United States Patent

Golde et al.

[15] **3,681,874**

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[54] **WINDOW OPERATING MECHANISM WITH FLEXIBLE THREADED CABLE TRANSMISSION PARTICULARLY FOR MOTOR VEHICLES**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.**.....**49/352,** 74/89.2

[51] **Int. Cl.**.....**F05f 11/40**

[58] **Field of Search**.....49/349, 352; 74/89.2, 89.15

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[57] **ABSTRACT**

An operating mechanism for raising and lowering windows, particularly automobile windows which move upwardly and downwardly in a guide track wherein the movement is controlled by the displacement of a threaded flexible cable which is guided from the rotating mechanism, which may be operated by a hand crank or a motor, to the connecting part for the window pane which is guided in a track. The driving mechanism for the threaded flexible cable includes a housing mounting a driving pinion which engages the cable and which also rotates a spring pulley which carries a spring which is wound during the opening of the window and which is unwound to aid in the driving force during the closing of the window. The construction includes a housing having two interengageable parts which together define an enclosing tube for receiving and holding a rigid plastic tube in which the cable is movable. The rigid tube is held in a secure position within the housing tubular formation in a manner which prevents axial displacement as well as rotation thereof by a formation of plastic sleeves at each end of the housing tubular formation which are formed directly over the rigid plastic tube carrying the threaded cable and which includes projections which engage within recesses of the housing and prevent rotation or axial displacement of the plastic tube. The tube and the plastic sleeves are preferably made of a material such as copolymerized polyacetals and are formed such as by spraying directly over a rigid tube formation for the threaded cable which has been provided with knurlings or grooves on its exterior surface for facilitating interengagement of the sleeve with the rigid tube. The rigid tube containing the threaded cable is provided with a notch or cut-away portion at the location on the interior of said housing to facilitate meshing engagement of a driving pinion within the housing with the threaded cable contained within the tube.

13 Claims, 9 Drawing Figures

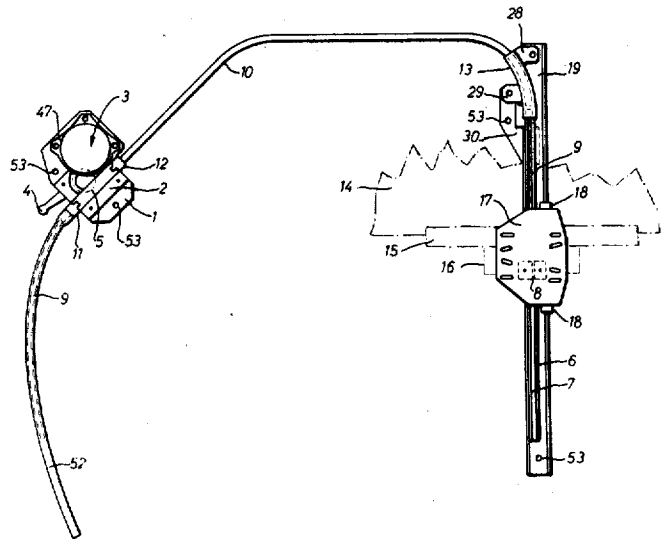


Fig. 1

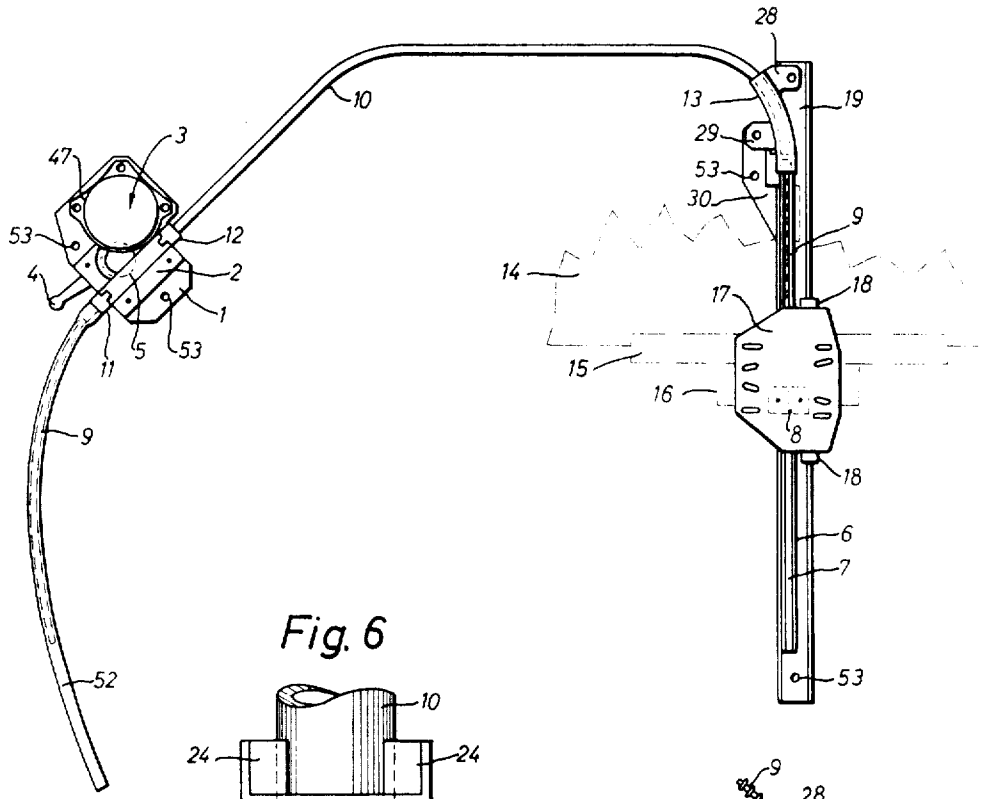
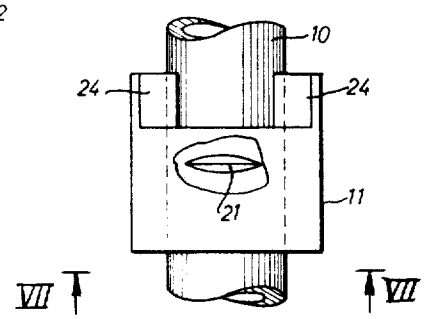


Fig. 6



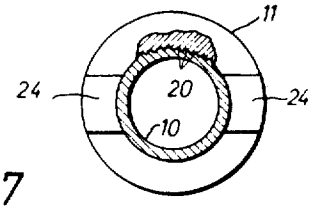


Fig. 7

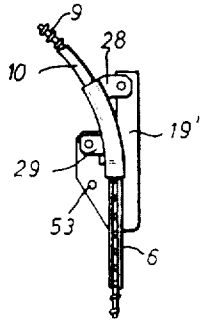


Fig. 2

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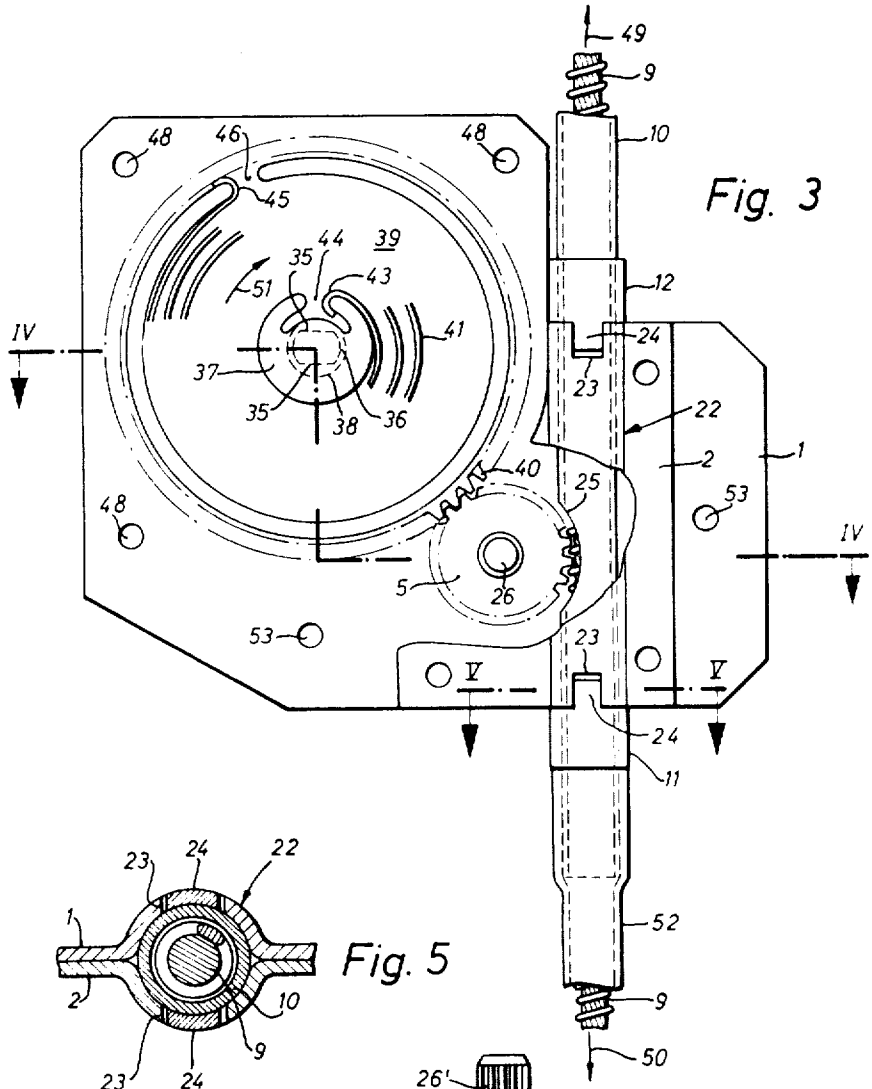

Fig. 3

Fig. 5

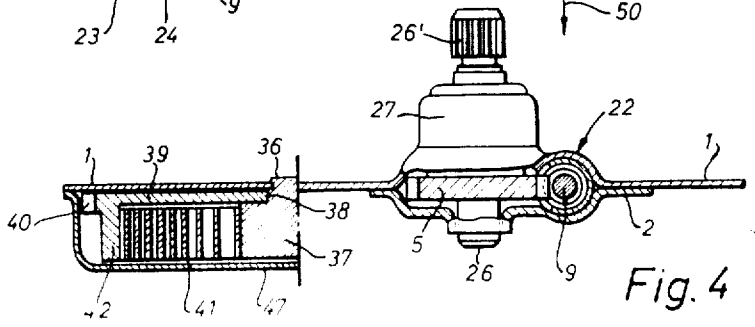

Fig. 4

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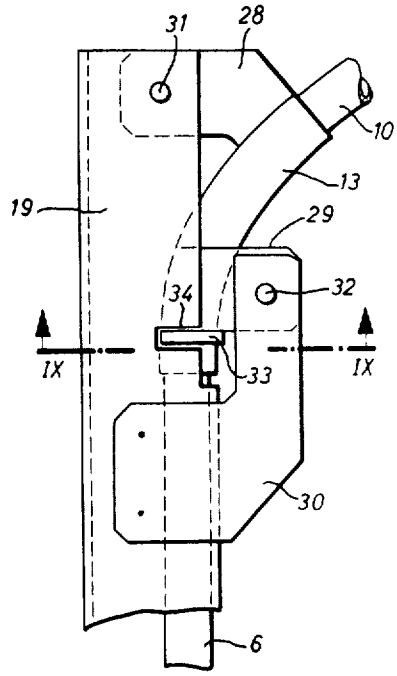

Fig. 8

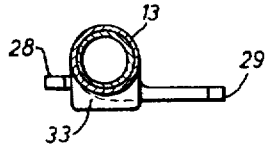

Fig. 9

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WINDOW OPERATING MECHANISM WITH FLEXIBLE THREADED CABLE TRANSMISSION PARTICULARLY FOR MOTOR VEHICLES

SUMMARY OF THE INVENTION

This invention relates in general to operating mechanisms including a rotatable and axially displaceable cable member for transmitting a moving force and in particular to a new and useful window operating mechanism which includes a rotatable and axially displaceable flexible threaded cable and to an improved means for mounting the cable to permit its axial displacement and rotation and engagement by a driving gear within a driving mechanism housing.

The invention particularly relates to a mechanism for raising and lowering windows in a car by the use of a flexible connecting cable which is rotated by a driving gear in order to advance it axially to cause displacement of a mounting member connected to the window pane which rides in a vertical trackway. For this widely known type of window operating device, it has been known to design the guide tube for the flexible cable as a slotted metal tube only in the area of the path of movement of the threaded cable in the vicinity of the driving mechanism and the remaining portion comprise a flexible plastic hose surrounding the threaded cable. This design permits easy adaptation of the cable path to the available mounting space and makes the difficult bending of a slotted metal tube unnecessary. However, in practice, it has not prevailed since the flexible plastic hose cannot transmit the occurring forces,especially when it is imparted with a very great curvature, since there is the possibility that it will buckle. This may result in considerable functional disturbances and also in the danger that the closed window can be opened by pressing down on the window pane, thus permitting breaking into the vehicle. In addition, the flexible plastic hoses can only be connected to the drive housing and the slotted metal tube by means of an extensive clamping and screw connection. The connection to the drive housing in such an arrangement is effected by hose ends which are hung in at both sides of the drive pinion between the housing halves so only the cable extends through the drive housing. This not only results in a considerable friction, caused by gear pressure, on the cable adjacent the housing wall which is opposite to the gear pinion but it also permits an axial displacement between the two hose ends and this still further increases the friction.

The use of plastic material for substantial lengths of the guide tube is otherwise desirable because it permits reduction of the friction of the threaded cable in its guide tube and this increases the operational torsional moment at the driving pinion. This is particularly so where the cable and the guide tube have to be placed within relatively small radius of curvature in the mounting space. It is known that the dynamic friction co-efficient of steel against steel is substantially higher than that of steel against most plastic materials. The invention permits in a window operating mechanism of the above indicated type, the replacement of the metal guide tube by plastic material and at the same time avoids the disadvantages of the known constructions. Generally speaking, the invention reduces the necessary driving torsion moment in the cable operated devices for raising and lowering windows.

According to the invention, a relatively stiff plastic tube is provided for rotatably supporting the threaded driving cable therewithin. The tube may be thermally bent to the desired cable path and it is advantageously provided with a recess which may be located within the drive housing for engagement of the driving pinion with the threaded cable contained within the plastic tube. The rigid plastic tube, or even a small length of a metal tube may be sprayed with plastic to form sleeves which project from the tube surface or extend outwardly and are rigidly connected with the drive housing and/or the rigid metal tube by interengagement of the matching molded parts.

A window operating mechanism constructed in accordance with the invention can be manufactured economically with either one track or two tracks and it is of outstanding construction in view of its simple and yet reliable connections between the plastic tubes for the rotatable flexible threaded cable and the drive housing. It is also sufficiently elastic in the area of the plastic tube so that the production tolerances at the mounting locations may be balanced without impermissible deformation in the tube axis in the area of the plastic tube which is under the load of tension or pressure as it occurs in the opening and closing of a vehicle window. The one piece construction of the plastic tube at the location of the engagement of the pinion with the flexible threaded cable prevents displacement of the guide tube in this area which would impair functioning and it also ensures that the cable at the side opposite the drive pinion is in a favorable position in respect to friction despite the high gear pressure. A window raiser constructed in accordance with the invention as compared to a cable window raiser having an all metal tube guiding for the threaded flexible cable requires a driving torsion moment which is 20 percent lower. In a one track window construction the drive torsional moment of 20 cmkg for an operating mechanism with continuous metal tube guiding is reduced by the invention to about only 16.5 cmkg.

Of great importance is the selection of a suitable plastic for the guide tube and for the sleeves which are bonded to the exterior of the tubes. The automobile industry requires that the window operating devices must function and be secure without limitation for a temperature range of minus 40° C. up to plus 70° C. This range of 110° C. clearly shows that it is not sufficient to use a plastic which is suitable in its mechanical characteristics at room temperatures. Both temperatures limits present difficulties because in the direction of lower temperatures impact resistance and notched bar impact resistance are strongly reduced in most plastics making the material more brittle and thus less suitable for dynamic stresses. The tensile strength and wear resistance are strongly reduced in most plastics with rising temperatures. A plastic material with substantially no reduction in the stability values over the wide temperature range indicated above and which will remain within permissible values and which possesses favorable endurance characteristics, high resistance to thermal and oxidation disintegration, small moisture absorption, easy spraying characteristics and resistance to mineral lubricants, is in its characteristics approximating steel to such a degree that previous failures in the use of plastic guidings for threaded cables seem understandable. Surprisingly, it has been found that for

the plastic tube and the plastic sleeves copolymerized polyacetals are excellent. Good results have been achieved with the plastic "Hostaform", (registered trademark of Farbwerke Hoechst AG) an acetal-copolymerizate essentially produced from trioxane. Window operating devices equipped with this plastic were fully functioning with as much as 80,000 up and down strokes (reversing movements).

According to a feature of the invention, the rigid guide tube of plastic material, although not chemically bound to the border surfaces is nevertheless fixedly connected to a sleeve element at each end of the tubular formation of the driving housing. The sleeve elements are advantageously sprayed over the material of the tube and the rigid tube is provided with depressions and/or elevations which interengage with the material of the sprayed on sleeves so that a firm nonrotatable connection is effected. This connection is further enhanced by a minor shrinking of the sleeve after it cools and the resultant structure provides a very durable tube which is resistant to mechanical stresses. The shape of the projections or recesses formed on the underlying tube determines the amount and degree of securement against rotation and axial displacement of the two parts. The affixed sleeves advantageously include extensions or projections which interengage in similarly formed recesses of the tubular housing portion in order to provide a locking interengagement of the tube with the housing for the purpose of fixing the orientation of the threaded flexible sleeve in respect to the driving gear within the housing.

The invention construction includes a drive housing having a rotatable spring gear or spring pulley which is hollow and provides a storage area for a spring. A coil spring arranged in the interior of the spring gear is wound when the driving pinion drives the flexible threaded cable in a direction to open the window and it unwinds and drives through its associated gear to the gear pinion when the window is to be moved in a closing direction. The arrangement provides a very compact orientation of the spring in a position to readily cooperate with the driving elements in the drive housing. By this spring storage the drive torsion moment of 16.5 cmkg referred in an earlier example is further reduced to about 10.1 cmkg. The spring pulley and also a cover therefore is advantageously made of a plastic material and it is mounted on a hub portion which is affixed to the drive housing at a stationary location and provides an inner fixed mounting for the inner end of the coil spring, the outer end being connected to the rotatable pulley.

It should be appreciated that the guiding tube for the threaded cable at the location of the drive housing may either be made of a rigid plastic or it may comprise a slotted metal tube, and in either instance a flexible plastic hose is secured to each end for the purpose of anchoring the tube in respect to the housing. The flexible plastic hose may comprise a polyvinylchloride based plastic which may be formed to provide for any modification of the mounting arrangement.

Accordingly, it is an object of the invention to provide an operating device for transmitting motion to an object such as a window through a flexible threaded cable by driving it through a rotatable gear or pinion and which includes a housing for the gear and pinion which accommodates a rigid plastic tube for the threaded cable and which includes a sleeve formation on each end of the tube, at the locations where it passes through the housing, for anchoring the tube against displacement in rotational and axial directions.

A further object of the invention is to provide a device particularly intended for operating car windows which includes a threaded flexible cable which is adapted to be connected to a guide member the latter being movable in a substantially vertical guideway for raising and lowering the window; and which includes a drive housing having a tubular portion which engages over a rigid plastic tube member for enclosing the threaded cable and which includes means for holding the tubular member in a fixed orientation in respect to the tubular portion of the housing and wherein the housing includes a driving spring gear having a hollow for containing a spring therein which is windable when the threaded member is driven in one direction and unwindable to drive the driving gear when the threaded flexible cable member is moved in an opposite direction.

A further object of the invention is to provide a window operating mechanism which is simple in design, rugged in construction, and economical to manufacture.

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 inventions, 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 a side elevational view of the operating mechanism for a one track window constructed in accordance with the invention;

FIG. 2 is a partial elevational view of another embodiment of the connecting portion of the mechanism indicated in FIG. 1 for interconnecting a metal slotted tube with the plastic tube;

FIG. 3 is an enlarged partial elevational and partial broken away view of the driving mechanism indicated in FIG. 1;

FIG. 4 is a section taken on the line IV—IV of FIG. 3;

FIG. 5 is a section taken on the line V—V of FIG. 3 but on a somewhat larger scale;

FIG. 6 is an enlarged partial elevational view of the portion of the rigid plastic tube adjacent the end of the housing with the sleeve thereon shown at 90° from the position indicated in FIG. 1;

FIG. 7 is a section taken along the line VII—VII of FIG. 6;

FIG. 8 is an enlarged partial elevational view of a portion of the mechanism indicated in FIG. 1; and

FIG. 9 is a section taken along the line IX—IX of FIG. 8.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in particular, the invention embodied therein comprises a drive housing formed of two sheet metal parts **1** and **2**, which also define a spring storage housing **3**. The drive mechanism is indicated as being operable by a rotatable handle or crank **4** which rotates a drive pinion **5**. A flexible threaded cable **9** is driven by the pinion **5** and it rotates and advances axially in a selected direction within a tube **10** of a rigid plastic material. The end of the cable **9** is connected to a carrier plate or window mounting member **17** having an engagement piece **8** which is attached to the cable **9**. The carrier plate **17** is supported for vertical movement on a metal tube **6** having a slot **7** for engagement of the engaging piece **8**, the threaded cable **9**, the rigid plastic tube **10**. In addition, plastic sleeve **13** is supported on a bracket **28** at the upper end of a central sheet metal guide rail **19**. A window pane indicated in dash lines at **14** carries a lifting rail **15** with a lifting tongue **16** which is attached to the carrier plate **17**. The carrier plate **17** includes a guiding or gliding member **18, 18** at each end which engages the central sheet metal guide rail **19** which provides for parallel guiding of the window pane **14**. The tube **6** and the bracket **28** are supported on the guide rail **19**. The guiding of the window is such that it prevents tilting of the window about a substantially horizontal axis in the event of insufficient side guiding as described in U.S. Pat. No. 3,427,748.

In accordance with a feature of the invention, the rigid tube **10** is made of Hostaform (Registered Trademark) material and is bent in an oil bath at **154** degrees centigrade to the desired shape. Its diameter measurements are 8 mm inside, 10 mm outside. The plastic sleeves **11, 12** and **13** which are shown in FIGS. **1** and **6** to **9** comprise the same material. In order to spray the ends of the plastic tube **10** to form sleeves such as the sleeves **11** and **12** thereon the ends are inserted into a spring tool corresponding to the shape of the sleeve to be formed. The required centering of the plastic tube ends, before the spraying in the spraying tool, may be effected by screw springs (not shown) which are placed on the tube ends and which remain in the sleeves after the spraying. As shown in the example of the sleeve **11** in FIG. **7**, the plastic sleeve is affixed to the tube **10** against rotation by means of the longitudinal grooves **20** which extend over the length of the tube **10**. These grooves **20** may be formed as continuous fine grooves during the extrusion of the tube **10** and only in the area of the sleeve formations. Therefore, when the material of the sleeve penetrates into the grooves, there is a gear like interconnection of the two parts to ensure that they do not rotate relative to each other.

In order to ensure that there is securement against axial displacement, the plastic tube **10** may be provided with one or more depressions which extend transversely, such as the depression **21** shown in FIG. **6**. The sleeve material penetrates into the depressions **21** during spraying and thus results in a formed closed connection of the sleeves with the plastic tubes **10**. The sleeves which are shown in FIGS. **8** and **9**, are also firmly connected with the plastic tube **10**.

Referring to FIGS. **1** and **3** to **5**, the rigid plastic tube **10** leads through the drive housing through a tube portion **22** formed by the joining of the two half portions **1** and **2**. The sleeves **11** and **12** which are affixed to the tube **10** bear against the respective ends of the tubular profile **22** such that the drive housing cannot be axially displaced along the plastic tube **10**. In order to preclude rotating of the drive housing on the plastic tube both housing halves **1** and **2** are provided at their ends with a recess **23** into which extend the extensions **24** of the sleeves **11** and **12** in a form closed manner.

The plastic tube **10** carries a recess or slot **25** at the interior of the tubular part **22** which permits engagement of the drive pinion **5** with the threaded cable **9**. The drive pinion **5** is affixed to a drive shaft **26** which is rotatably supported in the housing parts **1** and **2**. The shaft **26** carries a spline gear **26'** which provides means for the non-rotatable attachment of a drive crank **4** indicated in FIG. **1**. The housing also includes a cup portion **27** which carries a well known drag spring brake (not shown).

The tube **10** is provided with a plastic sleeve **13** at the connection of the tube with the slotted tube **6**. The slotted tube **6** extends into the sleeve **13** and in the injection molding of the sleeve **13** tongues **28** and **29** are formed as indicated in FIGS. **8** and **9**. The tongues **28** and **29** are connected with the rail **19** through the bracket **28** and a bracket **30** by rivets at **31** and **32**, respectively. A rib shaped extension **33** (FIG. **9**) is formed on the sleeve **13** which engages in a slot shaped recess **34** of the rail **19** (FIG. **8**). If the window operating device is to be employed with a parallel guiding rail **19**, a corresponding connection with the metal slot tube **6** may be produced by a sheet metal part **19'** secured thereto as indicated in FIG. **2**.

The housing part **1** includes an enlarged area for receiving the spring storage **3** as shown in FIGS. **3** and **4**. A pin **36** of a hub member **37** has flattenings **35** to ensure that it will not rotate relative to the housing and it is rivoted into position in part **1**. A bearing lug **38** is arranged concentrically to the hub **37** and it rotatably supports a spring gear **39** which is hollow to provide a space for accommodating a coil spring **41**. The spring gear **39** includes gear teeth **40** formed around the exterior periphery which engage with the drive pinion **5**. The gear **39** has a cylindrical wall which is concentric with the hub **38** and has about the same axial extent as the hub **37**. The inner end **43** of the spring is hung into a depression **44** of the hub **37** and the outer end of the spring **41** designated **45** is hook shaped and engages within a slot **46** of the cylindrical wall **42**. A plastic cover **47** encloses the spring and the cover is attached at places **48** to the drive housing **1** for instance by hollow rivets.

Rotation of the gear **5** in one direction, for example in the direction of the arrow **49**, to move the threaded cable **9** in an opening direction will cause lowering of the window pane **14** and the tensioning or winding of the coil spring **41**. Movement of the threaded cable **9** in the direction of the arrow **50** will cause the window to be moved to a closed position and this rotation will be aided by the unwinding of the spring **41** to drive the gear **5** through the gear **42**. During the opening displacement movement of the threaded cable the spring gear or pulley **42** is driven counter-clockwise in the direction of the arrow **51** and this causes the winding of the spring **41**. If the window **14** is to be closed, the

spring transmits the stored force through its connection to the gear **42** which in turn drives the pinion **5** so that the torsion moment required for closing the window is reduced. A spiral spring of spring steel of about 10 mm width and about 1 mm thickness with about 10 windings provides a considerable reduction of the drive torsion moment. A flexible plastic hose **52** is applied over the end of the plastic tube **10** which protrudes beyond the sleeve **11** as shown in FIG. **3** and this encompasses the free end of the drive cable **9**. The openings **53** shown in FIGS. **1, 2** and **3** provide means for mounting the operating mechanism at a mounting location, for example, at the inner door plate of a motor vehicle.

What is claimed is:

1. In a window operating mechanism including a drive housing having an axially extending tubular portion which is open at its opposite ends, a threaded flexible drive cable extending through and arranged to extend outwardly from both ends of said tubular portion, a rotatable drive gear positioned within said drive housing adjacent said tubular portion thereof for engagement with said flexible drive cable for rotating and axially displacing said drive cable, a window panel arranged to be moved selectively between opened and closed positions, and a support member for said window connected to said drive cable at a position spaced from said drive housing so that said window panel can be moved between its open and closed positions by the movement of said drive cable, a guideway for said drive cables and said support member formed of a rigid material and spaced from said drive housing, wherein the improvement comprises a tube formed of a rigid plastic material and bent to a desired configuration, said flexible cable located within said tube and being rotatably and axially displaceable therein, said tube extending between said drive housing and said guideway and having a slot therein in the range of said tubular portion of said drive housing with said drive gear extending through said slot to engage with said drive cable, and a plastic sleeve located at each end of said tubular portion, said plastic sleeves being co-extensive with, secured on and in interfitting engagement with the exterior of said tube, and said sleeves secured to said tubular portion for accurately positioning and holding said tube in a fixed position relative to said drive housing for preventing any rotation and axial displacement therebetween.

2. In a window operating mechanism, according to claim **1**, wherein another said sleeve is formed on said tube spaced from said drive housing with a form closed connection for joining said tube to said guideway.

3. In a window operating mechanism, according to claim **1**, wherein said sleeves on said tube comprise projections formed thereon and being locked with said tubular portion of said housing against axial and rotational displacement.

4. In a window operating mechanism, according to claim **3**, wherein said tube and said sleeves are made of a copolymerized polyacetal.

5. In a window operating mechanism, according to claim **1**, wherein said tube includes a surface provided with recess and projecting portions interengaged with the material of said sleeves and securing said sleeves against rotation and displacement on said tube.

6. In a window operating mechanism, according to claim **5**, wherein said tube includes a plurality of grooves extending over the surface thereof around the periphery.

7. In a window operating mechanism, according to claim **1**, wherein said drive housing comprises two separate parts which are interengaged to form said tubular portion, said tubular portion having an inwardly extending recess at each end, said sleeves including axially extending extensions engageable into the respective recesses of each end of said tubular portion in said housing.

8. In a window operating mechanism, according to claim **1**, wherein said tube includes an end plastic sleeve which extends beyond the end of said plastic tube and engages over said guideway, said end sleeve including a plurality of tongues extending parallel to said tube axis, said guideway including a metal part having a slot for accommodating each tongue.

9. In a window operating mechanism, according to claim **1**, wherein said plastic tube includes a guideway engaging said sleeve having a laterally extending portion, said guideway having a metal part with a slot into which said laterally extending portion extends, and means for securing said tube to said guideway.

10. In a window operating mechanism, according to claim **1**, wherein said drive housing includes a spring gear having a hollow interior space forming a spring storage, a spring located within said spring storage and being fixed at one end and connected at its opposite end to said gear, said spring gear being engageable with said drive gear and being rotatable by said drive gear to wind said spring when said window panel is moved in an opening direction and being rotatable by said spring to drive said drive gear when said window is moved in a closing direction.

11. In a window operating device, according to claim **10**, wherein said housing includes a hub affixed thereto and extending into the spring storage portion of said gear, said spring comprising a coil spring having an inner end wound around said hub and engaged therewith and an outer end extending into the inner periphery of said spring gear and secured thereto.

12. In a window operating mechanism, according to claim **11**, including a cover for said gear spring storage portion and said cover being made of a plastic material.

13. In a window operating mechanism, according to claim **1**, wherein a flexible plastic tube is fitted over the end of said tube and is arranged to receive the end of said threaded drive gear which extends through said tubular housing and which is remote from the end connected to said guideway.

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