COMBINATION LOCK WITH UPSET MECHANISM
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ABSTRACT OF THE DISCLOSURE
A rotatable tumbler combination lock having a resiliently mounted cam which interacts with a cam surface on the dog lever to disengage the dog mechanism upon movement of the bolt to the unlocked position and return the dog mechanism to the locked position. A spring normal urges the dog mechanism toward the position of engagement so that engagement for unlocking is accomplished when the tumblers and driving disc are properly aligned. Movement of the bolt plate toward the unlocked position removes the spring bias from the dog mechanism and the resiliently mounted cam disengages the dog mechanism for return to the locked position when the dial is released.

BACKGROUND OF THE INVENTION
Field of the invention
This invention relates to combination locks. More particularly, this invention relates to combination locks with an automatic upsetting mechanism whereby the operating mechanism of the lock is disengaged or scrambled upon release of the actuating dial to automatically upset the unlocking alignment of the operating mechanism of the lock eliminating the need of manual scrambling by the person operating the lock.

Background of the invention
A persistent problem in the combination lock art has been the danger of a lock being opened by an unauthorized person if the unlocking mechanism has not been completely upset. The problem arises when an authorized person dials the proper combination, opens the lock, and then closes the lock without disturbing the final setting. Since the final setting of the lock has placed the lock mechanism in proper alignment to accomplish the unlocking movement, it is possible in many locks for an unauthorized person to open a lock thus left undisturbed at its final dial setting.

Suggestions have been made in the past for tumbler upset mechanisms. However, these mechanisms proposed in the past have usually been relatively involved, complicated compared to the remainder of the lock structure, and not completely reliable.

SUMMARY OF THE INVENTION
The present invention provides tumbler type combination locks with a positive action upset mechanism without adding undue complications to the lock structure. A resiliently mounted cam element is positioned for cooperation with the dog mechanism of the lock structure, and the dog mechanism is spring biased toward the position of engagement for unlocking. When the tumblers and drive disc have been properly positioned in accordance with the right combination, the spring loading on the dog mechanism drives the dog mechanism into engagement with notches in the tumblers and drive disc, and the bolt plate is then free to move to the unlocked position with further movement of the dial. The dog mechanism rides over the resiliently mounted cam during movement of the bolt plate toward the open position, and a camming surface on the dog mechanism then comes into contact with the cam when the bolt plate reaches the unlocked position. Movement of the bolt plate to the unlocked position also relieves the spring loading normally biasing the dog mechanism, and thus the dog mechanism is free to respond to the interaction between the cam and the camming surface. The bolt plate is spring loaded toward the closed position, and thus when the operator releases the dial plate, the spring loading on the bolt plate causes a reaction between the cam and the camming surface whereby the dog mechanism is cammed out of engagement with the tumblers and drive disc. The spring loading on the bolt plate then returns the bolt and dog mechanism to the locked position so that the unlocking alignment between the dog mechanism and the tumblers and disc mechanism is upset. Once the dog mechanism has been returned to its locked position, the bolt can only be reopened by a complete recycling of the lock combination.

Accordingly, one object of the present invention is to provide a novel and improved combination lock and upset mechanism.

Still another object of the present invention is to provide a novel and improved combination lock and upset mechanism wherein the lock structure is not significantly increased in complexity by the presence of the upset mechanism.

Still another object of the present invention is to provide a novel and improved combination lock and upset mechanism wherein the upset mechanism employs a resiliently mounted cam element that is fool-proof.

Other objects and advantages of the present invention will be apparent and understood from the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS
In the drawings, wherein like elements are numbered alike in the several figures,
FIGURE 1 is an elevation view showing the combination lock of the present invention mounted in a structure to be locked.
FIGURE 2 is a rear view of the lock shown in FIGURE 1.
FIGURE 3 is an enlarged view taken in the direction of FIGURE 2 with the back plate removed.
FIGURE 4 is a view taken along line 4–4 of FIGURE 3 showing the dog mechanism in alignment with the tumbler grooves for opening, but prior to opening of the lock.
FIGURE 5 is a view similar to FIGURE 4, with some of the parts removed for purposes of illustration, and showing the dog in an intermediate position moving from the locked position to the unlocked position.
FIGURE 6 is a view similar to FIGURE 3 showing the bolt structure in the unlocked position with maximum bolt retraction.
FIGURE 7 is a partial view of the mechanism shown in FIGURE 6 showing the relative position of the mechanism with the bolt partly returned to the locked position.
FIGURE 8 is a view similar to FIGURE 7 showing the relative position of the lock mechanism with the bolt fully extended to the locked position.

DESCRIPTION OF THE PREFERRED EMBODIMENT
Referring now to FIGURE 1, a combination lock indicated generally at 10 is shown mounted in structure with which it might be associated such as, for example, a Post Office Box 12 having a door 14 in which the lock is mounted and a casing 16 into which the bolt extends.
3,481,167

for locking. As viewed externally, lock 10 has a dial plate 18 on which the combination numbers are displayed in the casing. Backing plate 26 is secured to the rest of the casing by a pair of screws 28.

Referring now to FIGURE 2, lock 10 is shown from the rear. A part of casing 24 is in the form of a backing plate 26 which is removable to expose the mechanism within the casing. Backing plate 26 is one of the parts of the mechanism in FIGURE 3 and is not shown in FIGURE 2. The arrangement of the lock mechanism in FIGURE 3 is literally minus backing plate 26 as distinguished from the state wherein backing plate 26 is removed. The interior side 30 of the front part of casing 24 can be seen along with screw posts 32 into which screws 28 fasten. A bolt plate 34 is positioned immediately adjacent interior surface 30 of casing 24, being an integral part and an extension of bolt plate 34. Bolt plate 34 is moveable laterally with respect to interior surface 30. As shown in FIGURE 3, bolt plate 34 and bolt 22 are in the locked position with maximum bolt extension, and unlocking movement would involve the sliding of bolt plate 34 and bolt 22 left with respect to the position shown. Bolt plate 34 has an open central section defined by edge 36 so that the bolt plate can slide without interference with other parts of the mechanism. The bottom part of bolt plate 34 is guided along the lower part of casing 24, and the upper part of the bolt plate is guided by a guildepost 38 mounted on interior surface 30 so that straight movement of bolt plate 34 and bolt 22 are accomplished without any unnecessary friction.

A torsion spring 39 is wrapped around a post on bolt plate 34, and one end of spring 39 bears against the side of casing 34 while the other end is positioned in a hole in bolt plate 34. The action of torsion spring 39 imparts a force to the bolt plate urging or biasing the bolt plate to the locked position.

An arbor 40 is rotatably mounted and extends into the interior of casing 24. A drive plate 42 is connected to arbor 40 so that drive plate 42 is rotated by arbor 40. Drive plate 42 may be permanently fixed to arbor 40, and arbor 40 is connected to be driven by operating post 20. Thus, rotation of operating post 20 causes rotation of arbor 40 and drive plate 42. Drive plate 42 has a section which is formed into the shape of a hook 46 having a notch 44. Drive plate 42 also carries a projection 48 perpendicularly to its surface and facing toward the interior of the lock.

A mounting post 50 extends from bolt plate 34, mounting post 50 being integral with bolt plate 34 and recessed from interior surface 30 to define a space between post 50 and interior surface 30. A dog lever 52 is positioned adjacent interior surface 30 above bolt plate 34, and one end of dog leg 52 extends into the space between post 50 and surface 30, and this end of the dog lever is pivotally connected to bolt plate 34 by pin 54. Thus, dog lever 52 is connected to bolt plate 34 but can move pivotally with respect to the bolt plate. A fence 56 extends from dog lever 52 toward the interior of the lock structure for tumbling engagement. A dog 60 at the end of dog lever 52 removed from the pivoted connection is adapted for engagement with notch 44.

A torsion spring 62 is mounted on pin 54, and torsion spring 62 imparts a force to dog lever 52 urging the dog lever downward against the periphery of drive plate 42. One end of torsion spring 62 normally bears against the right hand surface of an opening 64 in the top of casing 24, and the other end of spring 62 bears against a flat surface on the top of dog lever 52 so that the dog lever is urged in a counterclockwise direction (as viewed in FIGURE 3) toward the periphery of drive plate 42. The arrangement of the lock mechanism in FIGURE 3 shows the parts in their relative position when the dog has dropped into the notch in drive plate 42 upon completion of the tumbling action and just prior to unlocking the bolt. Ordinarily, dog 60 would ride against the outer periphery of drive plate 42 rather than be positioned in the notch as shown in FIGURE 3.

As previously pointed out, some of the structure depicted in FIGURE 3 is actually attached to or mounted on the interior of dial plate 18 as shown in FIGURE 2. The structure attached to the backing plate includes a pair of tumblers 68 (only one of which can be seen in FIGURE 3). The tumblers have a series of evenly spaced teeth 70 around their periphery corresponding to the numbers on dial plate 18, and each tumbler has associated therewith a finger 72 which is positioned in a selected hole to set the combination for the lock.

Referring now to FIGURE 4, the tumblers 68 and the fingers 72 can be seen more clearly. The tumblers are mounted on a shaft 74 which is fixed to backing plate 26 and which is stepped to provide a shoulder 76 to position the tumblers with respect to the backing plate. Each of the fingers 72 extends from a ring 78 which both supports the finger and acts as a separator between the tumblers. As can be seen, each finger 72 passes through the combination housing 84. The housing 84 limits what projects beyond the rear surface of the tumblers so that it can driveingly engage the finger on the next tumbler. A snap ring 80 mounted on a reduced diameter portion of shaft 74 is inserted into the housing assembly to the shaft while leaving the tumblers free to rotate about the axis of the shaft. Each of the tumblers has a notch 82 directed radially inwardly from rear surface (see also FIGURE 3), and when the notches 82 in the tumblers and notch 44 in drive plate 42 are in proper alignment, as a result of proper dialing of the combination, the fence 56 and the dog 60 drop into the notches to allow opening of the lock.

The structure described to this point has been a standard prior art combination lock mechanism without an upset feature. As previously stated, upset mechanisms herefore available have not been satisfactory for a number of reasons.

The upset mechanism of the present invention includes a cam 84 which is connected to a strip of resilient spring material 86 which is in turn fastened at one end by rivet 88 to backing plate 26 in a recessed portion thereof. Spring 86 is spaced from the surface of backing plate 26 a sufficient distance to allow it to be flexed and thus allow some movement of cam 84 toward the backing plate.

An extension at the end of fence 56 sets a camming surface 90 which also forms part of the upset mechanism. Camming surface 90 is adapted for engagement with cam 84 when the lock is in the unlocked position, and the interaction between cam 84 and camming surface 90 leads to the upsetting operation.

The upset mechanism and operation can best be illustrated by a description of the operation of the lock. Assuming that the lock is in a locked position and is to be unlocked, dial plate 18 is turned by manipulation of operating post 20 in the usual fashion to select the proper combination numbers. Movement of the dial plate acts through arbor 40 to turn drive plate 42. Drive plate 42 drives the tumblers in a manner well known in the art by contact between the fingers 72 and projection 48. The dialing of the proper combination results in the alignment of plate notch 44 and the tumbler notches 82 as shown in FIGURES 3 and 4 so that dog lever 52 is aligned with the tumbler notches and dog 60 is aligned with drive plate notch 44. The force of spring 62 then drives dog levers 52 downward and causes dog 60 to engage notch 44. The lock mechanism is then in the position shown in FIGURES 3 and 4 ready for opening, and the bolt can be moved to the open position. Movement of the bolt to the open position is accomplished by additional rotation of drive plate 42 in the counterclockwise direction as viewed.
In FIGURE 3, whereby dog lever 52 is pulled to the left and pulls with it bolt plate 44 to which it is pivotally connected and thus bolt 22.

Referring now to FIGURE 5, a view similar to FIGURE 4 is shown, with some of the parts removed, with the dog in an intermediate position moving from the locked position to the unlocked position. As previously stated, movement to the unlocked position is accomplished by additional rotation of drive plate 42 after dog 60 has engaged notch 44 in the drive plate. This additional rotation of the drive plate pulls dog lever 52 leftward thereby moving with it bolt plate 34 to which it is attached and thus bolt 22. As clearly shown in FIGURE 5, movement to the unlocked position causes the free end of fence 56 (i.e., the end adjacent to camming surface 90) to ride across the face of cam 84. The contact between the end of fence 56 and the face of cam 84 causes a flexing of spring 86 and results in cam 84 being moved rearwardly from its position shown in FIGURE 4 toward back plate 26 as shown in FIGURE 5. As can be seen from both FIGURES 4 and 5, the contact between the end of camming surface 90 and the face of cam 84 occurs because the distance from the free end of fence 56 to back plate 26 is less than the distance from the face of cam 84 to the back plate.

Referring now to FIGURE 6, bolt 22 is shown in the unlocked position with spring 39 being fully flexed to provide a biasing force urging the bolt back toward the locked position. As can be seen, the opening defined by edge 36 of bolt plate 34 has allowed full movement of the bolt plate to the left without interference of arbor 48. The counterclockwise movement of drive plate 42 has resulted in a counterclockwise movement of notch 44, and the contact between fence 56 and the back wall of notches 82 causes a similar counterclockwise rotation of the tumblers 68 so that the notches 82 also move counterclockwise. Thus, drive plate 42, tumblers 68, and the associated notches in each of these elements are moved from the previous position, wherein they were aligned in the one proper position to allow unlocking, to a new position. During movement to the unlocked position of FIGURE 6, the end of spring 62 in opening 64 engages the left face of opening 64 and is rotated in a clockwise direction out of contact with dog lever 52. Thus, movement of the bolt to the unlocked position removes the force normally biasing the dog lever toward the tumblers and drive disc.

Still referring to FIGURE 6, when the full unlocked position has been reached fence 56 has been moved leftward to a position wherein it clears the inclined surface of cam 84. Thus, spring 86 unflexes and returns cam 84 to its normal position with respect to the back plate. The inclined surface of cam 84 and camming surface 90 are now in bearing contact with each other.

When the operator of the lock releases post 20, the force from spring 39 starts to move bolt plate 34 to the right. The rightward movement of the bolt plate imposes a rightward force on dog lever 52, and, as can be seen in FIGURE 7, dog lever 52 is caused to rotate in a clockwise direction by the interaction between the inclined surface of cam 84 and camming surface 90. Dog 60 and fence 56 are thus cammed up and rotated out of their respective notches in the drive plate and tumblers, and spring 39 drives bolt plate 34 and bolt 22 to the closed position as shown in FIGURE 8. The reaction between dog 60 and drive plate 42 as the dog is being rotated out of engagement causes a clockwise rotation of the drive plate to approximately the position shown in FIGURE 8, and the dog is again bearing on the outer periphery of the drive plate with the force of spring 62 which has been withdrawn. The fact that the force of spring 62 is removed when the unlocked and camming surfaces engage between the cam 84 and camming surface 90.

As can be seen from the position of the elements in FIGURE 8, an automatic upsetting of the locking align-
3,481,167

7. A combination lock as in claim 6 wherein;
said projection is an extension of said fence.

8. A combination lock as in claim 6 including:
spring means biasing said lever toward said drive plate.

9. A combination lock as in claim 8 including:
means for removing the bias of said spring means upon
said further movement to said unlocked position.

10. A combination lock as in claim 6 wherein said up-
set includes:
rotating said lever to disengage said dog from said
drive plate notch and said fence from said tumbler
notches, said dog and said fence being returned to a
locked position, and said drive plate being rotated
away from said unlocked position.

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