TOGGLE LINKAGE FOR VEHICLE DOOR HINGE

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This invention relates generally to a hinge mechanism adapted to mount a vehicle door for opening movement, with respect to the vehicle body, in a substantially co-axial relationship and more particularly to a quadrilateral hinge mechanism for mounting such a vehicle body door for translatory opening and closing movement; and with regard to certain of its more specific aspects, to a toggle linkage for such a hinge mounted vehicle door.

Easier access to a vehicle passenger compartment and greater door opening movement in a restricted space may be provided by mounting the vehicle door on the vehicle body by spaced swinging bar hinge members cooperating to form quadrilateral hinge linkages with the hinge supporting door pillar and the opposing edge of the door. Such hinges translate the hinge mounted side of the door outwardly with the adjacent vehicle body door pillar during door opening with linkage controlled swinging movement of the door. The compound motion provided by such hinges further tends to eliminate any interference between the side body contoured edges of the door and the adjacent door opening and hinge supporting pillars of the vehicle body.

When used with a conventional vehicle door lock or latching mechanism however, quadrilateral swinging bar hinges tend to permit cyclic rebounding of the door relative to the hinge supporting pillar during vehicle operation. This rebounding or cyclic swinging movement of the hinge mounted side of the door results in objectionable noise and in excessive wear and destructive impacting of the interengaged door locking elements and of the resilient weatherseal normally interposed between the door and the door opening portion of the body. Hence, an auxiliary or secondary door stabilizing latch mechanism is usually provided at the hinge side of the door to prevent such rebounding between the hinge supporting pillar and the adjacent side face of the door. In the past, such secondary latching mechanisms have generally been connected to the primary latch mechanism for sequential or simultaneous release by appropriate operation of either an inside or outside button or handle. Such compound latch arrangement have necessarily required relatively complex detent operating linkages and excessive operating effort. More recently, several auxiliary door stabilizing latch mechanisms have been operably connected for door latching actuation and release by closing and opening movement of the door relative to the body opening and independently of latching engagement and detent releasing operating of the primary latch means.

The instant invention broadly contemplates an improved quadrilateral hinge mechanism of relatively simple, inexpensive, rigid construction and particularly adapted to mount vehicle body doors for controlled translatory swinging movement between an extreme door opened position and a locked rebound preventing closed position relative to the vehicle body door opening. The invention further contemplates a hinge mechanism or similar hinge mounted door with a toggle linkage folded in the closed position of the door to an overcenter door and hinge locking position and swingable therefrom by remote operating means to an intermediate position unlatching the door and hinge for opening movement to an opened position when the toggle and hinge members cooperate to define door holding and checking positions.

The foregoing and other objects, advantages and features of the invention will be apparent from the following description of several illustrative embodiments, having reference to the accompanying drawings, in which:

FIGURE 1 is a fragmentary sectional view of a portion of a vehicle body taken substantially in a horizontal plane through a closed door hinged on the body for translatory swinging movement by a quadrilateral hinge mechanism shown in plan elevation, the hinge mechanism being constructed in accordance with the invention and incorporating an illustrative door stabilizing toggle linkage, hold-open and door checking device;

FIGURE 2 is a view similar to FIGURE 1 and shows the door and hinge elements in their toggle maintained hold-open positions;

FIGURE 3 is an enlarged fragmentary view looking outwardly of the vehicle body with portions removed and sectioned to show the illustrative hinge mechanism and toggle linkage in side elevation when in their door closed hinge latching positions with respect to the adjacent door hinge supporting body pillar;

FIGURE 4 is a fragmentary sectional view taken substantially in the plane indicated at 4—4 of FIGURE 3 and shows the hinge and door locking toggle linkage and the hinge mounting on the jambs or pillar facing edge of the closed door in side or end elevation;

FIGURE 5 is a similar sectional view taken substantially in the plane indicated at 5—5 of FIGURE 3 and shows the door pillar mounting of the hinge mechanism opposite side elevation;

FIGURE 6 is an enlarged fragmentary sectional view of a portion of FIGURE 1 and shows the structure and geometry of the hinge locking and hold-open toggle linkage of the illustrative swinging bar quadrilateral hinge mechanism in plan elevation taken substantially in the direction indicated at 6—6 of FIGURE 4;

FIGURE 7 is a fragmentary sectional view taken substantially in the plane indicated at 7—7 of FIGURE 2 and shows the door hold-open detenting engagement effected between a spring member carried by one of the swinging hinge members and spaced arms of one of the door stabilizing toggle links;

FIGURE 8 is an enlarged fragmentary sectional view similar to FIGURE 6 and shows the structure and geometry of an alternative hinge and door locking, hold-open toggle linkage acting between and maintaining the several elements of the illustrative swinging bar quadrilateral hinge mechanism in the hinge mechanism;

FIGURE 9 is a similar enlarged fragmentary sectional view corresponding to a portion of FIGURE 1 and shows the several elements of the alternative toggle linkage and the quadrilateral hinge mechanism of FIGURE 8 in their hold-open maintained door opened position; and

FIGURE 10 is a fragmentary sectional view taken substantially in the plane indicated at 10—10 of FIGURE 9 and shows the door hold-open detenting engagement effected between the swinging hinge members and the several elements of the alternative toggle linkage.

Referring more particularly to FIGURES 1—7 of the drawings, a quadrilateral hinge mechanism constructed in accordance with the invention is indicated generally by the reference numeral 12. In the illustrative embodiment, the quadrilateral hinge mechanism 12 mounts a forwardly opening rear door 14 on a vehicle body door jamb forming pillar 16 located adjacent to the back of a rear seat partially shown at 18. As shown in FIGURES 1 and 2, swinging translation of the door is provided by this hinge mechanism between opened and closed positions relative to rear door body opening 20 which provides access to the rear passenger compartment 22 of the vehicle body. In the illustrative hinge mechanism, a hinge supporting member or bracket 24 is suitably secured as shown to the
3,399,226 3 jamb face of the body pillar 16. As best seen in FIGURES 3 and 5, the inner side of this support member forms vertically spaced clevis arms 26 which are vertically coaxially perforated to receive hinge pin 28. The pin 28 pivotally mounts the adjacent end of an inner hinge bar 30 for swinging motion relative to the pillar supported bracket 24. The inner bar 30 serves as the primary door supporting member of the illustrative hinge mechanism. The distal end of this inner hinge member is pivotally mounted about a parallel axis by a hinge pin 32. This hinge pin extends between vertically spaced clevis arms 34 formed by the inner end of flange or leg 36 angled inwardly from a door mounted hinge bracket 38. The angled bracket 38 is suitably secured to the wall 40 of the door inner panel. An outer panel 42 is hem flanged to wall 40 at 44.

The outer end of the door secured bracket 38 has a vertically perforated boss 46 of reduced vertical dimension. A hinge pin 48 is vertically inserted through and pivotally secures the vertically interconnected clevis arm forming ends 50 and 52 of a toggle link member 54 part of an outer hinge bar 56, respectively, to the supporting boss 46 of the door mounted hinge bracket 38. As best shown in FIGURE 3, the parallel vertically spaced clevis arm 52 of the hinge member 56 extend rearwardly from their door pivot ends through approximately 90 degrees from the hinge member. The other end 58 of the outer hinge bar 56 forms vertically spaced clevis arms which are pivotally connected by a hinge pin 60 to a supporting boss 62 formed outwardly of the pillar mounted hinge bracket 24.

It should be noted that the outer hinge bar is pivotally connected to the door rearwardly of the inner bar pivot pin 32 and is substantially shorter than the inner hinge bar. The outer hinge bar thus serves as a control link and is operable to swing the adjacent outer door flange 40 outwardly and rearwardly closely adjacent to the body side wall during door opening movement. In moving to its closed position, the rear door edge 44 sealingly engages a deflective and/or compressive weatherstrip 64 of suitable resilient material. The weatherstrip is mounted in a recess 66 formed in the hinge mounting pillar adjacent the outer door opening.

A hinge concealing panel 68 is secured to the hinge member 30. As shown in FIGURE 1, this panel extends between a door mounted interior panel 70 and a similar pillar mounted panel 72 when the door is in its closed position. The hinge panel 68 of the closed door thus conceals the hinge member 74 formed between this panel, the pillar and the adjacent flanges of the door. During door opening movement, the hinge panel 68 similarly cooperates with the rearwardly translated outer door flange 40 and the adjacent side wall of the vehicle body to substantially conceal the hinge mechanism.

In the hinge disclosed in FIGURES 1-7, a toggle linkage device operably interconnects the inner hinge bar 30 and the outer hinge pivot 48. This toggle device includes the link 54 and cooperates with the adjacent hinge members to form a combined door locking, hold-open and door checking mechanism. The toggle link 54 has vertically spaced arms 76 which extend arcuately from its door pivot end. The ends of these arms distal from the pivot 48 pivotally support one end of a shorter and thinner arcuate toggle link 80 connected thereto by a pivot pin 78. The opposite end of the toggle link 80 is bifurcated to form spaced arms which pivotally mount the intermediate portion of a toggle stop and release lever 82. The link 80 and the lever 82 are coaxially journaled on a pivot pin 84. This pin is supported by vertically spaced arms of flanges 86 formed integrally of the inner door supporting hinge 30. The lever 82 has a lever arm 88 opposite engageable between a door locking stop flange or abutment shoulder 92 formed on the inner hinge bar 30 and the toggle link 80 adjacent the toggle interconnected pivot 78. Such lever arm engagement occurs when the door is moved to its closed position. A second arm 96 on this lever is connected through a suitable linkage 98 to an inside door latch operating handle 100. This handle operated linkage is operable through the lever arm 88 to swing the toggle linkage to a door releasing or unlatching position. The linkage 98 may also be operably connected to a push button actuator 102 associated with an outside door handle. The outside push button actuator 102 and the inside handle 100 may be operably interconnected to the linkage 98 for alternative door unlatching actuation through a conventional door latching mechanism, not shown, associated with the adjacent side of the door.

A spring 90 is tensively interposed between the lever arm 88 and the spaced arms 86 of the inner hinge bar. As viewed in FIGURES 1, 2 and 7, the spring 90 biases the lever 82 in a clockwise direction toward toggle limiting, door locking engagement with the stop flange or shoulder 92 on the inner hinge bar. A second tensively extended spring 94 is connected between an eyelet mounted on the toggle link 54 and an adjacent pillar 56 suitably secured to the other toggle link 80 at a point slightly spaced from the pivotal connection 78 between the toggle link members.

During door closing movement of the hinge mechanism, the toggle geometry and the biasing action of the spring 94 cooperate to rotate the toggle link 80 and the pivot 78 in a clockwise direction into limiting abutment with the stop flange 92. This flange together with the interposed lever arm 88 defines an overcenter position for the pivot 78 with respect to the pivots 48 and 84. Such overcenter abutment causes the toggle linkage to lock the quadrilateral hinge in its door closed position since the door sealing pressures of the weatherstrip 64, and any other forces acting on the door in an opening direction, tend to rotate the toggle pivot 78 about the control hinge rod pivot 60 in a clockwise, abutment restrained direction.

Thus spring 94 maintains links 54 and 80 in their overcenter position in engagement with lever arm 88 which abuts stop flange 92. In this position any opening motion by door 14 will only force links 54 and 80 more tightly against stop flange 92 (and lever arm 88) to prevent opening of door 14.

The abutment engaging, door locking position of the lever 82 is shown in full and broken hidden lines in FIGURES 1 and 6. Actuation of this lever to the position shown in broken phantom lines FIGURE 6 by operation of either the inside handle 100 or the outside push button 102 carries the toggle pivot 78 overcenter with respect to the toggle hinge pivot connections 48 and 84. Such toggle movement effects an initial door opening movement and permits further door opening movement between the several hinge and toggle members.

A hold-open detenting and door locking spring member 104 is suitably secured to and extends between the vertically spaced arms 52 of the control hinge member 56. This spring member is bent to form a horseshaped central portion having oppositely inclined spring ramps or arms 106 and 108 connected by lateral external tangential arms 110 and 112 to the spaced arms of the hinge member 56. As shown in FIGURE 7, the spaced arms 76 of the link member 54 are of I-section. As the door 14 approaches its hold-open position shown in FIGURE 2, the vertically spaced arms 76 of the link 54 slidably engage and inwardly deflect the opposing arms 106 and 108 of the hold-open spring member 104. Such spring deflection occurs until these opposing spring arm portions pass or snap over the adjacent flanged edges 114 and slidably engage the opposing central portions 116 of the I-sectioned toggle arms to form a detented hold-open position permitting a limited range of further door opening movement. Subsequent door checking occurs when further door opening causes the toggle link arms 76 to abut the laterally extending arms 110 and 112 of the spring member 104.

Only the toggle portion of the alternative hinge structure is shown in FIGURES 8-10. The rear door, the pillar, and the pillar attached hinge members are substantially
the same or identical and are identified, where shown, by the same reference numerals used in describing the previous embodiment. The modified hinge and toggle elements of this second embodiment are generally identified by adding 100 to the corresponding reference numerals of the first embodiment. Hence, a door mounted hinge bracket 138 is pivotally connected at 32 to the inner hinge member 30 and has a hold-open and door checking toe 137. This toe extends from the pivoted inner side of the angled flange 136 of the bracket toward the toggle linkage. The outer or opposite side of the bracket 138 is pivotally connected at 48 to the spaced arms 52 of the swinging hinge member 56 and to the interleaved clevis arms 150 of the control hinge member 154.

As in the previous embodiment, a toggle linkage device including link 154 operably interconnects the inner hinge member and the outer door hinge pivot 48 to provide door locking, hold-open and door checking functions. The vertically spaced arms 176 of the toggle link 154 extend arcuately from its door pivoted end but are bowed oppositely of link 54. An arcuate toggle link 180 is connected by a pivot pin 175 to the arms 176 distal from the pivot 48. The opposite end of the toggle link 180 has spaced arms pivotally connected by a pin 84 and intersected between a toggle stop and release lever 182 and the vertically spaced clevis arms 86 of the inner hinge member 30. The lever 182 of this embodiment is generally of triangular shape and has a first lever arm 188 engageable between the toggle locking shoulder 92 on the inner hinge member and one of the toggle links 154 or 189 adjacent the pivot 178. Such lever arm engagement occurs when the door is moved to its fully opened closed position.

A spring 190 is tensely interposed between the inner hinge arms 86 and a second arm 189 on the lever 182. During initial toggle releasing door opening movement, this spring rotates the lever 182 and the toggle links 154 and 189 counterclockwise, as viewed in FIGURES 8 and 9, until the lever arm 189 engages an arcuate cam surface 139 formed on the hinge bracket toe 137. The lever arm 189 is perforated at 191 to form a detent engaging boss or striker 193. This boss has a relatively flat shoulder engageable to retain a cooperating detent lever 195 pivotally mounted at 197 between lateral extensions 186 of the toggle supporting clevis arms 86 of the inner hinge member. A spring 199 is compressively interposed between the detent lever 195 and a flange 201 extending between the detent supporting clevis arms 186. The spring 199 normally biases the detent lever toward engagement with the retaining shoulder formed on the striker boss 193 of the lever 182. Such detent engaging normally maintains the lever arm 188 in abutment with the stop 92 on the inner hinge member. As before, such lever abutment permits the toggle pivot 178 to be retained in its overcenter toggle and door hinge locking position with respect to the toggle hinge pivotal connections 48 and 84.

The detent member 195 is operably connected through a suitable linkage 195 to either an inside or outside door actuator for swinging movement out of detenting engagement with the striker 193 on the lever 182. Such detent releasing movement causes the spring 190 to actuate the lever 182 in a counterclockwise direction carrying the toggle pivot 178 to an overcenter toggle and door hinge releasing position limited by initial engagement between the lever arm 189 and the hinge bracket toe 137. During subsequent door opening movement, the cam surface 139 on the hinge bracket toe and the lever arm 189 cooperate to swing the toggle stop and release lever 182 against the spring action of the spring 190 to an intermediate hold-open position wherein the spring biased detent lever 195 initially engages the outer surface of the striker boss 193 on the lever 182 and further into door checking abutment between the lever arm 188 and the stop flange on the inner hinge member 30. As shown in FIGURE 9, this door checking lever position permits spring biased return of the pivotal detent lever 195 into retaining engagement with the striker shoulder on the lever 182. Such cam effected detenting of the lever 182 permits the pivotally connected ends of the toggle links to carry the lever 182 in a clockwise direction into abutment with the shoulder 92 on the inner hinge member. This lever position permits the spring biased detent member to again engage the retaining shoulder of the striker boss. As previously indicated, such detent maintained lever abutment provides an overcenter toggle and hinge locking position for the toggle pivot 178 which cooperates with the door pillar hinge pivots and the sealing pressures acting between the closed door and the resilient weatherstripping to maintain the toggle linkage in a hinge and door locking position.

In this embodiment, two hold-open spring members 206 and 208 are bent to form opposing spring arms and suitably secured to the vertically spaced arms 52 of the control hinge member 56. As best shown in FIGURE 10, these spring members are deflectable outwardly and slidably engageable with the vertically spaced arms of the link member 154 adjacent the pivot 178 during door opening movement approaching through its intermediate hold-open position. As the door reaches its fully opened checkered position, the opposing spring arms 206 and 208 are deflected or permitted to return inwardly behind the spaced arms of the toggle link member 154 and resiliently cooperate to detent or hold the door in its fully opened checkered position.

From the foregoing description, it will be seen that the illustrative embodiments provide improved quadrilateral hinge mechanisms for mounting vehicle body doors for lateral outward swinging translatory movement and novel toggle linkage devices operably connected therebetween capable of providing the several stated objects and advantages of the invention, of locking the door in a closed position, and of establishing several hold-open and door checking positions. It will be further apparent to those skilled in the art that various modifications and changes might be made in and from the hinge and toggle geometry of the disclosed embodiments and in the pivotal interconnection and shape and form of the several hinge and toggle elements without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. In combination with a support member, a closure member and hinge means mounting the closure member on the support member for movement between open and closed positions, the hinge means including a connecting link pivotally interconnecting the closure member and the support member, control means for controlling the swinging movement of the closure member including, a toggle linkage having a pair of links pivotally interconnected at a first pivot point, means pivotally connecting one of the toggle links to the connecting link at a second pivot point, means pivotally connecting the other of the toggle links to one of the members at a third pivot point, locating means locating the toggle linkage in an overcenter position in which the first pivot point is moved past a line defined by the second and third pivot points in a closure-closed position to prevent opening movement of the closure member, and selectively operable means for moving the toggle linkage out of overcenter position to permit opening movement of the closure member.

2. The combination according to claim 1, wherein the locating means include biasing means interposed in the toggle links and being operable in closure-closed position to bias the linkage to overcenter position and means limiting the overcenter movement of the toggle linkage.

3. The combination according to claim 2, wherein the toggle linkage is movable between a folded position in
closure-closed position and an unfolded position in closure-open position and the biasing means are operable in linkage-unfolded position to maintain the linkage in unfolded position and oppose closing movement of the closure member.

4. The combination according to claim 2, wherein the selectively operable means include a member interposed between one of the toggle links and the limiting means and actuable to oppose the biasing means to move the toggle linkage out of overcenter position to permit opening of the closure member.

5. The combination recited in claim 1, including means for retaining the closure in open position.

6. In combination with a door hinged for swinging movement between opened and closed positions relative to a vehicle body, a toggle linkage device interconnecting the door and a toggle linkage device interconnecting the door and body and foldable by door closing movement to a closed door locking position and releasable therefrom to permit door opening movement to hold-open and door checking positions established by the device, said device comprising a swinging support member extending between and pivotally connected at opposite ends to the door and to the body for swinging movement with the door about substantially parallel axes, two pivotally interconnected toggle link members of different length pivotally interconnected at one end and connected at their opposite ends to said swinging support member and to said door for toggle swinging movement about pivotal axes spaced laterally of the door between a folded door closed position and an extended opened door position, abutment means engageable to define an overcenter position limiting movement of the folded door closed link members relative to the pivotal axes connecting the opposite ends of said link members to said swinging support member and door thereby locking said link and swinging support members in their closed door positions to prevent door opening movement, and toggle releasing means including a lever pivotally mounted on the door swinging member and engageable with at least one of said toggle link members to swing the toggle interconnection from its folded door locking overcenter position, first spring means for biasing and tending to maintain the toggle stop and releasing lever in overcenter door locking engagement with the abutment means, means operably connected to actuate said toggle stop and releasing lever to swing the toggle interconnection between its overcenter door locking position and its overcenter door opening position, second spring means for biasing and tending to maintain the folded toggle link members in door locking engagement with said lever and abutment means, said second spring means being operably connected to permit the biasing action thereof to pass over the toggle interconnection during door opening movement and to bias said toggle linkage means thereafter toward its extended door opened position, and third spring means engageable with one of the toggle link members during door opening movement to establish an intermediate door hold-open position and a fully opened door checking position.

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