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Bode

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[54] HEATED WIPER BLADE

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[52] **U.S. Cl.**.....**15/250.06,** 15/250.36

[51] **Int. Cl.**.....**B60s 1/04**

[58] **Field of Search**.....15/250.05, 250.06, 250.07, 15/250.08, 250.09, 250.36, 250.42

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Primary Examiner—Peter Feldman
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[57] **ABSTRACT**

A blade for window wipers and the like wherein an electrical resistance element extends therethrough for heating the wiping lip; said electrical resistance element being characterized by a thin membrane comprised of flat plate sections joined by flexible coupling sections and thereby adapted to be independently bendable within the wiper blade body and all without distortion of said body which remains universally bendable to conform to the changing compound curvatures over which it is to wipe; and said membrane having maximum heat transfer and reinforcing features as related to the wiper blade body for a most direct and effective heat transfer to the working surface that is to be defrosted and wiped clean.

9 Claims, 8 Drawing Figures

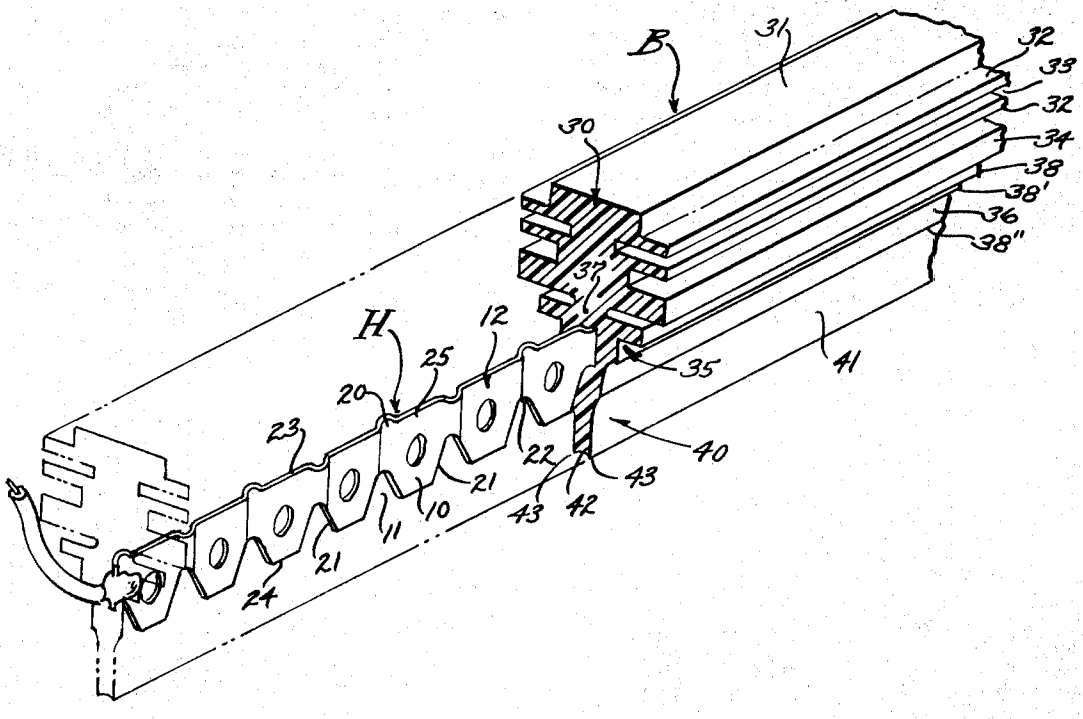


FIG. 1.

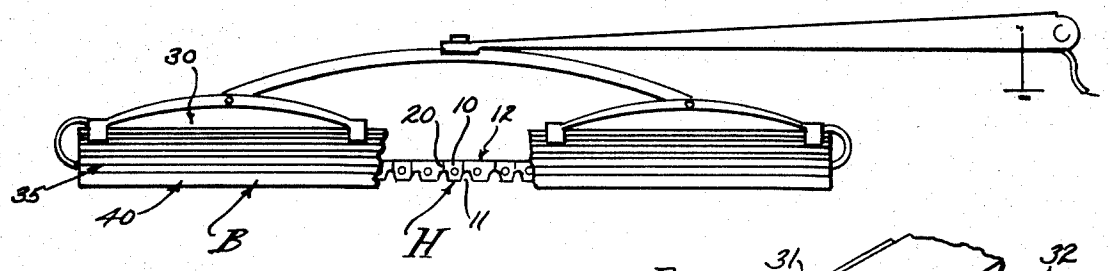


FIG. 2.

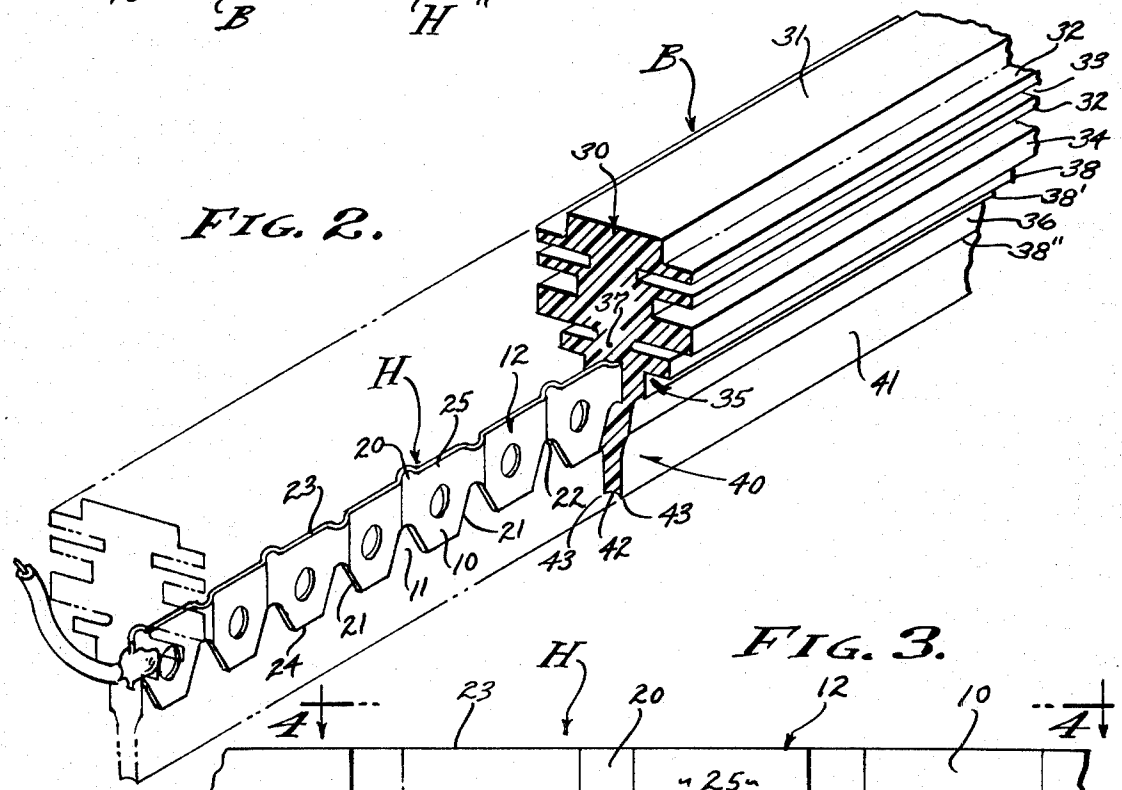


FIG. 3.

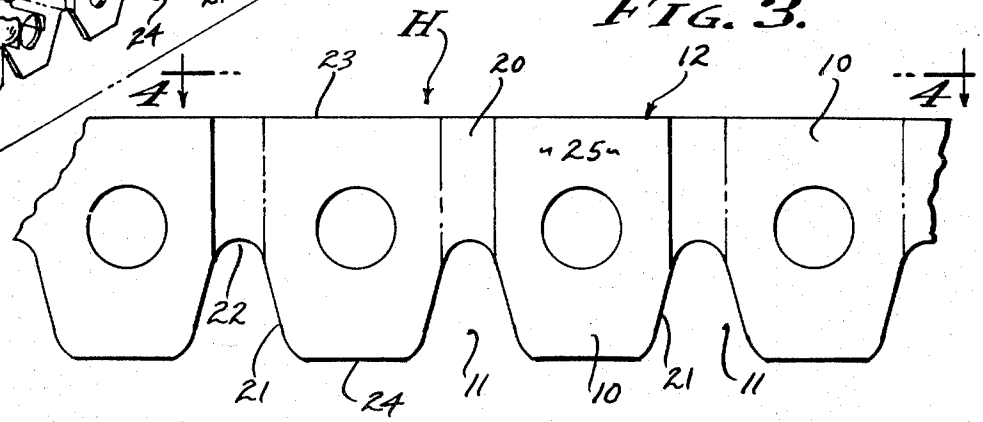
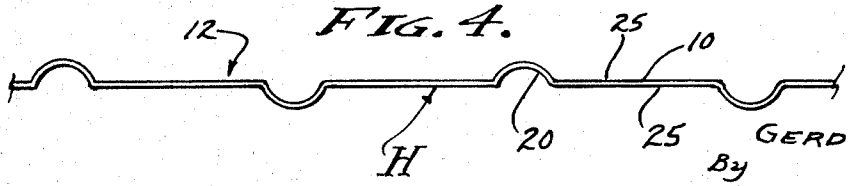
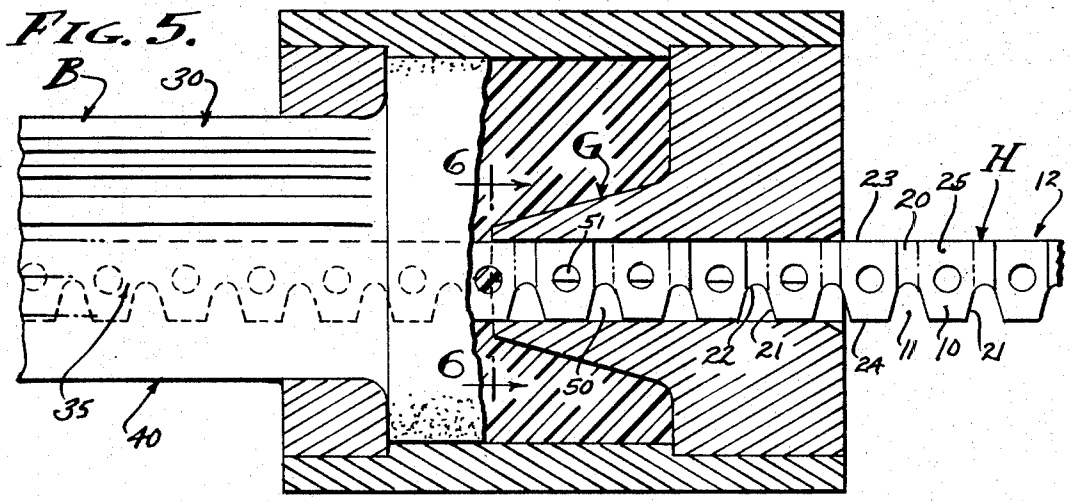


FIG. 4.



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FIG. 5.



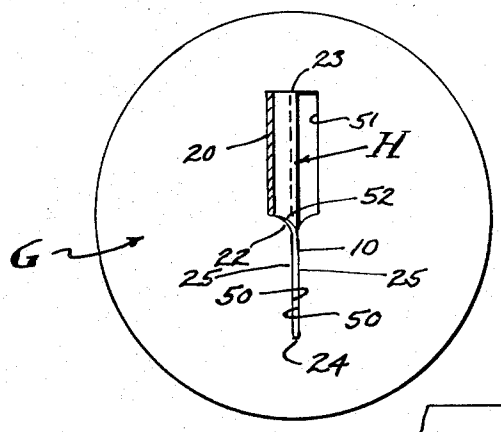
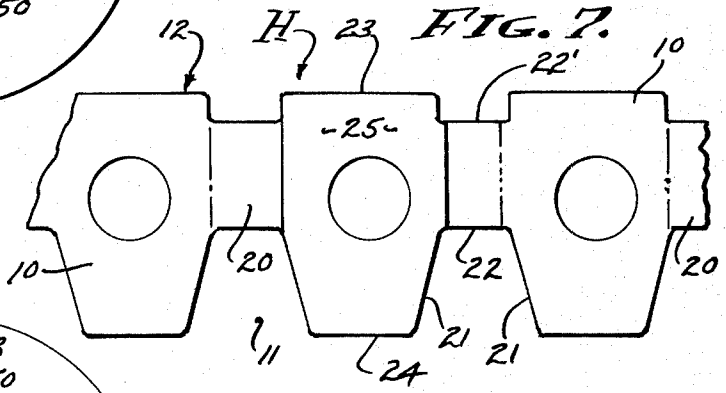


FIG. 6.

FIG. 7.



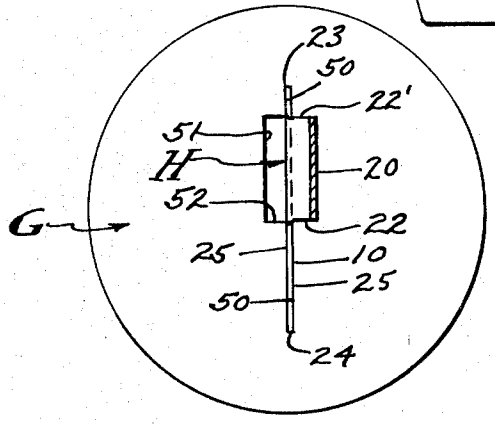


FIG. 8.

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HEATED WIPER BLADE

BACKGROUND

Heated window wipers have not been altogether practical for various reasons, among which are difficulties in manufacturing, nonuniformity of product, adversities imposed by the heating element which affect the physical properties of the product, and distortions which render the product unsuitable. These disadvantages are general, of course, it being an object of such wipers to employ the flow of electrical current to heat the wiping lip of the blade and thereby defrost ice formations from the surface being cleaned by means of the blade traversing said surface. The traversing motion of such blades is usually rapid and as a consequence utilitarian advantage of such heated blades is to prevent the accumulation and buildup of ice formations, rather than to melt away large ice formations previously formed. However, the heating of such wiper blades will disperse previous formations of ice and will cause secondary benefits in the form of freedom of the wiper blade and its supporting assembly from ice jams and, therefore, free to articulate and to conform to the compounded contours over which it is normally operated. For example, the internally heated wiper blade will melt itself free and to the end that the drive motor will not stall and be burned out.

Embedding of electrical conductors within the cross sectional confines of window wiper blades is met with various difficulties. Firstly, the coefficient of expansion of a metallic wire or coil, as is usually employed, is not expected to be the same as that of an elastomeric material such as rubber or the like. Further, the coefficient of expansion differential is aggravated by the substantial heat differences developed in the element and transferred to the wiper body (rubber) which is not the best conductor of heat; and all of which results in separation of the heating element from the body and internal abrasion, cutting and general mechanical breakdown within the heated wiper blade, with consequent loss of heat transfer due to separation of materials. Therefore, it is an object of this invention to provide a heating element configuration incorporated in an elastomeric body, especially a window wiper blade or the like, which is compatible with said body and which conforms to movements and/or deflections of said body, without undue restriction while acting secondarily as a reinforcement. With the present invention, the heating element is characterized by articulately related plate sections that are reinforced within the body area of the blade which is thereby strengthened and made of reduced cross section for a more direct heat transfer.

The usual filaments, elongated and/or coiled, heretofore employed in window wiper blades have been deficient for the purposes intended due to their adverse effect in distorting the end product and due to difficulties in manufacture, or both. Without detailing these adversities it is sufficient to refer to straight wires which lack flexibility, and to coils which are imbedded within such blades with difficulty or at substantial expense. Straight wire is no problem to embed within an extruded body, but a coiled wire is a difficulty which can be surmounted, for example, by means of extruding over a retractile mandrel that is withdrawn from the finished product after the wiper body has solidified over the coil initially supported by the mandrel. Therefore, it is an

object of this invention to provide a universally flexible electrical heating element embedded within a body of elastomeric material, to replace the prior art wires, filaments and coils; an electrical heating element characterized by a foil or membrane comprised of plate sections joined by flexible coupling sections, whereby the wiper body and said heating element are independently flexible in all directions respectively.

The aforementioned structures involving coiled heating elements embedded in wiper bodies and the like cannot be extruded as finished products because of the mandrel in each instance. With the present invention it is an object to extrude a finished product in the form of a continuous wiper body cross section wherein the heating element is properly located without remaining cavities such as the useless cavities resulting from the prior art use of mandrels and which are conducive to defective operation as caused by moisture entering therein or by gasifying from within when heat is applied. Therefore, it is also an object to provide a method to so construct a window wiper body with a heating element embedded therein without voids and/or remaining chambers, and a heating element which remains independently flexible, the wiper element body also remaining independently flexible without distortion despite the incorporation therein of said heating element.

The proper location of heating elements within the cross section of window wiper blades has heretofore resulted in deformity of the finished product and/or has required the employment of a removable mandrel with added cost. However, with the present invention a cooperative relationship is established between the plate sections of the heating element and the method and/or apparatus means to guide the same; it being an object to provide coupling sections in the heating element which not only serve the purpose of flexibility but also cooperate as a traction and guide means enabling the continuous centralized embedment thereof within the extrusion. And, with the invention it is also an object to provide an apparatus in the form of an extrusion die which carries out cooperative method steps in an extruder that continuously forms the same.

The transfer of heat out of the prior art window wiper blades of the type under consideration has been questionable at least, due to the limited capacity of a heating element confined within an elastomeric material. That is, the temperature to which ordinary rubber and the like can be subjected is limited, and this limitation is further restricted by the insulating properties of said rubber and like materials. Therefore, it is an object of this invention to provide an electrical resistance element having maximum contact area (surface) engaged within the elastomeric wiper body; and to provide a wiper body of material adapted to withstand higher heat. With the present invention, the normal plane of the wiper blade and its lip is occupied at its median plane by a foil or membrane having a unique profile and plan configuration comprising the heating element, such as to reinforce the body of the wiper blade while permitting both the body and its lip to remain flexible as is required.

DRAWINGS

The various objects and features of this invention will be fully understood from the following detailed description of the typical preferred forms and applications thereof, throughout which description reference is made to the accompanying drawings, in which:

FIG. 1 is a longitudinal elevation of the window wiper blade with a portion broken away to show the heating element thereof. FIG. 2 is a perspective view of the heated wiper blade of FIG. 1, illustrating the cross section of the surrounding body and the heating element exposed. FIG. 3 is an enlarged detailed side elevation of the heating element, and FIG. 4 is a plan view thereof taken as indicated by line 4—4 on FIG. 3. FIG. 5 is a longitudinal cross sectional view of the apparatus, namely the extrusion die and heating element guide, used in the process of making the reinforced cross section of the wiper blade. FIG. 6 is an enlarged detailed sectional view taken as indicated by line 6—6 on FIG. 5. FIG. 7 is a view similar to FIG. 3 showing a second embodiment of the invention, and FIG. 8 is a view similar to FIG. 6 showing the guide of the apparatus used in processing the reinforcing element of FIG. 7.

PREFERRED EMBODIMENT

This invention relates to a windshield wiper blade which is internally heated by means of an electrical resistance element that extends coextensively therethrough while remaining flexible and without being distorted by the presence therein of said resistance element. The wiper blade body B is itself made of an elastomer such as rubber or the like, and in this case one of the family of silicones which can withstand the localized high temperature of the heating element. The heating element H in accordance with the present invention is made of a foil or membrane of any one of a number of suitable metal alloys having the desired resistivity, the profile and plan configuration herein disclosed enabling the success of the finished article and enabling the operation of the apparatus used in extruding the same, all as a result of practicing the method of manufacture. The heating element H is made of a metal such as nichrome or any such electrically resistive material. It is these two elements which are prepared and combined according to the method, and which are assembled with the apparatus now to be described.

The method and cooperative apparatus involves and depends upon the preparation of the foil or membrane which forms the heating element H, and comprises the processing of a thin ribbon of electrically resistive material by notching and corrugating the same so as to form a continuous series of plate sections **10** therealong separated by substantial indentations or notches **11** along one margin and preferably the lower margin thereof. The wiper body B and heating element H will be described as disposed symmetrically in a vertical plane, the element H being, for example, several thousandths of an inch in thickness and of a substantial fraction of an inch in depth, for example one/eighth inch. Thus, the circular mil value of the element is relatively small compared with its surface area; that is the surface area of the element H is at a maximum. In order to maintain a uniform heating per unit length, despite the notches **11** which intermittently reduce the circular mil cross section of element H, the plate sections **10** are made of constant resistivity with the corrugated coupling section by perforating the ribbon at **12** as shown. Thus, the resistance is not only uniform but the resistivity remains substantial as related to the large cross section and surface area of the plate sections **10** which dissipate heat. The indentations **11** are of uniformly angled V-shape while the corrugations are vertically disposed at the center of each indentation and uniformly displaced alternately to one side and the other of the vertical plane of the ribbon or plate sections **10**.

The electrically resistant heating element H, referred to generally above, is made of resilient metal foil up to several thousandths of an inch in thickness and therefore flexible so as to be bendable. However, flat sheets of thin metal are known to wrinkle badly and to thereby develop permanent creases that are subject to cracking; these deficiencies being corrected by the configuration of this heating element H. The element H is ribbon-like and of modified vertical profile, being comprised of coplanar plate sections **10** separated by flexible coupling sections **20** of reduced cross section. The said coupling sections are formed by said notches **11** that penetrate into the ribbon, the side edges **21** of adjacent plates being convergent to the root **22** of the notch. The said root **22** is filleted as shown in FIG. 3, or is horizontally disposed as it extends between adjacent side edges of the plate sections as shown in FIG. 7. The coupling section of reduced cross section is displaced out of the plane of the ribbon throughout the root portion **22** of the notch, preferably by means of a vertically disposed corrugation or hat-section of concavo-convex curvature. As shown, the consecutive coupling sections **20** are displaced alternately from opposite sides of the ribbon of electrically resistive material which remains coplanar through the series of plate sections **10**. Characteristically therefore, the ribbon of material retains its parallel upper and lower edges **23** and **24** and its opposite side faces **25** at the plate sections **10**.

The wiper blade body B is of a resilient rubber-like material and in accordance with the invention is a silicone rubber which is capable of withstanding temperatures up to 600°F without disintegration and/or without separation from the heating source which is the heating element H. As shown throughout the drawings, the body B is comprised of a back **30**, a neck **35** and a lip **40**. The body comprised of parts **30**, **35** and **40** is bilaterally symmetrical and disposed about the vertical plane normal to the surface to be wiped. The body **30** is adapted to be carried by the wiper bows (as shown in FIG. 1) and the neck **35** and lip **40** house the heating element H in close proximity to the surface to be defrosted. The optimum manufactured condition of the parts and elements is shown throughout the drawings. It will be understood that lateral deflection of the lip is required, and which is permitted within the lip despite the presence of the depending metallic heating element therein. It will also be understood that the normally straight edge of the lip **40** is required to be warped to the contour of compound window surfaces and the like. Although not shown, it will be apparent that the wiper blade is, therefore, to be twisted as well as to be deflected laterally. Thus, it will be seen that this wiper blade B with its heating element H embedded therein is

flexibly bendable laterally in any direction and rotationally as well; however, the initial formation thereof remains straight and undistorted.

The back **30** of the wiper blade is a solid body of the elastomer of which it is formed. As shown, the back is comprised of a flat horizontal top **31** and opposite ribbed sides **32** that present coextensive grooves **33** adapted to receive the rails of a supporting frame (as shown). The back with its ribbed cross section presents the maximum width of the wiper blade, the lower extremity of the back presenting opposite coplanar protective ribs **34**. The back **30** thus far described is common in wipers of the type under consideration.

The neck **35** of the wiper blade is an integrally solid continuation of the back **30** and is comprised of a central depending flange **36** that is narrow in transverse extent and that is deep in vertical extent. The neck **35**, in accordance with this invention, retains its characteristic rectangular cross section and accommodates the resistance element H Which reinforces the neck for retension of said cross section. However, the unobvious function of the combined neck **35** and element H imbedded therein is the ability of the neck to be turned or bent laterally in all directions and to be twisted (all within reasonable limits) from its initial straight undistorted condition. And, according to usual practice, the neck **35** is joined to the back **30** by a laterally flexible unreinforced portion **37** from which opposite stepped coplanar wiping ridges **38**, **38'** and **38''** project as is common practice.

The wiping lip **40** of the wiper blade is also an integrally solid continuation of the back **30** and neck **35**, and is comprised of a central fin that tapers downward from the neck flange **36**. As pointed out above, the wiper blade is symmetrically formed about a vertical central plane, and the electrical resistance element H is embedded therein on said plane. Accordingly, it is the upper portion of the element H reinforced by the corrugations which is embedded in the confines of the neck **35**, while it is the lower and laterally flexible portion of the element H which is embedded into the upper portion of the lip **40**. That is and in accordance with this invention, the depending notched portion of the heating element H depends into the upper portion of the lip. The lip **40** has convexly convergent sides **41** that terminate at a lowermost concaved wiping edge **42** presenting acute corners **43**. Thus, the window wiper blade B is comprised of the elastomeric body molded around and coupling the electrical resistance heating element H that reinforces the neck and part of the lip thereof while permitting universal flexibility within practical limits.

In accordance with the method of manufacture the heating element H prepared by the steps of notching the margin thereof and by corrugating the same at each notch results in a ribbon of foil that is adapted to be subjected to the processes of extrusion for embeddment on the central plane of the wiper blade flange and lip. It is significant that the coplanar plate sections **10** depend from the corrugations of the coupling sections **20**, and accordingly the coplanar plate sections **10** are guided into the central plane of the wiper blade B during the extrusion process. It is cooperatively significant that the corrugated coupling sections **20** project laterally from the plate sections **10**, and accordingly they are anchored into the wiper blade B immediately during the extrusion process. Furthermore, additional anchorange is obtained through the perforations **12**, and all to the anchorage that the element H is assuredly drawn forwardly at the speed of extrusion, whatever it may be, with the elastomer body in coextensive engagement therewith and therethrough. Consequently, the method steps of manufacture include notching and bending a ribbon of foil so as to form coplanar plate sections thereof separated by corrugated coupling sections integral therewith, and guiding said coplanar plate sections into a body of material extruded therearound and anchored therein by said corrugations to move therewith and/or to remain in coextensive engagement therein.

In accordance with the apparatus applied to the manufacture of the heated wiper blade B hereinabove disclosed, the heating element H of the hereinabove described profile and plan configuration is to be accommodated by the guide G within the head of an extrusion machine, preferably one having a cross feed. Thus, the element H or any such element is fed into the rear and through the extrusion die so as to issue within the extruded body being produced. It is to be understood that the corrugated detail of the element H can vary as circumstances require, the characteristic feature being that element H is a thin and therefore flexible and/or bendable foil having a peculiarly unique profile and plan configuration. As is clearly described above, the foil is a continuous ribbon made up of coplanar plate sections separated by corrugated coupling sections with the said plate sections projecting from one or both edges of the said coupling sections. Therefore, the two said sections are passed independently through the extrusion die, the plate sections being guided therethrough for lateral side to side placement and the coupling sections being supported therethrough for vertical up and down placement. This lateral and vertical placement can be revolved as may be desired. Accordingly, the extrusion die D which includes the cross sectional features to be extruded as may be required as for a window wiper blade B, for example, is cooperatively associated with the guide G which comprises, a guide section having spaced opposed walls **50** slideably passing the plate sections **10** of the element H, and a support section having an enlarged opening **51** freely passing the corrugated coupling sections **20** and with a shoulder or shoulders **52** engageable with the laterally displaced roots **22** and/or **22'** of the corrugations to slideably support the same. The element H form of FIGS. **1–6** requires the guide walls **50** at one margin and the guide opening **51** at the other margin; while the element H form of FIGS. **7–8** requires the guide walls **50** at both margins and the guide openings **51** therebetween. The enlarged openings **51** is coextensive of at least two spaced corrugations, thereby sealing therewith to confine the extrusion and to insure forward movement thereof from the die with the element H anchored therewith so as to move forwardly into and through the extrusion chamber.

From the foregoing it will be apparent that I have provided a new, practical article of manufacture in the form of a heated window wiper blade, that I have also

provided a new method of manufacturing such an article, and that I have still further provided a new apparatus for combining the two elements of the said article. Concerning the article in the form of a heated window wiper blade per se, it is the coextensive interengagement of a resilient and universally flexible heating element and a resilient and universally flexible wiping element, wherein maximum surface area of contact is established therebetween, wherein anchored engagement is established therebetween so as to prevent separation and thereby eliminate deterioration otherwise due to cutting and abrasion, and wherein differences in expansion and contraction are compensated for. Concerning the method of manufacturing a window wiper blade or any similar article, it is the steps of preparing a ribbon of foil or a membrane for located position within a continuously extruded body followed by the step of guiding longitudinally separated coplanar plate sections established by the first mentioned steps and the step of extruding the said surrounding body onto the prepared foil and into permanent anchored engagement therewith immediate with said extrusion of the finished article. Concerning the new apparatus, it is the guide structure for introducing the continuous length of foil or membrane of interrupted plate configuration joined by flexible laterally displaced couplings, not necessarily for a window wiper blade but for extruding any member with a flattened internal element, which includes a guide for locating said plate sections and a cooperative support for locating the said coupling sections. The practice of this invention results in a decidedly advanced product, not only form the standpoint of economics in its manufacture but also in its durability and improved and most reliable operating characteristics.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details set forth, but wish to reserve to myself any modifications or variations that may appear to those skilled in the art:

I claim:

1. A heatable wiper blade construction including: a universally flexible body of solid and bendable material having at least one wiping portion for traversing a surface to be wiped; and a universally flexible electrical heating element extending coextensively within the first mentioned body and comprised of a ribbon of flat and bendable internal resistance material separated into a series of interconnected plate sections integrally joined together and separated by flexible coupling sections; whereby the composite structure of said body and heating element is universally flexible.

2. The heatable wiper blade as set forth in claim 1 wherein the series of plate sections are coplanar and extend laterally from the said coupling sections and project into the said at least one wiping portion to heat the same.

3. The heatable wiper blade as set forth in claim 1 wherein the series of plate sections are coplanar with laterally extended portions thereof separated by notches entering a margin of the ribbon comprising said heating element and said extended portions projected into the said at least one wiping portion to heat the same.

4. The heatable wiper blade as set forth in claim 1 wherein the coupling sections joining the plate sections are corrugations displaced out of the plane of the ribbon.

5. The heatable wiper blade as set forth in claim 1 wherein the series of coupling sections joining the series of plate sections are corrugations displaced alternately out of the plane of and at opposite sides of the ribbon.

6. The heatable wiper blade as set forth in claim 1 wherein the coupling sections are corrugations disposed normal to and displaced out of the plane of the ribbon.

7. The heatable wiper blade as set forth in claim 1 wherein the series of coupling sections joining the series of plate sections are corrugations disposed normal to and displaced alternately out of the plane of and at opposite sides of the ribbon.

8. The heatable wiper blade as set forth in claim 1, wherein the coupling sections joining the plate sections are corrugations disposed normal to and extending partially across the plane of the ribbon thereby reducing the cross section thereof, and wherein the cross section of each plate section is correspondingly reduced by a perforation therethrough, whereby a uniform heating per unit length is maintained.

9. The heatable wiper blade as set forth in claim 1 wherein the series of coupling sections joining the series of plate sections are corrugations disposed normal to and extending partially across and displaced alternately out of the plane of and at opposite sides of the ribbon thereby reducing the cross section thereof, and wherein the cross section of each plate section is correspondingly reduced by a perforation therethrough, whereby a uniform heating per unit length is maintained.

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