Dec. 19, 1967 L. H. PERRY 3,358,479

COMBINATION LOCK

Filed Sept. 28, 1965 2 Sheets-Sheet 1

Fig. 1

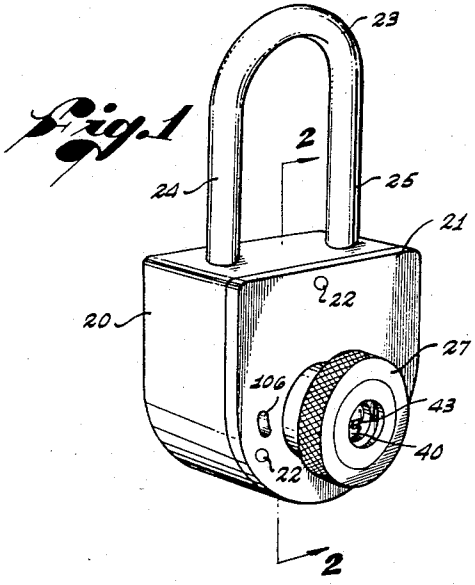


Fig. 3

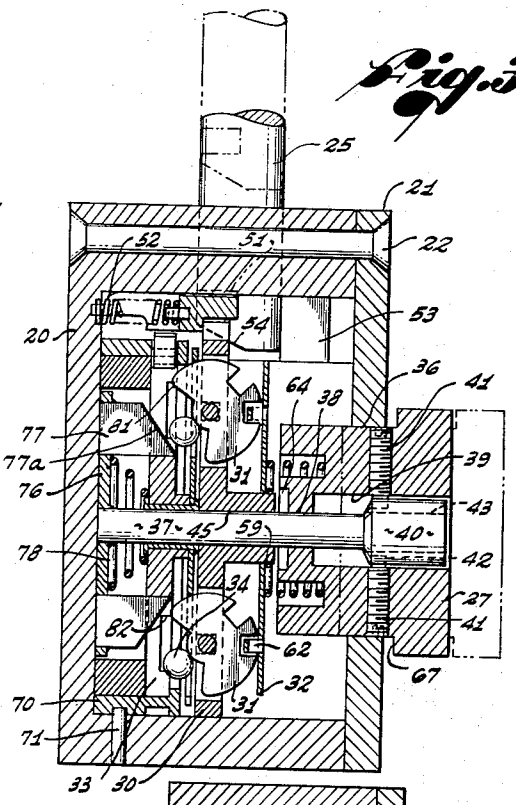


Fig. 2

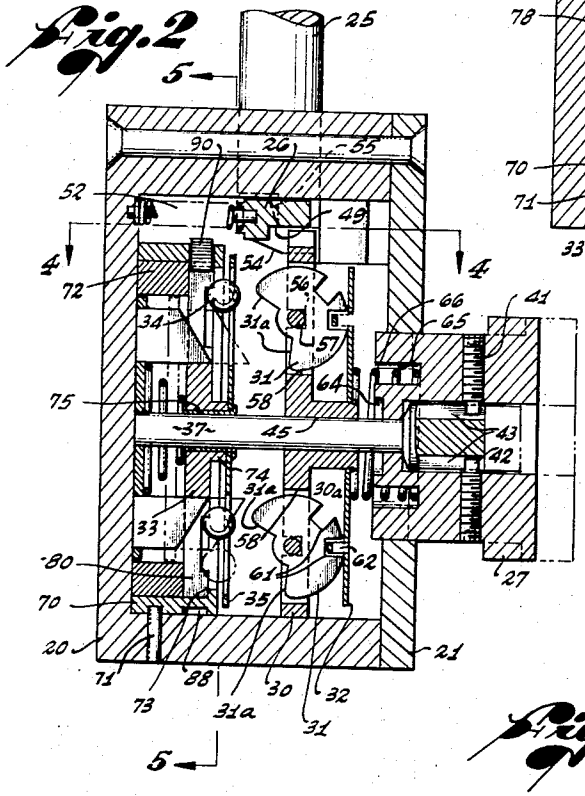
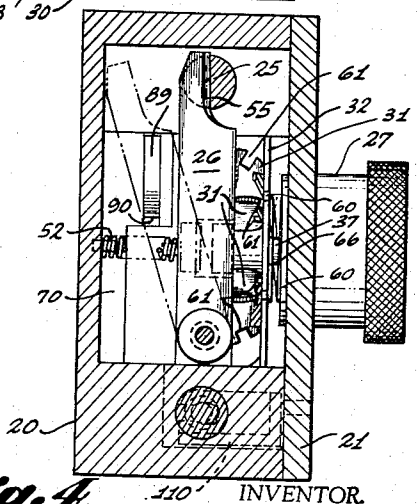


Fig. 4



INVENTOR.
LANDIS H. PERRY
BY Fulwider, Patton, Rieber, Lee, and Utecht
ATTORNEYS

Dec. 19, 1967 L. H. PERRY 3,358,479

COMBINATION LOCK

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Fig. 7b

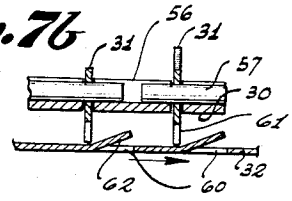


Fig. 7a

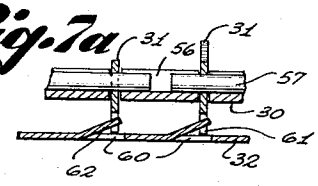


Fig. 6

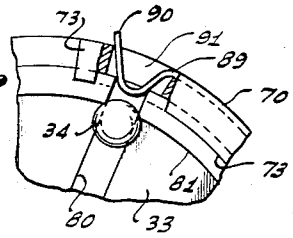


Fig. 5

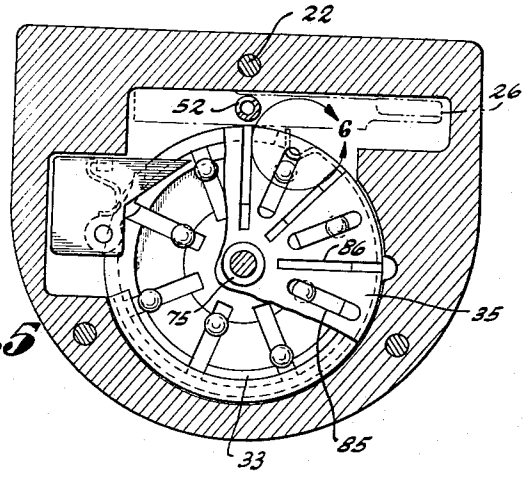
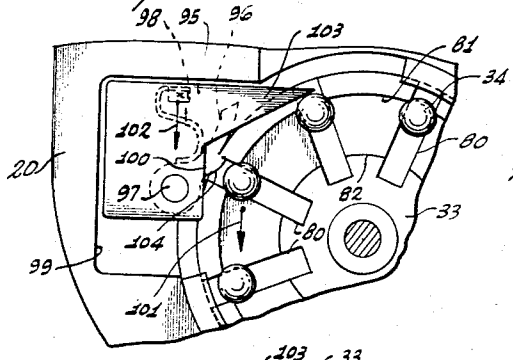


Fig. 8



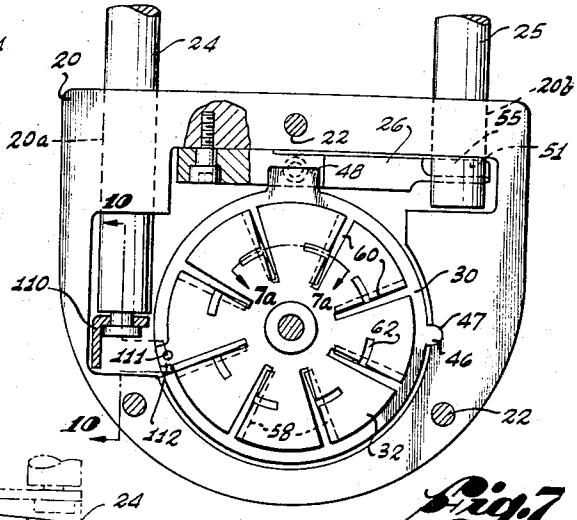
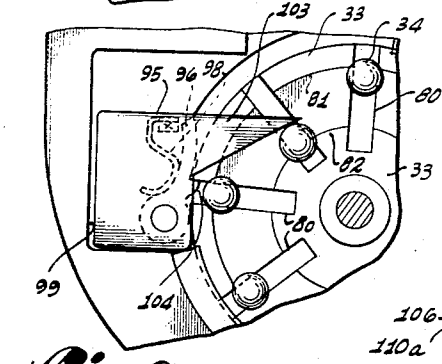


Fig. 7

Fig. 9



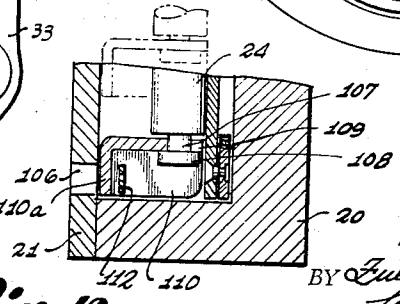


Fig. 10

INVENTOR.
LANDIS H. PERRY
BY Fulwider, Patton, Rieber, Lee, and Utecht
ATTORNEYS

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COMBINATION LOCK

Landis H. Perry, 213 41st St., Newport Beach, Calif. 92660

Filed Sept. 28, 1965, Ser. No. 490,989
17 Claims. (Cl. 70—25)

The present invention relates generally to combination locks and, more particularly, one without a numbered scale that is actuated by a predetermined sequence of movements of an operating knob. My prior Patent No. 2,957,355 discloses a numberless combination lock of this type.

An object of my invention is to provide an improved numberless combination lock that can be incorporated into a variety of latching devices; that is, easier to operate in that it reduces the friction of the internal moving parts; in that it is capable of a greater number of possible combinations being set into the mechanism at the option of the user; in that the movable elements of the commination mechanism can more readily be disposed in a desired pattern as a condition precedent to setting a new combination into the lock or to working a combination already set into the lock; and in that the actuating sequence of movements has been simplified.

It is also a further general object of this invention to provide a combination lock that will attain the objects and advantages of my aforementioned patent in a more facile manner and by means of a simplified construction that also has the advantage of achieving greater structural strength, whereby to better resist destruction of the lock.

These and other objects and advantages of the present invention will be apparent from the following description thereof and from the attached drawings illustrating the presently preferred embodment.

FIGURE 1 is a perspective view of a padlock into which my improved combination lock has been incorporated.

FIGURE 2 is a sectional view, taken on the line 2—2 of FIGURE 1, on an enlarged scale and showing the relative positions of internal parts of the combination mechanism disposed to prevent opening of the lock.

FIGURE 3 is a sectional view, similar to FIGURE 2, but showing the relative positions of internal parts of the mechanism disposed in a manner to allow opening of the lock.

FIGURE 4 is a sectional view on the line 4—4 of FIGURE 2.

FIGURE 5 is a sectional view on the line 5—5 of FIGURE 2.

FIGURE 6 is a view of the area 6 of FIGURE 5, on a further enlarged scale.

FIGURE 7 is a front view of the lock with the cover plate removed, other portions being shown in section and cut-away to more clearly show certain details of construction.

FIGURE 7*a* is a sectional view on the line 7*a*—7*a* of FIGURE 7, a further enlarged scale, to show a portion of the means for permitting changing of the combination.

FIGURE 7*b* is a view like FIGURE 7*a*, but showing the parts in different relative positions.

FIGURE 8 is a fragmentary plan view of the combination actuating means, on a further enlarged scale, overlying portions of the lock having been removed for clarity of illustration.

FIGURE 9 is a view similar to FIGURE 8, but showing the parts in different relative positions.

FIGURE 10 is a sectional view taken on the line 10—10 of FIGURE 7, on a slightly reduced scale.

Referring now to the drawings for the general arrangement of the invention, the lock includes a hollow body 20 that is permanently closed by means of a front plate 21 secured thereto by rivets 22 or other suitable permanent fasteners. As the invention is hereshown incorporated in a padlock, by way of example, the body is provided with the usual shackle or hasp 23 that is U-shaped and has legs 24 and 25 of unequal lengths (see FIG. 7) slidable in bores 20*a* and 20*b* of the body. Internally, the body 20 is provided with a pivotally mounted latch 26 (see FIG. 7), normally engaging the short leg 25 of the hasp to prevent opening the lock. Protruding from the front cover plate 21 is an actuating knob 27 through which the combination means can be operated to allow the latch 26 to be moved out of engagement with the short leg 25 of the hasp, whereby the hasp may be opened.

Broadly considered, the combination means of the present invention is substantially like that shown in my prior Patent No. 2,957,355. Thus, within the body 20, there is a disc carrier plate 30, disposed coaxially with the actuating knob 27 and adapted to swing the pivotally mounted latch 26 out of engagement with the short leg 25 of the hasp in response to depression of the knob. This carrier plate 30 mounts a plurality of index elements or combination discs 31 that are circularly spaced apart and which individually can be set in either of two positions relative to the plate 30 and releasably retained in a desired combination pattern by means of a disc locking plate 32, coaxially disposed with the carrier plate 30. Opposing the combination discs 31 is an axially immovable support plate 33 carrying a plurality of blocking elements or balls 34 held by a spring disc 35. These balls, individually, can occupy either of two positions relative to their supporting plate 33 and when disposed in a manner complementary to the preset pattern of combination discs 31, allow sufficient axial movement of the combination discs 31 and disc carrier plate 30 to allow the carrier plate 30 to allow the carrier plate to move the latch 26 out of engagement with the hasp.

More specifically, the cover plate 21 is formed with an opening 36 that rotatably seats the stem portion of the knob 27. In order to slidably receive an axle 37, the knob 27 is formed with a central bore 38, whose outer end is deeply counterbored, as at 39, to slidably mount a head 40 of the axle 37. The knob 27 and axle 37 are keyed together for co-rotation by means of a diametrically opposite pair of set screws 41, disposed in tapped bores of the knob 27, each of these set screws having plain ends 42 that are slidable longitudinally of the axle 37 with a pair of longitudinally extending and diametrically opposite grooves 43 formed in the head 40 of the axle.

The plate 30 that carries the combination discs 31 is centrally formed with a bore 45 that rotatably and slidably receives the axle 37. Referring to FIG. 7, it can be seen that the plate 30 is formed with a radially protruding index tab 46 that is slidably receivable within a groove 47 formed within the chamber of the body 20. By this means, the plate 30 remains in the proper angular orientation, relative to the axle 37 and the latch 26, whereby another radially protruding pad 48 on the plate 30 is disposed within a groove 49 formed in the underside of the latch 26 (see FIG. 2).

As shown in FIGURE 7, the short leg 25 of the hasp, adjacent its end, is formed with a notch 51 adapted to be entered by the swingable end of the latch 26. A spring 52 is disposed between the rear face of the latch 26 and rear wall of the body 20 to normally bias the latch into the engaged position or into engagement with the leg 25 of the hasp. As shown in FIGURE 3, the body 20 is interiorly provided with an integral pad 53 to limit forward movement of the lever 26 in response to the spring action.

As shown in FIGURES 2 and 3, the lower end of the hasp leg **25** is formed with a cam surface **54** and the swingable end of the latch **26** on its upper surface is formed with a cam surface **55**, these two surfaces co-operating to cam the latch **26** out of the way on reinsertion of the short leg **25**.

In the illustrated lock, the carrier plate **30** mounts eight of the combination discs **31**, although a greater or lesser number could be used. The discs **31** are identical in configuration. Thus, each is made from a circular piece that has had an arcuate sector of approximately 135° removed in order to leave a pair of apices symmetrically disposed with respect to the center of the piece. On the side of the carrier plate **30** that faces the balls **34**, it is formed with a circular groove **56** that seats a circular wire **57**. This wire passes through holes formed in the centers of the combination discs **31** and the carrier plate **30** is formed with eight radially disposed slots **58** through which the discs **31** freely extend. The combination discs **31** are thus pivotally mounted on the rod **57** so that one or the other of the apices **31***a* of the disc can protrude out of the carrier plate **30** at different radial distances from the center of the plate **30**.

In order to mount the locking plate **32** for holding the combination discs **31** in the desired individual orientation, the carrier plate **30** is formed with a central boss **30***a* on whose end the locking plate **32** is coaxially seated and held against axial displacement by a snap-ring **59** seated in an appropriate circumferential groove formed in the end of the boss **30***a*. The locking plate **32** is made of a thin sheet metal, having some resilience and, as shown in FIGURE 7, is formed with eight radially disposed slots **60**, opening into the periphery of the disc. The disc or plate **32** is thus biased against the protruding circular edges of the combination disc **31**. Each combination disc **31** is formed with a pair of slots **61** opening into the circular edge and equally spaced on opposite sides of the axis of symmetry of the disc **31**. The locking plate **32**, along one edge of each of the slots **60**, is formed with an integral tab **62**, the eight tabs being displaced from the plane of the plate **32** as best seen in FIGURES 7*a* and 7*b*. All of the tabs **62** are disposed on a diameter substantially equal to and superposed over the circular rod **57** seated in the carrier plate **30**. The locking plate **32** can be angularly adjusted relative to the carrier plate **30**, whereby the tabs **62** can be inserted into or withdrawn from the slots **61** of the combination discs **31**, whereby to dispose each disc with a desired one of the apices **31***a* protruding therefrom.

The inner end of the knob **27** is formed with a shallow counterbore **64** of sufficient diameter to freely receive the confronting end of the boss **30***a* of the carrier plate **30** and the snap-ring **59**. This same end of the knob **27** is also formed with a circular groove **65** that seats one end of a coiled spring **66**, whose other end bears against the disc locking plate **32**. Thus, in response to inward pressure on the knob **27**, the spring **66** is compressed and forces the plates **32** and **30** towards the latch **26** to ultimately swing the latch out of the way if the right combination has been set into the lock. This is accomplished without any direct contact or abutment occurring between the knob **27** and the boss **30***a* of the carrier plate **30**, because of the clearance afforded by the shallow counterbore **64**. This can be observed from FIGURE 3, showing the normal fully depressed position of the knob **27**. From that figure, it will be seen that upon any further inward movement of the knob **27**, a shoulder **67** defined between the head and the stem of the knob will seat upon the cover plate **21** of the body before any contact can occur between the inner end of the knob and the boss **30***a*. While FIGURE 3 shows the combination, i.e., the balls **34** and discs **31** in position to permit opening of the lock, nevertheless, upon inspection of FIGURE 2, it will be apparent that even when the proper combination has not been set into the balls **34**, clearance will still remain between the

boss **30***a* of the carrier plate **30** and the inner end of the knob, even though the knob be fully depressed until the shoulder **67** abuts the cover plate **21**. This arrangement avoids the possibility of opening the lock by hammering on the knob **27** in an attempt to break the discs **31**. The result of such hammering would be merely to drive the shoulder **67** of the knob on to the cover plate **21** without driving the combination discs **31** against the ball **34** to such an extent as to break the discs.

To support the ball support plate **33** rotatably within the body **20**, the body seats a restraining ring **70** against its floor or blind end. This ring may be secured in place by a plurality of press fitted pins **71** extending through the wall of the body **20** and into blind bores formed in the ring **70**. The ring **70**, in turn, contains a bushing **72** on top of which the ball support plate **33** rests, the plate being held rotatably within the ring on top of the bushing by means of a radially inwardly projecting lip **73** formed integrally with the ring **70**. The ball support plate **33** is formed with a central boss **74** on whose end the ball retainer spring disc **35** is seated in coaxial relationship to the plate **33**. A hollow rivet **75** extends through the centers of the plate **33** and spring disc **35** and slidably and rotatably receives the inner end of the axle **37**.

The innermost end of the axle **37** has a plate **76** secured thereto of a diameter to be axially slidable within the bushing **72**. This plate is provided with eight cam blocks **77**, equally circularly spaced around the axle **37** and rigidly secured to the plate **76** in radial relationship thereto. A spring **78** is coiled around the axle **37** to be compressed between the plate **76** and one side of the ball support plate **33**. Thus, the plate **76** is normally biased against the floor or blind end of the body **20**, but when the knob **27** is pulled, the plate and the cam blocks **77** thereon are moved towards the ball support plate **33**.

Referring to FIG. 8, the ball support plate **33** is formed with eight equally circularly spaced apart and radially extending slots **80**, opening into the periphery of the plate **33**. These slots are of a width to provide a track or race for the corresponding balls **34**, which are thus movable radially of their supporting plate. As it is desired to have each ball **34** capable of being definitely but yieldably positioned in one of two radially inner or outer positions on the plate **33**, that surface of the plate on which the balls are disposed is formed with a circular depression having outer and inner edges **81** and **82**, whose intersections with the slots **80** define the radial range of movement of the balls **34**. Referring to FIG. 2, it will be noted that the edges **81** and **82** are located approximately in registration with the diameters defined by the pairs of apices **31***a* of the combination discs **31**, when the apices project from the plate **30**.

Attention is drawn to the configuration of the cam blocks **77** and their relationship to the slots **80** and edges **81** and **82** of the ball support disc **33**. Thus, each of these blocks has a cam edge **77***a* on its free end whose apex is at the radially innermost edge of the block and which edge is freely receivable in one of the slots **80** of the ball plate **33**. This cam edge is in registration with the inner portion only of the length of the corresponding slot **80**. Thus, as is shown in FIGURE 2, referring to the lower half of the drawing, when a ball **34** is disposed in its radially inner position within a slot **80**, it can be shifted to its radially outer position merely by pulling on the knob **27**. This causes the plate **76** and the cam blocks **77** thereon to be displaced axially relative to the ball support plate **33**, moving the cam blocks **77** to the positions shown in phantom outline in FIGURE 2. The cam edge **77***a* thus cams the corresponding ball **34** to the radially outer position, as indicated by the dotted outline position of the ball in the lower half of the figure.

Referring to FIGURE 5, the ball retainer spring disc **35** is formed with a set of equally circularly spaced apart and radially disposed closed-end grooves **85** in registra-

tion with the combination discs 31 and the slots 80 formed in the ball carrier plate 33. The balls 34 are thus guided radially by the grooves 85 and slots 80 to be shiftable to positions leaving a portion of each groove 85 clear to receive an apex 31*a* of a combination disc 31 when the combination is worked successfully. Another set of equally circularly spaced apart and radially disposed slots 86 whose outer ends open into the periphery of the disc 35 to form spring fingers firmly biasing the balls 34 into the slots 80, against lateral displacement and against radial displacement, if contacted by an apex 31*a* of a disc 31.

In operating the lock, certain ones of the balls 34 are shifted to their radially inward position, while the other balls are allowed to remain in their radially outermost position. Accordingly, a means is provided for indicating to the user of the lock, every position of the ball support plate 33 in which one of the balls 34 is in a position to be shifted from a radially outer position to a radially inner position and such means are shown in FIGURES 5 and 6.

Thhe restraining ring 70 has an incomplete wall formed with an external circumferentially disposed groove 88 in whose upper portion a leaf spring 89 is seated. An end of this spring is formed into a generally V-shaped detent 90 that is directed inwardly through an opening 91 formed through the wall of the restraining ring 70. Thus, every time the outer end of a slot 80 formed in the ball support plate 33 comes into registration with the opening 91, it is engaged by the spring detent 90, the yieldable stop being sensed through the knob 27. Each of these stops indicates to the user that one of the balls 34 is in position to be shifted radially inwardly on the ball support plate 33.

The means by which the balls 34 can be individually moved from outer to inner positions in the slots 80 of the ball support plate 33 are shown in FIGURES 8 and 9. This ball actuating means includes an assembly of a generally L-shaped plate 95, a pawl 96 pivotally connected to the rear face of the plate 95 by a suitable fastener 97, and a generally S-shaped leaf spring 98, also fastened to the rear side of the plate 95 and having one end normally biasing the pawl 96. The housing 20 is provided with an internal pocket 99, registering with the opening in the incomplete wall of the ring 70, of a shape to slidably contain this assembly for movement between the two positions shown in FIGURES 8 and 9. Also, the spring 98 and pawl 96 are disposed by the pocket 99 in the same plane as the ball support plate 33, while the plate 95 of the assembly overlies the ball support plate, extending into the space between the ball retainer spring disc 35 and the ball support plate.

Disposed in this manner, the pawl 96 is biased by the spring 98 into engagement with the periphery of the ball support plate 33, while the plate 95 is disposed in substantially the same plane as the diametral planes of the balls 34. Further, the angular relationship between the pocket 99 and the spring detent 90 is such that when the detent engages one of the grooves 80 of the ball support plate 33, a shoulder 100 formed on the pawl 96 is simultaneously engaged by one edge of another groove 80, as shown in FIGURE 8. Then, when the support plate 33 is turned in counterclockwise direction as indicated by the directional arrow 101, the assembly is slid downwardly within the pocket 99, as indicated by the directional arrow 102, because of the abutment of the shoulder 100 of the pawl with one edge of the slot 80. Simultaneously, a cam edge 103 of the plate 95 engages one of the balls 34 and slides it radially inwardly in its groove 80. Thus, when the assembly reaches the bottom of the pocket 99, as viewed in FIG. 9, the cam edge 103 has forced a ball 34 to its radially inner seat in its groove 80. Now, upon clockwise movement of the plate 33, the assembly is forced upward to its starting position of FIGURE 8. The strength of the spring 98 is such that the

cam 104 and shoulder 100 cannot escape from the engaged groove 80 throughout the range of reciprocation of the assembly, as limited by the pocket 99, so the cam edge 104 is ineffective until the assembly returns to the position of FIGURE 8. Upon further clockwise movement of plate 33, one edge of a slot 80 engages cam edge 104 of the pawl 96 to pivot the pawl out of the way against the force of the spring 98 until another slot 80 is halted by the detent spring 90, whereupon the shoulder 100 of the pawl clicks back into a new groove 80.

The cover plate 21 is formed with a small opening 106 (see FIGURES 1 and 10) as a means of providing access to the interior of the lock for purposes of changing its combination. However, this opening is closed whenever the lock is in the locked condition. Thus, as is shown in FIGURE 10, the end of the long leg 24 of the hasp is integrally formed with a reduced diameter portion 107 that terminates in a head 108, whereby the portion 107 may be received within a slot 109 formed in one wall of a blocking member 110. This blocking member has another wall 110*a*, which obstructs the opening 106 whenever the hasp is locked into the body 20. Upon the combination being successfully worked, the legs 25 and 24 of the hasp can be withdrawn to a limited extent, whereupon the blocking member 110 is lifted away from the opening 106, being carried on the head 108. Thereupon, a needle-like instrument can be inserted through the opening 106 for insertion in a hole 111, that is formed in a tab 112 integrally formed with and projecting radially from the disc locking plate 32.

While the disc carrier plate 30 is keyed against angular movement relative to the body 20, the locking plate 32 is not so keyed and therefore, by the use of a needle-like instrument, the locking plate may be shifted clockwise as viewed in FIGURE 7 to be angularly displaced relative to the disc carrier plate 30. Such displacement is illustrated in FIGURE 7*b* and results in withdrawing the tabs 62 of the locking plate from one or the other of the slots 61 of all of the combination discs 31. As a result, all of the combination discs 31 are pivotal on the circular rod 57, although yieldably restrained by the plate 32. Then, if the balls 34 have previously been arranged in a combination pattern, if the knob 27 is pushed into the body 20, the disc carrier plate 30 is carried in the same direction and contact between one or the other of the apices 31*a* of each combination disc with a ball 34 will set the combination discs in the proper attitudes corresponding to the positions of balls 34. Pressure on the knob 27 can then be released and the locking plate then moved in the opposite direction, i.e., counterclockwise, as viewed in FIGURE 7, to reinsert the tabs 62 into one or the other of the slots 61 of each combination disc. The combination is thus preserved for subsequent operation of the lock.

In the operation of the lock, before it is attempted to work the combination, all of the balls 34 must be set in their radially outer positions. This is accomplished very simply, merely by pulling outwardly on the knob 27. This has a result of pulling the camming blocks 77 into the slots 80 of the ball carrier plate 33, whereby any of the balls 34 that are located on radially inner positions are moved to radially outward positions. After this is done, the lock is ready for working the combination.

As is apparent, in order to successfully work the combination, all of the balls 34 must be arranged in a pattern that is precisely complementary to the pattern which has been set into the combination discs 31. If the combination is worked improperly, the result will be as shown in FIGURE 2. There, it will be observed that each of the balls 34 is in a position to obstruct entry of an apex 31*a* of each of the combination discs 31, through the slots 85 of the plate 35 and so prevent sufficient advancement of the carrier plate 30 toward the ball support plate 33 to allow the tab 48 of the carrier plate to move the latch 26 out of the way. By contrast, in FIGURE 3, both of

the balls 34 illustrated there are in the proper positions relative to the combination discs 31, whereby apices 31*a* of these combination discs are not obstructed by the balls and can penetrate through the slots 85 of the plate 35 and into the slots 80 of the ball carrier 33. Accordingly, the disc carrier plate 30 is allowed a sufficient range of movement or clearance, whereby the tab 48 engages the latch 26 and swings it out of the way, whereupon the short leg of the hasp is freed and the hasp can be withdrawn from the lock.

By way of example, let it be assumed that the lock has had the combination 1–2–3 set thereinto. Arbitrarily, such combination is here defined as the number of clockwise steps of the knob 27, i.e., clicks of the detent 90 in slots 80 of the plate 33, between retrograde or limited counterclockwise movements of the knob. Such combination indicates that three appropriately spaced ones of the combination discs 31 are set with their radially inner apices 31*a* protruding through the carrier plate 30.

The knob 27 is first pulled axially outwardly to clear all of the balls 34 to radially outer positions. Following this, the knob 27 is rotated as follows: One clockwise step; one counterclockwise movement; two clockwise steps; one counterclockwise movement; three clockwise steps; one counterclockwise movement. This sequence will result in shifting three appropriately spaced apart balls 34 into radially inner positions, in a pattern complementary to the preset pattern of the combination discs 31. Thereupon, depressing the knob 27 forces the plate 30 to move axially, whereby its tab 48 contacts the latch 26 to displace the latch and the hasp can be withdrawn.

Withdrawal of the hasp leg 24 moves the blocking member 110 away from the opening 106 in the cover plate of the lock, so that if it is now desired to change the combination, the locking plate 32 can be displaced angularly relative to the carrier plate 30 to free the discs 31 from the locking tabs 62. Now, assuming a new combination is to be set into the lock, the lock is first cleared by pulling on the knob 27 to shift all of the balls 34 to radially outward positions. The knob 27 is then moved through a new sequence of movements corresponding to the new combination desired to be set into the lock. This will effect a corresponding radially inward shifting of certain balls 34. Thereafter, the knob 27 is depressed whereby those of the discs 31 that are not properly set will come into contact with the balls 34 to be pivoted to assume the proper positions. Thereafter, the knob 27 is released to allow the discs 31 to move away from the balls 34, while being maintained in the newly set condition by the spring force of the locking plate 32. The locking plate is then moved angularly to reinsert the tabs 62 into the proper slots 61 of the combination discs 31. The hasp is then reinserted into the lock, the knob 27 is pulled to clear the balls 34 and the locking is thereupon completed with the new changed combination.

The use of the balls 34 as blocking elements is advantageous, in that they have low frictional resistance to radial shifting, both in working the combination and in clearing the lock. It will also be observed that the process of clearing the lock has been greatly simplified, now involving merely a pull on the knob 27. Further, a greater number of possible combinations is possible with the structure of the present invention, since the knob 27 is not limited to less than 360° as the permissible range of movement in working a given combination. Also, the lock of this invention involves a simpler sequence of movements in operating the combination, in that a ratcheting mechanism is no longer required to advance the carrier for the blocking elements step by step.

While there has been shown herein, what is considered to be a presently preferred embodiment of the invention, it will be apparent that various modifications and changes may be made without departing from the scope of the following claims.

I claim:

1. A combination lock comprising:
a rotatable support means;
a plurality of blocking elements mounted on said support means in angularly spaced apart relationship around the axis of said support means,
said blocking elements being individually shiftable radially of said support means between inner and outer positions;
a second support means coaxially arranged with and coaxially spaced apart from said first mentioned support means,
said first and second support means being adapted for opposed relative axial movement and for co-rotation;
a plurality of camming elements rigidly mounted on said second support means in angularly spaced apart relationship around the axis of said second support means,
said camming elements projecting toward said blocking elements and each of said camming elements being in registration with one of said inner positions of one of said blocking elements on said first support means;
and cooperating surfaces formed on said camming elements and blocking elements for translating contact therebetween into radially outward shifting of said blocking elements to said outer positions in response to opposed relative axial movement of said first and second support means.

2. A lock as set forth in claim 1 in which:
said second support means is coaxially affixed to an axle that also coaxially slidably engages said first support means;
said first support means having a plurality of radially extending slots to mount said blocking elements for shifting radially of said first support means;
said camming elements projecting into said slots of said first support means to key said first and second support means together for co-rotation when said axle is turned.

3. A lock as set forth in claim 1 in which:
said first support means comprises a plate that is held against axial movement and in which said second support means is axially movable within a limited range towards and away from said first support means;
and in which a biasing means is disposed between said first and second support means to normally yieldably bias said support means away from one another.

4. A lock as set forth in claim 1 in which:
said blocking elements comprise balls and said first support means is formed with a plurality of radially extending slots in which said balls are disposed and into which said camming elements are receivable for contact with said balls.

5. A lock as set forth in claim 4 in which:
said first support means comprises a rigid plate and a spring disc in coaxially spaced apart relationship and between which said balls are disposed to be biased against one side of said plate by said spring disc;
said camming elements being disposed on the opposite side of said plate from said spring disc.

6. A combination lock comprising:
a body;
a support means rotatably mounted in said body;
a plurality of blocking elements mounted on said support means in angularly spaced apart relationship around the axis of said support means,
said blocking elements being individually shiftable radially of said support means between inner and outer positions;
an actuating member for said blocking elements that is movably mounted in said body for limited reciprocable movement within a plane including said blocking elements;
pawl means movably mounted in said body for limited

reciprocable movement and interconnecting said support means and actuating member to effect said limited reciprocation of said actuating member in response to reciprocation of said support means;

said pawl means including yieldable means adapted for release of said pawl means from said support means upon rotation of said support means in one direction only beyond the range of limited reciprocation of said pawl means;

said actuating member and each of said blocking elements having cooperating surfaces adapted to individually shift each of said blocking elements in a radially inward direction on said support means in response to rotational movement of said support means in the other direction only.

7. A combination lock as in claim **6** in which:

said cooperating surfaces of said actuating member and blocking elements include an edge of said actuating member that at one end of the limited range of reciprocation of said member is disposed at an outer position of one of said blocking elements on said support means to contact a blocking element in said outer position,

said edge being adapted to drive said blocking element to said inner position on said support means in response to rotational movement of said support means in said other direction as said actuating member moves to the other end of the limited range of reciprocation of said actuating member.

8. A lock as in claim **6** in which:

said actuating member and pawl means are inter-connected for co-reciprocation in response to reciprocation of said support means and are slidably contained within a pocket formed in said body adapted to confine said actuating member and pawl means to reciprocation within said limited range;

and in which said yieldable means comprises a spring normally biasing said pawl means against a periphery of said support means;

said pawl means and said periphery being formed with cooperating surfaces adapted both to drivingly interconnect said pawl means and support means for co-reciprocation in both directions within said limited range and to effect release of said pawl means from said support means upon rotation of said support means in said one direction beyond said limited range.

9. A lock as in claim **6** in which:

said support means is drivable by an axle mounted co-axially with said support means and adapted to be turned in either direction by a means on the exterior of said body;

and in which a yieldable detent means is mounted in said body in operative association with said support means to yieldably position said support means in a plurality of positions in which one of said blocking elements is positioned in operative registration with said actuating member.

10. A lock as in claim **6** in which:

a second support means is coaxially arranged with and coaxially spaced apart from said first mentioned support means;

said first and second support means being adapted for opposed relative axial movement and for co-rotation;

and in which a plurality of camming elements is rigidly mounted on said second support means in angularly spaced apart relationship around the axis of said second support means;

said camming elements projecting toward said blocking elements and each of said camming elements being in registration with one of said inner positions of one of said blocking elements on said first support means;

and in which cooperating surfaces are formed on said camming elements and blocking elements for translating contact therebetween into radially outward shifting of said blocking elements to outer positions in response to opposite relative axial movement of said first and second support means.

11. A lock as in claim **10** in which:

said first support means is formed with a plurality of radially extending slots in which said blocking elements are disposed;

said slots being in registration with said camming elements to receive said camming elements upon opposed relative axial movement of said first and second support means;

said slots also being engageable with said pawl means at the periphery of said first support means to effect said limited reciprocation of said actuating member in response to reciprocation of said first support means.

12. A lock as in claim **10** in which:

said first support means is formed with a plurality of radially extending slots in which said blocking elements are disposed;

said slots being in registration with said camming elements to receive said camming elements upon opposed relative axial movement of said first and second support means;

said blocking elements being disposed on the opposite side of said first support means from said camming elements and substantially within a plane including said actuating member.

13. A lock as in claim **12** in which:

said pawl means and said first support means are substantially in co-planar relationship;

said slots also being engageable with said pawl means at the periphery of said first support means to effect said limited reciprocation of said actuating member in response to reciprocation of said first support means.

14. In a lock, the combination comprising:

a body;

a latch movably mounted within said body;

a combination means within said body including a member mounted for axial movement to displace said latch only upon successful actuation of said combination means;

an operating knob having a stem rotatably extending through a wall of said body, said knob being mounted for limited axial movement;

an axle rotatably mounted within said body for actuating said combination means;

means interconnecting said knob and axle for co-rotation and for relative axial movement;

yieldable means within said body between said member and an inner end of said knob adapted to move said member axially in a direction to displace said latch in response to axial movement of said knob;

and cooperating surfaces on said knob and body adapted for contact to positively limit movement of said knob into said body to prevent direct contact between said member and the inner end of said knob when said member is prevented from being moved by unsuccessful actuation of said combination means.

15. A lock as in claim **14** in which said knob, said member and said axle are in coaxial alignment and said yieldable means comprises a spring interposed between said member and the inner end of said knob and normally biasing said knob and member apart;

said means interconnecting said knob and axle comprising a bore formed in said knob and opening into the external end of said knob and slidably containing an enlarged end of said axle that unidirectionally, positively limits axial outward movement of said knob on said axle by abutment of said enlarged head against an inner end of said bore.

16. In a changeable combination lock, the combination comprising:

a body;

combination means including a member in said body to carry a plurality of combination elements and a plurality of combination elements angularly spaced around an axis of said member and each of which is selectively positionable in one of a plurality of different positions relative to said member;

a combination element locking means in said body positioned coaxially with said member;

said combination elements and said means having engageable portions adapted to releasably lock each of said combination elements in a selected position relative to said member;

said engageable portions being disengageable and reengageable by relative angular movement of said member and said combination locking means;

a closure member movably mounted in said body to normally close an opening formed in said body, said opening being positioned to permit access to said combination locking means to effect said relative angular movement of said combination locking means when said closure member is displaced from said opening;

and latch means for said lock that can be displaced only as a result of successfully actuating said combination means and drivingly connected to said closure member to effect displacement of said closure member away from said opening only when said latch means is displaced.

17. A lock as in claim 16 in which said latch means includes a hasp having an end of one leg connected to said closure member to move said closure member into and out of registration with said opening as said hasp is moved;

said closure member and internal portions of said lock having cooperating portions that are engageable with one another to limit withdrawal of said hasp from said body.

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EDWARD McCARTHY, *Assistant Examiner.*

MARVIN A. CHAMPION, *Primary Examiner.*