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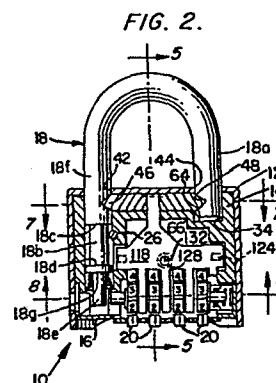
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Combination lock.

The present invention provides a permutation lock 10 comprising a housing 12-16 and a securing element 18 supported by the housing 12-16 for movement into and out of securing engagement for closing and opening the lock 10. A locking structure 50, 52 and structure 118 for controlling its operation whereby the securing element 18 may be opened by an authorised user are supported within the housing 12-16. The control structure generally includes a shaft 88, a plurality of permutation wheels 20 each carrying indicia in a sequence about its outer periphery, and an equal number of cam elements 104. Both the permutation wheels 20 and the cam elements 104 are supported for rotation on the shaft 88 and arranged alternately there-along in associate pairs of permutation wheels 20 and cam elements 104. The cam elements 104 normally are engaged with the associated wheel 20 in a first position, rotationally movable conjointly with the wheel 20 when the wheels 20 are selectively rotated from one angular position to another, and provide control to the locking structure 50, 52 to permit opening of the lock 10 when the permutation wheels 20 and cam elements 104 are angularly located to a preset combination.



movement of the bolts out of a shackle engaging position, preventing opening of the permutation lock. In the other position of the blocking lever, the finger is located to a position out of engagement with the bolts. This action
5 permits movement of the bolts out of engagement with the shackle so that the lock may be opened.

The problems and disadvantages of the then known prior art which are addressed by Vahlstrom and Foote include a problem resulting from a "rapping" operation
10 which in many instances was found to impart unauthorized movement to the finger of the blocking lever. The "rapping" operation, therefore, oftentimes resulted in an unauthorized relocation of the finger permitting opening of the lock.

While each of the prior art patents describe a
15 generally acceptable solution to that problem, the present invention is considered to be an improvement upon those teachings, and, the present invention improves upon other facets of the overall construction of the combination lock,
as well.

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Summary of the Invention

The permutation lock of the present invention includes a housing and a securing element supported by the housing for movement into and out of securing engagement for
25 opening and closing the lock. A locking structure and structure for controlling its operation whereby the securing element may be opened by an authorized user are supported within the housing. The control structure generally includes a shaft, a plurality of permutation wheels each carrying
30 indicia in a sequence about its outer periphery, and a plurality of cam elements equal in number to the number of permutation wheels. Both the permutation wheels and the cam elements are supported for rotation on the shaft and arranged alternately therealong in associate pairs of permutation
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Description

COMBINATION LOCK

5 Technical Field

The present invention relates to a lock of the type generally characterized as a combination or permutation lock.

10 Background Art

Permutation locks are well-known to the prior art. Exemplary of the prior art are Patent Nos. 3,419,893 to Carl A. Vahlstrom, 3,983,724 and 4,047,406 both to Daniel J. Foote.

15 The prior art disclosures for all intents and purposes are substantially similar in their statement of structure of the permutation lock and the problems and disadvantages of the prior art which they address. To this end, the prior art discloses a permutation lock including a housing,
20 a shackle of U-shaped outline carried by the housing and movable relative to the housing to both opened and closed positions, a pair of locking bolts movable into and out of engagement with legs of the shackle, a plurality of permutation wheels and associated clutches, together with a shaft
25 for supporting the permutation wheel and clutch structure, and a blocking lever having a body including a finger and a plurality of forks. The blocking lever is described as mounted for pivotal movement within the housing. The forks of the blocking lever comprise elements controlled in
30 movement by a control surface of each clutch, thereby to induce pivotal movement of the blocking lever in a direction opposite to the direction that the blocking lever is normally biased. In one position of the blocking lever, the finger is disposed between the bolts thereby to prevent

wheels and cam elements. The cam elements normally are engaged with the associated wheel in a first position, rotationally movable conjointly with the wheel when the wheels are selectively rotated from one angular position to another, and provide control to the locking structure to permit opening of the lock when the permutation wheels and cam elements are angularly located to a preset combination.

As an important aspect of the present invention a plurality of lugs are supported by the housing. The lugs are provided in a number equal to the number of associated pairs of permutation wheels and cam elements. The lugs are located in a position thereby to inhibit conjoint rotational movement of the cam elements when located to a second position whereby the permutation wheels may be freely rotated from one angular position to another angular position in the event that a new preset combination is to be provided.

In another aspect of the present invention, the housing includes an outer housing and an inner housing received in surface-to-surface engagement within the outer housing. A bore is formed through one wall of the outer housing and through the inner housing for receipt of a pin in force fit engagement. A pair of bores, one of which partially intersects the first-mentioned or pin bore, are formed in the housings for receipt of the securing element, in the form of a U-shaped shackle. The pin, in addition to use in the assembly of the housing, also serves an additional important function, namely that of engaging one shackle leg thereby to prevent its full retraction from the housings when the lock is opened.

Another important aspect of the invention relates to a keyway which is formed through the housings and which extends to the region of the end of the shaft. A key which

provides the function of a moving element for moving the shaft and cam elements against a spring bias to relocate the shaft and cam elements from the first position to a second position is received in the keyway. The key
5 and keyway include interengaging structure for maintaining the shaft and cam elements in the second position.

The locking structure of the permutation lock includes a blocking lever pivotable about a pivot axis, and a spring received between the housing and the blocking lever thereby
10 to bias the blocking lever in one direction of pivotal movement. The spring includes an extension at one end and a plurality of coils at the other end. The spring is received through an opening in the blocking lever, and the extension is connected to the housing. At least the end coil is of a
15 dimension larger than that of the opening thereby to maintain the positioning of the spring within the opening.

The blocking lever includes a central body, a plurality of parallel, spaced forks extending from the central body in one direction and a finger extending from the central
20 body in substantially the opposite direction. The finger functions in the manner as described by Vahlstrom and Foote but is of enlarged dimension to increase both the inertia to movement and its strength. Particularly, the finger is of a dimension only slightly less than a notch into which
25 it is received when out of engagement with the bolts and equal to about one-half the width of the bolts.

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Description of the Drawing

Figure 1 is a perspective view of the padlock of the present invention;

5 Figure 2 is an elevational view, partially in section, of the padlock of Fig. 1;

Figure 3 is a vertical section of a portion of the padlock illustrated in Fig. 2 with the blocking lever removed and structure in a padlock closed position;

10 Figure 4 is a view similar to that of Fig. 3 in a padlock open position and certain structure relocated to the right (in the Figure) for setting a series of permutation wheels;

Figure 5 is a view in section as seen along the line 5-5 in Fig. 2;

15 Figure 6 is a perspective, exploded view of a portion of Figs. 3 and 4;

Figure 7 is a view in section as seen along the line 7-7 in Fig. 2;

20 Figure 8 is a view in section as seen along the line 8-8 in Fig. 2;

Figure 9 is a view similar to Fig. 8 and, similar to that of Fig. 4, illustrates the structure in a relocated position; and

25 Figure 10 is a view in elevation of a spring.

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Best Mode for Carrying Out the Invention

The padlock 10 of the present invention, referring to Figs. 1 and 2, includes a housing 12 comprising an outer housing; a housing 14 providing a housing for the various operative structures, such as the permutation wheels, as will be described, a cover 16 and a shackle 18. The cover is telescopically received over the lower end of housing 14 within the region of permutation wheels 20. To this end, housing 14 may be recessed throughout its end from a shoulder 22. Cover 16 and housing 14 may be permanently assembled in any manner. This subassembly, in turn, is telescopically received in housing 12. In the assembled position, illustrated in Figs. 1 and 2, the lower surface of cover 16 is slightly recessed within the inner confines of housing 12, while the several permutation wheels 20, more particularly an arcuate surface portion of each wheel, is readily accessible for finger manipulation within the elongated arcuate cutout 24 extending along opposed side walls of the housing in its major dimension. The housings 12, 14 and cover 16 substantially completely enclose the operative structure of the padlock, except for the portion of each permutation wheel that extends from the cover and the length of shackle 18 which extends from housing 12. A pin 26 is provided for assembly of housings 12, 14. To this end, the pin is received in a bore 27 in housing 12 and into a bore extending coaxially through housing 14. The pin is of a length to extend substantially from the plane of the outer surface of the wall of housing 12 to the plane of the inner surface of the opposite wall of the housing.

Housing 14 is provided with a plurality of bores for receipt of shackle 18. To this end, a bore 28 and a counter-bore 30 providing a shoulder 32 (toward the upper end of housing 14) are located adjacent one end, while a bore 34

is located adjacent the other end of the housing. The bores are perpendicular to the major axis of the housing and preferably located within the rounded ends. As perhaps best seen in Fig. 2, a portion of the surface of
5 pin 26 extends into bore 30 along a secant. The pin preferably is of a diameter to provide a force fit engagement within the respective bores for assembly of housings 12, 14 and, as will be developed below, the pin serves the additional function of preventing full retraction of shackle
10 18 from the confines of padlock 10 when the permutation wheels are properly located to a position that the shackle may be opened.

Referring to Fig. 7, a cutout 36 of elongated, rectangular outline is located in the upper region of housing,
15 between bores 30, 34 to define a pair of walls, 38, 40.

The shackle 18 is received by padlock 10 for movement between open and closed positions. The shackle includes a long leg which extends into bores 28, 30 and a short leg 18a which extends into bore 34. The long leg includes an
20 annular cutout 18b substantially at midlength, providing an upper and a lower shoulder 18c, 18d, respectively, and a distal length 18e of a diameter substantially equal to that of the midlength. The legs extend into the bores through coaxially aligned bores 42, 44 in housing 12.

25 Each leg includes a notch as is conventional in padlock constructions of the present invention. To this end, a notch 46 is formed in the proximal length 18f of the long leg, and a notch 48 is formed in the short leg 18a. The notches face one another.

30 A pair of bolts 50, 52 are received in cutout 36. Preferably, the bolts are in the form of a rectangular body including a substantially V-shaped nose adapted to cooperate with the notches 46, 48. As illustrated in Fig. 7, the bolts are subjected to an outwardly bias into cooperating
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engagement with the respective notches. To this end,
a pin 54 may be carried by one bolt, for example, bolt
52 to extend in a direction toward and into a bore 56
in bolt 50. A spring 58 is supported within bore 56,
5 around pin 54, in a condition of compression thereby to
provide an outward bias to the bolts 50, 52. Each bolt
50, 52 includes a pair of notches 60 generally of rectan-
gular outline (see Fig. 7). The notches are located on
opposite sides of the pin 54 and across bore 56, and in
10 facing relation to one another. As will be discussed in
greater detail as the description continues, the bolts,
while they are compressively loaded by spring 58, nor-
mally (that is, when the padlock 10 is locked) will locate
closer together than illustrated in Fig. 7 to retain the
15 finger of the blocking lever in the position as is illu-
strated. This positioning of the bolts results from the
action of shackle 18 which normally is urged to the
opened position. Fig. 7 actually illustrates the position
taken by bolts 50, 52 when shackle 18 is pushed inwardly
20 of the padlock, and the position to which the bolts must
locate if the padlock is to be opened.

Referring again to Fig. 2, shackle 18 is illustrated
in closed position. A spring 62 is disposed within bore 30
for the stated purpose of biasing shackle 18 to the open
25 position. The spring is disposed on shoulder 32 and acts
between the shoulder and a shoulder 18g at the end of the
distal length 18e of the long leg of the shackle. When the
shackle is capable of being opened, that is, when the per-
mutation wheels 20 are properly aligned and the action pre-
30 viously described to locate the bolts 50, 52 has been
carried out, the long leg of the shackle may be moved
axially through a distance substantially equal to the distance
between pin 26 and shoulder 18d. Thus, pin 26 serves a dual
function, including that of maintenance of the assembly of

5 housings 12, 14, and the additional function of providing a stop for limiting axial movement of the shackle to the padlock opened position. The pin, together with the end surface 64 of bore 34, also limits axial movement of the shackle to the padlock closed position.

10 Referring to Figs. 2 and 6, housing 14 is substantially open below wall 66 defining the lower surface of cutout 36, within the region bounded by walls 68, 70 and 72. The wall 68 (see Fig. 6) may be considered a rear wall while the walls 70, 72 may be considered side walls which extend from the rear wall toward the front of the housing. A bore 74 is formed within wall 70, and a bore 76 is formed within wall 72. Wall 72, as may be appreciated from Figs. 2, 3 and so forth, is a wall of substantial thickness although not fully shown in Fig. 6. As discussed, bores 28, 30 extend through wall 72 of housing 14, from the top of the housing to the bottom, and a slot 78 substantially in co-axial alignment with keyhole 80 in casing 12 extends through wall 72 in a direction normal to bores 28, 30 toward bore 76. The upper surface of slot 78 is coextensive with the surface of bore 72. An opening 82 generally of rectangular outline extends upwardly from the bottom of housing 14 into bore 72, terminating at the bottom surface of shoulder 32.

25 Cover 16, as previously indicated, provides a closure at the bottom of housing 14 thereby to close the entry into opening 82. Cover 16, further, includes a slot 84 in one surface at least coextensive in length to that of slot 78, and the opposite surface of cover 16 provides a closure 86 at the end of bore 74.

30 Shaft 88 is received in the bores 74, 76. The shaft is of a diameter substantially equal to the diameter of bore 76, and the left end (as seen in Figs. 3 and 4) is supported in the bore. A cup 90 is carried at the right end of the shaft. The cup includes a recess and a wall

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whose outer diameter is substantially equal to that of bore 74 for support of the right end of the shaft. A spring 92 is supported within the recess of the cup around the shaft. The spring acts between the surface
5 of the recess and closure 86 thereby to normally bias the shaft to the left as represented by the arrow 94.

The permutation wheels 20 and a like number of clutches 96 are carried by shaft 88. In the embodiment illustrated there are four permutation wheels and four
10 clutches, identified as clutch 96a, 96b, 96c and 96d from left to right in Figs. 3 and 4. Referring to Figs. 3, 4 and 6, the clutches 96 are each formed with a plate 104 and a collar 106. More specifically, clutches 96a, 96b and 96c include a collar which is subdivided into
15 collars 106a and 106b by the plate which extends from the collar. The clutch 96d, on the other hand, includes a collar 106a, while the plate 104 of the clutch is in surface-to-surface engagement with the end wall of cup 90.

The collars 106 of the several clutches 96 are supported
20 on shaft 88 and extend in abutting relation along the length of the shaft from a position juxtaposed a clip 108 to the position of contact with cup 90. The clip may be a C-clip carried in an annular recess formed in the shaft to provide a shoulder for collar 106a of clutch 96a. In the Fig. 3
25 position of shaft 88 each permutation wheel 20 is carried by collar 106a of a respective clutch 96a, and so forth, while in the Fig. 4 position of shaft 88 each permutation wheel 20 is carried either by collar 106a of a clutch (the clutch 96a) or collars 106a, 106b of adjacent clutches
30 (the clutches 96a, 96b, for example).

The permutation wheels 20 in both the Fig. 3 and Fig. 4 positions of shaft 88 remain substantially fixed axially. To this end, each permutation wheel is disposed within an arcuate recess between adjacent, spaced walls including side
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walls 70, 72 and intermediate walls forming ridges 100 which extend outwardly of rear wall 68. A plurality of ribs 102 of arcuate outline formed adjacent spaced slots in cover 16 provide additional axial stabilization for
5 the portion of each permutation wheel which shall extend through the cover.

The purpose of the movement capability of shaft 88 in the direction of arrow 98, against the normal bias of spring 92 to the Fig. 4 position, is to reorder the parti-
10 cular combination of the padlock. This operation will be discussed below.

The collars 106a are of greater extending length than are collars 106b. A projection 110 and preferably a pair of diametrically opposite projections extends from each
15 collar 106a. The projections are juxtaposed to the plate and, as illustrated in the Figures, the projections are on the side of the plate toward clip 108. Each collar 106a is of a length substantially equal to the width dimension of the permutation wheel 20 which it supports.

20 Referring to Fig. 6, the permutation wheels 20 include an annular body 112 and an inner annular web 114. A plurality of grooves 116 are formed in the surface of the web facing the projections. A single groove is provided for each of the positional locations of numeric indicia, in
25 the form illustrated in the Figures there are ten positional locations, and the grooves are located in diametrically opposed pair of grooves to receive the diametrically opposed projections 110 on collars 106a.

With continued reference to Fig. 6, one is perhaps best
30 able to appreciate the overall outline of the plate 104 of each clutch 96. To this end, the plates include a flat cam surface 104a, a pair of arcuate surfaces 104b extending from each end of the flat and a notch 104c located diametrically opposite the flat.

A blocking lever 118, which perhaps may be best seen in Fig. 2, is supported by housing 14 for pivotal movement about a pair of pivot axes located in walls 70, 72. A plurality of forks 120 extend from a central body portion as a parallel, spaced family of forks, and a
5 finger 122 extends in substantially the opposite direction from the central body portion. The several forks extend between adjacent permutation wheels. In essence, the individual forks are subject to control by the cam surfaces 104a and 104b of individual plates, but in reality
10 a single cam surface 104b of any plate primarily will control movement of the blocking lever. This, obviously, necessitates correct alignment of each permutation wheel 20 and clutch 96a, 96b, ... so that the several forks may
15 move into contact with cam surfaces 104a.

A pair of knife edges 124 extend to the rear at opposite sides of the central body portion of blocking lever 118. The knife edges are located to cooperate in grooves 126 formed in walls 70, 72. A spring 128 in the
20 form of an extension spring is supported between wall 68 and lever 118. The spring includes a plurality of coils at one end received through a hole 132 in the blocking lever and an extension at the other end received around wall 68 and through a bore 130 in the wall. At least the
25 end coils of the spring are of a dimension to serve as a stop so that the spring will pull against the central body portion of the blocking lever. The spring is located below the pivot axes, angled slightly downwardly toward the wall 68, and biases the blocking lever 118 in a clock-
30 wise direction (see Fig. 5) to locate finger 122 within groove 134 in wall 40. Thus, the finger is pivoted out of locking engagement within the region between bolts 50, 52. With continued reference to Fig. 7, it may be seen that the
35 finger has a width dimension substantially equal to the

depth of groove 134. This width dimension provides increased strength characteristics and increased inertia against movement as a consequence of unauthorized manipulation, rapping, and so forth. Further, the width
5 dimension and the fact that the width dimension substantially equals the depth of the groove, requires that the finger move throughout its entire arc of movement into the groove before shackle 18 of padlock 10 may be retracted. This particular aspect of the invention provides
10 the padlock with a greater degree of prevention to tampering.

When it shall be desired to open shackle 18 of padlock 10, the several permutation wheels 20 are rotated relative to shaft 88 to dispose the proper numeric indicia of the combination at the set location alongside a family of
15 grooves 136 in ribs 102 of cover 16. Movement of each permutation wheel is followed by movement of its associated clutch 96 through engagement of projections 110 in grooves 116. When the proper numeric indicia for opening the combination lock is located adjacent grooves 136, each of
20 the clutches 96 will be disposed in the position illustrated in Fig. 6. In movement of the permutation wheels, the forks 120 of blocking lever 118 follow the individual cam surfaces 104b of plate 104. The action is one that causes pivotal movement of the blocking lever to locate finger 122 between
25 bolts 50, 52. The cam surface 104b, thus, overcomes the bias imparted the blocking lever by spring 128 which, as previously indicated, tends to urge the forks 120 of the blocking lever in the counterclockwise direction. Actually, the proper setting of all permutation wheels, that is, when
30 forks 120 are capable of moving into juxtaposed position adjacent the cam surfaces 104a, readies the padlock 10 to be opened. To this end, it should be recalled that the long leg of shackle 18 is compressively loaded thereby constantly to urge the shackle axially toward the opened position. The
35 bias imparted by spring 62 overcomes the force of spring 58

which tends to urge the bolts away from one another within cutout 36 and causes the bolts to move toward one another. Thus, finger 122 is captured within the opposed notches 60 in the confronting faces of the bolts. As perhaps best seen in Fig. 7, the finger includes a pair of opposite extensions 138 which act within the notches when the bolts are moved to a confronting relationship and in this condition irrespective of the position of clutches 96 movement of finger 122 of the blocking lever in the clockwise direction is prevented. An inward unlocking pressure on the shackle of the padlock, against the bias of spring 62, will eliminate the loading on bolts 50, 52 so that the bolts are capable of movement away from one another under control of spring 58. At this time the finger of the blocking lever pivots in the clockwise direction and the several forks move briskly against the flat cam surfaces 104a. Finger 122, thus, moves into the region of groove 134.

Each of the several permutation wheels is notched along its outer periphery in the axial direction, within the region between adjacent numeric indicia. A detent 140 including a plurality of arms 142 is supported by wall 68 so that the arms extend into the opening and into engagement with the notched surface of the permutation wheels. Each arm includes a rounded tip which locates into a notch as each permutation wheel is stepped from one numeric indicia location to another. Each arm provides a spring bias thereby to maintain the permutation wheel it controls in the position to which it is rotated.

When it is desired to change the combination of the padlock, it is necessary to disengage each clutch 96 from the permutation wheel 20 with which it is normally engaged. The combination may be changed only when the shackle 18

is in the open position so that entry may be gained to the region of bore 76 (see Figs. 4 and 9). As illustrated in Figs. 3 and 8, the entryway otherwise is blocked by the distal end 18e of shackle 18.

5 A key 144 is provided for the purpose of changing the combination under circumstances that the shackle is in the open position. To this end, key 144 is received through keyhole 80 in casing 12, through slots 78, 84 and opening 82 in housing 14 and cover 16 and into con-
10 tact with the end of shaft 88. Axial movement of the key against the force of spring 92 exerted on shaft 88 causes the shaft to move in the direction of arrow 98 to locate in the Fig. 4 position. Key 144 is formed with a projec-
15 tion 146 and upon a quarter turn rotation, when the key is fully received, the projection will move into the opening
82 to positionally locate both the key and the shaft to reorder the combination.

As previously indicated, a clip 108 is supported within an annular cutout in shaft 88 so that movement of
20 the shaft causes a following movement of the several clutches 96 and the cup 90. The projections 110 of each clutch 96, therefore, will disengage from the grooves 116 of the permutation wheel 20 with which it is associated.

A plurality of lugs 148 are provided for purposes of
25 rotationally locking each clutch 96. A lug is carried by each ridge 100 (see Fig. 6) and wall 70 in position to engage in the notch 104c of each clutch 96 when moved to the Fig. 4 position. While the clutches are fixed, each permutation wheel is capable of free movement and may be
30 moved rotationally to any particular angular position thereby to set a different combination. After setting the combination, key 144 is removed from the padlock 10. The shaft 88 and the several clutches 96, therefore, return to the Fig. 3 position under control of spring 92 and the
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clutches, again, engage the permutation wheels in a new angular position for conjoint movement with the wheel. In the Fig. 3 position, the notches 104c of clutches 96 are located in a position axially displaced
5 from the several lugs 148.

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CLAIMS

1. A permutation lock.(10).comprising the combination of a housing.(12), a securing element.(18).supported by said housing.(12).and movable into and out of securing engagement for opening and closing said lock.(10), locking means.(50, 52).supported within said housing.(12), means.(58).for control of said locking means.(50,52).thereby either to maintain said securing element.(18).in the closed securing engagement or as determined by proper manipulation of permutation wheels.(20).to a preset combination to permit
10 said securing element.(18).to move to an opened position, said control means including a shaft.(88).supported within said housing.(12), a plurality of permutation wheels.(20).each carrying indicia in a sequence about an outer periphery, a like plurality of cam elements.(104), each said permutation wheel.(20).and cam element.(104).supported for rotation
15 by said shaft.(88).in an alternating arrangement of associated pairs of permutation wheels.(20).and cam elements.(104).therealong said shaft.(88).being located relative to said housing.(12).so that substantially an arcuate sector
20 of each permutation wheel.(20).extends outwardly of said housing.(12).in position for digital manipulation and rotation of said wheels.(20).selectively from one indicia position to another, engagement structure.(116,110).on each said permutation wheel.(20).and cam element.(104).of
25 each associated pair, means.(92).for moving at least said cam elements.(104).to a first position of engagement with an associated permutation wheel.(20).whereby each cam element.(104).is adapted for movement conjointly with said permutation wheel.(20).as may be selectively rotated, and a
30 like plurality of lugs.(148).supported by said housing.(12), each said lug.(148).supported in a position thereby to inhibit movement of said cam elements.(104) when moved from said first position to a second position to permit free rotation of said permutation wheels.(20).which may
35 be angularly adjusted relative to said cam elements.(104).to a new preset combination.

2. A permutation lock according to claim 1 wherein said cam elements (104) include a collar (106) received on said shaft (88), and wherein is provided a biasing means (92) acting on said collars (106) of said cam elements (104) and between said shaft (88) and housing (12) thereby to bias both said shaft (88) and cam elements (104) to said first position.

3. A permutation lock according to claim 2 wherein said means acting between said shaft (88) and housing (12) includes a first stop (108) fixedly located adjacent one end of said shaft (88), a second stop (90) located adjacent the other end of said shaft (88) confining said cam elements (104) between stops, and a spring (92) acting between said housing (12) and said second stop (90).

4. A permutation lock according to claim 2 or claim 3 wherein is provided a key (144), said housing (12,14,16) including an opening (80, 78,84,82) forming a keyway extending toward said shaft (88), said key (144) adapted for receipt in said keyway (80,78,84,82) to a position at which it engages said shaft (88) and to a fully received position following movement of said shaft (88) axially in opposition to said bias whereby said cam elements (104) locate to said second position.

5. A permutation lock according to claim 4 wherein said key (144) includes a projection (146) and said keyway (80,78,84,82) includes a side opening (82) into which said projection (146) is free to move upon rotation of said key (144) when in said fully received position, said side opening (82) providing a stop for said projection (146) to maintain said key (144) in said fully received position.

6. A permutation lock according to any one of claims 2 to 5 wherein each said cam element (104) includes a plate (104) extending from said collar (106), said plate (104) including a pair of cam surfaces (104a, 104b), and a notch (104c) opposite one of said cam surfaces into which a

respective said lug.(148).enters when said cam element
(104).is moved from said first to said second position.

7. A permutation lock according to any one of claims
1 to 6 wherein said locking means.(50,52).includes a
5 plurality of follower members.(120), each adapted to
respond to rotational movement of a respective cam element
(104), and wherein one cam surface.(104a).provided on each
cam element.(104), if said cam elements.(104) are all in a
set position, controls said locking means.(50,52).to permit
10 said securing element.(18).to move to said opened position.

8. A permutation lock according to any one of claims
1 to 7 wherein said housing includes an outer housing.(12),
an inner housing.(14), and a cover.(16), said cover.(16).
including a plurality of slots equal in number to that of
15 said permutation wheels.(20).to accommodate said extending
arcuate sectors, said cover.(16).being carried telescopic-
ally on said inner housing.(14), and said inner housing
(14).and cover.(16).being carried telescopically in said
outer housing.(12).

20 9. A permutation lock according to any one of claims
1 to 8 wherein is provided a bore.(27) extending through
one wall of said outer housing.(12).and a bore coaxially
aligned through said inner housing.(14), and a pin.(26).
having a dimension substantially equal to that of said
25 bores.(27).providing a force fit engagement in said bores
(27).for assembled securement of said housings.(12-16).

10. A permutation lock according to any one of claims
1 to 9 wherein said securing means.(18).comprises a U-shaped
shackle.(18), including a pair of legs.(18a-f).of unequal
30 length, a pair of shackle leg bores.(28,30,34,42,44).
located in said housings.(12,14).for full receipt of said
legs.(18a-f).in said closed shackle legs position, said
shackle leg bore.(28,30,42).adapted for receipt of said
long leg.(18b-f).partially intersecting said pin bore
35 within said inner housing.(14), and means.(18c,d).on said

long leg.(18b-f) to provide, with said pin.(26), a stop thereby to prevent full retraction of said long leg.(18b-f) from said housings(12,14) when said permutation lock.(10) is opened.

5 11. A permutation lock according to any one of claims 1 to 10 wherein said securing means comprises a U-shaped shackle.(18), and wherein is provided a pair of bores.(28,30, 34,42,44) for receipt of respective shackle legs.(18a-f), said bores.(28,30,34,42,44) extending through said housings 10 (12-16) in a direction substantially normal to the plane of the closed end of said outer housing.(12), a cutout.(36) in a surface of said inner housing.(14) adjacent the closed end of said outer housing.(12) intersecting said shackle bores.(30,34), and wherein said locking means includes a 15 pair of bolts.(50,52) movable in said cutout.(36) in opposite directions, means for biasing.(58) said bolts (50,52) away from one another into engagement with said shackle legs.(18a-f), a finger.(122) controlled by said cam elements.(104) for movement into position between 20 said bolts.(50,52) thereby to maintain said engagement and said permutation lock.(10) in said closed position and out of said position to permit said shackle.(18) to move to said opened position, and a notch.(134) in the wall of said inner housing.(14) to receive said finger.(122).

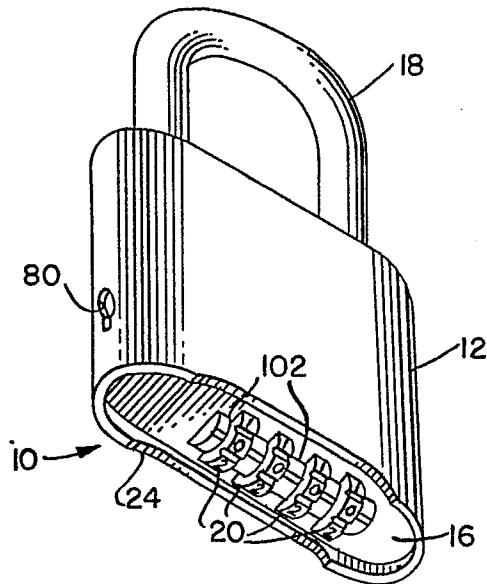
25 12. A permutation lock of claim 11 wherein the depth of said notch.(134) is only slightly greater than the width of said finger.(122) and equal to about one-half the width of said bolts.(50,52).

13. A permutation lock according to any one of claims 30 1 to 12 wherein said locking means includes a lever.(118), having a body portion, a plurality of forks.(120) equal in number to the plurality of cam elements.(104) extending as a parallel family from said body portion, a finger.(122) extending substantially in the opposite direction, means 35 (124,126) for mounting said lever.(118) for pivotal movement,

and means .(128) .for biasing said lever .(118) .and said
extending forks .(120) .in a direction toward said cam
elements .(104) .

14. A permutation lock according to claim 13 wherein
5 said biasing means is a coil spring .(128) , adapted to pass
through an opening .(132) .formed in said lever .(118) , and
at least one coil of said spring .(128) .having a diameter
larger than said opening .(132) .

FIG. 1.



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FIG. 2.

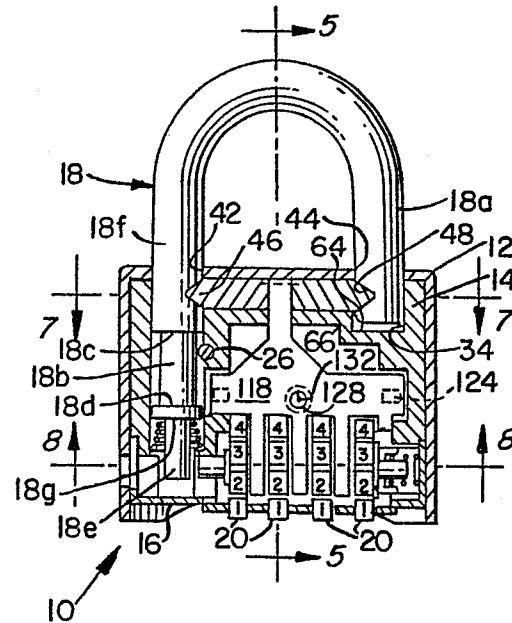


FIG. 5.

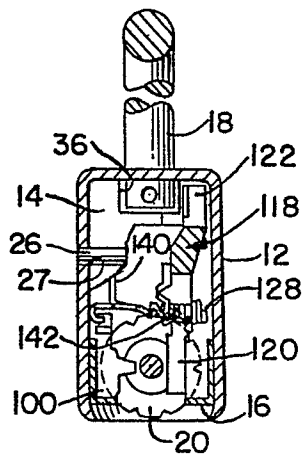


FIG. 7.

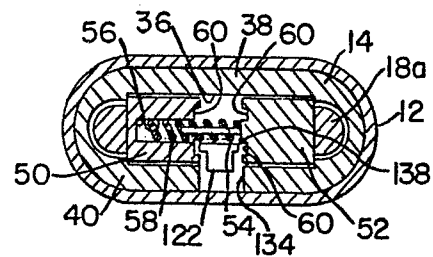


FIG. 8.

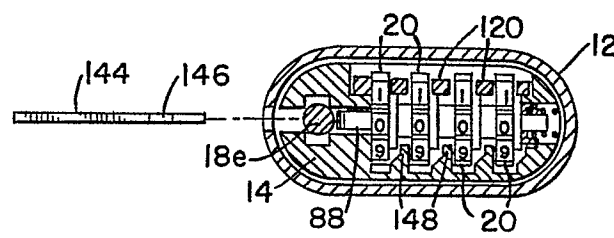


FIG. 9.

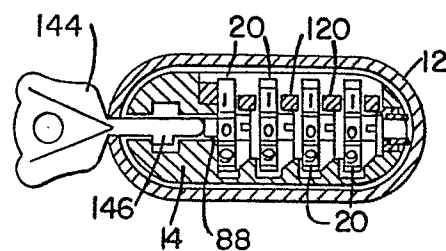
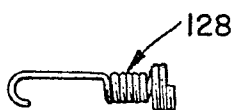


FIG. 10.





DOCUMENTS CONSIDERED TO BE RELEVANT															
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)												
X,D	US-A-3 983 724 (MASTER LOCK) * Whole document *	1-3,6- 8,11- 14	E 05 B 37/02												
Y	---	4,10													
Y	US-A-2 853 868 (VAHLSTROM) * Whole document *	4													
Y	--- GB-A- 201 957 (RULE) * Figure 1 * -----	10													
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)												
			E 05 B												
The present search report has been drawn up for all claims															
Place of search THE HAGUE		Date of completion of the search 02-06-1983	Examiner VAN BOGAERT J.A.M.M.												
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