US007441431B2

(12) **United States Patent**
Weber et al.

(10) **Patent No.: US 7,441,431 B2**
(45) **Date of Patent: Oct. 28, 2008**

(54) **HIGH SECURITY PIN TUMBLER LOCK**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/651,244**

(22) Filed: **Jan. 9, 2007**

(65) **Prior Publication Data**

US 2007/0157688 A1 Jul. 12, 2007

Related U.S. Application Data

(60) Provisional application No. 60/757,595, filed on Jan. 9, 2006.

(51) **Int. Cl.**
E05B 27/00 (2006.01)

(52) **U.S. Cl.** **70/491**; 70/416

(58) **Field of Classification Search** 70/491, 70/416, 418–421

See application file for complete search history.

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(57) **ABSTRACT**

A pin tumbler lock of a first embodiment includes a shell containing top pins; and a plug, rotatable within the shell, containing standard bottom pins, and a shorter bottom pin, set back from the face of the plug. A tubular key has bitings corresponding to the standard bottom pins, and a projection corresponding to the short bottom pin. When the key is inserted, the bitings and the projection press all the bottom pins to the shear line. In a second embodiment, a lock includes a shell containing top pins and a depression; and a plug, rotatable within the shell, containing bottom pins. The depression is configured and dimensioned to receive one of the bottom pins. The depression may be opposite one of the bottom pins, and there may be one more bottom pin than top pins. When the key is inserted, the bottom pins are moved to the shear line.

6 Claims, 3 Drawing Sheets

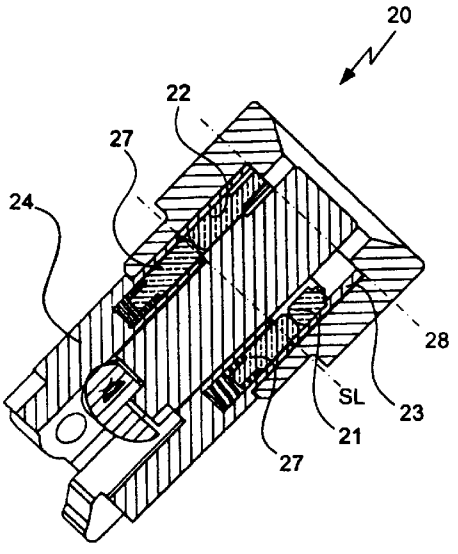


FIG. 1

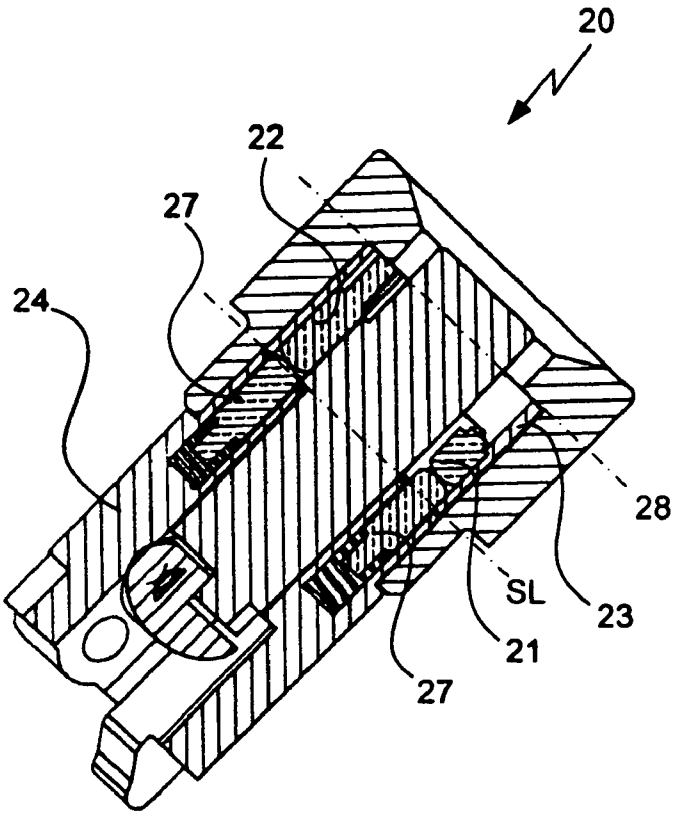


FIG. 2

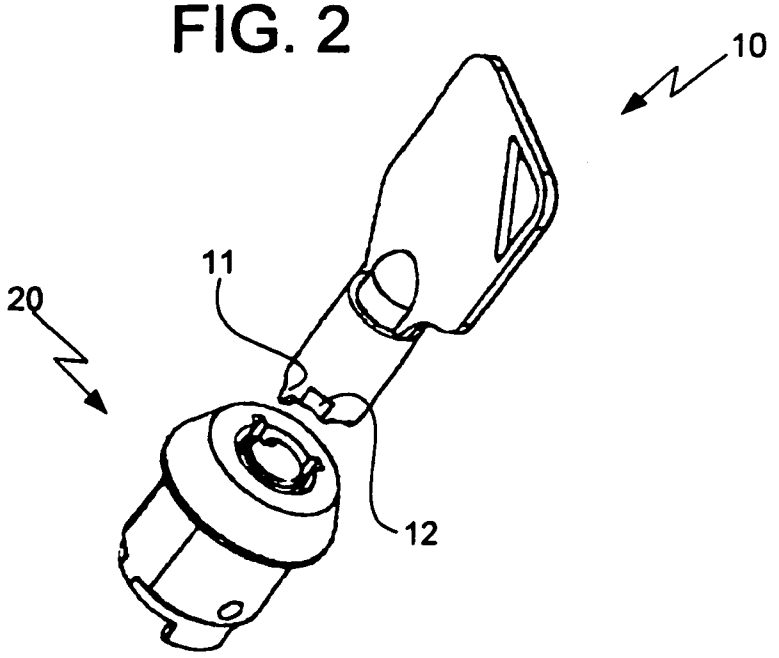


FIG. 3

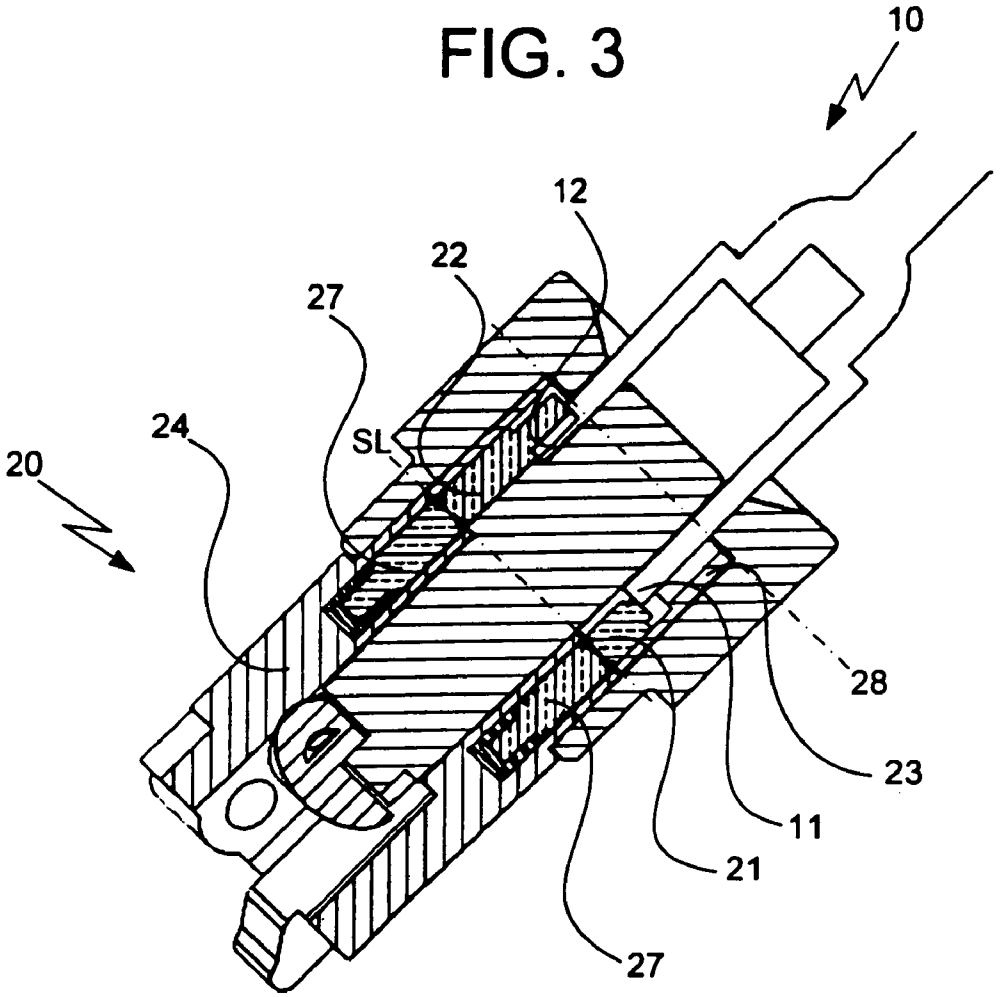


FIG. 4

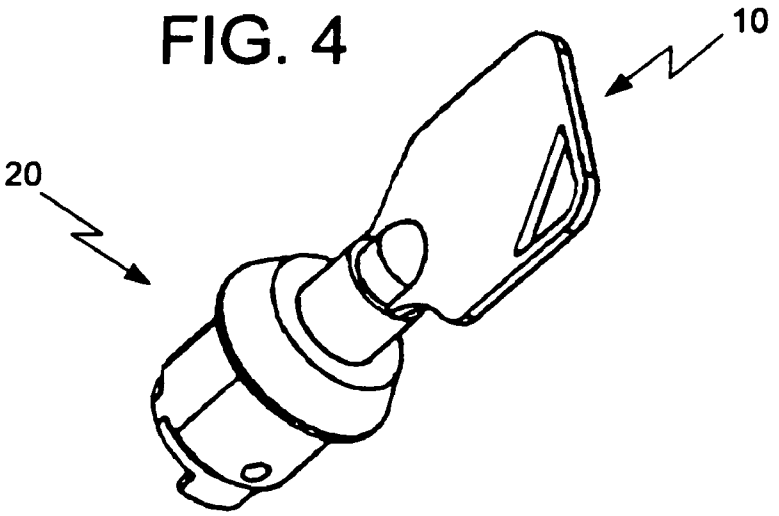


FIG. 5

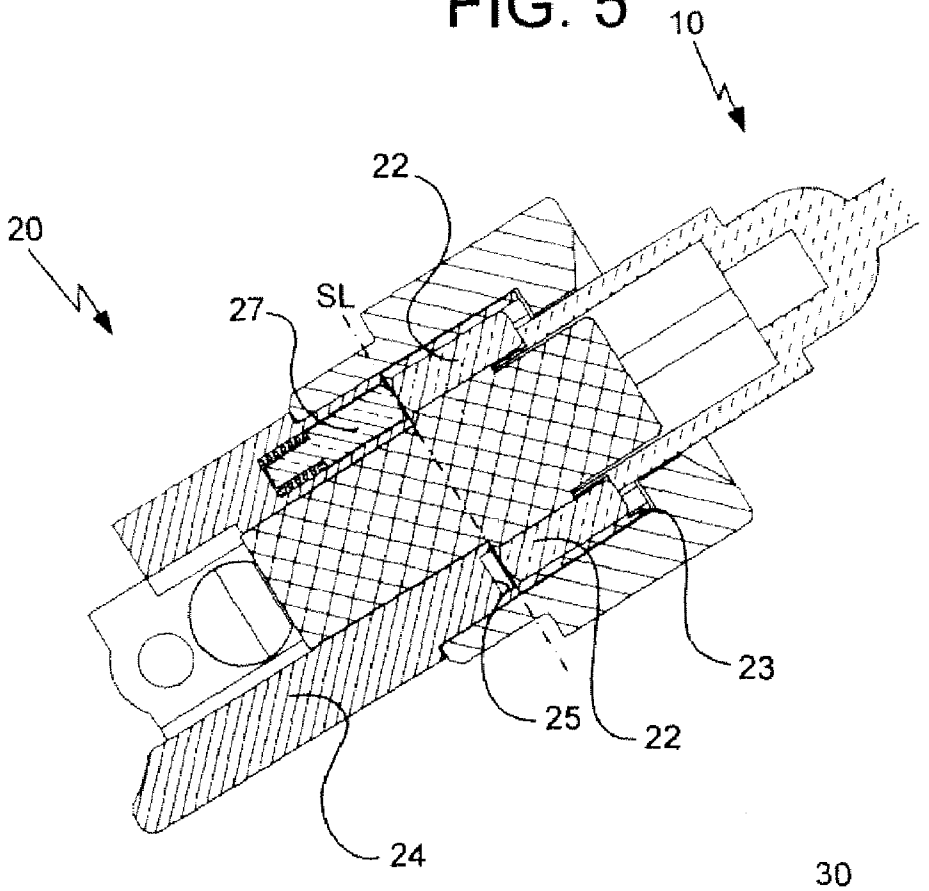
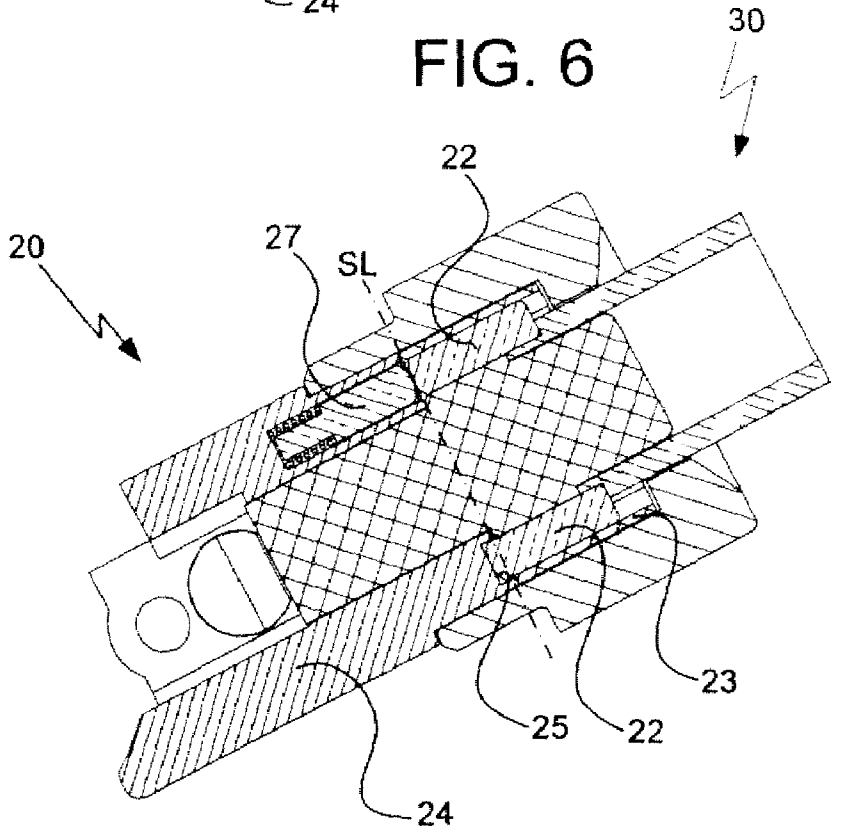


FIG. 6



HIGH SECURITY PIN TUMBLER LOCK

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of U.S. Provisional Application No. 60/757,595, filed on Jan. 9, 2006, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to an axial pin tumbler lock, and more particularly to an axial pin tumbler lock that cannot be easily unlocked by impressioning.

(b) Description of the Related Art

Generally, an axial pin tumbler lock, also called a tubular lock, comprises 4-7 pin tumblers located around the circumference of a circle. The body of the key is tubular and the biting corresponding to each pin tumbler is cut out of the end.

A shear line lies between a rotatable plug and a fixed shell of the lock. Each biting on the key presses one bottom pin, which in turn presses a corresponding top pin. The top surface of the bottom pin and the bottom surface of the top pin are thus moved to the shear line. When ends of all pins lie along the shear line, the plug, along with the bottom pins, is free to rotate within the shell and the lock can be unlocked. However, if one or more of the top pins projects into the plug, or one or more of the bottom pins projects into the shell, rotation of the plug is blocked by the projecting pins.

Unlike linear pin tumbler locks, in which the key is inserted from front to back, depressing one pin at a time, in a tubular lock the key presses all the pins simultaneously. This renders impressioning of the lock, that is, forcing each bottom pin precisely to the shear line, much easier than picking or impressioning its linear counterpart.

For example, it has been demonstrated that conventional tubular locks can be opened in a few seconds with a plastic tube removed from a ball-point pen. When pressure is applied, the soft plastic of the tube deforms to fit the pin tumblers, mimicking the biting of the corresponding key. The tube can then be turned as the key would and the lock opened.

Conventional tubular locks can also be easily picked by bumping; that is, inserting a tube and applying a sudden force to the end of the tube, "bumping" the pins to the shear line.

U.S. Pat. No. 4,112,820 to Conger et al. discloses a special tumbler including a modified bottom pin with a relatively smaller diameter extension protruding in the direction of the key. The key has a small diameter pin at its forward end to register with and abut the pin extension to move the bottom pin to the shear line. However, because the smaller diameter extension of the modified bottom pin lies flush with the face of the plug, this lock can be easily "bumped."

The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide a tubular lock that cannot be easily impressioned or bumped.

A pin tumbler lock according to a first exemplary embodiment of the present invention includes a shell containing top pins; and a plug, rotatable within the shell, containing one or more standard bottom pins, and a relatively shorter bottom pin, set back from the face of the plug. A tubular key has bitings corresponding to the standard bottom pins, and a longer projection that corresponds to the short bottom pin. When the key is inserted in the lock, the bitings press the standard bottom pins, and the projection presses the short bottom pin, to the shear line. The key can then be turned and the lock opened.

In a second exemplary embodiment, an axial pin tumbler lock includes a shell containing one or more top pins and a depression; and a plug, rotatable within the shell, containing one or more bottom pins. The depression is configured and dimensioned to receive one of the bottom pins. The depression may be opposite one of the bottom pins, and there may be one more bottom pin than top pins. When the key is inserted in the lock, the bottom pins, including the one opposite the depression, are moved to the shear line. The key can then be turned and the lock opened.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional side view of a pin tumbler lock according to a first exemplary embodiment of the present invention with the key removed.

FIG. **2** is a perspective view of the lock of FIG. **1** and associated key.

FIG. **3** is a sectional side view of the pin tumbler lock of FIG. **1** with the key inserted.

FIG. **4** is a perspective view of the lock and key of FIG. **3**.

FIG. **5** is a sectional side view of a pin tumbler lock and key according to a second exemplary embodiment of the present invention with the key inserted.

FIG. **6** is a sectional side view of the pin tumbler lock of FIG. **5** with an impressioning or bumping tool inserted.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Exemplary embodiments of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

As shown in FIGS. **1-4**, a first exemplary embodiment of the present invention provides a tubular key **10** comprising bitings **12** and a projection **11**. Each key blank may be manufactured with the projection **11** before the bitings **12** are cut. The length of the projection **11** varies from key to key; that is, one of several possible lengths is assigned to each key **10** during manufacture. The position of the projection **11** also varies from key to key.

A lock **20** may include a shell **24** with a rotatable plug **23** disposed therein. Top pins **27** are disposed in the shell **24**, each abutting a bottom pin **21**, **22** disposed in the plug **23**. While some of the bottom pins **22** have standard lengths, at least one bottom pin **21** is significantly shorter than the remainder of the bottom pins **22**. The surface of the shortened bottom pin **21** that faces the key **10** is set back from the surface **28** of the plug **23**; i.e. left of the surface **28** in FIGS. **1** and **3**.

The lengths of the projection **11** and short bottom pin **21** are selected such that when the key **10** is inserted in the lock **20**, as shown in FIGS. **3-4**, the bitings **12** press the standard bottom pins **22** to the shear line SL, and the projection **11** presses the short bottom pin **21** to the shear line SL. The key **10** can then be turned, rotating the plug **23** within the shell **24**, and opening the lock **20**.

For example and without limitation, the length of the bitings **12**, i.e. the length from where the biting is first recessed to the end of the key, may be approximately 2.0 mm. The projection **11** may protrude approximately 1.0 mm beyond the end of the key. The standard bottom pins **22** may be approximately 5.5 mm long, and the short bottom pin **21** may be approximately 2.5 mm long. These lengths may vary depending on the particular application and size of lock **20**.

If a would-be thief attempts to impression or bump the first embodiment of the present invention, the impressioning or bumping tool (not shown) may press the standard bottom pins **22** such that their top surfaces reach the shear line. The short bottom pin **21**, however, because it is distanced from the surface of the plug **23**, is not pressed by the tool, and remains in its initial position as shown in FIG. **1**. The top pin **27** that corresponds to the shortened bottom pin **21** thus remains projected into plug **23**, bridging the shear line and preventing rotation of the plug **23**.

As shown in FIGS. **5** and **6**, in a second exemplary embodiment, the lock **20** includes one more bottom pin **22** than top pins **27**. The shell **24** comprises a depression such as a blind hole **25**, which may be opposite the extra bottom pin **22**. When the key **10** is inserted, as shown in FIG. **5**, the extra bottom pin **22** is pressed precisely to the shear line, and the lock **20** can be opened. When an impressioning or bumping tool **30**, however, is inserted, as shown in FIG. **6**, the bottom pin is pressed into the hole **25**, bridging the shear line and preventing rotation of the plug **23**.

The end of the extra bottom pin **22** may be substantially hemispherical, and the hole **25** may have a shape corresponding to the shape of the extra bottom pin **25**. Because of the sloping surface of the hole **25**, if the extra bottom pin **22** moves too far into the lock during opening with the key **10**, it can slide out during turning, and be moved back to the shear line. During impressioning, however, the force imparted to the extra bottom pin **22** ensures that the pin **22** remains securely in the hole **25** and the plug **23** cannot be turned.

It should be understood, however, that the invention is not limited to the shape of the depression, nor is it limited to a blind hole **25**. Any depression configured to receive a bottom pin **22**, such as, without limitation, a through-hole, is suitable.

While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. An axial pin tumbler lock, comprising:

a shell oriented around an axial direction;

a plurality of first pins disposed in the shell, each first pin comprising a first and a second end;

a rotatable plug disposed within the shell and comprising a surface substantially perpendicular to the axial direction; and

at least one standard second pin and at least one relatively shorter second pin disposed within the rotatable plug, each second pin comprising a first end and a second end, the second end of the shorter second pin being distanced inwardly from the surface of the plug in the axial direction;

wherein the second end of each of the first pins contacts the first end of a respective one of the second pins in a locked state of the lock.

2. The lock of claim **1**, wherein a length of the shorter second pin is less than about 80% a length of the standard second pins.

3. A key configured and dimensioned for insertion into the pin tumbler lock of claim **1**, comprising:

one or more bitings, each configured and dimensioned to press a respective one of the standard second pins to a position corresponding to an opening state of the lock; and

a projection protruding beyond an end of the key and configured and dimensioned to press the shorter second pin to a position corresponding to the opening state of the lock.

4. The key of claim **3**, wherein the projection protrudes beyond the end of the key by a distance that is at least about 20% a length of the bitings.

5. An axial lock and cooperating, tubular key, configured for insertion into said lock, wherein:

the lock comprises a shell, a rotatable plug disposed within the shell with a surface facing the key during insertion of the key, and a plurality of pins disposed in the plug;

and the key comprises one or more bitings and a projection, configured and dimensioned such that, upon insertion of the key, the projection moves past the surface of the plug before contacting one of the pins.

6. The lock and key of claim **5**, wherein the projection moves past the surface of the plug by a distance that is at least approximately 20% a length of the bitings before contacting one of the pins.

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