An electrically heatable transparent glazing panel composed of a transparent glass substrate is provided with at least one electrically conductive coating strip by applying onto the substrate a coating composition composed of a suspension or paste incorporating metal particles and intermixed glass particles, at least some of which are of a glass having a softening point lower than that of the glass of the substrate, substantially all of which particles are less than 5 microns in size, and subsequently firing the applied composition. In the composition, the proportion of metal particles is sufficient to render the resulting coating electrically conductive.

10 Claims, 2 Drawing Figures
GLAZING PANEL WITH CONDUCTIVE STRIPS

BACKGROUND OF THE INVENTION

The invention relates to a method of manufacturing an electrically heatable transparent glazing panel, and particularly a method involving providing a transparent glass substrate with at least one electrically conductive coating strip in which heat can be generated by the Joule effect. The invention also relates to transparent glazing panels composed of a glass substrate carrying one or more attached electrically conductive coating strips in which heat can be thus generated.

Electrically heatable transparent glazing panels incorporating electrically conductive elements are extensively and increasingly used, as, or as components of, vehicle glazings, e.g., as glazing panels in aircraft and as rear glazing panels in road vehicles. Such glazing panels can be connected to a source of E.M.F. so that sufficient heat is generated by the passage of electric current through the conductive elements to keep the panel free from mist and ice.

The production of anti-mist glazing panels by providing a glass substrate with adherent electrically conductive coating strips has been the subject of considerable research in industry, and various such products are available on the market. However the formation of electrically conductive coatings with fully satisfactory properties involves numerous problems which so far have not been solved.

It is usually necessary for the electrically conductive coatings to adhere very strongly to the substrate, and it may even be necessary in some cases for the coating to be resistant to impairment or detachment from the substrate when this is subjected to a certain amount of flexure. In cases in which the coatings are to be exposed on an external face of the substrate, as distinct from being sandwiched between the substrate and a superimposed protective sheet or layer, the coatings should have good abrasion resistance.

Another important condition to be fulfilled in products of high quality is a high degree of uniformity in the composition of the coatings on a given substrate and, in mass production manufacture, a high degree of uniformity in the composition of the coatings from one substrate to another.

This requirement of uniformity and reproducibility in mass production manufacture has proved particularly difficult to fulfill without resorting to complex and expensive production methods.

In fact, specialist manufacturers in this field have resorted to production methods in which successive layers of a coating composition are applied to build up a coating in successive stages while monitoring the electrical resistivity of the panel and using the measured resistivity as a control factor in the application of the coating.

Another method which has been used involves the application of coating composition in excess of what is required followed by a controlled removal of deposited composition in dependence on electrical resistivity readings. Apart from being unduly expensive, these procedures do not ensure the required uniformity in the properties of the coatings because the resistivity measurements are necessarily measurements of the resistivity of the whole panel. Clearly a constant predetermined resistivity reading is compatible with a substantial variation in conductivity from one part of a conductor or conductor system to another and from one complete conductor or conductor system to another.

SUMMARY OF THE INVENTION

In view of the above considerations, it is an object of the present invention to achieve a method by which electrically heatable transparent glazing panels with substantially uniform electrically conductive coating strips can be manufactured in a relatively simple manner.

Another object of the invention is to provide such a method by which predetermined results can easily be reproduced by repetitive performance of the method in mass production manufacture.

A further object of the invention is to provide a method which can easily be adapted for achieving a wide range of strip conductivities.

Yet another object, which is fulfilled by preferred embodiments of the invention, is to enable conductive coating strips to be formed which have a particularly high abrasion resistance.

An important field of use of the invention is the manufacture of electrically heatable glazing panels for use in vehicle windows.

These and other objects are achieved, according to the present invention, by a method of manufacturing an electrically heatable transparent glazing panel, which includes providing a transparent glass substrate with at least one electrically conductive coating strip in which heat can be generated by Joule effect. In the method according to the invention, at least one such strip is formed by applying onto the substrate a coating composition composed of a suspension or paste incorporating metal particles all or substantially all of which are below 5 microns in size, intermixed with glass particles at least part of which having a softening point lower than that of the glass composing the substrate, and all or substantially all of which are likewise below 5 microns in size, and subsequently firing such applied composition, the metal particles being present in sufficient proportion in relation to the glass particles to render the coating strip or strips electrically conductive.

This method affords the important advantage that electrically conductive coating strips which have a substantially uniform conductivity along the length thereof can be formed in a relatively simple manner, using only one coating deposition step. It follows that a similarly high standard of uniformity can be attained as between one conductive coating strip and another formed on the same panel, or on a different panel in the course of mass production manufacture.

The observance of the specified conditions in respect of the granulometry of the applied coating composition is undoubtedly a factor which contributes to the foregoing advantageous result. In view of the differences in the specific gravities of metal and glass, it is surprising that the application of both the metal and the glass in the form of particles below 5 microns in size does not prevent the formation of coating strips of substantially uniform composition. In fact it is that granulometry condition which makes it possible for coating strips of substantially uniform conductivity to be easily formed.

Coating compositions hitherto known for forming electrically conductive coatings incorporate mixtures of metal and glass particles in which the glass particles cover a size range extending very much above 5 mi-
crons. Contrary to what would be expected on theoretical grounds, the highest standard of coating uniformity which can be realized when using such a composition is greatly inferior to that which can be achieved by using a method according to the present invention.

The performance of the present invention involves more careful preparation of the coating constituents in order to observe the specified granulometry condition, but this step is amply justified by the greatly improved results which are obtained.

Preferably, the glass particles have substantially the same average grain size as the metal particles. By observing this further granulometry condition the standard of uniformity which can be achieved is optimized.

Advantageously the glass particles in the coating composition are composed of intermixed particles of two lead borosilicate glasses of different softening points and the applied composition is fired to cause at least that one of such glasses which has the lower softening point to serve as a binder for the metal particles.

The use of different intermixed glasses of different softening points affords very important advantages. Firstly, the properties of the coating strips are not determined merely by the metal particles and one selected glass. The second glass can be selected to confer on the coating strips a property which the strips would not otherwise possess.

It is desirable for the coating composition to contain a glass which can be melted or sufficiently softened for binding the metal particles without the necessity for excessively high firing temperatures. When using intermixed glasses of different softening points, the glass of lower softening point can be selected to serve as a binder while the higher softening point glass can be selected to confer some special property on the coating strips, for example a high abrasion resistance.

Advantageously, the higher softening point glass, which is the harder glass, is present in a proportion not exceeding 40% by weight, based on the total weight of the glass mixture, in order to promote abrasion resistance. It is of course within the scope of the invention to use a composition in which the proportions of both glasses in the coating composition and the firing conditions are such that both glasses serve as binder for the metal particles.

Another advantage of using a mixture of glasses of different softening points is that, as the properties of the coating strips are in part dependent on the relative proportions of the different glasses, a range of properties is attainable by using the different glasses in different relative proportions.

Preferably at least 10% by weight of the glass having the higher softening point is constituted by oxides of aluminum and titanium or of aluminum, titanium and zirconium. The presence of such oxides in combination in the higher softening point glass has been found to improve the properties of the coatings, in particular their hardness and abrasion-resistance.

In certain methods according to the invention, which also yield coatings with favorably high abrasion resistance, the glass having the higher softening point includes oxides of aluminum, titanium, zirconium and cadmium in an aggregate proportion of at least 10% by weight of such glass.

Preferably the metal particles constitute at least 40% of the aggregate weight of the metal particles and glass particles. It has been found that the inclusion of such high proportions of metal particles, e.g. silver particles, further facilitates the formation of coatings having a predetermined and substantially uniform electrical conductivity in repetitive performances of the method.

Preferably the coating composition contains only a minor proportion of a liquid vehicle, sufficient to render the composition capable of being uniformly spread like a paint and the composition is fired substantially immediately after its application to the panel. By using a small proportion of liquid vehicle, the need for the coating strips to be left to dry before commencing the firing step is obviated. The panel can pass directly from a coating station to a firing station. This is very important in mass production manufacture. It is very suitable to use an oil as the liquid vehicle.

A panel containing a glass substrate which has been provided with one or more electrically conductive coating strips by a method according to the invention can be used as such for glazing purposes, e.g., for forming a vehicle window. Alternatively such glass panel may be combined with one or more other sheets to form a laminated or other composite glazing panel. For example, a protective sheet may be applied over the electrically conductive coating strip or strips so that such strip or strips are sandwiched between the glass panel substrate and the protective sheet.

The coating strip, or each coating strip, can be applied by a sero graphic technique. This technique involves the use of a screen which is prepared to form a stencil in which the open area or areas penetrable by the coating composition correspond to the strip-like zone or zones on which the coating composition is to be deposited.

The invention also includes a transparent glazing panel composed of a glass substrate carrying one or more attached electrically conductive coating strips in which heat can be generated by Joule effect, in which there is at least one such strip which is composed of metal particles together with intermixed lead borosilicate glasses of different softening points, at least the lower softening point glass serving as binder for such metal particles.

Such a panel has the important advantage that the coating strip has a combination of properties deriving from the different constituent glasses. When manufacturing a plurality of such panels the technical specifications of the coating strips can be modified quite easily from one panel to another by modifying the relative proportions of the different glasses in the coating composition.

In preferred embodiments of the invention the transparent glazing panel as above defined is one in which all or substantially all of the metal particles are below 5 microns in size and wherein at least the higher softening point glass is present in the form of particles all or substantially all of which are also below 5 microns in size. Such a product is advantageous because by virtue of the small size of the particles of the higher softening point glass they can more uniformly influence the properties of the coating strip or strips. Moreover, in manufacturing such a product there is even less risk of formation of a conductive strip which is liable to become locally overheated, than when making a product which does not satisfy the specified condition. Localized overheating would rapidly lead to the rupture of the conductive strip.
In a panel according to the invention as above defined it is preferable for at least 10% weight of the glass having the higher softening point to be constituted by oxides of aluminum and titanium or of aluminum, titanium and zirconium. The advantage of this feature, and of other preferred features hereafter referred to will be appreciated from the above discussion of the corresponding features as applied in a method according to the invention as hereinbefore defined.

Preferably the glass having the higher softening point is composed of oxides of aluminum, titanium, zirconium and cadmium in an aggregate proportion of at least 10% by weight.

In certain panels according to the invention there is at least one such electrically conductive strip which is composed of silver particles and such intermixed glasses and which contains such silver particles in a proportion of at least 40% by weight, based on the aggregate weight of the silver and glass particles.

In certain panels according to the invention there is at least one such strip which is composed of such intermixed glasses and less than 60% by weight of silver particles, and which is locally over-coated at least one region by a coating composed of at least 60% by weight of silver particles. Such over-coating forms a very satisfactory means of connecting a lead-in wire to the conductive coating strip. In the case of a panel composed of a single conductive coating strip, e.g., a strip which follows a zig-zag course across the panel, these may be two such local over-coatings, located at or near the opposite ends of the strip. In the case of a panel composed of a plurality of conductive coating strips disposed in spaced parallel relationship, electrically conductive deposits composed of at least 60% by weight of silver can be formed on strip-like zones running across the opposed end portions of the parallel strips. Such deposits form electrodes via which the strips can be connected in parallel to a source of E.M.F.

A glazing panel according to the invention can be used as a vehicle window or as part of a vehicle window, e.g., as part of a laminate which includes a protective sheet covering the electrically conductive coating strip or strips.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIGS. 1 and 2 are front views of two glazing panels formed according to the invention.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

**Example 1**

A heatable glazing panel for a vehicle rear window and including electrically conductive strips was manufactured by a serographic process.

The manufacturing technique was as follows:

Firstly, a photo-sensitive composition was applied onto both faces of a Nyalid screen manufactured by Schweiz Seiten Gaze Fabrik. CH 9425 Thal St. Gallen, Switzerland. It is equally suitable to use a polyester screen of type 110D manufactured by the same firm.

The photo-sensitive composition was "Tumisol Red" marketed by Pulpivenor, 87-91 rue de l'Église St. Pierre, 1080 Bruxelles-Jette, Belgium.

The screen covered by the photo-sensitive composition was exposed for about a half hour to a light source through a negative image of the intended pattern of conductive strips. The negative was constituted by a sheet of glass covered by self-adhesive opaque sheets along the strip zones. The latent image on the screen was then developed by soaking the screen in water at about 50°C, which caused removal of the photosensitive composition along the strip zones. This development was followed by rinsing in water and firing at about 105°C. for about 30 minutes. The screen was then ready for use in the manufacture of the heatable window.

The developed screen was applied onto a glass sheet substrate constituting the glazing panel and electrically conductive coating composition in the form of a paste was forced through the open meshes of the screen. The paste, which will subsequently be described, adhered to the glass substrate.

The panel, constituted by the glass substrate covered by the paste along the strip zones corresponding with the open areas of the screen, was subjected to a thermal treatment in order to fire the coating composition. The panel was then cooled and was then ready for use.

A heatable glazing panel made as above described is illustrated in FIG. 1. The panel is composed of a sheet substrate 1 made of sodalime glass of ordinary composition. This sheet measures 750 mm × 400 mm × 5 mm. On this sheet two electrodes 2 and 3 have been deposited so as to cover the ends of the eight conductive strips 4. Each of these strips 4 has a width of 1 mm and a thickness of 10 microns and is 730 mm in length.

The electrodes 2 and 3 as well as the strips 4 have been formed by applying to the glass sheet 1, and then firing, a paste obtained by mixing silver particles less than 5 microns in size with particles of two glasses of different compositions, the glass particles being less than 3 microns in size, and adding a liquid vehicle.

One of the glasses, which will hereafter be designated "the binder glass" and of which the softening point is lower than that of the other glass, has in this example, the following composition in percentages by weight: SiO₂ 25.95%; Na₂O, 1.49%; K₂O, 0.61%; CaO, 1.02%; Al₂O₃ + TiO₂, 8.06%; BaO, 0.41%; ZrO₂, 1.35%; PbO, 48.03%; B₂O₃, 13.01%; MgO, 0.067%.

The other glass has the following composition in percentages by weight: SiO₂, 28.31%; Na₂O, 1.72%; K₂O, 0.73%; CaO, 0.20%; Al₂O₃ + TiO₂, 11.41%; Fe₂O₃, 0.43%; BaO, 0.23%; ZrO₂, 1.68%; PbO, 47.08%; B₂O₃, 5.06%; CuO, 3.07%; MgO, 0.02%.

The paste was composed of the specified different constituents in the following amounts: 852.4 g silver, 147.6 g of the binder glass, 200 g of the higher softening point glass, and an organic liquid vehicle of conventional type in an amount of 15% by weight based on the total weight of the paste.

During the firing of the applied electrically conductive composition, the liquid vehicle in the paste evaporated and the binder glass was melted. This binder glass enveloped the particles of silver and of the higher softening point glass and adhered to the glass sheet substrate. The panel was then slowly cooled.

The panel manufactured by the above process has important advantages. When in use, that is to say when an electric current is passed through the parallel electrically conductive strips in order to heat them, the strips acquire a temperature which is substantially uniform along the length of the individual strips and substantially uniform from one strip to another.

The variation in electrical resistivity along each conductive strip does not exceed ±3% and the variation in
electrical resistivity from one strip to another does not exceed ±6%.

Various tests were performed to assess the mechanical resistance of the coating strips. One test involved applying a ball of tungsten carbide to the coated surface of the sheet of glass under a force of 125 grams and displacing the ball to and fro over the surface at a frequency of 60 cycles per minute, perpendicularly across the conductive strips, while these were connected to a source of electrical current at 6 volts. It was found that the electrically conductive strips became ruptured after from 2000 to 5000 cycles of the abrasive tool.

A test was also performed to determine the resistance of the electrically conductive coating strips to impairment by a humid environment. The test involved maintaining the window at a temperature of 42°C in an atmosphere of 100% humidity. After more than 10 days no deterioration of the panel was detected.

**Example 2**

An electrically heatable glazing panel was manufactured using a serographic process as described in Example 1. The panel was in all respects similar to that manufactured in accordance with Example 1 except for the fact that after firing the applied electrically conductive coating composition the panel was cooled in a current of gas in order to effect thermal tempering of the glass substrate and render it more resistant to breakage by thermal shocks.

**Example 3**

An electrically heatable glazing panel as shown in FIG. 1 was manufactured by a process similar to that described in Example 1.

The paste applied to the glass sheet substrate 1 for forming the electrodes 2 and 3 and the conductive strips 4 was composed of, in parts by weight, 2 parts of nitrocellulose, 25 parts of silver particles, and 73 parts of a glass having the following composition in percentages by weight: SiO₂ 8.5%; Al₂O₃ 10.7%; CaO 5.5%; K₂O 1.6%; SnO₂ 0.5%; Li₂O 1.5%; Ag₂O 49%; B₂O₃ 22%; Na₂O 0.7%.

The silver particles and the particles of glass were all equal to or less than 3 microns in size.

The conductive strips exhibited only a small variation in electrical resistivity along their lengths and electrical resistivities of the different strips were substantially the same.

**Example 4**

An electrically heatable glazing panel as shown in FIG. 1 was manufactured, using a sheet of glass of ordinary composition as the substrate 1.

The conductive strips 4 were formed by a serographic method. In order to obtain strips having an aesthetically pleasing appearance, the serographic screen was placed with its weft threads parallel to the direction of the electrically conductive strips.

The electrically conductive strips and the electrodes 2 and 3 were formed by applying, and then firing, a paste having the following composition by weight: 67.5% gold, 7.5% glass, 25% of an inert liquid vehicle. The gold and glass were in the form of particles equal to or smaller than 4 microns in size.

The glass had the following composition by weight:

- PbO 75%
- SiO₂ 24%
- Al₂O₃ 1%

The conductive strips exhibited only a very small variation in electrical resistivity along their lengths and from one strip to another, such variation being of the same order as in the panels formed according to the preceding examples.

**Example 5**

An electrically heatable glazing panel as shown in FIG. 1 was manufactured by a process similar to that of Example 1.

The conductive electrodes 2 and 3 and the conductive strips 4 were formed by applying, and firing, an electrically conductive paste having the following composition by weight: 80% silver, 10% of a lead borosilicate glass, 10% of methyl alcohol. The lead borosilicate glass had the following composition by weight:

- 75% PbO
- 6% SiO₂
- 6% Al₂O₃
- 13% B₂O₃

The silver and the borosilicate glass were in the form of particles less than 4 microns in size.

The reproducibility of electrically conductive strips formed by means of this paste is very good. The variation in electrical resistivity along the strips and from one strip to another is very small, being of the same order as in the panels formed according to the preceding examples.

**Example 6**

An electrically heatable glazing panel as shown in FIG. 1 was manufactured by a process similar to that of Example 1. The electrodes 2 and 3 and the conductive strip 4 were formed from a coating composition (applied as a paste) composed of particles of silver and glass. The silver and glass particles had approximately the same mean size, the particles sizes being 0–2 microns.

The glass particles included particles of two different glasses as follows:

- **Glass No. 1**: PbO, 48%; SiO₂, 26%; B₂O₃, 13%; Na₂O, 2%; Al₂O₃, 5%; TiO₂, 3%; BaO, 0.4%; ZrO₂, 1%; K₂O, 0.6%; CaO, 1% (percentages by weight).
- **Glass No. 2**: PbO, 45.5%; SiO₂, 30%; B₂O₃, 5%; Na₂O, 1.5%; Al₂O₃, 5.5%; TiO₂, 6.5%; ZrO₂, 1.7%; K₂O, 0.2%; CaO, 0.2%; BaO, 0.2%; MgO, 0.2%; Fe₂O₃, 0.5%; CdO, 3% (percentages by weight).

The coating composition contained 800 g of silver, 100 g of Glass No. 1 and 300 g of Glass No. 2.

It was found that the reproducibility of the electrical resistivity was even better than that obtainable when using the coating compositions used in the preceding examples and that it was possible to reduce the thickness and the width of the conductive strips 4 without rendering it more difficult to reproduce strips having similar resistivities on a succession of panels. The variation in the electrical resistivity along each conductive strip and from one strip and another is about half of that noted in the panels according to the previous examples.
Example 7

An electrically heatable glazing panel was manufactured according to Example 6 except that Glass No. 2 had the following composition by weight: PbO, 46.5%; B₂O₃, 5%; SiO₂, 30%; K₂O, 0.2%; CaO, 0.2%; Al₂O₃, 5.7%; Na₂O, 1.5%; BaO, 0.2%; TiO₂, 7%; ZrO₂, 2.2%; MgO, 1%; Fe₂O₃, 0.5%.

The uniformity and reproducibility of the electrical resistivity is of the same order as that obtained according to Example 6.

Example 8

An electrically heatable glazing panel as shown in FIG. 2 was manufactured. The components of this panel are designated by the same reference numeral as the functionally corresponding components of the panel shown in FIG. 1.

In the panel shown in FIG. 2 each of the electrodes 2 and 3 has a width of 20 mm.

The conductive paste used for forming the electrodes 2 and 3 and the conductive strips 4 contained particles of silver, particles of two glasses and an organic liquid vehicle of conventional type.

The silver particles and the glass particles had a granulometry of between 0 and 2 microns and were of the same mean size. The compositions of the two glasses were as set out in Example 1. The paste was composed of 400 g of silver, 257 g of the lower softening point glass (the binder glass) and 343 g of the higher softening point glass, together with the liquid vehicle in a proportion of 15% of the total weight of the paste.

On top of the electrodes 2 and 3, layers 5 were formed by the local deposit of a paste composed of the same ingredients but in the following proportions: 800 g silver, 85 g of the binder glass, 115 g of the higher softening point glass and 15% by weight of the liquid vehicles (based on the total weight of the composition).

The panel was subsequently heated to fire the coating compositions.

In addition to the fact that a good reproducibility of the electrical resistivity was realized, the product possesses the advantage that one can easily solder electrically conductive wires to the deposited layers 5. For this purpose one can for example use a lead-tin-silver or lead-tin-cadmium or a lead-tin-indium alloy.

It is within the scope of the invention to use other compositions of conductive paste, other screens and other photo-sensitive compositions. Although reference has been made to the use of a serographic technique for applying the electrically conductive compositions it is equally possible to use other techniques for applying such compositions.

The invention can be applied not only to vehicle glazing panels but also in the manufacture of electrically heatable glazing panels for other purposes. A panel according to the invention may comprise only the substrate sheet which bears the electrically conductive coating, strip or strips, or it may include one or more other transparent sheets forming with such substrate a multiple or hollow panel. The invention may be applied in the manufacture of a vehicle windshield composed of one or more transparent sheets. A glazing panel according to the invention may include one or more glass sheets, and/or may incorporate a radio antenna and/or an alarm device for anti-theft or other purposes.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims. We claim:

1. In a method of manufacturing an electrically heatable transparent glazing panel by providing a transparent glass substrate with at least one electrically conductive coating strip in which heat can be generated by the Joule effect, the improvement comprising: applying onto said substrate, to form at least one such strip, a coating composition composed of a suspension or paste incorporating electrically conductive metal particles substantially all of which are below 5 microns in size, intermixed with glass particles, the glass particles being composed of intermixed particles of lead borosilicate glasses of different softening points, at least one of which softening points is lower than that of the glass composing said substrate, and substantially all of which glass particles are below 5 microns in size; and subsequently firing such applied composition to cause at least one of such glasses which has such lower softening point to serve as a binder for the metal particles; and wherein the metal particles are present in the composition in sufficient proportion in relation to the glass particles to render the coating strip electrically conductive.

2. A method as defined in claim 1 wherein the glass particles have substantially the same average grain size as the metal particles.

3. A method as defined in claim 1 wherein at least 10%, by weight, of the glass having the higher softening point is constituted by oxides of aluminum and titanium, or of aluminum, titanium and zirconium.

4. A method as defined in claim 1 wherein the glass having the higher softening point comprises oxides of aluminum, titanium, zirconium and cadmium in an aggregate proportion of at least 10%, by weight, of such glass.

5. A method as defined in claim 1 wherein said metal particles constitute at least 40% of the total aggregate weight of metal particles and glass particles.

6. In a transparent glazing panel composed of a glass substrate carrying at least one attached electrically conductive coating strip in which heat can be generated by the Joule effect, the improvement wherein said strip comprises electrically conductive metal particles together with intermixed lead borosilicate glasses of at least two different softening points, at least the lower softening point glass serving as a binder for said metal particles, substantially all of the metal particles are below 5 microns in size and at least the higher softening point glass is present in the form of particles substantially all of which are below 5 microns in size.

7. A panel as defined in claim 6 wherein at least 10%, by weight, of the glass having the higher softening point is constituted by oxides of aluminum and titanium or of aluminum, titanium and zirconium.

8. A panel as defined in claim 6 wherein the glass having the higher softening point comprises oxides of aluminum, titanium, zirconium and cadmium in an aggregate proportion of at least 10%, by weight, of such glass.

9. A panel as defined in claim 6 wherein said metal particles are silver particles and comprise at least 40%.
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11. A panel as defined in claim 6 wherein said metal particles are silver particles and comprise less than 60% by weight of the total of silver particles and glass particles, and further comprising a coating covering at least part of said strip and comprising at least 60%, by weight, silver particles.

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