

(19)



(11)

**EP 1 932 993 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**01.07.2009 Bulletin 2009/27**

(51) Int Cl.:  
**E05F 15/12** <sup>(2006.01)</sup> **E05F 15/14** <sup>(2006.01)</sup>  
**E05F 15/16** <sup>(2006.01)</sup>

(21) Application number: **06025173.3**

(22) Date of filing: **06.12.2006**

(54) **Toothed steel cable transmission mechanism**

Übertragungsvorrichtung mit gezahntem Kabel

Mécanisme de transmission par câble cranté

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR  
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI  
SK TR**

(43) Date of publication of application:  
**18.06.2008 Bulletin 2008/25**

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## Description

### Background of the Invention

#### 1. Field of the Invention

[0001] The invention is related to a toothed steel cable transmission mechanism, especially with an electric motor which, through a reduction gear unit, drives a worm pertaining to a worm gear assembly engaging the toothed steel cable for linear movement in a curved section.

#### 2. Description of the Prior Art

[0002] Traditional transmission mechanisms have the drawback that additional articulated lever or steering mechanism is required to change transmission direction due to the rigid characteristic of the mechanism components. Thus, the whole mechanism has increased dimensions and poor transmission efficiency. Its application is also limited.

#### Summary of the Invention

[0003] The main objective of the invention is to improve the traditional transmission mechanism that has the drawback in failure to transmit forces in a curved path without additional steering mechanism.

[0004] After improvement, the transmission of forces through a curved mechanism can be achieved. This is the most important feature of the invention.

[0005] To achieve the above objective and function, the technical approach and scheme includes:

A toothed steel cable transmission mechanism, which consists of  
 a toothed flexible steel cable, which is a long and thin steel line with surface teeth and bendability; a steel cable elbow tube, which is a hollow tube to provide proper protection and guidance for the passing steel cable on its curved path; an electric motor, e. g. a DC motor driving a reduction gear unit to reduce output RPM; a worm provided on the output end of the reduction gear unit and engaging the worm wheel of a worm gear assembly consisting of the worm wheel as the driving gear and a coaxial gear as the driven gear engaging the teeth of the toothed steel cable and driving the same;  
 a steel cable guide in form of a hollow sleeve with a pair of ears for securing the engagement between the passing toothed steel cable and the driven gear of the gear assembly.  
 When the above mechanism is working, the motor with linear transmission characteristic transmits forces through the reduction gear unit to the worm and the worm gear assembly to drive the toothed steel cable to make linear movement in bendable structure.

The above toothed steel cable transmission mechanism can have a top cover to accommodate the driven gear of the gear assembly and a middle cover and a bottom cover to accommodate the worm and the driving gear of the worm gear assembly. The top cover also has a connector to fit the ears of the steel cable guide.

For the above transmission mechanism, the control of transmission direction for the toothed steel cable is through the motor steering and the worm and worm gear assembly.

For the above transmission mechanism, the end of the toothed steel cable is the power output end, which depending on applications can connect to peripherals that need switches or movement such as hopper windows, awning windows, casement windows, tilt-turn windows, sliding windows, window blinds, air vent system and skylights, or angle or height adjustment for hospital beds or sleep beds.

When the above toothed steel cable transmission mechanism is applied to window opening and closing, it is associated with a window actuator on the window frame, so the pull-push forces from the power output end of the toothed steel cable are transmitted to the window through the toothed steel cable. Regarding the technical approach and mechanism to achieve the objective of the invention, embodiments with illustrations in figures are described in details as follows:

#### Brief Description of the Drawings

##### [0006]

Figure 1: a three-dimensional exploded view of the structure of the transmission mechanism according to the invention.

Figure 2: a three-dimensional view of the assembled mechanism.

Figure 3: the two-dimensional illustration of the operation principle of the invention.

Figure 4: a partial cross-sectional view of the transmission mechanism of the invention.

Figure 5: an embodiment of the invention in application for a smoke vent window.

Figure 6: a plurality of smoke vent windows as an example for the invention.

#### Detailed Description of the Preferred Embodiment

[0007] To further explain the details of the invention, examples are given as follows:

Please refer to Figure 1 for the three-dimensional exploded view of the structure of the invention. The toothed steel cable 1 is a thin and long steel line that is bendable and has surface teeth 10. The elbow tube 2 is a hollow tube to properly protect and guide

the passing toothed steel cable 1 on a curved path. The motor 3 is an electric motor, preferably powered by direct current. The motor is connected with a reduction gear unit 30 that is made of a gear assembly. The worm 4 is a rod with threads 40 and mounted on the output end 31 of the reduction gear unit 30. The worm gear assembly 5 consists of two coaxial gears. The driving gear 50 of the worm gear assembly 5 is the worm wheel engaging and driven by the worm 4 to drive the coaxial driven gear 51 that engages and drives the toothed steel cable 1 in linear movement.

The toothed steel cable guide 6 is a hollow tube 60 to secure the close contact between the passing toothed steel cable 1 and the driven gear 51 of the worm gear assembly 5. The toothed steel cable guide 6 has a pair of ears 61 which connect to slots 70 for securing the toothed steel cable guide 6 with top cover 7 to prevent disengagement between the toothed steel cable 1 and the driven gear 51 of the gear assembly when in operation.

Please refer to Figure 2 for the three-dimensional exterior assembly diagram. The DC motor 3 has linear transmission characteristic and transmits torque to the worm 4 and worm gear assembly 5 and drives the toothed steel cable 1 to make curved movement. Then the toothed steel cable 1 is driven through the elbow tube 2 which forces it to follow the curved path and provides protection and a change of orientation. The close match between the toothed steel cable 1 and the worm gear assembly 5 is achieved through the toothed steel cable guide 6. The exterior of the worm 4 and the worm gear assembly 5 is protected by a top cover 7, a middle cover 8 and a bottom cover 9.

Please refer to Figure 3 for the two-dimensional illustration of the operation principle of the invention. The power output of DC motor 3 has linear characteristic. After conversion by the reduction gear unit 30, the torque is transmitted by the worm 4, which further transmits the power to the worm gear assembly 5 and drives the toothed steel cable 1 to perform a linear movement in the curved elbow tube 2.

Please refer to Figure 4 for a partial cross-sectional view of the transmission mechanism of the invention. The space inside the top cover 7 is to accommodate the driven gear 51 of the worm gear assembly 5. The space enclosed by the middle cover 8 and the bottom cover 9 is to accommodate the driving gear 50 of the worm 4 and worm gear assembly 5. The toothed steel cable 1 passes the hollow sleeve 60 of the toothed steel cable guide 6 and drives the driven gear 51 of the worm gear assembly 5.

From this figure, it is clear that the power transmission path is from the worm 4 to the driving gear 50, then through the coaxial driven gear 51 to the toothed steel cable 1.

Please refer to Figure 5 for an embodiment of the

invention for a smoke vent window. The figure shows an example of a hopper window with fire fighting significance. Depending on applications, the mechanism of the invention is used to actuate peripherals switchable or moveable, such as hopper windows, awning windows, casement windows, tilt-turn windows, sliding windows, window blinds, air vent system and skylights, or height adjustment for hospital beds or sleep beds. The opening and closing of the window panel 10d is brought about by the actuator 10a on the window frame 10c, which converts the power and transmits the power through the toothed steel cable 1 to the window panel 10d, so the window panel 10d is pushed open or pulled closed.

The linear movement of the toothed steel cable 1 inside the actuator 10a is activated by an authorizing main operator 10e or a manual switch 10g, which sends a fire alarm signal to the central control box 10f. Upon receiving the signal, the central control box 10f activates the DC motor assembly 3 and further transmits power through the actuator 10a to the toothed steel cable 1.

Please refer to Figure 6 for a smoke vent window. The figure shows an example of a multi-panel hopper window. On the window frame 10c for the individual window panel 10d there is an actuator 10a. Its independent power source (DC motor assembly 3) is used to control the opening and closing of the window panel 10d. Each switch assembly has a pipe (containing electric line and signal line) connecting to the central control box (containing microcomputer control chip) that operates on logic judgment.

In summary, the invention provides application technology for the toothed steel cable transmission mechanism. It is mainly through a DC motor to drive a worm and a worm gear assembly, and further drives a toothed steel cable for linear movement in a curved structure. This is the major improvement over the traditional transmission mechanism. The above description for the invention is only the preferred embodiment.

## Claims

1. A toothed steel cable transmission mechanism consisting of:

a toothed steel cable (1) in form of a long and thin flexible steel element with surface teeth (10);

a steel cable elbow tube (2) in form of a hollow tube to provide proper protection and guidance for the passing toothed steel cable (1);

an electric motor (3) with a reduction gear unit (30) to reduce output RPM;

a worm (4) with threads (40) attached to the output end (31) of the reduction gear unit (30)

- and  
 a worm gear assembly (5) consisting of two coaxial gears (50, 51), wherein the driving gear (50) engages the worm (4) to drive the coaxial driven gear (51), which in turn drives the toothed steel cable (1) for linear power transmission; a toothed steel cable guide (6) in form of a hollow sleeve to house the point of engagement between the toothed steel cable (1) and the driven gear (51) of the gear assembly; in addition, the said toothed steel cable guide has a pair of ears (61) that connect to slots (70) for securing the steel cable guide (6) with top cover (7) to prevent disengagement between the toothed steel cable (1) and the driven gear (51) of the gear assembly when in operation; wherein the electric motor (3) with linear transmission characteristic transmits forces through the reduction gear unit (30) to the worm (4) and the worm gear assembly (5) to drive the toothed steel cable (1) to perform a linear movement in curved path.
2. A toothed steel cable transmission mechanism as described in claim 1 comprising a top cover (7) the inside space of which is to accommodate the driven gear (51) of the worm gear assembly (5) and a middle cover (8) and a bottom cover (9) accommodating the worm (4) and the driving gear (50) of the worm gear assembly (5); the top cover (7) also has a connector (70) to fit the ears (61) of the toothed steel cable guide (6).
  3. A toothed steel cable transmission mechanism as described in claim 1, the control of linear push-pull for the toothed steel cable is through the driving by the electric motor and the control by the worm and worm assembly gear.
  4. A toothed steel cable transmission mechanism as described in claim 1 wherein the end of the toothed steel cable is the power output end, which depending on applications can connect to peripherals that need actuation or movement such as hopper windows, awning windows, casement windows, tilt-turn windows, sliding windows, window blinds, air vent system and skylights.
  5. A toothed steel cable transmission mechanism as described in claim 4 for the opening and closing of a window wherein an actuator (10a) on the window frame (10c) transmits the push-pull forces through the toothed steel cable (1) to the window panel (10d).
  6. A toothed steel cable transmission mechanism as described in claim 1 wherein the end of the toothed steel cable (1) is the power output end, which depending on applications can connect to peripherals

that need height or angle adjustment such as hospital beds or sleep beds.

## 5 Patentansprüche

1. Bewegungsübertragungsvorrichtung mit gezahntem Stahlkabel, bestehend aus:
  - einem gezahnten Stahlkabel (1) in Form eines langen und dünnen biegsamen Stahlelements mit gezahnter Fläche (10);
  - einem Stahlkabel-Rohrkrümmer (2) in Form eines Hohlrohres für den Schutz und die Führung des durchlaufenden gezahnten Stahlkabels (1);
  - einem Elektromotor (3) mit einem Untersetzungsgetriebe (30) zur Herabsetzung der Ausgangsdrehzahl;
  - einer am Antriebsende (31) des Untersetzungsgetriebes (30) angebrachten Schnecke (4) mit Schraubengängen (40) und
  - einem Schneckengetriebe (5) bestehend aus zwei coaxialen Rädern (50,51), von denen das Schneckenrad (50) mit der Schnecke (4) kämmt, um das koaxiale Treibrad (51) anzutreiben, welches wiederum das gezahnte Stahlkabel (1) zur linearen Kraftübertragung treibt; einer Führung (6) des gezahnten Stahlkabels in Form einer hohlen Buchse, in der der Eingriff zwischen dem gezahnten Stahlkabel (1) und dem Treibrad (51) der Getriebebaugruppe stattfindet; darüber hinaus hat die Führung des gezahnten Stahlkabels ein Paar Befestigungslappen (61), die in Schlitten (70) befestigt sind um die Führung (6) des gezahnten Stahlkabels mit einer oberen Abdeckung (7) zu sichern, die im Betrieb der Getriebeeinheit ein Außereingriffgehen des gezahnten Stahlkabels (1) mit dem Treibrad (51) verhindert;
  - wobei der Elektromotor (3) Kräfte über das Reduziergetriebe (30) auf die Schnecke (4) und das Schneckengetriebe (5) auf das gezahnte Stahlkabel (1) überträgt um dieses translatorisch auf einer gekrümmten Bahn zu bewegen.
2. Bewegungsübertragungsvorrichtung mit gezahntem Stahlkabel nach Anspruch 1 mit der oberen Abdeckung (7), in deren Innenraum das Treibrad (51) des Schneckengetriebes (5) untergebracht ist, und einer mittleren Abdeckung (8) und einer Bodenabdeckung (9) zur Unterbringung der Schnecke (4) und des Schneckenrades (50) des Schneckengetriebes (5); wobei die obere Abdeckung (7) Anschlußschlitze (70) für die Befestigungslappen (61) der Führung (6) des gezahnten Stahlkabels (1) aufweist.

3. Bewegungsübertragungsvorrichtung mit gezahntem Stahlkabel nach Anspruch 1, bei der die Steuerung des translatorischen Ziehens und Drückens des gezahnten Stahlkabels mittels des Antriebs durch den Elektromotor und die Beaufschlagung durch die Schnecke und das Schneckengetriebe. 5
4. Bewegungsübertragungsvorrichtung mit gezahntem Stahlkabel nach Anspruch 1, bei der das Ende des gezahnten Stahlkabels das Abtriebsende ist und abhängig vom Anwendungsfall verbunden ist mit zu betätigenden oder anzutreibenden Peripherieeinrichtungen wie unten angelenkte Kippfenster, Markisenfenster, Flügelfenster, Drehkippenfenster, Schiebefenster, Fensterjalousien, Belüftungssystemen und Dachflächenfenster. 10 15
5. Bewegungsübertragungsvorrichtung mit gezahntem Stahlkabel nach Anspruch 4 für das Öffnen und Schließen eines Fensters, wobei die Betätigungsvorrichtung (10a) am Zargenrahmen (10c) die Zug- und Drückkräfte über das gezahnte Stahlkabel (1) auf den Flügelrahmen (10d) überträgt. 20
6. Bewegungsübertragungsvorrichtung mit gezahntem Stahlkabel nach Anspruch 1, bei der das Ende des gezahnten Stahlkabels (1) das Kraftabtriebsende ist, welches abhängig vom Anwendungsfall verbunden sein kann mit in der Höhe oder in der Winkelstellung zu verstellenden Peripherievorrichtungen wie etwa Krankenhausbetten oder Betten. 25 30

## Revendications

1. Un mécanisme de transmission par câble en acier denté comprenant: 35

Un câble en acier denté (1) en forme d'un élément d'acier flexible long et mince avec la surface dentée (10) ; 40

Un tube de coude de câble en acier (2) en forme d'un tube creux en vue de fournir la protection et l'orientation appropriées pour le câble en acier denté passant (1); 45

Un moteur électrique (3) avec une unité d'engrenage de réducteur (30) pour réduire la sortie de puissance le TR-MIN ;

Un vis (4) avec des fils (40) attachés au bout de la sortie de puissance (31) de l'unité d'engrenage de réducteur (30), et un assemblage d'engrenage à vis (5) consistant de deux engrenages coaxiaux (50, 51), où l'engrenage d'entraînement (50) engage le vis (4) pour conduire l'engrenage coaxial de propulsion (51), qui conduit à son tour le câble en acier denté (1) pour la transmission linéaire de puissance ; 50

Un guide - câble en acier denté (6) sous forme 55

d'un manchon creux pour abriter le point d'engagement entre le câble en acier denté (1) et l'engrenage d'entraînement (51) de l'assemblage d'engrenage ; de plus, ledit guide-câble en acier denté a une paire d'oreilles (61) qui se connectent aux fentes (70) pour fixer le guide - câble en acier (6) au capot supérieure (7) pour empêcher le dégagement entre le câble en acier denté (1) et l'engrenage d'entraînement (51) de l'assemblage d'engrenage lors du fonctionnement ; le moteur électrique (3) avec la caractéristique de transmission linéaire transmet des forces à travers l'unité d'engrenage de réduction (30) au vis (4) et à l'assemblage d'engrenage à vis (5) pour faire le câble denté d'acier (1) exécuter un mouvement linéaire dans le chemin courbé.

2. Un mécanisme de transmission par câble en acier denté comme décrit dans la réclamation 1 comprenant un capot supérieur (7) dont l'espace intérieur est d'abriter l'engrenage de propulsion (51) de l'assemblage d'engrenage à vis (5) et un capot en milieu (8) 5

et un capot en bas (9) abritant le vis (4) et l'engrenage d'entraînement (50) de l'assemblage d'engrenage à vis (5) ; le capot supérieur (7) a aussi un connecteur (70) pour adapter les oreilles (61) du guide - câble en acier denté (6).

3. Un mécanisme de transmission de câble en acier denté comme décrit dans la réclamation 1, le contrôle de traction - poussée linéaire pour le câble en acier denté est par la conduite du moteur électrique et le contrôle par le vis et l'assemblage d'engrenage à vis. 35

4. Un mécanisme de transmission par câble en acier denté comme décrit dans la réclamation 1 où le bout du câble en acier denté est le bout de la sortie de puissance, qui, selon des applications peut se connecter aux périphériques qui ont besoin de la mise en action ou le mouvement comme des fenêtres de trémie, des fenêtres d'auvent, des fenêtres de vantail, des fenêtres de tournure d'inclinaison, des fenêtres glissantes, des stores, le système d'évacuation d'air et des lucarnes. 40

5. Un mécanisme de transmission de câble en acier denté comme décrit dans la réclamation 4 pour l'ouverture et la fermeture d'une fenêtre où un déclencheur (10a) sur le châssis de fenêtre (10c) transmet les forces de traction - poussée par le câble en acier denté (1) au panneau de fenêtre (10d). 45

6. Un mécanisme de transmission de câble en acier denté comme décrit dans la réclamation 1 où le bout du câble en acier denté (1) est le bout de la sortie de puissance, qui, selon des applications peut se 55

connecter aux périphériques qui ont besoin de l'ajustement de hauteur ou d'angle comme des lits hospitaliers ou des lits de sommeil.

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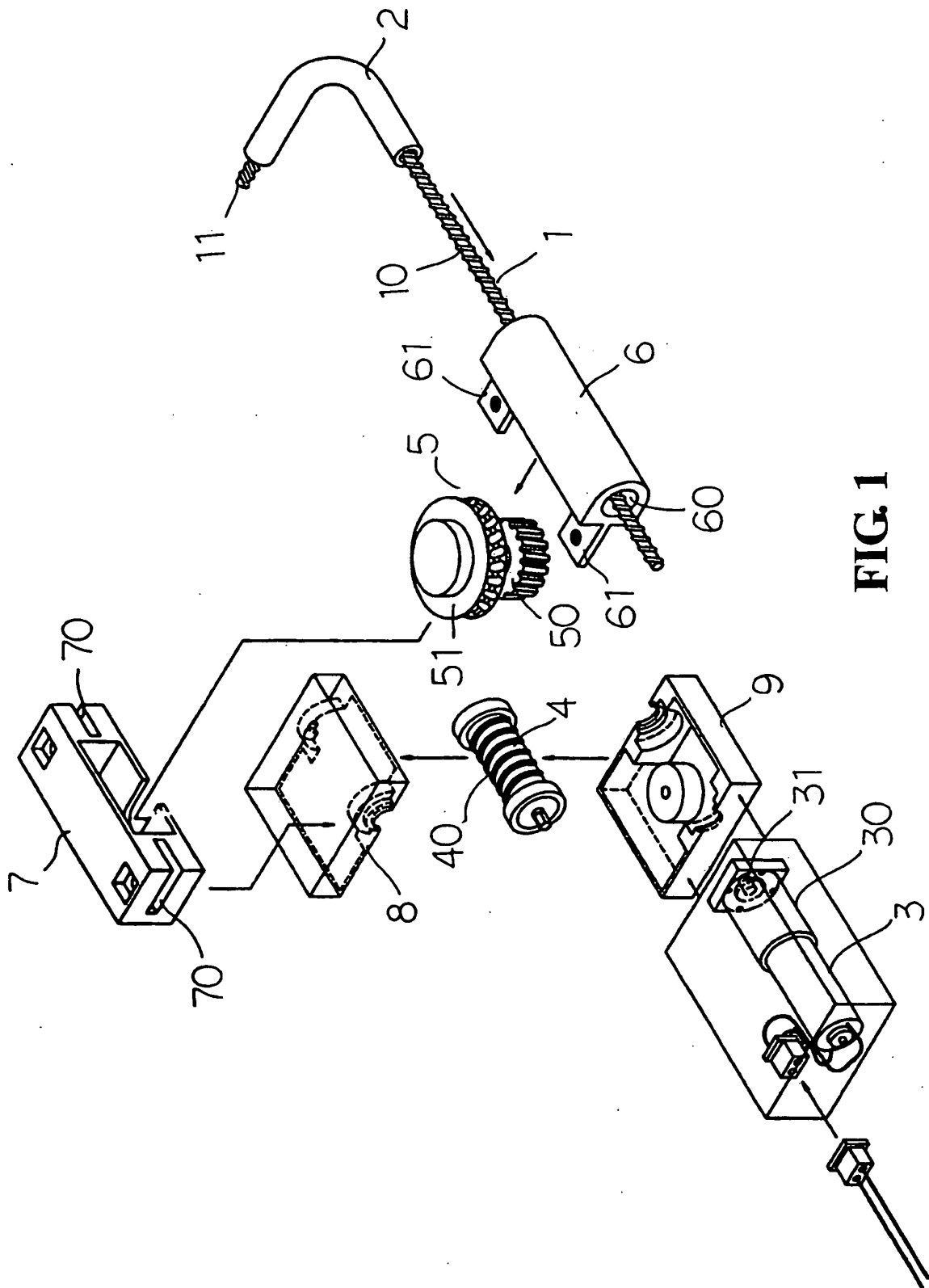


FIG. 1

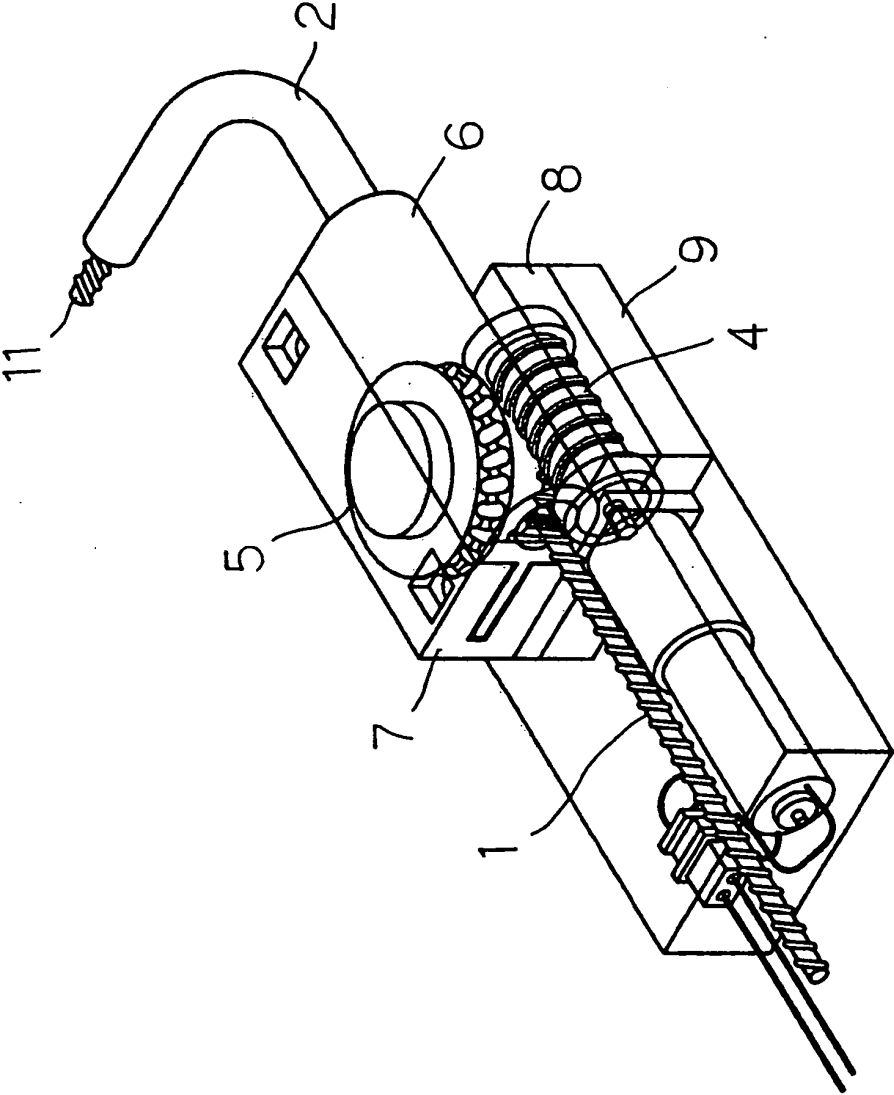


FIG 2

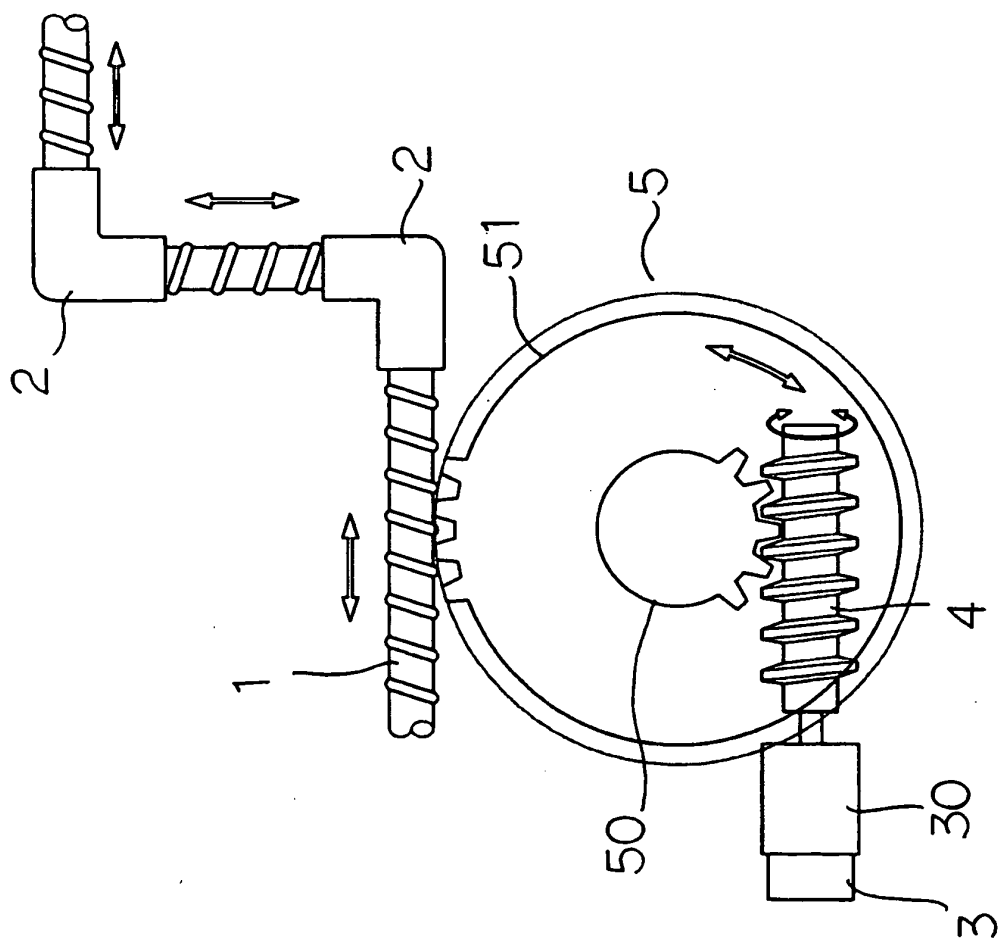


FIG. 3

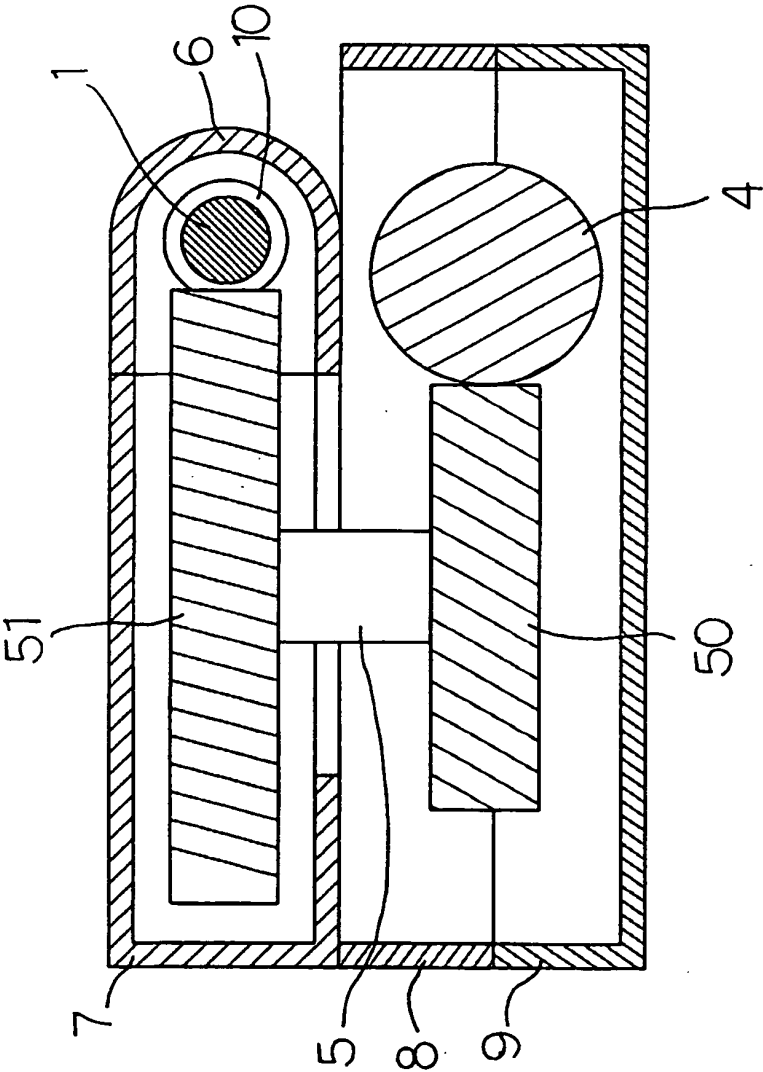


FIG. 4

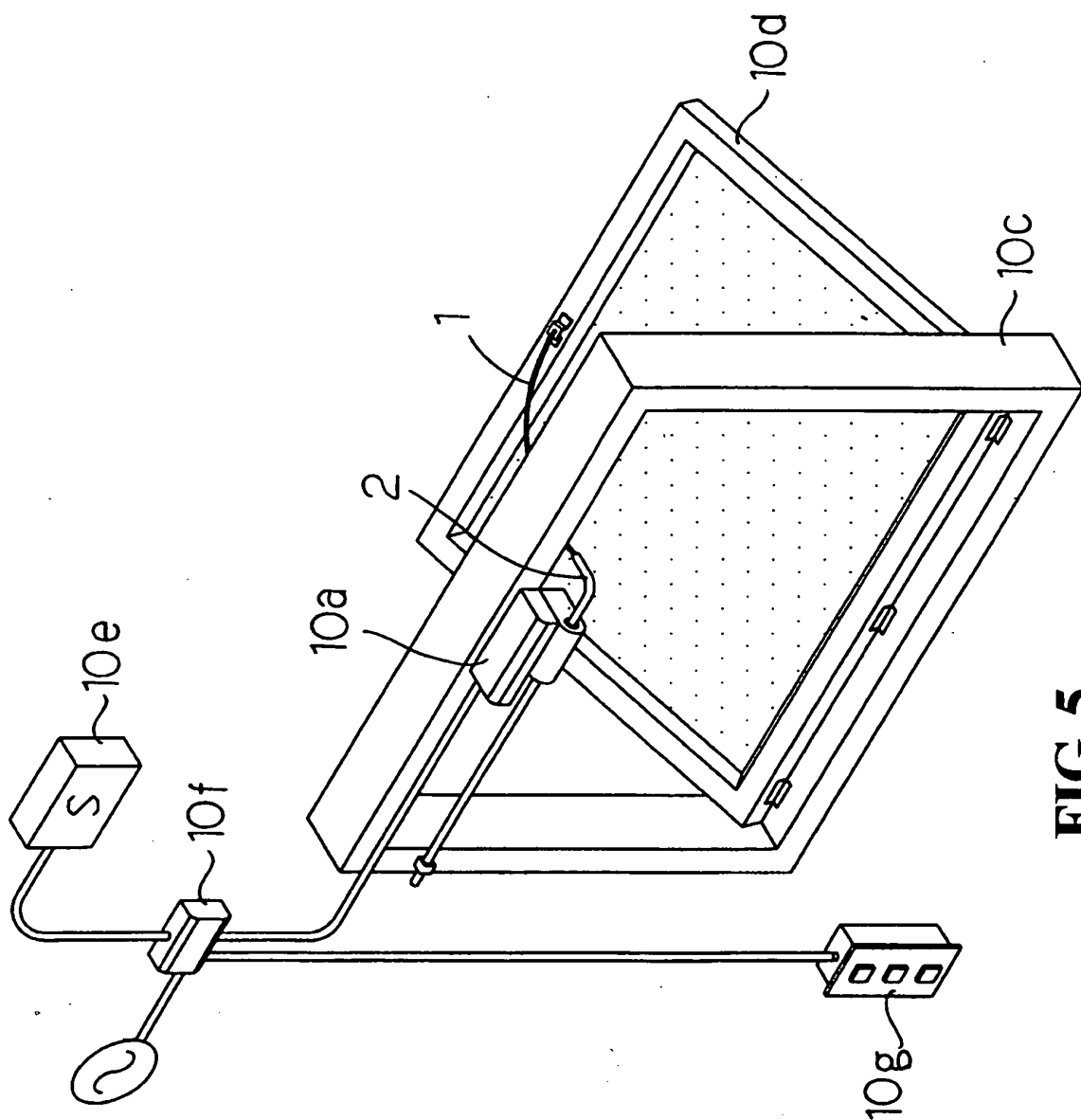


FIG. 5

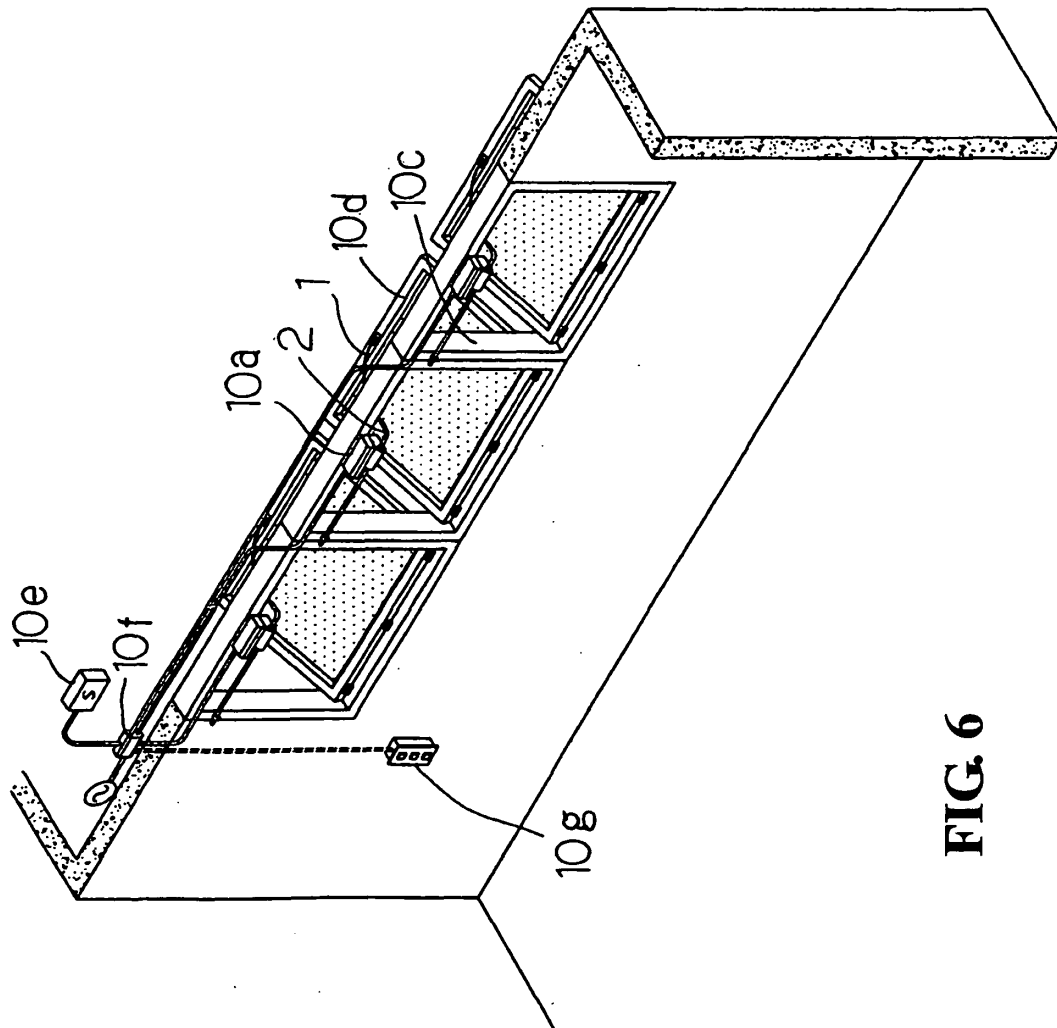


FIG. 6