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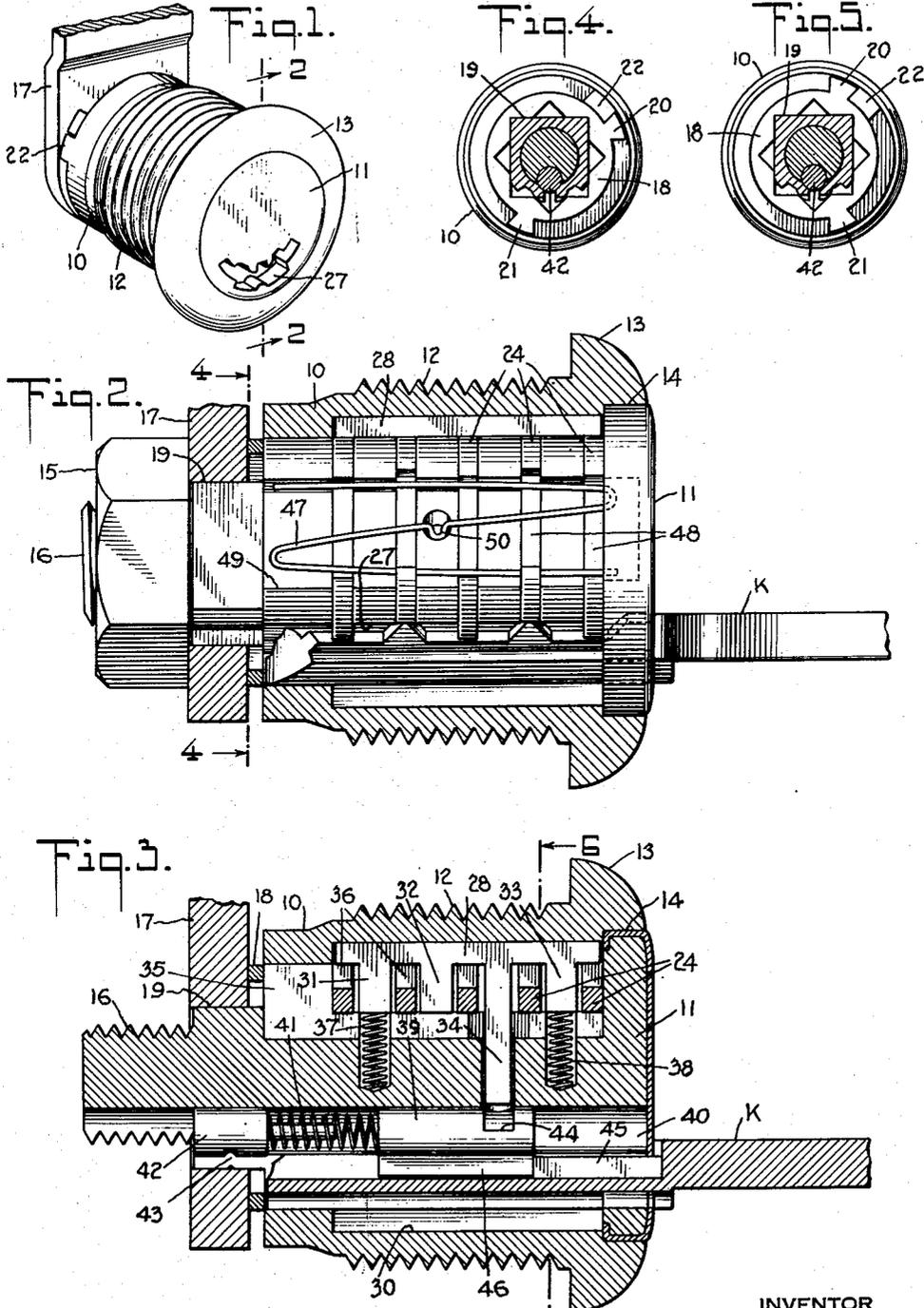
R. C. SPAIN

2,690,070

ROTARY TUMBLER CYLINDER LOCK

Filed May 26, 1951

2 Sheets-Sheet 1



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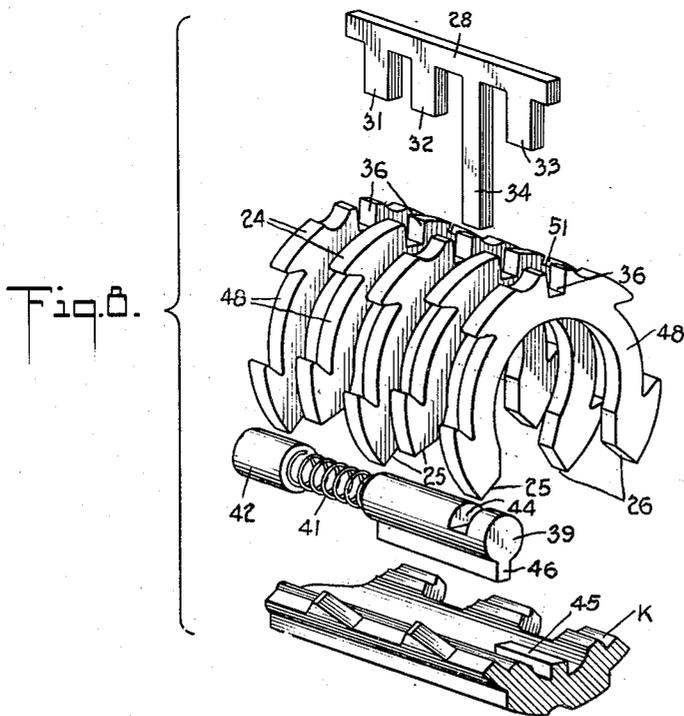
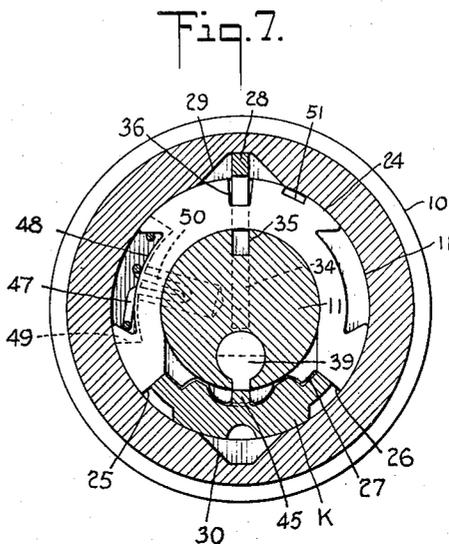
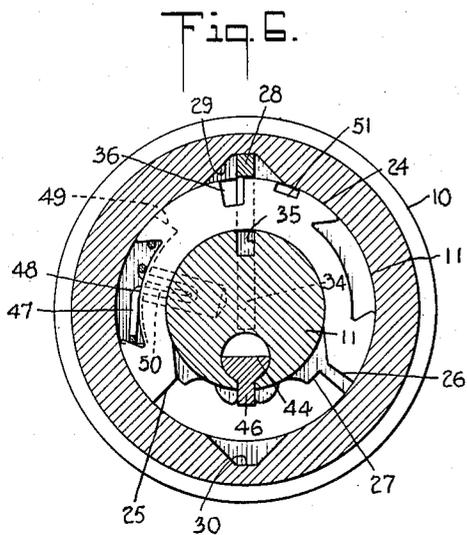
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# UNITED STATES PATENT OFFICE

2,690,070

## ROTARY TUMBLER CYLINDER LOCK

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16 Claims. (Cl. 70-421)

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This invention relates to tumbler locks and more particularly to an improved lock of the class having key operated tumblers that undergo rotary movement for controlling the lock.

It is the purpose of my invention to provide a lock of this general class that will offer increased security, that will permit a larger number of key combinations in a lock of a given size, and that will offer certain advantages in manufacture.

As one feature of the invention, I provide my improved lock with tumblers so arranged that they must be moved in angularly related directions by a key in order to release the locking means that locks the key plug against rotation. This arrangement preferably includes at least one tumbler that moves longitudinally of the key plug in addition to the rotary tumblers that rotate in a direction laterally of the key plug, and renders the lock exceedingly difficult to pick, since the full locking effect of the locking means will be maintained unless the tumblers are moved in different directions to their particular releasing positions.

Another feature of the invention resides in the compact arrangement of the tumblers whereby the lock may provide an increased number of key changes without a corresponding increase in the size of the lock or in the length of the key. This is accomplished by mounting the longitudinally moving tumbler at a location that is within at least one of the rotary tumblers. The longitudinally moving tumbler, therefore, will multiply the key changes obtainable through the rotary tumblers without contributing to the length or the diameter of the lock.

As another feature, the rotating movements whereby the rotary tumblers control the locking means in conjunction with the longitudinally moving tumbler are positive in nature. The rotary tumblers have radially extending shoulders that engage opposite edges of the key, these edges being so bitted that the position and movement of each rotary tumbler is determined directly by the key independently of any spring action during the time that the key is in the lock. As a further part of this feature of the invention, the manufacture and assembly of the lock is facilitated by mounting the rotary tumblers for rotation upon the key plug, and by forming the radially extending shoulders as ends that define an open side in each rotary tumbler whereby the rotary tumblers may be easily applied to the key plug.

I have thus outlined rather broadly the more

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important features of my invention in order that the detailed description thereof that follows may be better understood, and in order that my contribution to the art may be better appreciated. There are, of course, additional features of my invention that will be described hereinafter, and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which my disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out several purposes of my invention. It is important, therefore, that the claims to be granted me shall be of sufficient breadth to prevent the appropriation of my invention by those skilled in the art.

Referring now to the drawing:

Fig. 1 is a perspective view showing the preferred form of my improved lock.

Fig. 2 is a longitudinal sectional view taken substantially in the line 2-2 of Fig. 1, showing in elevation the inner parts of the lock and also a key therein.

Fig. 3 is a view similar to Fig. 2, but showing the key plug and the key in section to further illustrate the tumblers and the side bar.

Fig. 4 is a cross-sectional view taken on the line 4-4 of Fig. 2, showing the stop washer in one assembled position in which it will limit rotation of the key plug to 180°.

Fig. 5 is a view similar to Fig. 4, but showing the stop washer in another assembled position in which it will limit rotation of the key plug to 90°.

Fig. 6 is a cross-sectional view taken on the line 6-6 of Fig. 3, but showing the parts in the positions they would assume when the key has been removed from the lock.

Fig. 7 is a cross-sectional view similar to Fig. 6, but showing the key inserted and the tumblers positioned to release the side bar and thus permit rotation of the key plug.

Fig. 8 is a perspective view showing the side bar, the tumblers, and the bitted portion of the key in exploded relationship.

As shown in the drawing, the lock in which my invention is embodied is of the general class having a housing that may take the form of a cylinder 10 and key plug 11 mounted in the cylinder. The cylinder 10 is adapted to be mounted in any customary way in a door or other member to be locked, and may have external threads 12 and an outer flange 13 for this purpose. The key plug 11 is held assembled within the cylinder 10 with its head 14 (Fig. 2) at the

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forward end thereof. Nut 15 is threaded on a portion 16 of the key plug and secures a swinging cam 17 on a square portion 19 of the key plug 11 for rotation therewith. A stop washer 18 limits the rotating movements of the key plug 11 through a pair of outwardly extending lugs 20, 21, adapted to engage an abutment 22 on the cylinder 10 (Figs. 4 and 5).

In my improved lock, I employ a novel construction wherein both the rotary tumblers, and a further tumbler moving in a direction at an angle to the rotary tumblers, control a side bar that locks the key plug against rotation. Thus, I provide a series of rotary tumblers 24 that are of a generally circular U-shape, and that are mounted for coaxial rotation relatively to the key plug 11. Preferably, the rotary tumblers 24 are mounted in grooves in the periphery of the key plug 11 in such a way that the outer surfaces of the tumblers are flush with the surface of the key plug.

The ends of the rotary tumblers 24 are formed to provide radially extending shoulders 25, 26, that are engaged by bitted edges on the blade of a key K when the key is inserted through the front of the key plug 11 into a keyway 27 formed longitudinally in the lower portion of the periphery of the key plug, as shown in Fig. 7. Because the key K is so bitted as to engage both of the tumbler shoulders 25, 26, it will be seen that each of the rotary tumblers 24 will be positively moved and held in a predetermined position by the key when it is inserted into the keyway 27. Preferably the blade of the key K is laterally concave so as to be generally concentric with the key plug 11, the bittings thereon being formed radially of the key plug. It will also be noted that the ends of each U-shaped tumbler 24 define an open side in the tumbler which will permit the tumbler to be slipped or snapped over the key plug into one of the key plug grooves. This feature is quite novel and important.

The rotary tumblers 24 control a side bar 28 for locking the key plug 11 against rotation in the cylinder 10, the side bar in a locking position lying in one of two beveled grooves, 29, 30, formed longitudinally in the inner surface of the cylinder 10. The key plug 11 cannot rotate relatively to the side bar 28 because of depending fingers, 31, 32, 33, and also one elongated finger 34, that are formed integrally with the side bar and that are located between the tumblers 24 in a longitudinal slot 35 in the periphery of the key plug. However, the slot 35 is proportioned to receive the entire side bar 28 so as to release the key plug for rotation in the cylinder 10. This releasing action of the side bar may occur when the tumblers 24 are rotated by a properly bitted key K to bring tumbler gatings 36 in said tumblers into alignment with the side bar 28, provided the side bar is also released simultaneously by the further tumbler which is to be described.

The actual entry of the side bar 28 into the slot 35 and the gatings 36 will result from the camming action of the beveled sides of the slot 29 or 30, as the case may be, when a rotative force is applied to the key plug 11. The movement of the side bar 28 into the slot 35 will be accomplished against the force of a pair of coiled springs 37, 38 (Fig. 3), that press against the lower ends of the depending fingers 31 and 33 for the purpose of expelling the side bar from the gatings 36 when the key plug is to be locked. It will be observed at this point that if any great attempt is made to force the rotation of the key

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plug 11 when it is in locked condition, the side bar 28 will be crushed or otherwise deformed by the beveled sides of the slot 29 or 30, and will remain outwardly of the key plug so as to preclude release of the lock.

Although the rotary tumbler and side bar construction described constitutes in itself a valuable contribution to the art, the side bar of my improved lock is preferably controlled through the combined action of the rotary tumblers 24 and the further tumbler hereinbefore referred to, this further tumbler being moved to releasing position simultaneously with the rotary tumblers 24 by the properly bitted key. This further tumbler is indicated by the numeral 39, and is slidable longitudinally of the key plug 11 in a channel 40 formed in the key plug inwardly of the rotary tumblers 24. The further tumbler 39 is normally held in a forward position by a coiled spring 41 in the channel 40 behind the tumbler 39, said coil spring reacting against a base or plug 42 anchored within the channel by a staking 43. The elongated finger 34 of the side bar 28 extends downwardly as viewed in Fig. 3 into proximity with the further tumbler 39, so that release of the side bar cannot occur unless a gating 44 in the further tumbler is aligned with the elongated finger 34. The proper key K, however, has on its concave side a longitudinal ridge that provides an inner biting or shoulder 45 for engaging a lug or shoulder 46 depending from the further tumbler 39 into the keyway 27. Insertion of the key K into the keyway will push the further tumbler 39 to align the gating 44 with the elongated finger 34 of the side bar and thus permit release of the lock.

When the key plug 11 is to be locked and the key K is withdrawn therefrom, the spring 41 will, of course, move the push tumbler 39 forwardly until the gating 44 is no longer aligned with the finger 34, the side bar 28 previously having been projected into one of the cylinder grooves 29, 30, by the springs 37, 38. In order to insure also that the rotary tumblers 24 are dispersed when the key K is not in the lock, I provide a Z-shaped wire spring 47 (Fig. 2), the opposite legs of which are engaged with the sides of dovetail slots 48, in the peripheries of the rotary tumblers 24. The periphery of the key plug 11 is provided with a longitudinal groove 49 that contains the spring 47, and the spring preferably is anchored in position by a small central loop portion 50 received in an aperture in the bottom of the groove 49. It will be understood that the force of the Z-shaped dispersing spring 47 is insufficient to interfere with the action of the key K in rotating the tumblers 24, but will nevertheless be sufficient to hold the tumblers in a dispersed condition when the key is not in the key plug.

It will be apparent from the foregoing description that picking of my improved lock will be extremely difficult because of the fact that a person attempting to pick the lock must not only cope with the two shoulders 25, 26, on each rotary tumbler 24, but must also manipulate the longitudinally moving push tumbler 39 to a particular releasing position before the side bar 28 can be released. In order to render picking of the lock still more difficult, the peripheries of the rotary tumblers 24 preferably have false gatings 51 formed therein which will simulate the action of the true gatings 36 during the picking procedure. The false gatings 51 will allow some movement of the side bar 28, but this movement is insufficient to permit complete release of the side bar and

the alignment of any one of the false gatings with the side bar will prevent release of the lock.

In assembling my improved lock, the rotary tumblers 24 may be very easily slipped or snapped into place upon the key plug 11 because of the open side provided by their U-shape, after which they may be gated in accordance with any particular set of bittings on the key by inserting the key into the keyway 27 so as to position the tumblers 24, and then cutting the gatings 36 in these tumblers along the line of the slot 35 in the key plug 11. The false gatings 51 will, of course, be cut to a shallower depth at locations offset from the true gatings 36. The side bar 28 and the Z-shaped dispersing spring 47 will be applied prior to insertion of the key plug 11 into the cylinder 10. The longitudinally moving push tumbler 39 that operates in combination with the rotary tumblers 24 is formed with the gating 44 at the proper location to receive the elongated side bar finger 34 when this further tumbler is positioned by the inner biting or shoulder 45 of the key K. The push tumbler 39 preferably is inserted through the inner end of the channel 40, after which the spring 41 and the plug 42 are inserted and secured by the staking 43.

In view of the fact that the longitudinally moving push tumbler 39 is located within the rotary tumblers 24, the tumbler 39 multiplies the number of possible key changes without requiring any increase in the dimensions of the lock or in the length of the key. Thus, for example, if 5,000 changes are possible through the rotary tumblers 24 alone, and it is assumed that the gating 44 may be formed in any one of five different locations along the length of the push tumbler 39, the number of possible changes will then be 25,000.

I now claim:

1. In a lock of the class described, a cylinder, a key plug therein, movable means locking said key plug against movement relatively to said cylinder, a key positioned tumbler mounted on said key plug for controlling the movement of said movable locking means out of locking position, a further tumbler mounted on said key plug for movement relatively to said key plug in a direction angular to the movement of said first tumbler, and means whereby said further tumbler also controls the movement of said movable locking means out of locking position, both of said tumblers being moved by a single key to position releasing said movable locking means.

2. In a lock of the class described, a cylinder, a key plug therein, movable means locking said key plug against movement relatively to said cylinder, a key positioned rotary tumbler mounted on said key plug for controlling by its rotated position the movement of said movable locking means out of locking position, a further key positioned tumbler mounted in said key plug for movement relatively to said key plug in a direction angular to the rotary movement of said first tumbler, and means whereby said further tumbler also controls the movement of said movable locking means out of locking position, both of said tumblers being moved by a single key to position releasing said movable locking means.

3. In a lock of the class described, a cylinder, a key plug therein, a side bar locking said key plug against movement relatively to said cylinder, a key positioned rotary tumbler mounted on said key plug and having a peripheral gating for receiving said side bar whereby to control by its rotated position the movement of said side bar

out of locking position, and a further key positioned tumbler mounted for movement longitudinally of said key plug and having a gating for receiving said side bar whereby said further tumbler also controls through its longitudinal movement the movement of said side bar out of locking position, both of said tumblers being moved by a single key to releasing position wherein said side bar enters said gatings.

4. In a lock of the class described, a cylinder, a key plug therein having a keyway, movable means locking said key plug against movement relatively to said cylinder, a key positioned rotary tumbler mounted for rotation on said key plug and controlling by its rotated position relatively to said key plug the movement of said movable locking means out of locking position, shoulders formed radially on said rotary tumbler for engaging opposite edges of a properly bitted key inserted in said keyway whereby to determine positively the rotated position of the tumbler relatively to the key plug, and at least one of said shoulders coacting with the key for rotating said tumbler to release said movable locking means.

5. In a lock of the class described, a cylinder, a key plug movable therein, a key positioned rotary tumbler embracing said key plug, means whereby said tumbler controls by its rotated position relatively to said key plug the movement of said key plug in said cylinder, and radially formed ends on said rotary tumbler defining an open side in said tumbler, said open side being shaped to receive said key plug for entry laterally into said tumbler whereby to facilitate application of said tumbler to said key plug in assembly.

6. In a lock of the class described, a cylinder, a key plug therein, a side bar, means whereby said side bar when in a locking position locks said key plug against movement relatively to said cylinder, a key positioned tumbler mounted for rotation on said key plug and having a gating in its outer periphery for receiving said side bar whereby to control by its rotated position relatively to said key plug the movement of said movable side bar out of locking position, and radially formed ends on said rotary tumbler defining an open side in said tumbler, said open side being shaped to receive said key plug for entry laterally into said tumbler during assembly, said radially formed ends coacting with opposite edges of a properly bitted key whereby to determine positively the rotated position of the tumbler relatively to the key plug, and at least one of said radially formed ends coacting with the key for rotating said tumbler to releasing position in which said side bar may enter said gating.

7. In a lock of the class described, a cylinder, a key plug rotating in said cylinder, a series of tumblers rotating on said key plug, gatings in said rotary tumblers, a push tumbler mounted for sliding movement in said key plug, a gating in said push tumbler, a side bar for locking said key plug against rotation and movable in and out of locking position relatively to said cylinder, portions of said side bar being movable into said gatings when said gatings are aligned with said portions whereby to release the key plug for rotation, and said rotating tumblers and said push tumbler having portions contacted by a key to rotate said rotating tumblers and to move said push tumbler to align all of said gatings with said side bar.

8. In a lock of the class described, a cylinder,

a key plug therein, a side bar, means whereby said side bar when in a locking position locks said key plug against movement relatively to said cylinder, a series of key positioned rotary tumblers mounted in grooves in the periphery of said key plug and having gatings in their outer peripheries for receiving said side bar whereby to control by their rotated positions relatively to said key plug the movement of said side bar out of locking position, a further tumbler movable longitudinally of said key plug, said further tumbler having a gating whereby said further tumbler also controls the movement of said side bar out of locking position, shoulders formed radially on said rotary tumblers, and a shoulder on said further tumbler, said shoulders when engaged by a single key moving said tumblers to releasing positions wherein said side bar may enter said gatings.

9. In a combination of the class described, a cylinder, a key plug rotating in said cylinder, a series of tumblers rotating on said key plug, a push tumbler moving in said key plug in a direction at an angle to the rotating movement of said rotating tumblers, means through which said tumblers control by their positions the releasing and locking of said key plug in said cylinder, a key having edges bitted for moving said rotating tumblers to releasing positions as said key is inserted into said key plug, and said key being further bitted for moving said push tumbler to releasing position as said key is inserted into said key plug whereby all of said tumblers are moved simultaneously to releasing position by said key.

10. In a combination of the class described, a cylinder, a key plug rotating in said cylinder, a series of tumblers rotating on said key plug, a push tumbler moving in said key plug in a direction at an angle to the rotating movement of said rotating tumblers, means through which said tumblers control by their positions the releasing and locking of said key plug in said cylinder, spaced shoulders on each of said rotating tumblers, a shoulder on said push tumbler, a key bitted to engage said spaced shoulders on said rotating tumblers whereby to determine positively the rotated positions of the rotating tumblers relatively to the key plug, and said key coaxing with at least one of the shoulders on each rotating tumbler to move said rotating tumblers to releasing positions as said key is inserted into said key plug, and said key being further bitted for engaging said shoulder on said push tumbler whereby to move said push tumbler to releasing position simultaneously as said rotating tumblers are moved to releasing positions.

11. In a key of the class described, a blade having opposed edge surfaces to be bitted in accordance with a tumbler combination, and a ridge running longitudinally of said blade and having an end surface at a medial point on said blade, said end surface being bitted in accordance with a tumbler to be pushed by said ridge.

12. In a key of the class described, a laterally concave blade having opposed edge surfaces to be bitted in accordance with a tumbler combination, and a ridge running longitudinally of said blade on the concave side thereof and being bitted in accordance with a tumbler to be moved by said ridge.

13. In a lock of the class described, a cylinder, a key plug movable therein, a T-shaped side bar, means whereby said side bar when in a locking position locks said key plug against movement relatively to said cylinder, key positioned rotary tumblers mounted on said key plug and coaxing with the arms of said T-shaped side bar to control by their rotated positions the movement of said side bar out of locking position, and a further key-positioned tumbler movable relatively to said key plug and coaxing with the leg of said T-shaped side bar also to control the movement of said side bar out of locking position.

14. In a lock of the class described, a cylinder, a key plug movable therein, a key positioned rotary tumbler rotating on said key plug with a portion of its periphery aligned with the periphery of said key plug, means whereby said rotary tumbler controls by its rotated position relatively to said key plug the movement of said key plug in said cylinder, and ends formed on said rotary tumbler defining an open side in said tumbler, said open side being shaped to receive said key plug for entry laterally into said tumbler whereby to facilitate application of said tumbler to said key plug in assembly.

15. In a lock of the class described, a cylinder, a key plug movable therein, peripheral grooves in said key plug, key positioned rotary tumblers rotating in said grooves with their peripheries flush with the periphery of said key plug, means whereby said rotary tumblers control by their rotated positions relatively to said key plug the movement of said key plug in said cylinder, and ends formed on said rotary tumblers defining open sides in said tumblers, said open sides being shaped to receive said key plug at the location of said grooves for entry laterally into said tumblers whereby to facilitate application of said tumblers to said key plug and into said grooves in assembly.

16. In a lock of the class described, a cylinder, a key plug in said cylinder having a keyway, a side bar locking said key plug against movement relatively to said cylinder, a rotary tumbler mounted on said key plug and having a peripheral gating for receiving said side bar whereby to control by its rotated position the movement of said side bar out of locking position, a further tumbler mounted for movement longitudinally of said key plug and having a gating for receiving said side bar whereby said further tumbler through its longitudinal movement also controls the movement of said side bar out of locking position, and said tumblers having surfaces contacted by a key in said keyway of said key plug whereby to be moved by the key into a position with their gatings aligned relatively to said side bar.

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