United States Patent

Steger

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[54] HEATING DEVICES FOR VEHICLE WINDOWS

[72] Inventor: **Robert Hugo Steger,** Waldburgstrass 29, Boblingen, Baden Wuttemberg, Germany

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[51] **Int. Cl.**.....**H05b 3/06**

[58] **Field of Search**.....219/522, 543, 549, 203, 536, 219/526; 338/211–212, 308–309; 174/68.5, 117; 252/511

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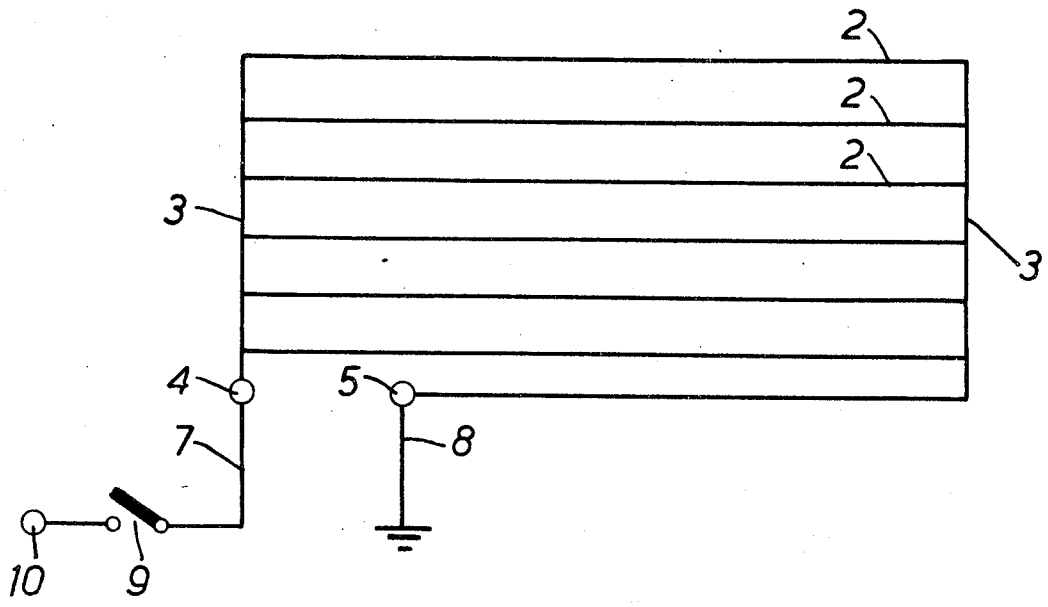
Primary Examiner—Volodymyr Y. Mayewsky
Attorney—Lawrence E. Laubscher

[57] **ABSTRACT**

A heating device for attachment to a vehicle window for deicing, defrosting or demisting purposes. The device comprises a sheet of flexible transparent material and means, such as an adhesive border, for attaching it to the vehicle window, and an electrical resistance heating element in the form of a layer of electrically conducting material, formed for example from metallic particles carried in a binder, bonded to the surfaces of the sheet.

1 Claims, 3 Drawing Figures



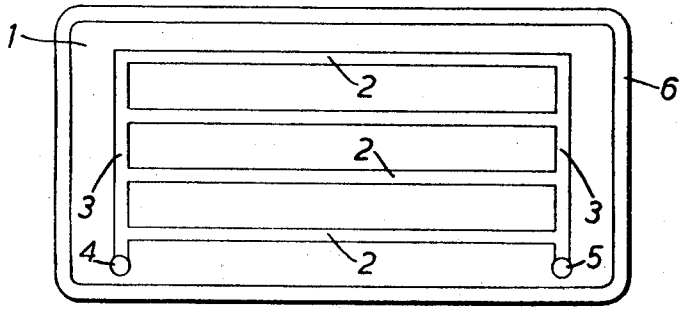


FIG. 1.

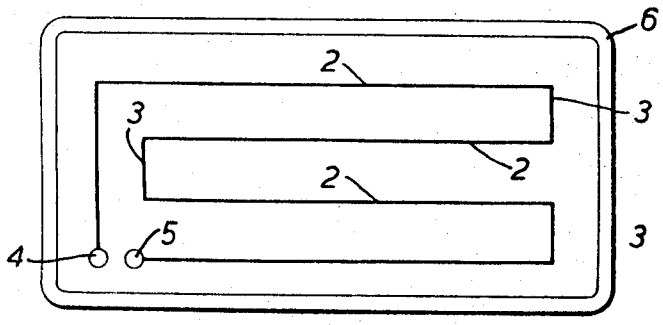


FIG. 2.

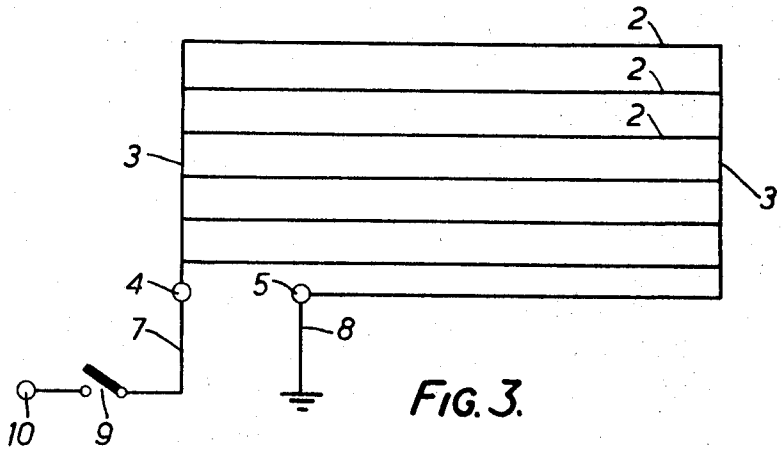


FIG. 3.

Robert Hugo Stegger
INVENTOR

BY
Lawrence E. Laubscher
ATTORNEY

HEATING DEVICES FOR VEHICLE WINDOWS

This invention relates to heating devices for vehicle windows and more specifically to a heating device for attachment to a windscreen or to a rear window of a vehicle, and to a method of producing such devices.

The heating device in accordance with the invention comprises a sheet of transparent electrically insulating material to which is applied an electrical resistance heating element comprising a layer of electrically conductive material, bonded to the surface of the sheet.

The sheet material is preferably a plastics material and may for example consist of, or include, a polyester resin material, that is to say a material which would provide the sheet with an appropriate degree of flexibility.

The layer of conductive material forming the resistance heating element can be produced by printing or spraying a conductive fluid onto the surface of the sheet. The fluid preferably includes metallic particles, such as particles of silver, which may be mixed with a binder, such as an essential oil or a liquid silicone, or both. The fluid must be such that it can be applied to the sheet to form a thin layer which will not obscure unduly the view of the driver of the vehicle through the windscreen or window to which the device is attached.

The resistance heating element is preferably made so that it operates from standard motor vehicle batteries, that is from either a 12-volt or a 6-volt supply. It can however be operated from higher voltage supplies if desired.

The primary purpose of the heating device in accordance with the invention is for deicing or defrosting motor vehicle windscreens or rear windows. Although the heat produced by the resistance heating element is not sufficient for it to become incandescent, care must be taken in selecting a material for the sheet which will withstand temperatures which will effect deicing or defrosting on the outside of a window, when the device is attached to the inside of the window, for example temperatures in the region of 190° C.

Thus, it is preferred to use for the sheet a plastics material comprising two components, one of which is a polyester resin and the other of which is a heat-resistant plastics material. Such a material can be produced which is completely transparent and which will withstand temperatures of the order of 190° C. without losing its desired properties of transparency and flexibility.

In practice the sheet will be provided on one of its surfaces with a self-adhesive border for use in attaching the heating device to a windscreen or window. This border is preferably provided on that surface of the sheet to which the layer of conductive material is bonded or applied.

In one practical form of heating device, the heating element may consist of a number of strips of electrically conductive material arranged in parallel relationship and spaced apart sufficiently so as not to obscure unduly the driver's view. Said strips may be connected in series by making connections at alternate ends or alternatively they may be connected in parallel by connecting all their corresponding ends together to produce a single heating element. The latter arrangement is preferred as the heater would still remain operative even if one or more of the individual conductor strips became disconnected or "burnt out." The connections between the strips may also consist of layers of conductive material, which form part of the heating element.

Finally, terminal connections can be provided to which electric wires leading to a source of electric current may be attached. A simple and very effective form of terminal connection may be provided by the use of press studs.

In order that the invention may be more clearly understood and readily carried into effect, one form of window-heating device will now be described with reference to the accompanying drawings, in which:

FIG. 1 shows a heating device in accordance with the invention;

FIG. 2 shows a similar heating device but with an alternative form of heating element; and

FIG. 3 is a circuit diagram for a heating device specifically intended for attachment to the rear window of a motor vehicle.

The heating device shown in FIG. 1 comprises a sheet 1 of transparent electrically insulating material such as a mixture of a polyester resin material and a heat-resistant plastics material. A resistance heating element comprising a number of electrical resistance conductors 2 is applied as a layer to one surface of the sheet 1. The conductors 2 are arranged in parallel relationship and their corresponding ends are joined to form a network by conductors 3 leading to terminals in the form of press studs 4 and 5 adapted to be connected to a source of electric supply, for example a vehicle battery. The conductors 2, and if desired the conductors 3, are produced by printing or spraying an electrically conductive material onto the surface of the sheet 1 so that the conductive material forms a layer which is bonded to the surface of the sheet 1. A self-adhesive border 6 is provided on that surface of the sheet 1 to which the conductors 2 and 3 are applied. This border has a protective covering which can be stripped off to improve adhesion just before the heating device is attached to a window.

One form of conductive material comprises metallic particles, for example silver particles, in a binder consisting of a mixture of an essential oil and liquid silicones. Alcohol may also be used to "thin" the mixture to the required consistency, depending on whether it is to be applied to the sheet 1 by spraying or by printing.

A preferred mixture produces a silver enamel type of composition of which the relative amounts of silver to its other constituents can be varied so as to vary the specific resistance of the applied conductive layer and thus enable accurate values of heating resistances to be calculated.

Printing is preferably carried out by a so-called "silk-screen" process, the screen being one of about 14,000 mesh per cm.^{2} and the conductive layer composition being printed onto the sheet at a temperature of about 180° C. Application of the conductive layer by printing also enables a thin layer to be applied which is not disconcerting to the driver of a vehicle and does not obscure his view to any great extent.

In the heating device shown in FIG. 2 the electrical resistance conductors 2 are also arranged in parallel relationship but they are connected together at alternate ends by conductors 3 to form one continuous series resistance conductor.

FIG. 3 illustrates the electrical connections between the heating device and the electrical wiring system of a motor vehicle. Electric leads 7 and 8 form the press stud and connections 4 and 5 lead to one terminal of an on-off switch 9 and to an earthing point on the vehicle body respectively. The other terminal 10 of the on-off switch 9 leads to the live battery terminal through the vehicle fuse box.

A particular two-component material which has been found to be very satisfactory for the transparent sheet is one made by Farbwerke Hoechst and sold by them under the trademark "Hostaphan."

To ensure comfortable vision through the heating device according to the invention, the conductive layer should be applied to the surface of the sheet so that it meets the following requirements:

a. It is light in color.
b. It is sufficiently thin.
c. The individual conductor strips are sufficiently narrow, and
d. The individual conductor strips are sufficiently spaced apart.

The requirement of (a) can be met by using metallic particles of silver. That of (b) can be met by using a mixture of silver particles and a binder in a solvent, and "screen" printing the mixture onto the sheet. Those of (c) and (d) are met by making the heating device large enough to accommodate a sufficient number of narrow, widely spaced strips. For example, if the device is made 28 cm.×56 cm., the strips can be made 1 to 1½ mm. wide and spaced 2.8 cm. apart.

Although the heating device described is primarily intended for defrosting or deicing purposes, it can be designed so as to effect demisting as well. The device will normally be designed to operate at temperatures of the order of 50°–60° C. with a wattage output of about 60 w.

In a heating device designed to operate from a standard 12-volt battery, the resistance of the heating element would be about 2.5 to 3 ohms, while the resistance of a device operating from a 6-volt battery would be about 0.5 to 0.65 ohm.

When silver particles are used to form the resistance elements, the particles will generally be of the order of 7 microns in size and are preferably in the form of minute sheets. Furthermore, in a parallel arrangement of resistance conductors, the width of the conductors is preferably varied to allow for the different currents passing through them. The width of the conductors 3, for example, may decrease in the direction of current flow and the width of the individual conductors 2 may also vary progressively from one end of the grid to the other.

One or more heating devices may be maintained in position against a window by means of a second plain covering sheet of transparent material provided with an adhesive border. A number of heating devices may be arranged within the "-pocket" formed between the plain covering sheet and the window, in a number of ways, for example side by side, back to back, one behind the other, or combinations thereof. Any otherwise-exposed heating elements or conductors connecting the devices together will then be insulated from persons in the vehicle, by the said second plain sheet.

When two devices back to back are arranged in this manner, one will serve to heat the vehicle window and the other to heat the vehicle interior.

Of course, the said second sheet need not overlap the devices but may be used simply to cover the heating element of the device facing towards the vehicle interior. In that case, each device and the said second sheet will be provided with its own adhesive border. If desired, the two heating devices may be produced by applying heating elements to opposite sides of one and the same electrically insulating sheet.

I claim:

1. A heating device for a vehicle window comprising,

a. at least one transparent electrically insulating support member comprising a single, nonlaminated sheet of flexible transparent synthetic plastic material formed from a plasticized polyester resin and a heat-resistant synthetic plastic material proportioned to enable said sheet to withstand temperatures to 190° C. without substantial loss of transparency or flexibility;

b. a layer of electrically conductive resistance material applied to the support member in the form of a pattern or grid to define an electrical circuit, said resistance material being mounted on one side of said nonlaminated sheet in the form of a number of parallel conductor strips light in color, narrow in width and spaced apart so as not to substantially impair a driver's vision therethrough, each said conductor strip being formed by silver particles in a binder of oil and liquid silicone mixed with alcohol solvent and applied to said support member;

c. electrical terminal means mounted on said support member for connecting said circuit defined by said electrically conductive resistance material with a voltage source; and

d. an adhesive border mounted on said transparent support member, said border being applied to the side of said nonlaminated sheet which receives said conductive resistance material.

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