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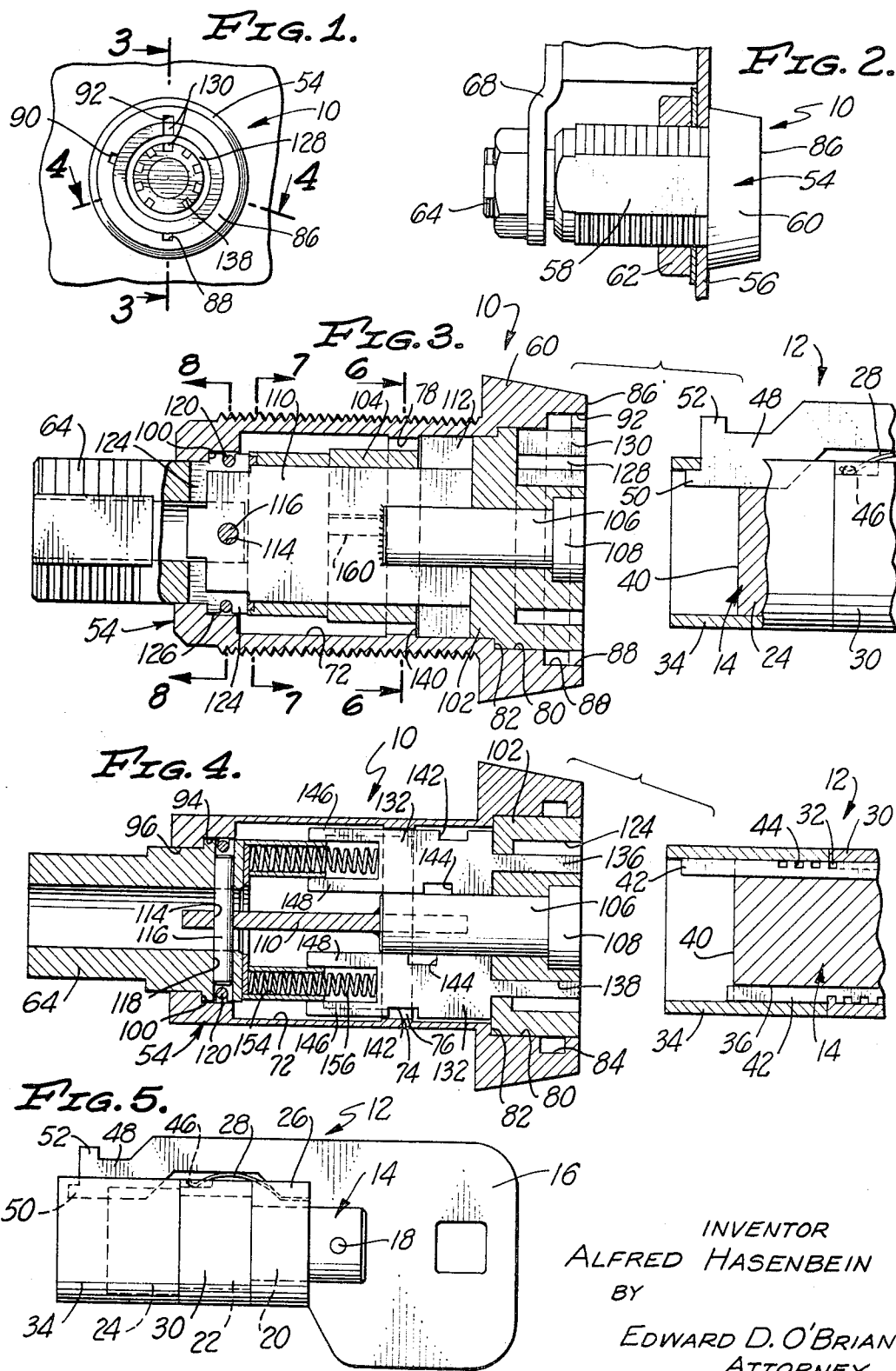
A. HASENBEIN

3,408,840

LOCK

Filed March 22, 1966

2 Sheets-Sheet 1



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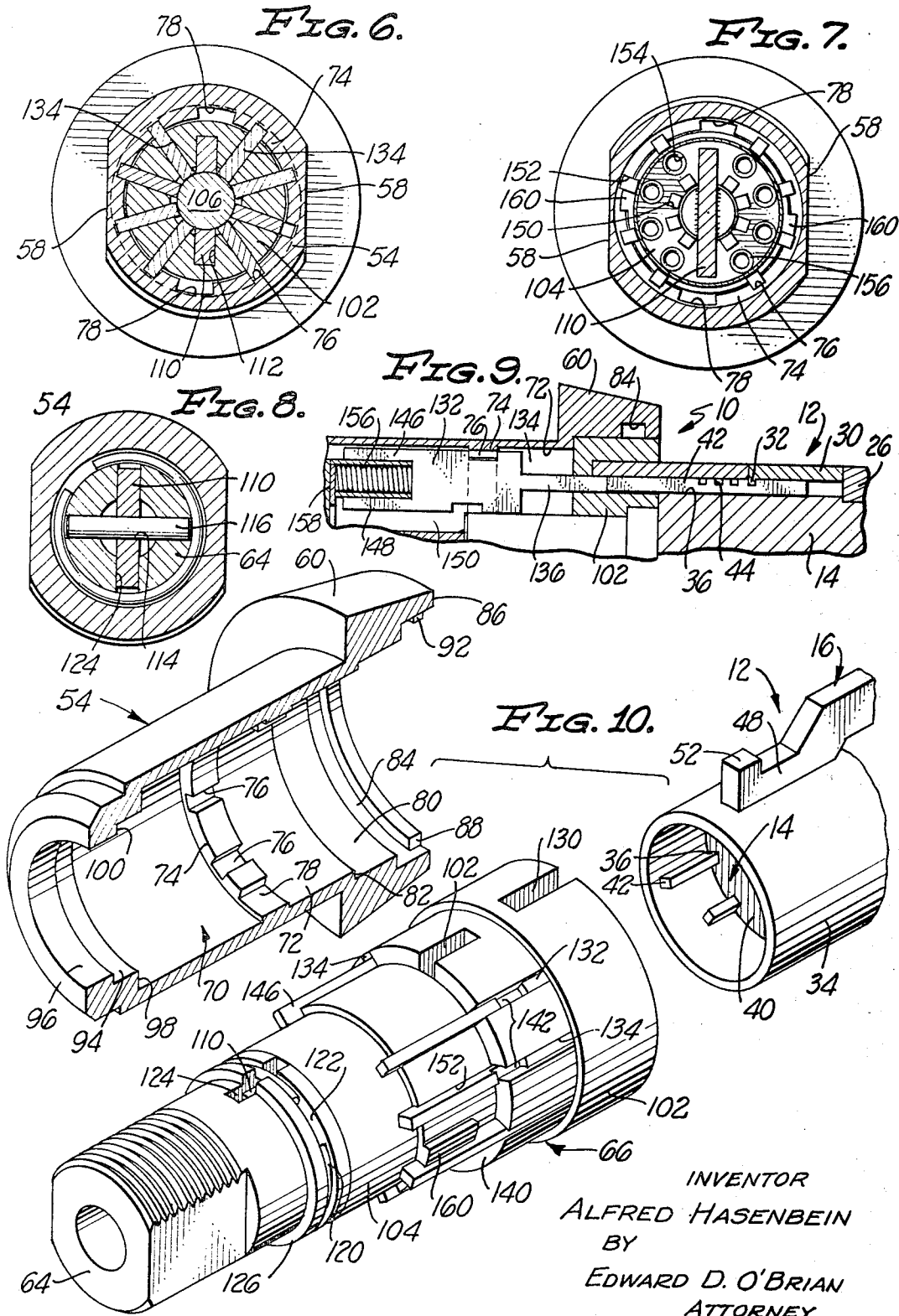
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3,408,840
LOCK

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ABSTRACT OF THE DISCLOSURE

An axial tumbler lock having a barrel rotatably mounted within a housing is disclosed. The barrel is provided with a plurality of tumbler slots, each of which carries a tumbler having a tumbler pin extending to the face of the barrel. A recessed bore adjacent to the front of the housing is provided in the housing around the barrel adjacent to the tumbler pins. This lock is used with a key having a locking lug which is adapted to fit through one of the latter slots into the bore as the tumblers are moved to a position in which the barrel can be rotated and to rotate within the bore as the barrel is rotated within the housing. In at least one position of the barrel when the key is inserted the barrel can be withdrawn from its housing.

This invention is directed to a lock, and particularly to a key operated lock having axial tumblers therein, the lock being particularly designed to inhibit being opened without the proper key.

The purpose of a lock is to prevent access to certain areas by persons who are not authorized to have access to these areas. Relatively simple locks are provided where access by other means than through the locked aperture is easy, and complex locks are provided in those situations where valuables are stored in a place where access by other openings is difficult. A particularly difficult situation is provided by coin controlled machines. In this case it is necessary to inexpensively, yet securely lock the coin boxes of the coin controlled machines so that access by unauthorized persons is inhibited. However, since in many cases one man has control over and/or collects the money from a plurality of such machines, it is desirable that any group be openable with a single key. Furthermore, ordinary locks which must be rekeyed by a locksmith are not considered satisfactory, for it is desirable to prevent the locksmith from having access to the key which will open a plurality of such coin boxes and it is desirable to often change the key to aid in preventing access by one who may have a suitable key for opening such coin boxes. Furthermore, it is desirable to provide a lock which cannot be easily picked. With these requirements in mind the axial tumbler lock has been developed. However, present axial tumbler locks are susceptible to opening by a person other than the one in charge of the coin boxes. Accordingly, there is great demand for an improved axial tumbler lock which is designed so that it cannot be picked by any of the known quick opening methods.

Accordingly, it is an object of this invention to provide an inexpensive lock and key combination which can be set by the owner of the lock and of which picking is inhibited.

It is a further object of this invention to provide a secure lock and key combination which have axial tumblers therein, the arrangement of the axial tumblers determining the shape of the proper key for opening the lock, which tumblers are partially visible from the exterior of the lock.

It is a further object of this invention to provide a lock which has a removable barrel, which barrel can be removed by unlocking of the lock and withdrawal of the

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barrel out of the front of the lock housing, which barrel is firmly secured in place when the lock is in the locked position.

It is a further object of this invention to provide an axial tumbler lock wherein each of the tumblers has two positions and there are two sizes of tumblers so that four positioning possibilities exist for each tumbler location, and there are a plurality of such tumblers in the lock.

Other objects and advantages of this invention will become apparent from a study of the following portion of this specification, the claims and the attached drawings in which:

FIG. 1 is a front elevational view of the lock of this invention;

FIG. 2 is a side elevational view of the lock of FIG. 1 showing the lock supporting structure in section;

FIG. 3 is an enlarged sectional view taken along the line 3—3 of FIG. 1, showing the key, partly broken away, in association therewith;

FIG. 4 is a section similar to FIG. 3 taken along the line 4—4 of FIG. 1;

FIG. 5 is a side elevational view of the key used in association with the lock of this invention;

FIG. 6 is a section taken generally along the line 6—6 of FIG. 3;

FIG. 7 is a section taken along the line 7—7 of FIG. 3;

FIG. 8 is a section taken along the line 8—8 of FIG. 3;

FIG. 9 is an enlarged partial section showing the key inserted in the lock and showing a tumbler depressed into the unlocked position; and

FIG. 10 is an exploded isometric view, partially in section, showing the relationship between the key, the lock barrel and the lock housing.

As an aid to understanding this invention it can be stated in essentially summary form that it is directed to a lock. The lock is of the axial tumbler type wherein there are a plurality of the axial tumblers located in a rotatable lock barrel. Each of the tumblers has one operative notch which must be aligned with a locking ring in the lock body to permit rotation of the barrel. Each of the tumblers has two of such notches, one of which is selected to be operative. Preferably, there are two types of tumblers with differently positioned notches, so that four selected positions of tumbler depression for unlocking are available. A key finger can be properly positioned to depress the tumbler to the unlocking point. Retaining lugs are provided on the lock barrel, which retaining lugs lock behind the locking rings until the barrel is unlocked and rotated to a position wherein the retaining lugs are released. A key is provided with a finger which permits the key to be inserted and withdrawn only when the lock is either in a locked position or is in the barrel withdrawal position. Thus, the tumblers must be in locked position when the key is withdrawn. Furthermore, the lock barrel has a solid inner core. This prevents any portion of the tumblers which can indicate the keying arrangement from being seen from the outside. Furthermore, the solid inner core retains the entire barrel together as a one piece structure while it is installed in the lock housing to prevent a portion of the lock from being withdrawn.

This invention will be understood in greater detail by reference to the following portion of this specification, wherein the drawings are described. Referring now to the drawings, the lock of this invention is generally indicated at 10 and the key particularly designed to cooperate with the lock 10 for the unlocking and locking thereof is generally indicated at 12. First describing the key 12, its basic structural element is a core 14. Core 14 is slotted at the outer end, and key tab 16 is secured in the slot by means of pin 18. Core 14 proceeds from a small diameter section 20, to a medium diameter 22 and thence to a

large diameter 24. Thus, core 14 comprises a stepped shaft. Collar 26 is secured upon diameter 20 and engages against the shoulder provided by diameter 22. Collar 26 is slotted part way through so as to receive a portion of the key tab 16. Leaf spring 28 is secured within the notch in collar 26 beneath key tab 16. Lock collar 30 has an interior diameter throughout most of its length equal to the external diameter of large diameter 24. However, it has a ring 32 projecting inwardly part of the distance toward the surface of diameter 22. Ring 32 is almost completely circumferential, and only has a small axial notch. Shield collar 34 is secured to the outer surface of large diameter 24. Large diameter 24 has axial slots 36 spaced around the circumference thereof. A plurality of these slots are provided and they have a slot depth equal to the exterior diameter of medium diameter 22. Thus, slots 36 extend into the key 12 from the face 40 of diameter 24. Shield collar 34 extends outwardly past face 40 so as to protect key fingers 42 which are positioned in the slots 36. In the embodiment disclosed, there are eight such slots and eight such key fingers. Each of the key fingers has a plurality of notches 44 therein. The notches 44 are of such dimension that the ring 32 fits reasonably firmly therein. Lock collar 30 has a notch 46 therein which accepts the end of leaf spring 28. Thus, lock collar 30 is prevented from rotation so long as spring 28 is in notch 46. In addition to the axial slots 36, large diameter 24 and shield collar 34 contain slots to accept the keying end 48 of key tab 16. The keying end 48 has a guide finger 50 and a locking lug 52.

It is clear from this description of construction that the key 12 is an adjustable key which can be set to a particular arrangement of keying finger 42 by the owner of the lock. This is accomplished by lifting of the spring 28 out of the notch 46 and rotation of the collar 30. When the opening in ring 32 is aligned with any one particular key finger 42 the key finger 42 can be adjusted until the appropriate notch 44 therein is in alignment with ring 32. Thereupon the opening in ring 32 is turned to the next key finger 42. When all of the key fingers 42 are reset to the desired position, slot collar 30 is returned to the position shown in FIG. 5 wherein the spring 28 enters notch 46 and retains collar 30 in position. Neither collars 26 or 34 are rotatable upon core 14, but are fixed with respect thereto by means of the slots which are engaged by tab 16, and any other convenient securing means.

Turning now to the description of the lock 10, for which key 12 is designed, the lock 10 comprises a housing 54. The housing 54, particularly see FIG. 2, is adapted to be secured in a panel 56 with respect to which a locking function is desired. Housing 54 has flats 58 thereon, which appropriately fit the hole within panel 56 to prevent rotation of housing 54. The exterior of housing 54 carries bezel 60 which is of larger diameter than the hole in the panel so that nut 62 engaging upon the threaded rear exterior of housing 54 can lock housing 54 with respect to panel 56. Rear shaft 64 is rotated by rotation of lock barrel 66 within housing 54. A suitable locking member 68 may be rotated by rotation of shaft 64 to perform the locking and unlocking operation. Of course, other means can be actuated by rotation of rear shaft 64, for locking of an appropriate structure.

Considering first the interior of housing 54, lock barrel 66 mounts within bore 70 in the interior of housing 54. Bore 70 is primarily comprised of cylindrical surfaces and shoulders. Bore 70 comprises cylindrical main bore 72 which has annular lock ring 74 extending inwardly therefrom. Lock ring 74 has a plurality of axial slots there-through. Tumbler slots 76 are suitably arranged around the ring 74. In the preferred embodiment shown, there are eight tumblers in the lock, as exemplified by the eight key fingers 42 and thus there are eight of the tumbler slots 76. Furthermore, there are preferably two diametrically opposed locking lug slots 78. Toward the bezel 60 from main bore 72, recess bore 80 is provided.

Recess bore 80 is of larger diameter than main bore 72 and they join at shoulder 82. Toward the front of recess bore 80, annular groove 84 is provided. Annular groove is open to the face 86 of bezel 60 by lug slots 88, 90 and 92.

Rearward of main bore 72 are bore 94 and opening 96. The opening 96 is of sufficient size to permit shaft 64 to extend therethrough. Bore 94 joins main bore 72 with shoulder 98 and bore 94 joins opening 96 with shoulder 100.

Now considering the construction of lock barrel 66, it is seen in the several figures to be made up of several parts which are firmly secured together. Toward the front of the barrel 66 is the tumbler retainer 102. Immediately behind the tumbler retainer is spring retainer 104. To the rear of spring retainer 104 is rear shaft 64. Pin 106 has a head 108 which respectively fit into an appropriate center hole and head recess in tumbler retainer 102. To the rear of pin 106 and secured thereto is blade 110. Blade 110 is secured as by brazing to pin 106. It extends forward past the back end of pin 106, along the sides thereof and fits into slot 112 across tumbler retainer 102. This construction prevents rearward motion of the pin 106-blade 110 combination by reason of head 108 and prevents forward motion and rotative motion of the combination by means of blade 110 in slot 112. Blade 110 extends rearwardly and has a hole 114 therein. As is best seen in FIGS. 3 and 4, pin 116 extends through hole 114 in blade 110 and into holes 118 in rear shaft 64. Snap ring 120 in groove 122 around holes 118 prevents pin 116 from accidentally dislodging. Furthermore, blade 110 fits into slot 124 in rear shaft 64 so that shaft 64 rotates with tumbler retainer 102. Shaft 64 has an enlarged head 126 which rotates against shoulder 100 to take up rearward thrust of the shaft 64 in the locking operation.

Tumbler retainer 102 has a circular groove 128 of such dimension as to accept shield collar 34. It has a slot 130 intersecting groove 128 and extending radially inwardly and outwardly therefrom. Slot 130 is of such size as to accept guide finger 50 and the portion of keying end 48 extending exteriorly of shield collar 34. This structure is best shown in FIG. 3. By this construction, key 12 can enter tumbler retainer 102 in only one rotative position of the key with respect to the tumbler retainer. A plurality of tumblers 132 are positioned in slots 134 in tumbler retainer 102. The forward end or tumblers 132 have forwardly extending tumbler pins 136 which are positioned in tumbler pin slots 138 which extend to the face of tumbler retainer 102. The tumbler pin slots 138 are inwardly positioned from groove 128. The tumbler pin slots 138 and tumbler pins 136 are appropriately positioned so as to be actuable by key fingers 42 when the key is inserted into tumbler retainer 102 with its keying end 48 in slot 130. Tumbler retainer 102 extends rearwardly to shoulder 140 which is positioned just in front of or against lock ring 74.

Tumblers 132, in addition to the forwardly extending tumbler pins 136, have relatively wide central blades positioned in slots 134 which extend all the way down to pin 106. Each of the tumbler blades 132 has an exterior lock notch 142 at a particular distance from the front end of the tumbler pin 136. Furthermore, each tumbler 132 can have an inwardly directed lock notch 144, which is ineffective, and which is positioned at a different distance from the end of tumbler pin 136 than the notches 142. As is shown in FIG. 4, each of the lock notches is spaced at a different distance from the end of lock pin 136. As becomes later apparent, the tumblers 132 may be changed into different tumbler slots 134, and may be reversed so that the lock notches 144 become effective so as to produce a large number of available unlocking combinations. The rear end of tumblers 134 are bifurcated so as to produce legs 146 and 148. These legs provide guidance and provide a space for a spring therebetween.

Referring particularly to FIGS. 3, 4 and 7, the spring retainer has inside and outside slots 150 and 152, respectively, to accept legs 148 and 146. Between these slots are spring retainer holes 154. Springs 156 are positioned in these holes to engage tumblers 136 between the legs 146 and 148 thereof and urge them to the right as is seen in FIG. 4. The bottoms of spring retainer holes 154 are closed by washer 158 which is secured to the rear end of spring retainer 104.

In addition to the spring retaining function of spring retainer 104, it also has a function of retaining the entire lock barrel 66 in place within housing 54. As was previously described, lug slot 78 is provided in lock ring 74. Lug 160 is provided on the exterior of spring retainer 104. Normally lug 160 has its front end engaging on the rear of lock ring 74. However, when the barrel 66 is turned to the appropriate angular position, as is defined by slot 90 on the face of the lock, see FIG. 1, lug 160 is aligned with lug slot 78 so that the entire structure can be pulled forwardly out of the housing 54. Preferably there are two or more of lugs 160 and an equal number of appropriately spaced lug slots 78.

As is apparent from the previous description of the construction, the rotation of lock barrel 66 within housing 54 is arranged to cause the locking and unlocking operation of the structure with which the lock 10 is associated. This rotation is allowed by alignment of lock notches 142 with lock ring 74. The key 12 can be inserted in the lock 10 only when its locking lug 52 enters one of the lug slots 88, 90 or 92, seen in FIG. 1. The lock is normally left in locked condition with the slot 130 in alignment with either lug slot 88 or 92. In this position, the springs 156 thrust tumblers 132 to the right so that the tumbler blades occupy the tumbler slot 76 in lock ring 74. Thus, each of the tumblers prevents rotation of barrel 66 within housing 54. In this position, the tumblers 132 are urged to the right until the major portion of their width stops at the right end of the slots 134. In this position, the ends of tumbler pins 136 are flush with the front face of the lock barrel. When the key is inserted, shield collar 34 enters into groove 128 and the guide finger 50 enters into slot 130. At the same time, the end of key fingers 42 engages upon the ends of tumbler pins 136 to thrust them to the left. When the key is fully inserted, with the face 40 of core 14 of the key against the face of the barrel, the tumblers 132 are thrust to the left. Providing the key fingers 42 are in the correct notches 44, tumbler notches 142 line up with lock ring 74 so that the barrel can be rotated within the housing. Thus, slot 130 in association with guide finger 50 permits the key to be placed into the lock barrel in only one relatively rotative position.

Furthermore, locking lug 52 in association with lug slots 88, 90 and 92 permits the key to be withdrawn only in three relative positions of the barrel with respect to the housing. Two of these positions, corresponding to slots 88 and 92 are locked positions and slot 90 corresponds to a position in which lugs 160 line up with lug slots 78. In this position, the entire barrel of the lock can be withdrawn from the housing, providing the locking member 68 or other related locking structure is first disconnected from shaft 64.

Upon withdrawal, the tumblers in the barrel can be changed to a new arrangement. This is managed by the removal of snap ring 120 and removal of pin 116 which permits rear shaft 164 to be removed. Spring retainer 104 can then be removed. In this position, the various tumblers 132 can be interchanged so that a different pattern of lock notches 142 is presented to lock ring 74. At the same time key 12 is adjusted to the new pattern of tumblers, as has been previously described. Thereupon, upon reassembly of the lock barrel, it can be inserted with the locking lug 52 entering through lug slot 90. Thereupon, turning of the key so that it is withdrawn either through slot 88 or slot 92 locks the barrel in the housing both

axially and rotatively. The lock is again ready for locking and unlocking operations with a new combination of tumblers.

It is apparent from the foregoing description of the construction and operation that the lock of this invention has constructional design features which make a secure lock. In view of the particular structure which makes the lock quite secure against picking, the following items are noted. The key itself is provided with a shield collar 34. This protects the key fingers 42 so that they are protected from being damaged. Since they are protected, the whole lock can be built to close tolerances so that accurate operation of the tumblers can be required to open the lock.

The solid inner core which is represented by pin 106 is strong and protects the notches of tumblers 132 from inspection and view. Furthermore, the enlarged head of the tumbler retainer 102 bearing against shoulder 82 prevents feelers from being inserted between the lock barrel and the housing from reaching the notches of tumblers 132. Thus, there is no access to the tumblers 132 except from the front. It is clear that tumbler retainer 102 and rear shaft 64 are firmly secured together. This prevents the front end of the lock from being popped out, for the entire structure is held in by retaining lugs 160, rather than light snap rings or small undercuts.

Another feature which protects the key fingers 42 is the fact that the key can only be placed into the barrel by alignment of guide finger 50 in slot 130. In this way the key is prevented from going in the wrong way which could cause bending of key fingers.

This lock employs a single key which is used both for locking and unlocking of the barrel with respect to the housing and which permits the barrel to be turned to the barrel withdrawal position. Thus, the key can only be pulled out in the locked or withdraw position, and in these positions the key tumblers are forward. If key could be withdrawn with the tumblers in the unlocked position, with the lock notches 142 engaged over lock ring 74, the ends of tumbler pins 136 would be depressed below the surface to permit measuring of them. This measurement in turn would result in the proper key combination to unlock the lock. In the instant lock, however, whenever the key is removed the tumblers are thrust forward to lie flush at the front face. Furthermore, this provides tumblers which are visible and return of the tumblers to the front, locked, position can easily be noted. This prevents the placement of viscous materials within the lock which hold the tumblers in the unlocked position after the key has been used. Thus, it is apparent that the instant lock is virtually impossible to open without the proper key or without virtual destruction of the lock.

This invention having been described in its preferred embodiment, it is clear that it is susceptible to numerous modifications and changes within the skill of those versed in the art and without the exercise of the inventive faculty. Accordingly, the scope of this invention is defined by the scope of the following claims.

I claim:

1. A lock, said lock comprising a housing and a barrel located within said housing, said barrel being rotatively lockable with respect to said housing, said barrel comprising a tumbler retainer and a rear shaft, said rear shaft being adapted to be rotatable with respect to said housing so as to control the locking of relative members, said tumbler retainer having axial tumbler slots therein, axial tumblers in said tumbler slots, said tumbler retainer having a solid center, said solid center being secured to said rear shaft so as to axially and rotatively restrain said rear shaft with respect to said tumbler retainer, said solid center comprising a pin having a head, said head and said pin being engaged with said tumbler retainer, a blade secured to said pin, said blade extending rearwardly into said rear shaft and being secured with respect to said rear shaft,

said tumbler retainer and said rear shaft being slotted, said blade being positioned within said slot in said tumbler retainer and said rear shaft so that said tumbler retainer and said rear shaft are rotatably restrained with respect to each other, a removable pin extending through said blade into said rear shaft so as to axially restrain rear shaft with respect to said headed pin,

said tumbler retainer having an enlarged head thereon and said housing having an enlarged bore therein, said enlarged head on said tumbler retainer entering said enlarged bore in said housing so as to prevent direct access to the sides of said tumblers within said tumbler retainer,

said tumblers in said tumbler retainer each having a substantially central tumbler pin extending forwardly therefrom, said tumblers being urged toward the face of said tumbler retainer, a stop on said tumbler retainer for each of said tumblers, said tumbler pins extending substantially to the face of said tumbler retainer when said tumblers are against said stop.

2. A lock, said lock comprising a housing and a barrel located within said housing, said barrel being rotatively lockable with respect to said housing, said barrel comprising a tumbler retainer and a rear shaft, said rear shaft being adapted to be rotatable with respect to said housing so as to control the locking of relative members, said tumbler retainer having axial tumbler slots therein, axial tumblers in said tumbler slots, said tumbler retainer having a solid center, said center extending rearwardly through said barrel, said solid center being secured to said rear shaft so as to axially and rotatively restrain said rear shaft with respect to said tumbler retainer,

a key for said lock, said lock housing having a bore therein, said tumbler retainer being positioned within said bore, an annular groove extending outwardly from said bore, at least one lug slot extending from said annular groove to the face of said housing, said key having a locking lug thereon, said locking lug being insertable into said slot in said tumbler retainer so that key can be inserted into said tumbler retainer in only one relatively rotative position of said key with respect to said tumbler retainer,

a locking ring extending inwardly within said lock housing, said locking ring having a lug slot therein, a lug secured to said tumbler retainer, said lug being positioned behind said locking ring to retain said barrel within said housing, said lug being alignable with said lug slot to permit withdrawal of said barrel from said housing, a key finger slot in said tumbler retainer and a slot in said housing, said lug on said tumbler retainer being aligned with said lug slot in said locking ring when said slots on said tumbler retainer and said housing are aligned.

3. An axial tumbler lock which includes:

a housing having a bore located therein and a front surface,

a barrel rotatably mounted within said bore and extending to said front surface so as to have a front surface,

said barrel including a tumbler retainer adjacent the front surface of said housing,

a plurality of tumbler slots located within said tumbler retainer so as to be spaced from the front surface of said barrel,

a tumbler pin slot extending from each of said tumbler slots so as to be open to the front surface of said barrel,

a stop means located on said tumbler retainer, a tumbler located in each of said tumbler slots, each of said tumblers having a pin extending therefrom through the corresponding tumbler pin slot,

spring means located within said housing for urging each of said tumblers into contact with said stop means in a position in which said tumbler pins extend to the front surface in said barrel,

said tumblers being capable of being moved away from the front surface of said barrel when engaged by a key,

lock ring means located in said housing and having axial slots therein extending towards the interior of said bore,

retaining lug means on said tumbler retainer fitting behind said lock ring means and being capable of being moved through one of said slots in a position of said barrel,

said tumblers each including notch means capable of being located with respect to said lock ring means upon movement of said tumblers to an unlocked position so as to permit rotation of said barrel,

said tumblers normally being in a locked position in which each of said tumblers extends through one of said axial slots in said lock ring means so as to prohibit rotation of said barrel,

engageable means located on the front surface of said barrel permitting a key to be engaged with said barrel in only one position with respect to said barrel and permitting said barrel to be rotated because of the engagement with said key upon rotation of said key,

an annular groove extending from said bore adjacent the front surface of said housing,

and at least one lug slot extending from said annular groove to said front surface of said housing wherein a portion of the key can be inserted and withdrawn from said annular groove only through said lug slot.

4. An axial tumbler lock as claimed in claim 3 including:

a plurality of lug slots leading from said annular groove to the front of said housing,

a key,

said key having a plurality of keying fingers,

each of said keying fingers being capable of engaging one of said tumbler pins when key is inserted within said lock so that each tumbler pin is moved so that the notch means in the tumbler associated therewith is located opposite said lock ring means, permitting said barrel to be rotated within said housing,

said key portion comprising a locking lug,

said locking lug being capable of fitting within said lug slots and engaging the interior of said annular groove during rotation of said key,

said key also having means engaging said engageable means,

said locking lug being capable of being withdrawn from the interior of said annular groove through one of said lug slots only when said barrel has been rotated to a position in which said locking lug is capable of being moved through said one of said lug slots.

5. An axial tumbler lock as claimed in claim 3 wherein:

said barrel comprises said tumbler retainer, a rear shaft member and a center means connecting said retainer and said rear shaft means,

said center means comprising a headed pin, engaging said tumbler retainer, a connecting member extending from said pin and means connecting said connecting member to said shaft so that as said barrel is rotated said shaft is rotated.

6. An axial tumbler lock as claimed in claim 5 wherein:

said center means is a blade,

said rear shaft means has a slot formed therein and said blade fits within said slot,

said means for connecting comprises a pin extending through said rear shaft means and said blade.

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