

- [54] **RESTRICTIVE MANIPULATION LIMITED
TRY MECHANISM FOR A COMBINATION
LOCK**
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represented by the Secretary of the
Navy, Washington, D.C.**
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- [21] **Appl. No.: 265,930**
- [52] **U.S. Cl. 70/333 R, 70/DIG. 49**
- [51] **Int. Cl. E05b 37/08**
- [58] **Field of Search..... 70/1.5, 1.7, 333 R**

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Donn McGiehan

[57] **ABSTRACT**

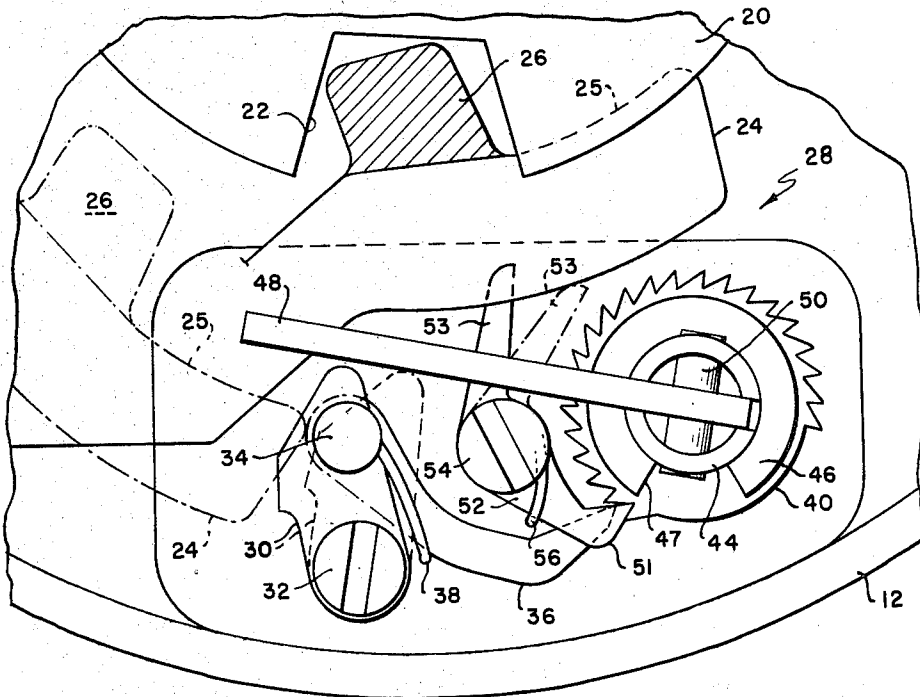
A combination lock having a restrictive manipulation or limited-try feature to prevent the opening of the lock by trial and error manipulation. The mechanism recognizes and counts each unsuccessful attempt at finding the proper code. After a predetermined number of unsuccessful attempts to open the lock, the mechanism renders the lock unopenable, without the knowledge of the illicit manipulator but will continue to accept additional manipulations. A registering device, associated with the mechanism, will reset to permit the opening of the lock by the owner only when the proper code is dialed before the predetermined number of unsuccessful attempts has been reached.

12 Claims, 3 Drawing Figures

References Cited

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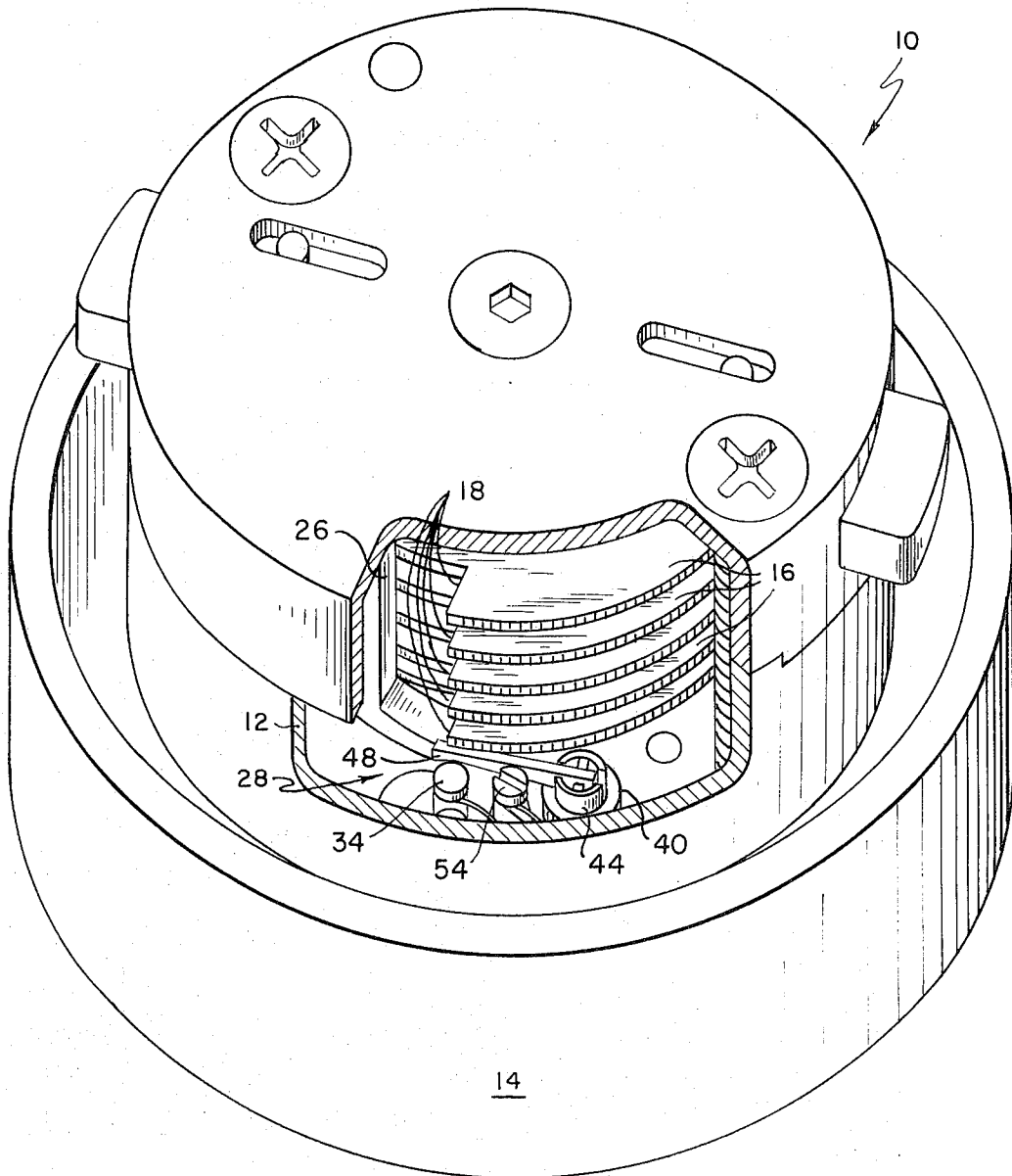


FIG. 1.

SHEET 2 OF 2

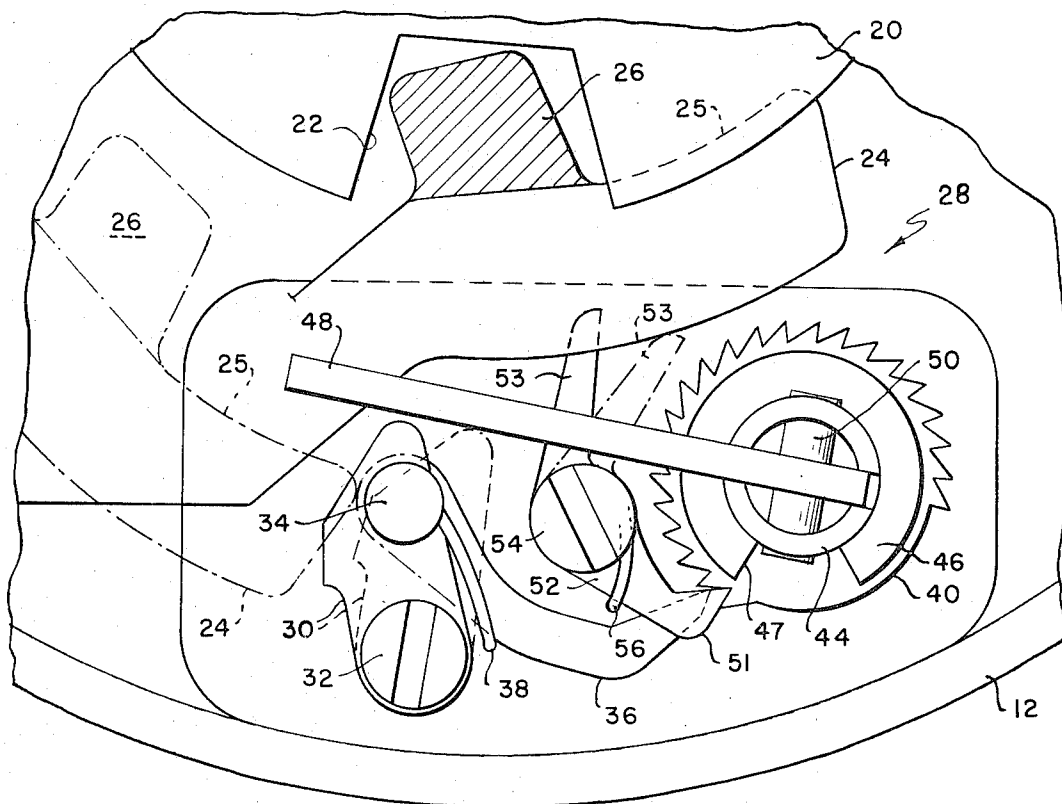


FIG. 2.

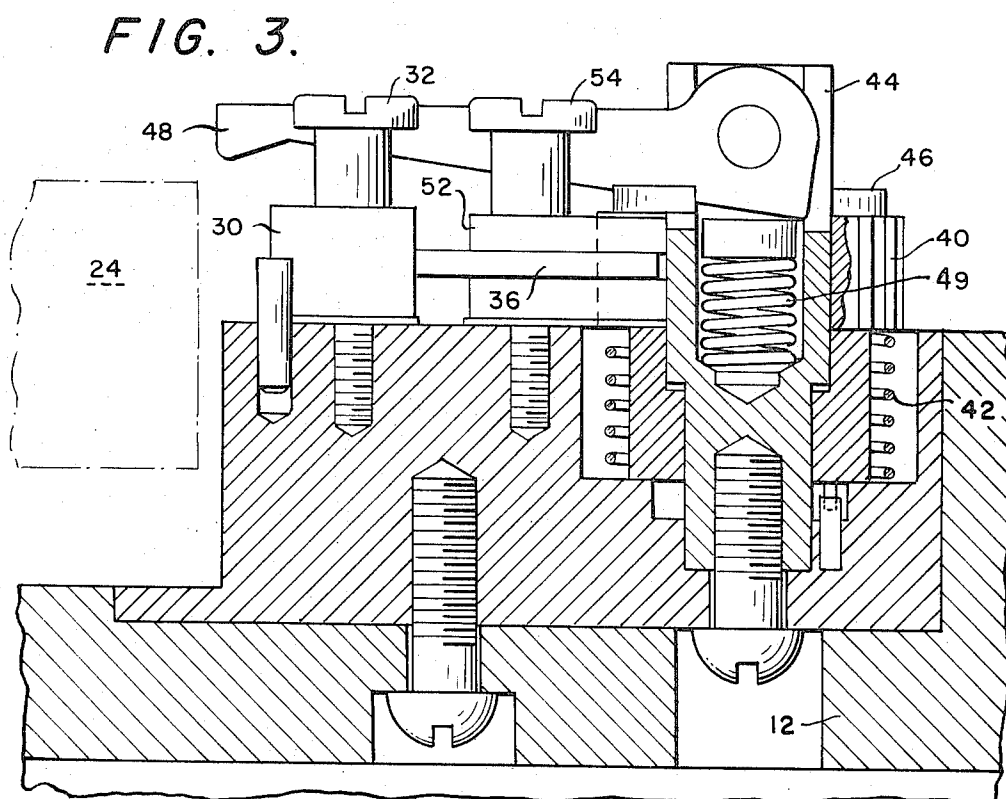


FIG. 3.

RESTRICTIVE MANIPULATION LIMITED TRY MECHANISM FOR A COMBINATION LOCK

BACKGROUND OF THE INVENTION

This invention relates generally to locks for securing a depository and, more particularly, to manipulation-proof combination locks. Combination locks are thought to provide good security against unauthorized entry because they require a certain succession of numbers to be set on a dial to gain entrance. However, present combination locks are vulnerable to manipulation by a knowledgeable expert using the sense of feel, sight and sound and given enough time to make a number of trial combinations of numbers to finally open the lock. A background study of the owner of the lock, including his birthdate, his wife's birthdate, anniversary date, children's birthdates, etc., will often provide the required combination to the particular lock. However, even with this knowledge and skill, an expert will have to make a number of manipulations or trials before he finds the successful combination of numbers. If the combination lock was provided with a mechanism which would render the lock unopenable after a predetermined number of unsuccessful tries, the security of the depository would be greatly enhanced.

Locks have a long history of providing good security against unauthorized entry to dwelling houses, vehicles, safes, cabinets, and other such security depositories. Key locks having a keyway and, therefore a hole, permit entry into the internal mechanism of the lock and allow manipulation of the tumblers with a pick and turning device. This procedure, called "picking," will readily open any key lock. Combination locks are far superior to key locks because there is no keyway or ready entrance into the internal mechanism for a key or adding nitroglycerin. Combination locks require a certain succession of numbers to be set on an outer dial through a left and right pattern of rotations of said dial before it may be opened. The most sophisticated combination lock has 100 possible settings for each directional turn of the dial, and some require as many as seven directional turns. The most common type combination lock has three directional turns, thus providing one million possible combination settings. A five directional turn lock will provide 10 billion possible combination settings. With these number of possible combinations, the average person would consider it an impossibility to open such a lock, but to a knowledgeable expert, they represent only a challenge. The vast number of possible combinations is of little concern to the expert manipulator who knows the characteristic of the lock and uses this knowledge to find the proper code to gain entry. His technique is to make a quantity of tries designed to minimize the amount of manipulations of the dial and the amount of time spent opening the depository.

Attempts in the past to increase the security afforded by combination locks have generally been directed to elimination of the possibility of attack by forceable means, such as drilling into the lock so that the combination may be set mechanically, or by adding heat and explosive shields to reduce the possibility of attack by torch cutting or "blowing open" the closure to the depository. Few, if any, attempts have been made to solve the problem of surreptitious entry by manipulation of the combination lock, because the general public is of

the opinion that modern sophisticated locks cannot be manipulated to opening. But, as discussed above, these locks are susceptible to being manipulated to opening by a knowledgeable expert, a fact known to those practicing in the security field.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to enhance the security provided by a combination lock.

Another object of the invention is to provide additional intelligence to a combination lock.

A further object of the invention is to provide a combination lock having the ability to distinguish between authorized manipulation and unauthorized manipulation.

A still further object of the present invention is to provide a combination lock with the ability to register the quantity of attempts at manipulation.

Still another object of the present invention is to provide a combination lock which is able to incapacitate the locking mechanism to prevent opening without the knowledge of the manipulator.

Still another object of the instant invention is to provide a combination lock with provisions to automatically reset the registering mechanism when authorized manipulation takes place prior to reaching the predetermined number of unsuccessful attempts at manipulation.

A still further object of the instant invention is to provide a means in combination locks to re-establish the limited-try feature for again accepting authorized attempts at manipulation after the predetermined number of attempts has been reached.

Briefly, these and other objects of the present invention are attained by the use of a restrictive manipulation or limited-try mechanism which substantially prevents opening the combination lock by trial and error manipulation. This feature recognizes and registers each unsuccessful attempt at finding the proper code and, after a predetermined number of tries, precludes the conventional fence-lever from entering the gates in the tumblers, thus rendering the lock unopenable. The register mechanism will continue to accept additional manipulations without the knowledge of the illicit manipulator that he is locked out. The register device, however, will reset to permit the fence-lever to enter the gates upon application of the proper code, if the predetermined number of unsuccessful attempts has not been reached, and thus will permit the opening of the lock by the owner.

The means by which the mechanism registers the number of unsuccessful tries at opening the lock includes a pawl in contact with the fence-lever and a spring loaded ratchet wheel against which the pawl operates. If the proper code is not set in, and the manipulator attempts to open the locking bar of the typical combination lock, the fence-lever can not drop into the gates of the tumblers, but rather comes to rest on the outer edge of the tumbler wheels. The fence-lever then slightly rotates on the wheels and also makes contact with the pawl, thus pushing the ratchet wheel and registering one stroke. If desired, the ratchet wheel may be coupled to an indicator on the face of the lock to indicate the number of advances or strokes that the ratchet wheel has taken. Further, if desired, a keyway and special key may be provided to release and reset the

ratchet wheel to the original position. Also, an additional set of tumbler wheels engaged by the limited-try mechanism can be used to re-set the mechanism for a fresh start by the owner.

The invention involves a technique to restrict or limit the number of tries and attempts to find a lost or unknown code of a combination lock, as by an unauthorized person seeking entry to the depository by manipulation or surreptitious entry. This feature will recognize and distinguish between attempts at unauthorized and authorized manipulation. The feature can be made to limit the number of unauthorized tries or attempts in search of the proper code, and a predetermined number may be designed into the mechanism. Then, for the purpose of this discussion, the predetermined number may be established as five. Therefore, the manipulator in search of the unknown code is limited to five attempts to open the lock. Upon reaching the fifth attempt, the restrictive manipulation mechanism will perform its function, causing the lock to become unopenable. In this state, the lock mechanism retains the ability to receive additional attempted codes and even the proper code, but will cease to recognize any. The lock will now refuse to open and is permanently locked. Further, other functions that the limited try feature performs at the end of the fifth attempt may be to explosively blow up the lock, sound an alarm or bell, or otherwise indicate that unauthorized manipulation has been underway.

An additional important ability of this invention is to recognize the proper code set into the combination lock before reaching the improper fifth attempt. When the proper code has been set up on the combination lock dial, the limited-try feature recognizes it and automatically returns the registering ratchet wheel to its original position. This feature is considered necessary because it takes into account the possibility of human error of the owner when he manipulates the lock with the knowledge of the proper code but makes a mistake in dialing the correct numbers. He will exercise extreme care not to reach the fifth attempt at opening the lock when he knows he will be then permanently locked out.

This invention also automatically advises the master or owner of the security depository that attempts at manipulation have taken place. This information will warn him to take precautionary measures to eliminate further illicit attempts at opening this combination lock. The information may be provided by a window or dial on the face of the lock so that the master can observe the unauthorized manipulation attempts by the tell-tale register. A visual indicator will also notify the observer that the full number of unsuccessful tries has been made and that other means will now have to be used to open the depository.

Under emergency conditions, the limited-try feature will permit the owner to intentionally perform a lock-out condition, thereby precluding anyone to open the lock. After the emergency, the owner can reset the lock to its functioning condition.

BREIF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention and many of the attendant advantages thereto will be readily appreciated as the same becomes better understood by reference to the following detailed description when

considered in connection with the accompanying drawings wherein:

FIG. 1 is a isometric view partially cut away showing the limited-try mechanism in association with a standard combination lock;

FIG. 2 is a plan view of the rear of a combination lock partially cut away to show the detail of the limited-try mechanism; and

FIG. 3 is a side view of a combination lock partially cut away showing the details of the limited-try mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now the drawings, wherein like reference numerals designate corresponding parts in the several views, there is shown in FIG. 1 generally a combination lock 10. The conventional lock comprises a casing 12, and a base 14 which is the internal rear surface of the face plate secured to a door (not shown) with suitable fastener means.

The casing 12 contains a plurality of tumblers 16 mounted for rotation with a shaft and a dial (both not shown). Each of the tumblers 16 has a suitable notch or gate 18, all of which must be in proper alignment in order to eventually nestle a fence-lever 24. Note FIGS. 2 and 3. As shown in FIG. 2, forward of the said tumblers 16 is a drive wheel cam 20 having a radially indented cam slot 22 therein. Coacting with the drive wheel cam 20 is a fence-lever 24 having an integral, rearward extending bar 26 to co-acting with the gates 18 in the tumblers 16, best shown in FIG. 1. This construction, just described in general, is conventional with most combination locks and further details are considered unnecessary.

The fence-lever 24, as shown in FIG. 2, is shown in two positions, one solid and the other as dot-dash phantom to show its cooperation with a limited-try mechanism 28 according to the invention.

The limited-try mechanism 28, according to the present invention, comprises a pusher lever 30, also shown in one solid and the other dot-dash phantom, mounted for rotation about a pivot screw 32. Pusher lever 30 has a surface which is contacted by the fence-lever 24 when an attempt is made to open the lock, and will hereinafter be further explained. At an eccentric pivot point 34 on push lever 30 is attached for articulation a feeder pawl 36. Feeder pawl 36 is spring-biased into engagement with the teeth of a ratchet wheel 40 by a spring 38 having an arm hooked over the back of the feeder pawl 36 and helically wound about the eccentric pivot point 34. The ratchet wheel 40 is spring-biased for clockwise rotation by a helically wound spring 42, shown in FIG. 3, under the ratchet wheel 40. The ratchet wheel 40 is mounted for rotation on an axis 44 extending above the top surface of the ratchet wheel. Further, on the top surface of the ratchet wheel is a circular cam surface 46 interrupted by a notch 47. A lock-out bar 48 is pivotally attached to the extended portion of the axle 44 by a cross pin 50 and is in contact with and normally in a raised position on the circular cam surface 46. The ratchet wheel 40 is held from freely rotating clockwise by a holding pawl 52 having a tooth engaging portion 51 and a lever portion 53 about a screw 54. The holding pawl 52 is spring-biased into engagement with the ratchet teeth by a spring 56.

In operation, assuming the normal manipulating procedure to open a combination lock with 5 sets of numbers and therefore 5 tumblers, the dial is first turned to the left or counterclockwise a minimum of six times. This action causes the lock spindle to pick up all five tumblers. The dial is then stopped at the first number setting of the code of the combination, thus aligning one of the gates in the tumbler with the fence-lever. The dial is then turned to the right passing the next number four times and stopping on it the fifth time to align the second tumbler. The dial is then turned to the left passing the third number of the code three times and stopping the fourth, then turned to the right two times past the fourth number and stopping the third time, then turned left once past the fifth number and stopping the second time. This procedure aligns the gates 18 of the five tumblers 16 with the fence-lever 24. The dial finally is turned to the right to zero thus aligning the cam slot 22 of the drive wheel 20 with the fence-lever 24. Then, depending on the type of lock, the dial is held on zero and the locking bar located in the center of the dial is rotated, or the dial is continued to be turned to the right. Turning the locking bar disengages the cam wheel 20 and permits the spring-loaded fence lever 24 to enter the aligned gates 18 of the tumblers 16. By turning the dial further to the right, the bolt of the lock is withdrawn and the depository is opened. This normal manipulation procedure of the lock does not engage the limited-try mechanism except at the end of the final opening turn when the fence-lever 24 strikes the lever portion 53 of holding pawl 52 to pivot the tooth engaging portion 51 out of engagement with the ratchet wheel 40 permitting it to rotate counterclockwise to the original reset position.

For unauthorized manipulation in search of the proper code to open the lock, the following action takes place. The manipulator turns the dial in the same sequence as outlined above with a selected set of numbers, perhaps from a list as previously described. When the dial is finally turned to zero and the locking bar located in the center of the dial is turned or the dial is continued passed zero, and presuming the improper code was inserted, the bar 26 of fence-lever 24 contacts at least one of the edges of the tumblers 16 rather than entering the gates 18. When this attempt or try is made to open the lock as by rotating the dial to the right beyond zero, the fence-lever 24 now makes contact with the push lever 30 which pushes the feeder pawl 36 into one of the teeth and rotates the ratchet wheel 40 one stroke or one tooth position. The holding pawl 52 engages the tooth next advanced by the bias of spring 56 and holds the ratchet wheel 40 in the counterclockwise advanced position.

The unauthorized manipulator, after finding that the lock will not open, will no doubt insert a second combination of numbers and repeat the opening operation. Again, if the proper combination has not been set in, the bar 26 of fence-lever 24 will rest on the edge of the tumblers 16 and when an attempt is made to open the lock, the fence rotates and makes contact with the pusher lever 30 which subsequently advances the ratchet wheel 40 another position counterclockwise. The limited-try mechanism has now registered the two attempts made to open the lock with the wrong set of numbers. Without knowing this, the unauthorized manipulator continues inserting combination codes searching for the proper code that will open the lock.

Upon reaching the fifth attempt, the ratchet wheel 40 has been advanced to the fifth tooth position. In this position, the cam surface 46 on the top surface of the ratchet wheel reaches a point where the lockout bar 48 will fall into the notch 47 by virtue of the bias of spring 49 under the crosspin 50. In this lockout position, any attempts, authorized or unauthorized, to open the lock, will cause the fence-lever to advance and its inside surface 25 will strike the distal end of the lockout bar 48 thereby precluding the bar 26 from entering the gates 18 of the tumblers 16. As can be now understood, the limited-try mechanism has rendered the lock unopenable and the manipulator is completely locked out. The locking mechanism will continue to refuse to recognize any code of numbers set in, and the manipulator is unaware that this action has taken place.

The master or owner of the depository will be aware of this condition when he is sure that he has set in the proper code, because the lock refuses to recognize the proper code. If desired in the construction of the lock, a hole may be provided to accept a special tool or key that may be inserted to release the holding pawl 52 from the ratchet wheel 40 allowing the ratchet wheel to rotate clockwise by virtue of its spring bias to its original position lifting the lockout bar 48 from behind the fence-lever 24.

This novel invention also recognizes that the owner of the depository may inadvertently set in the improper code when attempting to open the combination lock. From the prior discussion, it is obvious that he has at least four tries. However, as is obvious from the prior discussion, the limited-try mechanism operates only when the combination has been set in, the dial returned to zero, the locking bar in the center of the dial has been set, and an attempt is made to draw the bolt or open the lock. If, when the owner is dialing in the combination and realizes he has inadvertently set in an improper number, he should begin from the start by redialing the proper combination. As soon as the proper combination of numbers has been used, prior to the lockout feature operating at the fifth try, the limited-try mechanism will be automatically reset.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practised otherwise than as specifically described herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An improvement in combination locks having tumblers with gates and a fence-lever for improving the security thereof from unauthorized manipulation comprising

a limited-try mechanism cooperating with said tumblers and said fence-lever which prevents opening of the lock after a predetermined plurality of attempts have been made using the improper combination, the action of said mechanism undetectable by a manipulation.

2. The improvement of claim 1 wherein said limited-try mechanism includes blocking means preventing said fence-lever from cooperating with said tumbler gates to preclude the opening of the lock.

3. The improvement of claim 2 wherein

said limited-try mechanism further includes means for mechanically registering cumulatively the number of unsuccessful attempts to open the lock.

4. The improvement of claim 3 wherein said limited-try mechanism further includes reset means to permit opening the lock when the proper combination is used before the predetermined plurality of attempts have been made.

5. The improvement of claim 4 wherein said limited-try mechanism further includes means permitting resetting by a tool from the outside of the lock after the predetermined plurality of attempts have been made to open the lock.

6. The improvement of claim 5 wherein said limited-try mechanism further includes means for monitoring the plurality of attempts to open the combination lock on the face of the lock without notifying an unauthorized manipulator that the predetermined number has been reached.

7. The improvement of claim 2 wherein the limited-try mechanism further includes means for actuating an alarm when the predetermined plurality of attempts have been made to open the lock.

8. An improvement in a combination lock having tumblers with gates, a cam wheel, a fence-lever, and a dial on the face comprising:

- a limited-try mechanism comprising:
 - a pusher pawl cooperating with the fence-lever when it does not enter the gates;
 - a ratchet wheel rotatably advanced one step by said pusher pawl each time the fence-lever comes in contact with said pusher pawl;
 - a holding pawl coating with said ratchet wheel to hold it in the advanced position;
 - a cam surface having a slot on the side of said ratchet

wheel;

a lockout bar in slidable relationship with said cam and coacting with and precluding the entry of the fence lever into the tumbler gates when said lockout bar enters said slot in said cam surface,

whereby said limited-try mechanism renders the lock unopenable after the predetermined plurality of tries using the improper combination has been made and whereby said limited-try mechanism is reset by using the proper combination before the predetermined plurality of tries has been made.

9. The improvement of claim 8 wherein said limited-try mechanism further comprises:

a tell-tale dial outside the lock and coupled with said ratchet wheel to indicate the plurality of attempts made to open the lock.

10. The improvement of claim 9 further comprising:

an alarm coupled with said limited-try mechanism indicating when the predetermined plurality of attempts have been made.

11. The improvement of claim 10 further comprising:

a keyway through the face of the lock connecting with said limited-try mechanism; and
a key insertable in said keyway and coacting with said limited-try mechanism to reset said ratchet wheel permitting the lock to be opened by the use of the proper combination.

12. The improvement of claim 8 wherein:

said holding pawl is releasable from said ratchet wheel by contact with the fence-lever when the proper combination is used and said fence-lever enters the tumbler gates.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,786,658 Dated Jan. 22, 1974

Inventor(s) Frank H. Swaim

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

1. In claim 1, line 9, insert the word --being-- after the word "mechanism".
2. In claim 1, line 10, correct the word "manipulation" to read --manipulator--.
3. In claim 8, line 10, correct the word "coating" to read --coacting--.

Signed and sealed this 19th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents