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[54] **METHOD OF PRODUCING ANTENNA TYPE WINDSHIELDS**

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[21] Appl. No.: **193,227**

Related U.S. Application Data

[62] Division of Ser. No. 833,302, June 16, 1969, abandoned.

[52] **U.S. Cl.**..... **204/140,** 117/62, 117/64, 117/212, 343/873

[51] **Int. Cl.**..... **C23b 1/00,** B44d 1/18, H01q 1/40

[58] **Field of Search**..... 117/62, 64, 212, 117/227; 219/543, 547, 203; 29/625, 628; 204/140; 343/872, 873

[56] **References Cited**

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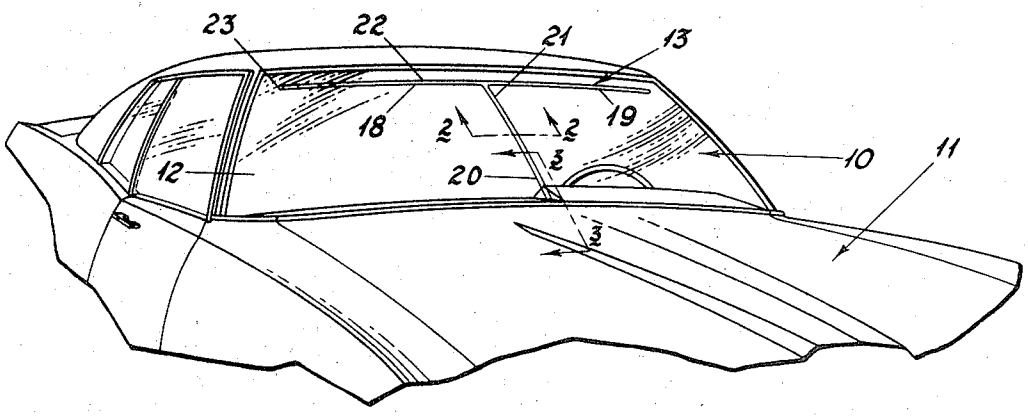
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Primary Examiner—T. Tufariello
Attorney—Elmer L. Collins et al.

[57] **ABSTRACT**

A laminated glass windshield having incorporated with it an antenna of tarnished silver that is produced by applying a silver-frit paste to a surface of one glass sheet in a pattern of thin lines extending horizontally across the upper portion of the sheet toward the middle and then downwardly into a crescent shaped figure, firing the applied pattern to the glass, and treating the lines of the pattern with sulfur. The lower edges of the plastic interlayer and the other glass sheet in the windshield are cut out to facilitate connection with a lead wire.

10 Claims, 7 Drawing Figures



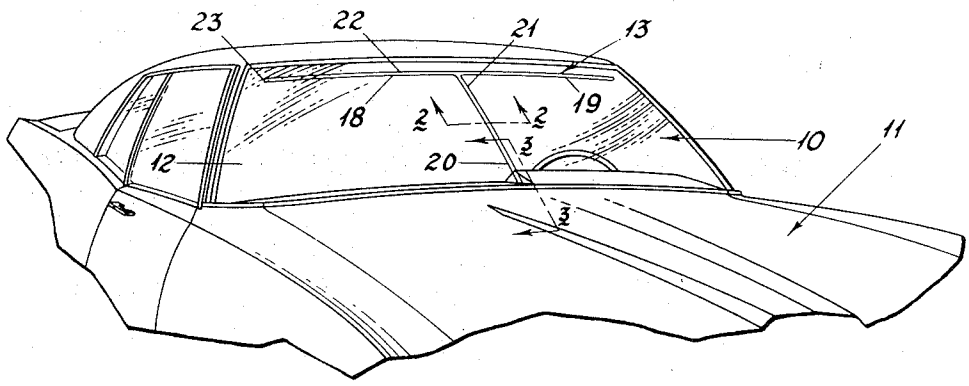


Fig. 1.

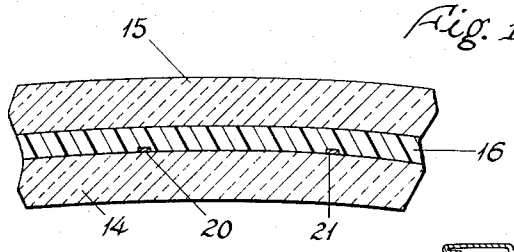


Fig. 2.

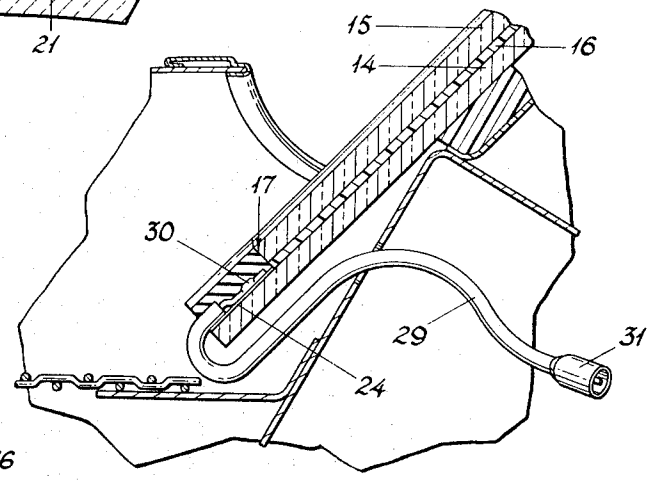


Fig. 3.

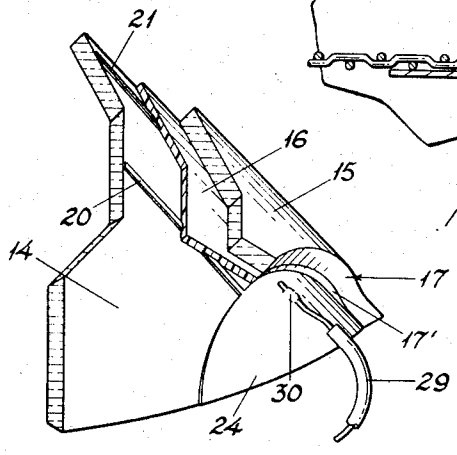


Fig. 4.

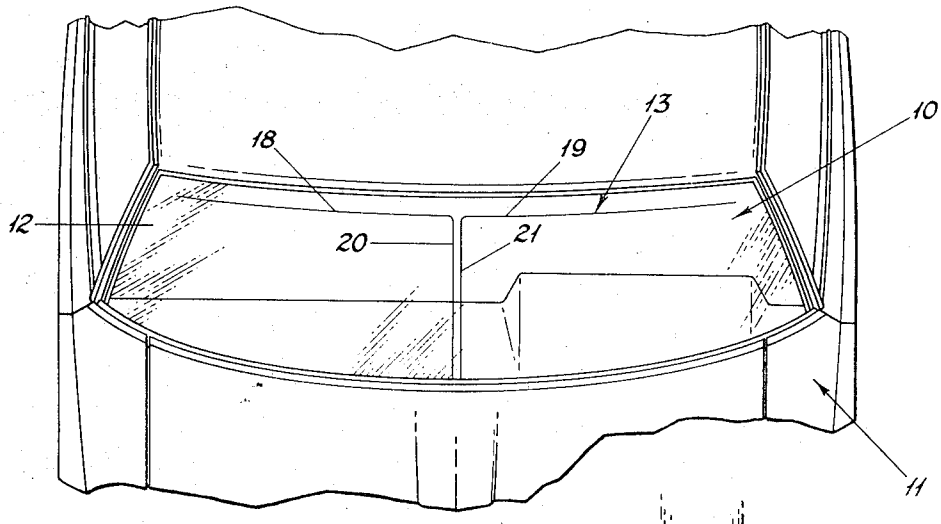


Fig. 5.

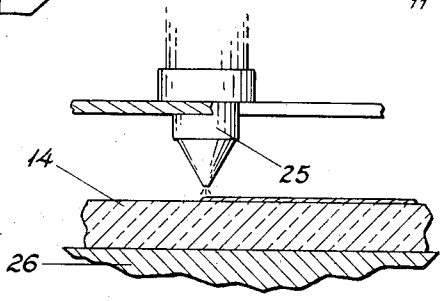


Fig. 6.

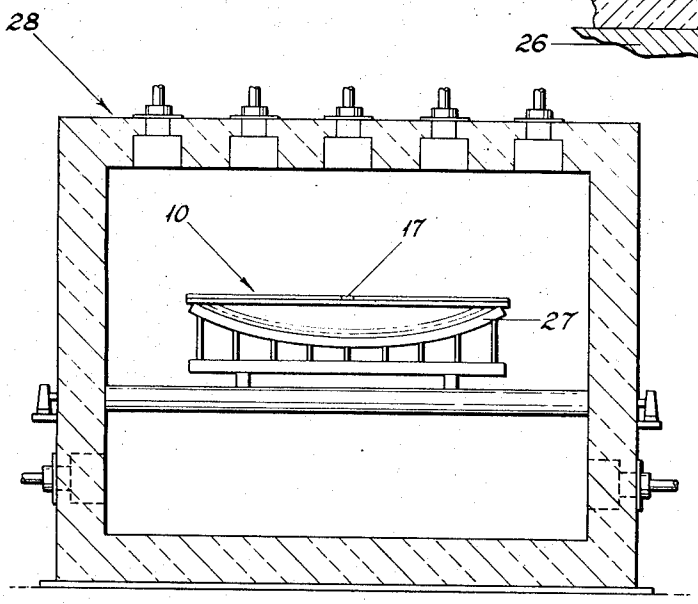


Fig. 7.

METHOD OF PRODUCING ANTENNA TYPE WINDSHIELDS

This application is a division of application Ser. No. 833,302, filed June 16, 1969 and now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention related broadly to the application and surface treatment of electrically conducting materials. More particularly it has to do with improvements in automobile windshields that have radio antennas associated therewith and in ways of producing the same.

2. Description of the Prior Art

Heretofore automobile antennas have been almost exclusively of the familiar, so-called "buggy whip" or flexible, telescoping rod type that are standard equipment on most passenger cars. However these projecting rods detract from the overall streamline effect desired in modern automotive designs and are highly susceptible to breakage and loss from vandals, garage door frames, and other frequently encountered obstructions. It has been suggested that the antenna be made up of wires concealed in various places on the car and, among others, in the windshield (see U.S. Pats. No. 3,208,070, issued Sept. 21, 1965 to James H. Boicey, and No. 3,414,902, issued Dec. 3, 1968 to H. E. Shaw, Jr.). However the combinations of windshield and wire antenna elements there shown never found any real acceptance in the automotive field as equipment for standard model cars.

SUMMARY OF THE INVENTION

According to this invention, on the other hand, there is provided a design of windshield-antenna structure that is distinctly different in character, that is technically and economically feasible, and that lends itself readily to product line installation in stock as well as in custom built automobiles.

Thus, a primary object of the invention is the provision of a windshield-antenna structure in which the antenna is capable of functioning adequately for its intended purpose while, at the same time, being virtually unnoticeable and so not materially affecting the appearance of the windshield or obstructing vision.

Another object is to provide such a structure that can be mounted in the automobile and electrically connected to the radio system at least as easily as conventional windshields and antennas can be mounted and connected.

Further and more detailed objects and advantages of the invention will become apparent in the course of the following description when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like numerals are employed to designate like parts throughout:

FIG. 1 is a fragmentary perspective view of the front end of an automobile provided with a windshield-antenna structure of the invention;

FIG. 2 is a horizontal sectional view taken substantially along the line 2—2 in FIG. 1;

FIG. 3 is a vertical, sectional view taken substantially along the line 3—3 in FIG. 1;

FIG. 4 is a quasi-perspective side elevation of portions of the windshield-antenna structure shown in FIG. 3, with parts broken away to show the connecting means and associated parts more clearly;

FIG. 5 is a view similar to FIG. 1, but illustrating a somewhat different form of horizontal antenna element;

FIG. 6 is a diagrammatic showing of one way in which the electrically conducting material can be applied to a glass sheet; and

FIG. 7 is a transverse, vertical, sectional view through a type of furnace that can be used to bend and/or fire the applied electrically conducting material onto a glass sheet.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to the drawings, there is illustrated in FIGS. 1 to 4 a windshield-antenna structure 10 of the character contemplated by the invention that is mounted in a convention manner in an automobile 11; and, generally speaking, the structure 10 consists essentially of a conventional windshield 12 with an antenna 13 built into or otherwise associated with it.

As shown in FIGS. 2 to 4 the windshield 12 is of the laminated safety glass type, being made up of two sheets of glass 14 and 15 and an interposed layer 16 of plastic all bonded together under heat and pressure to form a composite unit, and the lower edge of the outboard light or glass sheet 15 is notched or cut out prior to laminating to provide an indentation 17 (FIGS. 3 and 4) in the finished windshield.

The antenna 13 of the structure 10 is associated with the laminae of the windshield and is preferably made up of conducting material, such as a metal-frit, applied to the outboard surface of the inboard glass sheet 14 as thin horizontal lines 18 and 19 and thin vertical lines 20 and 21. The horizontal lines are located as near the upper edge of the windshield as consistent with adequate performance and may be given a loop configuration as illustrated in FIG. 1 by the provision of an upper horizontal line 22 and short vertical connecting lines 23; or, they may be employed as simple straight line elements arranged in end to end relationship as shown in FIG. 5.

In any event the horizontal lines of the antenna are positioned well out of the critical sight areas in the windshield, and where a shade band is incorporated in the windshield or sun visors are used they will be hidden thereby.

Similarly, the vertical lines 20 and 21 are located in the windshield midway between the driver and front seat passenger so that they are out of the critical sight area for either and will appear, if at all, only as a division line or lines. In addition to forming a part of the antenna pattern or configuration, these vertical lines also function as part of the special means for connecting the antenna-windshield structure to the radio that is an important feature of the present invention.

Thus, as can be seen in FIG. 1, vertical lines 20 and 21 extend downwardly from the inner ends of horizontal lines 18 and 19 respectively toward the bottom edge of the windshield and as best shown in FIGS. 3 and 4 terminate in a broad, substantially crescent shaped figure 24, that is preferably of the same material and is applied in the same way as the lines to the glass sheet 14, in alignment with the indentation 17 in the outboard

lite of glass **15** and with a similar indentation or cut **17'** in the plastic interlayer **16** (FIG. **4**).

The basic antenna-windshield structure just described may be produced by first applying the conducting lines and the figure that are to constitute the antenna portion **13** to a sheet of glass is to become the inboard lite **14** of the windshield portion **12** while the glass is still in the flat. Any electrically conducting material, such as silver, copper, palladium or the like, that will meet the necessary specification and withstand the uses to which it is to be put may be used to form the lines and it may be applied as a paste or in any convenient form.

For example commercially available silver-frit pastes have proved satisfactory and such pastes are usually made up of from 80 to 98 parts of powdered silver to form 2 to 20 parts of borosilicate glass frit in an organic vehicle.

As illustrated schematically in FIG. **6** of the drawings, the lines may be applied by drawing or painting them with a suitable tool **25,** preferably in widths between 0.005 inch and 0.015 inch, onto the desired surface of the glass sheet while it is supported as at **26** (FIG. **6**). However the lines may be up to 0.030 inch wide and can as well be applied in a substantially continuous process, with the glass supported for movement along a production line, and by any of the conventional procedures including printing, silk screening, stenciling, photo engraving, brushing, rolling and so forth.

When a conducting material that requires additional treatment is employed it is preferred that such treatment be performed as part of a conventional windshield producing procedure. Thus when a fusible material such as silver or other metal-frit paste, is used in applying the lines for a bent antenna-windshield, the necessary fusing or firing of the metal-frit onto the glass can be carried out while the glass is being heated to the temperature required to bend it. Similarly, where a lower heat treating temperature is necessary, adequate or desirable, residual heat from the bending operation, or the heat of the conventional prepressing or autoclaving procedures by which the glass and plastic laminations of the windshield are completed, can be used for the purpose.

Another feature of the invention that may involve the use of heat stems from the discovery that lines of a relatively bright material, such as silver for example, on a glass surface incorporated into a laminated windshield may result in one or more reflections of the applied lines of silver from other glass surfaces of the windshield and produce objectionable double images under normal lighting conditions, and that this can be avoided by a special treatment of the lines that provide the antenna portion of the windshield.

The matter of avoiding unwanted reflections also affects the choice of the glass surface to which the antenna lines are applied and, while their invention is by no means restricted thereto, applicants have determined that excellent results from an optical standpoint are obtained when the lines are on the outboard face of the inboard light in laminated safety glass structures if, after these lines are applied, they have their exposed faces chemically darkened to appreciably reduce if not entirely eliminate their light reflecting potential. More particularly they have found that a practical and efficient treatment, especially when the conducting material is silver results from exposing the applied lines to the action of a tarnishing agent, such as sulfur, in a form and manner that will rapidly and uniformly discolor the silver.

Also, in this same connection, applicants have found that darkening or tarnishing of the conducting material can be facilitated by combining the basic conducting element with another. To illustrate, combining or treating the silver, when a silver-frit paste is used, with chlorine, bromine, iodine or fluorine will surprisingly improve both the speed and character of the tarnish that is subsequently produced when the lines of fired on paste are treated with sulfur or a sulfur compound.

With all of these things in mind there are set forth below a number of representative examples of specific procedures that can be followed in producing antenna-windshields according to the invention.

EXAMPLE I

An antenna pattern or circuit is applied to one surface of a sheet of glass, cut to windshield shape and while still in the flat, by silk-screen printing, with a silver-frit paste, the lines **18** to **21** and the figure or connecting tab **24** (FIGS. **1** and **4**) thereon.

When dry a layer of parting material, of the type conventionally used between glass plates that are to be bent in pairs to prevent their sticking together, is applied to the printed sheet. This sheet is then assembled in face to face relation with another sheet of glass of the same size and shape, except that the latter has a notch **17** cut into its lower edge. The glass assembly, with parting material between the sheets, is then placed on a mold **27** and passed through a heated bending furnace **28** (FIG. **6**) to bend the glass to the desired windshield curvature and to fire on the silver-frit. After bending, the glass sheets are taken from the furnace, and the parting material is removed from their inner surfaces.

The surface of the glass sheet carrying the antenna pattern is then exposed to sulfur in a conventional form until the lines of the antenna pattern are uniformly tarnished to a desired darkness.

The glass sheets are then reassembled together with an interposed sheet of plastic of similar size and shape and notched at **17'** in the same way as the unprinted glass sheet. In assembling, the printed glass sheet is preferably positioned to become the inboard light of the windshield with the printed antenna circuit to the inside and the notches **17** and **17'** are aligned with the printed crescent shaped connecting tab **24** on the printed sheet. Thereafter the assembled glass and plastic sheets are temporarily bonded together by passing them through suitable pre-press rolls and are then finally composited into a unitary structure under heat and pressure in an autoclave to produce a windshield-antenna structure ready for mounting in an automobile.

Either before or after mounting, a suitable insulated pig tail lead wire **29** (FIG. **4**), which may be of tinned copper, is soldered in the conventional manner, but preferably with a silver containing solder, to the connecting tab **24,** which has been pre-tinned, to form a connection **30** and, as soon as this has been done, the indentation **17** may be filled with a heat and moisture resistant plastic sealing compound such as "Thiokol" where that type of protection is necessary or desirable.

The resulting complete windshield-antenna structure **10** is then ready to and can be mounted in the windshield opening of an automobile in the same way that

a conventional windshield for the same model is mounted. Also the lead **29** is preferably provided at its opposite end with an electrical connector, such as one half of a plug type fixture, **31** (FIG. 3) and, when this is done, installation of the device is completed by simply plugging the connector **31** into the radio of the car.

EXAMPLE II

In this example, as in the preceding and the following ones, the steps of applying the conducting material to form the electrical circuit, firing it onto and simultaneously bending the glass sheets, laminating the glass and plastic, and providing the electrical connections, when and as necessary, may be carried out as described in Example I or in any other known and conventional manner.

Thus, here, as in Example I, a silver-frit paste is applied to the glass to form the lines of the antenna pattern but, after firing and before exposing the lines to a tarnishing agent, they are sprayed with an acid solution of iodine, bromine, chlorine and/or fluorine.

In this as in the subsequent examples in which silver is treated or combined with a halogen element, any of the four elements of the halogen group may be used, either alone or in combination with one another, although with fluorine precautions must be taken to avoid any adverse effects of its corrosive tendencies.

A specific solution for the preliminary spray step of this example that has given excellent results comprises approximately 1 percent iodine with 1 percent concentrated hydrochloric acid in 98 percent isopropyl alcohol and, while variations in these proportions can be made, it is preferred that the halogen element content be kept within a range of substantially 0.5 percent to 5.0 percent.

When, after having been pretreated as described above, the antenna lines are exposed to the action of sulfur, as by spraying with a 1 percent to 10 percent sodium sulfide in water at room temperature, the lines darken immediately and with no appreciable time lapse.

An important phase of this latter step is that the spraying of the tarnishing solution serves to wash off the pretreating solution so that objectionable reaction between the two solutions will not occur.

EXAMPLE III

This is similar to Example II in that it involves a pretreatment by dipping in or spraying with an acid solution of a halogen element, followed by dipping in or spraying with a solution of a sulfur compound. However, here, a metal compound is added to the sulfur solution and will act to intensify the darkening of the lines and as an agent for obtaining shade changes.

Specifically, the tarnishing solution of this example may be a 2 percent to 10 percent $Na_2S \cdot 9H_2O$ solution containing from 5 to 10 percent of a metal compound such as lead tetraacetate, lead sulfide, cupric sulfide, stannous sulfide or cobaltous sulfide, which metal additions appear to add a very fine metallic layer at the surface of the silver-frit.

EXAMPLE IV

This resembles Examples II and III in that it involves the use of an element of the halogen group. However in this case the element is incorporated into the metal-frit employed in applying the antenna lines.

Specifically, from 1.5 to 5 percent of iodine, for example, may be specified as an added ingredient in a commercial silver-frit paste. Or, from 3 to 10 percent of silver iodine can be added and thoroughly mixed into a conventional silver-frit paste before applying it to the glass.

In any event, when the resulting lines of silver-frit-halogen element have been fired onto the glass and then dipped into or sprayed with a 1 percent to 10 percent solution of sodium sulfide in water, darkening is immediate as with Examples II and III, and another feature of tarnishing by these three examples is that no change in the electrical characteristics of the lines results from it.

EXAMPLE V

In this procedure, the steps of applying the conducting material to form the antenna circuit and firing it on the glass may be carried out as described in Example I. However, here, the silver in the lines of the antenna circuit is blackened by an electro-chemical tarnishing procedure.

To this end the frit paste may, but need not, include a tarnish accelerator, and an electrolyte or plating solution is made up which can be approximately a 10 percent solution of sodium sulfide although, for continuous production work, dilute NaOH into which H_2S is bubbled may be preferred. In this type of work, if an inert cathode is used, sulfide ion is given off at the anode and hydrogen at the cathode so that additions of H_2S will act to maintain the bath at a constant concentration level.

More dilute concentrations of Na_2S will also effectively blacken fired on silver but as concentration decreases the plating time increases for a given static potential so that a 5.0 percent concentration of Na_2S may require twice, and a 0.5 percent concentration four times as much treating time. The treatment can be carried out at room temperature and may be conventional plating which the glass sheet carrying the antenna circuit is dipped into the bath with the work being made the anode or positive. The preferred potential is 5 volts but can range from 2 to 10 volts. Plating time is in the 5 to 20 second range and gives a uniform black color to the lines.

A press and/or rubbing technique may also be employed in which a pad or pads of absorbent material are soaked with electrolyte, which may contain a wetting agent, and pressed against or rubbed over the printed circuit. With the press technique, which may also involve rubbing, the positive lead is a attached to the antenna circuit and the negative to the tool or support for the absorbent material. A somewhat different rubbing technique involves no electrical connection to the windshield but, instead, spaced areas of absorbing material are held in a tool with the positive lead being connected to one area and the negative to an adjacent one.

A modified form of the electro-chemical treatment involves the use of chloride baths, such as solutions of Na Cl or mixtures of Na Cl and H Cl, to form silver chloride.

EXAMPLE VI

In this the silver containing the printed circuit is placed in contact with a fresh concentrated solution of ammonium sulfide (light) at room temperature until sufficiently tarnished. Around two minutes produces a uniform and satisfactorily dark surface on the lines.

Example VII

A 10 percent aqueous solution of sodium sulfide that has been saturated with elemental powdered sulfur at room temperature is heated to 170° F. and the printed silver containing circuit is immersed in it. An immersion time of one minute gives a uniform dark color. With both this, the previous, and most of the following examples the glass sheet is thoroughly washed and rinsed in tap water and dried before proceeding with subsequent steps.

EXAMPLE VIII

The fired on silver containing antenna lines on the glass are tarnished by spraying with a stabilized sodium polysulfide solution. The solution is effective in concentrations as low as 0.25 percent and at temperatures between 160° and 195° F. However an approximately 1 percent solution at around 180° F. is preferred and, under these conditions the lines tarnish to a dark grey color in 4 to 5 seconds.

Specifically a typical bath of tarnishing solution can be made up by dissolving 0.84 pounds of sodium sulfide in 1 gallon of tap water, stirring in 0.70 pounds of flowers of sulfur and heating to 170° F. until dissolved. This stock solution is then diluted to 20 gallons with 180° F. tap water and 0.84 pounds of a stabilizer is stirred in, whereupon the solution is ready to spray.

Without the stabilizer sodium polysulfide may soon lose its effectiveness, free sulfur precipitates rapidly in the spraying operation and hydrogen sulfide is evolved at the spraying temperatures. However a stabilized solution can be cycled for several hours at these temperatures with no loss of coloring activity.

Many neutral or alkaline compounds can be used as stabilizers and all of the following have proved effective:

sodium nitrite — sorbitol
sodium thiosulfate — corn syrup
sodium sulfate — glycerine
cellosolve — triethylene glycol
methanol — ethylene glycol

However sodium sulfite is preferred. The sodium polysulfide (Na_2S_x) can act both as an oxidizing and reducing agent itself. Reducing agents seem to give the best stabilizing action and the preferred stabilizer is sodium sulfite.

EXAMPLE IX

The silver antenna frit lines can be colored to a dark gray or black almost instantly with the following sulfur containing organic compounds:

1. Thioacetamide
2. Dithiooxamide
3. 2-thio-orotic acid

The glass with the frit lines on it is heated to 210° F. and the hot compounds are swabbed over the lines. The color develops rapidly. The hot compounds are effective in the crystalline or molten state.

EXAMPLE X

The silver containing antenna circuit is tarnished by first heating it to around 250° F. and then introducing it into a closed chamber containing sulfur heated to the same temperature. Exposure from 2 to 4 minutes gives a uniform black color. However, by raising the circuit temperature to 400° F. and the sulfur temperature to 300° F. comparably dark colors can be obtained with from 8 seconds to 1 minute exposure.

EXAMPLE XI

This involves several specific procedures for tarnishing a silver antenna circuit by contact with a mixture of sulfur and carbon.

In one, equal parts of carbon powder and powdered sulfur are vigorously mixed with enough water to give a thick slurry or paste which is applied in a rather thick layer to the lines of the antenna circuit. The glass sheet containing the circuit is then heated at 250° F. until a sufficiently dark color is attained. Usually in about 4 minutes.

A similar procedure differs from the above only in that the circuit is "dry" sprayed, with a mixture of 25 grams each of carbon powder and precipitated sulfur that has been ball milled with 50 ml. of distilled water and 100 ml. of iso-propyl alcohol and to which another 100 ml. of iso-propyl alcohol has been added, until the lines of the circuit are thoroughly covered.

In the third procedure, equal parts of precipitated powdered sulfur and of a decolorized powdered carbon are intimately dry mixed and the mixture applied to the lines of the antenna circuit while it is at a temperature of 250° F. As in the case of the paste and spray procedures this dry powdered method requires a heating cycle of around 4 minutes.

However, in all three, higher temperatures may be employed to reduce exposure time and the antenna circuit may be heated by placing the glass sheet in an oven, by banks of heat lamps or by applying a current of electricity through the circuit.

EXAMPLE XII

This involves tarnishing the silver containing antenna circuit by contacting it with a sulfur compound at an elevated temperature while the circuit is covered with another sheet of glass.

In one method a dry mixture of sulfur and salt cake powder is applied to the circuit lines.

In another the antenna circuit is sprayed and thoroughly covered with a "dry" spray until the circuit is just visible, with the spray material being made up of one part of precipitated powdered sulfur and two parts of sodium sulfate (salt cake) ball milled with iso-propyl alcohol in the proportion of 400 ml. of the alcohol to 300 grams of the dry mix and with another 100 ml. of alcohol added.

In a third method the circuit is contacted with a chromotographic paper or other absorbent material that has been soaked with a sulfur saturated alcohol solution made up of 400 ml. of methanol, 10 grams of sodium sulphide ($Na_2S \cdot 9H_2O$) and 50 grams of sulfur powder.

With each of these methods the circuit bearing and its companion sheet of glass are heated to approximately 200° F., the dry mix, spray or soaked paper is applied to the lines of the circuit, the companion sheet

of glass is placed over the circuit, and heating is continued at the same temperature for about 5 minutes. The dry mix and spray treatment require a washing step to remove the sulfur but no cleaning is necessary with the paper treatment.

With all three methods an increase in exposure time to 15 minutes had no effect but a temperature increase to 250° F. gave the same result in 5 minutes time, with the tarnish going deeper into the circuit and showing through on the glass side.

It will be evident from the foregoing that, while sulfides are the most commonly employed tarnishing agents, sulfur and compounds of sulfur other than the sulfides and other than those specifically listed, such as sodium thiosulphate for example, can be employed to tarnish bright antenna circuits; that sulfur containing parting materials may be used to accelerate circuit tarnishing as well as for separating the glass sheets during bending; that conducting materials other than metal frits can be employed in applying antenna circuits and that such materials can be tarnished or darkened in a variety of different ways; that the glass sheet carrying the circuit can be tempered and that it can be used alone and/or with a protective coating over the circuit as well as within a conventional laminated glass structure and that an antenna circuit may be applied to any of the glass sheets in a laminated windshield and to any surface thereof as well as to the preferred surface specifically discussed.

Indeed it is to be understood that the forms of the invention herewith shown and described are to be taken as illustrative embodiments only of the same, and that various changes in the shape, size and arrangements of parts, as well as various procedural and compositional changes may be resorted to without departing from the spirit of the invention as defined in the following claims.

We claim:

1. A method of producing a transparent electrically conductive structure that is usuable as a glazing which comprises applying silver-frit paste to a glass sheet in a predetermined pattern to form an electrical circuit, intimately uniting said silver-frit with said glass by heating while in contact therewith and discoloring a surface of said circuit by treating the same with sulphur in at least part of said pattern to reduce the reflection of light therefrom.

2. A method as defined in claim 1 in which said fired on pattern pretreated with a halogen element.

3. A method as defined in claim 1 in which said paste contains a halogen compound, is fired onto said glass, and said chemical darkening comprises exposing said fired on halogen containing paste to the action of a sulfur compound.

4. A method as defined in claim 1 in which said fired on pattern is pretreated by spraying the same with a solution of 0.05 percent to 0.5 percent iodine with concentrated hydrochloric acid in isopropyl alcohol, and said sulfur treatment comprises spraying said pretreated pattern with a 1 percent to 10 percent solution of sodium sulfide in water.

5. A method as defined in claim 4 in which said solution of sodium sulfide contains from 5 percent to 10 percent of a metal compound.

6. A method as defined in claim 1 in which from 3 percent to 10 percent of silver iodide is added to said paste before it is applied, and said sulfur treatment comprises spraying said fired pattern with a solution of sodium sulfide.

7. A method as defined in claim 1 in which said circuit is darkened by an electro-chemical treatment comprising contacting the same with an electrolyte including the sulphur darkening agent, making said conducting material the anode and said electrolyte the cathode, and passing an electric current therebetween.

8. A method as defined in claim 1 in which said sulfur treatment comprises contacting said fired pattern with a stabilized sodium polysulfide solution.

9. A method as defined in claim 1 in which said sulfur treatment comprises exposing said conducting material to a mixture of sulfur and carbon.

10. A method as defined in claim 1 in which said structure is an automobile windshield, said conducting material is applied in a linear antenna pattern terminating in a relatively broad figure at the lower edge of said glass sheet, the lines of said pattern are protected from abrasion by assembling said glass sheet with a corresponding second glass sheet and an interposed layer of plastic covering said lines but having cutout portions therein corresponding in size shape and location to the figure on said first glass sheet.

* * * * *