Two SMA-Actuated Miniature Mechanisms

These mechanisms represent two different approaches to latch/release operation.

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The figures depict two miniature mechanisms actuated by strips made of shape-memory alloy (SMA). A typical SMA is a nickel-titanium alloy known by the trade name "Flexinol" or "Nitinol." In preparation for a typical application, a suitably sized and shaped piece of an SMA is deformed by a predetermined amount at the lower of two operating temperatures, then mounted in a mechanism. When stroking of the mechanism in one direction is desired, the piece of SMA is heated above a transition temperature to make it return to the "remembered" undeformed state. When stroking

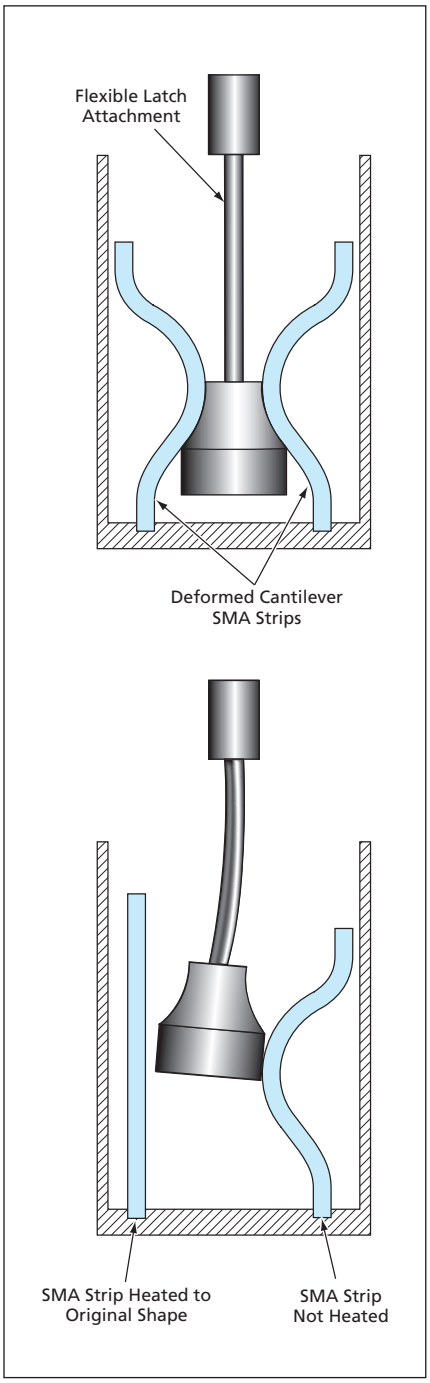

Figure 1. **Two Bent SMA Strips** act as two halves of a clamp that retains the knob. Both SMA strips are supposed to straighten when heated to release the knob. However, even if only one SMA strip straightens, the knob is released.

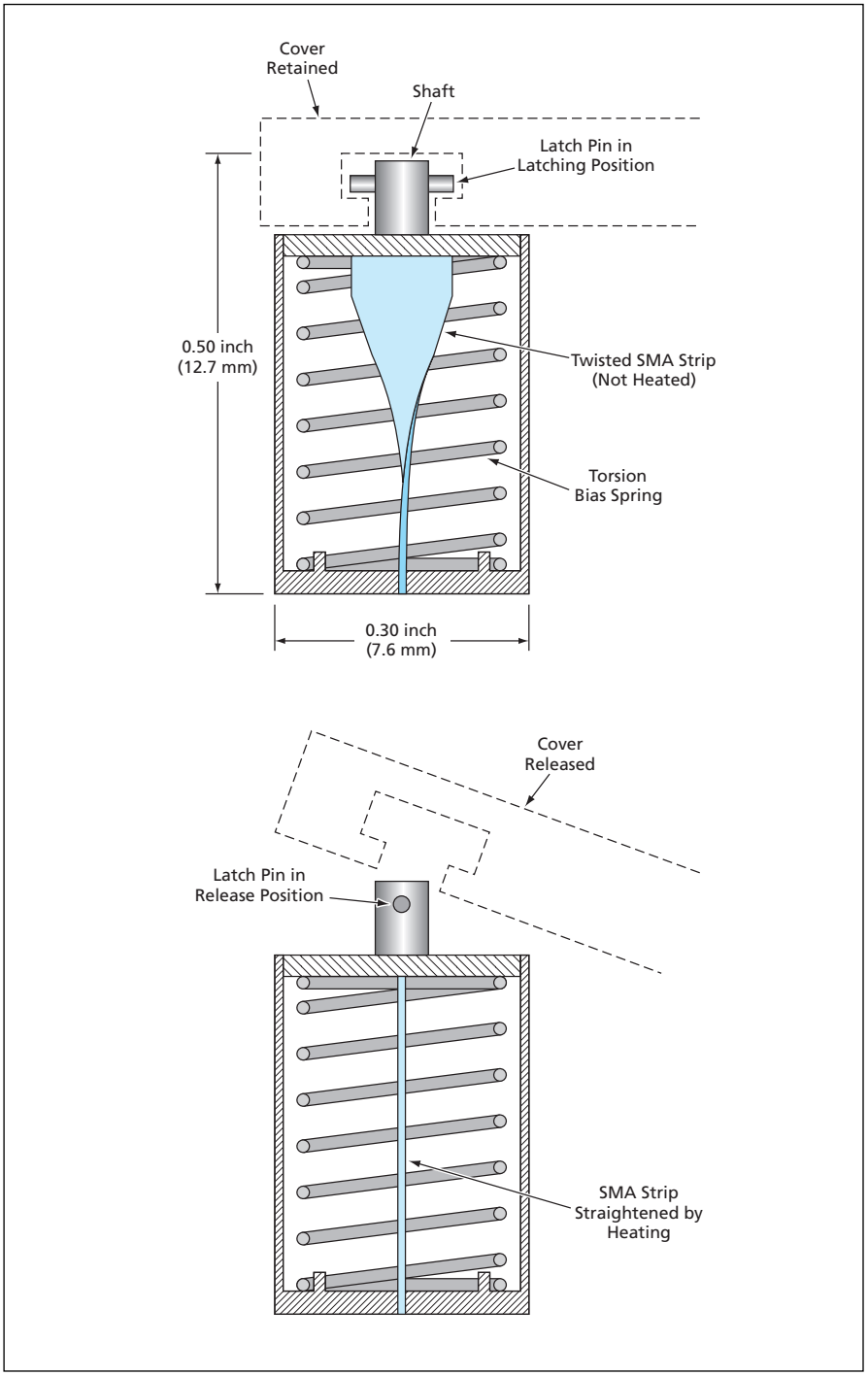

Figure 2. A **Torsion Bias Spring and a Twisted SMA Strip** cause the shaft holding the latch pin to rotate through a 90° angle to a release position when the SMA strip is heated above its transition temperature.

of the mechanism in the opposite direction is desired, the SMA is cooled below the transition temperature to make it return to the deformed state.

Also, the SMA alloy chosen for a specific application is one that has a transition temperature somewhat above the ambient temperature, so that stroking in one direction or the opposite direction can be achieved by heating the SMA, or refraining from heating the SMA, respectively, above the transition temperature. In the present mechanisms as in typical other SMA mechanisms, the heating is effected by electric currents applied via electrical contacts at the ends of the SMA strips.

The purpose served by the mechanism of Figure 1 is to lock or release a flexible latch attachment. In preparation for use in this mechanism, two initially straight SMA strips are deformed into curved springs that, when mounted in the mechanism at ambient temperature, clamp the knob at the lower end of the flexible latch attachment. When heated above their transition temperature by an electric current, the SMA strips return to their original straight configuration, thereby releasing the knob. This mechanism is redundant in the sense that as long as at least one of the two SMA strips straightens when commanded to do so, the knob is released.

The mechanism of Figure 2 is suited to any of a variety of applications in which there are requirements for a small mechanism that affords low-torque rotary actuation through a finite angular range. As shown here, the mechanism is used to rotate a cover-latch pin to a release position. In this case, a straight and flat SMA strip is torsionally deformed to a twist angle of about 90° by use of a torsion bias spring. When the SMA strip is heated, it rotates to its original straight and flat condition.

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