

Dec. 25, 1956

G. E. LEE  
COMBINATION LOCK

2,775,114

Filed Jan. 3, 1949

4 Sheets-Sheet 1

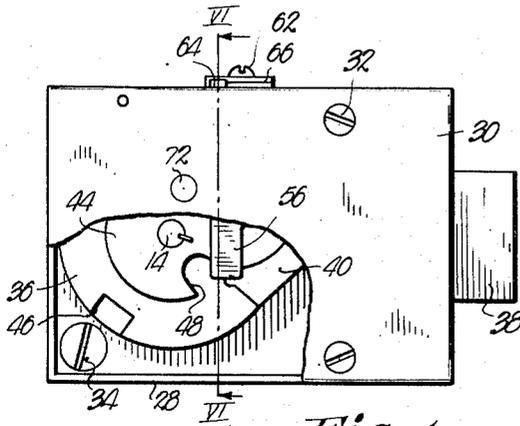


Fig. 1.

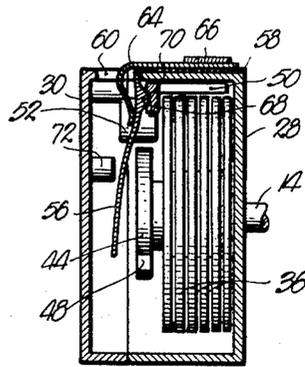


Fig. 6.

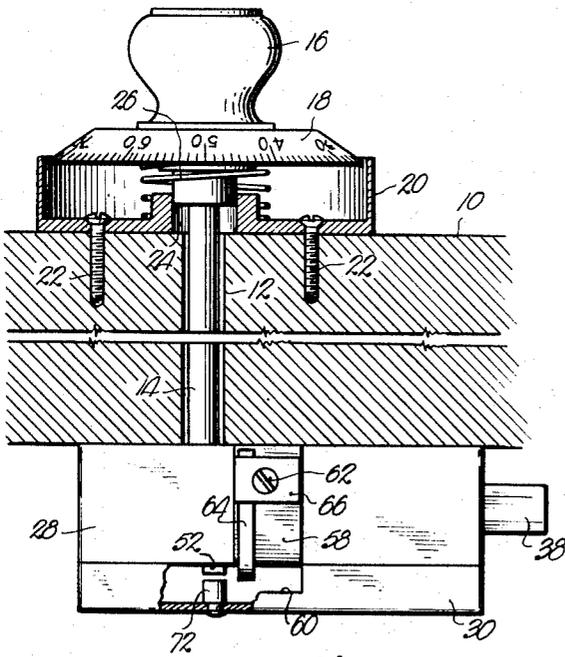


Fig. 2.

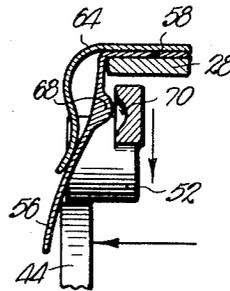


Fig. 9.

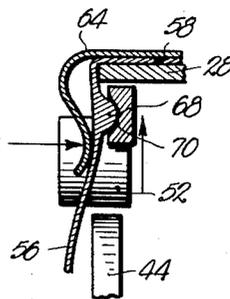


Fig. 10.

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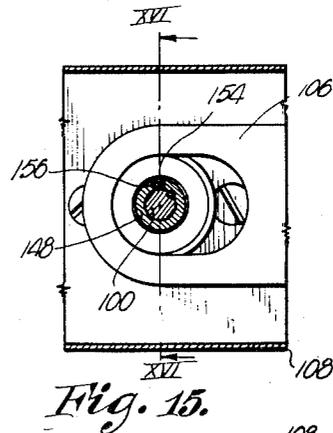
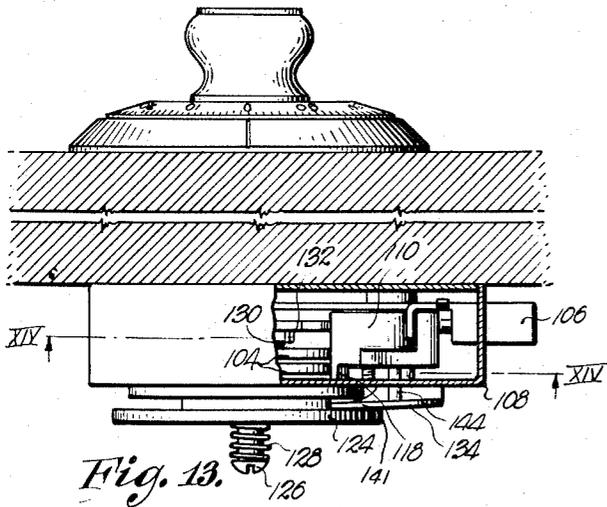
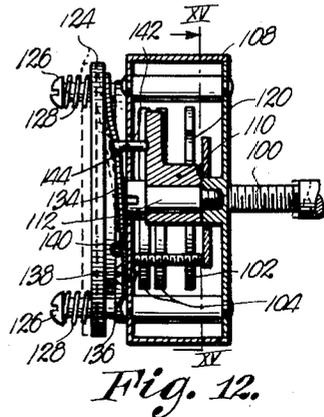
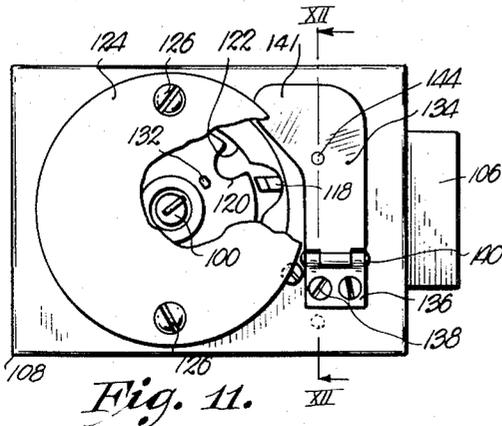


Fig. 13.

Fig. 15.

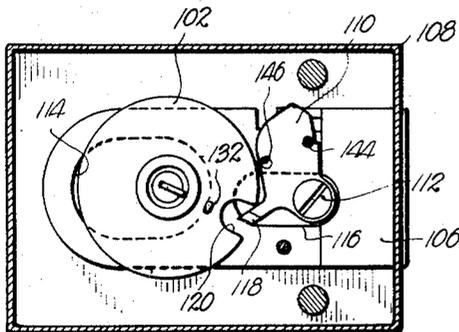


Fig. 14.

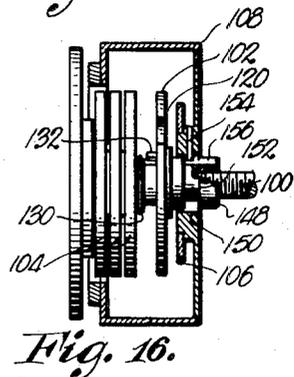


Fig. 16.

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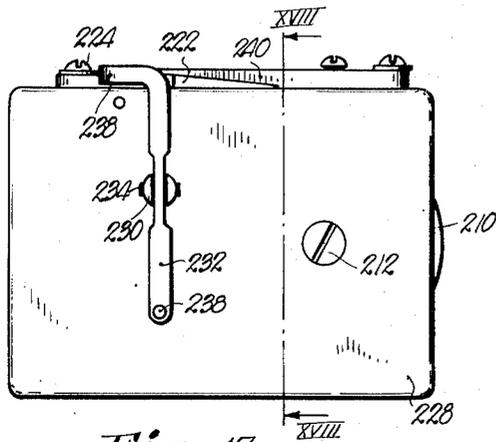


Fig. 17.

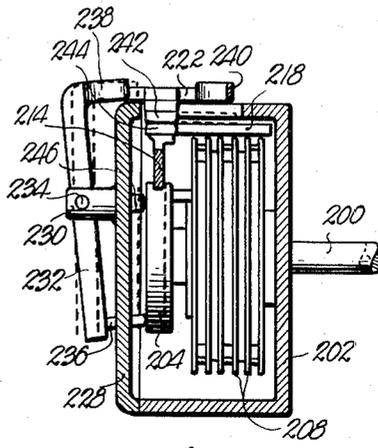


Fig. 18.

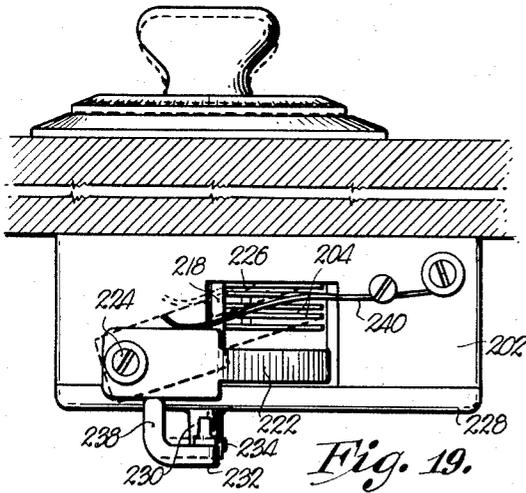


Fig. 19.

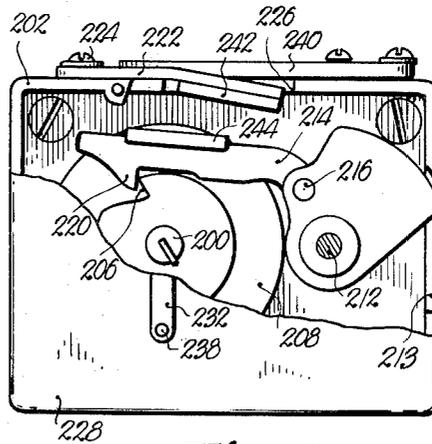


Fig. 21.

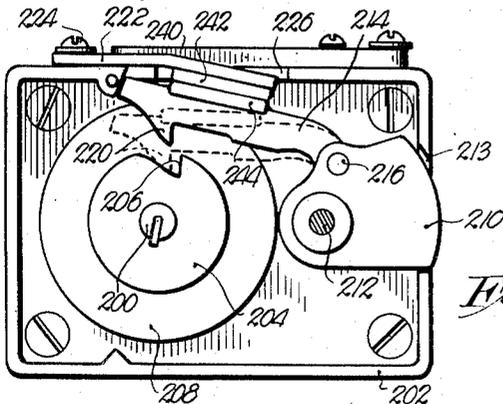


Fig. 20. INVENTOR. George Edward Lee

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2,775,114

**COMBINATION LOCK**

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Application January 3, 1949, Serial No. 68,976

18 Claims. (Cl. 70—133)

This invention relates to combination locks of the well known type, having a manually rotatable dial shaft and a plurality of notched tumblers operably mounted on the shaft for movement to a predetermined position upon pre-selected, rotative movements of the shaft, with the notches of the tumblers in relative alignment. Such combination locks are ordinarily provided with a recessed disc-like member commonly referred to as a "cam member," a shiftable bolt and a swingable arm-like element called a fence, that is adapted to interlock with the recess or gate of the cam when the tumblers are properly aligned to actuate the bolt through the fence upon continued rotation of the dial shaft in one direction.

Combination locks of the above mentioned character are widely used today and have become standardized to a point where all common types of such locks operate on substantially the same broad principle. Through such standardization, these locks are now relatively inexpensive and are kept on such low cost basis through elimination of high precision in manufacture thereof. Accordingly, so far as I am aware, there is no combination lock upon the market today that cannot be operated by those familiar with the broad principles thereof even though the particular combination is not known.

Manifestly, such locks could be manufactured with high accuracy of all of the component parts thereof to render the operation thereof difficult when the combination is not known, but the expense of manufacture would be so great as to be impractical in this highly competitive field. Furthermore, even if a combination lock were made with care and precision, the same would soon become worn to a point where the expert could easily determine the combination and thereby operate the lock.

It is the primary object of the present invention therefore, to provide a combination lock that is positively "fool proof" through the provision of means to prevent the "feel" and sound effects inherent in the usual lock which serve to aid in the unauthorized opening thereof.

It is appreciated that there has heretofore been developed means intended to accomplish the same broad objects hereof, but such prior devices have been impractical for many reasons including the necessity of rebuilding the combination lock in its entirety; expense of manufacture; complicated formation and assemblage of parts; continued operational difficulties; and complicated operation of the combination lock itself.

Accordingly, it is the most important object of the present invention to provide means for preventing unauthorized use of combination locks taking the form of an attachment than can be made for mounting up any one of the numerous inexpensive and highly developed combination locks now on the market, eliminating thereby the necessity of re-designing the lock itself or in any way changing the construction thereof in a material way, all to the end that the desired cheapness of manufacture of the combination locks can be maintained.

Another important object of the present invention is to provide an attachment for combination locks adapted

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to receive the fence thereof and to automatically move the same to a position where it is entirely out of engagement, not only with the plurality of tumblers of the lock but with the recessed cam member thereof and to maintain said fence in such position all the while the lock is operated to form the combination to the end that the "feel" and the sound of the fence riding on the cam member and/or the tumblers, is entirely eliminated.

Another important object of this invention is to provide an attachment of the aforesaid character for holding the combination lock fence out of engagement with the cam and the tumblers and additionally, the provision of means for reciprocally mounting the dial shaft for movement to a position where the fence holding means is released after the combination has been produced.

A further object of the present invention is to provide means for preventing rotation of the dial shaft to shift the bolt of the lock whenever the shaft is reciprocated in an attempt to release the fence holding means if the combination has not been produced.

A still further object of the present invention is to provide a combination lock wherein the aforesaid fence holding means is actuated to release the fence, after the combination has been formed through reciprocation of the dial shaft whereupon the fence engages with the recessed cam and the bolt is shiftable through rotation of the dial shaft in one direction in the usual manner.

Other objects of the present invention relating particularly to details of construction capable of making the important objects hereof possible, will be made clear or become apparent as the following specification progresses, reference being had to the accompanying drawings, wherein:

Fig. 1 is a side elevational view of one type of conventional combination lock, parts being broken away to reveal details of construction of one modification of the invention.

Fig. 2 is a top plan view of a portion of the lock illustrated in Fig. 1 and a sectional view through other portions thereof and through a door or the like upon which the same is mounted, parts being broken away for clearness.

Fig. 3 is a side elevational view similar to that illustrated in Fig. 1, showing the cam member and two of the tumblers in a position for receiving the fence, but with the remaining tumblers jumbled.

Fig. 4 is a side elevational view similar to Figs. 1 and 3 but illustrating the lock with the combination completely produced and the fence in a position interlocked with the cam and with the tumblers and ready to actuate the bolt.

Fig. 5 is a view similar to Figs. 1, 3 and 4 showing the position of the component parts of the lock when the bolt thereof is in the unlocked position.

Fig. 6 is a transverse cross-sectional view taken on line VI—VI of Fig. 1.

Fig. 7 is a transverse cross-sectional view taken on line VII—VII of Fig. 3.

Fig. 8 is a transverse cross-sectional view taken on line VIII—VIII of Fig. 4.

Fig. 9 is an enlarged, detailed, cross-sectional view showing the position of the fence with respect to the receiving means thereof forming the subject matter of the present invention when said fence is initially moved from the interlocked condition with the cam.

Fig. 10 is a fragmentary, detailed, enlarged, cross-sectional view similar to Fig. 9 showing the fence in a position spaced from the cam and the tumblers and operably held in such position by the attachment forming the subject matter hereof.

Fig. 11 is a side elevational view showing a conventional combination lock differing somewhat from that

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illustrated in Figs. 1 to 10 inclusive and illustrating another modification of the present invention, parts being broken away to reveal details of construction.

Fig. 12 is a transverse cross-sectional view taken on line XII—XII of Fig. 11.

Fig. 13 is a cross-sectional view through a door or the like showing a top plan view of the lock illustrated in Figs. 11 and 12, parts being broken away for clearness.

Fig. 14 is a cross-sectional view taken on irregular line XIV—XIV of Fig. 13.

Fig. 15 is a cross-sectional view taken on line XV—XV of Fig. 12.

Fig. 16 is a fragmentary, detailed, cross-sectional view taken on line XVI—XVI of Fig. 15.

Fig. 17 is a side elevational view of a third type of combination lock showing a still further modification of my present invention.

Fig. 18 is a transverse cross-sectional view taken on line XVIII—XVIII of Fig. 17.

Fig. 19 is a transverse cross-sectional view through a door or the like showing a top plan view of the lock illustrated in Figs. 17 and 18.

Fig. 20 is a view similar to that shown in Fig. 17 with the cover plate of the case entirely removed showing the position of the component parts when in a locked position; and

Fig. 21 is a side elevational view of the lock illustrated in Fig. 17, parts being broken away to reveal details of construction and showing the same in the unlocked position.

The combination lock chosen for illustration in Figs. 1 to 10 inclusive is shown in Fig. 2 operably mounted upon a door or the like 10, having a transverse bore 12 for receiving a rotatably and reciprocally mounted shaft 14.

Shaft 14 has an operating knob 16 and a dial 18 secured on one end thereof. To the end that the shaft 14 might reciprocate in order to accomplish one of the purposes of the present invention, a specially formed tray-like body 20 is provided for receiving the dial 18, said body 20 being secured directly to one face of the door 10 through the medium of screws 22. The bottom wall of this body 20 has an opening 24 for clearing the shaft 14 and a spring 26 is coiled about the shaft 14 within the body 20 for yieldably holding the shaft 14 at one end of its reciprocable path of travel with the dial 18 in the position illustrated in Fig. 2.

A hollow casing 28 provided with a cover plate 30 removably secured thereto through the medium of screws 32, is mounted upon that face of door 10 opposite to the body 20 through the medium of a plurality of screws 34. Within this casing 28, is mounted a plurality of disc-like tumblers 36, a reciprocable bolt 38 that extends through an opening in one end wall of case 28, a fence 40 pivotally secured to the bolt 38 adjacent the innermost end thereof through the medium of a pintle 42 and a disc-like cam member 44 secured directly to that end of the dial shaft 14 opposite to the knob 16 for rotation with shaft 14.

The plurality of tumblers 36 are operably mounted upon the shaft 14 in the conventional manner and these tumblers 36 are each provided with a notch or gate 46. The diameter of the cam 44 is appreciably less than that of the tumblers 36 and this cam member 44 is also provided with a recess or gate 48.

The fence 40 is provided with a laterally projecting pin 50 adjacent that end thereof opposite to the pintle 42, said pin 50 extending in overlying relationship to all of the tumblers 36 in the manner illustrated in Figs. 6 and 7 of the drawings.

Fence 40 is normally in substantial alignment with the cam member 44 as illustrated in Fig. 10 and is provided with a depending projection 52 disposed near the pin 50 and extending laterally from the fence 40 in a

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direction opposite to the pin 50, as is clear in Figs. 6, 9 and 10.

A spring 54 on the fence 40 is formed and disposed to normally hold the fence 40 biased toward the tumblers 36 and the cam 44.

In combination locks of this character, the projection 52 of the fence 40 normally rides on the periphery of the cam 44 as shown in Fig. 9, thereby holding the pin 50 out of contact with the peripheries of the tumblers 36.

This last mentioned feature of the present day combination locks was developed to in part prevent unwarranted operation of such locks by eliminating the "feel" of pin 50 on tumblers 26 and also the sound produced when the tumblers 36 are rotated and the pin 50 thereby riding across the gates 46 of tumblers 36.

As is well understood by those skilled in this field, when the knob 16 and dial 18 are properly rotated, depending upon the setting of the lock, all of the tumblers 36 will be actuated to bring the gates 46 thereof in relative register or alignment as illustrated in Fig. 4 of the drawing. When such gates 46 are so aligned, pin 50 of fence 40 will drop into gates 46 because of the action of spring 54 and the projection 52 will move into the gate 48 of cam 44. The bolt 38 can then be withdrawn to the unlocked position by continued rotation of the shaft 14. This manual operation forces the fence 40 and the bolt 38 inwardly where all of the component parts of the lock are positioned as illustrated in Fig. 5 of the drawing.

It is apparent from the foregoing that even though the pin 50 is normally held out of contact with the peripheries of the tumblers 36 because of the projection 52 riding on cam 44 and the unauthorized operation of the lock thereby rendered partially more difficult, nevertheless the lock can be operated by those skilled in this field even if the combination is not known. The projection 52 riding upon the periphery of the cam 44 will still permit the operator to "feel" movement of such projection 52 across the gate 48 as cam 44 is rotated. When cam 44 is in the position illustrated in Fig. 3, fence 40 will drop slightly even though the gates 46 of the tumblers 36 are not in alignment and the pin 50 will drop upon the peripheries of the tumblers 36. The operator can then determine through "feel" and sound, whether or not any of the gates 46 is in alignment with the pin 50 and through continued manipulation of the knob 16 he can progressively first align two of the gates 46 and finally all of the gates 46 of tumblers 36, whereupon the combination is determined and the lock rendered operable.

The attachment forming the modification of Figs. 1 to 10 inclusive and shown operably mounted upon the lock chosen for illustration in these said figures, includes an elongated finger 56 having a laterally turned flange 58 integral therewith. Finger 56 and its flange 58 are preferably made from resilient metallic material, the flange 58 overlapping the uppermost edge of the case 28 and the finger 56 extending into the case 28 through an opening 60 formed in the latter. Flange 58 is secured to the uppermost wall of case 28 through the medium of a screw 62. A substantially L-shaped spring 64 is clamped to the flange 58 by a washer 66 held in place by the screws 62, said spring 64 extending through the opening 60 of case 28 and bearing against the normally outermost face of finger 56 intermediate the ends of the latter. It is noted that the finger 56 extends into the case 28 in overlapping relationship to a portion of the fence 40 and extends downwardly to overlap a portion of the cam 44. That face of the finger 56 opposite to the spring 64 is provided with a detent 68 disposed immediately below the innermost face of that wall of case 28 having opening 60 formed therein. This detent 68 is dome-shaped and designed to fit snugly within a small cavity 70 formed in that face of the fence 40 proximal to finger 56.

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Figs. 9 and 10 of the drawings illustrate by arrows the reciprocable movement of cam member 44 because of the way in which shaft 14 is mounted and held at one end of its path of travel by spring 26. Through use of arrows in Figs. 9 and 10, the swinging movement of the fence 40 is also illustrated and an arrow in Fig. 10 also shows the way in which spring 64 aids in holding the finger 56 normally biased in a direction toward the fence 40 and the cam 44.

For purposes hereinafter to be made more clear and as shown particularly in Figs. 2, 6, 7 and 8, the cover plate 30 of the case 28 is provided with an inwardly extending pin 72. This pin 72 is in direct alignment with the gate 48 of cam 44 when the cam 44 is in the position illustrated in Figs. 3 and 4 of the drawings.

Assuming the component parts of the lock to be in the position illustrated in Fig. 4 of the drawing, rotation of the shaft 14 and the cam 44 in a direction for breaking the combination, i. e. in a direction opposite to that necessary for moving bolt 38 to the unlocked position, will swing the fence 40 upwardly and thereby force the projection 52 from within the gate 48 of cam 44. The projection 52 is then in the position shown in Fig. 9 relative to cam 44 and the gate 40 is in a position where the cavity 70 is about to receive and actually does partially receive the detent 68. Because of the complementary nature of detent 68 and the cavity 70, as soon as fence 40 is swung to the position of Fig. 9, fence 40 will be forced upwardly beyond the position shown in Fig. 9 where detent 68 is fully seated within the cavity 70. This action is caused by the finger 56 constantly bearing against the fence 40 the moment the latter is moved upwardly by cam 44. Once detent 68 and cavity 70 commence to interlock, as shown in Fig. 9, the interlocking operation will continue until detent 68 is fully seated in cavity 70 and the fence 40 thereby swung upwardly to the uppermost end of its path of travel as illustrated in Fig. 10.

Figs. 6 and 10 illustrate the way in which not only the pin 50 is held out of engagement with the tumblers 36 but the way in which the projection 52 is maintained out of engagement with cam 44 whenever the detent 68 of finger 56 and the cavity 70 of fence 40, are interlocked. Thus, whenever the lock is in the operative condition with bolt 38 in a locked position and with the tumblers 36 having their gates 46 jumbled, the fence 40 will be out of engagement entirely with cam 44 and tumblers 36.

When the lock is to be opened by the usual procedure of forming the combination by rotation of knob 46 and dial 18, the operator can positively receive no "feel" or sound of any part of the fence 40 against gates 46 and 48 while shaft 14, cam 44 and tumblers 36 are being rotated. After the combination has been produced in the correct manner to position the gates 46 of tumblers 36 in alignment as shown in Fig. 4, the operator imparts an inward pushing movement to the knob 56 to reciprocate shaft 14 in opening 12 and to thereby move cam 44 toward the cover plate 30 of case 28. When such reciprocable movement is imparted to the cam 44, the latter will move into engagement with the finger 56 as shown in Fig. 9 and thereby release the detent 68 from its interlocked engagement with the cavity 70. The fence 40 will thereupon drop downwardly because of the action of spring 54 as shown by the arrow in Fig. 9 and the pin 50 will move into the aligned gates 46 since projection 52 is free to also move into the gate 48 of cam 44.

With the fence 40 thus released from finger 56, the operator thereupon releases knob 16 to permit outward movement of shaft 14 because of the action of spring 26. Bolt 38 can thereupon be moved to the unlocked position shown in Fig. 5 in the manner above described. In the event that the operator attempts to reciprocate the shaft 14 to move cam 44 against finger 56 and thereby release the fence 40 before the combination has been produced, then cam member 44 will either strike pin 72

and prevent full reciprocation of shaft 14 or the pin 72 will receive the gate 48 of cam 44 and thereby prevent rotation of shaft 14 to actuate bolt 38, all because of the rigid mounting of pin 72 on the cover plate 30 of case 28. The pin 72 is chosen to fit relatively tightly within the gate 48 of cam 44 to the end that when the operator does actually release finger 56 before the combination has been produced, he will not be able to rotate shaft 14 enough to "feel" or hear movement of gate 48 against the projection 52 or the pin 50 on the gates 46 that happen to be in alignment with pin 50 when such fence releasing operation takes place.

In the form of the invention illustrated in Figs. 11 to 16 inclusive, there is shown a slightly different type of conventional combination lock including a rotatable dial shaft 100 having a cam element 102 secured thereto. Shaft 100 also carries a plurality of recessed tumblers 104 disposed outwardly from the cam element 102.

A bolt 106 is reciprocally mounted within an opening formed in one end of a hollow case 108 and a fence 110 within case 108 is swingably mounted on a pintle 112 that is in turn secured to the innermost face of one wall of case 108 in the manner illustrated in Fig. 12 of the drawings. Obviously, the cam 102, as well as all of the tumblers 104, are enclosed within the case 108.

As illustrated in Fig. 14 and also Figs. 12 and 15, the bolt 106 extends a considerable distance into the case 108 and is provided with a pair of elongated, longitudinally extending slots 114 and 116 for clearing shaft 100 and pintle 112 respectively, to permit free reciprocable movement of the bolt 106.

The fence 110 is normally biased toward the cam element 102 and the tumblers 104 through a spring, not shown, and is provided with parts capable of fitting within the gates of the tumblers 104 when such gates are properly aligned, whereby to permit an ear 118 on the fence 110 to interlock with a gate 120 on cam element 102. Said parts for entering the gates of tumblers 104 constitute an extension of the ear 118 in the manner illustrated in Fig. 13. When the ear 118 and the gate 120 are interlocked, rotation of the dial shaft 100 and the cam element 102 secured thereto for rotation with dial shaft 100 in one direction, will swing fence 110 and thereby reciprocate the bolt 106 to the unlocked condition illustrated in Fig. 14, because of an operable interconnection between fence 110 and bolt 106, not shown.

The outermost side wall of the case 108 is provided with a circular opening 122 and a disc 124 is mounted on the outermost face of case 108 in concentric relationship with opening 122 through the medium of a pair of screws 126. The disc 124 is in turn provided with a pair of openings for slidably receiving the screws 126, and a spring 128 coiled about each screw 126 respectively, normally holds the disc 124 biased toward the case 108.

Disc 124 has an inwardly extending axially disposed hollow hub 130 formed thereon and it is on this hub 130 that the tumblers 104 are rotatably mounted.

The innermost end of the hub 130 rotatably receives the proximal end of the shaft 100. A pin 132 on cam 102 operably engages the proximal tumbler 104 in a manner well known to those skilled in this art. It is thus seen that the disc 124, hub 130 thereon and the tumblers 104 on the hub 130, are all freely reciprocable on an extended line through the longitudinal axis of the shaft 100. There is also provided sufficient clearance between cam 102 and the bolt 106 to permit reciprocable movement of the dial shaft 100 on its longitudinal axis.

In addition to the means just described for permitting reciprocable movement of the dial shaft 100, the modification of this invention now being described, includes the provision of a hinge-like member, having an elongated strap 134 and a smaller strap 136, the latter being secured directly to the case 108 adjacent the disc 124 through the medium of a pair of screws 138.

A hinge pin 140 permits free swinging movement of

the strap 134 on strap 136. The outermost free end of the strap 134 projects laterally as at 141 for disposition between the disc 124 and the proximal face of the case 108. An opening 142 in that wall of case 108 having the strap 134 mounted thereon, receives a short pin 144 that is secured directly to the normally innermost face of strap 134. Said pin 144 serves as a detent and is designed to enter an opening 146 in the fence 110. The outermost free end of pin 144 and the opening 146 are complementary in contour, i. e. pin 144 is dome-shaped.

It is seen that the spring 128 acting upon the disc 124, causes the latter to normally bear against the finger 141 of strap 134 to in turn hold the pin 144 biased against the proximal face of fence 110. When the cam 102 is rotated to swing the fence 110 to disengage ear 118 and gate 120, the pin 144 will start its entrance into the opening 146. Once such interengagement of pin 144 and opening 146 commences, the force of spring 128 will cause fence 110 to continue its swinging movement away from the cam 102 and tumblers 104 until the outermost free end of pin or detent 144 is fully seated within the opening 146. The ear 118 of fence 110 will thereupon be entirely out of engagement with both cam 102 and tumblers 104. This position of the component parts of the lock continues throughout the time the lock is in an operative position and while the operator is attempting to form the combination.

The cam element 102 is provided with a hub 148 extending coaxially from one face thereof opposite to the tumblers 104 and passing through an opening 150 formed in the normally innermost side wall of the case 108. This hub 148 is threadably mounted upon the dial shaft 100 and is provided with an annular groove 152.

A stub pin 154 mounted on the case 108 extends radially into the opening 150 and into the groove 152; thus the dial shaft 100 cannot be normally reciprocated on its longitudinal axis because of the interlocking relationship between pin 154 and the groove 152. However, a slot 156 is formed in the hub 148 as illustrated in Fig. 16 for receiving the pin 154 when the slot 156 is in alignment with the pin 154.

In operation, therefore, when the tumblers 104 are properly aligned after producing the combination, the gate 120 of cam 102 is also in a position for receiving the ear 118 and the slot 156 of hub 148 is also in alignment with the pin 154. The operator can then force the shaft 100 inwardly to move the disc 124 away from the finger 141 of strap 134, thereby releasing the fence 110 for locking engagement with the cam 102. In the event however, that the combination has not been produced, an inward movement imparted to shaft 100 when slot 156 and pin 154 are aligned, will release the fence 110, but the interlocking relationship between slot 156 and pin 154, will prevent rotation of shaft 100 necessary to withdraw the bolt 106. Here again, there is a relatively tight fit between the pin 154 and the slot 156 to the end that the operator cannot oscillate the shaft 100 to any appreciable extent and thereby obtain a "feel" and a sound between the ear 118 and the cam 102 and tumblers 104.

It is also to be noted that the modification just described and illustrated in Figs. 11 to 16 inclusive, like that form of the invention of Figs. 1 to 10 inclusive, includes only elements that can be attached to a conventional lock without the necessity of changing the broad principle of operation of the lock and without the need of expensive and complicated re-arrangements of the component parts thereof.

A third type of conventional lock is illustrated in Figs. 17 to 21 inclusive and there is provided a slightly different form of the present invention adapted for use with this lock.

A rotatable and reciprocable dial shaft 200 extends into a hollow case 202 and has a disc-like cam 204 rigidly secured to the innermost end thereof. Cam 204

is provided with a gate 206 and a plurality of tumblers 208 within the case 202 are also each provided with a gate in the usual manner, said tumblers 208 being operably mounted upon the dial shaft 200.

A bolt 210 is swingably mounted upon a pintle 212 within the case 202, said bolt 210 moving within a slot 213 formed in one end wall of the case 202. The normally uppermost edge of the bolt 210 is bifurcated to swingably receive a fence 214 through the medium of a transverse pintle 216.

A laterally extending pin 218 adjacent the outermost end of the fence 214 overlies the tumblers 208 and is designed to fall within the gates of said tumblers 208 when the gates are in alignment. The normally lowermost edge of the fence 214 is also provided with an ear 220 that enters the gate 206 of cam 204 when the combination has been worked as indicated in dotted lines by Fig. 20. Sufficient clearance is provided between the cam 204 and the proximal tumbler 208 as illustrated in Fig. 18 to permit reciprocal movement of the shaft 200.

An elongated finger 222 is swingably mounted upon the normally uppermost face of case 202 through the medium of a screw 224. Case 202 has an opening 226 for clearing the innermost end of the finger 222, the latter of which extends into the opening 226 as shown in Fig. 20.

A cover plate 228 forming a part of the case 202 has a bifurcated boss 230 on the outermost face thereof for receiving an elongated arm 232 that is pivoted upon the boss 230 intermediate the ends of the arm 232 by a pin 234. The normally lowermost end of the arm 232 is provided with a pin 236 that passes freely through an opening formed in the cover plate 228, the uppermost end of the arm 232 being turned laterally to present a finger 238, engageable with the arm 222 intermediate the ends of the latter.

An elongated leaf spring 240 on the uppermost face of case 202, bears against the arm 232 and holds the same normally biased against the finger 238 as illustrated in Fig. 19.

A pair of magnets 242 and 244 on that end of the arm 222 opposite to screw 224, and upon the normally uppermost edge of the fence 214 respectively, are of differing polarity to the end that the same will normally attract each other. It is thus seen that when the cam 204 is rotated to tend to force fence 214 upwardly for disengaging the ear 220 and gate 206, the magnet 242 and 244 will be close enough to commence the attracting necessary to cause the fence 214 to swing upwardly to the position illustrated in Fig. 20. When fence 214 is thus held in the upwardly swung position by the arm 222, the ear 220 is completely disengaged with respect to the cam 204 and the pin 218 is completely raised out of engagement with the peripheries of tumblers 208.

In order to break the connection between magnets 242 and 244 after the combination has been produced, the operator exerts an inward pushing motion to the shaft 200 to move the cam 204 against pin 236. The arm 232 will thereupon be caused to swing on its axis 234 to thereby impart a swinging movement to arm 222 on screw 224 because of the pushing action of finger 238 against arm 222. Swinging of the arm 222 within the opening 226 and consequent shifting of magnet 242 laterally with respect to magnet 244 will release the attraction between such magnets and permit the fence 214 to fall to the dotted line position indicated in Fig. 20. An inwardly extending boss 246 on the inner face of the cover section 228, is positioned to be received by the gate 206 of cam 204 when the latter is shifted toward the cover section 228 to thereby prevent rotation of shaft 200.

The boss 246 is formed complementary with the gate 206 to the end that little, if any, oscillation is possible in the shaft 200 when cam 204 is held by the boss 246 to the end that at no time can the operator receive a "feel"

or sound even though the fence 214 may be in engagement with the cam 204 and/or the tumblers 208.

It is clear that all three modifications of the present invention operate on the principle of providing means for automatically moving the fence of a combination lock out of engagement with both the cam member and the tumblers forming a part of the lock and maintaining the fence in such position at all times and until the combination has actually been produced. It is absolutely impossible for an operator to learn the combination through "feel" or through sound and it is further impossible for the operator to move the fence into engagement with the cam or with the tumblers to any advantage while the tumblers are in a "jumbled" condition.

While three types of combination locks have been chosen for illustration, it is apparent that the three modifications of the invention are not limited respectively to such locks but may be used interchangeably as desired. These three modifications of the invention can also be used as an attachment to locks differing even from those illustrated. In any event, the re-designing of the entire lock is not necessary nor is it necessary to re-design doors of safes and the like in order to utilize the improvements forming the subject matter hereof.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a combination lock of the kind having a housing, a locking member movably mounted on said housing, an elongated, manually-rotatable dial shaft extending into said housing, a disk like cam secured to said shaft within said housing for rotation with said shaft, said cam having a gate in the periphery thereof, a movable fence associated with said locking member for controlling movement thereof, said fence being formed to interlock with the gate of said cam when the latter is rotated to a predetermined position with respect to said fence, whereby continued rotation of said cam in one direction shifts said fence and said locking member to an unlocked position, the walls defining said gate being formed to move said fence to a position released from said cam when said cam is rotated in the opposite direction, a plurality of tumblers interconnected by lost motion driving connections and being operably mounted within said housing and about the axis of said shaft, and a lost motion driving connection between said cam and one of said tumblers, said tumblers blocking movement of said fence from said released position except when they are shifted to a predetermined set position in which said fence is permitted to move to a position interlocked with said cam; the improvement of which comprises means for imparting continued movement to said fence, when said fence moves to said released position, to a position spaced from the cam and tumblers, releasable means for continuously holding said fence in said position spaced from the cam and tumblers throughout rotation of said cam to move said tumblers to said set position, and manually-operable means for releasing said releasable means.

2. In a combination lock of the kind having a housing, a locking member movably mounted on said housing, an elongated, manually-rotatable dial shaft extending into said housing, a disk like cam secured to said shaft within said housing for rotation with said shaft, said cam having a gate in the periphery thereof, a movable fence associated with said locking member for controlling movement thereof, said fence being formed to interlock with the gate of said cam when the latter is rotated to a predetermined position with respect to said fence, whereby continued rotation of said cam in one direction shifts said fence and said locking member to an unlocked position, the walls defining said gate being formed to move said fence to a position released from said cam when said cam is rotated in the opposite direction, a plurality of tumblers interconnected by lost motion driving connections and being operably mounted within said housing and about the axis of said shaft, and a lost motion

driving connection between said cam and one of said tumblers, said tumblers blocking movement of said fence from said released position except when they are shifted to a predetermined set position in which said fence is permitted to move to a position interlocked with said cam; the improvement of which comprises means for imparting continued movement to said fence, when said fence moves to said released position, to a position spaced from the cam and tumblers, releasable means for continuously holding said fence in said position spaced from the cam and tumblers throughout rotation of said cam to move said tumblers to said set position, manually-operable means for releasing said releasable means, and means for holding said shaft against rotation at the time of release of said releasable means.

3. A combination lock comprising a housing, a plurality of disk like tumblers interconnecting by lost motion driving connections and being operably mounted within said housing, said tumblers each having a peripheral gate therein, an elongated, manually-rotatable dial shaft extending into said housing, a disk like cam secured to said shaft within said housing for rotation with said shaft, a lost motion driving connection between said cam and one of said tumblers, a bolt movably mounted on said housing, a movable fence lever secured to said bolt for operating the same and having fence means overlying said tumblers and said cam, said fence means including a cam follower nose for selectively engaging the periphery of said cam, said cam having a gate in the periphery thereof to accommodate said cam follower nose and permit said fence means to seat in said tumbler gates for moving said bolt, means for axially shifting said cam, means biasing said cam toward said tumblers, and a leaf spring stop mounted in said housing in the path of axial movement of said cam and having a lip portion engaging and supporting said fence lever and biased to maintain said fence means out of engagement with said cam and tumbler peripheries, said stop means being flexed out of operative contact with said fence lever on axial movement of said cam from its normally biased position to permit said cam follower nose to seat in said cam gate on registry of said tumbler gates with said fence means.

4. In a combination lock of the kind having an elongated, manually-rotatable dial shaft, a recessed cam secured to said shaft for rotation therewith, a movable fence normally biased toward the cam, said fence being formed to interlock with said recess of the cam when the latter is rotated to a predetermined position with respect to the fence, whereby continued rotation of the cam in one direction shifts the fence to an unlocked position, the walls defining said recess being formed to move the fence to a released position when the cam is rotated in the opposite direction, and a plurality of tumblers operably mounted about the shaft for movement to and from a set position permitting said fence to move to a position interlocked with the cam; the improvement of which comprises releasable means for continuously holding said fence out of engagement with said cam and said tumblers throughout rotation of the cam to move the tumblers to said set position, said means including parts for imparting continued movement to the fence, when the fence moves to said released position, to a position spaced from the cam and tumblers; and manually-operable means for releasing said parts.

5. In a combination lock as set forth in claim 4 wherein is provided means for holding said shaft against rotation during operation of said manually-operable means to release said parts.

6. In a combination lock as set forth in claim 4 wherein said parts include fence-attracting means disposed to move the fence away from the cam and the tumblers when the fence moves to said released position.

7. In a combination lock as set forth in claim 4 wherein said parts comprise a movable detent, and a detent-receiving cavity formed in the fence.

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8. In a combination lock as set forth in claim 7 wherein is provided a swingable member, said detent being mounted on the member; and resilient means for yieldably holding the member biased toward the fence.

9. In a combination lock of the kind having an elongated, manually-rotatable dial shaft, a recessed cam secured to said shaft for rotation therewith, a movable fence normally biased toward the cam, said fence being formed to interlock with said recess of the cam when the latter is rotated to a predetermined position with respect to the fence, whereby continued rotation of the cam in one direction shifts the fence to an unlocked position, the walls defining said recess being formed to move the fence to a released position when the cam is rotated in the opposite direction, and a plurality of tumblers operably mounted about the shaft for movement to and from a set position permitting said fence to move to a position interlocked with the cam; the improvement of which comprises releasable means for continuously holding said fence out of engagement with said cam and said tumblers throughout rotation of the cam to move the tumblers to said set position, said means including parts for imparting continued movement to the fence, when the fence moves to said released position, to a position spaced from the cam and tumblers, said shaft being reciprocable on its longitudinal axis to and from a position moving said parts to a position releasing the fence.

10. In a combination lock as set forth in claim 9 wherein is provided means for holding said shaft against rotation when in said position releasing the fence.

11. In a combination lock as set forth in claim 10 wherein said shaft holding means comprises a stationary pin disposed to engage with the cam when the shaft is shifted to thereby move the cam therewith.

12. In a combination lock of the kind having an elongated, manually-rotatable dial shaft, a recessed cam secured to said shaft for rotation therewith, a movable fence normally biased toward the cam, said fence being formed to interlock with said recess of the cam when the latter is rotated to a predetermined position with respect to the fence, whereby continued rotation of the cam in one direction shifts the fence to an unlocked position, the walls defining said recess being formed to move the fence to a released position when the cam is rotated in the opposite direction, and a plurality of tumblers operably mounted about the shaft for movement to and from a set position permitting said fence to move to a position interlocked with the cam; the improvement of which comprises releasable means for continuously holding said fence out of engagement with said cam and said tumblers throughout rotation of the cam to move the tumblers to said set position, said means including parts for imparting continued movement to the fence, when the fence moves to said released position, to a position spaced from the cam and tumblers, said shaft being shiftable to and from a position moving said cam into engagement with said parts to move the latter to a position releasing the fence.

13. In a combination lock as set forth in claim 12 wherein is provided a stationary pin disposed to be received by the recess of the cam when the latter is moved to a position releasing said fence, whereby to hold said shaft against rotation while the cam engages said parts.

14. In a combination lock of the kind having a housing, a locking member movably mounted on said housing, an elongated, manually-rotatable dial shaft extending into said housing, a disk-like cam secured to said shaft within said housing for rotation with said shaft, said cam having a gate in the periphery thereof, a movable fence associated with said locking member for controlling movement thereof, said fence being formed to interlock with the gate of said cam when the latter is rotated to a predetermined position with respect to said fence, whereby continued rotation of said cam in one direction shifts said fence and said locking member to an unlocked posi-

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tion, the walls defining said gate being formed to move said fence to a position released from said cam when said cam is rotated in the opposite direction, a plurality of tumblers interconnected by lost motion driving connections and being operably mounted within said housing and about the axis of said shaft, and a lost motion driving connection between said cam and one of said tumblers, said tumblers blocking movement of said fence from said released position except when they are shifted to a predetermined set position in which said fence is permitted to move to a position interlocked with said cam; the improvement of which comprises means including a mechanical detent for imparting additional movement to said fence in a direction away from said cam, when said fence moves to said released position, to a position spaced from the cam and tumblers, releasable means for continuously holding said fence in said position spaced from the cam and tumblers throughout rotation of said cam to move said tumblers to said set position, and manually-operable means for releasing said releasable means.

15. In a combination lock of the kind having a housing, a locking member movably mounted on said housing, an elongated, manually-rotatable dial shaft extending into said housing, a disk-like cam secured to said shaft within said housing for rotation with said shaft, said cam having a gate in the periphery thereof, a movable fence associated with said locking member for controlling movement thereof, said fence being formed to interlock with the gate of said cam when the latter is rotated to a predetermined position with respect to said fence, whereby continued rotation of said cam in one direction shifts said fence and said locking member to an unlocked position, the walls defining said gate being formed to move said fence to a position released from said cam when said cam is rotated in the opposite direction, a plurality of tumblers interconnected by lost motion driving connections and being operably mounted within said housing and about the axis of said shaft, and a lost motion driving connection between said cam and one of said tumblers, said tumblers blocking movement of said fence from said released position except when they are shifted to a predetermined set position in which said fence is permitted to move to a position interlocked with said cam; the improvement of which comprises magnetic means for imparting continued movement to said fence in a direction away from said cam, when said fence moves to said released position, to a position spaced from the cam and tumblers, releasable means for continuously holding said fence in said position spaced from the cam and tumblers throughout rotation of said cam to move said tumblers to said set position, and manually-operable means for releasing said releasable means.

16. In a combination lock of the kind having an elongated, manually-rotatable dial shaft, a recessed cam secured to said shaft for rotation therewith, a movable fence normally biased toward the cam, said fence being formed to interlock with said recess of the cam when the latter is rotated to a predetermined position with respect to the fence, whereby continued rotation of the cam in one direction shifts the fence to an unlocked position, the walls defining said recess being formed to move the fence to a released position when the cam is rotated in the opposite direction, and a plurality of tumblers normally blocking movement of said fence from said released position and being operably mounted about the shaft for movement to and from a set position permitting said fence to move to a position interlocked with the cam; the improvement of which comprises releasable means automatically operable in response to movement of said manually-operable means for continuously holding said fence out of engagement with said cam and said tumblers throughout rotation of the cam to move the tumblers to said set position, said means including parts for imparting additional movement to the fence, when the fence moves to said released position, to a position spaced from the cam and

tumblers; and manually-operable means for releasing said parts.

17. In a combination lock of the kind having a housing, a locking member movably mounted on said housing, an elongated, manually-rotatable dial shaft extending into said housing, a disk-like cam secured to said shaft within said housing for rotation with said shaft, said cam having a gate in the periphery thereof, a movable fence associated with said locking member for controlling movement thereof, said fence being formed to interlock with the gate of said cam when the latter is rotated to a predetermined position with respect to said fence, whereby continued rotation of said cam in one direction shifts said fence and said locking member to an unlocked position, the walls defining said gate being formed to move said fence to a position released from said cam when said cam is rotated in the opposite direction, a plurality of tumblers interconnected by lost motion driving connections and being operably mounted within said housing and about the axis of said shaft, and a lost motion driving connection between said cam and one of said tumblers, said tumblers blocking movement of said fence from said released position except when they are shifted to a predetermined set position in which said fence is permitted to move to a position interlocked with said cam; the improvement of which comprises means for imparting continued movement to said fence, when said fence moves to said released position, to a position spaced from the cam and tumblers, a latch associated with said housing and engageable with said fence for continuously holding said fence in a position spaced from said cam and tumblers throughout rotation of said cam

to move said tumblers to said set position, when said fence is moved by said means to a position spaced from the cam and tumblers, and means responsive to axial movement of said dial shaft for releasing said latch.

18. A combination lock comprising peripherally recessed tumblers, an axially movable drive wheel for adjusting said tumblers, a bolt, a lever for operating said bolt, said lever having fence means thereon overlying said tumbler peripheries and a portion to overlie and selectively engage the periphery of said drive wheel, said drive wheel having gate means to accommodate said lever portion and permit said fence means to seat in said tumbler recesses for moving said bolt, and interlock means including a stop element resiliently biased to maintain said lever and fence out of contact with said drive wheel and tumblers, and means camming said stop element into suppressed condition on axial movement of said drive wheel to permit operative coupling of said lever with said drive wheel gate for seating said fence in said tumbler recesses.

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