

MULTI-WAY DOOR LOCK ✓**FIELD OF THE INVENTION**

The present invention relates to locks for doors. In particular, the
5 present invention relates to a multi-way locking mechanism suitable for
blast doors and security doors, gates, and others.

BACKGROUND OF THE INVENTION

Security doors and blast doors with multi-locking functions are
10 widely used. The locks are typically operated by cam or lever
mechanism, and directly manufactured as part of the door. Although
these prior art locks and doors serve the prescribed functions, they are
non-modular and cumbersome to operate, assemble or install.

It is therefore an object of the present invention to provide a multi-
15 way lock that is modular and convenient to operate and install.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is the perspective view of the housing of a lock according to one
embodiment of the present invention.

20 Figure 2A is a perspective view of the lock in Fig.1 with one side panel
removed to show the internal mechanism.

Figure 2B is a front view of the crank disc shown in Figure 2A.

Figure 3A is a schematic drawing of the lock in Fig. 2A in the double locking position.

Figure 3B is a schematic drawing of the lock in Fig. 2A in the single locking position.

5 Figure 3A is a schematic drawing of the lock in Fig. 2A in the release position.

Figure 4 shows a partially cut away door to show an example of the lock according to the present invention coupling to two locking mechanisms.

10 SUMMARY OF THE INVENTION

The present invention provides a lock that interlinks at least two locking mechanisms for sequential operation. The lock is modular in design, and can be incorporated to various types of doors and locking mechanisms. The present lock is operable between a release position,
15 an intermediate single locking position and a double locking position. In the release position, both locking mechanisms are unlocked, allowing the user to open the door. In the intermediate single locking position, the first locking mechanism is moved to the locking position, while the second locking mechanism remains in the unlocked position.
20 In the double locking position, both the first and second locking mechanisms are moved to the locking position to provide extra protection against the door being forced open. A door with a lock according to the present invention opens and closes just like a normal door. A normal downward turn of the door handle opens the door. The

handle, however, can be pushed vertically upwards to give the second locking feature.

According to the specific embodiment, the lock contains a rotary crank means rotatably coupled to a housing with its axis of rotation normal to the plane of the door. The first and second locking mechanisms are coupled to the crank means via a first and second actuating means respectively. A stopping means, in the form of a slot preferably in the housing panel, engages the lock to limit the rotation of the crank means to a predetermined angle. The crank means rotated in one direction results in the lock being in the release position. When the crank means is rotated in the opposite direction, the lock is moved to the double locking position. When the crank means is moved to a prescribed intermediate position between the release position and the double locking position, only the first locking mechanism is in the spring loaded locking position, while the second locking mechanism is in the unlocked position.

DESCRIPTION OF THE INVENTION

The following detailed description describes the preferred embodiment for implementing the underlying principles of the present invention. One skilled in the art should understand, however, that the following description is meant to be illustrative of the present invention, and should not be construed as limiting the principles discussed herein. In the following discussion, and in the claims the terms

“including”, “having” and “comprising” are used in an open-ended fashion, and thus should be interpreted to mean “including but not limited to”. Also, the term “couple” or “couples” is intended to mean either an indirect or direct mechanical connection. Thus if a first device
 5 “couples” to a second devices, that connection may be a direct mechanical connection or through an indirect mechanical connection via other devices or connections. Locking mechanisms are used as a generic term for latches, bolts, deadbolts, among others.

Referring first to Fig.4, the first locking mechanism shown in this
 10 example is spring loaded latch **22** adapted for engagement with the unhinged side **20a** of the door frame, while the second locking mechanism is bolt set **24** also adapted for engagement with the unhinged side of the door frame. Bolt set **24** includes lever **24b** coupled to four separate bolts **24a** indirectly via coupling to push rod
 15 **24c** and bolt lever **24d**. An upward movement of lever **24b** causes push rod **24c** to be shifted upwards. This translates into a counter-clockwise rotation of bolt lever **24d**, causing bolts **24a** to move towards the door frame and into the locked position.

Referring next to Figure 2B, rotary crank disc **26** can be divided
 20 into four quadrants, **CQ1**, **CQ2**, **CQ3** and **CQ4** arranged sequentially in a counter-clockwise direction for ease of description. An arcuate slot **36** is provided in **CQ1** and aperture **38** provided in adjacent **CQ2**. The profile of disc **26** contains two notches **P1** and **P2**. **P1** is located at the junction of **CQ3** and **CQ4**. **P2** is located at the junction of **CQ2** and
 25 **CQ3**. Arcuate slot **36** contains proximal end **36p** and distal end **36d**.

Referring now to the preferred embodiment shown in Figures 1 and 2A, the lock has a housing containing an outer edge 48 and two opposing panels 32 and 52 that are installed co-planar to the panel of the door. Each of panel 32 and 52 contains arcuate slot 50 having proximal end 50p and distal end 50d, and linear slot 51 having proximal end 51p and distal end 51d. Crank disc 26 is rotatably mounted to housing panels 32 and 52 via collar 34. Latch 22 and lever 24b are coupled to crank disc 26 via actuating arms 28 and 30 respectively. For ease of explanation, a horizontal axis (A-A') and a vertical axis (B-B') are shown on housing panel 52, with the centre of crank disc 26 in the assembled lock as the intersection of the two axes. The vertical axis is parallel to the outer edge 48 of the lock. The horizontal axis is perpendicular to the vertical axis and, in this embodiment, coincide with the longitudinal axis of latch 22. The two axes divide the housing panels 32 and 52 into four quadrants (Q1 to Q4). One end of actuating arm 28 is coupled to crank disc 26 via pin 37 through aperture 38 such that when crank disc 26 is rotated, actuating arm 28 follows the rotary movement of aperture 38. The other end of actuating arm 28 is slidably coupled via pin 27 to slot 29 at the end of latch 22. Slot 29 has proximal end 29p and distal end 29d. Pin 27 also slidably engages linear slot 51 in panels 32 and 52. A second pin 39 couples actuating arm 30 to crank disc 26 through slot 36 such that pin 39 can slide within slot 36. Pin 39 also slidably engages arcuate slot 50 in panels 32 and 52. Collar 34 is keyed to the centre of crank disc 26 and is provided with a square bore 46 through which

a square shaft passes for the mounting of the door lock handles 58 (shown as dotted lines in Figs. 3A-C). Spring 40 biases latch 22 towards the outer edge 48 of the lock with protrusion limited by stopper 25. Spring 42 interacts with notches P1 or P2 to provide a tension
 5 when crank disc 26 is positioned at the single locking position or the double locking position to eliminate the loss motion feeling of slot 36. Spring 44 biases actuating arm 30 towards the downward position and, together with the offset of pin 60, provide the positive effect of "over the centre" function. Latch 22 is secured to the lock housing by
 10 set screw 21.

Figures 3A-C show how the present lock is operated. In these schematic drawings, the position of slot 50 and 51 in the housing is shown as dotted lines for ease of understanding. The position of handle 58 is also shown in dotted lines to illustrate the operating steps of the
 15 lock. The reference numerals four quadrants (CQ1-CQ4) of crank disc 26 are shown next to the four quadrants (Q1-Q4) of the housing panel to better illustrate the relationship between the housing panel and crank disc 26 as it rotates into the various positions.

Referring first to Fig.3B, spring 40 maintains latch 22 tensioned
 20 towards the outer edge 48 of the lock (i.e. locked position) and spring 44 biases lever 24 in the downward (i.e. unlocked) position. Crank disc 26 is biased in the single locking position by spring 42 such that CQ1 coincide with Q1 and slot 36 lies in Q1, and pin 39 is abutted against the proximal ends 50p and 36p of slots 50 and 36
 25 respectively. Pin 27 is in the centre of slot 51 and against proximal end

29p. In this resting position (i.e. single locking position), pin **27** is positioned in the centre of slot **51**. Disc **26** is maintained tensioned in this resting position by the interaction between spring **42** and notch **P1**. This also eliminates the loss motion feeling.

5 When an operator turns the handle downward by 30 degrees (Fig.3C), crank disc **26** is rotated in the clockwise direction such that **CQ1** now coincide with **Q4** and slot **36** is now rotated to **Q4**. Pin **39** is prevented from moving downwards, as it is abutted against proximal end **50p** of slot **50**. However, crank disc **26** can rotate in this clockwise
10 rotation as slot **36** is able to slide along pin **39**. As it rotates, crank disc **26** pulls pin **37** and arm **28** towards the interior edge **56** of the lock, thereby pulling latch **22** inwards, opening the door. When the operator releases the handle, spring **40** recoils and draws crank disc **26** back to the resting (single locking) position. When the door closes free hand,
15 latch **22** slides back and forth between distal end **29d** and proximal end **29p** of slot **29**, such that the lock can latch onto the door frame without affecting pin **27**.

 When the operator pushes the handle upwards to the vertical position, crank disc **26** is rotated in a counter-clockwise direction into
20 the double locking position, as shown in Fig. 3A, such that **CQ1** now coincide with **Q2**. This causes slot **36** to rotate into **Q2**, pulling with it pin **39**. Since pin **39** is coupled to arm **30**, lever **24b** is activated to the upward (locked) position. While crank disc **26** is rotating, pin **37** is pushed downwards, pushing arm **28** towards the outer edge **48** of the
25 lock in the first 45 degrees of rotation. When pin **37** reaches the

horizontal axis A-A', pin 27 slides to the distal end 51d of slot 51 and distal end 29d of slot 29 concurrently. When crank disc 26 rotates further in the counter-clockwise direction until pin 37 passes horizontal axis A-A' into Q3, pin 27 slides back towards the centre of the slot 51 and the proximal end 29p of slot 29. Therefore, as the shifting of crank disc 26 from the single to the double locking position, the bolt is activated into the locking position while latch 22 is unaffected i.e. remains in the locked position. Spring 42 engages to notch P2 of disc 26 to ensure that the disc and handle maintain tension in this double locking position, thereby eliminating the loss motion feeling of slot 36.

The movement of pin 39 is restricted according to the arc length of slot 50. In the embodiment shown, slot 50 spans the entire Q1 (i.e. around 90 degrees), with the distal end 50d just extending into Q2. Pin 60, on the other hand, is attached to lever 24 such that it is offset into Q1. Arm 30 will be approximately 5 degrees from the vertical axis B-B' when it is in the double locking position. This arrangement, together with spring 44, allows actuating arm 30 to be maintained in an "over the centre" arrangement and thereby and in a stable condition while in the double lock position, such that unless an intentional push is given in the clockwise direction by the operator, the lock will not jump back into the resting position.

While the present invention has been described particularly with references to the aforementioned figures with emphasis on a left-hand door lock which can be opened by rotating the handle in the clockwise direction, it should be understood that the figures are for illustration only

and should not be taken as limitation on the invention. According to the preferred embodiment, the present invention may be converted to a right-hand door lock by simply switching the orientation of latch 22. Set screw 21 is designed to be removable with an Allen key, allowing the lock to be easily convertible at the time of installation. The direction of rotation would clearly be altered when the orientation is changed. The angle in which the door handle can turn is determined by the length of slot 36, and can be modified by the manufacturer. The position of coupling of the second actuating arm to the second locking mechanism is preferably well within off-set to maintain a stable double locking position. In the embodiment described above, a 5 degree off-set is provided, but the degree of off-set may be readily modified. In addition it is clear that the method and apparatus of the present invention has utility in many applications where locks are required. The actuating arms may be connected to various other locking mechanisms to provide a modular and 3-way operable door lock. It is contemplated that many changes and modifications may be made by one of ordinary skill in the art without departing from the spirit and the scope of the invention described.



CLAIMS

- 1 1. A multi-way lock for a door comprising :
 - 2 a housing;
 - 3 a rotary crank means, rotatably coupled to said housing, having an
 - 4 axis of rotation normal to the plane of said door;
 - 5 a first actuating means coupling a first locking mechanism to said
 - 6 crank means;
 - 7 a second actuating means, slidably coupling a second locking
 - 8 mechanism to said crank means; and
 - 9 a stopping means, engaging said crank means and said second
 - 10 actuating means to limit the rotation of said crank means to a
 - 11 prescribed angle, said angle defining a release position and a
 - 12 double locking position with a single locking position
 - 13 therebetween, said first locking mechanism and said second
 - 14 locking mechanism being in an unlocked position when said crank
 - 15 means is in said release position; said first locking mechanism
 - 16 being in a locked position and said second locking mechanism
 - 17 being in an unlocked position when said crank means is in said
 - 18 single locking position, said first locking mechanism and said
 - 19 second locking mechanism being in a locked position when said
 - 20 crank means is in said double locking position.



- 1 2. A lock according to claim 1 wherein
- 2 said crank means is a disc comprising four disc quadrants, said
- 3 disc having an arcuate disc slot in the first disc quadrant; said
- 4 second actuating means slidably coupling to said disc slot in said
- 5 disc; and
- 6 said first actuating means coupling to said disc at the second disc
- 7 quadrant adjacent said first disc quadrant.
- 1 3. A lock according to claim 2 wherein
- 2 one side of said door is hinged to a doorframe;
- 3 said housing comprises an outer edge adjacent to the unhinged
- 4 side of said door and two panels coplanar under operating
- 5 conditions to said door; said disc rotatably coupled to said panels;
- 6 said lock divided into a first, second, third and fourth panel
- 7 quadrant by a horizontal axis and a vertical axis, the intersection of
- 8 said horizontal axis and said vertical axis being at the centre of
- 9 said disc, said first panel quadrant positioned proximate said
- 10 hinged side of said door on the upper half of said lock, said
- 11 second panel quadrant positioned proximate said outer edge on
- 12 the upper half of said lock, said third panel quadrant positioned
- 13 proximate said unhinged side of said door on the lower half of said
- 14 lock, said fourth panel quadrant positioned proximate said hinged
- 15 side of said door on the lower half of said lock;



16 said first actuating means being a first actuating arm with one end
17 coupled to said first locking mechanism by a pin 27 and the
18 opposite end coupled to said disc by a pin 37;

19 said second actuating means being a second actuating arm with
20 one end coupled to said second locking mechanism by a pin 60
21 and the opposite end coupled to said disc by a pin 39; and

22 said panel of said lock further containing

23 an arcuate slot 50, functioning as said stopping means, in
24 said panel spanning said first quadrant, said second
25 actuating arm slidably coupled to said disc slot and said slot
26 50 by said pin 39; and

27 a linear horizontal slot 51 co-axial to said horizontal axis
28 and proximate said outer edge, said first actuating arm
29 coupled to said slot 51 by said pin 27.

1 4. A lock according to claim 3 wherein said first locking mechanism is
2 a spring-loaded latch with a horizontal latch slot, said latch slot co-
3 axial to and shorter than said slot 51, wherethrough said pin 27
4 extends.

1 5. A lock according to claim 4 wherein said first and second disc
2 quadrants coinciding with said first and second panel quadrants
3 respectively when said disc is in said single locking position; said
4 first and second disc quadrants coinciding with said fourth and first
5 panel quadrants when said disc is in said release position; and
6 said first and second disc quadrants coinciding with said second



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- 7 and third panel quadrants respectively when said disc is in said
- 8 double locking position.

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