

[54] **LOCK ASSEMBLY OF THE ROTARY CYLINDER TYPE**

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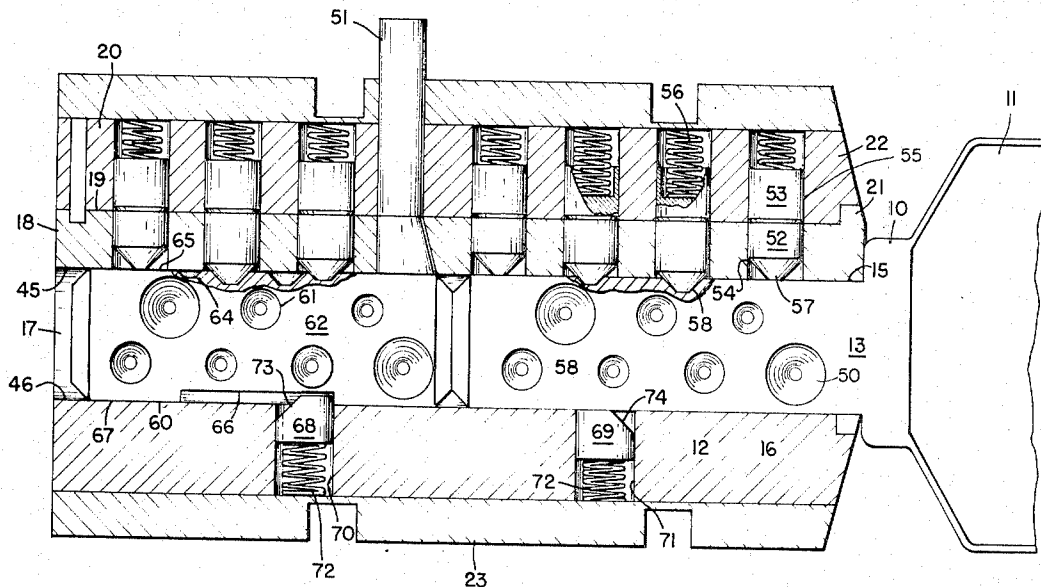
[52] **U.S. Cl.**..... 70/358, 70/364 A, 70/380, 70/409, 70/DIG. 60
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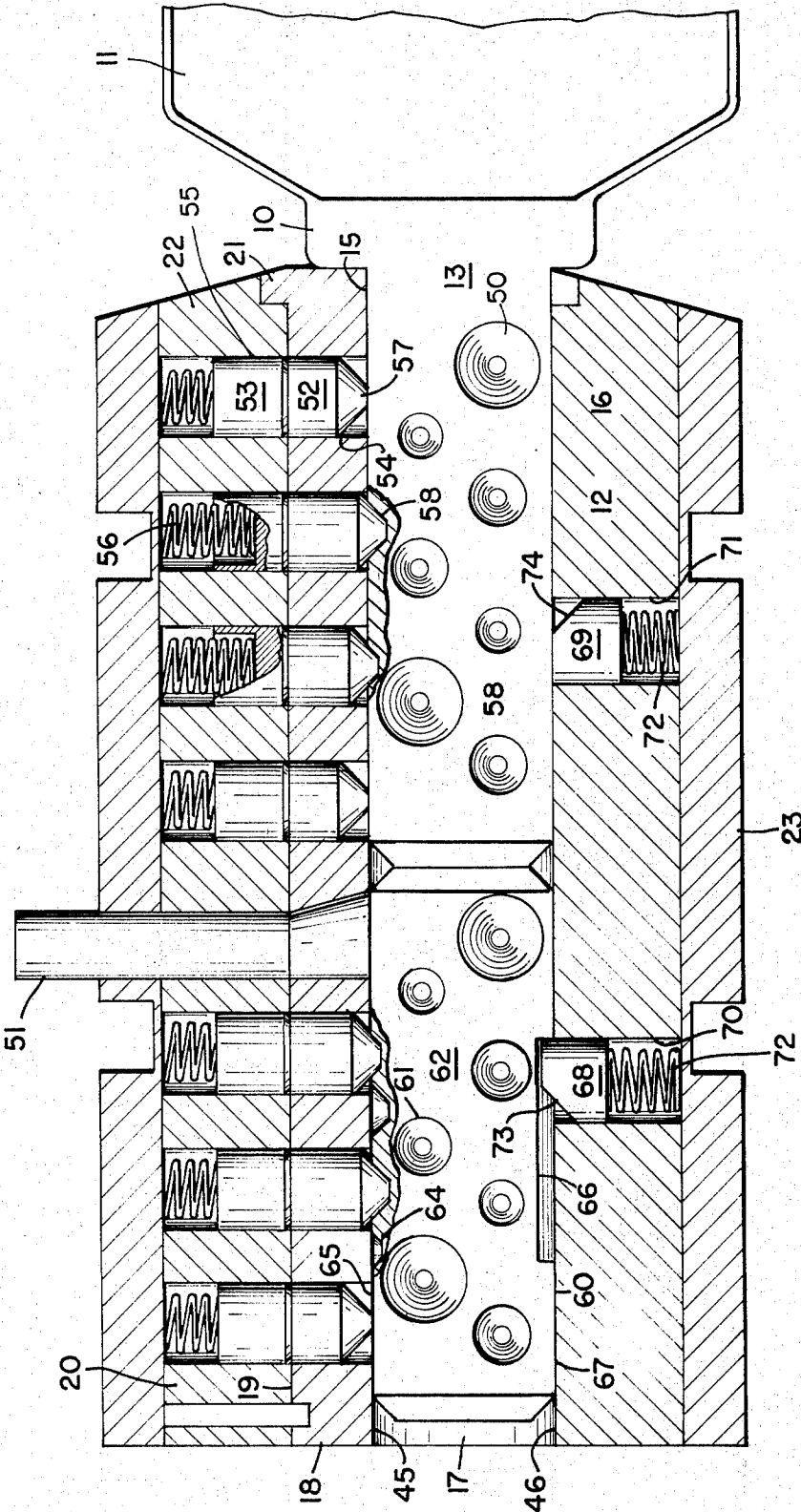
[57] **ABSTRACT**

A rotary cylinder lock assembly is disclosed which includes a plug having radially extending passages, which plug is rotatably mounted within a cylindrical housing having like passages which are adapted to be aligned with the passages in the plug upon rotation thereof. Spring-biased driver tumbler pins are disposed in the passages in the housing and engage follower tumbler pins disposed in the passages in the plug upon alignment therewith. The follower tumbler pins are conically shaped at their outer ends and are staggered along the plug and extend into a key-receiving slot extending longitudinally of the plug. The conically shaped ends of some of the pins engage the opposite wall of the slot when the key is not in the slot.

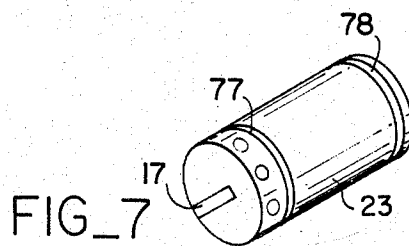
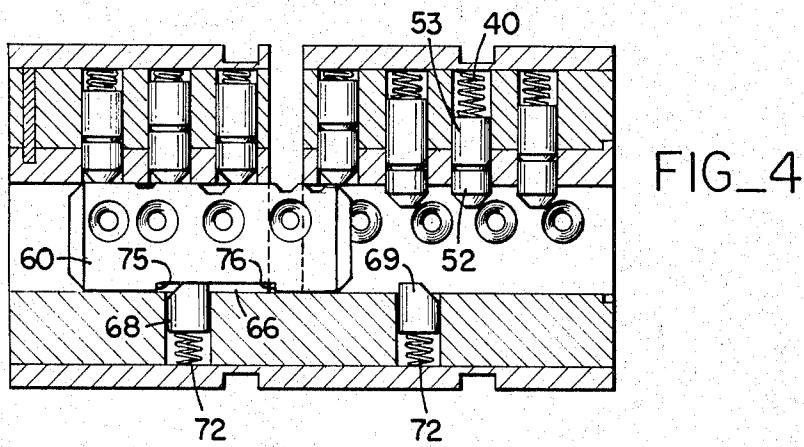
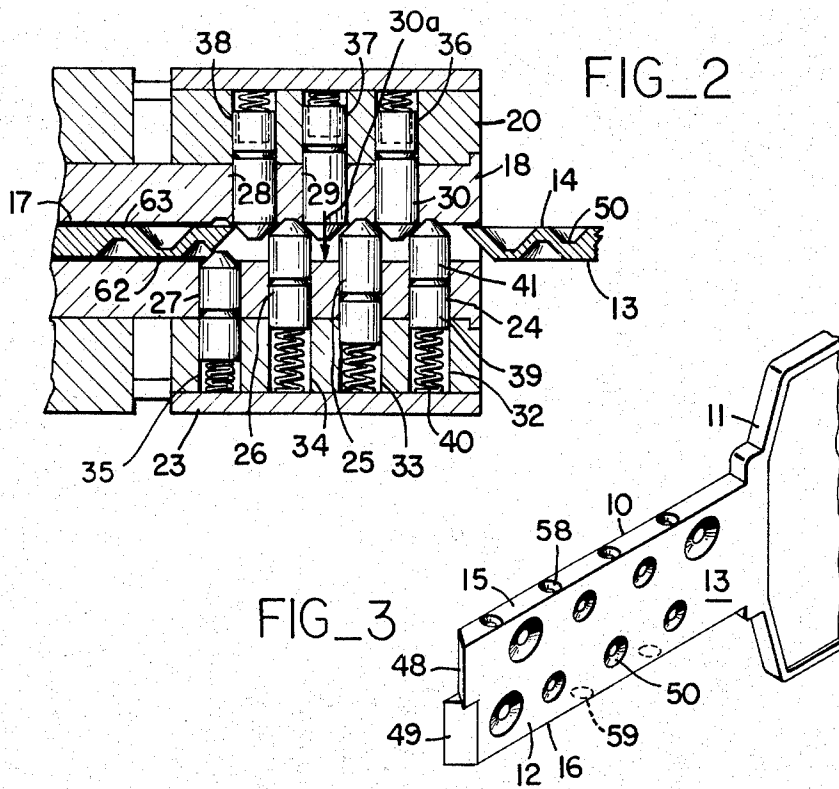
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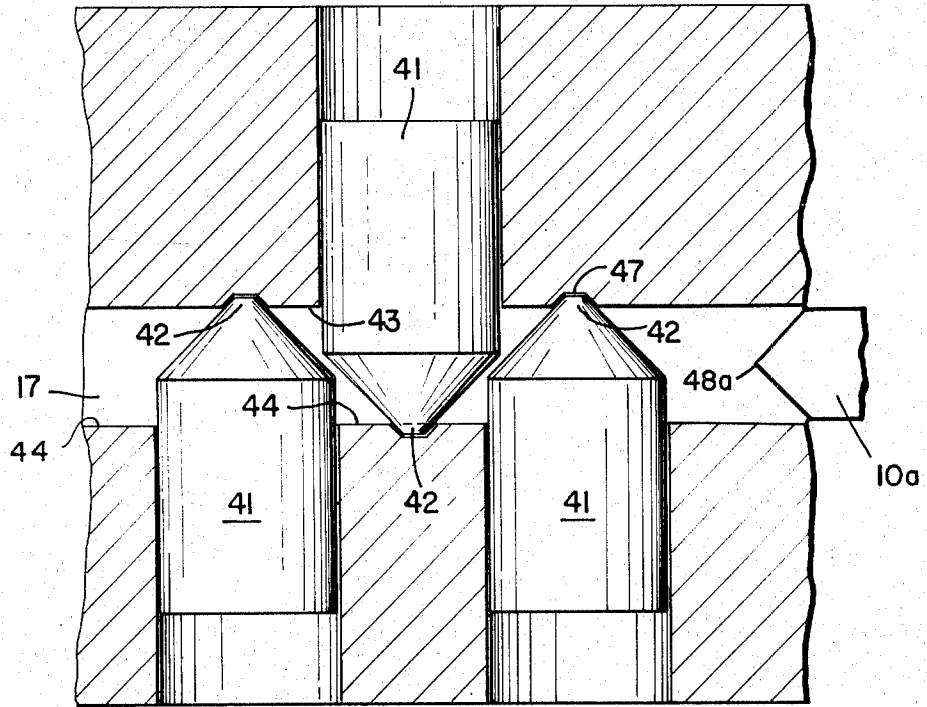
9 Claims, 7 Drawing Figures



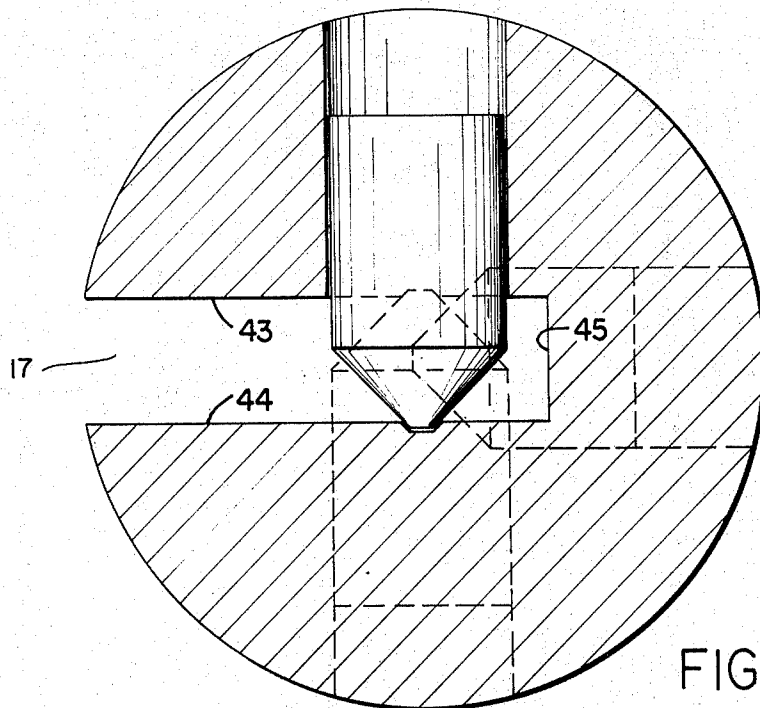


FIG_1





FIG_5



FIG_6

LOCK ASSEMBLY OF THE ROTARY CYLINDER TYPE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to locks; and, more particularly, to a lock assembly of the rotary cylinder type.

2. DESCRIPTION OF THE PRIOR ART

Locks of the rotary cylinder type have increased in popularity in recent years since they provide greater security than conventional locks. In my previous U.S. Pat. No. 3,393,542, I suggested an improved type of rotary cylinder lock wherein a flat key can be used in such a lock and an extremely high number of possible combinations could be obtained. In certain of these locks, however, shoulders are provided on the follower tumbler pins which engage the cylinder walls to maintain the points of the follower tumbler pins in substantially the center of the keyway in the plug so that the tip of the key, when inserted into the keyway, can push the pins back to unlock the lock. If no shoulders are provided, the pins would abut against the other wall and could not be opened with the key (the point of the key being generally tapered the same as the point of the pins). However, in such an arrangement, the keyway is of a size that the lock can be easily picked. That is, a lock-picking tool can be inserted into the keyway and the tips of the pins (which are at the midpoint or central axis of the keyway) can be pushed back against the springs biasing them toward the keyway by engaging the tapered portions of the pins that extend into the keyway.

Further, such shoulders limit the extent of the pins into the keyway and thus limit the number of possible tumbler pin combinations. Also, the shoulders require careful machining of such pins. Finally, the limited extent of such pins — which thus limits the overall pin length — limits the use of a master key which could be applied to all possible pin combinations. That is, the shoulders on the follower tumbler pins permit only two or three different depths of tumbler pin-receiving depressions in the key. If such depressions are too deep, the shoulders prevent the tapered tips of the pins from going deeper into these depressions. This thus eliminates the use of a master key (other than for a relatively few locks) since no one key can be manufactured which will open all of these locks.

Since the tumbler pins of such locks are limited to pins of a relatively short length, the pins cannot be divided into one or more parts very easily as such a relatively small space exists to accomplish this. Finally, most such rotary cylinder locks are in two separate parts, that is, one such rotary cylinder is threaded into a cavity on one side of the door and another is threaded into a like cavity on the other side thereof. Such cylinders are relatively easy to remove from the door.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved lock assembly of the rotary cylinder type which cannot be as easily picked as conventional rotary cylinder locks.

It is a further object of this invention to provide such a lock which has a relatively large number of possible combinations compared with conventional rotary cylinder locks.

It is a still further object of this invention to provide an improved lock assembly of the rotary-cylinder type which can be manufactured with a relatively high number of possible combinations, yet have a master key which fits all such combinations.

It is an even further object of this invention to provide such a lock which is of a unitary construction, yet can be opened by the same key from either side thereof.

These and other objects are preferably accomplished by providing a rotary cylinder lock assembly which includes a plug having radially extending passages, which plug is rotatably mounted within a cylinder housing having like passages which are adapted to be aligned with the passages in the plug upon rotation thereof. Spring-biased driver tumbler pins are disposed in the passages in the housing and engage follower tumbler pins disposed in the passages in the plug upon alignment therewith. The follower tumbler pins are conically shaped at their outer ends and are staggered along the plug and extend into a key-receiving slot extending longitudinally of the plug. The conically shaped ends of some of the pins engage the opposite wall of the slot when the key is not in the slot.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross-sectional view of a lock assembly of the rotary cylinder type in accordance with the teachings of my invention with a key positioned in the lock assembly;

FIG. 2 is a top sectional view of a portion of the lock assembly of FIG. 1;

FIG. 3 is a perspective view of a portion of a key to be used in the lock assembly of FIG. 1;

FIG. 4 is a side sectional view similar to FIG. 1 showing a blind key in position therein;

FIGS. 5 and 6 are enlarged cross-sectional views of a modification of a portion of the lock assembly of FIG. 1; and

FIG. 7 is a perspective view of the completed cylinder for the lock assembly of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawing, a portion of a key 10 is shown having a head 11 and shank portion 12 which includes side faces 13 and 14 (see also FIGS. 2 and 3) and a top 15 and bottom 16. Thus, as can be seen more particularly in FIG. 3, the shank portion 12 of key 10 is generally rectangular in cross section. Key 10 in FIG. 1 is shown as inserted into a generally rectangular slot 17 (which may be open-ended as shown in FIG. 6) extending longitudinally of a unitary generally cylindrical plug 18. Plug 18 is rotatably mounted in a generally cylindrical aperture 19 extending longitudinally of a generally cylindrical housing 20.

Plug 18 may include a face plate 21 which is shown as generally flush with the face plate 22 of housing 20. As is well known in locks of this type, plug 18 is in close-fitting rotatable engagement with housing 20. An outer generally cylindrical housing 23 (see also FIG. 2) encircles and thereby encloses plug 18 and inner housing 20.

Referring now particularly to FIG. 2, a plurality of spaced longitudinally extending passages are disposed radially in plug 18 (passages 24 through 30 being shown in FIG. 2 — of course, the number of such pas-

sages, their orientation, and their spacing may be varied by the artisan). These passages 24 through 30 extend all the way through plug 18 and open into communication with slot 17. Like passages 32 through 38 are radially disposed in housing 20. All these passages, when plug 18 is properly oriented by rotation in housing 20, are aligned with each other (i.e., passage 24 with passage 32, passage 25 with passage 33, etc.). A plurality of driver tumbler pins 39 are disposed in at least some of the passages 32 through 38 (as is well known in the art, the combination of my lock assembly may be varied by not providing pins in one or more of the passages). These pins 39 are resiliently biased, as by springs 40, toward slot 17. As can be seen in dotted lines of pin 39 in FIG. 2, the rear ends of pins 39 may be hollow to receive therein springs 40. The springs associated with passages 36 through 38 may be weaker than the springs associated with passages 32 through 35 to allow pins in passages 32 through 35 to extend further into slot 17 than the pins in passages 36 through 38 (that is, all the way to the other side of the slot 17).

Follower tumbler pins 41 are disposed in passages 24 through 30. As can be seen more particularly in FIG. 2, these pins 41 are staggered relative to each other. When slot 17 is unobstructed by the shank portion 12 of key 10, the tapered generally conically shaped points 42 of some of the pins 41 abut against the side wall of slot 17. Slot 17, as shown in FIGS. 5 and 6, is generally rectangular for receiving the generally rectangular shank portion 12 of key 10 and thus has side walls 43 and 44 and a top 45. However, in this modification on my invention, all of the pins 41 may extend to the opposite walls of slot 17 and enter depressions therein as shown. Like numerals, however, refer to like parts of FIGS. 1 and 7. In this case, however, the tip 48a of key 10a need only be pointed as shown, since the beginning tapered portion 42 of pins 41 is generally at the midpoint of slot 17. Also, this may be carried out by using springs 40 all of the same strength. The crisscrossing of the pins 41 — as shown in solid and dotted lines in FIG. 6 — makes it impossible to pick the lock. Further, the entire extent of the slot 17 may be as shown in FIG. 5, thus eliminating the need for a blind key 60, as will be discussed further hereinbelow. Many combinations of this lock are possible due to the various depths which can be used. It would be impossible to make a master key for such a lock which could open any meaningful number thereof.

However, in a preferred embodiment of my invention, the extreme tip of point 42 on some of pins 41 enters depressions 47 formed in the respective side walls 43 and 44 of slot 17. As can be seen in FIG. 2, the distance between the beginning of the taper of point 42 and the side wall of slot 17 is relatively narrow (see also FIG. 2). Thus, it is relatively difficult to pick such a lock by pushing back on tip 42 since the picking tool must somehow be angled from the center of the slot 17 to substantially the midpoint of this distance. Since this distance is extremely small as shown, such operation is practically impossible. Also, certain of the pins, such as 28 through 30, must be pulled down in the direction of arrow 30a (FIG. 2) to permit the lock to be picked. This is impossible to do with conventional picking tools. The weaker springs associated with these pins assist in carrying this out. Further, a conventional pointed key cannot be used to push pins 42 back against springs 40. Thus, as seen in FIG. 3 and shown in operation in

FIG. 2, the tip of the shank portion 12 of key 10 includes a first outwardly extending portion 48 which tapers to a point and a second oppositely extending portion 49 which also tapers to a point. Thus, as can be clearly seen in FIG. 2, the novel configuration of my key 10 enables the penetration of the tapered portion of point 42 (and into the depressions in plug 18) and the ready movement or pushing back of pins 42 against springs 40.

As can be seen in FIGS. 1 through 3, the shank portion 12 of key 10 includes a plurality of spaced depressions 50 of varying depths. These depressions 50 are vertically aligned with points 42 of pins 41 upon proper orientation of key 10 in slot 17 as is well known in the art. However, it should be noted that, by having some of pins 41 of such a length that they abut against opposite side walls of slot 17, relatively greater depths can be used in depressions 50, thus resulting in an appreciably greater amount of possible lock combinations.

It should also be noted that the proper orientation of key 10 in slot 17 results in the junction of pins 39 and pins 41 corresponding with the junction of plug 18 with housing 20. Thus, plug 18 can be rotated within housing 20 to actuate cam 51 to move the bolt and latch assembly (not shown) as is well known in the art.

In addition to pins 39 and 41, like pins 52 and 53 are disposed in passages 54 and 55, respectively, formed in plug 18 and housing 20, respectively. Like springs 56 also bias pins 52 and 53 toward the top wall 45 of slot 17 (and thus into the slot 17). However, such driver tumbler pins 53 are generally shorter than pins 41 and only extend a short distance into the top 45 of slot 17. The points 57 of these pins 52 enter into spaced depressions 58 of varying depths in the top wall 15 of the shank portion 12 of key 10. In like manner, the bottom wall 16 of the shank portion 12 of key 10 also includes similar depressions 59 (FIG. 3). The reason for such depressions 59 — inasmuch as slot 17 is open at the bottom — is that either side of key 10 may be inserted into the slot 17. Also, as will be explained further hereinbelow, my lock assembly may be unlocked from either side thereof.

Thus, referring once again to FIG. 1 with further reference to FIG. 4, I provide a blind key 60 which is slidably mounted within slot 17. Key 60 is generally rectangular in configuration — i.e., similar to the shank portion 13 of key 10 — and includes a plurality of spaced depressions 61 of varying depths on both side faces 62 and 63 thereof (see FIG. 2 for the other side of key 60). Similar depressions 64 are formed in the top wall 65 of blind key 60 for receiving points 57 of the follower tumbler pins 52.

As can be clearly seen in FIG. 1, key 10 and blind key 60 are so disposed in slot 17 that plug 18 can be rotated (i.e., the tumbler pins enter the proper depressions). Since blind key 60 slides in slot 17, means must be provided to properly orient blind key 60 in slot 17 depending upon the side of the plug 18 into which key 10 is inserted. Accordingly, a cutout or notched portion 66 is provided in the bottom wall 67 of blind key 60. Cylindrical housing 20 includes spaced detents 68 and 69 which are mounted in suitable apertures 70 and 71 formed in housing 20. Springs 72 bias detents 68 and 69 toward notched portion 66. The outer housing 23 serves to retain springs 72 and detents 68 and 69 in position. As can be seen, the outer faces 73 and 74 of detents 68 and 69 are undercut as shown. Face 73 is un-

dercut on one side of detent 68 while face 74 on detent 69 is undercut on a side opposite face 73 on detent 68. Thus, as can be seen in FIG. 4, as blind key 60 slides back and forth in slot 17, it first bypasses detent 68 in one direction then abuts against detent 69 (via portion 75 of notched portion 66) which extends into the open portion of slot 17. The blind key 60 is of course pushed into this position upon the insertion of key 10 into slot 17 from that first direction. When the key 10 is inserted into the other side of slot 10, blind key 60 is pushed in the opposite direction, slides over or bypasses detent 69, then portion 76 of notched portion 66 abuts against detent 68. In this manner, blind key 60 is both retained within slot 17 while being movable into correct position for engagement with the appropriate tumbler pins. As will also be evident, the depths and positions of the various depressions on key 10 and blind key 60 are related so that the key 10 can be inserted into either end of slot 17.

Finally, as can be seen in FIG. 7, the outer housing 23 preferably includes spaced arcuate slots 77 and 78 therein. These slots 77 and 78 are adapted to engage mating protrusions (not shown) in the steel case mounted in the door in which the lock assembly is to be mounted. Thus, the need for providing threads or the like on housing 23 is eliminated. Also, such an arrangement provides a lock assembly which would be extremely difficult to remove from the door in which it is mounted without such force which would physically damage the door. Conventional threaded double-cylinder arrangements are more readily removed. Of course, as is well known in the art, one or more of the driver tumbler pins 39 and 53 may be divided into one or more segments to further increase the possible combinations of my lock assembly. This, together with the increased depths possible in depressions 50 and 64, results in an extremely high number of such combinations. However, since such high combinations are possible without even splitting pins 39 and 53, due to the depths of my depressions 50 and 64, a master key could be made for such a lock assembly while the elimination of multiple tumbler pins (i.e., split into many segments) prevents easy picking of such a lock assembly.

The use of a single unitary housing arrangement permits both the use of a single key from either side of the lock while preventing the ready disengagement of the assembly from the door in which it is mounted.

My lock assembly not only cannot be easily picked, but the pin tumblers used herein can be manufactured more economically than those used in known rotary cylinder locks. The pin tumblers used herein are of a greater diameter than known pin tumblers (due to the use of deeper depressions) and thus have an advantage over the machining of smaller tumbler pins. These pins tumblers may, for example, be over 1/8 inch in diameter. Normal lock-picking tools cannot be used to pick my lock assembly since such tools cannot push back the heads of the follower tumbler pins at the side walls of the keyway slot. In addition, my follower tumbler pins are "locked" at the side walls of the keyway slot due to entering depressions therein. By varying the insertion of individual tumbler pin combinations, the combination of my lock assembly can be easily changed.

It is to be understood that the modified arrangement described in FIGS. 5 and 6 may of course be used, with or without the blind key 60 in the arrangement of FIGS.

1 and 2. Of course, the key 10a of FIG. 5 and springs of the same strength would be used.

I claim as my invention:

1. A rotary cylinder lock assembly comprising:
 - a generally cylindrical housing having a plurality of spaced elongated radially extending tumbler pin-receiving passages extending therethrough;
 - a generally cylindrical plug rotatably disposed in a generally cylindrical opening extending longitudinally of said housing, said plug also having a plurality of spaced elongated radially extending tumbler pin-receiving passages extending therethrough, said latter passages being adapted to be aligned with said first-mentioned passages upon rotation of said plug within said housing;
 - a key-receiving slot having at least a top and spaced side walls extending longitudinally through said plug for receiving a key therein, said passages in said plug opening into communication with said slot;
 - a plurality of driver tumbler pins slidably disposed in at least some of said passages of said housing;
 - a plurality of follower tumbler pins slidably disposed in at least some of said passages of said plug;
 - spring biasing means disposed in the passages in said housing and engaging said driver tumbler pins for biasing all of said pins in a direction toward said slot; and
 - said follower tumbler pins being staggered longitudinally along said slot and at least some of said follower tumbler pins having generally conically shaped outer ends engaging the side wall of said slot opposite from where the passage in which said follower tumbler pin is disposed opens into said slot when said slot is unobstructed by said key, wherein said side wall engaged by said outer ends of at least some of said follower tumbler pins when said slot is unobstructed includes a plurality of conically shaped depressions therein for receiving said conically shaped outer ends.
2. The lock assembly of claim 1 wherein said depressions are of a depth sufficient to receive substantially all of the conically shaped outer ends of at least some of said follower tumbler pins.
3. The lock assembly of claim 1 wherein said spring biasing means includes springs of generally the same strength biasing said pins; and
 - all of said follower tumbler pins being staggered along opposite sides of said slot and extending to the opposite side thereof, at least some of the oppositely staggered pins having their outer ends entering said depressions in the oppositely disposed side walls of said slot.
4. The lock assembly of claim 1 wherein said spring biasing means includes springs of varying strengths biasing said pins; and
 - the weaker of said springs biasing their respective pins toward said slot in a manner whereby their outer ends are not contiguous with the oppositely disposed side wall of said slot and the stronger of said springs bias their respective pins toward said slot in a manner whereby at least some of their outer ends enter said depressions in the oppositely disposed side wall of said slot.
5. The lock assembly of claim 2 further including a key adapted to be extended into said slot, said key having a plurality of depressions therein of a depth suffi-

cient to receive at least some of said conically shaped outer ends when inserted into said slot in a manner whereby the junction of said follower tumbler pins with said driver tumbler pins is aligned with the junction of said plug with said housing.

6. The lock assembly of claim 5 wherein said key is generally rectangular in cross section having elongated spaced side walls, and an elongated top and bottom wall and further includes a tumbler pin engaging end, said pin engaging end having an upper portion extending outwardly from a first elongated side wall of said key toward the other elongated side wall of said key to a first tapered point thereon and a lower portion extending outwardly from the other elongated side wall of said key to the first elongated side wall of said key to a second tapered point thereon.

7. The lock assembly of claim 5 wherein said housing further includes a plurality of spaced elongated linearly aligned tumbler pin receiving passages extending along the portions of said housing aligned with both the top and bottom of said slot;

a plurality of spaced elongated linearly aligned tumbler pin receiving passages extending along the portions of said plug adapted to be aligned with said linearly aligned passages in said housing upon rotation thereof;

a plurality of driver tumbler pins slidably disposed in at least some of said linearly aligned passages of said housing;

a plurality of follower tumbler pins slidably disposed in at least some of said linearly aligned passages of

said plug; spring biasing means disposed in the linearly aligned passages in said housing and engaging said driver tumbler pins for biasing all of said pins in a direction toward said slot; and

said follower tumbler pins in said linearly aligned passages in said plug having generally conically shaped outer ends which normally extend a short distance into said slot when said slot is unobstructed by said key.

8. The lock assembly of claim 7 wherein said key further includes a plurality of spaced depressions of varying depths extending linearly along the top and bottom thereof for receiving therein the conically shaped outer ends of said follower tumbler pins in said linearly aligned passages in said plug.

9. The lock assembly of claim 5 wherein said plug further includes a blind key freely slidable therein and movable from one end of said slot to the other;

blind key linear movement limiting means associated with said plug for limiting the linear movement of said blind key in both directions within said slot; and

said blind key having a plurality of depressions therein for receiving therein the conically shaped outer ends of said follower tumbler pins which are aligned with said depressions in said blind key when a key is inserted in either end of said slot to a point whereby the depressions in said key are aligned with the follower tumbler pins in said plug.

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