

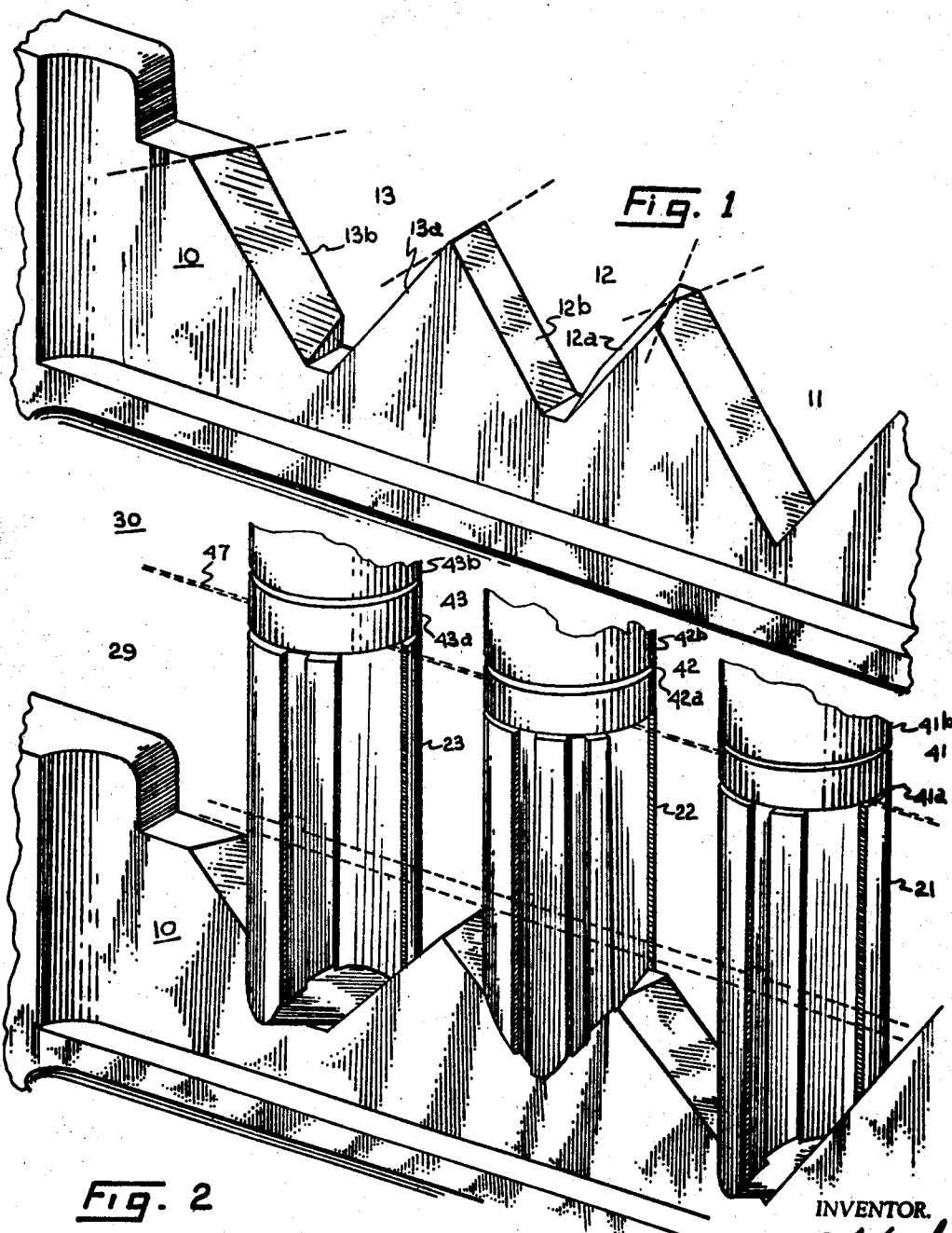
March 10, 1970

R. C. SPAIN
CYLINDER LOCK

3,499,303

Filed April 17, 1968

3 Sheets-Sheet 1



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March 10, 1970

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CYLINDER LOCK

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3 Sheets-Sheet 2

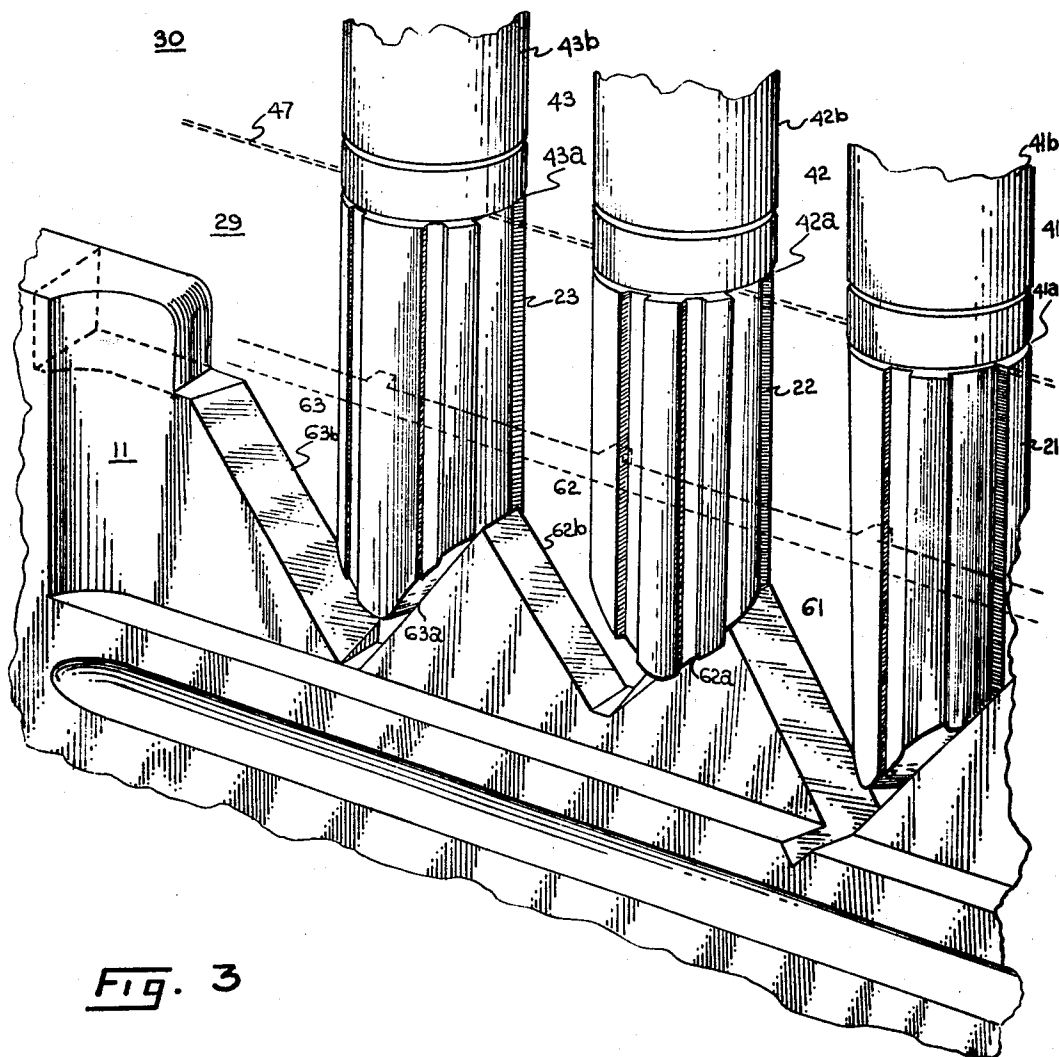


Fig. 3

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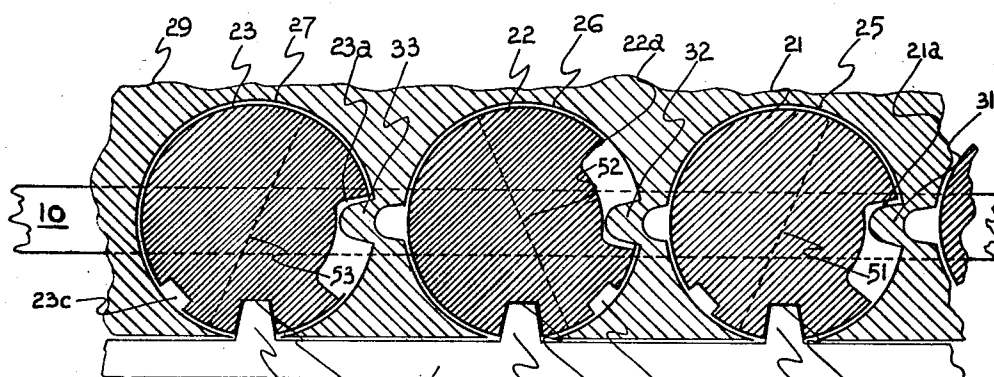
R. C. SPAIN

3,499,303

CYLINDER LOCK

Filed April 17, 1968

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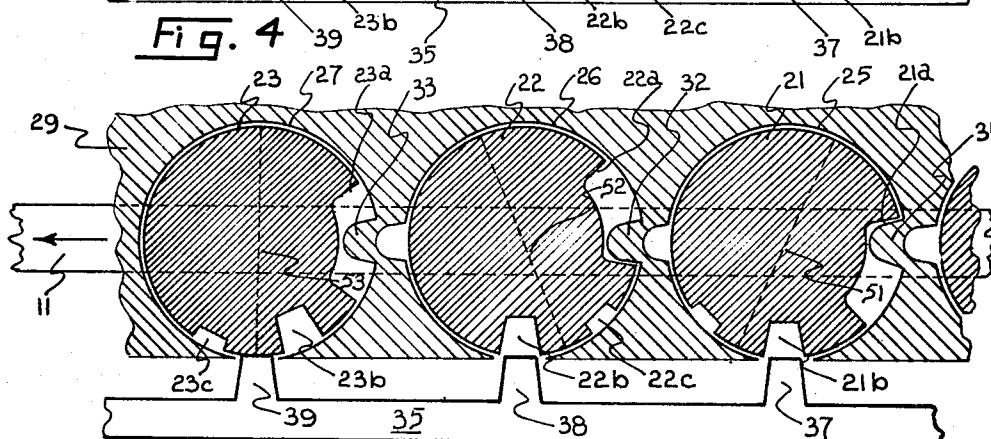


Fig. 5

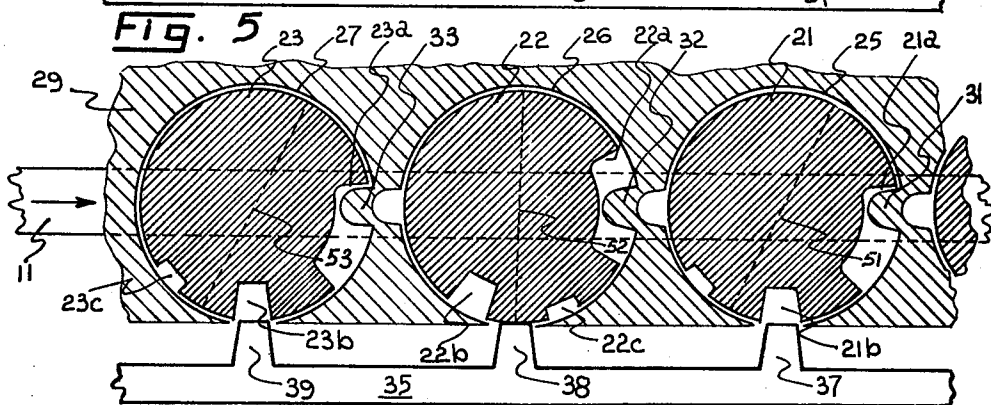


Fig. 6

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1

3,499,303

CYLINDER LOCK

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Int. Cl. E05b 15/14, 19/04, 63/00

U.S. Cl. 70—364

2 Claims

ABSTRACT OF THE DISCLOSURE

A cylinder lock may be operated by a properly angularly bitted key. The key plug is rotatably mounted in the cylinder shell. The key plug has a plurality of tumblers that are set by the V bits of a key inserted in the key plug. The key is cut at five different levels, and cut at two different angles. Each tumbler in the key plug may be reciprocally positioned by the properly bitted key to clear the shear line, and also rotationally positioned to allow the fence member to engage true gates in the tumblers. The cylinder lock may be used in a master key system using wafers as shown so that a master key cut at a lower level than the normal key can reciprocally position the tumbler, wafers, and drivers to clear the shear line. The angularly bitted keys used has at least one slope of one V bit cut perpendicular to axes of the key so that the use of an improper key causes at least one tumbler to be rotationally positioned to prevent the engagement of the fence member with the true gate of that tumbler.

This invention is directed to a cylinder lock, and more particularly to a cylinder lock which may be used in a master key system.

Conventional master key systems have a plurality of tumblers reciprocally mounted in the key plug with the key plug rotationally mounted to rotate in the cylinder shell of the cylinder lock. In a pin tumbler cylinder lock, drivers are associated with each tumbler. Driver springs normally urge the drivers across the shear line between the key plug and cylinder shell, keeping the key plug from rotating in the cylinder shell. The drivers and tumblers may be separated across the shear line by a properly bitted key cut at a plurality of level. The key plug may then be rotated. Wafers may be inserted with the pin tumblers and drivers so that different elevation levels of the tumblers will clear the shear line. In this manner a correct key will separate the tumblers from the wafers and drivers at one level, while a master key cut at different levels will separate the tumblers from the wafers and drivers at another level. Thus two different keys may be used to unlock the lock, one the normal key, and the other the master key.

Master key systems have always had a major shortcoming in that they are relatively easy to open by key jiggling. Such a jiggle key would have the V bits cut to the lower levels, with the leading edge of the jiggle key cut off, and the shoulder cut down to allow the key to be inserted into the keyway beyond its normal position. The jiggle key is then pushed in and out, torqueing it, with all of these motions carried out simultaneously. This action moves the tumblers, the wafers, and the drivers up and down. Due to manufacturing tolerances it is possible to effect minute rotary displacement of the key plug from its normal locked position and thereby produce a slight offset shoulder formation or ledge by the key plug at the shear line which will catch and support the edges of the lower ends of the drivers or wafers as the tumblers are elevated during the key jiggling. When a driver or wafer associated with each tumbler has been caught in the elevated position to clear the shear line the key plug then turns to unlock the lock.

2

It is therefore an object of this invention to provide a new and improved cylinder lock which may be used in a master key system.

Another object of this invention is to provide a new and improved master key system.

It is another object of this invention to provide a new and improved cylinder lock which may be opened by a master key and is difficult to open by key jiggling.

This invention is set forth with particularity in the appended claims. The principles and characteristics of the invention, as well as other objects and advantages are revealed and discussed through the medium of the illustrative embodiments appearing in the specifications and drawings which follow.

In the drawings:

FIG. 1 shows an angularly bitted key bitted according to the teachings of this invention.

FIG. 2 shows the same angularly bitted key positioned in a pin tumbler lock constructed according to the teachings of the invention.

FIG. 3 shows an attempt to open the pin tumbler lock by an improper key.

FIG. 4 is a cutaway view of the key plug showing the tumblers positioned to open the lock using the key shown in FIGS. 1 and 2.

FIG. 5 is a cutaway view of the key plug showing the tumblers positioned when an improper key is being pulled out during a jiggle attempt.

FIG. 6 is a cutaway view of the key plug showing the tumblers positioned when an improper key is being pushed into the keyway during a jiggle attempt.

Referring now to FIG. 1, a key 10 has three V bits 11-13. V bits 11 and 13 are cut to the third level, and V bit 12 is cut to the second level. V bit 11 is cut in a clockwise direction from the center cut with both slopes 11a and 11b cut in the clockwise direction from the center cut. V bit 12 is cut in a unique manner with its two slopes cut at different angles. The left slope 12b is cut perpendicular to the axis of the key, and the right slope 12a is cut in a counter-clockwise direction from the center cut. Note that the bottom of the valley in V bit 12 is flat resulting from the perpendicular cut on the left slope 12b. V bit 13 is also cut so that its two slopes are cut at different angles. The left slope 13b is cut in a clockwise direction from the center cut, and the right slope 13a is cut perpendicular to the axis of the key 10. The bottom of the valley in V bit 13 is also flat resulting from the perpendicular cut on the right slope 13a.

Referring now to FIG. 2 the same key 10 is shown as shown in FIG. 1, with three tumblers 21-23 positioned in V bits 11-13.

FIG. 4 is a cross-sectional view from the top of the lock showing the tumblers 21-23 positioned in the same manner that they are in FIG. 2. Taking FIGS. 2 and 4 together the parts of a cylinder lock are shown which are necessary to understand the operation of cylinder lock according to this invention. Copending patent application 627,243, Spain et al., for a Cylinder Lock, filed Mar. 1, 1967 shows the elements of the cylinder lock in more detail.

Each tumbler 21-23 is rotatably and longitudinally movable in a corresponding tumbler hole 25-27 in the key plug 29. The tumbler holes 25-27 communicate the keyway and corresponding driver holes in the cylinder shell 30. A tumbler stop 31-33 is positioned in the rear of each of the tumblers 25-27 to limit the rotational movement of the tumblers 21-23 in a manner to be explained.

A fence member 35 having three fence lugs 37-39 is laterally movable into the tumbler holes 25-27.

Three drivers 41-43 correspond to the tumblers 21-23,

with each driver 41-43 divided into a number of wafers. For instance driver 41 consists of wafer 42a and 42b, driver 42 consists of wafer 32a and 42b, and driver 43 consists of wafer 43a and 43b. The proper key will raise its driver and its associated tumbler to a position to clear the shear line 47 between the key plug 29 and the cylinder shell 30. The different wafers in the drivers are used so that different keys can raise the tumblers and associated drivers to different positions to clear the shear line. This is normally used in master key arrangements.

Each tumbler 21-23 has three longitudinal notches. Each tumbler 21-23 has a wide notch 21a-23a in which the corresponding tumbler stop 31-33 is positioned to stop the rotational movement of the tumbler when shoulders of the notches 21a-23a meet the stationary tumbler stops 31-33.

Each tumbler 21-23 also has a second longitudinal notch 21b-23b which is termed a true gate. Each true gate is wide enough and deep enough to completely engage the corresponding fence lug 37-39 when the fence member 35 is cammed towards the tumblers 21-23. The fence lugs 37-39 cannot engage the corresponding tumbler true gates 21b-23b until all the tumblers are rotated to position the true gates at right angles to the key 10 are facing the fence 35.

Each tumbler 21-23 also has a third longitudinal notch 21c-23c which is termed a false gate. False gates 21c-23c are deep enough and wide enough to admit merely the tip of corresponding fence lugs 37-39, and not the entire depth of the fence lugs 37-39.

In this particular embodiment described herein, the width of the notches 21a-23a is 38 degrees plus the width of the tumbler stop 31-33.

The true gates 21b-23b are positioned on their respective tumblers so that when tumblers 21 and 23 are rotated clockwise and the tumbler stops 31 and 33 meet the right-hand shoulder of notches 21a and 23a, respectively, the true gates 21b and 23b are at right angles to the keyway 10 facing the fence member 35. The true gate 22b positioned on its tumbler 22 is rotated in counterclockwise direction and when the tumbler stop 32 meets the left-hand shoulder of notch 22a the true gate 22b is at right angles to the keyway 10 facing the fence member 35.

False gates 21c and 23c are positioned in the clockwise direction from their associated true gates 21b and 23b so that a counterclockwise rotation of their respective tumblers 21 and 23, until the tumbler stops 31 and 33 meet the left-hand shoulder of notches 21a and 23a, will position the false gates 21c and 23c at right angles to the key 10 and facing the fence member 35. False gate 22c is positioned in the counterclockwise direction from its associated true gate 22b so that a clockwise rotation of its tumbler 22, until the tumbler stop 32 meets the right-hand shoulder of notch 22a, will position the false gate 22c at right angles to the key 10 and facing the fence member 35.

The operation and function of these true and false gates will become evident in the description of the operation of the cylinder lock.

Each tumbler end 51-53 in keyway 10 end of the tumbler 31-33 is formed in a 90-degree chisel tip with the chisel tip perpendicular to a line through the center of the tumbler and the center of the notch 21a-23a. The chisel tip is also provided with a twelve degree angle from its center to pass over the developed angles on the steeples of the key 24.

OPERATION OF CORRECT KEY

Referring now to FIGS. 1, 2 and 4 for a description of the correct key to operate the tumblers 21-23 shown, the key 10 is inserted in the cylinder lock. V bits 11 and 13 are cut to the third level so that tumblers 21 and 23 rest in the third level and the tops of tumblers 21 and 23 are at the shear line 47 and the bottoms of the drivers

41 and 43 are also at the shear line 47. V bit 12 is cut to the second level so that tumbler 22 rests in the second level and the top of tumbler 22 is at the shear line. The bottom of driver 42 is also at the shear line 47.

In the manner described the tumblers 21-23 rest in the proper level of the key so that all of the tumblers 21-23 and the associated drivers 41-43 clear the shear line 47. Thus there are no tumblers nor drivers obstructing or across the shear line 47.

However, at this point the fence 35 may not be moved into all of the true gates 21b-23b without the proper positioning of the true gates 21b-23b. The positioning of the true gates is accomplished by the rotation of the tumblers 21-23 as the chisel tips 51-53 are rotated by the angular slopes of the V bits. The significance of the perpendicular cuts of the left slope in V bit 12 and the right slope in V bit 13 will be explained and become apparent later during a description of an attempt to open the lock with an improper key.

The key shown in FIGS. 1, 2 and 4 is the proper key, and the V bits 11-13, cut in the manner shown, position tumblers 21-23 to present the true gates 21b-23b correctly in the following manner. V bit 11 is cut in a clockwise direction with both slopes 11a and 11b cut in the clockwise direction so that the chisel end 51 of tumbler 21 is rotated in a clockwise direction, rotating the tumbler 21 and its corresponding true gate 21b, false gate 21c, and angular notch 21a in a clockwise direction so that the right shoulder of angular notch 21a is stopped by the tumbler stop 31. The true gate 21b is thus presented perpendicular to the key 10, facing fence lug 37. Note that one fence lug by itself cannot be moved into its corresponding true gate, but all true gates must be properly positioned to accept simultaneously all of the fence lugs.

V bit 12 has its left slope 12b cut perpendicular to the axis of the key, and its right slope 12a cut in a counterclockwise direction from the center cut. The counterclockwise cut right slope 12a of V bit 12 rotates the chisel end 52 of tumbler 22 in a counterclockwise direction, rotating the tumbler 22 and its corresponding true gate 22b, false gate 22c, and angular notch 22a in a counterclockwise direction so that the left shoulder angular notch 22a is stopped by the tumbler stop 32. The true gate 22b is thus presented perpendicular to the key 10, facing fence lug 38. The left slope 12b which was cut perpendicular to the axis of the key 10 does not prevent the right slope 12a from rotating the chisel end 52 of tumbler 22. The function of the left slope 12b will be explained in the description of an attempt to open the lock with an improper key.

V bit 13 has its left slope 13b cut in a clockwise direction from a center cut and the right slope 13a cut perpendicular to the axis of the key 10. The clockwise cut left slope 13b of V bit 13 rotates the chisel end 53 of tumbler 23 in a clockwise direction, rotating the tumbler 23 and its corresponding true gate 23b, false gate 23c, and angular notch 23a in a clockwise direction so that the right shoulder of angular notch 23a is stopped by the tumbler stop 33. The true gate 23b is thus presented perpendicular to the key 10, facing fence lug 39.

In the manner described the correct key 10 for the lock has been inserted in the lock. The three V bits 11-13 as cut have positioned the three tumblers 21-23 so that all three tumblers present their true gates 21b-23b to the fence lugs 37-39 of fence member 35.

It has previously been described how the tumblers 21-23 and the drivers 41-43 have been positioned to clear the shear line 47. The key plug in the lock may then be rotated and the fence lugs 37-39 of the fence 35 moved into the true gates 21b-23b. Copending patent application 627,243 describes specifically how the fence is urged towards the tumblers by camming a cam projection out of a cam groove in the cylinder shell.

A correct key has operated the lock by properly positioning the tumblers 21-23 to clear the shear line, and

to present their true gates 21b-23b to the fence lugs 37-39 of the fence member 35.

MASTER KEY OPERATION

The lock shown may be operated by a master key by providing a master key with its V bits cut in the same angular displacements as the V bits shown in FIGS. 1 and 2. In other words, V bit 11 of the master key would be cut in a clockwise direction, V bit 12 of the master key would have one slope cut in a counterclockwise direction, and V bit 13 of the master key would have one slope cut in a clockwise direction. A master key cut in the manner described would position the tumblers 21-23 so that they all position their true gates 21b-23b to receive the fence lugs 37-39.

The wafers 41a-43a are each the thickness of one biting level of the key 10.

The master key has V bit 11 cut to the fourth level, V bit 12 cut to the third level, and V bit 13 cut to the fourth level.

When the master key is inserted V bit 11 cut to the fourth level positions the top of tumbler 21 below the shear line 47 one biting level. The wafer 41a is thus positioned below the shear line 47 so that the wafer 41a and the driver 41b clear the shear line 47. V bit 12 cut to the third level positions the top of tumbler 22 below the shear line 47 one biting level. The wafer 42a is thus positioned below the shear line 47 so that the top of wafer 42a and the driver 42b clear the shear line 47. The V bit 13 cut to the fourth level positions the top of tumbler 23 below the shear line 47 one biting level. The wafer 42a is thus positioned below the shear line 47 so that the top of wafer 43a and the bottom of driver 43b clear the shear line 47.

With the tumblers properly angularly positioned to accept the fence 35 and the tumblers positioned so that the shear line 47 is cleared between wafers in the drivers the key may be torqued to open the lock.

The same master key described may be used to open other locks having the same angular cut V bits by changing the sizes of the wafers and the drivers according to the levels to which a correct key will position the tumblers. Thus if the correct key has the V bit 12 cut to the first level to correctly position the tumbler to clear the shear line, to position the tumbler and drivers to clear the shear line 47 with the master key the wafer 42a must be two biting levels thick so that with the master key having V bit 12 cut to the third level the wafer 42a would be two biting levels below the shear line 47. Different size wafers would be used depending on what biting level the correct key is cut to so that the master key can also open the lock.

Master key systems have always had a major shortcoming in that they are relatively easy to open using an improper key by key jiggling. Such a jiggle key would have the V bits cut to the lower levels. The leading edge of the jiggle key is cut off, and the shoulder is cut down to allow the key to be inserted into the keyway beyond the normal position. The jiggle key is then pushed in and out, torquing it, with all of these motions carried out simultaneously. This moves the tumblers, the wafers, and the drivers up and down. Due to the manufacturing tolerances it is possible to effect minute rotary displacement of the key plug from its normal locked positions and thereby produce a slight offset shoulder formation or ledge by the key plug at the shear line which will catch and support the edges of the lower ends of the drivers or wafers as the tumblers are elevated during the jiggling. When a driver or wafer associated with each tumbler has been caught in the elevated position to clear the shear line key plug then turns to unlock the lock.

A master key system using this invention may not be easily opened by a jiggle key. It has been described how slope 12b of V bit 12 is cut perpendicular to the axis of the key 10, and slope 13a of V bit 13 is cut perpendicular

to the axis of the key 10. Note that thus one leading slope of one V bit has been cut perpendicular, and one trailing slope of another V bit has been cut perpendicular. It has been described how the other slopes of these V bits properly position the corresponding tumblers angularly to present their true gates to the fence member 35. The perpendicular slopes do not prevent this positioning for a proper key, or a proper master key in the manner previously described.

The perpendicular slope of the V bit does present key jiggling. Referring now to FIG. 3 an improper key 11 is shown which has V bit 61 cut to the fifth level, V bit 62 cut to the fourth level, and V bit 63 cut to the fifth level also. The slopes of the V bits 61-63 are cut in the same angular manner shown in FIGS. 1 and 2 with V bit 61 having both slopes cut in a clockwise direction. V bit 62 has the left slope 62b cut perpendicular to the axis of the key, and the right slope 62a cut in a counterclockwise direction from the center cut. V bit 63 has its left slope 63b cut in a clockwise direction, and the right slope 63a cut perpendicular to the axis of the key 11. Thus, the key 11 would angularly position the three tumblers 21-23 in the same manner as key 10 if the tumbler ends 51-53 rest in the valley of the V bits 61-63. However, as the V bits 61-63 are two biting levels below the biting levels in the key 10, and the drivers 41-43 are divided into wafers so that they would be opened by V bits 61-63 cut at the fourth, third and fourth levels, the drivers 41-43 do not clear the shear line, and the lock may not be unlocked.

If the lock is attempted to be opened by jiggling the key 11 and elevating the tumblers to catch the wafers or drivers on the shear line the perpendicular cut slopes 62b and 63a prevent the opening of the lock by jiggling angularly displacing the true gate of at least one of the tumblers away from where it can be engaged by its corresponding fence lug.

Referring first to FIGS. 3 and 5, the key 11 in FIG. 3 has been moved outwardly during a key jiggling effort. The tumblers have been moved up, driving the wafers and drivers up so that during torquing the edges of the lower ends of the drivers or wafers might be caught to clear the shear line.

The tumblers 21 and 22 remain angularly positioned to present the true gates 21b and 22b to the fence lugs 37 and 38 as shown in FIG. 5. However, as the chisel end 53 of the tumbler 23 rides up the slope 63a of the V bit 63 the perpendicular cut of slope 63a of V bit 63 rotates the tumbler 23 and its associated true gate 23b in a counterclockwise direction. The rotation is only 19° however so that the stop lug 33 is positioned in the center of notch 23a, and the chisel end 53 of tumbler 23 is perpendicular to the axis of the key 11. The true gate 23b of tumbler 23 is thus not presented to the fence lug 39 but is positioned counterclockwise in direction to the fence lug 39. The fence lug 39 may not be moved into the true gate 23b, so the fence member 35 cannot be moved into engagement with the three true gates of the tumblers 21-23.

There even if in the attempted jiggling the shear line catches and support the edges of the lower ends of the drivers or wafers of all three tumblers 21-23 to clear the shear line 47, the fence member 35 may not be moved into engagement with the tumbler true gates, and the cylinder lock may not be opened.

During jiggling the key 11 may also be moved further into the keyway in an attempt to elevate the tumblers 21-23 on the left slopes of the V bits and open the lock. During such a jiggling operation the tumblers 21 and 23 would have their chisel ends 51 and 53 ride up the slopes to elevate the tumblers and associated drivers and wafers. During this elevation the angular position of these two tumblers will remain correct as shown in FIG. 6 so that they present their true gates 21b and 23b to

receive their corresponding fence lugs 37 and 39. However as the chisel end 52 of tumbler 22 rides up the perpendicular cut slope 62b of V bit 62, the perpendicular cut of slope 62b rotates the tumbler 22 in a clockwise direction as shown in FIG. 6. This rotation in a clockwise direction of tumbler 22 also rotates the true gate 22b of tumbler 22 so that the true gate 22b is rotated away from the position where fence lug 38 can engage true gate 22b. Therefore fence member 35 cannot move all three fence lugs 37-39 into engagement with the three true gates of tumblers 21-23.

Thus even if in the attempted jiggling by moving the key 11 further into the keyway to elevate the tumblers on the trailing slopes of the V bits succeeds in catching and supporting the edges of the lower ends of the drivers or wafers of all three tumblers, thus clearing the shear line 47, the fence member 35 cannot be moved into engagement with the tumbler true gates, and the cylinder lock may not be opened.

Master key systems may be adopted using the principles of this invention wherein the opening of locks by key jiggling is extremely difficult. Even if a jiggling attempt is successful in catching the wafers or drivers of all of the tumblers to clear the shear line, one or more of the tumblers are rotated so that the fence member cannot be moved into engagement with the tumblers.

While the invention has been explained and described with the aid of particular embodiments thereon, it will be understood that the invention is not limited thereby and that many modifications retaining and utilizing the spirit thereof without departing essentially therefrom will occur to those skilled in the art in applying the invention to specific operating environments and conditions.

What is claimed is:

1. In a cylinder lock operated by a properly angularly bitted key having a plurality of V bits angularly cut to the axis of the key, at least one of said V bits having one slope cut perpendicular and one slope cut skew across the longitudinal axis of said key, a cylinder shell, a key plug rationally mounted in said cylinder shell to provide a shear line between said cylinder shell and said key plug, at least one tumbler mounted in said key plug to reciprocate and rotate therein as a whole, at least one driver associated with said tumbler positioned by the reciprocal movement of said tumbler upon engagement with the proper bitted key to clear the shear line, a fence

member blockingly associated with said tumbler and shaped so that the rotational positioning of said tumbler upon engagement with the proper angularly bitted key allows said fence to clear the shear line, wherein engagement of said tumbler by the perpendicular cut slope of one of said V bits rotationally positions said tumbler so that said fence member cannot clear the shear line.

2. A cylinder lock operated by a properly angularly bitted key, having a plurality of V bits angularly cut to the axis of the key, at least one of the angular V bits of said key having one slope cut perpendicular to the axis of the key, a cylinder shell, a key plug rotatably mounted in said cylinder shell to provide a shear line between said cylinder shell and said key plug, at least one tumbler mounted in said key plug to reciprocate and rotate therein as a whole, at least one driver associated with said tumbler, at least one wafer associated with said tumbler, said driver and wafer positioned by the reciprocal movement of said tumbler upon engagement with the properly bitted key to clear the shear line, said tumbler having a true gate parallel to the axis of said tumbler, a fence member blockingly associated with the true gate of said tumbler so that the rotational positioning of said tumbler by the proper angularly bitted key allows engagement of said fence member with the true gate of said tumbler, wherein the perpendicular cut slope of one of said V bit rotationally displaces said true gate so that said fence member cannot engage said true gate.

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U.S. Cl. X.R.

70-378, 392, 406, 409, 421