



- (51) International Patent Classification:
B60S 1/38 (2006.01) *B60S 1/40* (2006.01)
- (21) International Application Number:
PCT/US2017/033622
- (22) International Filing Date:
19 May 2017 (19.05.2017)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
62/338,990 19 May 2016 (19.05.2016) US
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- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: WINDSHIELD WIPER CONNECTOR

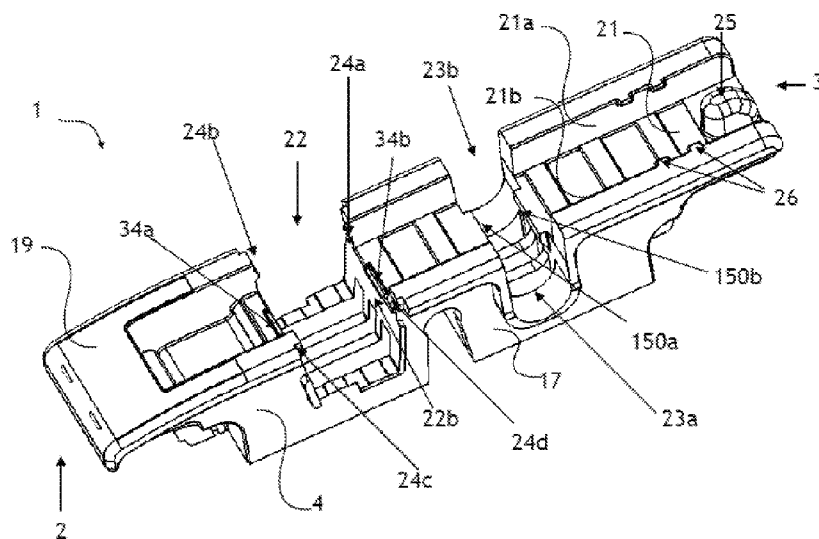


Figure 1

(57) Abstract: A windshield wiper connector having a peripheral wall having at least two opposing peripheral side walls, a top surface extending from one of the two opposing peripheral side walls to the other; and a channel formed in the top surface, and extending longitudinally along the top of the connector. The connector including a groove near to the proximal end of the connector and sized to be capable of engaging a trapezoidal roller of a wiper arm. The opposing peripheral side walls having a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm. The channel on the top of the connector sized to be capable of accepting a bayonet style wiper arm. A wiper blade assembly having a wiper strip, a force distribution structure, and a connector as described above.



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WINDSHIELD WIPER CONNECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/338,990 filed May 19, 2016, the disclosure of which is hereby incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This invention relates in general to windshield wipers, and more particularly, to an improved connector for a windshield wiper that allows the windshield wiper to be attached to multiple windshield wiper arm configurations. The invention is also directed to windshield wipers incorporating these novel connectors.

BACKGROUND OF THE INVENTION

[0003] There are a variety of wiper arms on which wiper blades are provided as original equipment. These various wiper arms have hooks, pins, or other configurations which may connect to the wiper blade with or without connectors. These various configurations have created a problem in the replacement market because wiper blade providers are required to have multiple wiper blade configurations to accommodate all of the existing wiper arms. It is therefore advantageous to have attachment structures that can accommodate a host of arms to reduce the complexity and cost associated with this problem.

[0004] The need to attach replacement windshield wiper blades to multiple arms has been addressed to some degree. For example, windshield wiper blades have been designed to work with various hook-type wiper arms having different sizes. Connectors may also be configured to receive either a pin-type arm or a hook arm. While these connectors may increase the usefulness of a given windshield wiper such that it can be used with different wiper arm types, the connectors are often expensive and have a complicated structure that is difficult and time-consuming to manufacture.

[0005] Thus, there is a need for inexpensive connectors that are capable of securing a windshield wiper blade to a variety of arms. In particular, it would be desirable to have a connector that can be attached to a wiper blade that will allow the wiper blade to be locked to a wide variety of wiper arms despite their various locking mechanisms. It would also be desirable to have a windshield wiper connector that can be fabricated or molded as a single piece at low-

cost. The prior art fails to provide a low-cost windshield wiper connector capable of attachment to a wide variety of windshield wiper arms, much less for the purpose of reducing the amounts of inventory parts required to supply a vehicle market that uses a wide variety of windshield wiper arm types.

SUMMARY OF THE INVENTION

[0006] 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.

[0007] This invention is generally directed to novel connectors for windshield wiper blades and wiper blades containing same. More particularly, the invention relates, in part, to a windshield wiper connector that can accommodate multiple pin-type windshield wiper arms having varying pin lengths and locking mechanisms, as well as bayonet and trapezoid roller style wiper arms.

[0008] In certain embodiments, a windshield wiper connector may include a peripheral wall having at least two opposing peripheral side walls, a top surface extending from one of the two opposing peripheral side walls to the other; and a channel formed in the top surface, and extending longitudinally along the top of the connector. The connector may also include a groove near to the proximal end of the connector and sized to be capable of engaging a trapezoidal roller of a wiper arm. The opposing peripheral side walls may each have a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm. The channel on the top of the connector may be sized to be capable of accepting a bayonet style wiper arm.

[0009] In certain embodiments, a wiper blade assembly may include a wiper strip, a force distribution structure, a connection device, and a connector. The connector may include a peripheral wall having at least two opposing peripheral side walls, a top surface extending from one of the two opposing peripheral side walls to the other; and a channel formed in the top surface, and extending longitudinally along the top of the connector. The connector may also

include a groove near to the proximal end of the connector and sized to be capable of engaging a trapezoidal roller of a wiper arm. The opposing peripheral side walls may each have a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm. The channel on the top of the connector may be sized to be capable of accepting a bayonet style wiper arm.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0010] Figure 1 is a top perspective view of an embodiment of a connector of the disclosure.
- [0011] Figure 2 is a bottom perspective view of an embodiment of the connector shown in Figure 1 that illustrates the internal support structure on the underside of the connector.
- [0012] Figure 3 is a top view of the connector shown in Figure 1.
- [0013] Figure 4 is distal end view of an embodiment of a connector of the disclosure.
- [0014] Figure 5 is proximal end view of an embodiment of a connector of the disclosure.
- [0015] Figure 6 is side view of an embodiment of a connector of the disclosure.
- [0016] Figure 7 is an opposing side view of the embodiment of the connector of the disclosure shown in Figure 6.
- [0017] Figure 8 is a top perspective view of a prior art wiper arm having a trapezoidal roller as connected to a connector of the disclosure.
- [0018] Figure 9A is a top, front perspective view of a trapezoidal roller for a wiper arm.
- [0019] Figure 9B is a bottom, front perspective view of the trapezoidal roller for a wiper arm shown in Figure 9A.
- [0020] Figure 10 is a top perspective view of a prior art wiper arm having a trapezoidal roller prior to being connected to a connector of the disclosure.
- [0021] Figure 11A is a perspective view of a groove cover for a connector of the disclosure.
- [0022] Figure 11B is a bottom perspective view of the groove cover shown in Figure 11A.
- [0023] Figure 12 is a perspective view of a connector of the disclosure with a groove cover attached thereto.

[0024] Figure 13 is a top perspective view of a prior art notched bayonet style wiper arm as connected to a connector of the disclosure.

[0025] Figure 14 is a top perspective view of a prior art notched bayonet style wiper arm prior to being connected to a connector of the disclosure.

[0026] Figure 15 is a top perspective view of a prior art French pin style wiper arm as connected to a connector of the disclosure.

[0027] Figure 16 is a top perspective view of a prior art French pin style wiper arm prior to being connected to a connector of the disclosure.

[0028] Figure 17 illustrates a connector of the disclosure connected to a wiper blade.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0029] The following detailed description and the appended drawings describe and illustrate exemplary embodiments 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.

[0030] In certain embodiments, a windshield wiper connector may include a peripheral wall having at least two opposing peripheral side walls, a top surface extending from one of the two opposing peripheral side walls to the other, and a channel formed in the top surface, and extending longitudinally along the top of the connector. The connector may also include a groove near to the proximal end of the connector and sized to be capable of engaging a trapezoidal roller of a wiper arm. The opposing peripheral side walls may each have a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm. The channel on the top of the connector may be sized to be capable of accepting a bayonet style wiper arm.

[0031] In certain embodiments, the top surface of the connector may include a proximal shelf with an opening underneath the proximal shelf that is sized to be capable of receiving the end of a bayonet style arm such that the bottom side of a bayonet style arm rests against a surface of the

channel. In certain embodiments, a distal end of the channel may have a pillar extending upwards from a surface of the channel, such that the pillar is capable of engaging a notch on the arm of a notched bayonet style wiper arm as it rests against the surface of the channel.

[0032] In certain embodiments, the channel may feature opposing side channel walls, and each side channel wall comprises one or more retaining appendages extending a distance towards opposing side channel walls. The retaining appendages may be capable of holding a bayonet style wiper arm against a surface of the channel. The retaining appendages may be sized such that they are capable of snapping a bayonet style wiper arm into place as the bayonet style wiper arm is pressed towards the surface of the channel.

[0033] In certain embodiments, the connector may have at least one rivet passage and arcuate rivet clip in each of the opposing peripheral side walls that may be capable of accepting and securing a rivet of a wiper blade, thereby securing the connector to the wiper blade. In certain embodiments, the connector may have at least one internal longitudinal support wall extending downwards from the top surface and extending substantially along the longitudinal direction of the connector for providing rigidity and structural support for the connector. In certain embodiments, the connector may have at least one internal perpendicular support wall extending downwards from the top surface and extending substantially from the one side wall of the connector to the next side wall.

[0034] In certain embodiments, the connector may include a groove cover sized to be capable of covering the groove, wherein the groove cover is shaped to complement the shape of the channel.

[0035] In certain embodiments, a wiper blade assembly may include a wiper strip, a force distribution structure, a connection device, and a connector. The connector may include a peripheral wall having at least two opposing peripheral side walls, a top surface extending from one of the two opposing peripheral side walls to the other; and a channel formed in the top surface, and extending longitudinally along the top of the connector. The connector may also include a groove near to the proximal end of the connector and sized to be capable of engaging a trapezoidal roller of a wiper arm. The opposing peripheral side walls may each have a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at

least one pin-type windshield wiper arm. The channel on the top of the connector may be sized to be capable of accepting a bayonet style wiper arm.

[0036] In certain embodiments, the wiper blade assembly may have the top surface of the connector include a proximal shelf with an opening underneath the proximal shelf that is sized to be capable of receiving the end of a bayonet style arm such that the bottom side of a bayonet style arm rests against a surface of the channel. In certain embodiments, a distal end of the channel may have a pillar extending upwards from a surface of the channel, wherein the pillar is capable of engaging a notch on the arm of a notched bayonet style wiper arm as it rests against the surface of the channel.

[0037] In certain embodiments, the channel may have opposing side channel walls, and each side channel wall comprises one or more retaining appendages extending a distance towards opposing side channel walls. In certain embodiments, the retaining appendages may be capable of holding the a bayonet style wiper arm against a surface of the channel, and wherein the retaining appendages are sized such that they are capable of snapping a bayonet style wiper arm into place as the bayonet style wiper arm is pressed towards the surface of the channel.

[0038] In certain embodiments, the wiper blade assembly may have at least one rivet passage and arcuate rivet clip in each of the opposing peripheral side walls of the connector that are capable of accepting and securing a rivet of a wiper blade, thereby securing the connector to the wiper blade. In certain embodiments, the connector may include at least one internal longitudinal support wall extending downwards from the top surface and extending substantially along the longitudinal direction of the connector for providing rigidity and structural support for the connector; and at least one internal perpendicular support wall extending downwards from the top surface and extending substantially from the one side wall of the connector to the next side wall.

[0039] In certain embodiments, the wiper blade assembly may include a groove cover sized to be capable of covering the groove, wherein the groove cover is shaped to complement the shape of the channel.

[0040] In certain embodiments, the wiper blade assembly may have a force distribution structure that includes a beam. In certain embodiments, the wiper blade assembly may have a force distribution structure that includes a frame.

[0041] In certain embodiments the connector for connecting a windshield wiper assembly to a wiper arm may have a peripheral wall having at least two opposing peripheral side walls and a top surface extending from one of the two opposing peripheral side walls to the other. The top surface may have a channel running lengthwise (longitudinally) and extending from the proximal end to the distal end of the connector. Further, at or near the proximal end of the connector, there may be a groove extending from one of the side walls to the opposite side wall sized such that it is capable of accepting a trapezoid roller of a trapezoid roller style wiper arm. The opposing peripheral side walls may each have a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm, such as a French pin style retaining pin.

[0042] In some embodiments, the top surface of the connector may further have a proximal shelf with an opening underneath the proximal shelf that is sized to receive the end of a bayonet style arm. The bottom side of a bayonet style arm further rests against the surface of the channel running lengthwise along the connector. The channel extends to the distal end of the connector wherein the arm extends therefrom when properly engaged with the connector.

[0043] In some embodiments, the distal end of the channel may have a pillar extending upwards from the surface of the channel. The pillar functions to engage a notch on the arm of a notched bayonet style wiper arm as it rests against the surface of the channel. Further, the opposing side channel walls of the channel may each have one or more retaining appendages extending a distance towards opposing side channel walls. The retaining appendages function to hold the wiper arm against the surface of the channel. The retaining appendages are sized such that the wiper arm snaps into place as it is pressed towards the surface of the channel.

[0044] In some embodiments, the connector may have at least one rivet passage and arcuate rivet clip in each of the side walls for accepting and securing a rivet of a wiper blade, thereby securing the connector to the wiper blade. In some of these embodiments, the connector may be capable of being secured to the mounting base of a windshield wiper blade assembly via the rivet through the mounting base.

[0045] In some embodiments, the connector may have at least one internal longitudinal support wall extending downwards from the top surface and extending substantially along the longitudinal length of the connector for providing rigidity and structural support for the

connector. In some embodiments, the connector may have at least one internal perpendicular support wall extending downwards from the top surface and extending substantially from the one side wall of the connector to the next side wall.

[0046] In some embodiments the connector may be fabricated as a single piece.

[0047] In addition, the connector is configured such that the orientation of either the windshield wiper or the connector can be reversed based on the particular windshield wiper arm that is being used.

[0048] **Figure 1** is a top, perspective view of an embodiment of a connector 1 of the disclosure. The connector 1 has a proximal end 2, and a distal end 3. A peripheral wall 4 extends around the periphery of connector 1. The peripheral wall 4 including a proximal portion, a distal portion, and opposing side portions that connect the proximal and distal portions, referred to as a first side 17 and a second side 18. A top surface 19 extends between opposing peripheral wall side portions. The top surface may also extend beyond the first and second sides of the peripheral wall 4 to form a ledge 20 that extends substantially along the longitudinal length of the connector 1 on each of the first 17 and second 18 sides (see Figure 2). The top surface 19 may have a channel 21 with opposing channel side walls 21a, 21b and a bottom wall 21c running lengthwise (longitudinally) and extending from the proximal end 2 to the distal end 3 of the connector 1. Further, at or near the proximal end 2 of the connector 1, there may be a groove 22 with opposing groove walls 22a, 22b, extending from one of the side walls to the opposite side wall sized such that it is capable of accepting a trapezoid roller of a trapezoid roller style wiper arm. The top surface 19 may extend slightly outward into the groove 22 such that retaining flanges 24a, b, c, d are formed for holding a trapezoid roller of a trapezoid roller style wiper arm in place within the groove. There may also be channel indentions 34a, 34b on each side of the groove 22 for engaging roller appendages 33 to aid in holding the roller in place (see Figures 9A and 9B).

[0049] The opposing peripheral side walls may also each have a retaining pin aperture 23a, 23b aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm, such as a French pin style retaining pin. The retaining pin aperture 23a, 23b may also include a retaining pin lock structure 150a, 150b therein for locking retaining pins that are inserted into the apertures and holding them within the aperture structure.

As illustrated, the channel bottom wall 21c may extend into the aperture space on each side of the aperture to form the retaining pin lock structure.

[0050] In some embodiments, the distal end of the channel 21 may have a pillar 25 extending upwards from the bottom wall 21c of the channel 21. The pillar 25 functions to engage a notch on the arm of a notched bayonet style wiper arm as it rests against the surface of the channel (see Figure 13). Further, the opposing side channel walls 21a, 21b of the channel may each have one or more retaining appendages 26 extending a distance towards opposing side channel walls 21a, 21b. The retaining appendages 26 function to hold the wiper arm against the surface of the channel 21. The retaining appendages 26 are sized such that the wiper arm snaps into place as it is pressed towards the surface of the channel.

[0051] Those skilled in the art will recognize that connector 1 can be fabricated from any suitable material known in the art, including without limitation, rigid or elastic plastics, metals, synthetic and natural rubber compounds, etc. However, certain embodiments contemplate materials that can be molded such that connector 1 is fabricated as a single piece. In addition, the connector 1 is configured such that the orientation of either the windshield wiper or the connector can be reversed based on the particular windshield wiper arm that is being used.

[0052] **Figure 2** is a bottom perspective view of an embodiment of a connector 1 of the disclosure that illustrates the internal support structure inside the connector 1. In particular, internal support walls provide rigidity and structural strength to the connector 1. The support walls can extend substantially along the length of the connector continuously, or intermittently, having gaps along the way. In this embodiment, the connector may have at least one internal longitudinal support wall 27 extending downwards from the top surface and extending substantially along the longitudinal length of the connector 1 for providing rigidity and structural support for the connector. In some embodiments, the connector 1 may have at least one internal perpendicular support wall 28 extending downwards from the top surface and extending substantially from the one side wall of the connector 1 to the opposing side wall.

[0053] In some embodiments, the connector 1 may have at least one rivet passage 29 and arcuate rivet clip 30 a, b in each of the side walls 17, 18 for accepting and securing a rivet of a wiper blade, thereby securing the connector 1 to the wiper blade. In some of these embodiments,

the connector 1 may be capable of being secured to the mounting base of a windshield wiper blade assembly via the rivet through the mounting base.

[0054] **Figure 3** is a top view of an embodiment of a connector 1 of the disclosure that illustrates the top surface 19 of the connector 1 may further have a proximal shelf 31 with an opening 32 underneath the proximal shelf that is sized to receive the end of a bayonet style arm. The bottom side of a bayonet style arm further rests against the bottom wall 21c of the channel 21 running lengthwise along the connector 1. The end of the arm would thus seat into the opening 32 and wedge against the underside of the proximal shelf 31. The channel 21 extends to the distal end of the connector wherein the arm extends therefrom when properly engaged with the connector 1.

[0055] **Figure 4** is a distal end view of an embodiment of the connector 1 that illustrates the distal end 3. Also shown on this view is the pillar 25 extending upwards from the bottom wall 21c of the channel 21. Those skilled in the art will recognize that the shape of distal end 2 can vary so long as it does not interfere with attachment of the connector 1 to the wiper arm.

[0056] **Figure 5** is a proximal end view of an embodiment of the connector 1 that illustrates the proximal end 2. Those skilled in the art will recognize that the shape of proximal end 2 can vary so long as it does not interfere with attachment of the connector 1 to the wiper arm.

[0057] **Figure 6** is a side view of an embodiment of the connector 1 that illustrates the retaining pin aperture 23 and the retaining pin lock structure 150a, 150b therein for locking retaining pins that are inserted into the apertures and holding them within the aperture structure. The retaining flanges 24a, b are also illustrated for holding a trapezoid roller of a trapezoid roller style wiper arm in place within the groove 22.

[0058] **Figure 7** is an opposite side view of the embodiments of the connector 1 illustrated in Figure 6. Figure 7 illustrates the retaining pin aperture 23 and the retaining pin lock structure 150a, 150b therein. The retaining flanges 24c, d are also illustrated within the groove 22.

[0059] **Figure 8** illustrates an embodiment of a connector 1 of the disclosure connected to a windshield wiper arm in one of several possible configurations. As shown, the trapezoid roller TR of a trapezoid roller style wiper arm (WA) is in place within the groove 22 of the connector 1. **Figure 9A** and **9B** illustrate a type of trapezoid roller that may be on a wiper arm (shown

unattached to the wiper arm for illustrative purposes). As shown, the rollers may have side appendages 33 for engaging the channel indentions 34a, 34b on each side of the groove 22. **Figure 10** illustrates the connector and wiper arm shown in **Figure 8** before attachment. The shaft of the wiper arm rests against the top surface 19 of the connector 1 when the roller is attached to the groove 22 of the connector 1.

[0060] **Figures 11A and 11B** illustrate a groove cover 34 that may be utilized to cover the groove 22 of the connector 1 when wiper arms other than a trapezoid roller style wiper arm is being utilized with the connector. The groove cover 34 comprises a groove cover first side 35 and a groove cover second side 36 with a groove cover top wall 37 connecting the two side walls such that a groove cover channel 38 is formed between the two side walls. As shown in **Figure 11B**, the underside of the groove cover 34 comprises one or more support structures 39. As also illustrated in **Figures 11A and 11B**, the groove cover 34 may also have groove cover notches 40a, b, c, d on each end of the side walls which are configured to engage the retaining flanges 24a, b, c, d extending into the space of the groove 22 to lock (i.e., snap) the groove cover 34 into place. **Figure 12** illustrates a connector 1 of the disclosure with a groove cover 34 in place. As shown, the groove cover is shaped to complement and match the configuration of the connector side walls and channel and substantially hides the groove 22.

[0061] **Figure 13** illustrates a notched bayonet style wiper arm (BWA) as attached to a connector 1 of the disclosure. The wiper arm BWA prior to attachment with the connector 1 is shown in **Figure 14**. As shown, the connector 1 has a groove cover 34 in place; however, one skilled in the art would recognize that the groove cover 34 could be absent from the connector 1. The pillar 25 of the connector 1 slides into the notch N of the wiper arm BWA when the wiper arm BWA is properly seated into the connector 1. The end E of the wiper arm BWA slides into the opening 32 underneath the proximal shelf 31 that is sized to receive the end E of a bayonet style arm such that the end E now rests underneath and against the proximal shelf 31. The one or more retaining appendages 26 snap the arm into place and help to retain the position of the arm within the channel 21 of the connector 1.

[0062] **Figure 15** illustrates a French pin style wiper arm (FWA) as attached to a connector 1 of the disclosure. The wiper arm FWA prior to attachment with the connector 1 is shown in **Figure 16**. As shown, the connector 1 has a groove cover 34 in place; however, one skilled in the

art would recognize that the groove cover 34 could be absent from the connector 1. The retaining pin P of the wiper arm FWA engages the retaining pin aperture 23. The retaining flanges 24 within the aperture helps to lock (i.e., snap) the retaining pin P into place. The retaining pin P may also have an end plate EP that prevents the pin P from sliding out of the retaining pin aperture 23 when seated therein. It is also contemplated that the connector 1 of the present disclosure could be utilized with a retaining pin that does not have an end plate EP. For instance, a retaining pin P with varying diameters thereon creating an edge that the retaining flanges 24 may rest against and function to prevent the retaining pin P from being released from the connector 1.

[0063] As can be seen from Figures 8, 10, 13, 14, 15 and 16, the same connector 1 can be used with differing windshield wiper arms. This allows a reduced inventory that can satisfy the needs of a larger number of windshield wiper arm types.

[0064] In operation, the windshield wiper connector 1 disclosed by this invention allows a single windshield wiper to be used in conjunction with windshield wiper arms having a wide variety of configurations. This reduces manufacturing cost, inventory cost, and provides for easy replacement of windshield wipers as needed.

[0065] In certain embodiments, the connector 1 may be connected to the wiper blade prior to connecting to the wiper arm. In certain embodiments, the connector 1 may be connected to the wiper arm prior to being connected to the wiper blade. In certain embodiments, the connector 1 may either be first connected to the wiper arm or to the wiper arm.

[0066] Another embodiment of the invention is a wiper blade provided with a connector as described above, or as shown in **Figure 17**. The wiper blade may be of any type suitable for use with the present invention. For example, the wiper blade can be a traditional wiper blade having a plurality of frames which carry a wiper strip which act as a force distribution structure, and having a mounting base. Alternatively, the wiper blade may be a beam blade, having one or more spring-elastic beams which act as a force distribution structure, a wiper strip, and a mounting base. The wiper blade may also be a hybrid wiper blade, which has a combination of a beam and one or more frames that collectively act as a force distribution structure, a wiper strip, and a mounting base. Regardless of the type of wiper blade, the connector 1 can be adapted to connect to the wiper blade, for example, via a rivet on the wiper blade (which is commonly

located in a mounting base or in the frame of the wiper blade) and a rivet passage 29 and arcuate rivet clips 30 a, b on the connector 1. Any other method discussed above or otherwise known in the art would also be suitable, such as having one or more pins, holes, recesses, channels, or other structure in the wiper blade, and having corresponding pin clips, detents or pins or any other structure complimentary to the structure in the connector 1.

[0067] Those skilled in the art will recognize that while the invention will most likely be used in conjunction with automobiles, it is suitable for use with any vehicle. For example, in addition to automobiles, trucks, buses, locomotives, aircrafts, or any other vehicle type that uses a windshield wiper can benefit from the invention.

[0068] While specific embodiments have been discussed to illustrate the invention, it will be understood by those skilled in the art that the descriptions herein are intended as illustrative, and not as limiting, and that variations in the embodiments can be made without departing from the spirit of the invention.

[0069] For example, any suitable material can be used to manufacture the connector. The number or position of the retaining pin apertures, locking apertures, or other mechanisms can vary so long as they are capable of performing their intended function.

We claim:

1. A windshield wiper connector comprising
a peripheral wall having at least two opposing peripheral side walls;
a top surface extending from one of the two opposing peripheral side walls to the other;
a channel formed in the top surface, and extending longitudinally along the top of the connector;
a groove near to the proximal end of the connector and sized to be capable of engaging a trapezoidal roller of a wiper arm;
wherein the opposing peripheral side walls each have a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm; and
wherein the channel on the top of the connector is sized to be capable of accepting a bayonet style wiper arm.
2. The connector of claim 1 wherein the top surface of the connector further comprises a proximal shelf with an opening underneath the proximal shelf that is sized to be capable of receiving the end of a bayonet style arm such that the bottom side of a bayonet style arm rests against a surface of the channel.
3. The connector of claim 1 wherein a distal end of the channel may have a pillar extending upwards from a surface of the channel, wherein the pillar is capable of engaging a notch on the arm of a notched bayonet style wiper arm as it rests against the surface of the channel.
4. The connector of claim 1 wherein the channel comprises opposing side channel walls, and each side channel wall comprises one or more retaining appendages extending a distance towards opposing side channel walls.
5. The connector of claim 4 wherein the retaining appendages are capable of holding a bayonet style wiper arm against a surface of the channel.
6. The connector of claim 4 wherein the retaining appendages are sized such that they are capable of snapping a bayonet style wiper arm into place as the bayonet style wiper arm is pressed towards the surface of the channel.

7. The connector of claim 1 further comprising at least one rivet passage and arcuate rivet clip in each of the opposing peripheral side walls that are capable of accepting and securing a rivet of a wiper blade, thereby securing the connector to the wiper blade.

8. The connector of claim 1 further comprising at least one internal longitudinal support wall extending downwards from the top surface and extending substantially along the longitudinal direction of the connector for providing rigidity and structural support for the connector.

9. The connector of claim 1 comprising at least one internal perpendicular support wall extending downwards from the top surface and extending substantially from the one side wall of the connector to the next side wall.

10. The connector of claim 1 further comprising a groove cover sized to be capable of covering the groove, wherein the groove cover is shaped to complement the shape of the channel.

11. A wiper blade assembly comprising:

- a wiper strip;

- a force distribution structure;

- a connection device; and

- a connector comprising:

- a peripheral wall having at least two opposing peripheral side walls;

- a top surface extending from one of the two opposing peripheral side walls to the other;

- a channel formed in the top surface, and extending longitudinally along the top of the connector;

- a groove near to the proximal end of the connector and sized to be capable of engaging a trapezoidal roller of a wiper arm;

wherein the opposing peripheral side walls each have a retaining pin aperture aligned with one another and sized to be capable of accepting a retaining pin of at least one pin-type windshield wiper arm; and

wherein the channel on the top of the connector is sized to be capable of accepting a bayonet style wiper arm.

12. The wiper blade assembly of claim 11 wherein the top surface of the connector further comprises a proximal shelf with an opening underneath the proximal shelf that is sized to be capable of receiving the end of a bayonet style arm such that the bottom side of a bayonet style arm rests against a surface of the channel.

13. The wiper blade assembly of claim 1 wherein a distal end of the channel may have a pillar extending upwards from a surface of the channel, wherein the pillar is capable of engaging a notch on the arm of a notched bayonet style wiper arm as it rests against the surface of the channel.

14. The wiper blade assembly of claim 1 wherein the channel comprises opposing side channel walls, and each side channel wall comprises one or more retaining appendages extending a distance towards opposing side channel walls.

15. The wiper blade assembly of claim 14 wherein the retaining appendages are capable of holding the a bayonet style wiper arm against a surface of the channel, and wherein the retaining appendages are sized such that they are capable of snapping a bayonet style wiper arm into place as the bayonet style wiper arm is pressed towards the surface of the channel.

16. The wiper blade assembly of claim 11 further comprising at least one rivet passage and arcuate rivet clip in each of the opposing peripheral side walls that are capable of accepting and securing a rivet of a wiper blade, thereby securing the connector to the wiper blade.

17. The wiper blade assembly of claim 1 further comprising at least one internal longitudinal support wall extending downwards from the top surface and extending substantially along the longitudinal direction of the connector for providing rigidity and structural support for the connector, and at least one internal perpendicular support wall extending downwards from the top surface and extending substantially from the one side wall of the connector to the next side wall.

18. The wiper blade assembly of claim 11 further comprising a groove cover sized to be capable of covering the groove, wherein the groove cover is shaped to complement the shape of the channel.

19. The wiper blade assembly of claim 11 wherein the force distribution structure comprises a beam.

20. The wiper blade assembly of claim 11 wherein the force distribution structure comprises a frame.

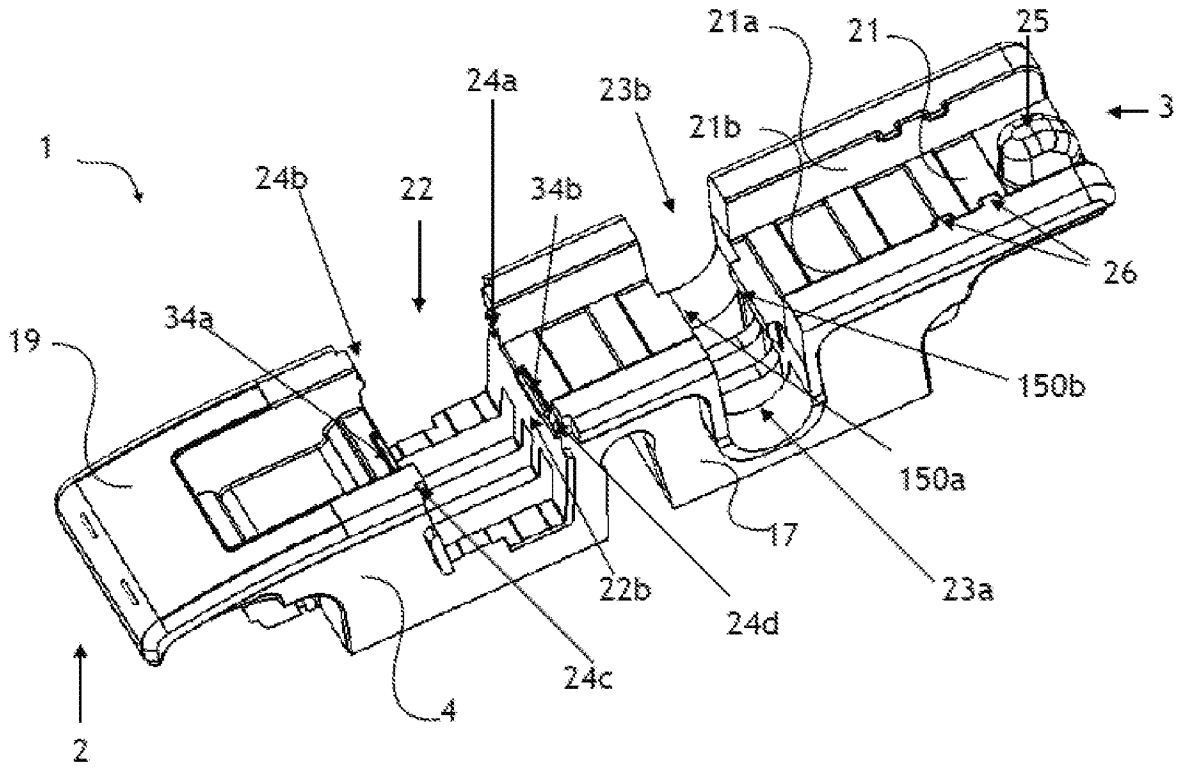


Figure 1

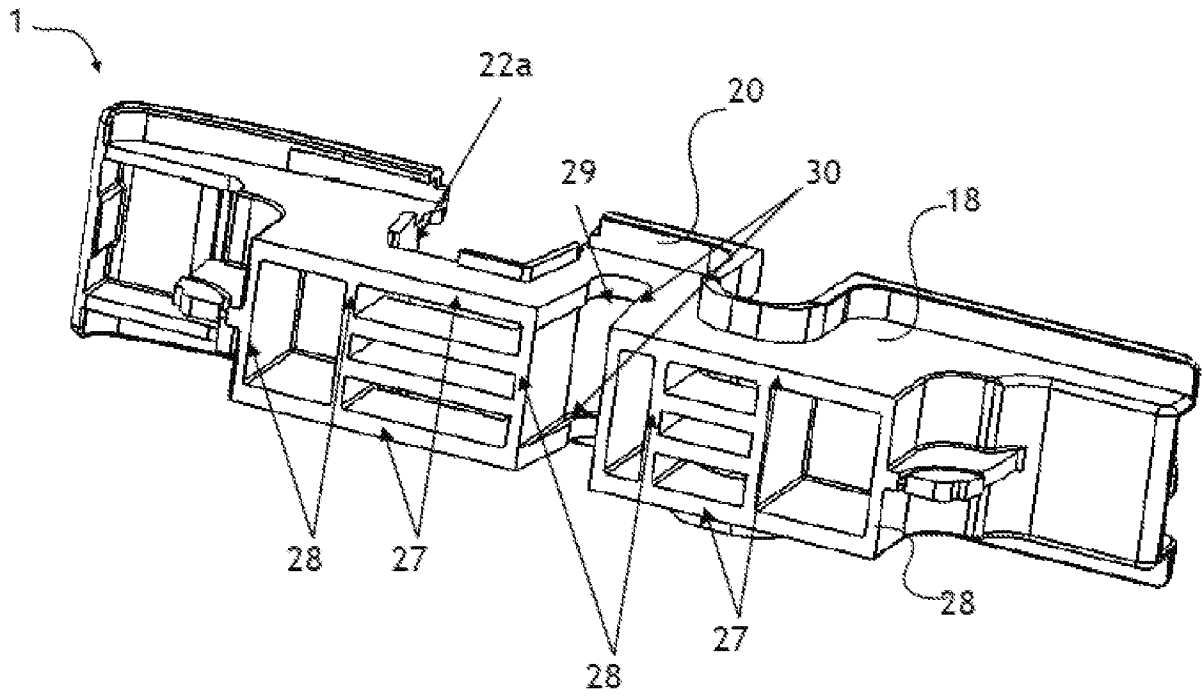


Figure 2

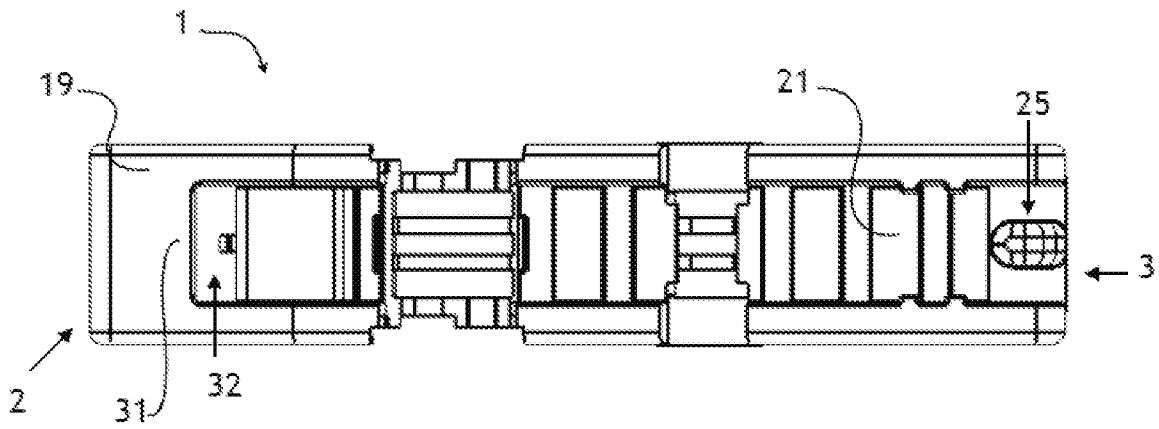


Figure 3

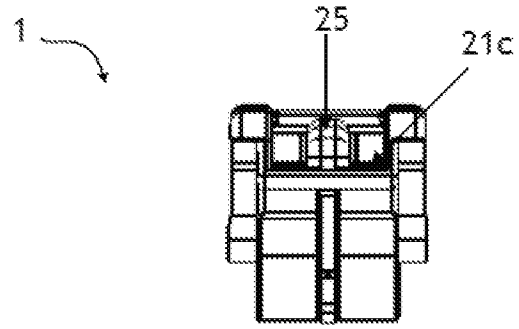


Figure 4

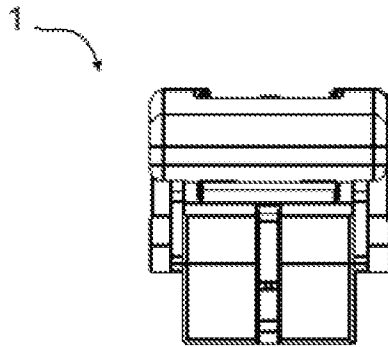


Figure 5

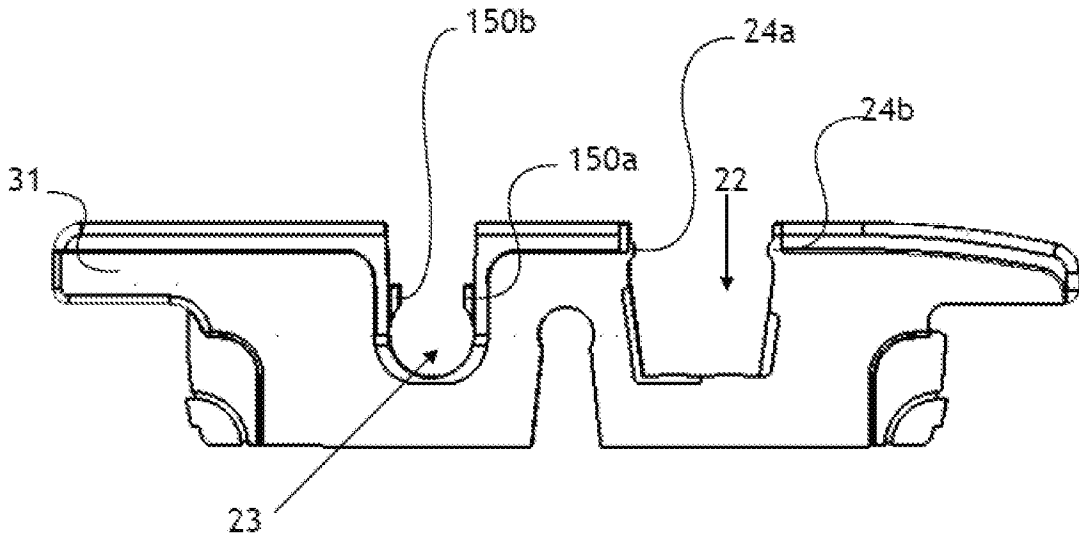


Figure 6

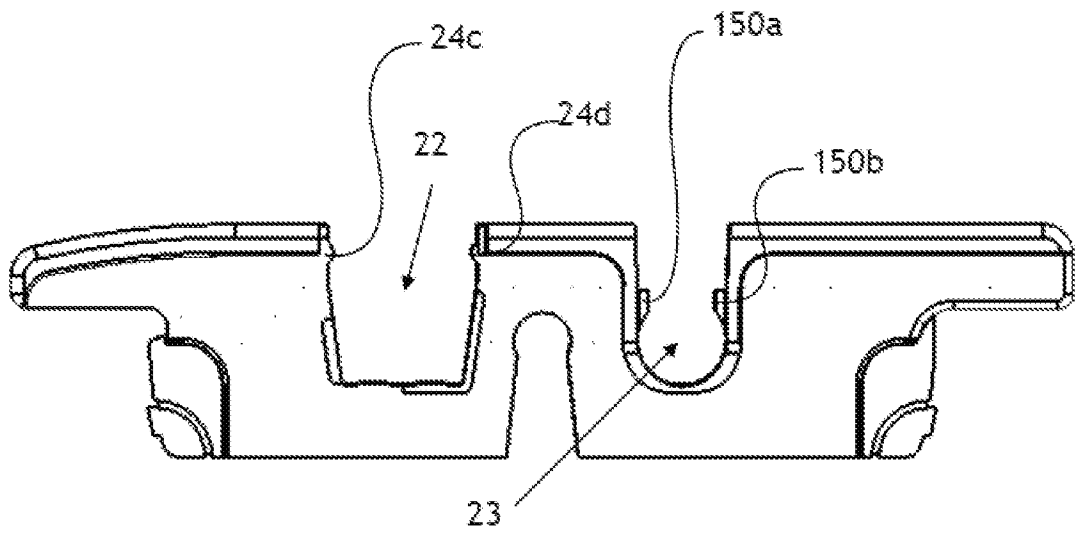


Figure 7

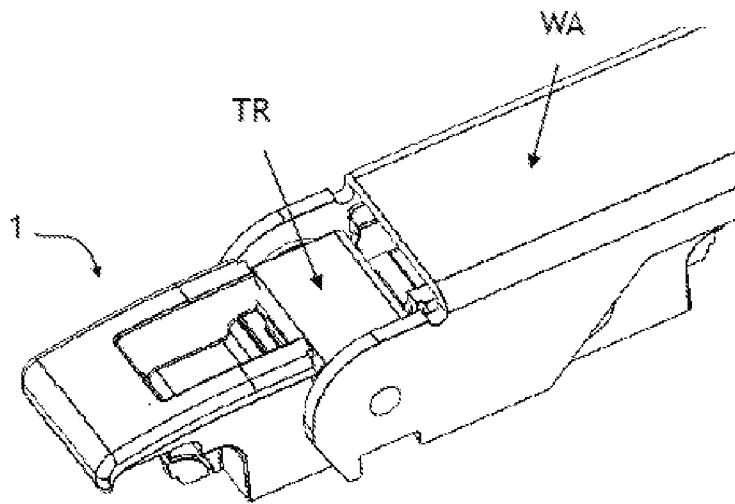


Figure 8

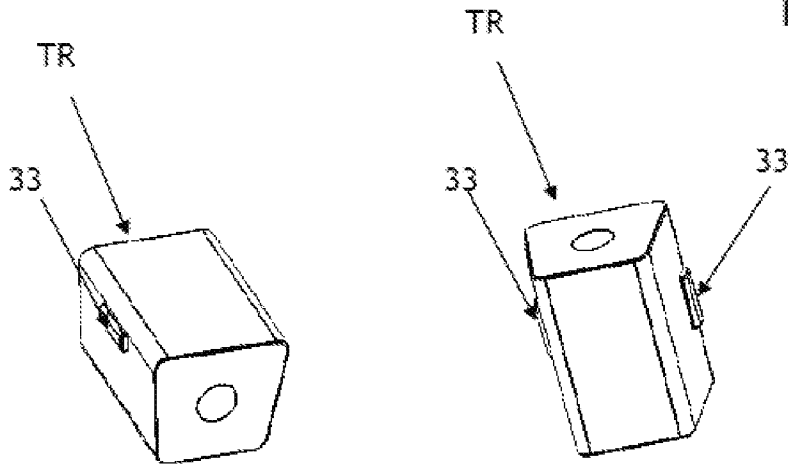


Figure 9A

Figure 9B

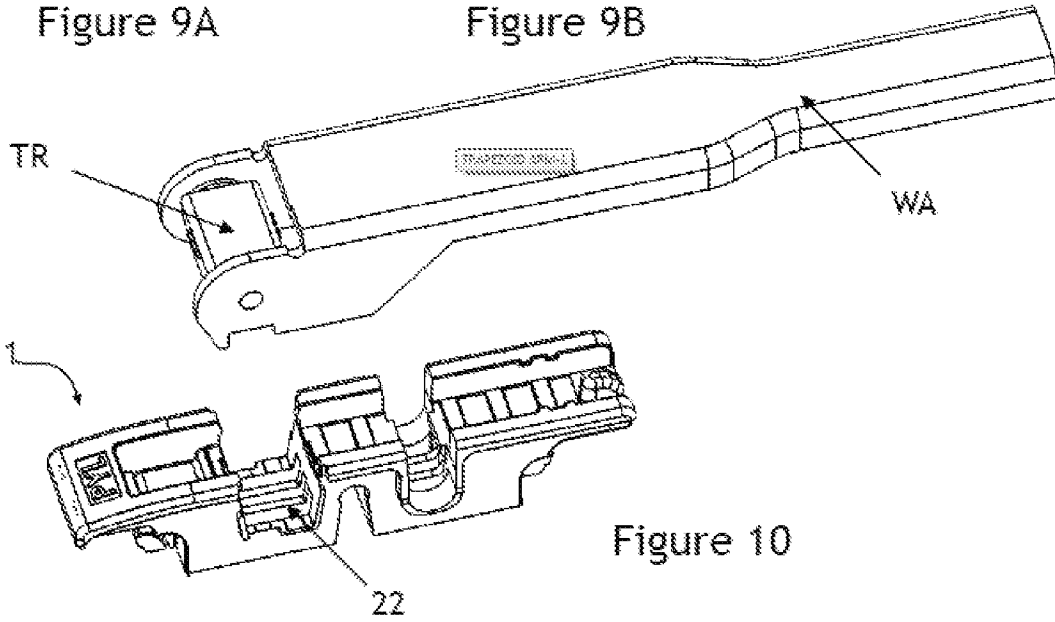


Figure 10

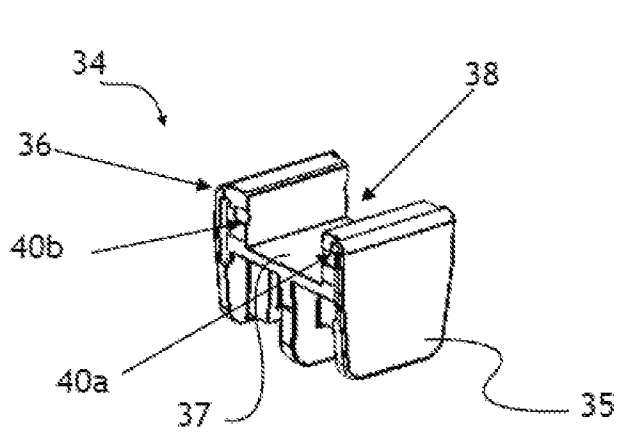


Figure 11A

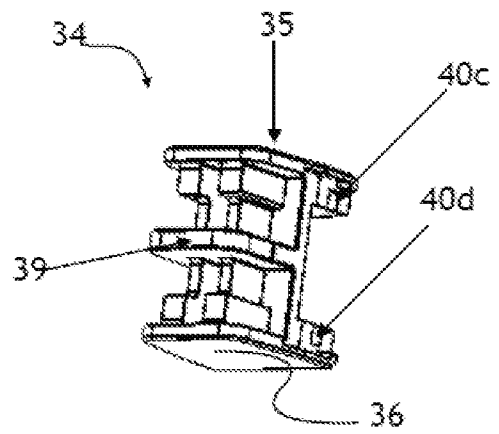


Figure 11B

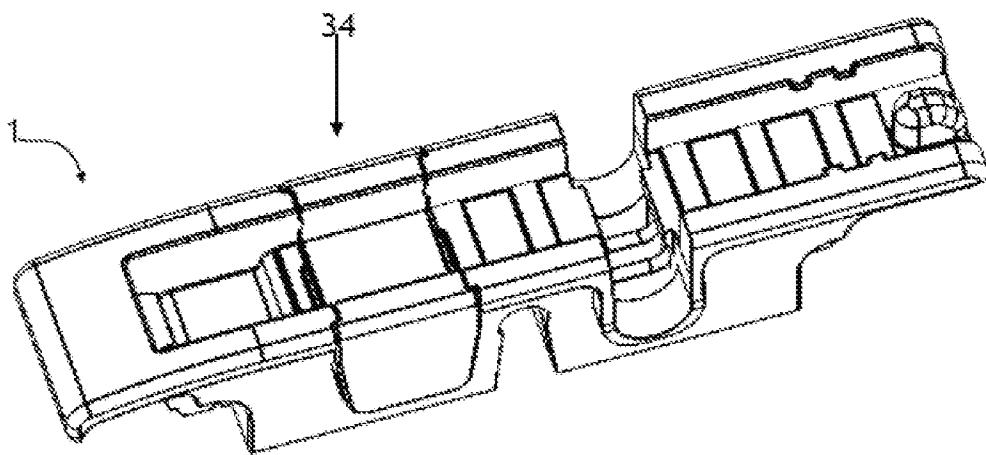


Figure 12

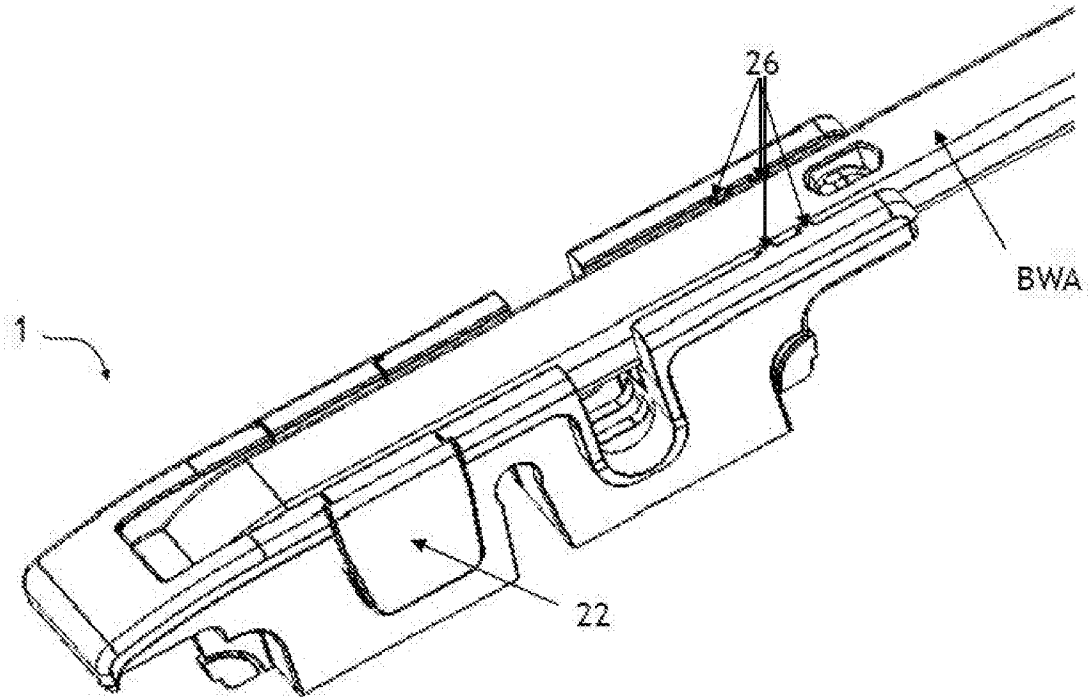


Figure 13

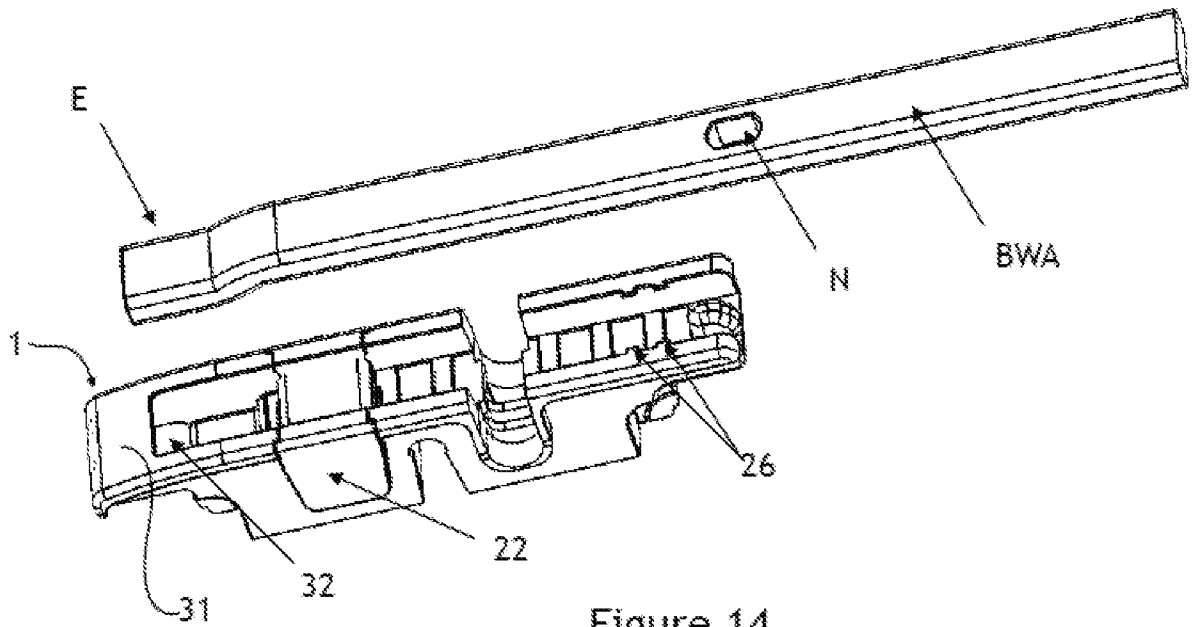


Figure 14

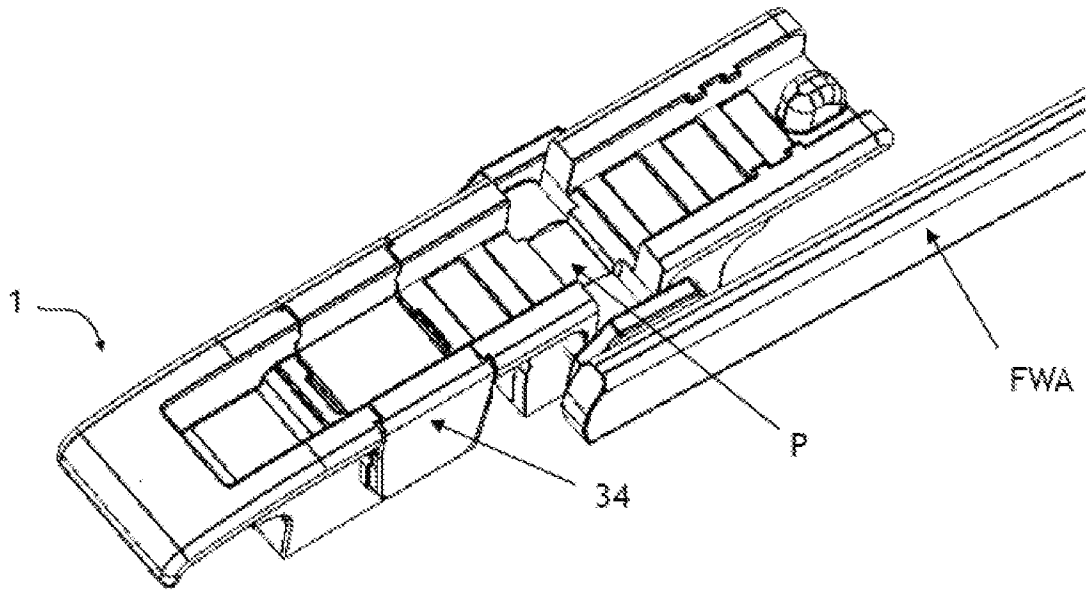


Figure 15

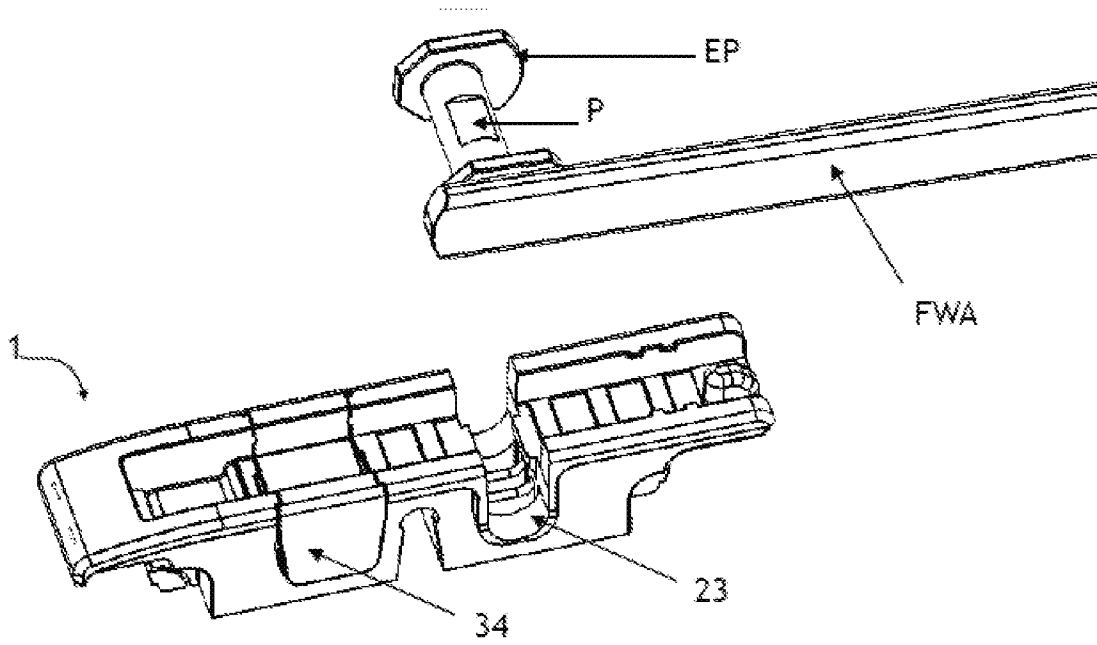


Figure 16

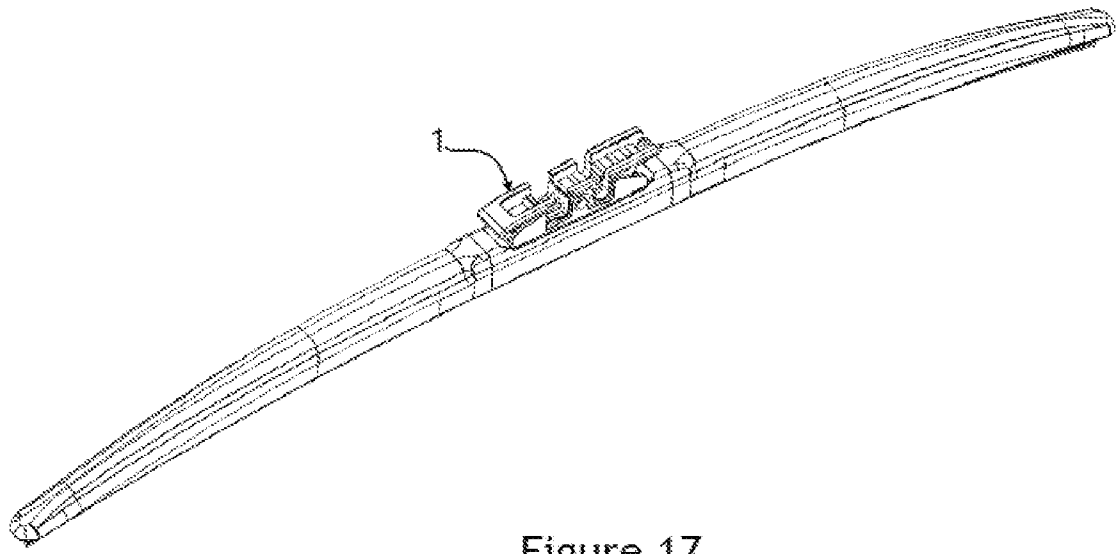


Figure 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 17/33622

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B60S 1/38, B60S 1/40 (2017.01)
CPC - B60S 1/4045 B60S 2001/4054 B60S 1/4064 B60S 1/387 B60S 1/4003 B60S 1/4048, B60S 1/4019, B60S 2001/4032

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7,055,207 B2 (COUGHLIN) 06 June 2006 (06.06.2006), entire document, especially Figs. 1-2, 5A-5B, 7A-11B	1-20
A	"First Time Fit Wiper Blades: Top Lock 1 Connector Wiper Blade Installation Instructions" (DENSO AUTO PARTS) 4 May 2016 (04.05.2016), accessed 18 July 2017 (18.07.2017), available at <http://densoautoparts.com/wiper-blades-first-time-fit-wiper-blades.aspx#undefined>, entire document	1-20
A	"Dupont Wiper Blade Installation: Trapezoid Arm Style" (PYLON MANUFACTURING CORP.) 1 January 2015 (01.01.2015), accessed 18 July 2017 (18.07.2017), available at <http://windshield-wiperblades.com/resources?do=installation_removal&country=United%20States#>, entire document	1-20
A	US 2003/0066153 A1 (ROSENSTEIN et al.) 10 April 2003 (10.04.2003), entire document	1-20
A	US 2014/0283325 A1 (KAWASHIMA et al.) 25 September 2014 (25.09.2014), entire document	1-20
A	US 2013/0025084 A1 (TOLENTINO et al.) 31 January 2013 (31.01.2013), entire document	1-20
A	US 2013/0192015 A1 (TOLENTINO et al.) 1 August 2013 (01.08.2013), entire document	1-20

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
18 July 2017

Date of mailing of the international search report
11-AUG 2017

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