

INSTRUCTION MANUAL

LINEAR ACTUATOR FOR
SATELLITE TV ANTENNA POSITIONING

MODEL: PJ-460



BOMAN INDUSTRIES

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Manufactured in Japan

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INSTRUCTION MANUAL

Thank you for your having purchased the Linear Actuator. This is the linear actuator developed for the purpose of automatic tuning of Satellite TV antenna. It is of extremely tough construction and has very sensitive electronic components. Accordingly, before installing and handling it, please read the description in this Manual, carefully.

1. SPECIFICATIONS

- 1). Model : PJ-460 (MDS300K-5.6LPD)
- 2). Thrust - Rated thrust : 900 lbs.
- Max. thrust : 1400 lbs.
When power capacity is small, the thrust level will be decreased.
- 3). Stroke - Normal stroke : About 21"
- Max. stroke : About 22"
- 4). Speed - DC 36V, No load: About 0.3"/sec.
- 5). Power source : DC 36V..To have sufficient capacity and no voltage drop.
- 6). Current - On rated : About 3.7A
- On max. : About 5.9A
- 7). Stroke setting : Both stroke ends to be controlled by limit switch.
Stroke setting on shipment to be about 21".
- 8). Ambient temp. : -4°F to 122°F (But not to be frozen).

- 9). Place of installation : Outdoors in good environment
- 10). Sensor : 2-sensor system
- ...Analog sensor, 1 unit
- ...Digital sensor, 1 unit

2. CONSTRUCTION

Please refer to Fig. 1. This Linear Actuator operates according to the following principle.

A DC motor which can rotate clockwise or counterclockwise in accordance with signals from controller is built in this actuator. The rotation speed of the motor is reduced by 2-stage reduction gears and the screw shaft is rotated. A nut unit is engaged with the screw shaft. A piston rod is mounted at this nut unit. So, the screw rotates clockwise or counterclockwise according to the rotation direction. Simultaneously, the nut unit can reciprocate linearly, thereby causing the piston rod to make linear actions, i.e., to come out and to come in.

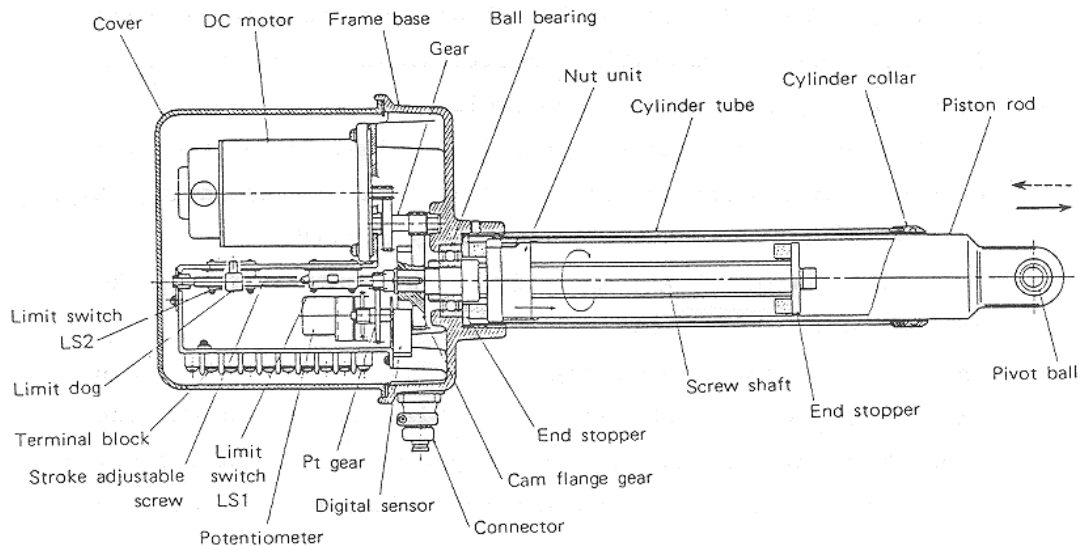


FIG. 1

2-1. Linear reciprocating movement

Now, if the motor rotates clockwise as seen from the side of output gear, the screw shaft as well rotates in the same direction. Then, the nut unit engaged with the screw shaft shifts in the coming-out direction, and the piston rod constructed integrally with the nut unit generates outward pushing force. Likewise, if the motor rotates counterclockwise, the piston rod generates inward pulling force in the same manner. As mentioned in the above, the Linear Actuator makes reciprocating linear movements by signals which come from the controller, and the Actuator can drive a satellite TV antenna with enormous power in either direction according to the signals.

2-2. Positioning

This Linear Actuator is controlled by a separately installed controller. The system is so designed that by the sensor built in this machine the present position is compared with the position preset in advance in the controller (e.g., the direction of satellite) and the satellite antenna is positioned to the optimum position. This performance is displayed together with the controller.

Two sensors are adopted in this machine. One of them can continuously generate analog signals to all the operating range of the actuator as potentiometer and can detect the preset positioning point by a comparator in the controller and make an automatic stop there.

The other of them has a digital sensor which can generate digital signals of ON and OFF. This digital sensor can generate ON and OFF signals of 1mm per pulse for the operating stroke of the actuator and count the pulses by a counter in the controller. And the actuator is positioned with the preset number of counting.

As mentioned in the above, this Linear Actuator has been so designed that it can best suit to the two types of the controller.

In either case, it is possible to automatically position a satellite TV antenna in high accuracy. However, as this actuator is furnished with no mechanical braking mechanism, it is highly recommended that a circuit by which electro-dynamic braking can be secured or a circuit by which a closed loop can be secured between the motor terminals when the motor stops, should be prepared in the controller. Then, higher accuracy positioning will be available.

2-3. Analog sensor

A precision potentiometer is built in this actuator as analog sensor. The specification is as follows;

* Specifications of the potentiometer

1). 10-turn type potentiometer

2). Resistance value : 1 kilo-ohm

3). Capacity - Max. : 1 W.

- Normal : 0.5 W

This potentiometer is so designed that it can rotate, accompanying with the rotation of the screw shaft which is further reduced by small-sized 2-stage reduction gears. Namely, in Fig.8, the potentiometer is so connected that the resistance value between the terminals 3 and 4 of the potentiometer can be increased when the screw shaft rotates in the direction along which the piston rod comes out and can be reduced when the screw shaft rotates in a direction that the piston rod comes in.

Further, as shown in Fig.2, the potentiometer is provided with a slip clutch for prevention of overturn at its shaft. The potentiometer can be prevented by this arrangement from damages at the end of its rotation.

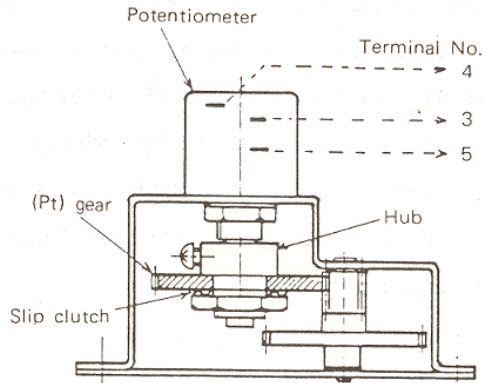


FIG. 2

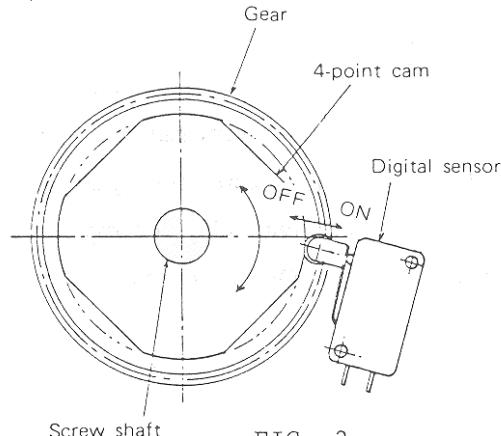
At the time when shipping the machine, the potentiometer is synchronized so that the resistance value between the terminals 3 and 4 can be minimized when the piston rod most comes in. And please never turn the piston rod before mounting it at a TV antenna.

In order to prevent the piston rod from turning in transit, it is fixed temporarily using a rod clamp when shipping the products.

If the piston rod is turned carelessly or when repair is made, synchronization will be broken. After setting the piston rod in accordance with the Adjustment of Synchronization in the clause 6, rotate the motor and reciprocate the piston rod once, and it can be synchronized automatically by virtue of the above slip clutch.

2-4. Digital sensor

The screw shaft gear furnished with a 4-point cam is provided at its screw shaft in this machine (See Fig.3 below).



When normal or reverse rotations are conveyed from the motor to the screw gear shaft, the digital sensor is given ON-OFF signals of 4-pulse per revolution of the screw shaft.

In other words, a pulse of 1mm/pulse will be generated according to the movements of the piston rod.

As this sensor is of reed switch type, it well withstands lightning, static electricity and high tension noises, is stabilized electrically and has longer service life.

* Specifications of Digital Sensor

- 1). Reed switch type digital sensor
- 2). Stroke/pulse : 0.039"/pulse (1mm/pulse)
- 3). Rated capacity : 0.01A, 6V DC to 0.1A, 24V DC

(To be used in the above range of voltage and current)

Also, the controller side load should be resistance load. As this sensor is of polar contact type, there will be naturally contact bounding of infinitesimal order. When it is deemed to be inconvenient, eliminate it through a capacitor, etc., at the controller side.

3. INSTALLATION

When installing the linear actuator to a satellite TV antenna, carry it out correctly, otherwise, failure or accident may result. Read the instruction manual carefully to secure perfect installation.

(NOTE) Take out the product from a carton box. Then, you will see that the piston rod is temporarily locked with the rod clamp in order not to allow the piston rod to turn in transit. Do not remove the clamp until the piston rod is installed with a TV antenna.

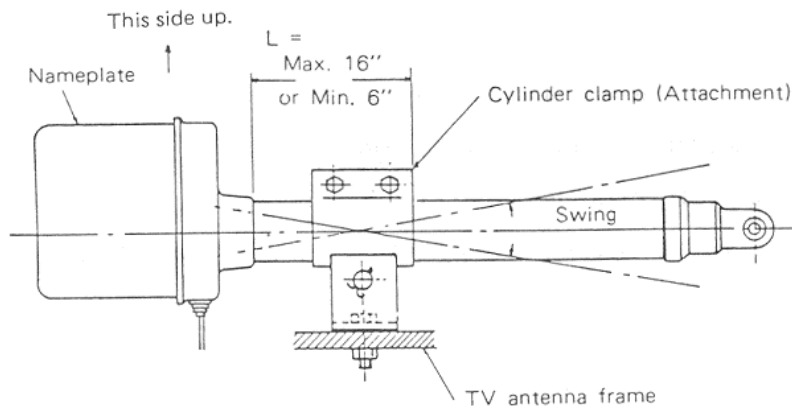


FIG. 4

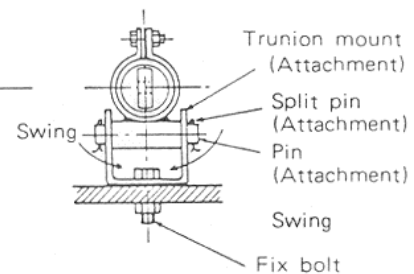


FIG. 5

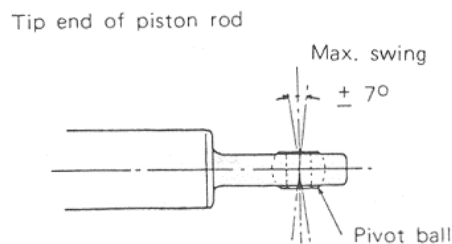


FIG. 6

Install the linear actuator in the following procedure;

3-1. In Fig.4, fix the cylinder clamp firmly in the range "L" between 6" and 16". However, if tightened excessively, the piston rod can not be moved resulting in a damage to burn out the motor.

3-2. Using the attached cylinder clamp, pin and split pin, set the linear actuator at the frame of a TV antenna as shown in Fig.4, 5 and 6. At this time, the antenna mounting bolts shall not be completely tightened, but they should be tightened to such a degree that the trunion mount can be swung somewhat. Please remember that if the setting is too loose the positioning accuracy of the actuator will be worsened.

Next, connect the machine and assemble it by using the trunion mount pin as shown in Fig.5, insert the split pins and bend its legs to prevent the pin from coming-off.

Give a small amount of grease to the trunion mount and the pin. Also, when carrying out the assembly of the above, make sure that the cable outlet for the machine is at the lower side and the drain hole of the cover is at the lower side as well as the cable outlet.

Thus, the machine installed to the TV antenna is allowed to swing freely up and down and right and left as shown Figs. 4 and 5.

3-3. Next, in Fig.6, install the mounting pin for driving a TV antenna at the pivot hole at the end of the piston rod. This is all for the installation.

Subsequently, connect the machine to the controller, turn on the power, perform inching operations.

and make sure that when the piston rod reciprocates in full stroke the machine moves smoothly in all respects.

If any failure is found, stop the operation immediately and install it again. As the actuator generates an enormous force, unreasonable operation will result in an accident.

3-4. After the above steps of procedure are completed, remove the piston rod locking clamp and its seal. If the piston rod is turned by mistake, synchronous setting will be off phase, resulting in non-conformity. Should it be turned inadvertently, read the procedure for synchronization adjustment of the clause 6.

4. METHOD FOR STROKE ADJUSTMENT

In this actuator, set the maximum stroke between the forward end and the backward end from about 6" to 22" by limit switches LS1 and LS2. When shipping the actuator from the workshop, the limit switch is set to the maximum (about 21"). If the actuator is used with the stroke shortened, set the stroke as shown below.

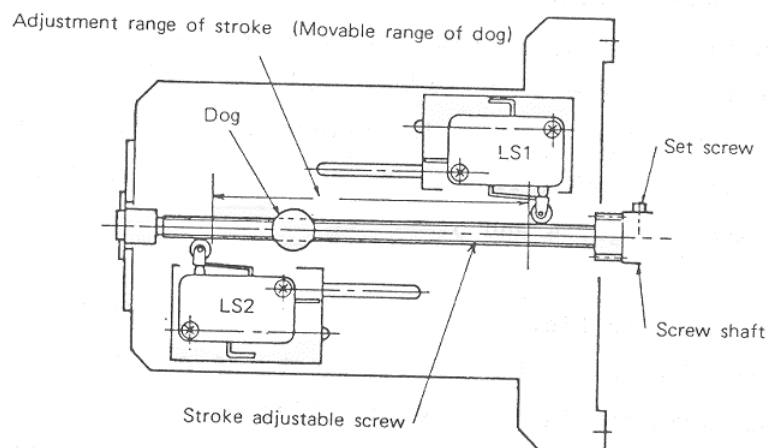


FIG. 7

4-1. When adjusting the advance end of the piston rod, adjust the position of LS1. When adjusting the retracted end of the piston rod, adjust the position of LS2.

In Fig.7, move the LS1 to the right side with the dog placed between both the limit switches, and the advance end of the stroke is extended. And move it to the left side, it is shortened. Likewise, move the LS2 towards the right, then the stroke at the retracted end will be shortened. Move the LS2 toward the left, and the stroke at the retracted end will be extended. In both the cases, the piston rod and the dog should be located roughly at the center of the stroke. If either LS1 or LS2 is moved extremely to each end of the stroke, respective dogs may not cut off the limit switch. So, please set the limit switches about 0.1" inwardly of each end of the stroke.

4-2. Here, the most important thing is that as shown in Fig.7, the dog must be absolutely located between the LS1 and LS2. Should they be set erroneously such that the dog is located outside either LS and the machine be actuated as they are, then either LS1 or LS2 will not be turned off at a stroke end and the dog of this actuator or limit switch actuating screws will be broken to make it unusable. When setting or replacing the limit switches, be careful about this point.

5. ELECTRIC CIRCUIT DIAGRAM

In this actuator, the electric circuits are designed as follows; Failure in making connections results in an unpredictable accident. Be careful.

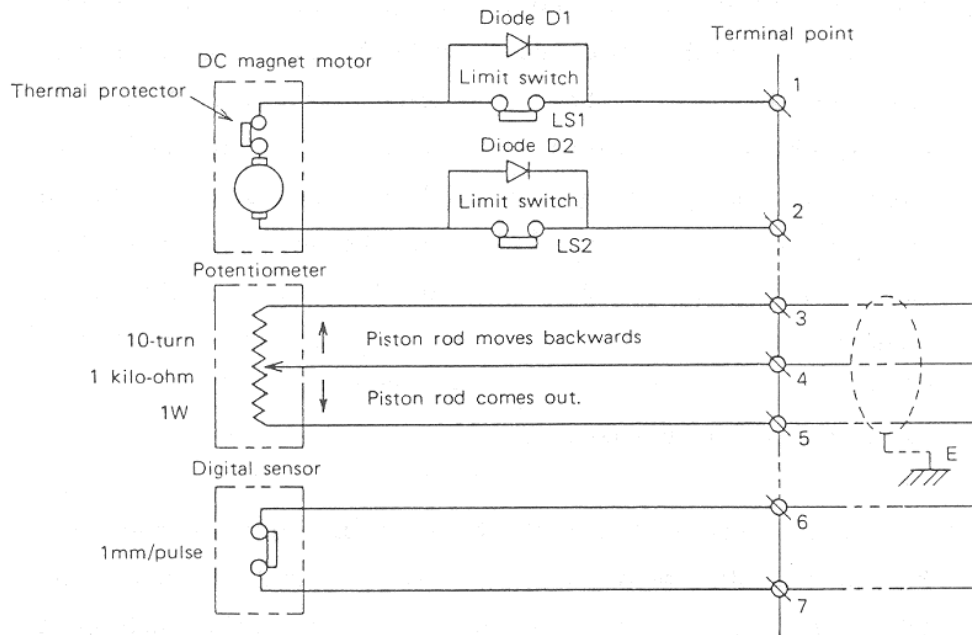


FIG. 8

LS1: This limit switch is turned OFF at the advance end of the rod. Otherwise, normally ON.

LS2: This limit switch is turned OFF at the retracted end of rod. Otherwise normally ON.

5-1. When the terminal 1 is energized plus(+) and terminal 2 minus (-), the piston rod comes out. At this moment, resistance value between the terminals 3 and 4 of the potentiometer is increased.

When the piston rod comes out to the set position, the limit switch LS1 is turned off and the piston rod stops.

- 5-2. When the terminal 1 is energized minus (-) and terminal 2 plus (+), the piston rod comes in. At this moment, resistance value between the terminals 3 and 4 of the potentiometer is decreased.

When the piston rod retracts to the set position, the limit switch LS2 is turned off and the piston rod stops.

- 5-3. For wiring of the terminals 1 and 2, use electric wire of 2mm² or over. For wiring of the terminals 3, 4 and 5 as well as 6 and 7, use shielded wires where used in a place with lots of noise

- 5-4. For connection, route electric wires in accordance with the terminal nos. Waterproof connectors are included in the carton box of this machine as accessory. Cut off the end of the connectors, matching to cable diameter, and tighten cables using tightening screws to provide complete waterproofing.

6. SYNCHRONIZATION ADJUSTMENT

When the piston rod has been turned inadvertently before installation of the actuator to a TV antenna, or when the potentiometer has been replaced or reset, or when limit switch (LS1 or LS2) has been replaced or reset, it is necessary to synchronize them in accordance with the following procedure;

Otherwise, the relative position between limit switch (LS1 or LS2) and the piston rod slips off, resulting in shorter stroke, or the piston rod reaches its stroke end before the limit switch (LS1 or LS2) is turned off. Then, it makes the motor locked and unusable. Before such trouble occurs, be sure to conduct synchronization adjustment according to the following procedure:

6-1. Method for adjusting the position of the piston rod and the actuating points of LS1 and LS2

- 1). Firstly, turn off the power. Move the LS2 in Fig.7 full to the left, and move the LS1 full to the right.
- 2). Then, remove the piston rod from the antenna and turn it by a hand in the direction it comes out. And make it come out fully. If the motor rotates together with the piston rod, push the cam flange gear with a wooden piece so that the motor does not rotate together.
- 3). Next, rotate the motor and retract the dog while giving the motor inching movements until the dog turns off the LS2 and stops.
- 4). When the LS2 is turned off and the motor stops, then, turn the piston rod by hand until it reaches the retracted end. (Turn it by hand slowly and lightly. It moves 4mm per turn).
- 5). When the piston rod reaches its retracted end, turn it reversely by one turn. Then, the synchronization is completed. Under this condition, install the actuator to a TV antenna, paying attention so that the piston rod will not be allowed to turn. (See the clause 3, INSTALLATION). After that, set the LS1 and LS2 to the desired stroke. In either case, the dog is to be located positively between the LS1 and LS2.

7. TROUBLES AND COUNTERMEASURES

7-1. Motor does not rotate.

Cause (1) : Power source (controller) is out of order. Or else, the connection is made with + and - mutually reverse. In this case, normally the limit switches (LS1 and LS2) have been operated.

Counter-measure : Correct the connection and start the motor again. In this moment, begin inching the motor and watch the dog carefully. If the motor does not stop even though the dog turns off either LS1 or LS2 at stroke end, the limit switch (LS1 or LS2) may be shortcircuited.

Cause (2) : The thermal protector built in the motor is actuated.

Counter-measure : If you touch the outside of the motor, you feel it very hot. This is because the motor is overloaded. Please wait until it is cooled down. It is automatically reset. To prevent the motor from starting, it is necessary to switch off the power of the motor.

Cause (3) : Motor is damaged by burnout.

Counter-measure : Replace the motor with new one.

measure

7-2. No specified stroke is obtained.

- Cause (1) : Faulty adjustment of the limit switch
LS1 or LS2
- Cause (2) : The piston rod and the limit switch are
out of synchronization.
- Counter-
measure : See the clause 6, Adjustment of synchro-
nization.

7-3. At stroke end the motor is locked and groans.

- Cause : The limit switch which is actuated at
the stroke end is not turned off. The
piston rod and the limit switch are out
of synchronization.
- Counter-
measure : See the clause 6, Adjustment for
synchronization.

7-4. After a limit switch is turned off, the reverse switch
is switched on, but the motor will not be turned.

- Cause : The diode is broken.
- Counter-
measure : Replace it. In this case,
be careful about the polarity of diode.
See Fig. 8.

7-5. Switch is turned on, but the motor only groans.

- Cause : Cylinder clamp is excessively tightened,
and the rod does not move.
- Counter-
measure : Apply correct tightening force.

7-6. Faulty movement of potentiometer

- Cause (1) : Potentiometer is damaged by burnout.
- Cause (2) : Slipping of the slip clutch

Cause (3) : Idle run of potentiometer gear
Faulty connection

Counter- : Observe phenomenon carefully and
measure replace it and conduct maintenance
service appropriately.

7-7. No pulses generated from the digital sensor

Cause (1) : Digital sensor is damaged by burnout.

Cause (2) : Faulty contact between the cam and
sensor.

Counter- : In the case (1), replace it.
measure In the case (2), reset it.

7-8. No predetermined power obtained

Cause : Power capacity of the controller is
small. Especially, voltage drops at
full load, resulting in insufficient
power.

Counter- : Replace it with a larger capacity
measure controller, or reduce the load.

7-9. On mechanical failure

Refer to Fig.1 and investigate the cause. Furnish it
with suitable countermeasures.

8. MAINTENANCE

8-1. In this linear actuator, normal use will require no
maintenance. However, when it is used for a long period
of time or the frequency of use is high or when used in
poor environments, give grease for lubrication.

Location of lubrication

1). Gear unit Open the cover and give a coat of
grease using a spatula, etc.

- 2). Screw shaft.... Advance the piston rod approx. 2/3, loosen the screw locking cylinder tube and turn the cylinder. Then, the screw shaft will come out. Give grease there using a spatula, etc.
(In this case, to be removed from a TV antenna).
- 3). Piston rod Remove the cylinder collar and give a coat of grease to the piston rod surface. For the other parts including the pivot, etc., which performs movements, give grease to them, too.

For the kind of grease to be used, automobile chassis grease will be all right. Conduct maintenance service in reference to Fig.1, Construction Drawing.

- 8-2. For service parts, apply to the store from which you have purchased the machine. The back-up system for supplying normal parts is complete. It is sincerely hoped that you make use of the machine always in the best available conditions.