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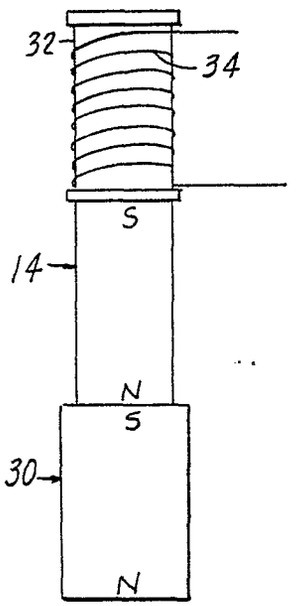
(54) Locking mechanisms and method of magnetizing a locking magnet therefor.

(57) The method starts from a magnet (14) having its opposite ends magnetized such that north and south pole be equally strong.

One pole (N) of the locking magnet is connected to the opposite pole (S) of a second magnet (30). A magnetic field is applied to the opposite end (S) of the locking magnet, and is collapsed to reverse the polarity of said opposite end, whereby the strenght of the magnetic pole adjacent the second magnet becomes relatively weak compared to the pole adjacent the magnetic field.

Use in order to prevent undesirable interaction between the locking magnets in magnetic locksets.



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"Locking mechanisms and method of magnetizing a locking magnet therefore"

This invention relates to magnetic key operated locks.

This invention also relates to a method of magnetizing a locking magnet therefore.

Although the invention is adapted for use in locking mechanisms actuable by magnetic keys of different configurations it will be described with respect to locking mechanisms operable by a relatively flat card key. Examples of the type of locking mechanism which lends itself to use with the present invention are shown in U.S. patents numbers 3 995 460 ; 4 133 194 and copending European Patent application No. 80 401 171.6 filed on August 8, 1980.

The locking mechanisms disclosed in the above noted prior art include a sliding block provided with a plurality of bores or recesses in which cylindrical shaped magnets are slidably received. When the mechanism is locked these magnets are attracted to a position in which they enter corresponding holes in a fixed locking plate thus preventing sliding unlocking movement of the block until a proper magnetic key is inserted in the mechanism to repel the magnets out of the locking plate holes.

Heretofore, the spacing between usable holes in the sliding block has been required to be relatively large due to interaction between adjacent magnets. It has been necessary to space adjacent magnets sufficiently far apart so that movement of one magnet does not cause corresponding movement of an adjacent magnet, or the proximity of magnets could prevent desired movement of one or more of them. Naturally this limits the number of magnets that may be employed within a given area and reduces the possible number of code combinations.

The purpose of the present invention is to improve magnetic key operated locking devices by permitting adjacent magnets to be placed closer together than has heretofore been possible.

According to one object of the invention, the locking mechanism that includes a pair of magnets in side by side spaced apart relationship is characterized in that one pair of corresponding ends of said magnets are each magnetized to provide a magnetic field of relatively low strength while the opposite pair of corresponding ends are magnetized to provide magnetic field of relatively high strength.

This permits to maintain substantially unchanged the strength of interaction between each magnet and the device such as a key intended to move it, while considerably reducing the strength of interaction between both magnets. It is thus possible to provide the magnets of the pair very near one another.

According to a second object of the invention, these features are especially usefull in the case of a magnetic key operated locking mechanism that included a slidable core movable from a locked position to an unlocking position by a properly coded magnetic key and formed with a plurality of recesses each containing a magnetized pin with each of said pins being slidable along said recesses between locking and unlocking position.

According to a further object of the invention, the method of magnetizing a locking magnet for use in a magnetic card key operated lockset, comprising the step of providing a locking magnet having its opposite ends magnetized to provide north and south poles of substantially equal strength, is characterized in that said method moreover comprises the steps of :

- magnetically connecting one end of said locking magnet to a second magnet at the pole of said second magnet that is opposite to the pole of said one end ,
- applying a magnetic field to the opposite end of said locking magnet and collapsing said field to reverse the polarity of said opposite end ,

whereby the strength of the magnetic pole at said one end of said locking magnet becomes relatively weak compared

to the pole at said opposite end.

Other features and advantages of the invention will be apparent from the following specifications.

In the accompanying drawings, given as examples:

Fig. 1 is a fragmentary cross section of a magnetic card key locking mechanism in locked position.

Fig. 2A is a greatly enlarged view of a portion of a structure similar to Fig. 1 with the nonmagnetic cover plate and attracting shield plate shown in elevation to simplify the drawing.

Fig. 2B is similar to 2A showing another card and magnet action.

Fig. 3 is a similar view of a portion of the structure of Fig. 2A with the card key inserted and showing the result of incorporating magnets made in accordance with the invention.

Fig. 4 is a schematic view showing one method of magnetizing a locking magnet in accordance with the invention.

Fig. 5 is a view of the locking magnet obtained by the method according to the invention.

In Fig. 1 a portion of a magnetic card key operated lockset is shown including a nonmagnetic slidable block or core 10 in which are formed a plurality of transversely extending bores 12 in which are slidably received elongated cylindrical magnets 14. Alongside core 10 is a stationary nonmagnetic locking plate 16 formed with holes 18 into which the adjacent ends of magnets 14 are adapted to be received to prevent downward movement of core 10 when the lockset is in locked condition.

Positioned next to locking plate 16 is a fixed nonmagnetizated cover plate 20 which is interposed between locking plate 16 and a fixed magnetizable shield plate 22. This shield plate aids in magnetically anchoring the magnets within holes 18 when the lockset is locked.

The above described structure is found in greater detail in my European patent application 80 401 171.6 to which reference is made for other details not referred to herein.

In Fig. 2A the above noted structure is shown in greater detail with the distance between adjacent bores 12 relatively closer than shown in Fig. 1.

If it is assumed that magnets 14 are magnetized in the conventional manner with the end surfaces of equal and opposite magnetized strengths indicated by N and S then when the magnets are relatively close together there is a magnetic attraction between the north pole of each magnet and the south pole of the adjacent magnet as indicated by the full line arrows in Fig. 2A. The undesirable result of this is that if a properly coded card key 24 is inserted in the lockset and such key is provided with two magnetic north pole spots 23 to repel both the upper and lower magnets out of the locking plate 16 then either the upper or lower magnet may remain in locking position due to the stronger action of the adjacent magnet. This interaction of closely adjacent magnets prevents the lock from being opened by a properly coded key.

In a reverse situation, as shown in Fig. 2B, when the upper and lower magnets of Fig. 2A have dissimilar poles entering the locking plate 16 the adjacent ends of the magnets attract each other thus magnetically locking them together in parallel, and if one magnet is repelled by a card spot the other magnet also moves to unlocking position without a repelling spot and the lock may be opened by an incorrectly coded card.

Another result of having conventionally magnetized magnets too close together is that, after a plurality of adjacent magnets have been repelled into core 10 by a properly magnetized magnetic card key they may not all

return to their locking positions in locking plate 16 after the key has been removed despite the attraction of shield plate 22.

By the present invention the above noted undesirable results are substantially eliminated by greatly reducing the intensity of magnetization of the end of each magnet that is opposite the end that cooperates with locking plate 16. Thus as seen in Fig. 3 the surfaces of the inner ends of the magnets are labelled "s" to indicate a lesser intensity of magnetization than the opposite end. The reduced mutual attraction of the pins is represented by dotted line arrows in Fig.3. The incorrectly coded key 24 of Fig. 3 repells the upper magnet 14 but the lower magnet being little affected by the upper one remains in locked position.

One method of obtaining this result is schematically indicated in Fig. 4. The full strength magnet 14 is preferably of alnico 6 grade material and is first magnetically connected to another magnet 30 of somewhat stronger field strength than magnet 14, and preferably ceramic. For example, if the strength of each pole of magnet 14 is about 500 gauss then the strength of each pole of ceramic magnet 30 should preferably be about 600 gauss.

A strong magnetizing field is then applied to the upper mouth pole of magnet 14 by a capacitance discharge device which includes a core 32 and windings 34. This sort of device is disclosed in U.S. Patent No. 4 128 851 and is wired so as to provide a collapsing field to reverse the polarity of the upper pole of magnet 14 from south to north as seen in. Fig. 5.

However, it has been found that such a magnetizing field, although of sufficient strength to reverse the original polarity of the upper south pole, has a substantially reduced effect on the opposite pole which

in Fig. 5 is labelled "s" to indicate its relative weakness.

In the example giver above the polarity reversal may result in creation of a new north pole of about 450 gauss while the opposite south pole attains a pole strength of 200 gauss or less.

The reason for the above noted result is believed to be that, although the electrical charges which create the new north pole are intensely concentrated on the surface of the upper end of magnet 14, the charges of opposite polarity which tend to create a south pole at the opposite lower end are scattered or nullified within the magnet and therefore tend not to create a strong concentrated field. This result apparently is due to the fact that the influence of the collapsing field at the upper end of the magnet tends to travel through the magnet to the lower end but is repelled and neutralized by the strong magnetic field of the permanent magnet 30.

Steel magnets thus polarized will no longer be attracted to the magnet 30 but will adhere to the adjacent end of magnetizing core 32 allowing the magnets to be easily placed end to end in a holder similar to a cocktail straw. Stored in this manner the magnets of properly selected material and dimensions will not change their magnetic strengths appreciably and may then be loaded into blocks such as shown at 10 in Fig. 1-3. By providing the strong end of each magnet with a selected color, the polarity and the strong end may be readily identified.

When magnets of about .100 inch in diameter and .215 inch long are magnetized as above described they can be placed very close together at approximately 7/32" centers and work very effectively to complex masterkey systems in mechanisms of the type disclosed in

my U.S. Patent No. 4 133 194.

It will be understood that although in the above noted example the reversal of poles was from south to north a similar but opposite procedure applies when a north pole is to be reversed to south.

CLAIMS

1. A locking mechanism that includes a pair of magnets (14) in side by side spaced apart relationship characterized in that one pair of corresponding ends (s) of said magnets are each magnetized to provide a magnetic field of relatively low strength while the opposite pair of corresponding ends (N) are magnetized to provide magnetic fields of relatively high strength.

2. A mechanism according to claim 1 characterized in that said magnets (14) are arranged with their longitudinal axis substantially parallel, means (10, 12) being provided for supporting said magnets (14) for longitudinal movement.

3. A mechanism according to claim 1 characterized in that said mechanism includes a slidable core (10), said magnets (14) being slidably supported in said core (10).

4. The method of magnetizing a locking magnet for use in a magnetic card key operated lockset, comprising the step of :

providinding a locking magnet (14) having its opposite ends magnetized to provide north and south poles of substantially equal strength,
characterized in that said method moreover comprises the steps of :

magnetically connecting one end of said locking magnets (14) to a second magnet (30) at the pole (S) of said second magnet (30) that is opposite to the pole (N) of said one end,

applying a magnetic field to the opposite end (S) of said locking magnet (14) and collapsing said field to reverse the polarity of said opposite end, whereby

the strength of the magnetic pole (s) at said one end of said locking magnet (14) become relatively weak

compared to the strength of the pole (N) at said opposite end.

5. The method of claim 4 characterized in that the magnetic fild strength of said second magnet (30) is stronger than the field strength of the adjacent pole (N) of said locking magnet (14).

6. A magnetic key operated locking machanism that includes a slidable core (10) moveable from a locked position to an unlocking position by a properly coded magnetic key (21) and formed with a plurality of recesses (12) each containing a magnetized pin (14) with each of said pins (14) being slidable along said recesses (12) between locking and unlocking positions, characterized in that one pair of corresponding ends (s) of said magnets are each magnetized to provide a magnetic field of relatively low strength while the opposite pair of corresponding ends (N) are magnetized to provide magnetic fields of relatively high strength.

7. A magnetic key operated locking mechanism according to claim 6, characterized in that the corresponding ends (s) of said magnets (14) inwardly of said recesses (12) are of relatively low strength.

Fig. 1.

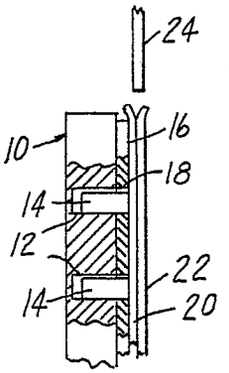


Fig 2B

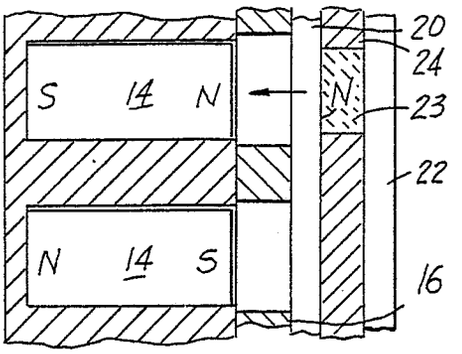
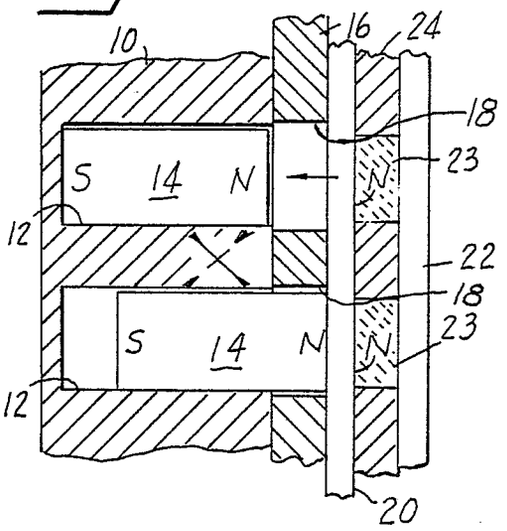


Fig. 2A



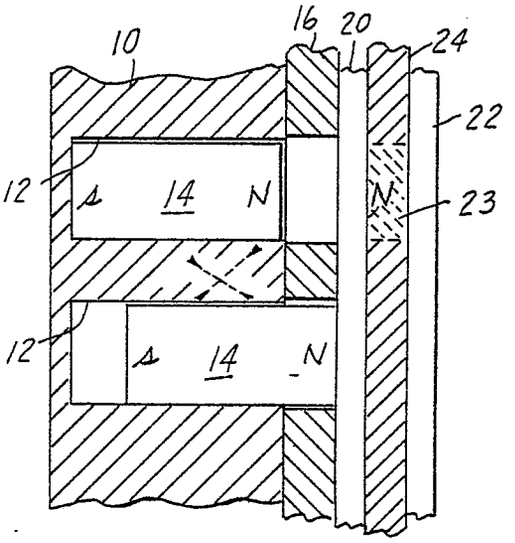


Fig. 3.

Fig. 4.

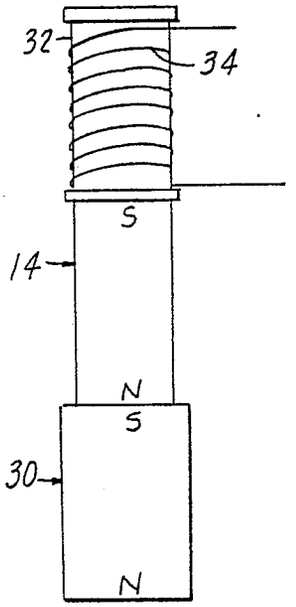
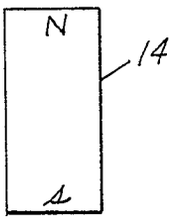


Fig 5



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EUROPEAN SEARCH REPORT

Application number
EP 82 40 1109.2

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
T	W.H. WESTPHAL "Kleines Lehrbuch der Physik" 6th to 8th editions 1967, SPRINGER-VERLAG, Berlin/Heidelberg/ New York page 139 and following pages, chapter 5, Section I. Magnete. Magnetische Felder * page 140, lines 5 to 7 *	1,7
A	CH - A5 - 620 492 (FICHTEL & SACHS AG) * page 4, right-hand column, lines 48 to 68 *	1
D,A	US - A - 4 133 194 (SEDLEY et al.) * claim 1; fig. 1 *	1

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

E 05 B 47/00
H 01 F 7/02

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

E 05 B 47/00
H 01 F 7/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	10-09-1982	WUNDERLICH

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