Aug. 18, 1959 B. F. MEYER 2,899,832

WINDOW REGULATOR DRIVE MECHANISM

Filed Dec. 17, 1956 2 Sheets-Sheet 1

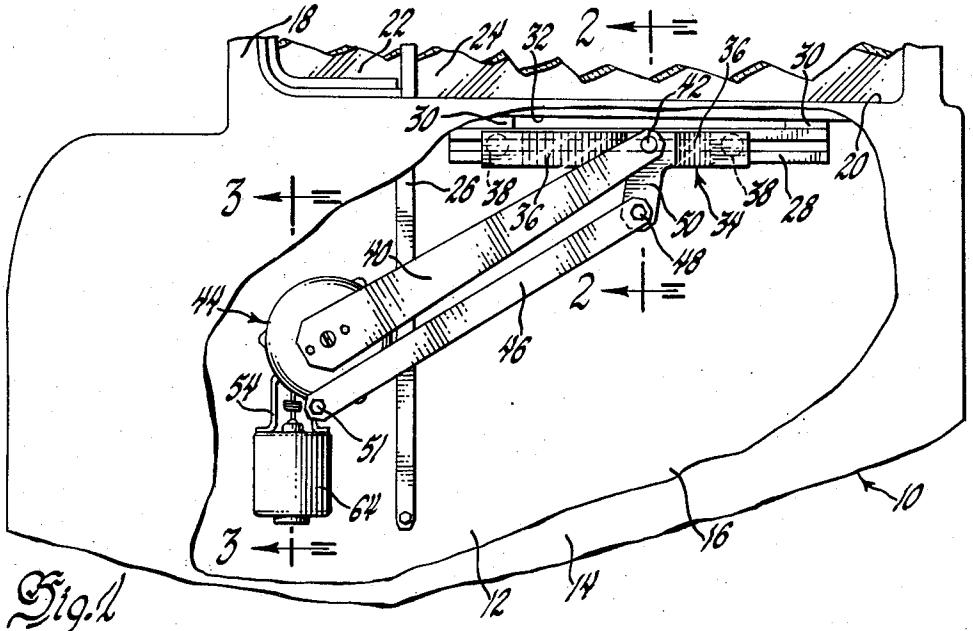

Fig. 1

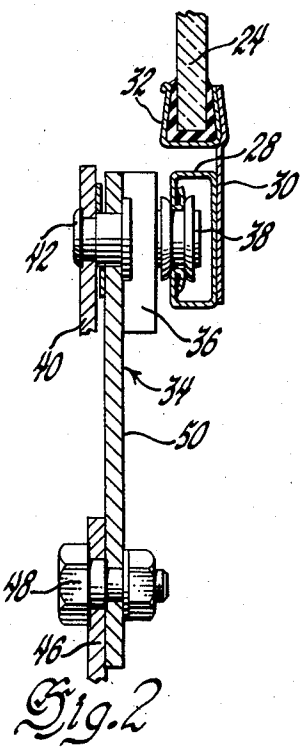

Fig. 2

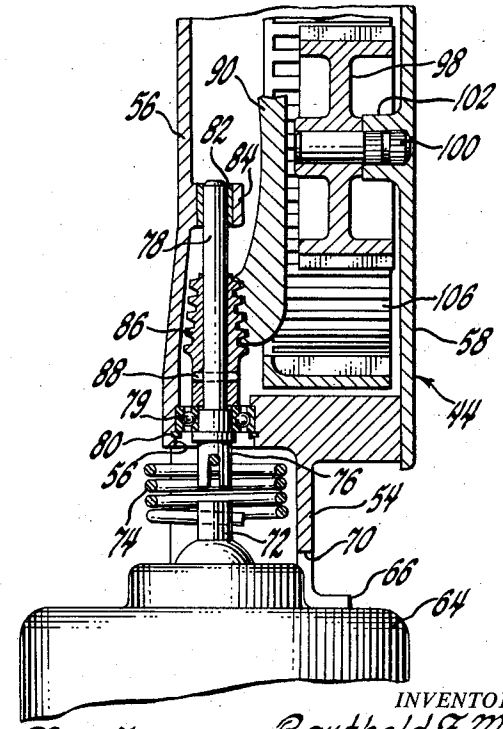

Fig. 3

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WINDOW REGULATOR DRIVE MECHANISM

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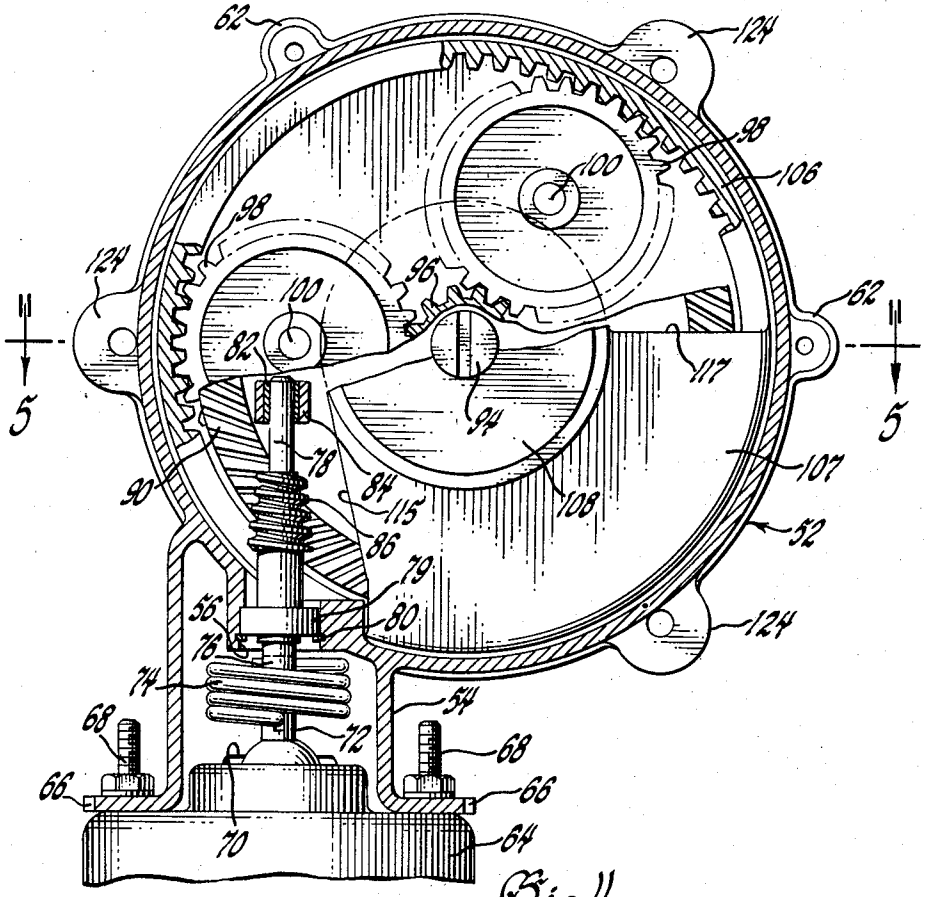

Fig. 4

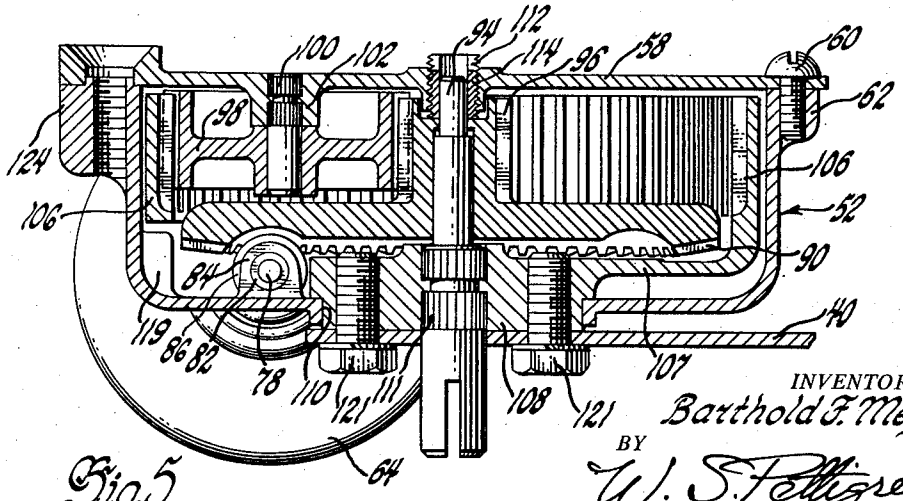

Fig. 5

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WINDOW REGULATOR DRIVE MECHANISM

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4 Claims. (Cl. 74—413)

This invention relates to window regulator drive mechanisms and more particularly to an improved window regulator drive mechanism for power operated vehicle windows.

The drive mechanism of this invention is of the package unit type and includes both the power operating means and the reduction gear arrangement for driving the window regulator linkage system. The reduction gear arrangement is of compact size and is mounted within a substantially sealed housing to protect the arrangement from dust and dirt and provide for permanent lubrication at the time of installation. The power operating means is easily detachable from the reduction gear arrangement for repair or replacement without requiring disassembly of the reduction gear arrangement from the body. In addition, the window regulator linkage may be assembled to the reduction gear arrangement when the reduction gear arrangement and power operating means have been assembled within the body to provide for increased ease of installation. The housing may also be directly mounted on the supporting body panel without the necessity of any intervening support or back plate to reduce the cost of the window regulator mechanism and also the time of assembly.

The primary object of this invention is to provide an improved window regular drive mechanism for power operated vehicle windows.

Another object of this invention is to provide an improved window regulator drive mechanism for power operated vehicle windows of the package unit type which includes both the power operating means and the reduction gear arrangement in an easy assembled and disassembled unit.

A further object of this invention is to provide an improved reduction gear arrangement for power operated window regulator drive mechanisms.

These and other objects of this invention will be readily apparent from the following specification and drawings, in which:

Figure 1 is a partial side elevational view of a vehicle door embodying a window regulator drive mechanism according to this invention, with parts thereof broken away for clarity of illustration;

Figure 2 is an enlarged sectional view taken on the plane indicated by line 2—2 of Figure 1;

Figure 3 is an enlarged partial sectional view taken on the plane indicated by line 3—3 of Figure 1;

Figure 4 is an enlarged view of the reduction gear arrangement, with parts thereof broken away for clarity of illustration; and

Figure 5 is a sectional view taken on the plane indicated by line 5—5 of Figure 4.

Referring now particularly to Figures 1 and 2 of the drawings, a vehicle door 10 includes a door inner panel 12 and a door outer panel 14 joined along their front, rear and bottom edges to provide a window well 16. The door upper portion 18 of generally U-shape defines

a window opening 20 which is adapted to be closed by a ventilation window 22 and a vertically movable window 24. The ventilation window 22 is located in the forward portion of the window opening 20 and is adapted to be swingable about a substantially vertical axis between open and closed positions, with the rear edge of the window sealing against a guide channel 26 in the closed position thereof. The window 24 is vertically movable between open and closed positions, with this movement being guided by the guide channel 26 and a similar channel (not shown) located within window well 16 adjacent the rearward edge of door 10.

An outwardly opening channel 28 is secured adjacent each end thereof to a pair of depending brackets 30 which in turn are secured to the lower frame member 32 of the window frame for window 24 to mount channel member 28 to the window. A bracket 34 is offset at 36 adjacent each end thereof and a stud 38 rotatably mounted on the offset portion at each end of the bracket is slidably and rotatably received within channel 28 to provide for rectilinear movement of bracket 34 relative to the channel as the window is raised and lowered.

A window lift arm 40 has one end thereof pivotally secured to bracket 34 at 42 and the other end thereof pivotally supported by the window regulator drive mechanism 44, as will be described. A balance arm 46 has one end thereof pivotally secured at 48 to a depending portion 50 of bracket 34 and the other end thereof pivotally secured at 51 to the window regulator drive mechanism 44. The lift arm 40 and the balance arm 46 swing about their respective pivots on the power operating mechanism to move window 24 between a closed position, as shown, and an open position within the window well 12 (not shown).

Referring now particularly to Figures 3, 4 and 5 of the drawings, the window regulator drive mechanism of this invention will be described. The mechanism generally includes a circular cup-shaped housing 52 provided with a generally trough-shaped housing 54 extending therefrom and opening to the interior of housing 52 through an apertured boss 56. A cover 58 is provided for housing 52 and is secured thereto by a number of screws 60 which are threaded into spaced enlarged threaded bosses 62 at the edge of the side wall of the housing. An electric motor 64 is secured to the flanged edge 66 of housing 54 by screws 68 to mount the motor on the housing. A portion of the wall of housing 54 may be cut away at 70, if necessary, in order to provide clearance for a portion of the motor which may extend within housing 54.

The bifurcated end 72 of the armature shaft of motor 64 receives one end of a coil spring 74, with the other end of the spring being received within a bifurcated end 76 of a shaft 78. Shaft 78 is rotatably supported at one end thereof by a thrust bearing 79 fixed within a shoulder portion of the apertured boss 56 by split ring 80 and at the other end thereof by a plain bearing 82 mounted within a looped portion 84 of the base wall of housing 52. Thus, rotation of motor 64 in either direction will drive shaft 78 through the resilient coupling provided by spring 74. The spring takes up all shock loads between the motor and the reduction gear arrangement and also takes up overtravel of the motor when the vertically movable window 24 has reached a limit position.

As can be seen particularly in Figure 3, a conical worm 86 is fixedly secured to shaft 78 by means of a pin 88 extending through the shaft and worm. The worm has only a slight taper and has a thread of uniform cross sectional shape and uniform lead. Worm 86 in turn meshes with a worm wheel 90 having teeth with side faces which engage the thread of the worm through-

out substantially their entire area. Thus, the gearing has a large power transmitting capacity in comparison to its size due to the large area of engagement between the worm and the teeth of the worm wheel.

The worm wheel **90** is rotatably mounted on a shaft **94** and includes a pinion **96** which is integral therewith although the pinion may be separate and secured thereto in a suitable manner. The pinion **96** is the sun gear of a planetary gear system and meshes with three plane pinions **98** of like construction. Each of the plane pinions **98** is rotatably mounted on a shaft **100** which is fixed within an apertured boss **102** of cover **58** by forcing a splined end of the pin within the boss. The plane pinions in turn mesh with a ring gear **106** which surrounds the plane pinions and the worm wheel **90**.

As can be seen particularly in Figures 4 and 5, the ring gear **106** includes a web **107** extending therefrom under the worm wheel **90** and terminating in a hub **108** which is rotatably received within an opening **110** in the base wall of housing **52** in order to rotatably mount the ring gear on housing **52**. The hub is provided with a central aperture and a splined end **111** of shaft **94** is forced within the aperture in order to fixedly secure the shaft to the ring gear and to also rotatably mount one end of the shaft on housing **52**. The other end of the shaft is rotatably supported by a bushing **112** which is threaded within a threaded bore **114** of cover **58**. Thus, it can be seen that the ring gear **106** is rotatably mounted on housing **52** and in turn rotatably supports the worm wheel **90** and the pinion **96**, with the plane pinions **98** being rotatably supported on cover **58**.

Since the worm **86** and shaft **78** lie in the plane of web **107**, the ring gear **106** cannot be provided with a full circular web and only the partial web **107** may be used. This partial web allows the ring gear to move through an arc of approximately 180 degrees without having the web engage the worm **86** or shaft **78**. As can be seen particularly in Figure 4, one edge **115** of web **107** is adapted to engage the apertured boss **56** to provide a limit stop in one direction and the other edge **117** of the web is adapted to engage a lug **119**, Fig. 5, of housing **52** to provide a limit stop in the other direction. The window lift arm **40** is rotatably received by shaft **94** and is secured to the hub **108** of the ring gear by bolts **121** in order to fix the lift arm to the ring gear **106** for operation of the window. The housing **52** further includes a number of spaced enlarged threaded bosses **124** in order to provide a mounting means for securing the housing to the door inner panel **12**.

The operation of the drive mechanism will now be described and it will be assumed that the window **24** is moved from its closed position, as shown, to an open position within the window well **16**. Upon operation of electric motor **64** in the desired direction, the worm **86** will drive the worm wheel **90** and the pinion **96**. The pinion **96**, which is the sun gear of a planetary gear system, in turn drives the planet pinions **98** which drive the ring gear **106**. As the hub **108** of the ring gear rotates within the opening **110** of housing **52** it will swing the lift arm **40** downwardly within the window well about an axis defined by the axis of rotation of shaft **94** to move the window to its open position. As the window moves to this position, the balance arm **46** will swing about its pivots **48** and **51** to aid in stabilizing the window **24** in any position thereof. When the window has reached its open position the edge **117** of the web **107** of the ring gear will engage lug **119** to provide a positive limit stop. Should the motor **64** overtravel when the window has reached this position and the edge **117** has engaged lug **119**, the torsion spring **74** will take up this overtravel to prevent damage to the reduction gear arrangement.

When it is desired to move the window to its closed position, the motor **64** will be operated in the reverse direction and the operation of the reduction gear arrangement will be the same except that the edge **115** of web **107** of the ring gear will engage the apertured boss **56** of housing **54** to provide a positive limit stop in the closed position of the window.

Thus, this invention provides an improved package unit type window regulator drive mechanism for power operated vehicle windows. The reduction gear arrangement is of compact size and is mounted within a substantially sealed housing for protection against dust and dirt and to also allow for a permanent lubrication at the time of installation. The reduction gear arrangement further provides several useful advantages for window regulator drive mechanisms. The spiroid worm and worm wheel arrangement has a large power transmitting capacity in comparison to its size due to the large area of engagement between the worm and the teeth of the worm wheel. The planetary gear arrangement which is driven by the worm wheel through the sun gear provides for smooth and easy operation of the window lift arm and is of compact size. The ring gear of this arrangement provides its own bearing support on the housing and also locates one end of the shaft **94** which provides the bearing support for pinion **96** and the worm wheel **90**.

I claim:

1. A window regulator drive mechanism comprising, a support, a shaft having one end thereof rotatably mounted on said support and defining a fixed axis of rotation, an input gear rotatably mounted on said shaft adjacent said one end thereof, a worm wheel secured to said input gear and extending radially outwardly therefrom, a worm rotatably mounted on said support and meshing with said worm wheel, power operated means for driving said worm to thereby drive said worm wheel and input gear, an output ring gear encircling said worm wheel and thereby disposed in radially spaced relationship to said input gear, said ring gear including a web portion lying in a plane containing said worm and a central hub portion secured to said shaft adjacent the other end thereof and rotatably mounted on said support to thereby rotatably mount the other end of said shaft on said support, a plurality of pinion gears rotatably mounted on said support and disposed within the radial space between said input and ring gears in meshing relationship therewith to drive said ring gear upon rotation of said input gear, stop means engageable by said web portion of said ring gear to limit the rotational movement thereof and prevent interference with said worm, and a window regulator drive arm fixed to said hub portion of said output gear and driven thereby about said axis of rotation.

2. A window regulator drive mechanism comprising, a support, a shaft having one end thereof rotatably mounted on said support and defining a fixed axis of rotation, an input gear rotatably mounted on said shaft adjacent said one end thereof, a worm wheel secured to said input gear and extending radially outwardly therefrom, a worm rotatably mounted on said support and meshing with said worm wheel, an output ring gear encircling said worm wheel and thereby disposed in radially spaced relationship with said input gear, said ring gear including a web portion lying in a plane containing said worm and a central hub portion secured to said shaft adjacent the other end thereof and rotatably mounted on said support to thereby rotatably mount the other end of said shaft on said support, a plurality of pinion gears rotatably mounted on said support and disposed within the radial space between said input and ring gears in meshing relationship therewith to drive said ring gear upon rotation of said input gear, stop means engageable by said web portion of said ring gear to limit the rotational movement thereof and prevent interference with said worm, a window regulator drive arm fixed to said hub portion of said output

gear and driven thereby about said axis of rotation, and power operated means including an electric motor drivingly connected with said worm through a resilient coupling, said coupling acting to take up overtravel of said motor when said web portion of said ring gear engages said stop means.

3. A window regulator drive mechanism comprising, a support, a shaft having one end thereof rotatably mounted on said support and defining an axis of rotation, an input gear rotatably mounted on said shaft adjacent said one end thereof, a worm wheel secured to said input gear and extending radially outwardly therefrom, means for driving said worm wheel to thereby drive said input gear, an output ring gear encircling said worm wheel in radially spaced relationship thereto, said ring gear including a hub portion fixed to said shaft adjacent the other end thereof and a web portion lying in a plane containing said driving means, means rotatably mounting said hub portion on said support to rotatably mount said ring gear and the other end of said shaft thereon, a plurality of pinion gears rotatably mounted on said support and disposed within the radial space between said input and ring gears in meshing relationship therewith for driving said ring gear upon rotation of said input gear, and means limiting the movement of said ring gear with respect to said driving means to prevent engagement of said web portion with said driving means.

4. A window regulator drive mechanism comprising, a housing having spaced walls, one of said walls being provided with an opening therein, a shaft having one end

thereof rotatably mounted on the other of said walls and defining an axis of rotation, an input gear rotatably mounted on said shaft adjacent said one end thereof, a worm wheel secured to said input gear and extending radially outwardly therefrom in spaced relationship to said one of said walls, a worm mounted on said one of said walls therebetween and said worm wheel for driving said worm wheel to thereby drive said input gear, an output ring gear encircling said worm wheel in radially spaced relationship thereto, said ring gear including a web portion lying in a plane containing said driving worm and a hub portion fixed to said shaft adjacent the other end thereof and rotatably received within said opening in said one of said walls to rotatably mount said ring gear and the other end of said shaft thereon, a plurality of pinion gears rotatably mounted on said support and disposed within the radial space between said input and ring gears in meshing relationship therewith for driving said ring gear upon rotation of said input gear, and means engageable by said web portion of said ring gear for preventing engagement of said web portion with said driving worm.

References Cited in the file of this patent

UNITED STATES PATENTS

1,059,450	Foote	Apr. 22, 1913
1,864,048	McNutt	June 21, 1932
2,252,967	Forton	Aug. 19, 1941
2,317,490	Simpson	Apr. 27, 1943