

[54] **SIDE BAR LOCK AND KEY MECHANISM**

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[63] Continuation of Ser. No. 97,714, Dec. 14, 1970, abandoned.

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[58] Field of Search..... **70/358, 364 R, 364 A, 368, 70/371, 378, 382, 384, 385, 395, 403, 404, 411, 419, 421**

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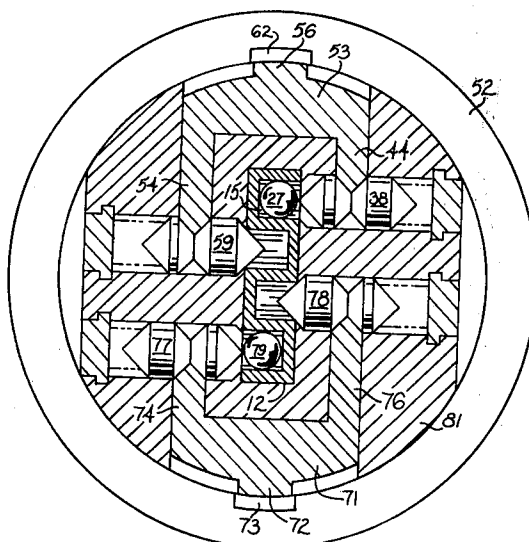
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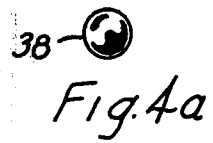
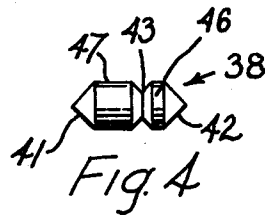
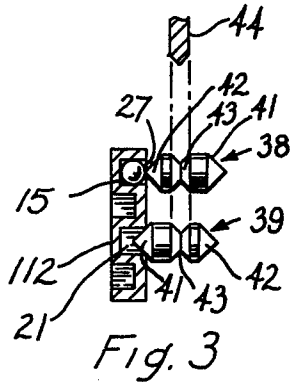
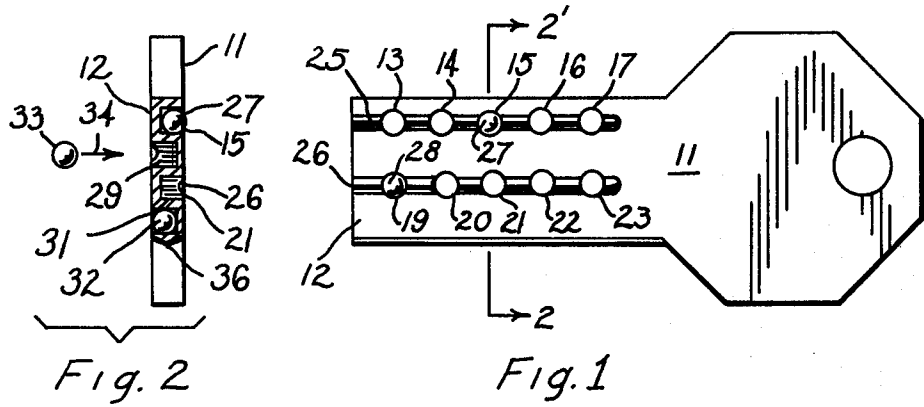
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ABSTRACT

A lock mechanism comprising tumblers to engage a key, a first member, and a second member. The first and second members, which may be a plug and shell or a cylinder and side bar, are movable relative to each other to two alternate positions, one of the positions corresponding to the unlocked position and reachable only when all of the tumblers are placed properly and the other position corresponding to a locked position when at least one of the tumblers is out of the interfitting position. All of the tumblers are identical and each has two end surfaces and a control surface between them. The control surface is not only unequally spaced from the two end surfaces, but the inequality of this spacing is the same for all tumblers. Each tumbler can be inserted so that either end faces the keyway. The tumblers engage selected locations on the key and are moved to one of two positions, depending on whether the key has a space-filling member to engage the tumblers or a void into which the tumbler can move. The lock is coded by placement of each tumbler in one of its two alternative positions, and the key is correspondingly coded by the existence or non-existence of the space-filling member at each location to be engaged by a tumbler.

15 Claims, 13 Drawing Figures





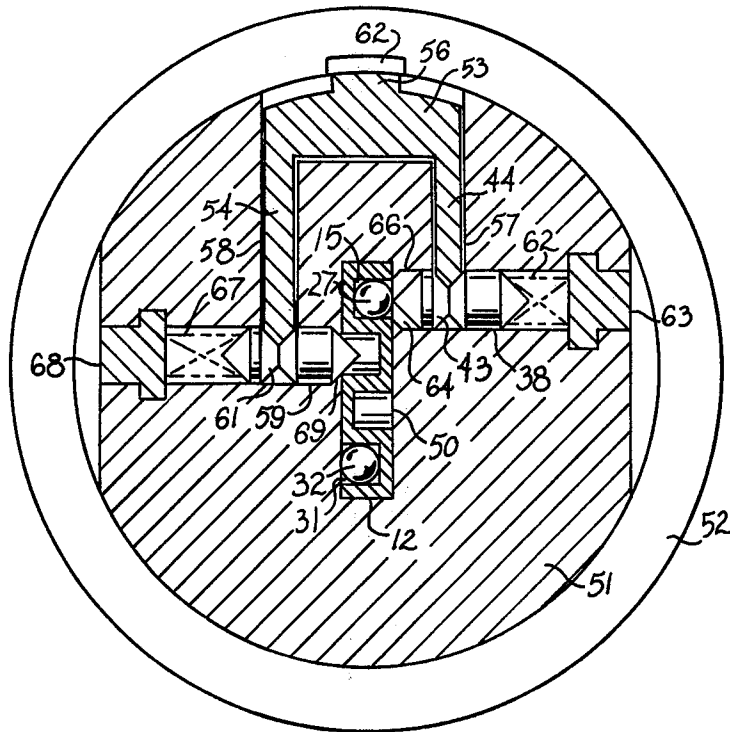


Fig. 7

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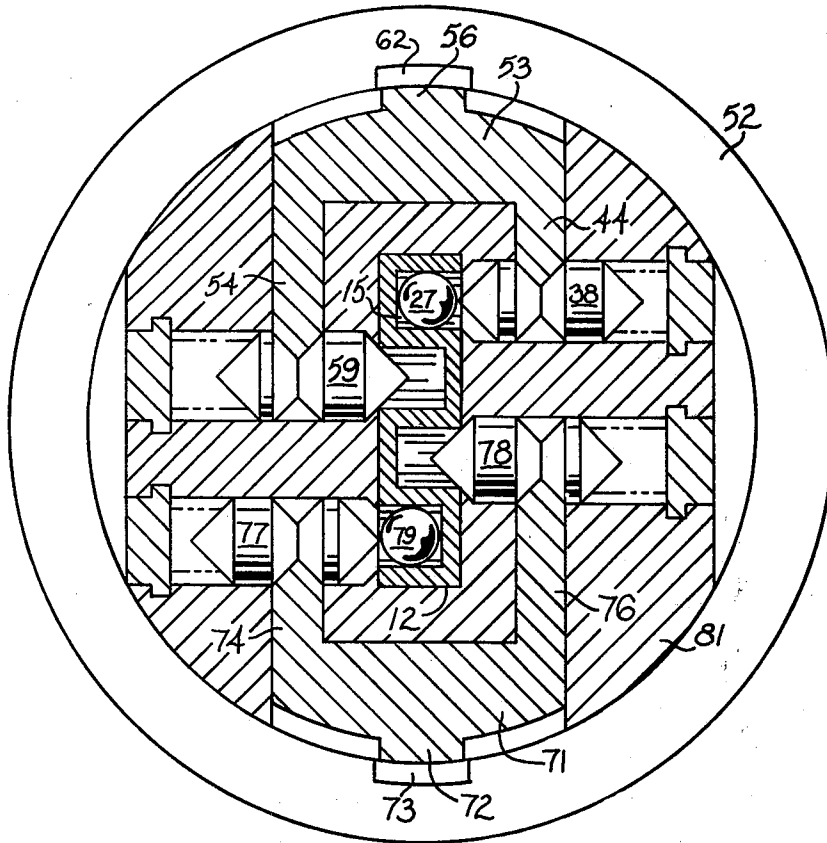
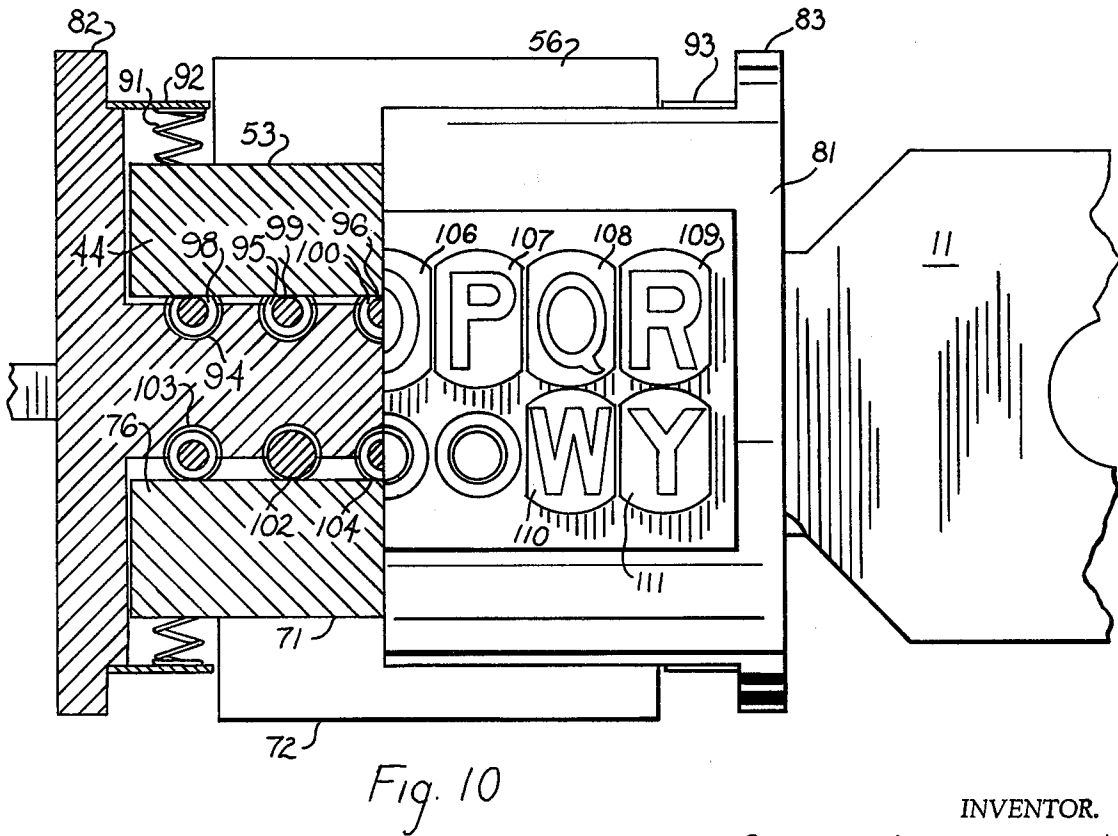
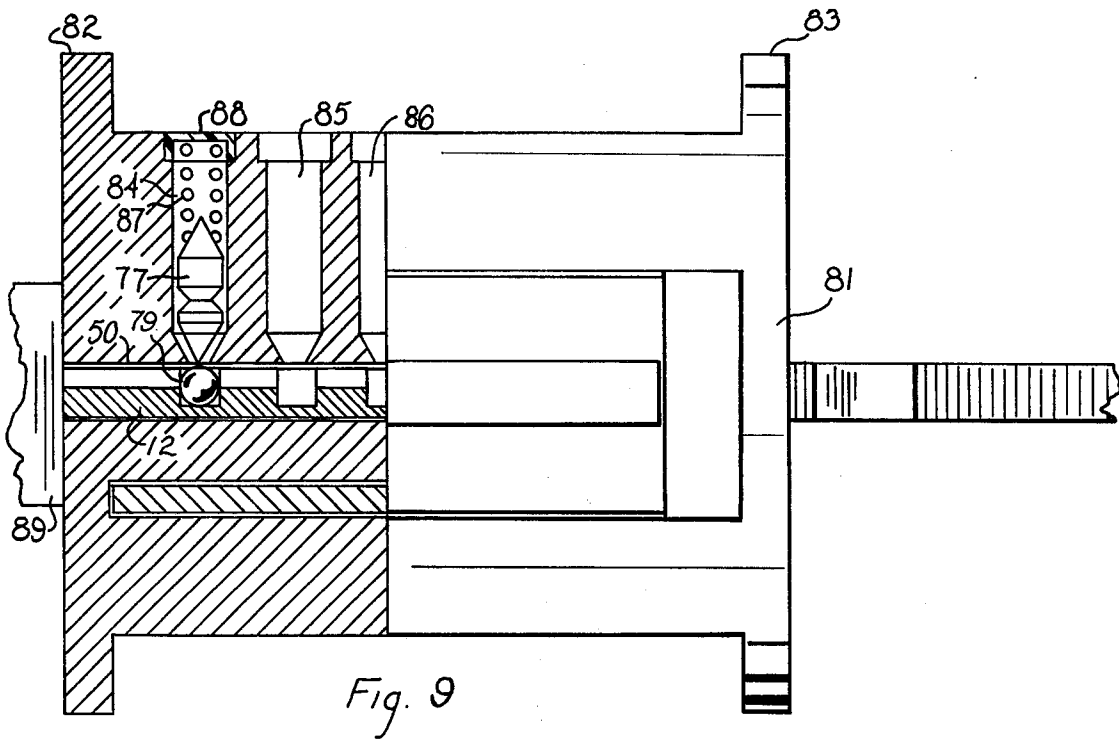


Fig. 8

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SIDE BAR LOCK AND KEY MECHANISM

This is a continuation of application Ser. No. 97,714, filed Dec. 14, 1970 and now abandoned.

FIELD OF THE INVENTION

This invention relates to locks having a movable member controlled by tumblers movable to one of only two positions, one of which allows the movable member to cooperate with the tumblers to move to an unlocked position.

BACKGROUND OF THE INVENTION

Some locks have two main components: one, which is sometimes called a "shell," that can be rigidly attached to a structure to be locked, and another movable with respect to the shell to control a bolt that operates a latch between locked and unlocked positions. The main members have tumbler channels within them and, in each channel, a tumbler divided into at least two separate sections. The last parts of each tumbler are normally of different length from corresponding parts of other tumblers so that, until a correct key is inserted, at least one section of one tumbler bridges the sheer surface between the two main members and locks the members together. When a correct key is inserted, the coded section of the key causes all the tumblers to move so that the abutting surfaces between the two sections of all of the tumblers are aligned with the sheer surface between the two main members thus allowing relative movement between the two members. This permits the bolt to actuate the latch to permit the structure, which may be a door or drawer or any other lockable structure, to be opened. A lock of this general type in which the change of each tumbler is binary, i.e., has only two conditions instead of the usual large number, is disclosed and claimed in my co-pending application Ser. No. 872,678 filed Oct. 30, 1969 and now abandoned.

Another well-known type of lock is referred to as a side bar lock. These locks have tumblers that engage the key but each tumbler has only one piece and does not divide into two parts along a sheer surface. Instead the tumblers have notches that permit a bar to fit into them when all of the tumblers are properly aligned by the key. The bar and the tumblers are located in a movable member and the bar either extends into locking engagement with a fixed external structure, such as the door or an outer shell, or is permitted to retract into the movable member only when all of the tumblers are aligned to allow the bar to fit into a notch of each tumbler. Unless this condition obtains, the bar is forced into the locking engagement mentioned.

Side bar locks have heretofore had tumblers such as disk tumblers with biting surfaces ground to a multiplicity of specific dimensions. The mechanical size difference from one bit to the next is so small that a key ground to fit a specific combination may also fit other combinations differing by only one change step, either up or down. Thus a side bar lock that apparently has millions of combinations may actually be operated with a relatively small number of keys, each of which accommodates not only the combination for which it is intended but also a relatively large number of adjacent combinations.

It is one object of the present invention to provide a lock with relatively large changes and yet with a suffi-

cient number of them to allow many different combinations. It is a further object of the present invention to provide a lock in which each tumbler is physically identical to every other tumbler and the combinations are set only by the orientation by which the tumblers are inserted into the body of the lock. It is a still further object to provide a combined lock and key in which the key can be coded easily to any combination of the lock by means of change plugs large enough to be handled manually and capable of being inserted into the key without special equipment.

BRIEF DESCRIPTION OF THE INVENTION

The present invention utilizes a structure in which there may be only one main movable member and a side bar. This main member is held within the structure to be locked and may either be moved with respect to that structure, when the lock is unlocked, or held rigid with respect to that structure by the side bar, when the lock is locked. One-piece tumblers are provided in channels in the main member, and they extend into a keyway to be engaged by a key inserted in it. Each tumbler has two substantially identical ends and a control surface in the form of a notch between them. The notch is closer to one end than the other, and all of the tumblers are identical in length and in notch location. Each tumbler may be considered as being divided by the notch into a short portion and a long portion.

The side bar is slidably mounted in a slot that intersects the tumbler channels at the proper position to permit an edge of the side bar to fit into the notches of all of the tumblers when the code of the key matches the code of the lock.

The lock can be coded in binary fashion by insertion of the tumblers so that the short portions of some tumblers and the long portions of others are inserted first into their respective channels. Individual tumbler springs push each tumbler inward, toward the keyway, and there is a stop that sets the limit as to how far each tumbler can be pressed toward the keyway.

The key has a straight shank with a number of holes aligned with the tumbler channels when the key is fully inserted into the keyway. Like the lock, the key can also be coded in a binary fashion by filling or not filling the holes. One suitable filler is a ball bearing of the proper size to be force-fitted into a hole in the key.

The relationship between the filled holes and the orientation of the tumblers is that each tumbler having its short portion inserted first into its respective channel must engage a filled hole in the key, and each tumbler having its long portion inserted first into its respective channel must engage an empty hole in the key. The location of the notch with respect to the two ends must be such that it occupies the same position, whether the short portion strikes a filled hole in the key or a long portion enters an unfilled hole. When this condition exists, the edge of the side bar can enter the notches and a fence portion on the outer edge of the side bar can be retracted within the main movable member so as not to interfere with movement of the member. However, when even one of the tumblers is not coded to match the corresponding hole in the key, the edge cannot so fit and the fence will extend outward into locking relationship with a recess in a shell surrounding the main movable member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a key for use in the lock of the present invention;

FIG. 2 is a cross-sectional view along the line 2-2' of the key in FIG. 1;

FIG. 3 illustrates the coding arrangement of the key and tumblers of the locking system of the invention;

FIG. 4 is a plan view of one type of tumbler;

FIG. 4a is an end view of the tumbler in FIG. 4;

FIG. 5 is a plan view of another type of tumbler;

FIG. 5a is an end view of the tumbler in FIG. 5;

FIG. 6 is a plan view of still another form of tumbler;

FIG. 6a is an end view of a tumbler in FIG. 6;

FIG. 7 is a cross-sectional view of a lock constructed according to the invention;

FIG. 8 is a cross-sectional view of another embodiment of the lock constructed according to the invention;

FIG. 9 is a top view, partly cross-sectional, of the lock in FIG. 8; and

FIG. 10 is a side view, partly cross-sectional, of the lock in FIG. 8 and 9.

DETAILED DESCRIPTION OF THE INVENTION

The key shown in FIG. 1 is of generally flat construction with a straight edged shank 12 having an upper row of holes 13-17 and a lower row of holes 19-23 in one side. A shallow groove 25 runs through the upper row of holes and another shallow groove 26 runs through the lower row of holes. This key has been coded by placing a space filling plug in the form of a ball 27 in the hole 15 and another space filling ball 28 in the hole 19. Preferably the balls may be slightly oversize so that they will not fall out. Alternatively, they may be cemented in place, but usually a press fit is sufficient.

FIG. 2 shows a cross-sectional view of the key 11. As indicated, there are also two rows of holes on the reverse side of the shank 12. One of these holes, 29, is empty and the other hole 31 has a ball 32 in it. An additional ball 33 is shown positioned to fit into the hole 29 by being moved in the direction of the arrow 34. At the bottom edge of the shank 12 is a slight ridge 36 that makes the shank asymmetrical and allows the key to be inserted into the lock with only one orientation. Alternatively, the ridge 36 may be omitted if it is desired to code the key and lock in such a way that it is immaterial which edge of the shank 12 is the upper one and which is the lower one when the key is inserted into the lock.

FIG. 3 shows the fundamental principle on which the lock operates and includes only the essential coding elements. The shank 112 has one ball 27 in a hole 15 and it has another hole 21 that is empty. Two tumblers, 38 and 39, are located as they would be in a lock in which the shank 112 was inserted. The tumblers 38 and 39 are identical with each other. The tumbler 38 has two tapered ends 41 and 42 with a notch 43 therebetween closer to the end 42 than to the end 41. The end 42 is pressed against the ball 27. The tumbler 39 is oriented in the reverse fashion so that its end 41 is pressed into the hole 21 in the key as far as it will go. Above the notches 43 in the two tumblers 38 and 39 is the edge 44 of a side bar. Broken lines leading down from the edge 44 intersect both of the notches 43 in the tumblers 38 and 39 when they are oriented as shown. This is the

condition for permitting the edge to enter the notches and allow the key to unlock the lock.

Before describing the lock itself, it will be useful to refer to several forms of tumblers which are shown in FIGS. 4-6. The tumbler 38 in FIGS. 4 and 4a has a round body. The portion between the notch 43 and the tapered end 42 may be referred to as the short portion 46 of the tumbler. The other part of the tumbler between the notch 43 and the end 41 may be referred to as the long portion 47. Because the tumbler 38 is round, it is free to rotate in its hole and the notch 43 must extend circumferentially around it.

A second form of tumbler 138 is shown in FIGS. 5 and 5a. This tumbler has a square cross-section but is otherwise similar to the tumbler in FIGS. 4 and 4a. It has a notch 143 that must be formed in each of the four sides of this polygonal tumbler because the symmetry of the tumbler would permit it to be inserted in any one of four positions.

Still another form of tumbler 238 is shown in FIGS. 6 and 6a. This tumbler may be stamped out of sheet metal and can have a notch 243 only in one edge 48 or in both the upper edge 48 and the lower edge 49. However, the two ends 141 and 142 must be symmetrical and the displacement of the notch 243 from the ends must be based on the principles described in connection with FIG. 3.

The shank 12 is shown in FIG. 7 fitted into a keyway 50 in a lock constructed according to the invention. The lock members comprise a cylindrical plug 51 rotatably held within a shell 52. The edge 44 is part of a complete side bar 53 that also includes another edge 54 and a side bar fence 56. The edge, or side bar finger, 44 fits slidably within a slot 57 that intersects the position of the notches 43, not only of the tumbler 38, but of all of the other tumblers that are aligned with the holes 13-17 in the key (FIG. 1).

Similarly, the edge, or side bar finger, 54 fits slidably within a slot 58 to engage the notches 61 in a tumbler 59 and all tumblers aligned in a row with it. The side bar fingers 44 and 54 thus partially embrace the shank 12 of the key and are equally spaced on each side of the keyway 50 since the same principles of location apply to both side bar fingers.

The side bar fingers are shown in their unlocked position interfitting with the notch 43 and a similar notch 61 in the tumbler 59. In this condition, the side bar fence 56 is within the perimeter of the plug 51 and does not enter a recess, or gate 62 in the shell 52.

The tumbler 38 is pressed inwardly toward the keyway 50 by a spring 62 which is held by a cap 63. At the other end of the channel 64 is a barrier 66 that limits the inward movement of the tumbler 38. The tumbler 59 is pressed inwardly by a similar spring 67 held by a cap 68 and pressed against a barrier 69.

When the key 12 is withdrawn, the tumbler 59 will return to approximately the same position in FIG. 7 but the tumbler 38 will move inwardly until it contacts the barrier 66. In this position, the side bar finger 44 will not be able to fit into the notch 43 and the side bar fence 56 will therefore be pushed upwardly into the gate 62. This prevents the plug 51 from being rotated within the shell 52. It should be noted that it is only necessary for one tumbler to be displaced in order to prevent the side bar 53 from moving downwardly from the unlocked position. Thus a key that has only one miscoded hole i.e., a hole that is empty when it should

contain a ball, or vice versa will prevent the lock from being opened.

FIG. 8 shows a lock having more tumblers and therefore greater security than the lock in FIG. 7. The basic operation is the same and components that operate in the same way as like components in FIG. 7 will be identified by the same reference numerals.

The lock in FIG. 8 has two side bars 53 and 71 diametrically opposite each other. These side bars are mirror images of each other and have fences 56 and 72 that engage gates 62 and 73 when the lock is in its latched condition. The side bar 71 has two fingers 74 and 76 that correspond to the fingers 44 and 54 of the side bar 53.

Instead of having only two rows of tumblers represented by the tumblers 38 and 59, the lock in FIG. 8 has two additional rows of tumblers represented by tumblers 77 and 78. In all ways the upper and lower halves of the lock in FIG. 8 are symmetrical. The row of tumblers represented by the tumbler 38 and the row of tumblers represented by the tumbler 77 engage the outer row of holes or balls, also referred to as change balls, in the key. As shown, the tumbler 38 engages the ball 27 and the tumbler 77 engages the ball 79. These rows, being closer to the perimeter of the plug 81, require that the fingers 44 and 74 be shorter than the fingers 54 and 76.

FIG. 9 is a top view of the plug 81 of FIG. 8 but with some of the parts removed to show the interior construction. The plug 81 has two circular end portions 82 and 83 but the central portion of the sides have been ground away. Part of one of the rows of tumbler channels is shown in the cut away portion of the drawing. These include the channels 84-86. The channel 84 contains the tumbler 77 which engages the ball 79 in the shank 12 of the key. The tumbler 77 is pressed inwardly by a spring 87 which is held in place by an individual plastic cap 88. At the end of the plug opposite the entrance to the keyway 50 is a bar 89 that makes connection with the latching mechanism of the lock. This latching mechanism is well known and need not be described in order to illustrate the present invention.

FIG. 10 shows a side view of the plug 81 and illustrates two conditions of the side bars. The side bar 53 is in the unlocked condition and its fence 56 is below the outermost level of the cylindrical end portions 82 and 83. The side bar is pressed inwardly by two springs, one at each end, of which only the spring 91 appears in the drawing. One end of this spring presses against the underside of a retainer plate 92, which may be spot welded, or otherwise securely attached to the plug 81. The other plate 93 is partially shown in the other end of the plug 81.

The lower end of the side bar finger 44 is shown fitting all of the way into the notches of the tumblers. The tumblers are identified by reference numerals 94-96 and their notches are indicated by reference numerals 98-100, respectively.

On the other side of the plug 81 is the side bar 71 which has its finger 76 resting against one of the tumblers at a point thereon other than the notch. This is the tumbler identified by reference numeral 102. Two other tumblers 103 and 104 are positioned by the key 11 so that the side bar finger 76 would fit into them but is prevented from doing so by the tumbler 102. Thus the key 11 is not properly coded for this particular plug

and the side bar fence 72 extends outwardly beyond the perimeter of the cylindrical ends 82 and 83.

FIG. 10 also shows individual caps for engaging the tumblers and the spring. These caps are identified by reference numerals 106-111 and that each have separate indicia printed on them. The indicia happen to be in the form of letters but numerals will do equally well. The particular code chosen for a given lock may be selected and the memory of it retained by the identifying indicia. For example, the owner of the lock may choose his own name or some abbreviation thereof or the name of some person or some other word that will serve as a helpful mnemonic. The tumblers under the chosen letters may then be inserted with their small portions first and the key correspondingly coded by placing change balls in the holes that would be aligned with those tumblers when the key is inserted into the lock.

I claim:

1. A lock comprising:

- A. A first member;
- B. A keyway extending along said first member;
- C. A plurality of channels intersecting said keyway;
- D. A second member, said first and second members being movable relative to each other between a locked position and an unlocked position; and
- E. A plurality of substantially identical control means to control relative movement between said first and second members, each of said control means comprising:

- 1. a first tapered end surface;
- 2. a second tapered end surface,
- 3. a control surface intermediate said end surfaces and dividing said control means into first and second portions, each of said first portions having one identical length and each of said second portions having a second identical length greater than said length of each of said first portions, each of said control means being movably located within a respective one of said channels to be actuated by a key inserted into said keyway, said lock being coded according to whether said first end surface or said second end surface of selected ones of said control means face toward or away from said keyway.

2. The lock of claim 1 in which each of said control means is a unitary member, and said control surface is a notch that extends part way through said unitary member.

3. The lock of claim 2 in which each said unitary member is an elongated cylinder that fits substantially co-axially within each of said channels, and said notch is intermediate the two ends thereof.

4. The lock of claim 3 in which each of said cylinders has a round cross-section and said notch extends circumferentially therearound.

5. The lock of claim 3 in which each of said cylinders has a polygonal cross-section and said notch is on one side thereof.

6. The lock of claim 3 in which said first end surface and said second end surface comprise substantially identically shaped tapered portions.

7. The lock of claim 3 in which said first end surface and said second end surface comprised reduced diameter cylinders rounded at the outer extremities thereof.

8. The lock of claim 2 in which each of said control means comprises a flat stamped sheet metal member.

9. The lock of claim 1 in which one end of each of said channels extends into said first member and the other end of each of said channels extends into said second member, and said first and second members are movable relative to each other to align said ends of each of said channels when said members are in said locked position.

10. The lock of claim 1 in which said second member is a side bar and moves substantially transversely with respect to said first member.

11. The lock of claim 10 in which said side bar comprises an edge to engage at least a portion of said control means to be actuated thereby between an unlocked position when said edge interfits with the control surfaces of all of said control means engaged by it and a locked position when said edge engages at least one of said control means at a location other than the control surface thereof.

12. The lock of claim 11 in which said first member is cylindrical and said side bar moves substantially radially with respect thereto.

13. The lock of claim 12 in which said keyway is enclosed within said cylindrical member and extends parallel to the axis thereof, and said channels are located

in said cylindrical member.

14. The lock of claim 12 in which said side bar extends radially beyond the outer surface of said cylinder only in said locked position.

15. The lock of claim 14 in which said keyway extends substantially co-axially through said cylindrical member and said channels extend substantially parallel to each other and substantially perpendicular to said keyway, said channels being divided into a first group on one side of said keyway and a second group on the other side of said keyway offset with respect to said channels of said first group, said cylindrical member comprising first and second side bar edge slots intersecting, respectively, said first and second groups of channels, said first-named edge of said side bar fitting slidably in said first slot to engage control means in said first group of channels and said side bar comprising, in addition: a second edge slidably located in said second slot to engage said control means in said second group of channels whereby said side bar is permitted to enter its locked position only when both of said edges fit into said control surfaces in all of said control means in both of said groups of channels.

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