May 5, 1970 P. M. TRAINOR 3,509,748

AXIAL PIN TUMBLER LOCK

Filed April 24, 1968 4 Sheets-Sheet 1

Fig. 1.

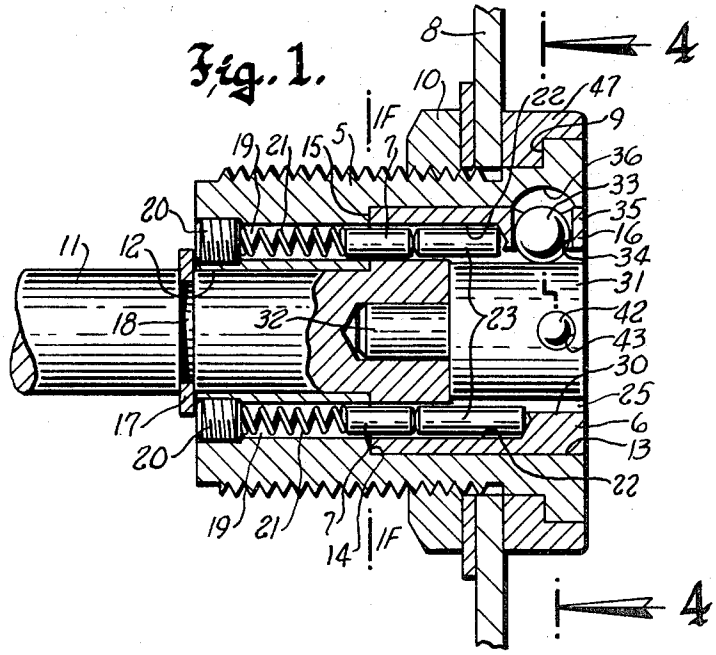

Fig. 2.

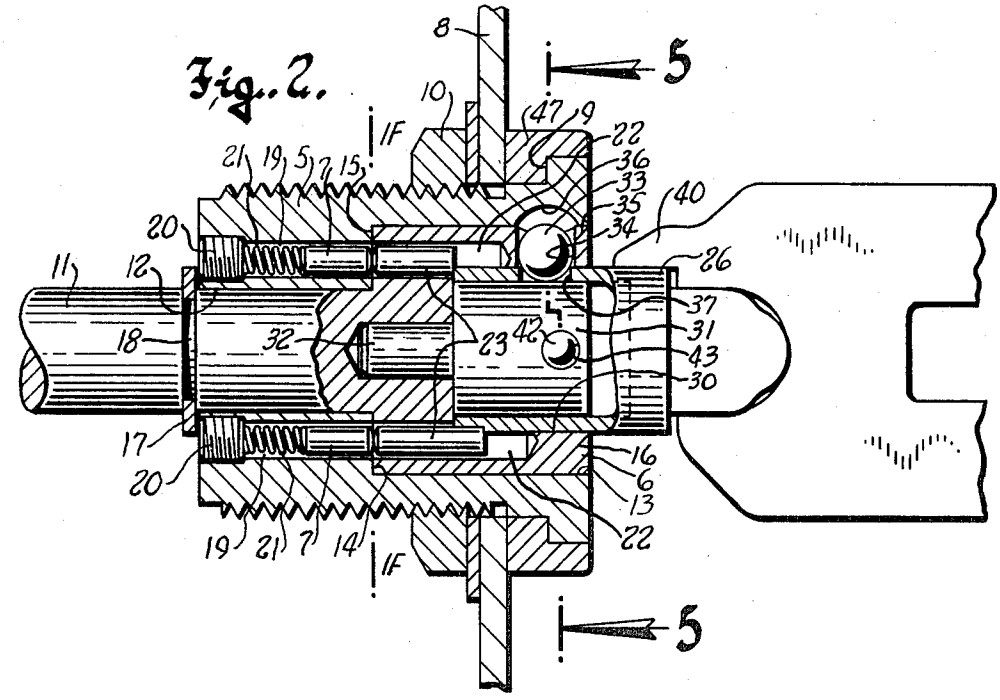

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Fig. 3.

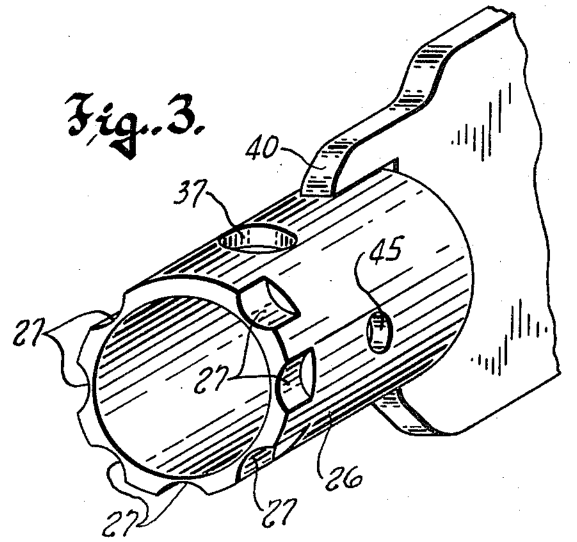


Fig. 4.

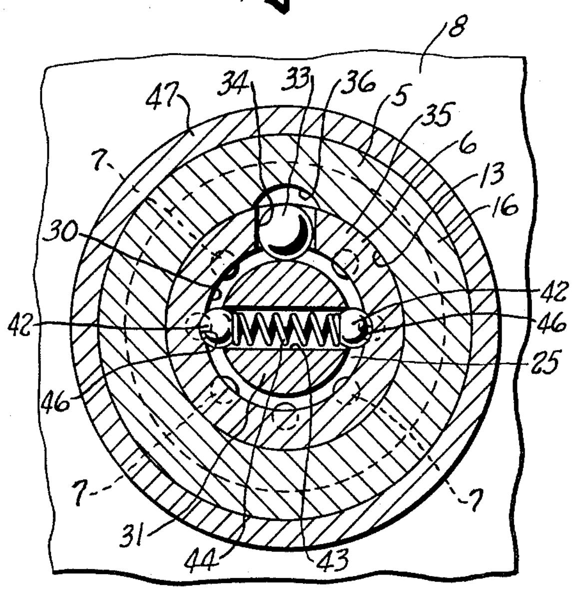
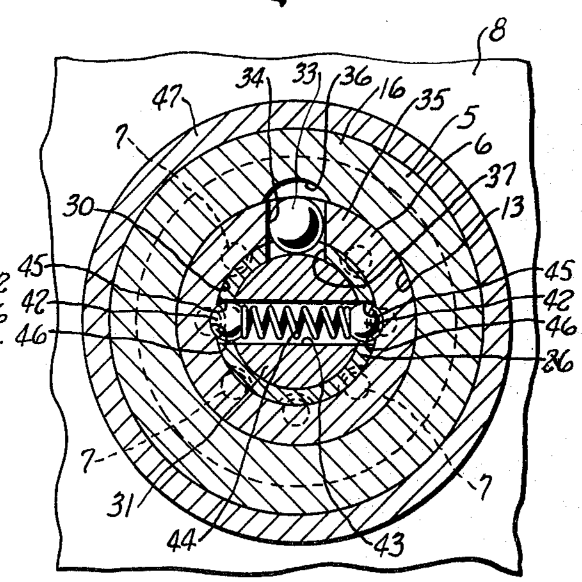


Fig. 5.



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AXIAL PIN TUMBLER LOCK

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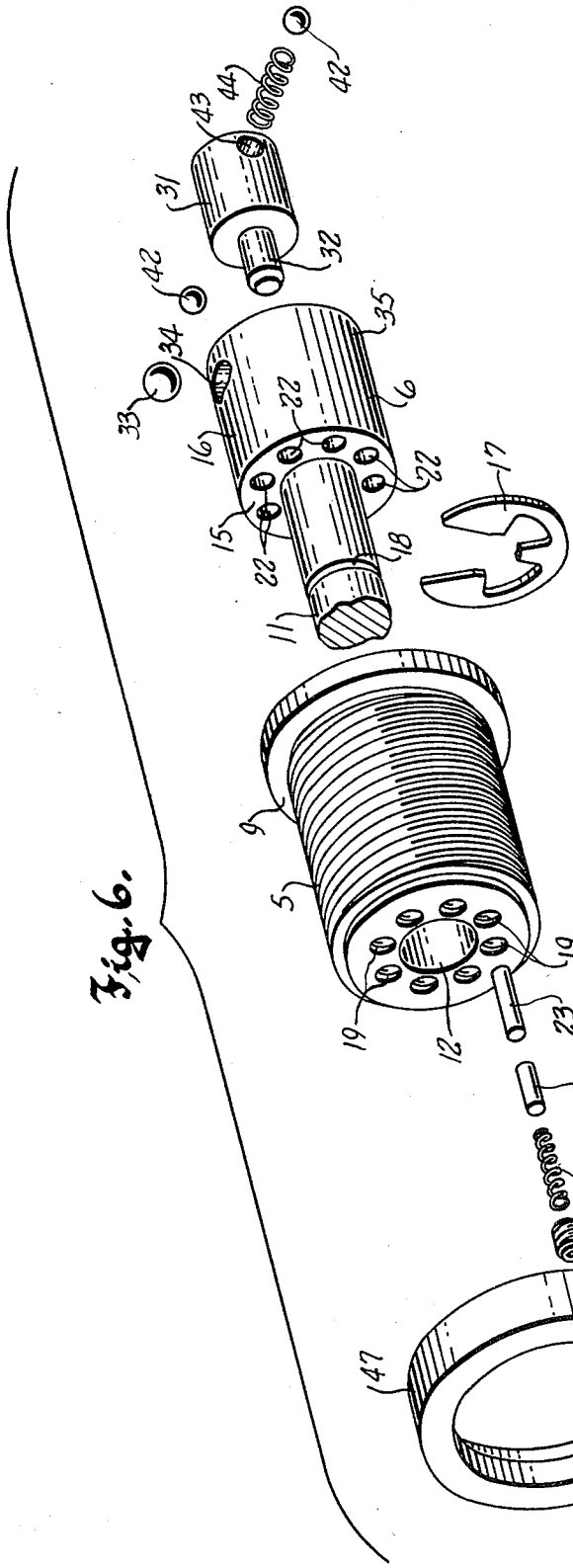

Fig. 6.

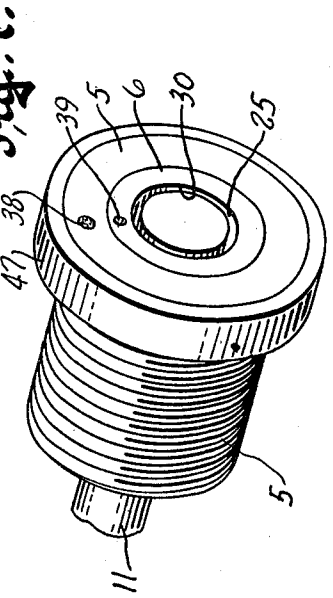

Fig. 7.

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Fig. 8.

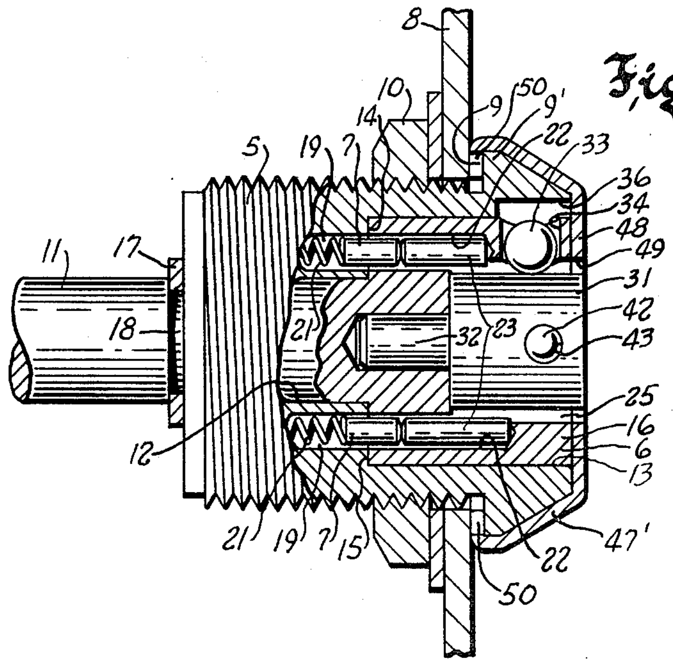
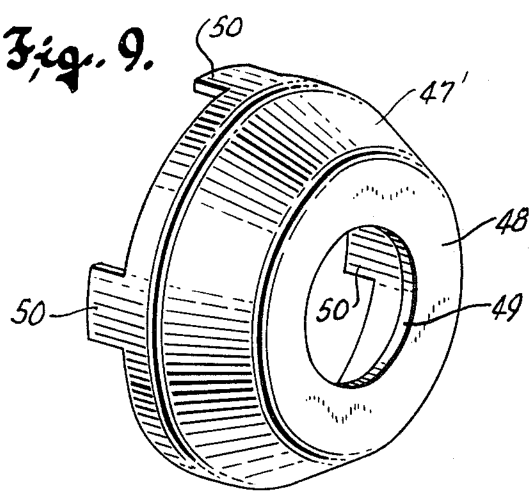


Fig. 9.



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Patented May 5, 1970

3,509,748

AXIAL PIN TUMBLER LOCK

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Int. Cl. E05b 27/10, 19/02
U.S. Cl. 70—363 6 Claims

ABSTRACT OF THE DISCLOSURE

A pin tumbler lock in which a rotatable spindle received in the bore of a casing is locked against rotation by a number of tumbler pins circumferentially spaced around a circle concentric to the axis of the lock, and spring biased to positions extending across an interface between transversely disposed contiguous surfaces on the spindle and the casing. These contiguous surfaces are the bottom of a counterbore opening to the front end of the casing and the shoulder formed at the junction between a head portion and a stem portion of the spindle. An annular keyway in the head portion of the spindle receives a tubular key by which the tumblers are moved to unlocking positions freeing the spindle for rotation. The tumblers are removable from the rear end of the lock casing to enable authorized changing of the combination of the lock. A freely rotatable protective collar on the front end of the lock guards against the application of torsion on the spindle except by a proper key. Ball detents releasably hold the key in its fully inserted position against the thrust of the tumbler springs thereon, and another ball detent prevents insertion and/or withdrawal of the key except when the spindle is in a predetermined position of rotation.

This invention relates to pin tumbler locks and refers particularly to such locks in which the tumblers are circumferentially spaced around a circle concentric to the axis of the lock, to be moved to unlocked positions by a cylindrically tubular key inserted into an annular keyway. The George patent, No. 2,588,230, issued Mar. 4, 1952, illustrates a lock of this type.

The primary purpose and object of the invention is to provide a lock of the aforesaid type which is for all intents and purposes pick-proof and not vulnerable to defeat by the customary methods employed in defeating locks.

Another object of this invention is to provide a lock of the type set forth, in which the combination can be quickly and easily changed.

It is also an object of this invention to provide a cylindrical tubular key operated lock in which the annular keyway is much narrower than has herebefore been possible in such locks.

Still another object of this invention is to provide a lock of the character described which is so designed and constructed that the key used to operate it has no protrusions whatsoever, either on its inner or outer cylindrical surface to engage in notches in the spindle, and wherein the key is nevertheless releasably held in its fully inserted position against the thrust of the tumbler spring thereon, even when the key is in its inserting and removing position of rotation; and wherein insertion and/or withdrawal of the key is possible only when the spindle is in a defined position of rotation.

With these and other objects in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings. This disclosure is intended merely to exemplify the invention. The invention is not limited to the particular structure disclosed, and changes can be made therein without departing from the invention.

The drawings illustrate two complete examples of the

physical embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof and in which:

FIG. 1 is a view similar to FIGURE 1 but showing embodying this invention;

FIG. 2 is a vi ew similar to FIGURE 1 but showing the same in its unlocked condition by virtue of the presence therein of a proper key;

FIG. 3 is a perspective view of the key, with the outer end portion of its handle broken away;

FIG. 4 is a cross sectional view through FIGURE 1 on the plane of the line 4—4;

FIG. 5 is a cross sectional view through FIGURE 2 on the plane of the line 5—5;

FIG. 6 is an exploded perspective view of the components of the lock;

FIG. 7 is a perspective view of the lock, viewing the same from the front;

FIG. 8 is a view partly in side elevation and partly in longitudinal section, illustrating a slightly modified embodiment of the invention; and

FIG. 9 is a perspective view of the protective collar of the modified embodiment of the lock.

Referring to the drawings, the numeral **5** designates the main body or casing of the lock. A spindle or cylinder **6** is mounted in the casing and restrained against rotation therein by a plurality of pin tumblers **7**, in the locked condition of the lock. Although the lock can be employed in different ways, and for different purposes, it is admirably suited to locking drawers or doors in their closed positions, in which event the body or casing **5** passes through a hole in a panel **8** and is fixed to the panel by clamping the portion of the panel immediately adjacent to the hole, between a flange **9** on the front end of the casing and a nut **10** threaded on the casing. The cylinder or spindle has a stem portion **11** protruding from the rear of the casing to actuate a latch bolt or other mechanism controlled by the lock.

To receive the spindle, the casing has a bore **12** which opens to the rear and a counterbore **13** which opens to the front end of the casing. The bottom **14** of this counterbore forms one of the two contiguous transversely disposed surfaces of an interface between the casing and the cylinder, and across which the pin tumblers extend in the locked condition of the lock. The other of the two surfaces of this interface is the shoulder **15** at the junction of the stem portion **11** of the spindle and a larger diameter head portion **16** which constitutes the fore part of the spindle and completely fills the counterbore so that the front faces of the spindle and casing are flush with one another. A C-washer **17** snapped into a groove **18** in the spindle, and bearing against the rear face of the casing, holds the spindle in place with its shoulder **15** abutting the bottom **14** of the counterbore to define the interface, which is depicted in FIGURES 1 and 2 by the line IF—IF.

The diameter of the counterbore **13** and the head portion **16** of the spindle is larger than the circle of pin tumblers, and the diameter of the spindle stem portion **11** and the bore **12** in which it is received, is smaller than that circle. Consequently, the drilled holes or wells **19** in which the pin tumblers are received can, and do, open to the bottom **14** of the counterbore as well as the rear face of the casing. Allen head set screws **20** close the rear ends of the wells and provide spring seats against which springs **21** react to yieldingly project the tumbler pins across the interface and into tumbler receiving pockets **22** drilled into the head portion of the spindle from the shoulder **14**.

Drive pins **23** slideably received in the pockets **22** provide means for displacing the tumbler pins from the pockets and aligning the abutting ends of the tumbler

pins and their drive pins with the interface to free the spindle for rotation. It is, of course, to be understood that the several sets of tumbler pins and their drive pins are of different lengths so that the drive pins must be pushed back different distances to free the spindle for rotation. It is this which determines the combination of the lock.

An annular circular keyway **25** in the head portion of the spindle opens to the front face of the spindle and communicates at its bottom with all of the tumbler receiving pockets **22**. Accordingly, upon full insertion of a proper cylindrical tubular key **26** into the keyway, all of the pin tumblers can be brought to their positions freeing the spindle for rotation. As shown in FIG. 3, the key has circumferentially spaced notches **27** opening to its front end and to its peripheral surface, one for each tumbler. As the key is inserted, the front ends of the drive pins either enter these notches to be engaged by the bottoms of the notches, or are engaged by an unnotched edge portion of the key. In any event, upon full insertion of the key, all of the drive pins will be depressed the correct distance to align the abutting ends of all of the drive pins and their respective tumbler pins with the interface providing the key is properly "bitted." With such alignment the spindle will be freed for rotation.

Rotation of the key is imparted to the spindle through the engagement of the sides of the notches **27** with the drive pins. In effect this interengagement between the drive pins and the sides of the notches constitutes a plurality of circumferentially spaced splines through which torque is applied to the spindle uniformly around its entire periphery and without the need for a driving lug on the key entering a recess in the spindle as was the case in earlier locks of this general type.

This manner of drivingly connecting the key with the spindle is also conducive to reduction in the width of the keyway a feature which is quite significant from the standpoint of increasing the security of the lock, since it minimizes the probability of defeat by means of a cylindrical tubular hole cutting saw.

Attention is directed to the fact that the annular keyway is defined by the side wall of a bore **30** in the head portion of the spindle and the side of a cylindrical plug **31** solidly mounted in the bore **30** by driving a pin **32** which protrudes from the inner end of the plug into a hole in the bottom of the bore. The bottom of the keyway which is of course defined by the bottom of the bore **30** is spaced from the front face of the lock a distance such that the shortest drive pin—which is engaged by an unnotched portion of the key—will be in its unlocking position when the key is bottomed in the keyway. This condition is illustrated in the upper half of FIG. 2.

As noted hereinbefore the rear ends of the tumbler wells **19** are closed by removable headless set screws **20**. Hence the combination of the lock can be easily and quickly changed by simply removing one or more of the set screws allowing the tumbler pins and their drive pins to drop out through the open rear ends of the tumbler wells and replacing them with other sets of pins. Since this combination changing operation requires access to the rear of the lock it can only be performed by someone having a proper key; moreover it requires removal of the C-washer—which partially covers the mouths of the tumbler wells and the set screws therein.

Obviously to unlock the spindle for rotation the key must be inserted into the keyway in one specific position of rotation. To define that proper rotational orientation between the lock and the key and to prevent insertion and/or withdrawal of the key except when the spindle is in any but the correct position a ball **33** is loosely seated in a hole **34** which extends radially through the annular wall **35** of the spindle head portion which surrounds the plug **31** and coacts therewith to define the

annular keyway. The ball has a free though relatively close fit in the hole **34** and is of a diameter substantially corresponding to the distance between the inner surface of the keyway i.e. the side of the plug **31** and the side of the bore **30**. Hence unless displaced the ball **33** bridges across and blocks the keyway. It can be so displaced only when the spindle is in a defined position of rotation which in the embodiment of the invention illustrated is a single position—namely, its locked position. In this position, the hole **34** aligns with a recess **36** in the wall of the bore **30** into which the ball may be pushed. The recess is deep enough to accommodate that part of the ball which exceeds the thickness of the wall **35**. Hence, insertion of the key into the keyway is possible when the spindle is in its position in which the hole **34** aligns with the recess **36**.

But it requires more than this for the ball **33** to identify the correct position of the key. This is done by providing the key with a hole **37** so located that when that hole is aligned with the ball and the ball drops into it, all the drive pin receiving pockets **27** of the key are correctly aligned with their respective drive pins. With the key thus positioned and shoved all the way into the keyway, the key can be turned in the casing, and since the drive pins in effect constitute torque transmitting splines, rotation of the key is imparted to the spindle.

Inasmuch as withdrawal of the key entails displacement of the ball **33** from the keyway, it follows that the key and spindle must be returned to the position at which the hole **34** and the ball therein align with the recess **36**. While this position can be "felt for" its attainment is facilitated by a pair of marker dots **38** and **39** on the front face of the casing and the spindle head. When these dots are opposite one another, as shown in FIG. 7, the spindle is in its key-inserting and key withdrawing position.

The marker dots **38–39** also cooperate with a finger **40** on the key to facilitate correct orientation of the key. This finger is angularly aligned with the hole **34** and since the marker dot **38** is angularly aligned with the recess **36**, the alignment of the finger **40** with the dots identifies the correct position of rotation for the key.

Another feature of this invention resides in the provision of detent means to hold the key in its fully inserted psition against the thrust of the tumbler springs thereon, to thus obviate the need for holding the key in manually as it is turned. The detent means by which this advantage is gained consists of a pair of balls **42**, smaller than the ball **33**, one at each end of a cross bore **43** extending axially through the plug **31** near its front face. The cross bore **43** is large enough to accept the balls **42** which, however, are yieldingly urged out of the bore by a spring **44** confined between the two balls. Thus, in their normal positions, the balls **42** bear against the side of the bore **30** which defines the outer wall of the keyway and bridge across the keyway.

During insertion of the key, the balls **42** are pushed into the cross bore to snap into holes **45** in the key when the key is fully inserted. The entry of the balls into the holes **45** holds the key against outward displacement by the thrust of the tumbler springs; and to assure adequate retention of the key, the wall of the bore **30** preferably has recesses **46** opposite the ends of the cross bore **43** to partially receive the balls. These recesses permit the balls to occupy more effective positions in the holes **45**. Obviously, of course, the entry of the balls **42** into the holes **45** does not prevent manual withdrawal of the key.

Formation of the keyway by insertion of the plug **31** into the bore **30** in the head portion of the spindle has the advantage of facilitating the formation of the cross bore **43**, which is done before the plug is driven home. But, more important, it enables the central part of the front face of the spindle to be hardened for resistance to drilling.

Protection against destruction of the lock by the application of torque to the casing is provided by a protective collar **47** which encircles the flange **9** at the front end of the casing. This collar, like the plug **31**, is hardened steel. Its front face is flush with that of the casing and spindle and it has an inwardly directed flange which lies behind the flange **9** to be confined between it and a panel on which the lock is mounted. Nothing but friction prevents rotation of the protective collar **47**; hence if torque is applied to it in any way, it simply turns without affecting the lock.

In the modified embodiment of the invention illustrated in FIG. 8, the protective collar **47'** is dome or cup-shaped to afford even greater protection. Thus, in this case, the collar not only overlies the radially outer surface of the casing flange but also has a front wall portion **48** to cover the front face of the casing and the adjacent portion of the spindle. A hole **49** in the front wall **48** leaves the mouth of the annular keyway uncovered; and preferably the front face of the plug **31** is coplanar with the face of the front wall **48**.

As best seen in FIG. 9, the dome or cup-shaped protective collar has a plurality of lugs or tangs **50** on its peripheral edge, which are bent down over the inner face of the flange **9'** to hold the collar in place, but this assembly cannot be effected until after the spindle has been assembled with the casing.

From the foregoing description, taken with the accompanying drawings, it will be apparent to those skilled in the art that this invention provides a greatly improved pin tumbler lock of the type controlled by a cylindrically tubular key.

What is claimed as my invention is:

1. In a pin tumbler lock of the type wherein a spindle rotatably received in a bored casing having front and rear ends is secured against unauthorized rotation, by a plurality of spring biased tumbler pins slidably mounted in tumbler wells in the casing for endwise movement parallel to the axis of the lock to and from spring maintained locking positions extending across an interface between contiguous transversely disposed surfaces on the spindle and the casing and into tumbler receiving pockets in the spindle, the tumbler wells and pockets being circumferentially spaced around a circle concentric to the lock axis and the tumbler pins being displaceable from said pockets by a tubular cylindrical key acting through drive pins slideably received in said pockets, the improvement which comprises:

(A) the bore in the casing having a counterbore which opens to the front end of the casing and the bottom of which forms one of the transversely disposed surfaces of said interface;

(B) the spindle being inserted into the bore through the front end thereof and being stepped in diameter to provide a head portion which fills the counterbore and a stem portion which protrudes from the rear of the casing,

the shoulder at the junction between the head and stem portions abutting the bottom of the counterbore and forming the other surface of said interface, the diameter of the counterbore and the spindle head portion therein being greater than the circle of tumbler and drive pins, and the diameter of the stem portion and the core in which it is received being smaller than the circle of tumbler and drive pins;

(C) the head portion of the spindle having a narrow annular keyway which opens to the front face of the spindle and communicates at its bottom with the tumbler receiving pockets,

the keyway having concentric inner and outer walls, each of which is a part of the spindle, and the diameters of said keyway walls with respect to the circle of tumbler wells and pockets being

such that the tumbler pockets open laterally to the keyway through its outer wall, while the inner wall of the keyway is spaced inwardly of the circle of tumbler wells and pockets, so that the drive pins in projecting axially into the keyway also partially bridge the keyway and provide circumferentially spaced torque transmitting splines adapted to be wedged between the outer wall of the keyway and the notched end of a tubular key inserted into the keyway to free the spindle for rotation; and

(D) stop means on the stem of the spindle reacting against the rear end of the casing to hold the spindle in the casing with its shoulder abutting the bottom of the counterbore.

2. The pin tumbler lock of claim **1**, further characterized by a protective collar encircling the front end of the bored casing and having a front wall portion covering the front face of the casing and the adjacent part of the front face of the head portion of the spindle,

said front wall portion of the protective collar having a round hole of a diameter corresponding to the outside diameter of the annular keyway.

3. The pin tumbler lock of claim **2**, wherein the central portion of the head portion of the spindle which defines the inner wall of the annular keyway, is a hardened steel plug solidly secured to the portion of the spindle rearwardly of the bottom of the keyway, to coact with said protective cover in affording protection for the lock against defeat by drilling.

4. The pin tumbler lock of claim **1**, further characterized by detent means on the head portion of the spindle to engage and releasably hold the key in its fully inserted tumbler depressing position against the thrust of the tumbler springs thereon, said detent means comprising:

a ball seated in a well in the central part of the spindle head portion which defines the inner wall of the annular keyway,

and a spring in said well yieldingly urging the ball from the mouth of the well and against the outer wall of the annular keyway,

so that said ball bridges the keyway to be pushed into its well upon insertion of the key and to snap into a hole in the key when the key reaches its fully inserted position.

5. The pin tumbler lock of claim **4**, wherein the well of the detent means is a cross bore extending diametrically through said central part of the spindle head portion,

and wherein there is a ball at each end of said cross bore and the spring is confined between the two balls.

6. The pin tumbler lock of claim **1**, further characterized by means for preventing insertion and/or withdrawal of the key except when the spindle is in a predetermined position of rotation,

said means comprising a ball seated in a hole extending radially through the part of the head portion of the spindle which circumscribes the annular keyway and defines its outer wall,

said ball being of a diameter greater than the distance between the wall of the counterbore in the casing and the surface of the central part of the spindle head portion which defines the inner wall of the annular keyway,

so that said ball bridges the keyway and must be displaced to permit insertion of the key, the key having a hole to receive the ball, and the wall of the counterbore having a recess therein to receive the ball and permit its displacement from the keyway during insertion of the key and until the ball is received in the hole in the key and during withdrawal of the key,

the mouth of said recess being of a size to block any substantial movement of the ball circumferentially of the casing, so that the ball must be in the hole in the key before the key can be turned, and the key and spindle must be in a position of rotation aligning the ball with said recess before the key can be withdrawn.

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R. L. WOLFE, Assistant Examiner

U.S. Cl. X.R.

70—386, 389, 404, 417

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,509,748 Dated May 5, 1970

Inventor(s) P.M. Trainor

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, lines 4 and 5 should read -- Figure 1 is a longitudinal sectional view through a lock embodying this invention -- .

SIGNED AND
SEALED
AUG 25 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

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