in a first direction toward the first position. Teeth **456** engage with teeth **458** and impart rotation to pin **450**. The movement of pin **450** in the first direction is guided by projection **460** within the first channel **480**. As projection **460** moves past the upper edge of lower guide **464**, the rotation imparted to pin **450** causes projection **460** to move between lower guide **464** and upper guide **466**. As spring **46** cools, pin **460** and projection **460** are urged in the second direction by second spring **44**. Projection **460** slidingly engages first guiding surface **472** and is supported within first rest **468** of guide **464**, as shown in FIG. **7**B. Vertices **457** and **459** are again aligned with the sloping portion of the opposing teeth.

In response to heating of spring **46** by the first amount of heat, projection **460** is urged toward third guiding surface of upper guide **466**. As a result of rotation imparted to pin **450** by teeth **456** of pin **454**, projection **460** moves toward and is restrained by second rest **469**. Upon cooling of spring **46**, projection **460** is urged downward by spring **44**, slides along lower guide **464**, and into a second channel **480** of member **462**.

Again referring to FIG. **7**A, in response to heating of spring **46** by a second, greater amount of heat pin **450** and projection **460** again move in the first direction toward the first position. However, because of the greater force imparted to pin **450**, projection **460** does not rotate and slide between guides **464** and **466**, but rather continues past upper guide **466** to a position above the uppermost part of vertical edge **476***a*. As spring **46** cools, projection **460** is urged downward by spring **44** and slides along second guiding surface **474**. Since there is no rest position along surface **474**, projection **460** continues to slide and moves into the second channel **480**.

Application of the second amount of heat to spring **46** when pins **452**, **450**, and **454** are in the first position as shown in FIG. **7**B also results in movement of projection **460** from first rest **468** toward second rest **469**. Upon cooling, projection **460** moves into channel **480**.

The second amount of heat and increased level of spring force from spring **46** is thus able to permit a general resetting of pins **452** to a channel **480**. Regardless of whether the projection is within a channel or being supported in the first position, application of the second amount of heat results in movement of projection **460** in a channel **480**. This is useful for assemblies controlled by a processor. With other types of supporting mechanisms described herein, a reset of a pin to the downward position is accomplished by a second actuation if the pin is already in the first position. When controlled by a processor, the processor should thus remember the position of a pin in order to determine whether or not an actuation signal is required. In the embodiment of reset mechanism shown in FIGS. **7**A and **7**B, the processor need not remember the position of the pins, and may apply the second amount of heat to effect a reset. Thus, processor controlled operation of a braille display, for example, requires less processor memory and time. The variable springs described herein, some of which are depicted in FIGS. **10**–**13**, are especially useful with the supporting mechanism described above and depicted in FIGS. **7**A–**7**B. The first amount of heat is applied to one portion of the spring, resulting in a first spring force sufficient to push projection **460** onto guiding surface **472**. The second amount of heat includes heating both portion of the variable spring, resulting in a second spring force sufficient to push projection **460** onto guiding surface **474**.

Although various embodiments of supporting mechanisms have been described herein, those of ordinary skill in the art will recognize many equivalents to these supporting mechanisms that are also useful in the present invention. Also, those of ordinary skill in the art will recognize various ways in which to incorporate stops in the various supporting mechanisms to limit the upward or downward travel of the pins.

The use of the various embodiments of supporting mechanisms permit continued support of pin **34** or **434** in the upward position without need for continued heating of spring **46**, and also permits pin **34** or **434** to resist larger axial loads that could otherwise be supported by spring **46**. Axial loads along pin **34** or **434** can be transmitted into midplate **26** by use of this supporting mechanism. The ability to support higher axial loads enhances the ability of pins **34** or **434** to emboss a surface presented to the top side of top plate **22**.

FIG. **8** depicts diagrammatically an alternate heating element useful with the present invention. Thermoelectric element **500** is shown schematically in a side view. Thermoelectric heaters (and coolers) utilize the Peltier effect to act as a solid-state heat pump with no moving parts or fluid reservoir. The Peltier effect is a physical phenomenon that occurs between a semiconductor junction of a p-type semiconductor **502** and an n-type semiconductor **504**. When current flows across the junction, electrons travel from the low-energy state in the n-type semiconductor to the high-energy state in the p-type semiconductor. This requires energy, which is absorbed from the surroundings, making a cool surface at the junction. Reversing the current makes the junction get hot. Typically, bismuth telluride junctions are placed as in FIG. **21** to create cold and hot surfaces. Thermoelectric elements **500** such as in FIG. **21** are commercially available in sizes as small as 1.8 mm×3.4 mm, including by way of example only the OptoTEC (™) brand thermoelectric module assemblies, which are useful in a braille-cell matrix or shaped memory spring actuator as shown in FIG. **8**.

As shown on the left side of FIG. **8**, a pin **34** is shown in the **34***a* first position. Pin **34** is in the first position in response to heating of memory spring **46** by thermal conductor **510***a* of thermoelectric heater **500'**. Heater **500'** is being supplied with power from interface controller **512** such that thermal conductor **510***a* is hot and thermal conductor **510***b* is cool. Although spring **46** may be permitted to cool by removing power to thermoelectric heater **500'**, it is also possible to actively cool memory spring **46**. Pin **34** shown on the right side of FIG. **8** is shown in the **34***b* downward position after spring **46** has been actively cooled by thermoelectric heater **500**. Control circuitry **512** includes a polarity inverter that permits a reversing of electrical polarity to lead wires **503** such that thermal conductor **510***a* of heater **500** is actively cooled, rejecting heat to thermal conductor **510***b*. One advantage of this technique is that by simply reversing the polarity of the thermoelectric heater **500**, one can actively cool the spring as well, thus reducing the lag time to allow the spring and pin to return to the un-actuated state.

The present invention contemplates heating memory spring **46** either by resistive heating or by thermoelectric heating. In one embodiment of the present invention, the resistive process used 12 V and 0.5 A over 0.2 sec in order to actuate the spring. This input produced a power of P=VI=6 W, and thus work W=Pt=1.2 J. In an embodiment of the present invention utilizing thermoelectric heating, the same actuation can be achieved with 0.5 V and 0.2 A. This results in an input power of only P=VI=0.100 J or about a factor of 12 times less than the resistive heating. According to an equation provided by one thermoelectric element