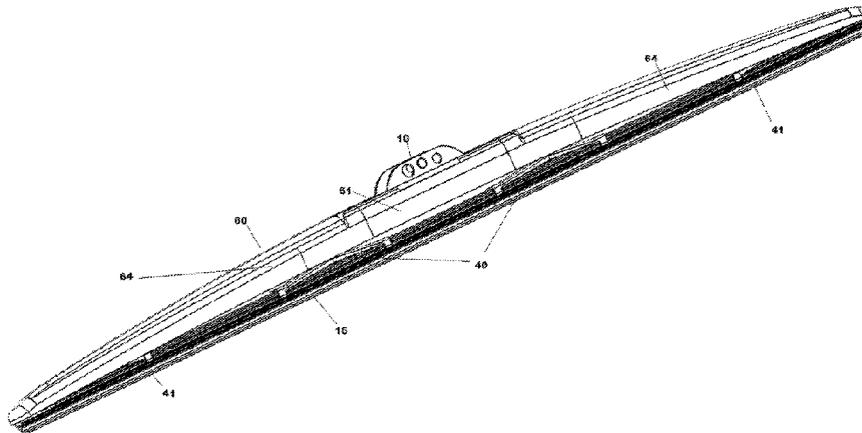




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 (54) Title: WIPER BLADE



(57) **Abrégé/Abstract:**

A wiper blade is presented having a wiper strip, a primary frame (20), and a pair of secondary frames (30). The primary frame (20) having a connection device (10) capable of connecting the wiper blade to a wiper arm disposed on a top side of the primary frame (20), and a connection structure disposed, on opposite ends of the primary frame (20). The pair of secondary frame (30), each have a central pivot connection portion and two leg portions extending from the central pivot connection portion (31), a pivot structure disposed on the central pivot connection portion (31) of the secondary frames wherein the pivot structure of the secondary frames (30) are connected to the connection structures on the ends of the primary frame (20). A wiper blade is also presented having a wiper strip, a force distribution structure having opposite ends, and a cover (60, 70).

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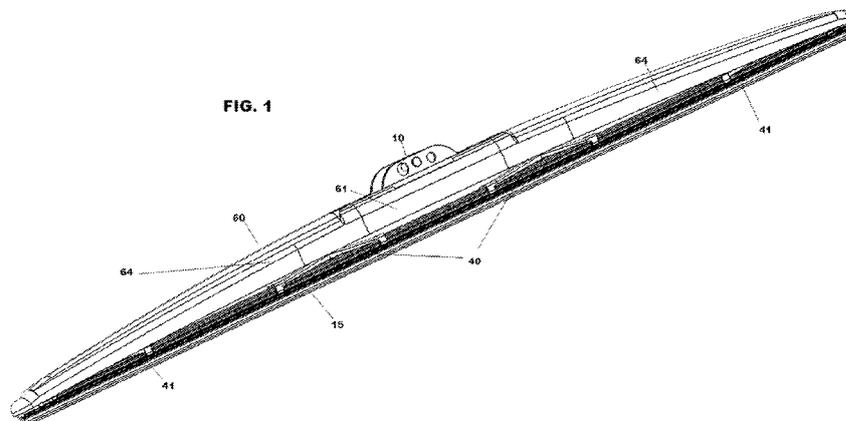
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(57) Abstract: A wiper blade is presented having a wiper strip, a primary frame (20), and a pair of secondary frames (30). The primary frame (20) having a connection device (10) capable of connecting the wiper blade to a wiper arm disposed on a top side of the primary frame (20), and a connection structure disposed, on opposite ends of the primary frame (20). The pair of secondary frame (30), each have a central pivot connection portion and two leg portions extending from the central pivot connection portion (31), a pivot structure disposed on the central pivot connection portion (31) of the secondary frames wherein the pivot structure of the secondary frames (30) are connected to the connection structures on the ends of the primary frame (20). A wiper blade is also presented having a wiper strip, a force distribution structure having opposite ends, and a cover (60, 70).

WO 2014/145538 A1

WIPER BLADE

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FIELD OF THE INVENTION

This invention relates to the field of windshield wiper blades.

BACKGROUND

Typical wiper blades used on vehicles are plagued with numerous persistent
10 drawbacks. In an effort to improve upon the traditional, bracketed wiper blade, the beam
blade (or flat blade) was developed, keeping a lower profile and generally providing a more
uniform force distribution than most bracketed wiper blades. However beam blades do not
have the lateral stability of bracketed blades, and can have problems with wrapping (i.e.
keeping contact between the outer edges of the wiper blade and the windshield) when their
15 curvature is not sufficiently sharp for the windshield, and banding (i.e. losing contact with the
windshield in the middle of the wiper blade, thereby leaving an unwiped band) when their
curvature is too sharp for the windshield. Accordingly, beam blades may serve well for
original equipment (i.e. the wiper blades installed by manufacturers on cars that are designed
specifically for that car, but can experience problems on certain vehicles if designed as
20 aftermarket wiper blades (i.e. replacement blades designed to be used on a variety of
different windshields where the manufacturer does not know what vehicle the blade will be
used on).

The first generation of hybrid wiper blades developed improved on beam blade
performance in these circumstances. These blades combine the use of brackets with a beam
25 to improve on the blades' wrapping characteristics without creating problems with banding.
The disclosed concept provides an improvement on the first generation hybrid wiper blades,
using a combination of traditional brackets and either beams or flat brackets.

30

BRIEF SUMMARY OF THE INVENTION

The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. It is intended to neither identify key or critical elements of the invention nor delineate the scope of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented later.

In one embodiment of the disclosure, a wiper blade includes a wiper strip, a primary frame, and a secondary frame. The primary frame may have a top side, opposite ends, a connection device capable of connecting the wiper blade to a wiper arm disposed on its top side, and a connection structure disposed on one of the opposite ends of the primary frame. The connection structure may include pivot extension walls. The secondary frame may include a central pivot connection portion and two leg portions extending from the central pivot connection portion. A pivot structure may be disposed on the central pivot connection portion of the secondary frame, wherein the pivot structure disposed on the secondary frame is connected with the connection structure on the primary frame, and the secondary frame may be pivotable about a pivot axis extending through the pivot structure and the connection structure.

In another embodiment of the disclosure, a wiper blade includes a wiper strip, a primary frame, and a secondary frame. The primary frame may have a top side and opposite ends, a connection device having a base attached to the primary frame on the top side, the connection device being capable of connecting the wiper blade to a wiper. The primary frame may further include a connection structure disposed on one of the opposite ends of the primary frame. The secondary frame may have a central pivot connection portion and two leg portions extending from the central pivot connection portion, a pivot structure disposed on the central pivot connection portion of the secondary frame, wherein the pivot structure disposed on the secondary frame is connected with the connection structure on the primary frame, the secondary frame pivotable about a pivot axis extending through the pivot structure and the connection structure.

In an additional embodiment of the disclosure, a wiper blade includes a wiper strip; a force distribution structure having opposite ends, the wiper strip connected to the force distribution center; and a cover, wherein the cover is a segmented hard cover comprising a

plurality of cover segments, and wherein the cover segments connect to one another via pivot joints, and wherein the cover is secured to the wiper blades at cover connection structures on the primary frame or secondary frame, wherein at least one of the cover segments has an end wall.

5 **Brief Description of the Figures**

Fig. 1 illustrates a perspective view from above of an embodiment of the disclosed concepts.

Fig. 2 illustrates a perspective view from above of an embodiment of the disclosed concepts without a cover attached.

10 Fig. 3 illustrates a frontal view of the embodiment of the disclosed concepts depicted in Fig. 2.

Fig. 4 illustrates a perspective view from above of an embodiment of the primary frame.

15 Fig. 5 illustrates a view of the primary frame of an embodiment of the disclosed concepts along the longitudinal axis of the wiper blade.

Fig. 6 illustrates a side view of a secondary frame of an embodiment of the disclosed concepts, wherein the beam is shown flattened for simplicity.

Fig. 7 illustrates a perspective view from above of a secondary frame of an embodiment of the disclosed concepts, wherein the beam is shown flattened for simplicity.

20 Fig. 8 illustrates a rivet which may be used in the joint of an embodiment of the disclosed concepts.

Fig. 9 illustrates a perspective view from the side of a turn-buckle holder used in a joint of an embodiment of the disclosed concepts.

25 Fig. 10 illustrates a view of a turn-buckle holder used in a joint of an embodiment of the disclosed concepts along the axis of the channel.

Fig. 11 shows a bottom view of a turn-buckle holder used in a joint of an embodiment of the disclosed concepts.

Fig. 12 shows a cross-sectional view of a turn-buckle holder used in a joint of an embodiment of the disclosed concepts through the turn-buckle holder's channel.

Fig. 13 illustrates a perspective view from the side of a holder half used in a joint in an embodiment of the disclosed concepts.

Fig. 14 illustrates a view of a holder half used in a joint in an embodiment of the disclosed concepts along the axis of the channel.

5 Fig. 15 illustrates a view of a holder half used in a joint in an embodiment of the disclosed concepts along the axis of the rivet passage.

Fig. 16 illustrates a bottom view of the holder half used in a joint in an embodiment of the disclosed concepts.

10 Fig. 17 illustrates a frontal view of a symmetric tertiary bracket of an embodiment of the disclosed concepts.

Fig. 18 illustrates a perspective view from above of a symmetric tertiary bracket of an embodiment of the disclosed concepts.

Fig. 19 illustrates a frontal view of an asymmetric tertiary bracket of an embodiment of the disclosed concepts.

15 Fig. 20 illustrates a perspective view from above of an asymmetric tertiary bracket of an embodiment of the disclosed concepts.

Fig. 21 illustrates a perspective view of the pivoting stud of an embodiment of the disclosed concepts.

20 Fig. 22 illustrates a side view of a “soft” cover of an embodiment of the disclosed concepts.

Fig. 23 illustrates a perspective view from above of a “soft” cover of an embodiment of the disclosed concepts.

Fig. 24 illustrates cross sectional view of the inside of the “soft cover” of an embodiment of the disclosed concepts.

25 Fig. 25 illustrates a perspective view from above of the cover center section of the “soft” section of an embodiment of the disclosed concepts.

Fig. 26 illustrates a perspective view from below of the cover center section of the “soft” cover of an embodiment of the disclosed concepts.

Fig. 27 illustrates a perspective view from above of the end portion of the cover side sections of the “soft” cover of an embodiment of the disclosed concepts.

Fig. 28 illustrates a perspective view from below of a cover side sections of the “soft” cover of an embodiment of the disclosed concepts.

5 Fig. 29 illustrates a frontal view of a cover side section of the “soft” cover of an embodiment of the disclosed concepts.

Fig. 30 illustrates a perspective view from above of a “hard” cover of an embodiment of the disclosed concepts.

10 Fig. 31 illustrates a perspective view from above of the center cover segment of a “hard” cover of an embodiment of the disclosed concepts.

Fig. 32 illustrates a perspective view from below of the end section of the center cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 33 illustrates a side view of the center cover segment of a hard cover of an embodiment of the disclosed concepts.

15 Fig. 34 illustrates a cross-sectional view of the middle of a center cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 35 illustrates a frontal view of the center cover segment of a hard cover of an embodiment of the disclosed concepts.

20 Fig. 36 illustrates a cross-sectional view along the middle of the center cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 37 illustrates a top view of the center cover segment of a hardcover of an embodiment of the disclosed concepts.

Fig. 38 illustrates a perspective view from the side of a secondary cover segment of a hard cover of an embodiment of the disclosed concepts.

25 Fig. 39 illustrates a perspective view of a secondary cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 40 illustrates a frontal view of a secondary cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 41 illustrates a top view of a secondary cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 42 illustrates a side view of the inner side of a secondary cover segment of a hard cover of an embodiment of the disclosed concepts.

5 Fig. 43 illustrates a side view of the outer side of a secondary cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 44 illustrates a frontal view of a tertiary cover segment of a hard cover of an embodiment of the disclosed concepts.

10 Fig. 45 illustrates a cross-sectional view along the middle of a tertiary cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 46 illustrates a top view of a tertiary cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 47 illustrates a perspective view from above of a tertiary cover segment of a hard cover of an embodiment of the disclosed concepts.

15 Fig. 48 illustrates a perspective view from below of a tertiary cover segment of a hard cover of an embodiment of the disclosed concepts.

Fig. 49 illustrates a side view of the inner side of a tertiary cover segment of a hard cover of an embodiment of the disclosed concepts.

20 Fig. 50 illustrates a side view of the end section of a hard cover of an embodiment of the disclosed concepts.

Fig. 51 illustrates a bottom view of the end section of a hard cover of an embodiment of the disclosed concepts.

Fig. 52 illustrates a perspective view from above an alternative embodiment of the primary frame of an embodiment of the disclosed concepts.

25 Fig. 53 illustrates a frontal view of the primary frame depicted in Fig. 52.

Fig. 54 illustrates a frontal concept diagram of a novel hybrid wiper blade that is an embodiment of the disclosed concepts.

Fig. 55 illustrates a perspective view of a primary frame, a second frame, and a bushing in a joint between the primary frame and the second frame in an alternative embodiment of the disclosed concept.

5 Fig. 56 illustrates a perspective view of the secondary frame and the bushing depicted in Fig. 55.

Fig. 57 illustrates a perspective view of the secondary frame depicted in Fig. 55.

Fig. 58 illustrates a perspective view of the bushing depicted in Fig. 55.

Fig. 59 illustrates a front view of the bushing depicted in Fig. 58.

Fig. 60 illustrates a side view of the bushing depicted in Fig. 58.

10 Fig. 61 illustrates a bottom view of the bushing depicted in Fig. 58.

Fig. 62 illustrates a perspective view of an alternative embodiment of the disclosed concept without a cover attached.

Fig. 63 illustrates an exploded side view of the embodiment depicted in Fig. 62.

15 Fig. 64 illustrates an exploded perspective view of the embodiment depicted in Fig. 62 without the connection device.

Fig. 65 illustrates an exploded side view of the embodiment depicted in Fig. 62 without the connection device.

Fig. 66 illustrates a perspective view of the connection device depicted in Fig. 62.

Fig. 67 illustrates a side view of the connection device depicted in Fig. 62.

20 Fig. 68 illustrates an exploded perspective view on an alternative embodiment of the disclosed concept with a side-saddle connection device.

Fig. 69 illustrates a top-perspective view of an embodiment of the disclosed concept with a side-saddle connection device.

25 Fig. 70 illustrates a bottom-perspective view of the side-saddle connection device depicted in Fig. 68.

Fig. 71 illustrates a side view of the side-saddle connection device depicted in Fig. 68.

Fig. 72 illustrates a perspective view of an additional embodiment of the central cover segment with the secondary cover segment removed.

DETAILED DESCRIPTION

The following detailed description and the appended drawings describe and illustrate exemplary embodiments of the invention solely for the purpose of enabling one of ordinary skill in the relevant art to make and use the invention. As such, the detailed description and illustration of these embodiments are purely exemplary in nature and are in no way intended to limit the scope of the invention, or its protection, in any manner. It should also be understood that the drawings are not to scale and in certain instances details have been omitted, which are not necessary for an understanding of the present invention, such as conventional details of fabrication and assembly.

10 A novel bracketed and/or hybrid (i.e. having both a spring elastic “beam” and one or more brackets/frames) wiper blade having a cover is presented. Several novel concepts are introduced which can be used both with the disclosed novel wiper blade, or separately with various kinds of traditional, hybrid or beam wiper blades. These novel concepts include, but are not limited to, a novel “soft” cover for any type of wiper blade that is more effective at
15 keeping debris out of the internal structure of the wiper blade than traditional covers; a novel segmented hard cover for any type of wiper blade whose segments connect to each other, and do not require connection to the frame, allowing for a tighter fit line between segments and thus reducing the chance of debris from getting into the mechanism.

In certain embodiments, a primary frame, a secondary frame, and a wiper strip. The
20 primary frame, may have a top side and opposite ends, a connection device capable of connecting the wiper blade to a wiper arm disposed on the top side of the primary frame, and a connection structure disposed on one of the opposite ends of the primary frame, the connection structure including pivot extension walls. The secondary frame may have a central pivot connection portion and two leg portions extending from the central pivot
25 connection portion, and a pivot structure disposed on the central pivot connection portion of the secondary frame. Additionally, the pivot structure disposed on the secondary frame may be connected with the connection structure on the primary frame, the secondary frame pivotable about a pivot axis extending through the pivot structure and the connection structure

30 In certain embodiments, the wiper blade also includes an additional connection structure and an additional secondary frame. The additional connection structure may be disposed on the other opposite end of the primary frame, the additional connection structure

including pivot extension walls each having a hole, the holes of the pivot extension walls substantially aligned along an additional pivot axis. The additional secondary frame may have a central pivot connection portion and two leg portions extending from the central pivot connection portion, an additional pivot structure disposed on the central pivot connection
5 portion of the secondary frames, the additional pivot structure may include a pair of holes, the wiper blade may be connected to at least one of the leg portions of both the secondary frame and the additional secondary frame. Additionally, the pivot structure may be disposed on the secondary frame is connected with the connection structure on the primary frame, the holes of the pivot structure substantially aligned along the pivot axis with the holes of the pivot
10 extension walls.

In certain embodiments, the pivot structure may be a separate structure attached to the secondary frame. In certain embodiments, the pivot structure may include a bushing provided between the secondary frame and the primary frame. In certain embodiments, the pivot extension walls may each include a hole, the holes of the pivot extension walls substantially
15 aligned along the pivot axis, and the pivot structure may include a pair of holes substantially aligned with holes of the pivot connection walls along the pivot axis. In some embodiments, a rivet may be insertable through the aligned holes of the pivot connection walls and the pivot structure along the pivot axis. In certain embodiments, the secondary frame may include a pair of wings extending from the central pivot connection portion, each including a hole
20 substantially aligned with the holes of the pivot connection walls and the pivot structure along the pivot axis. In certain embodiments, a rivet may be insertable through the aligned holes of the pivot connection walls, the pivot structure, and the wings of the secondary frame along the pivot axis. In certain embodiments, the central pivot connection portion and the pair of wings, the pivot structure, and the connection structure are dimensioned to have a
25 complimentary shape.

In certain embodiments, the legs of the secondary frame may be symmetrical. In certain embodiments, the wiper blade may also include at least one tertiary frame, wherein at least one leg portion of at least one of the secondary frames is provided with a tertiary frame connection structure, and wherein the at least one tertiary frame is connected to the tertiary
30 frame connection structure of the least one of the secondary frames.

In certain such embodiments, the wiper blade may also include a cover. In certain such embodiments, the primary frame further comprises a cover-connection structures. In

certain such embodiments the cover may be a segmented hard cover, and wherein the cover segments connect to one another via pivot joints, and wherein the cover may be secured to the wiper blades at cover connection structures on the primary frame or secondary frame.

5 In certain such embodiments the cover may include a cover center section and two cover side sections that are made from a soft, elastic material, wherein the cover side sections cover the ends of the cover center section and extend to the ends of the wiper blade. In certain such embodiments, a central cover portion may be made from a harder material than the two cover side sections.

10 In another embodiment of the disclosure, a wiper blade includes a wiper strip, a primary frame, and a secondary frame. The primary frame may have a top side and opposite ends, a connection device having a base attached to the primary frame on the top side, the connection device being capable of connecting the wiper blade to a wiper. The primary frame may further include a connection structure disposed on one of the opposite ends of the primary frame. The secondary frame may have a central pivot connection portion and two
15 leg portions extending from the central pivot connection portion, a pivot structure disposed on the central pivot connection portion of the secondary frame, wherein the pivot structure disposed on the secondary frame is connected with the connection structure on the primary frame, the secondary frame pivotable about a pivot axis extending through the pivot structure and the connection structure.

20 In certain embodiments the connection device may be disposed side-saddle to the wiper blade. In certain embodiments the base of the connection device may be recessed into the top side of the primary frame. In certain embodiments, device is attached by having a protrusion on each end of the connection device secured into a respective receiving hole in the primary frame.

25 In an additional embodiment of the disclosure, a wiper blade includes a wiper strip; a force distribution structure having opposite ends, the wiper strip connected to the force distribution center; and a cover, wherein the cover is a segmented hard cover comprising a plurality of cover segments, and wherein the cover segments connect to one another via pivot joints, and wherein the cover is secured to the wiper blades at cover connection structures on
30 the primary frame or secondary frame, wherein at least one of the cover segments has an end wall.

As can be seen in Figs. 2-4 the main support structure of the wiper blade preferably includes a primary frame **20** having a connection device **10** on its top side to which a connector and/or or adapter (not shown) can be used to connect the wiper blade to a wiper arm. Suitable connectors which allow the wiper blade to be connected to various different types of wiper arms are known in the art, and include U.S. Patent No. 6,640,380 and U.S. Patent Application Serial Nos. 13/558,624, and 13/560,585.

Alternatively, the connection device **10** can be implemented to connect directly to a particular kind of wiper arm with or without the use of a connector and/or adapter. The connection device **10** may attach to the primary frame **20** through the use of welding, screws, rivets, claws, crimping or any other method known in the art. Alternatively, the connection device **10** may be an integrated part of the structure of the primary frame **20**. The connection device **10** may be made out of metal, plastic or any other suitable material known in the art or any combination of suitable materials known in the art.

The primary frame **20** may be made out of metal, plastic or any other suitable material known in the art, or any combination of suitable materials known in the art. The primary frame **20** may be straight or predominantly straight in shape when viewed from the front (as shown in Fig. 2-4), or may bear a more pronounced curvature. A connection to a pivot structure may be located at each end of the primary frame **20**, and allows the primary frame **20** to connect to a secondary frame **30**, in such a manner as to allow the secondary frame **30** to pivot about a pivot axis. A novel pivot structure which is the subject of U.S. Provisional Application 61/603,223 and the nonprovisional application filed concurrently herewith is described below, but any pivot structure known in the art may be used in connection with the described wiper blade.

As shown in Fig. 5, the profile of the primary frame **20** below the connection device **10**, when viewed along the longitudinal axis of the wiper blade, is preferably U shaped to add strength and rigidity to the primary frame. The primary frame may have a horizontal wall **21** from which two side walls **22** may descend vertically. The distance between the side walls **22** may be constant along the length of the primary frame **20**, or it may taper or expand as it approaches either end of the primary frame **20**. As described above, at either end of the primary frame is a connection to a pivot structure. One such connection is shown in Figs 2-5, as pivot extension walls **23**. These pivot extension walls **23** extend from the side walls **22** of the primary frame **20** and facilitate the connection of the primary frame **20** to the pivot

structure. The pivot extension walls may be provided with holes **24** which will form part of the pivot structure, wherein a rivet, or protrusions may be placed to facilitate the pivoting of the secondary frame **30**. Persons of skill in the art will recognize that various alternative pivot structures, and connections to pivot structures might be used and remain within the scope of the disclosed concepts, including without limitation providing the pivot extension walls with protrusions instead of holes, or a rivet onto which other parts of the pivot structure can attach by in any known manner. The horizontal wall **21** may end before, or part way along, the pivot extension walls **23** in order to give the pivot structure a wider range of motion, or may optionally extend all the way to the end of, or past, the pivot extension walls **23**.

Figs. 52 and 53 show another embodiment of the primary frame **20** wherein the horizontal wall **21** running along the top of the primary frame **20** is angled such that from an area near the connection device **10** the surface of the horizontal wall **21** decreases in height it approaches the pivot extension walls **23**. The walls joining the horizontal wall **21** to the side walls **22** in this embodiment is also sloped (and in some embodiments, may be fluted), and the width of the horizontal wall **21** is narrower nearer to the connection device **10** than on the ends of the primary frame **20**. This allows a cover **60, 70** to have a greater degree of fluting and a narrower top, which can give it an aerodynamic effect similar to spoiler, which can improve the wiper blade's wind-lift performance.

Figs. 62-67 illustrate another embodiment of primary frame **20** wherein the horizontal wall **21** running along the top of the primary frame **20** as well as the side walls **22** include a cut-out, countersunk or recessed portion **24** where connection device **10** may be connected. Such cut-out, counter sunk or recessed portion **24** will be collectively referred to as "recessed" hereinafter. Recessed portion **24** may accordingly accommodate a lower profiled embodiment of connection device **10**, which may be sunk into the recessed portion thereby providing a lower profile along the top of the wiper blade. Horizontal wall **21** is illustrated as angled, similar to the embodiment shown in Figs. 52 and 53 and described above. The combination of an angled wall and a lower profile thereby provides an improved aerodynamic effect. In addition to the lower profile, recessed portion **24** may permit a raising of side walls of connection device **10**, thereby permitting a connecting device of a wiper arm to be fully covered while maintaining a low profile. Such raised side walls of connection device **10** may strengthen the stability of a connection to a wiper arm in order to reduce

dithering or fishtailing of the wiper blade as it passes over a window pane. In this embodiment the connection device 10 connects to the primary frame 20 by having a protrusion 12 on the connection device 10 inserted into a receiving hole 26 on the primary frame. The protrusion 12 on the connection device 10 is then secured to the primary frame 20 by crimping, welding, or otherwise secured by any method currently known in the art. As shown in Figs 64 and 66, positioning protrusions 12 may optionally be disposed on the primary frame, and corresponding positioning holes 26 or recesses may be disposed on the connection device 10.

An alternative low profile embodiment of primary frame 20 and connection device 10 is illustrated in Figs. 68-71 featuring a side-saddle embodiment of connection device 10. In this embodiment, primary frame 20 features the recessed portion 24, while connection device is offset from primary frame 20 in order to provide for an offset connection to a particular kind of wiper arm with or without the use of a connector and/or adapter. It should be understood a side-saddle connection device 10 is not restricted to a low profile embodiment, and may be alternatively provided with the other embodiments of primary frame 20 not featuring a low profile or recessed portion 24.

As discussed in greater detail below, the primary frame **20** and/or the connection device **10** may also have cover-connection structures, such as projections, recesses, extension walls with holes, recesses, projections or rivets, etc., to facilitate the connection of the cover **60, 70**, or portions thereof, to the primary frame **20**.

The secondary frame **30** is preferably made out of metal, such as steel, and can optionally be spring-elastic. The secondary frame **30** can also be made from plastic, or any other suitable material known in the art. In certain embodiments (not shown in the figures), the secondary frame **30** can be a curved, spring-elastic beam, making the such embodiments “hybrid” wiper blades, as they are a hybrid combining elements of a bracketed (or framed) wiper blade and a beam (or frameless) wiper blade. The secondary frame **30** preferably has a central pivot connection portion **31**, which connects the secondary frame **30** to the primary frame **20** via a pivot structure. The central pivot connection portion **31** is preferably flattened (as shown in Figs. 6 and 7), but may be curved. The central pivot connection portion **31** may have connecting structures, such as recesses **32**; projections; or pivot joint wings having either (1) a rivet or projections to attach to corresponding recesses, holes or clips in the primary frame’s **20** pivot extension walls **23** or other connection to a pivot structure; or (2)

recesses to receive corresponding projections, rivets, etc. in the primary frame's **20** pivot extension walls **23** or other connection to a pivot structure. The pivot structure may, accordingly, define a pivot or joint axis from which secondary frame **30** may pivot or rotate about when secondary frame **30** is connected to primary frame **20**. Persons of skill in the art will recognize that numerous types of pivot structures can be used, whether directly connecting the secondary frame **30** to the primary frame **20**, or as described below in the novel pivot joint presented, using an intermediary piece (or pieces) to join the two.

On either side of the central pivot connection portion **31**, the secondary frame **30** has legs **33**, **34**. The legs **33**, **34** of the secondary frame **30** may be symmetric or asymmetric (as shown). The legs **33**, **34** of the secondary frame **30** may be of the same, or different in lengths. In some embodiments, it may be advantageous to have the outer leg **33** (the leg further from the middle of the wiper blade) with a longer length than the inner leg **34** to allow a more compact primary frame **20**, while still allowing the wiper blade to wrap around the curvature of the windshield along its extremities, and improve wipe quality. Similarly, each leg **33**, **34** may be independently straight, curved, or have a more elaborate structure depending on the vehicle(s) for which they are designed. In some embodiments having curved legs **33,34** it may be advantageous to have the curvature of the inner leg **34** (i.e. the leg closer to the center of the wiper blade) be different than the curvature of the outer leg **33**. In some embodiments, it can be particularly advantageous to provide the inner leg **34** with a sharper curvature than the curvature of the outer leg **33** in order to provide better wrapping of the wiper blade around the curvature of a windshield, and thus improving wipe quality. Similarly, in embodiments with straight legs **33**, **34** it may be advantageous to provide the outer leg **33** with a smaller angle of descent from the central pivot connection portion θ than the angle of descent φ of the inner leg **34**.

As shown in Figs. 6 and 7, the secondary frame **30** may be a generally thin bracket, and may optionally be provided with a strengthening and stiffening bead **35**, giving it a more robust form, and increasing its lateral rigidity. The strengthening bead **35** may be provided along either, or both legs **33**, **34**, and may also extend onto portions of the central pivot connection portion **31**.

As discussed above, persons of skill in the art will recognize that the pivoting structure joining the primary frame **20** and the secondary frame **30** may be made in many different ways known in the art, either by directly connecting the two frames, or by using

intermediary structures to do so. One such method for connecting the primary frame **20** to the secondary frame **30**, described in greater detail in U.S. Provisional Patent Application No. 61/603,223, and in the concurrently filed non-provisional application entitled Hinged Wiper Blade filed concurrently herewith uses a turn-buckle holder **51** made up of two holder halves **52** held together by a rivet **50**. Thus, when assembled, one holder half **52** is attached to the secondary frame **30** opposite the other holder half **52** at the central pivot connection portion **31** wherein the central pivot connection portion **31** is inserted into the channel **54** formed between the upper channel wall **56** and lower channel wall **57** of each holder half **52**. The holder halves **52** are then pushed together such that the holder half's **52** projections **55** engage the recesses **32** on the central pivot connection portion **31** of the secondary frame **30**. Alternatively, in embodiments where the central pivot connection portion **31** has projections, the holder halves **52** can be implemented so as to have recesses to receive such projections.

Once the holder **52** halves have been pushed together such that the turn-buckle holder **51** contains the secondary frame **30** within its channel **54**, the turn-buckle holder **51** can be placed between the pivot extension walls **23** of the primary frame **20**, and a rivet **50** (shown in Fig. 8) can be passed through the holes **24** in the pivot extension walls **23** and through the rivet passage **53** in the turn-buckle holder **51** and secured on the opposite side. Persons of skill in the art will recognize that various modifications of such a structure can be made while remaining within the scope of the disclosed concepts, including without limitation, providing protrusions on the pivot extension walls **23** which can engage the rivet passage **53** in the holder, or providing the holder **51** with protrusions that can engage the holes **24** in the pivot extension walls **23**. Figures 9-12 show various views of the holder **51**. Fig. 12, in particular, shows a cross-section of the turn-buckle holder **51** taken through the channel **54** along its plane. As can be seen in Fig. 12, the projections inside the holder halves **52** (and thus also the corresponding recesses **32** in the secondary frame **30**) can be made of varying sizes, and need not be symmetric with the projections **55** in the opposite holder half **52**. In certain embodiments, such as that depicted in Fig. 12, two different sizes of projections **55** may be used in the holder halves **52** in order to facilitate proper alignment of the secondary frame **30** with the turn-buckle holder **51** during assembly. In an alternative embodiment, the turn-buckle holder **51** is a unitary structure. Such a structure can be made through insert molding, where the unitary turn-buckle holder is molded around the secondary frame. This provides a tighter grip by the turn-buckle holder on the secondary frame.

Figures 13-16 show various views of a holder half 52. As can best be seen in Figs. 13 and 15, the lower channel wall 57 may be angled, or curved in order to allow pivoting of the secondary frame 30 within the turn-buckle holder 51, or to facilitate the attachment of the turn-buckle holder to the secondary frame 30 by providing a wider entry point on the edges of the channel 54 in the holder half 52 while still providing a snug-fitting attachment in the middle portion of the holder half 52. Alternatively, both the top channel wall 56 and the lower channel wall 57 may be shaped to follow the contour of the central pivot connection portion 31 of the secondary frame 30 or to facilitate insertion of the secondary frame 30 into the holder halves 52. This novel pivot-hinge connection between the primary and secondary frames can be accomplished within the limited height of the pivot extension walls 23 of the primary frame 20, and thus allows the disclosed wiper blade to maintain a relatively low profile, thereby reducing the effect of wind-lift on the wiper blade at high speeds and reducing or obviating the need for a spoiler on the wiper blade.

An embodiment of the disclosed concept utilizing an alternative novel pivoting structure for pivotably connecting primary and secondary frames 20, 30 together at a central pivot connection portion is illustrated in Figs. 55-61. Figs. 55-57 illustrate a bushing 151 provided between primary frame 20 and secondary frame 30 and secured by rivet 50, in accordance with an embodiment of the invention, while Figs. 57-60 illustrate bushing 151 alone. Bushing 151 includes an upper wall 156 with a pair of side walls 152, each extending from an end of upper wall 156. Side walls 152 may each further include an aperture or hole 153 through which rivet 50 may be inserted. Side walls 152 are preferably parallel and holes 153 are preferably aligned in order to accommodate the insertion of rivet 50 there through. The bushing 151 is preferably made of molded plastic, but may be made of other types of plastic, steel, other metals, synthetic materials, or any suitable material known in the art. Upper wall 156 may further include an opening or gap 154 in order to facilitate a molding process for manufacturing bushing 151. Upper wall 156 and side walls 152 are illustrated as a single, integral structure, preferably manufactured through a molding process, however persons of skill in the art will appreciate that side walls 152 may be separately manufactured and attached to upper wall 156 by any appropriate securing method known or to be developed.

Also provided is an embodiment of secondary frame 30 having wings or legs 38 protruding downwards from either side of secondary frame 30 between recesses 32. Each

wing 38 is provided with a hole 39. As shown, bushing 151 may be placed over secondary frame 30, with primary frame 20 placed over bushing 151, all three mutually securable by rivet 50 through mutually aligned holes 24, 153, 39. By interposing bushing 151 between frames 20, 30, a joint connection may be provided permitting increased bendability while
5 separating frames 20, 30 from frictionally wearing against each other. By including bushing 151 in an embodiment of the pivoting structure, frictional wearing between frames 20, 30 is reduced or avoided, thereby reducing maintenance because bushing 151 is easily replaceable.

Bushing 151 may thus be dimensioned to form a complimentary shape in order to be interposed between primary frame 20 and secondary frame 30. Specifically, side walls 152
10 may be parallel or substantially parallel with wings 25, 38, while wall 156 may be parallel or substantially parallel with walls 21, 31. The complimentary shape may also include holes 153, 24, 39 mutually aligned along a joint axis in order to mutually receive rivet 50, or other known or to be developed connectors. In some embodiments, one or both holes 153 in bushing 151 includes a protruding channel 154 on the inner side of bushing 151 which may
15 be fittable into hole 39 thereby further securing bushing 151 to secondary frame 30 and preventing any frictional wear between the rivet 50 and the secondary frame 30. The complimentary shape may be described as a substantially “U” shape as viewed from a side profile, however it should be understood to a person of ordinary skill in the art that additional complimentary shapes are contemplated as within the scope of the invention. For instance,
20 wings 25, 38 and side walls 152 may project at a non-perpendicular angle away from their respective walls 21, 156, 31, and aligned holes 24, 153, 39 may not be co-axial, rather are mutually securable by a non-linear connector as opposed to rivet 50. Such an alternative complimentary shape may offer the benefit of increased pivotability.

The ends of the secondary frame 30 may either be provided with a wiper strip holder,
25 such as the claws 43 on the tertiary frames 40, 41, or may with a connection extension 36 having a structure to connect to a tertiary frame 40, 41. In certain embodiments, as shown in figs. 6-7 and 17-21 the connection between the secondary frame 30 and the tertiary frame(s) 41, 42 is formed by passing a pivoting stud 44 through a hole 42 in the central joint connection portion of the tertiary frame and a hole 37 in the connection extensions 36 on the
30 secondary frame 30. As shown in Fig. 21, the pivoting stud 44 has a tertiary base portion 45 sized to fit in the hole 42 of the tertiary frame 40, 41, and a bottom portion 47 that is wider than the hole 42 in the tertiary frame 40, 41. Thus tertiary frame 40, 41, is supported on the

bottom portion 47 of the pivoting stud 44 when the wiper blade is assembled. Accordingly the base portion 47 may be curved (as shown in Fig. 21) or angled in order to facilitate the pivoting of the tertiary frame 40, 41. The pivoting stud 44 is also provided with a top portion 48 and a neck 46 wherein the diameter of the neck is approximately the same as the width of top portion 48 and smaller than the length of the top portion. Both are the top portion and the neck are sized to fit into the hole 37 of the secondary frame, and the height of the neck is approximately the same as the thickness of the connection extension 36 of the secondary frame 30. During assembly, the pivoting stud's 44 top portion 48 and neck 46 are inserted into hole 37 in the connection extension 36 of the secondary frame 30, and then turned such that the top portion 48 is perpendicular to the long side of the hole 37 in the connection extension 36. Accordingly a high friction material, such as natural or synthetic rubber is preferred for the pivoting stud 44, but plastic and/or other suitable materials may also be used. Persons of skill in the art will recognize that alternative forms of connecting the tertiary frames to the secondary frames may be used within the scope of the disclosed concepts, and that any of the forms for creating a pivoting structure/joint between the primary and secondary frames discussed above could be implemented between the secondary and tertiary frames, and vice versa.

The tertiary frames 40, 41 may be symmetrical tertiary frames 40 or asymmetrical tertiary frames 41. In certain embodiments, as shown in Figs. 2-3, it may be advantageous to use symmetrical tertiary frames 40 on the connection extensions 36 nearer to the middle of the wiper blade, and asymmetric tertiary frames 41 on the connection extensions 36 nearer to the extremities of the wiper blade. In such embodiments it may be advantageous to put the longer leg of the asymmetric tertiary frames 41 extending outward from the wiper blade so as to provide a better wrap around the surface of a curved windshield of a vehicle.

Whether symmetric or asymmetric, the tertiary frames are provided with claws 43 which support the wiper strip 15. The wiper blade described herein can use any of the traditional wiper strips known in the art, which generally have a base portion having grooves into which metal vertebrae are inserted to provide lateral support for the wiper strip 15. Alternatively, the wiper blade described above can be implemented using the wiper strip carrier described in U.S. Patent Application Serial No. 13/558,624.

As shown in Figs. 19 and 20, the tertiary strip may have a structure to support and/or secure the cover **60, 70**. The support structure shown in Fig. 19 and 20 is a chamfered “T” shaped structure **49** which the end of the cover can grip onto and support itself. Such a support structure can be put on either an asymmetric tertiary frame **41**, as shown, or on a symmetric tertiary frame **40**. Any other types of supporting structures for the cover **60, 70** described above with regard to the primary frame, or otherwise known in the art, including rivets, projections, recesses, wing walls having same, etc. can be used on the tertiary frames **40, 41**. Similar such supporting structures can also optionally be included in the secondary frame **30** as well.

The novel “soft” cover **60** introduced in this provisional patent application can be used with any known type of wiper blade, including the above-described wiper blade, beam blades,

The wiper blade covers on commercial wiper blades (whether with or without spoilers) generally have a hard plastic cap (see U.S. Patent Nos. 7,293,321 and 7,523,520) hovering over the connection device (See U.S. Patent No. 6,944,905). Particularly in beam blades, the hard plastic cap above the cover must leave a gap between the top surface of the cover and the bottom surface of the cap. Failure to leave such a gap results in the cap pushing down on the cover during the operation of the wiper blade, which compresses the material of the cover, and exerts a force onto the beam or other support structure, which can have adverse effects on the wipe quality of the wiper blade. Similarly, designing a connection device to form a contact seal with a cover can really only be done by custom-tailoring the wiper blade to a particular curvature of a particular windshield. Thus for aftermarket wiper blades, where the manufacturer does not know what windshield its products will be used on, the required specific calculations cannot be made across multiple windshields, and thus the same problem of cover-material compression and adverse forces on the beam/support structure may be present on some windshields but not others. Accordingly most wiper blade manufacturers (particularly after-market manufacturers) provide wiper blades with a gap between the cover and the cap or other structure that covers it. The novel “soft” cover **60** presented in this application solves these problems by reversing the order of the pieces. This allows the relatively softer material on the cover side sections **64** stretch when necessary as the wiper moves over the windshield, which lessens or eliminates the adverse forces put upon the beam, vertebrae and/or support structure of the wiper blade. At

the same time the relatively harder material of the cover center section **61** helps secure the connection with the cover side sections **64**. Persons of skill in the art will recognize that it is not necessary for the cover center section **61** to be made from a harder material than the cover side sections **64**. Indeed they can be made from the same material. Suitable materials for both the cover center section **61** and the cover side sections **64** include natural and synthetic rubber, plastic, and other materials known in the art. However, in some embodiments it has been found advantageous to use a plastic material with a Shore hardness A values above 90 in the cover center section **61**, and plastic, natural rubber, or synthetic rubber material with Shore hardness A values between 60 and 90 in the cover side sections **64**. Improved results have been found using a material of Shore hardness A between 80 and 88 in the cover side sections **64**, as it is still flexible enough not to affect the beam/support structure, but hard enough to maintain good grips on the cover center section **61** as well as on the wiper blade's primary frame **20**, secondary frame **30**, tertiary frame **40**, **41** and/or a beam (in the case of beam blades and/or hybrid blades).

Accordingly a cover center ("hard") section **61** is provided with side connecting structures **62**, and top recesses/holes **63** which receive corresponding side receiving structures **65** and top projections **66** from the cover side sections **64**. The cover center section **61** is preferably, but not necessarily, made from a harder material than the cover side sections **64**.

Figures 22-24 show the novel "soft" cover with the cover center section **61** and the cover side sections **64** connected. Fig. 24, which has a cross-sectional view, shows the mechanics of the connections between the sections of the cover **60**, showing the top projections **66** on the cover side sections **64** engaging the top recesses/holes **63** in the cover center section **61**.

As shown in Figs. 25-26, the top holes **63** in the cover center section **61** may be located on a recessed ledge such that when the cover side sections **64** are attached, a smooth, continuous surface is present on the combined structure (see Fig. 22-24). The side connecting structures **62** on the cover center section **61** may project outwardly from the main body of the of the cover center section **61**, and may optionally include bottom projections (shown in Figs 24-26) which grip a corresponding recess or hole in the cover side sections' **64** side receiving structures **65**. These side connecting structures **62** may further be laterally recessed in order to provide a smooth transition of the outer surfaces of the cover center section and the cover side sections **64** on the sides as well. Moreover, the recessed ledge

housing the top hole **63** and the recessed side connecting structures **62** may be joined such that the cover side section lip which covers these structures forms a seal along the boundary of these structures to prevent any water or debris from entering therein. The cover center section may have a hole for the connection device to pass through, and may have internal
5 grips **68** which grip may be used to grip the primary frame **20**, connection device **10**, and/or beam (in the case of beam or hybrid wiper blades).

Figs. 27 and 28 show the corresponding structures on the cover side sections **64** that connect it to the cover center section **61**. The side receiving structures **65** on the cover side sections **64** receive the side connecting structures **62** from the cover center section **61**. As
10 shown in Fig. 28, these side receiving structures **65** may have a recess or hole in them to receive the optional bottom projection of the side connecting structures **62**. For added ease of making the connection, and to ensure a better connection, as shown in Figs. 24 & 29, the side receiving structures **65** can project outwardly from the cover side section **64**. This increases the surface area of the side connections, and provides a guiding path for the insertion of the
15 side connecting structures **62** into the side receiving structures **65**. The top projection **66** may be located on a lip of the which may be elevated, or have a smaller thickness than the main walls of the cover side section in order to facilitate the smooth transition in the outer surface of the joined cover center section **61** and cover side sections **64**. This lip may also help form a seal to keep water and debris out of the internal structure of the wiper blade. Accordingly,
20 the top projection **66** and side receiving structures **65** together with the top hole **63** and side connecting structures form a three sided locking mechanism which ensures better protection against the elements without interfering with the operation of the underlying support structure, whether it is brackets or beams.

Fig. 28 also shows several different kinds of internal grip structures. The contoured
25 grip **68a** extends back from the side receiving structures **65**, gripping and following the contour of the bottom of the primary frame **20**, including sloping downwards towards the end of the grip structure to follow the contour of the pivot extension walls **23**. The rib grip **68b** acts both as a structural supporting rib, and as a loose grip on the secondary frame **30**, and has a recess cut into it to accommodate a bead **35** on the secondary frame **30**. This loose grip
30 allows the secondary frame to move upwards and downwards during operation of the wiper blade within a set range without interfering with the movement of the secondary frame **30**. The loose internal grip can also be used on the “quarter” portion of beam/hybrid blades – half

way between the center and the end of the beam – to give that part of the beam room to bend without interfering with its behavior. Intermittent or continuous claw-like grips (not shown) can also be used, particularly on beam blades and/or hybrid blades where the cover must be secured to the beam. One possible internal end grip **69** is also shown in Fig. 28. This grip
5 has a slotted pocket in the end portion of the cover which receives the chamfered “T” structure on the tertiary frame **41** of the above-described wiper blade. Other types of end grips may be used, including detents, dovetails, projections, and all such end grips described in U.S. Patent Application Serial Nos. 13/453,601, 13/572,100 and 13/587,389.

10 A second type of novel cover – a “hard” cover **70** is presented in Figs. 30-52. As shown in Fig. 30, the cover **70** may be composed of multiple segments. A center cover segment **71** has an opening **74** through which the connection device **10** can be passed. Secondary cover segments **72** can be attached to each side of the central cover segment **71**. Optional, tertiary cover segments **73** can be attached to the outer ends of the secondary cover
15 segments **72**. Additional cover segments can also be used on covers of this type. The outermost end of the outermost segment has an end section **75**. The segments of the “hard” cover are preferably made of a plastic, and need not actually be “hard”. It can be advantageous to use a plastic having a Shore hardness A of greater than 90. However, any suitable material known in the art can be used to make the cover **70**, including materials
20 having a Shore hardness A values of 90 or less.

Figs. 31-37 illustrate various views of the center cover segment **71** of the cover **70**. The end sections of the center cover segment **71** has receiving walls **711**, which are used to connect to the secondary cover segments **72** using a pivoting connection. The receiving walls **711** may have a receiving channel **712** and a seating recess **713** which receives a projection
25 **722** from the secondary cover segments **72**. The a seating hole may also be used in place of a seating recess **713**. In some embodiments it may be advantageous for the receiving walls to be narrower than the main walls of the center cover segment **71**, or to have the receiving walls **711** taper so as to allow them to deflect enough to allow the insertion of the projections **722** of the secondary cover segment **72**. Persons of skill in the art will recognize that the
30 projection may be located on the center cover segment **71**, and that the seating recess may be located on the secondary cover segment **72**. Likewise other pivoting connections known in the art, including the use of rivets, or additional structures known in the art which allow the

center cover segment and the secondary cover segment to form a pivoting connection may also be used.

The center cover segment **71** may also have a lip **714** which can cover the sides of the connection device, and hold grips **715** and/or other structures which can help secure the center cover segment **71** to the primary frame **20**. Additional internal grips **717**, **718** can be located along the inner surface of the center cover section **71** and may also help secure the center cover section to the primary frame **20**. As can be seen in Figs. 33 and 34, the internal grips **717**, **718** may be implemented as appropriate to fit a particular design of primary frame **20**. For instance the inner internal grips **717** are sized to secure the shorter middle portion of the side walls **22** of the primary frame **20**, while the outer internal grips **718** are sized to secure the larger pivot extension walls **23** of the primary frame **20**.

Fig. 72 further illustrates an embodiment of the disclosure where the end sections of center cover segment **71** includes an end wall **719** thereby thickening the cover at least proximate to the end sections. The cover may protrude farther downward, towards secondary frame **35**, than the adjacent or adjoining wall of secondary cover **72**. By including end wall **719**, the central cover segment **71** blocks weather elements, such as snow or rain, from entering between central cover segment **71** and secondary cover segment **72** as they pivot respective to one another in order to avoid damage to or ice forming on the covered elements, such as secondary frame **35** or the pivot structure.

As shown in Figs 30, 31, 33 and 34, the cover **70** may be provided with fluting **716** on its outer walls. The fluting may act as an aerofoil to help increase the downward force on the wiper blade at higher speeds. Alternatively the cover may be shaped to embody a spoiler, with or without fluting. Such spoilers can be embodied as a symmetric isosceles triangle (with or without fluting), as an asymmetric right triangle (with or without fluting), or in any other suitable shape. Similarly, embodiments of the cover **70** that do not have a spoiler may also be symmetric, as shown in Fig. 30 - 51, or asymmetric.

Figs 38-43 illustrate various views of the secondary cover segments **72** of the cover **70**. The inner side of the secondary cover segment includes a connecting wall **721** which contains a projections **722** which pass through the receiving channel **712** and into the seating recess **713** of the receiving wall **711** of the center cover segment **71**. The connecting wall **721** may be narrowed, or may taper in order to bend to allow the insertion of the projection **722** into the seating recess **713**. As best shown in Figs. 39 and 41, the connecting wall **721** is

preferably laterally recessed, such that the receiving wall 711 of the center cover segment 71 can cover it. The outer edge 723 of the inner side of the secondary cover segment 72 and the edge of the receiving wall 711 may have complementary shapes which allow the secondary cover segment 72 and the center cover segment 71 to form a pivot joint that can move during
5 the operation of the windshield wiper as the curvature of the windshield underneath the wiper strip 15 changes. The outer edge 723 of the inner side of the secondary cover segment 72 may also define a covering portion 724 which covers a portion of the outer edge of the center cover segment 71, and can help prevent water, ice or debris from entering the internal structure of the wiper blade. Persons of skill in the art will recognize that a covering portion
10 can instead be located on the receiving walls of the center cover segment, and can cover corresponding portions of the inner side of the secondary cover segment. Persons of skill in the art will also recognize that a covering wall (not shown) can be used to join the portions of the edge of the segment that is covered by the covering portion 724, in order to increase the protection against debris, water and ice at the joint between the center cover segment and the
15 secondary cover segment.

The secondary cover segment may have an end section 75, or it may have a second receiving wall 725 with a second receiving channel 726 and a second seating recess 727 which connect the secondary cover segment 72 to a tertiary cover segment 73. Persons of skill in the art will recognize that it is not necessary for the cover 70 to be symmetric, or to
20 have the same number of segments on each side of the center cover segment 71. As discussed above, persons of skill in the art will also recognize that the projections and recesses connecting the cover segments may be reversed, and that other pivoting structures such as rivets may be used to make the pivoting connection between the cover segments.

As illustrated in Figs. 42 and 43, the secondary cover segment 72 may also have
25 internal grips 728, 729 which can grip the portion of the frame that the secondary cover segment 72 covers. The internal grips 728, 729 depicted are sized to secure the secondary frame 30 of the wiper blade. The internal grips may be sized to form a tight grip on the corresponding portion of the frame, or may be sized larger than the frame in order to give the frame a defined freedom of movement within the grip to allow for greater variability in its
30 positioning during the operation of the wiper blades, as the curvature of the windshield under the wiper changes.

An embodiment of a tertiary cover segment is illustrated in Figs. 33-50. The depicted tertiary cover segment **73** has a second connecting wall **731** having a second projection **732** which engages the second seating recess **727** on the second receiving wall **725** of the secondary cover segment **72**. The tertiary cover segment **73** may have an outer edge **733** which is shaped complementary to the second receiving wall **725** of the secondary cover segment **72** so as to allow the joint between the secondary cover segment **72** and the tertiary cover segment **71** to pivot and move during the operation of the wiper blade. The tertiary cover segment **73** may have a second covering portion **734** which covers the corresponding portion of the receiving wall **725** of the secondary cover segment **72** so as to help prevent water, ice and debris from entering the internal structure of the wiper blade. The edge of the second receiving wall **725** may be provided with a wall to help cover the region underneath the second covering portion **734** to add additional protection against the elements.

As can be seen in Figs. 46 and 47, on the second connecting wall, opposite the second projections **732**, reinforcing projections may be added to strengthen the integrity of the second connecting wall **731**, and the connection between the secondary cover segment **72** and the tertiary cover segment **73**. The second connecting wall **731** may be narrow, or may taper, so as to allow it to deflect enough to allow the second projection to enter the second seating recess **727**. Again, a hole may be used in place of the second seating recess **726**, and other pivoting connections known in the art, such as rivets, may also be used to establish the joint connection between the tertiary cover segments **73** and the secondary cover segments **72**.

The receiving channel **712** and second receiving channel **726** may be provided with a ramp or chamfer structure to facilitate the insertion of the corresponding projection **722** and second projection **732** into same.

The tertiary cover segments **73** may be provided with internal grips to secure the segments to the corresponding portion of the cover, as described above relating to the internal grips of the center cover segment **71** and the secondary cover segments **72**. The tertiary cover segment may also be provided with ribs between the side walls to give them additional structural strength and stability. Indeed, ribs may be provided to any of the cover segments **71**, **72**, **73**, or cover sections **61**, **62** described above, and the ribs may also help form the internal grips of all such structures. Persons of skill in the art will also recognize that there are numerous shapes that the internal grips can take, as described above, or as otherwise known in the art, including "L" shaped grips, "C" shaped grips, etc.

The tertiary cover segment **73** may optionally connect to additional cover segments (not shown), or may have on their outer end an end section **75**. The end section **75** of the cover **70** may optionally have a securing structure, connecting the end section to the frame of the wiper blade. One such structure is depicted in Fig. 51, shows a recess **751** and a detent
5 **752** that are shaped to engage the “T” shaped ends of the outer tertiary frames **41** of the wiper blades. As described above in connection with the “soft” cover, numerous structures are known in the art for forming that sort of connection,

and all such structures and other structures known in the art may be used, and are
10 contemplated as within the scope of the disclosed concepts.

A novel hybrid wiper blade is presented in Fig. 54. A specific embodiment of this hybrid wiper blade is set forth in concurrently filed provisional patent application entitled Hinged Wiper Blade filed concurrently herewith. The novel hybrid wiper blade generally has a primary frame, which may be as described above, and can be generally flat, curved,
15 triangular, or have any other suitable desired shape. The primary frame **120** preferably has a connection device **110** attached to its top surface or formed integrally therewith, in any of the methods known in the art or depicted above. At either end the primary frame connects to a pair of beams **130**, preferably made from spring-elastic steel, although other suitable materials may be used. As described above with respect to the connection device **1** in Fig. 1,
20 any manner of connector, adaptor or specialized design for a particular wiper arm known in the art can be used with the connection device **110**.

The connection between the beams **130** and the primary frame **120** is preferably formed by a pivot joint of some sort. This may be accomplished in any method currently known in the art. For example the beams **130** may be provided with structures (similar to a
25 connection device **10, 110**) having a two pairs of claws which are crimped, welded or formed onto the beams **130**, and having two parallel side walls having which may have projection, recesses or holes, rivets or other structures which can attach to recesses or holes, projections, clips and/or holes, and other complementary structures on the ends of the primary frame **120** in order to form a pivoting connection. The beams **130** may be symmetric
30 across the pivot joint in length and/or curvature, or asymmetric (as shown in Fig. 54).

Tertiary frames **140** are secured to the beams **130**, and in turn secure the wiper strip (and any vertebrae, and/or wiper strip carrier as described above. The connection between

the beams **130** and the tertiary frames **140** may be made in any manner known in the art, including the use of pivoting studs **44** and other pivot joints known in the art as described above. Like the inner and outer tertiary frames **40,41** described above, the hybrid blade depicted in Fig. 54 may have symmetric or asymmetric tertiary frames **140**. Additionally, 5 any one or more of the connection device **110**, primary frame **120**, beams **130**, and tertiary frames **140** may be provided with structure to help it connect to a cover **60, 70** described above, or any other type of cover or spoiler known in the art.

The descriptions set forth above are meant to be illustrative and not limiting, and persons of skill in the art will recognize that various common and known deviations from the 10 above described structures are considered to be within the scope of the disclosed concepts described herein.

Claims:

1. A wiper blade comprising:
a wiper strip;
a primary frame having a top side and opposite ends, the primary frame comprising
5 a connection device capable of connecting the wiper blade to a wiper arm
disposed on the top side of the primary frame, and
a connection structure disposed on one of the opposite ends of the primary frame,
the connection structure including a pair of pivot extension walls, each pivot
extension wall including a wall hole provided along a pivot axis; and
10 a secondary frame having a top surface and opposite ends, the secondary frame
comprising
a central pivot connection portion comprising a pair of wings each projecting
away from the top surface of the secondary frame, each wing comprising a
wing hole, and further including a plurality of recesses provided on the top
15 surface, each recess positioned adjacent to one of the pair of wings,
two leg portions extending from the central pivot connection portion, and
a pivot structure disposed on the central pivot connection portion of the secondary
frame; and
wherein the pivot structure disposed on the secondary frame is connected with the
20 connection structure on the primary frame, the secondary frame pivotable about
the pivot axis.
2. The wiper blade of claim 1, further comprising:
an additional connection structure disposed on the other opposite end of the primary
frame, the additional connection structure including pivot extension walls each
25 having a hole, the holes of the pivot extension walls substantially aligned along an
additional pivot axis;
an additional secondary frame having a central pivot connection portion and two leg
portions extending from the central pivot connection portion, an additional pivot
structure disposed on the central pivot connection portion of the secondary frames,
30 the additional pivot structure including a pair of holes, the wiper blade connected
to at least one of the leg portions of both the secondary frame and the additional
secondary frame,

wherein the pivot structure disposed on the secondary frame is connected with the connection structure on the primary frame, the holes of the pivot structure substantially aligned along the pivot axis with the holes of the pivot extension walls.

- 5 3. The wiper blade of claim 1 wherein the pivot structure is a separate structure attached to the secondary frame.
4. The wiper blade of claim 1, wherein the pivot structure includes a bushing provided between the secondary frame and the primary frame.
5. The wiper blade of claim 1, wherein the pivot extension walls each include a hole, the
10 holes of the pivot extension walls substantially aligned along the pivot axis, and the pivot structure including a pair of holes substantially aligned with holes of the pivot connection walls along the pivot axis.
6. The wiper blade of claim 5, wherein a rivet is insertable through the aligned holes of the pivot connection walls and the pivot structure along the pivot axis.
- 15 7. The wiper blade of claim 5, wherein the secondary frame includes a pair of wings extending from the central pivot connection portion, each including a hole substantially aligned with the holes of the pivot connection walls and the pivot structure along the pivot axis.
8. The wiper blade of claim 7, wherein a rivet is insertable through the aligned holes of
20 the pivot connection walls, the pivot structure, and the wings of the secondary frame along the pivot axis.
9. The wiper blade of claim 7, wherein the central pivot connection portion and the pair of wings, the pivot structure, and the connection structure are dimensioned to have a complimentary shape.
- 25 10. The wiper blade of claim 1 wherein one of the two leg portions is longer than the other leg portion.
11. The wiper blade of claim 1 further comprising at least one tertiary frame, wherein at least one leg portion of the secondary frame is provided with a tertiary frame connection structure, and wherein the at least one tertiary frame is connected to the tertiary frame
30 connection structure of the least one of the secondary frames.

12. The wiper blade of claim 1 further comprising a cover.
13. The wiper blade of claim 12 wherein the primary frame further comprises a cover-connection structures.
14. The wiper blade of claim 12 wherein the cover is a segmented hard cover, and
5 wherein the cover segments connect to one another via pivot joints, and wherein the cover is secured to the wiper blades at cover connection structures on the primary frame or secondary frame.
15. The wiper blade of claim 12 wherein the cover comprises a cover center section and two cover side sections that are made from a soft , elastic material, wherein the cover side
10 sections cover the ends of the cover center section and extend to the ends of the wiper blade.
16. A wiper blade comprising:
a wiper strip;
a primary frame, having a top side and opposite ends, the primary frame comprising
a connection device having a base attached to the primary frame on the top side,
15 the connection device capable of connecting the wiper blade to a wiper arm disposed on the top side of the primary frame, and
a connection structure disposed on one of the opposite ends of the primary frame,
the pivot extension portion comprising a pair of pivot extension walls, each
pivot extension wall comprising a wall hole provided along a pivot axis; and;
20 a secondary frame having a top surface and opposite ends, the secondary frame comprising
a central pivot connection portion comprising a pair of wings each projecting
away from the top surface of the secondary frame, each wing including a wing
hole, and further including a plurality of recesses provided on the top surface,
25 each recess positioned adjacent to one of the pair of wings,
two leg portions extending from the central pivot connection portion, each leg
portion is a thin frame, straight, and extending from the central pivot
connection portion at an oblique angle of descent relative to the pivot
connection portion, and each leg portion has a cross-section with a
30 substantially rectangular shape with the cross-section being made by a vertical
plane, and

a pivot structure disposed on the central pivot connection portion of the secondary frame;

wherein the pivot structure disposed on the secondary frame is connected with the connection structure on the primary frame, the secondary frame pivotable about the pivot axis.

5

17. The wiper blade of claim 16 wherein the connection device is disposed side-saddle to the wiper blade.

18. The wiper blade of claim 16 wherein the base of the connection device is recessed into the top side of the primary frame

10 19. The wiper blade of claim 16, wherein the connection device is attached by having a protrusion on each end of the connection device secured into a respective receiving hole in the primary frame.

20. A wiper blade comprising:

a wiper strip;

15 a force distribution structure having opposite ends, the wiper strip connected to the force distribution structure; and

a cover, wherein the cover is a segmented hard cover comprising a plurality of cover segments, and wherein the cover segments connect to one another via pivot joints, and wherein the cover is secured to the wiper blades at cover connection

20 structures on the primary frame or secondary frame.

21. The wiper blade of claim 20 further comprising an end wall on one of the cover segments adjacent to another, connected cover segment.

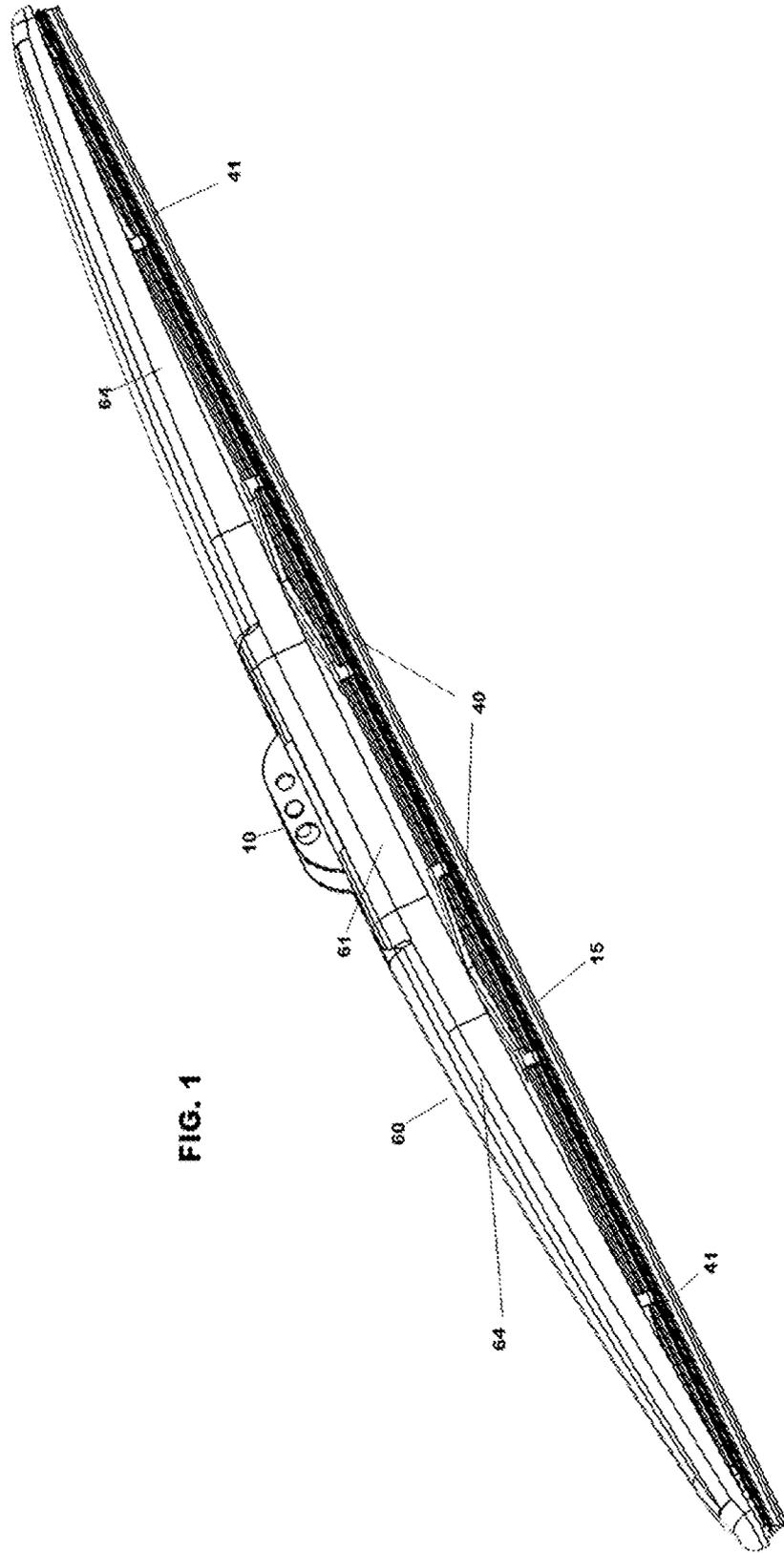
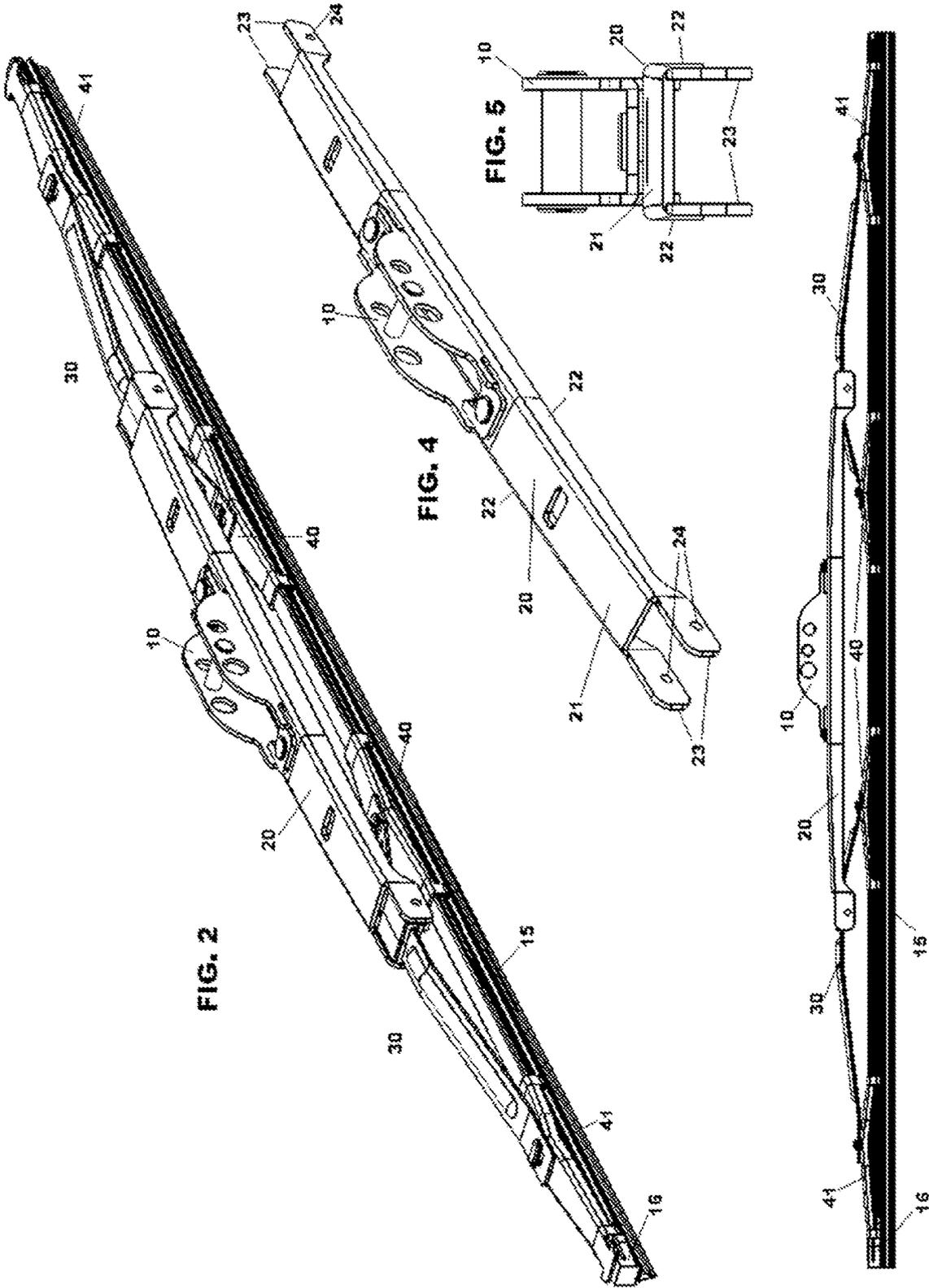


FIG. 1



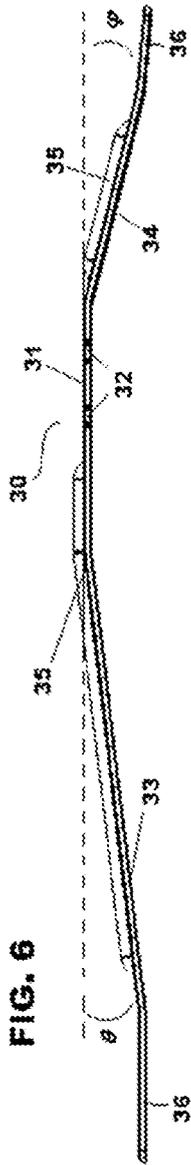


FIG. 6

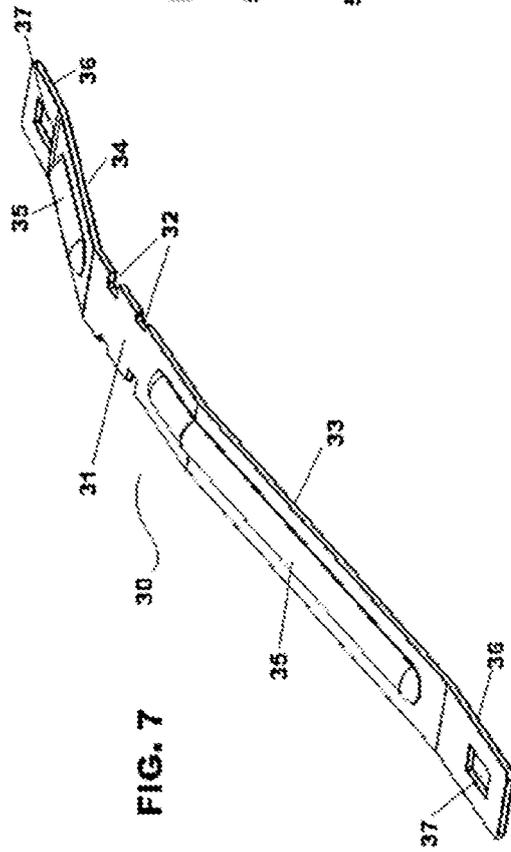


FIG. 7



FIG. 9

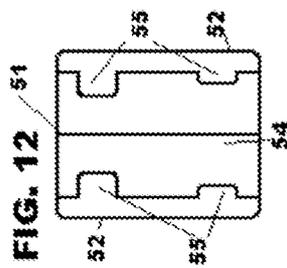


FIG. 10

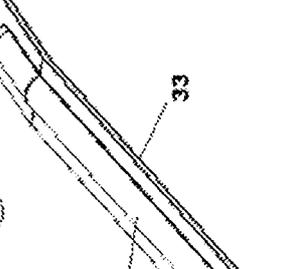


FIG. 11

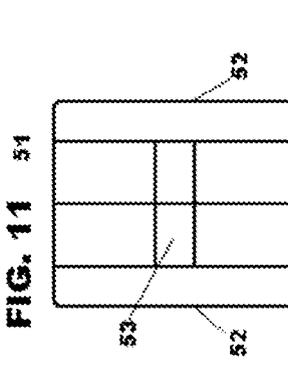


FIG. 12

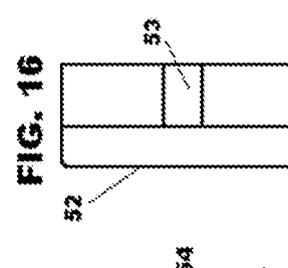


FIG. 13

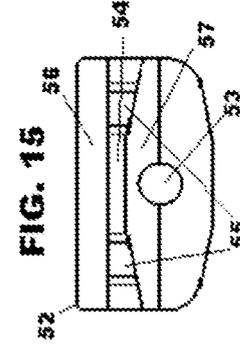


FIG. 14

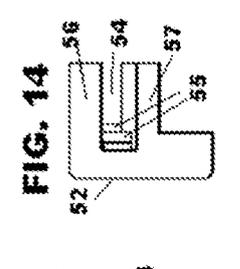


FIG. 15

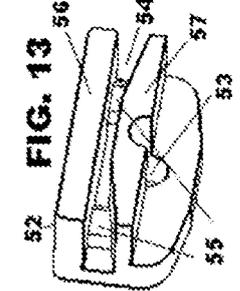
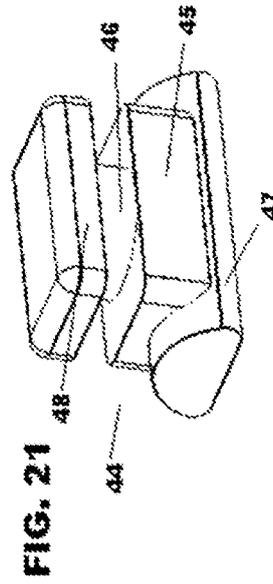
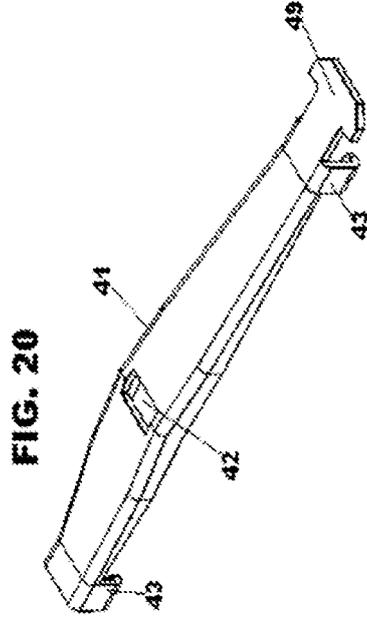
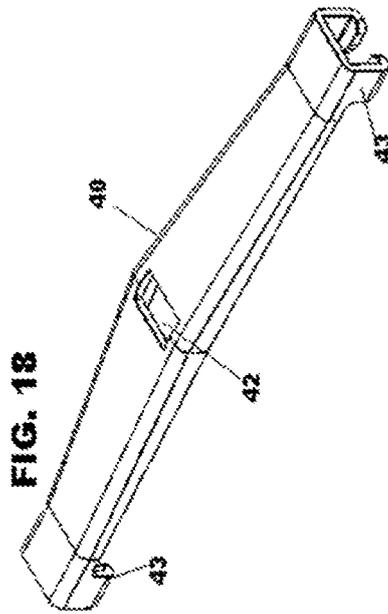
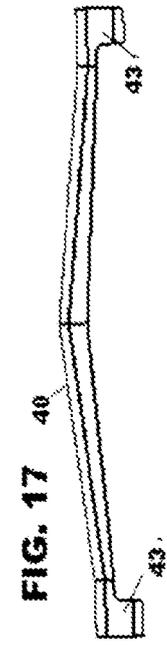
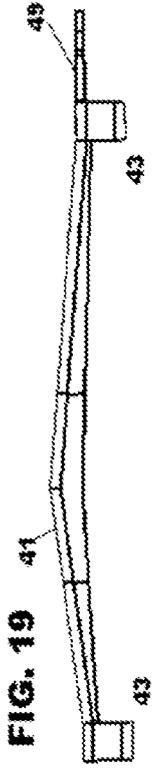
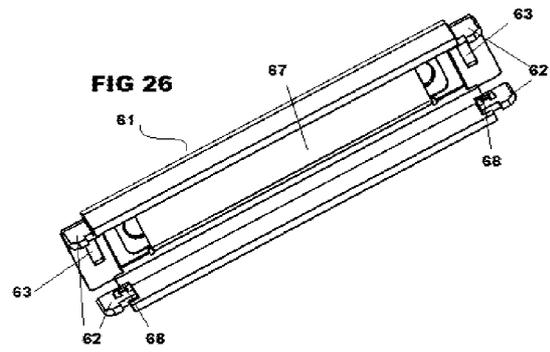
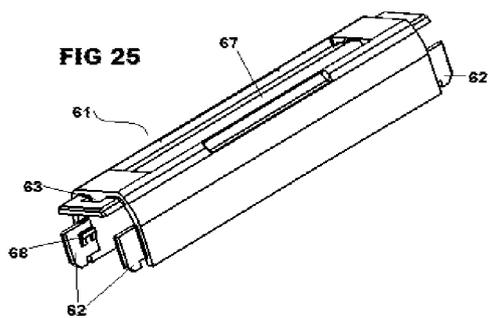
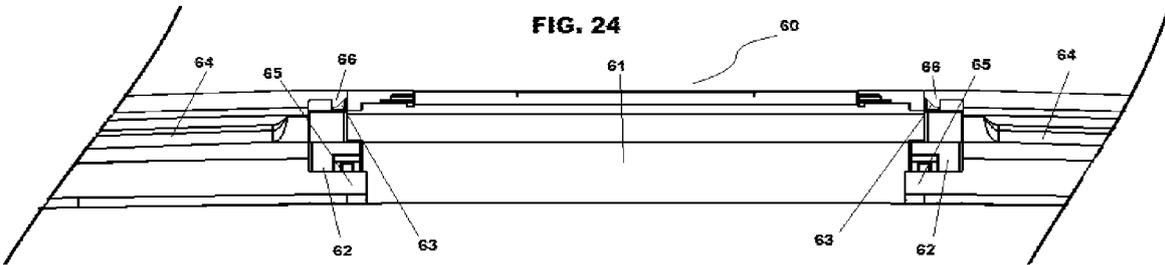
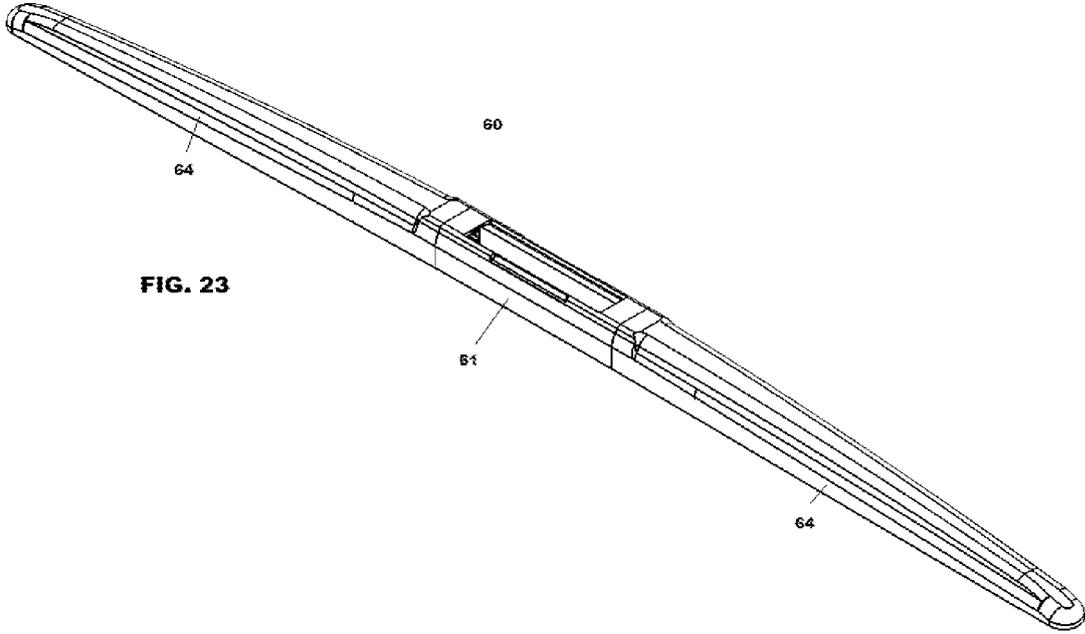
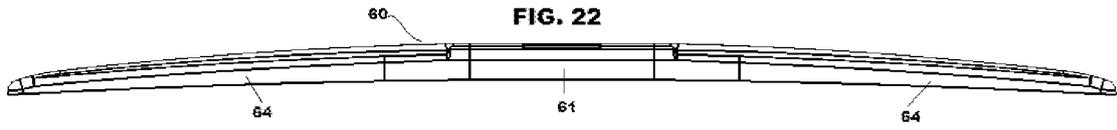


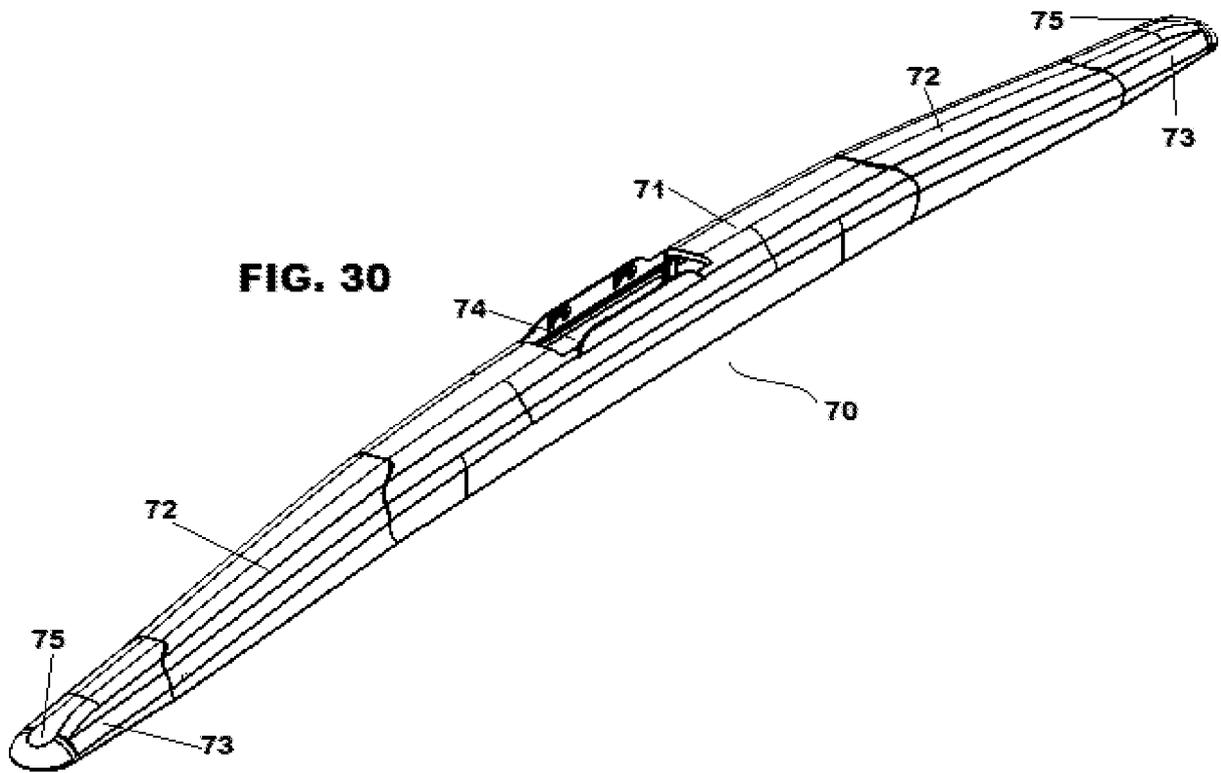
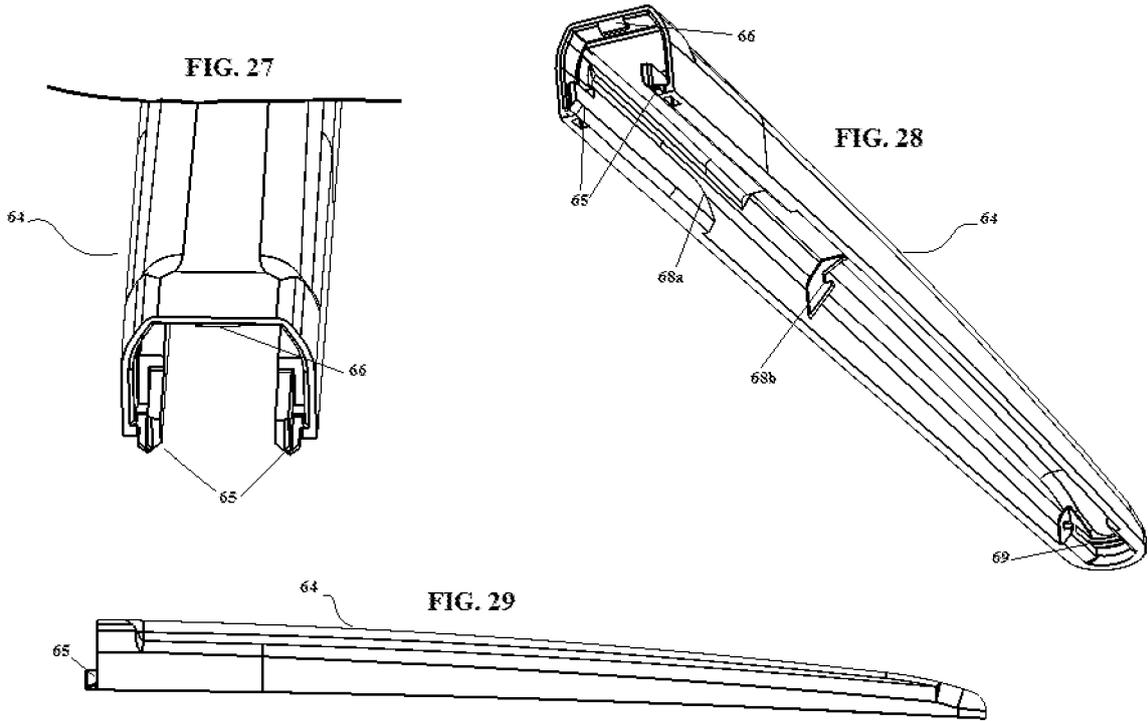
FIG. 16

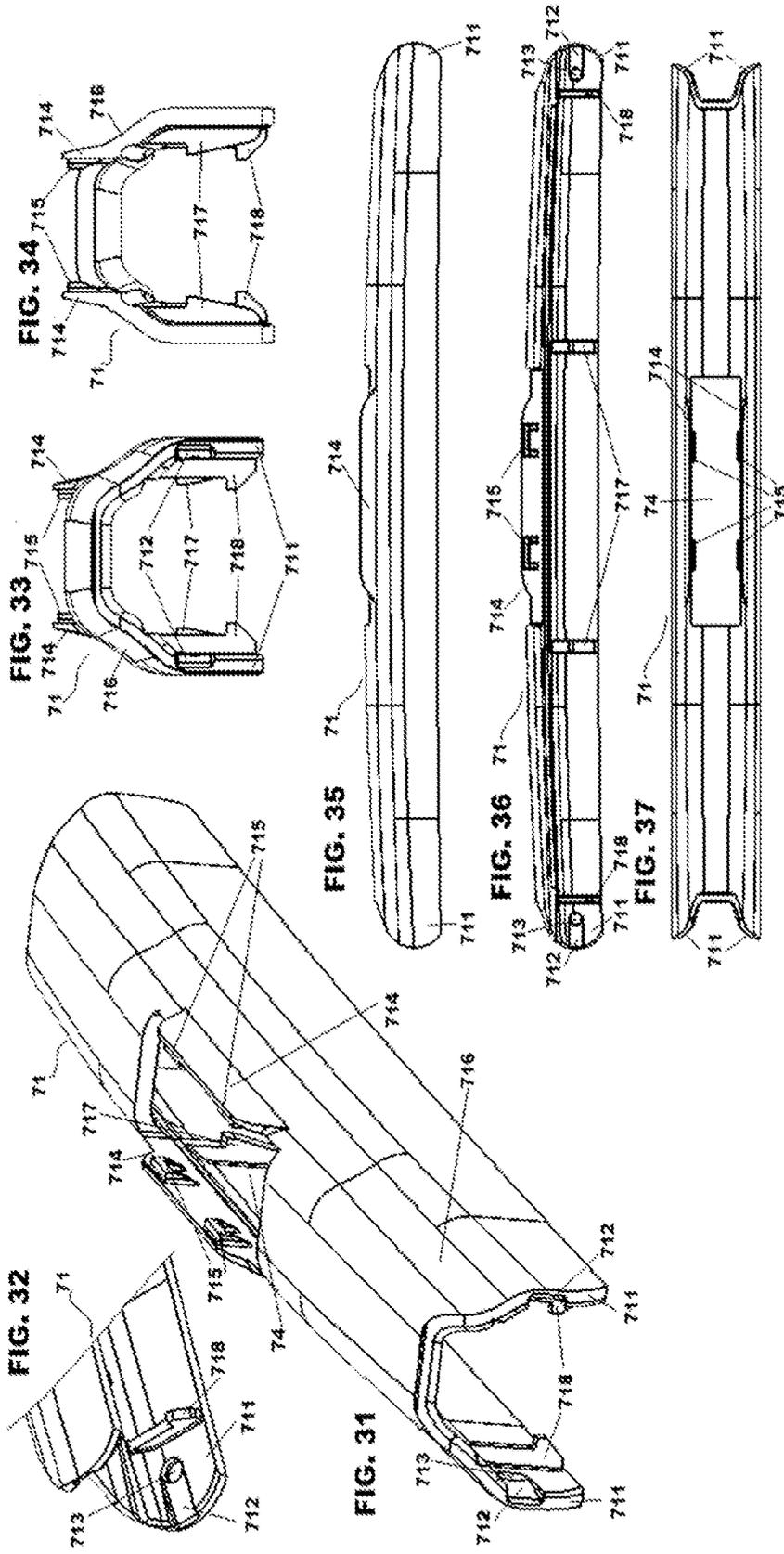


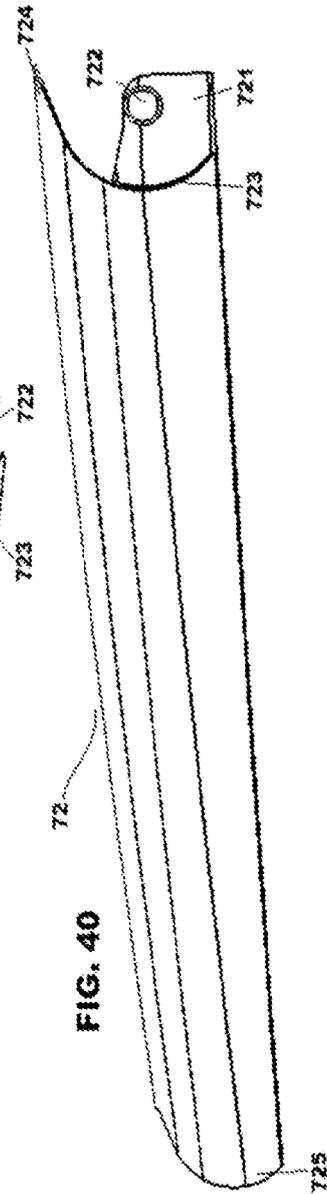
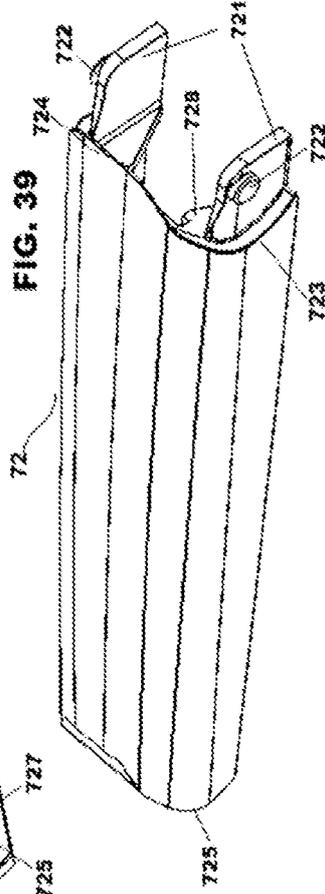
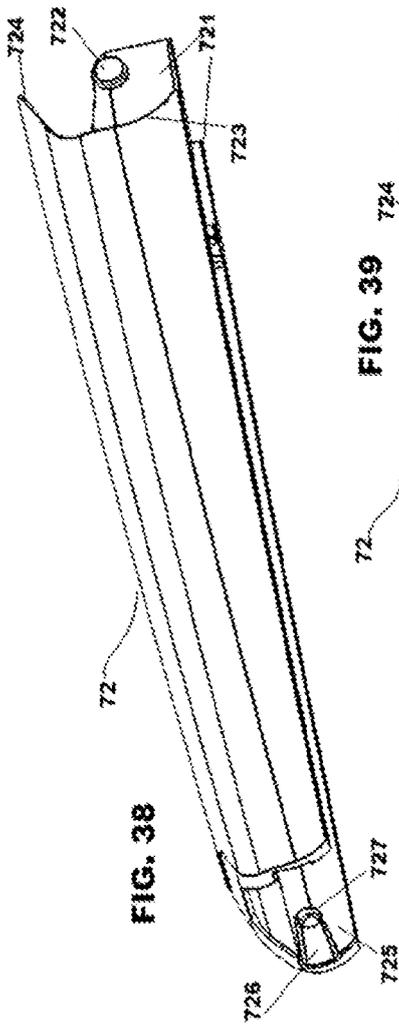
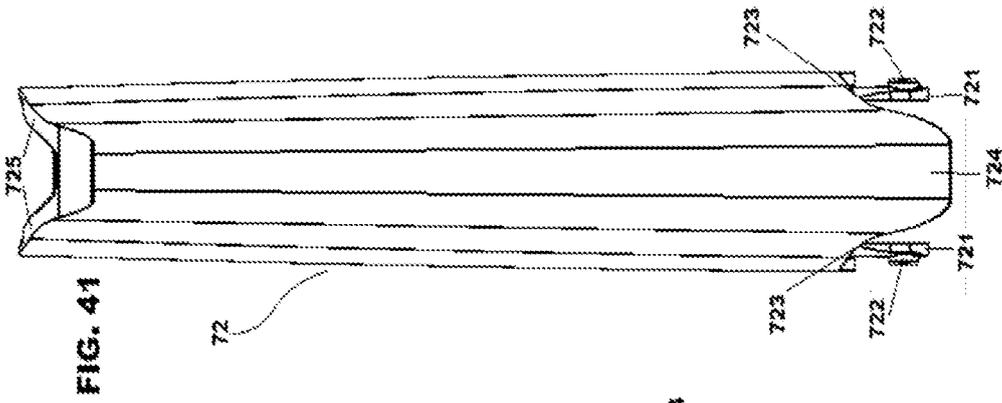
FIG. 8

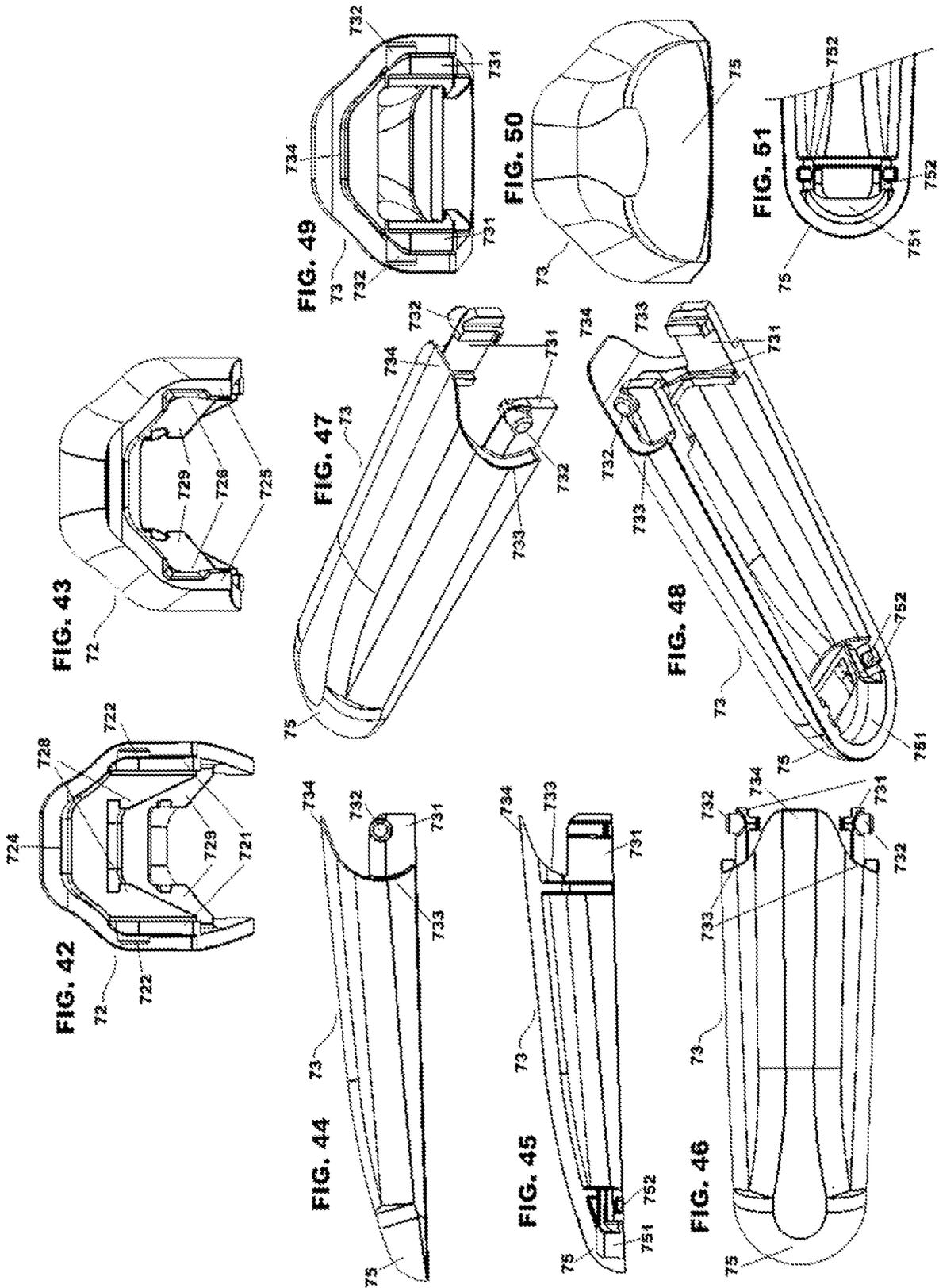












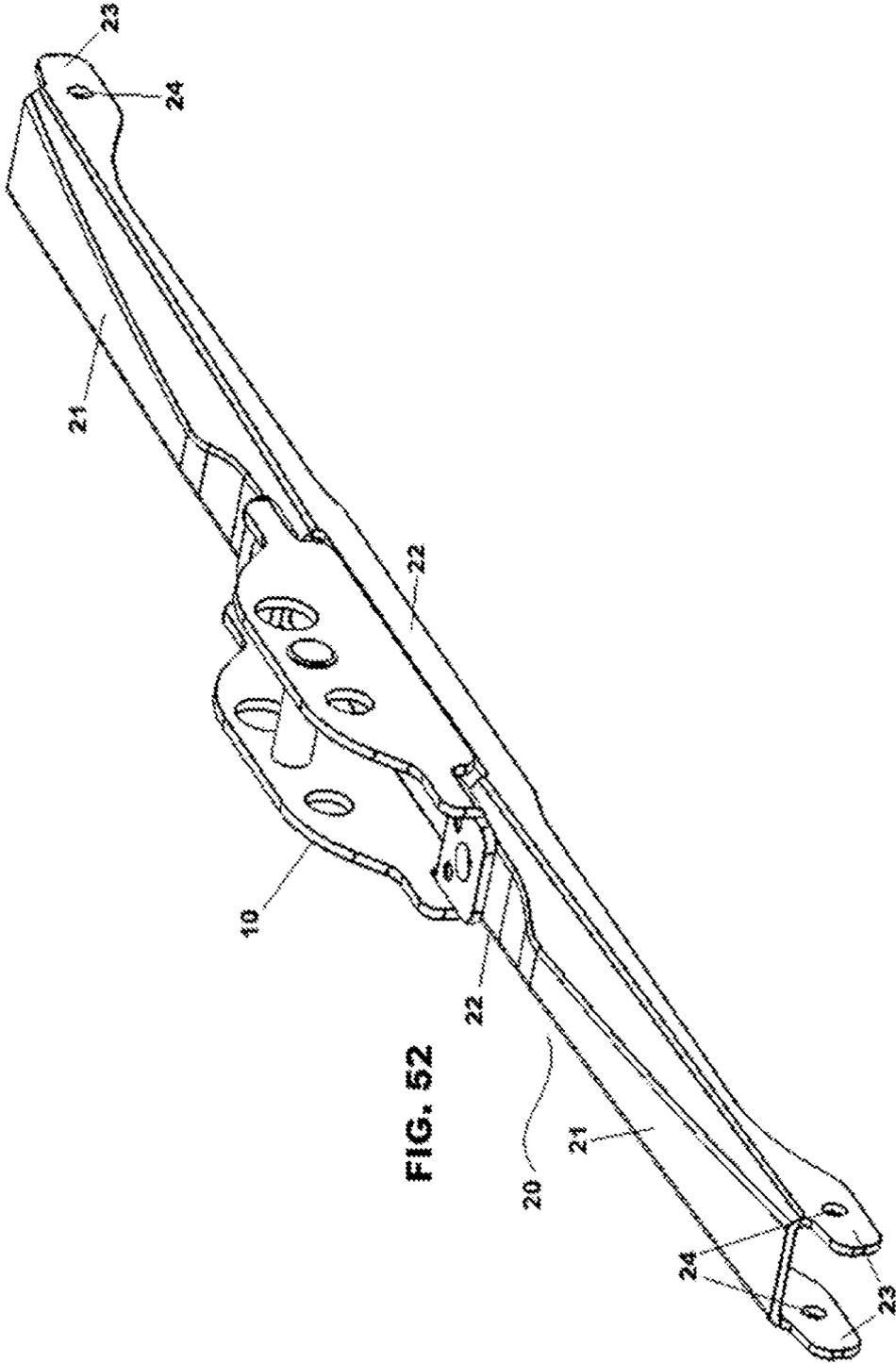


FIG. 52

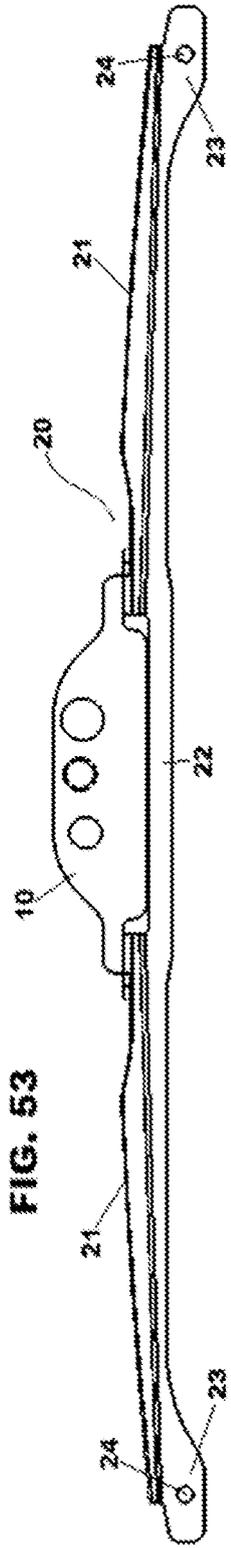


FIG. 53

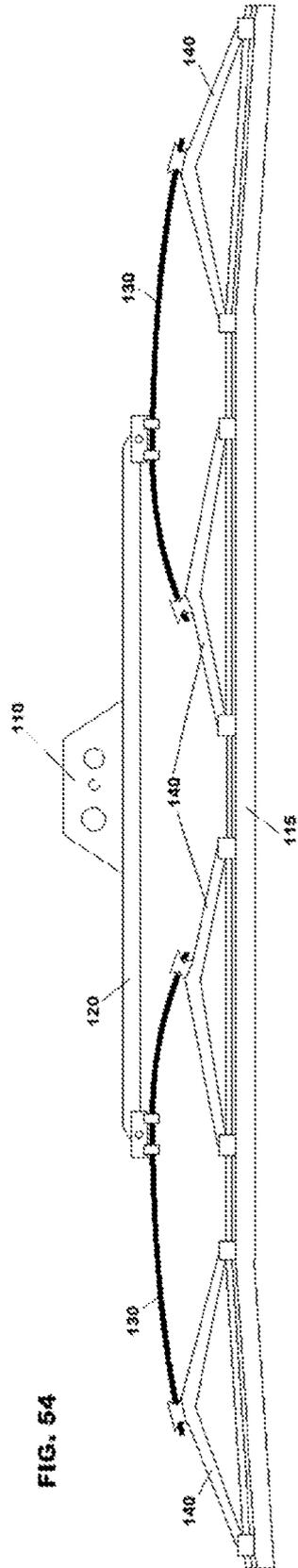
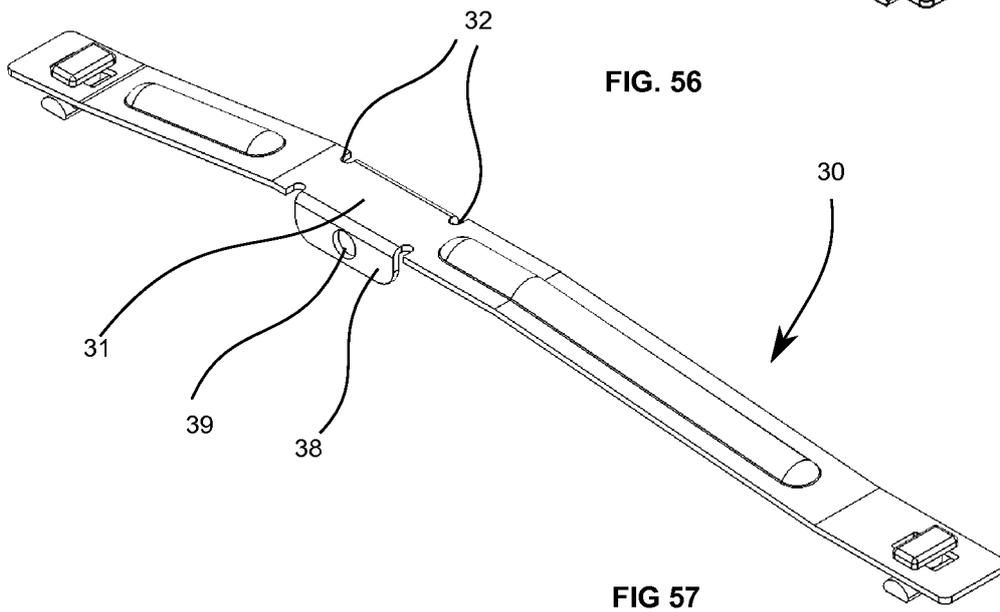
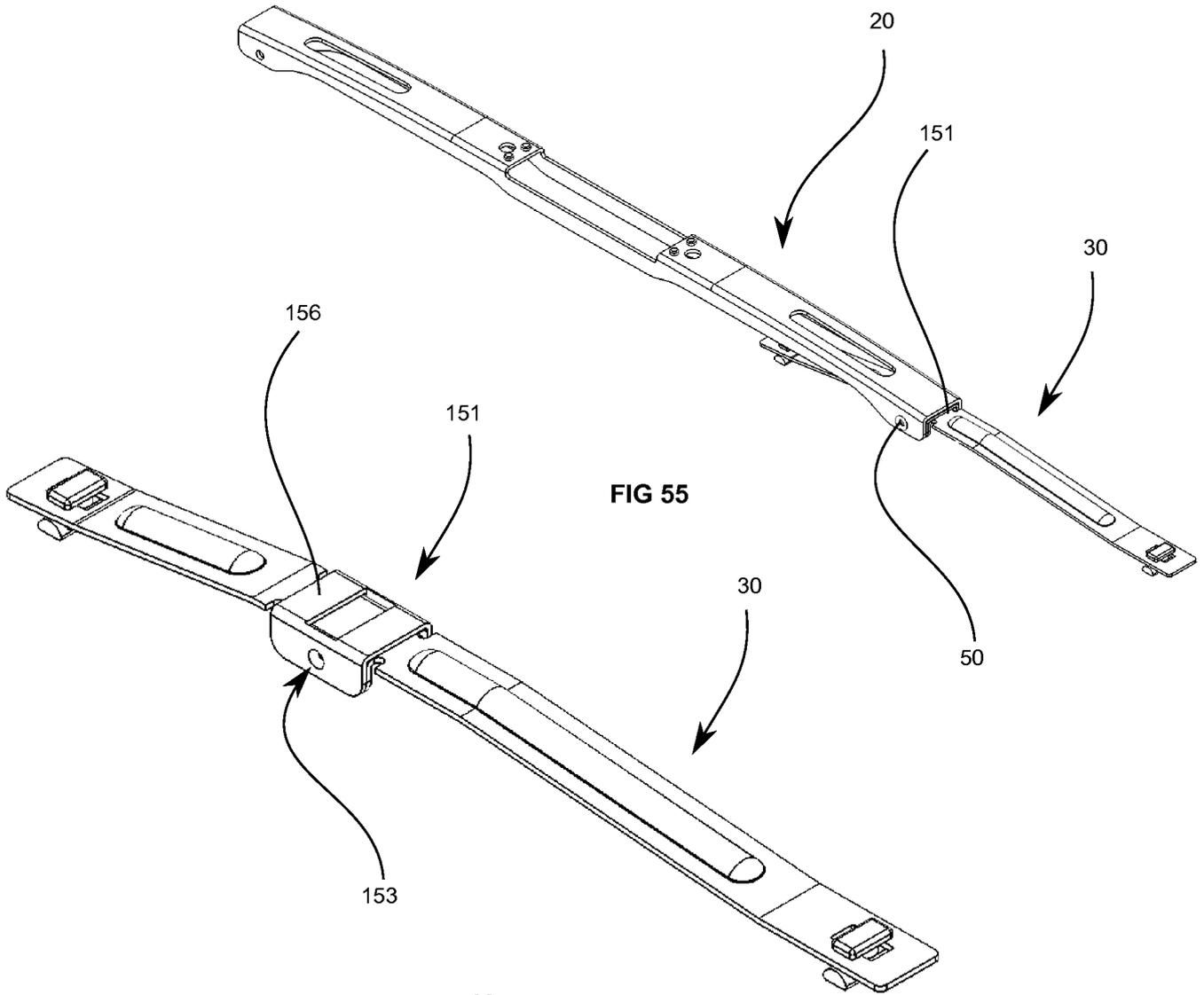


FIG. 54



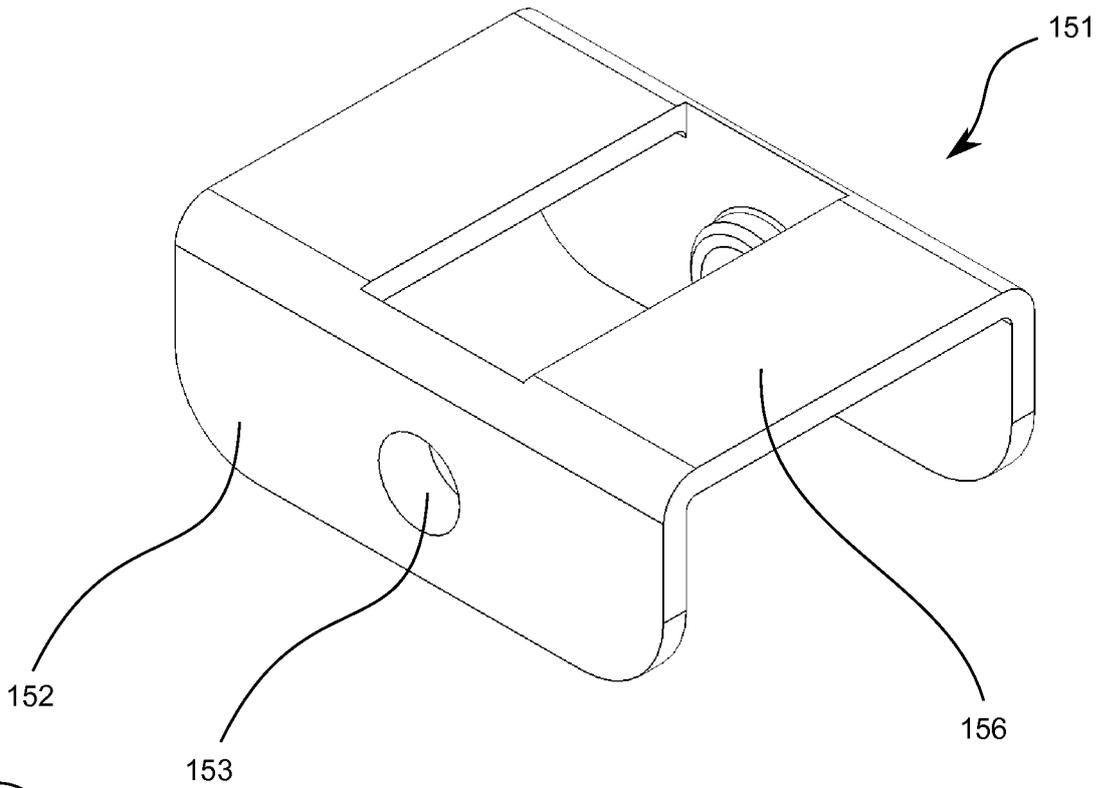


FIG. 58

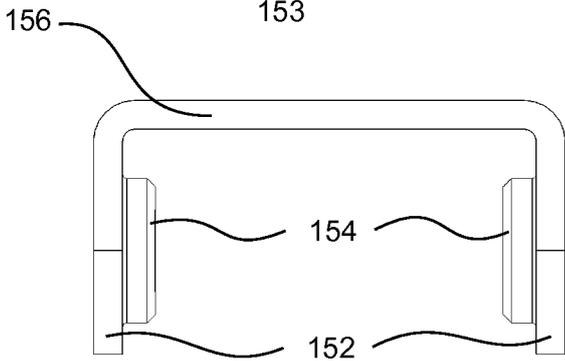


FIG. 59

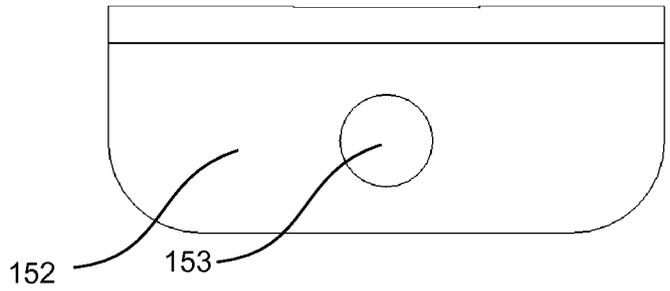


FIG. 60

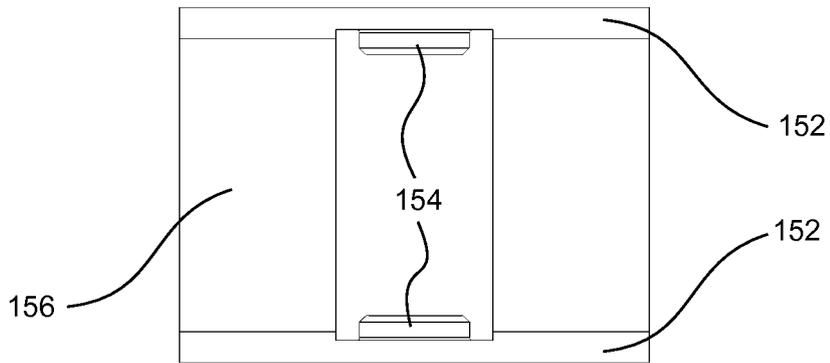


FIG. 61

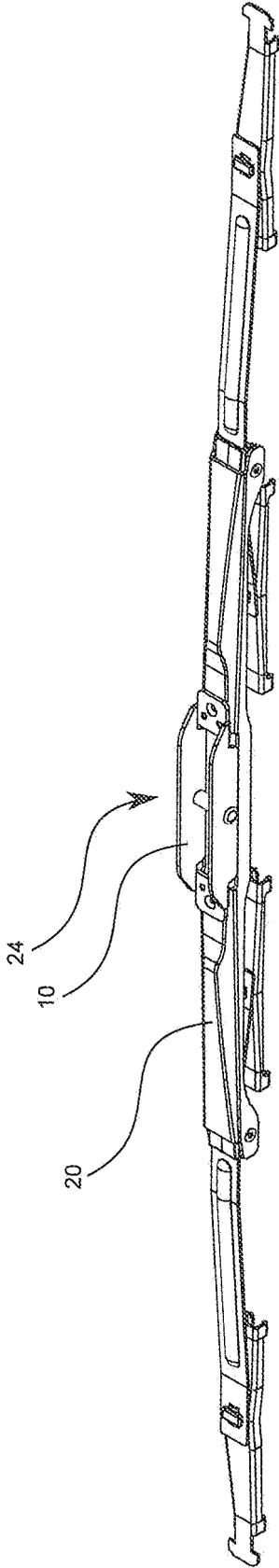


FIG. 62

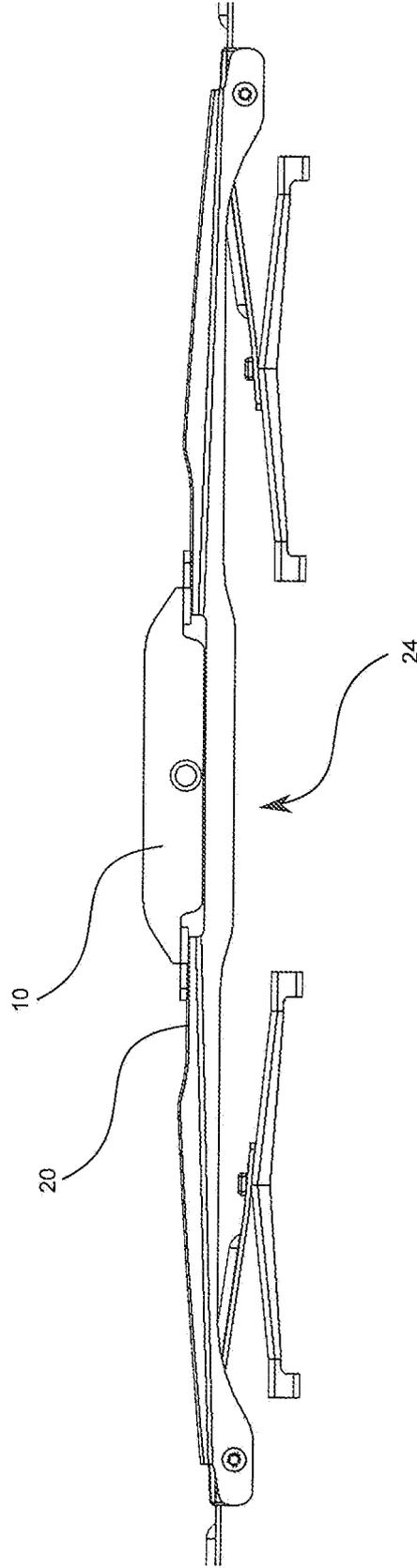


FIG. 63

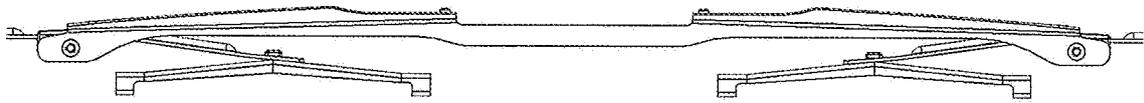
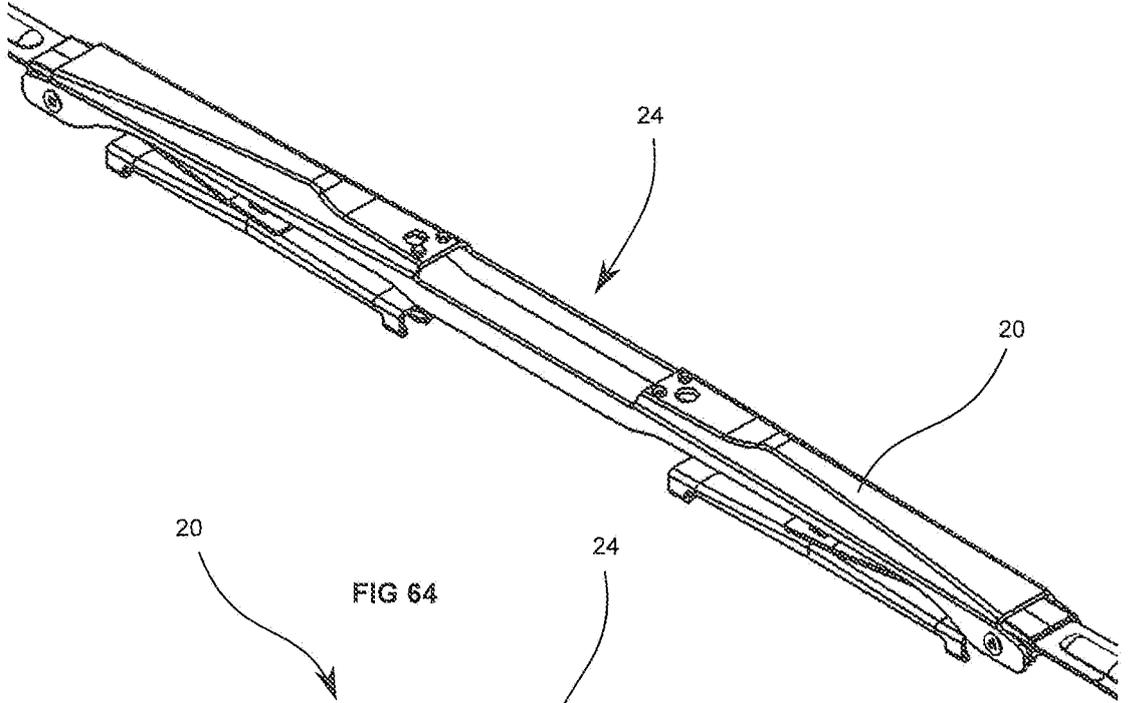


FIG 65

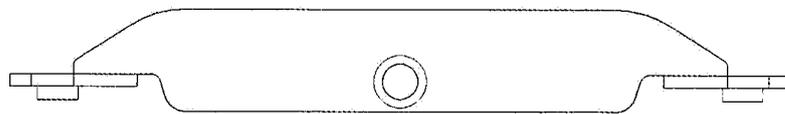
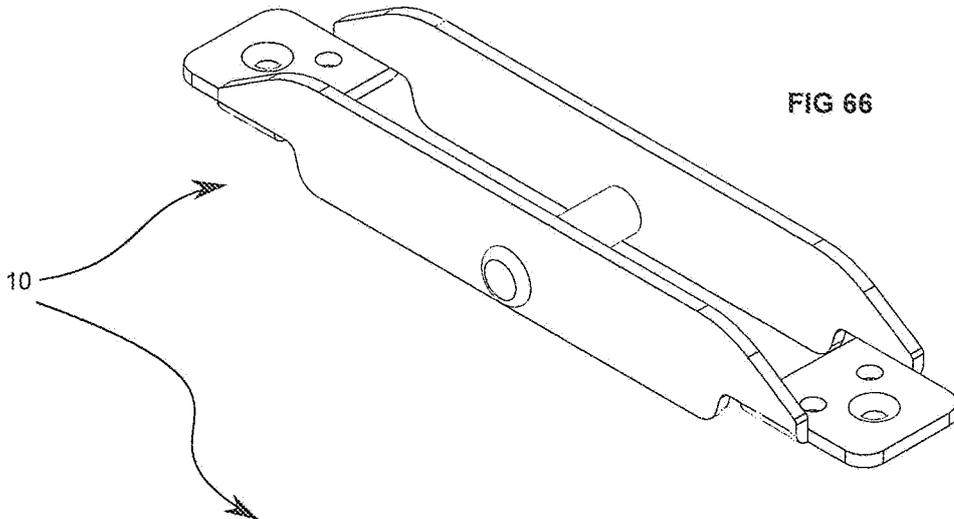


FIG 67

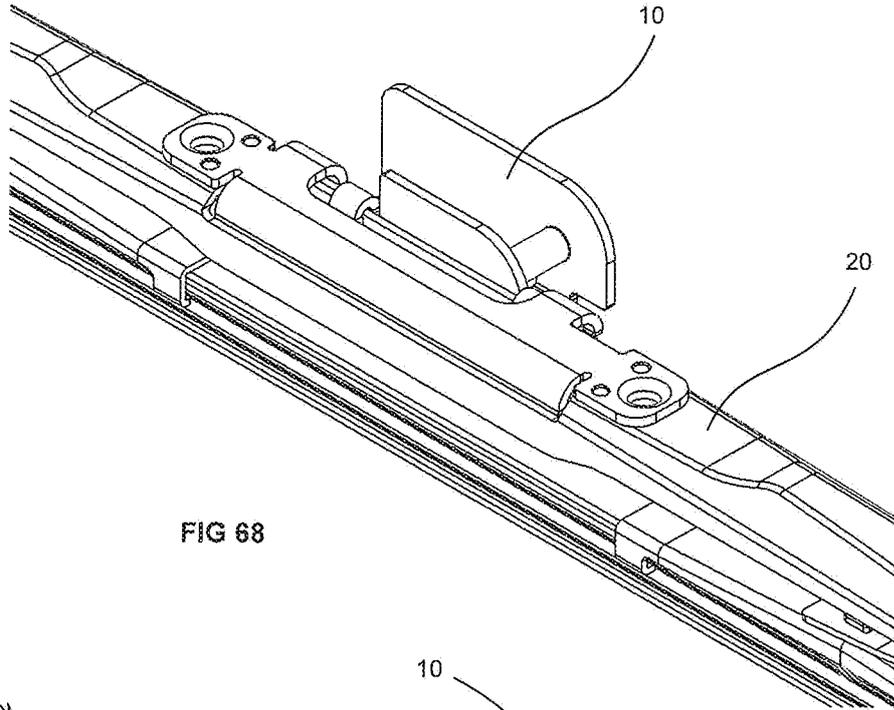


FIG 68

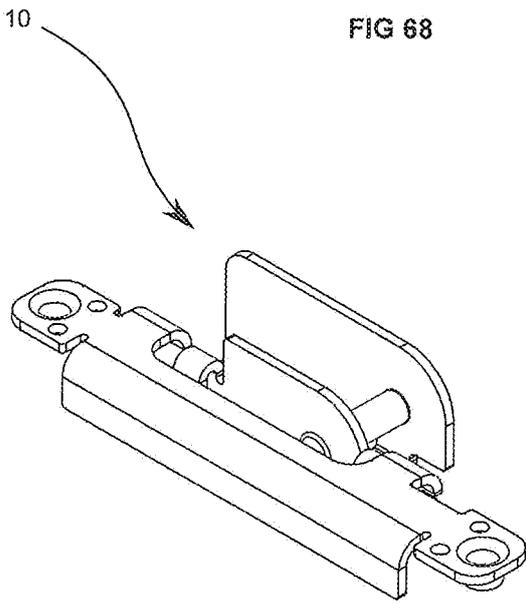


FIG 69

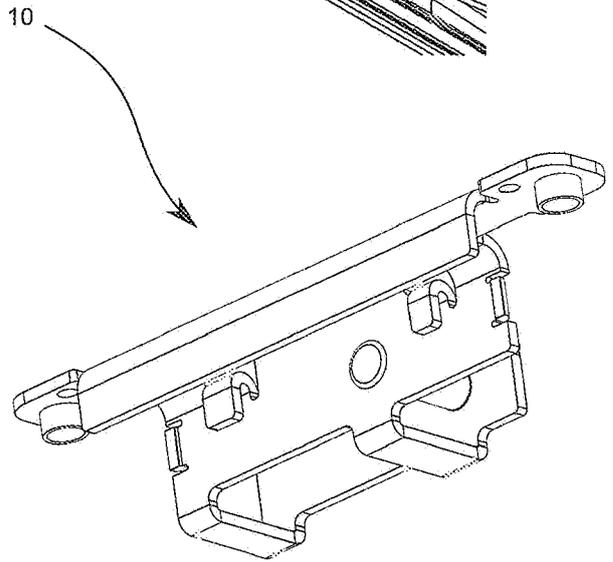


FIG 70

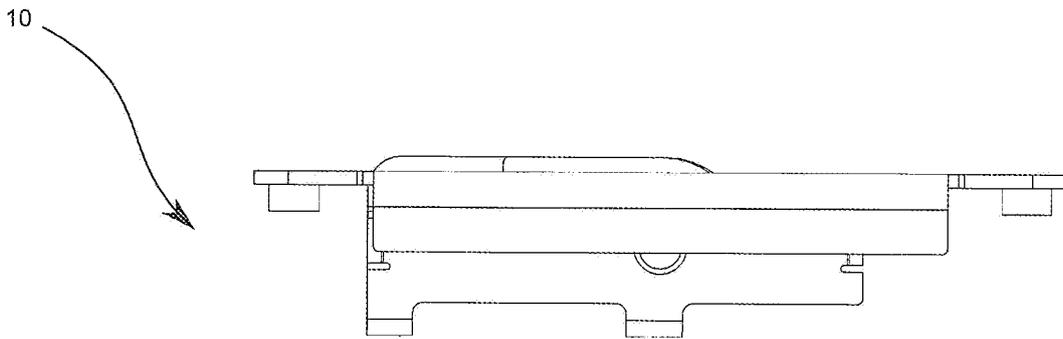


FIG 71

FIG. 72

