United States Patent

Zawodniak

[15] **3,638,225**

[45] **Jan. 25, 1972**

[54] ANTENNA WINDSHIELD

[72] Inventor: **Rodger V. Zawodniak,** Lower Burrell, Pa.

[73] Assignee: **PPG Industries, Inc.,** Pittsburgh, Pa.

[22] Filed: **Aug. 13, 1970**

[21] Appl. No.: **63,362**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 773,805, Nov., 1968, Pat. No. 3,543,272.

[52] **U.S. Cl.**.....**343/713,** 343/873, 174/68.5

[51] **Int. Cl.**.....**H01q 1/32**

[58] **Field of Search**.....343/711, 712, 713, 873, 906; 174/68.5

[56] **References Cited**

UNITED STATES PATENTS

3,484,583 12/1969 Shaw 343/712

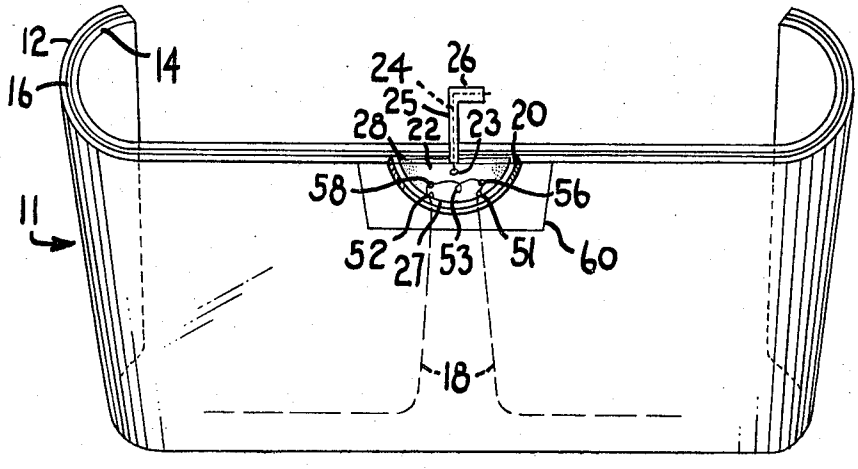
Primary Examiner—Eli Lieberman

Attorney—Chisholm and Spencer

[57] **ABSTRACT**

An improved antenna for a laminated windshield comprising two glass sheets, one of which has a notched portion in its lower edge portion and a single continuous antenna wire mounted in a plastic interlay that adheres the two glass sheets together. The wire has its central portion exposed for electrical connection within the notched portion to a metal tab electrically connected to a radio receiver. The notched portion is filled with an electrical insulating material, such as polysulfide resin, enclosed on one side with a transparent tape of electrical insulation material, such as polyurethane or polyethylene.

5 Claims, 4 Drawing Figures



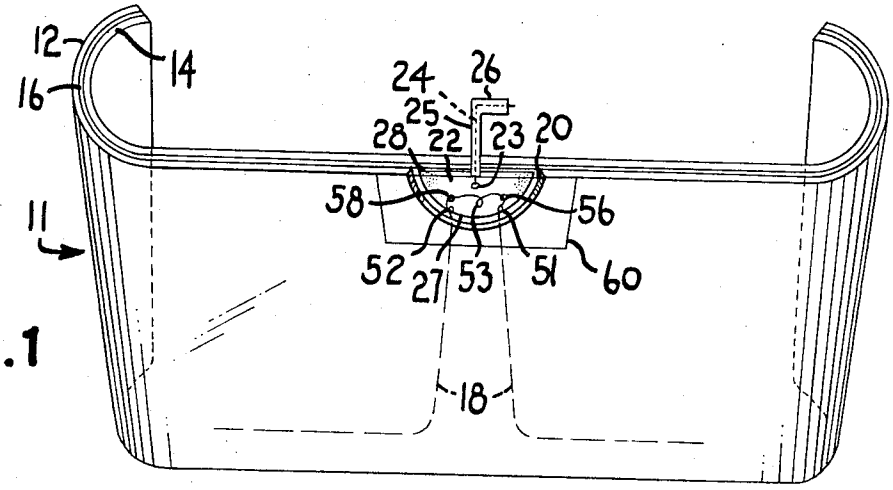


FIG. 1

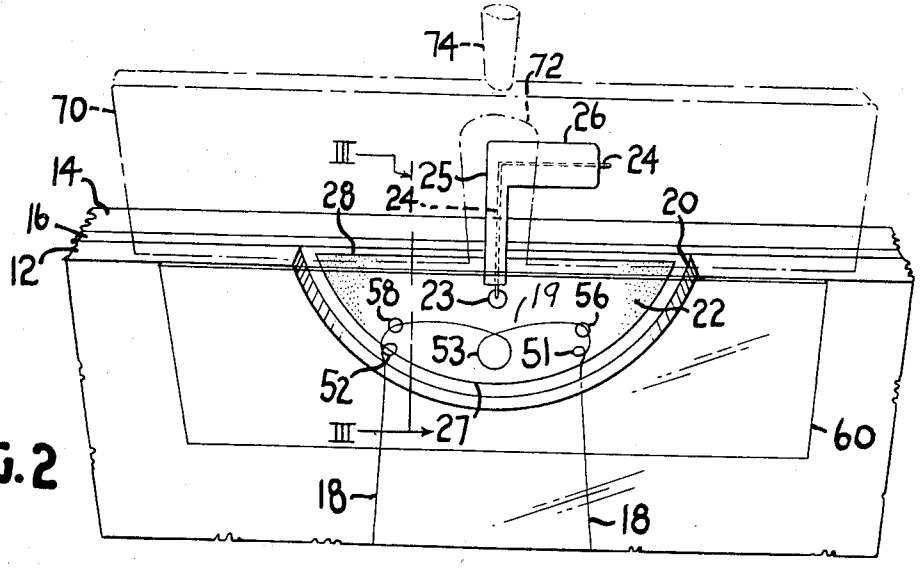


FIG. 2

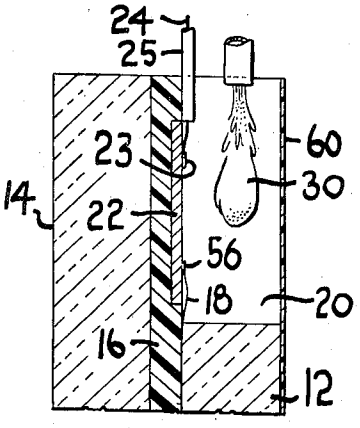


FIG. 3

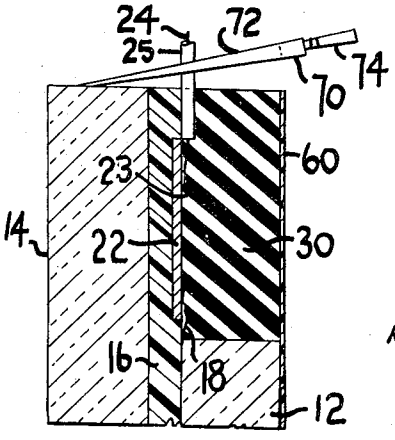


FIG. 4

INVENTOR
RODGER V. ZAWODNIAK

Charlton and Spencer
ATTORNEYS

ANTENNA WINDSHIELD

RELATION TO OTHER APPLICATIONS

This application is a continuation-in-part of application Ser. No. 773,805 of Rodger V. Zawodniak, filed Nov. 6, 1968, now U.S. Pat. No. 3,543,272.

BACKGROUND OF THE INVENTION

This invention concerns an antenna windshield. Prior to the present invention, the automobile industry developed laminated windshields comprising a pair of matched glass sheets laminated to opposite sides of a plastic interlayer in which a plurality of electroconductive wires are embedded in the plastic interlayer to serve as an antenna for a radio installed in the vehicle. The embedded wires were each connected to a common conductor plate that is in turn connected to the radio receiver.

Using the laminated windshield to support the antenna has improved the styling of automobiles by eliminating the whip antenna that extended from the vehicle body. Its use has also avoided a source of vandalism—the snapping of the antenna from the automobile.

Since automobile windshields require a lot of handling before they are installed in an automobile, it is very likely that as many as 10 percent of antenna windshields have electrical connections that become damaged from the time the windshields are assembled in a fabrication plant to the time the windshields are installed in an automobile. It is necessary to have the wires embedded within the windshield to extend substantially the full height and substantially the full length of the windshield to provide an antenna substantially equal in performance to the performance of the conventional whip antenna in its fully extended position. Therefore, any failure of an electrical connection of one or more of the antenna wires to the common plate or tab attached to the lead-in wire for the radio receiver causes the antenna to function in an inefficient manner.

The invention disclosed and claimed in the above-identified U.S. Pat. application Ser. No. 773,805 provides an arrangement of antenna wire such that antenna failure is virtually eliminated even though an electrical connection between the antenna wire and the common plate electrically connected to the radio receiver is broken.

The above objective of the above invention is accomplished by utilizing a single continuous electroconductive wire mounted in the plastic interlayer of a laminated windshield with the central portion of the wire extending outside of the interlayer. A pair of spaced electrical connections connect linearly spaced portions of the central portion of the single, continuous antenna wire outside said interlayer and within said noticed portion to a metal tab electrically connected to the radio receiver in such a manner that loose lengths of said wire are disposed between said pair of electrical connections and also between each of the said pair of electrical connections and the portion of said continuous wire that enters the interlayer.

THE PRESENT INVENTION

It is extremely important that the antenna wire and the metal tab to which the wire is electrically connected to be electrically insulated from the automobile body including the frame in which the antenna window is installed. The present invention accomplishes this object by properly orienting a laminated windshield with its notched portion containing the looped portion of antenna wire in an upward facing position, attaching the wire to the tab and enclosing the side of the notched portion facing an operator with some transparent insulating material, such as a section of any transparent tape adherent to glass, such as polyurethane, polyethylene, etc., that forms a chamber that receives a flowing, fast setting resin of electrically insulating material. The transparent wall facing the operator enables the latter to see whether the exposed metal parts are maintained in spaced relation to the edge of the windshield when the notched portion is filled, and also whether the filling is done without voids.

The present invention will be understood more clearly in the light of a description of a particular embodiment which follows.

In the drawings forming part of the description of the illustrative embodiment, and wherein like reference numbers refer to like structural elements;

FIG. 1 is a fragmentary, perspective view of an antenna windshield in the process of its fabrication, showing how it is oriented for a critical process step;

FIG. 2 is an enlarged view of a critical portion of said windshield depicted in FIG. 1 showing in phantom how a subsequent processing step is accomplished; and

FIGS. 3 and 4 are enlarged sectional views taken along the lines III—III of FIG. 2, showing steps in the processing of antenna windshields according to the present invention.

Referring to the drawings, reference number **11** refers to a laminated windshield comprising an outer glass sheet **12**, an inner glass sheet **14** of matching curvature and an interlayer sheet **16** of thermoplastic material, preferably plasticized polyvinyl butyral, which is commonly found in present day commercial windshields. In the usual automotive windshield, the outer and inner glass sheets **12** and **14**, respectively, are curved and have an outline conforming to the windshield frame in which the laminated windshield is installed. An elongated wire **18** is embedded within the interlayer **16** except for a central portion **19** which extends beyond the outline of the interlayer sheet for folding into a notched portion **20** along a longitudinal lower side edge of the outer glass sheet **12**.

The wire **18** is preferably a 36-guage copper wire encased in an enamel sheath and has a maximum diameter of 0.005 inch so as to be virtually invisible to an occupant. It is arranged in the laminated windshield in symmetrical arrangement relative to an axis extending transversely across the midpoint of the windshield.

A metal tab **22**, preferably a thin shim of copper about 10 mils thick connected at **23** to a lead-in wire **24** which terminates in a plug **26**, is inserted within the notched portion of the outer glass sheet **12**. The lead-in wire **24** is insulated except for its extremity portion that is connected to the metal tab **22** to which it is securely welded or soldered or otherwise securely fastened sufficiently strongly to withstand a pull of more than 25 pounds without failure.

The interlayer sheet **16** has the wire **18** embedded therein by using the apparatus depicted in FIG. **3** and **4** of U.S. Pat. application Ser. No. 773,805, filed Nov. 6, 1968, of which the present application is a continuation-in-part. An elongated wire is passed through a hot needle and the needle moved along a template to imbed the wire **18** into the interlayer sheet **16**. The heat of the needle causes the wire fed through the needle as the latter traverses the template to penetrate into the sheet of interlayer material along a path conforming to the shape of the template so that substantially the entire length of the wire except for its central portion **19** is embedded within the trimmed interlayer and the portion **19** forms a loop exterior to the interlayer. In order to accomplish this end, an operator lifts the needle from the sheet **16** as it approaches an edge portion of the interlayer destined to face the notched portion **20** of the outer glass sheet **12** and forms a loop of antenna wire material before returning the looped wire **18** into the sheet after the latter has completed its turn around a turnaround guide and started to move along a transverse return path. A cam may be provided to control the movement of the needle out of and into the plastic sheet **16** forming the interlayer.

In forming a laminated antenna windshield, a pair of glass sheets of matching outline is mounted on a bending mold of outline configuration and concave elevation and the glass is heated sufficiently to sag onto the shaping surface. A suitable parting material, such as a suspension of finely divided diatomaceous earth in water, is applied to the interfacial surface between the two sheets to prevent the sheets from fusing together during the bending operation. After the sheets are

bent, they are cooled at a controlled rate while still supported on the bending mold and then removed from the mold when cool enough to handle.

The sheets of plastic containing the embedded wire are stored in a room of controlled temperature and humidity until they are ready for lamination between a pair of bent glass sheets of matching curvature. The bent pair of matching glass sheets are then separated from one another. The unnotched glass sheet **14** is mounted with its concave surface downward over a support of convex elevation. The plastic sheet is then inserted over the glass sheet **14** that is not notched and the notched glass sheet **12** aligned over the plastic interlayer sheet **16**. The plastic interlayer sheet is trimmed with the loop **19** of exposed wire **18** carefully held to prevent its being cut during the plastic trimming operation. The glass-plastic assembly so formed is prepressed and laminated following conventional commercial practice. A preferred prepressing apparatus used is described and claimed in U.S. Pat. No. 3,351,001 to Anthony A. Achkio, assigned to PPG Industries, Inc.

The prepressed assemblies are later laminated in autoclaves at a temperature of about 275° F. and a pressure of about 225 pounds per square inch for about 45 minutes.

After prepressing and before final lamination, a shim **22** of a highly conductive metal such as copper having a lead-in wire **24** and a plug **26** for a radio receiver attached thereto and having a curved inner edge **27** matching the curvature of the arcuate inner wall of the notched portion **20** and a straight outer edge **28**, is pressed against the portion the interlayer sheet **16** that faces the notched portion **20** of notched sheet **12**. The central portion **19** of the wire **18** is then folded to form a pair of relaxed portions **51** and **52** and additionally twisted to form loop **53** intermediate the two relaxed portions **51** and **52** so that the entire central portion **19** of the wire **18** fits within the straight outer edge **28** of the metal shim or tab **22** within the notched portion **20** of the sheet **12** that lies over the interlayer sheet **16**. The metal shim or tab **22** is narrower than the width of the notched portion **20** to insure that when the wire **18** is fit within the desired area that it is entirely spaced inward from the edge of the prepressed assembly. The wire **18** is then electrically connected to the metal tab **22** at a solder or welding connection **56** which is intermediate relaxed portion **51** and loop **53** and at another solder or welding connection **58** which is intermediate relaxed portion **52** and loop **53**.

The electric circuit so formed is then tested. The plug **26** is inserted in a testing circuit for this test. This indicates whether a signal from the embedded wire will reach a radio circuit in sufficient strength to provide adequate reception.

The assembly is mounted on a rack and oriented with the notched portion **20** facing upward and masking tape applied to the unnotched sheet **14** in its portion aligned with and slightly beyond each end of the notched portion **20**.

An adhesive transparent tape of an electrically nonconductive material such as a transparent polyurethane tape **60** is then applied to the outer surface of the glass sheet **12** along sufficient area to insure adequate adhesion to the outer surface and to form a wall for the chamber formed by the notched portion in the sheet **12** in its region extending between the adhered regions. A suitable fast setting electrical insulating material **30**, such as a fast setting polysulfide resin sold under the trade name "Thiokol" by the Thiokol Chemical Company of Bristol, Pennsylvania or a room temperature vulcanizable silicone such as 615 RTV silicone supplied by the General Electric Company, Schenectady, New York or Scotchcast 225 electrical resin sold by the Minnesota Mining and Manufacturing Company, St. Paul, Minnesota, is injected molded into the recess **20** as depicted in FIG. **3**. The masking tape is removed, thereby removing any excess resin and leaving only the transparent polyurethane tape wall enclosing the injection molded material in the notched portion **20**.

A spatula **70** provided with an elongated slot **72** to provide clearance for the lead-in wire **24** and having a handle **74** as depicted in phantom in FIG. **2** and in full lines in FIG. **4**, is scraped along the upper edge of the assembly to remove any excess electrical insulating material **30** before the latter sets. If one is careful in applying the filler material **30** for the molded notched portion **20**, the masking tape need not be used. It is preferable that the masking tape be omitted so that an operator can observe more readily how the recessed portion is filling up with the quick setting material **30**. This insures that the wire **18** and the tab **22** is kept from electrical contact with the vehicle body in which the antenna windshield is installed.

The assembly is then kept in a storage area with other assemblies for sufficient time for the injection molded material to harden. Then the assembly is ready for the aforesaid lamination.

In an illustrative embodiment of this invention, the notched portion **20** of the notched glass sheet is about 2¼ inches long along its straight outer edge and gradually increases in width to about three-eighths inch at its widest portion. The metal tab **22** is about 1⅛ inches long and one-eighth inch wide. This permits the metal tab to be spaced about one-fourth inch inside the edge of the windshield **11**. A continuous strip of transparent polyurethane tape **60** about 1 inch wide and about 4 inches long insures adequate adhesion to the outer surface of notched glass sheet **12** in a portion inclosing the notched portion **20**, and also forms a wall for the notched portion.

Usually, the wire **18** is supplied with a coating of electrical insulation. In such a case, a razor blade is used to strip the insulation from the exposed 2 inches of the central portion **19** only. This step is preferably done after the prepressing and immediately before twisting the trimmed portion. The trimmed and twisted central portion **19** thus makes good electrical connection directly to the surface of the metal tab **22** in spaced relation to the edge of the assembly adjacent the notched portion **20**. Since a transparent tape **60** is used as a wall to enclose the notched portion during filling with electrical insulation material **30**, an operator can see that the electroconductive parts are well within the recessed portion **20** when the latter is filled. The ability to observe that the exposed 2 inches of length of the central portion **19** of the antenna wire **18** in direct electrical contact the metal tab and the tab are in spaced relation to the edge of the assembly avoids energy losses in the antenna system previously experienced in the prior art when the inability of an operator to observe that either the wire **18** or the tab **19** was in position to be exposed to direct contact with the vehicle frame or close enough to form a capacitive coupling that caused energy losses left no possibility of avoiding this cause of failure.

Other antenna windshields using opaque tape such as metal foil or reinforced fiberglass as a wall for the notched portion facing the operator do not permit the operator to see that the antenna wire and tab are retained in sufficiently spaced relation to the frame of the vehicle in which the antenna windshield is to be installed. The inability of the operator to observe what transpires during the application of the fast-setting electrical-insulating material into the notched portion is believed to be the reason for less reliability of other constructions that do not use a transparent wall for the notched portion.

The form of the invention shown and described in this disclosure represents an illustrative embodiment thereof. It is understood that various changes, such as changes in materials of the interlayer, wire, tab and glass sheet compositions and manner of attachment of the wire to the tab, for example, may be made without departing from the spirit of the invention as defined in the claimed subject matter that follows.

What is claimed is:

1. A laminated antenna window comprising a pair of matched glass sheets, one of which is notched to provide a notched portion along one of its longitudinal side edges to receive a metal tab electrically connected to an insulated wire adapted to be connected to a radio receiver, a plastic interlayer bonded between said sheets and electroconductive wire mounted in said plastic interlayer for use as a radio antenna for said radio receiver, said metal tab being smaller than said notched portion, a portion of said electroconductive wire

being in said notched portion, said electroconductive wire and said metal tab being spaced from the edge of said window, means in spaced relation to said edge for connecting said wire to said metal tab, a transparent, adherent tape of electrical insulation material larger than said notched portion adhered to an outer surface of said notched glass sheet in a region inclosing said notched portion to provide an outer, transparent wall for said notched portion in a region of said tape extending between adhered parts of said inclosing region, and a fast-setting electrical-insulating material within said notched portion for maintaining said tab and said portion of electroconductive wire in spaced relation to said edge.

2. A window as in claim 1, wherein said fast-setting electrical-insulating material is a polysulfide resin.

3. A window as in claim 1, wherein said fast-setting electrical-insulating material is a vulcanizable silicone.

4. In a method of fabricating an antenna windshield comprising an assembly comprising a pair of glass sheets, one of which has a notched portion along a longitudinal edge thereof and a plastic interlayer having electroconductive wire embedded therein, said interlayer being between said glass sheets, a portion of said wire extending outward of said interlayer within said notched portion and a metal tab having an insulated wire attached thereto disposed within said notched portion, the improvement comprising attaching said wire portion to said metal tab within said notched portion, maintaining said metal tab and said wire portion in spaced relation to said longitudinal edge, mounting said assembly with said notched portion facing upward, applying a transparent tape of electrical insulation material larger in size than said notched portion to the outer surface of said notched glass sheet in a region inclosing said notched portion in such a manner that a portion of said tape forms a transparent wall for said notched portion facing an operator, maintaining said tab and said wire portion in said notched portion in spaced relation to said longitudinal edge, applying a fast-setting electrically insulating material into said recessed portion within said transparent wall of tape thus formed while said assembly is so mounted, and observing through said transparent wall that the electroconductive elements remain in spaced relation to said longitudinal edge during said application of said fast-setting electrically insulating material.

5. The improvement as in claim 4, further including the step of scraping a slotted spatula along said longitudinal edge with the slot of said slotted spatula surrounding said insulated wire to remove excess fast setting material while maintaining said wire portion and said metal tab in spaced relation to said edge.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,638,225 Dated January 25, 1972

Inventor(s) Rodger V. Zawodniak

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 53 - after the word "said" the word "noticed" should be --notched--.

Signed and sealed this 3rd day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,638,225 Dated January 25, 1972

Inventor(s) Rodger V. Zawodniak

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 53 - after the word "said" the word "noticed" should be --notched--.

Signed and sealed this 3rd day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334