Nov. 3, 1953 L. S. GREENMUN 2,657,924

SOLENOID-OPERATED WINDOW REGULATOR

Filed Jan. 26, 1950 4 Sheets-Sheet 1

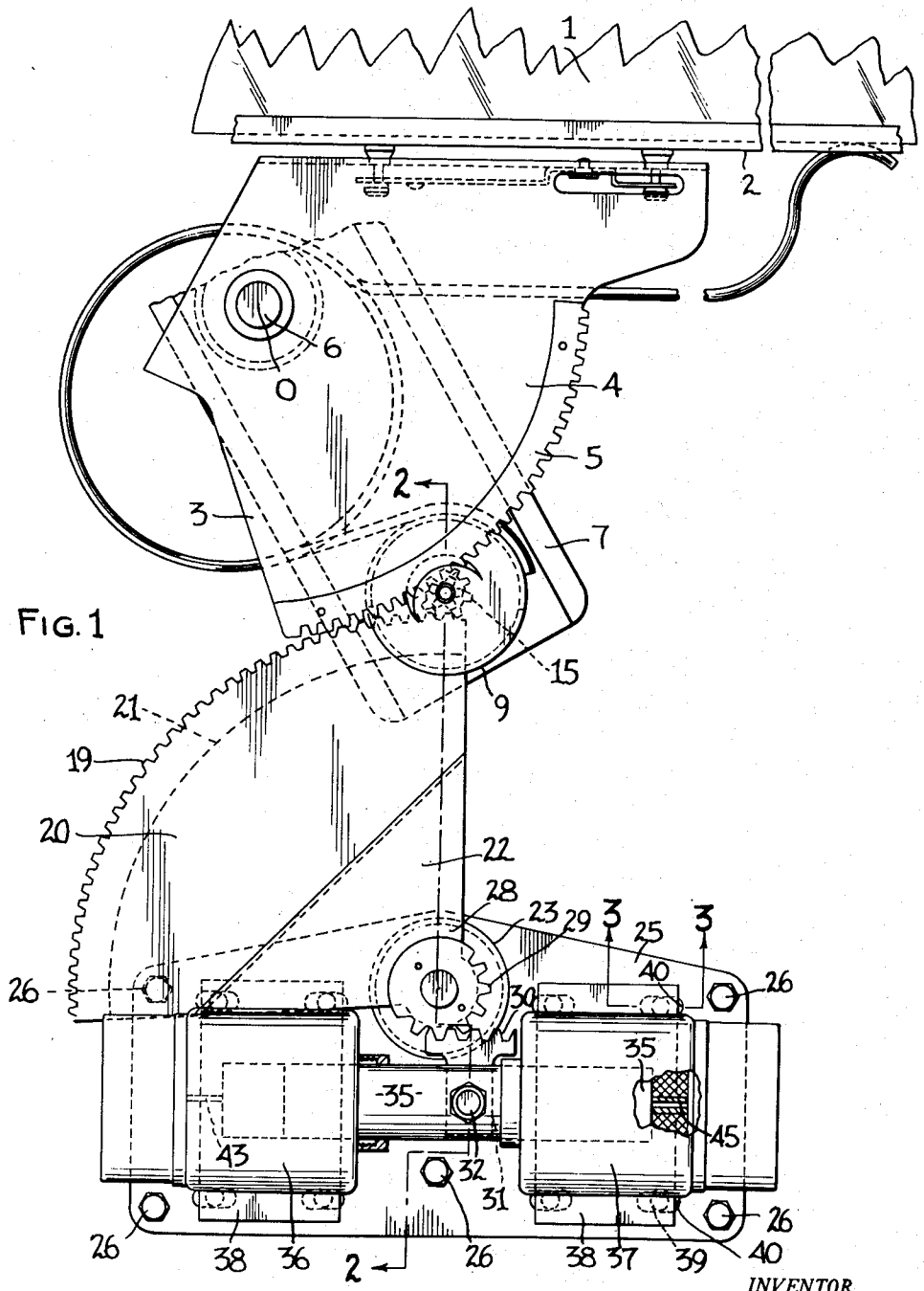

FIG. 1

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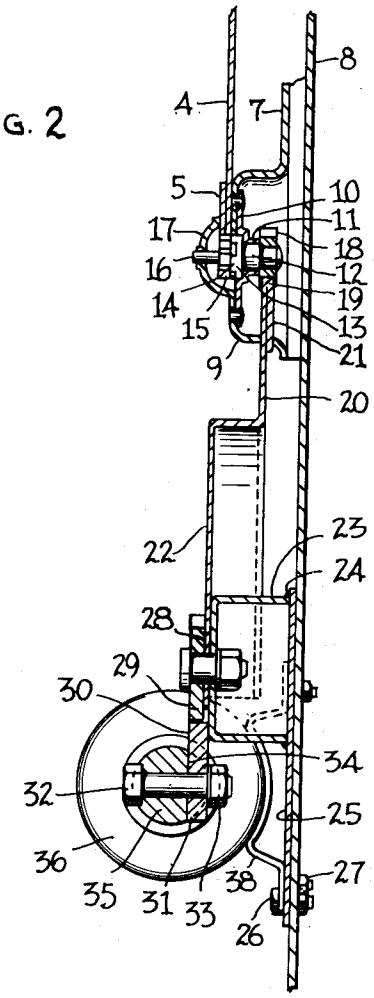
FIG. 2



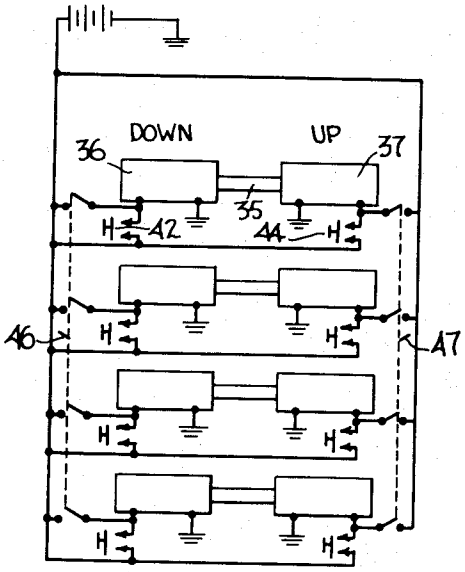


FIG. 4

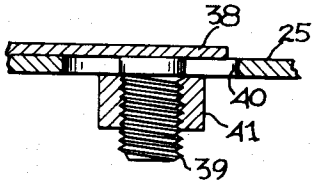
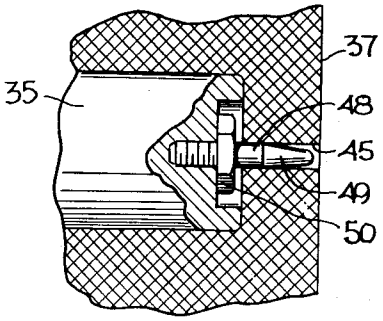


FIG. 3

FIG. 5



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SOLENOID-OPERATED WINDOW REGULATOR

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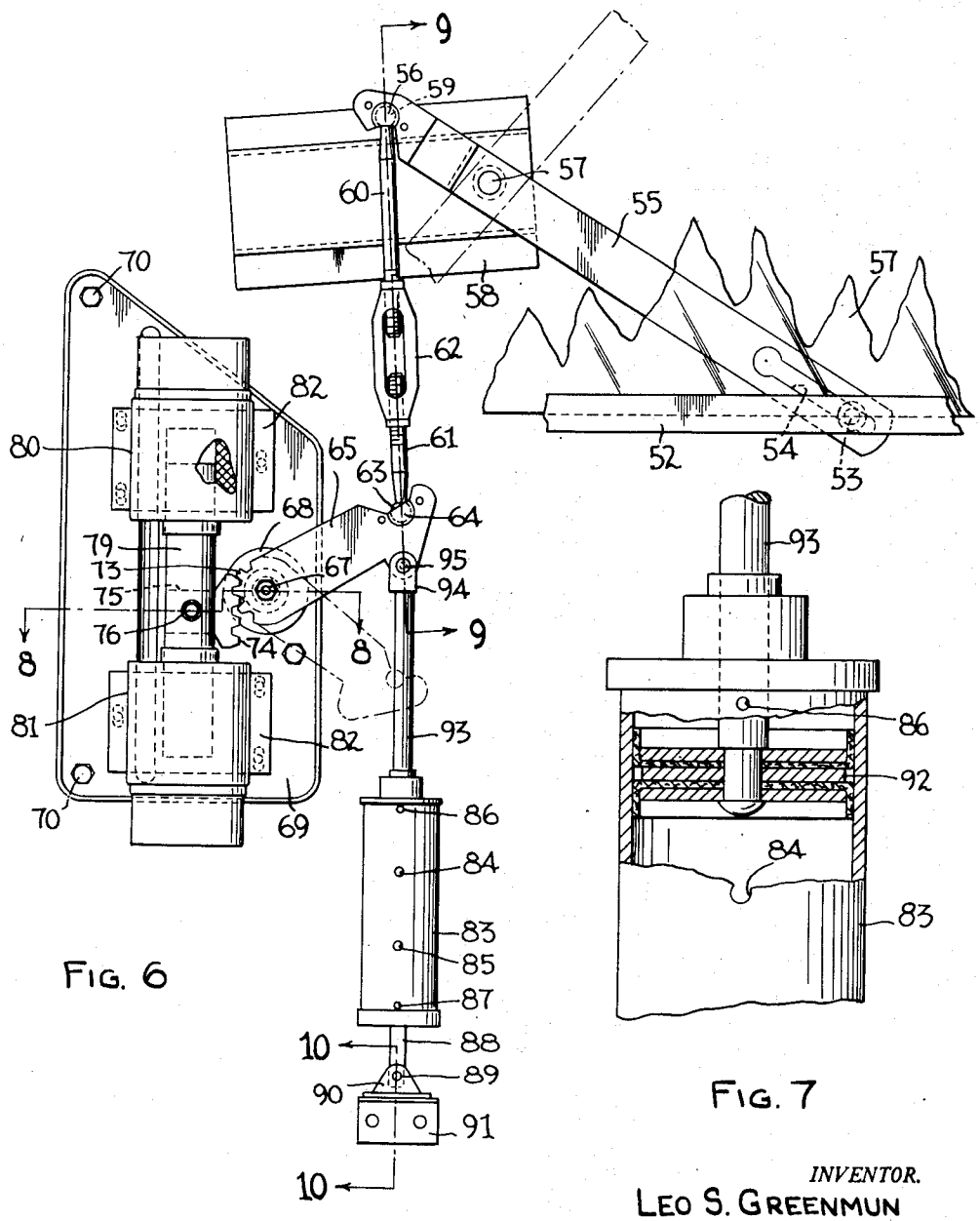

FIG. 6

FIG. 7

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SOLENOID-OPERATED WINDOW REGULATOR

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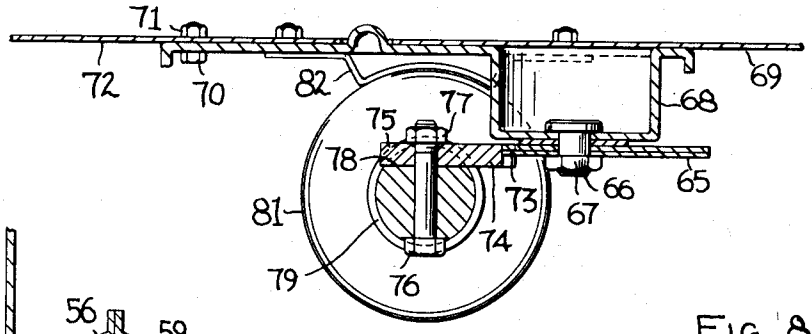

FIG. 8

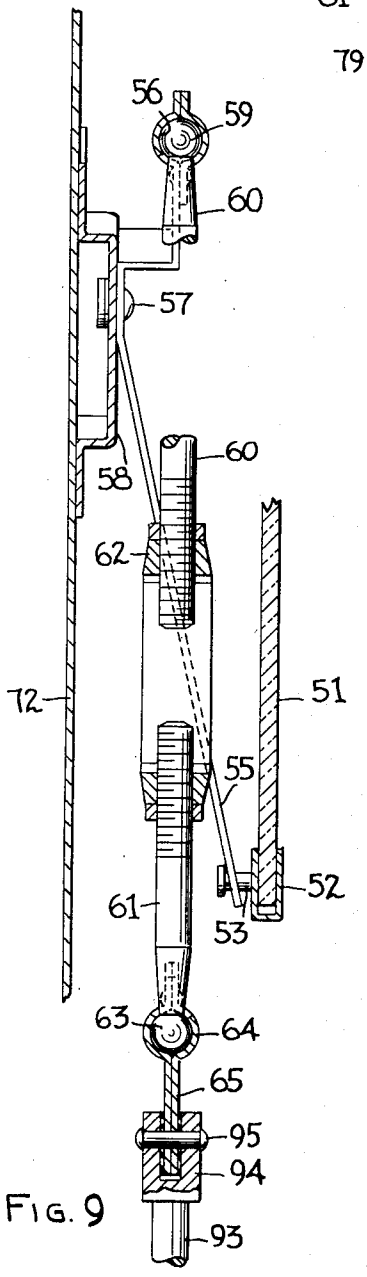

FIG. 9

FIG. 10

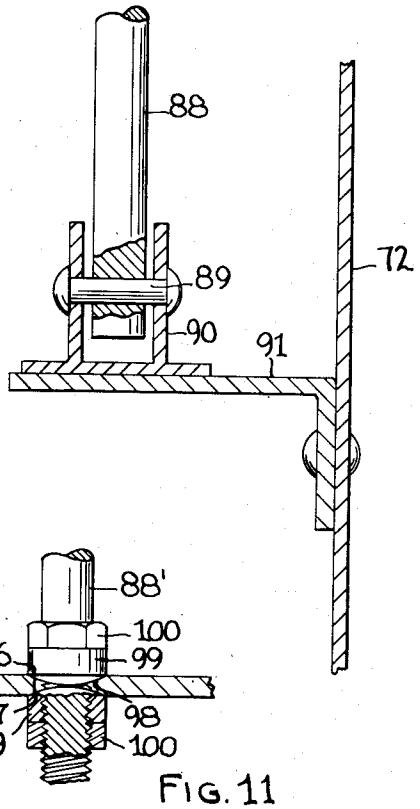

FIG. 11

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2,657,924

UNITED STATES PATENT OFFICE

2,657,924

SOLENOID-OPERATED WINDOW REGULATOR

Leo S. Greenmun, Avoca, N. Y.

Application January 26, 1950, Serial No. 140,672

3 Claims. (Cl. 268—104)

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This invention relates, as indicated, to window regulators, but has reference more particularly to a solenoid-operated window regulator.

A primary object of the invention is to provide a window regulator of the character described, which is relatively low in cost as well as in cost of installation, which can be installed on cars in a fraction of the time required for installation of hydraulically actuated regulators, which can be installed one unit at a time, without requiring installation of other units, and which has marked advantages from the viewpoint of safety.

Another object of the invention is to provide a regulator of the character described, which is adapted for installation as an accessory on existing or standard types of automobiles, utilizing conventional regulators for raising and lowering windows by vertical rectilinear movement.

A further object of the invention is to provide a regulator of the character described, having means for effectively cushioning the opening and closing movement of the windows.

A still further object of the invention is to provide a regulator of the character described, which is compact in construction and design, easy to install, and consists of a minimum number of parts which are inexpensive to manufacture.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings, forming a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a fragmentary elevational view, showing one form of solenoid-actuated window regulator, constructed in accordance with the invention;

Fig. 2 is a fragmentary cross-sectional view, taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary cross-sectional view, taken on the line 3—3 of Fig. 1;

Fig. 4 is a wiring diagram, showing, in a diagrammatic manner, the operation and electrical connections of a system embodying the window regulators;

Fig. 5 is a fragmentary detail view, showing a modification of the solenoid plunger cushioning means;

Fig. 6 is a view similar to Fig. 1, but showing a modified form of the invention;

Fig. 7 is a fragmentary view, partly in elevation and partly in section, on an enlarged scale, showing the cylinder for cushioning movements of the window;

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Fig. 8 is a fragmentary cross-sectional view, taken on the line 8—8 of Fig. 6;

Fig. 9 is a fragmentary cross-sectional view, taken on the line 9—9 of Fig. 6;

Fig. 10 is a fragmentary cross-sectional view, taken on the line 10—10 of Fig. 6; and

Fig. 11 is a fragmentary view, showing a modified form of pivotal mounting for the cushioning cylinder.

Referring more particularly to Figs. 1 to 4 inclusive of the drawings, there is illustrated, as viewed from the exterior of the automobile, the left front window 1, this window conforming generally with the shape of the window opening in the door. The window is pivotally movable about the axis O for opening and closing the same.

Such windows, including means for mounting and imparting pivotal movement thereto, are disclosed, by way of example, in my copending applications, Serial Nos. 622,032, now Patent No. 2,559,120, issued on July 3, 1951, and 791,319, particularly the latter.

In the present case, the window 1 has its lower or bottom edge enclosed in a channel mounting 2, and the channel mounting is removably secured to and supported by a plate 3, a portion 4 of which is in the form of a sector of a gear, which is reinforced by means of an arcuate member 5 having gear teeth aligned with the teeth of sector 4. The detailed manner in which the channel 2 is supported by the plate 3 is fully described in the aforesaid application, Serial No. 791,319, so that further description thereof is deemed unnecessary.

The plate 3 is mounted for rotation about a pivot screw 6, which is mounted in a generally rectangular mounting plate 7. The plate 7 is rigidly secured to the door frame structure, indicated at 8, by means of screws and lock washers (not shown).

The plate 3 is provided with a circular embossment 9, which serves as a support for a gear drive or mechanism for rotating the plate 3, for the purpose of raising or lowering the window 1. For this purpose, the embossment 9 has secured thereto a disc 10 having a central hub portion 11 in which a drive shaft 12 is journalled. The shaft 12 has an enlarged head 13 at its outer end provided with gear teeth 14 which extend axially of the shaft and into the spaces between the teeth of a pinion 15. The pinion 15 is in mesh with the teeth of the gear segment 4 and its reinforcement 5, and is mounted for rotation about a pin 16, one end of which is mounted in an opening in a portion of the embossment 9 which is struck or pressed outwardly to form a tongue

17. The other end of the pin 16 is mounted in an axial recess (not shown) in one end of the shaft 12. The shaft 12 has riveted to its inner end a pinion 18.

The pinion 18 is in mesh with the teeth 19 of a gear sector 20, which, like the gear sector 4, is reinforced by means of an arcuate member 21 having gear teeth aligned with the teeth of sector 20. The gear sector 20 is provided with an integral triangular portion 22, which lies in a plane parallel to the sector 20, but offset outwardly therefrom to form an enclosure for a hollow spacer element 23, which is welded, as at 24, to a base plate 25. The base plate 25 is secured, as by bolts 26 and nuts 27, to the frame 8 of the door.

Rigidly secured to the apex portion 28 of the portion 22 of the sector 20 is a sector pinion 29, the teeth of which are in mesh with a short rack element 30 having a vertical stem 31. The stem 31 of the rack 30 is removably secured, as by means of a bolt 32 and nut 33, to a flat surface 34 at the inner side of a piston or solenoid plunger 35. The plunger 35 has its ends disposed in encased solenoid coils 36 and 37.

The solenoid coils 36 and 37 are rigidly secured to brackets 38, the legs of which are provided with screw studs 39, which extend through slots 40 (Fig. 3) in the base plate 25. This permits the brackets 38 to be adjusted longitudinally of the base plate to some extent, thereby permitting the position of the solenoid coils to be adjusted to some degree to insure complete opening and closing of the window. After such adjustment has been effected, the brackets 38 are locked in adjusted position by forcing the nuts 41 on the studs 39 against the base plate 25.

The solenoids are adapted to be energized by current derived from the battery of the automobile, and in this connection, the wiring diagram shown in Fig. 4 may be utilized. This diagram shows an arrangement for energizing the solenoids of all four doors of an automobile separately or independently of each other, or simultaneously.

When the solenoid 36 is to be energized, for the purpose of lowering the window 1, without lowering any of the other windows of the car, the driver presses a push-button 42, which may be on the door, for as long as he desires movement of the window, the window stopping immediately on release of the button, which is a spring-pressed button. This closes a circuit to the solenoid 36, thereby energizing this solenoid, and causing the plunger 35 to be moved to the left, as viewed in Fig. 1. This causes clockwise rotation of the gear sector 20 and clockwise rotation of the gear sector 4, thereby causing the window 1 to be lowered, that is to say, rotated in a clockwise direction about the axis O.

For the purpose of slowing the speed of the plunger 35, in a progressive manner, as the latter approaches the end of its stroke, a small air egress opening or passageway 43 is provided in the end of the solenoid 36. This cushions the action or movement of the plunger, thereby controlling the movement of the plunger in a highly desirable manner. In other words, during the greater part of the stroke, the plunger moves at normal speed, but as the end of the stroke is approached, the speed of travel of the plunger is slowed, due to compression of the air in the solenoid ahead of the plunger, and slow leakage thereof through the passageway 43. This insures movement of the window in a gentle manner.

When it is desired to close the window or move it upwardly to any desired position, the driver energizes the solenoid 37 by pressing a push button 44, also located on the door, for as long as he desires movement of the window, the window stopping immediately upon release of the button, which, is similar to the button 42. This closes a circuit to the solenoid 37, thereby energizing this solenoid, and causing the plunger 35 to be moved to the right, as viewed in Fig. 1. This causes counter-clockwise rotation of the gear sector 20 and counter-clockwise rotation of the gear sector 4, thereby causing the window 1 to be raised, that is to say, rotated in a counter-clockwise direction about the axis O. This movement of the plunger 35 is slowed in the same manner as already described, due to the provision of an air egress opening or passageway 45 in the end of the solenoid 37.

By utilizing a pair of solenoids in tandem, and using a single solenoid plunger approximately twice as long as a conventional plunger (used with a single solenoid coil), the pulling power of each solenoid is virtually doubled. This is due to the fact that the cubical volume of the solenoid plunger is doubled over that of a conventional plunger, so that the magnetic permeability of the plunger as a whole is doubled. This was demonstrated in a test in which it was found that a solenoid plunger of conventional or standard length held 104 pounds, whereas, when two such plungers were bolted together in tandem, the solenoid coil held against a pull of more than 208 pounds. It follows from this that smaller solenoid units can be used where a pull of only 104 pounds is required. This feature enables the solenoid units to be reduced to a size which will conveniently fit within a conventional automobile door.

For separate or independent operation of the solenoids, a separate button or switch for each solenoid is provided on each of the car doors, as described.

When it is desired to operate all of the windows simultaneously, in a downward direction, a master switch 46 (Fig. 4), may be provided, which switch is preferably mounted on the dashboard, so that the car operator has access to it from his position behind the wheel. Similarly, a master switch 47 (Fig. 4), may be mounted on the dashboard, for simultaneously raising all four windows. The unnumbered solenoids and plungers in Fig. 4 are those on the other doors of the car.

In Fig. 5, a modification of the solenoid plunger cushioning means is shown, in which a pin 48 is threadedly secured in the end of the plunger 35, and is provided with a tapered end portion 49, so that the area of the space between this portion 49 and the wall of the bore 45 is progressively diminished as the portion 49 enters this bore. This produces a particularly effective diminution in speed of the plunger at the end of its stroke. Variations in the cushioning effect or speed may be effected by adjusting the positions of the pin 48 relatively to the plunger, a locknut 50 being provided for locking the pin in adjusted position.

A solenoid window operating unit or system, as described, is extremely low in cost as well as cost of installation. It can be installed on all four windows of a car in about four hours, as compared with 16 to 20 hours spent in installing a hydraulic window operating system. Moreover, it can be installed one unit at a time, thereby bringing it within an ordinary buyer's means, as

compared with a hydraulic system, which requires installation for all of the windows at the same time. It obviates the need for piping, motor driven pumps and solenoids for controlling the direction of oil flow required for hydraulic systems. In the case of a wreck, if an oil pipe anywhere in a hydraulic system is ruptured, none of the windows can be opened, and the driver might be incinerated. In a solenoid system, as described, in a crash, only the window which is damaged is thrown out of operation, the others being operable. The present system is accordingly deemed safer than a hydraulic system.

Referring more particularly to Figs. 6 to 10 inclusive of the drawings, a modification of the invention is shown, which is adapted for installation, as an accessory on existing or standard types of automobiles, utilizing conventional regulators for raising and lowering windows by vertical rectilinear movement.

For this purpose, the window 51 is mounted in a channel 52, from which a pin 53 extends laterally through a slot 54 in one end of a conventional regulator bar 55. The other end of this bar is formed to provide a spherical socket 56. The bar 55 is mounted for pivotal movement about a shaft or pin 57 which extends from a conventional bracket plate 58 rigidly secured to the door frame of the car.

The spherical socket 56 encloses a ball 59 at the upper end of a lever consisting of threaded rods 60 and 61 which are connected by a turnbuckle 62. The lower end of the rod 61 is provided with a ball 63, enclosed within a spherical socket 64 forming part of a lever 65. The lever 65 is mounted for pivotal movement about a pin 66, which is secured, as by a nut 67, to a hollow spacer element 68, which is mounted on a base plate 69. The base plate 69 is secured, as by bolts 70 and nuts 71, to the frame 72 of the door.

The lever 65 is also provided with gear teeth 73, which are in mesh with a short rack element 74, having a laterally extending stem 75. The stem 75 of the rack 74 is removably secured, as by means of a bolt 76 and nut 77, to a flat surface 78 (Fig. 8) at one side of a solenoid plunger or piston 79. The plunger 79 has its upper and lower ends disposed in encased solenoid coils 80 and 81, which are similar in all respects to the coils 36 and 37.

The solenoid coils 80 and 81 are rigidly secured to brackets 82, the legs of which are secured to the base plate 69 in the same manner that the brackets 38 are secured to the base plate 25, so as to permit vertical adjustment of the solenoid coils relatively to the base plate.

The solenoids are adapted to be energized in the same way as the coils in the previously described form of the invention.

When the solenoid 80 is energized, the plunger 79 is pulled upwardly causing clockwise rotation of the lever 65, from the solid line position shown in Fig. 6 to the broken line position, a downward pull on the lever 60—61, and counter-clockwise rotation of the bar 55, as seen in Fig. 6, thereby raising or closing the window 51. The extent of closing movement is determined by the length of time the closing button or switch is depressed. During the aforesaid movement, the pin 53 slides in the slot 54.

When the solenoid 81 is energized, the plunger 79 is pulled downwardly, causing counter-clockwise rotation of the lever 65, from the broken line position shown in Fig. 6 to the solid line position, an upward pull on the lever 60—61, and clockwise rotation of the bar 55, as seen in Fig. 6, thereby lowering or opening the window 51. The extent of this movement is, of course, determined by the length of time the opening button or switch is depressed.

Instead of relying on openings in the solenoid coils for controlling the speed of opening or closing the window, a modified form of means is used, for this purpose, as shown in Figs. 6, 7, 9 and 10.

Such means, comprises a cylinder 83 provided with vertically spaced openings 84 and 85 intermediate the ends of the cylinder, and vertically spaced openings 86 and 87 adjacent the ends of the cylinder, these openings being somewhat smaller in diameter than the openings 84 and 85. The cylinder 83 is provided at its lower end with a foot or stem 88, which is pivotally connected to a pin 89 mounted in a bracket 90. The bracket 90 is supported by a shelf bracket 91, which is riveted to the frame 72 of the door.

Disposed within the cylinder 83 is a piston 92, which is mounted on the lower end of a piston rod 93 which is mounted for reciprocal sliding movement in the upper end of the cylinder. The rod is provided at its upper end with a clevis 94, which is pivotally connected, as by a pin 95, to the lever 65.

As the lever 65 is swung downwardly, the rod 93 is moved downwardly, causing the piston 92 to compress the air in the cylinder. In the initial stages of this compression, air is bled out of both openings 85 and 87, thereby permitting the piston to move at normal speed. After the piston passes the opening 85, however, the air is bled out of only the small opening 87, and is compressed to such an extent as to effectively cushion the final closing movement of the window. The same action occurs on the upstroke of the piston rod 93, due to the provision of the holes 84 and 86.

During the movement of the lever 65 between the positions shown in Fig. 6, the cylinder 83 is canted to a slight degree, and this is permitted by virtue of the pivotal connection of the cylinder to the bracket 90.

In Fig. 11, a modified form of pivotal mounting for the cylinder 83 is shown. In this modification, the bracket 91′ is provided with spherical seats 96 and 97 surrounding a relatively large circular opening 98 in the bracket. The stem 88′ is provided with a threaded portion which extends through the opening 98 and is provided with spaced nuts 99 having spherical or convex surfaces engaging the seats 96 and 97. After these nuts have been properly seated, they may be locked in adjusted position by means of lock nuts 100. This mounting permits pivotal movement of the cylinder 83 relatively to the bracket 91′.

By the use of the adjustment for the solenoid coil mounting, or the turnbuckle 62, or both means of adjustment, the length of stroke may be adjusted to insure full opening and closing of the window.

It is thus seen that I have provided a novel solenoid operated window regulator, which is adapted for use on conventional types of cars, which is inexpensive to buy and install, and which has marked advantages in cost, installation and safety, over hydraulically-operated regulators.

It is to be understood that the form of my invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the shape, size and ar-

rangement of parts may be resorted to, without departing from the spirit of my invention, or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. In combination, a window mounted for opening and closing movement in a vertical plane, a rotatable toothed supporting member secured to said window in underlying relationship thereto, a pinion operatively engaging said toothed member, a pivotally mounted gear sector operatively engaging said pinion, a sector pinion secured to said gear sector for coaxial rotation therewith, a pair of solenoid coils mounted in tandem adjacent said sector pinion, a common core operatively associated with both said coils for reciprocable movement, said core having a toothed portion engaging said sector pinion, and means for selectively energizing one or the other of said coils to effect movement of said core, whereby to cause selective rotation of said supporting member.

2. A combination, as defined in claim 1, including adjusting means associated with said solenoid coils to vary the axial spacing between said coils, whereby to define the upper and lower limits of movement of said member.

3. A combination, as defined in claim 2, wherein said adjusting means comprises a longitudinally slotted mounting plate, and threaded elements integrated with said coils and projecting through the slots in said plate, whereby said coils may be shifted longitudinally relatively to said sector pinion and said core.

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