ABSTRACT

In an elongated rectangular cavity in a cylindrical body, elongated tumblers, in a row across the cavity, are lengthwise slidable parallel to the body axis. Each has longitudinal edges engaging opposite cavity walls, one edge having one notch therein, the other several, lengthwise spaced. Across each of said walls a groove-like recess extends in which the tumblers, when out of unlocking positions, confine a bar. In their unlocking positions the tumblers’ notches align to define grooves facing into said recesses and in which the bars are receivable. Balls guided in radial bores in the body engage the medial portions of the bars to be held projected by them when the bars are confined in said recesses.

13 Claims, 17 Drawing Figures
This invention relates to pick resistant lock cylinder mechanisms and is more particularly concerned with a lock cylinder mechanism that is especially well adapted for installations in which hard and rough usage and other circumstances unfavorable to the security and durability of a lock are likely to be encountered.

Herefore the designers and manufacturers of cylinder locks have placed great importance upon the attainment of small size, particularly of the key slot, on the theory that the picking of a lock is difficult if its key aperture leaves little space for the probing and manipulating required in the picking operation. But miniaturization of the lock cylinder mechanism and its parts entails the need for precision in manufacture, with its attendant expense, and correspondingly shortens the useful life of the mechanism by increasing its vulnerability to the effects of wear and the elements. Furthermore, other things being equal, a small lock mechanism is more easily forced than a large one. There is thus a point where miniaturization becomes incompatible with security, rather than promoting it.

There are many situations, moreover, in which security requires the use of a large and sturdy lock mechanism having relatively massive parts, including a stout key that will withstand all sorts of abuse. In a lock cylinder mechanism intended to meet such conditions, resistance to picking obviously cannot be achieved by miniaturization, but, instead, the arrangement of the lock mechanism must be inherently such as to render it pick resistant.

With the foregoing considerations in mind, it is a general object of this invention to provide a lock cylinder mechanism that is pick resistant by virtue of the shape, arrangement and cooperation of its parts, and which can therefore be made in very large sizes without any sacrifice of its security.

It is also an object of this invention to provide an inherently pick resistant lock cylinder mechanism having relatively few and simple parts that do not have to be manufactured to close tolerances in order to assure security and dependable operation, and which is thus nicely adaptable to small locks as well as to large ones, with cost advantages in locks of all sizes.

Another object of this invention is to provide a lock cylinder mechanism that can be so constructed as to be cooperable with a large and sturdy key, such as is generally favored for prison locks, but which is nevertheless very pick resistant and not readily disabled by foreign matter that enters, or is inserted into, its key aperture.

It is also an object of this invention to provide a lock cylinder mechanism in which the key does not have sliding engagement with the tumblers during its insertion and withdrawal, so that the tumblers can be made very hard, to insure high strength and security, without entailing the risk that the bitting on the key will be worn down or deformed by repeated use.

Another and more specific object of this invention is to provide a lock cylinder mechanism from which the key can be withdrawn in any position of cylinder rotation.

A further object of this invention is to provide a lock cylinder mechanism which is particularly well suited to applications in which high torque must be exerted through the cylinder mechanism and its key, the mechanism being well adapted for use with a sturdy key, as explained above, and arranged for insertion of the key concentrically to the cylinder body.

It is also a special object of this invention to provide a lock cylinder mechanism that is cooperating with a key having its bitting provided by movable fingers which are adapted to occupy normal retracted positions, wherein they do not reveal the coding of the lock, but which are readily extensible to operative positions by a person having knowledge of the combination for the lock.

With these observations and objectives in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings, which exemplify the invention, it being understood that such changes may be made in the specific apparatus disclosed herein as come within the scope of the appended claims.

The accompanying drawings illustrate several complete examples of embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

FIG. 1 is a perspective view of a lock cylinder mechanism embodying the principles of this invention, shown together with a key for actuating the same;
FIG. 2 is a longitudinal sectional view of the lock cylinder mechanism shown in FIG. 1;
FIG. 3 is a view similar to FIG. 2 but showing the mechanism actuated by its key to its unlocked condition;
FIG. 4 is a longitudinal sectional view taken on the plane of the line 4—4 in FIG. 2;
FIG. 5 is a view in longitudinal sectional view taken on the plane of the line 5—5 in FIG. 3;
FIG. 6 is a view in cross section taken on the plane of the line 6—6 in FIG. 4;
FIG. 7 is a view in cross section taken on the plane of the line 7—7 in FIG. 5;
FIG. 8 is a view in elevation, with portions broken away, to show the notches along one longitudinal edge of each tumbler, the lock cylinder mechanism being shown in a casing or housing in which it is rotatable;
FIG. 9 is a view in cross section corresponding generally to FIGS. 6 and 7, but showing the cylinder body in a condition that might occur during an attempt to pick it, rotated slightly out of its locked condition but still locked against free rotation; and FIG. 9 further differs from FIGS. 6 and 7 in illustrating a modified form of the locking elements;
FIG. 9a is a fragmentary sectional view generally like FIG. 9, but illustrating a further modified form of locking element;
FIG. 10 is a disassembled perspective view of the principal components of the lock;
FIG. 11 is a longitudinal sectional view illustrating a modified embodiment of the lock of this invention;
FIG. 12 is a sectional view taken on the plane of the line 12—12 in FIG. 11;
FIG. 13 is a plan view of a modified form of key for the lock of this invention;
FIG. 14 is a sectional view taken on the plane of the line 14—14 in FIG. 13;
FIG. 15 is a fragmentary view in longitudinal section of a further modified embodiment of the lock mechanism of this invention, shown with its key inserted and the mechanism in unlocked condition; and
FIG. 16 is a sectional view taken on the plane of the line 16—16 in FIG. 15.

Referring now to the accompanying drawings, the numeral 2 designates generally a hollow generally cylindrical body for a lock cylinder mechanism embodying the principles of this invention, adapted to be rotatably mounted in a bore 3 in a housing or casing 4. The body has in its interior a cavity 5 in which there are a plurality of tumblers 6, and it also carries a pair of locking elements 7, 7'. The tumblers 6 are actuated from normal locking positions to unlocking positions by insertion of a key 8 into the interior of the body through a key slot 9 in its front.

When the tumblers are in their locking positions, they confine each locking element 7, 7' to a projecting position in which a part of the locking element extends radially beyond the circumferential surface of the body to be engaged in a pocket or concavity 10, 10' in the housing that opens to the bore 3 therein. Such engagement of the locking elements in the concavities of course prevents rotation of the body in the bore. In their unlocking positions, the tumblers release the locking elements for movement radially inwardly relative to the body, so that torque applied to the body by means of the key can cam the locking elements out of the concavities 10, 10' and to retracted positions in which the locking elements do not interfere with rotation of the body.

The body 2 can be comprised of a pair of generally similar complementary units 12, 12', which can be either machined to shape or made as investment castings of stainless steel or other hard metal. These body units are, in the main, formed as the halves of a cylinder divided on a plane lying along its axis. Each has a large mortise 13 of rectangular cross section extending along most of its length to provide one-half of the cavity 5 in the body; hence the cavity is of rectangular or substantially square cross section. At its front end the body unit 12 has an integral disc-like projection 14 which overlies the front end of the other body unit 12' and in which the key slot 9 is formed. At its rear the body unit 12' has a generally similar projection 15 which overlies the rear end of the body unit 12. The body units are secured together, as by means of axially extending studs 16 on each, press fitted into the projection 14 or 15 on the other unit.

The two body units cooperate to define a row of axially extending tumbler guide holes 17 at the rear of the body, each having its axis on the parting plane of the body units. The tumbler guide holes (the purpose of which is described hereinafter) extend through a tongue 21 that projects rearwardly from the body to provide for connection of the body with a latch bolt (not shown) or the like that is to be secured by the lock mechanism. The tongue 21 can have rectangular cross section and is shown as symmetrical to the body axis and formed integrally with the projection 15 on the body unit 12'.

Each of the opposite cavity walls 18 and 18' that lies wholly in one of the body units has in it a groove-like recess 19, 19' that extends transversely across the wall, intermediate its ends. Each body unit also has a radial bore 20 that opens to the bottom of its recess 19 or 19' and to the outer circumferential surface of the body. Each recess and its bore cooperate with one of the locking elements 7, 7' as explained hereinafter.

The tumblers 6 are flat and plate-like. They are substantially elongated and are generally rectangular in shape, although one lengthwise extending edge 22 of each tumbler has a notch 23 therein and the opposite longitudinal edge 24 preferably has a plurality of generally similar notches 25 at uniformly spaced intervals along its length. The tumblers are arranged in the body cavity lengthwise parallel to the axis of the cylindrical body and in flatwise side-by-side relationship, in a row across the cavity walls 18 and 18'. They are of such width as to have their longitudinal edges 22 and 24 in sliding engagement with the cavity walls 18 and 18' respectively. The outermost tumblers of the row are in flatwise sliding engagement with the other two cavity walls 26 and 26'.

Thus it is a feature of the lock cylinder mechanism of this invention that the tumblers are confined by the cavity walls and one another to lengthwise motion in the body in directions parallel to its axis. The key 8 propels them rearwardly from normal positions at the front of the cavity to unlocking positions described hereinafter. The front edges 27 of the tumblers are normal to their longitudinal edges 22 and 24 and to the axis of the body, for abutting engagement with shoulders 34 on the key that face into the body and comprise its bitting, said shoulders being in stepped relation to one another across the width of the key shank. It will be observed that there is no relative sliding between the tumblers and the key, hence the tumblers can be very hard without danger that they will wear down the key bitting.

Because the tumblers slide upon one another, they tend to be self cleaning, that is, any foreign matter that gets between them tends to be worked forward by their sliding action, for expulsion through the key slot 9.

Each tumbler has a pin-like rearward extension 28 that is parallel to the body axis and is slidingly received in one of the tumbler guide holes 17 in the rear of the body. These extensions, in cooperation with the guide holes, further steady and guide the tumblers in their back and forth motion, but the main function of each extension is to serve as a pilot for a coiled compression spring 29 which surrounds it and which reacts between its tumbler proper and the rear wall of the cavity to bias the tumbler forwardly to its normal position.

The unlocking position of each tumbler is established by inserting the key all the way into the key slot until coplanar stop abutments 35 on the key, at each side of its stepped shank, engage the front face of the body adjacent to the ends of the key slot. When the tumblers are in their unlocking positions, the notch 23 in each is directly opposite the groove-like recess 19 in its adjacent cavity wall, so that the aligned notches 23 define a groove 30 which opens into said recess. At the same time one of the several notches 25 in the opposite edge of each tumbler is aligned with a notch 25 in each of the other tumblers, and such aligned notches define another groove 31 which opens into the opposite recess 19'.

Each locking element 7, 7' comprises a bar 32, 32' which can be in the form of a pin having a length to span the row of tumblers and a diameter to be wholly receivable in one of the groove-like recesses in the body. When the tumblers are out of their unlocking positions they confine the bar 32 in the recess 19 and the bar 32' in the recess 19'. When the tumblers are in their unlocking positions, the bars 32 and 32' are of course free to move radially inwardly relative to the
body to be partway receivable in the grooves 30 and 31, respectively in the row of tumblers.

Each locking element 7,7' also comprises another part 33, 33', shown as a ball in certain of the Figures and which is slideable in directions radial to the body in the bore 20. An inner portion of the part 33, 33' is engaged with the medial part of the bar to move therewith; an outer portion of said part is exposed at the exterior of the body.

When the tumblers are out of their unlocking positions and the bars 32, 32' are confined in the recesses 19, 19' in the body, each bar holds its associated ball 33, 33' in a projected position in which the outer portion of the ball extends beyond the body circumference to be receivable in one of the pockets or concavities 10, 10' in the casing or housing 4. Such engagement of the balls 33 in the concavities 10, 10' of course prevents rotation of the body in the casing and defines the locked position of the body. When the tumblers are key propelled to their unlocking positions, freeing the bars 32, 32' for radially inward motion relative to the body, the balls can be cammed inwardly by the ends of the concavities 10, 10' as the body is turned.

Suitable means (not shown) can be provided for defining the limits of rotation of the body to its locked and unlocked position. However, it should be noted that with the herein illustrated mechanism the key 8 can be withdrawn in any position of rotation of the body, although those skilled in the art will appreciate that there would be no difficulty in providing means for holding the key captive whenever the body is not in one or more predetermined positions of its rotation.

If an attempt is made to pick the lock of this invention, the notches 25 in the edges 24 of the several tumblers can align with one another in numerous combinations of tumbler positions, in each of which the bar 32' is freed for motion out of its recess 19 and into the groove defined by the notches thus aligned. But of course there is only one combination of tumbler positions in which the notches 25 in the opposite edges of the tumblers are also aligned with one another and the recess 19; hence in all but one combination of tumbler positions the freeing of the bar 32' provides a false clue to a person attempting to pick the lock. He is led to think that he has discovered the combination, whereas in fact the body cannot be rotated in its casing unless both balls 33 and 33' can retract. To increase the verisimilitude of the false clues thus provided, the pocket of concavity 10 that cooperates with the ball 33 can be circumferentially extended to a slight extent, to permit a few degrees of rotation of the cylinder body upon retraction of the other ball 33'. The multiplicity of false clues afforded by the lock mechanism of this invention makes it necessary to try a very large of tumbler position combinations in a systematic attempt to pick the lock, and therefore the picking operation is a tedious and discouraging one. Moreover, in any attempt to pick a lock it is necessary that a light torque force be applied to the cylinder all during the operation, so that arrival of the tumblers at their unlocking positions can be detected. With the lock of this invention, each positioning of the tumblers to align a group of the false clue notches 25 permits the cylinder to rotate a few degrees out of its locked position and then causes all of the tumblers to be held against any axial motion by reason of the engagement of the bar 32' into the aligned notches 25. To resume the picking operation, it is necessary to relieve the torque on the cylinder, whereupon all tumblers move back to their locking positions so that the whole picking operation must be resumed from the beginning.

To facilitate mass production, the notches 25 in the edge 24 of each tumbler are spaced at regular intervals along said edge, the pattern of said notches is identical from tumbler to tumbler, and in each tumbler the single notch 23 in the other longitudinal edge is located directly opposite one of the several notches 25. Thus mass production needs only as many different tumblers as there are notches 25 in the edge 24 of each, and the coding of each lock and its key is determined by the combination of such different tumblers used therein, in accordance with well-known practice in the lock art.

If desired, the locking element 7' can be omitted, and the longitudinal edge 24 on each tumbler can then be straight and unnotched. In that case false clues would not be given to a person attempting to pick the lock, but picking would still be attended by the usual difficulties encountered in trying to decode a conventional side bar lock, wherein at least a substantial minority of the tumblers must be brought to their unlocking positions before a readily discernible response of the lock mechanism can be detected. In this connection it should be noted that each ball 33, 33', in engaging its bar 32, 32' at the medial portion thereof, applies its inward biasing force to the bar in a manner that encourages the bar to move inward with a lateral translatory motion and discourages tilting of the bar.

With bars that are round in cross section, as shown, and with V-shaped notches in the tumblers to define the grooves 30 and 31 in which the bars are received, lengthwise motion of the tumblers out of their unlocking positions moves the bars into their recesses 19 and 19' as the oblique edges of the notches cam the bars outwardly. Hence no special provision need be made for biasing the locking elements to their locking positions. Furthermore, with V-shaped notches cooperating with a round bar, the tumblers need not be made with unduly high precision nor to extremely close tolerances.

However, V-shaped notches have the disadvantage that only a relatively small number of them can be accommodated along a given length of tumbler. For a compact lock capable of a larger number of tumbler combinations, the notches 23 and 25 can be made substantially square, as illustrated in FIG. 11, although in that event it may be necessary to go to somewhat higher standards of precision in the manufacture of the cylinder mechanism. Moreover, with square cut notches the locking elements 7, 7' will not be cammed outwardly to their locking positions by lengthwise motion of the tumblers, and separate biasing means must be provided for the bars 32 and 32'.

As shown in FIG. 11 and 12, such biasing means can comprise a pair of compression springs 37, each reacting between the adjacent ends of the two bars 32 and 32' to urge the bars away from one another. These springs are housed at opposite sides of the row of tumblers, in recesses 38 in the cavity walls 26 and 26'. The recesses 38 extend into the ends of the bar receiving recesses 19, 19', and each bar is of course long enough to have its opposite end portions project beyond the row of tumblers and into the end portions of the spring recesses 38 to be engaged by the ends of the springs 37.
When the locking elements 7 and 7' are in the form of balls, as shown for example in FIGS. 6 and 7, they make only point contact with the respective bars 32 and 32', and consequently the balls and bars are subjected to high localized forces and possible damage by attempted forcing or other abuse of the lock. As indicated in FIG. 9, this can be avoided to some extent by forming each of the locking elements 7, 7' with a cylindrical inner end portion 7a that makes a line contact with the cooperating bar, and with a hemispherical outer end portion 7b that cooperates with the concavity or pocket 10, 10' in the same manner as the ball.

Alternatively, as indicated in FIG. 9a, the locking elements 7 and 7' can comprise an inner cup-shaped member 7c, the bottom of which makes line contact with the adjacent bar, a ball 7d that is receivable in the cup-shaped member, and a small compression spring 7e that is also received in the cup-shaped member and reacts between it and the ball 7d to bias the latter outward. In this case the cup-shaped member 7c can have sufficient height to be part receivable in the adjacent concavity in the locking condition of the mechanism, providing a shear plane comparable to that in a conventional pin tumbler lock and thus providing further security against forcing. Note that the last described embodiment of the locking element has the further advantage that the spring urged ball 7d cooperates with its concavity to afford a detent which defines the locking position of the cylinder.

The modified forms of locking elements 7 and 7' just described, which make line contact with their cooperating bars 32, 32', have the further advantage that they prevent said bars from tilting when the several tumblers are between their respective locked and unlocked positions, and particularly when notches 23 or 25 on end tumblers are aligned with the bars. Hence those modified locking elements further tend to frustrate any attempt to pick the lock, by eliminating clues that might be afforded by such tilting of the bars.

An important consequence of the tumbler arrangement in a lock cylinder mechanism embodying the principles of the present invention is that it lends itself to cooperation with a novel type of key 8', illustrated in FIGS. 13 and 14. Instead of having fixed biting that can be set or less easily cut by unauthorized persons, the key here shown has a number of elongated lengthwise slidable fingers 40, each having a width and thickness equal to those of a tumbler. The fingers are slidable back and forth in a shell or housing 41 that comprises the shank of the key, so that they can be retracted to inoperative positions wholly within the shell or can be projected to operative positions in which they extend forwardly from the shell.

Each of the fingers can be releasably secured in any of a number of projected positions, corresponding to the coding of the tumblers, as by means of a button-like latch 43 that projects from the finger through a slot 44 in one wall 42 of the shell. Each slot 44 extends lengthwise along its finger and has widened bays 45 that are spaced along its length at intervals equal to the distances between the notches 25 in the tumblers. Each button-like latch has a large diameter inner portion 46 that is wider than the slot 44 but is receivable in any one of the bays 45, a smaller diameter outer portion 47 that is receivable in the slot 44 all along its length, and a large diameter head 48 that overlies the slotted wall 42 of the shell. A leaf spring 50 is confined between each finger and the opposite wall 51 of the shell. It biases the finger laterally toward the slotted shell wall 42 and tends to maintain the finger in a position in which the large diameter inner portion 46 of its button-like latch is engaged in one of the bays 45. However, each finger can be readily shifted lengthwise, to engage its latch 43 in a different selected bay, by depressing the head 48 of the latch to align its narrow outer portion 47 with the slot 44.

An authorized person intending to use the key will have knowledge of the combination of positions to which the fingers must be set, which combination corresponds to the coding of the tumblers in the lock mechanism that the key is intended to actuate. Normally all of the fingers will be in their retracted positions, in which the key is most compact and in which the lock cannot be decoded. To facilitate setting up the key for use, the several slots 44, and the bays 45 in said slots, can be identified by suitable indicia on the shell.

Since the lock of this invention can be made in large sizes without sacrifice of its resistance to picking, it lends itself to cooperation with a key of the kind just described, inasmuch as the key can be made correspondingly large and can thus accommodate various springs, latches and the like.

As will be apparent from FIG. 1, the key must be inserted into the key slot in the proper position lengthwise along the key slot, to insure that each of the shoulders 34 on the key will engage its proper tumbler. Proper location of the key during its insertion can be facilitated by providing the key with a lengthwise extending land 53 that projects up from one of its opposite flat faces and is receivable in a notch 54 in one of the longitudinal edges of the key slot, all as illustrated in FIG. 16.

If desired, the land 53 can be made to perform the additional function of capturing the key to prevent its withdrawal from the body except in predetermined rotational positions thereof. To this end, as illustrated in FIG. 15, the body is provided with a generally conventional pin tumbler means 55, located forwardly of the front ends of the tumblers 6 when they are in their normal positions. The tumbler means comprises a tumbler 57 in a radial bore in the body that opens to the cavity therein, a driver 58 in a radial bore 59 in the casing 41 opening to the bore 3 therein in which the body rotates, and a small spring 60, also confined in the radial bore 59. In the locked position of rotation of the body, its tumbler bore registers with the driver bore 59 in the casing, and the driver projects partway into the tumbler bore. Note that the tumbler bore is actually defined by a radially inner bore 62 and a counterbore 63, and that the tumbler has an enlarged head 64 which bottoms on the junction of the bore and the counterbore to define its normal position. The spring 60, which reacts between the driver and a spring retainer 65 on the casing, urges the driver radially inwardly and through it tends to maintain the tumbler in its normal position.

When the key is partway inserted into the body, the land 53 thereon propels the tumbler 57 partway into the drive bore, but when the key is fully inserted, as shown in FIG. 15, the tumbler seats in a notch 67 in the land 53 to establish the contacting surfaces of the tumbler and the driver on the so-called shear plane of the lock. It will be seen that this arrangement is the generally conventional one for pin tumbler locks, except that
the bitting for the pin tumbler is on the land 53 instead of being on the edge of the key as is usual.

Upon rotation of the cylindrical body, the tumbler and driver are confined in their key established positions by the conventional surfaces of the bore 3 and the body 2, respectively, and consequently the key cannot be withdrawn until the body is rotated back to its normal locking position. Such captivation of the key by a pin tumbler is again generally conventional in pin tumbler locks.

It will be apparent that the presence of the pin tumbler means 55 tends to further complicate the picking of the lock.

From the foregoing description taken with the accompanying drawings it will be apparent that this invention provides a high security lock cylinder mechanism which can be made at relatively low cost and which is inherently resistant to picking and therefore lends itself well to installations where a large, sturdy lock is required.

Those skilled in the art will appreciate that the invention can be embodied in forms other than as herein disclosed for purposes of illustration.

The invention is defined by the following claims.

I claim:

1. A lock cylinder mechanism of the type comprising a hollow generally cylindrical body, locking means carried by the body for rotation therewith and for generally radial motion relative thereto between a retracted position and a projected position, and a plurality of tumblers in the body normally blocking movement of the locking means out of its projected position but movable by a proper key to unlocking positions freeing the locking means for inward movement to its retracted position, said lock cylinder mechanism being characterized by:
   A. the tumblers being elongated and arranged for lengthwise movement in directions parallel to the axis of the body, and being disposed side by side in a row across the body;
   B. each tumbler having a longitudinal side edge in which there is a notch, said notches in the several tumblers all opening to the same side of the body and being aligned to define a groove transverse to the body axis when the tumblers are in their unlocking positions;
   C. the locking means comprising
      1. a bar in the interior of the body extending across the several tumblers and confined to motion in opposite directions transversely to its own length and to the body axis, said bar being at least partly receivable in said groove when the tumblers are in their unlocking positions, and the body having a recess opposite said groove in which the bar is confined when the tumblers are out of their unlocking positions, and
      2. an element confined by the body to substantially radial motion in opposite directions, said element having an inner part connected with the medial portion of the bar to move therewith, and an outer part exposed at the exterior of the body to project therebeyond when the bar is confined in said recess;
   D. each tumbler further having an opposite longitudinal side edge in which there are a plurality of lengthwise spaced apart notches, one of said notches in each tumbler being transversely aligned with one of said notches in each of the other tumblers to define a second groove, parallel to the first, when the several tumblers are in their unlocking positions; and
   E. a second bar disposed at the opposite side of the tumblers from the first mentioned bar, said second bar being at least partly receivable in said second groove when the several tumblers are in their unlocking positions, and being confined in a second recess in the body, opposite the first mentioned recess, when the tumblers are out of their locking positions.

2. The lock cylinder mechanism of claim 1, further characterized by:
   means biasing said second bar radially inwardly relative to the body at least at times when torque is applied to the body.

3. A lock cylinder mechanism of the type comprising a hollow generally cylindrical body having a key slot opening to its interior through a front end thereof, characterized by:
   A. a plurality of tumblers in the body,
      1. each of said tumblers
         a. being elongated in the direction of the body axis,
         b. being confined to lengthwise movement in the body, and
         c. having a notch in one longitudinal edge thereof,
      2. the several tumblers being arranged side-by-side in the body in a row that extends lengthwise of the key slot and having their said notches all facing one side of the body and alignable, when the tumblers are propelled to unlocking positions, to form a groove that extends transversely to the body axis;
   B. a bar in the body extending transversely to the body axis and across the several tumblers, said bar being at least partly receivable in said groove that is formed when the tumblers are in their unlocking positions;
   C. the body having a groove-like recess in its interior which opens to and opposes said groove and in which the bar is confined when the tumblers are out of their unlocking positions;
   D. the body also having a substantially radial bore which opens from the bottom of said groove-like recess to its exterior, at one side of it; and
   E. a ball in said bore, confined thereby to projecting and retracting motion in directions substantially radial to the body, said ball being
      1. engageable with the medial part of the bar to be propelled outwardly by the bar when the latter is moved into said recess in the body, and
      2. exposed at the exterior of the body and projecting radially outwardly of the body when the bar is confined in said recess.

4. The lock cylinder mechanism of claim 3, further characterized by:
   A. biasing means reacting between the body and each of the tumblers to bias the tumblers individually forwardly away from their unlocking positions;
   B. said bar having a substantially circular cross section; and
   C. said notches in the tumblers being substantially V-shaped, with their edges oblique to the directions of tumbler motion, so that they cam the bar out of
said groove and into said recess in the body as the tumblers move out of their unlocking positions.

5. The lock cylinder mechanism of claim 3, further characterized by:
   A. each of the tumblers having an opposite longitudinal edge in which there are a plurality of other notches at lengthwise spaced intervals, one of said other notches being in the same relationship to the first mentioned notch in every tumbler so as to define a second and oppositely opening groove when the tumblers are in their unlocking positions;

B. the body having
   1. a second groove-like recess which opens to and opposes said second groove, and
   2. a second substantially radial bore opening to its exterior and to the bottom of said second recess;

C. a second bar in the body, at least partway receivable in said second groove and otherwise confined in the second recess by the tumblers; and

D. a second member in said second substantially radial bore having an inner part engageable with the medial portion of the second bar and an outer part exposed at the exterior of the body.

6. A lock cylinder mechanism of the type comprising a generally cylindrical body which is rotatable in a bore in a casing and which has a cavity in its interior that opens to its front through a key slot, and a plurality of tumblers that are normally in locking positions but are propellable to unlocking positions by means of a proper key inserted into the key slot, said lock cylinder mechanism being characterized by:
   A. the cavity in the body being defined by a pair of opposite walls that extend lengthwise substantially parallel to the body axis and are spaced apart transversely of said axis, each of said walls having an inwardly opening groove-like recess wherein that extends transversely thereacross;

B. each of the tumblers being elongated and having a pair of opposite longitudinal edges that are respectively slideably engaged with said opposite walls, the tumblers being arranged in a side-by-side row across said walls and being movable lengthwise in directions parallel to the body axis;

C. means biasing each of the tumblers, independently of the others, forwardly toward its locking position;

D. a pair of bars in the body cavity, one for each of said recesses, each being of a length to substantially span the row of tumblers and of a width to be confined in its recess by the tumblers when the same are in their locking positions;

E. each tumbler having a plurality of lengthwise spaced substantially V-shaped notches in one of its said longitudinal edges and a substantially V-shaped notch in its opposite longitudinal edge, said notches being so arranged that when the several tumblers are in their unlocking positions one of said plurality of notches in each tumbler is aligned with one of said plurality of notches in each of the other tumblers to define a groove which faces into one of said recesses and in which one of said bars is partway receivable, and said notches in the other longitudinal edges of the tumblers are similarly aligned to form a groove which faces into the other recess and in which the other bar is partway receivable, the V-shape of said notches being effective to cam the bars outwardly into their recesses as the tumblers move out of their unlocking positions; and

F. means biasing each of said bars radially inwardly relative to the body at least at times when torque is applied to the body, said means for at least one of the bars comprising a member confined to radial motion relative to the body between projected and retracted positions and having
   1. an inner portion engaged with the medial portion of said one bar to move therewith, and
   2. an outer portion exposed at the exterior of the body and which, when said member is in its extended position and the body is in one position of its rotation, is engageable in a concavity opening to said bore in the casing, said outer portion being shaped to be cammed inwardly by rotation of the body to carry said member out of said concavity.

7. A lock cylinder mechanism of the type comprising a hollow generally cylindrical body, a plurality of tumblers confined by the body to motion parallel to one another and in opposite directions, each of said tumblers having an edge which extends in said directions of its motion and in which there is a laterally opening notch in the notches in the several tumblers being aligned to define a groove when the tumblers are in key propelled unlocking positions, and a locking element comprising a bar which spans the tumblers and is at least partway receivable in said groove, said bar being movable out of said groove in a direction radially of the body to a projecting position in which the bar is held by the tumblers when the latter are out of their unlocking positions, said lock cylinder mechanism being characterized by:
   A. each of the tumblers having an opposite edge which extends in the direction of its motion and in which there are a plurality of other notches, one of said other notches in each tumbler being aligned with one of said other notches in each of the other tumblers to define a second and oppositely opening groove when the tumblers are in their unlocking positions; and

B. a second locking element comprising another bar which spans the tumblers and is at least partway receivable in said second groove and which is movable out of said groove in the opposite direction radially of the cylinder body.

8. The lock cylinder mechanism of claim 7 wherein one of said locking elements further comprises:
   a member confined to substantially radial motion relative to the body and having an inner portion engaged with one of said bars to move therewith and an outer portion which is exposed at the exterior of the body and which projects beyond the periphery of the body when said one bar is out of its said groove in the tumblers.

9. A lock cylinder mechanism comprising:
   A. a generally cylindrical body having in its interior a cavity of substantially rectangular cross-section that occupies a substantial portion of the length of the body and opens to its exterior through a key slot at a front end of the body, said body also having a transversely elongated inwardly opening groove in one axially extending wall of the cavity and a substantially radial bore opening to the exterior of the body and to the bottom of said groove, intermediate its ends;
3,733,863

B. a plurality of flat, elongated tumblers in said cavity, each having a longitudinal edge which is adjacent to said wall of the cavity and in which there is a notch, said tumblers being arranged in the cavity lengthwise parallel to the axis of the body and in flatwise side-by-side contiguous relationship so that they are guided by the cavity walls and by one another for lengthwise motion parallel to the body axis to and from key propelled unlocking positions in which the notches in the several tumblers are aligned to define another groove that opens to and is opposite said groove in the body; 

C. means in the body behind the tumblers reacting between the body and each of the tumblers and engaging the tumbler at its rear end to bias the tumblers independently forwardly away from their unlocking positions; 

D. a bar in the body wholly receivable in the first mentioned groove and of a length to span the tumblers so as to be confined against motion out of said first mentioned groove by the tumblers when the same are out of their unlocking positions, said bar being movable transversely to its length to a position in which it is at least partly received in said other groove; and 

E. a member movable in said bore in directions radial to the body, the last mentioned member having an inner part that has a connection with the medial portion of said bar for motion therewith in the last mentioned directions and having an outer portion which projects beyond the surface of the body when the bar is wholly received in the first mentioned groove. 

10. In combination with a cylindrical lock body having a cavity in its interior that opens to the front of the body through an elongated key slot, and a casing having a bore in which the body is rotatable, 

A. a plurality of elongated tumblers, 

1. each having a pair of opposite longitudinal edges, in one of which there is a notch; 

2. said tumblers being arranged side-by-side in a row across said cavity in the direction lengthwise of the key slot, with said edges of the tumblers engaging opposite flat walls of the cavity to be guided by the walls of the cavity and one another for lengthwise motion parallel to the body axis to and from unlocking positions in which said notches in the several tumblers align to define a groove that opens to one of said walls of the cavity; 

B. a locking element in the body comprising 

1. an elongated bar spanning the row of tumblers and at least partly receivable in said groove when the tumblers are in their unlocking positions, said bar being confined in a recess in said one wall of the cavity by the tumblers when they are out of their unlocking positions, and 

2. an element confined to substantially radial motion in the body and having an inner portion that has a connection with said bar and an outer portion exposed at the exterior of the body and engageable in a concavity in the casing when the bar is confined in said recess; 

C. means individually biasing the tumblers forwardly out of their unlocking positions to normal positions; 

D. a key having

1. transversely stepwise arranged shoulders, each engageable with one of the tumblers upon insertion of the key into the key slot, for propelling the tumblers rearwardly to their unlocking positions, 

2. opposite substantially flat surfaces engageable with opposite longitudinal edges of the key slot, 

3. a lengthwise extending land projecting from one of said flat surfaces and receivable in a notch in the body that opens to one of said edges of the key slot, to confine the key against movement lengthwise of said edges of the key slot and thus ensure that each of said shoulders will engage with its proper tumbler, said land having a notch therein spaced from its front end, and 

4. forwardly facing abutment surfaces engageable with front surface portions of the body to define the limit of insertion of the key thereinto; and 

E. pin tumbler means cooperating with the body and the casing to normally confine the body against rotation, said pin tumbler means being spaced forwardly in the body from the front ends of the first designated tumblers when the same are in their normal positions and being engageable in said notch in the land to be positioned for release of the body for rotation upon full insertion of the key into the body, such engagement of the pin tumbler means in said notch confining the key against withdrawal from the body when the body is out of predetermined rotational positions. 

11. A lock mechanism of the type comprising a hollow body in which a plurality of tumblers are individually slidably forward and backward between locking and unlocking positions, and locking means carried by the body for motion between a locked position in which the locking means is maintained by any tumbler that is not in its unlocking position and an unlocked position to which the locking means can move only when all of the tumblers are in their unlocking positions, said lock mechanism being characterized by: 

A. the body having therein a cavity that is rectangular in cross-section and which cavity opens to the front of the body through a single key slot substantially as wide as the larger cross-sectional dimension of the cavity but shallower than its smaller cross-sectional dimension to define at least one rearwardly facing shoulder at the front of the cavity that extends across its said larger dimension; 

B. the tumblers 

1. being elongated and each having opposite flat sides, 

2. being arranged side-by-side in a row across the cavity in the body, between opposite flat side surfaces of the body that define said cavity, and with said flat sides of the tumblers flatwise contiguous to one another and to said surfaces, so that the tumblers are guided for lengthwise sliding motion by their engagement with one another and said surfaces, and 

3. each tumbler having its front end engageable with said shoulder to define the locking position of the tumbler; 

C. each tumbler having a longitudinal edge in which there is a notch, said notches in the several tumblers all opening in the same direction to a wall of the body that extends between said surfaces, and said notches being alignable, upon lengthwise slid-
3,733,863

15

D. the locking means comprising

1. a bar in the interior of the body extending across

the several tumblers and confined to motion in

opposite directions transversely to its own length

and to the lengths of the tumblers, said bar being

at least partway receivable in said groove when

the tumblers are in their unlocking positions, and

the body having a recess in its said wall, opening

to said cavity, in which the bar is confined when

the tumblers are out of their unlocking positions,

and

2. an element confined to motion in substantially

said opposite directions of motion of the bar, said

element having an inner part connected with the

bar to move therewith and which extends

through a hole in said wall of the body, and hav-

ing an outer part that projects beyond the body

when the bar is confined in said recess; and

E. spring means in the body, behind the tumblers, re-

acting against the body, and engaging each tumbler

at its rear end, biasing each tumbler forwardly in-

dependently of the others towards its defined lock-

ing position.

12. The lock mechanism of claim 11, further charac-

terized by:

F. said body having a plurality of wells in its rear por-
tion, one for each tumbler, each opening forwardly

into the cavity at the rear thereof;

G. a pin-like rearward projection on each tumbler;

and

H. said spring means comprising a plurality of coiled

expansion springs, one for each tumbler, each of

said springs having a rear end portion received in

one of said wells and a front end portion piloted on

the pin-like projection on its tumbler.

13. The lock mechanism of claim 12, further charac-
terized by:

I. said body having a bore concentric with each of

said wells and of smaller diameter than its well,

opening to the well and to the rear end of the body;

and

J. each of said pin-like projections being long enough

to extend a substantial distance into its well, within

its spring, when the tumbler is in its locking posi-
tion, and being receivable in the bore concentric

with the well when the tumbler is in its unlocking

position.

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