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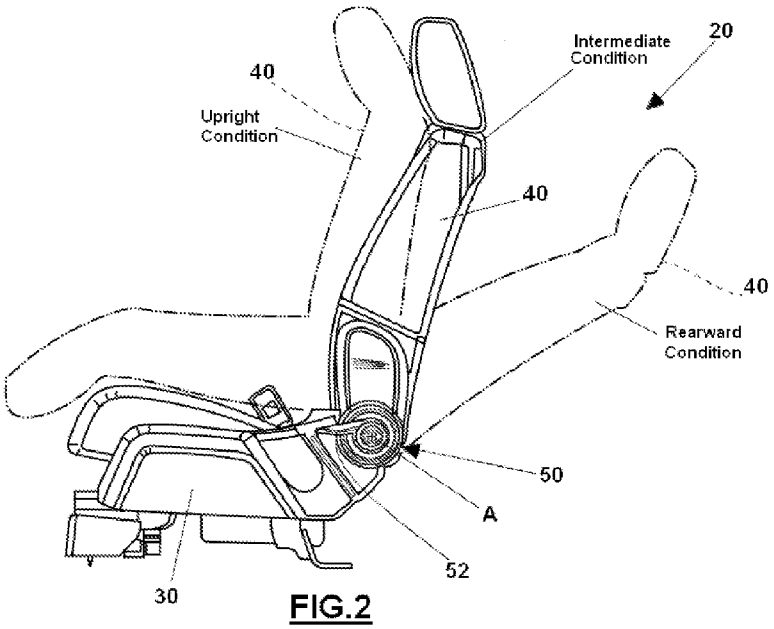

FIG.2

(57) Abstract: A recliner mechanism for use in connection with reclining a vehicle seat, The recliner mechanism includes a wedge displaced between a pawl, a base plate and a cam. The wedge is approximately triangular in shape and one edge includes a curved surface.

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MANUAL LEVER RECLINER EVOLUTION

CROSS-REFERENCE TO PRIOR APPLICATION

[0001] This PCT patent application claims the benefit of U.S. Provisional Patent Application Serial No. 61/437,249 filed January 28, 2011, entitled "Manual Lever Recliner Evolution," the entire disclosure of the application being considered part of the disclosure of this application and hereby incorporated by reference.

BACKGROUND

[0002] The present disclosure relates generally to the field of vehicle seating. More specifically, this disclosure relates to a recliner mechanism for use in connection with reclining a vehicle seat.

[0003] It is generally known to provide a vehicle seat having a recliner mechanism so that a seat occupant may selectively adjust a seat back relative to the seat base to provide different positions depending on the desired position of the occupant. Generally a puck-shaped, internally-toothed, rotary style recliner mechanism may be employed to provide the recline functionality. These rotary recliner mechanisms, commonly referred to by seating engineers as the "heart," use an internal cam mechanism to selectively lock and release the seat back relative to the seat base.

[0004] The recliner mechanism is interposed and encapsulated between a base plate and a top plate. Typically, the base plate is affixed to the seat base and the top plate to the seat back. Secure welds or other fastening techniques are used to secure the base plate to the seat base and the top plate to the seat back.

[0005] The base plate includes contoured bosses which support first and second pawl members having teeth. The base plate further includes an aperture at its center through which a pivot member extends. The top plate includes an aperture at its center for coupling the top plate to the pivot member. The top plate includes a plurality of internal

teeth for engaging the teeth of the pawl members. Typically the top plate also includes an attachment member for coupling the top plate to the seat component (e.g., the seat back). The attachment member is typically semi-circular overlapping only a portion of a circumference of the base plate.

[0006] In operation, a typical manual rotary recliner mechanism is spring biased to a locked condition, i.e., so the seat back is fixed in an angular position until the recliner mechanism is intentionally activated. When the recliner mechanism is actuated, typically by a handle or lever rotating the pivot, the cam member rotates to move the pawl members, thereby removing the teeth of the pawl members from the teeth of the top plate and unlocking (or releasing) the recliner mechanism. Once the recliner mechanism is unlocked, the seat back may be selectively pivoted in the fore or aft direction to adjust the vehicle seat.

[0007] Rotary recliner mechanisms are carefully designed to meet current safety requirements while also limiting the amount of slack or play that can be perceived by a seat occupant. As a result, prior art recliner mechanisms tend to be heavily constructed in order to withstand certain load conditions and as such, add significantly to the overall vehicle weight. For example, in order to withstand radial stresses caused when the pawl member teeth are engaged with the internal teeth of the top plate, the base plate and the top plate are typically formed from a thick sheet of material which adds to the weight of the recliner mechanism.

[0008] The pivot and cam can be subjected to high forces, which may ultimately cause play or looseness in the interaction between the release handle and the recliner mechanism. As the release handle is often used by the occupant of the seat, any real or perceived looseness is undesirable.

[0009] There remains a significant and continuing need to provide an improved recliner mechanism that can handle greater loads, weigh less and reduce play between the release handle and the recliner mechanism, and reduced rocking of the seat back.

SUMMARY

[0010] A recliner mechanism for use in connection with reclining a vehicle seat. The recliner mechanism is moveable between a locked position and an unlocked position and generally includes a pawl; a cam; a base plate; and a wedge having a substantially triangular shape. The wedge engages the pawl, the cam and the base plate in the locked position. The substantially triangular shape of the wedge includes a first surface on the wedge engaging the pawl, a second surface on the wedge engaging the cam and a third surface on the wedge engaging the base plate.

[0011] The base plate further includes a linear guide path configured to receive the pawl and wherein the linear guide path is defined by a first linear surface opposing a second linear surface. The third surface on the wedge engages the first linear surface in the locked position. The pawl engages only one of the first and second linear surfaces. The wedge and the pawl engage opposing side surfaces in the locked position. In addition, the third surface of the wedge is offset from but substantially aligned with a pawl slide surface. The second surface includes a recess extending outwardly toward the third surface. The recess shapes the function of the locking curve and extraction curve.

[0012] The cam further includes a first arm having a cam engagement surface and wherein the first arm engages the second surface of the wedge in the locked position. The cam further includes a second arm which does not engage the pawl in the locked position. The pawl includes a crash surface in close proximity to the second arm on the cam. The second arm on the cam includes a cam crash support surface and wherein the cam crash

support surface and the crash surface on the pawl are separated by less than 0.5 mm, preferably less than 0.1 mm and more preferably approximately 0.075 mm.

[0013] The recliner mechanism has a wedge with a triangular shape that includes a first surface engaging a pawl, a second surface engaging a cam and a third surface on engaging a base plate, and wherein the first surface is substantially flat and wherein the third surface is curved. More specifically, the third surface has a radius that is equal to or greater than the distance between the third surface and the apex between the second and first surfaces.

DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a perspective view of a vehicle shown in broken lines and having a seat assembly including the recliner mechanism of the present invention.

[0015] FIG. 2 is a perspective view of an exemplary seat assembly including the recliner mechanism of the present invention.

[0016] FIG. 3 is a perspective view of a partially assembled prior art recliner assembly.

[0017] FIG. 4 is a perspective view of a partially assembled prior art recliner assembly.

[0018] FIG. 5 is an exploded perspective view of a prior art recliner assembly, seat base bracket and seat base return spring.

[0019] FIG. 6 is a perspective view of the subject improved recliner assembly.

[0020] FIG. 7 is a perspective view of the subject improved recliner assembly.

[0021] FIG. 8 is an exploded perspective view of the subject improved recliner assembly, seat base bracket and seat base return spring.

[0022] FIG. 9 is an exploded perspective view of the subject improved recliner mechanism.

[0023] FIG. 10 is a partial side view showing differences between the base plate, pawl and disc members of a prior art recliner mechanism and the subject improved recliner mechanism.

[0024] FIG. 11a is a partial side view of the cam and cam spring of the subject improved recliner mechanism.

[0025] FIG. 11b is an partial enlarged perspective view of the cam and cam spring, showing the cam spring extending across the engagement groove.

[0026] FIG. 11c is an partial enlarged perspective view of the cam and cam spring, of the opposing side shown in FIG. 11b, clearly showing the cam spring extending across and into the engagement groove.

[0027] FIG. 11d is an partial enlarged view of the cam and cam spring, showing the cam spring extending across two opposing engagement grooves.

[0028] FIG. 12 is an exploded perspective view of the recliner mechanism for assembly to a seat base bracket and seat base return spring.

[0029] FIG. 13 is a partial perspective view of the recliner mechanism including wedges having integral release arms.

[0030] FIG. 14 is an exploded perspective view of the recliner mechanism from FIG. 13.

[0031] FIG. 15 is a partial side view of the recliner mechanism identifying the blocker gap.

[0032] FIG. 16 is partial perspective view showing improved load sharing areas.

[0033] FIG. 17 is a partial exploded view of a prior art mechanism compared to the present invention including a wedge with a fulcrum leg portion and each including shading to illustrate stress.

[0034] FIG. 18 is a graphical representation of moment versus displacement comparing a prior mechanism and the present invention including the wedge with a fulcrum leg portion.

[0035] FIG. 19 is an enlarged perspective view of an exemplary wedge having integral arms;

[0036] FIG. 20 is an enlarged front view of the edge in FIG. 19, showing the radius of the edge of the triangular portion that is configured to engage the base plate.

[0037] Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, an exemplary motor vehicle 10 is shown. The vehicle 10 is shown in FIG. 1 in the form of a passenger van, but it will be appreciated that the vehicle type is not relevant to this disclosure. The vehicle 10 includes at least one seat assembly 20 of the type including a seat back 40 hingedly connected to a seat base 30, but it will also be appreciated that the style, shape or size of the seat is not relevant to this disclosure other than that the seat back 40 may pivot relative to the seat base 30 to allow adjustment of the recline. The seat base 30 is anchored to the floor of the passenger compartment using any of the various anchoring techniques, such as fore and aft adjustable slides, releasable hooks, fixed mounts, and the like.

[0038] As shown in FIG. 2, the seat back 40, shown in an intermediate condition is capable of reclining rearwardly to a maximum rearward condition, or maximum upright condition, both shown in broken lines. The angular orientation of the maximum rearward condition, and maximum upright condition is merely exemplary, and in fact either a greater or lesser degree of angular tilt may be achieved according to the design specification.

[0039] Movement of the seat back between its maximum upright and maximum rearward reclining conditions is accomplished through a pair of rotary recliner mechanisms 50. One rotary recliner mechanism 50 is located on each side of the seat assembly, and is of

generally identical or mirror-image construction. The rotary recliner mechanism 50 is configured to establish incremental reclining adjustments about a generally horizontal first axis A. Thus, the rotary recliner mechanism 50 permits relative pivotal movement between the seat back 40 and the seat base 30. The rotary recliner mechanism can accomplish incremental reclining adjustments using various tooth engaging constructions, as described below and selectively illustrated in FIGS. 5-17.

[0040] Referring in particular now to FIGS. 3 - 5, a prior art recliner mechanism for use as an adjuster in a vehicle seat is shown. The prior art recliner mechanism includes a base plate, a top (or sector) plate, a cam, a pivot, a first or upper pawl, a second or lower pawl, a first or upper round disc, and a second or lower round disc. The base plate includes contoured bosses or extension members which support a first (or upper) and a second (or lower) pawl members in position. The base plate also includes an aperture at its center through which a pivot member extends. In the prior art mechanism shown, the cam member is a separate piece and is carried by the pivot member such that the cam member engages the first and second pawls and the first and second disc members. In the prior art mechanism, the top plate includes a semi-circular attachment member for coupling to a vehicle seat component (e.g., seat back, etc.). The top plate also includes an aperture at its center for coupling the top plate to the pivot member and, along with the base plate, thereby enclosing the internal components of the recliner mechanism (i.e., first and pawl members, cam member, discs, etc.). The top plate also includes a plurality of teeth for engaging the first and second pawl members. The first and second pawl members also each include a plurality of teeth to engage the respective teeth in the top plate and also include contoured sides that interact with the base plate, the cam member, and the first and the second discs for operating the recliner mechanism. When the recliner mechanism is actuated, such as by the pivot member being rotated, the cam member rotates to release and then move the first

and second pawl members to remove (disengage) the teeth of the pawl members from the teeth of the top plate thereby unlocking (or unlatching or releasing) the recliner mechanism so that the seat back may be selectively pivoted in the fore or aft direction and thereby adjusting the vehicle seat according to the needs of the occupant.

[0041] FIGS. 6-15 show an improved recliner mechanism 50 for use as an adjuster in a vehicle seat 20, more specifically to allow the seat back 40 to pivot relative to the seat base 30. The improvements include at least one triangular-shaped wedge 140 between the cam 120 and the pawls 160 and a cam spring 80 that engages both the driveshaft 54 and the cam 120. The improved recliner mechanism (also known as the "heart") includes a base bracket 66, seat back return spring 60, retainer 100, base plate 110, cam 120, pawls 160, guide plate 180, top plate or toothplate 190 and driveshaft 54. An optional paint shield or handle attachment 70 may be included. The optional paint shield 70 protects the recliner mechanism 50 from paint intrusion and provides an assembly feature for the release handle 52. Of course, the above listed components as illustrated in the Figures could vary in design, shape, size and configuration. In the embodiment illustrated in FIGS. 6 – 12, the base plate 110 and the top plate 190 are affixed to the seat back 40. More specifically, the base plate 110 is assembled to the seat base bracket 66 and the top plate 190 is assembled to a seat back bracket (not shown). A seat back return spring 60 is interconnected to both the seat base bracket 66 and the top plate 190 through use of the retainer 100.

[0042] The subject recliner mechanism includes the use of a fully circular retainer plate 100 instead of the attachment feature used in prior art recliner mechanisms. The retainer plate is fully circular and ring-like having an inner ring surface 102 and an outer ring surface 104. The retainer plate 100 is attached to the top plate 190 and is designed to interact with an external surface of the base plate 110 about a full 360 degrees to thereby help to counteract radial forces extending from the base plate 110 when the recliner

mechanism 50 is in a locked condition. In addition, the external surface 112 of the base plate 110 is at least partially defined to receive the inner ring surface 102 of the retainer plate 100 has a diameter which is less than an overall outer diameter of the base plate 110. By providing this stepped configuration 114 to the base plate 100, with the location of the retainer plate 100 on the base plate 110, not only are the radial forces reduced, but also the lateral movement of the base plate to the top plate is reduced. As discussed below, an optional guide plate 180 may be formed from the center material of the retainer plate 100.

[0043] The retainer plate 100 includes a spring attachment leg 106 extending axially from the outer surface 104 of the retainer plate 100. The spring attachment leg 106 includes a u-shaped channel 108 defined to receive one end, such as the outer end 62 or inner end 64, of the seat back return spring 60. The retainer plate 100 also includes at least one stop flange 105 extending radially outward from the external surface of the retainer plate 100 for use in connection with at least one detent formed on the seat base bracket. In use, the retainer plate flange is designed to interact with the detent 68 formed on the seat base bracket 66 to limit the amount of overall rotation between the seat back 40 and seat base 30. The retainer plate 100 is typically formed of stamped steel but may also be formed in any number of other ways including fine-blanking. The retainer plate 100 further includes at least one alignment indicator 109 formed on the outer ring surface 104 for use in connection with aligning with the top plate 190. In this embodiment, the top plate 190 and the retainer plate 100 are shown having three alignment indicators 104 positioned at predetermined locations; however, it should be appreciated that any number of alignment indicators may be used.

[0044] The exploded recliner mechanism 50 in FIG. 8 shows another improvement of the recliner mechanism 50 in the present invention. The base plate 110 includes an aperture 118 at its center through which a one-piece cam member 120 extends having the

pivot formed integral therewith. In the prior art recliner, as illustrated in FIG. 5, the pivot is a separate component from the cam. The prior art pivot in FIG. 5 includes an internal drive spline formed with use of an expensive broaching process, performed after assembly into the "heart" mechanism. With the improved one-piece cam and pivot 120 the need to separately form the pivot, including an internal spline, with the expensive broaching process after assembly is eliminated, thereby reducing the cost of the improved recliner mechanism. The cam 120 may also now be formed from the center material of the top plate 190. With the improved one-piece cam and pivot 120, the internal spline 122 can be formed in the pivot portion 124 prior to assembly of the "heart" mechanism thereby reducing cost and complexity. In this embodiment, the one-piece cam is provided with a cam portion 126 and a pivot portion 124, including an internal spline 122, both formed integrally as a single piece. The cam portion 126 is defined for interaction with the pawl members 160 and the pivot portion 124 interacts with the base plate 110, cam spring 80 and the recliner shaft or driveshaft 54. In addition, since the cam and the pivot are formed integral, the cam spring 80 can be mounted directly to the one piece cam and pivot 120, specifically the pivot portion 124 without the need for an additional plastic bushing (not shown) used in connection with the prior art two-piece cam and pivot. The internal spline 122 formed on the pivot portion 124 is provided for interaction with a drive shaft 54 extending from one side of the seat assembly to the other. The spline includes at least one engagement groove 130 that passes through the outer cam spring engagement surface 132 of the cam 120.

[0045] The cam 120 of the present invention could also be configured in two pieces or separately with a pivot. The cam generally includes a first arm 131 extending from the cam portion 126. The first arm includes a cam engagement surface 132 for engaging the wedge 140, specifically the second surface 146 on the wedge 140. The cam portion 126 further includes a second arm 136 displaced from the first arm 131, which does not engage

the pawl in the unlocked or locked position, except in the event of a crash condition, as further discussed below. As shown in FIG. 10, a blocker gap 214 remains between the pawl 160 and the cam 120 during normal operation, specifically between the second arm 136 and more specifically the cam crash support surface 138, and the pawl 160, specifically the crash surface 150. The blocker gap 214 is typically less than 1 mm, preferably less than 0.5 mm, more preferably less than 0.1 mm and typically about 0.075 mm for teeth 162 on the pawl 160 having a height of approximately 0.7 mm . More specifically, the blocker gap is typically preferred to have a width that is less than the height of the teeth, more preferably less than twice the height of the teeth and yet more preferably less than twenty percent the height of the teeth.

[0046] As illustrated in FIGS. 8-12 and more specifically FIGS. 11a-11d, the present invention includes an improved cam spring 80 that directly engages both the driveshaft 54 and cam 120, specifically cam engagement surface 132, thereby providing improved tolerances and reduced rattling of the driveshaft 54 against the cam 120 and other components of the recline mechanism 50. Previously, the driveshaft passed through the cam and in view of manufacturing tolerances from time to time, small amount of play and thereby rattles could occur from the driveshaft 54 sporadically contacting the inner surface of the cam 120 or other parts of the recline mechanism 50. The improved cam spring 80 uses an inner circumferential surface 82 that in its relaxed and non-installed state is smaller than the outer circumferential surface of the spring engagement area 132 on the cam 120. Therefore, the cam spring 80 is configured to tightly grip the cam 120. In addition, the cam spring 80 is configured along with the cam 120 such that the cam spring 80 when installed on the cam 120 passes at least partially through at least one engagement groove 130, allowing the cam spring 80 to engage both the cam 120 and the driveshaft 54 when the recline mechanism is assembled. This feature is most clearly illustrated in FIGS. 11a-11d

wherein the groove 130 for a spline on the drive shaft 54 is deeper than the outer engagement surface 132 on the cam 120 such that the cam spring 80 may directly engage the driveshaft 54. While the present invention is illustrated as having two opposing surfaces of the cam spring 80 engaging the driveshaft 54 to prevent rattling is believed that the present invention could be configured such that the cam spring 80 only engages one surface of the driveshaft 54 creating the necessary pressure to prevent rattling of the driveshaft 54 relative to the cam 120 or other recliner mechanisms. Of course, instead of opposing surfaces, it could engage two to three adjacent surfaces, but it would be unlikely that it would engage every side of the driveshaft 54 because then the cam spring 80 would be limited from fully engaging the cam engagement surface 132. Although the shape is preferably illustrated as a square for the inner surface 82 of the cam spring 80, it is believed that other polygon shapes such as a quadrilateral polygon or a hexagon will provide sufficient pressure to the driveshaft to prevent rattling and could be used in place of the illustrated square shape in FIGS. 11a-11d. One advantage to using a cam spring 80 having an inner coil in a shape other than a circle, preferably a polygon, more preferably a rectangular and yet more preferably a square, and a similar profile on the cam 120, is that the cam spring 80 is prevented from rotating relative to the cam 120, without the need for special attachment features or tabs.

[0047] FIG. 8 also shows another improvement of the subject recliner mechanism 50. In the prior art recliner mechanism, the attachment feature is welded to the top plate. Since the material selection of the top plate requires a certain hardness value in order to obtain a given strength for the interaction of the internal teeth and the pawl teeth, an additional costly manufacturing step is required for the prior art recliner mechanism. Such additional step is referred to in the industry as masking. It will be appreciated that this masking process is required in order to weld the attachment feature to the top plate without

loss of the hardness required for the top plate. However, for the subject improved recliner, since the retainer plate 100 provides some additional strength to the recliner mechanism, the top plate 190 can be made with a lower hardness value thereby not requiring this costly masking process. It has been found that by adding boron to the top plate material 190, it markedly increases hardenability when it is added to a fully deoxidized steel. The preferred material for the top plate is the 10B21 material with no masking required. In addition, the top plate includes at least one alignment indicator formed on the outer surface of the top plate for use in connection with providing proper alignment during assembly of the "heart" mechanism.

[0048] FIG. 9 illustrates the opposing perspective view of the recliner mechanism 50 illustrated in FIG. 8.

[0049] FIG. 10 shows another improvement of the subject recliner mechanisms 50 compared to prior recline mechanisms. Referring in particular to FIG. 10, the recliner mechanism 50 is shown with the top plate 190 removed, and compared to a similar prior art mechanism. The present invention illustrated on the right in FIG. 10 has a base plate 110 that includes linear guidepaths 116 which support first and second pawl members 160 having teeth 162. The base plate 110 further supports first and second pawl wedges 140 defined for interaction between the one-piece cam 120 and the first and second pawl members 160, respectively.

[0050] Each of the pawl wedges 140 is in an approximately triangular shape with one edge 142 engaging the respective guidepath 116, the other edge 142 engaging the respective pawl 160 and the last edge 142 engaging the cam 120. Typically, as also shown in the prior art recline mechanism illustrated on the left in FIG. 10, the pawl wedges are actually completely circular discs with no flat interface and no corresponding flat portion formed on the pawl member. As such, without the flat interface, the prior art pawl disc can

rotate when the pawl translates in the pawl pocket. This rotation of the prior art pawl disc causes the cam to then rotate and the pawl member can slip causing the teeth of the pawl member to be disengaged, or significantly less engaged with the internal teeth of the top plate. Instead, with the improvement of the subject recliner mechanism 50, the triangular shape of the pawl wedges 140 engage the linear guidepath 116 pawl 160 and cam 120 and substantially move along a single axis, with only a minor amount of rotation occurring to prevent the wedge from becoming over constrained and thereby preventing the desired sliding movement. More specifically, a very minor amount of rotation is designed into the wedge 140, but overall, the pawl member, cam 120 and linear guidepath 116 prevent rotation of the wedge 140, unlike the prior art discs, thereby reducing unintended disengagement (or slip) of the recliner mechanism 50. As illustrated in FIG. 10, the wedges generally have a triangular shape and include a first surface 145 configured to engage the pawl 160, a second surface 146 configured to engage the cam 120 and a third surface 147 configured to engage the base plate 110. While the first surface 145 is configured to be substantially flat to maximize engagement against the pawl 160, the third surface has a slight curve, for example a radius that is equal to or greater than 3/4 the width to the opposing apex, preferably at least two times the width and more preferably at least four times the width. When viewed, the radius is relatively large in comparison to the pawl, such that the surface is almost flat. The third surface 147 allows the contact with the base plate to be a substantially single point of contact. The wedges 140 further include and indent or recessed portion 144 proximate to the apex of between the first and second surfaces 145, 146, but predominantly occurring on the second surface 146. The recess or indent portion 144 is configured to provide room for the cam to disengage from the locked position to allow the pawl to disengage from the top plate. A locking engagement point

may be seen on the wedge 140 where the cam passes out of the recess 144 to be engaged with the second surface 146.

[0051] Referring to FIG. 12, the recliner mechanism 50 is shown for assembly to the seat base bracket 66 and the seat base return spring 60. The recliner mechanism 50 is generally laser welded to the seat base bracket 66 and the seat back bracket (not shown). More specifically, the base plate 110 can be selectively aligned with the seat base bracket 66 in order to ensure complete alignment with the other recliner mechanism (not shown) disposed for use on the other side of the seat assembly. After aligning the base plate 110 of the recliner mechanism 50 to the seat base bracket 66, the base plate 110 is generally welded, such as laser welded to the seat base bracket 60. Further, as part of this alignment step, the seat return spring 60 is attached to the seat base bracket 66 and the retainer plate 100 prior to the final laser welding of the base plate 110 to the seat base bracket 66. One end of the seat return spring 60 is attached to the seat base bracket 66 and the other end is attached to the retainer plate 100. Since the retainer plate 100 and the seat base bracket 66 can be easily modified to provide different features for each vehicle application without having to modify the complete recliner mechanism. For example, the stop features 105 of the retainer plate 100 can be modified to provide a different seat back 40 ultimate stop position and the seat back spring load can be easily changed for each vehicle by simply changing the configuration or location of the u-shaped channel 108 on the retainer plate 100 without having to change the recliner mechanism components.

[0052] As illustrated in FIGS. 13-15, the recliner mechanism includes the improved pawl having an integrated or trapped wedge 164, integral release arms 170 and a modified cam 200. As more specifically illustrated in FIG. 14, the improved recliner mechanism including the improved or modified cam 200 and pawls with integral or trapped wedges 164. The improved wedges 164 have internal release arms 170 that allow for the

elimination of the guide plate (illustrated in FIG. 8) with the modified cam 200 solely controlling the directional movement of the pawls 160, both outwardly to the locked position and inwardly to be held in an unlocked position. More specifically the cam 200 engages a release engagement area 172 on the integral release arms 170 to pull the modified wedge 164, and the pawl 160 via the trapped arm 174 from engagement with the top plate 190. The improved wedges 164 also include trapped arms 174 secured within a cavity on the pawl and are configured to provide pressure to the pawl 160 in a locked position or in a crash condition at a fulcrum surface 176, as illustrated in FIGS. 19 and 20.

[0053] The modified cam 200 is configured as further illustrated in FIGS. 13 – 15 to have a first outwardly extending arm 202 including an outward cam engagement surface 204 and a second outwardly extending arm 206 including a hook portion 208 for interaction with each pawl 160 and wedge 164 combination and more specifically with the integral release arms 170 of each wedge 164. The modified cam 200 as illustrated in FIG. 14 includes two first arms 202 and two second arms 206 configured to interact with each set of pawl 160 and wedges 164 and integral release arms 170. Of course, the cam 200 could include additional arms if additional pawls or wedges were included or in some embodiments include only a first and second release arm set that interacts with a single combination of pawl and wedge. The second release arm 206 , including the hook 208, has an inner engagement surface 210 and a crash engagement surface 212 on the opposing side of the extended arm 206, which will be described in more detail in relation to the wedges 164 and pawls 160 below.

[0054] The wedge 164 is configured to have a triangle portion with integral release arms 170 extending from one end of the triangle portion 166. The triangle portion 166 that generally includes a first load surface 167 which is configured to apply a load to the pawl 160 in the locked position, specifically the pawl load surface 161 as described below, and a

second load surface 168 which is adjacent to the first load surface 167 and applies a load to the side surface 117 of the linear guidepath 116 on the base plate 110. The wedge 164 further includes a third load surface 169 configured to directly engage the first arm 202 of the cam 200 and more specifically the cam engagement surface 204. As may be seen in FIGS. 13 and 15 when the cam engagement surface 204 engages the third load surface 209 on the wedge 164, the triangular portion 166 of the wedge 164 is forced away from the axis 115 along the linear guidepath 116 of the base plate 110 with the first load surface 167 of the wedge 164 directly engaging the pawl load surface 161 on the pawl 160 and the second load surface 168 of the wedge 164 directly engaging the side 117 of the linear guidepath 116. As the cam 200, specifically the first arm 202, applies force to the wedge 164, the wedge 164 is forced to slide along a first linear guidepath 116 surface 117a and at the same time, forces the pawl 160 against the opposing linear guide surface 117b. This expansive movement in the locked position creates a gap between the pawl 160 and the first linear guidepath surface 117a. With the 160 pawl engaging the top plate 190 to restrain the recline mechanism 50 from moving, the movement of the wedge 164 in coordination with the pawl 160 prevents rocking of the seat back while in the locked position. As described above, the wedge 164 includes integral release arms 170 extending from the triangular portion 166. The integral release arm 170 includes the release engagement surface 172, which when engaged against the inner engagement surface 210 on the second release arm 206, allows the wedge 164 to be driven or pulled towards the pivot axis A thereby moving the wedge 164 and pawl 160 to an unlocked or free recline state of the rotary recline mechanism. The trapped arm 174 extends towards and is constrained by the pawl 160 after assembly. The second load surface 168 of the modified pawl 164 is configured to have a slightly curved surface, almost flat, but configured to have a single point of contact 161 with the side surface 117 in a locked position. The single point of contact 161 is configured

to allow easier sliding and prevent the wedge from becoming wedged between the pawl and the base plate, such that it does not allow the pawl to be removed from engagement with the top plate 190. More specifically, the radius has to be great enough such that the curved surface 168 does not damage the side surfaces 117 of the base plate 110, but also small enough to prevent the wedge 164 from becoming wedged in fashion that prevents easy removal of the pawl to an unlocked position. It is expected that the second load surface 168 will have a radius that is greater than half of the length of the body of the modified wedge, preferably greater than the full length, and even more preferably greater than two times the length, as illustrated in FIG. 20. The third surface 169 further includes the recess 144 as well as a load engagement disengagement point 163 where the cam is forcing the wedge 164 into a locked position or where it is release it from a locked position and starting to use the second arm 208 to engage the release arm 170 on the wedge 164.

[0055] The pawl 160 is configured to have an outer surface with teeth 102 for engaging the top plate 190, two linear side surfaces 156 extending therefrom and an inner surface 154 including the pawl engagement or load surface 161, a contoured channel 152 for receiving the trapped arm 174 on the wedge 164 and a pawl crash surface 150 generally aligned with the crash engagement surface 212 on the second arm 206 of the cam 200 when the recline mechanism 50 is locked to prevent movement. The contoured channel 152 is generally configured to be larger than the profile of the trapped arm 174 on the wedge 164 and more specifically with tolerances such that while the wedge 164 is constrained to generally move with the pawl 100, yet allowing the wedge 164 to shift the position of the pawl 160 between the linear guidepaths 117a and 117b and relative to the pawl 160 to ensure a locked position without rocking of the coupled seat back.

[0056] During normal operation, the pawls 160 are typically locked against a top plate 190 as illustrated in FIGS. 13 and 15. In this locked position, the first arm 202 on the

cam 200 engages the third engagement surface 169 on the wedge 164 driving the wedge 164 along the linear guidepaths 117 on the base plate 110 and at the same time driving the pawl 160 away from the first linear guidepath 117a against the second linear guidepath 117b. This locks the seat back 40 in place and it remains locked until an occupant of the seat 20 desires to adjust the tilt of the seat back 40 relative to the seat base 30. In this locked state as best illustrated in FIG. 15, a blocker gap 214 exists between the crash engagement surface 212 on the second arm 206 of the cam 200 and the pawl crash surface 150 on the pawl 160. This blocker gap 214 is very narrow and as illustrated in FIG. 15 in the exemplary embodiment is preferably on the order of magnitude or approximately 0.075 mm, however the blocker gap 214 is configured to be less than the height of the teeth 162 on the pawl 160, preferably less than half the height of the teeth on the pawl 160, even more preferably less than twenty percent the height of the teeth on the pawl 160. In addition in the locked, normal operating condition, the cam engagement surface 204 and the third wedge surface 209 will always be engaged to keep the pawl 160 in a locked position. The crash engagement surface 212 is specifically provided to provide additional support in a crash situation especially when a large force outside of normal operating parameters is applied to the recline mechanism, typically called a crash load. The blocker gap 214 is intentionally small such that when forces beyond normal operating conditions are applied to the recline mechanism, the pawl and the crash engagement surfaces 212, 150 can contact each other providing support for the pawl 160 such that the pawl stays in its locked state and minimizes potential distortion of the recline mechanism 50 when excessive force is applied such as in a crash condition. By keeping the blocker gap 214 extremely small as illustrated, very little movement occurs when excessive force is applied in the recline mechanism 50 and thereby distortion is minimized. In the embodiments illustrated in FIGS. 13 and 15 as the cam 200 moves counterclockwise, the cam engagement surface 204 moves

out of contact with the third engagement surface 169 on the wedge 164 releasing the pawls 160 from their locked position. As the cam engagement surface 204 loses contact with the engagement surface 169 on the wedge 164, the inner engagement surface 210 on the second extending arm 206 of the cam 200 engages the integral release arm 170 pulling the wedges 164 and thereby the pawls 100 toward the pivot axis A releasing the teeth 162 on the pawls 160 from the top plate 190 and allowing the recline mechanism to rotate freely. The second arms 206 on the cam 200 hold the integral release arms 170 on the wedges 164 to constrain the pawls 160 in the release position while the seat is adjusted. This allows the seat 20 to be adjusted without the need for a guide plate within the recline mechanism 50. When the proper angle of adjustment is reached with the seat back 40, the seat occupant would release the lever or handle 52 and the cam spring 80 would drive the cam 200 back into engagement with the wedges 164 thereby driving the pawls 160 outward into the locked position as the cam 120 rotates in a clockwise manner. Of course, it should be recognized that the above described clockwise and counterclockwise movements are for reference purposes with the illustrated example in the Figures and the present invention can be easily modified to use a cam in combination with the particular wedges and pawls is reversed such that the cam is driven clockwise to create the unlocked position and counterclockwise to create the locked position.

[0057] The method of assembling the recliner mechanism includes assembling the pawl members 160 and wedge members 140 into the base plate 110 adjacent the one-piece cam 120 which, with the pivot integral thereto, is inserted into the base plate 110. Assembling the retainer plate 100 onto the base plate 110 so that the centerline of the retainer plate 100 is aligned with axis A. Aligning the aperture 192 of the top plate 190 and aperture 118 of the base plate 110 along axis A using the alignment indicators 109 positioned on the retainer plate 100 and the top plate 190. Laser welding the retainer plate

100 to the top plate 190 to thereby form the final recliner "heart" mechanism. Aligning the pivot portion 124, having the internal spline 122, to the seat base bracket 66 and laser welding the recliner "heart" assembly to the seat base bracket 66. Assembling the recliner "heart" mechanism having the seat base bracket mounted thereto to either (or both) sides of the seat assembly 20, and mounting a drive shaft 54 between each side of the seat assembly 20.

[0058] As illustrated in FIGS 16-18 the integral release arms 170 and trapped arms 174 also provide an improved fulcrum allowing for improved engagement of the teeth 102 and improved stress loading, thereby preventing or reducing failure of the recliner mechanism under stress. In view of the foregoing, it may be possible to create a lighter weight recliner mechanism having improved strength characteristics, in addition to the characteristics outlined above. As illustrated in detail in FIG. 13, the integral release arms 170 and trapped arms 174 improve tooth load sharing and load capability by preventing the pawl from unintended extracting while in a locked position (undesired disengagement or slippage of teeth) during rearward loading. As illustrated in more detail in FIG. 17, the stress map has improved and there is less separation of teeth between the top plate and the pawl, thereby creating a better engagement. The results of this improved engagement caused by the wedge 164 having the integral release arms 170 is clear from the graph in FIG. 18. More specifically, the prior wedge design experienced a failure, specifically an unintended extracting of the teeth, which the new wedge design did not have any failure. As clearly illustrated in the FIGS, the leg extraction arm acts as a fulcrum, applying force near the center of the pawl to improve tooth engagement near the center of the pawl under load.

[0059] These illustrations, together with the accompanying annotations are highly informative and will be readily appreciated by those skilled in the art. Furthermore, the

various depictions throughout all of the Figures in this application may be mixed and matched with one another, thus multiplying the use of three-dimensionally knit materials within a seat trim cover.

[0060] The foregoing invention has been described in accordance with the relevant legal standards, thus the description is exemplary rather than limiting in nature. Variations and modifications to the disclosed embodiment may become apparent to those skilled in the art and fall within the scope of the invention.

CLAIMS

We claim:

Claim 1. A recliner mechanism for a vehicle seat assembly having a locked position and an unlocked position, said recliner mechanism comprising:

a pawl;

a cam;

a base plate; and

a wedge having a substantially triangular shape and engaging said pawl, said cam and said base plate in the locked position.

Claim 2. The recliner mechanism of Claim 1 wherein said substantially triangular shape includes a first surface on said wedge engaging said pawl, a second surface on said wedge engaging said cam and a third surface on said wedge engaging said base plate.

Claim 3. The recliner mechanism of Claim 2 wherein said base plate further includes a linear guidepath configured to receive said pawl and wherein said linear guidepath is defined by a first linear surface opposing a second linear surface.

Claim 4. The recliner mechanism of Claim 2 wherein said third surface on said wedge engages said first linear surface in said locked position.

Claim 5. The recliner mechanism of Claim 4 wherein said pawl engages only one of said first and second linear surfaces.

Claim 6. The recliner mechanism of Claim 5 wherein said wedge and said pawl engage opposing side surfaces in said locked position.

Claim 7. The recliner mechanism of Claim 4 wherein said third surface of said wedge is offset from but substantially aligned with a pawl slide surface.

Claim 8. The recliner mechanism of Claim 1 wherein said cam further includes a first arm having a cam engagement surface and wherein said first arm engages said second surface of said wedge in said locked position.

Claim 9. The recliner mechanism of Claim 8 wherein said second surface includes a recess extending outwardly toward said third surface.

Claim 10. The recliner mechanism of Claim 8 wherein said cam includes a second arm which does not engage said pawl in said locked position.

Claim 11. The recliner mechanism of Claim 10 wherein said pawl includes a crash surface in close proximity to said second arm on said cam, and wherein said second arm on said cam includes a cam crash support surface and wherein said cam crash support surface and said crash surface on said pawl are separated by less than 0.5 mm.

Claim 12. The recliner mechanism of Claim 11 wherein said pawl includes teeth and wherein said cam crash support surface and said crash surface on said pawl are separated by less than half the height of the teeth.

Claim 13. The recliner mechanism of Claim 12 wherein said cam crash support surface and said crash surface on said pawl are separated by approximately 0.075 mm.

Claim 14. The recliner mechanism of Claim 1 wherein said triangular shape includes a first surface on said wedge engaging said pawl, a second surface on said wedge engaging said cam and a third surface on said wedge engaging said base plate, and wherein said first surface is substantially flat and wherein said third surface is curved.

Claim 15. The recliner mechanism of Claim 14 wherein said third surface has a radius that is equal to or greater than the distance between the third surface and the apex between said second and first surfaces.

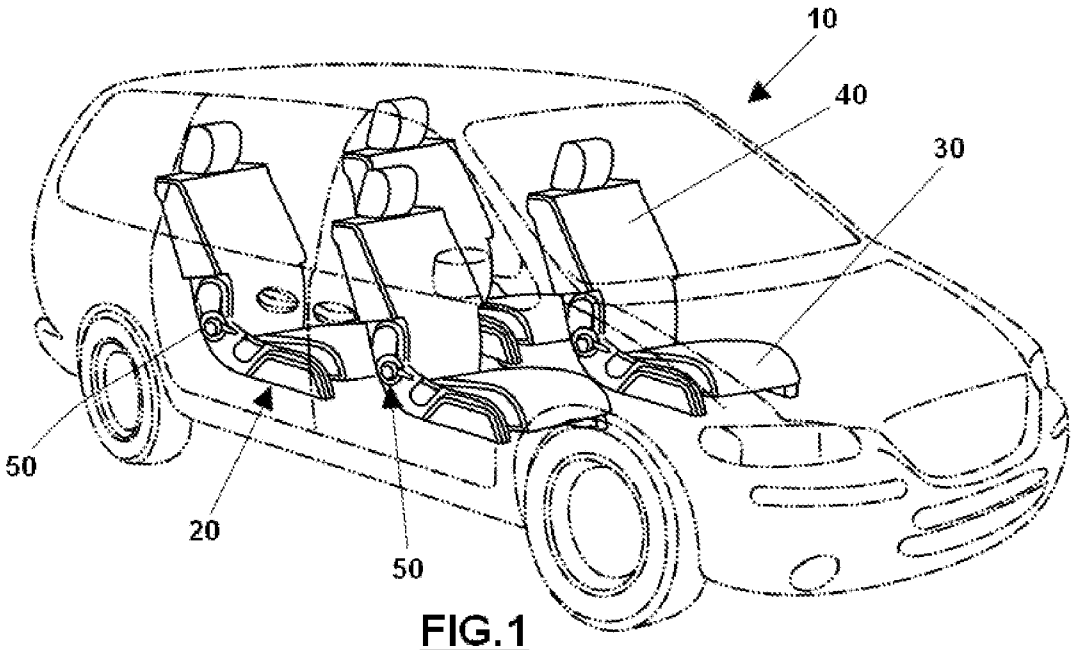

10
40
30
50
20
50

FIG.1

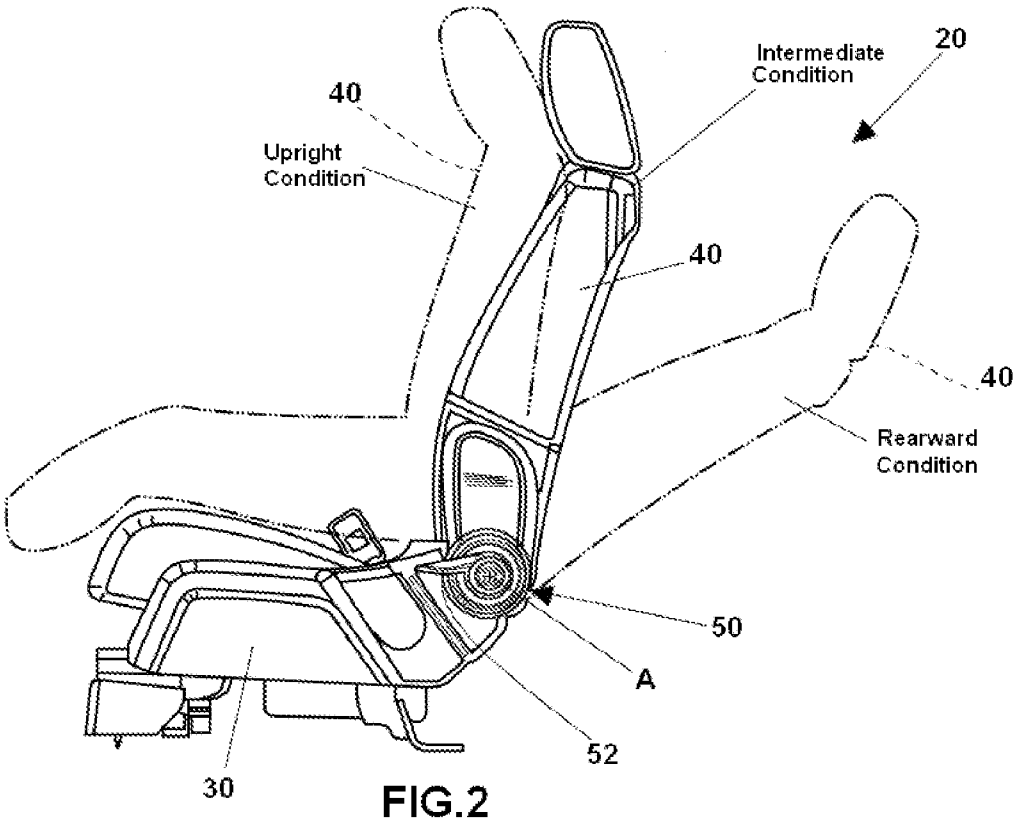

20
Intermediate Condition
40
Upright Condition
40
40
Rearward Condition
50
A
52
30

FIG.2

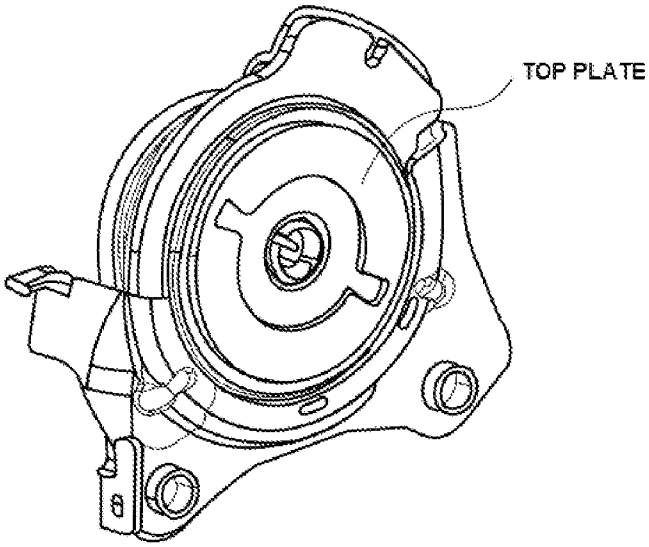


FIG.3
PRIOR ART

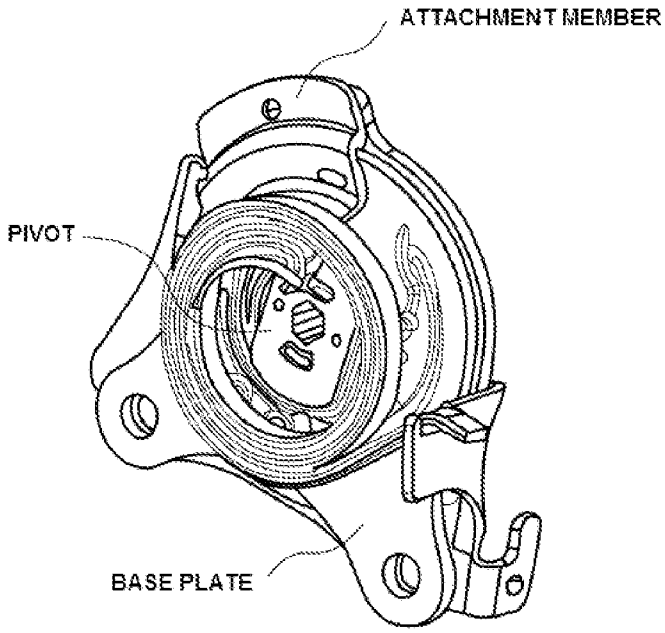


FIG.4
PRIOR ART

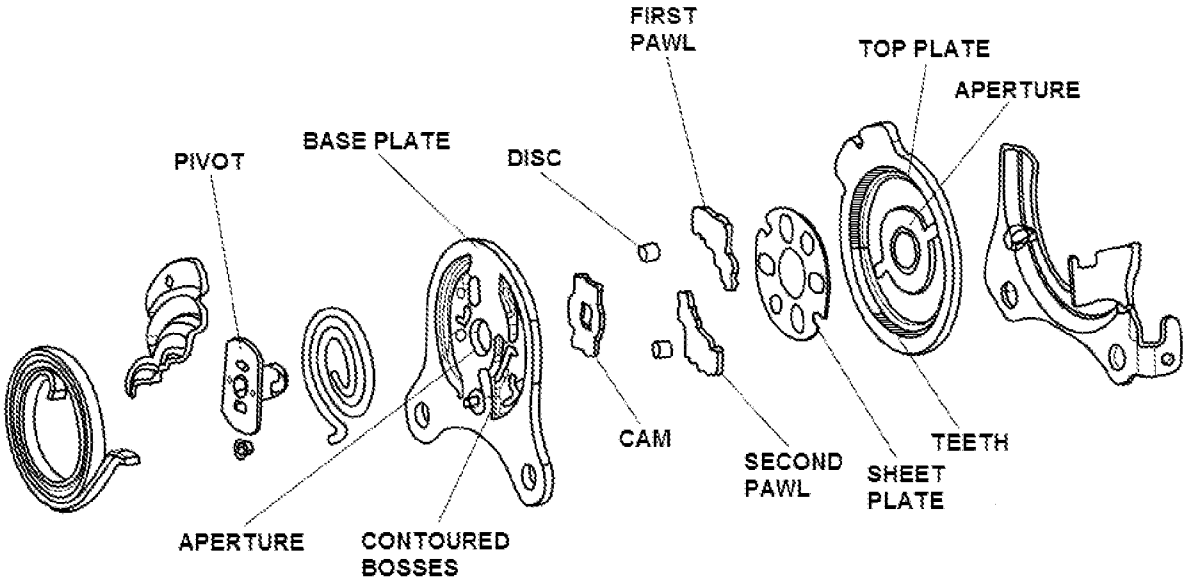


FIG.5
PRIOR ART

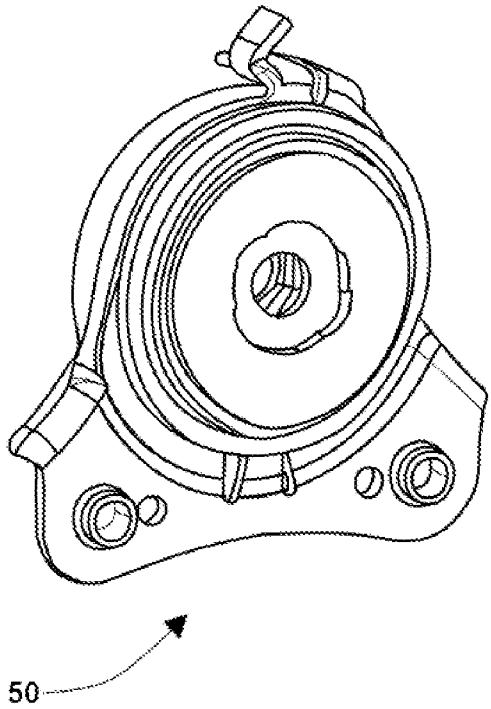


FIG.6

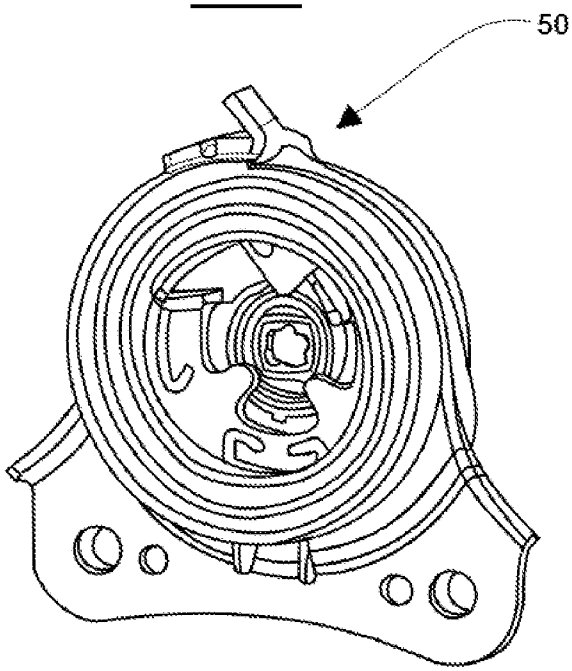


FIG.7

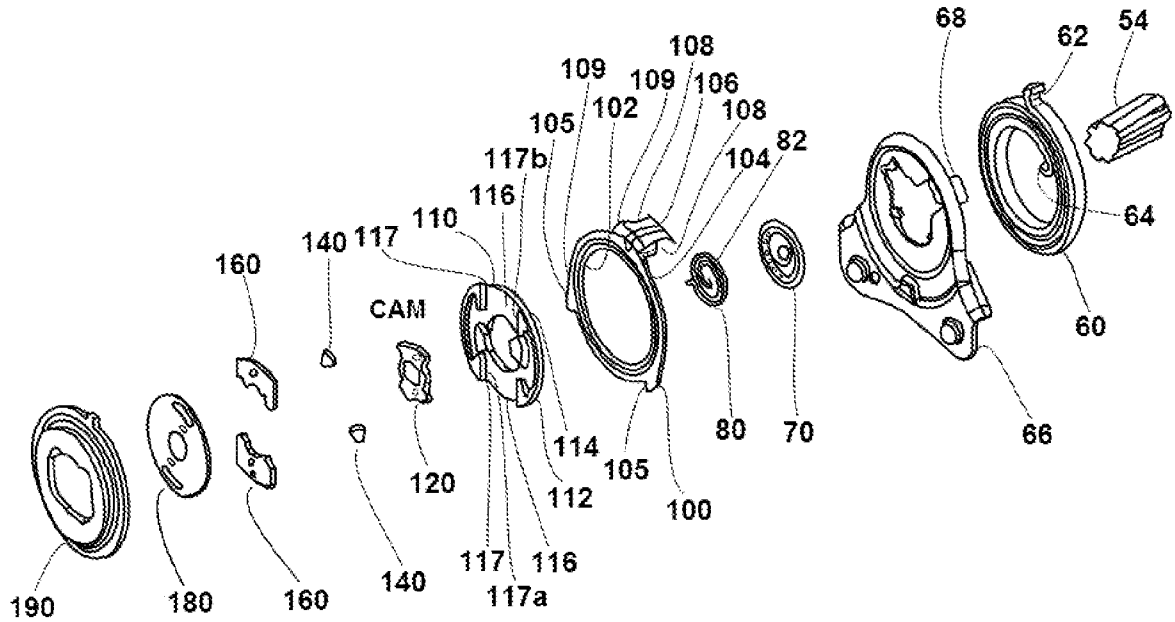

68
62
54
108
109
109
106
102
108
105
82
117b
104
116
64
110
140
117
160
CAM
60
114
105
80
70
120
112
66
100
140
117
116
190
180
160
117a

FIG.8

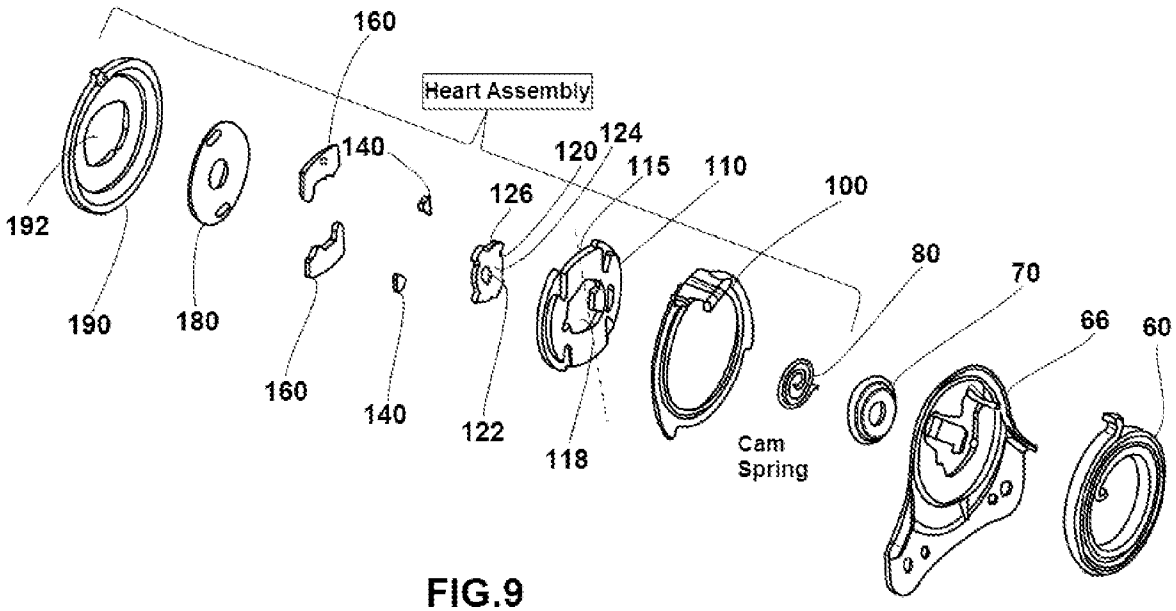
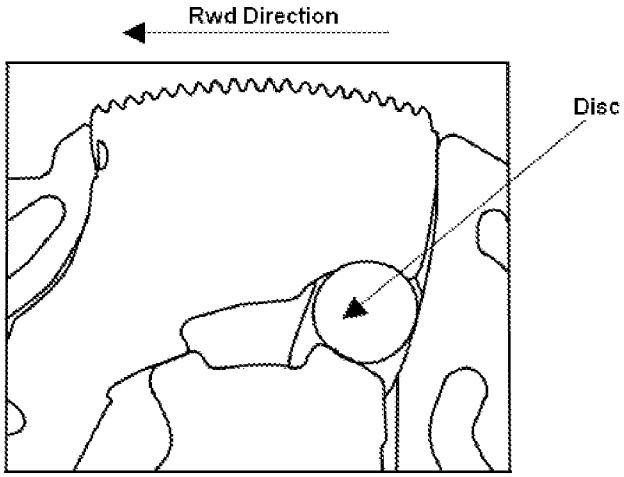

160
Heart Assembly
140
120
124
115
110
100
126
192
80
70
66
60
190
180
160
140
122
118
Cam
Spring

FIG.9



PRIOR ART

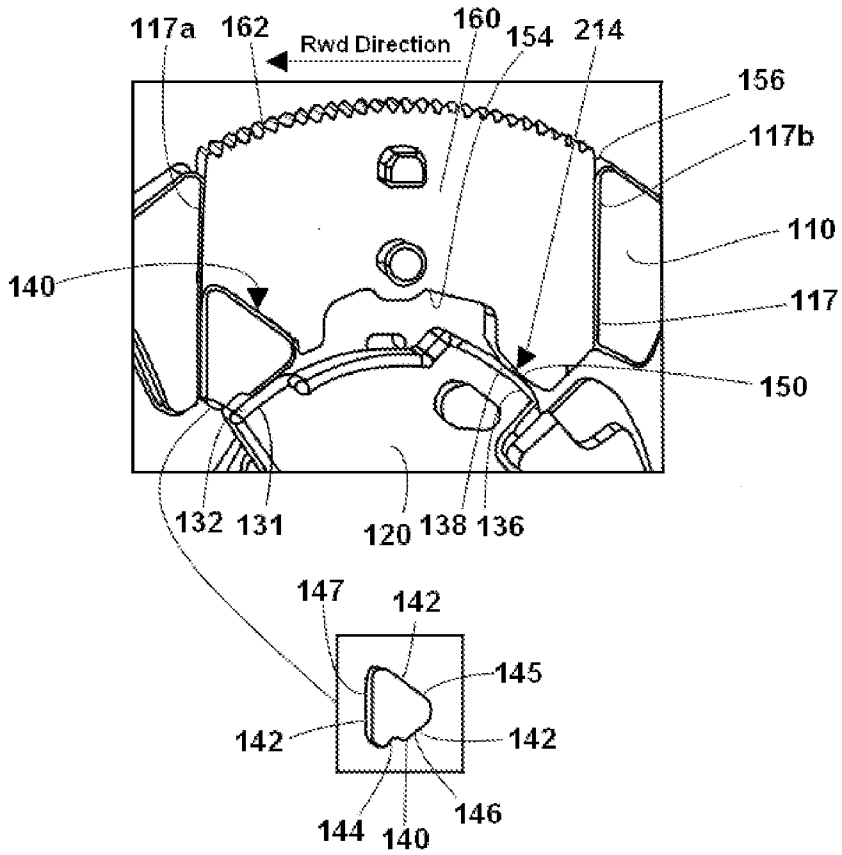


FIG.10

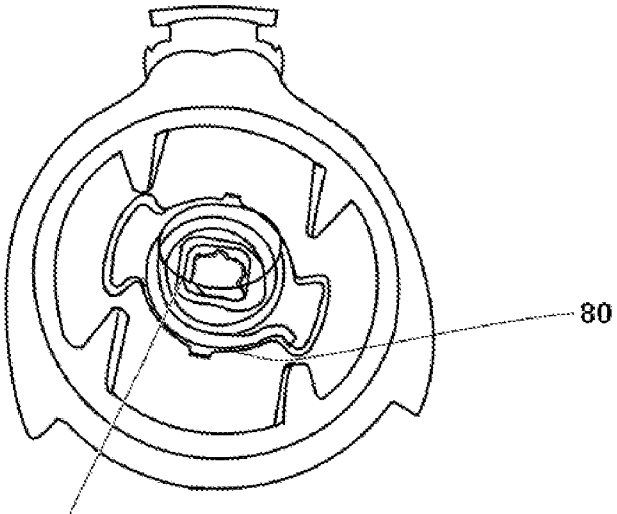


FIG.11a

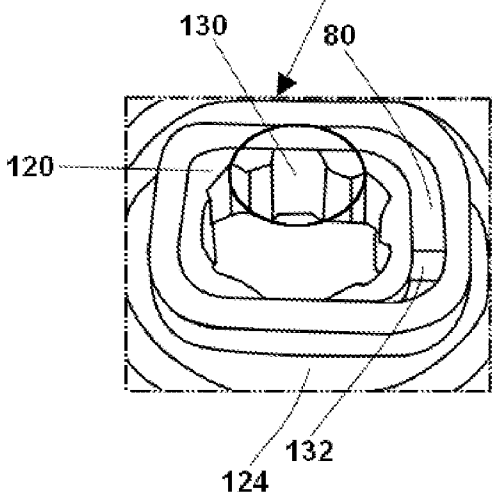


FIG.11b

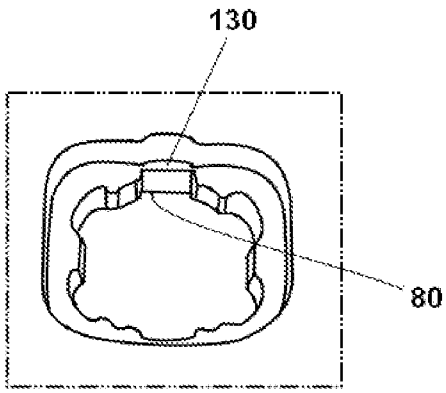
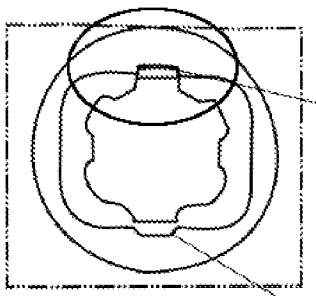


FIG.11c



Drive shaft spline pushes spring outwards during installation resulting in an "anti-rattle load" on the drive shaft.

FIG.11d

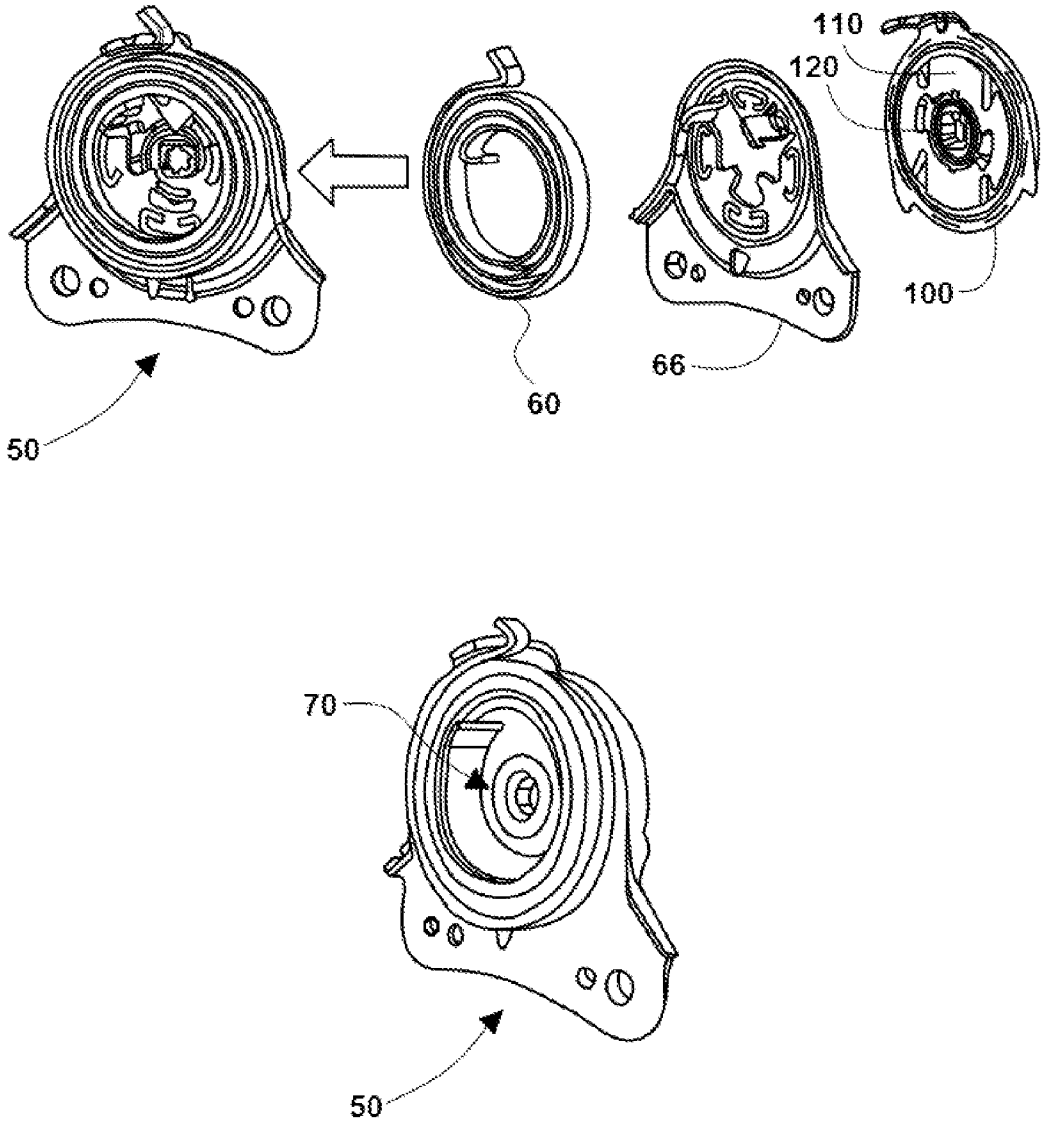


FIG.12

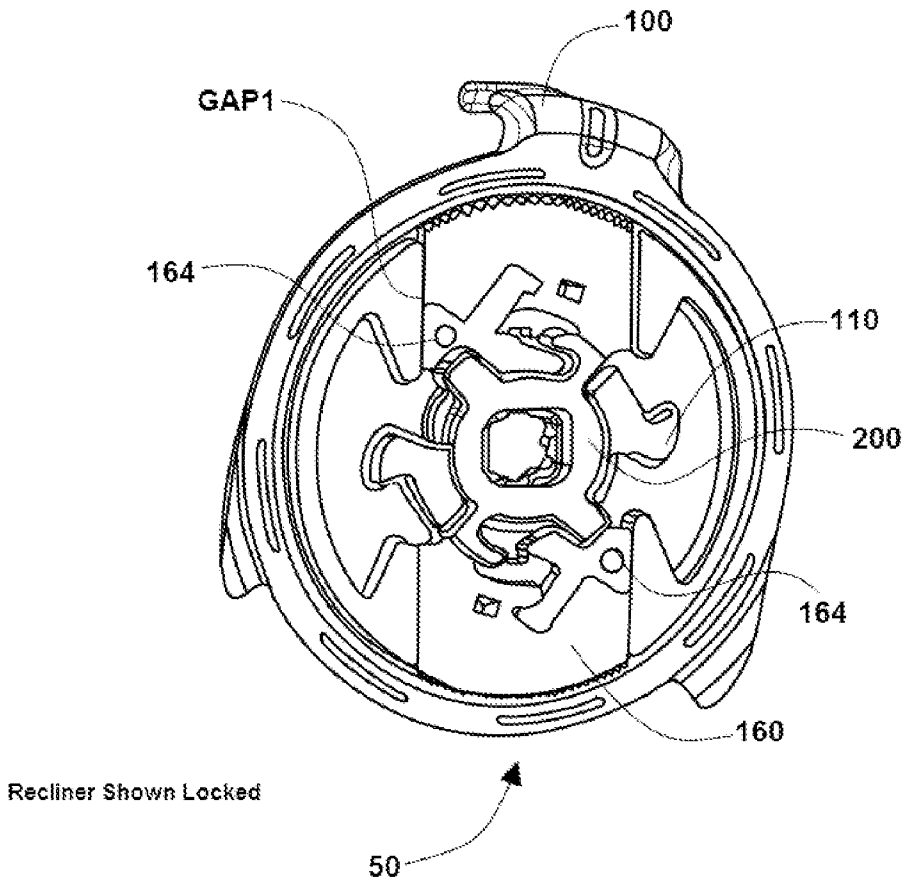


FIG.13

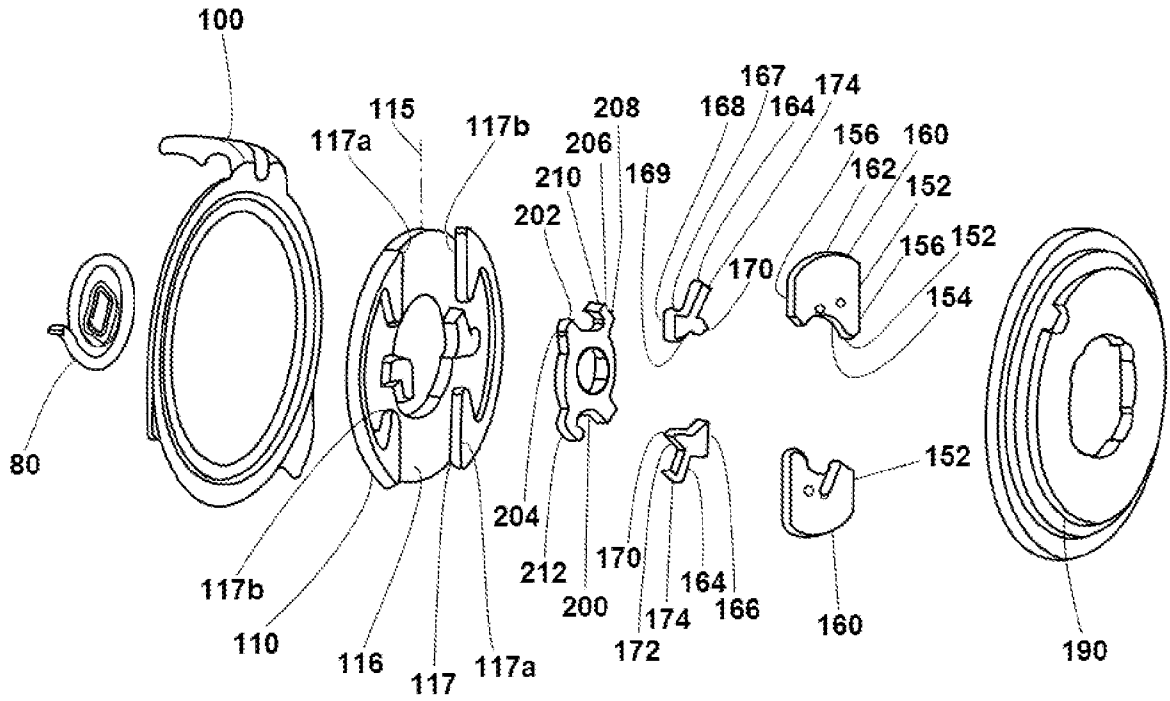

100
115
117a
117b
208
206
210
202
169
167
168
164
174
156
160
162
152
156
152
154
170
80
117b
110
116
117
117a
204
212
200
170
164
174
172
166
152
160
190

FIG.14

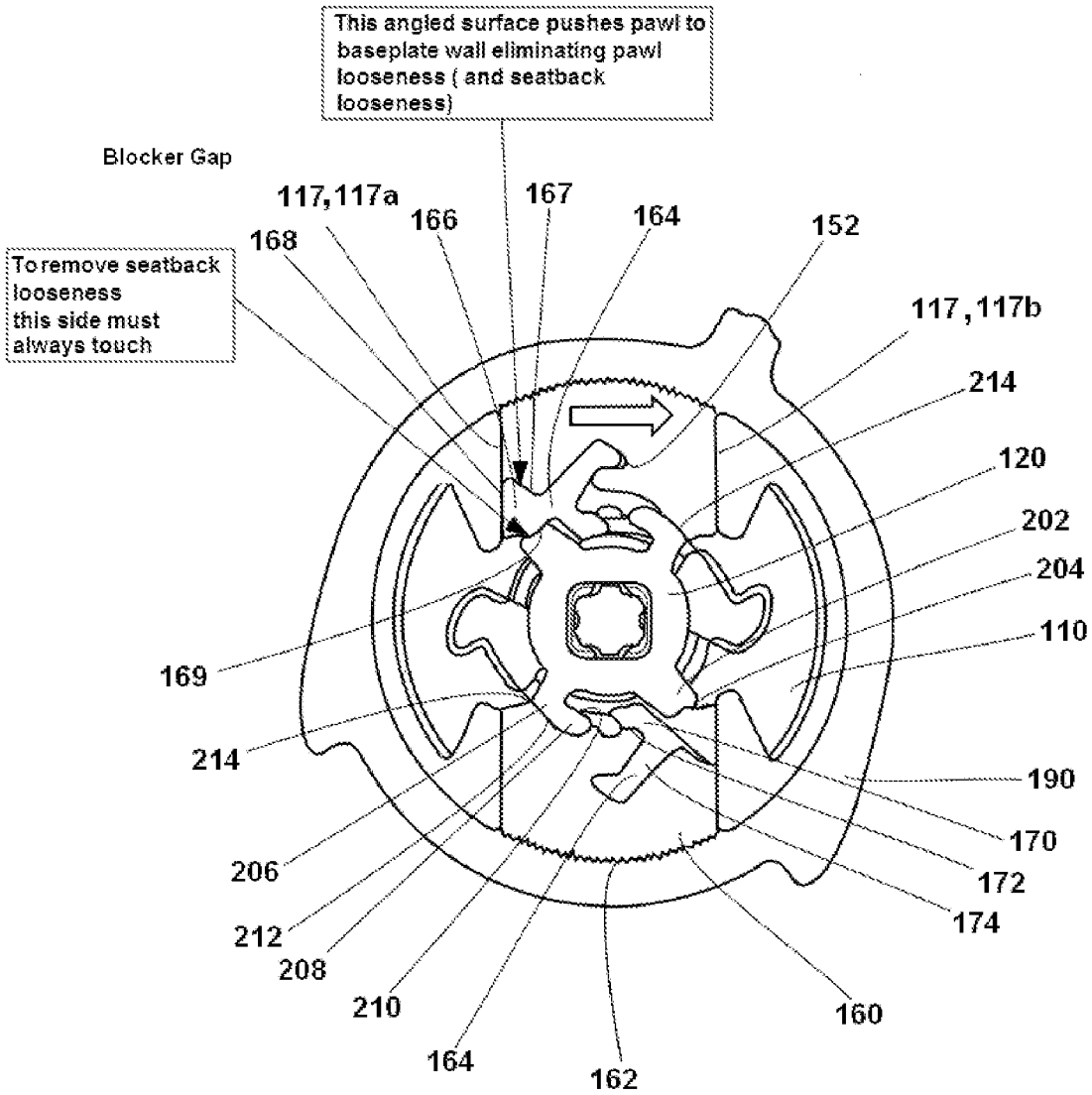

This angled surface pushes pawl to baseplate wall eliminating pawl looseness (and seatback looseness)
Blocker Gap
To remove seatback looseness this side must always touch
117,117a
168
166
167
164
152
117,117b
214
120
202
204
110
169
214
190
170
172
174
206
212
208
210
164
162
160
Mechanism Shown Locked

FIG.15

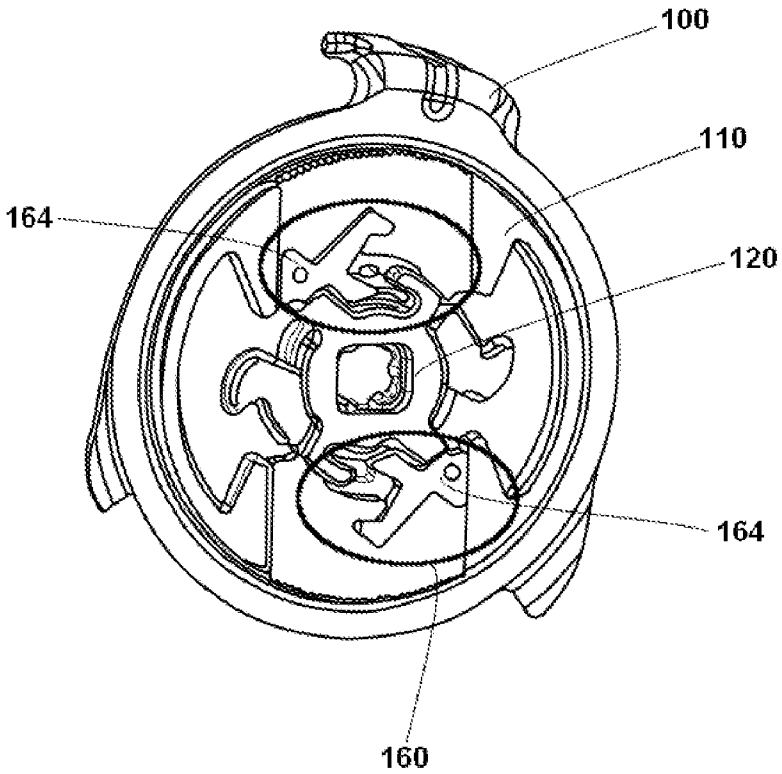


FIG.16

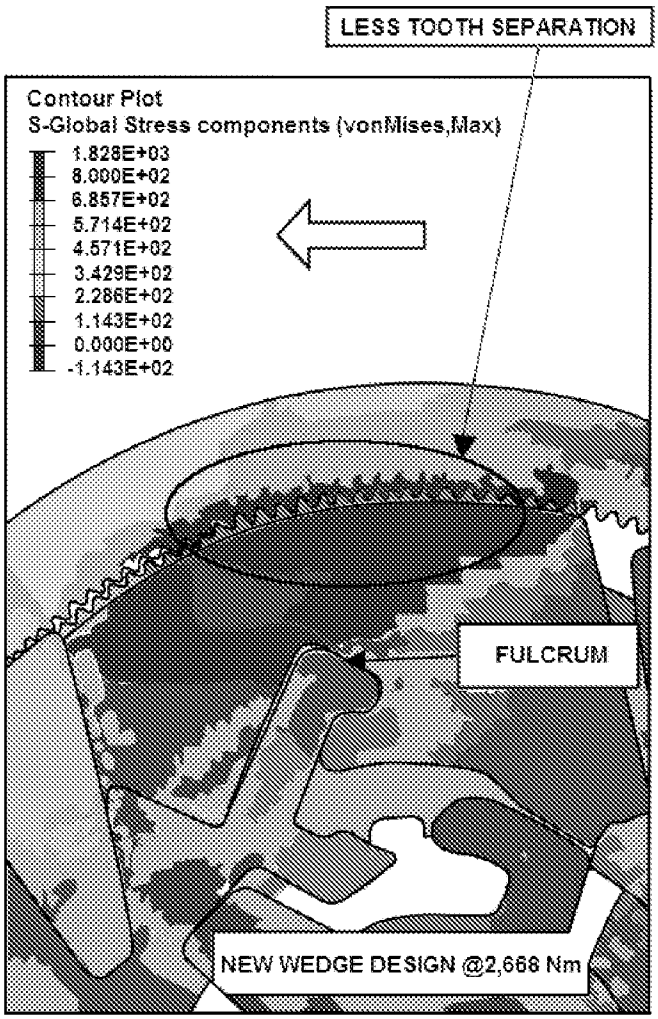
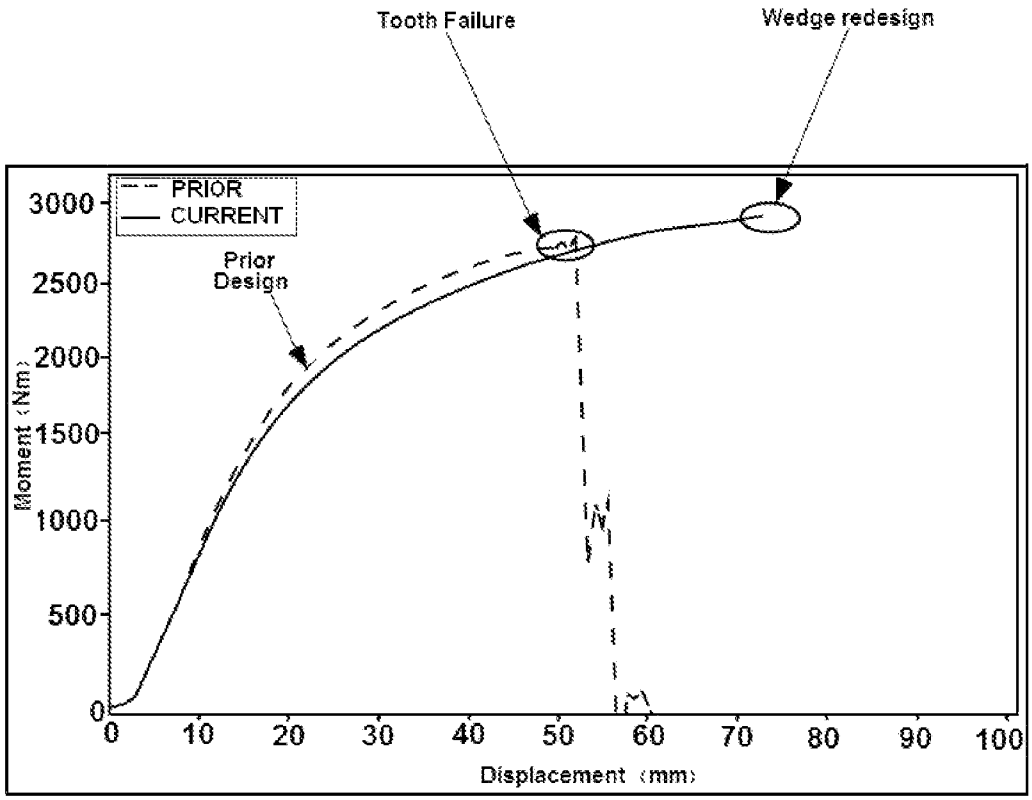

LESS TOOTH SEPARATION
Contour Plot
S-Global Stress components (vonMises,Max)
1.828E+03
8.000E+02
6.857E+02
5.714E+02
4.571E+02
3.429E+02
2.286E+02
1.143E+02
0.000E+00
-1.143E+02
FULCRUM
NEW WEDGE DESIGN @2,668 Nm

FIG.17



Rearward Loading

Greater energy absorption (area under curve) and higher load capability

Note : The run timed out before failure

FIG.18

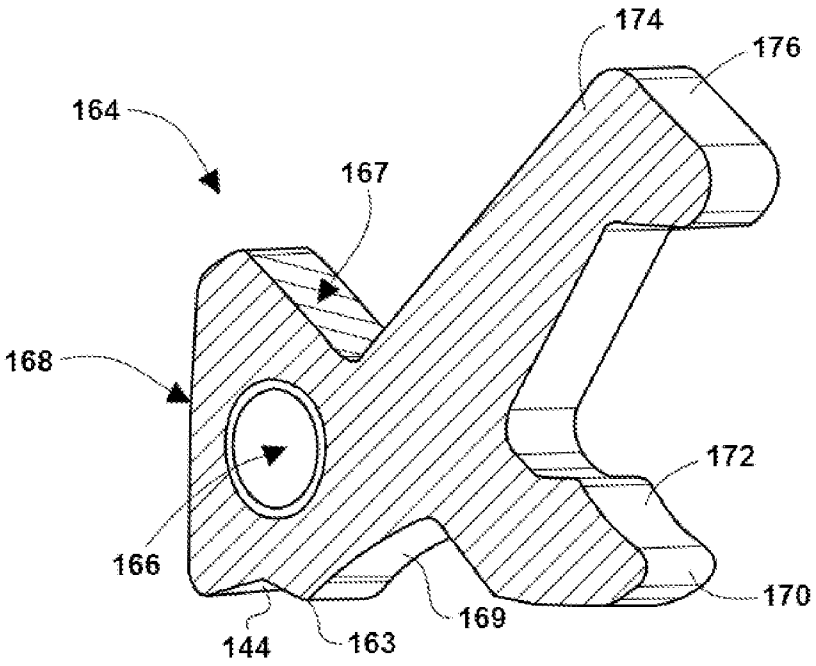

174
176
164
167
168
172
166
170
169
144
163

FIG.19

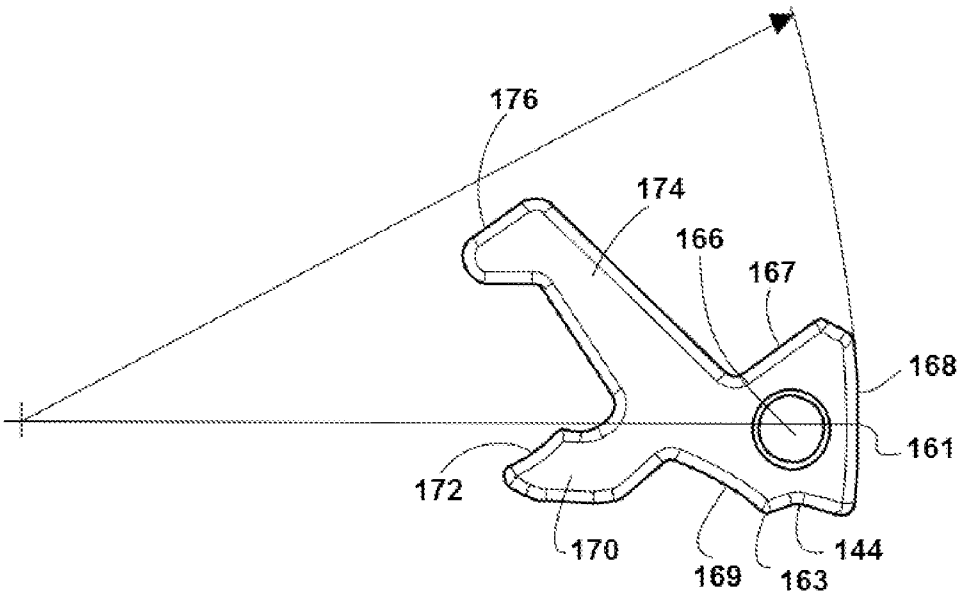

176
174
166
167
168
161
172
170
169
163
144

FIG.20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/22916

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B60N 2/235 (2012.01)
USPC - 297/367R
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)
IPC(8): B60N 2/235 (2012.01)
USPC: 297/367R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
additional USPC: 297/353, 297/354.1, 297/354.12, 297/361.1, 297/366, 297/367R, 297/367P; 296/65.05, 296/65.06, 296/65.07, 296/65.08, 296/65.09

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(PGPB,USPT,USOC,EPAB,JPAB); Google Patents, Google, PAIR
Search terms used: recliner, pawl, cam, base plate, wedge, triangular, vehicle seat, locked, unlocked, apex, curved, guide path, millimeters, mm, crash support, surfaces, faces, pivot

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 6,220,666 B1 (OHYA) 24 April 2001 (24.04.2001) Fig 1; col 1 ,ln 11-23; col 3, ln 14-26, 48-63; col 4,ln 1-30; col 5, ln 8-14; col 6, ln 5-7	1 ---------- 2-15
Y	US 2005/0168034 A1 (FAST) 4 August 2005 (04.08.2005) Fig 2b, 10, 11; para [0040-0043]; para [0062]; para [0071]; para [0074]).	2-15
Y	US 5,973,888 A (Chawanya et al.) 26 October 1999 (26.10.1999) col 6, ln 55-65	11-13
Y	US 2008/0122282 A1 (Matsumoto et al) 29 May 2008 (29.05.2008) Fig 1; para [0024]	1
Y	US 7,520,568 B2 (Hoshihara et al) 21 April 2009 (21.04.2009) Fig 2; col 3, ln 47-67; col 4, ln 1-14	1
A	US 4,113,219 A (Mieyal) 12 September 1978 (12.09.1978) col 3, ln 9-59	1

☒ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 May 2012 (06.05.2012)	15 MAY 2012
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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
T	US 2011/0181088 A1 (Zhang et al.) 28 July 2011 (28.07.2011) Fig 7; para [0052-0053]	1
T	US 20110309665 A1 (Leighton et al.) 22 December 2011 (22.12.2011) Fig 3; para [0023-0025]	1