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(54) **LEAD SCREW DRIVE FOR A POWER LIFTGATE**

LEITSPINDELANTRIEB FÜR EINE MOTORISCH BETÄTIGTE HECKKLAPPE

MECANISME D'ENTRAINEMENT A VIS-MERE POUR HAYON RELEVABLE ELECTRIQUE

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(73) Proprietor: **INTIER AUTOMOTIVE CLOSURES INC.**
**Newmarket, Ontario L3Y 4X7 (CA)**

(72) Inventor: **TOMASZEWSKI, Kris**
**Newmarket, Ontario L3X 1N4 (CA)**

(74) Representative: **Jorio, Paolo et al**
**STUDIO TORTA S.r.l.**
**Via Viotti, 9**
**10121 Torino (IT)**

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## Description

### BACKGROUND ART

1. Field of the Invention

**[0001]** The invention relates to liftgate assemblies for motor vehicles. More specifically, the invention relates to a power drive assembly for a liftgate assembly for providing power to move the liftgate assembly between open and closed positions.

**2.** Description of the Related Art

**[0002]** As motor vehicles characterized by their utility become a mainstream choice, consumers demand certain luxuries primarily associated with passenger cars, either due to their inherent design and/or size. One of the features desired by consumers is the automated movement of such items as sliding doors and liftgates. While features providing automated motion are available, the designs for mechanisms used to accommodate manual overrides are lacking in capability and functionality. Further, the systems consume space within the motor vehicle that makes the interior less efficient and aesthetically less appealing.

**[0003]** United States Patent 5,144,769 discloses an automatic door operating system. This system requires a great deal of control, both by an electronic controller and an operator of the motor vehicle. To overcome forces due to manual operation, the manually operated seesaw switch used by the operator to electromechanically operate the door is in an open state, preventing current from passing through the motor.

**[0004]** US 6055776 discloses a power drive assembly as defined in the preamble of claim 1.

### SUMMARY OF THE INVENTION

**[0005]** The invention is defined by a power drive assembly for a motor vehicle according to claim 1. Further advantageous embodiments of the invention are given in the dependent claims.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0006]** Advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Figure 1 is a side view, partially cut away, of a motor vehicle incorporating one embodiment of the invention wherein the liftgate is located in its open position;
Figure 2 is a cross-sectional side view of one embodiment of the invention in a motor vehicle with the liftgate in the closed position; and
Figure 3 is a perspective view of one embodiment of the invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0007]** Referring to Figure 1, a motor vehicle is generally indicated at 10. In the embodiment shown, the motor vehicle 10 is a minivan. The motor vehicle 10 includes a liftgate 12. The liftgate 12 is shown in an open position in Figure 1 and a closed position in Figure 2. It should be appreciated by those skilled in the art that the motor vehicle 10 and liftgate 12 could be configured differently depending on the style of the motor vehicle 10 and size of the liftgate 12.

**[0008]** The liftgate 12 is pivotally mounted to the motor vehicle 10 with a hinge 14. The hinge 14 allows the liftgate 12 to move between its two extreme positions shown in Figures 1 and 2.

**[0009]** When the liftgate 12 is in its open position, access is provided to the motor vehicle 10 through an opening 16. A piece of trim 18 extends along the sides (one shown) and a top 20 of the opening 16. The load floor (not shown) extends between the side trim 18 to create the bottom boundary for the opening 16.

**[0010]** The invention is a power drive assembly, generally indicated at 22, that moves the liftgate 12 between its two extreme positions. The power drive assembly 22 is fixedly secured to the motor vehicle 10 at a position disposed adjacent the opening 16 thereof. The power drive assembly 22 is secured to a roof structure 23 of the motor vehicle 10 such that the power drive assembly 22 extends above and is hidden from view by the top trim piece 20, typically referred to as the headliner. The power drive assembly 22 is secured to the roof structure 23 under an angle with respect thereto. More specifically, the power drive assembly 22 is not aligned nor is perpendicular to either the roof structure 23 or the liftgate 12 when the liftgate 12 is in the closed position.

**[0011]** The power drive assembly 22 includes a base 24. The base 24 includes a plurality of mounting holes 26 designed to receive fasteners 28 (one shown) therein. As should be appreciated by those skilled in the art, the screw fastener 28 shown in Figure 2 may be one of several types of fasteners that may be used to secure the base 24 to the roof structure 23.

**[0012]** The base 24 includes two side flanges 30, 32. Both of the side flanges 30, 32 extend along the longitudinal sides of the base 24 generally perpendicular to a support section 34 of the base 24. The two side flanges 30, 32 and the support section 34 form a generally U-shaped cross section. The second side flange 32 includes a slot 36 extending therealong. The slot 36 is linear and will be discussed in greater detail subsequently.

**[0013]** The power drive assembly 22 includes a drive mechanism, generally indicated at 38. The drive mechanism 38 transforms electrical energy received from a power source (not shown) into mechanical energy pro-

viding the necessary force to move the liftgate 12 between its open and closed positions.

**[0014]** The drive mechanism 38 includes a motor 40. The motor 40 receives the electrical energy and converts it to a mechanical rotational energy. That energy is transmitted out of the motor 40 via an output shaft (not shown) and into a set of gears 42. The gears 42 eventually transmit the rotational energy through a shaft 44 to a clutch 46.

**[0015]** The clutch 46 allows an operator of the liftgate 12 to override the power drive assembly 22 and open or close the liftgate 12 manually. Therefore, the clutch 46 allows the operator to open or close the liftgate 12 at a speed other than that which is set by the power drive assembly 22. It should be appreciated by those skilled in the art that, without adding to the inventive concept shown herein, the clutch 46 may be removed in systems that do not permit manual operation.

**[0016]** A transmission 48 receives the output force from the clutch 46 and redirects it. The transmission 48 includes a plurality of gears that are rotatably mounted to the base 24. The transmission 48 also is used to further increase torque output of the drive mechanism 38.

**[0017]** The output of the transmission 48 is also a rotating mechanical force. This force is used to rotate a lead screw 50. The lead screw 50 extends between the two side flanges 30, 32 and alongside the motor 40, set of gears 42, clutch 46.

**[0018]** A nut threadingly engages the lead screw 50. The nut is driven along the lead screw 50. by the rotation thereof. Therefore, the lead screw 50 defines the length of linear motion created by the power drive assembly 22. More specifically, the rotation of the motor 40 eventually translates into rotation of the lead screw 50 which, in turn, drives the nut in a linear motion along the lead screw 50 and the nut may only travel the length of the lead screw 50.

**[0019]** The nut cannot rotate with the lead screw 50 because it is secured in its orientation by a guide roller 54. The guide roller 54 rotates about a pin 56 that is fixedly secured to the nut. The guide roller 54 rolls through the slot 36 in the second side flange 32. The guide roller 54, in combination with the pin 56, prevents the nut from rotating with the lead screw 50 as it rotates. Thus, the nut travels along the lead screw 50 when the lead screw 50 is being rotated by the drive mechanism 38.

**[0020]** The power drive assembly 22 also includes a translation linkage 58. The translation linkage 58 is secured to the nut such that when the nut travels along the lead screw 50, the translation linkage 58 moves along therewith. The translation linkage 58 includes a linear portion 60 and an arcuate portion 62. The translation linkage 58 extends between a drive end and a bracket end. The linear portion 60 is disposed adjacent the drive end whereas the arcuate portion 62 is disposed adjacent the bracket end. In the embodiment shown in the Figures, the linear portion 60 is greater in length than the arcuate portion 62.

**[0021]** Pivotally secured to the bracket end of the translation linkage 58 is a bracket 68. The bracket 68 extends through an arc that terminates with a pivotal connection with the liftgate 12. More specifically, the bracket 68 extends between the translation linkage 58 and the liftgate 12. The arcuate path of the bracket 68 allows an opening in the top trim piece 20 to be smaller. More specifically, the arcuate shape of the bracket 68 defines a constant cross-sectional area as the bracket 68 travels through the opening 70.

**[0022]** In opening the liftgate 12, the motor 40 and clutch 46 are energized forcing the lead screw 50 to rotate in a first direction. The nut travels along the lead screw 50 away from the transmission 48 toward the bracket 68. In doing so, the translation linkage 58 moves in a linear fashion forcing the bracket 68 to move in a nonlinear manner. With the top trim piece 20 acting as a guide (with reinforcement, not shown), the bracket 68 moves along its arcuate path forcing the liftgate 12 toward its open position. While no connection is shown, a hinge may pivotally secure the bracket 68 to the liftgate 12. Once the liftgate 12 has completed its opening travel, the clutch 46 is de-energized, de-coupling the motor 40 from the lead screw 50. Gas struts (not shown) support the liftgate 12 in the open position.

**[0023]** Rotation of the motor 40 in the opposite direction moves the nut along the lead screw 50 toward the transmission 48 forcing the liftgate 12 to return to its closed position for eventual latching.

**[0024]** Many modifications and variations of the invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the invention may be practiced other than as specifically described.

## Claims

1. A power drive assembly (22) for a motor vehicle; said motor vehicle defining an opening (16), and including a liftgate (12) pivotable between a closed position covering said opening (16) and an open position providing access through said opening (16); said power drive assembly (22) comprising:

   a base (24) adadpted to be fixedly secured to the motor vehicle (10) at a position, in spaced relation to said opening (16); and
   a drive mechanism (38) fixedly secured to said base (24) and comprising a motor (40) for transforming electrical power into mechanical power;

   **characterized in that** said drive mechanism (38) converts electrical energy into a linear force;
   said power drive assembly further comprising a translation linkage (58) connected to said drive mechanism (38) so as to be moved by said mechanical power, receiving said linear force and translating said linear force into a nonlinear force to move said

liftgate (12) between the open position and the closed position;
said drive mechanism (38) comprising a lead screw (50) receiving said mechanical power in order to be rotated thereby, a nut being threadingly engaged with said lead screw (50) for travelling along said lead screw (50) when said lead screw (50) rotates;
said base (24) comprising a side flange (30, 32) defining a slot (36) cut therethrough.

2. A power drive assembly as set forth in claim 1, **characterized in that** said nut includes a guide roller (54) for travel through said slot (36) as said nut travels along said lead screw (50).

3. A power drive assembly as set forth in claim 2, **characterized in that** said translation linkage (58) includes a linear portion (60) and an arcuate portion (62).

4. A power drive assembly as set forth in claim 3, **characterized in that** said translation linkage (58) includes a drive end and a bracket end such that said linear portion (60) is disposed adjacent said drive end and said arcuate portion (62) is disposed adjacent said bracket end

5. A power drive assembly as set forth in claim 4, **characterized in that** it further comprises a bracket (68) pivotally connected to said bracket end of said translation linkage (58).

**Patentansprüche**

1. Motorantrieb-Baugruppe (22) für ein Kraftfahrzeug; wobei das Kraftfahrzeug eine Öffnung (16) definiert und eine Hubtür (12) enthält, die zwischen einer geschlossenen Position, in der sie die Öffnung (16) abdeckt, und einer geöffneten Position, in der sie einen Zugang durch die Öffnung (16) schafft, schwenkbar ist; wobei die Motorantrieb-Baugruppe (22) umfasst:

   eine Basis (24), die so beschaffen ist, dass sie an dem Kraftfahrzeug (10) an einer von der Öffnung (16) beabstandeten Position fest angebracht werden kann; und
   einen Antriebsmechanismus (38), der an der Basis (24) fest angebracht ist und einen Motor (40) zum Umformen elektrischer Leistung in mechanische Leistung umfasst;

   **dadurch gekennzeichnet, dass** der Antriebsmechanismus (38) elektrische Energie in eine geradlinig wirkende Kraft umsetzt;
   die Motorantrieb-Baugruppe ferner ein Umsetzungsgestänge (58) umfasst, das mit dem Antriebsmechanismus (38) verbunden ist, um durch die mechanische Leistung bewegt zu werden, und die geradlinig wirkende Kraft aufnimmt und die geradlinig wirkende Kraft in eine nicht geradlinig wirkende Kraft umsetzt, um die Hubtür (12) zwischen der geöffneten Position und der geschlossenen Position zu bewegen;
   wobei der Antriebsmechanismus (38) eine Antriebsspindel (50) umfasst, die die mechanische Leistung aufnimmt, um **dadurch** gedreht zu werden, wobei eine Mutter mit der Antriebsspindel (50) in einem Gewindeeingriff ist, um sich längs der Antriebsspindel (50) zu bewegen, wenn sich die Antriebsspindel (50) dreht;
   wobei die Basis (24) einen seitlichen Flansch (30, 32) umfasst, der einen in ihm ausgeschnittenen Schlitz (36) definiert.

2. Motorantrieb-Baugruppe nach Anspruch 1, **dadurch gekennzeichnet, dass** die Mutter eine Führungswalze (54) umfasst, die sich durch den Schlitz (36) bewegen kann, wenn sich die Mutter längs der Antriebsspindel (50) bewegt.

3. Motorantrieb-Baugruppe nach Anspruch 2, **dadurch gekennzeichnet, dass** das Umsetzungsgestänge (58) einen geradlinigen Abschnitt (60) und einen gebogenen Abschnitt (62) umfasst.

4. Motorantrieb-Baugruppe nach Anspruch 3, **dadurch gekennzeichnet, dass** das Umsetzungsgestänge (58) ein Antriebsende und ein Stützende umfasst, derart, dass der geradlinige Abschnitt (60) in der Nähe des Antriebsendes angeordnet ist und der gebogene Abschnitt (62) in der Nähe des Stützendes angeordnet ist.

5. Motorantrieb-Baugruppe nach Anspruch 4, **dadurch gekennzeichnet, dass** sie ferner eine Stütze (68) umfasst, die an dem Stützende des Umsetzungsgestänges (58) angelenkt ist.

**Revendications**

1. Ensemble d'entraînement électrique (22) pour un véhicule à moteur ; ledit véhicule à moteur définissant une ouverture (16), et comportant un hayon (12) qui pivote entre une position fermée couvrant ladite ouverture (16) et une position ouverte fournissant l'accès à travers ladite ouverture (16) ; ledit ensemble d'entraînement électrique (22) comprenant :

   une base (24) adaptée pour être raccordée de façon fixe au véhicule à moteur (10) à une position, en relation espacée par rapport à ladite ouverture (16) ; et
   un mécanisme d'entraînement (38) raccordé de façon fixe à ladite base (24) et comprenant un

moteur (40) pour transformer l'énergie électrique en puissance mécanique ;

**caractérisé en ce que** ledit mécanisme d'entraînement (38) transforme l'énergie électrique en une force linéaire ;
ledit ensemble d'entraînement électrique comprenant en outre une transmission de conversion (58) reliée audit mécanisme d'entraînement (38) de façon à être déplacée par ladite puissance mécanique, en recevant ladite force linéaire et en convertissant ladite force linéaire en une force non linéaire pour déplacer ledit hayon (12) entre la position ouverte et la position fermée ;
ledit mécanisme d'entraînement (38) comprenant une vis mère (50) recevant ladite puissance mécanique afin d'être tournée par celle-ci, un écrou étant engagé par filetage sur ladite vis mère (50) de façon à se déplacer le long de ladite vis mère (50) quand ladite vis mère (50) tourne ;
ladite base (24) comprenant une bride latérale (30, 32) définissant une encoche (36) découpée dans celle-ci.

**2.** Ensemble d'entraînement électrique selon la revendication 1, **caractérisé en ce que** ledit écrou comprend un galet de guidage (54) destiné à se déplacer à travers ladite encoche (36) en même temps que ledit écrou se déplace le long de ladite vis mère (50).

**3.** Ensemble d'entraînement électrique selon la revendication 2, **caractérisé en ce que** ladite transmission de conversion (58) comprend une partie linéaire (60) et une partie arquée (62).

**4.** Ensemble d'entraînement électrique selon la revendication 3, **caractérisé en ce que** ladite transmission de conversion (58) comprend une extrémité entraînement et une extrémité support de telle façon que ladite partie linéaire (60) est disposée en position adjacente à ladite extrémité entraînement et ladite partie arquée (62) est disposée en position adjacente à ladite extrémité support.

**5.** Ensemble d'entraînement électrique selon la revendication 4, **caractérisé en ce qu'**il comprend en outre un support (68) relié de façon pivotante à ladite extrémité support de ladite transmission de conversion (58).

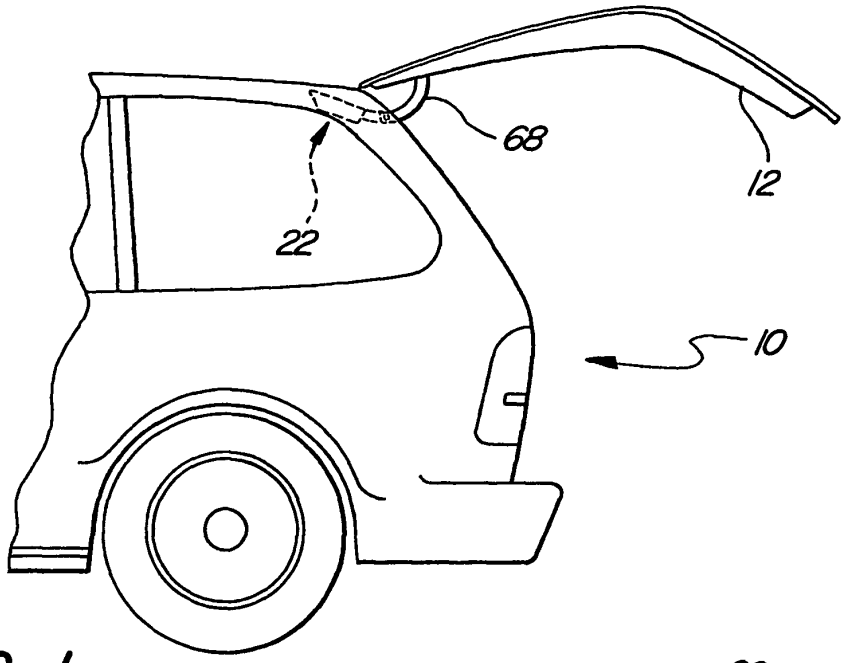



FIG-1

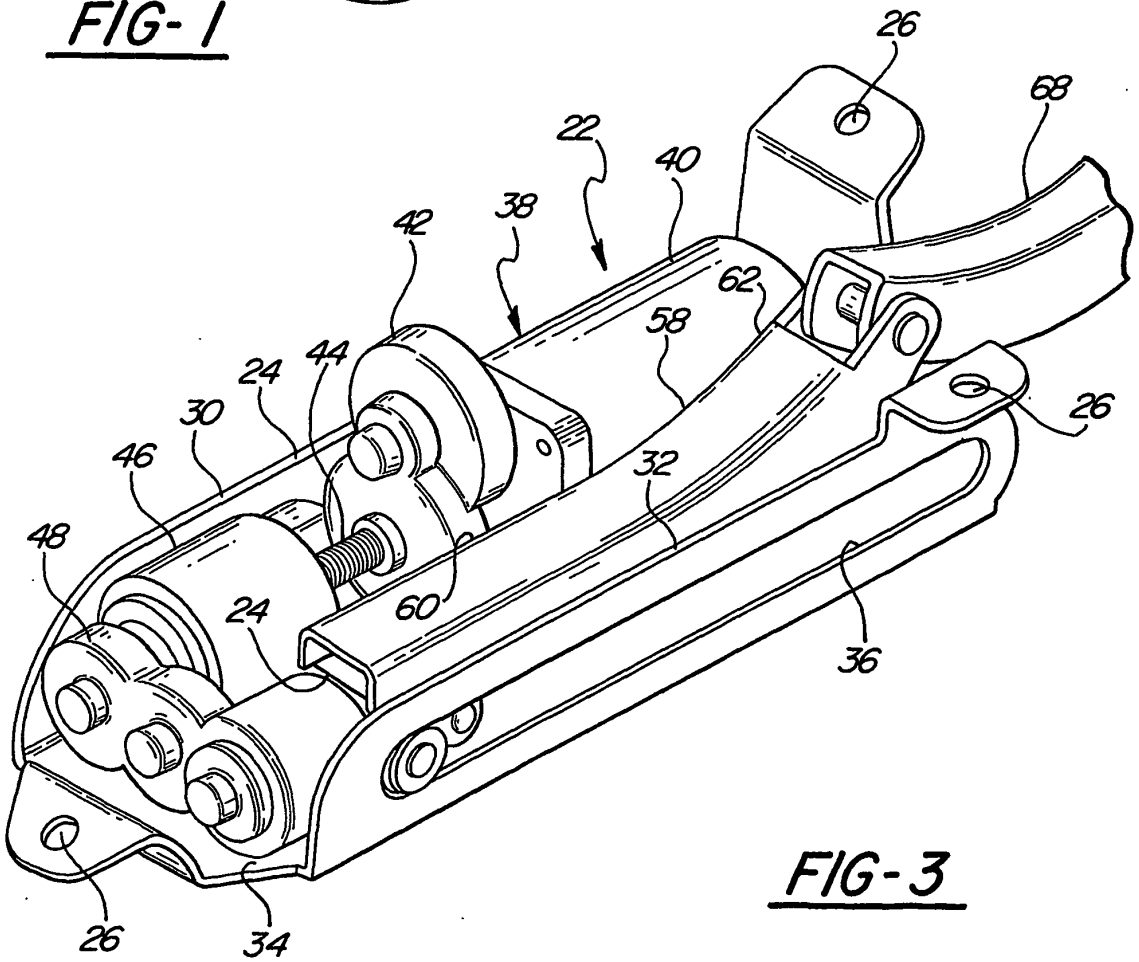



FIG-3

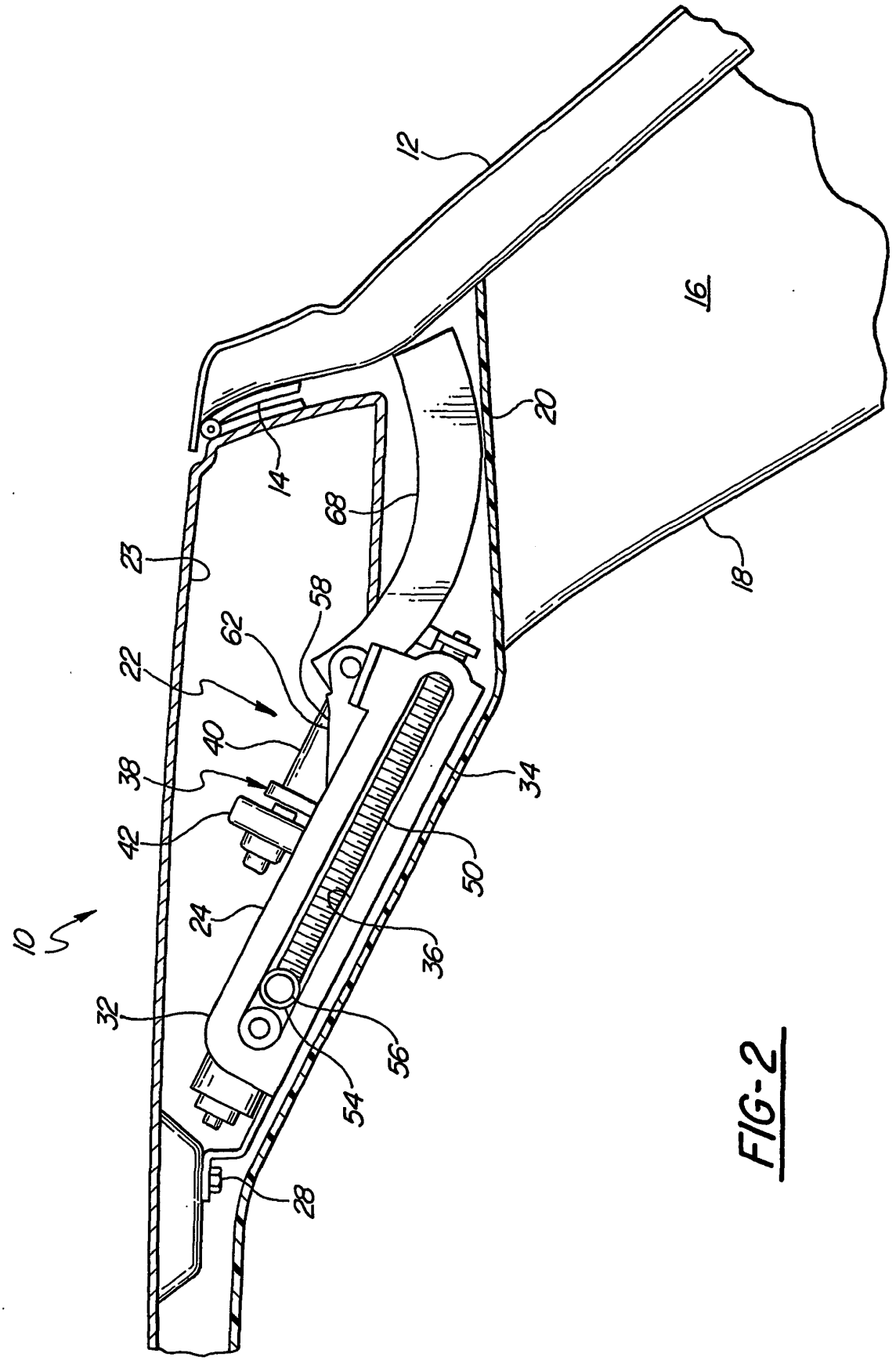



FIG-2