

Stepping Motors

Although not truly “mechanisms,” stepping motors deserve consideration in this book because they comprise one of the most important of all modern-day methods for producing high-speed intermittent motion. They are electrical motors that are designed to take a single step when fed a single electrical pulse. Some types of stepping motors, or *steppers*, as they are often called, will also run continuously just as a “regular” motor if the input frequency is high enough; but most steppers are not used in this way.

Stepping motors are much in favor today since a large number of industrial and commercial functions are now controlled by digital computers or other digital equipment, and the stepping motor offers an excellent method of converting electrical pulses into various types of motion. Of course, such things as solenoid operated ratchets, clutch and brake systems, inverse escapements, etc., can also serve the purpose and are used to produce motion from pulses. The step motor, however, can operate at much higher speeds (thousands of steps per second in some cases) and with a much longer life than an impacting mechanism such as a ratchet. One of the most significant advantages of most stepping motors, in fact, is the absence of contact impact between input and output members. Accelerations and decelerations are comparatively gentle, extending the life of any machine which is driven by the device (see Fig. 5-6).

Advantages and Disadvantages

High speed, absence of impact and very long life are the principal advantages of the stepper. Another

advantage, in some applications, is its versatility. Dwell and motion periods can be as long as desired (if the motion period includes one, or more than one, step). Steppers are frequently used, therefore, in systems where the dwell period or length of motion is expected to be variable; in digital process control systems, for example, where they might be used to position valves, etc.

Stepping motors are also very compact drive systems (compared to motor-clutch-brake combinations, for example). We tend to overlook the fact that a cam or Geneva must be driven by something. The cam looks small and compact, but the total intermittent motion drive system also involves a motor. With a stepper the “motor” is the whole system (except for the control circuits, of which some type is also required with “regular” motors).

Stepping motors are generally used in an open loop control system. There is no feedback since none is required, presumably, to position the load. If the stepper is fed five pulses it will move to a new position five steps beyond the first. Some designers, however, insist that it is very dangerous to count on this if your personal safety or the safety of your machine depends upon the certainty that the motor has obeyed you. Digital pulses have a way of getting lost or of appearing when least expected (thanks to electrical “noise”).

Many designers, therefore, provide the stepper system with a feedback of some type; perhaps a shaft encoder on the load that is checked by the digital computer which has given the original instructions

