(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 January 2002 (17.01.2002)

PCT

(10) International Publication Number
WO 02/04267 A2

(51) International Patent Classification[7]: B60S 1/38

(21) International Application Number: PCT/US01/41295

(22) International Filing Date: 6 July 2001 (06.07.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/610,500 6 July 2000 (06.07.2000) US

(71) Applicant: **TRICO PRODUCTS CORPORATION** [US/US]; 3255 West Hamlin Road, Rochester Hills, MI 48309 (US).

(72) Inventors: **STEWART, Jeffrey**; 93 Franklin Wright Blvd., Lake Orion, MI 48362 (US). **YOUNG, William, III.**; 29848 Evergreen, Southfield, MI 48076 (US).

(74) Agent: **MCGLYNN, Gerald, E., III.**; Bliss McGlynn & Nolan, P.C., 2075 West Big Beaver Road, Suite 600, Troy, MI 48084 (US).

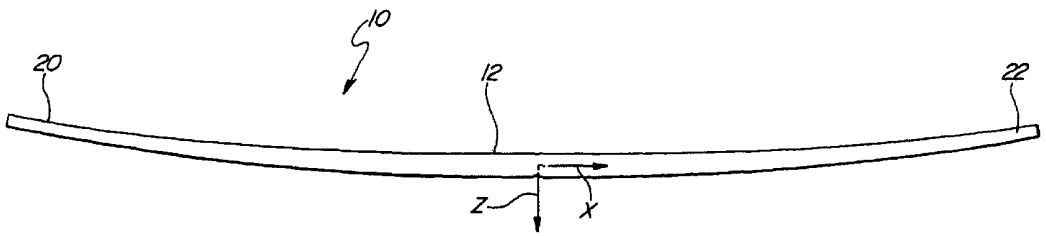
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ONE PIECE BEAM BLADE WIPER ASSEMBLY WHICH IS ARCUATE IN THE PLAN VIEW



(57) Abstract: A beam blade windshield wiper assembly including an elongated backdone having a longitudinal beam length extending between first and second longitudinal ends of the backdone, and upper surface and an oppposed mounting surface with first and second sides extending between the upper surface and the mounting surface. The distance between the upper surface and the mounting surface on the backdone defines a thickness thereof. Similarly, the distance between the first and second sides defines the width of the backdone. A wiper element is mounted to the mounting surface of the backdone and extends for a substantial portion of its longitudinal beam length. The backdone defines an X-axis extending in the direction of the longitudinal beam length, a Y-axis extending transverse to the X-axis and through the upper surface and the mounting surface so as to define an X-Y plane as well as a Z-axis extending perpendicular to the X-Y plane. Furthermore, the width of the backdone varies between the longitudinal first and second ends and the thickness of the backdone is constant between the longitudinal first and second ends. In addition, the backdone varies or curves from the X-axis in the direction of the Z-axis in the plan view.

WO 02/04267 A2

ONE PIECE BEAM BLADE WIPER ASSEMBLY WHICH IS ARCUATE IN THE PLAN VIEW

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates, generally, to windshield wiper assemblies and, more specifically, to a beam blade windshield wiper assembly having an elongated, curved backbone which is also arcuate in the plan view.

2. Description of the Related Art

Conventional windshield wiper assemblies known in the related art include some type of blade assembly mounted to an arm which, in turn, is mounted adjacent the windshield and pivotally driven to impart reciprocating motion to the wiper blade assembly across the windshield. A rubber wiping element is supported by the blade assembly and contacts the windshield across the surface to be wiped. The wiper element often incorporates one or more metal strips which act to reinforce the wiper element and facilitate wiping contact by the element across what is typically a curved glass surface.

One type of blade assembly commonly employed in the related art includes a "tournament" style superstructure including a primary lever carried by the arm, two or more secondary levers and a series of two or more tertiary levers. The secondary levers are articulated to the primary lever at pivot points located at the opposed, lateral ends of the primary lever. Similarly, the tertiary levers are each articulated to a secondary lever at pivot points located at the opposed lateral ends of the secondary levers. As noted above, the blade assembly is located on the end of the wiper arm and

represents a significant portion of the inertia generated by the wiping system when in operation. Furthermore, the profile of the blade assembly as it is reciprocated across the windshield is an important design consideration with respect to avoiding wind lift at higher vehicle speeds. In addition, since components of the windshield wiping system are often visible, even when not in operation, the aesthetic appearance of the components of the system is an important design consideration.

Beam blade type windshield wiper assemblies are also known in the art. The beam blade type windshield wiper includes an single elongated, homogeneous strip forming a spring backbone. The backbone has a connecting formation at a central position for connection to a reciprocally driven arm which applies a downward force and moves the blade assembly across the windshield. The backbone is curved along a single plane which is the same plane of curvature as that defined by the windshield. A wiper element is secured to the backbone. Examples of beam blade type windshield wipers can be found in United States Patent No. 5,325,564 issued July 5, 1994, and 5,485,650 issued January 23, 1996, both in the name of Swanepoel. The beam blade backbone disclosed in the Swanepoel '650 and '564 patents is made from spring steel and preferably tapers in width from its center towards its free ends or tips. Swanepoel teaches that the thickness and width of the backbone and its radius of curvature should be matched along the length of the backbone so that the backbone will provide a force per unit length distribution in a longitudinal direction which increases towards both tips of the windshield wiper when the windshield wiper is in use, pressed downward intermediate its ends onto a flat surface. Beam blade wiper assemblies have the advantages of a lower profile as compared with tournament style wiper assemblies, consist of fewer parts and are considered to be aesthetically pleasing.

Recently it has become desirable to curve windshield wiper blade assemblies in the plan view, or substantially parallel to the overall plane of the windshield, so that the blade assembly follows the contour of the vehicle cowl which borders the windshield. One example of a "tournament style" windshield wiper assembly which is curved in the plan view is disclosed in UK patent application No. 2,308,542 A, published on July 2, 1997. However, it has proved difficult in the past to manufacture tournament style blade structures having compound curvatures including primary, secondary or tertiary levers which are curved in the plan view. Furthermore, tournament style blade structures which are also curved in the plan view are prone to poor wipe quality. In a similar way, beam blade type wiper assemblies having compound curvatures, including being arcuate in the plan view, have been proposed in the related art with limited success.

Accordingly, there continues to be a need in the art for improvements in the windshield wiper systems which result in improved or alternative aesthetics with simplicity of parts and reduction in manufacturing costs. At the same time, there is a need for a beam blade type wiper assembly which is arcuate in the plan view and which meets required performance characteristics.

SUMMARY OF THE INVENTION

The present invention overcomes the disadvantages in the related art in a beam blade windshield wiper assembly including an elongated backbone having a longitudinal beam length extending between first and second longitudinal ends of the backbone, an upper surface and an opposed mounting surface with first and second sides extending between the upper surface and the mounting surface. The distance between the upper surface and the mounting surface on the backbone defines a thickness thereof. Similarly, the distance between the first and second sides

defines the width of the backbone. A wiper element is mounted to the mounting surface of the backbone and extends for a substantial portion of its longitudinal beam length. The backbone defines an X-axis extending in the direction of the longitudinal beam length, a Y-axis extending transverse to the X-axis and through the upper surface and the mounting surface so as to define an X-Y plane as well as a Z-axis extending perpendicular to the X-Y plane. Furthermore, the width of the backbone varies between the longitudinal first and second ends and the thickness of the backbone is constant between the longitudinal first and second ends. In addition, the backbone varies or curves from the X-axis in the direction of the Z-axis in the plan view.

One advantage of the present invention is that it provides a beam blade windshield wiper assembly having a low profile and consisting of relatively few parts when compared with the conventional "tournament" style wiper assemblies of the related art. Another advantage of the present invention is that the curved beam blade provides improved force distribution resulting in improved wipe quality. Still another advantage of the beam blade windshield wiper assembly of the present invention is curved in the plan view and is considered aesthetically pleasing when mounted on a vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is a partial plan view of the front of an automotive vehicle illustrating the beam blade wiper assembly of the present invention;

Figure 2 is a perspective view of a first embodiment of the present invention;

Figure 3 is a cross sectional view of the first embodiment taken along lines 3-3 of Figure 2.

Figure 4 is an enlarged plan view of the first embodiment;

Figure 5 is a plan view of a second embodiment of the present invention;

Figure 6 is a plan view of a third embodiment of the present invention; and

Figure 7 is a perspective view of a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring now to Figures 1-3, a beam blade wiper assembly of the present invention is generally indicated at 10 where like numbers are used to designate like structure throughout the drawings. The beam blade wiper assembly 10 includes a backbone 12 and a wiper element 14. As illustrated in Figure 1, the beam blade wiper assembly 10 is controlled and driven by a spring loaded arm 16 (shown in phantom) mounted adjacent the windshield 11 of a vehicle and pivotally driven to impart reciprocating motion to the beam blade wiper assembly 10 across the windshield 11, as commonly known in the art. The backbone 12 has a centrally located connector schematically indicated at 18 for releasably connecting the wiper assembly 10 to the spring loaded wiper arm 16. The connector 18 can be of any suitable design. Preferably, the wiper element 14 is glued or otherwise adhered or bonded to the backbone 12. Alternatively, other structural interlocking methods may be used.

The elongated backbone 12 has a longitudinal beam length extending between first and second ends 20, 22. The beam length defines a median line 24 extending along the beam length. More specifically, the median line 24 is defined by the locus of points equidistant from the sides of

the backbone 12, that will be described in greater detail below. The connector portion 18 is located at an intermediate position, commonly at the longitudinal center, between the first and second longitudinal ends 20,22. The backbone 12 is of resiliently flexible material which applies a force from the spring loaded wiper arm 16 through the connecting portion 18 along the backbone's length to the first and second longitudinal ends 20, 22. The backbone 12 is typically made of a single, integral piece of material such that it defines a consolidated cross-section. Alternatively, the backbone 12 may be formed into a single piece by laminates.

The backbone 12 includes an upper surface 26 and an opposing mounting surface 28 with first and second sides 30, 32 extending therebetween. In the preferred embodiment, the cross-section of the backbone 12 is generally rectangular making the first and second sides 30, 32 generally perpendicular to both the upper surface 26 and mounting surface 28. However, those having ordinary skill in the art will appreciate that the cross-section may have any suitable geometric shape. The backbone 12 has a width defined along a width line W drawn between the first and second sides 30, 32 and perpendicular to the median line 24. In general, the backbone 12 varies in width W from the longitudinal center to the longitudinal ends 20, 22. In the preferred embodiment illustrated in the figures, a width line W1 dawn at the center will be greater than a width line W2 drawn at the ends 20, 22. Therefore, the width W is tapered from the general midpoint of the backbone to the first and second ends 20, 22. The thickness of the backbone 12 is defined by a line t extending perpendicular to the width between the upper surface 26 and mounting surface 28 (Figure 3). The thickness of the backbone 12 of the beam blade windshield wiper assembly 10 of the present invention is substantially constant along the longitudinal beam length extending between the first and second ends 20, 22 of the backbone 12.

The backbone 12 is curved longitudinally with a predetermined curvature parallel to the plane of curvature of the windshield 11 (hereinafter "windshield curvature"). An X-Y plane is defined by a cross section taken longitudinally along the median line 24 and through the backbone 12 and wiper element14, with the X-axis extending tangentially to the median line 24 at the center of the backbone 12 and the Y-axis extending through the cross-section of the backbone 12 and wiper element 14. The Z-axis extends perpendicular to the x-y plane in the direction of the width line W drawn at the center or connecting portion 18. The curvature of the backbone 12 in the X-Y plane may be symmetrical or asymmetrical depending on the force requirements and the contour of the windshield 11. The flexible, free form, pre-curved backbone 12 straightens out when the wiper arm 16 applies a force thereto to flatten the backbone 12 on a windshield 11. Thus, the backbone 12 must have adequate free-form curvature to ensure a good force distribution on windshields having various curvatures and to effect proper wrapping about the windshield 11. To this end, the disclosures of United States Patent Nos. 5,325,564 and 5,485,650 issued to Swanepoel are incorporated herein by reference. The backbone 12 must also have high lateral stiffness to avoid chatter caused when a backbone's lateral deflection causes stick/slip behavior of the rubber wiper element 14 on the windshield 11. Lateral stiffness is provided mainly by the width of the backbone 12. Furthermore, the backbone 12 must have high torsional stiffness to avoid chatter due to torsional deflection. The torsional stiffness is provided mainly by the thickness of the backbone 12.

The backbone 12, and therefore also the wiper element 14, is arcuate, offset, or varies from the X-axis in the direction of the Z-axis in the plan view. Thus, the median line 24 curves in the X-Z axis and the backbone 12 has a curvature such that a width line W1 extending transverse to the first and second sides 30, 32 at the central or intermediate position is disposed in non-parallel relationship

to a width line W2 extending transverse to the first and second sides 30, 32 proximate, adjacent or near one of the first or second longitudinal ends 20, 22. In other words, in addition to any free form curvature of the assembly in a plane contained by the X-Y axes, the beam blade wiper assembly 10 is curved in the plan view in a plane contained in the X-Z axes identified with respect to Figure 2 and 3 (hereinafter "plan view curvature").

The plan view curvature may take a variety of geometries, and may be symmetrical or asymmetrical, as illustrated in the embodiments of Figures 4-6. More specifically, Figure 4 illustrates the backbone 12 having a symmetrical curve in the direction of the z-axis and displaced, or offset, from the X-axis of the backbone 12. Thus, as illustrated in Figure 4, the first and second longitudinal ends 20, 22 are displaced or offset in the direction of the z-axis an equal distance from the X-axis. Figure 5 illustrates the backbone 12' having an asymmetrical curve wherein the Z-axis offset values are different. More specifically and as illustrated in this figure, the Z-axis offset at the second end 22 is greater than the Z-axis offset at the first end 20 (i.e., the second end 22 is curved to a greater extent in the plan view than the first end 20). Figure 6 illustrates a backbone 12" having an asymmetrical curve wherein the Z-axis offset of the first end 20 is greater than the offset of the second end 22 (i.e., the first end 20 is curved to a greater extent in the plan view than the second end 22). Other curvatures than those specifically illustrated may be used under the teachings of the invention. In general, the plan view curvature and offset distance is only limited by the width of the raw stock utilized prior to fabrication of the beams12.

An alternative embodiment of the present invention utilizes a two piece backbone 12'''a, 12'''b as illustrated in Figure 7. The same stiffness and force considerations for the single piece backbone 12 must also be considered. A joining member or bracket 40 interconnects the two beams

12'''a, 12'''b providing the connector formation 18''' to which the arm (not shown) is attached. Therefore, the bracket 40 transfers the forces from the arm 16''' to each of the beams 12'''a, 12'''b as in the first embodiment. The use of two beams 12'''a, 12'''b simplifies the manufacture and implementation of the plan view curvature.

The curvature in the plan view of either embodiment of the present invention may be further described with respect to an equation where $F_1(X)$ defines the plan view curvature of the median line 24 of the backbone 12 starting from the geometric center toward the outboard tip or first end 20 of the backbone 12. Similarly, $F_2(X)$ defines the plan view curvature of the median line 24 starting from the geometric center of the backbone 12 toward the inboard tip or second end 22 of the backbone 12. In this context, these equations can be defined as follows:

$$F(X) = AX^2 + BX + C \text{ (parabolic); or}$$

$$F(X) = K_0 + K_1X + \ldots\ldots K_nX^n \text{ (polynomial); or}$$

$$F(X) = AX + B \text{ (linear); or}$$

$$F(X) = A^n \text{ (exponential).}$$

In addition, the curvature function F(X) used for either equation (F_1X or F_2X) may be defined using a combination of one or more of the above equations to define different types of curvatures of the median line 24 from the geometric center of the backbone 12 toward either first 20 or second ends 22 thereof.

The invention has been described in an illustrative manner. It is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations of the invention are possible in light of the above

teachings. Therefore, within the scope of the appended claims, the invention may be practiced other than as specifically described.

I CLAIM

1. A beam blade windshield wiper assembly comprising:

an elongated backbone having a longitudinal beam length extending between first and second longitudinal ends of said backbone, an upper surface and an opposed mounting surface with first and second sides extending between said upper surface and said mounting surface wherein the distance between said upper surface and said mounting surface on said backbone defines a thickness thereof and wherein the distance between said first and second sides defines the width of said backbone;

a wiper element mounted to said mounting surface of said backbone and extending for a substantial portion of said longitudinal beam length;

said backbone defining an X-axis extending in the direction of said longitudinal beam length, a Y-axis extending transverse to said X-axis and through said upper surface and said mounting surface so as to define an X-Y plane and a Z-axis extending perpendicular to said X-Y plane; and

said width of said backbone varying between said longitudinal first and second ends and said thickness of said backbone being substantially constant between said longitudinal first and second ends with said backbone varying from said X-axis in the direction of said Z-axis in the plan view.

2. A beam blade windshield wiper assembly as set forth in claim 1 wherein said backbone defines a geometric center and a median line which is formed by the locus of points equidistant from said first and second sides of said backbone along its longitudinal extent, said median line having a predetermined curvature in the plane defined by an X-Z axis.

3. A beam blade windshield wiper assembly as set forth in claim 1 wherein said backbone defines an imaginary width line W1 extending transverse to said first and second sides at a position intermediate said first and second ends and a second width line W2 extending transverse to said first and second sides and disposed proximate at least one of said first and second longitudinal ends such that said first and second width lines W1 and W2 are disposed in non-parallel relationship with respect to one another.

4. A beam blade windshield wiper assembly as set forth in claim 1 wherein said backbone is curved symmetrically in the plan view such that said first and second longitudinal ends are offset and substantially equal distance from said X-axis in the direction of said Z-axis.

5. A beam blade windshield wiper assembly as set forth in claim 1 wherein said backbone is curved asymmetrically in the plan view such that said first and second longitudinal ends are offset in differing amounts from said X-axis in the direction of said Z-axis.

6. A beam blade windshield wiper assembly as set forth in claim 5 wherein said backbone is curved asymmetrically in the plan view such that said first end is offset from said X-axis in the direction of said Z-axis to a greater extent than said second end.

7. A beam blade windshield wiper assembly as set forth in claim 5 wherein said backbone is curved asymmetrically in the plan view such that said second end is offset in the plan view to a greater extent than said first end.

8. A beam blade windshield wiper assembly as set forth in claim 1 wherein said backbone includes a connecting portion disposed intermediate said first and second ends and said width of said backbone is tapered in decreasing fashion from said intermediate connecting portion to said first and second ends.

9. A beam blade wiper assembly as set forth in claim 8 further characterized by said connecting portion being located at a longitudinal center of said backbone.

10. A beam blade wiper assembly as set forth in claim 1 further characterized by beam forming a consolidated cross-section.

11. A beam blade wiper assembly as set forth in claim 1 further characterized by said backbone comprising a first backbone member and a second backbone member, a joining member connecting said first backbone member to said second backbone member, and said connecting portion connected to said joining member.

12. A beam blade wiper assembly as set forth in claim 8 further characterized by said backbone being substantially coextensive with said wiper element.

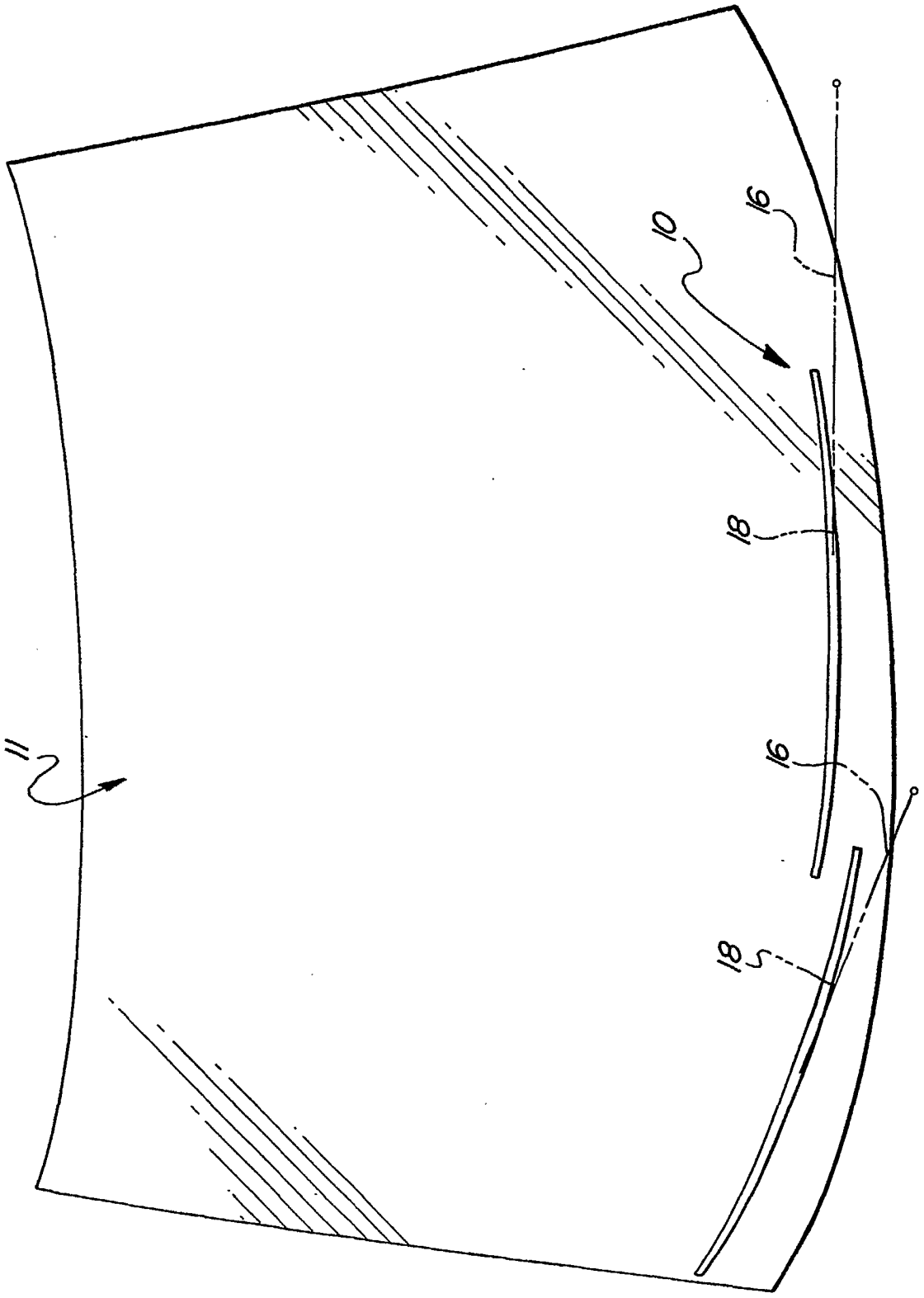


FIG-1

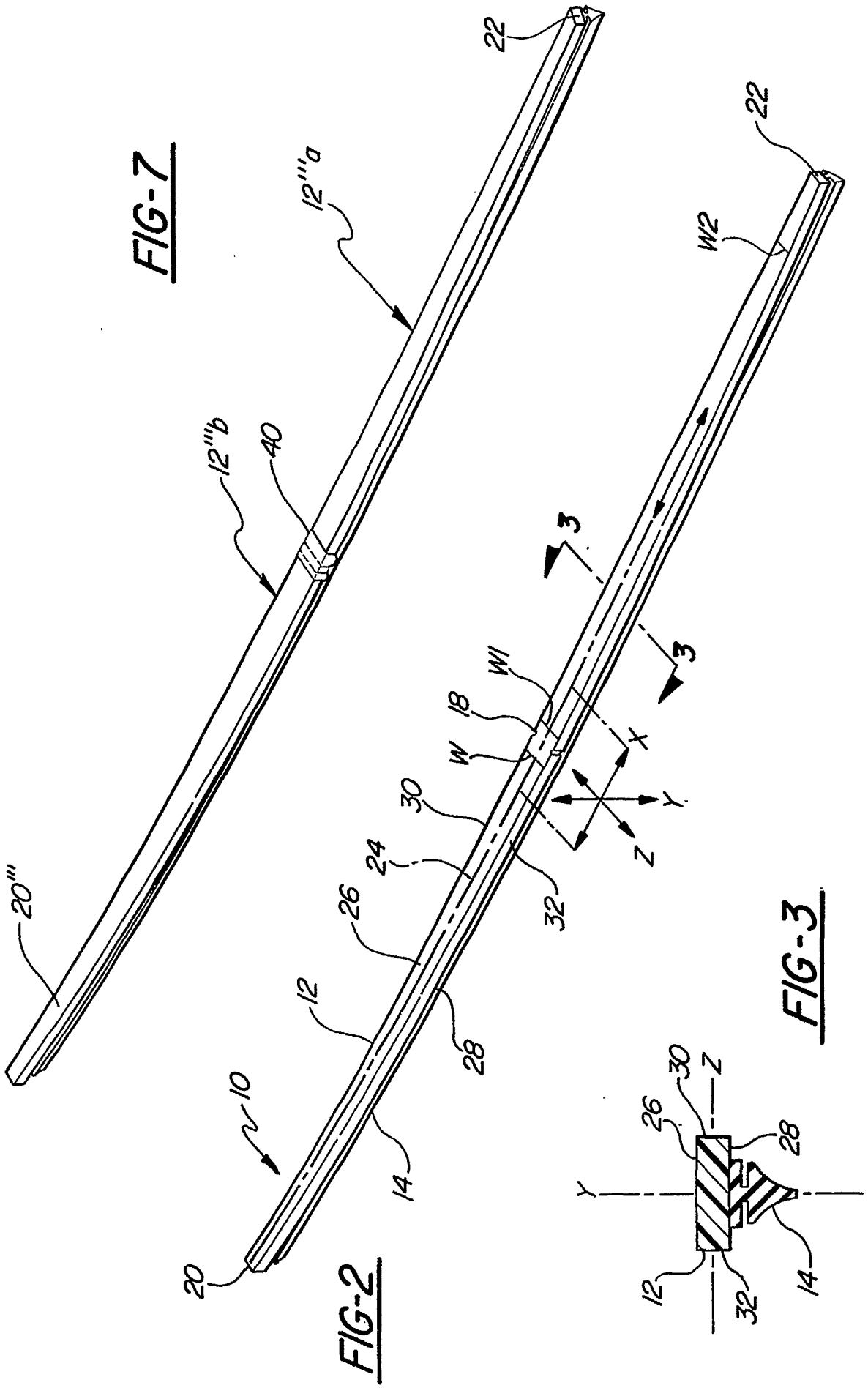


FIG-7

FIG-2

FIG-3

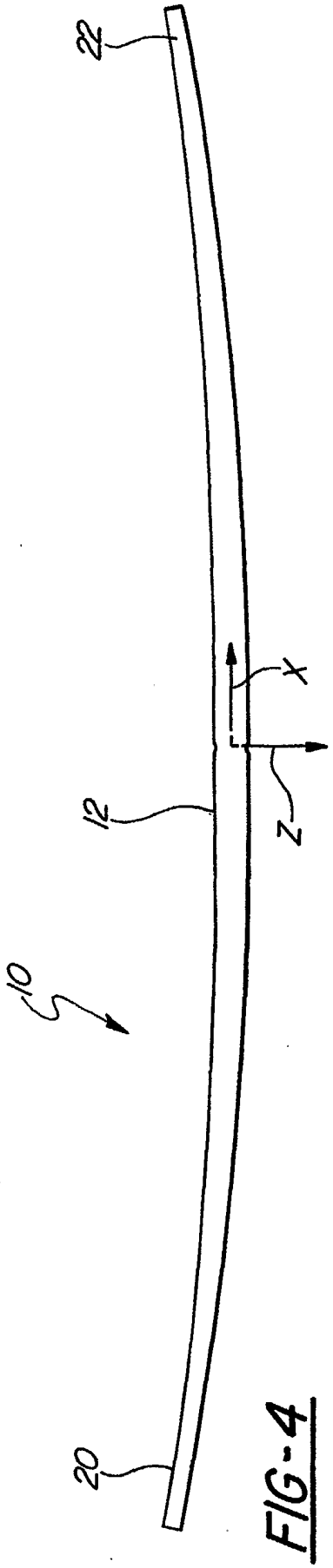


FIG-4

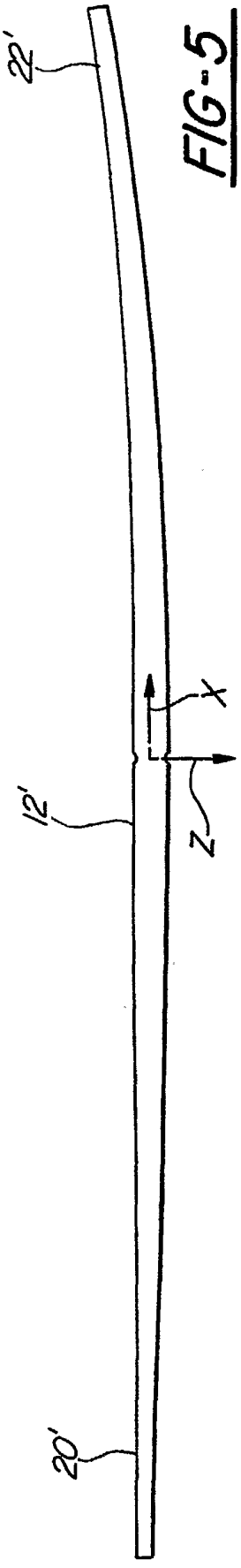


FIG-5

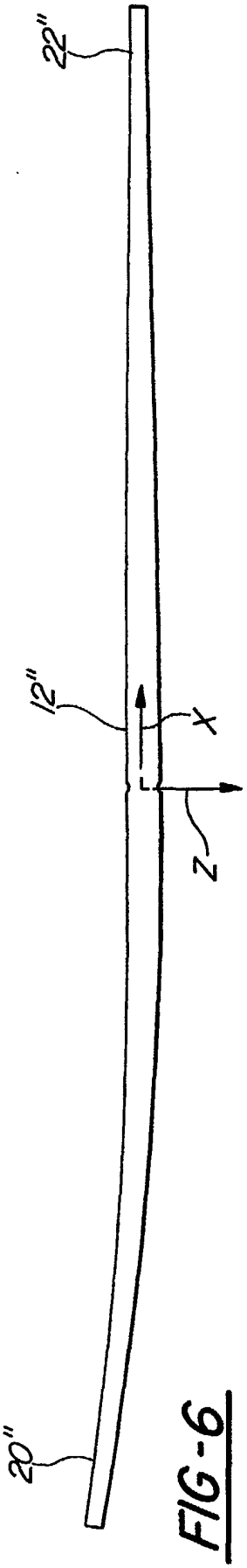


FIG-6