United States Patent [19]

Hickman

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[54] **MAGNETIC LOCK**

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[52] **U.S. Cl.** ..... **70/38 B,** 70/276

[51] **Int. Cl.** **E05b 47/00,** E05b 67/22

[58] **Field of Search** ..... 70/38 B, 27 C, 38 R, 70/38 A, 38 C, 413

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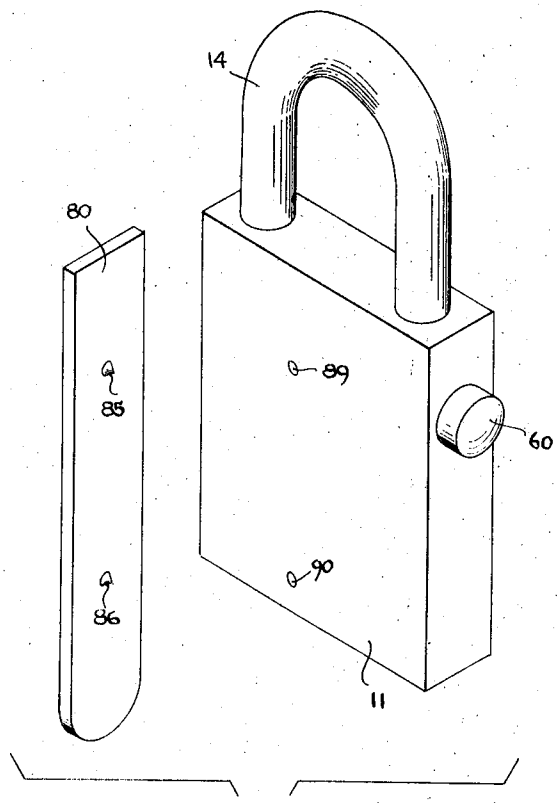
Attorney—Edward A. Sokolski et al.

[57] **ABSTRACT**

A plurality of tumblers are rotatably mounted in the main body portion of a lock, these tumblers having keyways formed therein. Each of the tumblers has a magnetic pole piece imbedded therein, these pole pieces being located at a predetermined angular position about the rotation axis of the tumblers relative to the keyways, the tumblers having common rotation axes. A bar member is mounted adjacent to the tumblers, this bar member having a finger portion extending therefrom which is adapted to fit into the tumbler keyways. A magnetic key is utilized to open the lock, this key having magnetic pole pieces imbedded therein of opposite polarity to corresponding pole pieces in the tumblers. The key pole pieces are thereby drawn opposite corresponding tumbler pole pieces to rotate the tumblers to bring the keyways thereof into alignment with the finger portions of the bar member. This permits an actuator arm to drive the latch for the lock so as to open the lock.

9 Claims, 9 Drawing Figures



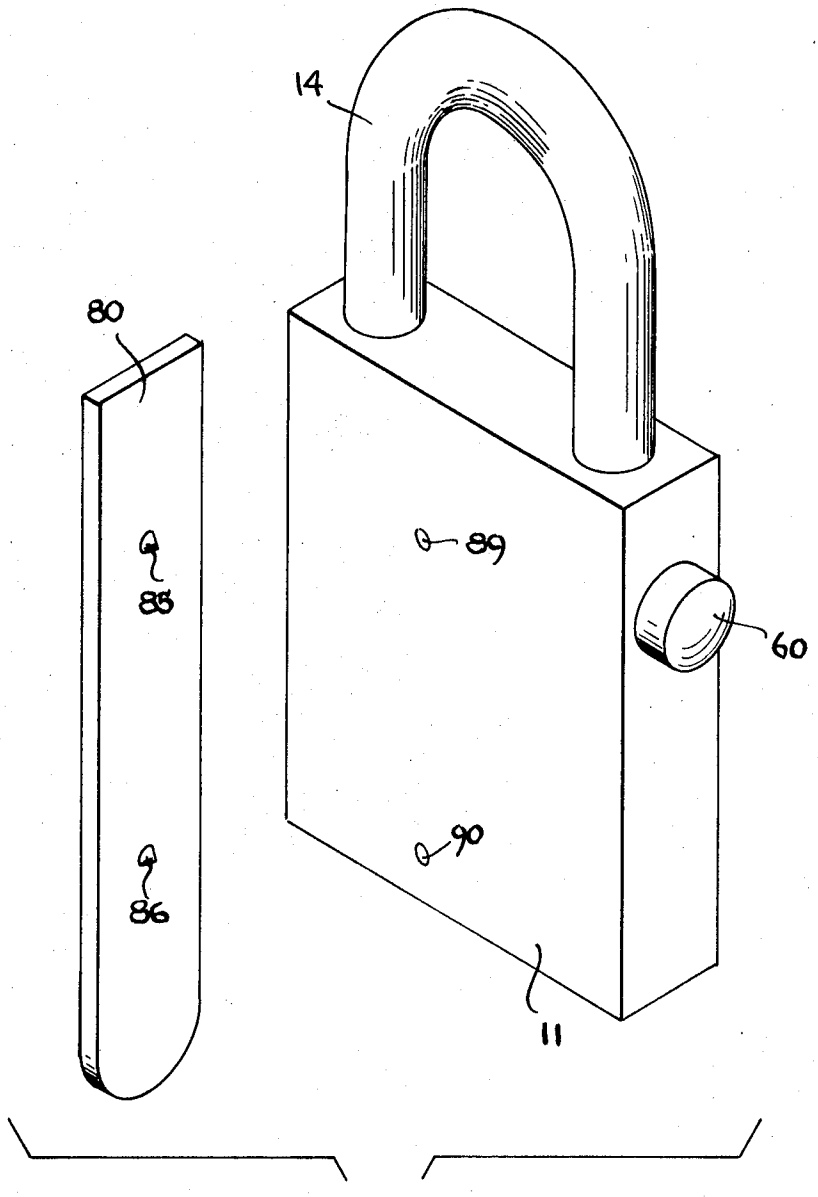


FIG. 1

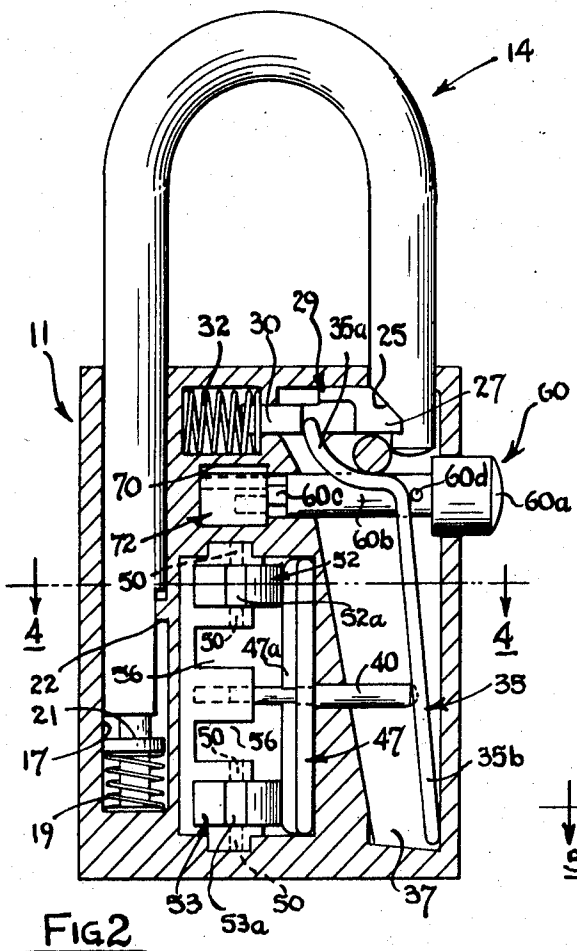


FIG.2

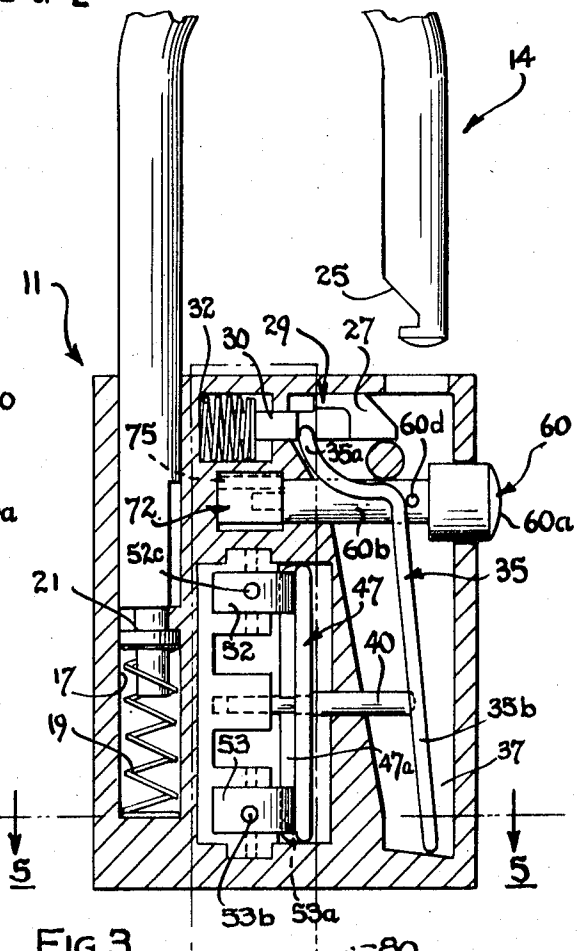


FIG.3

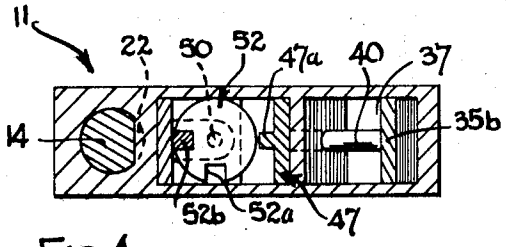


FIG.4

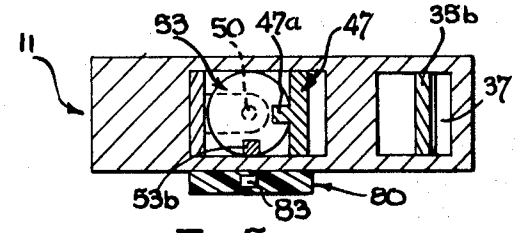


FIG.5

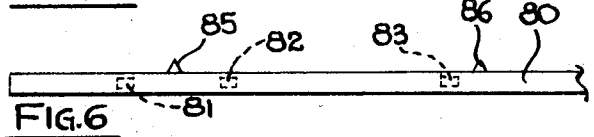


FIG.6

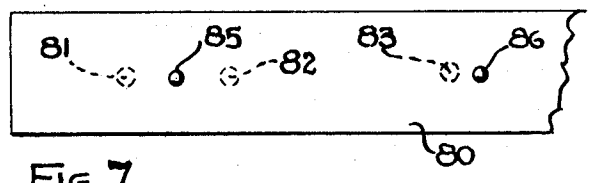


FIG.7

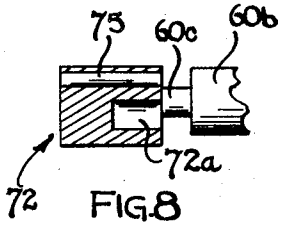


FIG.8

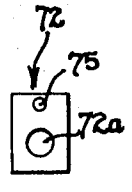


FIG.9

MAGNETIC LOCK

This invention relates to magnetic locks and more particularly to such a device utilizing rotatably magnetic tumblers arranged in a predetermined coded fashion, which are operated in response to a magnetic key having pole pieces arranged therein in a corresponding code.

Lock devices utilizing magnetism for actuating their locking mechanisms have been in use for some time. These devices have the advantage over conventional key operated locks in that they are generally less subject to being picked in view of the fact that no immediate access to the tumblers is provided, as is provided through the keyholes of key operated locks. While combination locks, of course, avoid this problem, they have the disadvantage of requiring memorization of the combination numbers for their operation.

Magnetic locks have been developed in the prior art such as described in my U.S. Pat. No. 3,395,555 which utilize keying devices which do not employ coded keying which enables the use of a great number of different codes. This has the obvious disadvantage of limited security. Other prior art magnetic lock devices, while utilizing separate coded magnetic keying arrangements for each lock to afford high security, tend to be overly complicated and costly in their design. A further disadvantage of many prior art magnetic lock devices is that they fail to provide a "dead-bolt" device to resist the operation of the latch mechanism when the lock is in the locked condition, thus making it possible for the latching mechanism to be forced.

The device of this invention overcomes the aforementioned shortcomings of the prior art in providing a simple and reliable magnetically operated lock of economical construction. The device of this invention also lends itself to the use of a great variety of keying codes so as to afford high security. Further, the device of this invention utilizes a highly resistant "dead-bolt" device which prevents forcing of the lock, this "dead-bolt" device being magnetically released by the key.

It is therefore an object of this invention to improve the security of magnetic lock devices.

It is a further object of this invention to provide a magnetic lock device which is less subject to being forced than certain prior art devices.

It is still another object of this invention to provide an improved magnetic lock device capable of utilization with a great variety of keying codes.

Other objects of this invention will become apparent as the description proceeds in connection with the accompanying drawings, of which:

FIG. 1 is a perspective view of a preferred embodiment of the invention;

FIG. 2 is a cross-sectional view of the preferred embodiment shown in the locked condition;

FIG. 3 is a cross-sectional view of the preferred embodiment shown in the unlocked condition;

FIG. 4 is a cross-sectional view taken along the plane indicated by 4—4 of FIG. 2;

FIG. 5 is a cross-sectional view taken along the plane indicated by 5—5 in FIG. 3;

FIG. 6 is an elevational vieew illustrating the key utilized in the preferred embodiment;

FIG. 7 is a top plan view illustrating the key of the preferred embodiment;

FIG. 8 is a cross-sectional view illustrating the "dead-bolt" device of the preferred embodiment; and

FIG. 9 is an end view of the "dead-bolt" device.

Briefly described, the device of the invention comprises a non-magnetic main body having a conventional padlock shackle slidably installed therein. A spring actuated latching mechanism engages a mating groove in one end of the shackle to retain it in the locked position. The latching mechanism is actuated by an actuator arm mounted in the main body portion which in turn is driven by a manual plunger. The actuator arm is connected through a shaft to a bar which has an elongated finger portion extending therefrom. With the lock in its locked condition, the finger portion of the bar abuts against the side walls of a plurality of tumblers which are rotatably mounted in the main body of the lock. Under these conditions, the actuator arm is prevented from actuating the latching mechanism by virtue of the obstruction to its freedom of movement by the shaft and bar. The movement of the plunger is also limited by a "dead-bolt" member mounted in the main body portion of the lock.

The tumblers have keyways formed therein which mate with the bar finger portion. These tumblers also have magnetic pole pieces installed therein positioned at a pre-determined angle about their common rotation axis relative to the key-ways. To open the lock, a key is utilized, this key having magnetic pole pieces installed therein, these pole pieces being positioned and having a plurality such as to attract associated pole pieces on the tumblers. The tumblers are thereby rotated so as to align their keyways with the elongated finger, thereby permitting the finger to enter the keyways. The key also has a magnetic pole piece which mates with an associated pole piece in the "dead-bolt" so as to align an aperture in the "dead-bolt" with an associated plug portion on the end of the plunger, thereby permitting the plug portion to enter the aperture. Under these conditions, the plunger is permitted to drive the actuator arm, this arm now having sufficient freedom of motion to actuate the latching device.

Referring now to the drawings, a preferred embodiment of the invention is illustrated. The lock includes a main body portion **11** which has a shackle **14** slidably installed therein for limited longitudinal motion. Shackle **14** may be fabricated of a magnetic material such as steel, while it is essential that main body portion **11** be fabricated of a non-magnetic material such as aluminum or brass. One end portion of shackle **14** is slidably mounted in cylindrical channel **17** of the body portion. A spring **19** is installed in the bottom of channel **17** to urge the shackle upwardly, as shown in FIG. **3** when the lock is in its opened condition. Shackle **14** has an end ring portion **21** which is engaged by retainer portion **22** on the wall of channel **17**, which limits the upward movement of the shackle and prevents it from being pulled out of channel **17**, the end of the shackle being undercut to accommodate the retainer portion. Shackle **14** has a grooved end portion **25** which mates with the end portion **27** of latch **29**.

Latch **29** has a plunger **30** on one end thereof which abuts against spring **32**, this plunger being urged to the right as shown in FIG. **2** by spring **32** to cause end portion **27** of the latch to tightly engage groove **25** of the shackle. Actuator arm **35** is mounted in cavity **37** of the main body portion and has an arcuate portion **35*a*** which engages plunger **30**, and a straight portion **35*b*** which is attached to shaft **40**. Shaft **40** is attached to

bar 47. Bar 47 is substantially T-shaped having a finger portion 47*a* forming the base of the "T".

Rotatably mounted in main body portion 11 on pins 50 for rotation about a common axis are tumblers 52 and 53. Tumblers 52 and 53 are disc shaped and have axial keyways 52*a* and 53*a* respectively formed in their peripheries. Tumblers 52 and 53 further each have a respective magnetic pole piece 52*b* and 53*b* imbedded therein at a predetermined angular position about the tumbler rotation axis, relative to the keyways. A plunger 60 has an end button portion 60*a* for manual actuation, a shaft portion 60*b* which extends into main body 11, and end finger portion 60*c*, and a tab 60d which extends from shaft portion 60*b*. Tab portion 60*d* engages actuator arm 35. loosely mounted in compartment 70 formed in main body portion 11 is dead bolt device 72. Dead bolt device 72 is free to move in compartment 70 and has an aperture 72*a* formed therein which mates with finger portion 60c of the plunger. This dead bolt device, as can best be seen in FIGS. 8 and 9, is in the form of a small block 72 having an aperture 72a formed therein and a magnetic pole piece 75 is fitted therein.

With the lock in the closed condition as shown in FIG. 2, tumblers 52 and 53 are in a position such that keyways 52*a* and 53*a* are not in engagement with finger portion 47*a*. This is generally assured by virtue of the magnetic attraction between the magnetic material of shackle 14 and spring 19 and the magnets 52*b* and 53*b* of the tumblers. With the elongated finger portion 47*a* riding against the walls of the tumblers, actuator arm 35 is prevented from moving to the left (as shown in FIG. 2). Thus, bar 47 is prevented from being driven by plunger 60 to actuate latch 29. Further, the end finger portion 60*c* of the plunger is out of alignment with aperture 72*a* of the dead bolt device, this dead bolt device thus resisting any sidewise movement of the plunger to prevent the forcing of the plunger to open the lock.

The key member 80, which can best be seen in FIGS. 6 and 7, is fabricated of a non-magnetic material and has a plurality of pole pieces 81–83 imbedded therein. Pole pieces 81–83 are installed below the surface of the key, with the surfaces of the key being appropriately covered and finished so that the location of the pole pieces is not discernible. A pair of aligning tabs 85 and 86 extend from the surface of key 80 and mate with corresponding recesses 89 and 90 respectively formed in the outer surface of main body portion 11. With tabs 85 and 86 inserted in corresponding recesses 89 and 90 on the main body portion, magnetic pole pieces 81–83 are longitudinally aligned with pole pieces 75, 52*b* and 53*b* respectively.

The associated pole pieces on the key and on the dead bolt and tumblers are chosen to be of opposite polarity, i.e., for example, if pole pieces 75, 52*b* and 53*b* are all North poles, then pole pieces 81–83 would all be South poles. Various combinations of opposite polarities for the various pole pieces can be utilized, and thus this is one way in which the coding for the lock can be varied. A further way in which the coding can be varied is by positioning tumblers 52 and 53 in various combinations of pairs of recesses 56 of main body portion 11. Also, three tumblers can be used and variously placed in the available four recesses. Further variations in coding can be achieved by variously positioning pole pieces 81–83 across the width dimension of key 80 and correspondingly changing the axial angular relationship between the pole pieces on the tumblers and their associated keyways.

With key 80 placed in position to open the lock, as shown in FIG. 3, the magnetic pole pieces 75, 52*b* and 53*b* are attracted towards pole pieces 81, 82 and 83 respectively. This draws dead bolt device 72 upwardly so that finger portion 60c can enter cavity 72*a*. This also causes tumblers 52 and 53 to be rotated so that keyways 52*a* and 53*a* are placed opposite elongated finger 47*a*. Thus when plunger 60*a* is manually actuated, finger 47*a* enters the keyways and the plunger is able to move to the left, as shown in FIG. 3. This results in a corresponding leftward movement of actuator arm 35 thereby driving latch 29 out of engagement with the grooved end portion 25 of the shackle to open the lock.

The device of this invention thus provides a simple and reliable magnetic lock having a high degree of security and a capability for a great variety of key codes.

While the device of the invention has been described and illustrated in detail, it is to be clearly understood that this is intended by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the following claims:

I claim:

1. A magnetic lock device comprising:

a main body portion,

a plurality of tumblers mounted in said body portion for rotation about a common axis, said tumblers having axial keyways formed in their peripheries, said tumblers further each having a magnetic pole piece installed therein at a predetermined angular position relative to the keyways about the common rotation axis,

a bar member having an elongated finger portion extending therefrom, said finger portion being adapted to engage the keyways of said tumblers,

an actuator arm mounted in said main body portion,

means interconnecting said actuator arm and said bar member,

a shackle member having one end portion thereof mounted in said main body portion for slidable motion relative thereto,

a latching device mounted in said main body portion, said latching device being adapted to engage the other end portion of said shackle member,

manually operable drive means for driving said actuator arm against said latching device, and

key means having magnetic pole pieces installed therein for each of the pole pieces of said tumblers whereby when said key means is placed in position along the main body portion of said lock device, the pole pieces of said key means attracts associated pole pieces of said tumblers to rotate said tumblers until the keyways thereof are opposite said elongated finger portion of said bar member, thereby enabling said finger portion to enter said keyways when said manually operable means is actuated to permit said actuator arm to actuate said latching device.

2. The device of claim 1 and additionally including a dead bolt device positioned opposite said manually operable drive means, said dead bolt device having a pole piece therein and an aperture for receiving the end portion of said manually operable drive means, said key means having a pole piece therein for aligning the pole piece on said dead bolt to align the aperture thereof

with the aforementioned end portion of said manually operable drive means to permit said drive means to be driven.

3. The device of claim 1 wherein said means for interconnecting said bar member and said actuator arm comprises a shaft fixedly attached at one end thereof to said bar member and pivotally connected at the other end thereof to said actuator arm.

4. The device of claim 1 wherein said bar member is substantially T-shaped, the finger portion thereof forming the base of the T.

5. The device of claim 1 wherein said manual drive means comprises a plunger having a button portion thereof extending to the outside of said main body portion, and a shaft portion extending into said main body portion, said shaft portion having a tab extending therefrom which engages the actuator arm.

6. In a magnetic lock having a main body portion and a shackle member mounted in said body portion for latching engagement therewith,

latch means mounted in said body portion for latching one end portion of said shackle member,

actuator means for actuating said latch means,

a plurality of tumblers mounted in said body portion for rotation about a common axis, said tumblers having axial keyways formed in their peripheries, said tumblers further each having a magnetic pole piece installed therein at a predetermined angular position about said common axis relative to the keyways,

a bar member having finger means extending therefrom for engaging the keyways of said tumblers, said actuator means being connected to said bar member,

means for manually driving said actuator means, and

key means having magnetic pole pieces installed therein for each of the pole pieces of said tumblers,

whereby when said key means is placed along the body portion in a predetermined position, the pole pieces of the key means each attracts an associated pole piece of the tumblers so as to rotate the tumblers until the keyways thereof are opposite the finger means of the bar member, said finger means entering said keyways when said manual driving means is actuated, to permit the actuator means to actuate the latch means.

7. The device of claim 6 and additionally including a dead bolt device positioned opposite said means for driving the actuator, said dead bolt device having a pole piece therein and an aperture for receiving the end portion of said means for driving the actuator, said key means having a pole piece therein for aligning the pole piece on said dead bolt to align the aperture thereof with the aforementioned end portion of said manually operable drive means to permit said drive means to be driven.

8. The device of claim 7 wherein said bar member is substantially T-shaped, the finger means thereof forming the base of the T.

9. The device of claim 6 wherein said means for manually driving the actuator means comprises a plunger having a button portion thereof extending to the outside of said main body portion, and a shaft portion extending into said main body portion, said shaft portion having a tab extending therefrom which engages the actuator means.

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