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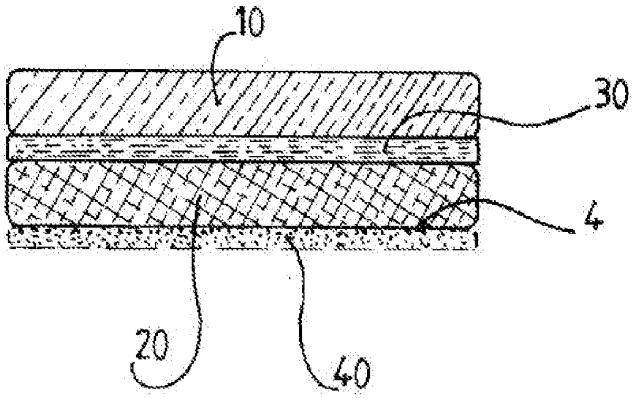
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(54) High thermal performance glazing for vehicles, in particular for motor vehicle roofs

(57) This is a laminated glazing composed of an outer glass (10), an inner glass (20), an interlayer (30) between the two glasses (10, 20) consisting of at least one PVB-based absorbing film, the inner glass (20) being coated on its inner face (4) with a low-emissivity layer (40).

Motor vehicles. “Skyroofs” of motor vehicles. Glazing for the roofs of motor vehicles.

Fig. 2



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Description

[0001] The present invention relates to high thermal performance glazing for a vehicle, in particular for a motor vehicle roof. It also applies to a vehicle that has a roof or roof panel fitted with such glazing.

[0002] Many motor vehicle roofs - often called sunroofs or "skyroofs" - are made of glazing consisting of tinted glass laminated together by a clear or tinted PVB interlayer (PVB is the acronym for "polyvinyl butyral"). These glasses break safely. They crack in a star shape while remaining in place. The shards and sharp pieces remain stuck to the interlayer.

[0003] These vehicle roof windows are now systematically complemented by an interior blackout blind- also referred to as "blackout" in the rest of this text - which allows the opening given to the outside by the glazing to be visually and thermally closed when the user wishes. This blackout can be operated manually or electrically, but in all cases results in an additional mass. It also results in an additional volume, necessary for its installation under the glazing.

[0004] In other vehicle glazing, such as windshields, functional layers have been introduced to improve energy performance while preserving sufficient light transmission to allow the approval of these glazings. Thus, for example, document FR 2 755 962 discloses a glazing that comprises a transparent substrate (for example, a polyethylene terephthalate film) provided with a stack of thin layers comprising successively: a first coating of dielectric material, a first functional layer with infrared reflective properties, a second coating of dielectric material, a second functional layer with infrared reflective properties, specifically metallic, and a third coating of dielectric material. The sum of the thicknesses of the first and second functional layers is greater than or equal to 25 nm. The ratio of the thickness of the first functional layer to the thickness of the second functional layer is less than 0.55. The properties of this glazing are mainly due to the reflective nature of the functional layers in the near-infrared.

[0005] It is also known, according to document EP 1 857 424, for example, a laminated glass with an interlayer film that comprises a resinous compound based on a polyvinyl acetal resin, a coloring agent, an infrared protection agent and also a phosphoric acid ester compound in a given proportion relative to the polyvinyl acetal resin. Document US 7 160 624 describes an interlayer film that is enriched in its formulation with an agent having an infrared radiation absorption property in the near and/or mid-infrared, such as Indium-Tin Oxide (ITO).

[0006] Finally, glazing systems used in buildings are known, featuring so-called "low-emissivity" glass, that rely on reducing the emissivity of the glazing surface to limit heat transmission toward the interior, while also limiting heat loss via radiation from the interior toward the exterior in cold weather. These are "floating" glasses on which a thin layer of metallic oxide has been deposited during their manufacture. This layer allows sunlight and heat to enter the building while preventing that same heat from evaporating outside, thus significantly reducing energy losses.

[0007] The purely tinted nature of current sunroofs or "skyroofs" only allows playing on the tint of the glazing and finding a compromise between light transmission and energy performance characterized solely by their capacity to absorb received radiation (ultraviolet, visible and infrared). High thermal performance with such a design is accompanied by reduced light transmission and increased energy absorption in the glazing. This absorption of energy by the glazing causes it to heat up, and the glazing re-emits this energy by infrared radiation both inwards and outwards from the vehicle. When the vehicle is stationary, the absence of forced convection around the glazing results in the vehicle's interior heating up. Thus, the reduction in light transmission caused by increasing the tint of the glazing only results in a fairly small gain in the level of comfort in the vehicle, even though the brightness provided by the "skyroof" can be greatly reduced.

[0008] The object of the present invention is to provide high thermal performance glazing for a vehicle, in particular for a motor vehicle roof, which new glazing has performance such that it makes it possible to do without the blackout blind to guarantee a good level of thermal comfort in the passenger compartment of the vehicle and, consequently, performance such that it makes it possible to achieve savings in the manufacture of the vehicle roof and a reduction in the mass of the latter.

[0009] Another object of the present invention is to provide such improved glazing, which allows to achieve a reduction in the height of the vehicle for the same habitability of the vehicle.

[0010] It is also an object of the present invention to provide such improved glazing, which allows a reduction in the vehicle's frontal area, and, combined with the mass reduction on the superstructure, a reduction in the vehicle's fuel consumption.

[0011] To achieve these goals, the present invention relates to a new high thermal performance glazing for a vehicle, in particular for a motor

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vehicle roof, and this new glazing is a laminated glazing composed of an outer pane, an inner pane, an interlayer between the two panes consisting of at least one absorbing PVB-based film, the inner pane being coated on its inner face with a low emissivity layer.

[0012] According to a preferred embodiment of the invention, the outer glass and the inner glass are tinted glass.

[0013] Alternatively, the outer glass and the inner glass can be clear glass, if the low-emissivity coating is itself tinted.

[0014] The optimal solution preferred in our invention is the use of a tinted outer glass, and a clear inner glass as a support for the low emissivity layer.

[0015] Preferably, the interlayer contains in its formulation at least one agent absorbing near and/or mid-infrared radiation.

[0016] Preferably also, the low-emissivity layer has an emissivity close to 20% (+/- 5%)

[0017] According to a preferred embodiment of the invention, the outer glass is a green or gray tinted glass, with the following performance characteristics:

- Light transmission (LT): 29%, and
- Energy transmission (ET): 25%.

[0018] According to a second preferred embodiment of the invention, the outer glass is a green or gray tinted glass, with the following performance:

- Light transmission (LT): 54%, and
- Energy transmission (ET): 40%.

[0019] According to either of these two preferred embodiments of the invention, the inner glass is a clear glass, with the following performance:

- Light transmission (LT): 89%, and
- Energy transmission (ET): 87%.

[0020] The inner glass can be, for example, approximately 2.1 mm thick.

[0021] The outer glass can, for example, also be approximately 2.1 mm thick

[0022] The interlayer has sufficient thickness to ensure the required mechanical, thermal, and acoustic performance.

[0023] The interlayer may consist of several films, one of which is based on absorbing PVB, laminated together so that said interlayer provides the required mechanical, thermal, and acoustic performance.

[0024] (Preferably, the interlayer is provided with a specific tint allowing adjustment of the color transmission and the light transmission of the glazing.)

[0025] Preferably also, the interlayer is provided with improved sound absorption by the use of an “acoustic” PVB in its composition.

[0026] The invention also relates to a vehicle, in particular a motor vehicle, which includes a sunroof - or “skyroof” - whose glazing conforms to that described above in its main features.

[0027] Other objects, advantages, and features of the invention will become apparent from the following description of a preferred embodiment, which is not limiting in scope and subject matter of this patent application, accompanied by drawings, in which:

- Figure 1 is a schematic cross-sectional view of laminated glazing, allowing for the description of the geometry, in particular the different faces, of the constituent glass panes.
- Figure 2 is a schematic cross-sectional view of the glazing according to the present invention, and
- Figure 3 is a graph illustrating the spectral behavior of the roof glazing according to the present invention compared to the behavior of glazing of the prior art.

[0028] With reference to the drawing in Figure 1, the geometry of a classic double-pane glass glazing, known from prior art, has been described.

[0029] Such glazing comprises an outer glass 10 and an inner glass 20. Face 1 is the outer face of the outer glass 10, face 2 is the opposite face of the same outer glass 10, face 3 is the face of the inner glass 20 turned towards the outer glass 10 and face 4 is the inner face of the inner glass 20.

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[0030] The performance of the glasses will be expressed by their energy transmission, designated ET, and their light transmission, designated LT. The ratio of light transmission to energy transmission LT/ET - designated "selectivity" - constitutes a performance indicator of the glass.

[0031] Light transmission LT is expressed as a percentage and is the amount of light that the glass lets through. The sum of the light transmission, light reflection, and light absorption of a glass or glazing is equal to 100%.

[0032] Energy transmission ET is also expressed as a % and it is the percentage of energy, from solar radiation, transmitted directly through the glass.

[0033] The choice of a "tinted" glass involves selecting, from among the many available glass references, the glass with the lowest energy performance (expressed by the ET coefficient) while maintaining sufficiently high optical performance (expressed by the LT coefficient) in order to achieve the desired results on the final assembled glazing.

[0034] With reference to Figure 2, we will now describe a high thermal performance glazing, according to the present invention.

[0035] This glazing, according to the invention, is composed of an outer glass 10, an inner glass 20, an interlayer 30 between the two glass 10 and 20 consisting of at least one PVB-based absorbing and acoustic film, and a layer called "low emissivity layer," referenced 40, on the inner face 4 of the inner glass 20.

[0036] The outer glass 10 is a tinted glass with high energy absorption performance and good selectivity (high LT/ET ratio). Preferably, this involves the thinnest possible sheet of glass, in order to help minimize the mass of the assembled glazing.

[0037] The absorbent PVB of the interlayer 30 is identical to the standard formulation of PVB, in terms of plasticizer and resin. The difference lies in the incorporation of nanoparticles. Their tiny size and the fact that they are inorganic guarantee optimized light transmission and stability over time. The absorbent PVB used in the present invention contains in its formulation one or more agents absorbing near and/or mid-infrared radiation. The thickness of the interlayer 30 is chosen to ensure mechanical, thermal, or acoustic performance on the final glazing, always seeking to minimize the mass of the final glazing.

[0038] The inner glass 20 is, unlike the outer glass, rather a clear glass which, once coated with the low emissivity layer, will behave like tinted glass during the forming of the glazing. It is also preferably a sheet of glass that is as thin as possible, in order to help minimize the mass of the assembled glazing.

[0039] The low emissivity layer 40 reduces the emissivity of the inner face 4 of the glazing. "Emissivity" means the ability of the material to emit heat radiatively. The emissivity coefficient varies depending on the wavelength of the signal. The low emissivity layer 40 of the present invention is lower than that of untreated glass. Layer 40 has an emissivity of around 20% (+/-5%) to allow the elimination of the blackout.

[0040] According to variant embodiments of the present invention, the absorbing PVB-based interlayer 30 can perform other functions, such as, for example, a function of adjusting the color in transmission and the light transmission of the final glazing, this adjustment being able to be obtained by choosing a specific tint of the interlayer 30.

[0041] Alternatively, the interlayer 30 can also consist of several PVB-based films that are absorbent, acoustic or tinted, laminated together so that said interlayer 30 provides the mechanical, thermal, colorimetric, and acoustic performance required for the final glazing.

[0042] According to another embodiment of the invention, the inner glass 20 is not clear glass, but tinted glass if the low emissivity layer 40 or the PVB-based absorbing interlayer 30 selected requires it in order to achieve light transmission at the desired level.

[0043] By way of example of a non-limiting embodiment of the object of the present invention, the glazing may be composed in the following manner:

Table I

Component	**Nature**
Exterior glass 10	2.1mm thick gray tinted glass LT = 29% and ET = 25%
PVB acoustic absorbent 30	PVB Sekisui © SSF thickness 0.76mm
Interior glass 20	Clear glass thickness 2.1 mm LT = 29% and ET = 25%

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(continued)

Component	Nature
Low-emissivity layer 40	Emissivity 0.20
Assembled glazing	**LT = 6.7%; ET = 4.2%; g = 19.2%; TTF = 3.77%; 124 W/m^2**
Tinted "sky" reference	LT = 24.0%; ET = 14.9%; g = 35.7%; TTF = 15.5%; 254 W/m^2

where:

LT: luminous transmission under illuminant D65 (see ISO 9050),
ET: energy transmission, with "Moon Air Mass" = 2, according to ISO 9050 standard ("Moon Air Mass" being the air mass as defined by P. Moon),
g: solar factor according to ISO 9050 standard (Air mass 1.5),
TTF: as defined by Hisashi Ogawa, Tatsuya Noguchi, Takashi Muromachi, Harunori Murakami, NIPPON SHEET GLASS Co., Ltd, and Transmitted power (in W/m^2): under external radiation according to illuminant D65 of 1000 W/m^2.

[0044] The Sekisui © SSF PVB (S-Lec®Sound and Solar Film) is a high-performance product manufactured and marketed by the Sekisui company. This is an example of sound-absorbing PVB: this product offers 40% greater IR (infrared) absorption than standard PVB.

[0045] ISO 9050 refers to the standard, published by the International Organization for Standardization, relating to the determination of light transmission, direct solar transmission, total solar energy transmission, ultraviolet transmission and derived factors of glazing.

[0046] As previously mentioned, the present invention aims, by the choice of tints, the composition and the thickness of the glass and the interlayer, to obtain for the assembled glazing a light transmission allowing the elimination of the blackout without inconvenience to the users. Appropriately, a light transmission LT of the complete glazing of less than 8% should be chosen, so as to avoid introducing lighting conditions that could cause glare.

[0047] It should be noted that the choice of glazing which includes an absorbing PVB-based layer and a low-emissivity layer allows great freedom in the choice of glass, the tint of which can be chosen in such a way as to facilitate the curvature of the glass constituting the glazing. Indeed, the presence of a low emissivity layer 40 makes the forming of the glazing more complex, and in particular obtaining compatible shapes for the inner glass 20 and the outer glass 10. The presence of the low emissivity layer 40 on the lower glass 20 gives the latter a behavior when heated very different from the behavior of a conventional glass. A judicious choice of tint between outer glass 10 and inner glass 20 taking into account the heating conditions in the bending oven can facilitate the forming of the glazing coated with the low emissivity layer.

[0048] The principle of the present invention allows a significant improvement in the thermal performance of the "skyroof". This improvement is illustrated by the graph in Figure 3, on which:

- curve A illustrates the spectral transmission of an ideal theoretical configuration corresponding to a glazing with a spectral transmission taken, for example, of 20% in the visible wavelengths, i.e., wavelengths between 0.38 µm and 0.78 µm, and of 0% outside these visible wavelengths.
- curve B represents the spectral transmission of a standard type "skyroof", known in itself, which exhibits significant transmission in the infrared range.
- curve C represents the spectral transmission of a glazing according to the present invention, the composition of which may be that described previously in Table I.

[0049] Apart from visible wavelengths, the object of the present invention is to prevent the penetration of infrared radiation into the interior of the vehicle.

[0050] The following two effects, specific to the present invention, can be observed on curve C:

- On the one hand, infrared radiation up to 2.2 µm is almost completely absorbed from about 1.3 µm by the absorbing PVB, whether or not supplemented by the contribution of the glass when it is chosen tinted, and
- on the other hand, beyond about 1.5 µm, the low emissivity layer 40 means that the infrared radiation, which has been absorbed by the PVB and will cause the glazing to heat up by its absorption, does not heat the passenger compartment or heats it very little. Indeed, the longer wavelength infrared radiation resulting from the heating of the glazing is not transmitted by radiation into the vehicle's

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interior thanks to the low emissivity layer 40, which strongly limits the infrared radiation from the glazing into the interior of the vehicle.

[0051] The conjunction of these two effects forms the very principle of the present invention, and explains the high level of performance obtained.

[0052] The present invention has many advantages, including the following:

- it allows for the possibility of removing the blackout blind, which is currently essential with classic "skyroofs" to insulate the passenger compartment in very sunny weather when the radiation is strong, but also in cold weather when heat loss is significant.
- removing the blackout blind results in the following:
  - a substantial gain in mass and cost,
  - a reduction in vehicle height while maintaining constant "habitable space,"
  - a reduction in the frontal area, and therefore in aerodynamic drag,
  - and finally, improved vehicle fuel consumption.

[0053] Of course, the present invention is not limited to the embodiments described and represented above by way of example; other embodiments may be devised by those skilled in the art without departing from the scope and extent of the present invention.

Claims

1. High thermal performance glazing for a vehicle, in particular for a motor vehicle roof, **characterized in that** it is a laminated glazing composed of an outer glass (10), an inner glass (20), an interlayer (30) between the two glass (10, 20) consisting of at least one absorbing PVB-based film, said interlayer (30) containing in its formulation at least one near and/or mid-infrared absorption agent and having improved acoustic absorption through the use of an "acoustic" PVB in its composition, the inner glass (20) being coated on its inner face (4) with a low-emissivity layer (40).

2. Glazing according to claim 1, **characterized in that** the outer glass (10) and the inner glass (20) are tinted glass.

3. Glazing according to claim 1, **characterized in that** the outer glass (10) and the inner glass (20) are clear glass.

4. Glazing according to any one of claims 1 to 3, **characterized in that** the low emissivity layer (40) has an emissivity of less than 0.85, preferably less than 0.15.

5. Glazing according to claim 2, **characterized in that** the outer glass (10) is a green tinted glass, with the following performance:
   - Light transmission (LT): 79%, and
   - Energy transmission (ET): 55%.

6. Glazing according to claim 2, **characterized in that** the inner glass (20) is a dark gray tinted glass, with the following performance:
   - Light transmission (LT): 29%, and
   - Energy transmission (ET): 25%.

7. Glazing according to claim 3 or 7, **characterized in that** the inner glass (20) is of a thickness substantially equal to 2.1 mm.

8. Glazing according to claim 3 or 6, **characterized in that** the outer glass (10) is of thickness between 2.1 mm and 3.15 mm.

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9. Glazing according to claim 4, **characterized in that** the interlayer (30) has a sufficient thickness to ensure the required mechanical, thermal, and acoustic performance.

10. Glazing according to claim 1, **characterized in that** the interlayer (30) is made up of several films, one of which is based on absorbing PVB, laminated together so that said interlayer (30) provides the required mechanical, thermal, and acoustic performance.

11. Glazing according to any one of claims 1 and 10, **characterized in that** the interlayer (30) is provided with a specific tint allowing adjustment of the color in transmission and the light transmission of the glazing.

12. Motor vehicle, **characterized in that** it comprises a roof whose glazing conforms to any one of claims 1 to 11.

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Fig. 1

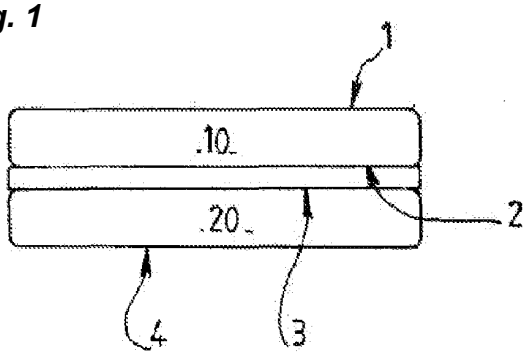
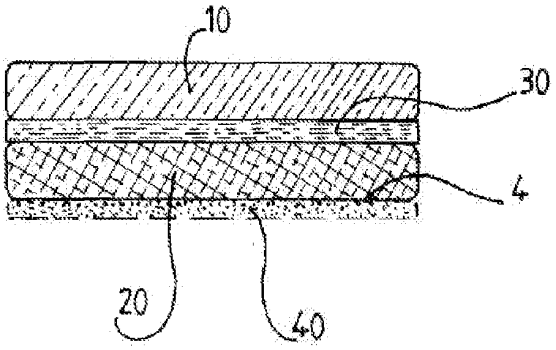


Fig. 2



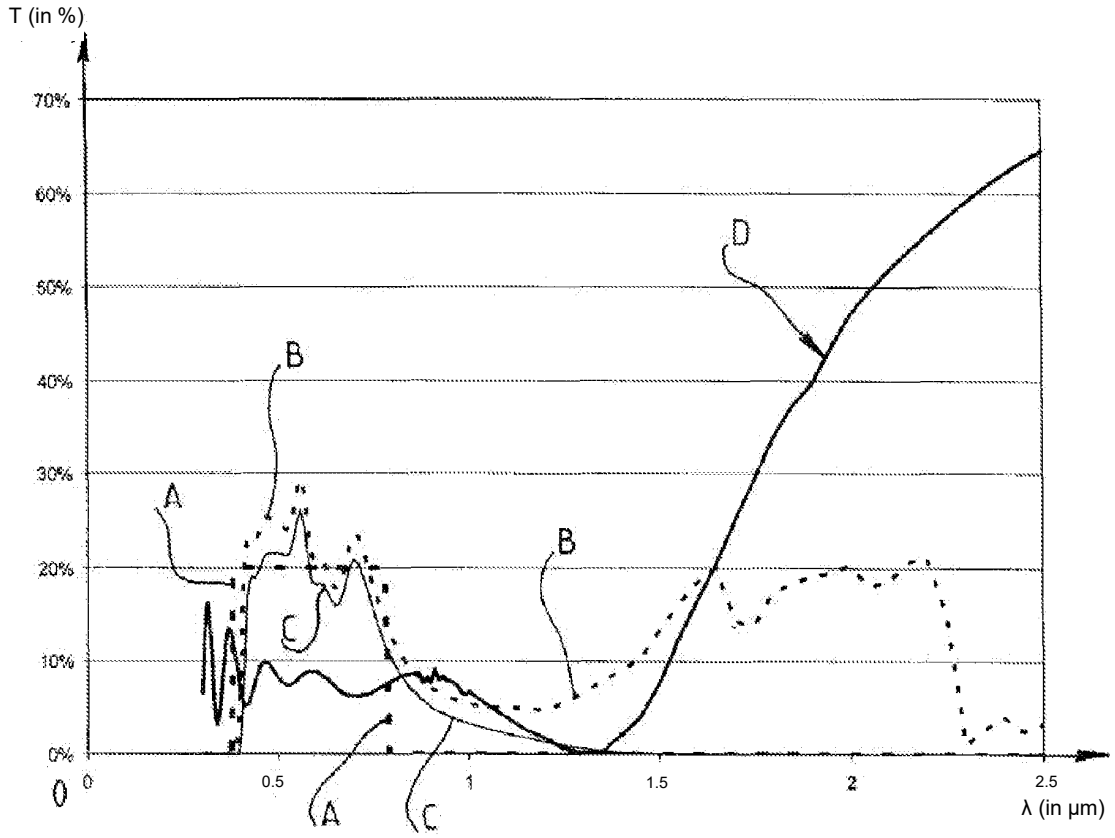


Fig. 3

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EUROPEAN RESEARCH REPORT

Application number
EP 09 15 1839

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1 This report has been prepared for all claims

Location of the research	Research completion date	Examiner
Munich	May 8, 2009	Lindner, Thomas

CATEGORY OF CITED DOCUMENTS
X: particularly relevant on its own
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Application number
EP 09 15 1839

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1	This report has been prepared for all claims		

Location of the research	Research completion date	Examiner
Munich	May 8, 2009	Lindner, Thomas

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This annex lists the patent family members relating to the patent documents cited in the European search report referred to above.
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