Jan. 17, 1950 E. O'BRIEN 2,494,575

COMBINED PERMUTATION AND AUXILIARY LOCK FOR SAFES

Filed Sept. 26, 1945 5 Sheets-Sheet 1

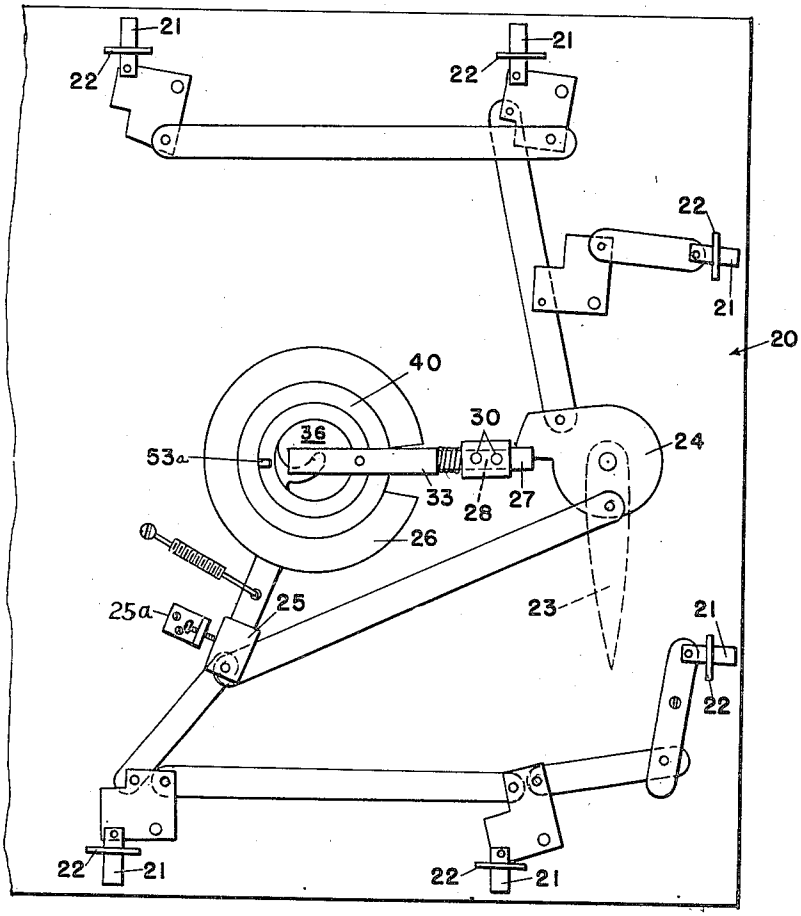


FIG. 1

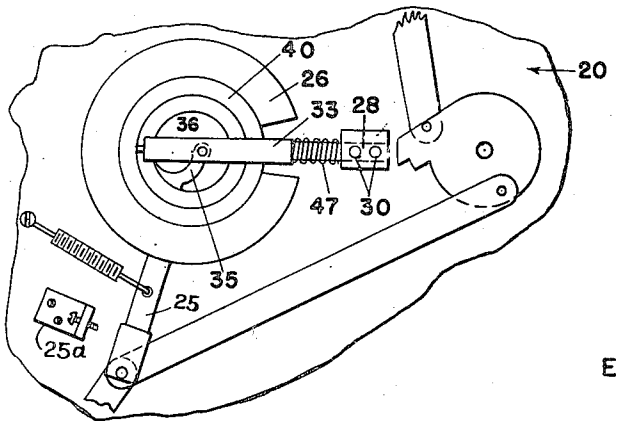


FIG. 2

Inventor
EUGENE O'BRIEN

By Ralph L. Chappell

Attorney

Jan. 17, 1950 E. O'BRIEN 2,494,575

COMBINED PERMUTATION AND AUXILIARY LOCK FOR SAFES

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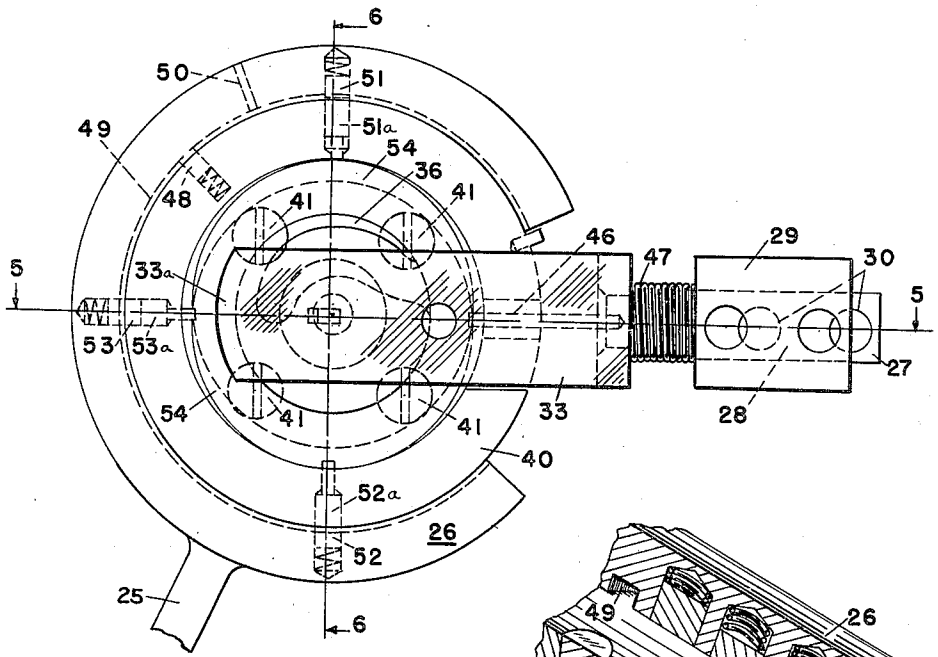


FIG. 3

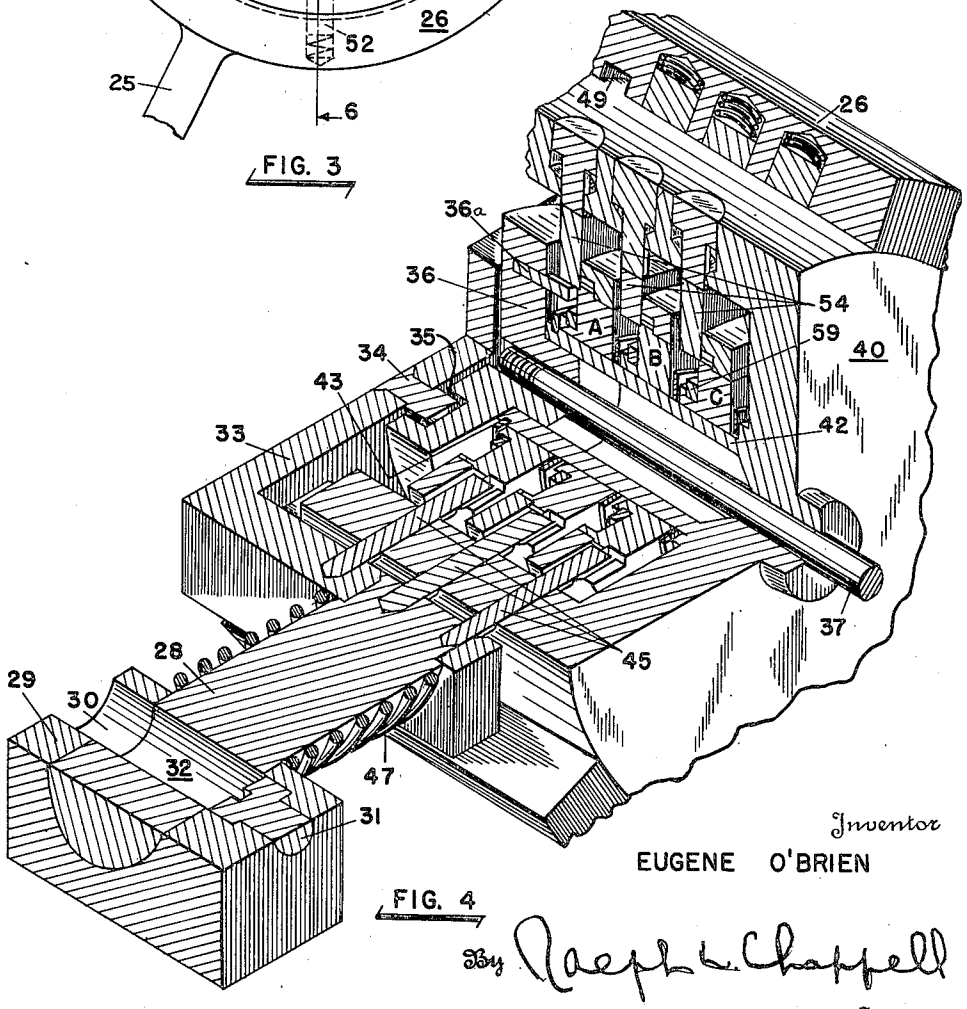


FIG. 4

Inventor

EUGENE O'BRIEN

By Joseph L. Chappell

Attorney

Jan. 17, 1950 E. O'BRIEN 2,494,575

COMBINED PERMUTATION AND AUXILIARY LOCK FOR SAFES

Filed Sept. 26, 1945 5 Sheets-Sheet 3

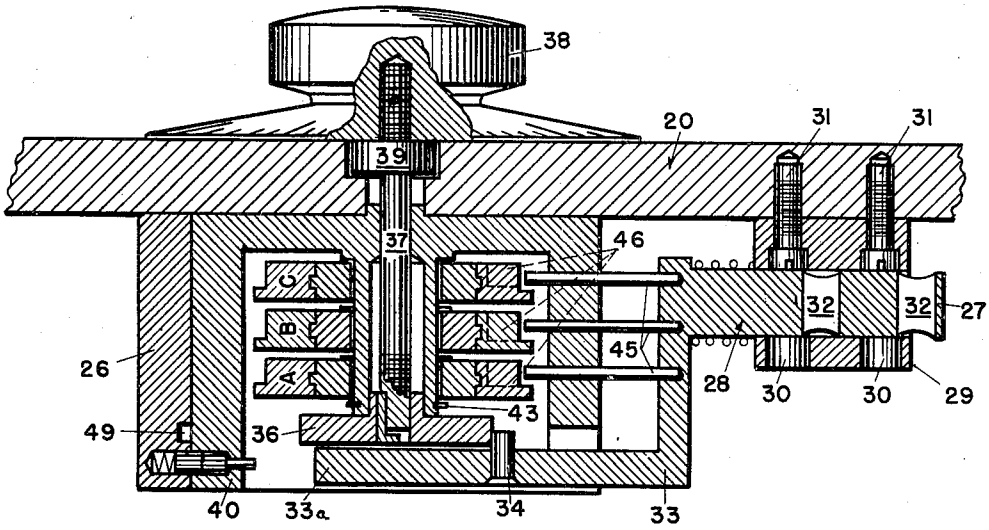


FIG. 5

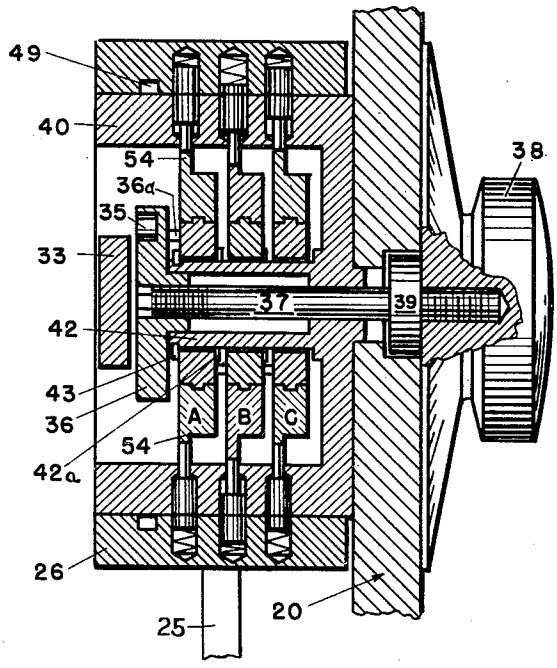


FIG. 6

Inventor
EUGENE O'BRIEN

By Ralph L. Chappell
Attorney

Jan. 17, 1950 E. O'BRIEN 2,494,575

COMBINED PERMUTATION AND AUXILIARY LOCK FOR SAFES

Filed Sept. 26, 1945 5 Sheets-Sheet 4

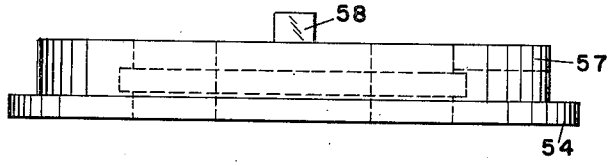


FIG. 8

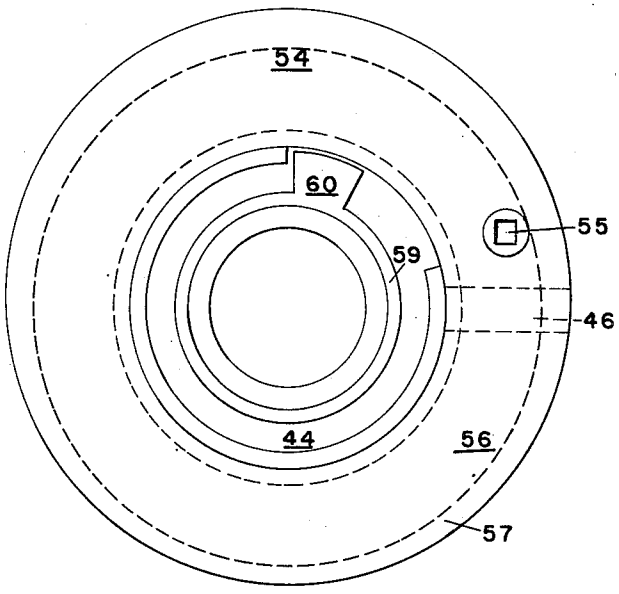


FIG. 7

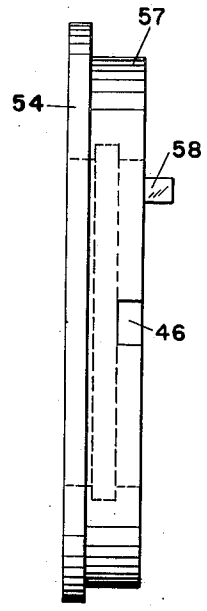


FIG. 9

Inventor

EUGENE O'BRIEN

By Ralph L. Chappell

Attorney

Jan. 17, 1950 E. O'BRIEN 2,494,575

COMBINED PERMUTATION AND AUXILIARY LOCK FOR SAFES

Filed Sept. 26, 1945 5 Sheets-Sheet 5

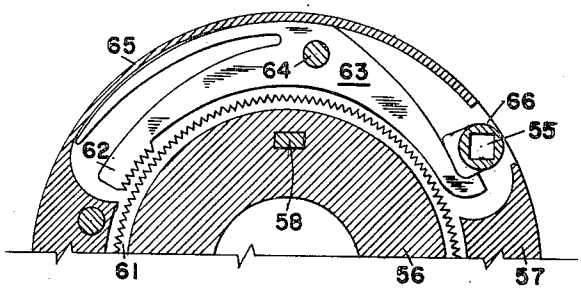


FIG. 12

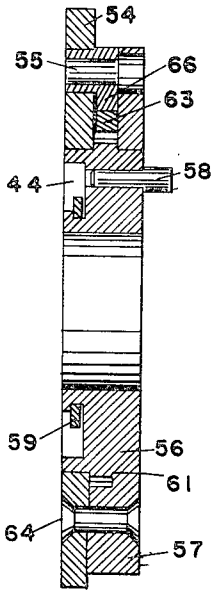


FIG. 11

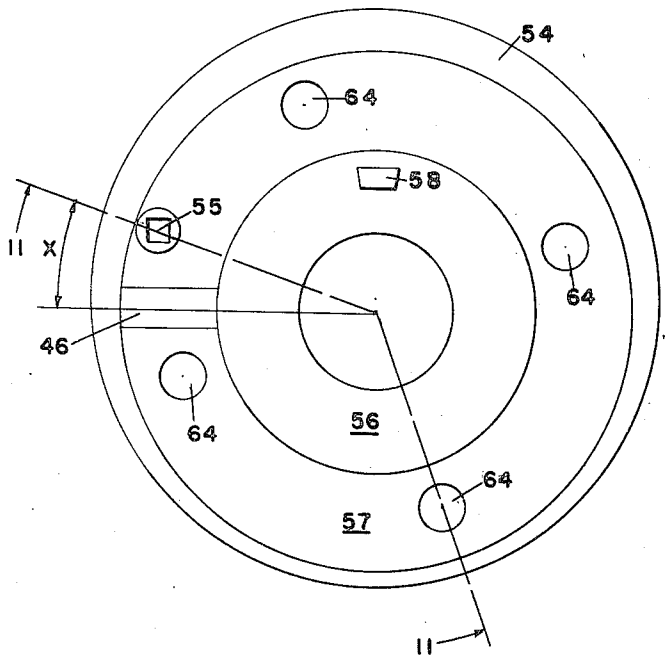


FIG. 10

Inventor

EUGENE O'BRIEN

By Ralph L. Chappell

Attorney

Patented Jan. 17, 1950 2,494,575

UNITED STATES PATENT OFFICE

2,494,575

COMBINED PERMUTATION AND AUXILIARY LOCK FOR SAFES

Eugene O'Brien, United States Navy

Application September 26, 1945, Serial No. 618,800

10 Claims. (Cl. 70—119)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to permutation locks and more particularly to a new and improved lock structure and operating mechanism.

Heretofore permutation locks have been proposed in which manually operable tumblers are rotatable to control the movement of a bolt-operating fence. The present invention is an improvement on such constructions and provides a permutation closure and lock mechanism which is more nearly invulnerable to attack.

It is an object of the present invention to provide a permutation controlled lock construction which offers increased obstacles to unauthorized operation and yet does not provide any increased difficulty for normal operation.

A further object of the present invention is to provide a permutation lock which, though simple and readily constructed, has its parts enclosed within a portion of the operating mechanism so as to foil unauthorized operation thereof.

Still another object is to provide in combination, auxiliary and supplemental locking means which are inaccessible for unauthorized operation and which serve to prevent manipulation of the mechanism until the device is operated according to its proper combination.

An additional object is to provide a novel means for arranging the combination changing mechanism whereby this feature cannot be used for unauthorized opening of the lock.

Other objects and advantages will be apparent from the specification and appended drawings, in which:

Fig. 1 is a rear elevation of a door to which a lock constructed in accordance with the present invention has been applied and wherein the parts are shown in locked position;

Fig. 2 is a change position view of a portion of the mechanism shown in Fig. 1 in the unlocked position;

Fig. 3 is an enlarged detailed rear elevation of a combination lock embodying the present invention;

Fig. 4 is a perspective view partly in section of a permutation lock constructed in accordance with the present invention;

Fig. 5 is a longitudinal sectional view through the lock taken along a line substantially corresponding to line 5—5 of Fig. 3;

Fig. 6 is a view similar to Fig. 5 but taken along a line substantially corresponding to line 6—6 of Fig. 3;

Fig. 7 is an enlarged vertical side elevation of a tumbler constructed in accordance with the present invention;

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Fig. 8 is a top view of the tumbler illustrated in Fig. 7;

Fig. 9 is a side elevation of the tumbler illustrated in Fig. 7;

Fig. 10 is a rear elevation of the tumbler illustrated in Fig. 7;

Fig. 11 is a detailed sectional view of a tumbler taken along a line substantially corresponding to line 11—11 of Fig. 10; and

Fig. 12 is a vertical sectional view through the upper half of a tumbler constructed in accordance with the disclosure of Figs. 7 to 11 inclusive showing the change combination mechanism within the tumbler.

Referring to the drawings in detail, Fig. 1 illustrates the rear of a safe door or other closure which embodies the present invention and is shown to comprise the door 20 which may be hinged along the left side or otherwise suitably mounted, and is provided with a plurality of radially extendable door bolts 21 which are operated in guide members 22 secured to the door and by means of which the door may be bolted in locked position when desired. These door bolts may be interconnected by suitable levers and bell crank arms as illustrated, for operation in unison into locked and unlocked positions by means of a manually operable handle 23 which rotates latch plate 24 for this purpose.

The mechanism for transmitting the door opening force from the latch plate 24 to the door bolts 21 may be of any desired construction. However, it is preferred to provide a link means whereby one link arm engages with an outwardly extending post 25 which is secured for rotation with a lock chamber enclosing sleeve 26 whereby movement of the operating handle 23 must rotate the sleeve 26 about the lock chamber.

The present invention includes, in combination with the door bolt actuating mechanism aforesaid, a permutation controlled means for freeing the latch plate 24 for rotation and simultaneously freeing the lock chamber enclosing sleeve 26, both of which must be actuated in the proper fashion to effect a release of latch plate 24.

In Fig. 1 the plate 24 is shown latched in place by means of the terminal end 27 of a longitudinally slidable lock bolt 28, which end 27 is moved from the path of movement of the latch plate only by longitudinal movement of the bolt 28. The movement of the lock bolt 28 is controlled by the permutation controlled mechanism hereinafter set forth.

In addition, though freed by the bolt 28 the latch plate 24 and associated mechanism still cannot

be operated until the lock chamber enclosing sleeve 26 is freed by internally actuated lock pins in the manner hereinafter set forth, so as to permit bodily rotation of the sleeve and consequent movement of the linkage to unlock the safe door.

Fig. 2 illustrates the parts in a changed position with the lock bolt 28 retracted and the sleeve 26 rotated to move the door latching mechanism into unlocked position.

The details of the permutation controlled lock forming part of the present invention are set forth in Figs. 3 to 6 inclusive, and as there illustrated the bolt 28 is slidably mounted in a suitable bearing block 29 which is provided with a pair of transversely extending openings 30 through which, in installation, cap screws 31 are inserted to hold the bearing block 29 in place. Screw receiving openings 32 in the bolt 28 permit cap screws 31 to be installed when the bolt is in the unlocked position. It will be apparent that the longitudinal movement of the bolt incident to locking the safe covers the openings 30 in the block and prevents unauthorized tampering with the cap screws 31 while the safe is locked.

The bolt 28 has an offset portion 33 which extends over the rear of the combination lock mechanism and is provided with a cam pin 34 adapted to engage with and ride into a spirally shaped cam slot 35 formed in the rear face of a rotatable drive tumbler 36.

Drive tumbler 36 is keyed to the rear end of a manually operable dial shaft 39 which extends through the door and is provided at its outer end with the usual graduated combination dial 38 of the character well known in the art. Intermediate the ends of the dial shaft 37 may be located an enlargement 39 which constitutes an abutment to prevent unauthorized tampering along the path of the shaft 37.

The combination lock illustrated in the present embodiment comprises a stationary lock housing 40 which may be secured to the rear of the door 20 by means of holding screws 41 and may be centrally apertured to receive the axially extending dial shaft 37. About the central aperture may be located a rearwardly extending tumbler supporting sleeve 42 about which three spaced tumblers A, B, and C, are shown disposed and these tumblers are free to rotate, hindered only by the frictional engagement of tumbler friction rings 42A and tumbler retaining ring 43, all of which serve to space the tumblers and retain them in place in the manner illustrated.

Protruding from the inner face of the drive tumbler 36 is a tumbler engaging pin 36A which protrudes into a drive slot 44 in the adjacent face of tumbler A and engages a centralizing ring to drive the tumbler in the manner hereinafter set forth in detail. Each tumbler may be provided with a similar pin so that rotation of drive tumbler 36 through the usual lost motion means including the centralizing ring in each tumbler serves to rotate the tumblers until finally the motion is transmitted to tumbler C which is then set to the desired position. Next, the direction of rotation of dial 38 is reversed until the second tumbler, tumbler B, is likewise set in the desired position. A final reversal is then made until tumbler A is set in the desired position and, when so arranged, fence posts 45, controlling movement of the bolt 28, are permitted to enter aligned gates 46 in the periphery of the individual tumblers A, B, and C. A coiled lock bolt spring 47 surrounding the bolt 28 adjacent bearing block 29 normally urges the bolt into unlocked position.

In addition to the fence and gate lock mechanism aforesaid, there is provided in the present invention a plurality of additional or supplementary lock means operated by the individual tumblers A, B, and C, which comprise the bodily rotatable lock chamber enclosing ring 26 disposed about the outside of the lock case which ring in installation is moved bodily over the rear end of the housing 40 of the lock until spring-biased retainer plunger 48 (Fig. 3) snaps into an interior annular retainer groove 49 extending around the inner surface of the sleeve 26. For removal purposes a small access opening 50 is provided through the sleeve 26 and in the removal operation this opening is first aligned with the plunger 48 and a suitable tool then inserted to depress the plunger and free it from the groove 49. As illustrated this opening 50 is located out of alignment with the plunger when the device is in locked position.

The auxiliary lock means of the present embodiment includes a plurality of split pins each having a portion slidable in the sleeve 26 and individually operable by the adjacent tumbler to move the split portion into registry with the point of separation between the sleeve 26 and the stationary lock casing 40. As shown, these split pins may be several in number and include split parts 51 and 51A located in the upper portion of the lock body and 52 and 52A disposed in the lower portion of the lock body. Each of these pins is spring-biased as illustrated and is provided at its inner end with a reduced stem which is engageable by the pin operating means. These stems are engageable by eccentrically disposed offset cam portions 54 on each of the tumblers A, B, and C.

A secondary lock is also provided in the form of another split pin 53—53A of similar construction and its operating stem is engageable by the terminal end 33A of the offset portion 33 of the slidable bolt 28 when the bolt reaches the extreme unlocked position.

The unlocking of ring 26 by the action of the split-pin 53—53A permits ring 26 to rotate around the lock-housing 40 and permits the movement of radial arm 25 which is attached to ring 26 and to the latch mechanism. It will be seen that unless the split-pin 53—53A is moved by the off-set portion 33A of the bolt 28, the latching mechanism will not be released. Means for limiting the rotary movement of the ring 26 and of positioning the split-pin 53—53A in the locked position is accomplished by adjustment of the stop 25A.

It will be noted that with the above construction and arrangement there is provided in addition to the positive fence and gate lock mechanism, auxiliary lock means and secondary lock means in the form of split pins operable by the several tumblers and also operable by movement of the bolt to its extreme position, all of which lock means must be released in order to permit operation of the door unlatching mechanism.

The combination changing mechanism illustrated in the enlarged views of the tumblers comprising Figs. 7 to 12 inclusive may be operated in the usual manner by a square shank key which is insertable through keyholes 55. In order to minimize the possibility of unauthorized entry by aligning the gates 46 in the tumblers A, B, and C, by means of the use of instruments

through the keyholes 55, the angle X as indicated in Fig. 10 may be varied on each eccentric disc tumbler A, B, and C, so that when the keyholes 55 are aligned, the gates 46 are out of alignment.

The use of the change key permits a relative rotation between the inner ring portion 56 and the outer ring portion 57 of the cam. The inner ring 56 carries a laterally projecting centralizing ring engaging stop pin 58 and the opposite face of the inner ring is recessed to receive a centralizing ring 59 having a protruding ring lug 60 for engagement with the stop pin 58 of the adjacent tumbler in the customary manner.

The serrations 61 on the outer portion of the inner ring member 56 are engageable by the toothed outer end 62 of a lever 63 pivoted at 64 and having a resilient portion 65 in engagement with the casing of the tumbler. The opposite end of this lever is operable to release the toothed outer end 62 from the serrations and permit relative rotation of the tumbler parts by rotation of a key receiving cam 66.

With the staggered arrangement of the gates with respect to the keyholes 55 it is necessary to have a combination changing code in order to make a change in the combination. The procedure is as follows:

1. Open safe door.
2. Turn door handle to closed position.
3. Turn dial clockwise to lock the lock and continue turning in same direction until the proper procedure for setting the original first number has been completed.
4. Refer to code, which will give the correct number of divisions to continue turning after each original number has been reached.
5. Continue setting procedure for original number and continue turnings as given in code sheet.
6. When this procedure has been carried through and all three settings have been made, insert the change key and turn counter clockwise until it stops. This action disengages the toothed outer end of lever 63 from the serrations 61 on the inner ring 56, permitting repositioning of the stop pin 58 with respect to the gate of the tumbler.
7. Choosing whatever numbers are desired to be used as a new combination, refer again to the code, and proceed exactly as outlined in steps for aligning keyholes.
8. Turn change key clockwise to original position and remove. New combination has now been set for numbers chosen in step 7.

Factors which lower the security of the widely used dial operated safe lock are its vulnerability to picking by gaining access to the front or rear of the lock through drilling, and safety or relocking devices which depend upon the intruder achieving his purpose in a certain way.

While maintaining the fundamental principles used in the conventional dial operated lock, that of rotating disk tumblers providing blocks and entries for a movable bolt which locks the door, and a numbered dial for operating purposes, the lock of the present invention, as above described, departs from that design in several respects.

First: Vulnerability to picking has been lowered by staggering the change key openings. The change key method of changing safe combinations is widely used. A weakness has been that the openings through which the key passes in each tumbler are so arranged that when they are aligned the gates in the tumbler are aligned with the fence making possible the use of instruments to pick the lock. The use of a staggered keyhole,

that is, placing the key opening in successive tumblers at different angular locations about the center of the tumblers with respect to the gate, as explained previously, will eliminate this method of lock picking.

Second: Vulnerability to picking has been reduced by the use of concealed gates. The conventional safe lock tumbler as commonly used has visible openings as gates for the entry of the fence which operates the lock bolt. This visibility is a weakness which may permit unauthorized entry by drilling and picking either by sight or by instruments. Even though the rear tumbler is sometimes concealed by the hinged fence which operates the bolt, it is still possible to pick by sight or instrument if a bit of patience is exercised. And while the front tumbler is covered by a dial, a hole drilled at an angle will expose the gates to view or feel by instrument. The tumblers of the present invention have their gates concealed behind a strong shoulder. If drilling from the front of the safe is resorted to only the first gate is visible. The shoulder of each tumbler from that point on serves as a block to further picking. From the rear of the safe, as from the front, no gates are visible at any time even when near at hand.

Third: Vulnerability is reduced by the provision of a minimum clearance between disk tumblers and lock case. The conventional safe lock case is of rectangular construction, having considerable clearance between the outer diameter of the disk tumblers and the inside walls of the lock case. This allows considerable opportunity for picking either from front or rear, but is necessitated by a hinged motion of the fence which operates the locking bar, since this hinge is placed within the lock case. The design of the present invention provides but very little clearance between the tumblers and the tumbler case, replaces the usual hinged fence with a combined rigid locking bar and fence as shown, and reduces the size of the gates in the tumblers through which the fence must pass to open the lock.

Fourth: Vulnerability is reduced by making the part fastenings inaccessible in locked position. Many locks of conventional design have a lock case cover fastened by screws. This cover conceals the tumblers. If the cover is successfully removed the lock can easily be picked. Others have covers to which the tumblers themselves are attached, and if the cover is successfully removed the tumblers are also removed. In either case the lock can be picked. In the present device it is impossible to remove any part of the lock until the bolt is in its retracted position, exposing the holding screws and allowing access to the tumblers.

As part of the present invention there is provided an auxiliary locking device, mechanically connected to the primary lock and operating automatically each time it is opened and closed. This includes the cam tracks on the disk tumblers which tracks contact two sets of split pin tumblers installed in the auxiliary locking device. Two opposed sets are used in order to equalize spring pressure and prevent the possibility of sensing pressure while dialing. It will also be noted that the positions of the eccentrics for opening the pin tumblers have been set at the high and low points to avoid the possibility of recurring opening positions. Positions have been alternated to minimize still further whatever slight possibility of feel against spring pressure might exist.

There is also provided a secondary safety lock, which acts as an anti-pick device and prevents any attempt to feel the tumblers above described by exerting pressure against the door handle. This secondary safety lock is not opened until the lock bolt 28 is in full unlocked position. This lock also has a split pin which in this case is operated by the end of the bolt as it is moved into final unlocked position. The spring of this pin is preferably much stronger than other split pin springs in order to prevent picking from a distance by instrument.

While a particular embodiment of the invention is shown, it will be understood, of course, that it is not desired to be limited thereto since many modifications may be made, and it is, therefore, contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of this invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In a permutation lock for a closure wherein a closure latch operating handle may be secured by a slidable bolt, a cylindrical permutation lock enclosing housing, a rotatable sleeve disposed around the housing and linked to the closure latch operating means to limit operation thereof, a series of tumblers within the housing, the tumblers having fence receiving openings therein, a bolt mounted adjacent the lock housing and having a fence portion extending within the housing, a tumbler operating member, means mounted upon the bolt and engageable with the tumbler operating member for retracting or extending the bolt when the fence receiving openings in the tumblers are aligned with the fence, and separate sleeve lock means for limiting rotation of the sleeve about the cylinder when the fence receiving openings are out of alignment.

2. A permutation lock for a theftproof closure latch comprising, a stationary lock housing, a plurality of tumblers mounted within the lock housing, said tumblers each having a fence receiving gate therein, a bolt having a fence aligned with the gates in the tumblers when the tumblers are adjusted into unlocked position, a sleeve rotatable about the lock housing, said sleeve being interconnected with the closure latching mechanism, and lock means separate from the bolt for securing the sleeve against rotation.

3. A permutation lock for a theftproof closure comprising, a stationary casing, a plurality of tumblers mounted within the casing and each having a fence receiving opening, means for manipulating said tumblers for aligning the openings therein with a fence, a bolt having a fence portion adjacent said openings, and means operated by the tumbler manipulating means for retracting and extending the bolt, each of the tumblers being provided with an eccentrically contoured peripheral margin, and each of said peripheral margins being in alignment with a tumbler pin and operable by rotation to move the pin into an unlocked position simultaneously with the alignment of the fence receiving openings with the fence.

4. A permutation lock for a theftproof closure comprising, a stationary housing, a plurality of tumblers mounted within the housing, each having a fence receiving gate therein, a bolt having a fence portion, means for manipulating said tumblers to align the gates with the fence, means including the tumbler manipulation means for moving the bolt upon alignment of the gates with the fence, a lock sleeve rotatable about the housing, lock pins movable to control rotation of the lock sleeve, the tumblers each having a contoured periphery in alignment with a tumbler pin and operable to move the same into an unlocked position simultaneously with the alignment of the fence receiving gates with fence.

5. A permutation lock for a theftproof closure comprising, a stationary housing, a plurality of tumblers mounted within the housing, and having fence receiving gates therein, a bolt having a fence portion, means for manipulating said tumblers to align the gates with the fence, means operated by the tumbler manipulating means for moving the bolt upon alignment of the gates with the fence, a lock sleeve rotatable about the housing, lock pins movable to control rotation of the lock sleeve, the tumblers each having a contoured periphery in alignment with a tumbler pin and operable to move the same into an unlocked position simultaneously with the alignment of the fence receiving gates with fence, and a separate tumbler pin assembly operable by opening movement of the slidable bolt to unlock the lock sleeve.

6. In a permutation lock for a tamperproof closure wherein a closure latch operating handle is provided for moving closure latch members into and out of locked position, the combination with said members of, a movement inhibiting ring, a permutation lock having an exterior casing about which the movement inhibiting ring rotates, and means operable by the permutation lock mechanism and cooperating with the ring to inhibit relative rotation therebetween and control the movement of the closure locking mechanism.

7. In a permutation controlled tamperproof closure having a latch mechanism operable to latched and unlatched position the combination of, means for operating the latch mechanism, a bolt operable to prevent movement of the latch mechanism, permutation controlled means to control the movement of the bolt, a housing enclosing said permutation controlled means, and auxiliary locking means acting upon the latch mechanism independently of the bolt, said auxiliary locking means comprising, a sleeve rotatable about the housing, and sleeve locking means operable by the permutation lock mechanism to secure the sleeve against relative latch mechanism unlocking movement.

8. A permutation controlled lock comprising, a lock housing, a plurality of tumblers mounted within the housing, each of said tumblers having a gate, a fence mounted for movement within the gate when aligned therewith, each of the tumblers being of multipart construction, a connection between the parts of the tumblers to permit a change in the relative location of the gate, said tumblers being arranged to permit simultaneous manipulation by a combination changing key when the gates are out of alignment with the fence and prevent manipulation by said key when the gates are in aligned relationship.

9. A permutation controlled lock comprising, a lock housing, a plurality of rotatable tumblers located within the housing, a bolt having a fence portion movable into the housing, at least one of

the tumblers having an outer portion with a fence receiving gate and an inner portion with a movement transmitting pin protruding therefrom, means for permitting relative adjustment between the outer and inner portions including a change combination lock, a key receiving opening in each tumbler to receive a combination change key, the key receiving opening of the several tumblers being out of alignment when the gates are in relative alignment.

10. A permutation lock comprising, a lock mechanism including a plurality of manually operable tumblers, each of the tumblers having a fence post receiving gate therein, and a change combination mechanism in each of the tumblers including a change key receiving opening, the change key receiving openings of adjacent tumblers being arranged to be out of alignment

when the fence post receiving gates are in alignment.

EUGENE O'BRIEN.

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