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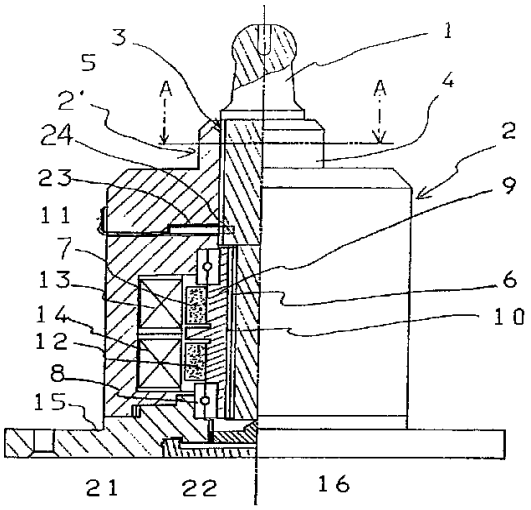
(54) [Title of the Invention]
LINEAR ACTUATOR
(57) [ABSTRACT]
[Object] To provide a linear actuator that can mount a position detector of an actuator therein and has a reliable mechanical stopper.
[Configuration] An actuator is provided at a center of a rotor of an electric motor, the actuator being screwed into a screw portion provided at the center of the rotor, and when a motor composed of a stator and the rotor is driven, the rotor starts to rotate. When the rotor rotates, the actuator that is screwed therein starts an up-down motion, and when a position indicator provided on the actuator, passes across an opposing portion of a position indicator detecting portion provided inside a case, an electric position of the actuator is confirmed. When the actuator goes out of control and is about to deviate from a predetermined range, the movement of the actuator is restricted by a stopper. The point of action of the stopper is adjustable.



[CLAIMS]

[Claim 1] A linear actuator which converts rotational force of a motor into a linear direction of an actuator, characterized in that the linear actuator comprises a stator forming a motor, a rotor supported rotatably at a center of the stator, an actuator that is screwed into a screw provided around a rotation center line of the rotor and is movable along the rotation center line by rotation of the rotor, a position indicator that is provided on the actuator and indicates a position of the actuator, a position indicator detecting portion that is located inside a case on the same stationary side as the stator and detects the position indicator, and a stopper that is located outside an moving range of the actuator and by which a mechanical end position of the actuator is adjustable.

[Claim 2] The linear actuator as set forth in claim 1, characterized in that the motor is a stepping motor.

[Claim 3] The linear actuator as set forth in claim 1 or claim 2, characterized in that the position indicator is a plastic magnet, and the position indicator detecting portion is a magnetic detecting device.

[DETAILED DESCRIPTION OF INVENTION]

[0001]

[Field of Industrial Application] This invention relates to a linear actuator, and in particular, relates to a linear actuator that is used for an optical axis adjustment of a headlight of a vehicle, more specifically, for an adjustment of an optical axis associated with a change of levelness of a vehicle, or for achieving a currently used short/long distance switching by changing an inclination of an optical axis with a single lamp.

[0002]

[Conventional Art] For automatic in-and-out operations of vehicle headlights or operations of office automation equipments, actuators using a motor as a drive source and having a linearly moving drive body are used. These actuators include linear actuators that convert rotational force of a motor into a linear movement. Such linear actuators include a linear motor type in which, on a stator of an electric motor expanded in a shape of a plate, a movable element also formed in a shape of a plate is moved, but normally, rotational force of a motor is converted into a linear movement using a gear mechanism to drive the actuator in the linear direction. In case of using this type of linear actuator for the headlight optical axis direction adjustment described above for example, if it is possible to accurately find out a position within a stroke range of the actuator moving in the linear direction, it is possible to set an optical axis to a desired direction. Further, by detecting only an uppermost position or a lowermost end position of the actuator, it is possible to eliminate the need of a mechanical stopper with regard to the headlight optical axis position setting. In the past, in order to find out a position of the actuator, a position detector is provided outside a case of the linear actuator, and therefore, fine positional adjustment between the position detector and the actuator is required at the time of assembling. Also, there is a drawback that a configuration becomes large in size. In addition, a conventional linear actuator does not have a reliable mechanical stopper.

[0003]

[Problem to be Solved by Invention] The present invention is to eliminate conventional drawbacks described above, and it is an object thereof to provide a linear actuator that can mount an actuator position detector therein and has a reliable mechanical stopper.

[0004]

[Means for Solving the Problem] In order to achieve the object of the present invention described above, this invention provides a linear actuator which converts rotational force of a motor into a linear direction of an actuator, characterized in that the linear actuator comprises a stator forming a motor, a rotor supported rotatably at a center of the stator, an actuator that

is screwed into a screw provided around a rotation center line of the rotor and is movable along the rotation center line by rotation of the rotor, a position indicator that is provided on the actuator and indicates a position of the actuator, a position indicator detecting portion that is located inside a case on the same stationary side as the stator and detects the position indicator, and a stopper that is located outside an moving range of the actuator and by which a mechanical end position of the actuator is adjustable.

[0005]

[Operation] When a motor composed of a stator and a rotor is driven, the rotor starts to rotate. When the rotor rotates, an actuator that is screwed therein starts an up-down motion, and when a position indicator provided on the actuator passes across an opposing portion of a position indicator detecting portion provided inside a case, an electric position of the actuator is confirmed. When the actuator goes out of control and is about to deviate from a predetermined range, the movement of the actuator is restricted by the stopper. The point of action of the stopper is adjustable.

[0006]

[Embodiment] Next, an embodiment of the present invention will be described using the drawings. Fig. 1 is a cross-sectional view of the embodiment of this invention, and in the same figure, 1 denotes an actuator. The actuator 1 is made of non-magnetic metal, and is arranged, so as to be movable in and out in up-down directions, in a case 2 having a projecting type cross section and made of non-magnetic material in the same manner. A bearing portion 3 of the actuator 1 is axially supported in the form of spline in the upper and lower direction, in the vicinity of an inside of a neck portion 4 of the case 2. Fig. 2 is a cross-sectional view cut along an A-A line of Fig. 1. As you can understand from Fig. 2, as for the bearing portion 3 of the actuator 1, three lines of protrusions 3' are provided in a longitudinal direction of the actuator 1, and inside the neck portion 4, three lines of grooves 4' are provided in a longitudinal direction, so that the protrusions 3 are fitted into the grooves 4' in a slidable manner. For this reason, the actuator 1 is movable in the longitudinal direction, but is not rotatable. On an outer periphery of a lower end portion of the actuator 1, a screw 6 is threaded. Inside the case 2, a cylindrical rotor 9 is axially supported in a rotatable manner, by bearings 7, 8. On an inner surface of the rotor 9, a screw 10, which mesh with the screw 6 threaded in the actuator 1, is threaded. In addition, to an outer periphery of the rotor 9, two pieces of ring shaped permanent magnets 11 and 12 are attached as a rotor magnet. Stator coils 13 and 14 including magnetic poles are provided through a little gap, locating on an outer periphery of the rotor magnet 11 and the rotor magnet 12. Meanwhile, by these rotor magnets 11, 12 and the stator coils 13, 14, a widely known PM type stepping motor is configured.

[0007] To a lower part of the case 2, a mounting base plate 15 is attached by screw-in. On a lower end of the actuator 1, a stopper 16 for positioning of the actuator 1 is arranged. The stopper 16 is screwed in a center part of the mounting base plate 15. As for the stopper 16, as shown in Fig. 3, a setter 18 having a point stopper 17 at a tip point thereof is provided at a central upper part, a fitting groove 19 of a screw driver is provided on a lower part, and a screw part 20 for being screwed in the mounting base plate 15 is provided on an outer periphery. Meanwhile, a diameter R of this screw 20 is larger than a diameter of the screw 10 provided inside the rotor 9. 21 denotes a cover fitted in a bottom surface of the mounting base plate 15, which protects the stopper 16. As shown in Fig. 1, Fig. 4 and Fig. 5, at an inner side of a shoulder portion 2' of the case 2, a position detecting device 23 using a HALL device that detects magnetism is fitted therein. This position detecting device 23 serves as a position indicator detecting portion. A conductive wire is pulled out from the position detecting device 23, and is connected to a terminal 24. A cut is formed in the protrusion 3' of the actuator 3, and furthermore, a hole communicating with this cut is drilled in the

actuator 3, so that a plastic magnet 25 for position indicator is fitted in these cut and hole.

[0008] Next, an operation of the above-described embodiment is explained. When predetermined pulses for driving are applied to the stator coils 13 and 14 from a stepping motor driving circuit provided separately, the rotor 9 starts to rotate. By the rotation of the rotor 9, the actuator 1, which is screwed into the rotor 9, moves in the upper and lower direction in Fig. 1. A tip point of the actuator 1 is connected to a base to which a headlight of a vehicle has been attached. Then, if the actuator 1 starts to move in the front-rear (A) direction shown in Fig. 6, an optical axis of a headlight is changed by θ degree. In addition, if rotation of the rotor 9 is stopped in the mid-course of the movement of the actuator 1, the actuator 1 stops at that position, so that it is possible to fix a light radiation direction of the headlight in a desired direction.

[0009] When the actuator 1 continues to move down, the cover covering the headlight is closed. Then, the plastic magnet 25 passes in front of the position detecting device 23, and the position detecting device 23 detects magnetism of the plastic magnet 25, so that a current position of the actuator 1 is detected. Although the drawings do not show, a driving circuit of a pulse motor receives this signal. For example, it detects that the actuator 1 arrives at an electric end position, to give an instruction to stop rotation of the pulse motor or the like.

[00010] When the driving circuit of the pulse motor goes out of order at this time and there occurs a situation that rotation of the pulse motor does not stop, a bottom 22 of the actuator 1 is brought into contact with the point stopper 17 of the stopper 16. At this time, the actuator 1 stops moving further downwards by this means. In addition to the diameter R of the screw of the stopper 16 being larger than a diameter of the screw of the actuator 1, a tip of the point stopper 17 is of a point touch. Therefore, rotational force of the actuator 1 is not transmitted to the stopper 16, so that a situation that the screw of the stopper 16 slackens by contact of the actuator 1 and drops out from the mounting base plate 15 does not occur. Then, the driving circuit of the stepping motor supplies a pulse of a certain period of time (desired pulses + α pulse) to the stepping motor and stops it after that, to stop rotation of the stepping motor.

[0011] In addition, when a position where the point stopper 17 and the bottom 22 of the actuator 1 are brought into contact with each other is changed by fitting a screw driver in the fitting groove 19 provided in the bottom of the stopper 16 and rotating the screw driver stopper 16, it is possible to change a mechanical lowermost end position of the actuator 1.

[0012]

[Effect of Invention] As described above in detail, according to the present invention, with the linear actuator that converts rotational force of the motor in a linear direction of the actuator, the position indicator is provided on the actuator and the position indicator detecting portion is provided inside the case that supports the movement of the actuator, and therefore, as compared with conventional ones in which a position indicator detecting portion is provided outside the linear actuator, it has many advantages - not only it is possible to form a compact configuration, but also possible to eliminate the need to align the position indicator and the position indicator detecting portion when assembling, and furthermore, even if the motor goes out of control, unnecessary overrun of the actuator does not occur since the mechanical stopper is provided.

[Brief Description of the Drawings]

[Fig. 1] a partial cross-sectional view of an embodiment of a linear actuator according to the present invention.

[Fig. 2] a cross-sectional view taken along the line A-A of Fig. 1.

[Fig. 3] a cross-sectional view of a stopper 16.

[Fig. 4] a partial perspective view of the actuator.

[Fig. 5] a cross-sectional view showing a positional relationship between a position indicator and a position indicator detecting portion.

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