

IMPROVED CYLINDER LOCK SYSTEM

Background of the Invention

(1) Field of the Invention

5 The present invention relates to enhancements in security devices and, particularly, to increasing the difficulty of defeating mechanical locking systems. More specifically, this invention is directed to improved lock systems and, especially, to improved cylinder locks and cooperating keys therefor. Accordingly, the general objects of the present invention are to provide novel and improved methods and articles of such character.

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(2) Description of the Prior Art

Mechanical locks which employ one or more linear arrays of pin tumblers are, of course, well known in the art. The pin tumblers, i.e., the stacks of cooperating tumbler pins, of such locks are linearly displaceable, typically
15 radially relative to the axis of rotation of a plug or core, in response to insertion of a key in a keyway provided in the core. The pin tumblers are comprised of at least an upper or driver pin, which is spring biased toward the axis of core rotation, and a driven or bottom pin which is axially aligned with the driver pin when the lock is in the locked state. The pin tumblers are received in chambers
20 provided in the core and shell of the lock, the pin chambers in the core being in communication with the keyway of the lock and the outer circumference of the core. The pin tumbler receiving chambers of the core and shell are also in axial alignment with the lock in the locked state. A properly bitted key will, through communication with bottom pins in the pin chambers in the core,
25 produce pin tumbler displacement which causes an interface between pins of each of the pin tumblers to be coincident with a shear line defined by the core outer circumference. Thus, a properly bitted key will permit the core, with the bottom pins, to rotate within the shell. Core rotation will, through the action of a cam or tail piece coupled thereto, cause operation of a latch or other similar
30 locking mechanism.

Locks of the type generally discussed above are known in the art as "cylinder" locks. The most common manner of defeating a cylinder lock consists



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of "manufacture" of an unauthorized key. It is believed fair to state that it is not possible to ensure against lock defeat simply by designing an intricate keyway, i.e., a keyway having a complex profile, and/or through the use of various arrangements of pin tumblers. Rather, a high level of security dictates
5 that the lock manufacturer have the ability to exercise key control by being the sole authorized source of key blanks which may be employed as the key portion of the system.

Summary of the Invention

The present invention overcomes the above-briefly discussed and other
10 deficiencies and disadvantages of the prior art and, in so doing, provides a novel lock system which includes a key with a blade having unique physical characteristics. This unique key blade cooperates with one or more auxiliary locking pins which are provided in the lock core.

A lock system in accordance with the invention includes a cylinder lock
15 with a rotatable core which carries at least one reciprocal auxiliary locking pin. As used herein, the term "pin" is intended to describe a single member or a plurality, i.e., a stack, of pin segments. In the locked condition of the system, the auxiliary locking pin is resiliently biased away from the keyway and across the shear line of the lock so as to engage the shell, such engagement typically
20 being established by insertion of the outer end of the auxiliary pin into a chamber, i.e., a cooperating recess, provided in the shell. The auxiliary locking pin thus aids in inhibiting relative movement between the core and shell. The auxiliary locking pin is reciprocal along an axis which is generally transverse to a plane defined by the keyway. The axis of movement of the auxiliary locking
25 pin preferably does not intersect the axis of core rotation, i.e., the auxiliary locking pin is displaced from a line through the center of the cylinder lock. At its opposite inner end, the auxiliary locking pin is provided with a shaped head portion which at all times extends into the keyway from a side thereof. This shaped head portion includes a reaction surface against which a force directed
30 axially with respect to the auxiliary pin may be applied.

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The lock system of the invention further includes a key which is provided, in the side of the blade which faces in the direction of the auxiliary locking pin, with a longitudinal slot sized and shaped to cooperate with the head portion of the auxiliary locking pin. In a first region extending longitudinally from the blade tip toward the bow, wall(s) of the longitudinal slot which are generally complementary in shape and juxtapositioned to the auxiliary locking pin reaction surface have a first average displacement from the side of the keyway through which the auxiliary locking pin extends. This first average displacement is selected such that the shaped head portion of the auxiliary locking pin will be loosely received in the slot at the blade tip. The key blade slot wall(s) which face the auxiliary locking pin reaction surface, in a second longitudinal region displaced from the blade tip, have a second greater average displacement from the side of the keyway. This second displacement is commensurate with engagement of the auxiliary locking pin head portion and application of an axial force thereto which exceeds and is directed oppositely to the resilient bias. The maximum displacement of the complementary shaped wall(s) of the longitudinal slot second portion is, in a preferred embodiment, insufficient to fully withdraw the auxiliary locking pin from the cooperating recess in the shell. The coaction between the slot wall(s) in the second longitudinal portion of the slot and the auxiliary locking pin reaction surface will produce sufficient displacement of the auxiliary locking pin to enable rotation of the core relative to the shell to at least be initiated. In the preferred embodiment, however, the auxiliary locking pin will be only partially withdrawn from the shell recess by the cooperation between the key slot second portion and pin reaction surface. Accordingly, sufficient relative rotation between the core and shell to operate the lock from the locked to the unlocked state will still not be permitted.

In the preferred embodiment, the second end of the auxiliary locking pin is shaped to cooperate with a shaped wall at one side of the shell recess in the manner of a cam follower and cam. Accordingly, when enabled by partial pin withdrawal, the initial rotation of the core relative to the shell will, through camming action, produce further axial displacement of the auxiliary locking pin in a direction which will tend to cause the auxiliary locking pin to move

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completely out of engagement with the shell recess. Such further axial movement of the auxiliary locking pin requires that the key be bitted or coded such that movement of the auxiliary locking pin head portion laterally with respect to the longitudinal slot second portion is enabled. Such enablement is
5 achieved by providing the head portion of the auxiliary locking pin with an extension which normally abuts the base of the longitudinal slot in the key blade. This extension is sized and shaped to be received in an opening, preferably an aperture, provided in the base of the key blade slot in the second region thereof. When this further code condition is met, i.e., when the auxiliary
10 locking pin head extension can pass into a properly located and complementary shaped opening, the partially withdrawn auxiliary locking pin may be cammed out of locking engagement with the shell recess subsequent to partial withdrawal of the auxiliary locking pin and also subsequent to displacement of the pin tumbler stacks of the lock to the unlocked condition by the other, i.e.,
15 conventional, bitting on the blade.

A key of a locking system in accordance with the present invention must, accordingly, be provided with a properly shaped longitudinal slot or groove which will coact with the head of a locking pin to apply a pulling force to the pin, that longitudinal slot must have at least two linear portions wherein the average
20 displacement from a keyway side of a surface provided to engage and coact with an auxiliary locking pin reaction surface is different, the blade must have a profile in addition to the longitudinal slot which is commensurate with the keyway of the lock and the blade must be bitted on the appropriate surface(s) so as to cooperate with the primary pin tumblers of the lock. Further, in the
25 preferred embodiment, the blade must be provided with a properly shaped and located recess or aperture in that portion of the slot where axial forces are being applied to the auxiliary locking pin.

In accordance with a preferred embodiment of the invention, the head portion of the auxiliary locking pin and the cooperating slot in the side of the key
30 blade respectively constitute a tenon and mortise.

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Brief Description of the Drawing

The present invention may be better understood, and its numerous objects and advantages will become apparent to those skilled in the art, by reference to the accompanying drawing, wherein like reference numerals refer to like elements in the several Figures and in which:

Figure 1 is a side elevation view, partly broken away to reveal detail, of a preferred embodiment of a lock system in accordance with the present invention;

Figure 2A is a side elevation view of a preferred embodiment of a key blank from which the key of the lock system of Figure 1 may be formed by producing the cuts which define the bitting;

Figure 2B is a cross-sectional top plan view, taken along line 2-2 of Figure 2, of the blade portion of the key blank of Figure 2A;

Figure 3 is a cross-sectional, schematic side-elevation view of the lock of Figure 1 without a key present in the keyway;

Figure 4A is a view similar to Figure 3 but with an authorized key partly inserted in the keyway;

Figure 4B is a view taken along line 4-4 of Figure 4A;

Figures 5A and 5B are views respectively identical to Figures 4A and 4B but with the key fully inserted in the keyway;

Figures 6A and 6B are respectively views identical to Figures 5A and 5B but with the lock core rotated relative to the shell; and

Figure 7 is an enlarged side elevation view of the auxiliary locking pin of the lock of Figures 1 and 3 - 6.

Description of the Preferred Embodiment

The disclosed embodiment of the present invention will now be described with reference to the drawing. It is to be noted that conventional elements of the lock have been omitted from the drawing in the interest of facilitating understanding of the invention and that the various cross-sectional views of the lock are schematic illustrations rather than manufacturing drawings.

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A lock system in accordance with the invention is indicated generally at 10 in Figure 1. The lock system is comprised of a cylinder lock, indicated generally at 12, and a cooperating key 14. Cylinder lock 12, as is conventional, comprises a core 16, see also Figures 3 - 6, which is rotatable about its longitudinal axis within and relative to a shell 18. The cylindrical boundary, i.e., the interface between core 16 and shell 18, defines the shear line or plane of the lock. The core 16 is provided with a keyway 20 having a profile, i.e., a cross-sectional shape, which is unique to the lock.

Referring to Figure 2A, a partially manufactured key 14, i.e., a key blank, has a bow portion 22 and a blade 24 which extends longitudinally from the bow and terminates at a tip. Blade 24 will be shaped, i.e., the initially flat side faces of the article from which the key blank of Figure 2A is formed will be milled, so that the profile of blade 24 matches the cross-sectional shape of keyway 20. Accordingly, the key blade 24 may be inserted into the keyway.

As is also conventional, cylinder lock 12 will be provided with one or more arrays of reciprocally movable primary pin tumblers, the pin tumblers also sometimes being referred to as pin tumbler stacks. In the disclosed embodiment, the lock has a single linear array of pin tumblers. Referring to Figure 3, each pin tumbler will comprise at least a top or driver pin 26 and a bottom or driven pin 28. The pins comprising the pin tumblers are housed in pin tumbler chambers provided in the core 16 and shell 18. The chambers in the core and shell which receive a given pin tumbler stack will be in axial alignment when the lock is in the locked state. In the disclosed embodiment, the axes of the pin tumbler chambers are radially oriented with respect to the axis of rotation of core 16. The pin tumbler chambers in the core communicate with the keyway and, as shown in Figure 3, the bottom pins 28 of each pin tumbler extend into the keyway. In the disclosed embodiment of the invention, the pin tumblers are, in part, housed in an extension 30 of shell 18, such an extension being known in the art as a "bible". It will be understood that, in the locked condition, the pin tumblers are biased in the direction of the axis of rotation of core 16 by springs, not shown. Also in the locked condition of the cylinder lock, one of the pins of each pin tumbler extends across the shear line,

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i.e., is partly in a chamber in each of the shell and core, and thus prevents rotation of the core relative to the shell. Rotation of the core relative to the shell is conventionally enabled by providing the key blade with biting, i.e., surface irregularities, which engage the bottom pins and cause the pin tumblers to be displaced so that an interface between a pair of axially aligned pins is located on the shear line. In the embodiment disclosed, the key biting would, as may be seen from Figure 1, be in the form of flat bottomed serrations provided in edge 32 of key blade 24. Cylinder lock 12 may have one or a plurality of arrays of pin tumblers, and the key biting which cooperates with such pin tumblers may be on an edge(s) and/or side faces of the key blade and/or may take various forms and the axes along which the pins move do not have to be radially oriented with respect to the axis of core rotation.

In accordance with the present invention, and as best seen from Figures 3 - 6, cylinder lock 12 is provided with at least one auxiliary locking pin 40. Pin 40 is housed, for reciprocal motion, in a pin chamber 42 in core 16. Chamber 42 extends between a side of keyway 20 and the outer circumference of the core. Pin chamber 42 is provided with an inwardly extending rim or shoulder which functions as a seat for the first end of a biasing spring 44. The opposite end of biasing spring 44 coacts with a shoulder 45 on pin 40 (see Figure 7), i.e., spring 44 is in compression and surrounds a reduced diameter intermediate portion of pin 40. Spring 44 thus biases pin 40 outwardly, i.e., in a direction generally transverse to a plane defined by and extending through the center of keyway 20. The axes of the above-described primary pin tumblers, in the disclosed embodiment, lie in this plane. In contradistinction to the primary pin tumblers, the axis along which the auxiliary locking pin 40 moves does not, in the disclosed embodiment, intersect the axis of rotation of core 16. Auxiliary locking pin 40 is, accordingly, offset with respect to a center line of the core.

Referring to Figure 7, which is an enlarged view of auxiliary locking pin 40, at a first or inner end the pin includes a shaped head 46. Head 46, when viewed in cross-section in a plane transverse to the keyway, generally has the shape of a tenon which flares, i.e., enlarges, in the direction of the side of the keyway opposite to that through which pin 40 extends. Thus, the head 46 of

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auxiliary locking pin 40, from the reduced diameter intermediate portion thereof, tapers outwardly. This tapered, i.e., frustoconical, portion of head 46 defines, as will be described below, a first reaction surface against which an axial force is applied. The first end of auxiliary locking pin 40, in the preferred
5 embodiment, is further characterized by an extension 48 having a predetermined length, cross-sectional size and shape. In the disclosed embodiment, extension 48 is of cylindrical shape and is coaxial with pin 40.

The second, opposite end of auxiliary locking pin 40, i.e., the portion of pin 40 disposed on the shell side of the reduced diameter intermediate portion,
10 releasably engages shell 18. This engagement may be accomplished by providing an opening 50, i.e., a recess, in the inner wall of shell 18. Referring jointly to Figures 4B, 5B, 6B and 7, the second end of pin 40 includes a projection 52 sized and shaped to engage recess 50. The outwardly facing side of projection 52, i.e., the end of pin 40 disposed oppositely with respect to
15 extension 48, defines a second pin reaction surface 54 (Figures 6A and 7). In the preferred embodiment, in the manner to be described below, the provision of reaction surface 54 permits auxiliary locking pin 40 to function as a cam follower. Restated, axial motion may be imparted to pin 40 by means of the application of mechanical force to angled surface 54. With the lock in the locked
20 state as represented by Figure 3, projection 52 is engaged in recess 50 and auxiliary locking pin 40 thus bridges the shear line of the lock and cooperates with the primary pin tumblers to prevent relative rotation between the core and shell. In this state, a pair of abutting walls 80 and 82, oriented generally
25 parallelly with respect to the axis of pin 40 in the disclosed embodiment, respectively on the projection 52 and in recess 50, coact to prevent rotation of core 16 relative to shell 18.

Referring again to Figures 2A and 2B, and also referring to Figures 4 - 6, the side 59 of blade 24 of key 14 which faces the side of the keyway through which auxiliary locking pin 40 extends is provided with a longitudinal slot 60.
30 Slot 60 has a shape which is generally complementary to that of head 46 of pin 40. Thus, extending longitudinally from the blade tip, blade 24 has a slot 60 which functions as a mortise which receives and coacts with the tenon defined

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by the head 46 of auxiliary locking pin 40. The walls of key blade slot 60 which operatively engage the head of pin 40 have an average displacement from the side of the keyway, this displacement hereinafter being referred to as the operational slot depth. Slot 60 also has an overall depth measured between
5 the base 61 of slot 60 and the outermost plane defined by side 59 of blade 24. Slot 60 has a first overall depth and a first operational depth in a first linear section 62 thereof which extends inwardly from the blade tip. Slot 60 also includes, in the disclosed embodiment, a ramp 64 where both its overall depth and operational depth transition from first or initial depths to second depths.
10 Slot 60 further has at least a third linear section 66 having the second overall and operational depths. In the preferred embodiment where pin 40 has a shaped head extension 48, an aperture 68 is provided in the base 61 of the key blade slot in linear portion 66. The size and shape of aperture 68 is complementary to the cross-sectional size and shape of extension 48 of head
15 46 of pin 40.

Figure 3 depicts the disclosed embodiment of a lock in accordance with the present invention in the locked state, i.e., without a properly configured and bitted key inserted in keyway 20. In this condition, the resilient bias of the primary pin tumblers causes the bottom pins 28 of the primary pin tumblers to
20 extend into the keyway. The head 46 of auxiliary locking pin 40 also extends into the keyway. In the locked state of Figure 3, the second end of pin 40, namely the projection 52, is fully engaged in recess 50 in the wall of shell 18. Thus, in the Figure 3 state, rotation of core 16 relative to shell 18 is prevented by the extension, across the shear line, of a pin of each of the primary pin
25 tumblers and by the auxiliary locking pin 40. The head 46 of auxiliary locking pin 40, in the preferred embodiment, normally extends into the keyway to a position where it does not cross the center plane of the keyway.

When an authorized key is started into keyway 20, as represented in Figures 4A and 4B, the head portion 46 of pin 40 will be received in the first
30 section 62 of key blade slot 60. The first overall and operational depths of slot 60 are selected such that the key slot will capture the head of pin 40 and will initially slide relative to the auxiliary locking pin without any significant force

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being transferred to the pin reaction surface, i.e., the tenon, by the complementary shaped inwardly facing surfaces of groove 60, i.e., the mortise. Restated, the initial displacement of the mortise defining walls from the keyway side, commensurate with the first slot operational depth, is insufficient to pull
5 pin 40 inwardly.

When the key blade 44 is fully inserted in the keyway 20, i.e., when the condition depicted in Figures 5A and 5B is reached, a ramp portion of slot 60, the section 64 in the disclosed embodiment, will have coacted with the head 46 of pin 40 to pull pin 40 outwardly against the bias of spring 44. Restated, the
10 transition of longitudinal slot 60 from the linear first operational depth portion to the deeper second operational depth portion will cause an axial force to be applied to the reaction surface on the head 46 of pin 40 by the complementary surface which in part defines slot 60. This applied axial force will result in the auxiliary locking pin 40 being at least partially withdrawn from recess 50 in shell
15 18. In the disclosed embodiment, the cooperation between the head portion of the auxiliary locking pin and slot portion 64 will result in partial withdrawal of pin 40 from recess 50 as depicted in Figure 5A. In this partially withdrawn position, the wall 80 on the pin no longer abuts recess defining wall 82 and the downstream edge of camming surface 54 of pin 40 is thus disposed on the core
20 side of recess side wall surface 82. Restated, the coaction between the slot in the key blade and head of the auxiliary locking pin will impart sufficient axial movement to pin 40, against the bias of spring 44, to discontinue the rotation blocking cooperation between pin 40 and recess 50 and, thereby, enable core rotation. However, when the head 46 of pin 40 has a shaped projection 48,
25 rotation of core 16 relative to shell 18 to the point where the latch coupled to core 16 could be operated will be prevented in the absence of some provision to enable further axial movement of pin 40 away from shell 18. Thus, in the disclosed embodiment, partial withdrawal of the auxiliary locking pin 40 from engagement in recess 50, as depicted in Figures 5A and 5B, does not permit
30 lock operation because full rotation of core 16 is still prevented by interference between a camming surface 70, provided on the inner wall of the shell immediately adjacent wall 82 of recess 50, and an axially immobilized auxiliary

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locking pin, i.e., a locking pin that cannot move further in the axial direction into the keyway because the pin extension 48 bottoms in key slot 60.

Referring to Figures 6A and 6B, by providing the aperture 68 in the key blade, the cam surface 70 on shell 18 may cooperate with surface 54 on projection 52 of auxiliary locking pin 40 to produce an axial force which drives the extension 48 on the head 46 of pin 40 into aperture 68 in response to the application of torque to bow 22 of key 20. In the preferred embodiment, in the unlocked state depicted in Figure 6, at least a portion of the head 46 of auxiliary locking pin 40 extends across the plane of the center of the keyway.

In a lock in accordance with the present invention, the most outwardly disposed surface area(s) of the projecting second end 52 of the auxiliary locking pin, i.e., the camming surface 54 in the disclosed embodiment, are preferably, but are not necessarily, complementary in shape to the inner diameter of shell 18. Also, referring to Figure 2A, the longitudinal slot 60 in the key blade is preferably continued past the location of the auxiliary locking pin and will preferably transition back to at least its initial depth. This extension of slot 60 is in the interest of facilitating the cleaning thereof. As will be obvious to those skilled in the art, it is possible to employ a plurality of the auxiliary locking pins 40. Where a plurality of auxiliary locking pins is employed, they could enter the keyway from opposite sides.

While a preferred embodiment has been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustration and not limitation.

What is claimed is:

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1. A cylinder lock comprising:

a shell, said shell having a plurality of pin tumbler receiving chambers, said shell further having an interior surface which defines a core receiving chamber having a longitudinal axis, said shell pin tumbler receiving chambers
5 each extending to said shell interior surface and having an axis, said shell interior surface being provided with at least a first recess, said first recess having a depth and being in part defined by a camming surface which extends from and merges with said shell interior surface, said shell being mounted with a fixed orientation in the use environment of said lock;

10 a core cooperating with said shell to form the relatively rotatable component of said lock, said core having an exterior surface and being disposed within said core receiving chamber of said shell for rotation about said longitudinal axis, said core including a longitudinally extending keyway, said keyway having oppositely disposed first and second sides and defining a plane
15 in which said longitudinal axis lies, said core also having a plurality of pin tumbler receiving chambers, each of said core pin tumbler receiving chambers having an axis, said core pin tumbler receiving chambers being located so as to be axially alignable with an associated one of said shell pin tumbler receiving chambers, said core pin tumbler receiving chambers extending between said
20 keyway and said exterior surface of said core, a shear line for said lock being defined by the interface between said interior surface of said shell and said exterior surface of said core, said core further having at least a first auxiliary locking pin receiving chamber which extends between said first side of said keyway and said core exterior surface, said first auxiliary locking pin receiving
25 chamber having an axis, said first auxiliary locking pin receiving chamber being in registration with said shell first recess when said pin tumbler receiving chambers of said shell and core are in axial alignment;

a plurality of pin tumblers, said pin tumblers each having at least a bottom pin and a driver pin, said pins at each of said pin tumblers being in
30 alignment when said core and shell pin tumbler receiving chambers are in axial alignment whereby said pin tumblers are reciprocally movable as units, said pin





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tumblers each further including a first spring for urging said driver pins in the direction of said keyway whereby at least one of said pins of at least some of said pin tumblers normally extends across said shear line so as to be partly disposed in an aligned shell pin tumbler receiving chamber and core pin tumbler receiving chamber;

an auxiliary locking pin having first and second oppositely disposed end portions, said auxiliary locking pin being disposed in said core auxiliary locking pin receiving chamber for reciprocal motion, said auxiliary locking pin defining an axis, said first end portion of said auxiliary locking pin including a shaped head, said shaped head extending into said keyway through said first side of said keyway, said second end portion of said auxiliary locking pin being normally engaged in said first recess in said shell interior surface, said shaped head of said auxiliary locking pin including a reaction surface against which a force directed axially with respect to said auxiliary locking pin may be exerted, said reaction surface facing generally toward said second end portion of said auxiliary locking pin, said first end portion also including an extension of said shaped head, said extension projecting toward said second side of said keyway, said auxiliary locking pin second end portion including a cam surface which is at least in part complementary in shape to said shell recess defining camming surface; and

an auxiliary locking pin spring for applying an axial resilient bias force to said auxiliary locking pin to urge said auxiliary locking pin toward said shell interior surface whereby said auxiliary locking pin will normally extend across said shear line and said second end portion thereof will engage said shell first recess and said auxiliary locking pin will prevent rotation of said core relative to said shell in the absence of the application of forces to said auxiliary locking pin which are in a direction opposite to and in excess of said resilient bias force.

2. The cylinder lock of claim 1 wherein each of said shell first recess and said locking pin second end portion is provided with a rotation prevention wall surface, said wall surfaces being in abutting relationship and being oriented generally parallelly with respect to said auxiliary locking pin axis when said

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auxiliary locking pin is caused to fully engage said shell first recess by said auxiliary locking pin spring, the length of said shell wall surface being less than the depth of said shell first recess, said wall surfaces coacting to prevent rotation of said core relative to said shell when said auxiliary locking pin second
5 end portion is fully engaged in said shell first recess.

3. The cylinder lock of claim 1 wherein said head of said auxiliary locking pin in part defines a flaring tenon.

4. The cylinder lock of claim 2 wherein said head of said auxiliary locking pin in part defines a flaring tenon.

10 5. The cylinder lock of claim 2 wherein said camming surface and said shell recess defining rotation prevention wall surface cooperate to define a first side of said shell first recess and wherein said auxiliary locking pin cam surface at least in part defines an end face of said auxiliary locking pin, said end face extending angularly from said auxiliary locking pin rotation prevention wall
15 surface.

6. The cylinder lock of claim 5 wherein said head of said auxiliary locking pin in part defines a flaring tenon.

7. A cylinder lock system comprising:
a shell, said shell defining a plurality of pin tumbler receiving chambers,
20 said shell further having an interior surface which defines a core receiving chamber having a longitudinal axis, said shell pin tumbler receiving chambers each having an axis and communicating with said interior surface, said shell interior surface being provided with at least a first opening at a point displaced from said chambers, said shell being mounted with a fixed orientation in the use
25 environment of the lock of said system;

a core cooperating with said shell to form the relatively rotatable component of the lock of said system, said core having an exterior surface and

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being disposed within said core receiving chamber of said shell for rotation about said longitudinal axis, said core including a longitudinally extending keyway, said keyway having oppositely disposed first and second sides and defining a plane in which said longitudinal axis lies, said core also having a plurality of pin tumbler receiving chambers, said core pin tumbler receiving chambers each having an axis, each of said core pin tumbler receiving chambers being axially alignable with an associated one of said shell pin tumbler receiving chambers, said core pin tumbler receiving chambers extending between said keyway and said exterior surface of said core, a shear line for the lock of said system being defined by the interface between the interior surface of said shell and said exterior surface of said core, said core further having at least a first auxiliary locking pin receiving chamber which extends between said first side of said keyway and said core exterior surface, said auxiliary locking pin receiving chamber having an axis which intersects said shell first opening when said pin tumbler receiving chambers of said shell and core are in axial alignment;

pin tumblers disposed in said pin tumbler receiving chambers, said pin tumblers each having at least a bottom pin and a driver pin, axial alignment of said core and shell pin tumbler receiving chambers permitting reciprocal motion of said pin tumblers, at least one of said pins of each of said pin tumblers extending across said shear line so as to be partly disposed in an aligned shell pin tumbler receiving chamber and core pin tumbler receiving chamber in the absence of a properly bitted key in said keyway, said pin tumblers each further including a spring for urging said driver pins in the direction of said keyway whereby said bottom pins extend into said keyway for cooperation with a key;

an auxiliary locking pin having first and second oppositely disposed end portions, said auxiliary locking pin being reciprocally disposed in said core auxiliary locking pin receiving chamber, said auxiliary locking pin defining an axis, said first end portion of said auxiliary locking pin extending into said keyway, said second end portion of said auxiliary locking pin being sized and shaped to engage said first opening in said shell interior surface, said first end portion of said auxiliary locking pin including a reaction surface against which

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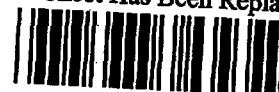




a force directed axially with respect to said auxilliary locking pin may be exerted, said reaction surface facing generally toward said second end portion of said auxilliary locking pin, said first end portion of said auxilliary locking pin further including a shaped extension which faces away from said reaction surface and projects toward the second side of said keyway, said projection defining the first end of said auxilliary locking pin,

an auxilliary locking pin spring for applying an axial resilient bias force to said auxilliary locking pin to normally urge said second end portion of said auxilliary locking pin into engagement with said shell first opening whereby said auxilliary locking pin will extend across said shear line to prevent rotation of said core relative to said shell in the absence of the application of an axial force to said auxilliary locking pin reaction surface which is in a direction opposite to and in excess of said resilient bias force; and

a key, said key comprising a bow and a blade which extends longitudinally from said bow to a blade tip, said blade having a pair of spatially displaced opposite side surfaces which are at least in part substantially parallel, at least one of said side surfaces being provided with a longitudinal slot extending from said tip toward said bow, said longitudinal slot being in part defined by a base and a force transmission wall which is spatially displaced from said base, said force transmission wall being at least in part generally complementary in shape to at least a portion of said auxilliary locking pin reaction surface, said auxilliary locking pin first end portion being receivable in said longitudinal groove, the spacing between said slot base and said keyway first side defining a first slot operational depth at said blade tip and defining a second slot operational depth in a section of said slot which is displaced from said blade tip, said second operational depth being greater than said first operational depth, said first operational depth being commensurate with capture of said first auxilliary locking pin first end portion without the imposition of sufficient force on said reaction surface thereof to overcome said resilient axial bias and impart motion thereto, said section of said slot having said second depth being in registration with said auxilliary locking pin when said key blade is fully inserted in said keyway, the depth of said slot transitioning smoothly





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from said first depth to said second depth, said blade further having an opening disposed in the base of said slot section which has said second depth, said opening having a size and cross-sectional shape which accommodates said auxiliary locking pin first end portion shaped extension, said full insertion of said key blade into said keyway with said locking pin first end portion received in said slot resulting in a cooperation between said force transmission wall and said reaction surface to impose an axial force on said reaction surface which overcomes said resilient bias.

8. The lock system of claim 7 wherein said axis of said auxiliary locking pin is oriented generally transversely with respect to said keyway defined plane and said auxiliary locking pin axis intersects said plane at a point displaced from said longitudinal axis.

9. The lock system of claim 7 wherein said opening in said base of said key blade slot comprises an aperture which extends to the side of said slot disposed oppositely with respect to said base.

10. The lock system of claim 7 wherein said first end portion of said auxiliary locking pin in part defines a flaring tenon.

11. The lock system of claim 7 wherein said auxiliary locking pin second end portion includes a camming surface and said shell is provided with a cam surface generally complementary in shape to said pin camming surface, said shell cam surface extending from said opening, and wherein each of said shell first opening and said auxiliary locking pin second end portion is further provided with a wall surface which is oriented generally parallelly with respect to said auxiliary locking pin axis when said auxiliary locking pin is fully engaged in said shell first opening, said shell first opening wall surface having a length in a direction parallel to said auxiliary locking pin axis which is commensurate with the difference between said key blade slot first and second depths, said auxiliary locking pin and shell first opening parallel wall surfaces coacting to

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prevent rotation of said core relative to said shell when said auxiliary locking pin is fully engaged in said shell first opening, said shell cam surface and said auxiliary locking pin camming surface cooperating to impart axial motion to said auxiliary locking pin in response to relative rotation between said shell and core, said imparted axial motion resulting from said cam surface cooperation being permitted by reception of said shaped extension of said auxiliary locking pin first end portion in said opening in said base of said key blade slot.

12. The lock system of claim 11 wherein said opening in said base of said key blade slot comprises an aperture which extends to the side of said slot disposed oppositely with respect to said base.

13. The lock system of claim 11 wherein said first end portion of said auxiliary locking pin in part defines a flaring tenon.

14. The lock system of claim 12 wherein said first end portion of said auxiliary locking pin in part defines a flaring tenon.

15. The lock system of claim 7 wherein said longitudinal slot in said key blade defines a mortise.

16. The lock system of claim 12 wherein said longitudinal slot in said key blade defines a mortise.

17. The cylinder lock system of claim 16 wherein said mortise includes a reaction surface which is generally complementary in shape to said locking pin first end portion reaction surface.

18. The cylinder lock system of claim 17 wherein said first end portion of said auxiliary locking pin in part defines a flaring tenon.

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19. The cylinder lock system of claim 18 wherein said axis of said auxiliary locking pin is oriented generally transversely with respect to said keyway defined plane and said auxiliary locking pin axis intersects with said plane at a point displaced from said longitudinal axis.

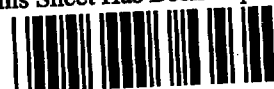
5 20. A key blank for use with a cylinder lock having at least a first resiliently biased auxiliary locking pin, the locking pin having a shaped head portion which extends into the lock keyway, the shaped head portion being at a first end of the auxiliary locking pin and including a reaction surface which generally faces the second end of the auxiliary locking pin, said key blank
10 comprising:

 a bow;

 a blade longitudinally extending from said bow and terminating at a tip, said blade having first and second spatially displaced sides and a pair of oppositely disposed and spaced edges which interconnect said sides, said first
15 and second sides being at least in part substantially parallel to one another;

 a slot extending longitudinally along a substantial portion of the length of at least a first of said blade sides from said blade tip in the direction of said bow, said slot having a base which defines the depth thereof, said slot defining a mortise which is at least in part complementary in shape to at least a portion
20 of the reaction surface of the shaped head portion of the auxiliary locking pin, said mortise enlarging in the direction of the base of said slot whereby an auxiliary locking pin head portion may be inserted in said slot at said blade tip and captured therein, said complementary shaped part of said mortise including a reaction surface which faces generally in the direction of the second of said
25 blade sides, said slot having a first linear section with an average first depth, said slot first linear section extending from said blade tip, said slot depth transitioning smoothly from said first depth to a second depth occurring in a second slot linear section, said reaction surface of said mortise following the depth profile of said slot, said second linear section of said slot being located in
30 a longitudinal region along said blade which is displaced from said tip by said first slot section; and

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an opening in said base of said slot, said opening being located in said second slot linear section.

21. The key blank of claim 20 wherein the auxiliary locking pin shaped head portion has an extension and wherein said opening is sized and shaped to receive the extension.

22. The key blank of claim 21 wherein said opening is an aperture extending between said slot base and said second of said blade sides.

23. The key blank of claim 22 wherein said slot first depth is less than one half of the thickness of said blade and said slot second depth exceeds one half of the thickness of said blade.

24. The key blank of claim 22 wherein the depth of said slot first linear section is substantially constant.

25. The key blank of claim 24 wherein said transition in depth of said slot occurs in a third linear section disposed intermediate said first and second linear sections.

26. The key blank of claim 20 wherein the cross-section of said opening in part defines the bitting of the key to be formed from said blank.

27. A cylinder lock comprising:
a shell, said shell having a plurality of pin tumbler receiving chambers, said shell further having an interior surface which defines a core receiving chamber having a longitudinal axis, said pin tumbler receiving chambers each extending to said interior surface and having an axis, said shell interior surface being provided with at least a first recess, said shell being mounted with a fixed orientation in the use environment of said lock;

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a core cooperating with said shell to form the relatively rotatable component of said lock, said core having an exterior surface and being disposed within said core receiving chamber of said shell for rotation about said longitudinal axis, said core including a longitudinally extending keyway, said
5 keyway having oppositely disposed sides and defining a plane in which said longitudinal axis lies, said core also having a plurality of pin tumbler receiving chambers, each of said core pin tumbler receiving chambers having an axis and being axially alignable with an associated one of said shell pin tumbler receiving chambers, said core pin tumbler receiving chambers extending between said
10 keyway and said exterior surface of said core whereby communication may be established between said shell and core pin tumbler receiving chambers, a shear line for said lock being defined by the interface between said interior surface of said shell and said exterior surface of said core, said core further having at least a first auxiliary locking pin receiving chamber which extends between a first side
15 of said keyway and said core exterior surface, said first auxiliary locking pin receiving chamber having an axis which is generally transverse to said keyway defined plane, the axis of said first auxiliary locking pin intersecting said keyway defined plane at a point offset from said longitudinal axis, said axis of said first auxiliary locking pin receiving chamber being in registration with said shell first
20 recess when said pin tumbler receiving chambers of said shell and core are in axial alignment;

pin tumblers reciprocally disposed in said pin tumbler receiving chambers, said pin tumblers each having at least a bottom pin and a driver pin, said pins being in alignment when said core and shell pin tumbler receiving chambers are
25 in axial alignment whereby said pin tumblers are movable as units, at least one of said pins of at least some of said pin tumblers normally extending across said shear line so as to be partly disposed in an aligned shell pin tumbler receiving chamber and core pin tumbler receiving chamber, said pin tumblers each further including a first spring for biasing said driver pins in the direction of said
30 core;

an auxiliary locking pin reciprocally disposed in said core auxiliary locking pin receiving chamber, said auxiliary locking pin defining an axis and having a

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shaped head portion at a first end thereof, said head portion extending into said keyway, the second opposite end portion of said auxiliary locking pin normally engaging said first recess in said shell interior surface, said head portion of said auxiliary locking pin including a reaction surface against which a force directed axially with respect to said auxiliary locking pin may be exerted, said reaction surface facing generally toward said second end of said auxiliary locking pin; and

an auxiliary locking pin spring for applying an axial resilient bias force to said auxiliary locking pin to urge said second end of said auxiliary locking pin away from said keyway and toward said shell interior surface whereby said auxiliary locking pin will extend across said shear line into said shell first recess and prevent rotation of said core relative to said shell in the absence of the application of a force to said auxiliary locking pin head portion reaction surface which is in a direction opposite to and in excess of said resilient bias force.

28. The cylinder lock of claim 27 wherein said auxiliary locking pin opposite end has a shape which is in part generally complementary to the shape of said shell first recess, and wherein said shell first recess and said locking pin second end are provided with wall surfaces which coact to prevent rotation of said core relative to said shell when said auxiliary locking pin opposite end is engaged in said first recess.

29. A cylinder lock system comprising:

a shell, said shell defining a plurality of pin tumbler receiving chambers, said shell further having an interior surface which defines a core receiving chamber having a longitudinal axis, said pin tumbler receiving chambers each having an axis and communicating with said interior surface, said shell interior surface being provided with at least a first recess, said shell being mounted with a fixed orientation in the use environment of the lock of said system;

a core cooperating with said shell to form the relatively rotatable component of the lock of said system, said core having an exterior surface and being disposed within said core receiving chamber of said shell for rotation

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about said longitudinal axis, said core including a longitudinally extending keyway, said keyway having oppositely disposed sides and defining a plane in which said longitudinal axis lies, said core also having a plurality of pin tumbler receiving chambers, said core pin tumbler receiving chambers each having an axis and being axially alignable with associated of said shell pin tumbler receiving chambers, said core pin tumbler receiving chambers extending between said keyway and said exterior surface of said core whereby communication may be established between said shell and core pin tumbler receiving chambers, a shear line for the lock of said system being defined by the interface between the interior surface of said shell and said exterior surface of said core, said core further having at least a first auxiliary locking pin receiving chamber which extends between a first side of said keyway and said core exterior surface, said auxiliary locking pin receiving chamber having an axis which intersects said shell first recess when said pin tumbler receiving chambers of said shell and core are in axial alignment;

pin tumblers disposed in said pin tumbler receiving chambers, said pin tumblers each having at least a bottom pin and a driver pin, axial alignment of said core and shell pin tumbler receiving chambers permitting reciprocal motion of said pin tumblers, at least one of said pins of each of said pin tumblers extending across said shear line so as to be partly disposed in an aligned shell pin tumbler receiving chamber and core pin tumbler receiving chamber in the absence of a properly bitted key in said keyway, said pin tumblers each further including a spring for urging said driver pins in the direction of said core;

an auxiliary locking pin reciprocally disposed in said core auxiliary locking pin receiving chamber, said auxiliary locking pin defining an axis and having a shaped head portion at a first end thereof, said head portion extending into said keyway, the second opposite end of said auxiliary locking pin being sized and shaped to engage said first recess in said shell interior surface, said head portion of said auxiliary locking pin including a reaction surface against which a force directed axially with respect to said auxiliary locking pin may be exerted, said reaction surface facing generally toward said second end of said auxiliary locking pin;



an auxiliary locking pin spring for applying an axial resilient bias force to said auxiliary locking pin to urge said second end of said auxiliary locking pin away from said keyway and toward said shell interior surface whereby said auxiliary locking pin will extend across said shear line into said shell first recess and prevent rotation of said core relative to said shell in the absence of the application of an axial force to said auxiliary locking pin head portion reaction surface which is in a direction opposite to and in excess of said resilient bias force; and

a key, said key comprising a bow and a blade which extends longitudinally from said bow to a blade tip, said blade having a pair of spatially displaced side surfaces which are at least in part substantially parallel, at least one of said side surfaces being provided with a longitudinal groove extending from said tip toward said bow, said longitudinal groove having a shape which at least in part is complementary to the shape of said auxiliary locking pin head portion whereby said auxiliary locking pin head portion may be received in said longitudinal groove of said blade at said blade tip, said groove having a first substantially constant depth in a first linear portion thereof extending from said tip and having a second substantially constant depth in a second portion thereof which is displaced from said blade tip by said first groove portion, said second groove portion being in registration with said auxiliary locking pin when said key blade is fully inserted in said keyway, the depth of said groove transitioning smoothly from said first depth to said second depth, insertion of said key blade into said keyway with said locking pin head received in said groove to the point where said groove transitions to said second depth resulting in generation of and application to said reaction surface of said auxiliary locking pin head of an axial force of sufficient magnitude to overcome the bias of said auxiliary locking pin spring.

30. The cylinder lock system of claim 29 wherein said axis of said auxiliary locking pin is oriented generally transversely with respect to said keyway defined plane and said auxiliary locking pin axis intersects said plane at a point displaced from said longitudinal axis.



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31. The cylinder lock of claim 29 wherein said auxiliary locking pin second end at least in part has a shape which is generally complementary to the shape of said shell first recess, and wherein said shell first recess and said auxiliary locking pin second end are provided with wall surfaces which coact to prevent rotation of said core relative to said shell when said auxiliary locking pin is fully engaged in said first recess.

32. The cylinder lock of claim 30 wherein said auxiliary locking pin second end at least in part has a shape which is generally complementary to the shape of said shell first recess, and wherein said shell first recess and said auxiliary locking pin second end are provided with wall surfaces which coact to prevent rotation of said core relative to said shell when said auxiliary locking pin is fully engaged in said first recess.

33. The cylinder lock system of claim 31 wherein said longitudinal groove in part defines a mortise which is generally complementary in shape to said locking pin head portion reaction surface, cooperation between said reaction surface and mortise causing displacement of said auxiliary locking pin when said head is disposed in said groove second portion.

34. The cylinder lock system of claim 33 wherein said axis of said auxiliary locking pin is oriented generally transversely with respect to said keyway defined plane and said auxiliary locking pin axis intersects said plane at a point displaced from said longitudinal axis.

35. A key blank for use with a cylinder lock having at least a first resiliently biased auxiliary locking pin, the locking pin having a shaped head portion which extends into the lock keyway, the shaped head portion being at a first end of the auxiliary locking pin and including a reaction surface which generally faces the second end of the auxiliary locking pin, said key blank comprising:

a bow;



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a blade longitudinally extending from said bow and terminating at a tip, said blade having first and second spatially displaced sides and a pair of oppositely disposed and spaced edges which interconnect said sides, said first and second sides being at least in part substantially parallel to one another; and

- 5 a groove extending longitudinally along at least a first of said blade sides from said blade tip in the direction of said bow, said groove at least in part defining a mortise which is complementary in shape to at least a portion of the reaction surface of the shaped head of the auxiliary locking pin, said complementary groove shape including a reaction surface which faces generally
- 10 in the direction of the second of said blade sides, said groove having a first linear section with an average first depth for receiving the locking pin head portion, the depth of said first groove section of said blade tip being generally commensurate with the extension of the auxiliary locking pin into the lock keyway whereby the auxiliary locking pin head portion may be received in said
- 15 groove first linear section, said groove first linear section extending from said blade tip, said groove first section transitioning smoothly into a groove second linear section having a second depth which exceeds said first depth, said second linear section of said groove being located in a longitudinal region along said blade which is displaced from said tip by said first groove section.

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36. The key blank of claim 35 wherein the depth of said groove first linear section is substantially constant.