(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 139 269**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **84111988.6**

(22) Date of filing: **05.10.84**

(51) Int. Cl.⁴: **E 05 F 15/16**
E 05 F 11/48

(30) Priority: **07.10.83 JP 186841/83**

(43) Date of publication of application:
02.05.85 Bulletin 85/18

(84) Designated Contracting States:
DE FR GB

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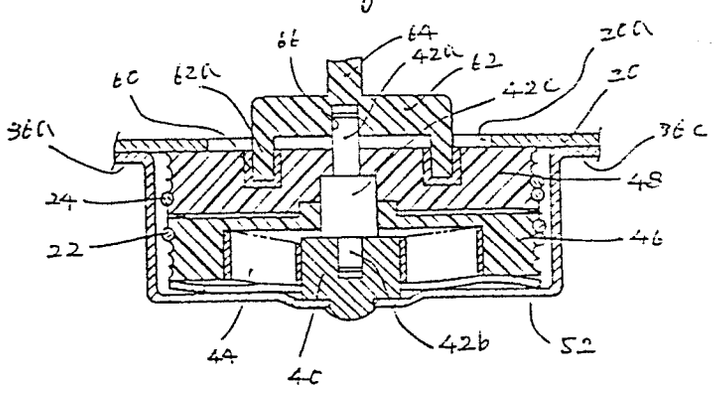
(54) Wire retracting device of motor-powered window regulator.

(57) In order to stably hold a drum shaft (42) of drive and driven drums (46,48) of the wire retracting device, one axial end (42b) of the shaft is supported by a bearing (40) fixed to a casing (36), and the other axial end (42a) of the same is supported by an output shaft (64) of a motor-powered drive unit (32,34).

Fig. 3



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WIRE RETRACTING DEVICE OF MOTOR-POWERED WINDOW REGULATOR

The present invention relates to a wire retracting device of a window regulator which moves the window pane to a desired position by moving a wire or wires, and more particularly to a wire retracting device which is powered by an electric motor.

Hitherto, there have been proposed various kinds of wire retracting devices for a motor-powered window regulator. As will be described in detail hereinafter, an exemplified motor-powered window regulator comprises generally a window pane carrier movable together with the window pane, two wires extending from the carrier, a wire retracting device to which the wires lead, and a motor-powered drive unit for driving the wire retracting device. Upon electric energization of the drive unit, the power created by the motor drives the wire retracting device to retract either one of the wires thereby moving the window pane carrier. Upon deenergization of the electric drive unit, the movement of the carrier stops and thus the window pane stops at a desired position. Some of the wire retracting devices employed in the above-mentioned window regulator are of a type which is equipped with a so-called "automatic wire slack remover" which automatically removes the slackness of the wires. Usually, the remover comprises two wire retracting drums (viz., drive and driven drums) which are coaxially and rotatably disposed about a common supporting shaft

and mated with each other through ratchet means formed therebetween. However, due to insufficient supporting function of the supporting shaft employed therein, some of such wire retracting devices tend to induce unstable rotation of the two drums particularly after long use thereof. Of course, such undesirable rotation of the drums brings about unbalanced operation of the wire retracting device.

It is therefore an essential object of the present invention to provide an improved wire retracting device which is free of the above-mentioned drawback.

According to the present invention, there is provided, in a motor-powered window regulator having a motor-powered drive unit with an output shaft, a wire retracting device which comprises a casing, a supporting shaft disposed in the casing with its axial one end supported by a bearing fixed to the casing, a wire winding annular device concentrically and rotatably disposed on the supporting shaft and winding thereon a wire which extends to a window pane mover, and supporting means for rotatably supporting the axial other end of the supporting shaft to an axial end portion of the output shaft of the drive unit.

Other objects and advantages of the present invention will be apparent from the following description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a sectional view of a less preferred embodiment of a wire retracting device employed in a motor-powered window regulator;

Fig. 2 is an entire view of a motor-powered window regulator which incorporates therein an improved wire retracting device according to the present invention;

Fig. 3 is a sectional view of the improved wire retracting device of the invention, which is taken along the line III-III of Fig. 2;

Fig. 4 is an exploded view of the improved wire retracting device of the invention; and

Fig. 5 is a perspective view of a motor-powered drive unit which is incorporated with the improved wire retracting device of the invention.

Prior to describing in detail the construction of the improved wire retracting device of the invention, the entire system of a motor-powered window regulator in which the wire retracting device is employed will be described with reference to Fig. 2.

Referring to Fig. 2, there is shown the motor-powered window regulator which is designed to move up or down an automotive door window to a desired position by the force of an electric motor. The window regulator comprises an elongate plate 10 which is disposed in an automotive door (not shown) to extend vertically. The elongate plate 10 is formed at its one side with a guide rail 12 which extends therealong. Slidably moved along the rail 12 is a carrier plate 14 which has a grooved portion (not shown) for slidably receiving therein the rail 12. A window pane 16 is mounted on and secured to the carrier plate 14 and thus they are moved together. It is thus to be noted that the window pane 16 as illustrated in the drawing assumes its

lowermost position thereby fully opening the door window. Designated by numeral 18 is a wire retracting device of the invention which is mounted on a base plate 20 secured to an inner panel (not shown) of the door. The wire retracting device 18 is positioned at the outboard side with respect to the door inner panel. Extending from the device 18 are two flexible wires 22 and 24 which lead to the carrier plate 14. That is, the leading end 22a of the wire 22 is fixed to the carrier plate 14 after passing over a guide roller 26 arranged at the upper portion of the elongate plate 10, while, the leading end 24a of the other wire 24 is also fixed to the carrier plate 14 after passing through a guide groove 28 arranged at the upper portion of the elongate plate 10 and then passing through a turning groove 30 formed at the lower portion of the elongate plate 10. On the inboard side of the base plate 20, there is mounted a motor-powered drive unit (see Fig. 5) which comprises an electric motor 32 and a speed reduction gear 34. As will be described in detail hereinafter, the output shaft of the speed reduction gear 34 is detachably connected to the wire retracting device 18 to drive the same.

When, in operation, the electric motor 32 is energized to run in one direction, the wire retracting device 18 retracts one of the wires, for example, the wire 22 while drawing out the other wire 24 therefrom. With this, the carrier plate 14 and thus the window pane 16 mounted thereon are moved together upward along the rail 12 until the electric supply to the motor 32 stops. Upon this stop of electric supply, the movement of the window pane

16 stops, and thereafter, the window pane 16 keeps its half-open position irrespective of its weight. When, on the contrary, the electric motor 32 is energized to run in the reversed direction, the wire retracting device 18 retracts the wire 24 while drawing out the wire 22 therefrom. With this, the window pane 16 is moved downward until the electric supply to the motor 32 stops.

In the following, the construction of the wire retracting device 18 will be described in detail with reference to Figs. 2 to 5, particularly Figs. 3 and 4.

As will be best seen from Fig. 4, the wire retracting device 18 comprises a casing 36 which has three lug portions 36a, 36b and 36c each extending radially outwardly from the open side of the casing 36. The casing 36 is bolted at the lug portions 36a, 36b and 36c to the base plate 20 which has an opening 20a, as shown in Fig. 3. The casing 36 is formed at the bottom portion thereof with an opening 38 into which a reduced end portion 40a of a bearing 40 is securedly fixed. The bearing 40 has a recess consisting of an axially extending cylindrical section 40b and a rectangular section 40c. The diameter of the cylindrical section 40b is greater than the thickness of the rectangular section 40c.

A drum shaft 42 having upper and lower pin portions 42a and 42b is beared by the bearing 40 in such a manner that the lower pin portion 42b is rotatably received in the cylindrical section 40b of the bearing 40. A spiral spring 44 having inner and outer ends 44a and 44b is disposed about the fixed bearing 40 (see Fig. 3) with the inner

end 44a hooked to the rectangular section 40c of the recess of the bearing 40.

Designated by numeral 46 is a driven drum which has at its lower portion a circular recess into which the spiral spring 44 is received (see Fig. 3). The cylindrical outer wall of the driven drum 46 is formed with a helical guide groove 46a, and the circular upper portion of the same is formed at the periphery thereof with ratchet teeth 46b and at the center thereof with a rimmed hole 46c. The rimmed hole 46c extends to the above-mentioned circular recess of the driven drum 46. The outer end 44b of the spiral spring is hooked to a suitable portion of the circular recess of the driven drum 46 so that the drum 46 is biased to rotate in a wire retracting direction, that is, in the counterclockwise direction in Fig. 4. As is seen from Fig. 3, the drum shaft 42 is received in the rimmed hole 46c of the driven drum 46 and projected upwardly considerably from the same.

As is understood from Fig. 3, a drive drum 48 is coaxially arranged on the driven drum 46 with its upper surface slidably contacting with the inner surface of the base plate 20. The drive drum 48 has a center bore 50 consisting of a smaller diameter section, an intermediate section and a larger diameter section. Similar to the driven drum 46, the cylindrical outer wall of the drive drum 48 is formed with a helical guide groove 48a, and the circular lower portion of the same is formed at the periphery thereof with ratchet teeth 48b. The drive drum 48 is arranged on the driven drum 46 in such a manner that the smaller diameter section, the intermediate section

and the larger diameter section of the center bore 50 receive therein respectively the upper pin portion 42a of the drum shaft 42, the major portion 42c of the same and the bored rim portion 46c of the driven drum 46, as is understood from Fig. 3. It is to be noted that the upper pin portion 42a of the drum shaft 42 is projected outwardly from the center bore 50 of the drive drum 48. Upon proper mounting of the drive drum 48 on the driven drum 46, the ratchet teeth 48b of the drive drum 48 are operatively mated with the ratchet teeth 46b of the driven drum 46. For assuring this ratchet engagement between the ratchet teeth 48b and 46b, a wave washer 52 is disposed between the bottom portion of the casing 36 and the driven drum 46, by which the driven drum 46 is biased toward the drive drum 48. The ratchet teeth 48b and 46b are so designed as to couple these two drums 48 and 46 when the drive drum 48 is rotated in the counterclockwise direction (in Fig. 4) or the driven drum 46 is rotated in the clockwise direction (in Fig. 4). Thus, relative rotation between them is permitted only when the drive drum 48 is rotated in the clockwise direction or the driven drum 46 is rotated in the counterclockwise direction. The flexible wires 22 and 24 are helically wound along the guide grooves 46a and 48a of the driven and drive drums 46 and 48, respectively. The end 22b of the wire 22 is hooked to a cut 46d formed in the driven drum 46, while, the end 24b of the other wire 24 is hooked to a cut (not shown) formed in the drive drum 48, so that the wire 22 is retracted by the driven drum 46 when the latter 46 is rotated in the counterclockwise direction

in Fig. 4, while, the wire 24 is retracted by the drive drum 48 when the latter 48 is rotated in the clockwise direction. It is thus to be noted that pull-out movement of the wire 22 induces the coupled rotation of the driven and drive drums 46 and 48 in the clockwise direction in Fig. 4 thereby causing the other wire 24 to be retracted by the drive drum 48, while, the pull-out movement of the wire 24 induces the coupled rotation of the drums 48 and 46 in the counterclockwise direction in Fig. 4 thereby causing the wire 22 to be retracted by the driven drum 46. In order to provide simultaneous and equivalent movement between these wires 22 and 24, the guide grooves 46a and 48a of the drums 46 and 48 have the same sizes.

The drive drum 48 is formed with an annular recess 54 about the center bore 50. The recess 54 is formed at its bottom portion with a coupling recess which consists of three equally spaced rectangular depressions 56a, 56b and 56c and three equally spaced arcuate thin grooves (no numerals) through which the depressions are merged with one another. The drive drum 48 is further formed at the peripheral portion with six depressions 58 (only one is numbered) for the purpose of reducing the weight thereof.

A generally triangular bush 60 of rubber material is intimately fitted in the coupling recess of the drive drum 48. For this, the bush 60 has an external shape matching with the shape of the coupling recess. The bush 60 has thus equally spaced three lug portions 60a, 60b and 60c each having therein a deformable recess (no numeral), as is seen from Fig. 4. As will become clear from the following description,

the deformable recesses of the lug portions 60a, 60b and 60c of the bush 60 catch three projections 62a, 62b and 62c formed on the after-mentioned output shaft of the speed reduction gear 34.

Referring to Fig. 5, there is shown the motor-powered drive unit comprising the electric motor 32 and the speed reduction gear 34. As is seen from this drawing, the three projections 62a, 62b and 62c are provided on a circular plate 62 which is coaxially connected to an output shaft 64 (see Fig. 3) of the speed reduction gear 34. The circular plate 62 is formed at its center with a bore 66 which has a size matching with the upper pin portion 42a of the drum shaft 42. The drive unit has several bored lug portions 68 (only one is numbered) which are bolted to the base plate 20.

As is seen from Fig. 3, upon assembly, the three projections 62a, 62b and 62c of the output shaft 64 of the drive unit are respectively caught by the deformable recesses of the bush 60 fitted in the drive drum 48. It is now to be noted that under this coupling condition, the outwardly projected upper pin portion 42a of the drum shaft 42 is neatly received in the bore 66 of the circular plate 62. With this coupling, the driving force produced by the motor 32 can be transmitted to the wire retracting device 18 for moving the window pane upward or downward in the following manner.

For ease with which the description of the operation is made, the description will be commenced with respect to the condition as shown in Fig. 2 wherein the window pane 16 assumes its lowermost position (viz., the window is fully open).

When the motor 32 is energized to run in a direction to rotate the drive drum 48 in the counterclockwise direction in Fig. 4, the driven drum 46 is rotated together thereby winding thereon the wire 22 while drawing out the other wire 24 from the drive drum 48. With this motion, the window pane 16 is moved upward together with the carrier plate 14. When, now, the motor 32 is deenergized, the movement of the window pane 16 stops and thereafter, the window pane 16 keeps the stopped position irrespective of the weight of the window pane 16. This is because of the inherency of the output shaft 64 of the speed reduction gear 34, that is, the unmovableness of the output shaft 64 under such condition. When, then, the motor 32 is energized to run in the reversed direction to rotate the drive drum 48 in the clockwise direction in Fig. 4, the drive drum 48 winds thereon the wire 24 while pulling and thus drawing the other wire 22 from the driven drum 46. With this movement, the window pane 16 lowers. Of course, this downward movement stops upon deenergization of the motor 32.

When the wire 22 becomes slackened during the operation for some reasons, the driven drum 46 is rotated slightly in the wire retracting direction (viz., in the counterclockwise direction in Fig. 4) relative to the drive drum 48 by the biasing force of the spiral spring 44. Thus, the slackness of the wire 22 disappears. When, now, the other wire 24 becomes slackened, the carrier plate 14 and thus the window pane 16 are both moved upwardly but slightly because of the biasing force of the spiral spring 44 constantly applied to driven drum 46 to rotate in the wire retracting direction. Thus, the slackness

of the wire 24 is removed.

In the following, advantageous features of the present invention will be described.

(1) Because the axial ends 42b and 42a of the drum shaft 42 are both stably supported by the fixed bearing 40 and the output shaft 64 (or 62) of the drive unit fixed to the base plate 20, the rotation of the drive and driven drums 48 and 46 about it is smoothly and reliably carried out. This advantage will be well understood when compared with the wire retracting device shown in Fig. 1. In this less preferred device, the drum shaft 42 is supported by only the fixed bearing 40. Experiment has revealed that such device tends to induce unstable rotation of the drive and driven drums particularly after long use thereof due to insufficient supporting of the drum shaft 42.

(2) Upon assembly of drive unit to the wire retracting device 18, the outwardly projected pin portion 42a of the drum shaft 42 serves as a guide means for positioning the output shaft 64 of the drive unit. Thus, the assembly work is facilitated considerably.

CLAIMS:

1. Wire retracting device of motor-powered window regulator having a motor-powered drive unit with an output shaft, said wire retracting device comprising a casing (36), a wire winding annular device (46,48) concentrically and rotatably disposed on a supporting shaft (42) and winding thereon a wire (22,24) which extends to a window pane mover (14), characterized in that said supporting shaft (42) is disposed in said casing (36) with its axial one end (42b) supported by a bearing (40) fixed to said casing (36).

2. Wire retracting device as claimed in claim 1, characterized by supporting means (66) for rotatably supporting the axial other end (42a) of said supporting shaft (42) to an axial end portion (62, 66) of the output shaft (64) of said drive unit (32,34).

3. Wire retracting device as claimed in claim 1 or 2, characterized in that said wire winding annular device comprises:

drive and driven drums (46,48) which are coaxially and rotatably disposed on said supporting shaft (42) and winding thereon respective wires (22,24) in a mutually reversed relationship, said wires leading to said window pane mover (14);

biasing means (44) for biasing said driven drum (46) in a direction to wind thereon the associated wire (22); and

ratchet means (46b,48b) for providing a ratchet engagement between said drive and driven drums so that said drive and driven drums rotate together in the same direction under a given condition.

4. Wire retracting device as claimed in one of claims 1 to 3, characterized in that said supporting means comprises a portion (42a) of said supporting shaft (42) which forms said axial other end of said supporting shaft, said portion being projected outwardly from said drive drum (48), and means defining a bearing bore (66) in said axial end portion of said output shaft (64) of the drive unit (32,34), wherein said portion is rotatably received in said bearing bore.

5. Wire retracting device as claimed in claim 4, characterized in that said bearing bore (66) has a size matching with said portion (42a) of the supporting shaft (42).

6. Wire retracting device as claimed in one of claims 1 to 5, characterized in that said axial one end (42b) of said supporting shaft (42) is rotatably received in a bore formed in said bearing (40).

7. Wire retracting device as claimed in one of claims 3 to 6, characterized in that said biasing means comprises a spiral spring (44) which has one end (44a) hooked to said bearing (40) and the other end (44b) hooked to said driven drum (46).

8. Wire retracting device as claimed in one of claims 3 to 7, characterized in that said ratchet means comprises ratchet teeth (48b) formed on said drive drum (48) and ratchet teeth (46b) formed on said driven drum (46) and operatively engaged with those of said drive drum, wherein the teeth of these two drums are so designed as to couple them only when

either of them is rotated in a given direction.

9. Wire retracting device as claimed in claim 8, c h a r a c t e r i z e d b y a wave washer (52) which is disposed between the bottom of said casing (36) and said driven drum (46) to bias said driven drum toward said drive drum for assuring the ratchet engagement between said drive and driven drums.

10. Wire retracting device as claimed in one of claims 2 to 9, c h a r a c t e r i z e d b y a bush (60) which is detachably mounted in a recess (54) of said drive (48) drum for assuring coupling between the output shaft (64) of the drive unit (32,34) and the drive drum (48).

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Fig. 1

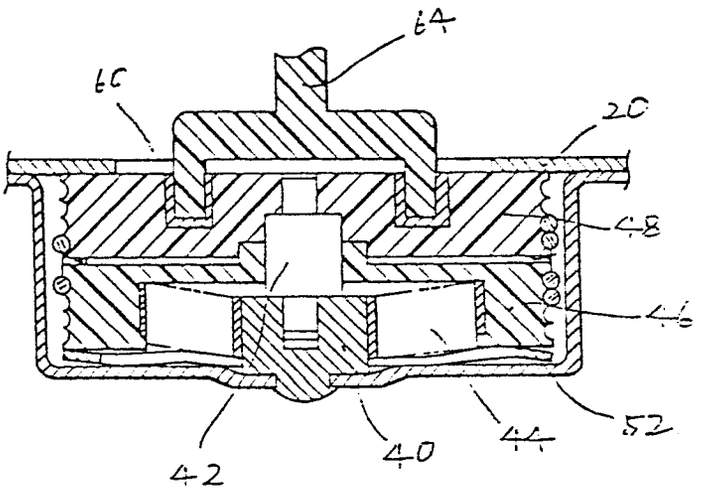

Fig. 3

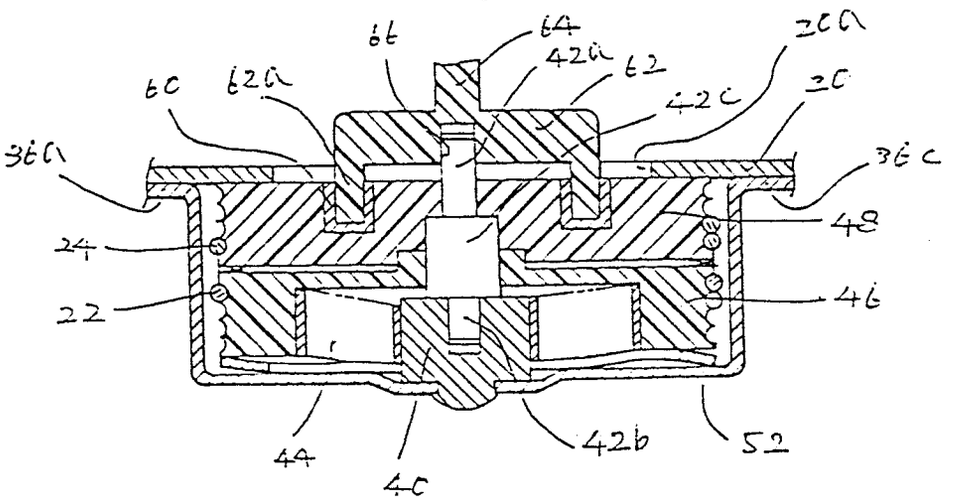

Fig. 2

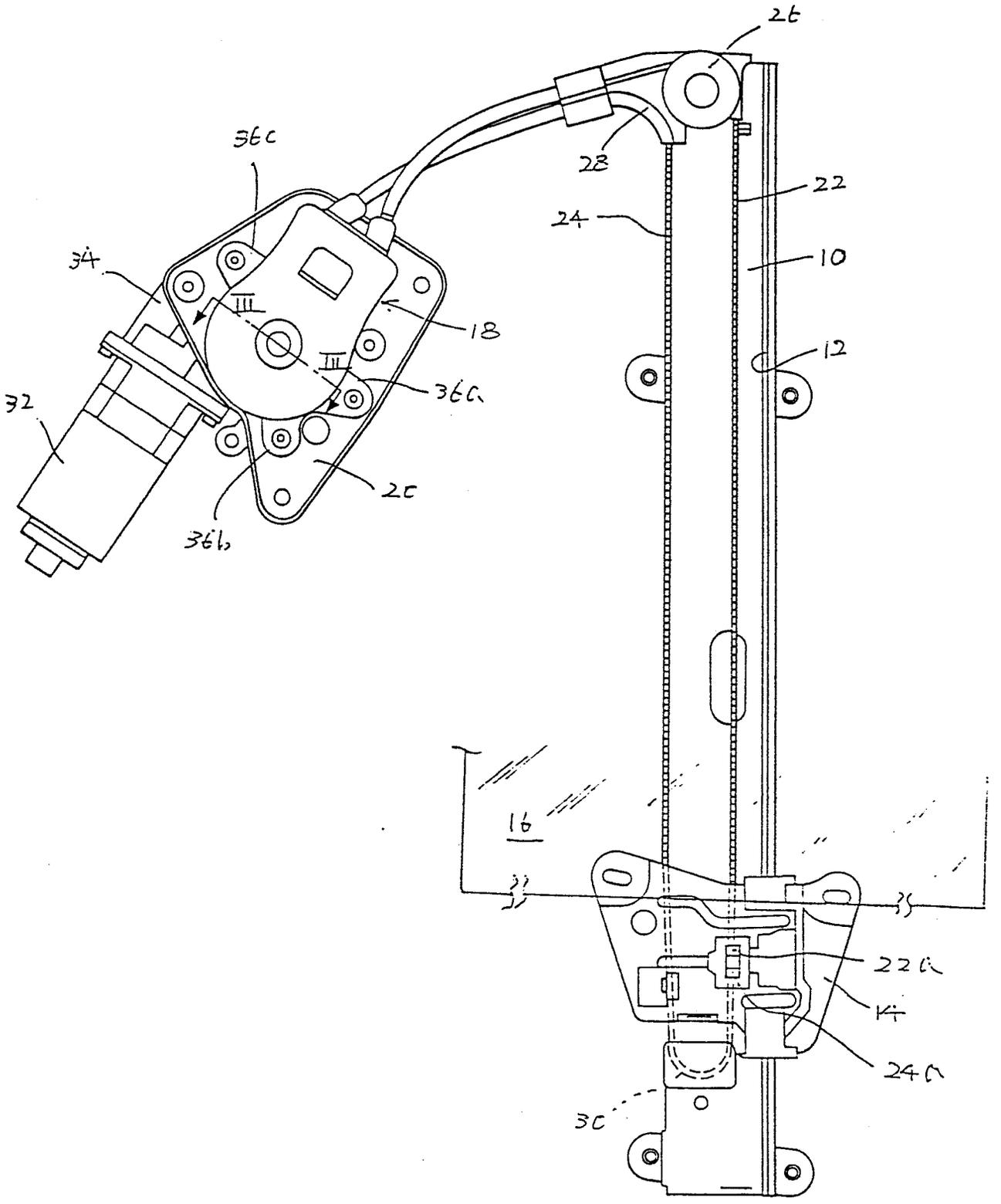

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Fig. 4

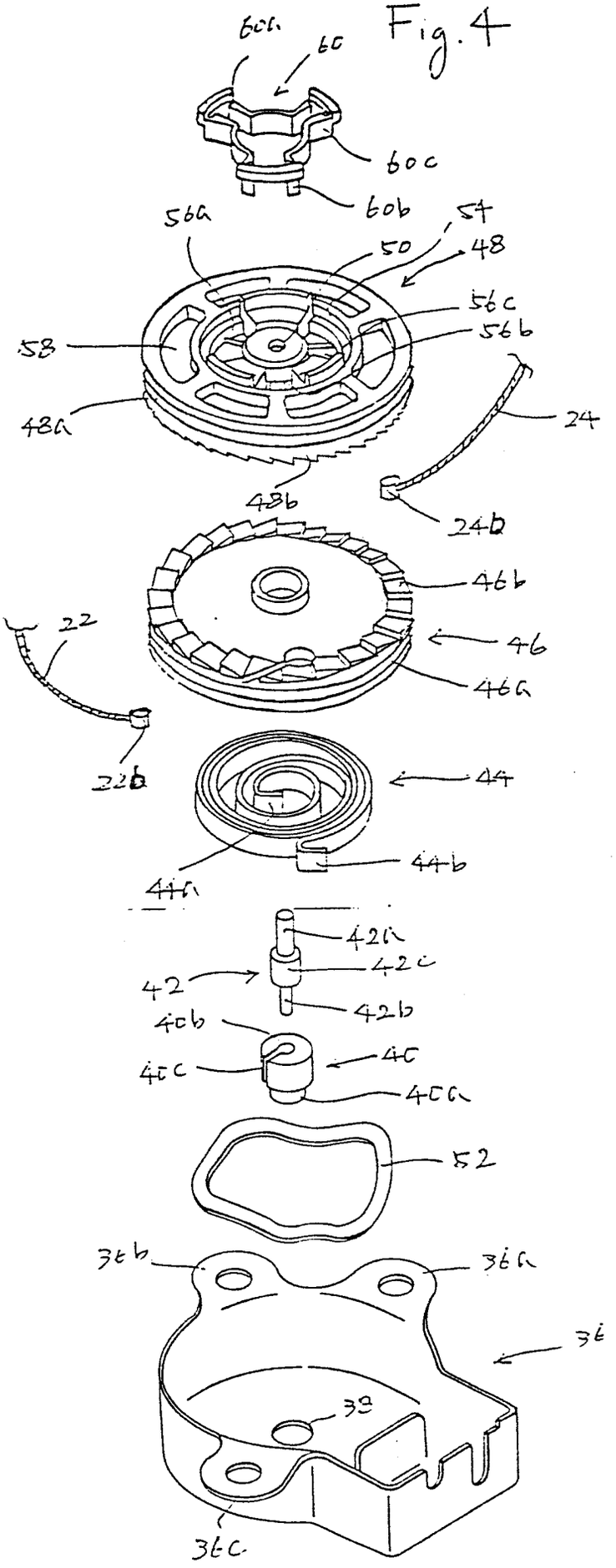

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Fig. 5