Dec. 12, 1939. K. H. POND 2,183,168

LOCK CONSTRUCTION

Filed Feb. 21, 1939 2 Sheets-Sheet 1

FIG. 1.

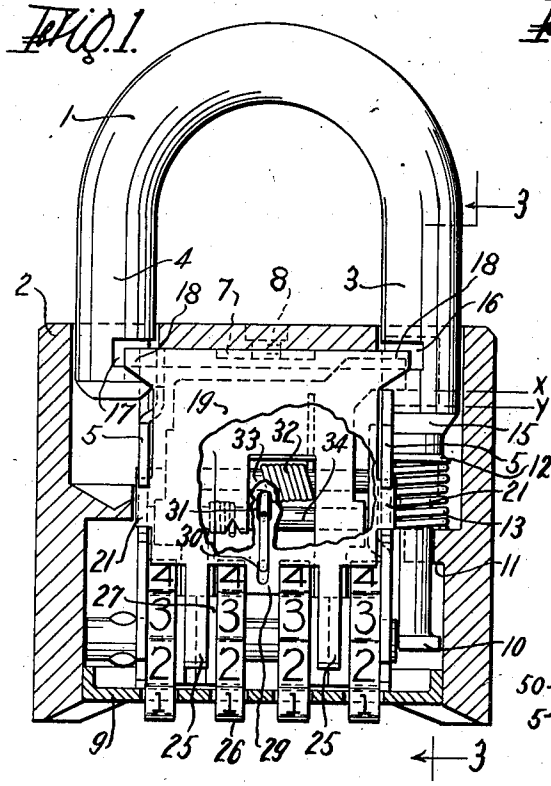


FIG. 2.

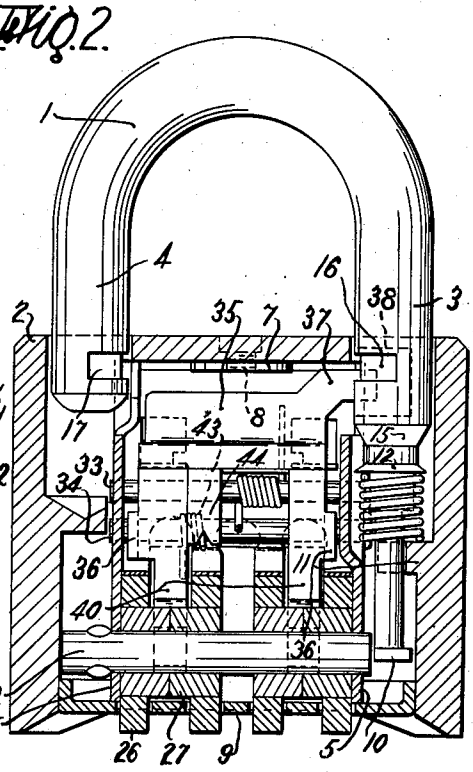


FIG. 3.

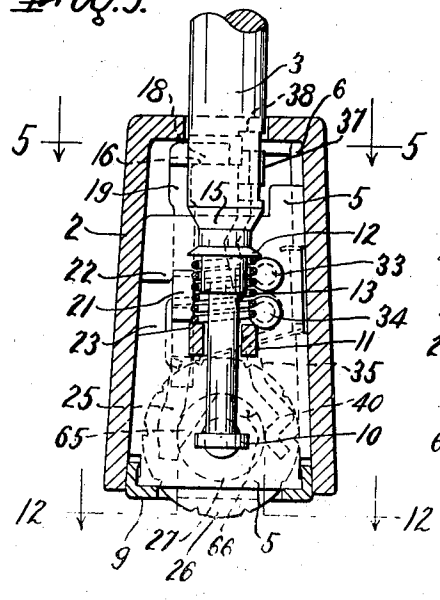


FIG. 4.

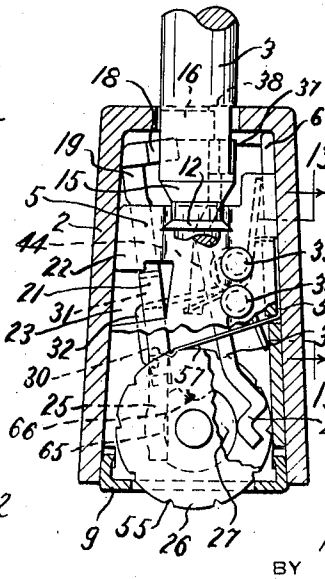
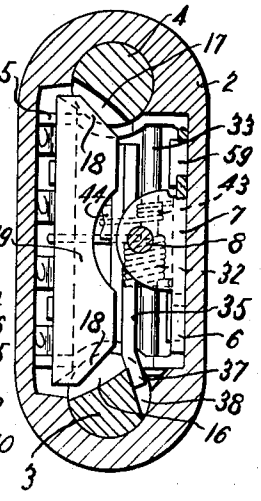


FIG. 5.



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LOCK CONSTRUCTION

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FIG. 6.

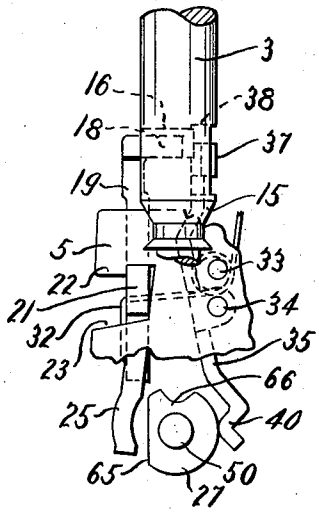


FIG. 7.

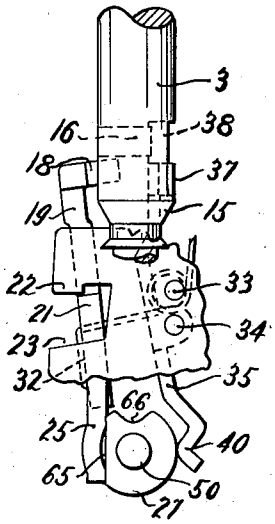


FIG. 8.

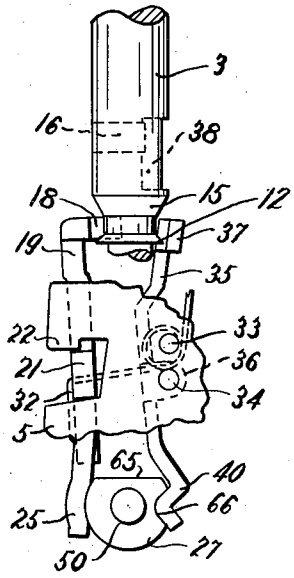


FIG. 9.

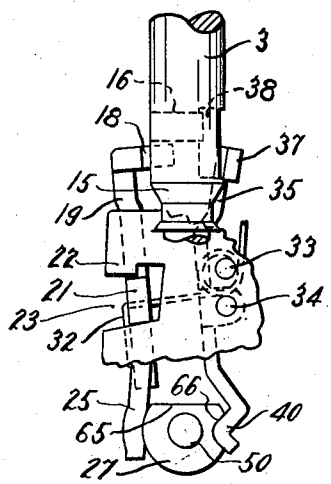


FIG. 10.

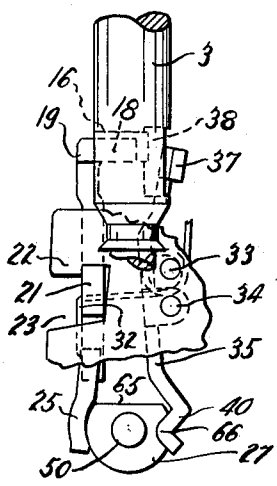


FIG. 11.

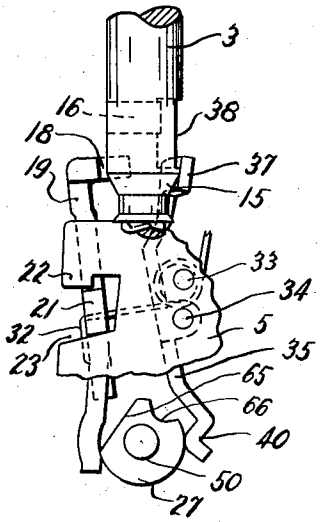


FIG. 12.

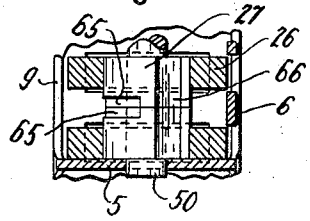
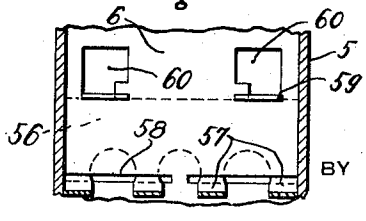


FIG. 13.



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2,183,168

LOCK CONSTRUCTION

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Application February 21, 1939, Serial No. 257,596

14 Claims. (Cl. 70—25)

This invention relates to improvements in permutation locks and deals particularly with a locking mechanism which has incorporated in it certain novel features which render the locking operation simpler and which, in addition, serve to prevent unauthorized persons from becoming familiar with the unlocking combination.

Broadly, the mechanism is arranged so that the unlocking operation proceeds in two steps; the first of which consists in setting a combination on the permutation wheels and then partially unlocking the securing element of the lock; and the second of which consists in setting the permutation wheels to another combination on the completion of which operation the securing element is automatically freed so that it can move to its fully unlocked position. In addition to freeing the securing element, this last setting of the combination prepares the lock to again be rendered effective by simply moving the securing element to its original locked position without further adjustment of the permutation wheels.

As can be appreciated from the above, the user cannot with such a general arrangement of the invention inadvertently leave the lock unlocked and with the permutation wheels set at the first of the combinations included in the total opening operation. In addition to this advantage, the relocking operation compares in simplicity with that of an ordinary key lock.

In the drawings the parts have been shown constructed to operate as a simple padlock but this embodiment is used by way of illustration only, the arrangement being equally applicable to other forms of locks as will be readily understood by those familiar with the art; and I, therefore, do not intend to necessarily limit myself to the particular form shown.

A full disclosure of suitable means which I prefer to use in carrying out the main purpose of my invention, as well as the other purposes, can best be understood by the following detail specification considered with the accompanying drawings, in which:

Fig. 1 is an elevation of the locking mechanism arranged as a padlock with the body shown in section and certain of the elements broken away for clearness;

Fig. 2 is a vertical longitudinal section of the lock of Fig. 1;

Fig. 3 is a sectional end view taken on line 3—3 of Fig. 1;

Fig. 4 is a view similar to Fig. 3 but showing the position assumed by the elements after the first step in the unlocking operation has been performed;

Fig. 5 is a sectional view on line 5—5 of Fig. 3;

Figs. 6 to 10 are fragmentary views showing important locking elements and their various positions during a complete unlocking cycle;

Fig. 11 is a view of the parts in Fig. 10 but showing an alternate position of the elements from which the lock can be locked;

Fig. 12 is a detail view taken on line 12—12 of Fig. 3, showing a feature of the permutation wheel construction; and

Fig. 13 is a view taken on line 13—13 of Fig. 4 and showing how the detent spring is mounted.

Referring to Figs. 1 to 5, the locking mechanism with the exception of the securing member or shackle 1 is contained as a unit within the lock base 2. Base 2 has openings at the top to accommodate the long and short legs 3 and 4 of the shackle 1 and a large opening at the bottom through which the locking mechanism is inserted during assembly. The locking mechanism is supported on the wings 5 of a U-shaped frame 6 which has a lip 7 secured to the underside of the upper surface of the base 2 as by screw 8. A base or cover plate 9 is crimped into notches formed in the bottom of the vertical edges of wings 5, see Figs. 3 and 4, and in the assembled position of the lock forms a closure for the bottom of the base 2 and also serves to stiffen the frame 6.

The long leg 3 of shackle 1 terminates at its lower end in a reduced cylindrical portion having a semi-circular foot 10 which underlies an inwardly directed shoulder 11 formed in the base 2. When the lock has been unlocked by suitable manipulation of the permutation mechanism, this foot 10 serves to limit the upward motion of shackle 1 towards the unlocked position by contacting the bottom of shoulder 11. Above shoulder 11, long leg 3 has an integral rib 12 forming an abutment for the upper end of the shackle spring 13 which at its opposite end presses against shoulder 11. As is plain from the drawings, shackle spring 13 always tends to force the shackle upwards to the open position, being limited in its final outward position by foot 10 previously described. Immediately above rib 12, the long leg 3 has a chamfered portion 15 which, as will be described, serves as a camming surface during the resecuring of shackle 1 in its locked position.

A short distance above the chamfered portion 15 there is a milled slot 16 cut in the surface of leg 3, this slot being opposite a similar slot 17 cut in

the short leg 4, see Fig. 5. As is indicated in Figs. 1, 3 and 5, the shackle in the locked position is secured against the upward pressure of shackle spring 13 by interengagement of slots 16 and 17 with toes or dogs 18 formed integrally with the upper end of a primary bolt 19.

This bolt 19 has a pair of ears 21 which, when the lock is locked, lie behind the lips 22 of slots 23 cut in lock frame wing 5, see Fig. 3. In this position, bolt 19 is constantly urged upward to contact the top of slots 23 by pressure of the shackle spring 13 transmitted through the shackle and slots 16 and 17 to the dogs 18 previously described.

At the lower end bolt 19 is provided with a pair of control fingers 25 which extend between the permutation wheels 26 and ride on the peripheries of inner wheels 27 of the permutation mechanism, see Fig. 1. As is well known in the art, and will be explained more in detail at another point, the inner wheels 27 are adjusted by means of the permutation wheels to position the bolt for freeing the shackle 1.

Between the control fingers 25, the bolt has a depending tongue 29 provided with a hole 30 which is directly in line with and below a slot 31 cut in the bolt. A bolt spring 32 is threaded over one of two spring rods 33 and 34 which span the U frame and have their ends penetrating holes in the frame wings 5. One end of the bolt spring 32 rests on the back inner surface of the base 2 and the opposite end passes through slot 31 and has its terminal slipped through hole 30, see Fig. 4. This spring 32 is wound so that it constantly forces the bolt downwardly and inwardly. Thus the control fingers 25 are constantly being urged against inner wheels 27 and in the position of Fig. 4 where the first of the unlocking steps has been performed, the ears 21 are forced downward to contact the lower surface of the slots 23. This particular bolt structure is similar in many respects to that shown in the patent to Denerich 1,964,936, dated July 3, 1934, and therefore will not be described further.

Referring now to Figs. 2 to 5, a secondary bolt 35 is mounted on trunnions 36, through which rod 34 passes. This secondary bolt 35 has at its upper end a laterally extending toe 37 which is adapted, in the locked position of Fig. 2, to lie between the upper and lower edges of a notch 38 cut in the long leg 3 of the shackle on the opposite side from the cut 16 previously described, see also Fig. 5. Slot 38 is dimensioned so that when the first of the unlocking operations has been performed and the parts are positioned as in Fig. 4, the toe 37 contacts the bottom of notch 38, and holds the shackle from continuing its upward motion.

At its lower end bolt 35 has control fingers 40 which, as with the control fingers 25 of primary bolt 19, lie between the permutation wheels 26 and contact the peripheries of the inner wheels 27. However, control fingers 40 are wider than control fingers 25 and contact the peripheries of the inner wheels 27 at a point about opposite to the contact point of control fingers 25, see Fig. 4. Also, the control fingers 40 are in the shape of a dog in cross section, while fingers 25 are generally flat. These differences, while evident from the drawings, are pointed out in detail so that the operation of the mechanism can be better understood when its detailed cycle is described.

As with bolt 19, secondary bolt 35 has a bolt spring 43 which in this case is threaded over rod 34 and has one end resting against the inner wall of the back of the base 2 with its opposite end lying in a V notch cut in the lower edge of a depending tongue 44 extending downwardly between the control fingers 40, see Fig. 2. In this case, too, the bolt spring is wound to force the control fingers 40 against the inner wheels 27.

Referring now to Figs. 2 to 4, the permutation mechanism is preferably of the fixed combination type,—that is, the combinations to which the permutation wheels must be set cannot be varied by the user. Thus each permutation wheel 26 is in the form of a collar and is suitably secured to the periphery of its inner wheel 27 by, for instance, a force fit. As can be seen from Fig. 2 in particular, the inner wheels 27 themselves are in the form of bushings and rotate freely on shaft 50, this last member being journaled in the frame wings 5. The permutation wheels 26 are considerably narrower than the inner wheels 27 and therefore, with the mechanism assembled as indicated, there is ample space to accommodate the control fingers 25 and 40 of the primary and secondary bolts, respectively. The lateral positions of the inner whels 27 on shaft 50 are maintained by that portion of the permutation wheels which extends through slots cut in the cover plate 9, see Fig. 2.

The permutation wheels, see Fig. 4, have a series of notches 55 cut in their periphery corresponding in number to the indicia provided to set the lock to various combinations. A detent spring 56 having a separate tongue 57 for each permutation wheel is mounted on the U frame 6. As shown in Fig. 13, the spring 56 lies against the back of the frame with the tongues 57 extending through a slot 58 and with its opposite end secured by integral tabs 59 which pass through openings 60 in the frame 6. The ends of the tongues 57 engage the notches 55 and serve to aline the indicia at any setting of the permutation wheels, as is well known.

Referring now to Figs. 3, 4, 8 and 12, each inner wheel has a flat 65 and a notch 66 cut in its periphery. When the permutation wheels 26 have been set to what I will term the primary combination, the flats 65 all lie parallel to the control fingers 25 of the primary bolt 19 and that bolt may be moved to disengage itself from the shackle 1 by having the bolt assume the position of Fig. 4 where the toes 18 are free of the slots 16 and 17 in the short and long legs of the shackle. Similarly, if the notch 66 is positioned as in Fig. 8, or to what I will call the secondary combination of the permutation wheels, the control fingers 40 of the secondary bolt 35 will lie in these notches 66 and the toe 37 will be free of the notch 38 in the long leg 3 of the shackle. However, in this position, the control fingers 25 of the primary bolt 19 will be no longer contacting the flats 65 but will be riding on the peripheries of the inner wheels 27 with one toe 18 riding against the long leg 3 of the shackle just below the chamfered portion 15, see Fig. 8. This arrangement is what provides for the two-step opening which has already been referred to and which will be described in more detail shortly.

As is indicated in Fig. 12, the flat 65 on each inner wheel 27 is much narower than notch 66, the dimensions being such that the combination of two flats 65 or two abutting inner wheels 27 is equal to the width of the narrow control fingers 25 of the primary bolt 19. Therefore, remembering that control fingers 40 of secondary bolt 35 are wider than fingers 25, it is plain that these fingers 40 cannot be affected by the flats 65 because they span them laterally. On the

other hand, while the fingers 25 of the primary bolt are narrow, they are flat and will therefore span the notches 66 longitudinally. This arrangement not only prevents any accidental manipulation of either bolt at an improper point on the inner wheel 27, but it also prevents an unauthorized user from "feeling" the combination by carefully turning the permutation wheels and noting when the sense of touch tells that a flat 65 or notch 66 has passed either set of control fingers 25 and 40.

As was pointed out earlier, this particular permutation mechanism is in its preferred form of the fixed combination type. This preference is governed primarily by considerations of economy and ease of assembly. The operating principles of the lock will apply to a permutation mechanism capable of having the opening combination changed as with the permutation mechanism shown in the Denerich patent referred to. I therefore do not desire to limit my invention to a lock construction having the fixed type of combination.

With the detailed description of the various elements in mind, the complete operating cycle as shown by Figs. 3 and 6 to 10 can now easily be understood.

Considering first Fig. 3 which is a view of the locked position, it will be recalled that the slots 16 and 17 on the legs 3 and 4 of the shackle are engaged by the toes 18 on the primary bolt 19 and the ears 21 of that bolt lie behind the lips 22 of the slots 23 cut in the frame wings 5 with the ears pulled up against the top of slots 23. Also the toe 37 of the secondary bolt 35 lies in the notch 38 cut in the long leg 3 of the shackle. The control fingers 25 and 40 of the primary and secondary bolts are riding on the peripheries of the inner wheels 27.

To unlock the mechanism, the user manipulates the permutation wheels until they are set at the primary combination, as indicated in Fig. 6. From that view it will be seen that neither of the bolts 19 and 35 change position from that shown in Fig. 3, the primary bolt being held upward in position by the pressure of shackle spring which is, of course, transmitted to the bolt through the toes 18, and the secondary bolt continuing to ride on the peripheries of the inner wheels.

Then the shackle is depressed far enough to push the ears 21 on the primary bolt clear of the lips 22. Immediately the primary bolt spring rocks the primary bolt in a counterclockwise direction to the position of Fig. 7. This frees the toes 18 from the slots 16 and 17 and when the shackle is released it will rise upward until toe 37 on the secondary bolt 35 contacts the bottom of slot 38. The final position is a semi-opened position and represented by Fig. 7. It is to be noted that while the shackle has moved upward, the motion has not been sufficient to allow the short leg 4 of the shackle to clear the top of base 2, see Fig. 1 where the motion of the shackle between the locked and semi-opened position is shown by the distance between the lines X and Y.

The lock is then finally opened by setting the permutation wheels to the secondary setting where the control fingers 40 of the secondary bolt 35 can enter the notches 66 on the inner wheels 27, as in Fig. 8, the control fingers 40 being forced into the notches 66 by the secondary bolt spring previously described. When this last occurs, toe 37 on the secondary bolt will clear slot 38 and the shackle will rise to its fully opened position (see Fig. 8), in which position the short leg 4 will clear the top of the base.

As was pointed out earlier, this last setting of the permutation wheels will make the control fingers 25 on the primary bolt ride on the peripheries of the inner wheels, see Fig. 8. Comparing Figs. 7 and 8, the control fingers 25 are first forced outward as the permutation wheels are moved; then, since the primary bolt spring is urging the bolt towards the inner wheels, the bolt 19 will pivot about the ears 21 until the toes 18 contact the shackle legs 3 and 4. Continued rotation of the permutation wheels until the control fingers 25 ride on the peripheries of the inner wheels will then force the ears 21 outward along the slanting lower edge of the slots 23 but against the tension of the primary bolt spring. Fig. 9 shows the position of the primary bolt at the instant that the secondary bolt is released. This action of the primary bolt will not, however, interfere with the shackle when it is released by the secondary bolt, for the toes 18 on the primary bolt engage the shackle 1 below the notches 16 and 17 and ride on the outer surface of the shackle from the position of Fig. 7 to that of Fig. 8. On the other hand, the lock can now be locked by simply depressing the shackle, for with the primary bolt positioned as in Fig. 8, if the shackle is depressed the toes 18 follow up the chamfer 15 along the periphery of the shackle past the position of Fig. 9 until they snap into the slots 16 and 17. The ears 21 will then be resting in the corner formed by the lower and back edges of the notches 23 with the bolt vertical. Finally, when the shackle is released and the shackle spring forces it upward, the ears 21 are pulled up behind the lips 22 by the interengagement of toes 18 with the slots 16 and 17 of the shackle leg 3 which is being pushed up by spring 13. This last position is that of Fig. 10 which shows the final position of the parts when the toes 18 have snapped into slots 16 and 17 and then been pulled upwardly by the action of spring 13.

It will be noted that in this last position, the toe 37 on the secondary bolt is out of the slot 38 and not in position to stop the vertical motion of the shackle. However, to unlock the lock again, the primary setting of the permutation wheels must be set up to release the primary bolt. As is clear from the drawings, any manipulation of the permutation wheels with a view of setting up the primary combination will immediately render the secondary bolt ready to function.

By comparing Figs. 8 and 11, another feature will be noted for, as illustrated by the latter figure, if by mistake or intentionally, when the lock is unlocked the permutation wheels are moved so that they no longer are on the secondary combination, the locking of the shackle will not be interfered with. Thus in Fig. 8 when the permutation wheels are moved, the control fingers 40 ride up into the peripheries of the inner wheels as in Fig. 11, and the toe 37 immediately rests against the rib 12. When the shackle is then depressed, the chamfer 15 forcibly cams the toe 37 of the secondary bolt outwardly as shown. As the shackle is pressed further downward the toe 37 will finally snap into the slot 38, the toes 18 on the primary bolt in the meantime sliding along the side of the legs 3 and 4. Of course, after the toe 37 is in the slot 38 the shackle is pressed inwardly until the toes 18 engage the slots 16 and 17, as previously described for the locking operation.

In addition, this point should be noted regard-

ing the above locking operation. If instead of positioning the inner wheels as in Fig. 11, the permutation wheels are turned so that the primary combination is accidentally set up and the primary bolt released to assume the position shown in Fig. 7 where it does not rest on the shackle at all, as soon as the toe 37 of the secondary bolt snaps into the slot 38 the shackle cannot be withdrawn beyond its half-opened position so that it is effectively locked but not in its normal position. On the other hand, the shackle will rise to this half-opened position when the downward pressure is released and this will warn the user that the primary bolt is not locked.

With the details of the lock construction and its operating cycle complete, certain of the features involved will now be emphasized. In the first place, the toe 37 on the secondary bolt, when the mechanism is locked as in Fig. 3, lies free between the upper and lower surfaces of the notch 38. The shackle is secured by the toes 18 on the primary bolt engaging with the slots 16 and 17. Now, therefore, if the permutation wheels are set to the secondary combination and the secondary bolt moves free of the shackle, and the shackle is then depressed, as is necessary to start the opening operation, the shackle is in no way released but still remains secured by the primary bolt; this is plain from Fig.10. The only time that the secondary bolt can operate to release the shackle is when the primary bolt has been first released by setting up the primary combination on the permutation wheels as described.

However, as soon as the secondary combination is set on the permutation wheels, the primary combination is effectively concealed. Thus, though the user leaves the lock with the shackle unsecured, and the secondary combination set, which is probably the normal way in which the lock will be used, only one of the two combinations can be observed.

On the other hand, while the secondary combination can properly be called an "opening combination", this secondary setting does not have to be destroyed to again lock the lock. Yet, if the secondary combination is disturbed, it does not interfere with the locking of the shackle. Therefore, the secondary bolt functions to constrain a definite cycle of operations during the unlocking of the lock but does not require the same cycle in opposite succession during locking of the shackle.

In addition, as was pointed out above, this secondary bolt functions as a safety factor to lock the shackle in semi-opened position in case the primary bolt is unlocked and not ready to secure the shackle when the lock is being locked.

Numerous other desirable features have been included in my lock construction and these, together with the particular ones pointed out, have enabled me to combine intricate mechanism into a small unitary construction which, though inexpensive to make, does not sacrifice positiveness of operation to economy.

However, a main function of the secondary locking bolt is to permit these operations: (1) unlocking completely; (2) relocking without the necessity of touching the permutation wheels. Thus I have furnished a lock structure which can be locked with all the simplicity of an ordinary spring lock. Prior to my invention, so far as I know, this simple spring lock result was not possible in permutation locks. By this I mean that in prior permutation locks it was necessary to disturb the permutation wheels as part of the necessary locking operations. This has been avoided to the great advantage of permutation locks.

What I claim is:

1. In a permutation lock, a securing element having an effective position, an ineffective position and an intermediate position, permutation members each provided with a lock controlling element and having a primary and secondary combination, primary and secondary locking elements controlled by said lock controlling elements and respectively adapted to hold said securing member in said effective position until said primary combination is set and in said intermediate position until said secondary combination is set for the purpose described.

2. The structure of claim 1 with the primary and secondary locking elements controlled by separate means on said lock controlling elements.

3. In a permutation lock, a securing element having an effective position, an ineffective position and an intermediate position, permutation members each provided with a lock controlling element and having a primary and secondary combination, primary and secondary locking elements controlled by said lock controlling elements and respectively adapted to hold said securing element in said effective position until said primary combination is set and in said intermediate position until said secondary combination is set, said primary locking element being, as soon as said secondary combination is set, ready to secure said securing element when it is again moved to its effective position.

4. In a permutation lock, a securing element having an effective position, an ineffective position and an intermediate position, permutation members each provided with a lock controlling element and having a primary and secondary combination, primary and secondary locking elements controlled by said lock controlling elements and respectively adapted to hold said securing element in said effective position until said primary combination is set and in said intermediate position until said secondary combination is set, said secondary locking element being always in position to hold said securing element in the intermediate position whenever said primary combination is set if the securing element is in its effective position.

5. In a permutation lock, a securing element having an effective position, an ineffective position and an intermediate position, permutation members each provided with a lock controlling element and having a primary and secondary combination, primary and secondary locking elements controlled by said lock controlling elements and respectively adapted to hold said securing element in said effective position until said primary combination is set and in said intermediate position until said secondary combination is set, the primary and secondary locking elements being affected by separate means on said lock controlling elements and neither by the other's means.

6. In a permutation lock, a securing element having an effective position, an ineffective position, and an intermediate position, permutation members each provided with a lock controlling element and having a primary and secondary combination, primary and secondary locking elements controlled by said lock controlling elements and respectively adapted to hold said securing element in said effective position until said primary combination is set and in said intermediate position until said secondary combination

is set, on the last of which operations said securing element is free to pass to its ineffective position, and additional means on said securing element to cooperate with said locking elements and allow the securing element to be returned to its effective position and locked although neither combination is set.

7. In a permutation lock, a securing element having an effective position, an ineffective position, a third position, to which said element may be moved, slightly beyond said effective position and a position intermediate said effective and ineffective positions, permutation members each having a lock controlling element and a primary and secondary combination, and primary and secondary locking elements controlled by said lock controlling elements, said primary locking element being adapted, when said primary combination is disturbed, to hold the securing element in its effective position, and when the primary combination is set and the securing element afterwards moved towards its third position, to release said securing element and allow it to pass towards its intermediate position, said secondary locking element being adapted when the secondary combination is disturbed to hold said securing element in said intermediate position, and when said secondary combination is set to allow the securing element to pass to its ineffective position, all for the purpose described.

8. In a padlock construction, a hasp having short and long legs, similar narrow slots one cut in each of said legs transverse to their axes, and a wider slot cut in the long leg adjacent its narrow slot and with its lower edge located lower down the leg than its adjacent narrow slot, a hasp spring mounted on said hasp and adapted to force the hasp upwards, permutation members each provided with a lock controlling element and having a primary and secondary combination, primary and secondary locking bolts controlled by said lock controlling elements, said primary bolt having toes at one end adapted, when the hasp is in one position, to engage said similar narrow slots and hold the hasp secured until said primary combination is set, said secondary bolt having a toe at one end adapted to engage said lower edge of said wider slot as soon as the primary combination is set and the hasp has been forced slightly upward from its first position by said hasp spring, and to hold said hasp from further unlocking movement in its said raised position until said secondary combination is set, all for the purpose described.

9. The structure of claim 8 with the primary and secondary bolts controlled by separate means on the lock controlling elements.

10. In a padlock construction, a hasp having an effective position, an ineffective position, and an intermediate position, permutation members each having a lock controlling element consisting of a wheel with a flat and a notch cut in its periphery, primary and secondary locking bolts having at least one toe at one end and at the other end, control fingers adapted to engage said flats and notches respectively to render the bolts ineffective, and slots cut in said hasp and adapted to be engaged by the toes on the respective bolts to hold the hasp when the latter is in effective and intermediate positions respectively, and to be disengaged from the toes when the permutation members are adjusted until the flats and notches respectively engage the primary and secondary bolts for the purpose described.

11. The structure of claim 10 with the control fingers on the respective bolts and the flats and notches on the lock controlling elements arranged so that the control fingers on each bolt are affected only by the flats or by the notches and not by both.

12. In a permutation lock having a securing member, a bolt for holding said securing member, and permutation mechanism for freeing said bolt from said securing member when the opening combination is set, said bolt and permutation mechanism being so constructed that when the securing member is unlocked by setting the opening combination in the permutation mechanism, said member may be relocked from said unlocked position by merely moving the securing element to its locked position.

13. In a permutation lock having a securing member, primary and secondary bolts for holding the securing member, and permutation mechanism controlling said bolts and having a primary and secondary combination to which said mechanism must respectively and successively be set to free said bolts from said securing members, said permutation mechanism and bolts being so constructed that the securing member may be relocked from its unlocked position without moving the permutation mechanism from its secondary combination.

14. In a permutation lock having a securing member, automatic locking means and permutation means to render said locking means effective and ineffective, said permutation means when manipulated to render said locking means ineffective being thereby put in position to render the same effective upon the mere movement of said securing means to its locked position from its unlocked position.

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