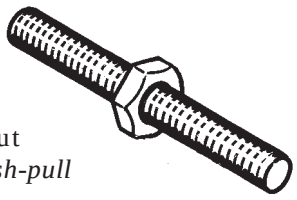
SECTION 4

LINEAR ACTUATORS



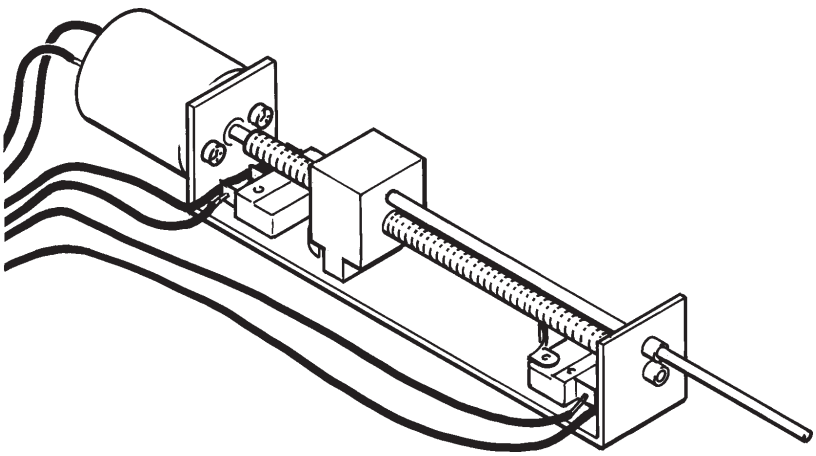
A *linear actuator* is a motorised unit which often resembles a hydraulic or pneumatic cylinder. It contains a motor, gearbox and a means of converting the rotary output from the gearbox into a powerful *push-pull* linear movement. This movement is normally obtained by a *nut* moving along a rotating screw thread - the same means used to move the carriage on a manual lathe.

Most larger commercial linear actuators use a *ball screw*. This works on the same principle as a basic nut and screw but the nut is separated from the screw by ball bearings to minimise friction.

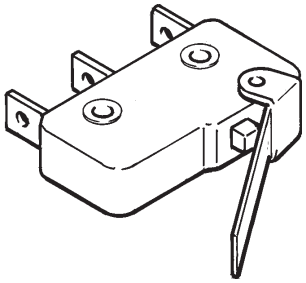
Linear actuators are normally used to provide *intermittent* rather than continuous push-pull movements. They are self-contained units, and very easy to build into systems such as window opening mechanisms. However, because the motor is totally enclosed, they have a limited *duty cycle*. This means that they can be energised for only a certain percentage of the time. For example, an actuator with a duty cycle of 50% means that it should only be running for only - say - 2 minutes within a 4 minute period. Manufacturers state the precise duty cycle conditions in their literature.

TEP linear actuator

The TEP linear actuator is an *open-frame* type that comes almost completely assembled. It uses a 5mm diameter screw driven directly by a miniature DC motor. The screw engages a brass nut set into a plastic block which also accommodates a push rod. The end of the screw is supported in a nylon bearing at one end of the frame and above this an identical bearing providing support for the push rod.



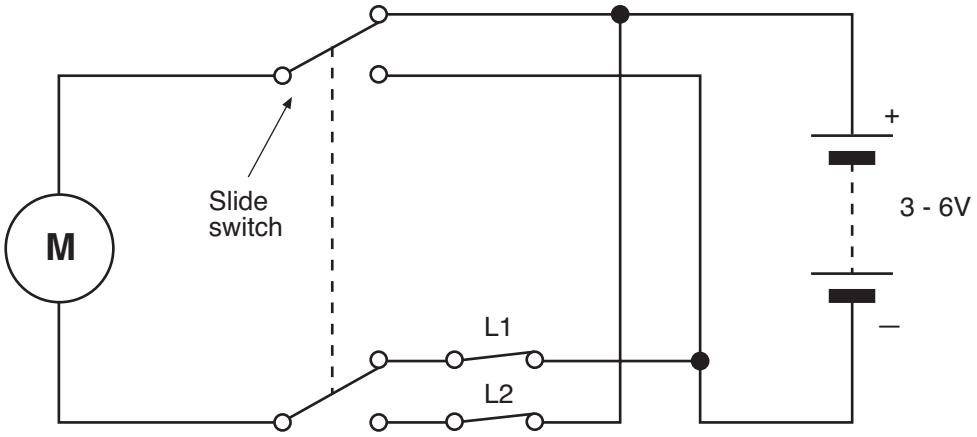
If the motor is connected to a 3v - 6v battery supply, the nut will run rapidly to one end of the frame. Reversing the motor supply will cause it to run in the opposite direction. If you do this simple experiment, however, you will find that at the end of its travel, the nut will lock onto the screw and simply reversing the motor will not be enough to free it. To prevent the nut reaching the extremity of the thread and to provide proper control, it is necessary to add two *limit switches* to the frame. These switch off the motor when the nut is almost at the end of its travel. They also enable manual or automatic reversing of the nut.



Setting up the limit switches
The actuator is supplied with two limit switches and small self-tapping screws for fixing. Two leads should be soldered to each switch as shown, and the switches fastened to the frame. **The lever of each switch should be bent outwards so that the supply is switched off well before the end of the nut's travel.** This needs to be done because the motor continues to spin after the supply is switched off, and the nut travelling beyond its limit will jam.

As a guide, use only a 3 volt supply either to trial the actuator or run it with a light load. With a heavier load, you can use a 4.5v - 6v supply.

For manual operation of the actuator, the limit switches are connected to a DPDT (double pole, double throw) switch as shown. When the slide switch, provided with the actuator, is in the centre position, it is 'off'. In either of the other two positions it supplies current to the motor until one of the limit switches breaks the circuit. The slide switch can then be thrown to the other 'on' position to reverse the nut. Manual switching might be used, for example, to cause the actuator to throw a lock bolt.



L1 and L2 are the limit switches. Use connections marked 'con' and 'NC"

The actuator can be controlled electronically by using an appropriate circuit and a DPDT relay (or two SPST relays). For example, a "Bit by bit" controller can be programmed to switch a pair of SPST relays on and off.

There are many variations on the control theme. For example, a sensor might be used so that the actuator opens:

- a vent when a set temperature is reached
- a vent above a set light level
- a valve when water (or moisture) falls below a fixed level