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MECHANICAL CARD LOCK

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Technical Field

This invention relates to a mechanical lock system using cards.

Background Art

5 Increasingly, electronic card systems using magnetic or otherwise coded cards and slide type readers have been used to replace mechanical locks. These are relatively expensive, both in capital costs and in frequency of maintenance.

One problem associated with key operated locks is the difficulty of re-keying the lock. If a key is lost or stolen, a locksmith is required to provide a set of new keys and
10 alter all the common-keyed locks.

Mechanical card locking systems are known from e.g. US patent No 4149394 to Sornes, which utilise a card having round holes therein. The card can be inserted into the lock, whereby biased ball bearings are displaced. If the ball bearings are displaced in a predetermined manner, the lock can be opened. A similar ring-operated lock is disclosed
15 in US Patent No 4338805 to Nygren. These arrangements all subject the card to considerable wear, and allow for operation from one side only. Further, they cannot be readily re-keyed, nor do they allow for the use of a magnetic strip in addition to the mechanical mechanism. Such arrangements only allow for one possible position for each ball or ring, and do not allow for master keying hierarchies.

20 US patent No 4627252 to Lo discloses a card operated lock using a set of plates arranged to directly receive a card with notches selectively removed in the end. This lock is only operable from one side, and re-keying involves rearranging the plates. The user card directly engages the lock mechanism. This arrangement only allows for one possible position for each ball or ring, and does not allow for master keying hierarchies.

25 It is an object of the present invention to provide a mechanical card lock which overcomes at least partly, the disadvantages of the prior art.

Disclosure of Invention

According to one aspect the present invention comprises a lock mechanism comprising a plurality of generally parallel plates arranged such that the plates are
30 operatively enabled to move relative to each other, said plates including means for engaging a user card, and means for engaging a combination profile, the arrangement being such that said lock mechanism is released only if a user card is engaged which causes said plates to assume a configuration wherein the means for engaging a combination profile are correctly positioned to engage said profile.

35 According to another aspect the present invention provides a lock comprising a plurality

of generally parallel plates arranged such that the plates are operatively enabled to move relative to each other, said plates including means for engaging a user card, and means for engaging a combination profile, and means for driving a latch mechanism, the arrangement being such that said means for driving a latch mechanism is operable only if a user card is engaged which causes said plates to assume a configuration wherein the means for engaging a combination profile are correctly positioned to engage said profile.

According to a further aspect the present invention comprises card adapted to be used with a lock mechanism of the type comprising a plurality of generally parallel plates, said plates including on one edge at least one projection for insertion through a user card, wherein said card has a plurality of openings cut into it of predetermined size, such that the depth of insertion of each of said projections is dependent on the size of the openings, and the depth of insertion and hence extent of movement by said plates provides the combination for opening said lock.

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Brief Description of Drawings

The invention will now be described in more detail with reference to the drawings, in which:

Figure 1 illustrates a simplified schematic view of an assembled lock according to a first embodiment in a cut-away view;

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Figure 2 illustrates in perspective the card and lock components of the first embodiment;

Figure 3 is a perspective view of the body and plate components of the first embodiment;

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Figure 4 shows in perspective one form of the assembled lock;

Figure 5 shows a simplified schematic view of a second embodiment;

Figure 6 shows one embodiment of a card key according to the present invention;

Figure 7 is a perspective view of the plate components according to the second embodiment;

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Figure 8 illustrates partly in perspective an exploded view illustrating the operation of the second embodiment;

Figure 9 is a cut away perspective view of a third embodiment of the present invention;

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Figure 10 shows a perspective view of the assembled lock according to the third embodiment;

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Figure 11 is a cut away perspective view of a fourth embodiment of the present invention;

Figure 12 is a perspective view of an assembled lock according to the forth embodiment showing the combination card shutter open;

5 Figure 13 is a similar view to figure 12 showing the shutter closed;

Figure 14 shows the rear of the assembled lock according to the fourth embodiment;

Figure 15 illustrates the slide plates according to the fourth embodiment; and

Figure 16 illustrates the cam arrangement according to the forth embodiment.

10

Detailed Description

First Embodiment

Referring to Figure 1, the lock 15 is based on body 80. The body 80 includes a number of pins and recesses, whose functions will be described in more detail below, and
15 provides the externally visible surfaces of the lock.

Body 80 supports plate 50 via pins 88, 89 and 101-104. It can be seen that plate 50 in the assembled position is enabled to slide vertically relative to body 80.

Body 80 also supports lock plate assembly 30, via pins 86, 87 and recesses 33, 34. As will be seen from Figure 2, lock plate assembly 30 comprises a series of similar
20 plates 31 stacked in a laminar fashion and enabled to slide horizontally - note the movement available between pins 86, 87 and recesses 33, 34.

Body 80 also includes recess 84 for insertion of combination card 40. Combination card 40 includes a shaped pattern of recesses and protrusions 41 (see Figure 2) with widths matching the thickness of plates 31 so that the plates 31 are
25 pushed horizontally into a pattern defined by combination card 40. Spring 91 retained by pin 105 maintains the plates in position when no combination key 40 is in place.

Plate 50 supports, via pins 51 and 52, and recesses 23, 24, key plate assembly 20. The key plate assembly 20 comprises a set of plates arranged similarly to lock plate assembly 30, and of the same thickness but of a different cross-sectional shape.

30 Bolt 70 rests on plate 50 and is secured in the locked or open position by pin 54. Spring 92 retains the bolt 70 in position. Bolt 70 includes recesses 72, 73 in its upper surface which define the open and locked positions respectively.

Referring to Figure 2, user card 10 includes various slots 11, the distance from the end 13 of each of which is predetermined, while the sideways displacement defines a
35 particular key combination from the variety available. Preferably, the slot



combinations 11, 12 at each end are mirror images to facilitate locking and unlocking from either side of the door.

The operation of the interlocking mechanism will now be described with reference to Figure 2.

5 User card 10 is inserted into the cavity 27 of key plate assembly 20. The plates 21 and thus lugs 26 are upward relative to user card 10, the lugs 26 pass through the recesses 11 in user card 10, causing plates 21 to re-align horizontally. The mechanism for relative movement will be described below.

10 The thereby re-aligned plates 21 accordingly define a specific pattern in the protruding tabs 25 which extend upwardly from the plates.

Referring to the lock plate assembly 30, the combination key 40 when inserted displaces the plates 31 so as to create a specific pattern of recesses 32 in the base of the lock plate assembly 30.

15 If the pattern of recesses 32 and tabs 25 match, the tabs are received in the recesses and the lock released (as will be described below).

It will therefore be appreciated that for each combination card 40 there is a corresponding pattern of plates formed, and hence a corresponding pattern of slots 11 in user card 10.

20 The exact number of recesses, and hence plates, may be varied as desired with corresponding alternatives to the number of key plates 21 and lock plates 31.

Figure 3 shows in detail the other lock components. Referring also to Figure 2, the operation of the lock will be described.

25 Cam means 60 is received in recesses 56 and 82 (not shown). As cam means 60 is rotated clockwise, it raises plate 50 and hence key plate assembly 20 towards lock plate assembly 30. It also lifts pin 57 in slot 72. As the key plate assembly 20 is moved up, the lugs 22 are pushed into slots 12 of the user card 10 and hence are shifted horizontally in a pattern corresponding to the key. As cam means 60 is rotated towards the top position, tabs 25 and recesses 32 approach each other. If they match, and tabs 25 are received in recesses 32, then pin 57 is lifted clear of slot 72, the cam acts on recess 30 71, and the bolt 70 moves to the locked position. On further rotation, pin 57 enters slot 73 and so retains bolt 70 in the locked or unlocked position.

Preferably, spring means (not shown) ensures that key plates 21 return to the aligned position as they are lowered, so as to not retain a record of the correct alignment of the plates for opening.

35 It will be appreciated that if one key is lost or otherwise "re-keying" of the lock



is required, all that is needed is a new combination card 40 and a set of new user cards 10. This system may be used to enhance security in hotels, by providing each guest with a randomly selected key and combination cards.

An example of a possible external configuration is shown in Figure 4. Combination card 40 has already been placed in opening 84. User card 10 is inserted into slot 85, and knob 63 rotated. If the correct key is inserted, it will rotate from locked to unlocked or vice-versa: otherwise, it will only rotate part-way and will not move bolt 75.

Second Embodiment

10 Illustrated in figures 5 to 8 is an embodiment of the present invention which utilises a set plate configuration, wherein the combination can only be changes by replacing one or more plates. This embodiment uses a preferred stepped plate arrangement for engaging the card.

The lock according to this embodiment comprises a lock body 202 having pins 203
15 located thereon. A lever slide plate 214 which slides up and down and is located by pins 201,203. (Slide plate 214 is also visible in Figure 8.) The lever slide plate 214 has attached to it, by means of pins 199, 205, 219, a series of card engaging means in the form of slide plates 206. As illustrated in Figure 7 and Figure 8, the slide plates 206 are located in staggered formation as this allows a greater distance between the holes 222
20 on card 221, illustrated in figure 6. Slide plates 206 have a stepped portion 209 on an upper portion thereof, whilst at a middle or lower portion there are locked gates 217, one on either end of slide plates 206. Having a gate 217 on either end allows the slide plates 206 to be reversible , and so they can be arranged in alternate arrangement as illustrated in Figure 7 with steps portions 209 on the left and right hand side. The slide
25 plates 206 are mounted on pins 199, 205, 219 which are attached to plate 4 , and as illustrated in Figure 5 a spring 208 biases slide plates 206 relative to pins 201,203 on lever slide plate 214.

The locking mechanism also includes a bolt plate 210 having a gate post or pin 211. The bolt plate 210 is locked either in the open or in the closed position when the
30 gates 207 are not aligned. The body of the locked mechanism includes a slot 215 for the insertion of card 221 (illustrated in Figure 6). Also pivoted to the body 202 is a shaft 60 which (as in the first embodiment) has a dual purpose of pushing the slide plates in an upward direction and once the gates 207 are aligned, so as to open channel 230, moving the bolt 211 to the locked or unlocked position. These actions are performed in
35 this arrangement when the card 221 having the correct combination is inserted in the



slot 215. The shaft 60 is of a shape to engage recesses 223, 224 in the plates 214 and 210.

Operation of the locking device 202 is as follows. A card 221 is inserted in slot 215. The card is of a reversible nature and the lock 202 can be opened from either side.

5 Once in position, the card has holes 222, preferably of a square or rectangular nature, which when correctly positioned allow step portion 209 of each slide plate 206 to move in an upward direction until such time as a step of step portion 209 cannot pass through the hole 222 in card 221. The length of the slot or hole 222 in the card 221 determines the length of travel in the vertical direction which the slide plate 206 will move. When
10 the slide plate 206 is prevented from moving any further through card hole 222 the slide plate 214 continues in an upward direction compressing respective springs 208 of those slide plates 206 which can move no further. Slide plates 206 that can move will continue to do so until such time as a corresponding step engages the side of the hole 222 on card 221. When all the step portions 209 of slide plate 206 are in the correct
15 position, gates 207 on adjacent slide plates 206 are in an aligned orientation so as to form channel 230, allowing the gate post 211 on bolt plate 210 to move into the gate 207. A single turn of shaft 60 (e.g. by a mating knob) which can only occur when user card 221 is in its correct position will open or unlock lock 202.

Once the gate is located inside channel 230 of slide plate 206 , if so desired, the
20 user card 221 can be removed with the locking mechanism in the secured unlocked position.

The user card 221 as illustrated in Figure 6 preferably also contains a magnetic strip for use in those situations where other information may be required , or possibly other locking mechanisms can be associated with the mechanical locking mechanism of the
25 present invention. The arrangement of holes 222 allows the presence of a magnetic strip without diminishing the possible number of combinations.

Possible variations include the provision of latching means to generally operate the lock, and deadlocking means to make the bolt 210 go through a double length movement in order to ensure deadlocking of lock 202.

30 Combinations of these locks whilst not being variable can be changed by changing the combination of slide plates 206 . The locking mechanism 202 has preferably 7 or 8 slide plates 206. The locking mechanism 202 can operate with any number of slide plates 206, however, a lower number will result in a decrease in the number of combinations which are possible and thus a reduction in security level.

35 One of the advantages of the present invention is that the card is not worn and the



lock mechanism is not worn by the action of inserting the card. Wearing occurs only when the shaft 60 is turned, and this does not transfer any force to the card.

Third Embodiment

This embodiment of the invention allows for use of the stepped plate arrangement ,
5 together with a simple re-keying procedure using a combination card.

Referring to Figure 9, there is shown generally a lock 220 including a setting or combination card carriage 247 supported via pins 253 and 254 received in recesses 253, 254. Cam means 246 is defined in carriage 247.

10 Combination card receiving means 243 is arranged on carriage 247, and is adapted to receive combination card 244.

Plate assembly 249 comprises a number of slide plates 242 having a predefined stepwise configuration on or in an upper surface thereof, as has been described in relation to the second embodiment. However, according to this embodiment each slide
15 plate 242 also includes, remote from the stepwise configured upper surface, a tab or lug 245 engageable in a corresponding slot 256 in combination card receiving means 243.

Combination card 244 includes a number of slots or holes 265 of predetermined configuration to match the configuration of the number of lugs 245 on slide plates 245.

User card 221 as previously described includes recesses 222 , which may be of
20 any desired configuration, but are preferably square or rectangular, which when correctly positioned with respect to the step portions of slide plates 242 allow the step portions to move in an upward direction until such time as a step of the step portion cannot progress any further.

Biasing means 248 in the form of a spring biases the combination card receiving
25 means 243 in the direction of slide plates 242 and if the combination card 244 corresponding to the user card 221 is present in the receiving means 243, the lock can be opened.

Figure 10 provides a depiction of a preferred external lock configuration, similar to figure 4. Shutter 255 is slidable with respect to the body of lock 220, and provides
30 added security in that it acts as a barrier to improper insertion of a combination card 244. The shutter 255 is operable and openable by user card 221 to allow ingress of a combination card 244 into receiving means 243 only if the correct user card 221 is inserted into user card slot 85. Latch mechanism 75 may be of any suitable type .

The operation of the interlocking mechanism can be described as follows.

35 User card 221 is inserted into slot 85 and the cam means 246 is rotated by knob

63, preferably in an anti-clockwise direction. The step portions of slide plates 242 pass upwardly through the recesses 222 in user card 221, causing the slide plates 242 to re-align horizontally. The re-aligned plate assembly 249 accordingly defines a specific pattern of the lugs 245 on slide plates 242. The user card 221 thus facilitates the
 5 formation of a desired lug combination.

On matching of the correct user card/ slide plate combination, shutter 255 slides open, allowing the insertion of combination card 244 through slot 85 and engages card receiving means 243. The combination card 244 has a predefined punched pattern therein, which is configured to align with the combination formed by the lugs 245 as the
 10 cam means 246 is rotated further.

Spring 248 biases the card receiving means 243 towards the lugs 245 if the correct combination card 244 is inserted into the receiver 243. On matching, the lugs 245 will pass through the card 244, allowing the cam means 246 to continue to rotate and to thereby facilitate unlocking of the lock.

15 It will be realised that if re-keying of the lock is for some reason required or desired, it is a simple matter of changing the combination card 244 so as to correspond to a new user card 221 combination.

Fourth Embodiment

20 A further example of a lock utilising the principles of the present invention will be described with reference to Figure 11. This example is the preferred mode of implementing the invention.

Figure 11 shows a generally similar embodiment to Figure 9, utilising user cards 221 and combination cards 244 of similar type.

25 The slide plate assembly 360 comprises alternating left 362 and right 361 slide plates. The front slide plate 369 and rear plate 368 are slightly different in their construction from the other plates as will be discussed below (see Figure 15).

The combination assembly 301 comprises a carrier 308 for receiving combination card 244, recesses 306, 307 receiving corresponding pins 302, 303, teeth 305 and
 30 projection 304. Pins 302, 303 are part of the body, which is not shown so as to enhance clarity.

Main plate assembly 350 is arranged so as to travel up and down relative to the combination assembly 301 and slide plate assembly 360, and includes cam device 320. Lock plate 340 lies parallel to plate assembly 350, and includes teeth 342
 35 corresponding to teeth 305.

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Cam device 320 includes a channel 328 for receiving a handle, cams 322 and 324 for raising and lowering respectively plate assembly 350, and cams 323 and 321 for raising and lowering respectively the lock plate assembly.

It will be understood that for correct operation to occur, combination card 244 and user card 221 are correctly inserted into their respective positions, and that they must be a corresponding pair.

In use, rotating cam device 320 initially causes cam 322 to engage fans 352 (the left side is not visible) which engage teeth 351 and start to lift main plate assembly 350. This starts to lift drive plate assembly 360 via compressible fingers 363 on each drive plate, and rollers 364. It will be understood that (after some travel) step portions of slide plates 361, 362 enter the slots of user card 221 as far as possible, and that each slide plate then ceases further upward motion. This causes lugs 367 on the (as drawn) right sides on the slide plates 361, 362 to form a specific pattern.

At the same time, cam 323 engages the lock plate 340 and moves it up and to the left. This also moves, via spring 345, the combination assembly 301.

It can therefore be seen that the combination assembly 301 is moving left and up at the same time as the slide plates 361, 362 are engaging user card 221 and forming a pattern of lugs 367. If the lugs match the combination card, both parts continue their relative travel, the lugs enter the slots, and the lock completes its movement to the unlocked position.

If, however, any one of the lugs 367 is in the incorrect position, the travel of the combination assembly 301 is blocked, spring 345 compresses, and teeth 305 and 342 engage so as to halt travel. It is emphasised that very little force is sufficient to cause this engagement, so that little or no wear of the combination card 244 occurs.

Moreover, there is very little force transferred to the user card 221 - merely the weak upward movement of the slide plates 361, 362.

Preferably, the slide plates 361, 362 and as much as possible of the rest of the mechanism are formed from a relatively rigid plastics material such as perspex. The cam device 320, and lock-operative parts of the lock plate 340 and combination carriage 301 are preferably formed from a metal alloy so as to provide break resistance.

Preferably, means are provided with the knob (not shown) for turning cam device 320 such that excessive force results in slippage of the knob, rather than damage to the mechanism.

The fan 352 and tooth 351 lifting arrangement provides for a smooth action when the knob is rotated.

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When the knob is released and returned to the initial position, cam 321 returns the lock plate through engagement with a suitable recess (not shown), and cam 323 lowers the main plate assembly 350.

5 The operation of the "fingers" 370 of the slide plates 361, 362 is important to functionally implementing a reliable lock.

When the fingers 370 are rising in the recess 344, rollers 364, 365 maintain pressure on the fingers, and are forced into the upper part of recess 375 by the resilient outward force of the fingers 370. At the end of the fingers 370 travel, this force is removed and rollers 364, 365 can drop into the lower part of the recess. Extra fingers
10 371 on the front slide plate 369 and rear slide plate 368 ensure this occurs prior to the downward travel.

In the embodiment shown in Figure 11, any time a correct card is engaged, the combination card can be changed. The present invention, however, lends itself readily to master keying, and many possible keys may match any given combination card -
15 particularly maid keys, and master keys (of various levels) may be employed. The more slots and options for size, the more possibilities for cards are created. Dummy slots or indentations are preferably included in the combination cards thus further increasing the difficulty of surreptitiously manipulating the lock.

In a master keyed environment, for instance a hotel, it is desirable that only
20 authorised personnel can alter the combination key. Using an arrangement with a master key, the lock has two open positions, only one of which allows the combination card 244 to be removed. The H-shaped opening on slide plate 369 allows, in combination with pin in shutter 380, for such an arrangement. Normal user keys leave the pin at the top, and then bottom, of the left arm of the H. The master key leaves the pin in the middle, so that
25 the shutter 380 can be slid back (see Figures 12, 13) and the combination card changed.

The lock, shown in Figures 12 and 13, also allows for a privacy feature. As shown in Figure 14, the user card may be inserted into a slot once in the room. This engages a levelled end of a pin, which protrudes 381 so as to indicate a desire for privacy. It also engages a small lug which prevents other cards, or the maid's card, from being fully
30 inserted. The master card may include a notch corresponding to the lug, so as to override the privacy request if necessary.

The user cards and combination cards may be formed from any suitable material, but a plastics material such as is commonly used for credit cards is preferred.

It will be appreciated that while the embodiments shown relate to one-sided key
35 arrangements, the present invention is readily adapted to be opened from either side of

the lock if desired. It will also be noted that the mechanism can be manufactured such that it can be used for either left or right hand opening doors.

Cards may be cut by any suitable means, but a computer-controlled punching system is currently preferred.

5 Industrial Applicability

The present invention is suitable for use particularly in commercial or industrial situations, such as hotels, offices, factories, schools and the like. It is also, however, applicable for domestic use. Whilst the embodiments described relate to door latch applications, the invention can equally be used for locks of any type, subject to
10 modifications of size, shape, etc.

It will be appreciated that variations and additions are possible within the spirit and scope of the invention.

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**CLAIMS**

1. A lock mechanism comprising a plurality of generally parallel plates arranged such that the plates are operatively enabled to move relative to each other, said plates including means for engaging a user card, and means for engaging a combination profile, the arrangement being such that said lock mechanism is released only if a user card is engaged which causes said plates to assume a configuration wherein the means for engaging a combination profile are correctly positioned to engage said profile.
2. A lock mechanism according to claim 1, wherein said means for engaging recesses and said means for engaging a combination profile operate in directions which are not parallel.
3. A lock mechanism according to claim 1, wherein said means for engaging recesses and said means for engaging a combination profile operate in directions which are substantially perpendicular.
4. A lock mechanism according to claim 1, wherein said means for engaging a combination profile comprise a set of lugs extending from a plurality of said plates, and said combination profile comprises a combination plate including a plurality of slots, the arrangement being such that a corresponding user card will cause said lugs to be positioned such that they can be received by the slots.
5. A lock mechanism according to claim 1, wherein said means for engaging a user card comprise projections extending from a plurality of said plates, said projections being adapted to pass into openings in said user card.
6. A lock mechanism according to claim 5, wherein said projections are constructed such that they extend different depths into the card depending on the shape of the openings.
7. A lock mechanism according to claim 6, wherein said projections include a step-like surface, such that the depth of insertion depends on the length of the opening in the card through which the projection passes.



8. A lock mechanism according to claim 4, wherein the combination plate is adapted to be removed and replaced so as to rekey the lock mechanism.

9. A locking mechanism according to claim 1, wherein the arrangement is such that the lock handle is mechanically buffered from the means for engaging a user card, and means for engaging a combination profile, such that only a limited amount of force can be operatively transferred to the user card or the combination profile.

10. A lock comprising a plurality of generally parallel plates arranged such that the plates are operatively enabled to move relative to each other, said plates including means for engaging a user card, and means for engaging a combination profile, and means for driving a latch mechanism, the arrangement being such that said means for driving a latch mechanism is operable only if a user card is engaged which causes said plates to assume a configuration wherein the means for engaging a combination profile are correctly positioned to engage said profile.

11. A card adapted to be used with a lock mechanism of the type comprising a plurality of generally parallel plates, said plates including on one edge at least one projection for insertion through a user card, wherein said card has a plurality of openings cut into it of predetermined size, such that the depth of insertion of each of said projections is dependent on the size of the openings, and the depth of insertion and hence extent of movement by said plates provides the combination for opening said lock.

12. A card according to claim 11, further comprising magnetic stripe means for operating a magnetic card reader.

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