

Jan. 26, 1960

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2,922,639

WINDOW ACTUATOR

Filed Dec. 29, 1958

2 Sheets-Sheet 1

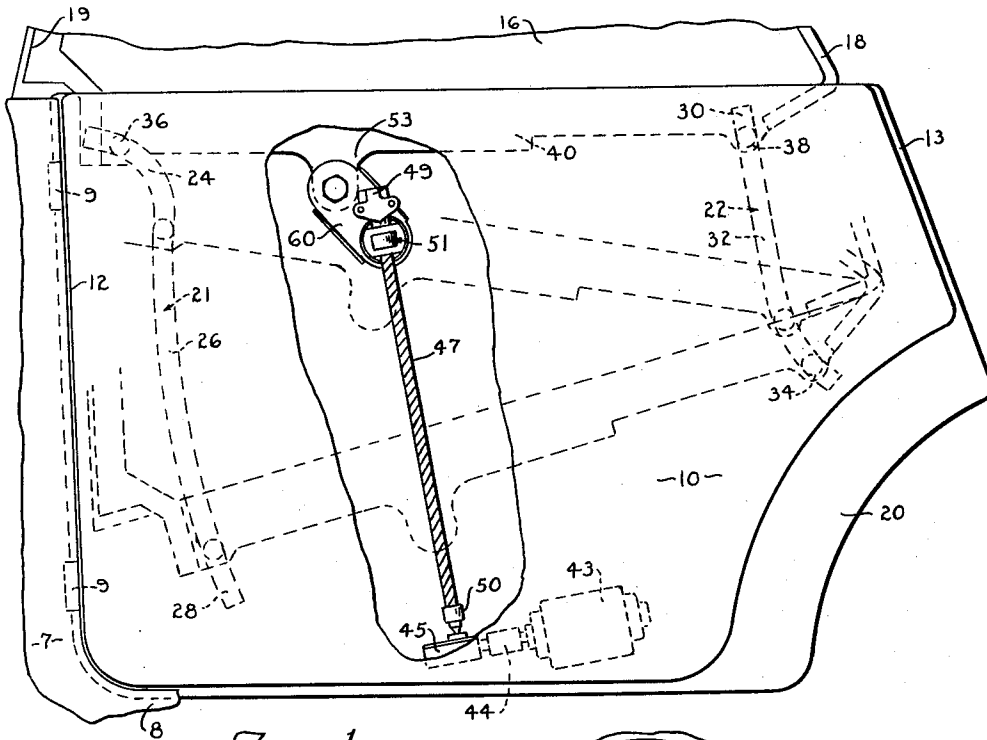


Fig. 1

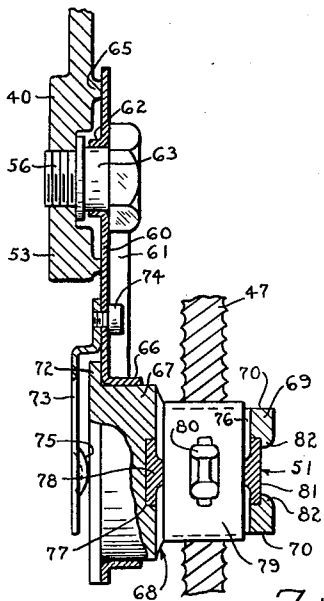


Fig. 2

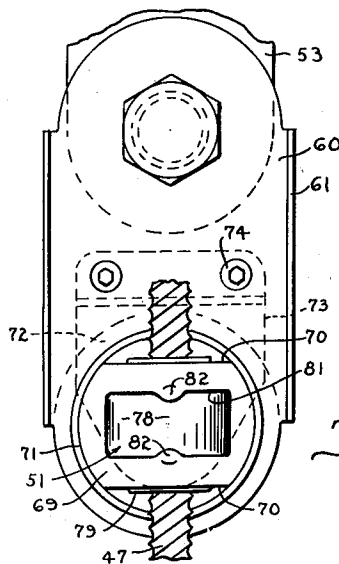


Fig. 3

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2 Sheets-Sheet 2

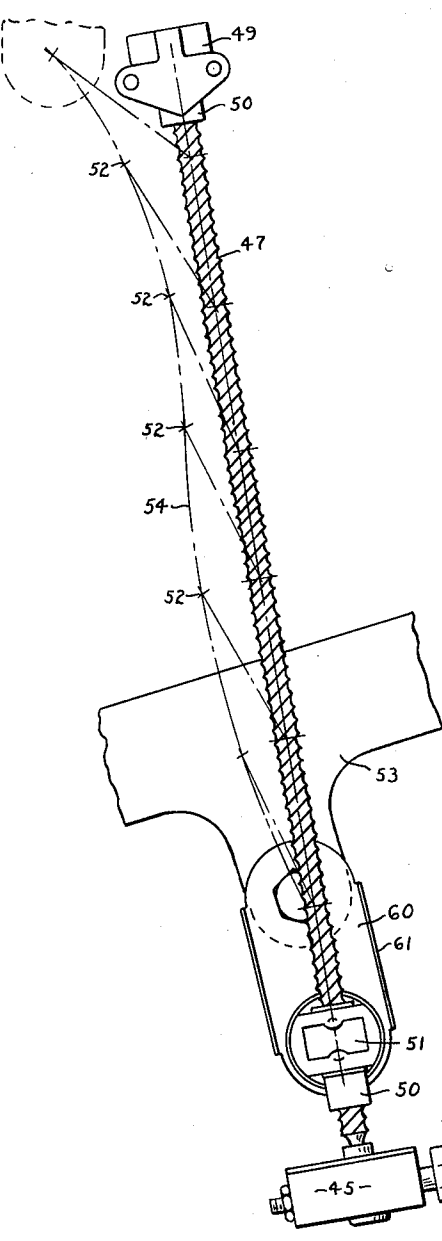


Fig.-5

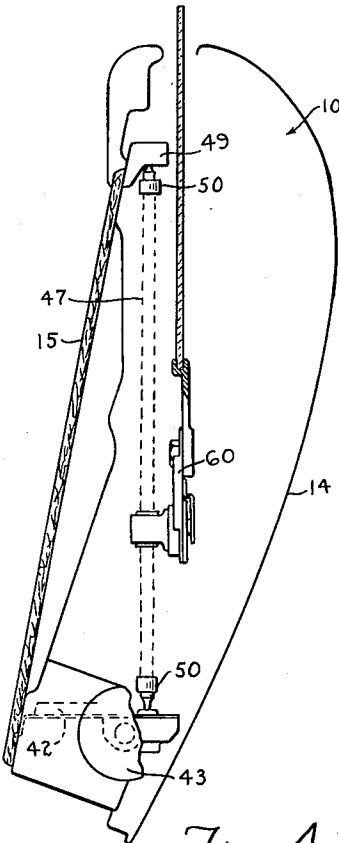


Fig.-4

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WINDOW ACTUATOR

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Application December 29, 1958, Serial No. 783,304

6 Claims. (Cl. 268—124)

This invention relates to window regulators for motor vehicles, and has particular reference to a window-regulator mechanism adapted to move a vehicle window in a predetermined nonlinear path.

Current automotive body design has imposed a rather complex system of motions in maneuvering certain window panels from lowered to raised position, or vice versa. The maneuvering includes, aside from moving the panel vertically, operations of tilting the panel endwise—first one end, then the other—as well as moving it forwardly and rearwardly. To accommodate the maneuvering just mentioned requires extensive transmission structure between the nut of the motor-driven lift screw and the window panel. A common type of such transmission structure includes a slidable crosshead.

The primary object of this invention is to provide a window actuator incorporating a simple and novel link transmission structure between the nut of the lift screw and the window panel for accommodating the aforementioned maneuvers.

A further object of this invention is to provide a window actuator having an improved bearing structure for one end of the link assembly that materially improves the operation of the device.

Another object of this invention is to provide a window-lift mechanism that is quiet and efficient in operation, and operative for years under all conditions of use without requiring service.

A still further object of this invention is to provide a window-actuator mechanism having improved means for attaching the link assembly to the motion-transmitting nut device.

And a still further object of this invention is to provide a window actuator that is relatively inexpensive to build and which can be easily and quickly assembled and installed.

These and other objects and advantages of the invention will become apparent as the description of the same proceeds. The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawing forming part of this specification, with the understanding, however, that the invention is not confined to any strict conformity with the showing of the drawing, but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Figure 1 is a side elevational view, partly broken away, of a portion of the side of a motor vehicle door assembly incorporating the power-driven regulator mechanism of the present invention;

Figure 2 is a lengthwise sectional view of the link and pivot arrangement of the present invention;

Figure 3 is an enlarged side elevational view of the link and pivot arrangement;

Figure 4 is an end view of the window-regulator

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mechanism of Figure 1 with the window in a partially raised position; and

Figure 5 is an enlarged elevational view of the operating parts of the improved lift assembly.

Referring now to the drawings, and particularly to Figure 1, a pillar 7 integral with the floor 8 of a vehicle is shown wherein hinges 9 support the door 10 having a hinge edge 12, latch edge 13, an outer side panel 14, and an inner side panel 15. The door illustrated is a rear door of a four-door hardtop automobile which is supported by hinges on a center pillar that terminates at the belt line of the vehicle so that there is no fixed supporting pillar of any kind disposed between the front and rear window portions above the belt line thereof. It is to be understood, however, that the window-lift mechanism here illustrated can also be mounted in the front door, rear door, rear-quarter panel, or the like of any type automobile.

A window panel 16 having a surrounding metal frame 18 is mounted for bodily movement between the raised or closed position shown in solid lines in Figure 1 and the lowered or opened position shown by the lowermost set of dotted lines in Figure 1. In the lowered position, the window is completely housed within the window well provided in the body portion of the vehicle.

In the present showing of this invention as incorporated in the rear-door assembly, the space available to house the window 16 in its lowered position is rather limited due to the location of the pillar 7 to which the door 10 is hinged. It will be noted that in the raised position the forward edge 19 of the window projects forwardly beyond the hinge portion 12 of said door. The door must also be formed to have a rear-wheel cutout portion 20 which is adapted to fit over the housing provided in the body for covering the rear wheel on that side of the vehicle. The distance, therefore, through which the rearward position of the window 16 may be moved along the latch edge of the door is shortened considerably. As a result of the design limitations inherent in these just-mentioned body components, the window 16 cannot be moved between its closed and opened positions either by direct vertical movement or by a simple pivotal movement, but instead must be moved in a predetermined irregular path having several combinations of both longitudinal and vertical movements so as to move the forward edge 19 of the window around the pillar 7 as well as to conform to the limitations imposed by the wheel cutout portion 20.

The window is mounted on suitable means to accomplish the necessary compound longitudinal and vertical movements, and for this purpose there are mounted within the door 10 on the frame of the inner side 15 a pair of guideways 21 and 22, each one of which is disposed, respectively, in close proximity to the generally vertically disposed door edges 12, 13. The forward guideway 21 is shaped so that the top portion 24 is turned at a slight angle with respect to the horizontal, whereupon the guideway is bent gradually until it is directed substantially vertically downward throughout an intermediate portion 26 with a lower portion 28 shaped in a gradual curve away from the hinge edge 12 of the door. The rearward guideway 22 is shaped such that the top portion 30 and central portion 32 are substantially in line with each other and are sloped rearwardly a few degrees. The lower portion 34 of guideway 22 is curved rearwardly from portion 32 in a gradual arc.

The guideways 21, 22 are supported on the frame of the inner panel of the door in such a position that a pair of rollers 36 and 38 carried on the frame 18 of the window at the front and rear lower corners, respectively, are engaged in said guideways for supporting and guiding the window during the opening and closing movements.

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The rollers 36 and 38 are rotatably carried by and extend laterally from a support member 40 of the window frame 18, the support 40 being of conventional design and engaged with the lower edge portion of the window 16 in such a way that any upward or downward forces exerted on said member 40 will be transmitted directly to the window to effect its raising or lowering. The guideways 21, 22 and their mounting with respect to the window are of a well-known design and are related to the present invention only insofar as they define the path of movement of the window and produce the desired compound motions required to complete the opening and closing thereof. Since the distance between the centers of the rollers 36 and 38 is fixed and the guideways are immovably fastened to the door panel, it is apparent that the window will follow a predetermined pattern of movement while being driven between the raised and lowered positions.

In following the present teaching, the window is raised and lowered by means of a power-operated motion-transmitting means, and for this purpose a motor support bracket 42 is secured to the frame of the inside panel 15 of the door. A motor 43 is mounted on said bracket and has a flexible coupling 44 interposed between the motor and the input side of a gear reduction drive 45, also carried by said bracket 42. The output side of the gear reduction drive is keyed to a motion-transmitting screw or shaft 47 which is rotatably mounted at its upper end portion in a stationary swivel-type bearing 49 carried by the frame of the door panel 15. The screw member 47 has a pair of freewheeling stops 50 fastened to said shaft near the opposite end portions for limiting movement of a nut member 51 along the axis of the shaft.

In the example here shown, due to the geometry of the system, there is a point 52 located on a projection 53 carried by the lower edge portion 40 of the window frame that describes, in space, a predetermined path of travel as the window 16 is guided between the raised and lowered position by the guides 21, 22. The path followed by this point 52 is best illustrated by the dotted line 54 in Figure 5 of the drawing and lies generally in the plane of the glass. A pivot pin 56 is fastened to said projection 53 and extends laterally therefrom in such a way that the point 52 is located on the longitudinal axis of said pin 56, which is transverse to the plane of the window.

The position of the pin 56 may be varied within reason, but as here shown is located in the position which follows the simplest path of travel between the raised and lowered positions of the window. The path of travel 54 is located completely to one side of the centerline of the shaft in the illustrated showing of Figure 5; however, it is to be understood that the path could cross the axis of the shaft once or several times without departing from the invention.

The shaft 47 has the nut means 51 drivingly connected therewith for movement up and down the shaft as the shaft 47 is rotated. The novel link transmission structure 60 of this invention, as shown in Figures 2 and 3, is pivotally connected at one end to pin 56 and at its opposite end to nut member 51. Link 60 preferably is fabricated from sheet metal with side edge flanges 61 to give it strength and rigidity. The upper end of the link is formed with a flanged opening 62 in which is journaled a neck portion 63 of the headed pin 56 threaded into the projection 53 of the window. Projection 53 is formed with a circular outstanding rib 65 concentrically disposed with respect to the pin 56 for engaging the face of link 60. Adjustment of pin 56 relative to the projection 53 of the window will vary the frictional resistance to pivotal movement of the upper end of link 60. The lower end of link 60 is formed with a much larger flanged opening 66 for pivotally receiving an enlarged cylindrical body portion or bearing pin 67 formed on one end of a motion-transmitting bracket 68.

The bracket 68 includes the cylindrical body portion

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67 pivotally fitted in opening 66 and a projecting head portion or nut holder 69 of a size to be readily passed through opening 66. Nut holder 69 is formed with substantially flat upper and lower walls 70 with side walls 71 rounded for ready passage through opening 66, as above alluded to. The inner end of the cylindrical portion 67 is formed with a flange 72 abutting the face of link 60. A spring arm 73 is secured at one end to link 60 by self-tapping screws 74 or the like. Arm 73 projects over the end of cylindrical body portion 67 and is formed with a protuberance 75 for seating in an indentation in the end of the body portion for urging and retaining flange 72 against link 60.

Head portion 69 is formed with an opening 76 extending through the flat walls 70 along an axis substantially perpendicular to the axis of the bearing pin or body portion 67. Medially of said opening 76 is formed a groove 77 in which a ring member or casing 78 of the nut assembly 51 is held. The nut assembly includes the casing 78 and a cage 79 having apertures therein for bearing elements 80. The ends of cage 79 extend beyond walls 70 for contacting the stops 50 at either end of shaft 47. It should be understood that when the cage encounters either stop, the nut assembly will simply "freewheel" without imparting material driving force to the window panel.

Body 67 may be of either metal or plastic and casing 78 may be incorporated therein during casting or moulding thereof. I prefer, however, to form the arcuate end of head portion 69 with a slot 81 corresponding to the outside diameter and thickness of casing 78 for passage of the casing therethrough. After insertion of the casing, portions of the material defining said slot may be deformed, as at 82, to retain the casing in place. It will be understood that the cage 79 and bearing elements 80 are introduced subsequently from either end of opening 76. Since the opposite end portions of the link 60 are free to pivot about the axes of both pin 56 and the body portion 67 during the window panel raising and lowering cycles, pin 56 may shift toward or away from shaft 47 according to the pattern of the dotted line 54, Figure 5.

As the nut member 51 is moved up the shaft, a linear force is exerted on the body portion 67 in a direction substantially parallel to the axis of the shaft 47. This force is transmitted through the link 60 to the pivot 56 joining the link to the projection 53 on the window frame. Since the linear unidirectional force on the body portion 67 is transmitted to the pivot 56 at a point off the axis of the force, the force at pivot 56 is broken down into substantially two components. One component of force is tending to move the window up the channels 21, 22, the other component of force is tending to move the window toward the hinge end of the door. Thus, as the nut member 51 is moved up the screw, the window is moved in an upward and generally forward direction. Conversely, as the nut member 51 is moved down the shaft 47, the window is moved in a downward and generally rearward direction by the forces acting through the link 60.

The horizontal axis of the body portion 67 moves in a substantially straight line in a plane containing the axis of the shaft 47. The axis 52 of the pin 56 traverses a path, shown as the dashed line 54, which describes a relatively flat sine-type curve lying to the one side of the plane containing the axis of the shaft 47 and the axis of the body portion 67. The angle lying between the axis of the shaft and the line joining the axis of the body portion and axis 52 of pivot 56 must of necessity vary between zero degrees and an acute angle of preferably less than 45 degrees in order for the forces to be transmitted from the nut 51 to the window frame assembly. Due to the fact that the just-enumerated angle is generally acute and due to the position of the link 60 in the fully raised position of the window, the forward component of force on the window is greater than usual

tending to drive the window forward with an extra push for seating the window in the closed position. The extra closing push results from the toggle arrangement created by the angle between the axis of the shaft 47 and the line joining the pivot 56 and body portion 67 approaching the 45° value, such that practically all the force from the nut is thrown over into a short generally forward direction for driving the window into closed position.

Due to the large bearing surface on the body portion 67 which is held in operative contact with the flange 66 on the link 60 by the point contact 75 on the spring arm 73, a highly efficient substantially trouble-free connection is created between the nut 51 and the window 16. The bracket 68 is moved along the longitudinal axis of the screw 47 with the axis of the body portion 67 lying perpendicular to the axis of the screw 47. As the nut 51 moves up and down the shaft 47, the body portion 67 exerts forces on the link 60 through the surface of said body portion 67 and through the flange 66 of the link 60. Since the window 16 is trapped into following a particular nonlinear path, the substantially vertical forces from the nut 51 will be transmitted through the body portion 67 to the link in a plurality of directions, whereupon the guides 21, 22 will constrain the window to move in a particular predetermined path in a trouble-free manner. The point support 75 and the large bearing surface on the body portion 67 substantially eliminate wedging and jamming between the nut 51 and the link 60.

Having thus described my invention, it is obvious that various modifications may be made in the same without departing from the spirit of the invention; and, therefore, I do not wish to be understood as limiting myself to the exact form, construction, arrangement, and combination of parts herein shown and described.

I claim:

1. In a window regulator for a vehicle window panel movable between raised and lowered positions, coating means on the panel and vehicle for maneuvering said panel in a predetermined guided path including horizontal, vertical and endwise tilting motions of the panel, a threaded shaft arranged along a substantially fixed axis, a nut assembly on said shaft, transmission means be-

tween said panel and nut assembly including a link pivotally connected at one end to said panel and at its other end pivotally connected to said nut assembly, said last-mentioned connection including a cylindrical body pivotally arranged in an opening in said end of the link, and a head portion projecting axially from said body and being of a size adapted to pass through said opening, said head portion being formed with a vertical opening there-through, said nut assembly being fixed medially of said last-named opening.

2. The structure as defined in claim 1 wherein the end of said cylindrical body opposite said head portion is formed with a peripheral flange engaging said link, and a spring-presser member having one end fixed to said link and its opposite end engaging the center of the flanged end of said body for urging the flange into contact with the link.

3. The structure as defined in claim 2 wherein the free end of said presser member is formed with a protuberance, and the center of the end of said cylindrical body is formed with a recess receiving said protuberance.

4. The structure as defined in claim 1 wherein the medial portion of said vertical opening in said head portion is formed with a groove, and the casing of said nut assembly is fixed in said groove.

5. The structure as defined in claim 4 wherein the outer end of the head member is formed with a slot registering with said groove and of a size to admit insertion of said casing therethrough, a portion of the edges defining said slot being deformed against said casing for retaining it in place.

6. The structure as defined in claim 1 wherein the panel end of the link is formed with a flanged pivot opening, a headed pin passing through said pivot opening and threaded into said panel, the wall of the panel about said pin being formed with a raised circular rib engaging the corresponding end portion of the link.

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