July 30, 1963 M. M. CHECK 3,099,150

COMBINATION PUSH BUTTON LOCK

Filed Dec. 19, 1961 4 Sheets-Sheet 1

Fig. 1.

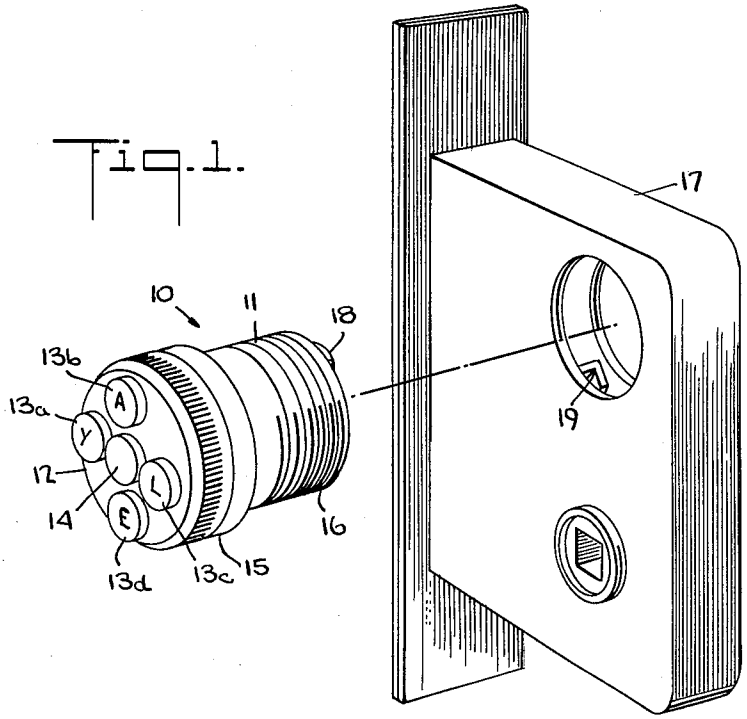
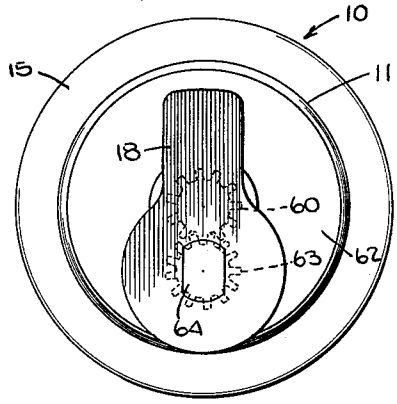


Fig. 2.



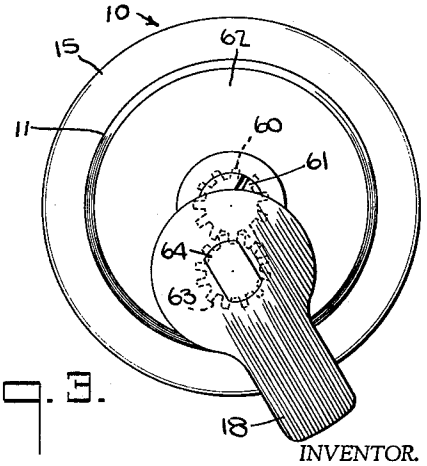


Fig. 3.

INVENTOR.
MATHIAS M. CHECK

BY

ATTORNEY

July 30, 1963 M. M. CHECK 3,099,150

COMBINATION PUSH BUTTON LOCK

Filed Dec. 19, 1961 4 Sheets-Sheet 2

Fig. 4.

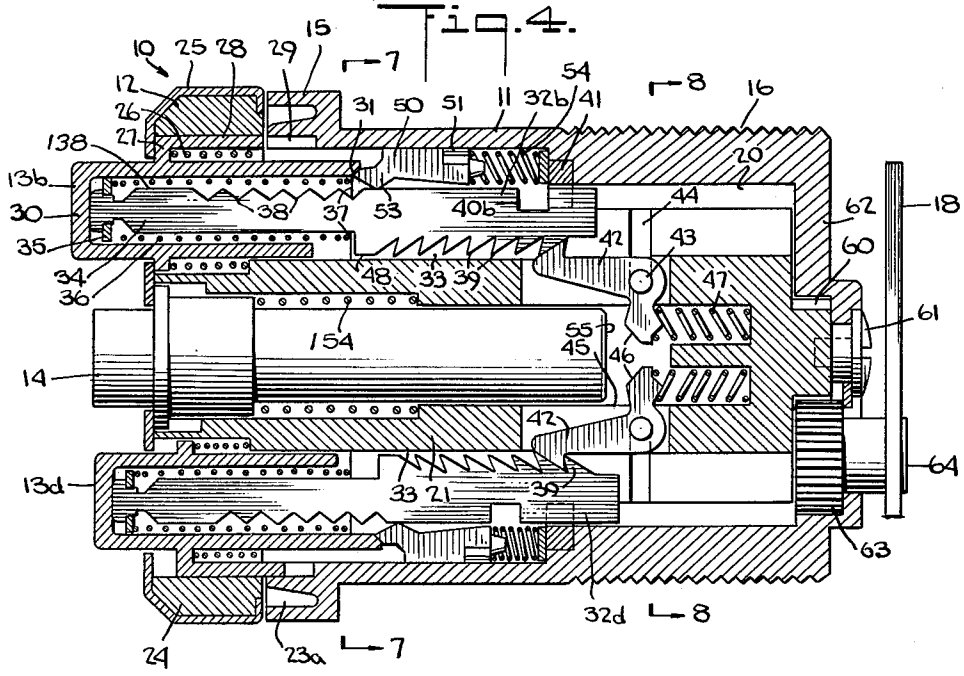
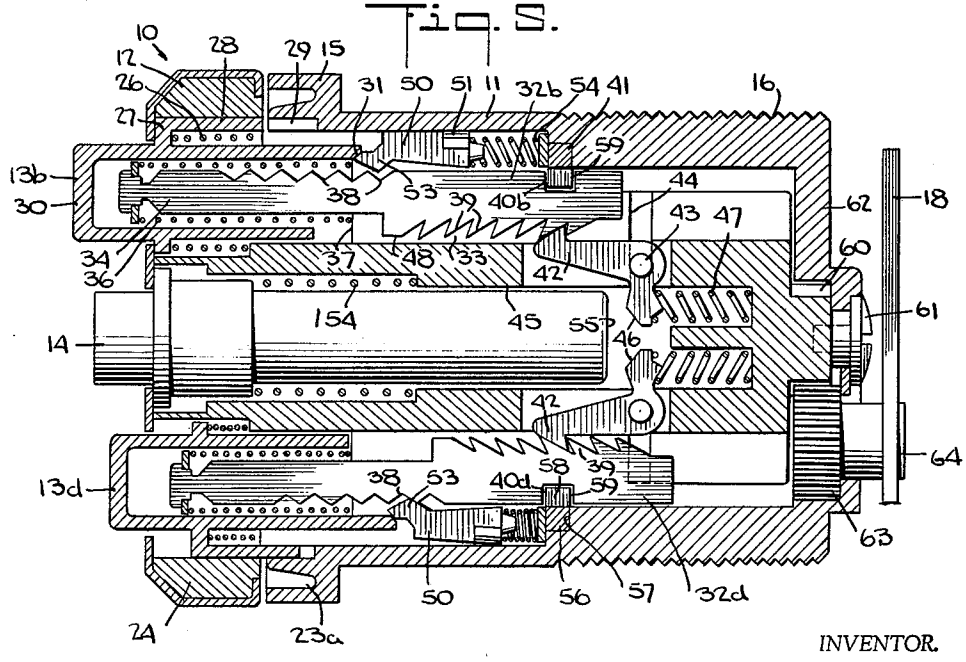


Fig. 5.



INVENTOR.
MATHIAS M. CHECK
BY
ATTORNEY

July 30, 1963 M. M. CHECK 3,099,150

COMBINATION PUSH BUTTON LOCK

Filed Dec. 19, 1961 4 Sheets-Sheet 3

Fig. 10.

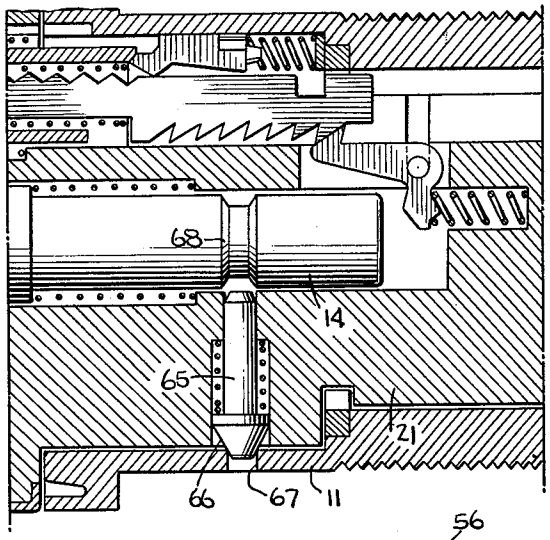


Fig. 6.

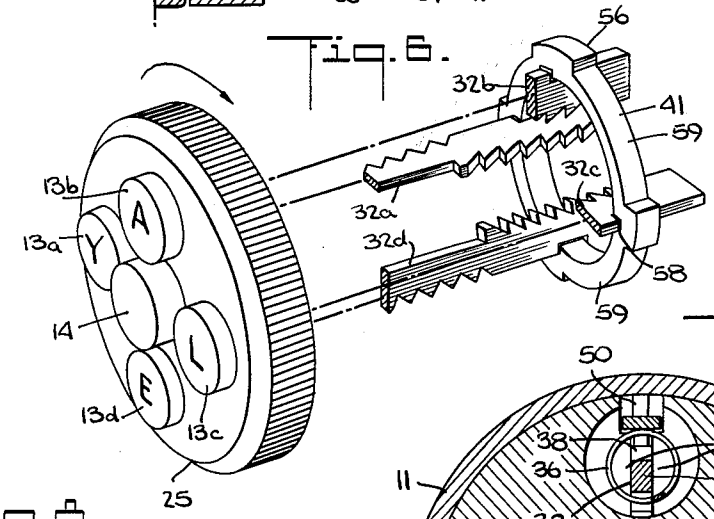


Fig. 7.

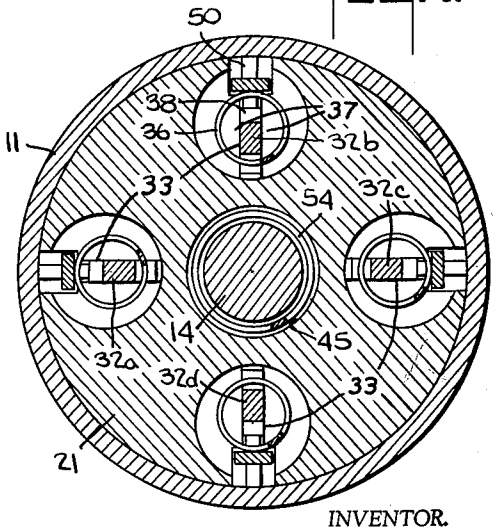
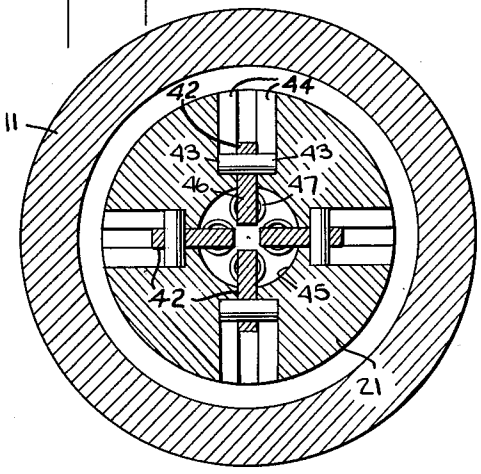


Fig. 8.



INVENTOR.
MATHIAS M. CHECK
BY
ATTORNEY

July 30, 1963 M. M. CHECK 3,099,150

COMBINATION PUSH BUTTON LOCK

Filed Dec. 19, 1961 4 Sheets-Sheet 4

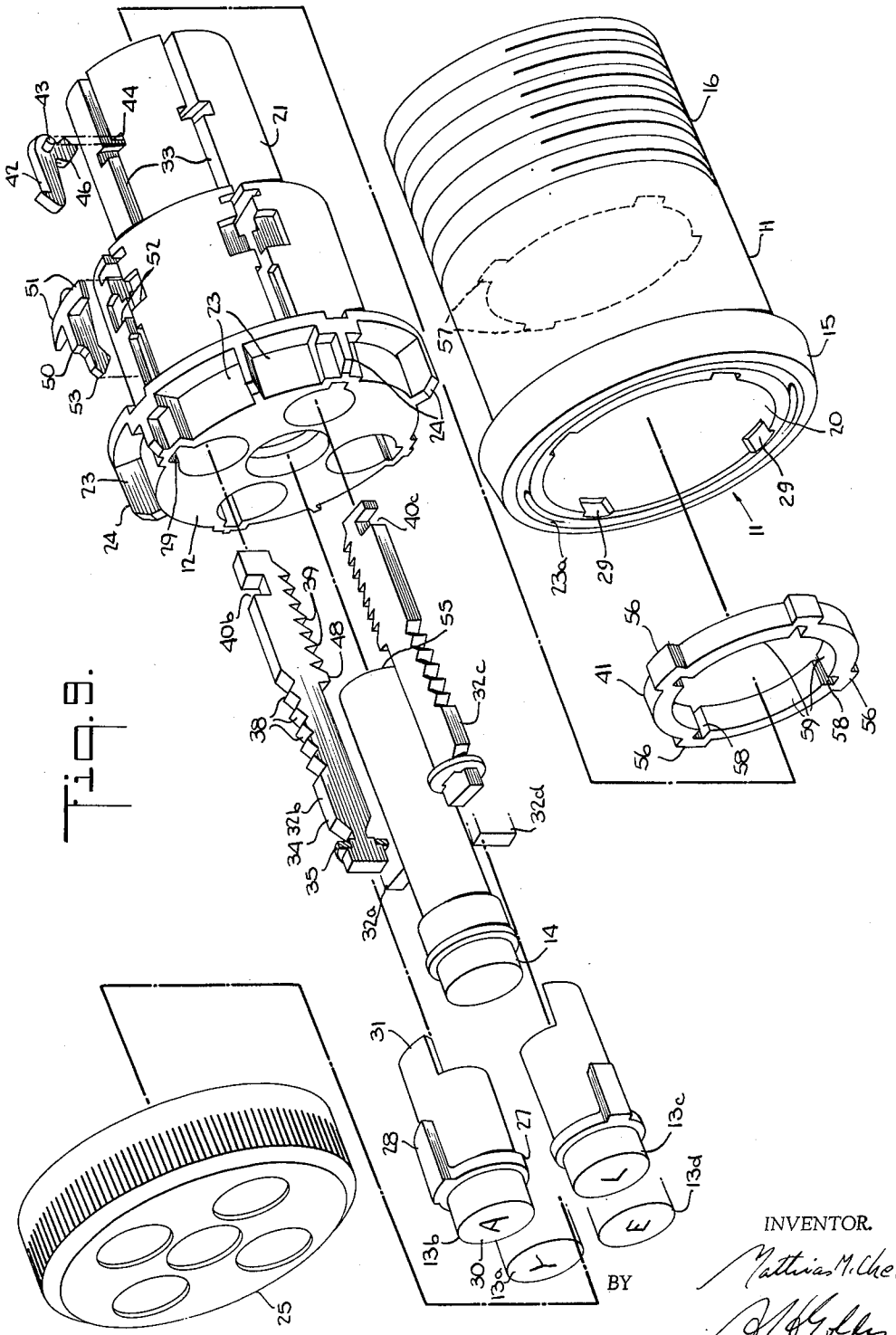


Fig. 9.

INVENTOR.
Matthias M. Check
BY
ATTORNEY

United States Patent Office 3,099,150 Patented July 30, 1963

3,099,150

COMBINATION PUSH BUTTON LOCK

Mathias M. Check, Strafford, Pa., assignor to The Yale and Towne Manufacturing Company, Stamford, Conn., a corporation of Connecticut

Filed Dec. 19, 1961, Ser. No. 160,556
19 Claims. (Cl. 70—313)

This invention relates to a combination lock, and more particularly to a novel combination lock of that type in which the tumblers are positioned by a series of push buttons.

Push button operated combination locks are quite old in the art and many attempts have been made to manufacture and sell such locks. So far as I know, no push button operated combination lock has ever been commercially successful, due mainly to the fact that the physical form and mode of operation of prior art locks have not been desirable. I believe that the push button combination lock that I have conceived, and which is described below, is particularly desirable because of its physical form, its mode of assembly to various types of lock mechanisms, and its operation.

As a feature of my invention, my combination lock is in the form of a cylinder that is readily adapted for assembly to various types of lock mechanisms for controlling those lock mechanisms in an effective manner, and in a manner that will be commercially desirable. Thus, as a particular feature of the invention, my lock utilizes a cylinder having a simple rotating plug that is released upon operation of a series of push buttons carried by the plug and rotatable therewith.

As a further feature of the invention, the rotating plug of my lock carries a series of tumblers for actuation by the push buttons, and for movement to release position upon effective operation of the push buttons in accordance with a particular combination. Thus, as an important feature, the cylinder in which the plug is mounted carries a series of locking lugs that project into the opening in which the plug rotates, the tumblers of the plug engaging in spaces provided between the lugs. Obviously, rotation of the plug will be prevented because the tumblers will impinge against the lugs upon attempted rotation of the plug. By providing the tumblers with gatings which may be set in alignment with the locking lugs, it is obvious that effective positioning of all of the tumblers will enable the plug to rotate freely.

It is possible through my concept to set the tumblers when the plug is in different rotated positions, since each push button is operated in the same manner for releasing the plug regardless of the rotated position of the plug. The particular feature is valuable for many reasons, but especially for permitting unlocking of the plug in the event that it may be inadvertently locked in a rotated position. Those skilled in the art also will appreciate that by locking the plug in a particular rotated position, the plug may be utilized to hold retracted, or dogged, or projected, a bolt or other lock mechanism.

As a still further feature of the invention, my cylinder and plug are adapted for mounting as a unit relatively to a lock casing in a conventional manner. Thus, the cylinder may be mounted in the same manner as is a commercial pin tumbler cylinder, while yet permitting effective push button combination tumbler operation. That is an extremely important contribution of my invention.

As a further particular feature, I prevent the application of picking torque by locking the plug against rotation when a push button is being actuated. Since the tumblers may be moved only by the push buttons, it

is obvious that it becomes impossible to manipulate the tumblers while picking torque is applied.

As a further feature of the invention, each of the push buttons is maintained in direct physical contact with a tumbler when that tumbler is in an outward initial locking position and the push button is in a projected position. Therefore, a first depression of a push button applies direct pressure to move its tumbler a particular predetermined distance. The tumbler is held by suitable detent mechanism in the position to which it has been so moved. Thereafter, further depressions of the push button act through a clutch action to move its tumbler step-by-step to release position. Upon positioning of all the tumblers in release position, they will be held in release position to permit rotation of the plug. Therefore, the combination mechanism of my lock may be released, and maintained released indefinitely.

Through effective operation of a reset mechanism, preferably including a button, the tumblers may be placed in locking position while the plug is in any rotated position, so long as the plug has first been rotated to align the tumblers with the spaces between the locking lugs. Obviously, the tumblers may again be set in release position through the some operation of the push buttons that was initially required to release the plug for rotation. Thus, my novel push button lock may have a practically unlimited number of locking positions, depending upon the design of the particular lock.

I have thus outlined rather broadly the more 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 the several purposes of my invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of my invention, in order to prevent the appropriation of my invention by those skilled in the art.

In the drawings:

FIG. 1 shows a perspective view of my novel push button lock, with a conventional lock casing to which it may be assembled;

FIGS. 2 and 3 are rear end views of my lock;

FIG. 4 is a longitudinal section showing parts of my lock in certain positions;

FIG. 5 shows further positions of the parts;

FIG. 6 is a perspective view showing the tumbler and fence arrangement;

FIGS. 7 and 8 are sections on the lines 7—7 and 8—8 in FIG. 4;

FIG. 9 is an exploded view showing the mechanism of my lock;

FIG. 10 shows a control pin that I may use in my lock.

Referring now more particularly to FIG. 1 of the drawings, my novel push button lock **10** icludes a cylinder **11** and a knob or head **12** that rotates at the front end of cylinder **11**. The knob or head **12** is equipped with a series of push buttons **13***a*, **13***b*, **13***c*, **13***d*, that may be depressed in the proper combination to effect release of my lock, and a reset button **14** that may be depressed to effect locking. Just behind the knob or head **12**, the cylinder **11** has a flange **15** that will lie against the outer surface of a door when the cylinder is assembled in an opening in the door. I show screw threads **16** formed on a rearward portion of cylinder **11** for mounting my lock

in a threaded opening in a lock casing **17** on the door, a cam **18** on the cylinder then being in position to actuate lock mechanism **19** in the casing **17**, as I shall presently describe in full detail. It is to be understood that I show the screw threads **16** and lock casing **17** merely to emphasize that my cylinder lock may be assembled to a lock in a conventional manner, this being an extremely important feature.

To proceed with a description of my novel push button lock, I shall first refer to FIGS. 4 and 9 of the drawings. It will be seen that I form the cylinder **11** with a stepped opening **20** that extends inwardly from the front end of the cylinder. The head **12**, to which I have referred, is integral with a plug **21** that is fitted in the cylinder opening **20** so as to rotate in the longitudinal axis of the cylinder. At this point, I may call attention to the fact that I relieve the material of the plug head **12** to form recesses **23**, shown in detail in FIG. 9, thus leaving relatively weak portions **24** between the recesses **23**. A rather conventional sheet metal scalp **25** is formed over the head **12**, covering the recesses **23** and portions **24**. Should a tool be forcibly applied to the scalp **25**, in an attempt to rotate the plug **21** when it is locked, the scalp **25** and portions **24** will yield while the plug remains locked. I further form a circular recess **23***a* in the flange **15** on cylinder **11**, causing the flange **15** to yield should the tool be applied to the flange.

Since the push buttons **13***a*, **13***b*, **13***c*, **13***d* are alike, I shall describe merely one of those buttons and its related mechanism, referring particularly to button **13***b*. As will be understood from FIGS. 4 and 9, the button **13***b* is mounted to slide longitudinally in openings in the plug head **12** and scalp **25**. A coil spring **26**, FIG. 4, is assembled about the button **13***b* and acts against a flange **27** on the button to press the flange toward the inner surface of scalp **25**, holding the button normally in a projected position. One side of the push button **13***b*, that being the upper side as viewed in FIG. 4, has an integral dogging portion **28** extending inwardly from the flange **27**. The cylinder **11** has a slot **29** that is adapted to accept the dogging portion **28**, so as to interlock the plug **21** and cylinder **11** to prevent rotation of the plug whenever the button **13***b* is depressed from its fully projected position. As shown in FIG. 4, button **13***b* is made hollow for a substantial part of its length while having an outer end wall **30**. Button **13***b* is further formed with a cam portion **31** at its inner end, to which I shall refer again.

I equip my novel lock with a series of bar-like tumblers **32***a*, **32***b*, **32***c*, **32***d*, FIGS. 6, 7 and 9, that slide in longitudinal slots **33** arranged around the periphery of the rotating plug **21**. One of those tumblers is actuated by each of the push buttons, it being understood that push button **13***b* actuates tumbler **32***b*. Referring to FIG. 4, it will be seen that a stem portion **34** of tumbler **32***b* is mounted to slide within the button **13***b*, being equipped with a washer **35** for that purpose. A coil spring **36** is seated on shoulders **37** on the plug **21** and acts against the washer **35**, normally pressing the stem portion **34** of tumbler **32***b* into contact with the end wall **30** on button **13***b*.

The upper edge of tumbler **32***b*, as view in FIG. 4, is formed with a series of driver notches **38** while its lower edge has ratchet teeth **39**. Further, tumbler **32***b* has a gating **40***b* that is formed at a point on a longitudinal edge of the tumbler. The tumbler **32***b* with its gating **40***b* will coact with a fence **41** for controlling the rotation of the plug **21** in a manner that I shall described. It will be appreciated, of course, that the tumblers **32***a*, **32***b*, **32***c*, **32***d* may differ as to the longitudinal points at which their gatings are formed, those points being chosen to set up the desired combination in the lock. However, the tumblers may easily be made from blanks that are alike, it merely being necessary to form each blank with a particular gating.

Returning to the tumbler **32***b*, it will be seen in FIG. 4 that the ratchet teeth **39** on that tumbler coact with a corresponding detent **42**, there actually being one detent **42** for each tumbler. The construction of detents **42** will be understood when considering FIGS. 8 and 9 together with FIG. 4, each detent having opposed shaft portions **43** mounted to rotate in slots **44** on the plug **21**, and being arranged in an opening that extends between the corresponding tumbler slot **33** and an axial bore **45** in plug **21**. An arm **46** on each detent **42** extends into the axial bore **45**, and a coil spring **47** acts against that arm to press the detent toward the ratchet teeth **39** on a corresponding tumbler. Thus, if we assume that tumbler **32***b* is moved inwardly, the corresponding detent **42** will be effective to hold the tumbler **32***b* against the outward pressure of its spring **36**. At this point, it may be noted that I form tumbler **32***b* with a plain surface **48** just beyond the teeth **39**, so that detent **42** will not hold the tumbler should the tumbler be moved inwardly beyond a predetermined position. Also, tumbler **32***b* has a plain surface **138** beyond the driver notches **38**, for reasons I shall describe.

I have already referred to the cam surface **31** that is formed on the inner end of push button **13***b*, FIG. 4. Coacting with that cam surface **31** is a corresponding tumbler driver **50**. As shown in more detail in FIG. 9, tumbler driver **50** is generally T-shaped, having at one end two projecting side portions **51** that can slide and also rotate in recesses **52** in plug **21**. At its opposed end, driver **50** has a beveled tooth **53**. A coil spring **54**, FIG. 4, presses the driver **50** in a longitudinal direction, pressing its tooth **53** against the cam surface **31** on button **13***b*. The arrangement is such that spring **54** also tends to rotate the driver **50**, normally pressing it in a direction away from tumbler **32***b* and toward the inner surface of cylinder **11**, all as shown in FIG. 4.

The manner in which the tumblers are actuated will be best understood if we first consider that FIG. 4 shows push button **13***b* and tumbler **32***b* in their normal position. Push button **13***b* is in contact with the outer end of tumbler stem **34**, and if depressed will act directly against tumbler **32***b* to move it inwardly. That movement of a tumbler actually is illustrated by the position of the tumbler **32***d* in FIG. 4, with button **13***d* moving that tumbler so as to engage its first ratchet tooth **39** with the corresponding detent **42**.

In FIG. 5, the tumbler **32***b* illustrates the position of a tumbler after a first depression and release of its push button. Thus, the push button **13***b* in FIG. 5 has been returned by its spring **26** to projected position, but tumbler **32***b* is held by its detent **42** in a first depressed position. It will be seen that button **13***b* in the FIG. 5 position cannot again act directly to move tumbler **32***b*, because the end wall **30** of that button now is spaced from the tumbler. However, the first driver notch **38** on tumbler **32***b* now is opposite the tooth **53** on the corresponding driver **50**. Thus, if push button **13***b* is now depressed a second time, the cam surface **31** on that button will cause tooth **53** on the corresponding driver **50** to rotate into the first driver notch **38**, clutching button **13***b* to tumbler **32***b* and enabling that button again to slide tumbler **32***b*.

The actual driver operation is illustrated in reference to the push button **13***d* in FIG. 5. Thus, button **13***d* in FIG. 5 is being depressed a third time, causing the corresponding driver **50** to engage the second driver notch of tumbler **32***d* and sliding that tumbler to a third depresesd position in which it will be held by its detent **42**. Subsequent depressions of a push button will act in like manner, with the appropriate driver **50** engaging successive driver notches **38** on a tumbler to move the tumbler step-by-step to still further depressed positions.

I now call attention to the fact that it will be impossible to damage a tumbler in my lock by depressing a push button an excessive number of times. That will be understood when it is seen that tumbler **32***b*, for example, when moved inwardly a predetermined distance, will position its plain surface **138** opposite its corresponding driver **50**. Then, that driver no longer can engage a

notch 38 and will not move the tumbler 32*b*. Also, a detent 42 will not hold its tumbler when engaging the plain surface 48 on the tumbler. Thus, after a push button has been depressed a predetermined number of times, the button cannot set its tumbler in a further position. Therefore, a button will not move its tumbler beyond a normal limit position and cannot apply pressure that would injure the lock.

The tumblers 32*a*, 32*b*, 32*c*, 32*d* may reset in their normal locking positions through the reset button 14, FIG. 4. That button 14 slides in the axial bore 45 in the plug 21, and has an end portion 55 that will engage the detent arms 46 when the button is depressed against the pressure of a spring 154. Thereby the reset button 14 will rotate detents 42, moving the detents away from the tumblers and enabling the tumbler springs 36 to return the tumblers to normal position.

Thus far, I have confined my description to the tumbler and button mechanism that I utilize in my novel push button lock. I shall now describe the fence 41 and the extremely novel manner in which that fence acts together with the tumbler mechanism. In the construction that I prefer, the fence 41 is a ring-like member, best seen in FIGS. 6 and 9, that is assembled within the stepped cylinder opening 20. The fence 41 is formed with key portions 56 that engage recesses 57 in the cylinder 11, so that the fence and cylinder are interlocked. The inner periphery of the fence 41 is formed with a series of lugs 59, FIGS. 6 and 9, that project inwardly along the inner circumference of the cylinder 11, with slots 58 between the lugs.

As will be understood from FIG. 6, one tumbler 32*a*, 32*b*, 32*c*, 32*d*, is adapted to move longitudinally in each fence slot 58, or in other words, between two juxtaposed lugs 59. Thus, when in a normal locking position, each tumbler coacts with the fence lugs so as to lock the plug 21 against rotation in cylinder 11. That locking position of a tumbler is illustrated by the tumbler 32*b* in FIG. 4, for example.

If we refer to the tumbler 32*b* in FIG. 5, we see the release position of a tumbler. Thus, in FIG. 5, tumbler 32*b* has been actuated by its push button 13*b* to align its gating 40*b* with the fence lugs 59. When all of the tumblers 32*a*, 32*b*, 32*c*, 32*d* have been actuated to release position, their gatings will be aligned with lugs 59, so that the plug 21 no longer will be locked and may be rotated, as will be understood.

In order to actuate the cam 18, I form the rearward end of plug 21 in my preferred construction with a relatively small integral gear 60 that is shown in FIGS. 4 and 5, and in dotted lines in FIGS. 2 and 3. I may incidentally equip gear 60 with means for retaining the plug 21 in cylinder 11, as by a screw 61 extending through an opening in rear end wall 62 on cylinder 11 and threaded into an axial opening in gear 60. The gear 60 meshes with a further gear 63 rotating in an axis that is offset relatively to the axis of plug 21 on the cylinder 11. Gear 63 has a stub shaft 64 that projects beyond the rear end wall 62 of the cylinder, and that carries the cam 18. When the cam 18 is in one position, as in FIGS. 1, 2, 4 and 5, that cam will lie within the outer periphery of cylinder 11, enabling the cylinder to be threaded into the opening of the casing 17, FIG. 1. Nevertheless, the plug 21 by rotating can rotate cam 18 beyond the periphery of cylinder 11, as is indicated in FIG. 3, enabling the cam to actuate the lock mechanism 19 in the casing. Thus, cam 18 will effectively operate while the actual rotation of the plug 21 is in the longitudinal axis of cylinder 11.

Perhaps the importance of that feature will be better appreciated when it is realized that the tumblers 32*a*, 32*b*, 32*c*, 32*d* coact with the fence 41 at points that also are arranged about the axis of cylinder 11. Moreover, each particular tumbler may coact with several different points on the fence 41, those points being represented by the four slots 58 in the construction I have chosen to illustrate. Thus, the plug 21 when released may be rotated to several different positions, and then locked in any of those positions by the tumblers 32*a*, 32*b*, 32*c*, 32*d*. That locking will be effected by merely depressing the reset button 14 when the plug 21 is in the desired position, causing the tumblers to move into locking position at the particular points relatively to the fence lug 59. Actually, regardless of the rotated positions of the plug 21, each push button 13*a*, 13*b*, 13*c*, 13*d* will be operated in the same manner for releasing the plug 21. Also, reset button 14 may be operated for locking the plug in any rotated position.

Thereby I may utilize my novel push button lock for achieving several lock functions, such as the locking of a bolt mechanism, the dogging of a bolt in projected position, or the holding of a bolt in retracted position. Further, my lock can do those things when used with lock mechanisms that may require the plug or cam to rotate through different angles, or when the mechanisms require the plug to have locking positions that are in a different angular relation to the lock cylinder.

It will be impossible to decode my lock through an application of pressure to the push buttons. Thus, should a push button be depressed, its dogging portion 28 will interlock with the cylinder 11 so that the plug 21 cannot be rotated. It is not then possible to apply pressure between the fence 41 and the tumblers, as would be necessary to detect the position of the tumbler gatings.

In FIG. 10, I show a construction that I may utilize in my cylinder when it is desired to apply further control to the locking operation. As shown, that construction has a control pin 65 that is spring pressed in an outward direction in a radial opening in plug 21, the opening being arranged in angular position intermediate two of the tumbler slots 33. The outer end of pin 65 has a tapered head 66 that engages an opening 67 in the side of the cylinder 11 when plug 21 is in a predetermined locking position. The inner end of pin 65 is in opposed relation to a circular groove 68 that I form on reset button 14. When the plug 21 is rotated from its predetermined locking position, the opening 67 cams the tapered head 66 inwardly, causing pin 65 to engage the groove 68 in reset button 14. Thus, when the tumblers 32*a*, 32*b*, 32*c*, 32*d* have been set in release position, and the plug 21 has been rotated from its predetermined locking position, the reset button 14 cannot be operated to effect locking movement of the tumblers until the plug has again rotated to its predetermined position.

The particular construction utilizing control pin 65 will be of value to control locking of the plug 21, when my lock is used in an application that requires merely one locking position of the plug. Of course, it will be appreciated that I may utilize the control pin 65 to control two or more predetermined locking positions, merely by forming further openings like the opening 67 at the proper points on the sides of cylinder 11.

I believe that those persons skilled in the art will now understand that I contribute an exceedingly novel push button lock that will operate very effectively, and that is very well adapted for use with existing types of lock mechanisms. Moreover, through the different locking or control positions that are possible, my push button lock will be effective for controllong different lock functions. These things I accomplish while achieving a high degree of security. Therefore, I believe that the very considerable merits of my invention will be fully appreciated.

I now claim:

1. In a lock of the class described,
a cylinder,
a plug rotatably mounted in the cylinder,
a series of push buttons mounted on said plug and each adapted to be depressed one or more times from a normal projected position to a limit position and each

time to be returned to its initial projected position from said limit position,

tumblers locking the plug and actuated by the depression of said push buttons to release said plug for rotation,

and a portion on each push button interlocking with the cylinder when the button is depressed whereby to dog the plug against rotation while said tumblers are being moved by said push buttons.

2. In a lock of the class described,

a cylinder,

a plug rotatably mounted in the cylinder,

a series of push buttons mounted on said plug and adapted to be depressed from a normal projected position,

tumblers locking the plug and actuated by the depression of said push buttons to release said plug for rotation,

and means actuated by said push buttons for interlocking the cylinder and plug when a button is depressed, whereby to dog the plug against rotation while said tumblers are being moved by said push buttons.

3. In a lock of the class described,

a cylinder,

a plug rotatably mounted in the cylinder,

a series of push buttons mounted on said plug and each adapted to be depressed one or more times from a normal projected position to a limit position and each time to be returned to its initial position projected from said limit position,

a series of tumblers mounted for axial movement parallel to said push buttons with one tumbler impinging against each push button when said tumbler is in an initial spring pressed position,

means whereby each push button directly depresses its tumbler in the axis of movement of said tumbler when said push button is depressed a first time,

clutch means through which each push button depresses its tumbler thereafter,

said tumblers locking said plug against rotation relatively to said cylinder until depressed by said push buttons into a release position,

dogging means for holding each tumbler against movement from any depressed position to said initial projected position,

and release means for said dogging means.

4. In a lock of the class described,

a cylinder having a central opening with a series of lugs protruding into said opening along a particular circumferential section,

a plug mounted in said cylinder opening for rotation in a particular axis,

a series of push buttons mounted for axial movement in said plug parallel to said axis of rotation of said plug,

a series of tumblers in said plug movably mounted relatively thereto and lying each initially in a locking position coacting with said lugs to prevent rotation of said plug,

means whereby said push buttons move said tumblers to align a gating in each tumbler relatively to all of said lugs when said push buttons are operated in accordance with a predetermined combination whereby to release said plug for rotation from any rotated position of said plug in said cylinder,

detent means for locking each of said tumblers in its release position to allow free rotation of said plug,

and means effective when the tumblers are so locked for releasing said tumblers for movement to their initial position locking said plug in any rotated position in said cylinder.

5. In a lock of the class described,

a cylinder having a central opening with a series of lugs protruding into said opening along a particular circumferential section,

a plug mounted in said cylinder opening for rotation in a particular axis.

a series of push buttons mounted for limited axial movement in said plug parallel to said axis and spring pressed to a projected position,

a series of tumblers in said plug movably mounted relatively thereto and each spring pressed to an initial position coacting with said lugs to prevent rotation of said plug,

means whereby said push buttons when depressed against their springs move said tumblers against the tumbler springs to align a gating in each tumbler relatively to all of said lugs when said push buttons are operated in accordance with a predetermined combination whereby to release said plug for rotation from any rotated position of said plug in said cylinder,

detent means for locking each of said tumblers in its release position to allow free rotation of said plug,

and means effective when the tumblers are so locked for releasing said tumblers for spring pressed movement to said initial position locking said plug in any rotated position in said cylinder.

6. In a lock of the class described,

a cylinder having a central opening with a series of lugs protruding into said opening along a particular circumferential section,

a plug mounted in said cylinder opening for rotation in the cylinder axis,

a series of push buttons mounted for axial movement in said plug parallel to said axis,

a series of tumblers in said plug movably mounted relatively thereto and lying each normally in a locking position coacting with said lugs to prevent rotation of said plug,

means for positioning said tumblers by operation of said push buttons whereby to align a gating in each tumbler relatively to all of said lugs to release said plug for free rotation from any rotated position of said plug in said cylinder,

said tumblers when moved into a locking position locking said plug in any rotated position in said cylinder.

7. In a lock of the class described,

a cylinder having a central opening with a series of lugs protruding into said opening along a particular circumferential section,

a plug mounted in said cylinder opening for rotation in a particular axis,

a series of push buttons mounted for axial movement in said plug parallel to said axis,

a series of tumblers mounted each for movement in said plug for coacting with certain of said lugs to lock the plug in one rotated position,

each tumbler adapted to coact with other of said lugs whereby to lock the plug when the plug is in another rotated position,

and means for positioning said tumblers by operation of said push buttons whereby to align a gating in each tumbler relatively to all of said lugs to release said plug for free rotation from each of said rotated positions of said plug in said cylinder.

8. In a lock of the class described,

a cylinder having a central opening,

a plug mounted for rotation in said cylinder opening,

said plug having a series of longitudinal slots arranged around the periphery of the plug,

a series of lugs protruding into the central opening on said cylinder and into juxtaposed relation to the plug slots,

tumblers mounted to slide in said slots and normally lying in position coacting with the lugs on the cylinder to lock the plug against rotation,

a series of push buttons on said plug,

and means effective through operation of each push button to slide a tumbler for setting the tumblers

in release position relatively to the cylinder lugs whereby to allow the plug to rotate.

9. In a lock of the class described,
a cylinder having a central opening,
a plug mounted for rotation in said cylinder opening,
said plug having a series of longitudinal slots arranged around the periphery of the plug,
a tumbler mounted to slide in each slot,
a series of lugs protruding into the cylinder opening along a particular circumferential section on said cylinder,
opposed sides of said lugs contributing openings in which the tumblers engage to lock the plug against rotation,
a series of push buttons on said plug,
and means effective through operation of each push button to slide a tumbler for aligning a gating in each tumbler relatively to the cylinder lugs whereby to allow the plug to rotate.

10. In a lock of the class described,
a casing,
a lock mechanism in said casing,
a cylinder,
screw threads on said cylinder and on said casing whereby said cylinder may be threaded into a mounted position at least partially in said casing,
a plug mounted in said cylinder for rotation in a predetermined axis,
a series of push buttons mounted for axial movement on said plug parallel to said axis,
a series of tumblers in said plug,
means for positioning said tumblers by operation of said push buttons,
said tumblers locking said plug against rotation relatively to said cylinder until moved by said push buttons into a release position,
a cam mounted on said cylinder for rotation on an axis parallel to the axis of rotation of said plug but offset relatively thereto, with said cam lying within the periphery of said cylinder to permit threading rotation of said cylinder into said casing,
and means whereby rotation of said plug effects rotation of said cam beyond the periphery of said cylinder to actuate said lock mechanism.

11. In a lock of the class described,
a casing,
a lock mechanism in said casing,
a cylinder having a central opening with a series of lugs protruding into said opening along a particular circumferential section,
screw threads on said cylinder and on said casing whereby said cylinder may be threaded into a mounted position at least partially in said casing,
a plug mounted in said cylinder for rotation in a predetermined axis,
a series of push buttons mounted for limited axial movement in said plug parallel to said axis and spring pressed to a projected position,
a series of tumblers in said plug movably mounted relatively thereto and each spring pressed to an initial position coacting with said lugs to prevent rotation of said plug,
means whereby said push buttons when depressed against their springs move said tumblers against the tumbler springs to align a gating in each tumbler relatively to all of said lugs when said push buttons are operated in accordance with a predetermined combination whereby to release said plug for free rotation from any rotated position of said plug in said cylinder,
a cam mounted on said cylinder for rotation on an axis parallel to the axis of rotation of said plug but offset relatively thereto, with said cam lying within the periphery of said cylinder to permit threading rotation of said cylinder into said casing,

and means whereby rotation of said plug effects rotation of said cam beyond the periphery of said cylinder to actuate said lock mechanism.

12. In a lock of the class described,
a casing,
a lock mechanism in said casing,
a cylinder having a central opening with a series of lugs protruding into said opening along a particular circumferential section,
means on said cylinder and on said casing whereby said cylinder is mounted on said casing,
a plug mounted in said cylinder for rotation in a predetermined axis,
a series of push buttons mounted for limited axial movement in said plug parallel to said axis and spring pressed to a projected position,
a series of tumblers in said plug movably mounted relatively thereto and each spring pressed to an initial position coacting with said lugs to prevent rotation of said plug,
means whereby said push buttons when depressed against their springs move said tumblers against the tumbler springs to align a gating in each tumbler relatively to all of said lugs when said push buttons are operated in accordance with a predetermined combination whereby to release said plug for free rotation from any rotated position of said plug in said cylinder,
a cam mounted on said cylinder for rotation on an axis parallel to the axis of rotation of said plug but offset relatively thereto,
and means whereby rotation of said plug effects rotation of said cam to actuate said lock mechanism.

13. In a lock of the class described,
a cylinder,
a plug mounted in said cylinder for rotation in a predetermined axis,
a series of push buttons mounted for axial movement on said plug parallel to said axis,
a series of tumblers in said plug,
means for positioning said tumblers by operation of said push buttons, said tumblers locking said plug against rotation relatively to said cylinder until moved by said push buttons into a release position,
a cam mounted on said cylinder for rotation on an axis parallel to the axis of rotation of said plug but offset relatively thereto,
and means whereby rotation of said plug effects rotation of said cam.

14. In a lock of the class described,
a casing,
a lock mechanism in said casing,
a cylinder,
means on said cylinder and on said casing for mounting said cylinder with its rear end in predetermined relation to the casing and its lock mechanism,
a plug mounted for rotation in a longitudinal axis in said cylinder,
a series of push buttons mounted for longitudinal movement on said plug at the front end of the cylinder,
a series of tumblers in said plug,
means for positioning said tumblers by operation of said push buttons,
said tumblers locking said plug against rotation relatively to said cylinder until moved by said push buttons into a release position,
a lock mechanism actuating member having one end portion mounted on said cylinder for rotation of said member on an axis offset relatively to the axis of rotation of said plug,
an opposed end portion of said actuating member extending in coacting relation to the lock mechanism in the casing when the rear end of said cylinder is mounted in its predetermined relation to said casing,
and means extending between the plug and lock actuat-

ing member on said cylinder whereby rotation of said plug effects rotation of said member to actuate said lock mechanism.

15. In a lock of the class described,
a cylinder,
a plug mounted to rotate in said cylinder with a front end portion of the plug exposed,
a series of movable tumblers controlling the rotation of the plug,
a series of push buttons mounted on the exposed front end portion of said plug,
a tumbler driver actuated by each push button,
each tumbler having notches successively engaged by a corersponding driver to move the tumbler to an extreme position when the driver is actuated by depression of its push button a predetermined number of times,
and a surface on each tumbler holding its driver in an inactive position after the tumbler has moved to its extreme position, whereby an operation of the push button will be ineffective to damage the lock through movement of the tumblers beyond their extreme position.

16. In a lock of the class described,
a cylinder,
a plug having an end portion exposed at the front end of the cylinder to enable the plug to be manually rotated in the cylinder,
a series of push button actuated tumblers,
an opening mounting each tumbler for longitudinal movement between locking and release positions on the key plug,
a fence integral with the cylinder and relatively to which the plug and tumblers rotate when the tumblers are in release position,
parts of said fence having openings in which the tumblers are engaged when in locking position,
and said fence parts being closely juxtaposed to the tumbler openings in the rotating plug so that the tumblers in locking position will oppose forceful rotation of the plug.

17. In a lock of the class described,
a cylinder,
a plug having a head exposed at the front end of the cylinder to enable the plug to be manually rotated in the cylinder,
the material of the plug head being relieved to form one or more cavities extending around a greater part of the periphery of the head,
a series of push buttons on said head of the plug for controlling the rotation of the plug,
a scalp covering the plug head and its cavities and having openings through which the push buttons extend,
and said cavities causing the scalp to yield and to become deformed due to the application of a tool when a forceful attempt is made to rotate the plug.

18. In a lock of the class described,
a cylinder,
a plug having a head exposed at the front end of said cylinder to enable the plug to be manually rotated in the cylinder,
a circular fence in said cylinder,
a series of tumblers mounted in a circular arrangement on the plug with each tumbler in position to coact with a corresponding point on the fence for locking the plug against rotation,
a series of push buttons on the head of the plug,
means whereby said push buttons when depressed in a predetermined combination move each tumbler to a release position relatively to the fence,
a reset button mounted on the plug head and adapted to be depressed to reset the tumblers in locking position relatively to their corresponding points on the fence,
and said reset button being effective to reset the tumblers when the plug has been rotated to place each tumbler in position to coact with a fence point corresponding to another tumbler, whereby to enable the tumblers to lock the plug in several different rotated positions.

19. In a lock of the class described,
a cylinder,
a plug having a head exposed at the front end of said cylinder to enable the plug to be manually rotated in the cylinder,
a circular fence in said cylinder,
a series of tumblers mounted in a circular arrangement on the plug,
each tumbler having a portion for coacting with a corresponding point on the fence for locking the plug in a predetermined rotated position,
a series of push buttons on the head of the plug,
means whereby said push buttons when depressed in a predetermined combination move each tumbler to a release position relatively to the fence,
a reset button mounted on the plug head and adapted to be depressed to reset the tumblers in locking position when the plug is in its predetermined rotated position,
and interlocking means actuated to prevent resetting of the tumblers by said reset button when the plug rotates from its predetermined rotated position so that the plug may be locked only in said predetermined position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,792,949 Wissenboeck ---------- Feb. 17, 1931