Oct. 25, 1960 L. H. PERRY 2,957,355

COMBINATION LOCK

Filed Dec. 24, 1956 3 Sheets-Sheet 1

Fig. 1

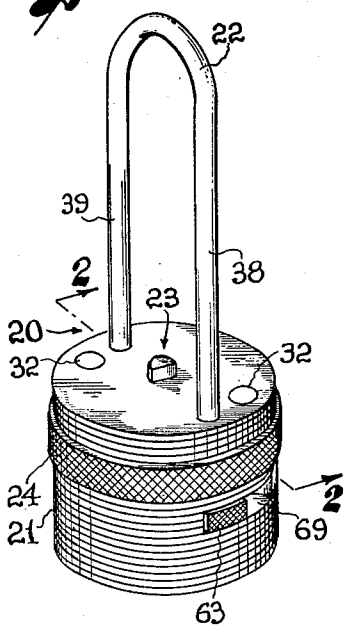


Fig. 3

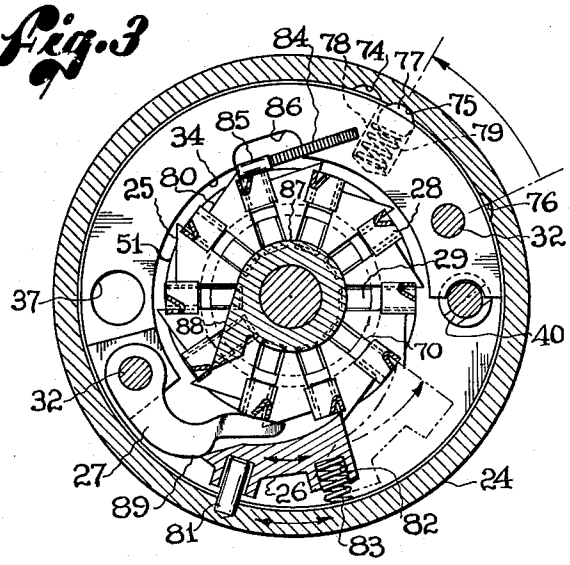
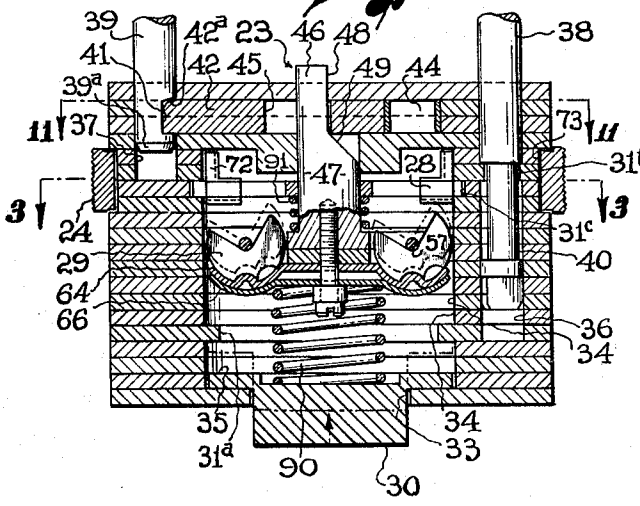


Fig. 2



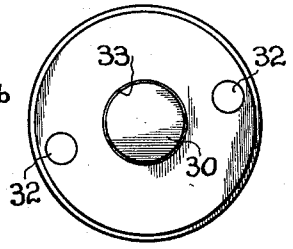


Fig. 4

INVENTOR.
LANDIS H. PERRY
BY Fulwider Mattingly & Huntley
Attorneys

Oct. 25, 1960 L. H. PERRY 2,957,355

COMBINATION LOCK

Filed Dec. 24, 1956 3 Sheets-Sheet 2

Fig. 5

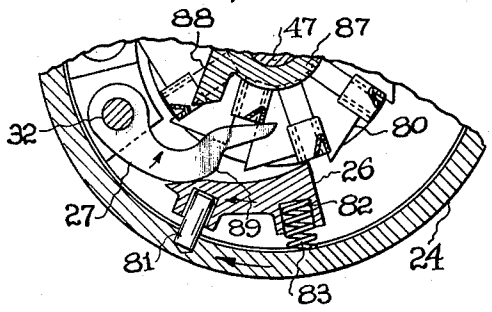


Fig. 6

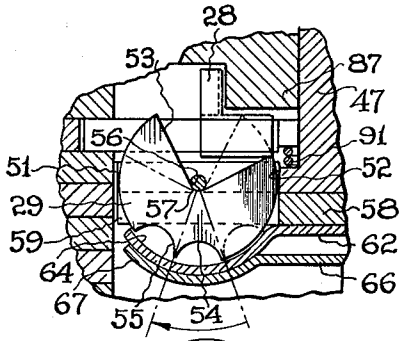


Fig. 7

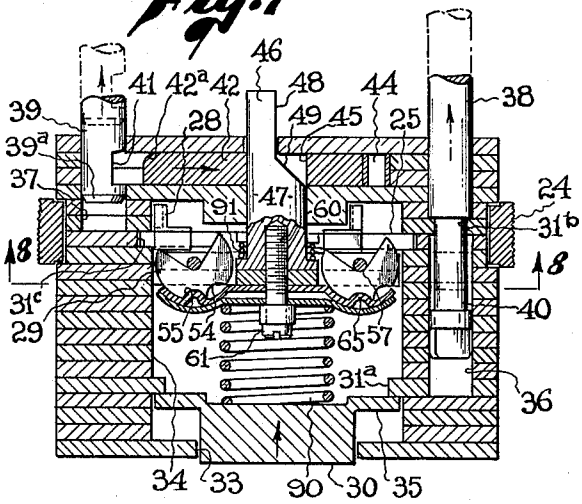


Fig. 8

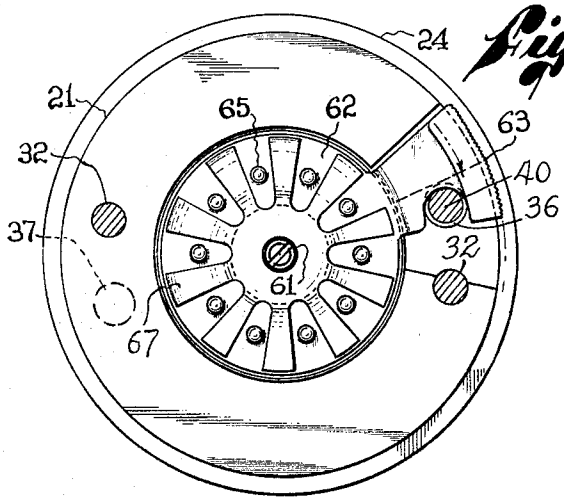
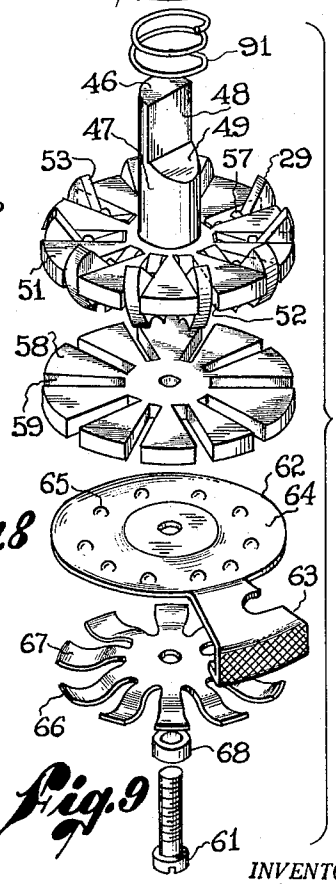


Fig. 9



INVENTOR.
LANDIS H. PERRY
BY Fulwider Mattingly & Hunt Ley
Attorneys

Oct. 25, 1960 L. H. PERRY 2,957,355

COMBINATION LOCK

Filed Dec. 24, 1956 3 Sheets-Sheet 3

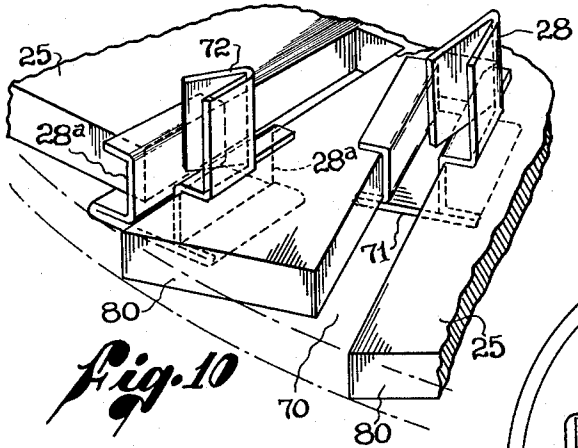


Fig. 10

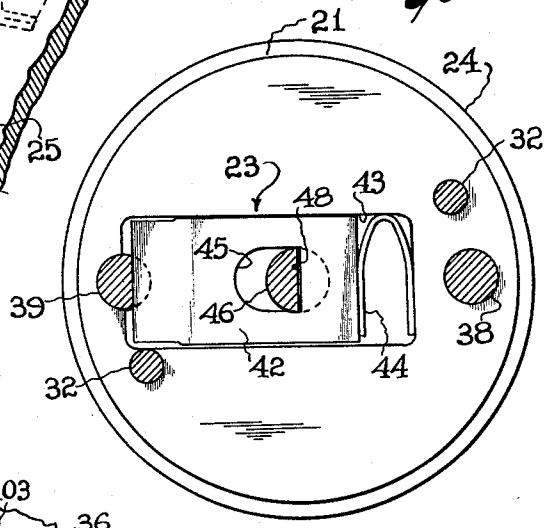


Fig. 11

Fig. 12

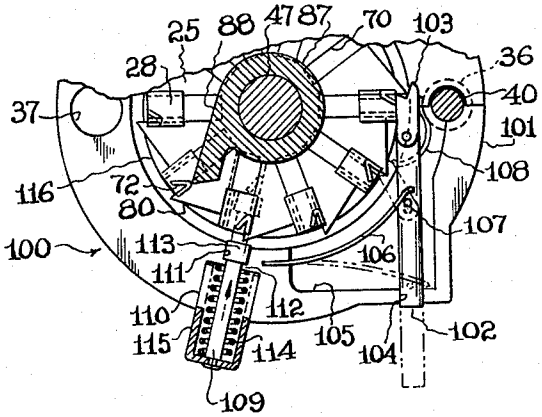


Fig. 13

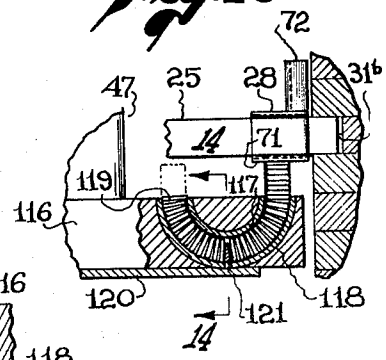
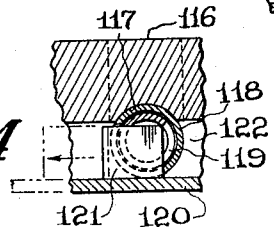


Fig. 14



INVENTOR.
LANDIS H. PERRY
BY Fulwider Mattingly & Hunttley
Attorneys

United States Patent Office 2,957,355 Patented Oct. 25, 1960

2,957,355

COMBINATION LOCK

Landis H. Perry, 3801 Seashore Drive, Newport Beach, Calif., assignor of thirty-five percent to James E. Meagher, Altadena, and fifteen percent to Thomas C. Ellingson, Fullerton, Calif.

Filed Dec. 24, 1956, Ser. No. 630,244

19 Claims. (Cl. 70—25)

The present invention relates generally to the field of locking devices and particularly to a combination lock.

An object of my invention is to provide a lock of the combination type having changeable index elements that can be preset by the owner to any desired combination. With this arrangement custody of an article can be transferred from one person to another without any danger that the former custodian will retain the means of gaining access to the transferred article. The new custodian upon receiving the article and the open lock can set his own combination into the lock and thereafter affix it to the article to be secured.

Another object of the invention is to provide a combination lock having unnumbered actuating means, the combination being workable by moving the actuating member through a predetermined sequence of movements through a limited range rather than by positioning a freely movable member with respect to a numbered scale.

A further object of my invention is to provide a combination lock that can be sold as an integral unit and can also be incorporated into other latching devices such as hotel room doors, motor vehicle doors, ignition locks, and many other articles. These and other adaptations of the invention are made possible by virtue of the simplicity and compactness of the combination means and particularly because the combination means can be adapted for actuation by rings, levers, pins or the like in such a way that only limited movement of such actuating members is required to work the combination.

It is also an object of the invention to provide a lock of this type that can be manufactured with either fixed or changeable combination means. In either case the lock is absolutely tamper-proof since it discloses no visible, audible or palpable clues to its combination. Specifically, the sensory characteristics of each movement of its actuating means remain constant whether or not the movement is part of the correct combination. Consequently, only persons having the correct combination can move the actuating means through the correct sequence of movements to open the lock.

Yet another object of my invention is to provide a combination lock that can be sold by a manufacturer without the necessity of maintaining files of the combination for each lock sold. The utility of such a file is eliminated because the combination of any of the locks can be changed at the will of its owner and is thus secret even as against the lock's manufacturer.

These and other objects and advantages of my invention will be apparent from the following description thereof and from the annexed drawings illustrating a presently preferred embodiment of the invention and an alternate form thereof in which:

Figure 1 is a perspective view of a changeable combination lock embodying the invention;

Figure 2 is an axial vertical sectional view of the lock shown in Figure 1 taken in the direction 2—2;

Figure 3 is a transverse sectional view taken along line 3—3 of Figure 2;

Figure 4 is a bottom plan view of the lock shown in Figure 1;

Figure 5 is a partial transverse sectional view similar to Figure 3 and showing another step in working the combination of the lock;

Figure 6 is a partial vertical sectional view on enlarged scale illustrating the method of presetting a combination of the lock;

Figure 7 is a vertical sectional view similar to Figure 2 but showing the arrangement of the elements of the lock when they are disposed in opening position;

Figure 8 is a transverse sectional view taken on the line 8—8 of Figure 7;

Figure 9 is a vertically exploded view in perspective of a sub-assembly of the combination means which holds the changeable index elements for setting a predetermined combination into the lock;

Figure 10 is a partial perspective view showing the slidable elements forming a part of the combination means of the lock;

Figure 11 is a transverse sectional view taken on the line 11—11 of Figure 2;

Figure 12 is a partial transverse sectional view showing an alternate embodiment of the invention;

Figure 13 is a partial vertical sectional view on enlarged scale showing another form of shiftable elements for the combination means used in the lock of Figure 12; and

Figure 14 is a partial vertical sectional view taken on the line 14—14 of Figure 13.

In the drawings, the presently preferred embodiment of the invention is indicated by the numeral 20 and is shown in detail in Figures 1 to 11, inclusive. The lock 20 includes a generally cylindrical body 21 that in one form, is composed of a plurality of superimposed annular plates which are adapted to enclose the combination means of the lock. Body 21 is also adapted to receive the inner ends of the two legs of a locking member or hasp 22. The hasp 22 is conventional in action and is normally held in locked position in body 21 by a latching means 23 concealed in the body (Figure 11). When latching means 23 are released, hasp 22 can be pulled outwardly of body 21 until one of its legs is free of the body after which the hasp is pivoted about the other of its legs in order to release a member secured between the legs of the hasp.

The body 21 mounts a reciprocally rotatable actuating ring 24 that is movable between predetermined limits. Rotatably housed inside the body 21 in the same plane with the ring 24 is a ratchet wheel 25. Ring 24 carries a pawl 26 (Figures 3 and 5) by means of which the wheel can be advanced one step at a time when the actuating ring 24 is advanced from a neutral position. When ring 24 is reversed from its neutral position, the pawl 26 actuates lever 27 pivotally mounted in body 21 in order to shift one of a plurality of blocking elements 28 carried by the wheel 25 (Figure 10). The blocking elements 28 can thus be individually shifted into a predetermined pattern in which certain of the blocking elements are in radially inward position while the balance are in a radially outward position.

When the blocking elements 28 are arranged in a particular pattern complementary to the preset combination of the lock, they permit unlatching movement of the assembly shown in Figure 9 that carries a plurality of index elements 29 which can be set into any desired combination. When the pattern of blocking elements 28 is complementary to the pattern of index elements 29, the assembly carrying the latter is axially movable by means of a button 30 on the bottom of the lock in order to release the latching means 23, as will be apparent from the following detailed description of the invention.

Specifically, the body 21 is preferably composed of a

plurality of superimposed concentric annular plates that are rigidly maintained in assembled relationship by a pair of diametrically opposite studs 32. The plate defining the bottom of body 21 is formed with a central opening 33 adapted to slidably receive the head of button 30. This opening 33 is smaller than the central openings formed in most of the other plates which thus define an axially extending chamber 34 in the body 21.

Button 30 on its inner end has a radially outwardly extending flange 35 that is axially slidable in chamber 34 between predetermined limits and is shown in Figure 2 in full line in its lower position wherein flange 35 rests on the inner surface of the bottom plate. The depressed position of button 30 is shown in dotted line and is determined by a plate spaced at least three plate widths above the bottom plate that has a central opening indicated at 31*a* of lesser diameter than chamber 34. Button 30 is thus movable through a distance equal to the combined widths of two body plates. As will subsequently appear this amount of travel of the button will cause sufficient axial travel of the assembly carrying index elements 29 to release latching means 23 when the correct combination for lock 20 is used.

In order to mount the hasp 22, the body 21 is formed with a pair of diametrically opposite bores 36 and 37 that open into the upper end of the body. As can be seen in Figure 2, the bore 36 is appreciably deeper than the bore 37, in order to receive a longer or pivot leg 38 of hasp 22. A shorter leg 39 of hasp 22 is receivable in the bore 37. This arrangement is conventional and permits the hasp 22 to remain pivotally connected to body 21 when the shorter leg 39 is withdrawn from the bore 37 in order to permit the body 21 to be swung free of the space between the hasp legs so that an article can be withdrawn from the hasp or inserted thereinto. To this end the inner end of the longer leg 38 has a reduced diameter portion 40 which coacts with a reduced diameter hole in the bore 36 indicated at 31*b*. With this arrangement, the range of axial movement of hasp 22 is limited by the opposite end shoulders of reduced diameter portion 40 of the longer leg 38 coming into contact with opposite sides of the plate in which the bore 31*b* is formed. As is apparent, this range of movement must be sufficient to permit complete withdrawal of the short leg 39 of the hasp.

The lower end of the short hasp leg 39 is formed with an inwardly facing notch 41 that is adapted to be engageable by latching means 23 in order to normally hold the hasp to the body 21 in locked condition (Figure 2). Latching means 23 includes a substantially rectangular latch member 42, best seen in Figure 11, that is longitudinally slidably disposed in a diametrically disposed slot 43 which is longer than the latch member 42. A U-shaped spring 44 or the like is interposed between an end of latch 42 and an end of the slot 43 to at all times bias the latch into locking engagement with the notch 41 of the hasp leg 39. Referring to Figure 2 it will be seen that latch 42 is approximately as wide as the width of two body plates and is slidably housed between the top plate of body 21 and a plate spaced two plate widths therebelow.

The lower end of the short hasp leg 39 is beveled as at 39*a* while the adjacent upper edge 42*a* of the latch 42 is rounded. With this arrangement, when the hasp 22 is pushed inwardly the beveled edge 39*a* will first contact the rounded edge 42*a* of the latch member in order to move the latch member 42 longitudinally against the urging of the spring 44, whereby the latch 42 is momentarily displaced to place the notch 40 of hasp leg 39 in alignment for locking engagement with latch 42.

Referring to Figure 11 it will be seen that latch member 42 in the approximate center thereof is formed with an opening 45 which is semi-circular in configuration at the end thereof adjacent to the hasp leg 39. This hole 45 is adapted to receive the semicircular upper end 46 of a generally cylindrical stem 47 that is axially slidably mounted in the body 21. Intermediate the lower portion of the stem 47 and the upper end portion 46, the stem develops into a tapered surface 49 which in turn develops into a vertical flat face 48 that is adapted to cooperate with the square end of the latch member hole 45. The vertical altitude of the tapered surface 49 is at least equal to the width of two body plates whereby when the stem 47 is moved axially upwardly the tapered surface 49 thereof causes unlocking movement of the latch 42. As will presently appear, this unlatching movement of stem 47 can occur only when the combination means of the lock 20 are worked according to the preset combination.

The stem 47 forms a part of the assembly shown in exploded perspective in Figure 9 and rigidly mounts at its lower end a circular carrier 51 that is formed with a plurality of radially extending slots 52. Pivotally mounted in each of the slots 52 is one of the index elements 29 whose configuration can best be seen by reference to Figures 2, 6 and 7. It will be observed that the overall length of index elements 29 is approximately that of the slots 52 and that the index elements 29 are partially circular in configuration. Each of the index elements has a quadrant section thereof removed as is indicated at 53 so that the axis of symmetry of each index element 29 is a line bisecting the removed quadrant. Oppositely to the cutout section 53 each index element 29 is formed with an inner notch 54 and an adjacent outer notch 55 that are symmetrically disposed, on opposite sides of the axis of symmetry.

The underside of the carrier 51 is formed with an annular groove 56 that is adapted to receive or seat therein a ring of wire 57 that provides means for the pivotal connection of each of the index elements 29 to the carrier 51. Each of the index elements 29 is adapted to pivotally engage the wire 57 by wedging between the radially extending edges thereof defining the cutout quadrant 53. The wire 57 is held in place by a retainer disc 58 that is also formed with a plurality of radially extending slots 59 which are adapted to register with the slots 52 of the carrier 51. Therefore, when the disc 58 is thrust against the lower surface of carrier 51, the pivot wire 57 is retained therebetween in order to provide a pivotal axis for the index elements 29. As can be seen by reference to Figure 6 when the index elements 29 are so mounted, the notches 54 and 55 thereof protrude downwardly beneath the lower surface of the retainer disc 58.

As an examination of Figures 2, 6 and 7 will show, each of the index elements 29 is adapted to be placed in a position in which either the inner notch 54 or the outer notch 55 is substantially vertically disposed under the pivotal axis of the index elements. The combination of the lock is determined by which of the index elements 29 is positioned with the inner notch in vertical alignment with the index element axis and by the number of index elements set in position with the outer notches thereof in vertical alignment with the pivotal axis of he elements.

The means to retain each of the index elements 29 in predetermined position is shown in Figures 2, 6, 7 and 9. It will be seen that the stem 47 is formed with an axial internally threaded bore 60 opening into the lower end thereof that is adapted to receive a screw 61 which serves to support a combination holding wheel 62 and retainer 66 in forceful engagement with all of the index elements 29. The combination wheel 62 can best be seen in Figure 9, wherein it will be seen to comprise a circular disc having a radially outwardly protruding lever 63. Referring to Figure 2, it will be seen that the central portion of the wheel 62 is flat but that an annular upwardly concave depression 64 has been formed in the outer portions thereof. Formed in the annularly depressed portion 64 of the wheel 62 are a plurality of upwardly projecting dimples 65 that are adapted to coact with the notches 54 and 55 in order to hold each of the index elements 29 in predetermined position. Referring

to Figure 9 it will be seen that the annular retainer **66** is formed with a plurality of finger elements **67** adapted to resiliently urge the combination setting wheel into engagement with the index elements **29**. A washer **68** acts in conjunction with the screw **61** to maintain these elements in the assembled condition shown in Figures 2 and 7.

Referring now to Figure 1 it will be seen that some of the intermediate body plates have radial segments cut out of them in order to define a recess **69** in a side-wall portion of the body **21** which is adapted to accommodate the lever **63** of the setting wheel **62**. The lever **63** can thus be moved through a predetermined arcuate range whereby the dimples **65** can be moved out of engagement with the notches **54** or **55** of the index elements **29**. Thus, when the lever **63** is moved counter-clockwise to the right as viewed in Figure 1, all of the index elements **29** are freely pivotable (Figure 6). When the levers **63** is in this position, a new combination can be set into the lock.

In order to mount the blocking elements **28** for independently shiftable movement into a pattern complementary to the combination set into the lock, the rachet wheel **25** is formed with a plurality of radially extending slots **70** equal in number to the number of slots carried by the carrier **51** and retainer disc **58**. Referring to Figure **10** it will be seen that each of the ratchet wheel slots **70** slidably mounts one of the blocking elements **28** that are formed with oppositely facing channels **28***a* which slidably engage the confronting walls of each of the slots **70**. It will particularly be observed that a web **71** which interconnects the oppositely facing channels **28***a* of the blocking elements **28** is thus disposed on the lower side of the ratchet wheel **25** and serves to obstruct entry into portions of these slots **70**. The blocking elements **28** also carry V-shaped projecting portions **72** or the like that project upwardly above wheel **25** for a purpose presently to be described.

Referring now to Figure 2 it will be seen that four of the body plates are of smaller external diameter than the other plates. The external circumferential groove **73** thus defined is adapted to receive the actuating ring **24**. Referring now to Figure 3, it will be seen that on its inner face the actuating ring **24** is formed with three spaced apart depressions **74**, **75** and **76** which are adapted to coact with a spring loaded ball **77** that is housed in a spring pocket **78** formed in the body **21**. The pocket **78** seats a compression spring **79** that at all times urges the ball **77** into engagement with the inner surface of the ring **24**.

It will be observed that the depressions **74** and **75** are closely spaced together and are spaced apart an appreciable distance counter-clockwise from the depression **76** as viewed in Figure 3. The depression **75** serves to define the neutral position of the actuating ring **24**. Thus, when the ring **24** is moved counter-clockwise as viewed in Figure 3 until the depression **76** is engaged by the ball **77**, the ratchet wheel **25** is advanced one step in a manner presently to be described. When the actuating ring **24** is then retracted in a clockwise direction as viewed in Figure 3, the ball **77** will again seat itself in the neutral depression **75**. Further retracting movement of the ring **24** in clockwise direction will cause the ball **77** to be seated in the depression **74** which will cause one of the blocking elements **28** to be moved to its radially innermost position in a manner presently to be described.

At a position remote from the depressions **74**, **75** and **76**, the actuating ring **24** mounts an inwardly projecting pin **81** which is adapted to carry the pawl **26** that at its forward or counter-clockwise end as viewed in Figure 3 is formed with a spring pocket **82** which is adapted to seat another compression spring **83** which at all times urges the pawl **26** radially inwardly into engagement with ratchet teeth **80** formed on the periphery of the ratchet wheel **25**. Thus, when actuating ring **24** is moved in a counter-clockwise direction, the ratchet wheel **25** is advanced one step when the ball **77** seats itself in the depression **76**. In order to prevent the ratchet wheel **25** from returning along with the return of the actuating ring **24** to neutral position a flexible stop member **84** is mounted on the interior of body **21** and positioned in the same plane as ratchet wheel **25**. As is shown in Figure 3, the stop member **84** at its outer end mounts a cap **85** which is adapted for engagement with ratchet teeth **80**. A depression **85** formed at the interior of the body cavity **34** permits bending of the stop member during advancement of ratchet wheel **25** in response to the camming action of the ratchet teeth **80**. The stop member **84** will thus permit advancement of the ratchet wheel **25** but will prevent any retraction thereof.

Referring again now to Figure 2, it will be seen that the body plate defining the upper end of the chamber **34** is formed with an integral downwardly depending boss **87** which can be seen in transverse section in Figure 3 that is formed with a tangentially projecting edge **88** which serves to cam to radially outward position any of the blocking elements **28** which are disposed in radially inward position. The edge **88** is so positioned that those blocking elements which are next in line for possible camming action by the lever **27** are forced to radially outwardly position. As can be observed from Figure 2, the tangential edge **88** of boss **87** is in substantially the same horizontal plane as the projecting portions **72** of blocking elements **28**.

As is obvious many other equivalent structures can be used in lieu of the tangential camming edge **88** for setting the blocking elements **28** to radially outermost position.

As is indicated by the full line and dotted line positions of Figure 3, the pawl **26** is reciprocally movable within a predetermined range. To accommodate such movement of pawl **26**, the particular plates **31** on the same level with the ring **24** have radial segments removed therefrom in order to provide clearance space for the action of the pawl **26**. At the clockwise end of this clearance space the lever **27** is pivotally connected to the body **21** by being journaled around one of the studs **32**. It will be observed that the advanced or counter-clockwise leading portion of the lever **27** is formed with a cam portion **89** which in response to reverse movement of the pawl **26** will pivot the lever **27** inwardly against the projecting portions **72** of the elements **28**. It will particularly be observed that the configuration of lever **27** is such that reverse movement of the actuating ring **24** through a very short arc will cause radially inward movement of the blocking elements **28**. Thus, if it be assumed that the ring **24** is in the position shown in Figure 3, if the ring is moved in a clockwise direction for a distance equal to the arc between the centers of the depressions **74** and **75** the lever **27** will be caused to pivot inwardly a sufficient distance to place the blocking element **28** in a radially innermost position. The lever **27** is preferably provided with a spring (not shown) which will at all times tend to hold the lever in the position of Figure 3.

Referring now to Figure 2 it will be seen that a compression spring **90** is interposed between the innerface of the button **30** and the lower face of the retainer **66**. It will also be noted that the ratchet wheel **25** is rotatably seated in the body **21** against axial movement by an enlargement in the chamber **34** indicated at **31***c* and is rotatable relative to the stem **47**. Coiled around the stem **47** between the lower face of the ratchet wheel **25** and the upper face of the carrier **51** is a smaller compression spring **91**. The button **30** is thus yieldably held in the position shown in full line in Figure 2. Pressing inward on the button **30** will also cause inward movement of the assembly carried by the stem **47**. However, as will presently appear unless the setting of the index elements **29** is exactly complementary to the setting of the blocking elements **28**, one or more of the blocking elements **28**

will prevent unlatching movement of the stem 47 whereby opening of the lock is prevented.

Assuming the lock 20 to be open, a combniation can be set into the lock in the following manner. The ring 24 is first advanced at least ten times in order to effect movement of all of the blocking elements 28 to their radially outermost position by means of the cam edge 88. During this operation, care must be taken not to reverse the actuating ring 24 in a clockwise direction beyond the point of engagement of the ball 77 with the neutral depression 75. This will hereafter be referred to as the neutral position.

Let it be assumed that the desired combination is one, two, three. To set this combination, the ring 24 from its neutral position is first moved in reverse direction, i.e. clockwise as viewed in Figure 3 until the ball 77 engages the depression 74. Referring to Figure 5 it will be seen that such reverse movement of the ring 24 will cause one of the blocking elements 28 to be moved to its radially innermost position. Accordingly, the radially outermost portion of the slot 70 associated with that particular blocking element 28 will then be opened while the blocking element 28 will obstruct any penetration of an index element 29 into slot 70 in its radially innermost portion. The ring 24 is then returned to its neutral position in which ball 77 engages the neutral depression 75. The ring 24 is then advanced twice, care being taken not to reverse the movement of the ring 24 beyond neutral position. This will accomplish advancing the ratchet wheel 25 two steps which means that one slot 70 thereof will have passed the lever 27 without having had its blocking element 28 moved inwardly. After two such advancements of the ring 24, the ring is once again moved in the reverse direction beyond the neutral depression 75. This will cause another blocking element 28 to be moved to its radially innermost position and this second inwardly disposed element 28 will be spaced one step apart from the first inwardly moved element 28. The ring 24 is once again returned to neutral position and then advanced three steps, care being taken once more not to cause reverse movement of the ring 24 beyond its neutral position. This will result in the last radially inwardly moved element 28 being spaced three slots distantly from an element 28 now in position to be moved by the lever 27. Once again the ring 24 is moved in reverse direction to cause another element 28 to be moved to a radially innermost direction.

Starting with the first of the inwardly moved blocking elements 28 it will be observed that the sequence is now one radially inwardly disposed blocking element; one radially outwardly disposed blocking element; one radially inwardly disposed element 28; two radially outwardly disposed elements 28; and finally a third radially inwardly disposed blocking element 28. It will be observed that this sequence as viewed in Figure 3 would read in a counter-clockwise direction. All the other blocking elements 28 will remain in radially outermost position.

The combination one, two, three can now be set into the index elements 29. In order to accomplish this, the combination wheel lever 63 is advanced in a counterclockwise direction as viewed in Figure 1. When lever 63 has been advanced, the button 30 is depressed to its fullest extent. By virtue of the advancement of the lever 63 each of the index elements 29 is now freely pivotal and therefore as they are moved into engagement with the blocking elements 28 they will assume positions complementary to the blocking elements and in the same pattern. The index elements having assumed the pattern or combination of the blocking elements, the button 30 is released after which the lever 63 is returned to its normal position. The return of lever 63 to its normal position will result in the dimples 65 re-engaging the appropriate inner or outer notches 54, 55 of each index element 29. The lock 20 can be closed by pivoting the hasp 22 until the leg 39 is in alignment with the body bore 37 and thereafter pushing the hasp inwardly. After the lock has been closed in this manner, the ring 24 should be actuated one or two times in order to insure that the lock is fully closed.

In order to prevent any movement of the combination wheel 62 when the lock is closed the lower end of the hasp leg 38 is adapted to extend through the cavity 69 next to lever 63. This arrangement can be seen in Figures 1 and 8 and from an examination of Figure 8 it will be apparent that lever 63 can be advanced only when hasp 22 is withdrawn to open position (shown in dotted outline in Figure 7) to permit the lever to pass under the lower end of the leg 38.

When it is desired to open the lock, the combination one, two, three will be used in the manner just described. However, before starting to work the combination the lock 20 should first be cleared which means that all blocking elements 28 should be set to their radially outermost position. This can be accomplished by advancement of the ring 24 through at least ten steps.

It should be remarked that since the carrier 51 is not rotatable the particular combination of index elements 29 set up therein will remain stationary relative to the body 21. It is for this reason that the lock must first be cleared and it is also for this reason that the tangential edge 88 is positioned adjacent to the shifting lever 27. After clearing, if the actuating ring 24 is worked to the combination one, two, three in the manner just described for the setting of the combination, it will be found that each blocking element 28 is in complementary registration with a properly positioned index element 29. This is illustrated in Figure 7 which shows on one side of the stem 47 a blocking element 28 in radially outermost position which thus leaves opened the radially inner portion of the slot 70 associated therewith. This open inner portion of the slot 70 will thus permit entry thereinto of the associated index element 29. On the other side of the stem 47 in Figure 7 it will be seen that a blocking element 28 is in radially innermost position thus leaving the radially outermost portion of this slot 70 associated therewith unobstructed to the entry of the associated index element 29 which is positioned with its radially outermost tip in raised position above the carrier 51.

Figure 2 is illustrative of the condition which results when an improper combination is used. In this instance it will be observed that although the index element 29 and blocking element 28 on the left hand side of the stem 47 are in complementary positions, the elements 28, 29 on the right hand side of this stem 47 are in opposing conditions so that the elevated corner of the index element 29 is stopped from appreciable movement by the blocking element 28 which obstructs the portion of slot 70 immediately above the elevated portion of index element 29. In the arrangement shown in Figure 2, only very limited movement of the stem 47 is possible but such movement cannot serve to lift the latch 42 out of locking engagement with the hasp 39 because the stem 47 is prevented from moving through a distance equal to the width of two body plates. Thus it will be seen that only when all of the elements 28 and 29 are arranged in complementary position, can the stem 47 be moved axially to the position shown in Figure 7. Such movement of the stem 47 causes unlocking movement of the latch member 42 by virtue of the engagement of the tapered face 49 of the member 47 with the squared end of the latch hole 45.

An alternate form of lock 100 embodying my invention is shown in Figures 12 to 14, inclusive, that is similar in construction and operation to the above described lock 20 but incorporates another type of combination working means and another form of index elements.

As is shown in Figure 12, the lock 100 has a generally cylindrical body 101 that may be formed from a

plurality of superimposed concentrically assembled plates of uniform width. The interior of the body **101** is formed with an axially extending chamber **34** which is identical to the chamber **34** of the previously described lock **20**. The body **101** also mounts a button **30** mounted in the chamber **34** for movement between predetermined limits as in the case of the lock **20**. The hasp **22**, latching means **23**, ratchet wheel **25** and blocking elements **28** of the lock **100** are identical in construction to the corresponding elements of the lock **20**.

In order to advance the ratchet wheel **25**, the body **101** is adapted to support a reciprocally slidable rod **102** that has an advancing pawl **103** pivotally connected to its inner end. The rod **102** is slidably mounted in a bore **104** formed in the wall of an enlarged cavity **105** defined in body **101** that is adapted to support rod **102** in the same plane as ratchet wheel **25**. Embedded in an interior wall of the cavity **105** is one end of a leaf spring **106** whose other end engages a pin **107** carried by rod **102** in order to bias the rod to the position indicated in dotted outline in Figure 12. The inner end of rod **102** carries another leaf spring **108** whose free end is adapted to at all times urge the pawl **103** radially inwardly into engagement with ratchet wheel teeth **80**.

The length of the stroke of the rod **102** is such that for each actuation of the rod, the ratchet wheel **25** is advanced one step, i.e. through an arc equal to the spacing between adjacent ratchet wheel slots **70**. As is apparent, the leaf spring **106** will normally hold rod **102** in the dotted outline position of Figure 12. To advance the ratchet wheel **25** through one step, the outer end of the rod **102** is depressed until it is flush with the exterior wall of the body **101**. Because of the engagement of the biased pawl **103** with ratchet teeth **80** this will result in advancement of the ratchet wheel **25** through one step as aforesaid. During the return stroke of the rod **102**, the pawl **103** will tend to cause retraction of the ratchet wheel **25** also but any such tendency will be prevented because of the stop member **84** shown in Figure 3.

The lock **100** is also provided with a camming edge **88** which is identical to that used in the previously described embodiment of the invention. This cam edge **88** works in the manner previously described, to cause each of the blocking elements **28** to be consecutively moved to radially outermost position. In order to shift selected ones of the blocking elements **28** into radially innermost position, the lock **100** is provided with a slidable member **109** that is adjacent to the cam edge **88** and spaced counterclockwise therefrom as viewed in Figure 12.

In order to support the member **109** the wall of body **101** is provided with a radially extending bore **110** having a reduced diameter inner end **111** that is separated from the larger outer end of the bore by a land **112**. The member **109** on its inner end has a head **113** that is slidably receivable in the bore end **111** while the smaller stem of the member **109** is slidable in the land **112**. The engagement of the head **113** with the land **112** thus prevents the member **109** from being fully withdrawn from the bore **110**.

The enlarged outer end of the bore **110** provides a pocket for a compression spring **114** that is coiled around the stem of member **109**. This pocket is adapted to slidably receive a cylindrical cap **115** that is rigidly mounted to the outer end of the member **109**.

It will be understood that the member **109** is mounted in substantially the same horizontal plane with the V-shaped projecting sections **72** of the blocking elements **28**. Due to the action of the compression spring **114**, the member **109** will normally be biased out of contact with the blocking elements **28** whereby the ratchet wheel **25** can be freely advanced by means of the rod **104** in the manner previously described. When it is desired to move a selected one of the blocking elements **28** to its radially innermost position, the cap **115** is fully depressed. As is apparent, this will cause the particular blocking element **28** to be moved inwardly after which release of the cap **115** will permit the spring **114** to return the member **109** to its outer position.

The combination working means just described can be used in lieu of the corresponding parts of the lock **20** and operate in substantially the same way. In other words, the rod **104** and member **109** can be used in conjunction with the index elements **29** previously described as well as in conjunction with the alternate form of index elements shown in Figures 13 and 14 presently to be described.

In the lock **100** the lower end of the stem **47** rigidly mounts a disc **116** that takes the place of the discs **51** and **58** of the lock **20**. The disc **116** is provided with a plurality of annularly grouped U-shaped apertures **117** that at both ends thereof open upwardly into the upper surface of the disc. The apertures **117** are radially disposed relative to the discs **116** for alignment with the slots **70** of the ratchet wheel **25**. Rigidly mounted in the apertures **117** are U-shaped sleeves or liners **118** that are adapted to slidably receive a flexible coil of wire **119**, which is longer than the axial length of the apertures **117** by a distance equal to the space between the web **71** of the blocking element **28** and the upper face of the disc **116**. The coils **119** serve as index elements in the lock **100** and are adapted to coact with the blocking elements **28** in a manner analogous to the action of the index elements **29** of the lock **20**.

As appears from Figure 13, the coils **119** can be adjusted with their radially outermost ends in elevated position or as indicated in dotted outline with their radially innermost ends in elevated position. The setting of a combination into coils **119** is accomplished in precisely the same manner as the adjustment of the index elements **29** previously described. In order to allow for such adjustment these coils are releasably held by means of a combination setting wheel **120** mounted in lock **100** in substantially the same manner as the combination setting wheel **62** of lock **20**.

The wheel **120** is a flat, circular member that is rotatably mounted at the underside of the disc **116** and is formed with a plurality of circularly grouped teeth **121** that project above the upper face of the wheel. The underside of disc **116** is formed with a circular groove **122** that extends through the sleeves **118** and is adapted to receive the teeth **121**. The wheel **120** is normally positioned with its teeth engaging coils **119** whereby to hold them in the desired position but is provided with a lever (not shown) accessible from the exterior of the lock **100** that can be turned to rotate teeth **121** out of engagement with coils **119**. This lever is normally held in coil locking position when the lock is closed by means identical to the previously described arrangement of hasp leg **38** and lever **63**.

While there has been shown herein what is considered to be the preferred embodiment of the present invention and an alternate form thereof, it will be apparent that various modifications and changes may be made with respect to the foregoing description without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. A combination lock which includes: a body; latching means mounted in said body and movable between locked and unlocked position; a locking member engageable by said latching means; a carrier operatively associated with said latching means and mounted for movement in a given path to unlock said latching means; a plurality of index elements on said carrier arranged in a predetermined pattern; a blocking member in the path of said carrier having a plurality of passages formed therein in alignment with said index elements; a plurality of independently movable blocking elements for said passages that in one position prevent entry into said passages of said index elements to prevent movement of said carrier

in said given path; and manually operable means to selectively move said passage blocking elements and said blocking member whereby said blocking elements can be moved into a pattern complementary to the predetermined pattern of said index elements and said carrier then moved to move said latching means to unlocked position and thereby release said locking member.

2. A combination lock which includes: a body member; latching means mounted in said body member and movable between locked and unlocked positions; a locking member engageable by said latching means; a carrier mounted in said body for movement in a given path and drivingly connected to said latching means, at least a portion of said movement being an unlatching movement adapted to release said latching means; a plurality of generally circularly grouped index elements on said carrier that are arranged in a predetermined pattern; a rotatable member in said body member concentrically superimposed in said given path that is formed with an annular group of apertures adapted for alignment with said index elements; a plurality of independently movable blocking elements operatively associated with the apertures of said rotatable member, said blocking elements being selectively arrangeable in a manner complementary to said predetermined pattern of said index elements, the positioning of said blocking elements in a non-complementary pattern preventing movement of said carrier in said given path; means manually operable from the exterior of said lock to advance said rotatable member through a predetermined arc to consecutively bring the apertures of said member into registration with said index elements; means operatively associated with said blocking elements that can be actuated to move all of said blocking elements into the same position relative to said apertures; and means operable from the exterior of said lock to move selected ones of said blocking elements to other positions relative to said apertures whereby said blocking elements can be arranged in a pattern complementary to said predetermined pattern of index elements to permit unlatching movement of said carrier.

3. A combination lock which includes: a body member; latching means mounted in said body member and movable between locked and unlocked positions; a locking member engageable by said latching means; a carrier mounted within the body of said lock for limited axial movement and adapted to release said latching means from locked engagement with said locking member; a plurality of index elements annularly grouped around the axis of said carrier some of which have one end portion thereof elevated above the upper surface of said carrier and the others of which have the other end portion thereof elevated above the upper surfaces of said carrier all of said index elements being thus arranged in a predetermined pattern; a rotatable member in said lock mounted in the path of movement of said carrier that is formed with a plurality of annularly grouped slots therein adapted to receive said index elements; means operable from the exterior of said lock to advance said rotatable member through a predetermined arc to selectively bring said slots into registration with said index elements; a plurality of independently movable blocking elements slidably mounted in the slots of said rotatable member, said blocking elements being selectively positionable in a manner complementary to said predetermined pattern of said index elements, the positioning of said blocking elements in a non-complementary pattern preventing entry of said index elements into said slots whereby unlatching axial movement of said carrier is prevented; means operatively associated with said blocking elements to move all of said blocking elements into the same position relative to said slots; and means responsive to actuation of said rotatable member to move selected ones of said blocking elements to other positions relative to said slots, whereby said blocking elements can be arranged into a pattern complementary to said predetermined pattern of index elements and said carrier then moved axially to unlock said latching means.

4. A combination lock which includes: a body member; latching means mounted in said body member and movable between locked and unlocked position; a locking member engageable by said latching means; a pair of members mounted in said body member and movable with respect to each other, at least a portion of said movement being an unlatching movement adapted to move said latching means to unlocked position; a plurality of index elements carried on one of said members and mounted for movement independently of one another and of said one member; a plurality of movable blocking elements on the other of said pair of members; means for selectively positioning each of said blocking elements to arrange said blocking elements in a predetermined pattern so that when said pair of members is moved with respect to each other to abut said blocking means against said index elements, said index elements are urged into a combination complementary to said predetermined pattern of blocking elements said index elements being adapted for yieldable movement into said complementary combination upon contact with said blocking elements; means to releasably hold said index elements in said combination; and means responsive to independent movement of said other member to move at least one of said blocking elements out of said predetermined pattern whereby said lock can be opened only by selectively repositioning said blocking elements and said other member into said predetermined pattern of said blocking elements.

5. A combination lock which includes: a body member; latching means mounted in said body member and movable between locked and unlocked position; a locking member engageable by said latching means; a carrier mounted in said body member for movement in a given path, at least a portion of said movement being an unlatching movement adapted to release said latching means; a plurality of index elements carried on said carrier and mounted for movement independently of one another and of said carrier; a member in the path of unlatching movement of said carrier; a plurality of independently movable blocking elements on said last mentioned member; manually operable means for selectively positioning each of said blocking elements to arrange them into a predetermined pattern so that when said carrier is moved in said given path to abut said index elements against said predetermined pattern of blocking elements, said index elements are urged into positions defining a combination complementary to said predetermined pattern, said index elements being adapted for yieldable movement into said complementary combination upon contact with said blocking elements; means on said body to releasably retain said combination in said index elements after said index elements have been withdrawn from contact with said predetermined pattern of blocking elements; and means to move at least one of said blocking elements out of said predetermined pattern whereby such displaced blocking element prevents said unlatching movement of said carrier, after which said lock can be opened only by selectively re-positioning said blocking elements into said predetermined pattern, complementary to the combination of said index elements, and then moving said carrier to move said latching means to unlocked position to thereby release said locking member.

6. A combination lock which includes: a body member; latching means mounted in said body member and movable between locked and unlocked position; a locking member engageable by said latching means; a carirer mounted in said body for unlatching movement in an axial path to release said latching means; a plurality of independently movable index elements on said carrier; a rotatable member coaxially aligned with said carrier in said path; a plurality of independently movable blocking elements on said rotatable member; ratcheting means to

advance said rotatable member through a predetermined arc to selectively position said blocking elements in alignment with said index elements; manually operable means for selectively positioning each of said blocking elements to arrange them into a predetermined pattern so that when said carrier is moved in said unlatching path to abut said index elements against said predetermined pattern of blocking elements, said index elements are urged into positions defining a combination complementary to said predetermined pattern; means in said body to releasably retain said combination in said index elements after said index elements have been withdrawn from contact with said predetermined pattern of blocking elements; and manually operable means to move at least one of said blocking elements out of said predetermined pattern whereby such displaced blocking element prevents said unlatching movement of said carrier, after which said lock can be opened only by selectively re-positioning said blocking elements into said predetermined pattern, complementary to the combination of said index elements, and then moving said carrier to move said latching means to unlocked position and thereby release said locking member.

7. A combination lock which includes: a body member; latching means mounted in said body member and movable between locked and unlocked positions; a locking member engageable by said latching means; a carrier mounted in said body that is adapted for unlatching movement in an axial path to release said latching means; a plurality of pivotally mounted index elements on said carrier and equally circularly spaced about the axis of said carrier; a rotatable member in said lock coaxially mounted in the path of movement of said carrier, said rotatable member being formed with a plurality of annularly grouped slots therein that are adapted to receive said index elements; a plurality of independently movable blocking elements slidably mounted in the slots of said member; ratcheting means to advance said rotatable member through a predetermined arc to selectively position said blocking elements in alignment with said index elements; manually operable means for selectively positioning each of said blocking elements to arrange them into a predetermined pattern so that when said carrier is moved in said given path to abut said index elements against said predetermined pattern of blocking elements, said index elements are pivoted into positions defining a combination complementary to said predetermined pattern; means in said body to releasably retain said index elements in said combination after said index elements have been withdrawn from contact with said predetermined pattern of blocking elements; and manually operable means to move at least one of said blocking elements out of said predetermined pattern whereby such displaced blocking element prevents said unlatching movement of said carrier by preventing entry into the slot associated therewith of an aligned index element, after which said lock can be opened only by selectively repositioning said blocking elements into said predetermined pattern, complementary to the combination of said index elements, and then moving said carrier to move said latching means to unlocked position and thereby release said locking member.

8. A device as set forth in claim 7 in which said body is a cylindrical member and said ratcheting means for advancing said rotatable member includes a movably mounted ring encircling said body in substantially the same plane as said rotatable member, said rotatable member being formed with a plurality of ratchet teeth and said ring carrying an advancing pawl adapted to engage said teeth, said body also mounting on the interior thereof means adapted to prevent reversal of said rotatable member after an advance thereof through said predetermined arc.

9. A combination lock which includes: a cylindrical body member; latching means mounted in said body member and movable between locked and unlocked positions; a hasp engageable by said latching means; an axially movable carrier disc mounted in said body, at least a portion of such movement being an unlatching movement adapted to move said latching means to unlocked position, and said disc being formed with a plurality of equally circularly spaced, radially extending slots; a plurality of radially extending index elements pivotally mounted in said slots of said carrier disc; a ratchet wheel rotatably mounted in said body in the path of said unlatching movement of said carrier disc, said wheel being formed with a plurality of radially extending, equally circularly spaced slots; means to advance said ratchet wheel through a predetermined arc to selectively position the slots thereof in alignment with said index elements of said carrier disc; a plurality of independently movable blocking elements slidably mounted in the slots of said ratchet wheel, each of said blocking elements being adapted to block a portion only of the slot associated therewith; manually operable means for selectively positioning each of said blocking elements to arrange them into a predetermined pattern in which certain of said blocking elements are radially inwardly positioned in the slots associated therewith while the others of said blocking elements are positioned in radially outermost positions in the slots associated therewith so that when said carrier is axially moved in said unlatching movement to abut said index elements against said predetermined pattern of blocking elements, said index elements are pivotally urged into positions defining a combination complementary to said predetermined pattern; spring means in said body yieldably resisting unlatching movement of said carrier disc; means in said body to releasably retain said combination in said index elements after said index elements have been withdrawn from contact with said predetermined pattern of blocking elements; and manually operable means to move at least one of said blocking elements out of said predetermined pattern whereby said displaced blocking element prevents unlatching movement of said carrier disc, after which said lock can be opened only by selectively re-positioning said blocking elements into said predetermined pattern, complementary to the combination of said index elements, and then moving said carrier to move said latching means to unlocked position and thereby release said hasp.

10. A device as set forth in claim 9 in which said means to advance said ratchet wheel comprises a reciprocally slidable rod mounted in said body that carries an advancing pawl on its interior end adapted for engagement with the teeth of said ratchet wheel, the stroke of said rod being adapted to advance said ratchet wheel through said predetermined arc and said body also carrying spring means that at all times urge said rod to a position in which it protrudes outwardly from said body.

11. A device as set forth in claim 9 in which said manually operable means for selectively positioning each of said blocking elements into said predetermined pattern comprises a radially outwardly projecting member mounted in the wall of said body whose interior end is adapted for engagement with a projection formed on each of said blocking elements, said member being yieldably maintained in a radially outwardly projecting position in which it is depressible inwardly to move a selected one of said blocking elements into radially innermost position in the slot associated therewith.

12. A device as set forth in claim 9 in which said means to advance said ratchet wheel through said predetermined arc includes a movably mounted ring encircling said body in substantially the same plane as said ratchet wheel, said ring on its inner face carrying an advancing pawl adapted to engage the teeth of said ratchet wheel, said body also mounting on the interior thereof another pawl adapted to prevent reversal of movement

of said ratchet wheel after an advance thereof through said predetermined arc.

13. A device as set forth in claim 12 in which said manually operable means for selectively positioning each of said blocking elements into said predetermined pattern includes a pivotally mounted lever in said body that is adapted to be cammed radially inwardly by said advancing pawl when said ring is reversed in a direction beyond the range of said predetermined arc whereby said pawl cams said lever inwardly, said lever being adapted to engage a projection formed on each of said blocking elements in order to force a selected one of said blocking elements to radially innermost position in the slot associated therewith.

14. A device as set forth in claim 13 in which said means to move at least one of said blocking elements out of said predetermined pattern includes a cam edge formed on the interior of said body that is adapted to consecutively engage said blocking elements upon advancement of said ratchet wheel, said cam edge being adapted to force a blocking element passing it into radially outermost position in the slot associated therewith.

15. A combination lock which includes: a body; latching means mounted in said body and movable between locked and unlocked position; a locking member engageable by said latching means; a pair of opposed members mounted in and concealed by said body one of which is adapted for an unlatching movement to move said latching means to unlocked position; an index element on one of said pair of members; a movable blocking element on the other of said pair of members, said other member being adapted for movement in a direction other than oppositely to said one member, said blocking element being selectively movable between opposing and complementary positions thereof, said blocking element in opposing position coacting with said index element to prevent said unlatching movement between said pair of members; and actuating means for moving said other member in said other direction and for alternately selectively positioning said blocking element in said opposing and complementary positions of said blocking element through a series of positions one of which is said complementary position, said blocking element in complementary position being adapted and arranged for said unlatching movement of one of said concealed members.

16. A combination lock which includes: a body; latching means mounted in said body member and movable between locked and unlocked positions; a locking member engageable by said latching means; a pair of members mounted within said body, at least one of said members being drivingly engaged to said latching means and adapted for an unlatching movement to move said latching means to unlocked position; a plurality of index elements on one of said pair of members and arranged in a predetermined pattern; a plurality of blocking elements independently movably mounted on the other of said members, said other member being movably held by said body in the path of unlatching movement of said one member, said blocking elements being selectively positionable through movement of said other member and movement independently of said other member into a pattern complementary to said predetermined pattern of index elements, the positioning of said blocking elements in a non-complementary pattern preventing said unlatching movement between said pair of members; and actuating means for incrementally moving said other member and for selectively positioning each of said blocking elements on said other member alternately with increments of movement of said other member whereby said blocking elements can be moved into a pattern complementary to the pattern of said index elements.

17. A combination lock which includes: a body; latching means mounted in said body and movable between locked and unlocked position; a locking member engageable by said latching means; a pair of members concealed in said body and one of which is adapted for an unlatching movement to unlock said latching means and the other of which is movably held by said body in the path of said unlatching movement; co-acting means on said pair of members comprising a plurality of index elements on said one member arranged in a predetermined pattern and a plurality of blocking elements carried on the other of said members that are separately movable independently of movement of said other member, said index elements and blocking elements being adapted to prevent said unlatching movement whenever their patterns are other than complementary; and actuating means adapted to selectively move said other member and said blocking elements, said actuating means being adapted for a given sequence of movements of said other member and of said blocking elements to cause said blocking elements to be moved into a complementary pattern to permit said unlatching movement of said one member.

18. In a combination lock having a body, a locking member, and a latching means for said locking member, the combination of: a pair of members mounted in said body for relative opposed movement, one of said members being adapted to translate such movement into release of said latching means; at least one blocking element movably mounted on the other of said members; manually operable means to selectively shift said blocking element relative to its supporting member, at least one index element mounted on said one member for movement relative to its supporting member to a position complementary to the position of said blocking element in response to contact with said blocking element upon relative movement of said members; means to releasably retain said index element in said complementary position whenever said locking member is latched; means for selectively shifting said other member into and out of confronting positions of said index element and blocking element; and means adapted to relatively move said members to release said latching means only when said elements are simultaneously in said confronting and said complementary positions.

19. In a combination lock having a body, a locking member, and a latching means for said locking member, the combination of: first and second members mounted in said body for relative opposed movement, one of said members being adapted to translate such movement into release of said latching means, each of said members carrying a plurality of elements, each of which elements is independently movable relative to its supporting member and relative to the others of said elements on the same supporting member; means for selectively moving the elements of said first member into and out of a predetermined pattern on said first member; means for imparting said relative movement to said members to bring said elements of said first and second members into contact with one another, the independently movable elements of said second member being adapted for shifting into a pattern complementary to said predetermined pattern as a result of contact with said elements of said first member; and means to releasably maintain said elements of said second member in said complementary pattern, said complementary pattern of elements being adapted to permit said relative movement of said members only when said elements of said first member are selectively repositioned in said predetermined pattern.

References Cited in the file of this patent

UNITED STATES PATENTS

2,173,680	Curran	Sept. 19, 1939
2,497,619	Mass	Feb. 14, 1950