-01) claims 1,6,8,16,18-20 paragraphs [0007] - [0009], [0032], [0033], [0036], [0086], [0087] -----	1-9
A	US 2015/171624 A1 (DUARTE NICOLAS B [US] ET AL) 18 June 2015 (2015-06-18) paragraphs [0003], [0009], [0042] -----	1-9
A	US 2014/067199 A1 (JIAO YU [US] ET AL) 6 March 2014 (2014-03-06) paragraphs [0007], [0035], [0056] -----	1-9



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

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Somerville, Fiona

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2010163675	A1	01-07-2010	CN	102271995 A	07-12-2011
			EP	2373542 A2	12-10-2011
			JP	5253587 B2	31-07-2013
			JP	2012513932 A	21-06-2012
			US	2010163675 A1	01-07-2010
			WO	2010077507 A2	08-07-2010

US 2015171624	A1	18-06-2015	NONE		

US 2014067199	A1	06-03-2014	CA	2878950 A1	06-02-2014
			CN	104507796 A	08-04-2015
			JP	5933841 B2	15-06-2016
			JP	2015530303 A	15-10-2015
			RU	2015107007 A	20-09-2016
			TW	201410543 A	16-03-2014
			US	2014067199 A1	06-03-2014
			WO	2014022188 A2	06-02-2014
