Jan. 15, 1963 A. J. POTZICK 3,073,145

MANIPULATION RESISTANT COMBINATION LOCK

Filed Nov. 1, 1961 3 Sheets-Sheet 1

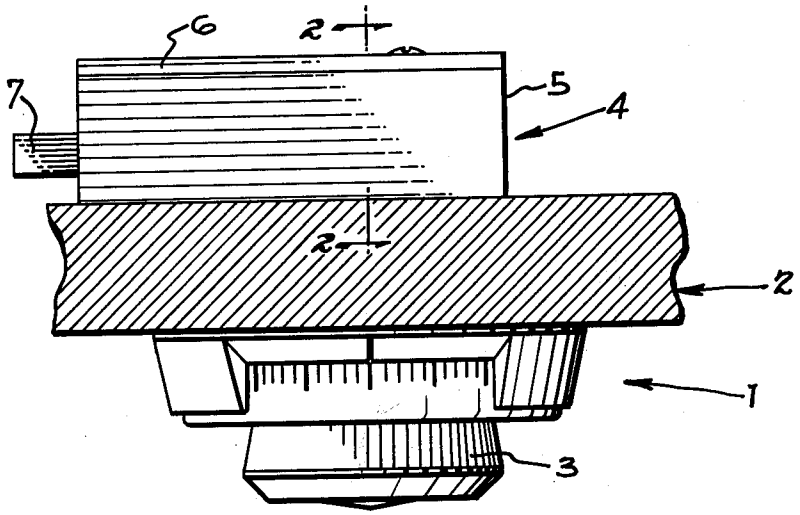


Fig. 1

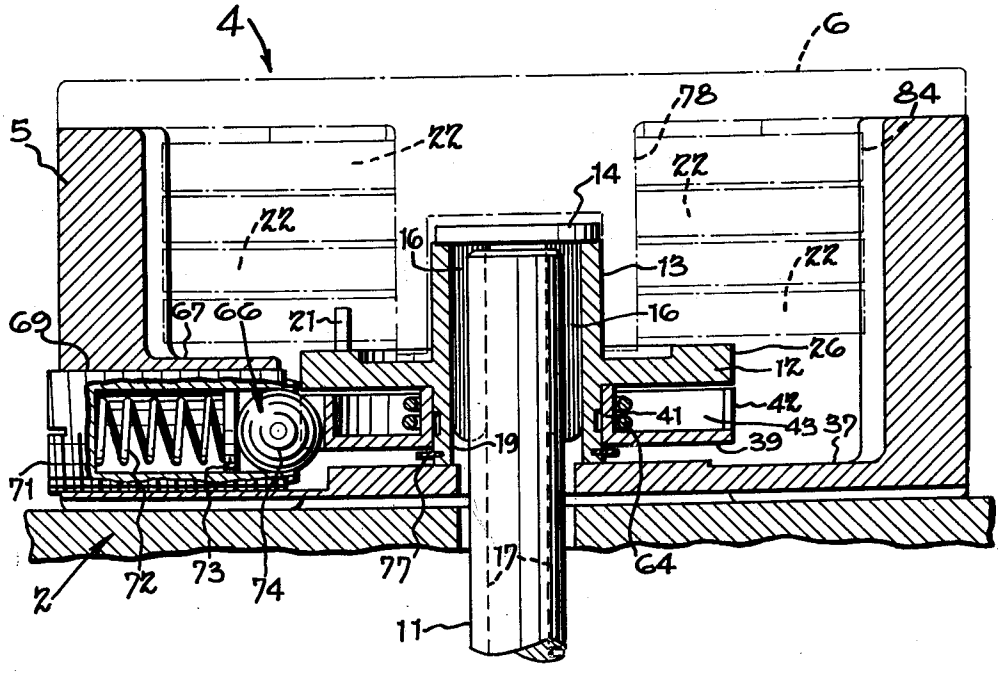


Fig. 2

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MANIPULATION RESISTANT COMBINATION LOCK

Filed Nov. 1, 1961 3 Sheets-Sheet 2

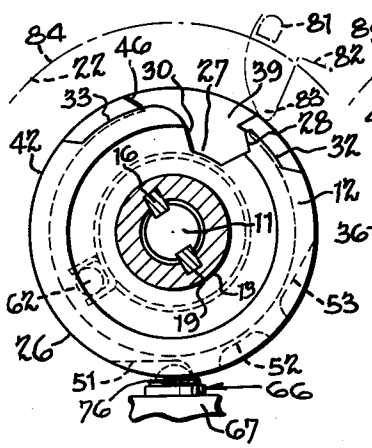


Fig. 5

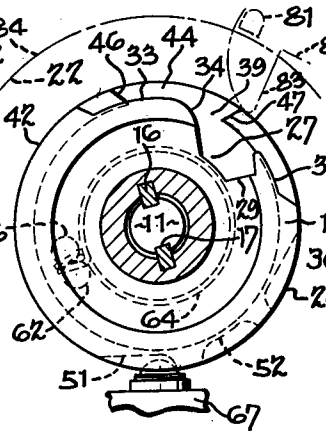


Fig. 6

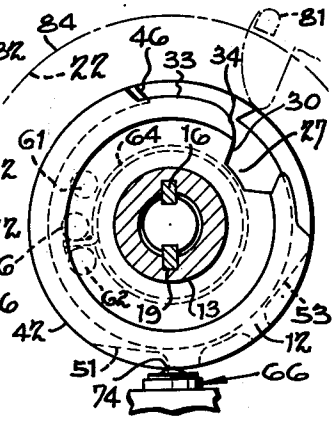


Fig. 7

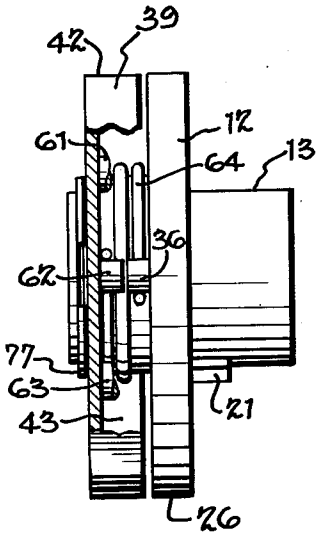


Fig. 4

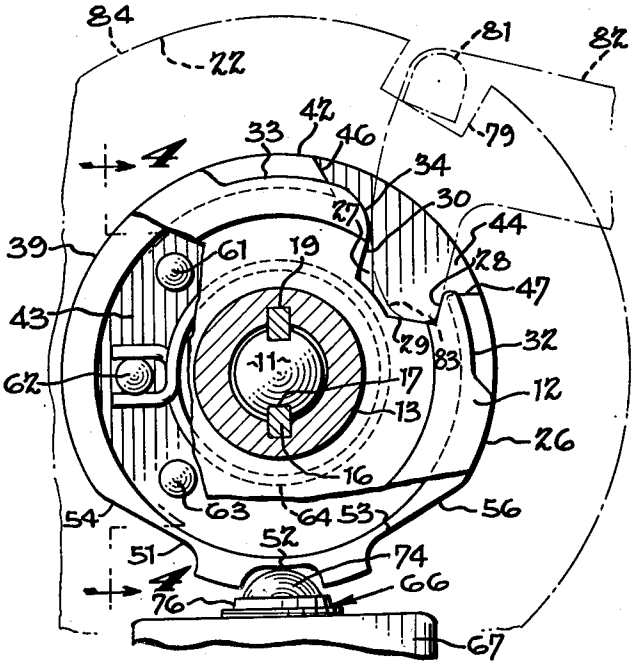


Fig. 3

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MANIPULATION RESISTANT COMBINATION LOCK

Filed Nov. 1, 1961 3 Sheets-Sheet 3

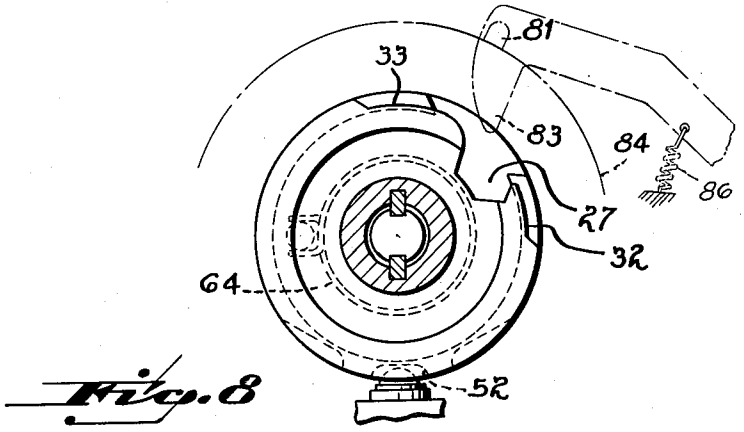


Fig. 8

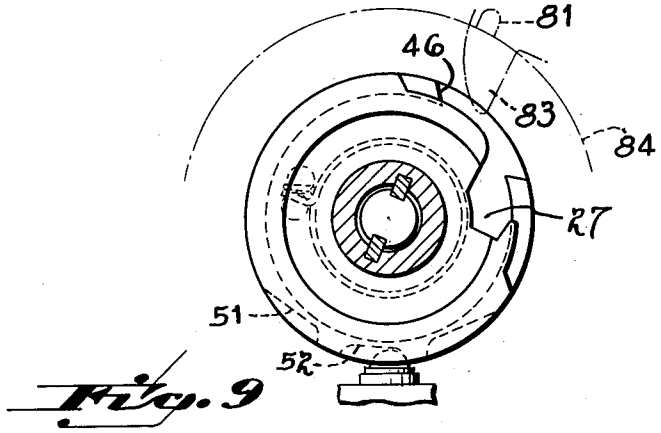


Fig. 9

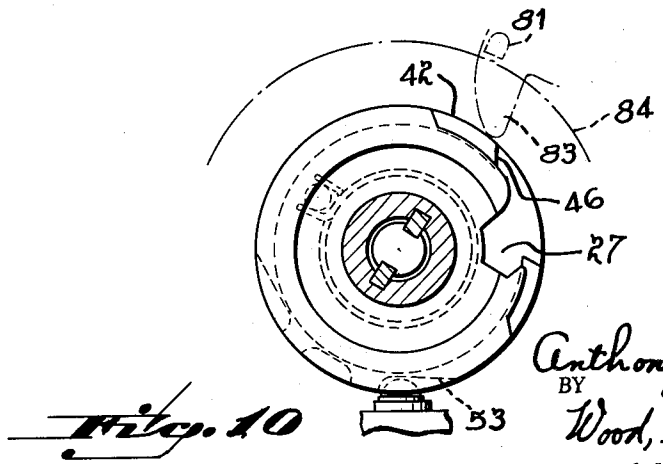


Fig. 10

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United States Patent Office 3,073,145 Patented Jan. 15, 1963

3,073,145

MANIPULATION RESISTANT COMBINATION LOCK

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Filed Nov. 1, 1961, Ser. No. 149,267
15 Claims. (Cl. 70—303)

This invention is directed to a combination lock which is resistant to attack by manipulation intended to determine the location of the tumbler gates.

In conventional combination locks, a plurality of rotatable tumblers, each of which has a peripheral gate, are sequentially operable by a driver through a series of lost motion interconnections, to bring all of the tumbler gates into alignment with each other at the proper angular position. The driver, which is connected to the shaft or arbor of the lock, has a notch formed in its periphery which, when the gates have been properly aligned, receives the nose of a pivotally mounted angle bar. The angle bar is connected to the bolt of the lock, and when the nose of the angle bar is engaged in the driver notch, the bolt can be moved to open position by rotating the driver, drawing the angle bar and bolt into lock opening position.

The nose of the angle bar can be engaged in the driver notch only when the tumbler gates are all aligned at the proper angular position. The angle bar has an outwardly projecting finger or fence which overhangs the tumblers. As the driver is turned to operate the tumblers, the nose of the angle bar rides on the periphery of the driver, positioning the fence slightly above the peripheries of the tumblers. When the driver is turned to that position at which its notch is proximate to the angle bar nose, a spring tends to cause the nose to drop into the notch, but if the tumbler gates have not been properly aligned, the fence will be arrested by the peripheries of the tumblers so that the angle bar nose will be prevented from seating in the notch in bolt operating relation. As the driver is rotated further, the notch passes beneath the nose, and the nose is cammed outwardly by the driver periphery on the other side of the notch, again lifting the fence off the tumblers.

If the tumbler gates have all been aligned by operating the driver in accordance with the proper combination, the fence is not arrested by the tumblers, but rather can move into the gates as the nose drops into the driver notch, so that the bolt can be withdrawn. Such operation is conventional, and affords the background for the present invention.

Among those skilled in such techniques, it is possible to manipulate the driver so as to determine the locations of the tumbler gates, and thereby discover the combination to which the lock has been set. Such techniques make use of slight differences in the "feel" of the arbor and the sound as the fence is lowered onto the tumblers when the driver is turned slowly in such manner as to cause the angle bar nose to slide gradually off the periphery of the driver toward the notch. These techniques also make use of slight but detectable differences in the feel and sound of the angle bar nose engaging the sides of the notch when the fence is engaged with the tumblers' peripheries. By such differences in feel and sound, it is possible to tell whether one or more, even though not all, of the tumbler gates are properly aligned, and thereby determine the numbers of the correct combination.

The effectiveness of such manipulation proceeds upon the existence of small differences in the diameters and concentricities of the tumblers. A slightly different feel and/or sound is obtained when the fence drops onto the next largest tumbler once the largest tumbler has been aligned, and thus one knows how to turn the arbor to

align the largest tumbler, though he may not know which tumbler of the several it is. By continuing in this manner all of the gate positions can eventually be determined.

In commercial mass produced locks it is nearly impossible to avoid such minor differences in tumbler diameters and concentricities, at least at a cost which is not prohibitive. In consequence of this, such manipulation has continued to be one of the more popular, if less reputable, methods of opening locks the combinations of which are unknown. The lock of this invention is provided with means whereby such manipulation is rendered virtually impossible.

In accordance with this invention, the lock is provided with means whereby the angle bar fence cannot be lowered gently onto or lifted gently off of the tumblers, but rather such that the fence is caused to move abruptly toward and away from the tumblers at a rate not controllable by the manipulator. The uncontrollable rapidity with which the fence falls onto and rises from the tumblers' peripheries makes it impossible to detect differences in the feel and sound of the fence striking the tumblers and in the feel and sound of the angle bar nose engaging the notch in the driver, and thus prevents manipulation dependent on such factors.

In a preferred lock which embodies the principles of this invention, the driver is provided with a "mask" or "shutter" which prevents the angle bar nose from ever engaging the corners of the driver notch and from ever engaging the driver notch itself except when all of the tumbler gates have been aligned. The mask is coupled to the driver through a torsion spring, and normally rotates with it. The mask is provided with a cutout in its periphery through which the noise of the angle bar can drop directly into the driver notch when the gates are aligned. A detent or click engageable with a series of detent notches in the mask, and when engaged in any of those notches, prevents the mask from rotating with the driver, disaligning the cutout in the mask with the driver notch, thereby causing the mask to block or cover the driver notch. The detent notches are so positioned that when the driver is being turned to position its notch under the angle bar nose, the mask is held stationary by the detent and does not turn, blocking the notch. The mask supports the nose on its periphery until the driver is exactly positioned with respect to the nose, so that the nose cannot contact the corners of the driver notch. The torsion spring intercoupling the mask to the driver then overcomes the retarding force of the detent and spins the mask relative to the driver so that the cutout in the mask is again aligned with the notch, and the fence falls abruptly on the tumblers as the mask spins out from under it. If the tumbler gates have been aligned, the fence is not arrested by the tumblers and moves into the gates, thereby permitting the nose to drop into the driver notch so that the bolt can be withdrawn. The operator of the lock has no control over the rate at which the spring spins the mask out from under the nose, which occurs quickly, with the result that differences in the feel or sound of the fence hitting the tumblers cannot be distinguished. Similarly, when the fence is on the tumblers' peripheries and the driver is turned from the position in which its notch is aligned with the angle bar nose, the mask is temporarily held stationary by the detent, and then is abruptly spun by the torsion spring, very rapidly lifting the fence off the tumblers so that differences in sound and feel again cannot be distinguished.

The operation and details of the invention can best be further described by referring to the accompanying drawings, in which,

FIGURE 1 is a top view of a combination lock of the general type to which this invention relates;

FIGURE 2 is a vertical cross-sectional view taken on

line 2—2 of FIGURE 1, illustrating a preferred mask, driver, and detent assembly in accordance with the invention;

FIGURE 3 is an elevation, partly broken away, of the assembly illustrated in FIGURE 2, showing the tumbler gates in alignment and the nose of the angle bar engaged in the driver notch;

FIGURE 4 is a sectional view, partly broken away, taken on line 4—4 of FIGURE 3;

FIGURES 5–10 are a sequential series of diagrammatic views illustrating the operation of the invention as the arbor of the lock is turned in a given direction when the tumbler gates are disaligned. Specifically;

FIGURE 5 is a diagrammatic view of the mask, detent, and driver assembly as the arbor is rotated in clockwise direction, looking at the lock end of the arbor, the detent being engaged in the first detent notch of the mask;

FIGURE 6 is similar to FIGURE 5, but shows the change in the angular positional relationship between the mask and the driver as the driver is rotated further in clockwise direction, the detent remaining engaged in the first notch of the mask;

FIGURE 7 is a diagrammatic view similar to FIGURE 6, but shows the angular positional relation between the driver and mask as the driver is rotated to a point such that the detent has just been cammed out of the first detent notch;

FIGURE 8 shows the position of the mask in relation to the driver and the nose of the angle bar when the detent is engaged in the second detent notch and the tumbler gates are not aligned;

FIGURE 9 shows the position of the mask in relation to the driver when the driver has been rotated beyond the position shown in FIGURE 8, to a position in which the detent is nearly disengaged from the second detent notch of the mask; and

FIGURE 10 shows the relation of the driver to the mask when the driver has been rotated to a position such that the detent is engaged in the third detent notch.

A lock 1 of the type to which the present invention relates is shown mounted to a door 2 in FIGURE 1. The lock 1 comprises a rotatable dial 3 on the outside of the door 2 and a lock mechanism 4 which is contained within a case 5 affixed to the inside of the door. The case 5 has a removable back or cover plate 6 which is secured to it by suitable means not shown. A bolt 7 which is shown in extended or locking position in FIGURE 1 extends through an opening in one side of the case 5 in position for engagement with a fixed bolt receiving member on the body of the structure supporting the door, which is not shown in the drawings.

An arbor or shaft 11 (see FIGURE 2) is connected to the dial 3 for rotation therewith, and extends through the door 2 into the case 5 of the lock for operating the mechanism 4 therein. A driver 12 is mounted to the arbor 11 within the case 5. The shape of the driver 12 approximates that of a flat cylinder from each face of which a hub portion 13 extends. The hub 13 has an axial bore into which the arbor 11 is received. The driver 12 is keyed to the arbor 11 by an arbor key 14 which has a pair of axially extending spaced legs 16, 16 that are received in diametrically spaced grooves 17 and 19 formed respectively in the arbor 11 and on the inside of the driver hub 13. A tumbler drive pin 21 extends outwardly from the driver and is positioned to engage and rotate a plurality of tumblers 22. The tumblers themselves may be of known type, for example of the type described in detail in Robert W. Maynard U.S. patent application Serial No. 25,074, filed April 27, 1960, entitled "Tamper Proof Combination Lock," now abandoned, and for that reason are indicated in the drawings in outline form only.

The periphery 26 of the driver 12 is provided with a notch 27 (see FIGURE 3) defined by a side wall 28, a bottom 29 and an opposite side wall 30. Adjacent side wall 28 of the driver notch 27, an inwardly offset shoulder surface 32 is formed in the driver which is gradually angulated toward the periphery 26 of the driver. Adjacent side wall 30 of driver notch 27 another inwardly offset shoulder surface 33 is formed. Shoulder surface 33 meets driver notch side edge 30 in a rounded cam surface 34, and at its other end extends angularly outwardly to the periphery 26 of the driver. A spring pin 36 extends outwardly from the driver 12 toward the bottom wall 37 of case 5.

A mask or shutter 39 is rotatably mounted on driver hub 13, in axial alignment with the driver between the driver and the bottom wall 37 of the case 5. This mask is best shown in FIGURES 2, 3 and 4, and comprises a generally flat cylindrical member having a central hub 41 which is rotatably journalled on the driver hub 13, and an annular peripheral rim 42 which extends toward the driver, a cavity 43 being defined between the mask 39, the rim 42, and the driver 12. As can be seen in FIGURE 3, the peripheral rim 42 of the mask is partly cut away to form an opening 44. The edges 46 and 47 of the cut-away portion of the mask rim are angulated toward each other, as shown in FIGURE 3, and comprise cam surfaces. Over an area which is not quite diametrically opposite the driver notch 27, the rim 42 of the mask 39 is provided with three spaced notches 51, 52 and 53. The middle detent notch 52 is generally U-shaped, while the outer edges of the notches 51 and 53 on either side of the middle notch 52 extend gradually outwardly to the rim 42, as at 54 and 56 respectively.

On the rear face of the mask 39, in the cavity 43 between hub 41 and the rim 42, three spaced pins 61, 62, and 63 are provided, which extend toward the driver. The middle pin 62 comprises a spring pin, and is positioned so as normally to be aligned with the spring pin 36 of the driver, while the other two pins 61 and 63 comprise safety or stop pins the function of which will be explained. The safety pins 61 and 63 are somewhat longer than the spring pins 36 and 62, and are positioned to be engaged by the driver spring pin 36.

A torsion spring 64 intercouples the mask 39 to the driver 12. As shown in FIGURES 3 and 4, this spring 64 fits around the hub 41 of the mask in the cavity 43, and at one end is hooked around spring pin 36 on the driver and at the other end is hooked around spring pin 62 on the mask. The spring 64 is preferably so formed that its two ends are normally adjacent each other, so that the spring pins 36 and 62 will normally be aligned as shown in FIGURE 4. Spring 64 tends to transmit rotational movement imparted to the driver 12 to the mask 39, thus tending to cause the mask to rotate with the driver, keeping the driver and mask in radial alignment. The normal angular positional relationship between the mask and the driver, i.e. when the spring 64 is not stressed, is shown in FIGURE 3, in which it can be seen that side edge 28 of driver notch 27 is normally adjacent edge 47 of the cutout 44 in the mask rim. It can also be seen in FIGURE 3 that the angular dimension of the mask rim cutout 44 is somewhat greater than the angular dimension of the driver notch 27, and that edge 46 of the cutout is normally positioned between cam surface 34 of the driver notch 27 and the point at which shoulder surface 33 meets the driver periphery 26. When the driver and mask occupy the relative positions shown in FIGURES 3 and 4, the spring pins 36 and 62 are axially aligned.

A detent 66 is mounted in the lock case 5 in position to engage each of the three detent notches 51, 52 and 53 of the mask. A boss 67 (see FIGURES 2 and 3) is formed on the inside of the case 5, and presents a bore 69 into which an externally threaded cylindrical sleeve 71 is screwed. The sleeve 71 has an axial bore which extends toward its outer end, in which are received a compression spring 72, a pressure plate 73 and a ball 74.

The inner end of the sleeve 71 is crimped inwardly around the ball 74, as at 76, to retain the spring 72, plate 73, and ball 74 in the sleeve. Spring 72 urges the pressure plate and ball outwardly, radially toward the axis of arbor 11. Ball 74 of detent 66 bears upon the rim 42 of the mask 39 forwardly of the driver, as shown in FIGURE 2, and does not engage the driver.

A spring clip 77 is secured in a circumferential groove on the driver hub 13, and holds the mask 39 loosely on the hub. It is preferred, although not necessary, that the mask 39 be coated with a suitable lubricating medium such as molybdenum disulfide to provide a smooth rim surface over which the detent ball 74 can slide or roll with a minimum of friction as the mask is rotated.

The cover plate 6 of the lock case, shown in dashed lines in the drawings, is provided with a forwardly extending hollow sleeve 78 which is aligned with and extends over the end of the driver hub 13. The several tumblers 22 are rotatably journalled on sleeve 78. The tumblers 22 have peripheral gates 79 which, when the tumblers have been properly operated so that the gates 79 are all aligned with each other in the proper axial position shown in FIGURE 3, receive the outwardly projecting fence 81 of a pivotally mounted angle bar or bolt lever 82 which is connected to the bolt 7 to move the bolt relative to the case between lock and unlock positions. A spring, designated by numeral 86 in FIGURE 8, urges the angle bar 82 toward the driver notch 27, so that the nose 83 of the driver normally bears on the peripheries of the mask 39 and the driver 12, as shown in FIGURE 5. The diameters of the mask and driver are preferably substantially, though not necessarily precisely, equal, and are such as to normally hold the fence 81 slightly above the peripheries 84 of the tumblers, as also shown in FIGURE 5. The peripheries of the tumblers need not be precisely equal, so long as the fence does not normally contact any of them.

As previously suggested, the tumblers themselves may be of suitable known type, as can be the angle bar and bolt. These members may, for example, be similar to those described in detail in the previously identified Maynard application Serial No. 25,074.

The operation of the lock may now be described. When the dial 3 of the lock is turned in either direction, the arbor 11 rotates with it, which in turn rotates the driver 12. So long as the detent 66 is not engaged in any of the detent notches 51–53, the rotational movement of the driver will be imparted through the torsion spring 64 to the mask 39, thereby causing the mask to turn with the driver and preserve the normal angular relation between the two, which is shown in FIGURE 5 of the drawings. The nose 83 of the angle bar 82 rides on the peripheries of the driver and mask over the greater part of their rotation. Rotational movement of the driver is transmitted to the tumblers 22 through the tumbler drive pin 21, thereby rotating some or all of the tumblers. As previously explained, the fence 81 of the angle bar 82 is normally positioned a slight distance off of the peripheries 84 of the tumblers and does not contact them.

Assuming, for purposes of explanation, that the dial 3 and driver 12 are being rotated in clockwise direction (as viewed from the rear or arbor end of the lock mechanism), when the driver and mask have been rotated to the position shown in FIGURE 5 the detent 66 comes gradually into engagement with detent notch 51 of the mask. The detent spring 72 holds the ball 74 in the notch 51 and tends to prevent the mask from rotating further in the clockwise direction. The position of the right side of detent notch 51 is such that, when the detent bears upon that side of the notch, the angle bar nose 83 is supported on the rim 42 of the mask adjacent the edge 47 thereof, above the inwardly offset shoulder surface 32 of the driver (see FIGURE 5).

As the driver is rotated further in clockwise direction, the detent 66 temporarily restrains the mask from rotating with it, thus holding the mask stationary as the driver is advanced toward the position at which the driver notch 27 is aligned with the angle bar nose 83. The relation of the mask to the driver notch in this position is shown in FIGURE 6.

As the driver is thus rotated with respect to the mask, the torsion spring 64 is stressed and exerts a force on mask spring pin 62 tending to turn the mask in clockwise direction relative to the driver to "catch up" with the driver and return to its normal positional relationship, in which the spring is not stressed. However, the detent exerts sufficient retarding force on the mask to prevent such movement, and the mask momentarily remains stationary and continues to support the nose 83 of the angle bar and to prevent it from dropping into the driver notch 27.

As the driver is rotated still further in clockwise direction from the position shown in FIGURE 6, the torsion spring 64 becomes more and more stressed, and the torque it exerts on the mask 39 eventually overcomes the restraining force of the detent. The exact point at which this occurs depends on the relative characteristics of the two springs 64 and 72, and can be adjusted by tightening or loosening the sleeve 71 in its bore 69, which charges the compression of the detent spring 72. Preferably the mask spring overcomes the detent spring and spins the mask just before the driver spring pin 36 comes into contact with the safety pin 61 of the mask, when the driver notch is nearly aligned with the nose. The relation of the mask and the driver when the detent ball 74 has just been cammed out of detent notch 51 is shown in FIGURE 7. The angle bar nose is still supported by the mask rim 42.

The function of the safety pins 61 and 63 is to insure that the mask will be released from the detent in the event that the torsion spring 64 does not overcome the force of the detent spring at the proper time, or, for example, should the spring 64 ever break. If the spring 64 does not overcome the detent spring as the driver is rotated, the driver spring pin 36 comes into abutting relation with safety pin 61 of the mask, which is longer than mask spring pin 62, thereby establishing a positive drive connection between the driver and the mask, camming the detent ball 74 out of notch 51 and causing the mask to catch up with the driver. The safety pins are preferably so arranged that this happens just when the driver notch is aligned with the nose.

As soon as the detent 66 has been cammed out of the detent notch 51, the mask is free to rotate, and consequently the coil spring 64 spins the mask clockwise, restoring the normal angular relation between the mask and driver. The spring spins the mask rapidly out from under the angle bar nose, so that the nose is very suddenly permitted to move downwardly under the force exerted upon it by its operating spring 86, at a rate beyond the control of the operator of the lock.

If the tumbler gates 79 have not been properly aligned, the movement of the angle bar nose toward the driver notch will be abruptly arrested when the fence 81 of the angle bar hits the peripheries 84, or some of them, of the tumblers, and the nose will not engage the notch 27 nor the periphery 32 of the driver, which is inwardly offset. By reason of the rapid rate at which the spring 64 spins the mask rim 42 out from under the nose 83, the fence hits the tumblers suddenly, and it is impossible to detect minor variations in the way in which this happens. In other words, the elements of sound and feel, which are vital to attack by manipulation, are obviated. In actual tests it has been found that it is virtually impossible to manipulate the present lock to determine the locations of the gate tumblers.

As the mask is spun by the spring 64, it moves to a position at which the detent 66 becomes engaged in the middle detent notch 52 of the mask (see FIGURE 8),

and the mask again cannot rotate with the driver. The mask cutout 44 is now aligned with the notch 27, but the disaligned tumblers prevent the nose from dropping into the notch 27.

As the driver is rotated still further when the detent is engaged in the middle notch 52 of the mask, spring 64 again is stressed until it overcomes the restraining effect of the detent and cams the detent out of notch 52. The mask is then spun under the angle bar nose, and edge 46 of the cutout 44 cams or "kicks" the nose 83 outwardly onto the mask periphery 42. The gradually angulated trailing edge of the third notch 53 cams the detent gradually outwardly and does not impede clockwise rotation of the mask. Thus, the mask prevents the nose of the angle bar from touching the corners of the driver notch when the tumblers are disaligned, making it impossible to feel the locations of the tumbler gates.

If the gates 79 of the tumblers have all been aligned at the proper angular position when the driver is at the position shown in FIGURE 7, when the mask spins out from under the nose 83 the fence 81 will not be arrested by the tumbler peripheries and will drop into the gates, permitting the nose 83 to seat in the notch 27 (see FIGURE 3). The dial can then be turned (counterclockwise in the embodiment illustrated) to retract the bolt. The detent is engaged in the second notch 52 of the mask, and as the driver is turned counterclockwise to move the bolt to unlock position the angle bar nose 83 will abut the left edge 46 of the mask cutout and cause the mask to rotate with it, camming the detent out of the notch 52. When the bolt is thereafter moved to lock position, the driver is rotated clockwise again and the nose 83 is cammed out of the driver notch 27 by the rounded edge 34 which comes to bear upon it. The detent again engages detent notch 52 and prevents the mask from rotating with the driver. As the latter is turned, nose 83 is lifted by driver cam surface 34 onto shoulder surface 33 of the driver. After this has occurred, spring 64 cams the detent out of notch 52 and spins the mask clockwise, and the left edge 46 of the mask cutout cams the driver nose upwardly onto the rim 42 of the mask.

The operation of the invention is the same in principal when the driver is rotated in counterclockwise direction. In this case, the detent first engages notch 53 and prevents the mask from rotating. The angle bar nose is supported by rim 42 adjacent cutout edge 46 until the driver has been turned to such position that its notch 27 is disposed beneath nose 83, when the spring 64 spins the mask rim from underneath the nose; if the tumblers are not aligned the fence will drop abruptly onto the peripheries of the tumblers, and further clockwise movement of the driver will cause the opposite edge 47 of the mask cutout to be spun by the spring 64 under the nose 83 to cam it outwardly back onto the periphery 42 of the mask. If the tumblers are aligned when the nose is released by the mask, the nose will drop into the driver notch 27.

From the foregoing, it will be seen that it is impossible to manipulate the lock of the present invention to detect variations in the feel and sound of the fence dropping onto the tumblers and of the nose contacting the sides of the driver notch.

While the invention has been described herein primarily in relation to a preferred embodiment, it is to be understood that the invention is not limited to that embodiment alone, but also includes other modifications and variations which come within the scope of the following claims.

What is claimed is:

1. A combination lock including a rotatable driver having a peripheral notch, a plurality of tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose and a fence overhanging said tumblers, said nose being engageable in said notch at a certain position of said driver when said gates are aligned at a predetermined angular location, said fence contacting said tumblers if said tumblers are not aligned at said location when said driver is at said certain position thereby preventing said nose from engaging said notch, means urging said nose toward said driver, a rotatable mask axially aligned with said driver, said mask peripherally engaging said angle bar and holding said fence out of contact with said tumblers as said driver is turned toward said certain position, said mask having a slot through which said nose engages said notch when said slot is aligned with said notch at said certain position and said tumblers are aligned at said location, means disaligning said slot with said notch when said driver is being turned to approach said certain position, and means rapidly turning said mask to align said slot with said notch when said driver reaches said certain position, thereby permitting said nose to move rapidly toward said notch.

2. A combination lock including a rotatable driver having a peripheral notch, means for turning said driver, a plurality of tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose engageable with said notch when said driver is turned to a given position and a fence engageable with said tumblers, a mask rotatably journalled in axial alignment with said driver, said mask presenting an opening through which said nose must pass to engage said notch, means yieldably holding said mask in angular alignment with said driver such that said opening is normally aligned with said notch, means urging said nose onto said mask, said mask positioning said fence away from said tumblers when said driver is near to but not at said given position, releasable means angularly displacing said mask relative to said driver as said notch is being turned to said given position thereby disaligning said opening from said notch, said mask solely supporting said nose out of engagement with said driver as said driver is being turned to said position, and means automatically releasing said releasable means when said driver is at said position whereby said mask is moved by said yieldable means relative to said driver to realign said opening with said notch and thereby permit said nose to move toward said notch through said opening.

3. A combination lock including a rotatable drive having a peripheral notch, a plurality of alignable tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose which is engageable in said notch when said driver is at a predetermined angular position, said angle bar having a fence overhanging said tumblers and engaging said tumblers when said driver is at said predetermined position and said gates are not aligned, said fence being receivable in said gates when said gates are aligned and said driver is at said predetermined position thereby permitting said nose to be engaged by said notch, means urging said nose toward said driver, mask means disengageably engaging said angle bar and holding said nose away from said driver and positioning said fence out of contact with said tumblers when said driver is approaching said position, spring means for disengaging said mask means from said angle bar, detent means engaging said mask means and restraining said spring means as said driver is being turned to said predetermined position, and means releasing said detent means when said driver reaches said predetermined position thereby permitting said spring means to move said mask means out of engagement with said angle bar and permitting said nose to move rapidly toward said notch.

4. A combination lock including a rotatable, generally circular driver having a peripheral notch, means for turning said driver, a plurality of alignable circular tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose engageable with said notch when said driver is turned to a given position and said gates are aligned, said angle bar also

having a fence positioned to be arrested by the peripheries of said tumblers to prevent said nose from engaging said notch if said gates are not aligned when said driver is turned to said given position, rotatable mask means axially aligned with said driver, means urging said nose toward said driver, said nose normally riding on the periphery of said mask as said driver is rotated toward said given position, said fence being spaced away from said tumblers when said nose is on the periphery of said mask, spring means tending to maintain a constant angular relation between said mask means and said driver, releasable means restraining said mask means against said spring means as said driver is approaching said given position whereby said mask means prevents said nose from engaging said driver, and means automatically releasing said releasable means when said driver reaches said given position whereby said mask means is then moved by said spring means to restore the normal angular position with respect to said driver, said mask means being shaped to permit said nose to move rapidly toward said notch when said releasable means are released and to engage said notch if said gates are aligned.

5. A combination lock including a rotatable, generally circular driver having a peripheral notch, means for turning said driver, a plurality of alignable circular tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose engageable with said notch when said driver is turned to a given position and said gates are aligned, said angle bar also having a fence positioned to be arrested by the peripheries of said tumblers to prevent said nose from engaging said notch if said gates are not aligned when said driver is turned to said given position, a generally circular mask rotatably journalled in axial alignment with and adjacent to said driver, said mask and driver having diameters which are substantially equal, means urging said nose toward said driver, said nose normally riding on the peripheries of said mask and driver as said driver is rotated toward said given position, said fence being spaced away from said tumblers when said nose is on the periphery of said mask, said mask having a peripheral opening so positioned that said nose must pass through said opening to engage said notch, a torsion spring interconnecting said mask to said driver and tending to hold said opening in angular alignment with said notch as said driver is rotated, releasable means angularly displacing said mask relative to said driver when said driver is being turned to approach said given position whereby said mask then solely supports said nose and said nose does not contact said driver, and means automatically releasing said releasable means when said driver reaches said given position whereby said mask is spun by said spring relative to said driver to realign said opening with said notch, thereby permitting said nose to be moved by said urging means through said opening toward said notch and to engage said notch if said gates are aligned.

6. A combination lock including a rotatable, generally circular driver having a peripheral notch, means for turning said driver, a plurality of alignable circular tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose engageable with said notch when said driver is turned to a given position and said gates are aligned, said angle bar also having a fence positioned to be arrested by the peripheries of said tumblers to prevent said nose from engaging said notch if said gates are not aligned when said driver is turned to said given position, a generally circular mask rotatably journalled in axial alignment with and adjacent to said driver, said mask and driver having diameters which are substantially equal, a spring connected to said angle bar urging said nose toward said driver, said nose normally riding on the peripheries of said mask and driver as said driver is rotated toward said given position, said fence being spaced away from said tumblers when said nose is on the periphery of said mask, said mask having a peripheral slot so positioned that said nose must pass through said slot to engage said notch, a torsion spring interconnecting said mask to said driver and tending to hold said slot in angular alignment with said notch as said driver is rotated, and yieldable means angularly displacing said mask relative to said driver when said driver is being turned proximate to said given position whereby said mask then solely supports said nose and said nose does not contact said driver, said torsion spring overcoming said yieldable means when said driver is proximate to said given position and spinning said mask relative to said driver to realign said slot with said notch, thereby permitting said nose to drop through said slot toward said notch and to engage said notch if said gates are aligned.

7. A combination lock including a rotatable, generally circular driver having a peripheral notch, means for turning said driver, a plurality of alignable circular tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose engageable with said notch when said driver is turned to a given position and said gates are aligned, said angle bar also having a fence positioned to be arrested by the peripheries of said tumblers to prevent said nose from engaging said notch if said gates are not aligned when said driver is turned to said given position, a generally circular mask rotatably journalled in axial alignment with and adjacent to said driver, said mask and driver having diameters which are substantially equal, means urging said nose toward said driver, said nose normally riding on the peripheries of said mask and driver as said driver is rotated toward said given position, said fence being spaced away from said tumblers when said nose is on the periphery of said mask, said mask having a peripheral opening so positioned that said nose must pass through said opening to engage said notch, a torsion spring interconnecting said mask to said driver and tending to hold said opening in angular alignment with said notch as said driver is rotated, detent means engageable with at least one detent notch provided in said mask, said detent notch being so positioned that said detent means engages said detent notch and holds said mask from rotating with said driver as said driver is approaching said given position whereby said mask then solely supports said nose and said nose does not contact said driver, and abutting drive means between said driver and mask whereby said detent means is released from the detent notch in which it is engaged when said driver reaches said given position thereby causing said spring to spin said mask relative to said driver to realign said opening with said notch so that said nose can drop through said opening toward said notch and into engagement with said notch if said tumbler gates are aligned.

8. A combination lock including a rotatable, generally circular driver having a peripheral notch, means for turning said driver, a plurality of alignable circular tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose engageable with said notch when said driver is turned to a given position and said gates are aligned, said angle bar also having a fence positioned to be arrested by the peripheries of said tumblers to prevent said nose from engaging said notch if said gates are not aligned when said driver is turned to said given position, a generally circular mask rotatably journalled in axial alignment with and adjacent to said driver, said mask and driver having diameters which are substantially equal, means urging said nose toward said driver, said nose normally riding on the peripheries of said mask and driver as said driver is rotated toward said given position, said fence being spaced away from said tumblers when said nose is on the periphery of said mask, said mask having a peripheral opening so positioned that said nose must pass through said opening to engage said notch, a torsion spring interconnecting said mask to said driver and tending to hold said opening

in angular alignment with said notch as said driver is rotated, three detent notches formed in said mask, a detent sequentially engageable with said detent notches as said mask is rotated to temporarily restrain said mask from rotating with said driver, said detent notches being so positioned that said detent engages one of said detent notches as said driver is rotated in either direction towards said given position and engages one of said detent notches when said driver is at said given position, whereby said detent restrains said mask from rotating with said driver as said driver approaches said given position and whereby said opening is disaligned from said notch and said nose is supported solely by said mask, said torsion spring overcoming the restraining effect of said detent when said driver reaches said given position and spinning said mask relative to said driver to realign said opening with said notch, thereby permitting said nose to drop through said opening toward said notch and to engage said notch if said tumbler gates are aligned.

9. A combination lock including a rotatable generally circular driver having a peripheral notch, means for turning said driver, a plurality of alignable circular tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose engageable with said notch when said driver is turned to a given potion and said gates are aligned, said angle bar also having a fence positioned to be arrested by the peripheries of said tumblers to prevent said nose from engaging said notch if said gates are not aligned when said driver is turned to said given position, a generally circular mask rotatably journalled in axial alignment with and adjacent to said driver, said mask and driver having diameters which are substantially equal, a spring connected to said angle bar urging said nose toward said driver, said nose normally riding on the peripheries of said mask and driver as said driver is rotated toward said given position, said fence being spaced away from said tumblers when said nose is on the periphery of said mask, said mask having a peripheral slot so positioned that said nose must pass through said slot to engage said notch, the opposite edges of said slot being sharply angulated toward each other and comprising cam surfaces, a torsion spring interconnecting said mask to said driver and tending to hold said slot in angular alignment with said notch as said driver is rotated, and a plurality of detent means adapted to angularly displace said mask relative to said driver when said driver is near to and at said given position whereby said mask solely supports said nose and said nose does not contact said driver, said torsion spring overcoming said detent means when said driver is turned relative to said mask and spinning said mask relative to said driver to realign said slot with said notch, said nose thereby being disengaged and engaged with said mask at a rate determined by the rate at which said torsion spring spins said mask.

10. A combination lock including a bolt, a rotatable driver having a peripheral recess, an angle bar adapted to engage said recess when said driver is positioned so that said recess is in alignment with said angle bar and thereby enable said bolt to be operated, means urging said angle bar toward said driver, tumblers requiring presetting to specified positions before permitting said angle bar to engage said recess, said angle bar having a fence arrested by said tumblers when said tumblers are not preset to said specified positions, rotatably disengageable means engaging said angle bar and positioning said fence out of contact with said tumblers when said recess is near but not in alignment with said angle bar, biasing mechanism connected to said disengageable means tending to disengage said disengageable means from said angle bar when said driver is being rotated to bring said recess in alignment with said angle bar, and automatic release brake means restraining said biasing mechanism from disengaging said disengageable means with said angle bar until said recess is in alignment with said angle bar, said automatic release brake means being responsive to positioning of said recess in alignment with said angle bar to thereupon remove the restraint from said biasing mechanism and permit said biasing mechanism to disengage said disengageable means from said angle bar.

11. A combination lock including a bolt, a rotatable driver having a peripheral recess, an angle bar adapted to engage said recess when said driver is rotated to bring said recess into alignment with said angle bar and thereby enable said bolt to be operated, an angle bar spring urging said angle bar toward said driver, tumblers requiring presetting to specified positions before permitting said angle bar to engage said recess, said angle bar having a fence arrested by said tumblers when said tumblers are not preset to said specified positions, movable means associated with the driver and releasably engaging said angle bar and positioning said fence out of contact with said tumblers when said recess is near but not in alignment with said angle bar, and spring loaded automatic release mechanism responsive to positioning of said recess in alignment with said angle bar to thereupon automatically move said movable means out of engagement with said angle bar and thereby permit said angle bar to be moved toward said driver by said angle bar spring.

12. A combination lock including a driver having a peripheral notch, a plurality of tumblers operated by said driver, each of said tumblers having a peripheral gate, an angle bar having a nose and a fence overhanging said tumblers, said nose being engageable in said notch when said driver is at a certain position and when said gates are aligned at a predetermined angular position, said tumblers arresting said fence and preventing said nose from engaging said notch when said driver is at said certain position if said gates are not aligned at said predetermined angular position, an angle bar spring urging said nose toward said driver, rotatable mask means axially aligned with said driver, said mask means engaging said angle bar and holding said fence out of contact with said tumblers as said driver is being turned adjacent to said certain position, said mask means being disengageable with said angle bar by rotation relative to said driver, spring means biasing said mask means toward disengaging said angle bar as said driver is turned toward said certain position, check means holding said mask means from disengaging said angle bar, and automatic release means responsive to positioning of said driver in said certain position to thereupon automatically release said mask means from said check means, thereby permitting said mask means to disengage said angle bar and said angle bar to be moved toward said driver by said angle bar spring.

13. A combination lock including a bolt, a rotatable driver having a peripheral recess, an angle bar adapted to engage said recess when in alignment therewith and thereby enable said bolt to be operated, an angle bar spring urging said angle bar toward said driver, tumblers requiring presetting to specified positions before permitting said angle bar to engage said recess, said angle bar having a fence arrested by said tumblers when said tumblers are not preset to said specified positions, releasable means engaging said angle bar and positioning said fence out of contact with said tumblers when said recess is near to but not in alignment with said angle bar, a second spring tending to move said releasable means out of engagement with said angle bar when said recess is near to alignment with said angle bar, and means responsive to the position of said recess restraining said second spring until recess is actually in alignment with said angle bar.

14. A combination lock including a bolt, a rotatable driver having a peripheral notch, an angle bar adapted to engage said notch when said driver is positioned so that said notch is in alignment with said angle bar and thereby enable said bolt to be operated, a spring constantly urging said angle bar toward said driver, tumblers

requiring presetting to specified positions before permitting said angle bar to engage said notch, said angle bar having a fence arrested by said tumblers when said tumblers are not preset to said specified positions, mask means associated with said driver for blocking said angle bar from engaging said notch, said mask means being movable relative to said driver to a position in which said mask means do not block said angle bar, spring means connected to said mask means for moving said mask means to said position in which said mask means do not block said angle bar, means for increasingly stressing said spring means when said notch is brought into alignment with said angle bar so that said spring means tend to move said mask means to said position in which said mask means do not block said angle bar, and detent means restraining said mask means from moving under stress imparted to said spring means until said detent means is overcome by increasing stress of said spring means.

15. A combination lock including a bolt, a rotatable driver having a peripheral notch, an angle bar adapted to engage said notch when said driver is positioned so that said notch is in alignment with said angle bar and thereby enable said bolt to be operated, a spring urging said angle bar toward said driver, tumblers requiring presetting to specified positions before permitting said angle bar to engage said notch, said angle bar having a fence arrested by said tumblers when said tumblers are not preset to said specified positions, mask means associated with said driver for blocking said notch in a manner preventing said angle bar from engaging said notch, said mask means being movable relative to said driver to a position in which said mask means do not block said notch, spring means connected to said mask means for moving said mask means to said position in which said mask means do not block said recess, means for increasingly stressing said spring means when said notch is brought to alignment with said angle bar to bias said mask means toward said position in which said mask means do not block said notch and brake means restraining said mask means from moving under stress imparted to said spring means by said stressing means until the restraining effect of said brake means is overcome by increasing stress of said spring means.

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