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(54) LAMINATED TRANSPARENT PANE

(71) We, THERGLAS G.m.b.H. FUR FLACHENHEIZUNG, a Swiss Company, of Moosweg 10, CH-4125 Reihen BS, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to transparent panes of laminated construction with a fine wire insert, and in particular to heated panes. Such panes are necessary for the prevention or elimination of condensation and/or ice accretion. Vision through such panes should be unimpaired by the wire insert.

Known heated panes contain a heating area consisting of a plurality of thin wires which are electrically connected within the pane, and near the edge thereof, to flat supply leads which are connected to a current source to enable the pane to be heated. Spectral splitting and brightness in the field of vision due to diffraction of the light at the plurality of non-reflecting fine wires should not impair vision in such a case. For good heating efficiency, the surface of the heated pane should be uniformly warmed, without the field of view becoming disturbed due to striation of an intermediate film in the pane construction. The conditions under which a heated pane may be uniformly heated at its surface to prevent optical distortion are sufficiently known from German Specification 15 16 130 of 27.1.1967. In German Patent 876 874 of 6.3.1951, it has already been suggested how the splitting of light due to the glitter effect of a plurality of parallel fine wires can be substantially reduced without the viewing conditions being impaired. According to this Patent, the heating wires should be disposed in an undulating manner along their main direction parallel to the surface of the pane. In order to obtain optimum conditions the changes in direction of the heating wire undulations should progressively and uniformly increase and decrease between 0 and 90°. This cannot be attained with available technical resources, and all the more so because even on this basis, fundamental limits are set on the possibility of eliminating the occurrence of diffraction. In the most satisfactory case, the heating wires can be laid in approximately sinusoidal curves, which give rise to the appearance of segment-like brightness in the field of vision.

According to the present invention, there is provided a laminated transparent pane having two exterior laminations and an intermediate film between the exterior laminations, and a plurality of wires, each in the form of a helix, embedded in the intermediate film.

When viewed through the pane, the heating wire helices appear as sine curves.

Each individual turn of the wires is preferably in contact with an inner side of one of the exterior laminations, so that each turn is in local heat conducting contact with the exterior laminations.

The diameters of the wire helices are preferably substantially equal to or less than the thickness of the intermediate film.

When viewed in the axial direction, the turns of the wire helices do not have to be round. They may also be oblate or rectangular.

The distance, measured along the helical axis between adjacent turns of each helix may be at least equal to the diameter of the helix.

Neighbouring wire helices with their axes disposed parallel to the pane surface may also be normally parallel to each other. However, they can also be split apart from each other trapezoidally so that the heating capacity can be applied to the pane in any desired pattern. The wire helices can also be disposed meander-shaped or undulating in the axial direction.

Stranded wires previously twisted from several single wires may be used instead of

single strands for the wire helices. A plurality of helices may be wound on a common helical axis.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an enlarged plan view of a portion of a heated pane,

Figure 2 is a sectional elevation through the same heated pane portion,

Figure 3 shows, on a large scale, a wire helix, and

Figure 4 shows a wire helix on the same scale as in Figure 3, but consisting of two separate helical wires extending parallel to each other and spaced apart.

The portion of heated pane 1 shown in Figure 1 of the drawing contains an arrangement of heating wire helices 2 of fine wire with a diameter D_f of 0·02 mm, the turn diameter D_w of which is 0·3 mm, and which have a pitch S equal to twice the turn diameter. The fine wire can have a diameter D_f of 0·005 to 0·1 mm or more, the upper limit being determined by impaired visibility. The upper limit may be 0·5 mm. The distance S between adjacent turns of the wire helix 2 can be greater or smaller than in the embodiment shown, but should not fall below one turn diameter D_w. The distance, a, between adjacent parallel helices 2 is 0·9 mm in this embodiment. It may vary from 0·1 to 4·0 mm according to requirements.

Figure 2 shows the same pane portion as in Figure 1, but in sectional elevation in the direction of the wire helix axes. The heating wire helices 2 of circular appearance are embedded in a suitable thermoplastic film 3, for example polyvinylbutyral film having a thickness of 0·76 mm, to the extent that each individual wire turn lies locally against the inner side of an exterior cover pane 4, in order to improve heat transfer. The turn diameter D_w of the wire helix 2, at 0·3 mm, is equal in this case to only a fraction of the film thickness. The wire helices 2 when embedded may be of round oblate or rectangular form when viewed in the axial direction. The turn diameter D_w of the wire helices can however be equal to or slightly greater than the thickness of the intermediate film 3. In such cases, each individual turn of the spirals 2 should lie locally against the opposing inner surfaces of both of the cover panes 4 and 5, in order to provide a greater heat distribution, if required.

Figure 3 is an elevational view of a few turns of a wire helix 2 similar to the wire helices shown in Figures 1 and 2. The helical turns appear as sinusoidal curves. This appearance would also be the same in plan view. The single wire strand used for the helix has in this case a diameter D_f of 0·01 mm. Wire helices of several single strands twisted together would have the same appearance. Their distance S between turns is $2D_w$.

Figure 4 shows a few turns of two wire helices 6 analogous to the one shown in Figure 3, each with a turn diameter of D_w, and a distance S between turns of $2D_w$.

The present invention has the advantage over the prior art of providing a new type of arrangement for the wire insert of heated panes, which reduces the occurrence of diffraction and prevents optical distortion, in a new manner. This is attained in that the thin heating wires are no longer disposed in a single plane, but instead are disposed in the form of three-dimensional elongated helices, by which the possibility of interference is considerably reduced. At the same time, because of the helical arrangement of the heating wires, they are more difficult to see, so that even heating wires having a diameter exceeding 0·02 mm can be used.

The invention is not limited to heated panes; it can be advantageously used wherever a wire insert should not be visible, such as for alarm panes, screening or antennae.

WHAT WE CLAIM IS:—

1. A laminated transparent pane having two exterior laminations and an intermediate film between the exterior laminations, and a plurality of wires, each in the form of a helix, embedded in the intermediate film.

2. A pane as claimed in claim 1, wherein each helix has an axis, and all the axes lie parallel to the plane of the pane so that the wires appear to lie in a single plane when viewed through the pane.

3. A pane as claimed in claim 1 or claim 2 wherein each individual turn of the wires is in contact with an inner side of one of the exterior laminations.

4. A pane as claimed in any preceding claim, wherein the diameters of the wire helices are substantially equal to or less than the thickness of the intermediate film.

5. A pane as claimed in any preceding claim, wherein the wires are arranged with their helical axes parallel to one another and spaced apart a distance of from 0·1 to 4 mm.

6. A pane as claimed in any preceding claim, wherein the distance, measured along the helical axis, between adjacent turns of each helix is at least equal to the diameter of the helix.

7. A pane as claimed in any preceding claim, wherein the wires have a diameter of 0·005 to 0·5 mm.

8. A pane as claimed in any preceding claim, wherein the wires each consist of a single wire strand.

9. A pane as claimed in any of claims 1 to 7, wherein the wires each consist of several strands twisted together to form stranded wire.

10. A pane as claimed in any preceding claim, wherein a plurality of helices are wound on a common axis.

11. A pane as claimed in any preceding claim, wherein the wires are heating wires.

12. A laminated transparent pane substantially as herein described with reference to Figures 1, 2 and 3 or Figure 4 of the accompanying drawings.

MARKS & CLERK,
Chartered Patent Agents,
57–60 Lincolns Inn Fields,
London WC2A 3LS.
Agents for the Applicants.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig.1

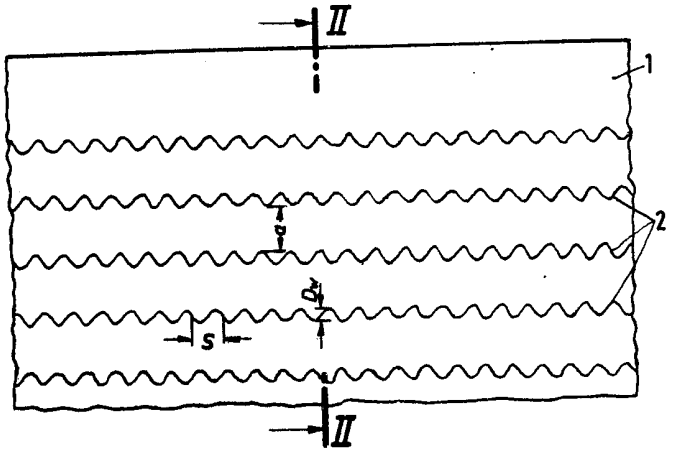

Fig.2

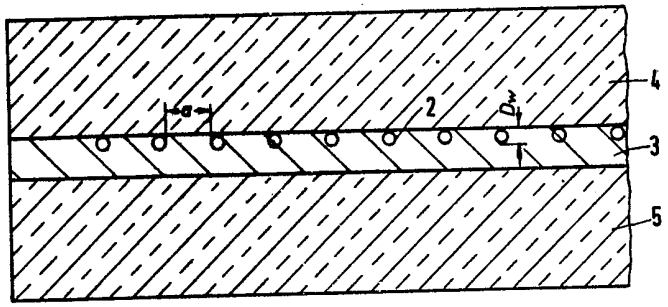

Fig.3

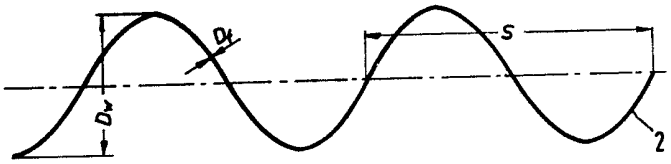

Fig.4