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Bobel, II et al.

[11] **3,818,489**

[45] **June 18, 1974**

[54] **ANTENNA WINDSHIELD WITH ELECTRICAL CONNECTOR AND METHOD OF PRODUCING THE SAME**

[75] Inventors: **Robert J. Bobel, II; Robert B. Kimura,** both of Toledo, Ohio

[73] Assignee: **Libbey-Owens-Ford Company,** Toledo, Ohio

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[21] Appl. No.: **299,624**

[52] **U.S. Cl.** **343/713,** 343/906

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

[58] **Field of Search** 343/711, 712, 713, 906

[56] **References Cited**

UNITED STATES PATENTS

3,579,243	5/1971	Dickason et al.	343/713
3,618,102	11/1971	Dickason et al.	343/713
3,680,132	7/1972	Tolliver	343/713

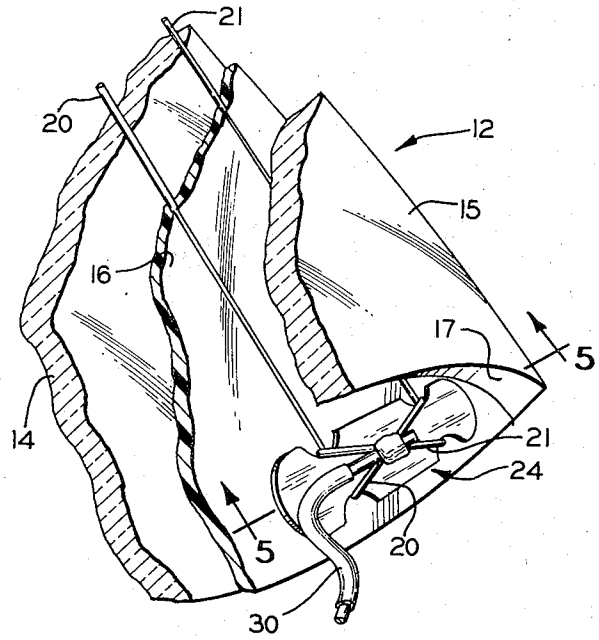
Primary Examiner—Eli Lieberman

Attorney, Agent, or Firm—Collins, Oberlin & Darr

[57] **ABSTRACT**

An automobile windshield of laminated safety glass with an indentation in the lower edge of its outboard glass sheet, and provided with an antenna carried by its plastic interlayer that terminates in a pair of parallel, vertically disposed, wire elements wrapped around and soldered to an elongated metal connecting tab that is adhered to the interlayer within the area of the indentation in the glass edge; and a method of producing such an antenna-windshield structure.

6 Claims, 12 Drawing Figures



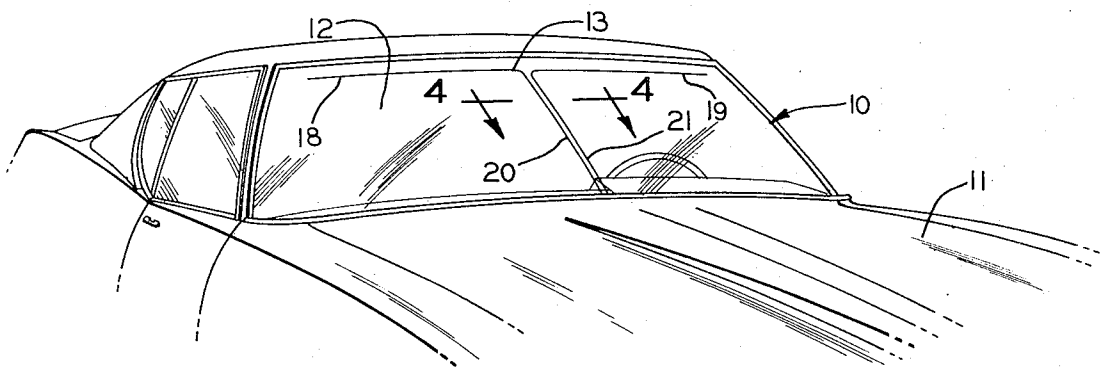


FIG. 1

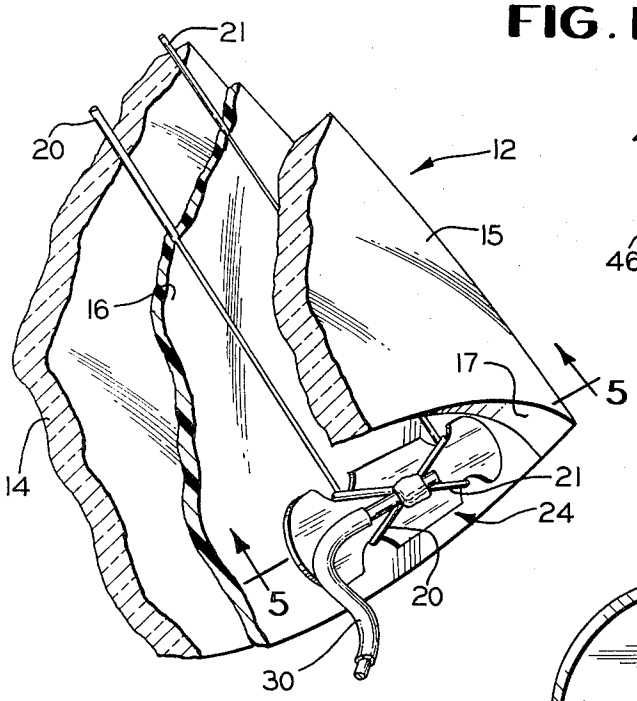


FIG. 2

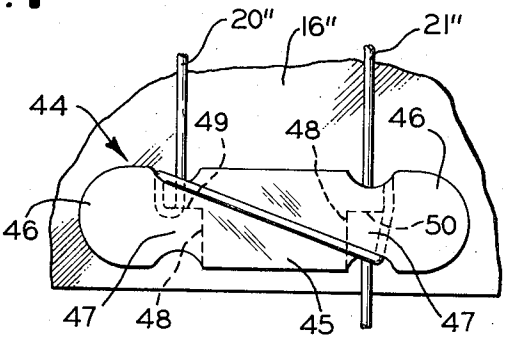


FIG. 12

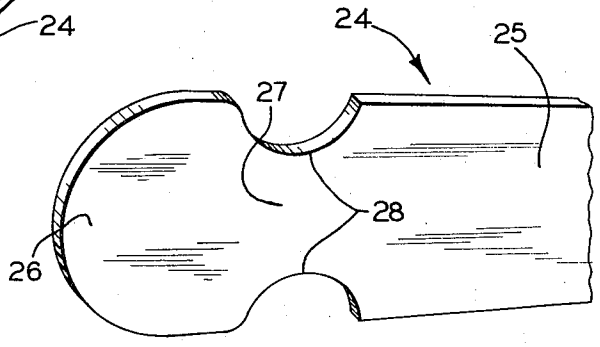


FIG. 3

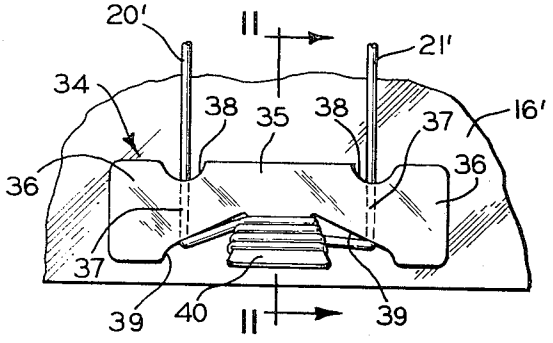


FIG. 10

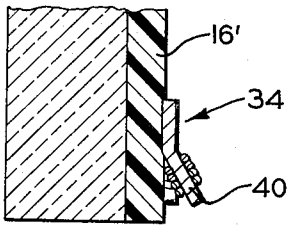


FIG. 11

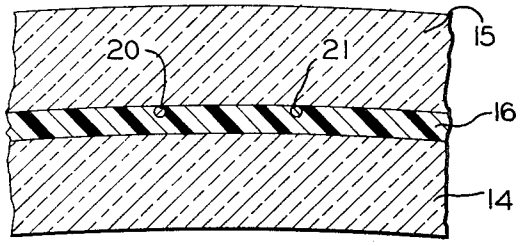


FIG. 4

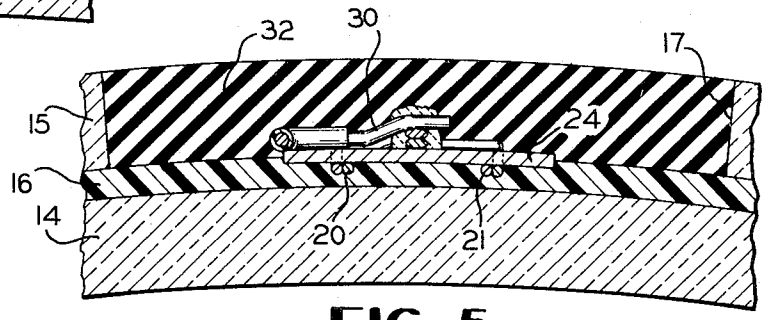


FIG. 5

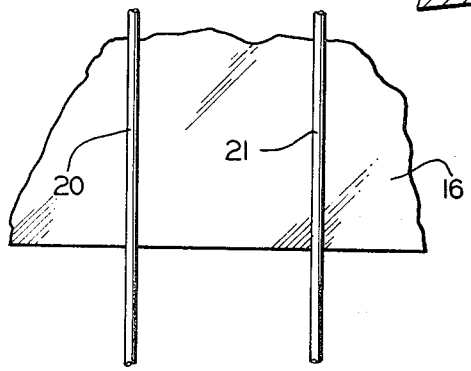


FIG. 6

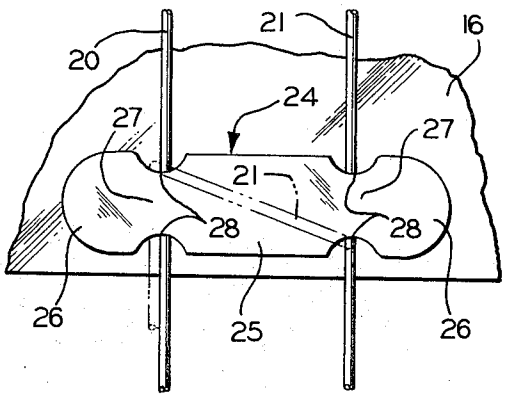


FIG. 7

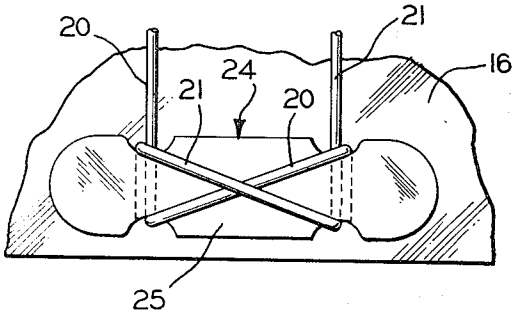


FIG. 8

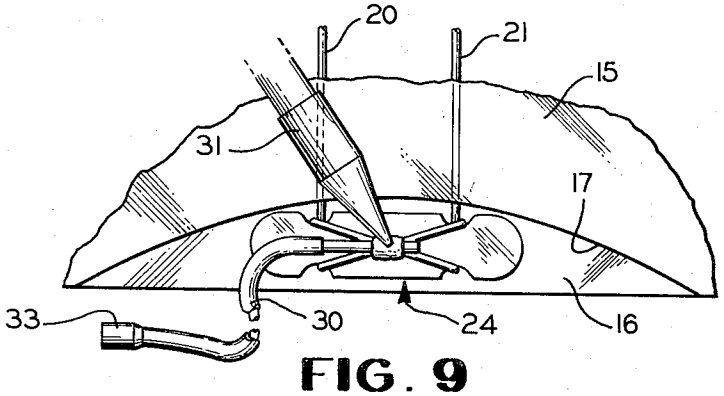


FIG. 9

ANTENNA WINDSHIELD WITH ELECTRICAL CONNECTOR AND METHOD OF PRODUCING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates broadly to laminated safety glass windshields that are provided with built-in radio antennas, and more particularly to improvements in the connections between the antennas of such windshields and the radios in their automobiles.

2. Description of the Prior Art

Recently antenna windshields have come into wide use in automobiles, and appear to be eliminating the need for the familiar but troublesome buggy-whip type aerials. Although the built-in antennas of the antenna windshields can take various forms, the one that has been most commonly accepted is made up of a pair of fine wire conductors disposed in a pattern of inverted, reversely symmetrical, L-shapes such as disclosed in U.S. Pats. Nos. 3,576,576 and 3,673,044, and has provided adequate reception in use.

However, one problem that has been encountered is in providing an electrically satisfactory and readily makable connection between the antenna in the windshield and the radio in the automobile.

SUMMARY OF THE INVENTION

According to the present invention there is provided a completed windshield antenna structure of a character that is technically and commercially acceptable to both the automotive inductry and its customers and that, at the same time, lends itself readily to production line installation on both stock and custom built automobiles.

Thus, a primary object of the invention is the provision of a structure of this character that can be rapidly produced to rigid specifications at a minimum of cost.

Another object is to provide such a structure that will function satisfactorily for its intended purpose, and that can be mounted in an automobile and electrically connected to the radio system more easily and permanently than prior known structures.

Further 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 according to the invention;

FIG. 2 is a quasi perspective, fragmentary, side view of the connecting area of the antenna windshield of FIG. 1, with portions broken away or removed to show the connecting tab and associated parts more clearly;

FIG. 3 is an enlarged perspective view of one end of the connecting tab of FIG. 2;

FIG. 4 is a fragmentary sectional view taken substantially along the lines 4—4 in FIG. 1;

FIG. 5 is a fragmentary sectional view taken substantially along the line 5—5 in FIG. 2;

FIG. 6 is a fragmentary plan view of an area of a plastic interlayer sheet showing the terminal ends of parallel antenna wires laid therein;

FIG. 7 is a view similar to FIG. 6, after the connecting tab has been positioned across the antenna wires and preliminarily heat-sealed to the plastic interlayer sheet;

FIG. 8 is a view similar to FIGS. 6 and 7 after the antenna wires have been wrapped around the connecting tab;

FIG. 9 is a similar view of the lead wire being soldered to the crossed antenna wires on the connecting tab;

FIG. 10 is a view similar to FIG. 8 but showing a modified form of tab;

FIG. 11 is a vertical, sectional view taken substantially along the line 11—11 in FIG. 10; and

FIG. 12 is a view generally similar to FIGS. 8 and 10 showing still another form of tab and wrap.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to the drawings, there is illustrated in FIGS. 1 and 2 a complete antenna-windshield structure 10 of the general character contemplated by the invention, mounted in a conventional manner in an automobile 11, and comprising a laminated safety glass windshield 12 with a built in antenna 13.

As shown in FIGS. 2, 4 and 5 the windshield 12 is 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 or opening 17 (FIGS. 2 and 5) in the finished windshield.

The antenna portion 13 of the structure 10 is contained between laminae of the windshield 12 and may be made up, first, of fine wire elements which preferably include both horizontal wire elements 18 and 19 and vertical wire elements 20 and 21. The horizontal wire elements are located as near the upper edge of the windshield as consistent with adequate performance, for example from 1½ to 2 inches, and so are positioned well out of the critical sight areas in the windshield. Consequently, where a shade band is incorporated in the windshield, or where sun visors are used, these parts of the antenna will be completely hidden.

Similarly, the vertical wire elements 20 and 21, which may be approximately ½ inch apart, 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 wire elements also function as part of the special means for connecting the antenna-windshield structure to the radio than is an important feature of the invention.

Thus, as can be seen in FIGS. 2 and 4 through 9, vertical wire elements 20 and 21 extend downwardly from the inner ends of the horizontal wire elements 18 and 19 respectively toward the bottom edge of the windshield and, as best shown in FIGS. 2, 5 and 7 to 9, there is also provided between the laminae, and in alignment with the indentation 17 in the outboard lite of glass 15, a thin, flat, elongated metal plate or tab 24 under which

the wires **20** and **21** extend, around which they are wrapped, and to which they are soldered or otherwise permanently secured.

At this point it may be explained that, while the present invention is in no way limited to any specific method or apparatus for producing the windshield-antenna structure thereof, one suitable and relatively simple procedure for doing so involves securing the antenna **13**, including the connecting tab or plate **24**, to or incorporating them in the plastic sheet that is to become the interlayer **16** before laminating it to the glass. This can be done for example by, first, embedding the wire elements of the antenna **13**, under heat and pressure, into the surface of the plastic sheet on the side that will face the outboard sheet of glass **15** in the finished windsheield (FIGS. **2** and **4**) but leaving their lower ends free and extending out beyond the plastic sheet (FIG. **6**); next, superimposing the connecting tab **24**, which may be of thin sheet copper or steel and is preferably phalange or digital bone shaped in outline, symmetrically over the wire elements **20** and **21**; and heat sealing or otherwise bonding the mid portion of the tab, that lies between the wires, to the plastic sheet (FIG. **7**).

More precisely the tab or plate **24**, as illustrated in FIGS. **3** and **7**, comprises a substantially rectangular middle portion **25**, with generally semi-circular end portions **26** connected thereto by necks **27** formed by substantially semi-circular cuts **28**; and the rectangular middle portion **25** of the tab can be heat sealed to the plastic sheet by the application of approximately 30 pounds pressure and a temperature of around 300° F. for about 4 seconds.

The loose end of the wire element **21**, for example, is then wrapped upwardly, over and across the exposed surface of the mid portion of the tab **24**, and down behind the neck portion, as indicated in broken lines in FIG. **7**; after which the surplus length of the wire is cut off by a sharp upward tug against the lower edge of the curved neck of the connecting tab. Then the same thing is done with the loose end of the wire element **20** to leave the elements **20** and **21** crossed over one another at the center of the exposed surface of the rectangular portion **25** of the tab (FIG. **8**).

The plastic sheet or interlayer **16**, with the antenna wires and connecting tab incorporated therewith, is then assembled with two sheets of glass **14** and **15**, and with the tab **24** in proper registry with the indentation **17** in the outboard sheet of glass **15** (FIGS. **2**, **5** and **9**). The resulting assembly is then subjected to conventional prepressing procedures, usually involving roller pressing first at room temperatures and again after the assembly has been heated at around 150° F. This is preferably followed by a localized pressing over the entire area of the connecting tab **24**, and against the portions of the interlayer **16** and of the glass sheet **14** that are in alignment therewith, while the assembly is still at the prepressing temperature. Such a procedure, which may be performed by the use of air actuated, sponge rubber faced, opposed clamping members, insures the entire area of the connecting tab **24** being tightly bonded to the plastic interlayer **16** prior to the subsequent and final laminating treatment of the glass-plastic assembly in an oil autoclave.

Either before or after autoclaving, a suitable pigtail or lead wire **30** (FIG. **9**), which may be of tinned copper and suitably insulated, is soldered to the crossed wires **20** and **21** and, together with them, to the connecting tab **24** by a single high temperature soldering operation employing a soldering iron **31**. To insure "burn-off" of the lead wire insulation and faster set up of the solder, a solder alloy comprising 0.75% tin, 97.5% lead, 1.75% silver, and a suitable flux, such as Kester 1544, may be used with a metal temperature of from 900° to 1,000° F.

The final step of the procedure is to fill the indentation **17** in the glass and to cover the connecting plate and wires, with a heat and moisture resistant plastic sealing compound **32** such as "Thiokol" (FIG. **5**), after which the resulting windshield-antenna structure is ready for use 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 by providing the lead wire **30** with a suitable electrical connection, such as one half of a plug type fixture **33**, installation of the device can be completed by simply plugging the connector **33** into the radio of the automobile.

In lieu of the preferred form of tab, which has been designated **24** and described in detail above, other specifically different forms may be employed and, indeed, may offer other or additional advantages. For example, the middle and end portions of the tab could be connected by other than the relatively narrow neck portions **27**. Similarly, there is shown in FIG. **10** a tab **34** of the same general character as the tab **24** but which is of still different outline and is of lesser area.

Thus, the tab **34** comprises a middle portion **35**, with curvilinear end portions **36** connected thereto by neck portions **37** that are formed by substantially semi-circular or concave upper cuts **38** and lower cuts **39**. Besides assisting in creating the neck portions **37**, the cuts **39** also create a downward extension **40** from the middle portion **35**, which extension can be bent outwardly away from the body of the tab **34** as shown in FIG. **11**.

The procedure for sealing the tab **34** to a plastic interlayer **16'**, to be used in a laminated glass structure, and for wrapping the loose ends of parallel, vertical antenna wires **20'** and **21'** around the tab are similar to that described for the tab **24**, as are the remaining steps necessary to incorporate the wound tab into the laminated structure and to provide suitable means for facilitating its connection to the automobile radio.

However, with the tab **34**, instead of first sealing the middle portion and subsequently sealing the end portions to the interlayer, the entire tab, (except for the outwardly bent portion) can be sealed by the heat and pressure to the interlayer **16'** as soon as it has been placed over the wires **20'** and **21'**. Immediately thereafter (FIGS. **10** and **11**), the uncovered end of first one and then the other of the wires **20'** and **21'** are brought over and wrapped, preferably twice, around the outwardly bent extension **40** and broken off by a sharp tug against its edge.

With this arrangement the wires that are wrapped around the tab will not necessarily be in crossing, although they will always be in contacting, relationship; and, as described in connection with the tab **24**, can have a pigtail or connecting wire soldered to the contacting wires **20'** and **21'** and, together with them, to the connecting tab **34** by a single soldering operation.

Another desirable modification is illustrated in FIG. 12 wherein a tab 44, of the same form as the tab 24 of FIGS. 2 through 9, and having a similar mid portion 45 and end portions 46 connected thereto by necks 47, is located on a plastic sheet 16'' and in the same relation to antenna wires 20'' and 21'' carried thereby as was the tab 24. Here, however, instead of initially sealing only the rectangular mid portion 45 of the tab 44 that lies between the wires 20'' and 21'', the portion of the tab 44 that is initially heat sealed to the plastic sheet 16'' includes, along with the mid portion 45, portions of the necks 47 to provide an adhered or sealed area outlined by broken lines 48 and which includes extensions 49 and 50 from the mid portion 45, which extensions seal the wires 20'' and 21'' between the tab 44 and the plastic sheet 16'' and bond them thereto.

The loose end of the wire 20'', for example, is then wrapped parallel to the tab 46 around the seal at the extension 49, then downwardly across the exposed face of the tab 44 to the low side of the opposite neck 47, then under this neck of the tab, after which the excess length of the wire is broken off by a sharp tug outwardly and downwardly against the sharp upper side of the neck of the tab. The loose end of the other wire, 21'' in this case, is then wrapped in a reverse manner around the seal at the extension 50, across the exposed face of the tab 44, and behind the opposite neck portion 47 before tugging it outwardly and downwardly to break off the surplus. Thereafter, the completion of an antenna windshield incorporationg the tab 44 in the arrangement illustrated in FIG. 12, and the soldering of the crossed wires 20'' and 21'', will be the same as that described in connection with the tab 24.

Other, and specifically different shapes of connecting tabs can be envisiond for obtaining a variety of specifically differing results. For example, by employing the undercuts 28 at the bottom only of the tabs 24 or 44 in creating the necks 27 or 47, the undercut may be made much deeper. This will have two advantages, the first being that the wrapped wires will be farther upward away from the bottom edge of the laminated structure, and the second that total area of the tab will be less, with correspondingly less capacitance to ground.

The latter feature is also provided by the tab 34 which, in addition, permits faster heat up in the solder area; and both the tabs 34 and 44 exhibit increased resistance to wrapped wire and pigtail pull, the former because of the presence of the extension 40, and the latter because of the service loop in the wires around the extensions 49 and 50 in the initial seal.

Accordingly, 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, arrangement and character of the parts as well as various procedural changes may be resorted to without departing from the spirit of the invention as defined in the following claims.

We claim:

1. In a laminated safety glass windshield, comprising alternate sheets of glass and plastic bonded together in face-to-face relation and having a radio circuit supported on one of said sheets, which circuit includes horizontally disposed wire elements with spaced, parallel, vertically disposed wire elements extending downwardly therefrom; the improvement in which an elongated connecting tab having a middle portion, opposite end portions, and portions connecting said end portions to said middle portion is disposed across and in contact with said vertically disposed wire elements, and each of the wires of said spaced, parallel, vertically disposed elements is wrapped over an edge of one of said connecting portions of said tab while in spaced relation to the other wire of said elements and extends therefrom toward said other wire and is then wrapped around the other connecting portion of said tab.

2. A laminated safety glass windshield as defined in claim 1, in which said circuit is supported on and embedded into a surface of a plastic interlayer sheet; said tab is bonded to said interlayer sheet with said vertically disposed wire elements therebetween; each of said wrapped wires passes under one of said connecting portions adjacent one end of said tab then across the face of said tab in crossing relation to the other and over and behind the connecting portion adjacent the opposite end of said tab, and terminates adjacent an edge of said tab; and a lead wire is electrically connected to said wires and to the face of said tab where said wires are in said crossing relation.

3. In a method of producing an antenna windshield structure which is made up of alternate sheets of glass and plastic bonded together in face-to-face relation and has a radio circuit that includes spaced, parallel, vertically disposed wires supported on one of said sheets, the steps of supporting said circuit on said sheet with the ends of said vertically disposed wires unattached to said sheet adjacent its lower edge, locating an elongated metal connecting tab having a middle portion, opposite end portions, and portions connecting said end portions to said middle portion across said wires on said supporting sheet, bonding said middle portion of the tab to the surface of said supporting sheet between said wires, and wrapping the loose ends of each of said spaced wires first over an edge of one of said connecting portions of said tab then across the face of the middle portion of the tab and over and behind an edge of the opposite tab connecting portion to cross each other on the face of said tab.

4. A method as defined in claim 3, in which said supporting sheet is a sheet of plastic, said circuit is embedded in a surface of said supporting sheet, the portion of said tab lying between said parallel wires is heat sealed to said supporting sheet before wrapping said wires and the end portions of said tab are heat sealed to said supporting sheet after wrapping said wires.

5. A method as defined in claim 3, in which a lead wire is soldered to said wrapped wires and to the face of said tab where said wires cross each other by a high temperature soldering operation.

6. In a method of producing an antenna windshield structure which is made up of alternating sheets of glass and plastic bonded together in face-to-face relation and has a radio circuit that includes spaced, parallel, vertically disposed wires supported on one of said sheets, the steps of supporting said circuit on said sheet with the ends of said vertically disposed wires unattached to said supporting sheet adjacent its lower edge, locating an elongated metal connecting tab having a middle portion, opposite end portions, and portions connecting said end portions to said middle portion across said wires on said supporting sheet, said tab also including an extension projecting outwardly from said middle portion and out of the plane of the supporting sheet, bonding said tab other than said extension thereof to the surface of said supporting sheet, and wrapping the loose ends of each of said spaced wires to said tab by passing said wires from under said connecting portions of said tab and then toward each other and wrapping them around said outwardly projecting extension and in contact with each other.

* * * * *