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(54) **Title:** RELATIVE AXIAL TRANSLATION PREVENTION SYSTEM

(57) **Abstract:** A windshield wiper blade assembly is disclosed which comprises a resilient wiper blade having an axial passage through which a flexible support beam is positioned to provide structure. A universal connector element for connecting the blade assembly to a plurality of different wiper arms crimps onto the blade and support beam assembly approximately midway along the wiper blade in a manner which does not puncture nor interfere with the resilient windshield wiper material, while at the same time preventing the relative axial translation of the support beam within the windshield wiper blade as well as translation between the blade and the connector itself.



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RELATIVE AXIAL TRANSLATION PREVENTION SYSTEM

FIELD OF THE INVENTION

5 [0001] The present invention relates to windshield wiping blade assemblies. More particularly, this invention relates to the connector means of attaching a windshield wiping blade assembly to a wiper arm, minimizing or preventing relative axial translation thereto.

BACKGROUND OF THE INVENTION

10 [0002] A frequently encountered shortcoming in the design of conventional automotive windshield wipers is observed in that various automobile manufacturers utilize various windshield wiper arms. Some of the more frequently used designs comprise wiper arms which have a hook end, flat
15 end or bayonet style, or lateral side pin. Each of these varying styles of windshield wiper arms generally requires a different adapter for attaching the wiper arm to a wiper blade assembly.

 [0003] These connectors frequently come in the package when a consumer purchases a windshield wiper, and it is often difficult for the consumer
20 to discern how to use and how to attach the various adapters. Many times, loose pieces can be lost and wrong pieces used to install the wiper, which can hinder the performance of the wiper blade.

 [0004] Additionally, the connectors on the windshield wiper blades, which receive the various wiper arm adapters, are slipped on, spot welded, or
25 riveted to the support beam of the wiper blade. The use of these methods of attachment can cause the connector to slip off or break loose under severe circumstances, allowing tangential disassembly of the wiper blade assembly and possible damage to the windshield of the vehicle. Furthermore, this type of design requires intimate or direct contact between the connector and the wiper
30 support beam. The current attachment means do not provide an option for attachment with a resilient medium between the connector and the beam, which would prolong the life of the blade assembly. Additionally, separate connection means are often necessary to prevent relative translation between the wiper

beam and the wiper blade, as well as between the wiper blade and the wiper arm connector. Current methods do not provide one means to accomplish both objectives.

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SUMMARY OF THE INVENTION

[0005] It is therefore proposed herein that an object of the present invention is to provide a windshield wiper having an encapsulated beam for providing structure and uniform support for the wiper blade throughout its various oscillations.

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[0006] A further object of the present invention is to provide a wiper blade having an encapsulated beam which prevents the rotation and twisting of the resilient wiper blade around the support beam.

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[0007] It is another object of the present invention to provide a wiper blade having an encapsulated beam which prevents the axial translation of the resilient wiper blade along the support beam.

[0008] Another object of the present invention is to provide a wiper blade having the encapsulated beam detachably attachable as a unit to a wiper arm connector element.

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[0009] Another object of the present invention is to provide a wiper beam having a construction whereas the beam is isolated from the windshield wiper connector system while still preventing the rotation/translation of the resilient portion relative to the beam.

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[0010] Another object of the present invention is to provide a universal wiper arm connector for attaching the windshield wiper to a plurality of different wiper arms.

[0011] Another object of the present invention is to provide a shrouded windshield wiper connector and collar which provides a smooth transition between a wind deflector or airfoil portion of a windshield wiper and the connector element.

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[0012] Finally, it is an objective of the present invention to provide an easy-to-assemble, simple-to-manufacture universal windshield wiper assembly which is durable and economical to create.

[0013] These and other objects will become more apparent in the following detailed description describing a windshield wiper blade assembly comprising a resilient wiper blade having an axial passage through which a semi-flexible support beam is positioned to provide structure. A universal connector element, for connecting the blade assembly to a plurality of different wiper arms, crimps onto the blade and support beam assembly approximately midway along the wiper blade in a manner which does not puncture or interfere with the resilient windshield wiper material, while at the same time preventing the relative axial translation of the support beam within the windshield wiper blade as well as translation between the blade and the connector itself.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0015] Figure A-1 illustrates a partial perspective exploded view of a first embodiment of a windshield wiper beam assembly;

[0016] Figure A-2 illustrates a partial perspective assembled view of the embodiment shown in Figure A-1 ;

[0017] Figure A-3 illustrates a cross-sectional view of the embodiment of Figure A-1 ;

[0018] Figure B-1 illustrates a cross-sectional end view of the embodiment of Figure A-1 ;

[0019] Figure B-2 illustrates an additional perspective view of the connector element shown in Figure A-1 ;

[0020] Figures C-1 through C-6 illustrate partial perspective views of alternative embodiments for the crimping tabs of the connector element shown in Figure B-2 ;

[0021] Figure C-7 illustrates a partial perspective view of an alternative embodiment of the assembly shown in Figure A-1 ;

[0022] Figures C-8 through C-12 illustrate cross-sectional top views of alternative embodiments for the crimping tabs of the connector element shown in Figure C-7 ;

[0023] Figure D-1 illustrates a partial perspective exploded view of a windshield wiper beam assembly having a perforated beam;

[0024] Figures D-1 .1 through D-1 .4 illustrate partial overhead views of alternative embodiments for the beam illustrated in Figure D-1 ;

5 [0025] Figure D-2 illustrates a partial perspective assembled view of the embodiment shown in Figure D-1 ;

[0026] Figure D-3 illustrates a cross-sectional view of the embodiment shown in Figure D-2;

10 [0027] Figures E-1 and E-2 illustrate cross-sectional views of alternative embodiments for the wiper beam of D-1 ;

[0028] Figures E-3 and E-4 illustrate partial perspective views of the embodiments of Figures E-1 and E-2, respectively;

[0029] Figure E-5 and E-6 illustrate partial perspective views of alternative embodiments of the windshield wiper beam of Figure D-1 ;

15 [0030] Figure F-1 illustrates a partial perspective view of a first embodiment of the crimping tab of the connector element shown in Figure D-1 ;

[0031] Figure F-2 is a cross-sectional view of Figure F-1;

[0032] Figures F-3 and F-4 are alternative embodiments of the crimping tab shown in Figures F-1 and F-2;

20 [0033] Figure F-5 illustrates a cross-sectional view of Figure F-4;

[0034] Figure G-1 illustrates a partial perspective view of an alternative embodiment to the connector element of Figure D-1 ;

[0035] Figure G-2 illustrates a cross-sectional view of the connector of Figure G-1 ;

25 [0036] Figure G-3 illustrates a partial perspective view of an alternative embodiment to the connector element of Figure D-1 ;

[0037] Figure G-4 illustrates a cross-sectional view of the connector of Figure G-3;

30 [0038] Figures H-1 through H-3 illustrate cross-sectional views of the connector of D-1 showing crimping tabs in the open, intermediate, and fully-clamped orientations, respectively;

[0039] Figure H-4 illustrates a partial perspective view of an alternative embodiment of the windshield wiper connector assembly;

[0040] Figure H-5 illustrates a cross-sectional view of the wiper connector assembly of Figure H-4;

5 [0041] Figures H-6 through H-8 illustrate a bottom view, a close-up bottom view, and a cross-sectional end view, respectively, of an alternative embodiment of the connector and windshield wiper assembly;

[0042] Figure H-9 illustrates a partial perspective assemblage view of an alternative embodiment to the connector element of Figure D-1 ;

10 [0043] Figure H-10 illustrates a cross-sectional assembled view of the connector of Figure H-9;

[0044] Figures I-1 and I-2 illustrate alternative embodiments to the connector element shown in Figure D-1 ;

15 [0045] Figures I-3 and I-4 illustrate alternative embodiments to the connector element shown in Figure D-1 ;

[0046] Figures I-5 through I-7 illustrate a cross-sectional, perspective and cross-sectional view, respectively, of an alternative connector assembly showing crimping tabs in the open, intermediate, and fully-clamped orientations, respectively;

20 [0047] Figures J-1 and J-2 illustrate partial perspective side views of the wiper blade assembly of the preferred embodiment in a flat and arcuate disposition, respectively;

[0048] Figures J-3 through J-8 illustrate partial overhead views of alternative embodiments to wiper blade support beams of the present invention;

25 [0049] Figure J-9 illustrates a cross-sectional view of a wiper connector assembly with the anchoring means of the beam to the connector assembly;

[0050] Figures J-10 through J-11 illustrate alternative embodiments of means of anchoring the beam to the connector assembly;

30 [0051] Figures K-1 and K-2 illustrate alternative embodiments for the connector element of the present invention;

[0052] Figures K-3 and K-8 illustrate alternative embodiments for the connector element of the present invention;

[0053] Figures K-9 and K-10 illustrate cross-sectional views of the pre-clamped and post-clamped connector element of Figure K-8 in conjunction with
5 a wiper blade and support beam;

[0054] Figures L-1 and L-2 illustrate partial perspective side views of the wiper blade assembly of the an alternative embodiment in a flat and arcuate disposition, respectively;

[0055] Figure L-3 illustrates a pre-assembled perspective view of the
10 connector assembly of Figure L-1 ;

[0056] Figure L-4 shows a cross section of the connector assembly of Figure L-3 illustrating the releasable, re-connectable crimping tabs;

[0057] Figures M-1 and M-2 illustrate a partial perspective and cross-sectional end view, respectively, of an alternative embodiment of the connection
15 means between the wiper blade and the support beam;

[0058] Figures M-3 and M-4 illustrate a cross-sectional view and a close-up, cross-sectional view of the connector tab/wiper blade/support beam interface;

[0059] Figure N-1 illustrates a pre-assembly perspective view of
20 alternative embodiment for the connector wiper blade junction;

[0060] Figure N-2 illustrates a partial perspective view of the connector junction of Figure N-1 in an assembled disposition;

[0061] Figure N-3 illustrates a pre-assembly perspective view of an alternative embodiment for the connector wiper blade junction;

[0062] Figure O-1 is a cross-sectional, pre-assembly end view of a
25 further embodiment of the present invention;

[0063] Figure O-2 is a partial perspective preassembly view of the embodiment shown in Figure O-1 ;

[0064] Figure O-3 is a cross-sectional, assembled end view of the
30 embodiment shown in Figure O-1 ;

[0065] Figure O-4 is a perspective view of a collar and connector representing another embodiment of the present invention;

[0066] Figure O-5 is a side view of the embodiment shown in Figure O-4;

[0067] Figure O-6 is an opened side view of the embodiment shown in Figure O-4 attached to a windshield wiper assembly;

5 [0068] Figure O-7 is a closed side view of the embodiment shown in Figure O-4 attached to a windshield wiper assembly;

[0069] Figures P-1 through P-5 are partial perspective views of a plurality of windshield wiper arms known in the art;

10 [0070] Figure P-6 illustrates a partial perspective view of a windshield wiper assembly in conjunction with the wiper arms of Figures P-1 and P-5;

[0071] Figure P-7 illustrates a partial perspective view of a windshield wiper assembly in conjunction with the wiper arm of Figure P-3;

[0072] Figures Q-1 and Q-2 illustrate partial perspective assembly views of a further embodiment of the present invention comprising the connector collar/shroud;

[0073] Figure R-1 is a partial perspective view of a further embodiment representing a collar/connector combination;

[0074] Figure R-2 is a partial perspective view of a further embodiment representing a collar/connector combination;

20 [0075] Figure S-1 is a partial perspective pre-assembly view of a further embodiment representing a wiper blade/connector combination; and

[0076] Figure S-2 is a partial perspective assembled view of the embodiment shown in Figure S-1.

25 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0077] The following description of the preferred embodiments is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

30 [0078] Referring now to the figures, particularly Figure A-1, a first embodiment of a windshield wiper assembly 10 is shown. Assembly 10 comprises an elongated, resilient wiping blade 12 having a flexible windshield wiping element 14 and a longitudinal beam-receiving passage 13 therethrough

for accepting a support beam 20 therewithin. Support beam 20 is retained within wiping blade 12 by a releasable connector element 30 which secures the assembly by one or more paired crimping tabs 32 shown with additional securing apertures 33.

5 [0079] Figures A-2 and A-3 illustrate the wiper assembly 10 of Figure A-1 wherein wiping blade 12, support beam 20, and connector element 30 are assembled together, showing the support beam positioned within the resilient wiping blade 12 and secured by crimping tabs 32, which wrap around the edges 15, 16 of blade 12, clamping beam 20 therebetween. Figure A-3, illustrating a cross-sectional overhead view of Figure A-2 taken along plane 3 of Figure A-2, further shows the assembly interface between connector 30, wiping blade 12, and support beam 20. Support beam 20, shown in this embodiment, has a plurality of lateral serrations 22 which assist in securing beam 20 within blade 12. When crimping tabs 32 are crimped around the assembly of blade 12 and beam 15 20, a portion of the resilient material of blade 12 flows/bulges inward to form an inward bulge 17 proximal these serrations, preventing axial translation of wiping blade 12 relative to support beam 20 at the connector location. Furthermore, outward bulges 18 of the resilient blade material form within apertures 33 of crimping tabs 32 upon the crimping of the tabs around the assembly, preventing 20 relative axial translation between the connector element 30 and wiping blade 12. Figures B-1 and B-2 further illustrate connector element 30 as a cross-sectional view in conjunction with wiping blade 12 and as an isolated illustration, respectively, for clarification purposes.

25 [0080] Referring now to Figures C-1 through C-6, alternative embodiments of crimping tabs 32 of connector element 30 are shown. Particularly, the scope of the present invention is intended to cover resilient bulge receiving apertures 33 in any number, shape, or combination, both on the lateral portion 34 and the supporting lower portion 36 of crimping tabs 32. These apertures can be of oval, round, or triangular shape, for example, and all 30 contribute to the ability of assembly 10 to prevent lateral translation between the connector and wiper blade.

[0081] Figures C-4 and C-5 illustrate an even further means of blade retention by implementing one or more serrations 37, 40 in lower portion 36 of crimping tabs 32 within which additional portions of the resilient blade material are deflected during assembly. Figure C-6 illustrates an alternative design in which one or more teeth 41 extend inward from the lower portion of crimping tab 32, between which deflected blade material is received when the assembly is crimped together. Optionally, concave portions 38, 39 within lateral portion 34 and lower portion 36 of tab 32 are shown, respectively, at the junction therebetween, further carrying out the objective of retaining the blade element within connector 30.

[0082] Referring now to Figures C-7 through C-12, alternative embodiments to the crimping tabs 32 of connector 30 are shown. Figure C-7 illustrates crimping tabs 32 of connector element 30 in conjunction with one or more pairs of lateral stabilizer tabs 41, which are also formed within connector element 30. These tabs may be present in any number of shapes and add to the overall support of the assembly in controlling the lateral play between wiping blade 12 and connector 30, while further providing additional frictional force to aid in preventing relative translation between the blade and connector elements, as well. As shown in these figures, tabs 32, 41 may comprise any number or combination of inward deflections 43, 45, and 48, outward deflections 42, 44, or stamped protrusions 46, 47.

[0083] Additional means of preventing the relative translation between support beam 20 and wiping blade 12 are shown in Figures D-1 through D-1 .4. The retaining means are similar to those discussed above for retaining blade element 20 within connector 30, wherein the support beam comprises one or more apertures 23 positioned on beam 20 approximately midway so as to be located at connector 30 when assembled. These aperture(s) 23 partially receive a deflected portion of resilient wiper blade 12 material when connector 30 is crimped around the blade and beam assembly, frictionally holding beam 20 in position within blade 12 at the position of connector element 30. As shown in Figures D-1 .1 through D-1 .4, these apertures 23, 24, and 25 can be of any shape, size, or orientation on the support beam 30.

[0084] Figures D-2 and D-3 further illustrate this element of the present invention, wherein Figure D-3 is a cross-sectional view taken along plane 4 of Figure D-2. Connector 30 is shown crimped around blade 12, and support beam 20 is shown having aperture 23 therethrough, receiving deflected portions 17, 18 of wiper blade 12 for frictionally securing blade 12 to support beam 20. Referring to Figures E-1 through E-6, further embodiments of support beam 20 are shown. In particular, Figures E-3 and E-4 show support beam 20 with a single, longitudinal raised impression 26, or a plurality of latitudinal raised impressions 27. This is best illustrated in cross-sectional views E-1 and E-2 taken along lines 1 and 2 of Figures E-3 and E-4, respectively. These impressions further act to frictionally hold the longitudinal position of the support beam 20 within the wiper element 12.

[0085] Alternatively, as shown in Figures, E-5 and E-6, lateral protrusions 28, 29 can be utilized in any number combination or orientation to achieve the same frictional retention. The number, shape, and orientation of both impressions 26, 27, as well as the protrusions 28, 29, are intended to be within the scope of the present invention.

[0086] Referring now to Figures F-1 through F-5, a plurality of embodiments is shown for crimping tab 32. In particular, Figures F-1 and F-2 illustrate tabs 32 comprising a pair of raised dimples 51, both on lateral portion 34 and supporting lower portion 36 of crimping tabs 32. Figure F-3 shows a pair of parallel ridges 52, formed in the tabs, running axially to the windshield wiper blade. Figures F-4 and F-5 utilize a pair of inwardly deflected tabs 53. Though different in means, the function of each of these embodiments is to provide for the increased frictional gripping of the resilient blade material within the crimping tabs 32 when the connector element 30 is attached to the wiper blade assembly.

[0087] Figures G-1 through G-4 illustrate alternative embodiments for connector element 30, wherein the means of attaching to the wiper blade comprise separate elements attachable to the connector element by a plurality of means, such as gluing, welding, bonding, or crimping, though not limited to these methods per se. In particular, Figures G-1 and G-2 illustrate the wiper blade attachment means as a U-shaped channel 56, having a pair of crimping tabs 57,

58, which frictionally grip the wiper blade as described herein above. Channel 56 is affixed to the bottom side of connector element 30. Alternatively, as shown in Figures G-3 and G-4, the wiper blade attachment means can comprise a pair of L-shaped tabs 54, 55 which also crimp onto the wiper blade element and are
5 secured to the sides of connector element 30 by a plurality of permanent or releasable means.

[0088] Figures H-1 through H-3 illustrate the crimping steps of the blade attachment means of Figure G-1. U-shaped channel 56 is affixed to the bottom of connector element 30 with crimping tabs 57, 58 initially in the
10 outwardly deflected orientation. When wiper blade 12 with support beam 20 positioned therein is brought up within crimping tabs 57, 58, the tabs are biased inward, as shown by the arrows, to hold blade 12 and support beam securely there within.

[0089] Figures H-4 and H-5 further illustrate wiper assembly 10 having
15 a unitary connector element 30 and a serrated support beam 20. Wiping blade 12, support beam 20, and connector element 30 are assembled together, wherein support beam 20 is positioned within resilient wiping blade 12 and secured by crimping tabs 32 which wrap around edges 15, 16 of blade 12, clamping beam 20 therebetween without perforating the material of resilient
20 blade 12. Figure A-3, illustrating a cross-sectional overhead view of Figure A-2 taken along plane 3 of Figure A-2, further shows the assembly interface between connector 30, wiping blade 12, and support beam 20. Support beam 20, as shown in this embodiment, has a plurality of lateral serrations 22 which assist in securing beam 20 within blade 12. When crimping tabs 32 are crimped around
25 the assembly of blade 12 and beam 20, a portion of the resilient material of blade 12 forms inward bulges 17 proximal these serrations, preventing axial translation of wiping blade 12 relative to support beam 20 at the connector location. Furthermore, outward bulges 18 of resilient material of blade 12 form within apertures 33 of crimping tabs 32, upon the crimping of the tabs around the
30 assembly, preventing relative axial translation between connector element 30 and wiping blade 12.

[0090] Referring now to Figures H-6 through H-8, connector element 30 is shown with crimping tabs 32 crimped around windshield wiper blade 12. This embodiment shown utilizes serrations 40 on tabs 32 to provide increased frictional retention of blade 12 due to bulges 17 flowing partially into the void
5 created by the serrations, thereby securing blade 12 to connector 30.

[0091] As shown in Figures H-9 and H-10, an alternative embodiment for connector element 30 is shown, wherein the means of attaching to the wiper blade comprises a separate element 63, permanently or releasably attachable to connector element 30 by a pair of longitudinal ridges 61, 62 located on blade
10 attachment element 63. Ridges 61, 62 are received in a pair of corresponding grooves 59, 60 located on the lateral sides of connector element 30.

[0092] Figures 1-1 and I-4 illustrate further embodiments of connector elements 30. In Figure 1-1, connector element 30 comprises a pair of tabs 66, 67 projected outward from the lateral sides of connector element 30 which are deflected downward and then slightly inward, creating a seven-sided channel on the under side of connector 30 for receiving a wiper blade. Figure I-2, similar in design, has a pair of outward projected tabs 64, 65 which are bowed outward a predetermined distance from connector 30 before reflecting back inwards and terminating in a pair of blade support channels 68, 69. Figure I-3 shows the
15 connector element formed of a single piece of either metal or other suitably stamped material wherein tabs 68, 69 are cut out from connector element 30 and deflected downward prior to installation. Tabs 68, 69 comprise a pair of inward deflecting crimping tabs 32 described herein, for securing a wiper blade there between. Furthermore, this embodiment illustrates the apertures 33 through
20 which the resilient blade material is partially received upon the crimping of the tabs around the assembly, preventing relative axial translation between connector element 30 and the wiper blade. Figure I-4 is a similar designed embodiment, wherein connector element 30 is formed with crimping tabs 32 in the already downward disposition, ready for receiving the wiper blade and support beam therebetween.
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[0093] Figures J-1 and J-2 illustrate windshield wiper assembly 10 in both a generally planar and an arcuate flexed orientation. As disclosed,

connector element 30, when attached to blade 12, securely holds the blade generally in mid section by means of crimping tabs 32 without puncturing the resilient material that blade 30 is manufactured from. When wiper assembly 10 is applied to an arcuate surface, such as a windshield, the support beam which may be pre-formed with an arch is allowed to axially slip within blade 12 on either side of the connector element 30, but not within the connector. This is illustrated by the length of the support element 20 L' and L extending beyond wiping blade 12 in Figures J-1 and J-2. When the blade assembly is flattened out as illustrated in Figure J-1, the length of L' is significantly shorter than the length of L shown in Figure J-2 which shows the blade in its natural state.

[0094] Figures J-3 through J-8 illustrate a plurality of embodiments for support beam 20 having serrations 22 proximal the location of the attachment zone of connector element 30. These serrations provide the security of the support beam to the blade element, preventing relative axial translation at the point of the connector element. Figures J-9 through J-12 further illustrate various means of anchoring support beam 20 within connector element 30 to prevent relative axial translation of the beam within blade 12. These anchoring means 81, 82, 83 are detachably attachable and can be a single-point, relatively-short length or multiple points and may comprise: plastic, wood, tape, paint, adhesive, epoxy, foil, rubber, metalized spray, or grit wrap, for example.

[0095] Referring now to Figures K-1 through K-10, connector elements 30 are shown in various embodiments having stabilizing tabs 82 formed within or attached thereto. These tabs 82 in a preferred embodiment are formed of steel, though not limited to this material, and are bendable to impinge upon or simply close upon blade 12 and the assembly of support beam 20. This provides a stabilized position between connector element 30 and beam 20 to resist and prevent rotational movement of the connector relative to the beam. Additionally, it does not require the intimate contact of tabs 82 and the beam itself, retaining the integrity of blade 12. Figures L-1 through L-4 further illustrate wiper assembly 10 utilizing connector element 30 having stabilizer tabs 82, in conjunction with crimping tabs 32.

[0096] Figures M-1 and M-2 illustrate an alternative embodiment to the assembly of support beam 20 and wiping blade 12. This embodiment utilizes the application of adhesive 83 at one or more positions along the top surface of wiping blade 12 for securing to the bottom portion of support beam 20. This embodiment does not require the insertion of support beam 20 through an aperture in blade 12 and can provide for the application-specific tuning of preventing relative axial translation.

[0097] Referring now to Figures M-3 and M-4, a close-up, cross-sectional view of the interface between crimping tabs 32, wiping blade 12, and support beam 20 is shown. Support beam 20, as shown in this embodiment, comprises a lateral groove 22 which assists in securing beam 20 within blade 12. When crimping tabs 32 are crimped around blade 12 and beam 20 assembly, a portion of the resilient material of blade 12 form inward bulges 17 proximal the serrations or grooves 22, preventing axial translation of wiping blade 12 relative to support beam 20 at the connector location. Upon the crimping of the tabs around the assembly, outward bulges 18 of the resilient material of blade 12 form within apertures 33 of crimping tabs 32, which prevents relative axial translation between connector element 30 and wiping blade 12.

[0098] An alternative embodiment to connector element 30 is shown in Figures N-1 through N-3. Connector 30 comprises a plurality of downward stabilizing tabs 85 and at least one pair of downward projecting attachment tabs 86, which have receiving apertures 87 there through. Receiving apertures 87 receive attachment tab 88 of support beam 20. A portion 89 of blade 12 is removed to expose attachment tab 88 which is press-fitted down upon the blade and beam assembly. In a further example shown in Figure N-3, an intermediate adapter 90 is implemented. Adapter 90 comprises a pair of downward projecting tabs 91, 92 which have corresponding receiving apertures 87 there through for receiving attachment tabs 88. The upper portion of adapter 90 has a pair of upward projecting connector attachment tabs 93, 94 with corresponding inward-orientated connector locking tabs 95, 96 which are received in corresponding apertures 97 on connector element 30.

[0099] Referring now to Figures O-1 through O-3, the assembly steps are shown for an alternative embodiment to connector element 30. This embodiment, similar in design and function to the one illustrated in Figures H-9 and H-10, comprises connector element 30, having a pair of longitudinal receiving channels 59, 60 on the lateral sides therewith for receiving corresponding longitudinal ridges 61, 62 of blade attachment element 63. This attachment element is preformed with a pair of outwardly deflected crimping tabs 71, 72, which terminate in a T, having a pair of inward blade supporting elements 73, 74 and a pair of outward projecting collar supporting elements 75, 76. When the combination of blade 12 and support beam 20 is brought up under connector element 30 in the desired position for attachment, a corresponding rectangular collar 80 is placed over connector element 30, as shown, and pushed downward over blade attachment element 63. As collar 80 is pushed downward, it biases crimping tabs 71, 72 inward until blade 12 and support beam 20 are secured therebetween and wherein the collar is retained by collar support elements 75, 76. Blade 12 may be releasable from connector element 30 by simply reversing the process and raising collar 80, thereby allowing tabs 71, 72 to reflect outwards, releasing the assembly of blade 12 and support beam 20.

[00100] Figures O-4 through O-7 show an alternative embodiment to the collar shown in Figures O-1 and O-2. In this embodiment collar 80 is manufactured in combination with a universal wiper arm connector 104 having a hinge 102 on one end for connecting the two components, forming a universal attachment assembly 100. Connector 104 further comprises a living hinge 120 that cooperates with connector 104 to adapt to several of the most popular wiper arm styles. Assembly 100 can be manufactured or formed from plastics or other engineered polymers or castings known in the art.

[00101] Figures P-1 through P-5 illustrate the five most popular types of windshield wiper arms 130 on the market. These types include windshield wiper arms 130 with a large lateral pin 134, a small lateral pin 135, a large hook end 131, a small hook end 132, as well as one that is flat and has a receiving aperture 133. These styles are all intended to be compatible with universal

assembly 100. Figure P-6 shows how the style that is flat and has a receiving aperture 133, as well as the style with large and small lateral pins 134, 135, respectively, are attached to assembly 100. To attach lateral pin 134, 135 to assembly 100, lateral pin 134, 135 is inserted through receiving aperture 109 in connector element 30 and cooperates with living hinge 120 so the hinge is biased out of the way during insertion of the pin but reflects back when it is adjacent the locking groove 137 located on lateral pin 134. This secures the pin within connector 104 and is releasable by pushing the exposed portion 121 of hinge 120 that extends partially out of the release aperture 123 located in the connector 104 while simultaneously withdrawing lateral pin 134 or 135.

[00102] With regard to wiper arm 130 having a flat end, it is received in the adapter 110, which is pivotally attached to a rivet 115 or other pivot point connecting the two lateral sides of connector element 30. Adapter 110 comprises a receiving aperture 111 and an internal locking means which cooperates with aperture 133 to releasably secure the flat end style wiper arm to connector 30. An additional adapter 113 is pivoted upwards while connector 104 is open and further provides a means for attaching hook style wiper arm 132, 133 as shown in Figure P-7. Hook ends 131 or 132 are received around pivot point 115, wherein connector 104 is subsequently closed as indicated by the arrows. Once connector 104 is hinged closed, adapter 113 prevents the hook from dislodging, securing the wiper assembly to wiper arm 130. Universal connector 104 is secured to connector element 30 by a pair of biasing tabs 138 which are received in corresponding apertures 139 on connector element 30. This and collar are intended to provide a smooth transition between an airfoil portion of the windshield wiper and the connector.

[00103] Referring now to Figures Q-1 and Q-2, an alternative embodiment is shown wherein collar 80 is attached to the wiper blade and beam assembly by a pair of attaching tabs 143 which are received in corresponding apertures 141 located in a raised airfoil portion 140 of blade 12. The raised portion 140 is notched out to receive collar 80, which may include a pivotally attached connector 104 as shown in Figures O-4 through O-6. Figures R-1 and R-2 illustrate a further embodiment wherein pin style wiper arm 134 is receivable

in connector 104 and collar 80 comprises a floor member 145 which has apertures 146, 147 for receiving stabilizer tabs 85 and crimping tabs 32 of connector element 30.

5 **[00104]** Figures S-1 and S-2 represent a further embodiment of the present invention wherein connector element 30 comprises rivet 157 connecting the two lateral sides of the connector element, apertures 155 for receiving pin 154 on wiper arm 130, and support shoulders 151, 152 for supporting arm 153 of wiper arm 130. This style of wiper arm 130 utilizes the arm 153 to restrict rotation of the wiper blade assembly around pin 154. Locking foot 150, 10 comprising a pin receiving aperture 158 and rivet locking slot 156, is inserted into connector element 30 between the lateral sides so as to releasably attach to rivet 157, and apertures 158 and 155 are in alignment for receiving pin 154 of the wiper arm therethrough.

15 **[00105]** The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

20

CLAIMS

What is claimed is:

- 5 1. A windshield wiper blade assembly comprising:
 a resilient wiping element, said wiping element comprising a
longitudinal passage therethrough;
 a semi-rigid, encapsulated beam member, said beam member
positioned within said longitudinal passage;
- 10 a windshield wiper connector element, said connector element
universally detachably attaching said wiper blade assembly to at least one type
of windshield wiper arm attached to a motor vehicle, wherein said wiper
connector element is isolated from said encapsulated beam member;
 said connector element coupled by a securement means to said
15 resilient wiping element and said encapsulated beam in such a way as to
prevent the rotation and twisting of the resilient wiper blade around said support
beam, and further preventing longitudinal translation of said encapsulated beam
within said resilient wiping member.
- 20 2. The windshield wiper blade assembly of Claim 1, wherein said
resilient wiping member comprises a longitudinally extending raised airfoil
element positioned on an upper side of the windshield wiping element.
3. The windshield wiper blade assembly of Claim 2, wherein said
25 securement means of said connector element comprises at least two lateral,
downward projecting crimping arms, frictionally attaching to said encapsulated
beam and wiping element.
4. The windshield wiper blade assembly of Claim 3, wherein said
30 downward projecting crimping arms comprise at least one pair of apertures
therein, through which resilient wiping element is partially forced within when

said crimping arms are crimped to the encapsulated beam and wiping element assembly.

5 5. The windshield wiper blade assembly of Claim 3, wherein said encapsulated beam comprises a plurality of lateral detents, proximal the attachment location of said connector element, through which resilient wiping element is partially forced within when said crimping arms are crimped to the encapsulated beam and wiping element assembly.

10 6. The windshield wiper blade assembly of Claim 3, wherein said downward projecting crimping arms comprise at least one pair of impinging points, which impinge the resilient wiping element when said crimping arms are crimped to the encapsulated beam and wiping element assembly.

15 7. The windshield wiper blade assembly of Claim 3, wherein said encapsulated beam comprises at least one aperture positioned proximal the attachment location of said connector element, through which resilient wiping element is partially forced within when said crimping arms are crimped to the encapsulated beam and wiping element assembly.

20 8. The windshield wiper blade assembly of Claim 3, wherein said encapsulated beam comprises at least one pair of lateral protrusions proximal the attachment location of said connector element, frictionally retaining the position of said support beam within said wiping element when said crimping
25 arms are crimped to the encapsulated beam and wiping element assembly.

 9. The windshield wiper blade assembly of Claim 3, wherein said encapsulated beam comprises at least one raised impression, proximal the attachment location of said connector element, frictionally retaining the position
30 of said support beam within said wiping element when said crimping arms are crimped to the encapsulated beam and wiping element assembly.

10. The windshield wiper blade assembly of Claim 3, wherein said downward projecting crimping arms comprise at least one pair of raised impressions, frictionally retaining the position of said support beam within said wiping element when said crimping arms are crimped to the encapsulated beam
5 and wiping element assembly.

11. The windshield wiper blade assembly of Claim 1, wherein said connector element comprises two elements, a first windshield wiper blade assembly attaching element and a second universal windshield wiper arm
10 attachment means, said second element couplingly attached to said first element, said first and said second element being attached to one another by at least one of the following means: gluing, welding, crimping, or bonding.

12. The windshield wiper blade assembly of Claim 3, wherein said
15 encapsulated beam further comprises at least one means of frictionally maintaining its position within said wiping element proximal the attachment location of said connector element, frictionally retaining the position of said support beam within said wiping element when said crimping arms are crimped to the encapsulated beam and wiping element assembly, said means of
20 frictionally maintaining its position comprising at least one of the following: plastic, wood, tape, paint, adhesive, epoxy, foil, rubber, metalized spray, or grit wrap.

13. The windshield wiper blade assembly of Claim 4, wherein said
25 encapsulated beam comprises a plurality of lateral detents, aligned with said apertures of said crimping arms proximal the attachment location of said connector element, through which resilient wiping element is partially forced within when said crimping arms are crimped to the encapsulated beam and wiping element assembly.

30

14. A windshield wiper blade assembly comprising:

a resilient wiping element, said wiping element comprising a longitudinal passage therethrough, and at least one pair of lateral through passages, proximal said wiping elements midpoint;

5 a semi-rigid, encapsulated beam member, said beam member positioned within said longitudinal passage and having at least one pair of laterally outward projecting attachment tabs, said attachment tabs extending through said lateral through passages of said wiping element;

10 a windshield wiper connector element, said connector element universally detachably attaching said wiper blade assembly to at least one type of windshield wiper arm attached to a motor vehicle, said connector element coupled by a securement means to said resilient wiping element and said encapsulated beam in such a way as to prevent the rotation and twisting of the resilient wiper blade around said support beam, and further preventing longitudinal translation of said encapsulated beam within said resilient wiping
15 member, said securement means comprising at least one pair of lateral downward projecting crimping tabs for frictionally holding said connector element to said resilient wiping element and said encapsulated beam, and further comprising at least one pair of lateral, downward projecting attachment tabs having receiving apertures which attach to said outward projecting attachment
20 tabs of said beam member.

15. The windshield wiper blade assembly of Claim 14, wherein said windshield wiper connector element comprises an upper universal connector element and an intermediate transition member comprising at least one pair of
25 lateral, downward projecting attachment tabs having receiving apertures which attach to said outward projecting attachment tabs of said beam member, and at least one pair of lateral, upward projecting attachment tabs having inward projecting locking tabs which are received within corresponding apertures within said upper universal connector element.

30

16. The windshield wiper blade assembly of Claim 3, wherein said downward projecting crimping arms are biased against said encapsulated beam

and said wiping element, frictionally attaching said connector element to said encapsulated beam and wiping element by means of a collar pressed downward over said connector element and said crimping arms.

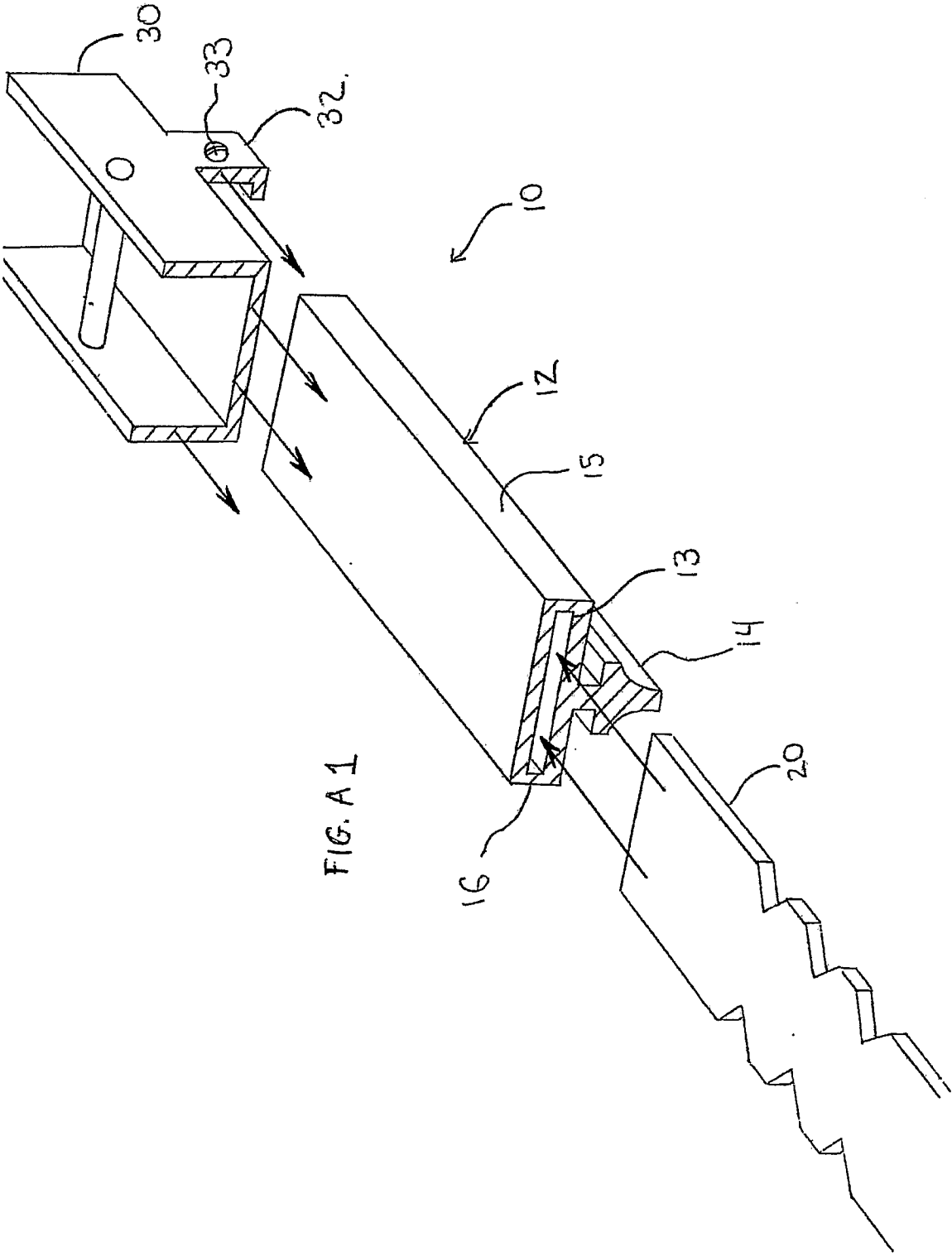
5 17. The windshield wiper blade assembly of Claim 16, wherein said collar comprises a means for universally attaching said wiper blade assembly to at least one of the following wiper arm styles: large lateral pin, small lateral pin, large hook end, small hook end, and bayonet.

10 18. The windshield wiper blade assembly of Claim 17, wherein said resilient wiping member comprises a longitudinally extending raised airfoil element positioned on an upper side of the windshield wiping element, having a centrally positioned cutout in said airfoil for receiving said collar, said collar attaching to said resilient wiping element and said beam assembly by a pair of
15 longitudinal extending tabs in said collar, which are received within corresponding apertures in said raised airfoil of said resilient wiping element.

 19. The windshield wiper blade assembly of Claim 2, wherein said second universal windshield wiper arm attachment means comprises a means
20 for universally attaching said wiper blade assembly to at least one of the following wiper arm styles: large lateral pin, small lateral pin, large hook end, small hook end, and bayonet.

 20. The windshield wiper blade assembly of Claim 17, wherein said
25 means for universally attaching said wiper blade assembly to said wiper arm is pivotally attached to said collar at a first end of said collar and detachably attachable at a second end of said collar.

 21. The windshield wiper blade assembly of Claim 17, wherein there is
30 a smooth transition between said airfoil element and said connector element.



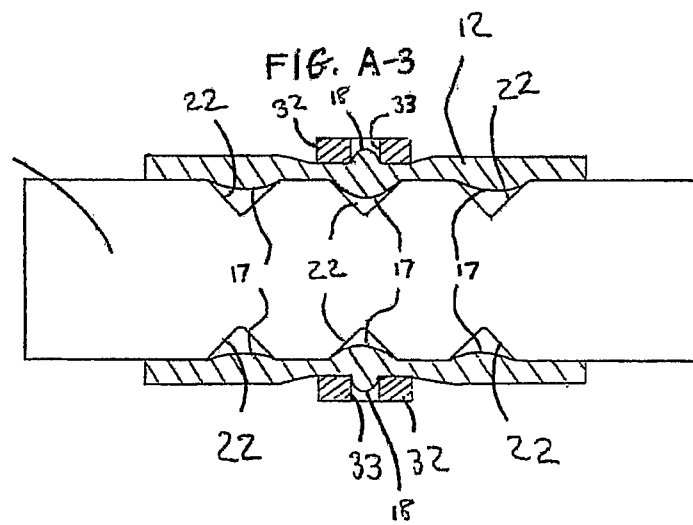
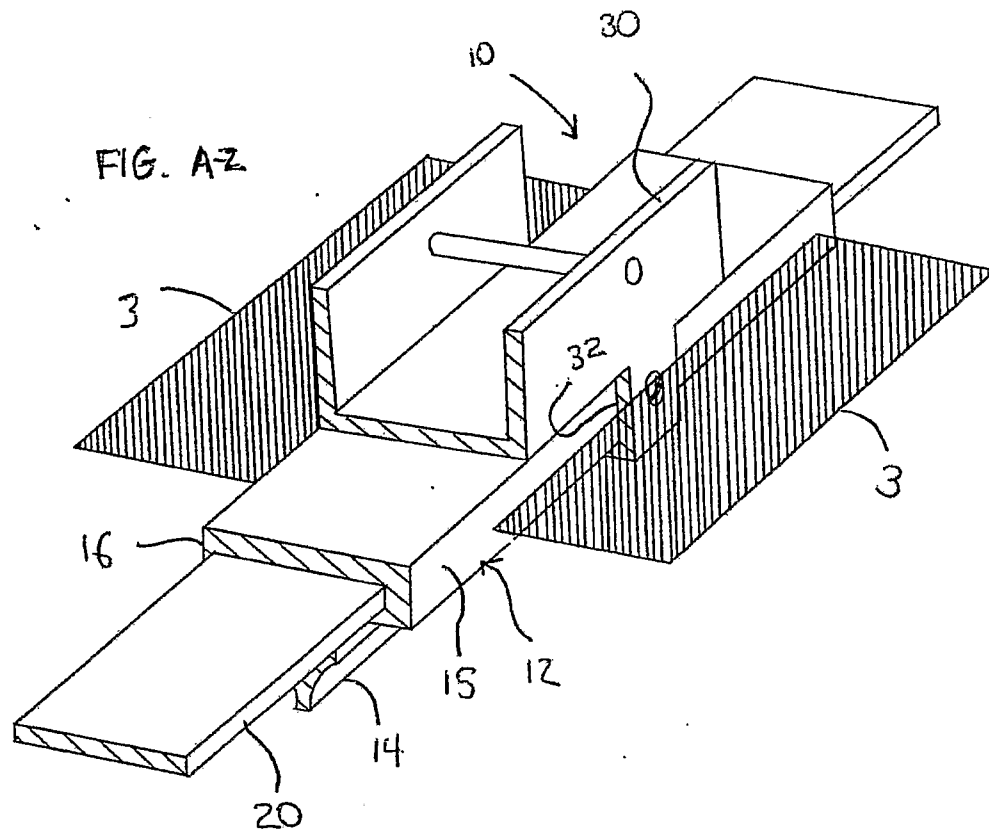


FIG. B-1

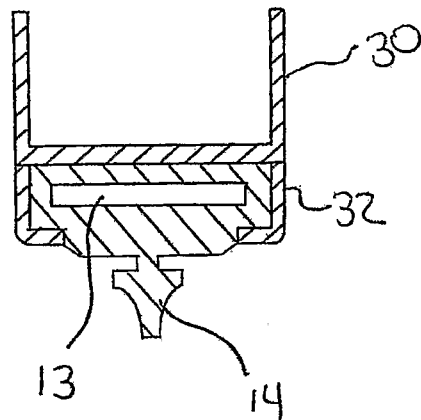


FIG-B-2

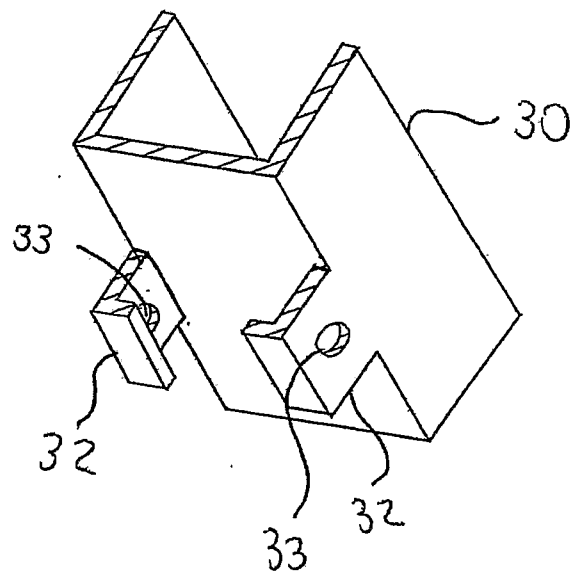


FIG C-1

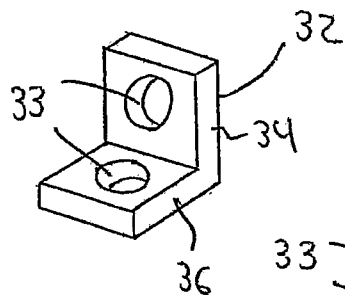


FIG C-2

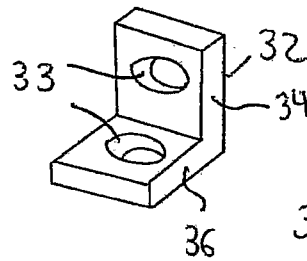


Fig C-3

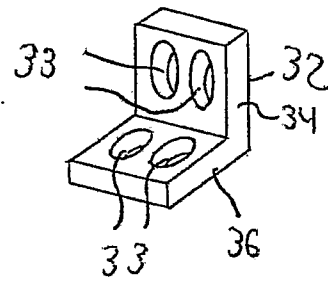


Fig C-4

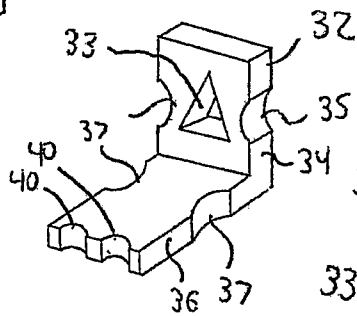
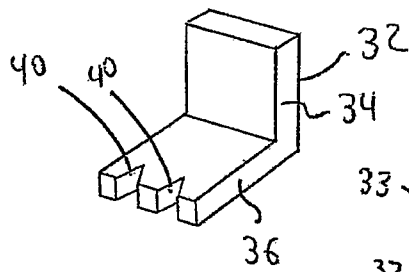


FIG C-5

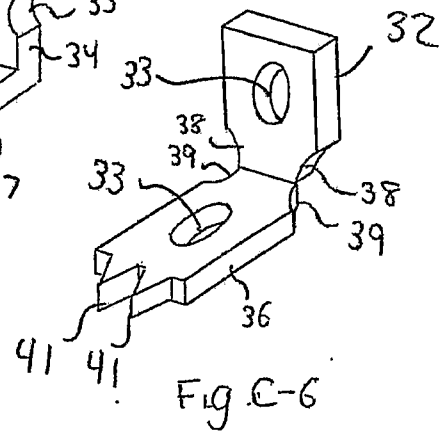
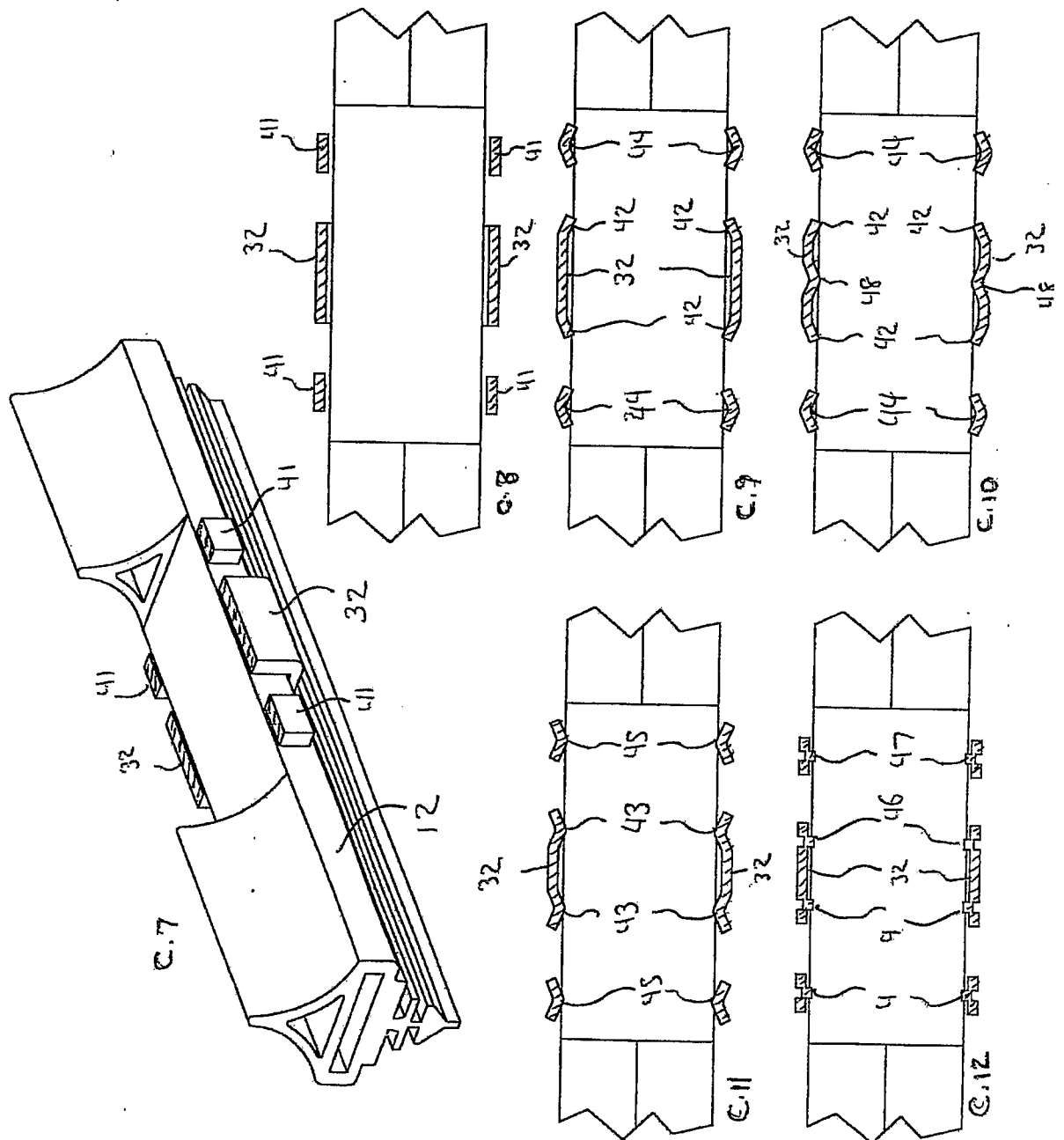
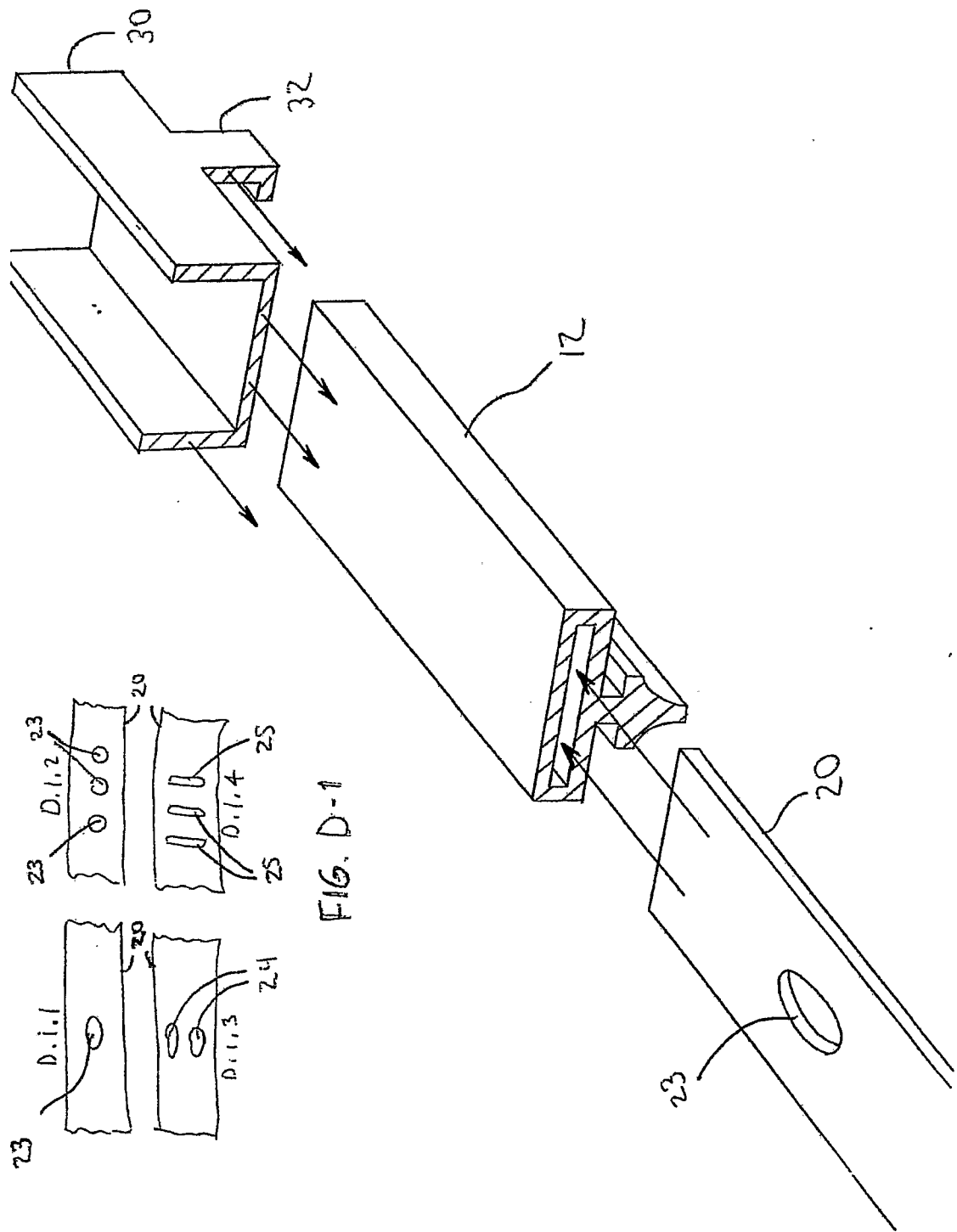


FIG C-6





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FIG. D-2

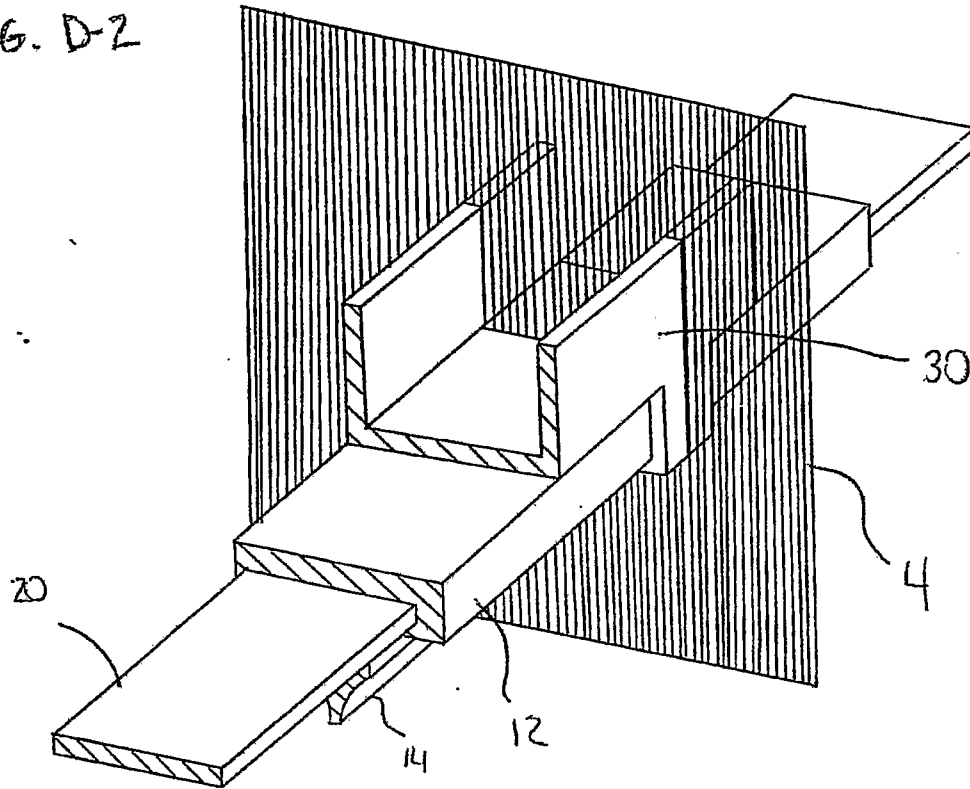
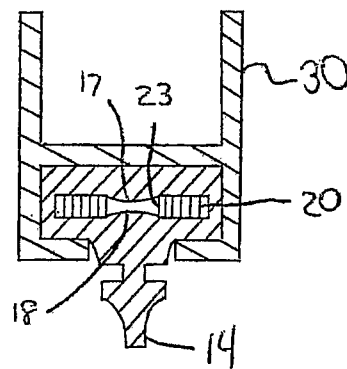
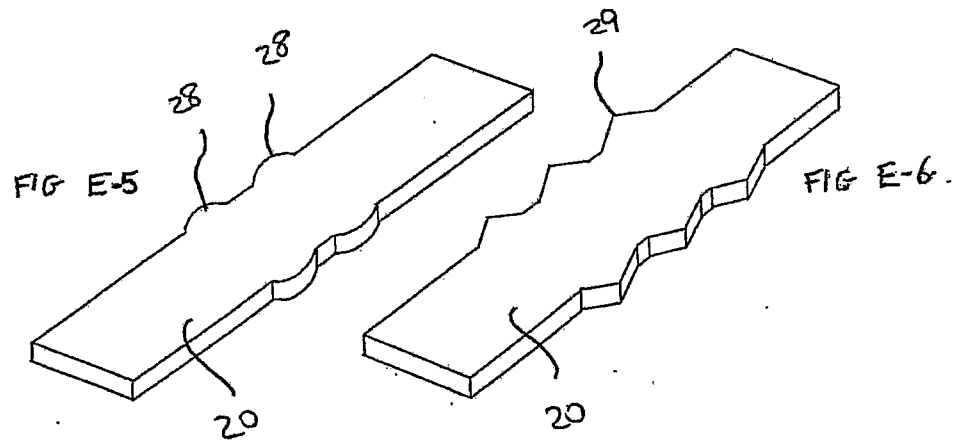
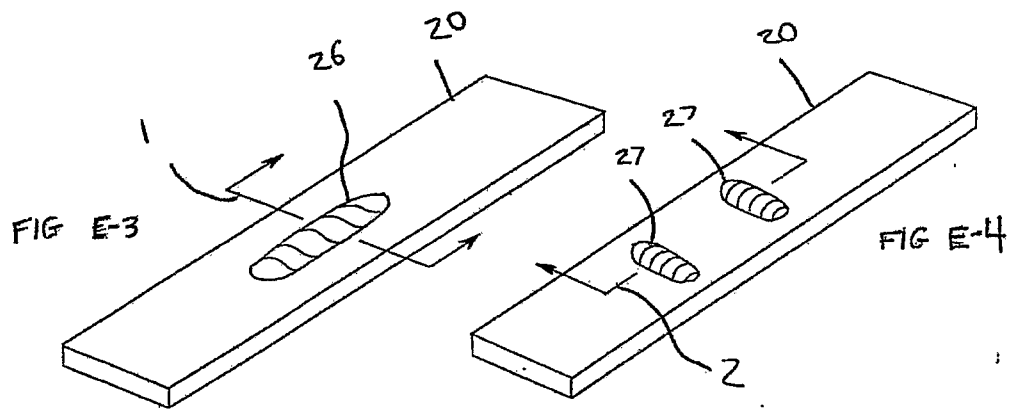
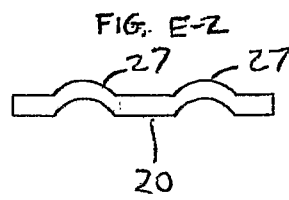
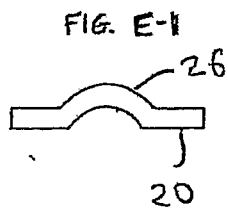


FIG. D-3





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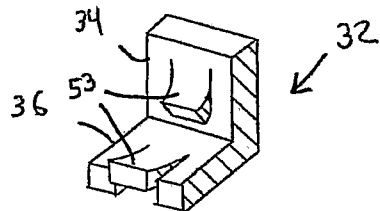
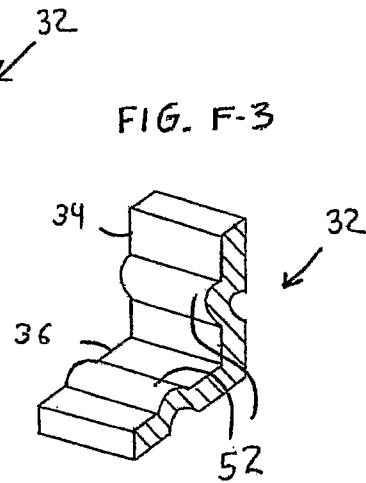
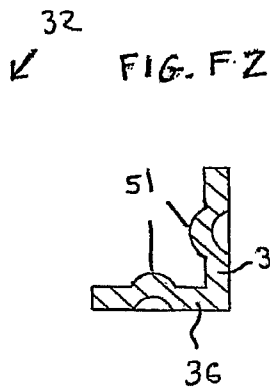
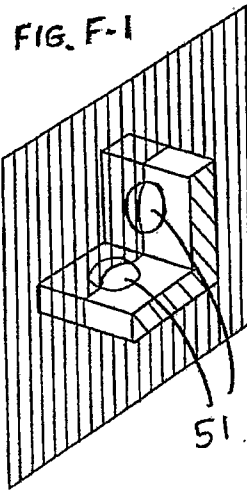


FIG. F-4

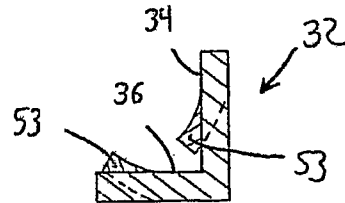


FIG. F-5

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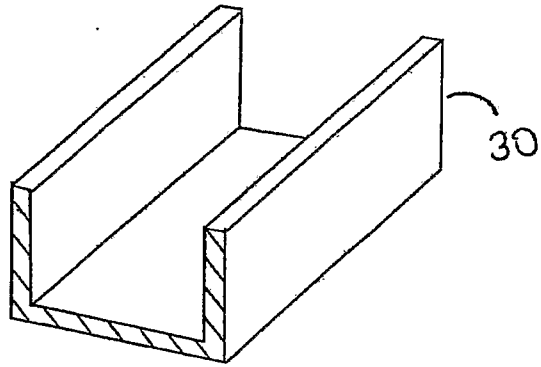


FIG. G-1

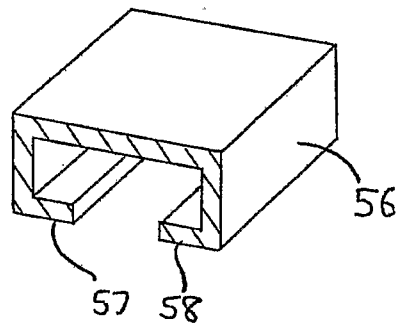


FIG. G-2

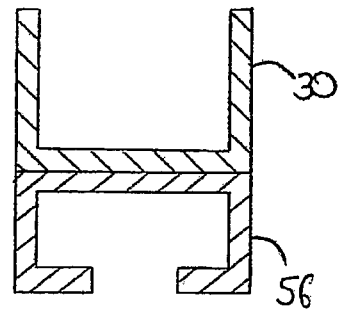


FIG. G-3

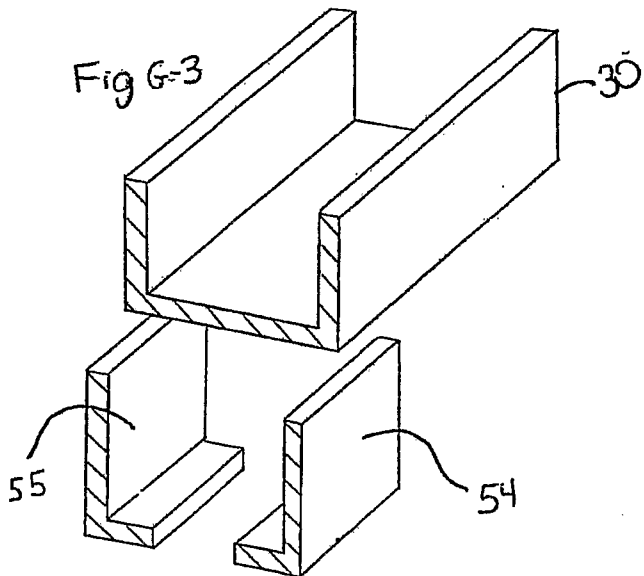


FIG. G-4

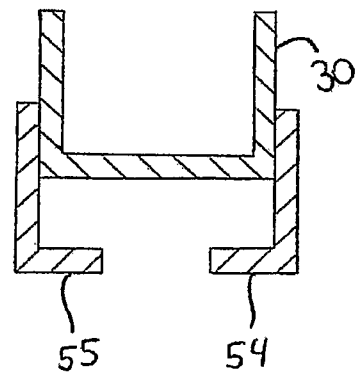


FIG. H-1

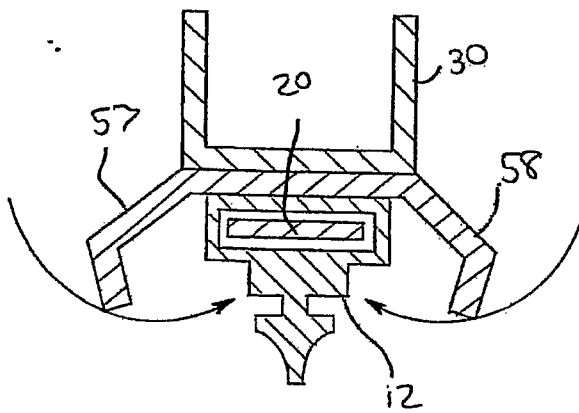


FIG. H-2

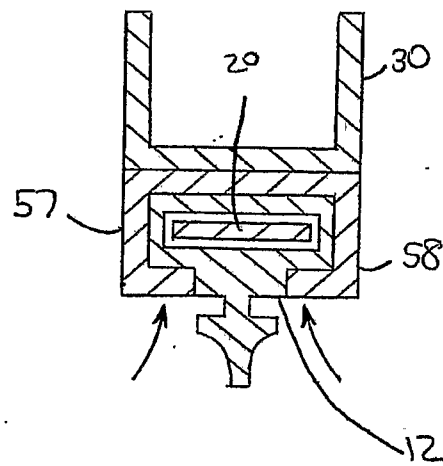
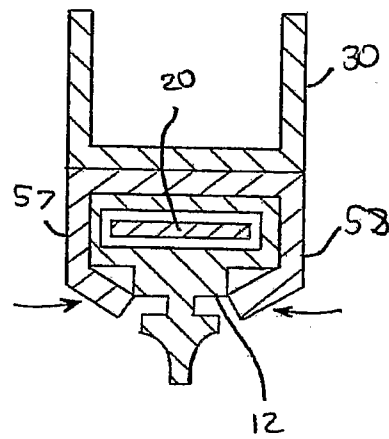
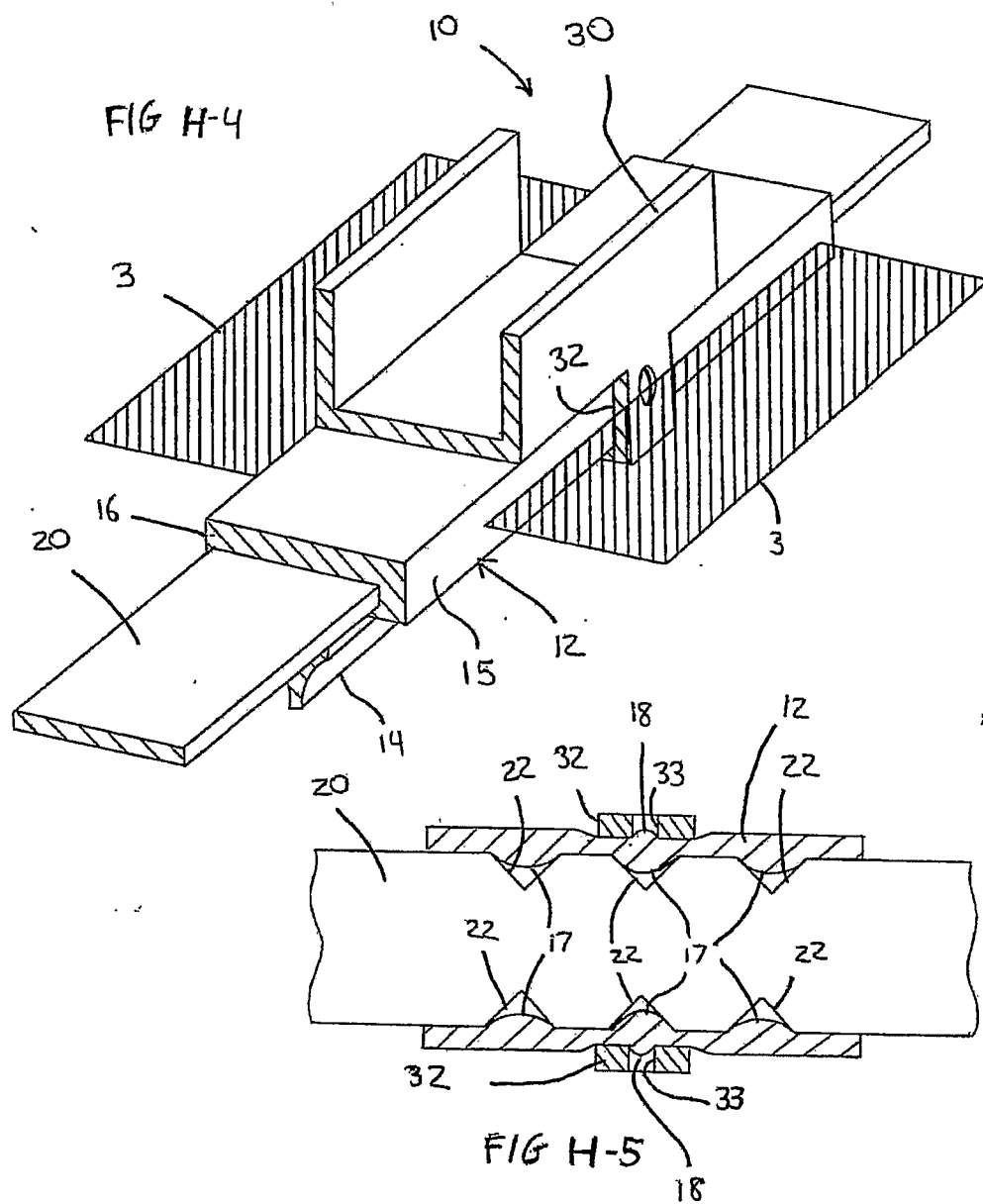
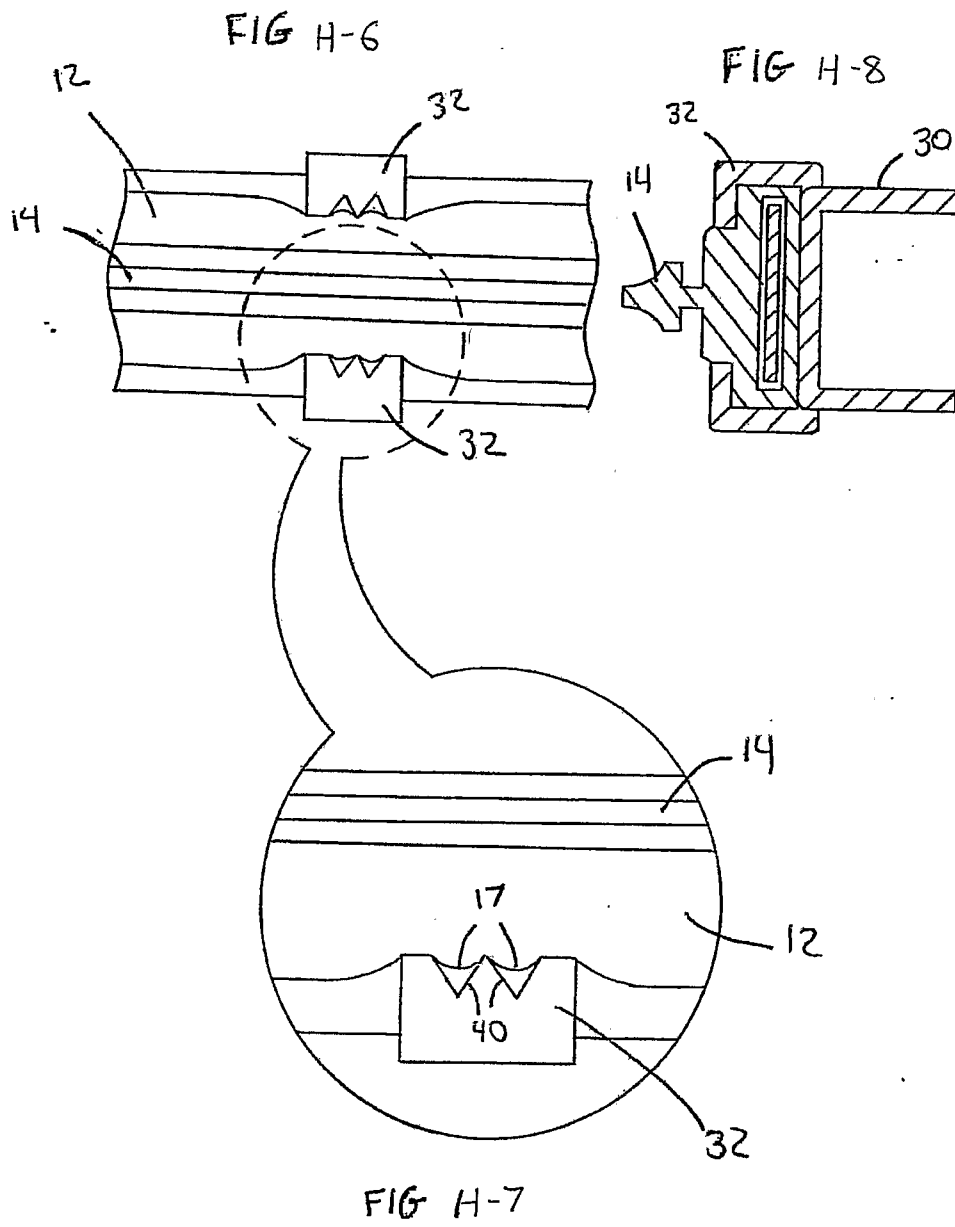


FIG. H-3





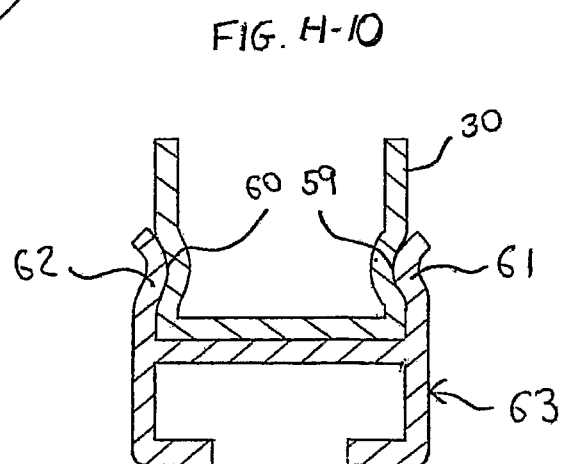
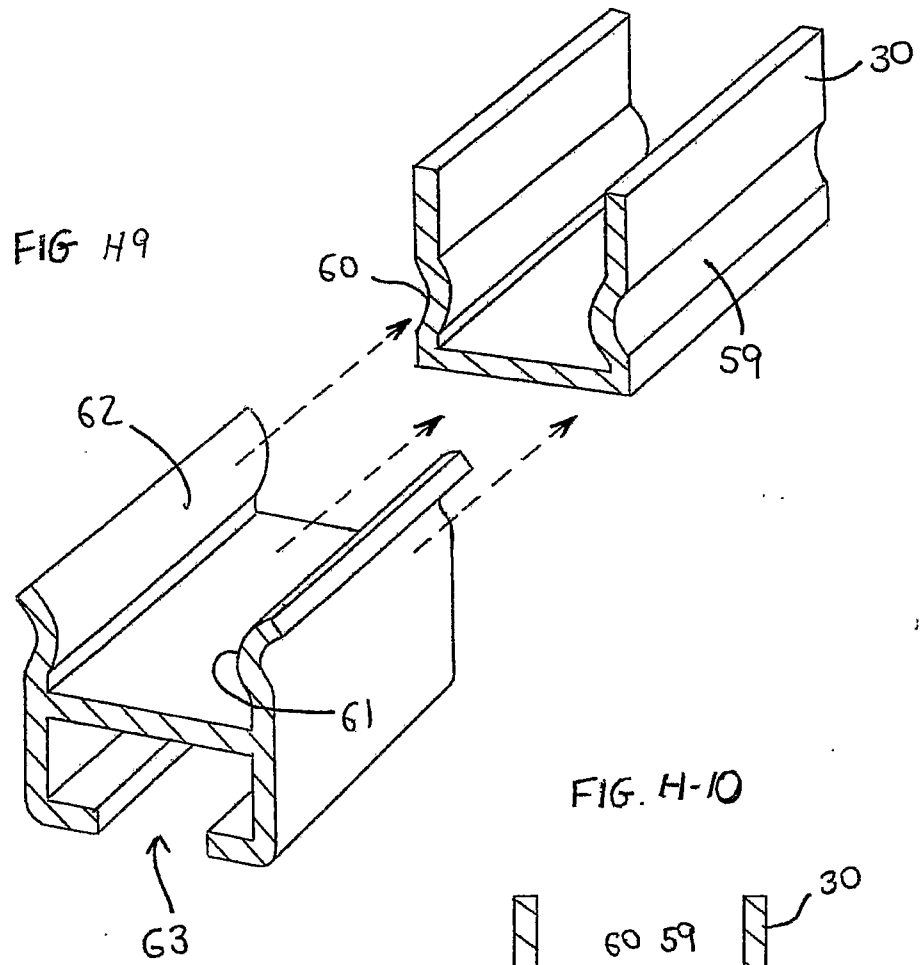


FIG. I-1

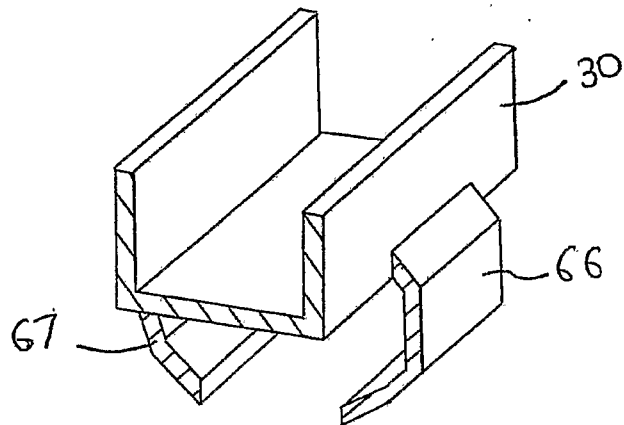


FIG. I-2

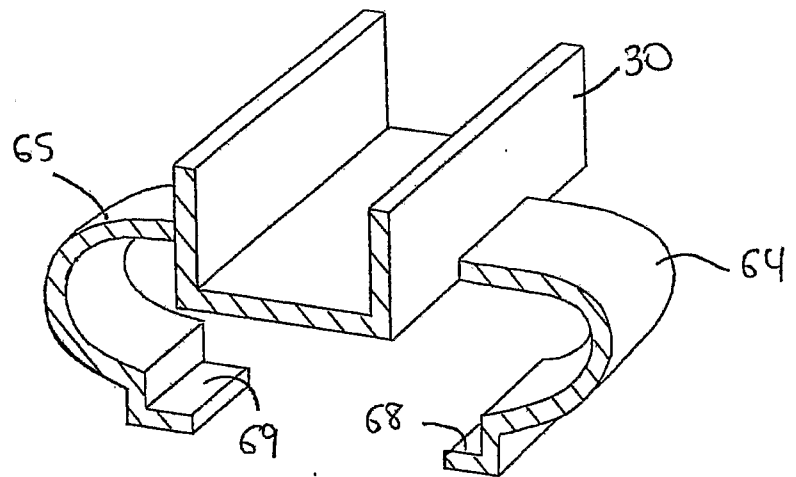
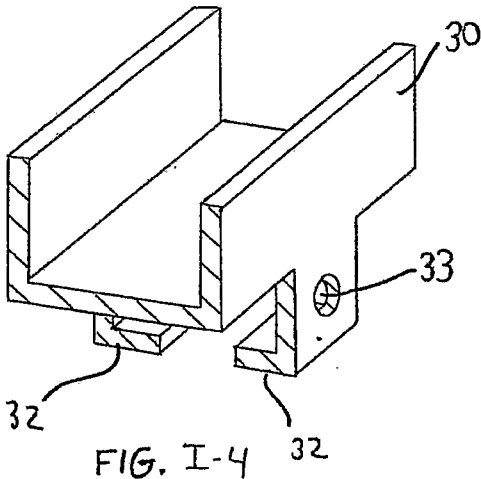
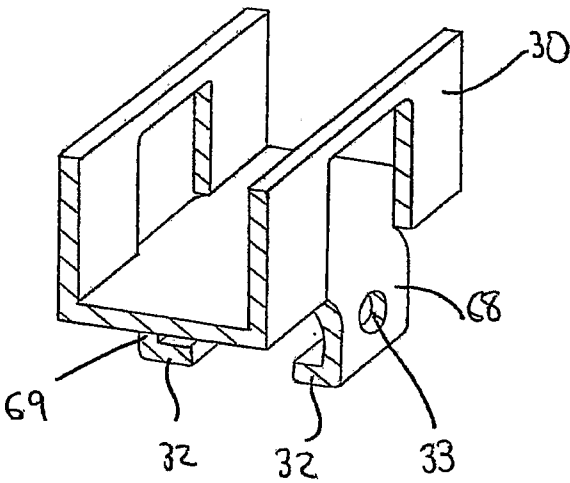
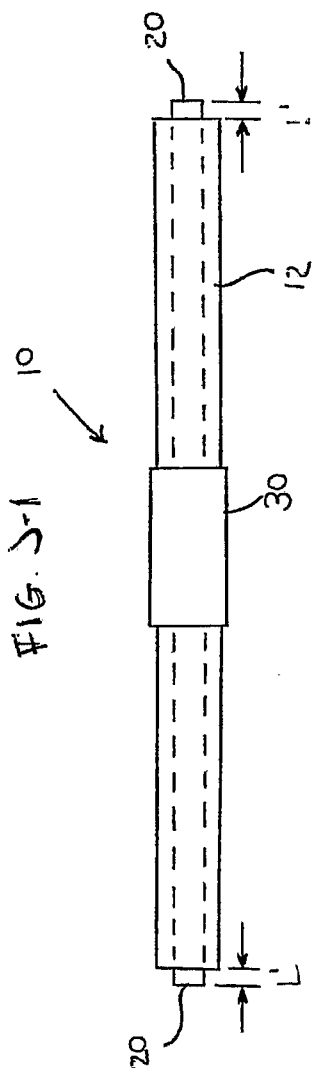
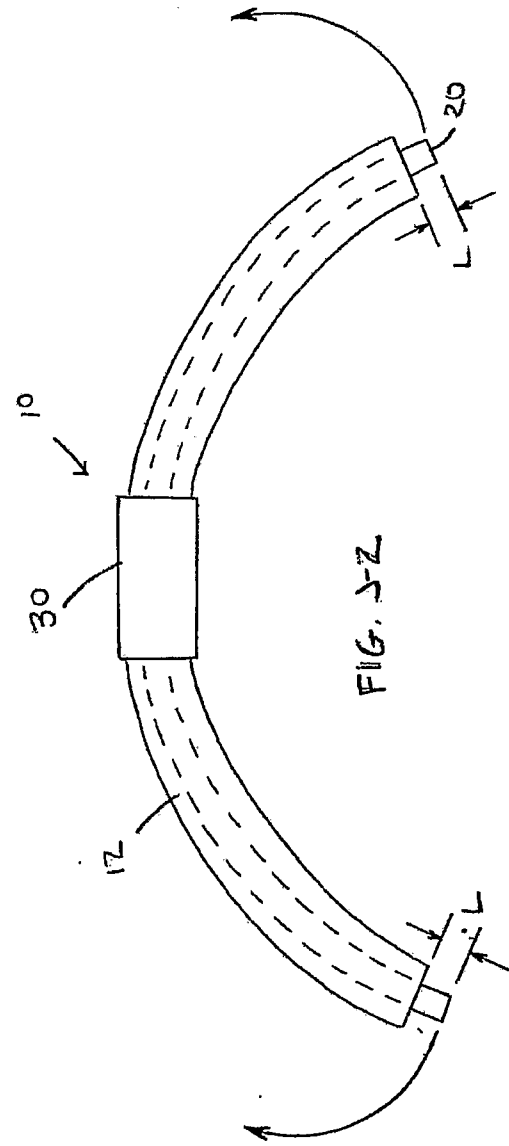


FIG. I-3





$L > L'$



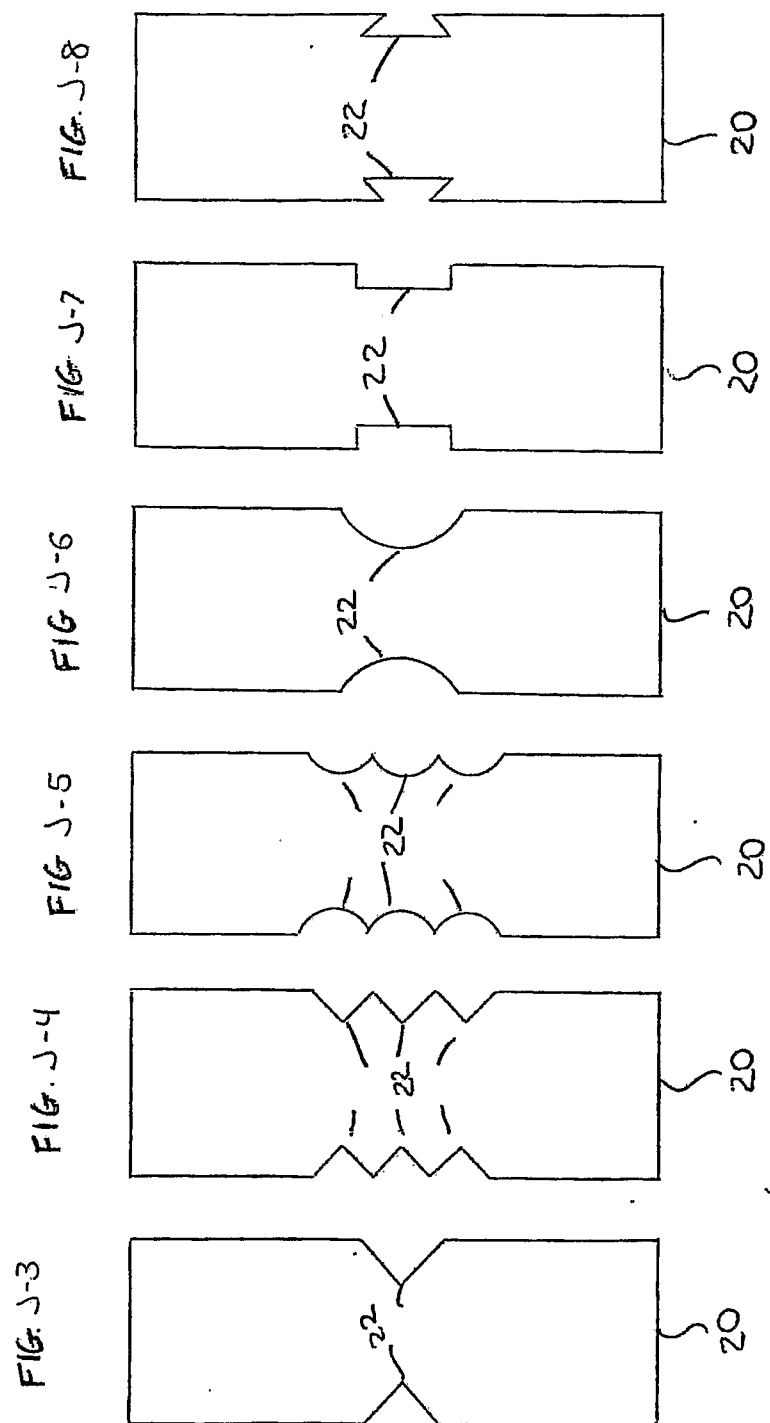


FIG. J-9

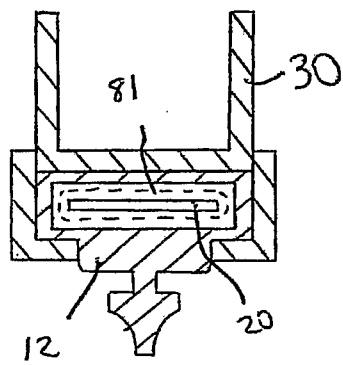


FIG. J-10

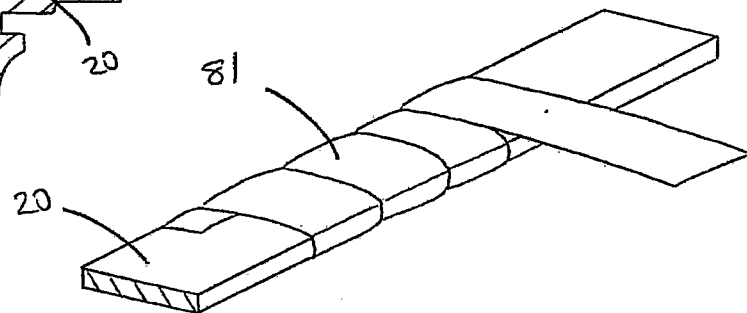


FIG. J-11

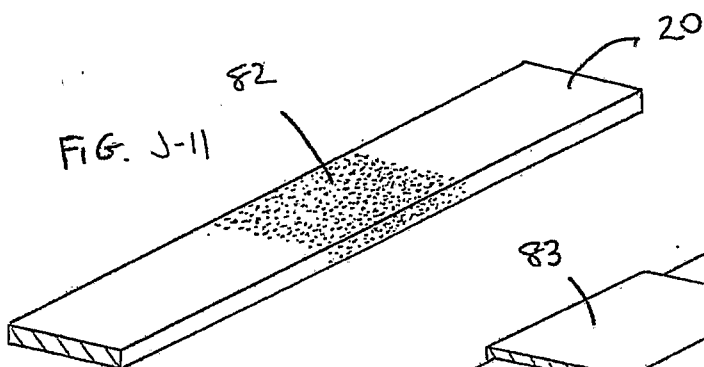


FIG. J-12

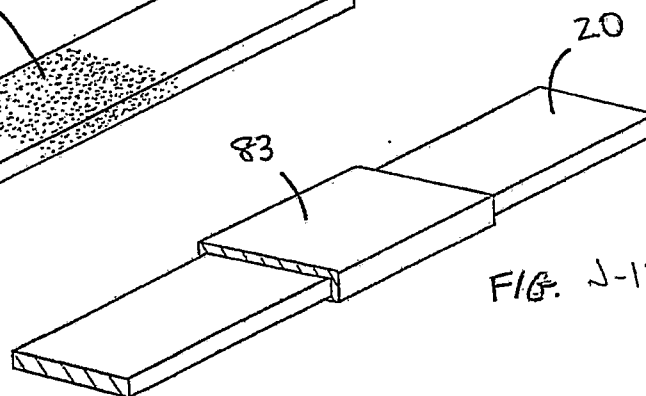


FIG. K-1

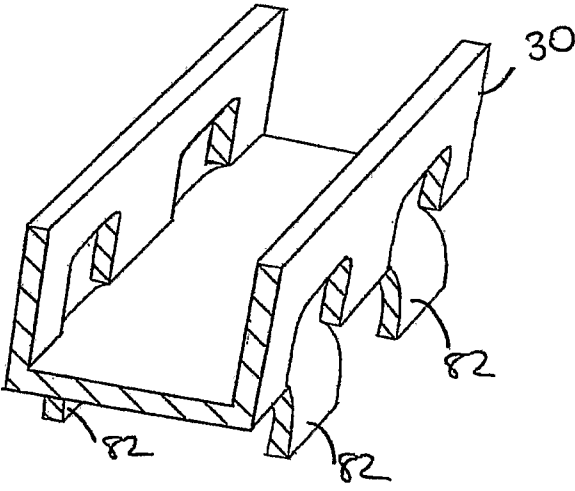
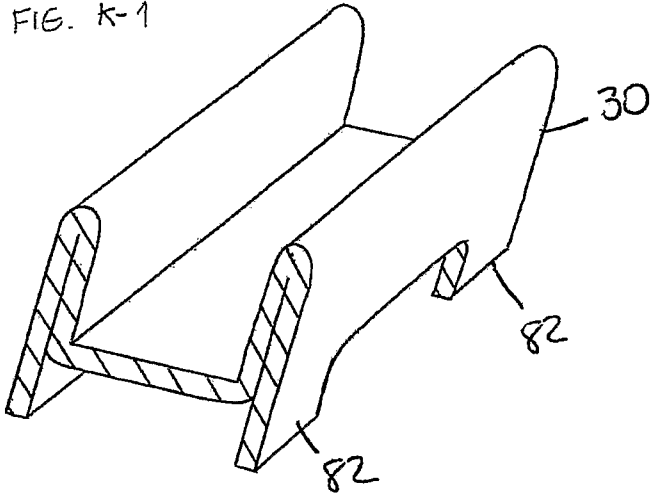


FIG. K-2

FIG. K-3

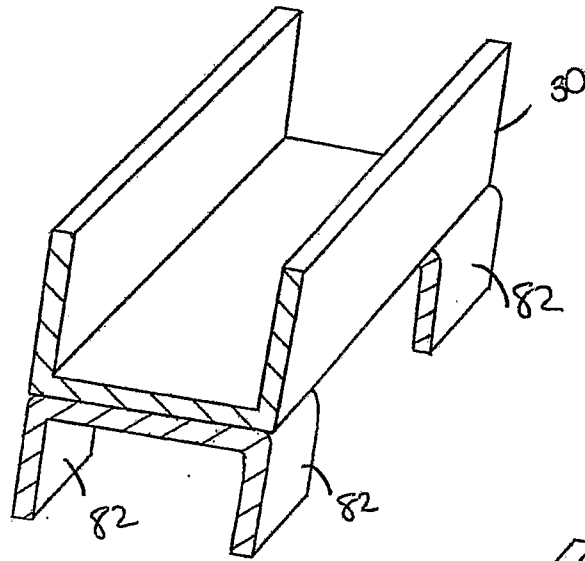


FIG. K-4

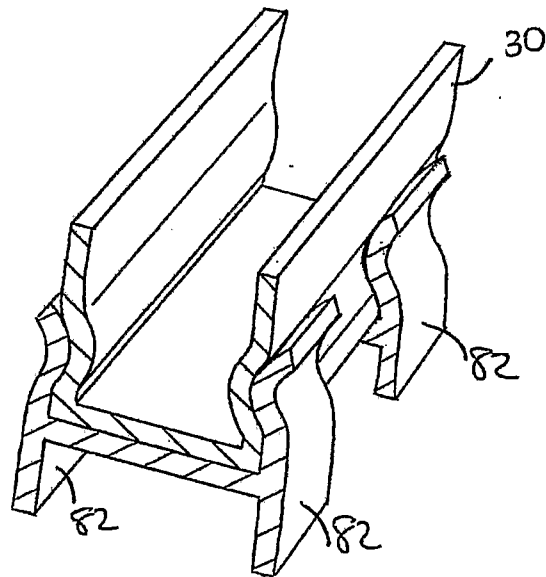


FIG. K-5

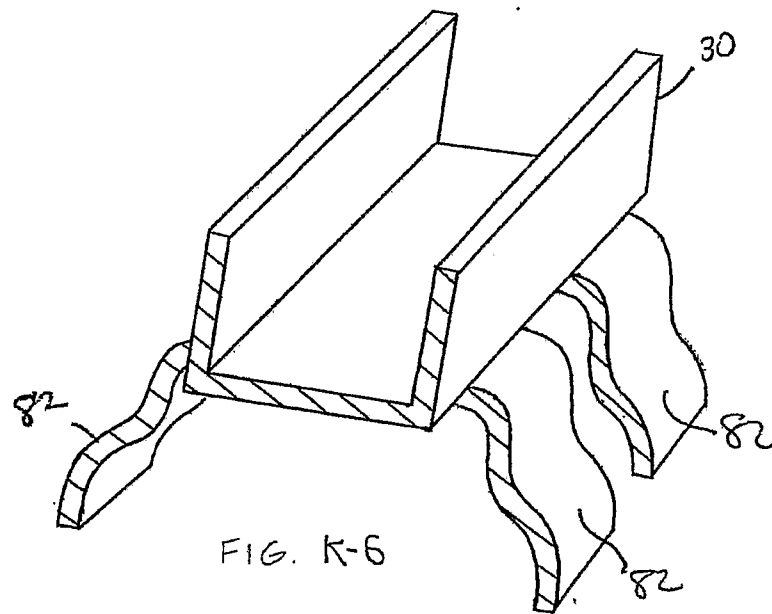
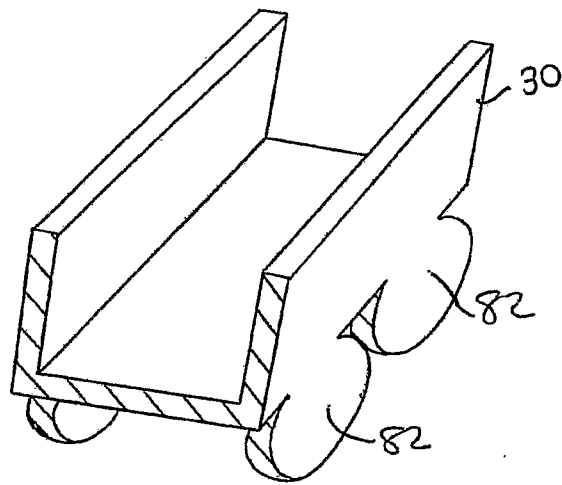


FIG. K-6

FIG. K-7

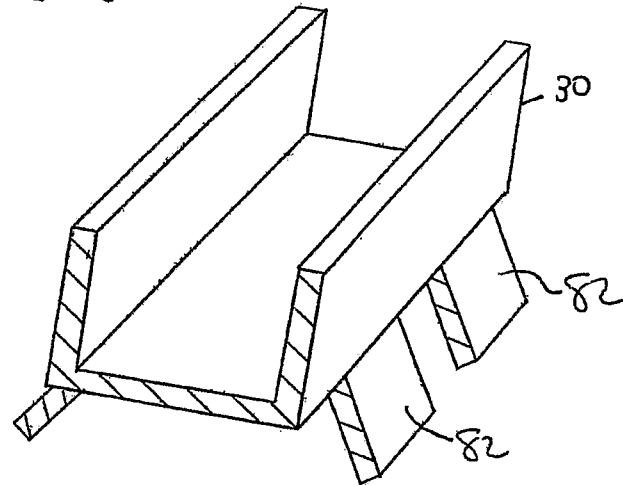
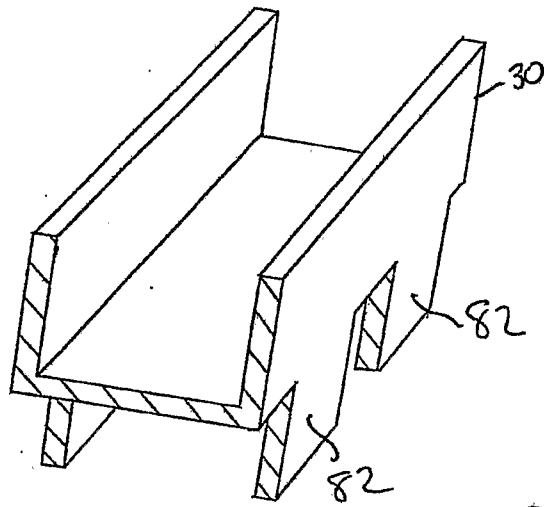


FIG. K-8

FIG K-9

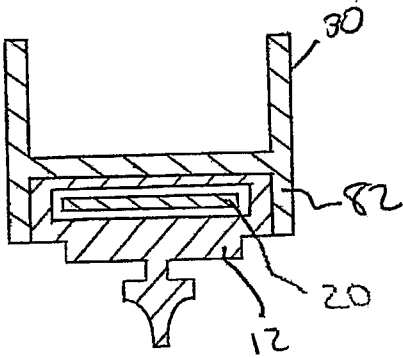
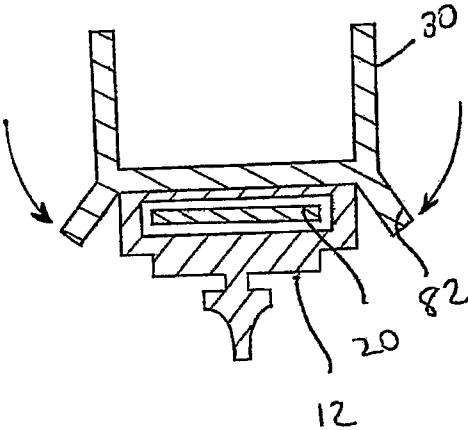
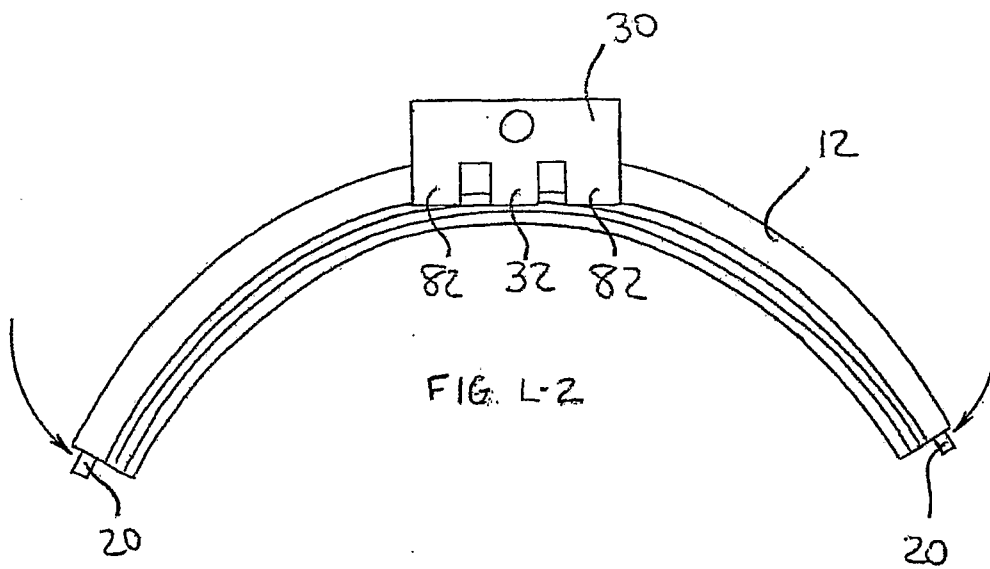
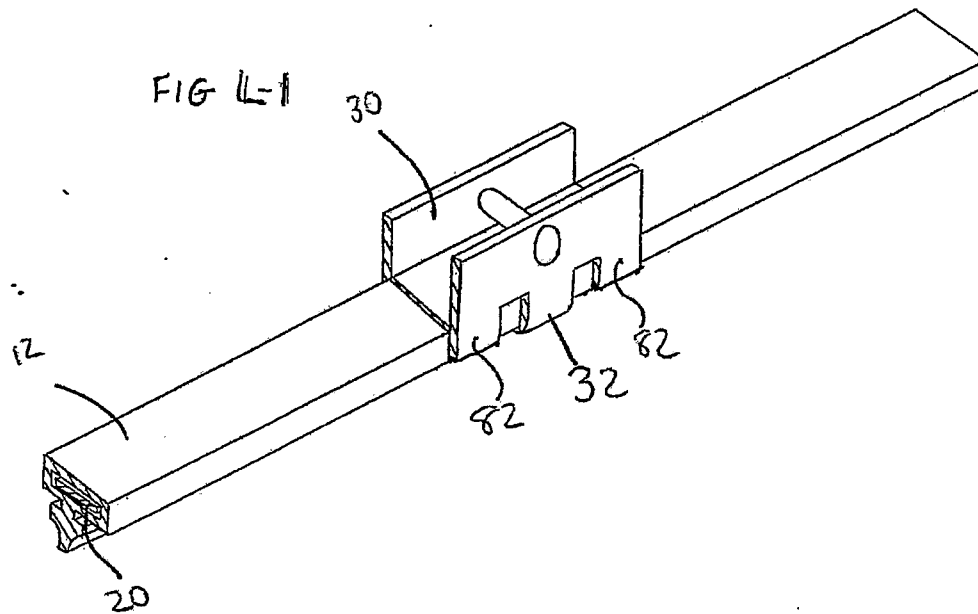
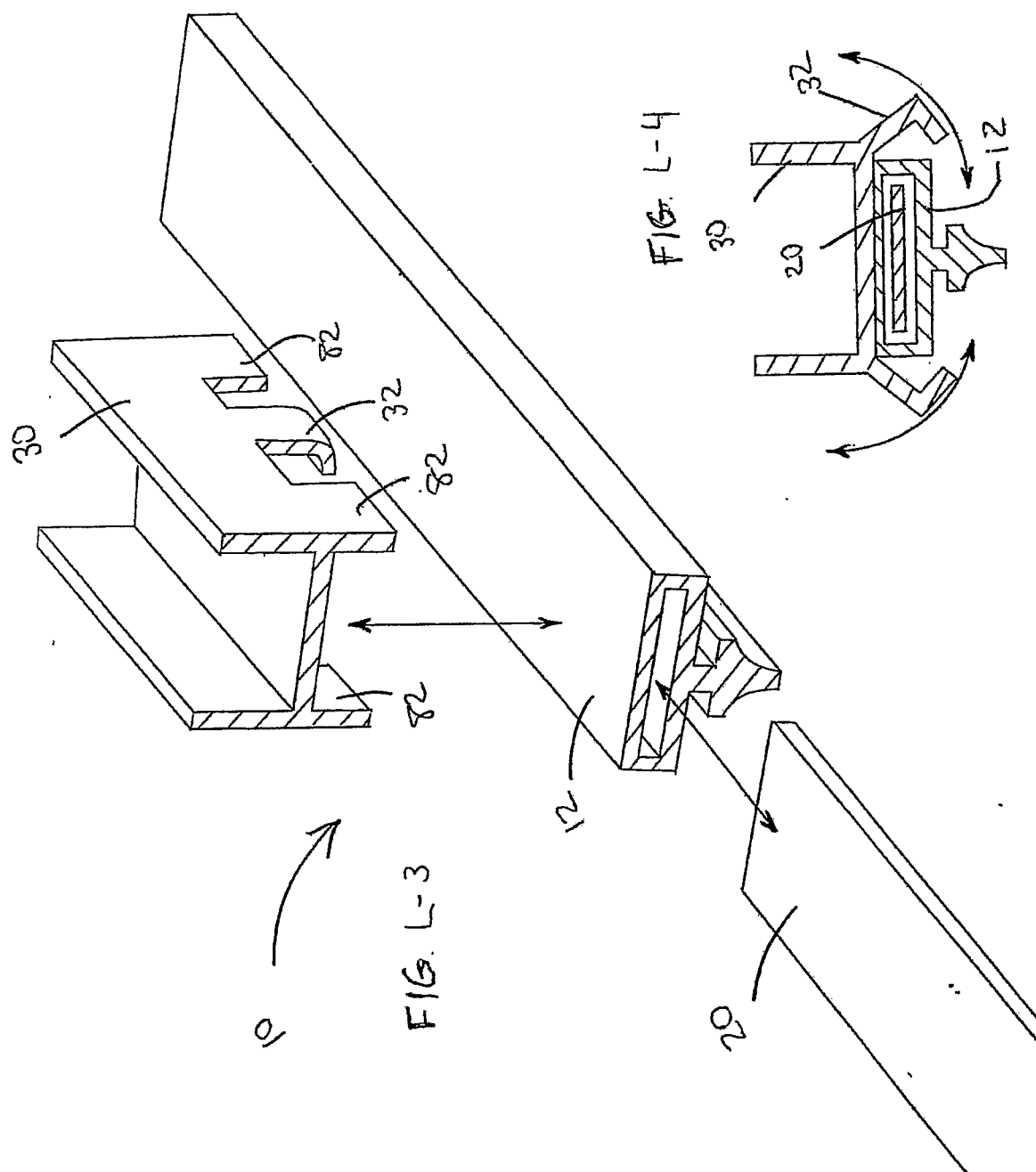


FIG. K-10





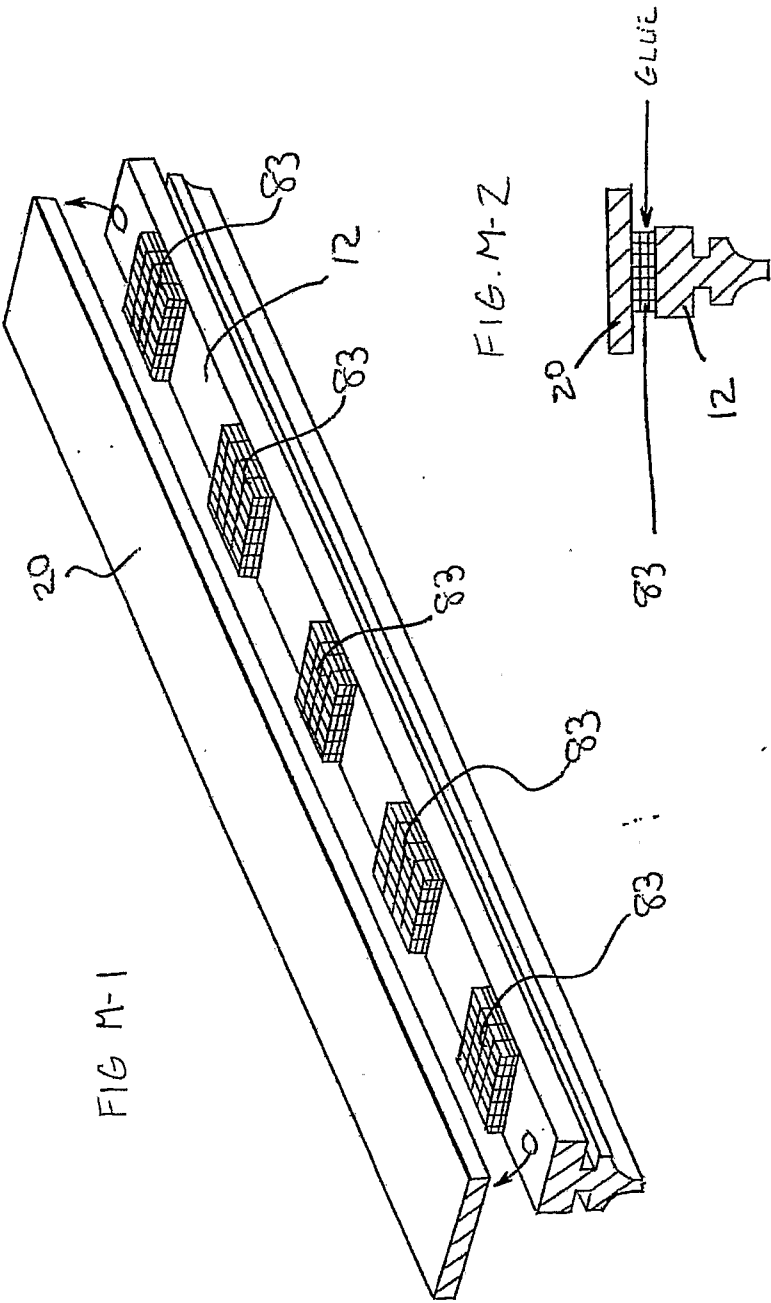


FIG. M-3

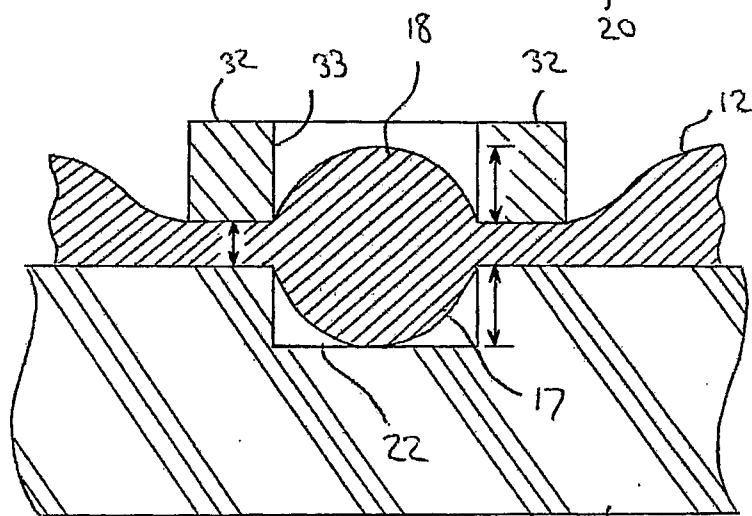
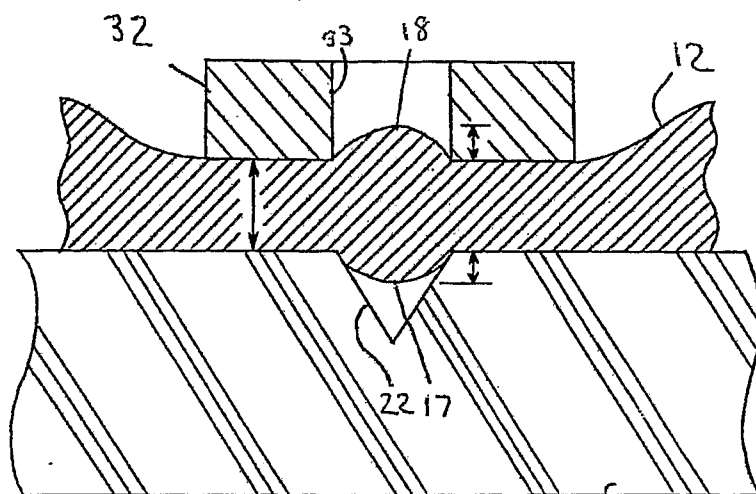
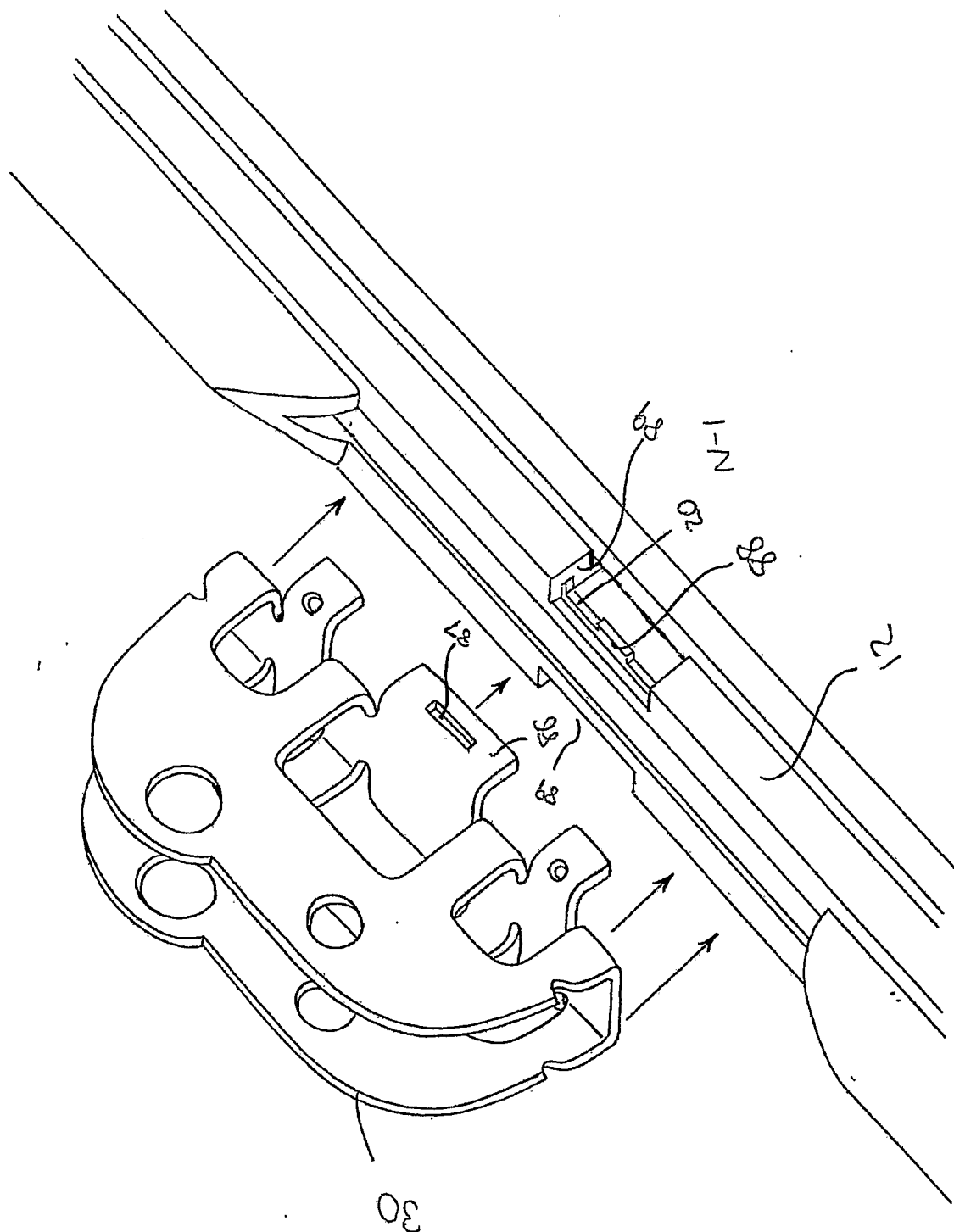
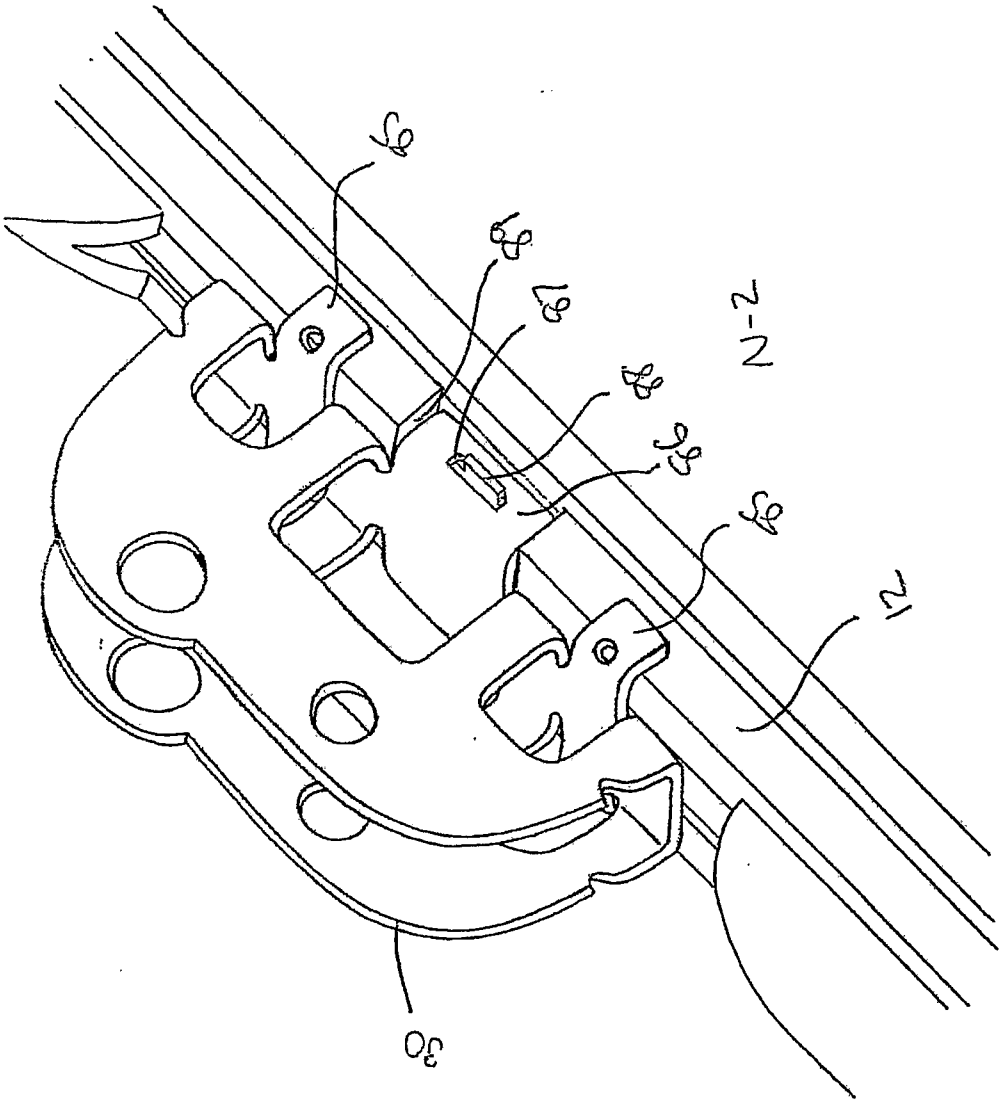


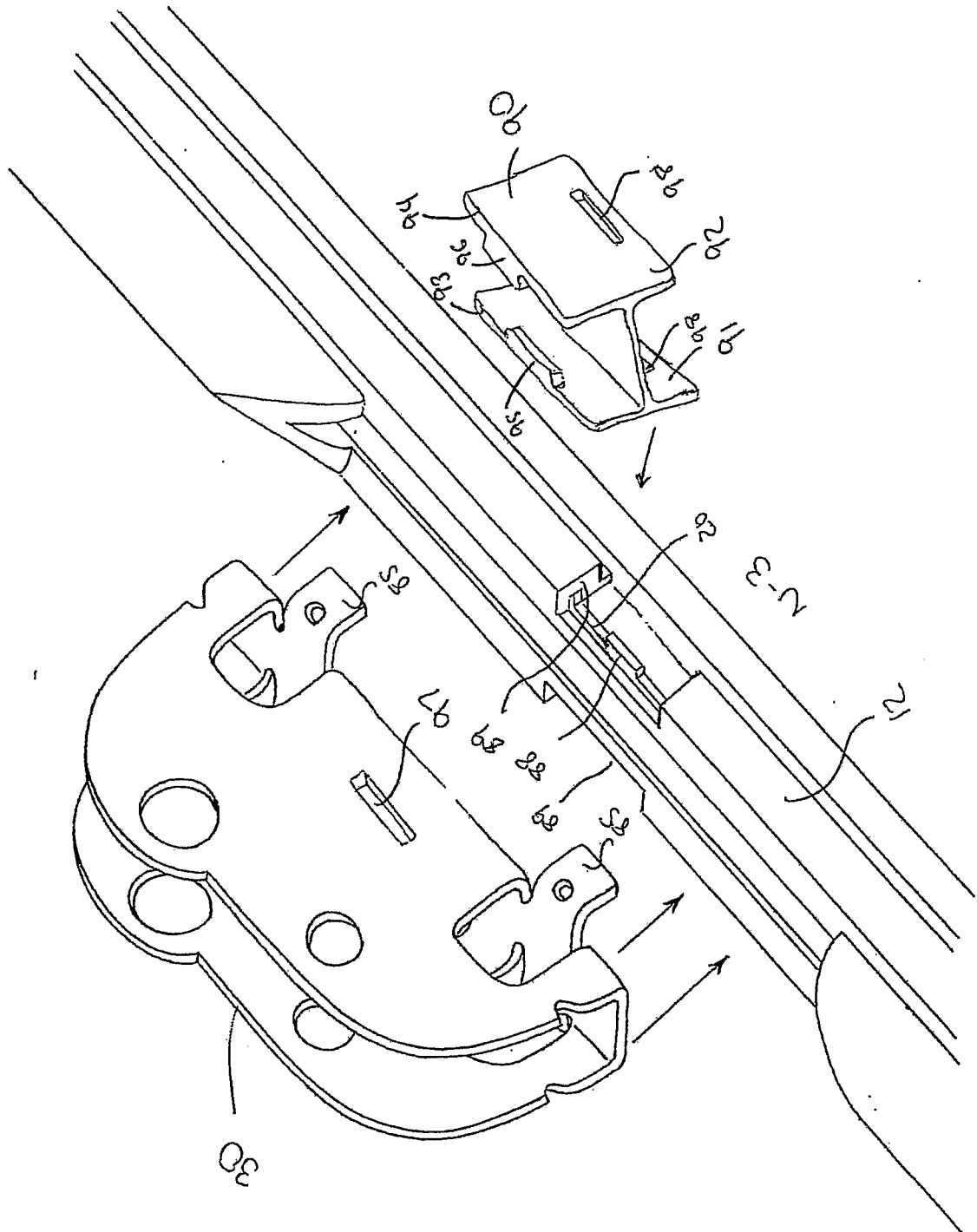
FIG. M-4

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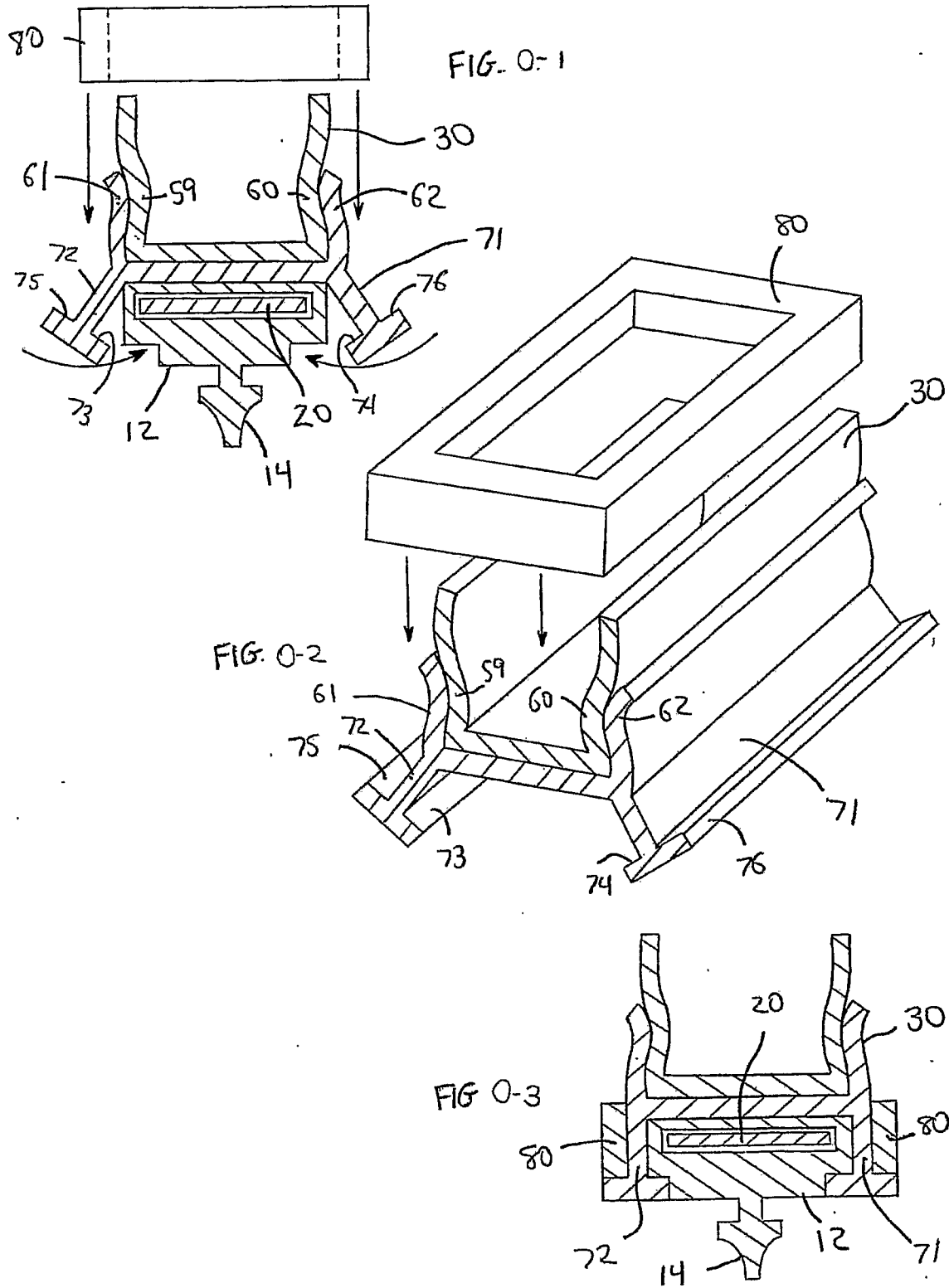




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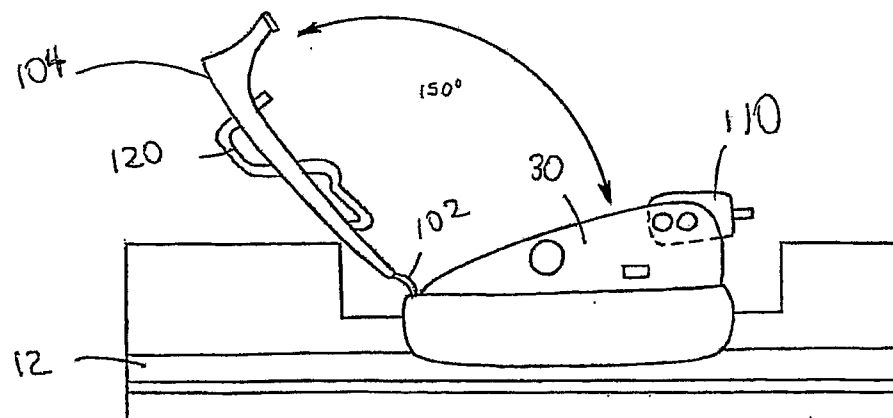
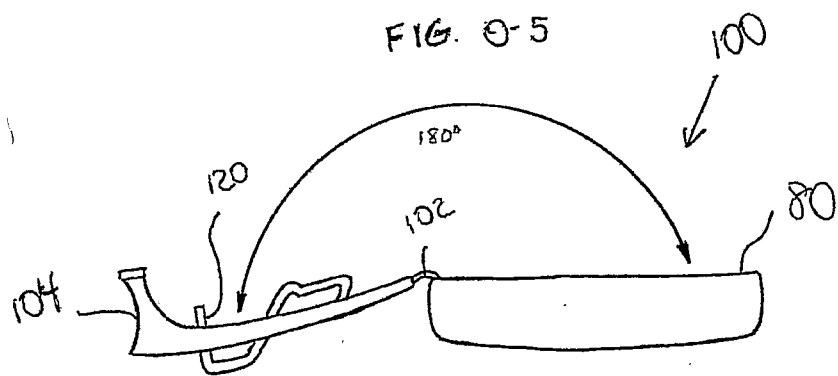
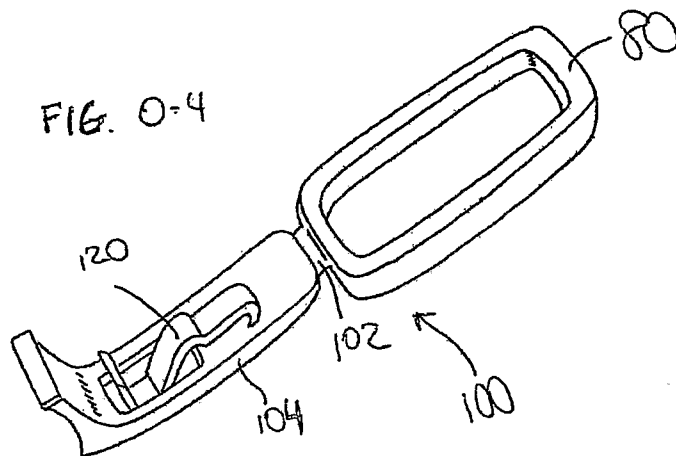


FIG. 0-6

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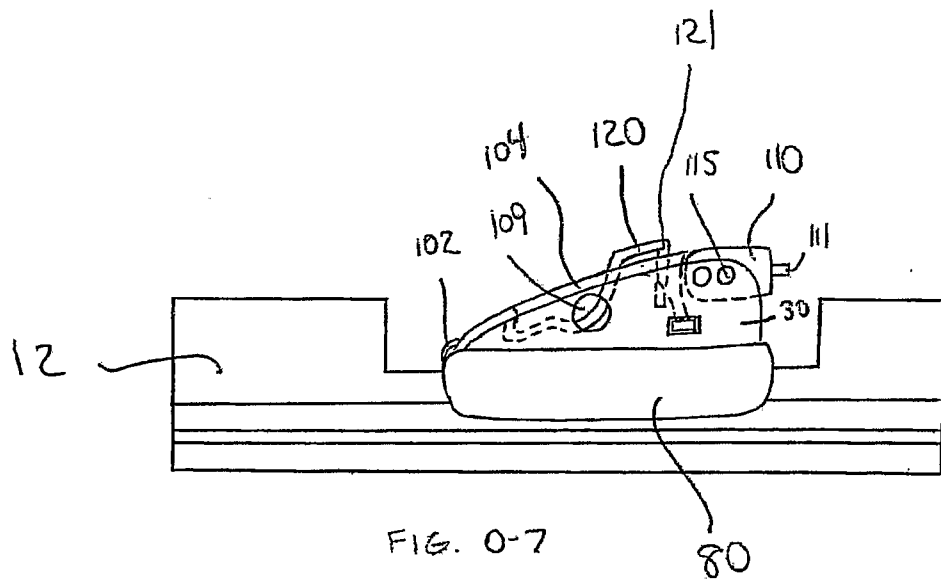


FIG. P-1

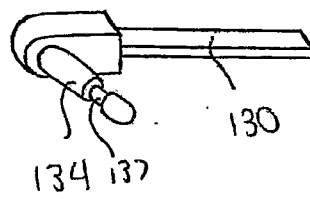


FIG. P-2

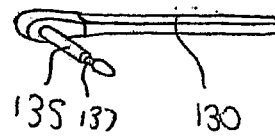


FIG. P-3

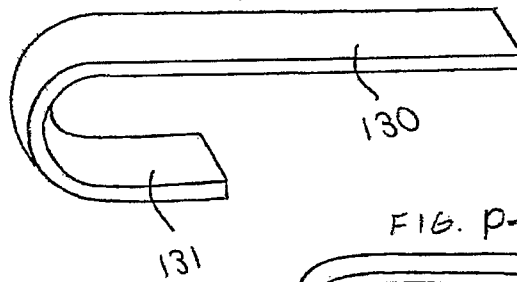


FIG. P-4

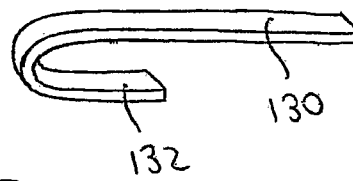
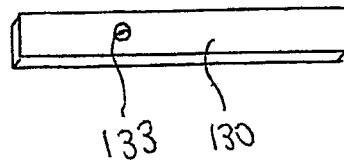
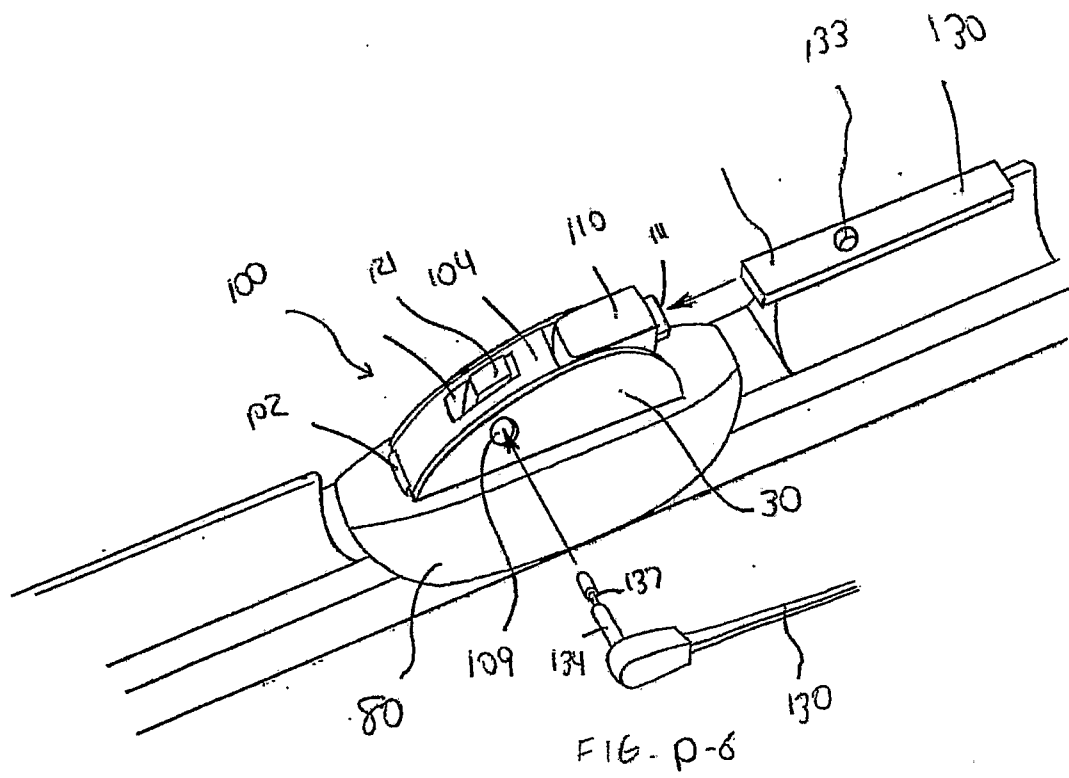


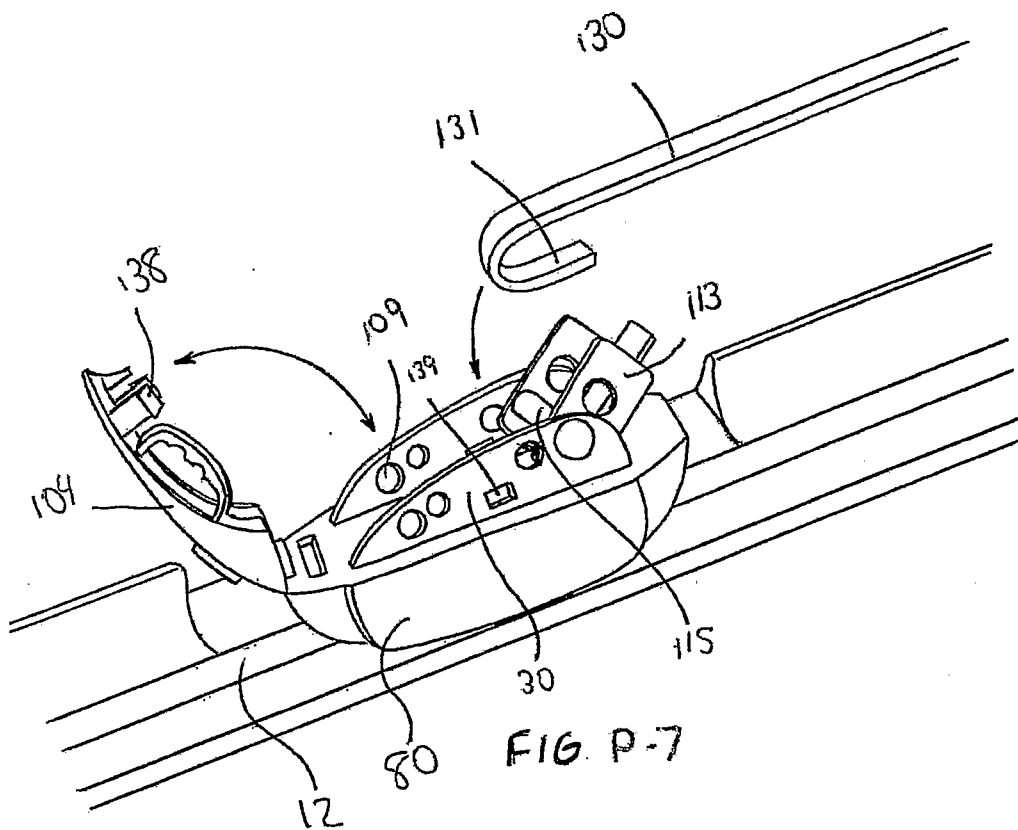
FIG. P-5

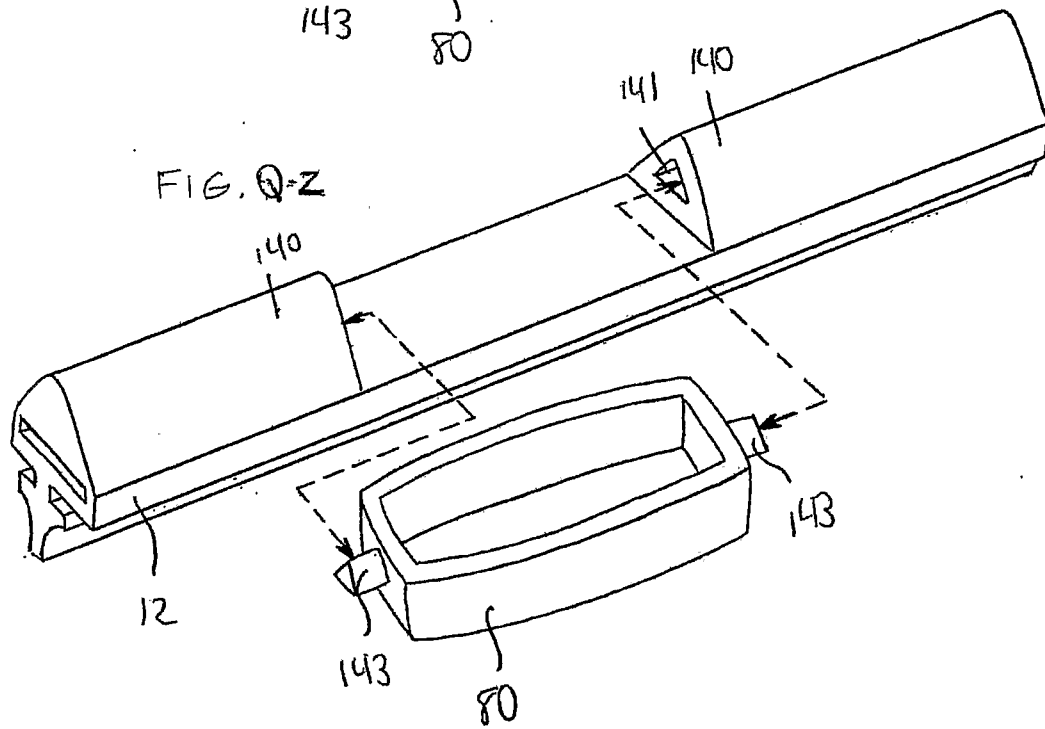
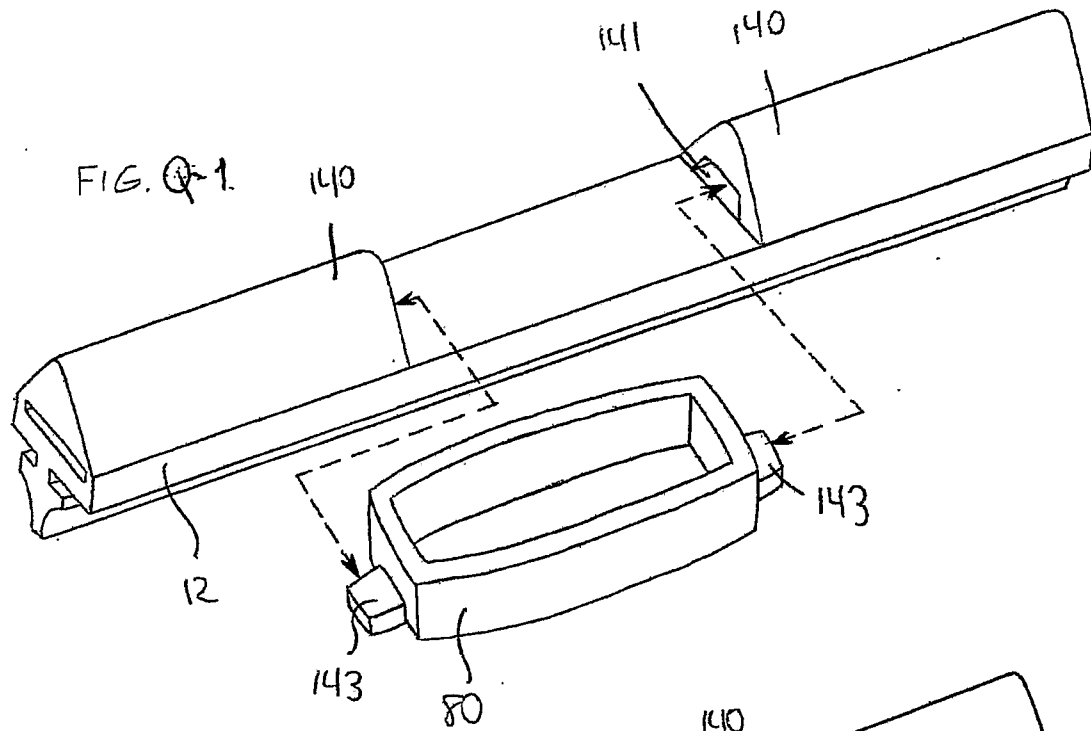


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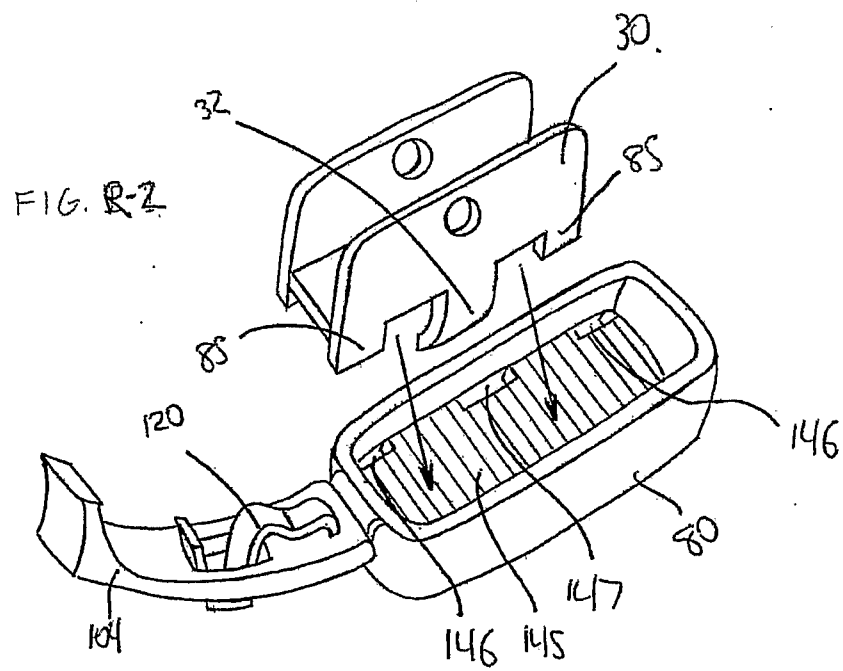
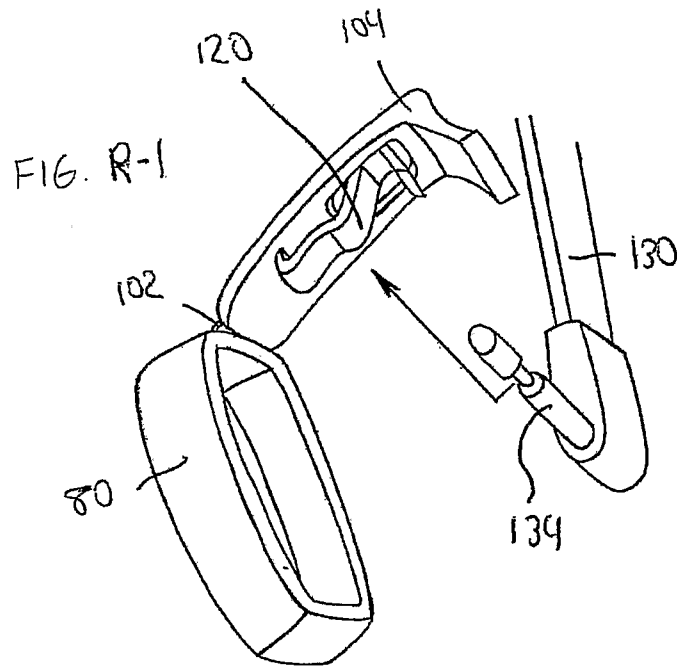


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FIG. 5-1

