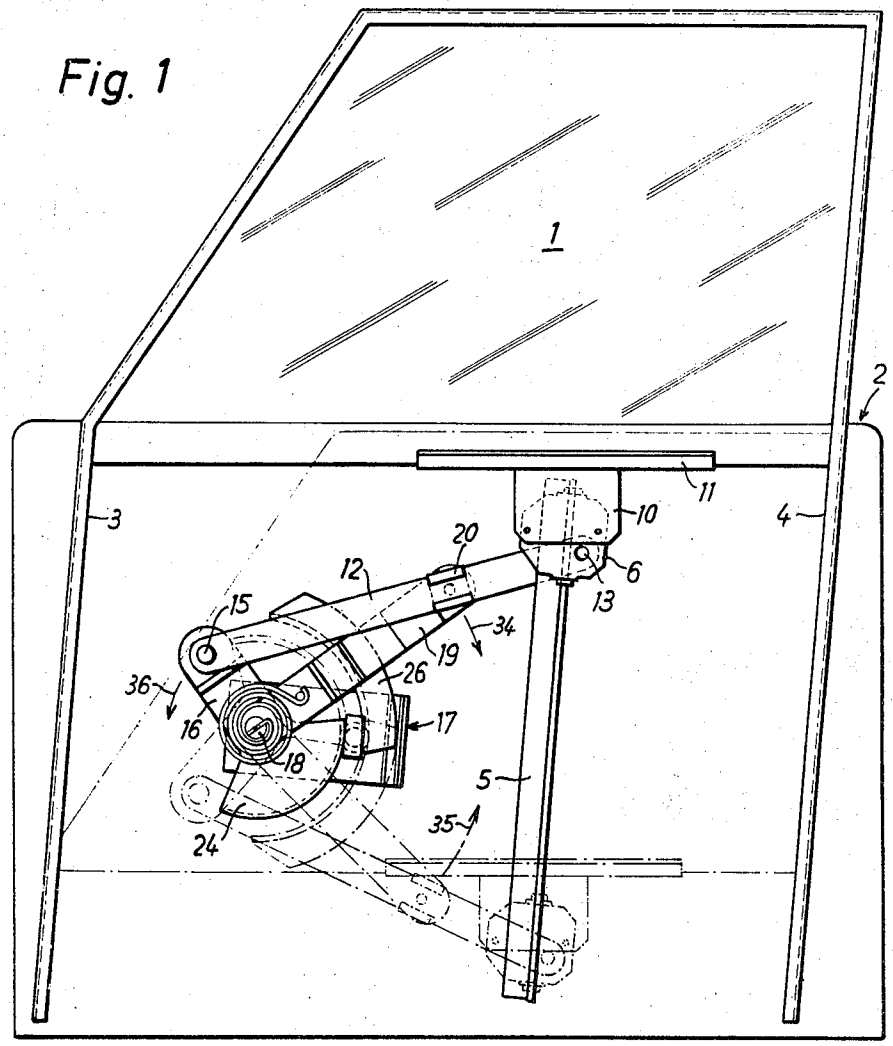
Jan. 5, 1971 F. HERMANN 3,552,061

DEVICE FOR OPENING AND CLOSING A WINDOW

Filed April 16, 1969 4 Sheets-Sheet 1

Fig. 1



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DEVICE FOR OPENING AND CLOSING A WINDOW

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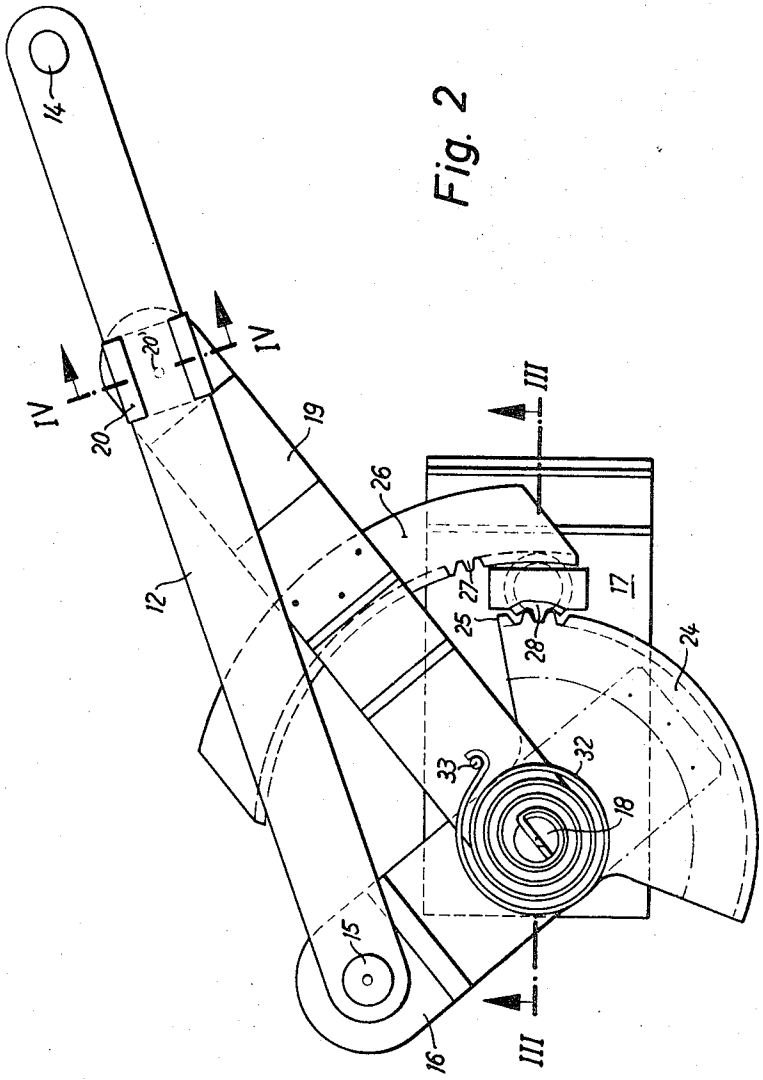


Fig. 2

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DEVICE FOR OPENING AND CLOSING A WINDOW

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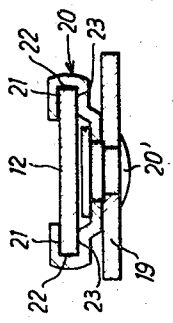


Fig. 4

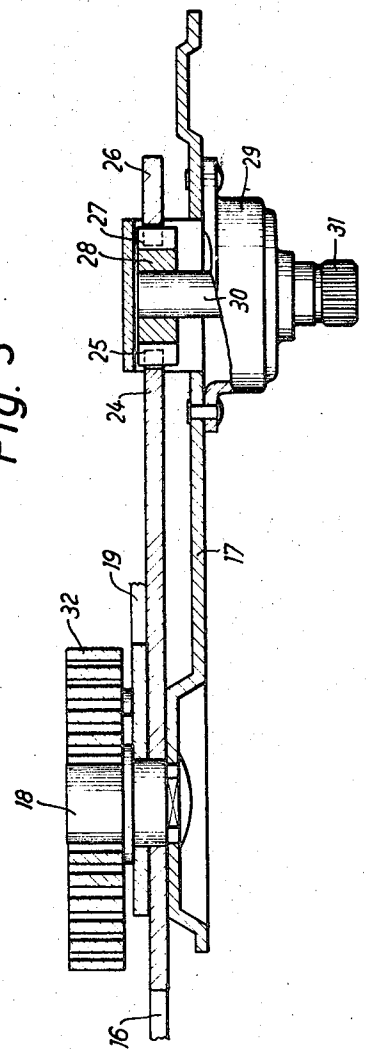


Fig. 3

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DEVICE FOR OPENING AND CLOSING A WINDOW

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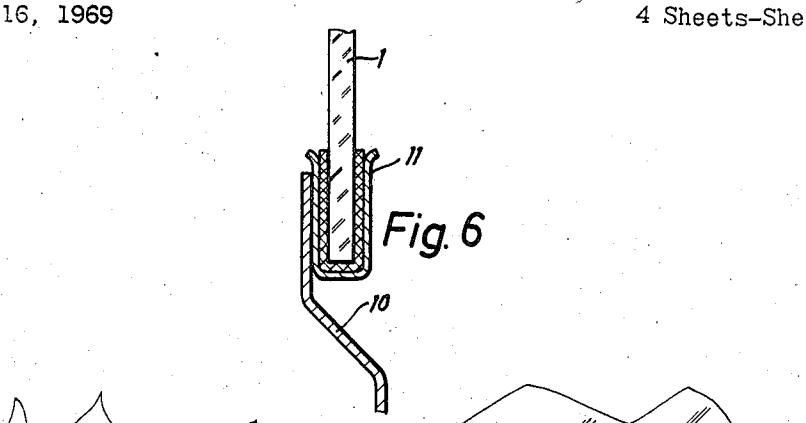


Fig. 6

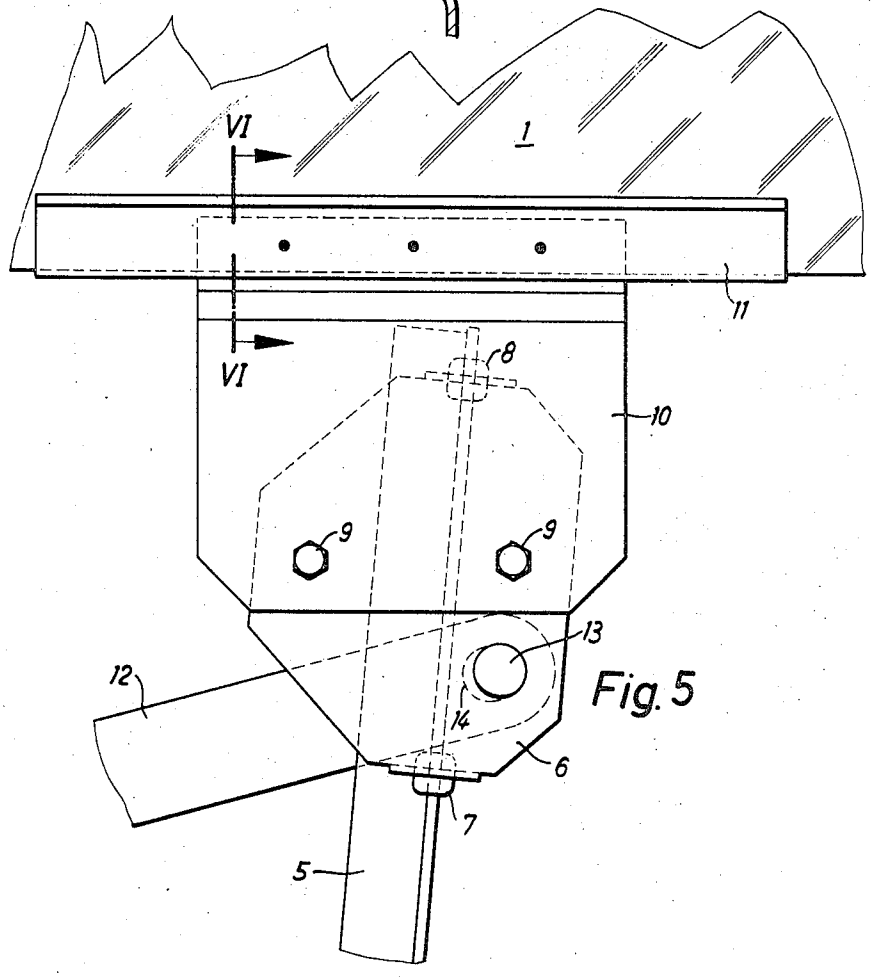


Fig. 5

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3,552,061

DEVICE FOR OPENING AND CLOSING A WINDOW

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Int. Cl. E05f *11/44*
U.S. Cl. 49—351 13 Claims

ABSTRACT OF THE DISCLOSURE

A device for opening and closing a window, such as in a vehicle door, is comprised of an arm for moving the window. A guide arm and an actuating arm are pivotally mounted on a stationary collar pin and are in engagement with means for rotating them in opposite directions about the pin. The guide arm is pivotally connected to the end of the arm for moving the window and a slide member connects the actuating arm to the arm so that the end of the arm connected to the window travels in a substantially rectilinear path as it moves the window.

SUMMARY OF THE INVENTION

The invention is directed to a device for opening and closing a window, such as windows mounted in a vehicle door, and more particularly, it is directed to a device in which the torque required for moving the window is substantially uniform throughout the full travel of the window.

Various devices are known which employ a pivotally mounted lift arm for moving a window between an opened and a closed position within a frame. The lift arm can be attached directly or indirectly to the window. In many of these devices the pivot angle of the arm for the full stroke or travel of the window is so considerable that the ratio of the load arm to the power arm, that is the effective leverage ratio of the lift arm, varies over the path of travel of the window. Accordingly, the torque furnished to the arm for lifting the window, that is by means of an actuating crank or the like, is subject to considerable variation and as a result, impairs the ease of operation in opening and closing the window.

Moreover, in a number of known constructions the end of the arm engaging the window moves along an arc shaped path, frequently a circular arc shaped path, and accordingly, it is impossible to support the window throughout its entire path of travel at its center of gravity. Applications of force against the window which are unsymmetrical with respect to its center of gravity line may cause jamming of the window within its frame.

Arms for lifting and lowering the window have been constructed to overcome this problem, usually at considerable expense due to the various elements involved, whereby during the pivotal movement of the arm it is arranged to be displaced so that the path of travel of the window is in approximately a straight line and the application of force is along the center of gravity line of the window. However, in such arrangements the leverage ratio and as a result the actuation torque still varies to a disadvantage degree. Another problem, in such known window lifting devices, is the number of crank revolutions required to displace the window between its fully opened and fully closed positions, normally 4 to 8 revolutions are required for the full travel.

Accordingly, the primary object of the present invention is to overcome the disadvantages indicated above and to afford a window moving device in which the actuation torque is maintained substantially constant over the total stroke or path of travel of the window.

Another object of the invention is to provide a device in which the end of the arm attached to the window travels in approximately a straight line as it moves the window between its opened and closed positions.

Still another object of the invention is to provide an arrangement in which the required number of crank revolutions for the full travel of the window is reduced.

A further object of the invention is to provide a device which is simple in arrangement, inexpensive in construction and efficient in operation.

Therefore, in accordance with the present invention, an arm is provided for moving a window within a frame, such as in a vehicle door, which employs a pair of arms to afford the desired movement of the arm and the window. One of the pair of arms acts as a guide member and the other arm acts as an actuating member lifting and lowering the window within its frame. Both the guide arm and the actuating arm are mounted on a stationary pivot member with the guide arm pivotally connected to the opposite end of the arm from the end secured to the window the actuating arm connected to the arm intermediate its ends by means of a slide member which is shaped to travel along the edges of the arm. Sector gears are secured to the guide arm and to the actuating arm and are operated by a stationary drive pinion for pivoting these arms in opposite directions as the arm supporting the window is moved in the desired direction. In this device the arm moving the window experiences only a limited pivotal movement because of the opposite movement of the guide arm and the actuating arm, accordingly, the leverage ratio varies only slightly so that an almost constant torque is sufficient to obtain the desired movement of the window. Because of this arrangement 2.5 to 3 crank revolutions are sufficient in a manual drive to afford the full window travel.

In a particularly simple preferred embodiment of the present invention the guide arm for the moving or lifting arm is provided by a relatively shorter member to which is attached a gear sector having gear teeth formed on its radially outer periphery while the actuating arm is formed of a relatively longer member and has a gear sector attached to it with the gear teeth located along a radially inner edge thereof. Both of the gear sectors are disposed concentrically about the fixed pivot point of the guide arm and the actuating arm and are in engagement with a fixed driving pinion positioned between the gear surfaces on each. Due to this simple gear arrangement the opposite drive of the guide arm and the actuating arm is achieved and the parts of the gear transmission system may be formed inexpensively of parts stamped from sheet metal.

The actuating arm which effects the lifting or movement of the arm supporting the window can be equipped with a spring reservoir, such as known in window lifters, to compensate for the weight of the window during the closing or lifting stroke of the arm. Preferably, the compensating spring is a spiral spring positioned about the fixed bearing on which the actuating arm and guide arm are mounted, with its outer end in engagement with a projection on the actuating arm.

To provide a particularly economical arrangement the various parts making up the device that is the arms, the drive members, and the spring can be combined in a single assembly mounted on a common base plate.

The interconnection of the actuating arm and the arm moving the window is obtained by means of a thrust joint, that is, a slide member pivotally attached to the actuating arm and slidably engaged along the edges of the lift arm. This arrangement ensures a minimum of play between the actuating arm and the lift arm. Further, by coating the

surfaces of the slide member in contact with the arm with an abrasion-resistant plastic, such as a polytetra-fluoroethylene-based plastic, it is possible to reduce the friction between the sliding parts to a minimum.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an elavation view of a device, in accordance with the present invention, for opening and closing a window mounted in a motor vehicle door;

FIG. 2 is an enlarged elevational view of a portion of the device shown in FIG. 1;

FIG. 3 is a view, partly in section, taken along the line III—III in FIG. 2;

FIG. 4 is a view, partly in section, taken along the line IV—IV in FIG. 2;

FIG. 5 is an enlarged elevational view of a portion of the device shown in FIG. 1; and

FIG. 6 is a sectional view taken along line VI—VI in FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 a portion of a vehicle door is displayed containing a window **1** shown in the closed position. Lateral tracks **3** and **4** are mounted in the door for guiding the window between its closed position and its opened position, shown in dot-dash lines in the lower part of the door. Spaced between the lateral tracks **3** and **4** within the door is a track **5**, having an angular profile, for guiding the movement of the window between its opened and closed positions. The track **5** is in substantially parallel relationship with the lateral tracks **3** and **4**.

As is best illustrated in FIG. 5, a slide is positioned on and, by means of sliding elements **7** and **8**, is secured to an outstanding leg of the track **5**. Attached to the upper part of the slide **6** is a connector member **10** rigidly secured to the slide by a pair of screws **9**. Along the upper edge of the connector member **10**, a lift rail **11** is secured in place and provides a support for the lower edge of the window **1** located within the door. While it is not a feature of the present invention, the window is held in a non-jamming arrangement because its forward edge is secured within the guide track **3** for only a short length whereby jamming or blocking is avoided.

Secured indirectly to the window **1** is an arm **12** which moves the window between its opened and closed positions. The arm **12** is pivotally connected to the slide **6** by means of a slot **14**, note FIGS. 2 and 5, which fits onto the pin **13**. The slot **14** has a slightly oval form which permits slight relative movements between the arm and the slide as the two are displaced along the track **5**. Since the track **5** is rectilinear or straight the movement of the end of the arm secured to the slide is substantially straight and deviates from the path of the track **5** only by the slight tolerance permitted by the slot **14**.

At the opposite end of the arm **12**, it is pin connected to a guide arm **16** which in turn is pivoted at its opposite end on a stationary collar pin **18** mounted on a base plate **17**. As indicated in FIGS. 1 and 2, the head of the collar pin is slotted. In addition to the arm, an actuating arm **19**, of considerably greater length than the guide arm, is pivotally connected onto the collar pin. The actuating arm extends outwardly from the pin and has a slide member **20** pivotally attached at its outer end by a bolt **20'**. The slide member **20** as shown in FIG. 4, is bent inwardly along its sides providing a pair of grooves or guideways for slidingly engaging the edges of the arm **12**.

The interior surfaces **21**, **22**, **23** of the guideways are coated with an abrasion-resistant plastic, for example, polytetra-fluoroethylene (Teflon®), for reducing friction and wear between the slide member **20** and arm **12**.

Referring to FIGS. 1 and 2, on the opposite side of the collar pin from the point of attachment of the guide arm **16** to the arm **12**, the guide arm has a gear sector **24** disposed concentrically about the collar pin. Gear teeth **25** are formed on the radially outer surface of the gear sector. While a regular gear sector **24** has been shown, it can be appreciated that a circular ring fastened to a prolongation of the arm beyond the collar pin could also be used, is shown in dot-dash lines in FIG. 2. In addition, a second gear sector **26** is secured to the actuating arm **19** and is also concentrically arranged about the collar pin **18**. The inner peripheral surface of the gear sector **26** is provided with gear teeth spaced from and disposed opposite to the teeth on the gear sector.

Mounted on the base plate **17** between the gear sector **24** and gear sector **26** is a drive pinion **28** which engages the teeth **25**, **27** on the respective gears for moving the guide arm **16** and the actuating arm **19** in opposite directions as indicated by the arrows shown in FIG. 1. The drive pinion **28** is fixed to a shaft **30** and is equipped in a known manner with a drag spring brake, not shown. The shaft **30** is mounted in a casing **29** which in turn is secured, as by riveting, to the base plate **17**. The outer end of the shaft **30**, which extends through the casing **29**, is formed as a fastening head **31** with splines for connecting a hand crank, not shown. Alternatively, the drive pinion can be coupled in a known manner to an electric motor for automatically opening and closing the windows.

As shown in FIGS. 1 to 3, a spiral spring **32** is disposed about the collar pin **18** with its inner end fitted into the slot in the head of the collar pin. The spiral spring is disposed concentrically about the collar pin and its outer end is fitted to a bolt fastened to the actuating arm **19**. When the actuating arm **19** is pivoted in the direction of the arrow **34**, see FIG. 1, that is, in its opening stroke, the spring **32** is wound. Conversely when the actuating arm moves in the direction of the arrow **35**, that is, for moving the window into its closed position, the spring **32** transmits its stored force to the actuating arm and thus facilitates the closing operation.

As mentioned previously (in FIG. 1, the window **1** is shown, in its opened position, in solid lines and, in its closed position, in dot-dash lines. Similarly, the device which moves the window **1** between its opened and closed positions is shown in full lines in the position it assumes when the window in the closed position, and in dot-dash lines in the position it assumes when the window is in the fully opened position. These two limiting positions of the window serve to indicate the manner in which the guide arm **16** and the actuating arm **19** operate in effecting the desired movement of the arm **12** and its slide **6** along the track **5**. When the window is being opened the guide arm **16** is rotated about the collar pin **18** in the direction indicated by the arrow **36**, that is counterclockwise, and at the same time, the actuating arm **19** is being rotated through an arc in the clockwise direction as indicated by the arrow **34**. These two arc-like paths of travel, in opposite directions, permit the end of the arm **12** to travel in almost a straight line as it passes downwardly along the track **5**. At the commencement of the opening operation the arm **12** pivots in the clockwise direction about the pin **15** while the slide member **20** moves toward the track **5**. After the arm **12** has traversed approximately half of its downward path along the track **5** the slide member **20** starts to move slightly away from the track. As can be appreciated in FIG. 1, the relative movement of the slide member is slight so that the transverse movement of the arm **12** with respect to the pin **13** on the slide **6** is only about 3 mm. for a device of the type shown in the drawings, such as in a conventional vehicle door. With only a small variation in the lever ratio for

example, the horizontal distance between the pins **15** and **13** and the horizontal distance between the bearings **15** and **20'**, the actuation torque for the device is maintained substantially constant throughout the movement of the window. As the arm **12** travels downwardly along the track **5** its outer end describes the figure of a numeral **3** having very flat loops. Moreover, the guide arm **16** and and actuating arm **19** are so arranged that the lift arm intersects the axis of the collar pin **18** and the compensating spiral spring **32** in its upward and downward movement. The guide arm is intended to displace the location of the hinge for the arm **12** during the movement of the window while the actuating arm provides the force for lifting and lowering the lift arm and, in turn, for the movement of the window.

Further, with respect to the motion of the various elements involved in the device, it should be noted that because of the smaller circle diameter of the gear sector **24** the guide arm **16** has a greater angular velocity than the actuating arm **19**, which has a larger circle diameter for its gear sector **26**, and for this reason the guide arm leads somewhat in the movement of the various parts of the device.

As is obvious from the arrangement shown in the drawing, the movement of the various parts, when the window is being displaced from the opened to the closed position, is the opposite as described above. Actually, the arm **12** passes through a relatively small pivot angle as the window is moved between its limiting positions and this arrangement has the advantage of affording a constant leverage ratio and therefore a substantially uniform actuation torque. If all other conditions are maintained the same, by extending the guide arm **16** or the actuating arm **19** it will lead to a reduction in the travel or stroke of the window, while a corresponding shortening of the arms will have a tendency to increase the stroke. For the gear transmission the absolute dimensions are not determinitive of the desired sequence of movement, but rather the gear transmission ratio and hence the number of teeth of the pinion. With a smaller number of teeth more crank revolutions per stroke are required, and vice versa. Without increasing the torque in a manner which would impair the ease of operation, the number of crank revolutions of the stroke can be reduced according to the invention to between 2.5 to 3.

What is claimed is:

1. A device for moving a window within a frame between a closed position and an opened position such as in a vehicle door or the like, comprising an arm having a first end and a second end and adapted to be connected adjacent its first end to a window for moving the window between its closed and opened positions, a guide arm pivoted to the second end of said arm, an actuating arm, a thrust member pivotally attached to one end of said actuating member and disposed in movable engagement with said arm, a stationary collar pin, said guide arm pivoted to said collar pin at a position spaced from the connection of said guide arm and arm, said actuating arm pivoted to said collar pin at a position spaced from the connection of said thrust member to said actuating arm, means for rotating said guide member and said actuating member in opposite directions about said collar pin whereby said arm movably positions the end of said arm about said collar pin and said actuating member by means of said slide member displaces said arm so that its first end travels in a substantially rectilinear direction for moving the window between its opened and closed positions.

2. A device, as set forth in claim **1**, wherein said means for rotating said guide arm and actuating arm comprising a first gear sector secured to said guide arm, a second gear sector secured to said actuating arm, said first and second gear sectors being concentrically arranged relative to said collar pin, and a stationary drive pinion engaging said first and second gear sectors for rotating said guide arm and actuating arm about said collar pin.

3. A device, as set forth in claim **2**, wherein said first gear sector having gear teeth located on its radially outer surface, said second gear sector having gear teeth located on its radially inner surface disposed radially outwardly from the gear teeth on said first gear sector, and said drive pinion spaced between and in engagement with the gear teeth on said first and second gear sectors.

4. A device, as set forth in claim **1**, wherein a compensating spring arranged in engagement with said actuating arm for counteracting the weight of the window when the said actuating arm is moving said arm for displacing the window from its opened to its closed position.

5. A device, as set forth in claim **4**, wherein said compensating spring comprises a spiral spring anchored into said collar pin at its inner end and concentrically disposed about said collar pin with its outer end secured to a projection on said actuating arm.

6. A device, as set forth in claim **1**, comprising a common base plate, said collar pin fixed to said base plate, said drive pinion fixed to said base plate at a position laterally spaced from said collar pin, and means attached to said drive pinion for rotating said pinion and driving said first and second gear sectors.

7. A device, as set forth in claim **1**, wherein said thrust member comprises a slide member pivotally secured to the end of said actuating member and disposed in sliding engagement with the sides of said arm.

8. A device, as set forth in claim **7**, wherein said slide member comprises a plate section pivotally fixed to said actuating arm, an angle section secured to each of the opposite sides of said plate section and forming a pair of inwardly directed guideways along the opposite sides of said slide member, and said guideways arranged to be disposed in sliding engagement with the sides of said arm.

9. A device, as set forth in claim **8**, wherein the interior surfaces of said guideways in contact with said arm having a coating of an abrasion-resistant plastic.

10. A device, as set forth in claim **1**, wherein a track arranged for guiding in a substantially rectilinear path the end of said arm connected to the window, a slide mounted on said track for movement therealong, means for securing said arm to said slide for providing slight relative movement between the said arm and said slide in a direction transverse to the longitudinal direction of said track.

11. A device, as set forth in claim **10**, wherein said means comprising a pin mounted on one of said arm and said slide, and a slot slightly elongated in the direction transverse to the longitudinal direction of said track located in the other one of said arm and said slide, and said slot arranged to receive said pin for guiding the movement of said arm along said track.

12. A device, as set forth in claim **10**, wherein sliding elements secured to said slide and disposed in sliding engagement with said track.

13. A device, as set forth in claim **10**, wherein a connector member rigidly attached to said slide and adapted to support the window for displacing the window between its opened and closed position in response to the movement of said arm and said slide traveling along said track.

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U.S. Cl. X.R.

49—363; 74—89