Jan. 4, 1955 J. KELLMAN ET AL 2,698,753

WINDOW REGULATOR

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FIG. 1

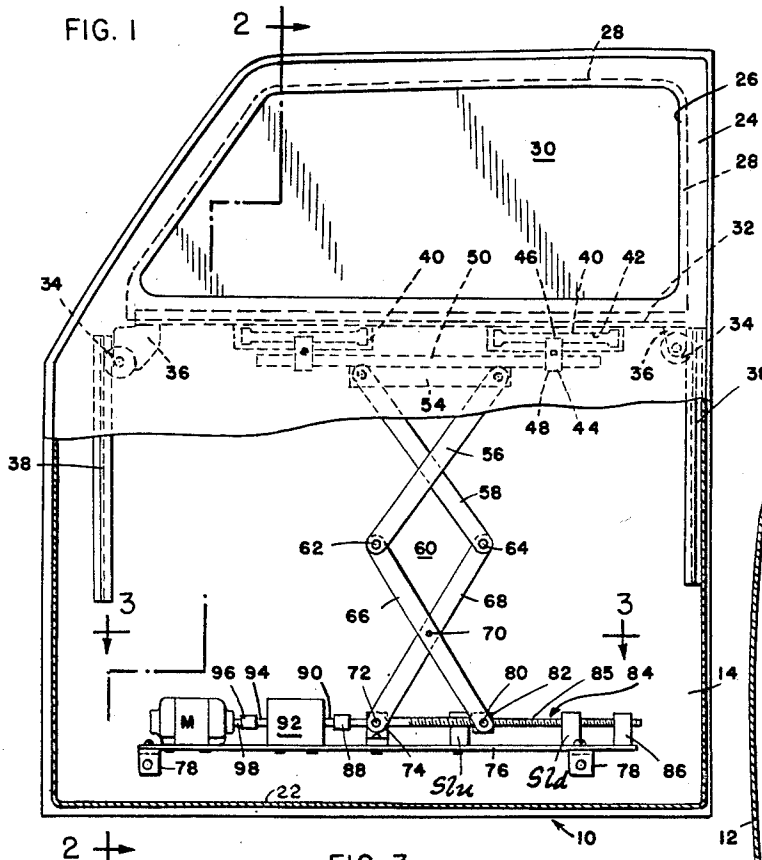

FIG. 2

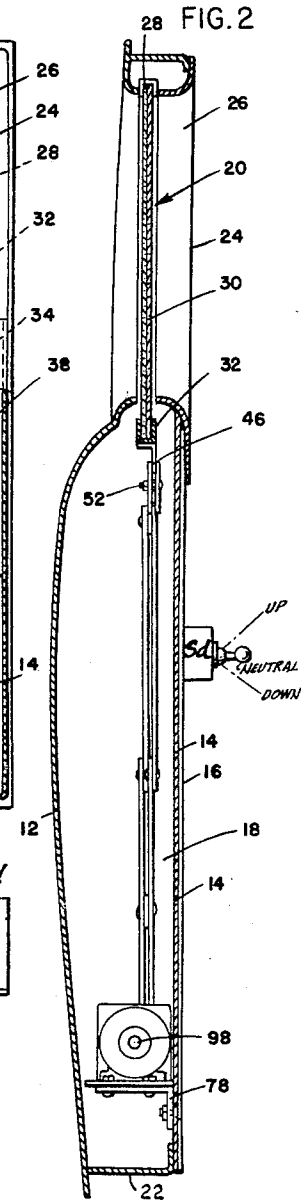

FIG 3

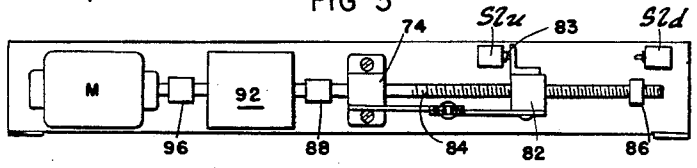

FIG. 4

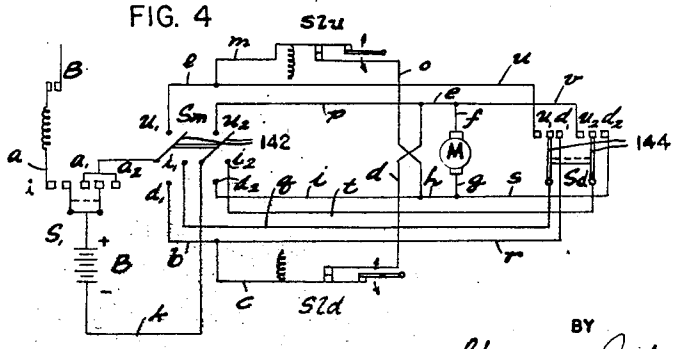

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FIG. 5

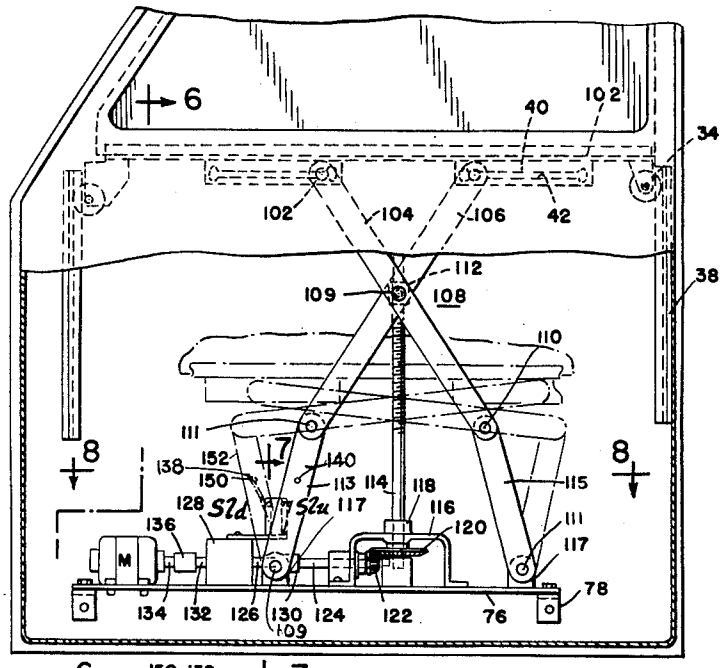
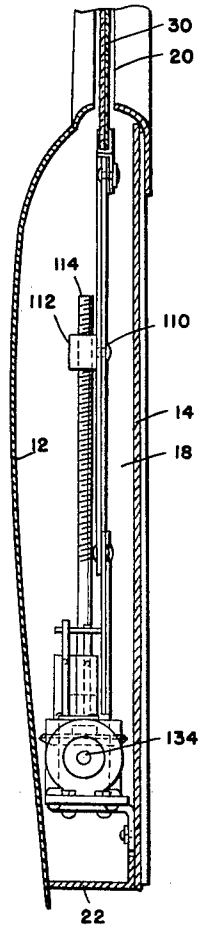


FIG. 6



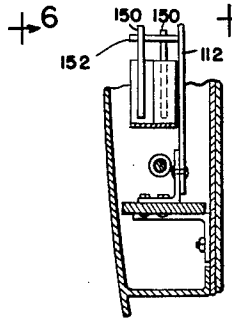
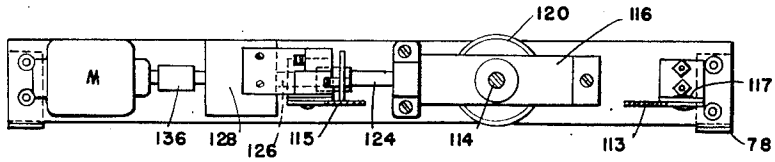


FIG. 7

FIG. 8



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United States Patent Office

2,698,753

Patented Jan. 4, 1955

2,698,753

WINDOW REGULATOR

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Application July 18, 1950, Serial No. 174,426

3 Claims. (Cl. 268—127)

The present invention relates to automatic window regulators for automotive vehicle windows and, more particularly, to an electrically controlled window regulator which is so designed as to enable it to be applied to the mechanism already present in the conventional manually operated type of window regulator by the elimination of certain parts of the installed mechanism.

The majority of automobiles are provided with window regulator mechanisms which are manually controlled by means of a crank or handle which is rotated to raise the window to closed position, or to lower the window to open position. Some manufacturers grant the option to the purchaser of the automobile to have automatic mechanism installed at the factory, whereby the raising and lowering of the automobile windows may be accomplished automatically and usually by means of a hydraulic system. The installation of the hydraulic type of automatic window regulator is usually expensive. Furthermore, such mechanism must be installed at the factory since the character of the mechanism is such that it is not feasible to have it installed on an automobile which is already provided with the manual type.

The present invention is directed to a relatively simple window regulator mechanism which is controlled electrically and which is capable of being applied to the conventional manually operable window regulator mechanism by the elimination of the manually operable crank which is ordinarily employed in such mechanisms, together with certain of the gearing and leverage systems employed in connection therewith. Such a device will enable the owner of an automobile provided with the manual type of window regulator to change to the improved automatic window regulator at an expense which is considerably less than that required for the factory installation of the hydraulic type of regulator set forth above.

It is, therefore, one of the principal objects of the present invention to provide an electrically controlled window regulator for automobiles which may be substituted in existing installations of the manually controlled type by the elimination of certain of the original parts of the mechanism and by the substitution or addition or other automatically operable mechanisms.

A further object of the invention is to provide an electrically controlled window regulator consisting of a relatively simple leverage system capable of operative attachment to the usual depending slotted track members which are secured to the usual window channel member and which is capable of being actuated under the control of an electric motor through a relatively simple system of gearing for the purpose of raising or lowering the window.

Yet another object of the invention is to provide electrically controlled window regulating mechanism including an electric circuit having associated therewith a manually operable switch capable of being mounted at a suitable location as, for example, inside of the door frame, and also including a master control switch conveniently accessible to the driver of the vehicle, the circuit being such that either switch may be utilized for raising or lowering the window, and whereby the circuit through one of the switches will become opened if an attempt is made to operate both switches simultaneously.

Yet another object of the invention is to provide a window regulator of the type briefly outlined above in which the leverage system employed is an extremely powerful one requiring a relatively low actuating force to effect either window opening or closing operations, and which, therefore, may be actuated under the control of a relatively small, compact and light motor of the six volt direct current variety.

The provision of a window regulator of the character briefly outlined above which is extremely simple in its construction; one which is comprised of a minimum number of moving parts, and which, therefore, is unlikely to get out of order; one which is rugged and durable in its construction; one which is capable of quick and easy assembly in the automobile door compartment ordinarily provided for structures of this type, whether the installation be originally made in the automobile door, or whether it be in the form of a partial substitution for already existing equipment; and one which is well adapted to perform the services required of it, are further desiderata which have been borne in mind in the production and development of the present invention.

Other objects and advantages of the invention not at this time enumerated will become more readily apparent as the nature of the invention is understood.

In the accompanying two sheets of drawings forming a part of this specification, two embodiments of the invention have been shown.

In these drawings:

Fig. 1 is a side elevational view of a typical automobile door assembly showing the window regulating mechanism comprising the present invention applied thereto. In this view a portion of the inside door panel has been removed more clearly to illustrate the nature of the invention.

Fig. 2 is an enlarged sectional view taken substantially along the line **2**—**2** of Fig. 1;

Fig. 3 is a sectional view taken substantially along the line **3**—**3** of Fig. 1;

Fig. 4 is a circuit diagram showing the electrical operation of the present invention;

Fig. 5 is a fragmentary side elevational view similar to Fig. 1 showing a modified form of the invention;

Fig. 6 is a sectional view taken substantially along the line **6**—**6** of Fig. 5;

Fig. 7 is a sectional view taken substantially along the line 7—7 of Fig. 5; and

Fig. 8 is a sectional view taken substantially along the line **8**—**8** of Fig. 5.

In all of the above described views, similar characters of reference are employed to designate similar parts throughout.

Referring now to the drawings in detail and, more particularly to Figs. 1 to 4, inclusive, a typical automobile door is illustrated and is designated in its entirety at **10**. As is conventional in doors of this type, the door **10** is provided with an outer side or panel **12** and an inner side or panel **14**, the latter being covered with a suitable upholstery material **16**. The sides or panels **12** and **14** are spaced apart to provide an interior space or compartment **18** into which the window assembly **20** is capable of being retracted at different degrees of elevation from its fully extended position, as shown in Fig. 2. A bottom flange **22** extends laterally from the front side or panel **12**, and is secured in any suitable manner as, for example, welding, to the inner door panel **14**. The upper part of the door is provided with a framelike portion **24** providing an opening **26** therethrough adapted to receive the window assembly **20**, suitable channel-like recesses **28** being provided for guiding the window assembly in its sliding movements, as well as for sealing purposes. The window assembly includes a windowpane proper **30** which consists of a sheet or laminae of plate glass having a contour designed to fit the window opening **26**, and having its lower end seated or clamped in a horizontal channel member **32**. Each end of the channel member **32** is provided with a roller **34** suitably mounted on ears **36** depending from the channel member and adapted to ride in respective vertically positioned channel shaped guide members **38** suitably secured to the door framework, whereby the window assembly **20** will be guided in its movements and will be maintained in proper alignment with the various guiding members therefor so that the same will not bind in the frame structure provided for it.

Present day existing window assemblies are many and varied, and for purposes of illustration the window channel **32** is illustrated as being of the type which is pro-

vided with a pair of depending flange portions **40** which are spaced apart on the channel member and occupy positions medially of the ends thereof. The flanges **40** are provided with elongated slots **42** therein which extend horizontally and which are ordinarily provided for the purposes of receiving therein the usual cam rollers associated with the well-known rotating arm type of window regulator. The flanges **40** and the slots **42** perform no such function in connection with the present invention, but are provided merely as anchoring elements for attachment thereto of a pair of straddle clamps **44** having upper clamping arms **46** which straddle the lower portion of the flange **40** and which may have inturned ends **46** extending into the slots **42**, and also having lower straddle arms **48** adapted to receive and clamp therebetween an elongated horizontally extending bar **50**. Nut and bolt assemblies **52** serve, when tightened, to draw the two parts of the straddle clamps **44** toward each other and securely clamp the bar **50** to the flanges **40**.

The bar **50** has welded, or otherwise secured thereto, a depending flange portion **54** at the opposite ends of which there are pivoted the outer ends of a pair of cross links **56** and **58** of a modified lazy-tongs device designated in its entirety at **60**. The free ends of the links **56** and **58** are pivoted as at **62** and **64** to respective cross links **66** and **68**, the latter links being pivoted medially as at **70** to each other. The lower end of the link **68** is pivoted as at **72** to a bracket **74** suitably secured to a platform or ledge **76** suitably mounted on brackets **78** secured to the inner side panel **14** of the door assembly **10**.

The lower end of the link **66** is pivotally secured as at **80** to a block member **82** which is threadedly received on a feed screw **84** in the form of an elongated threaded rod having one end thereof pivoted in a bearing block **86** mounted on the platform **76** and having the other end thereof secured by means of a coupling member **88** to the output shaft **90** of a gear reduction box **92**. The feed screw **84** is provided with a threaded portion **85** having threads of relatively short pitch. The input shaft **94** of the gear reduction box **92** is connected by a flexible coupling **96** to the motor shaft **98** of an electrical motor M, the motor and gear reduction box **92** being suitably supported on the ledge **76**. A medial bearing block **100** suitably supported on the ledge **76** serves to support the medial region of the feed screw **84**.

The motor M is reversible and is of the usual six or twelve volt variety ordinarily employed for energizing the ignition system as well as operating the auxiliary automotive equipment as, for example, windshield wipers, radios, retractible convertible tops, and the like. The motor is adapted to be operatively connected in a circuit whereby operation of the window may be placed under the control of the driver of the vehicle in the driver's seat or of one of the passengers thereof, all in a manner that will be fully described subsequently.

In Fig. 1 the window assembly **20** is shown as being positioned in its fully elevated or closed position. When a circuit is established through the field windings in such a direction as to cause counterclockwise rotation of the motor shaft, as viewed in Fig. 2, the block member **82** will travel outwardly along the feed screw **84**, it being assumed, of course, that the threads on the feed screw are of the right-hand variety. Since the lower end of the link **68** is pivotally secured to the stationary bracket **74**, the tendency will be for the lower ends of the links **66** and **68** to move relatively away from each other, thus collapsing the modified form of lazy-tongs device **60**, previously described. Thus, the upper ends of the links **66** and **68**, as well as the lower ends of the links **56** and **58**, will be spread apart and the upper ends of the links **56** and **58** which are fixedly pivoted to the flange **54** of the window assembly **30** will be drawn downwardly within the space or compartment **18**, thus pulled with the entire assembly per se **30**.

Since the pitch of the threads provided on the feed screw **84** is relatively short, and since a reduction gearing is disposed between the motor M and the feed screw **85** an extremely high leverage is afforded and a powerful downward thrust is exerted upon the flange **54** tending to lower the window assembly **20**, despite any loss of leverage that may exist through the lazy-tongs device **60**. This high leverage also provides a braking factor tending to quickly stop or cease the motion of the window assembly whenever the current supply to the motor M is interrupted. In other words, upon deenergization of the motor M, there will be no coasting thereof and, as a consequence, the operator may, by simply opening the electrical circuit leading to the motor, stop the window assembly in its motion at a required instant to attain any desired degree of window regulation.

Obviously, reverse rotation of the motor, i. e., in such a manner as to cause clockwise rotation of the motor shaft **98**, as viewed in Fig. 2, will cause raising of the window assembly **20**.

The control circuit for the motor M is illustrated in Fig. 4 and this control circuit is identical with the control circuit employed in connection with the motor utilized in connection with the form of the invention shown in Figs. 5 to 8, inclusive, and, as a consequence, the description of this control circuit of Fig. 4 will be left until the form of the invention shown in Figs. 5 to 8, inclusive, have been described and fully understood.

Referring now to Figs. 5, 6, 7 and 8, wherein a modified form of the invention has been illustrated, the door assembly **10** is substantially identical with the door assembly shown in Fig. 1, and, as a consequence, in order to avoid repetitious description, similar characters of reference have been employed to designate the corresponding parts of the two door constructions. The outer side or panel **12**, the inner side or panel **14**, the flange portion **22** at the bottom of the door assembly, the window assembly **20**, including the window proper **30**, and all of the various parts thereof, such as the rollers **34**, guide members **38**, etc., as well as the platform **76** for the motor M and its supporting brackets **78**, remain substantially the same as the corresponding parts of Fig. 1.

The depending flange portions **40** having the slot portions **42** formed therein are employed in this form of the invention in a manner similar to that for which they were originally intended, in that each slot receives therein an operating roller **102** carried at the upper ends of a pair of cross links **104** and **106** associated with a modified form of lazy-tongs assembly **108**. The links **104** and **106** are pivoted to each other in their medial regions by means of a pivot pin or stud **110** secured in a block member **112** threadedly mounted on a feed screw **114** and the purpose of which will be described subsequently. The lower ends of the links **104** and **106** are pivotally connected as at **109** and **111**, to a pair of links **113** and **115**, respectively, the lower ends of these latter links being pivotally secured each to an upstanding bracket **117** suitably mounted on the platform **76**.

From the above description of parts, it will be seen that the lazy-tongs structure **108** just described is collapsible and that downward movement of the block **112** in the door space or compartment **18** will serve to spread the pivot points **109** and **111** of the lazy-tongs assembly apart so that the entire lazy-tong linkage system **108** assumes the collapsed dotted line position shown in Fig. 5. Such collapsing of the lazy-tong system causes the rollers **102** to move downwardly in the compartment **18** while at the same time they travel outwardly or away from each other in the slots **42** of their respective flanges **40**, thus forcibly moving the window assembly **20** downwardly.

In order to impart a vertical component of movement of the block **112** in either direction, a spider **116** is suitably secured to the platform **76** and is provided with a hub **118** in which the lower end or feed screw **114** is rotatably journalled. The extreme lower end of the feed screw **114** has mounted thereon a bevel gear **120** which meshes with a second bevel gear **122** mounted on the outer end of a shaft **124** which is connected to the output shaft **126** of a gear reduction box **128** by means of a flexible connection **130**. The input shaft **132** of the gear reduction box **128** is connected to motor shaft **134** of the motor M by a flexible connection **136**.

It will be seen that upon rotation of the motor shaft **134** in a clockwise direction, as viewed in Fig. 2, the gear **122** will drive the gear **120** in such a direction as to rotate the feed screw **114** in a counterclockwise direction as viewed from the bottom of Fig. 5. Thus, assuming that the threads of the feed screw **114** are right-handed, such rotation of the feed screw will serve to draw the block **112** downwardly to lower the window assembly in the manner previously described. Obviously, reverse rota-

tion of the motor M will cause raising of the window assembly **20**. Because of the fact that the diameter of the bevel gear **122** is relatively small and the diameter of the bevel gear **120** is relatively large, and also because of the gear reduction device **128**, and the small pitch of the thread of the feed screw **114**, a powerful force is exerted upon the block **112** in either direction depending upon whether window opening or closing movements are in effect. This gear reduction effect also provides a breaking action so that when the circuit existing through the windings of the motor M is interrupted, the window assembly will come immediately to rest at the desired position of adjustment.

The electrical controls for the form of the invention shown in Figs. 1 to 3, inclusive, differ slightly from the controls for the form of the invention shown in Figs. 5 to 8, inclusive, but the circuit diagram of Fig. 4 will suffice to illustrate the operation of both forms of the invention.

In the form of the invention shown in Figs. 1 to 3, inclusive, a pair of limit switches *Slu* and *Sld* which may be in the form of microswitch units are suitably mounted on the platform **76** and are positioned in the path of movement of a finger **83** provided on the block **82** which travels longitudinally in either direction on the threaded portion **85** of the feed screw **84**.

In the form of the invention shown in Figs. 5 to 8, inclusive, the limit switches *Slu* and *Sld* are each in the form of normally closed contacts, one of which has associated therewith a finger **138** engageable with a pin **140** provided on the link **113** of the lazy-tongs mechanism **108**.

The disclosure of the limit switches *Slu* and *Sld* and the positioning thereof is purely exemplary as these instrumentalities may vary in their form and they may be located at any suitable regions where they will be actuated upon contact with a part of the window assembly **20** or a moving part of its actuating mechanism. The normally closed limit switches *Slu* of either form of the invention are adapted to be actuated to become open when the window proper **30** reaches the upper limit of its motion, while the limit switches *Sld* are adapted to be actuated when the window attains its lowermost position. The purpose of the limit switches *Slu* and *Sld* will become apparent presently.

The electrical instrumentalities of both forms of the invention include a master switch *Sm* of the three-way or triple throw, double pole type, having movable pole arms **142**, and a door switch *Sd* of the two-way or double throw, double pole type, having pole arms **144**, the former being adapted to be suitably positioned under the control of the driver of the vehicle as, for example, on the instrument panel of the vehicle and the latter being suitably positioned where it is convenient to a passenger within the vehicle as, for example, on the door panel **14**. The function of the master switch *Sm* is to give the driver of the vehicle control over the regulation of the window at any time, even to the exclusion of the passenger, while the door switch *Sd* is adapted to permit window regulation by the passenger whenever the condition of the master switch *Sw* will permit.

Referring now to the circuit diagram of Fig. 4 wherein the electrical controls for either form of the invention are illustrated, the circuit arrangement is such that all of the various control switches are in their neutral or inoperative positions, while the limit switches *Slu* and *Sld* are in their normally closed positions indicating that the window **30** is in some intermediate position and is neither wide open, nor completely closed.

The window regulating circuits may be associated with the ignition circuit of the motor vehicle in such a manner that they will be available for operation when the ignition key is inserted in the ignition lock and turned in either direction, and toward this end the ignition switch *Si* may be disposed in the circuit between the battery B and the master switch *Sm*. In one position of the ignition switch, current is available through the *i* contacts of the ignition switch to the lead *a* extending to the ignition coil of the vehicle, and is also available through the contacts, *a*1 thereof to the master switch *Sm*. In the other position of the ignition switch current is excluded from the ignition circuit, but is available for window regulation through the *a*2 contacts. In the following description it will be assumed that the ignition switch is turned to the one or the other to its "on" positions for energization of the various auxiliary equipment of the vehicle including the window regulating mechanism, as well as the ignition, or for only

such auxiliary equipment as may be connected to the *a*2 contacts to the exclusion of the ignition system.

Assuming now that it is desired to lower the window **30** from its fully closed or raised position, as illustrated in Fig. 1, and that this lowering operation is to take place under the control of the driver of the vehicle, the master switch will be moved to its "down" position, wherein the arms **142** thereof engage the *d*1 and *d*2 contacts thereof so that a circuit is completed from the positive side of the battery B through either the *a*1 and *a*2 contacts of the ignition switch *Si*, arm **142** and contacts *d*1 of the master switch *Sm* leads *b*, *c*, limit switch *Sld* (now closed by virtue of the closed position of the window), leads *d*, *e*, *f*, the winding of the motor M, leads *g*, *h*, *i*, *d*2 contacts, arm **142** of the master switch, and lead *k*, to the negative side of the battery B.

Closure of the circuit just described will cause the motor M to become energized so that the motor shaft **94** thereof will rotate in the proper direction to cause lowering of the window **30**. The window will become progressively lower, during existence of the circuit just described, until such time as the limit switch *Sld* becomes open due to the arrival of the window at its lowermost or completely open position, at which time the circuit will become open and the window will remain lowered, while the drain of current from the battery B for window regulating purposes will terminate.

It is quite obvious that if it is desired to interrupt the circuit just described at any intermediate point in the cycle of operations by moving the master switch to an open position, or to its intermediate position wherein the arm **142** engages the contacts *i*1 and *i*2, the motor will become deenergized and the window will immediately come to rest at the position it assumes at the time of opening of the circuits.

Reestablishment of the circuit just described from any intermediate position of the window, by again moving the master switch to its "down" position, will again cause lowering of the window in the manner just described.

If it is desired to raise the window to close the same under the control of the master switch *Sm*, the arms **142** will be moved to their "up" positions so that a circuit will exist from the positive side of the battery through the ignition switch *Si*, master switch contact *u*1, leads *l*, *m*, limit switch *Slu* (closed by virtue of the partially open or wide open position of the window), leads *o*, *h*, *g*, winding of the motor M, leads *e*, *p*, contact *u*2 and arm **142** of the master switch *Sm*, and lead *k* to the negative side of the battery B.

It is to be noted that closure of the circuit just described will cause current to flow through the motor in a direction to cause raising of the window, and the window will become progressively raised during existence of the circuit until such time as the limit switch *Slu* becomes open due to arrival of the window at its uppermost or closed position, at which time the circuit through the motor will become open and the window will remain raised while drain of the current from the battery B for window regulating purposes will terminate.

Such operation of the master switch *Sm* to effect window raising or lowering is independent of the position of the door switch *Sd* which may be in any position of adjustment inasmuch as with the arms **142** of the master switch in any position other than in engagement with the contacts *i*1 or *i*2, no circuit path exists leading from the door switch *Sd* to the battery B. The master switch *Ms* therefore may be said to overrule the door switch *Sw* in any of its positions.

When the master switch *Ms* is in its intermediate position with the arms **142** in engagement with the contacts *i*1 and *i*2, the door switch may be operated for window raising or lowering purposes. If it is desired to lower the window through the medium of the door switch *Sw*, this latter switch is moved to its "down" position and a circuit will exist from the battery B through the ignition switch *Si*, arm **142** and contact *i*1 of the master switch *Sm*, lead *q*, arm **144** and *d*1 contacts of the door switch *Sd*, leads r, c, door limit switch *Sld*, leads *d*, *e*, *f*, winding of the motor M, leads *g*, *s*, *d*2 contacts and arm **144** of the door switch *Sd*, lead *t*, contacts *i*2 and arm **142** of the master switch *Sm*, and lead *k* to the negative side of the battery B.

The "up" circuit for the door switch, whereby the window may be raised with the master switch in its intermediate position exists from the positive side of the bat-

tery B through the ignition switch S*i*, arm **142** and contacts *i***1**, lead *q*, arm **144** and contact *u***1** of the door switch S*d*, leads *u*, *m*, switch S*lu* (now closed by virtue of the fully open or partially open position of the window **30**), leads *o*, *h*, *g*, winding of the motor M, leads *f*, *v*, *u***2** and arm **144** of the door switch S*d*, lead *t*, contacts *i***2** and arm **142** of the master switch S*m*, and lead *k* to the negative side of the battery B.

Since the "up" circuit for the door switch previously described includes the limit switch S*lu*, and since the "down" circuit for the door switch just described includes the limit switch S*ld*, it is obvious that when the window reaches either of its limiting positions (i. e., up or down), the respective circuits will be open to permit the window to remain in either of its limiting positions, up or down, as the case may be.

Movement of the door switch S*d* to its intermediate position at any time during the window regulating cycle will interrupt the cycle by opening the existing circuit to leave the window in any desired position of adjustment, whether the interrupted cycle be an "up" cycle or a "down" cycle.

As in the case of the master switch control, reestablishment of either the "up" or "down" circuits leading through the door switch S*w*, with the master switch in its intermediate position, will cause energization of the motor for rotation in the proper direction to attain the desired "up" and "down" adjustment of the window.

Changes may be made in the form, construction and arrangement of parts from those disclosed herein without in any way departing from the spirit of the invention or sacrificing any of the attendant advantages thereof, provided, however, that such changes fall within the scope of the claims appended hereto.

The invention is hereby claimed as follows:

1. Electrically controlled window regulating mechanism adapted to be installed between the side panels of an automotive vehicle door having a conventional slidable window assembly including a windowpane supporting channel, or the like, comprising a lazy-tongs device capable of extension and contraction in the direction of window movement, and including an upper pair of cross links and a lower pair of cross links, means pivotally connecting the upper ends of said upper pair of cross links to said pane supporting channel at fixed spaced points therealong, means pivotally connecting the medial region of said lower pair of links, the medial regions of said upper pair of cross links being free each from the other, means providing a stationary pivotal connection for the lower end of one of said lower pair of links, a feed screw connected to the lower end of said lower pair of links and operable on rotation thereof in opposite directions to move said latter end toward and away from said first mentioned lower end of said lower pair of links, a reversible motor operatively connected to said feed screw in driving relationship and means for selectively energizing said motor for rotation in opposite directions.

2. Electrically controlled window regulating mechanism adapted to be installed between the side panels of an automotive vehicle door having a conventional slidable window assembly including a windowpane supporting channel or the like having spaced slotted attachment flanges depending therefrom, a supporting bar for said window assembly, a straddle clamp securing each attachment flange to the supporting bar in fixed relation, a pair of cross links pivotally connected together in their medial regions, means connecting the upper ends of said cross links to said pane supporting channel whereby vertical components of motion of said ends will be transmitted to the channel to raise or lower the window assembly, means providing a stationary pivotal connection for the lower end of one of said links, a feed screw operatively connected to the lower end of the other link and operable upon rotation thereof in opposite directions to move said latter end toward and away from said first mentioned lower end, a reversible motor operatively connected to said feed screw in driving relationship, and means for selectively energizing said motor for rotation in opposite directions.

3. Electrically controlled window regulating mechanism adapted to be installed between the side panels of an automotive vehicle door having a conventional slidable window assembly including a windowpane supporting channel, or the like, having spaced slotted attachment flanges depending therefrom, a supporting bar for said window assembly, a straddle clamp securing each attachment flange to the supporting bar in fixed relation, a lazy-tongs device capable of extension and contraction in the direction of window movement, and including an upper pair of cross links and a lower pair of cross links, means connecting the upper ends of said upper pair of cross links to said pane supporting channel at spaced apart fixed points whereby vertical components of motion of said ends will be transmitted to the channel to raise or lower the window assembly, means pivotally connecting the medial region of said lower pair of links, the medial regions of said upper pair of cross links being free each from the other, means providing a stationary pivotal connection for the lower end of one of said lower pair of links, a feed screw operatively connected to the lower free end of the other link of said lower pair and operable upon rotation thereof in opposite directions to move said latter end toward and away from said first mentioned lower end of said lower pair, a reversible motor operatively connected to said feed screw in driving relationship and means for selectively energizing said motor for rotation in opposite directions.

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