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Sussina

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[45] **Mar. 27, 1973**

[54] **SECURITY CYLINDER LOCK**

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[73] Assignee: **Liquidonics Industries, Inc.**, Plainview, N.Y.

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[21] Appl. No.: **120,529**

[52] **U.S. Cl.** ..... **70/364 R**, 70/372, 70/377, 70/419, 70/DIG. 54

[51] **Int. Cl.** **E05b 29/02**

[58] **Field of Search** ..... 70/364 R, 377, 419, DIG. 54

[56] **References Cited**

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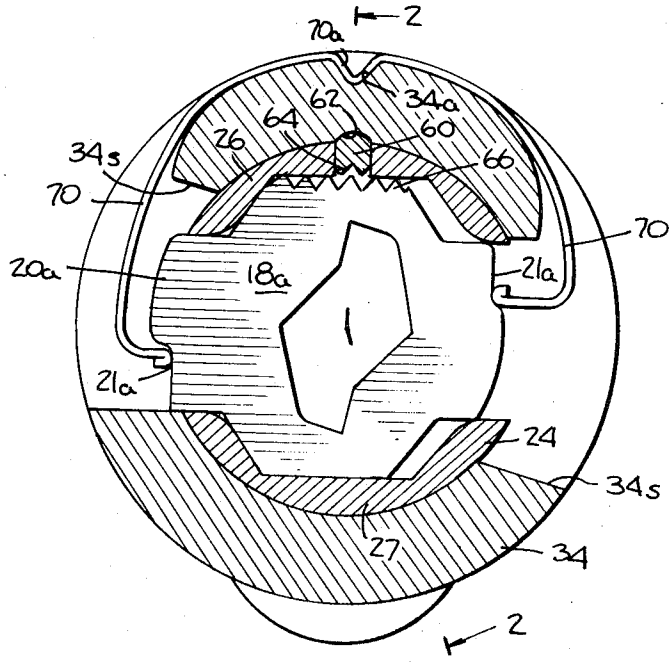
[57] **ABSTRACT**

A longitudinal side bar is employed in connection with a standard type of cylinder lock having wafer tumblers with ears that extend through a opening in the rotatable cylinder into the cylinder housing. In order to open the lock, the tumbler ears must be retracted into the cylinder. The longitudinal side bar is held in a longitudinal groove in the rotatable cylinder. When the cylinder rotates, the side bar cams radially inward to engage the tumblers. When the lock is being comprised and torque is applied to the cylinder, the cylinder rotates a predetermined amount even though the tumbler ears are not retracted. The side bar will then ride in to engage the edges of the tumblers to prevent further retraction of the tumbler ears. In this fashion, compromise of the lock is defeated.

A sheet metal curved leaf type spring is also employed to grip the tumblers and provide a constant spring force tending to prevent the tumblers from being aligned by a pick.

5 Claims, 7 Drawing Figures



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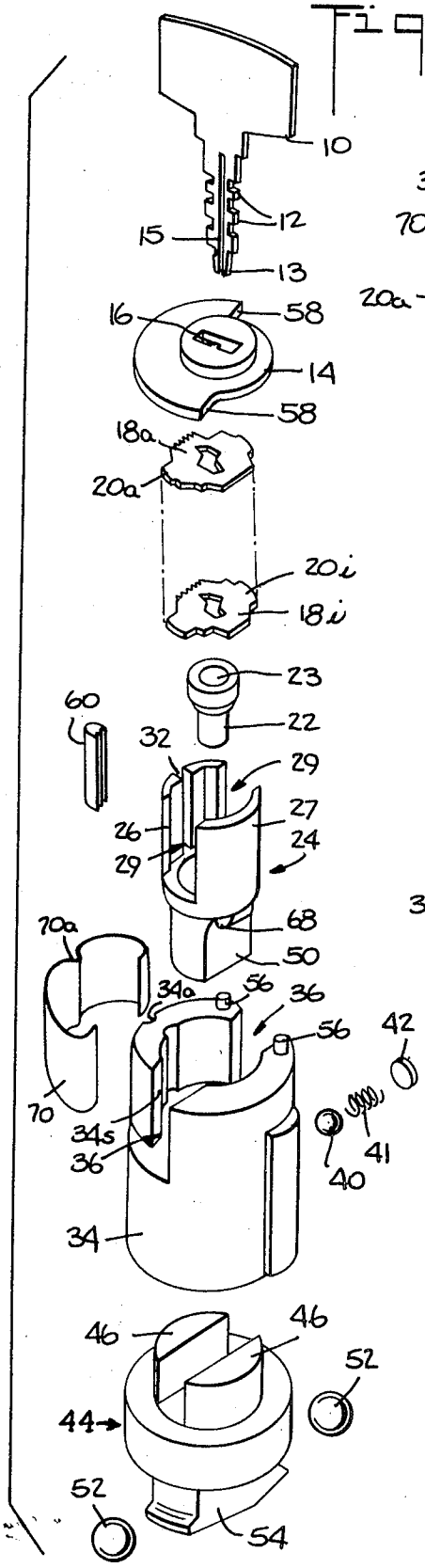
SHEET 1 OF 2

Fig. 1.



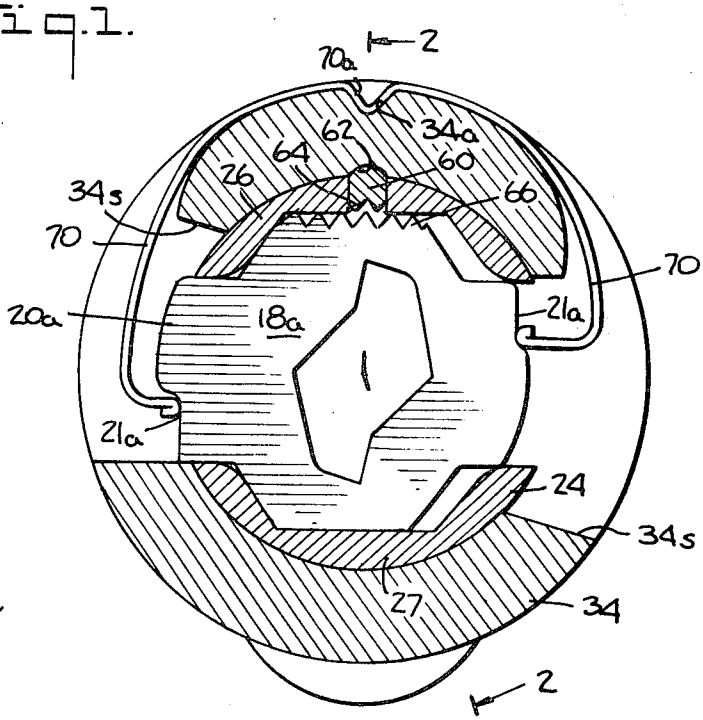


Fig. 3.

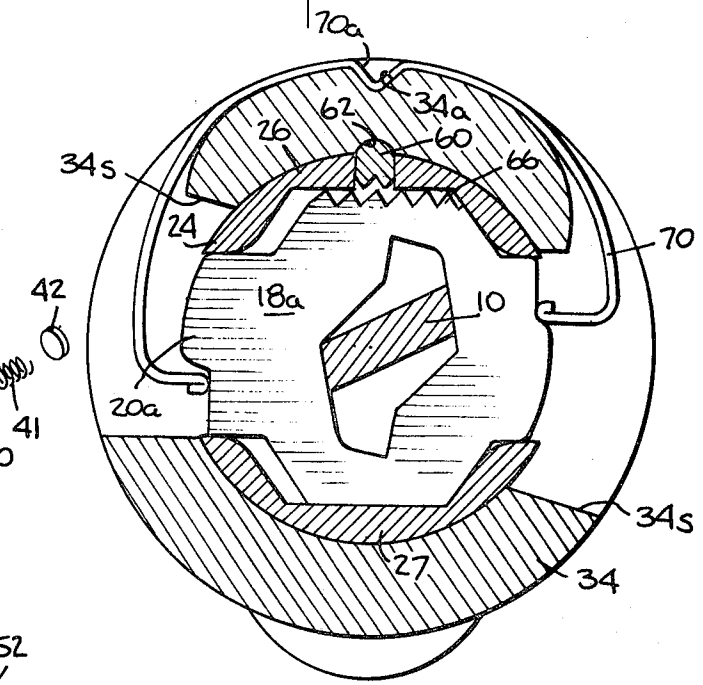


Fig. 4.

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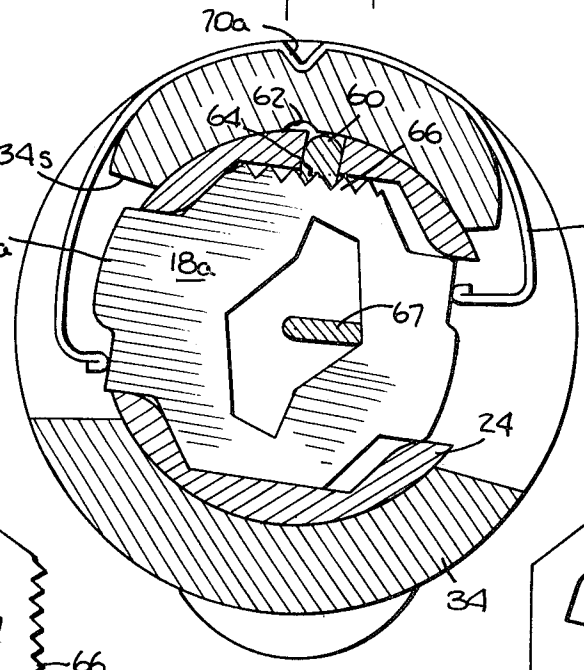
Fig. 5.



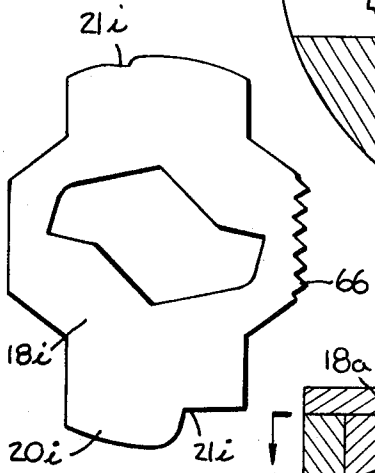


Fig. 7.

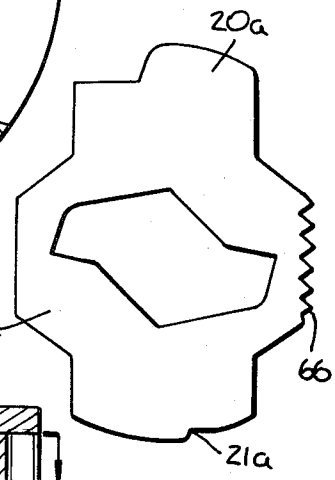


Fig. 6.

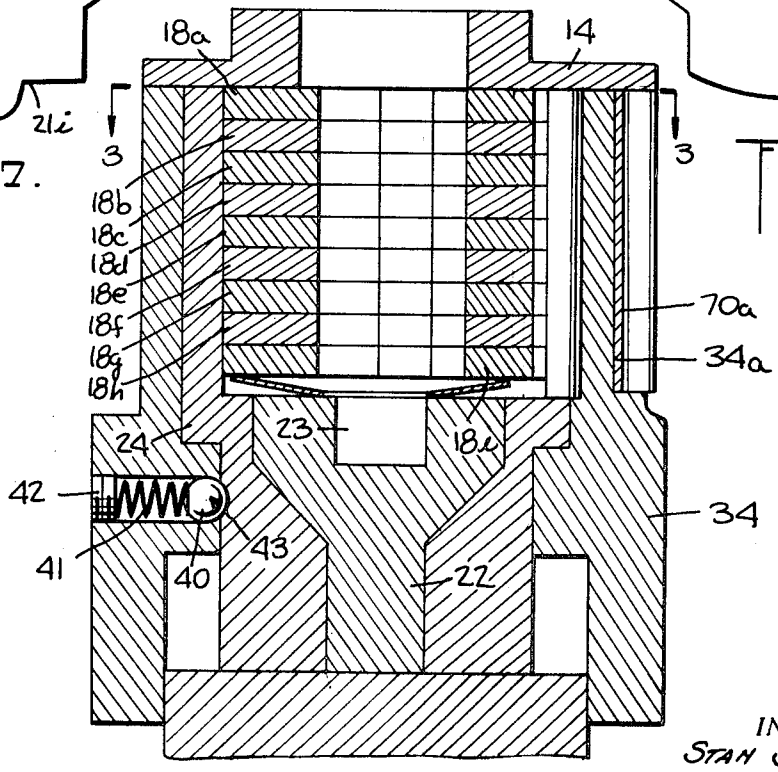


Fig. 2.

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SECURITY CYLINDER LOCK

This invention relates in general to cylinder locks and more particularly to means for increasing the difficulty of compromising cylinder locks.

BACKGROUND OF THE INVENTION

A known type of cylinder lock is illustrated in U.S. Pat. No. 2,832,211 issued on Apr. 29, 1958 to A. A. Saarento. To surreptitiously defeat the prior art it is common to adjust the tumblers individually with a pick or probe or collectively with blow from a mallet while in either case providing torque in the opening direction. The security that a lock provides is directly related to the length of time it takes to compromise the lock.

Accordingly, it is a major purpose of this invention to provide an improvement in the degree of security provided by a cylinder lock.

It is a more particular purpose of this invention to provide a security feature which will be immune to the traditional techniques of picking the tumblers in a lock.

In order to provide a lock that can be employed in a wide variety of situations, it is important that the overall physical dimensions of the lock remain standard. Accordingly, it is another important purpose of this invention that the improved security be obtained by use of means that fit within the lock dimensions presently employed.

If a lock with improved security is to be widely used, it is important that the security enhancing features be relatively inexpensive to manufacture and incorporate in the lock. Accordingly, it is another important purpose of this invention that the security enhancing features be simple and relatively inexpensive.

SUMMARY OF THE INVENTION

In a preferred embodiment, the first improvement of this invention involves a longitudinally disposed side bar which is positioned within a longtiduinal slot in the wall of the rotatable cylinder. The radial width of the side bar(that is, its width along the direction of a radius of the cylinder) is greater than the width of the wall of the cylinder. When the tumblers are in a locked (extended) position, the longitudinal slot in the cylinder wall is aligned with a longitudinal groove in the cylinder housing and a longitudinal edge of the side bar extends radially outward into the groove. The radially inner longitudinal edge of the side bar has teeth which face and are normally spaced from radially outward facing teeth on the wafer type tumblers. When the proper key is inserted into the lock, the initial rotation of the key causes the various tumblers to move in a linear direction so that the outwardly extending tumbler ears are drawn within the rotatable cylinder. Further rotation of the key will then cause rotation of the tumblers and of the cylinder within the housing. Rotation of the cylinder causes the side bar to ride out of the groove in the cylinder housing and thus extend radially inward. The radially inward facing teeth of the side bar then engage the radially outward facing teeth of the tumblers. But, since such engagement occurs subsequent to the alignment of the tumblers and retraction of the tumbler ears, it has no effect on the unlocking action and the side bar rotates together with the tumblers and cylinder.

The opening in the housing, into which the tumbler ears extend when in the locked state, is wide enough so that the cylinder can rotate approximately fifteen degrees (15°) clockwise even when locked. Thus, if someone seeks to compromise the lock, such as by the use of an improper key or by the use of a pick and mallet, the torque applied to the cylinder will cause the cylinder to rotate within the housing even though the tumblers are not aligned within the cylinder. As a consequence, the side bar, positioned in the slot in the cylinder wall, will be carried along with the cylinder and will ride out of the groove in the housing to move radially inward and engage the teeth of the tumblers. The engagement of the tumblers, commits the tumblers so that no further linear adjustment of the tumblers is possible. Rotation of the cylinder past the 15° point will be impossible because the outwardly protruding ears of the tumblers will engage the cylinder housing and prevent unlocking the lock.

The second improvement is a curved metal leaf spring which fits around the cylinder housing and grips the tumblers to normally align the key holes. This spring helps to prevent picking of the tumblers as it tends to return a tumbler to the locked position after the pick is removed.

Either of these improvements, or both, may be used to reduce the incidence of unauthorized opening of a cylinder lock.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of a cylinder lock including the improvements of this invention,

FIG. 2 is a longitudinal sectional view of the FIG. 1 lock when assembled. FIG. 2 is taken along the section 2—2 of FIGS. 3,

FIG. 3 is a cross-sectional view taken along the plane 3—3 of FIG. 2 and illustrates the relationship of the lock parts when the lock is in a locked state. One tumber 18*a* is shown. The other tumblers 18*b*–18*i* and other inner details are omitted to provide a clearer picture,

FIG. 4 is a cross-sectional view similar to that of FIG. 3, except that FIG. 4 shows the state of the tumblers when the proper key is inserted and has been rotated sufficiently to retract the tumbler ears that extend into the housing to within the shear line, which in this case is the outer circumference of the rotatable cylinder. The state shown in FIG. 4 is immediately prior to rotation of the cylinder,

FIG. 5 is a view similar to that of FIG. 3 showing the operation of the side bar to prevent adjustment of the tumblers when an attempt is made to open the lock without the proper key,

FIG. 6 is an enlarged plan view of the tumbler 18*a* shown in FIG. 1, and

FIG. 7 is an enlarged plan view of the tumbler 18*i* shown in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Basic Lock Structure

The figures all illustrate a single embodiment. A key 10 has a bow 11, bittings 12, an end portion 13 and a ward 15. The key 10 is inserted into the cylinder lock through a key guide 14 and through the center

openings of a group of wafer tumblers 18*a*–18*i*. A projection 16 on the guide 14 mates with the key ward 15. The end 13 of the key 10 fits within a well 23 of the key stop 22.

Nine wafer tumblers 18*a*–18*i* are positioned within the rotatable cylinder 24. The cylinder 24 has two sidewalls 26, 27, separated circumferentially by two major longitudinal side slots 29. A relatively narrow longitudinal slot 32 extends along the length of the sidewall 26.

The cylinder 24 is mounted for rotation within the housing 34. The housing 34 has two major longitudinal slots 36, which roughly correspond to the slots 29 in the cylinder 24. However, as may be seen in FIG. 3, the width of the housing slots 36 is appreciably greater than is the width of the cylinder slots 26. As a consequence, even when in the locked condition, the cylinder 24 is free to rotate approximately 15° before the ears (20*a*, 20*i*, for example) of the tumblers 18 engage the housing 34.

As may best be seen in FIGS. 1 and 2, a ball 40, spring 41, and lock screw 42 make up a detent assembly. The ball 40 engages a corresponding hemispherical indentation 43 in the rotatable cylinder 24. Thus, a minimum force is required in order to overcome the effect of this detent assembly and cause the cylinder 24 to rotate within the housing 34. This ball detent assembly is important to assure that, in normal operation, the ears of the wafers 18 are retracted to within the cylinder circumference before the cylinder 24 starts turning.

A cam member 44 has longitudinal projections 46 which engage the axially rearmost portion 50 of the cylinder 24 so that the cam 44 rotates with the cylinder 24.

The lock in assembled form is retained assembled by conventional means not shown. One manner of use of the lock is to have a lock body (not shown) encasing the lock and having a shackle with cut-out portions that mate with the outwardly facing surfaces of the balls 52 when locked. When the lock is unlocked, the cam 44 rotates and the cammed surface 54 of the member 44 rotates from a position where the two balls 52 are held radially outward as far as possible to a position where the two balls 52 can ride radially inward. At the latter point, the shackle can be withdrawn.

The key guide 14 rotates with the key 10. Two forwardly extending stops 56 cooperate with the radial edges 58 on the key guide 14 to limit the rotation of the key guide 14 and thus of the key 10 and of the tumblers 18 as well as of the cylinder 24 and cam 44.

Basic Lock Operation

With the above structure in mind, it can be seen that the operation of this known type of wafer tumbler lock system is as follows:

When the proper key is inserted into the lock, the initial turning of the key causes these wafer tumblers 18 to shift (but not rotate) from the locked position shown for tumbler 18*a* in FIG. 3 to the unlocked position shown for that tumbler 18*a* in FIG. 4.

When in the locked state, the ear 20 of certain of the tumbler 18 projects through one or the other cylinder slots 29 into one or the other, but not both, of the housing slots 36. Thus, clockwise rotation (as seen in the Figures) of the cylinder 24 will cause these ears 20 to abut against the housing surfaces 34*s*. This will prevent further rotation of the cylinder 24. But when the proper key has been inserted and partly rotated, those tumblers (such as the tumbler 18*a*) with ears that extend through the left cylinder slot 29 into the left housing slot 36 will be drawn to the right as seen in the Figures and thus, their ears retracted to within the shear line. Those tumblers (such as the tumbler 18*i*) whose ears extend through the right cylinder slot 29 into the right housing slot 36 will be drawn to the left and thus their ears retracted. With all the ears within the shear line, the tumblers are adjusted in that the ears are all within the outer circumference of the cylinder 24. At this point, further rotation of the key 10 will overcome the detent and the cylinder 24, as well as the aligned tumblers 18 will rotate to the unlocked state.

Structure and Operation of the Side Bar

With the above lock operation in mind, it can be seen how the side bar 60 operates. The side bar 60 is longitudinally aligned within the longitudinal slot 32 in the cylinder 24. The side bar 60 has a slip-fit relationship with the cylinder 24 so that the side bar can move radially in and out such as from the radially outermost position shown in FIG. 3 to the radially innermost position shown in FIG. 5. The radial width of the side bar 60 is greater than the thickness of the cylinder 24 sidewall. Accordingly, a groove 62 is provided in the housing 34 to accommodate the curved radially outward edge of the side bar 60. The radial outward edge of the side bar 60 is rounded as shown and the groove 62 provides a matching curved surface so that the side bar 60 can cam out of the groove 62 when the cylinder 24 is rotated.

FIG. 3 shows the normally locked state in which the ear 20a of the tumbler 18a extends into the left housing slot 36 and in which the side bar 60 extends outwardly into the groove 62.

FIG. 4 shows the state when the proper key 10 is inserted and rotated sufficiently so that the tumblers 18 are adjusted; that is, the extended ear 20 of each tumbler is retracted to within the circumference of the cylinder 24. As may be seen from FIG. 4, further rotation of the key 10 will mean rotation of the tumblers 18 and of the cylinder 24 relative to the housing 34. Rotation of the cylinder 24 will force the side bar 60 to ride out of the groove 62. This will mean that the inwardly facing teeth 64 of the side bar 60 will engage the outwardly facing teeth 66 of the tumblers 18.

However, as may best be seen with reference to FIG. 5, the side bar 60 will prevent opening of the lock if a torque has been applied to the cylinder 24 in any improper manner as is typically the case when the lock is being picked (a pick 67 is illustrated) or when an improper key is inserted. If a rotational torque is applied to the cylinder 24 before the ears on the tumblers have been retracted, the cylinder 24 will rotate by a predetermined amount, 15° in the embodiment shown, that is a function of the extent to which the housing slots 36 are wider than the cylinder slots 29. Once the cylinder 24 rotates, the side bar 60 rides out of the groove 62 just as when the lock is being properly opened. The radially inward facing teeth 64 on the side bar 60 engage the outwardly facing teeth 66 on the tumblers 18. Once this engagement of teeth occurs, a commitment of the tumbler 18 occurred in that the

tumblers can no longer move relative to the cylinder **24** and are thus held in the position shown in FIG. **5**. This means that the outwardly extending ears, such as the ear **20***a* shown, will remain extended into the housing slots **36** and thus will prevent rotation of the cylinder **24** once these tumbler ears have contacted the housing surfaces **34***s*.

When the proper key **10** turns the cylinder to the locking position (the position shown in FIG. **3**), the cylinder turns until a shoulder **68** (see FIG. **1**) under the cylinder sidewall **27** strikes a mating stop (not shown) in the housing **34**. This shoulder **68** and stop arrangement assures that the side bar **60** is aligned with the groove **62**. Further rotation of the key causes the tumblers **18** to move into their locking state in which the ears **20***a* are extended out into one or the other housing slots **36**. This movement of the tumblers causes the side bar **60** to ride up on the outwardly facing tumbler teeth **66** and be forced outward into the groove **62**.

It might be noted that in normal operation, the side bar **60** has no effect. It is the tumbler ears that create the locking state and it is in the alignment of the tumblers that brings about the unlocked state. Thus, the side bar **60** does not create the locking state. It is only when there is an attempt to compromise the lock that involves applying torque to the cylinder **24**, that the side bar **60** operates in a meaningful fashion. It is then that the side bar **60** moves radially inward prior to tumbler alignment to engage the tumbler teeth **66** and prevent further tumbler adjustment.

Enhanced security can be achieved by varying the depth and width of the well **23** in the key stop **22**. In this fashion, an improper key **10** having an end **13** that does not fit properly within the well **23** will fail to have its bittings **12** properly aligned with corresponding tumblers **18**.

In the embodiment shown, there are five incremental positions in which there can be full engagement between the side bar teeth **64** and the tumbler teeth **66**. These five positions correspond to five incremental lengths of the bittings **12**. Thus, there is assurance that the side bar **60** will properly engage each of the wafer tumblers **18** when the cylinder **24** rotates. In addition, the engagement will be over two of the teeth on each tumbler **18** and thus avoid undue strain on any one tooth.

The use of the side bar **60** to provide a locking state comitment for the tumblers **18** when the cylinder **24** has been rotated during picking or when an improper key is employed has been described in connection with a particular wafer tumbler lock design. It should be understood that this side bar commitment mechanism can be employed with certain other similar lock structures. Thus this invention could be employed with locks employing rotary tumblers having gates or with locks having rotary tumblers used in conjunction with an opposing lever arrangement.

Structure and Operation of the Spring

The spring **70** is a further security enhancing device which serves to increase the difficulty of picking the lock.

The spring **70** defeats an attempt to adjust the tumblers prior to applying torque to the cylinder **24**. If a pick, such as the pick **67** shown in FIG. **5**, is applied without torque to the tumblers having the locking state shown in FIG. **3**, the tumblers can be moved linearly. Although there is no shoulder at the shear line to aid in picking the lock, there might be circumstances where someone attempting to pick the lock would have some idea as to how much tumbler movement is required. But the spring **70** will return each tumbler to its locked position once the pick is removed from the tumbler and applied to some other tumbler.

The two ends of the spring **70** press against notched corners **21** on the tumblers **18**. The relationship between the spring **70** ends and the notched corners **21***a* of the wafer **18***a* are shown in FIGS. **3** and **4**. When in the locked state, the corresponding notched corners of the wafers **18***b*, **18***i* are in longitudinal alignment so that each end of the spring **70** effectively bears against each of the wafers **18**. Thus, when in the locked state, the spring tends to hold each tumbler in the locked position. The proper key must be turned with sufficient force to overcome the spring **70** when unlocking. That force, in turn, bust be less than is required to overcome the detent **40**, **41**.

The spring **70** has an inwardly facing protrusion **72** that fits within a recess **34***a* of the housing **34** so that the spring may be properly positioned relative to the rest of the lock.

The spring **70** further serves to assure alignment of the tumbler **18** key holes within the locking state so that the key **10** can be readily inserted and removed. This key hole registry also assures that the ears will be positioned properly to effect locking.

In the embodiment shown, the cylinder rotation of approximately 30° to 45° will provide an unlocked condition between the shackle (not shown) and the balls **52**. One of the key guide edges **58** will contact a pin **56** to prevent further rotation of the cylinder and thus prevent the side bar **60** from falling out of the slot **32** as well as prevent the spring **70** from riding off the surface of the ears on which it must ride as the cylinder turns (see FIG. **5**).

What is claimed is:

1. In a cylinder lock having a plurality of wafer tumblers within the cylinder, the tumblers having retractable ears extending through sidewall openings in the cylinder into sidewall openings of the housing, the improvement comprising:

said sidewall openings of said housing being circumferentially greater than said sidewall openings of said cylinder so that said cylinder is rotatable by a predetermined number of degrees within said housing when said tumblers are in the locking state,

a longitudinal side bar longitudinally disposed within a longitudinal opening through the sidewall of said cylinder, the radial length of said side bar being greater than the thickness of said sidewall of said cylinder, said side bar being radially movable from a radial outward position to a radially inward position,

said housing having a longitudinal groove adapted to receive the radial outward portion of said side bar when said side bar is in said radially outward position,

the mating surfaces between said side bar and said groove being such that when said cylinder is rotated said side bar is cammed out of said groove into said radially inward position,

a first mating surface on the radially inward portion of said side bar, and

a second mating surface on the radially outward portion of said tumblers,

said mating surfaces being disengaged when said side bar is in said radially outward position and said mating surfaces being engaged when said side bar is in said radially inward position,

said mating surfaces between said side bar and said tumblers have a relationship such that a force tending to move said tumblers into their locking state tends to cam said side bar radially outward,

said side bar when aligned with said groove being forced outwardly into said groove in response to said tumblers being moved into their locking state.

2. The cylinder lock improvement of claim 1 further comprising:

means to inhibit rotation of the cylinder when the cylinder is subject to a torque less than a predetermined magnitude, said predetermined magnitude being greater than the torque transmitted to the cylinder when said wafer tumblers are being moved into an unlocking state by a key.

3. The cylinder lock improvement of claim 2 further comprising:

each tumbler having first and second outwardly facing bearing surfaces in communication respectively with first and second side wall openings of the housing,

said second bearing surfaces of said tumblers being in longitudinal alignment with each other when said first bearing surfaces of said tumblers are in longitudinal alignment with each other, and

a bow shaped leaf type spring having a first end bearing on said first bearing surfaces and a second end bearing on said second bearing surfaces.

4. The cylinder lock improvement of claim 1 further comprising:

each tumbler having first and second outwardly facing bearing surfaces in communication respectively with first and second side wall openings of the housing,

said second bearing surfaces of said tumblers being in longitudinal alignment with each other when said first bearing surfaces of said tumblers are in longitudinal alignment with each other, and

a bow shaped leaf type spring having a first end bearing on said first bearing surfaces and a second end bearing on said second bearing surfaces.

5. In a cylinder lock having a plurality of wafer tumblers within the cylinder, the tumblers having retractable ears extending through sidewall openings in the cylinder into sidewall openings of the housing, the improvement comprising:

each tumbler having first and second outwardly facing bearing surfaces in communication respectively with first and second side wall openings of the housing,

said second bearing surfaces of said tumblers being in longitudinal alignment with each other when said first bearing surfaces of said tumblers are in longitudinal alignment with each other, and

a bow shaped leaf type spring having a first end bearing on said first bearing surfaces and a second end bearing on said second bearing surfaces.

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