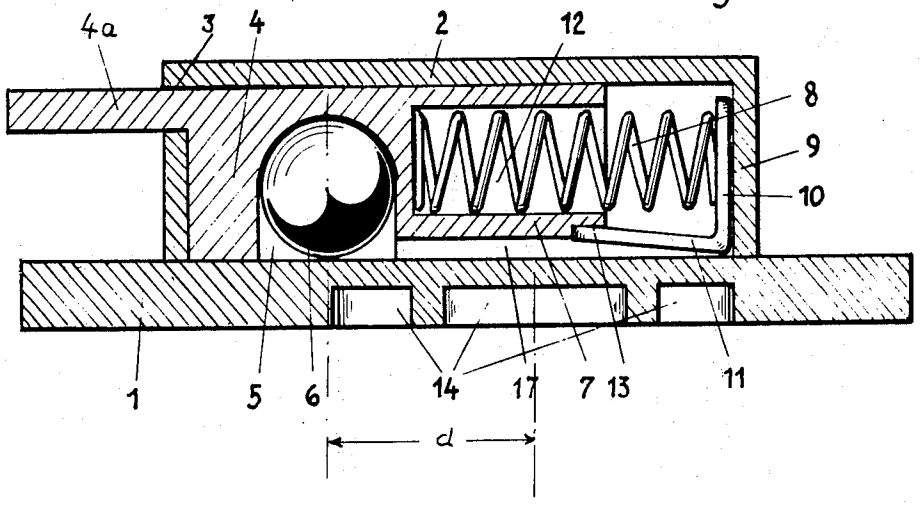
March 2, 1971 H. RUDOLF ET AL 3,566,636

MAGNETICALLY OPERABLE LOCKING DEVICE

Filed Dec. 9, 1968

Fig. 1



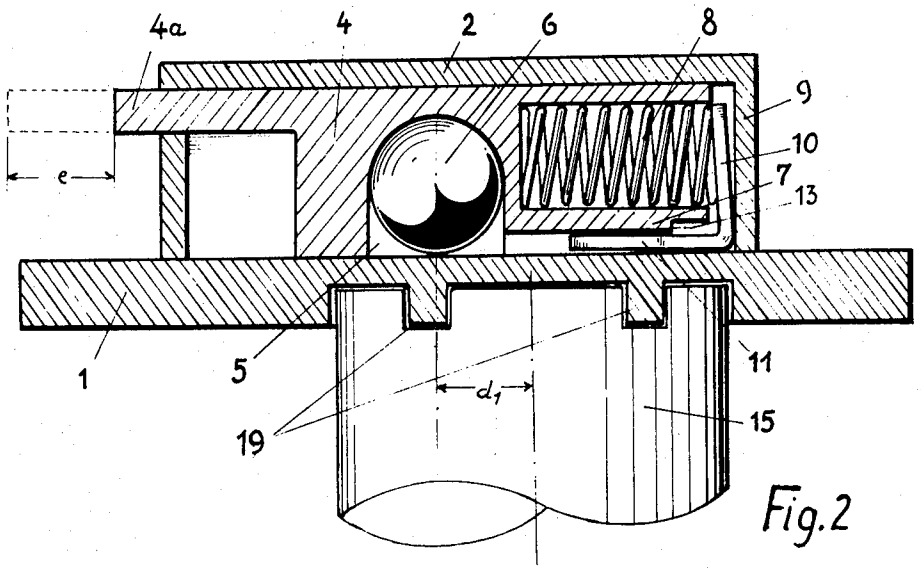


Fig. 2

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MAGNETICALLY OPERABLE LOCKING DEVICE

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ABSTRACT OF THE DISCLOSURE

A magnetically operable locking device having latching means in a housing, a spring loaded detent means of magnetically influenced material and magnetic means for releasing the detent. The magnetic means exerts a magnetic field force large enough to include a magnetizable roller, the length of the force being only slightly larger than the distance required to move the latch to an unlocked position.

BACKGROUND AND OBJECTS

This invention relates to a magnetically operable lock for doors, drawers, and strongboxes, particularly for piggy-banks, with a magnetic key which can be applied to the front of the lock.

Various magnetically operable locks of this type are known in the prior art. In these locks the tumbler or locking combinations, in the form of magnetically influenced balls or pins, operate only if the latter are attracted by a corresponding combination of magnetic components in an applicable plate or magnetic key, thus making it possible to open the lock. The containers required that the balls and pins be very carefully and accurately assembled mechanical devices which, for each individual lock, required individual parts that must be differently designed and/or arranged.

The state of the art also shows magnetically operable locks, as door openers, which work without a key. Here, the bolt trap falls into the locking plate opening due to the action of a tensioned spring, while the door is opened with the help of an electromagnet. Such locks are not suitable for attachment to piggy-banks or the like, in particular. They do not offer suitable variation possibilities in this particular design.

It is the purpose of this invention to create a magnetically operable lock for doors, particularly piggy-banks of the above mentioned type, whereby the complicated closing and opening mechanism is considerably simplified and whereby all locks are provided with the same simple locking mechanism consisting of light-weight and inexpensively produced individual parts, as well as activating magnets of uniform shape and size which must always be attached at the same place on the lock, in order to unlock the box. The latch of the magnetically operable lock is moved out of its closing position by means of a magnetic force which operates against a closing or locking spring force.

GENERAL DESCRIPTION

This problem is solved in the following manner: a trap or latch which consists of material that cannot be influenced magnetically is slidably guided in a lock housing along a base plate. In a recess which is open toward the base plate, this latch contains a magnetically conducting sliding or rolling part, which, in case the lock is in the closed position, lies within the radius of effectiveness of a magnetic field of an electromagnet or a permanent magnet. A magnet can be inserted in a recess which is made in the base plate and which has a certain pattern. The magnet of course has a pole or poles which are designed

in accordance with this pattern. The magnetic field of the magnet is only a little bit further away from the gliding or rolling part than roughly about the length of the opening lift of the latch head which protrudes through an exit slot in the lock housing.

In this design, the magnetic key and its force lines, which come out of one or more poles and which run perpendicularly to the direction of movement of the latch, grasp the magnetically conducting movable or rolling part which is lodged in the nonmagnetic latch. The force lines have a tendency to draw this gliding or rolling part as much as possible into the center of the magnetic field which is located in and in front of the middle of the pole or poles of the magnetic key. Here, the force of the pressure spring, which is coordinated with the force of the available electromagnet or permanent magnet is overcome.

If the pressure spring which moves the latch into the closing position, is so dimensioned that only an electromagnet or permanent magnet (made of an aluminum-nickel-cobalt alloy) with a very high field of intensity, whose pole, especially provided with special recesses and raised portions accurately fits into the correspondingly designed recess in the base plate, can move the latch into its open position, then it is practically impossible for any unauthorized person to open the box. Smaller magnets, which might likewise fit into the recess, do not have enough force. Larger magnets will not fit into the recess and their force will not be sufficient to influence the latch and open the lock because of the greater distance between them and the magnetically conducting gliding or rolling part.

The pressure spring is best placed in a blind hole in the latch tail in a compressed state, in other words, in the lock's open position.

In a further design of this invention, a shank of a locking piece, consisting of magnetically conducting flat material, can be clamped between the housing wall and the adjacent end of the pressure spring. The other shank of this locking piece is at an angle of about 80° toward the first shank and runs essentially parallel to the inside of the base plate and opposite that base plate. The free end of this second shank comes to rest against a stepped contact surface of the latch which points toward the direction of the opening, when the lock is in the closed position. This contact surface of the latch has a recess at its side which points toward the base plate, below the blind hole containing the pressure spring, for the reception of the bent shank which can be drawn away from the contact surface by magnetic force.

This locking piece enables in a very simple but effective manner to make sure that the latch head cannot be pushed in by hand against the tension of the pressure spring, so long as the electromagnet or permanent magnet has not been inserted or turned on.

If, in accordance, with a further possible version of the object of this invention, the magnetically conducting gliding or rolling part consists of a cylindrical roller, which is placed laterally to the direction of the opening lift, in the recess of the latch, then the base plate is provided with two outside recesses that are arranged next to each other, at an equal interval from the roller axis, in the opening position, as attachment or contact point for the two poles of a horseshoe magnet. This gives the opening force of the horseshoe magnet the desired and adequate strength.

The base plate and the lock housing are preferably made in one piece, consisting of hard, impact-resistant and breakproof plastic material. In the recesses of the base plate, we can provide relief-like patterns in the form of raised circular rings, letters, or numbers. In this way, it is possible to obtain many variation possibilities for

the magnetically operable lock. In accordance with the patterns which are provided relief-like recesses, the associated pole surface of the electromagnet or the permanent magnet also contains correspondingly designed recesses and raised portions. In all of these design forms, the essential point in the opening process is this: the force of the magnet, which is provided with a correspondingly designed pole surface, must be sufficient to draw the magnetically conductible rolling or gliding part, which at first is placed further away in the latch, into the densest area of the force lines, after the angular locking piece has first been drawn away from the contact surface along the latch so that the way can be cleared for the latch. An additional way to make it more difficult to unlock the box would be this: the walled thickness of the base plate in the area of the recesses, could be made less than the integral between all of the other points on the base plate and the magnetically guiding roller or gliding part.

As in most cases, where banking or finance institutions hand out locking piggy-banks, whose keys are retained by the savings bank, one or more electromagnets or permanent magnets would be retained by the savings bank also. In the case of the instant magnetically operated lock, these magnets of course would have the specially designed pole surface. Indeed, the same electromagnet or permanent magnet could be used for all of the piggy-banks to be handed out because the owners of the piggy-banks would hardly be in a position to open the piggy-bank with the customary magnetic devices.

These and other objects will be seen from the specification and drawings wherein:

FIG. 1 is a cross-section of a magnetically operated lock in the closed position, shown on a scale somewhat enlarged, compared to the customary designs, and

FIG. 2, illustrates the device as in FIG. 1, wherein the bolt-latch is in its open position by means of a magnet.

DETAILED DESCRIPTION

The magnetically operable lock, shown in these figures, can be so inserted into the wall of a lid or a door in a container in a piggy-bank which can be closed and which is not shown in the drawing, that the recesses **14** in base plate **1**, preferably made of plastic, will be visible and accessible from the outside. Base plate **1** thus constitutes the outer wall of lock housing **2**. Protruding through exit slot **3** of the lock wall, is a latch head **4***a*, which consists of a non-magnetic material, e.g., hard, breakproof plastic, and which is attached to a latch **4**. Latch **4** contains a recess **5** which is open toward base plate **1** and can be longitudinally moved in the housing. In this recess **5**, is a gliding or rolling part **6** with low friction properties in the form of one or more rollers or balls made of magnetically good conducting material. It fills the height of recess **5** and rolls or glides together with latch **4**, when the latter is moved on the smooth inside wall of base plate **1**.

At the rear end of latch **4** we have a substantially cylindrical hole **12** for the reception of a prestressed pressure spring **8** which is supported along the housing wall **9** opposite latch head **4***a* and which holds latch **4** in the closed position.

Between housing wall **9** and the adjacent end of pressure spring **8**, a shank **10** of a locking piece made of magnetically conducting flat material is clamped. This locking piece has another shank **11** which is bent toward the first shank at an angle of about 80°; this second shank **11** which runs essentially parallel to the direction of movement of latch **4** and is in a recess **17** of latch **4**, directly above base plate **1**.

When the magnetically operable lock is in the closed position, in accordance with FIG. 1, the free end of shank **11** comes to rest against a contact surface **13** on the latch. When the lock is opened (2), it lies between base plate **1** and the lower surface **7** of the rear latch

position. The contact surface **13**, which points toward housing wall **9**, thus constitutes a step or ledge, which is in the recess and extends all the way to the rear end of the latch and is on surface **7**. Pressure spring **8**, which normally holds latch **4** and its latch head **4***a* under prestressed condition in a closed position, presses shank **10**, and along with it the other lower shank **11** of the locking piece, in the clockwise direction into the recess of contact surface **13** and thus enables one to make sure that the latch cannot be pushed back or drawn into its open position by hand, when the spring force is overcome.

In order to cancel out the locking effect of the locking piece, the lower shank **11** must be released from the contact surface **13** and must come to rest against the inside wall of base plate **1** in accordance with FIG. 2.

The recess **14** which is accessible from the outside and which is located in the base plate **1**, serves as contact service for the pole or poles of the manually inserted electromagnet or permanent magnet **15**.

Recess **14** conforms to the shape of the pole surface; the position of this recess **14** with respect to the lock housing is so selected that the magnetically conducting gliding or rolling part **6**, in latch **4**, when in the closed position, already in the effective range of the magnetic field of electromagnet or permanent magnet **15**, has a distance or interval *d*, which is only a little bit bigger than the distance *e* over which the latch head **4***a* must be moved in order to open the lock. Recess **14** in the base plate is so arranged, that the length of the lower shank **11** of the locking piece is so selected that the latter is drawn away from the contact surface **13**, against the force of the pressure spring, when electromagnet or permanent magnet **15** is attached. FIG. 2 shows us that the gliding or rolling part, when the lock is in the opening position, is still removed from the maximum of the magnetic field by a smaller distance d_1; however, shank **11** of the locking device is also located in a correspondingly effective part of the magnetic force lines, so that this illustration would roughly represent the arrangement for the gliding or rolling part and the electromagnet or the permanent magnet that would be best to open the magnetically operable lock.

Inside recess **14** of base plate **1** there are raised patterns **19** to which are associated corresponding recesses in the pole surface of electromagnet or permanent magnet **15**. These patterns can have any desired form, i.e., cylinders, letters, or numbers so that for every lock only one pole surface, adjusted to the patterns, can be used for opening.

In place of the single-pole electromagnet or permanent magnet **15**, which is indicated in FIG. 2, there can also be used a two-pole horseshoe magnet both of whose poles are arranged in the recesses **14**, one behind the other, perpendicularly to the plane of the drawing. In this case, the magnetically conducting gliding or rolling part **6** is a roller. The magnetic flow between the two poles is effectively closed via the roller and represents a very strong opening force. Accordingly, the size of recesses **14** and of the magnets can be kept comparatively small and the tension of pressure spring **8** can be increased to exert a strong closing pressure.

To prevent the unauthorized opening of the lock, electromagnets or permanent magnets with the greatest possible field intensity can be used. If the size of recesses **14** and of the magnetic poles, as well as the spring force, are so dimensioned that the strongest magnets will just accomplish the opening lift of latch **4**, coupled with the simultaneous unlocking of the locking piece, then the unauthorized opening of the lock with a magnet of equal or even greater field of intensity will be practically impossible. This stronger magnet could be attached only outside the recess **14** and its effective force lines would not operate on the gliding or rolling part which opens the lock.

When a so-called mortise dead lock is used then the housing wall **9** can have a protrusion (not shown) at a place corresponding to the latch head **4***a* of latch **4**. With this protrusion, the magnetically operable lock would come to rest under the edge of exit slot **3** and against the inside wall of a piggy-bank. The dimensions of such a mortise dead lock will then not be any larger than known locks of the same type which are opened with keys.

We claim:

1. A magnetically operable locking device comprising:

(a) a housing,

(b) a latch means of non-magnetic material movable within said housing,

(c) a first magnetizable movable member in said latch means,

(d) recess means of a particular design located adjacent said latch adapted to receive magnetic means of a design complementary to said recess design.

(e) a latch head on said latch means protruding from said housing and movable a predetermined distance,

(f) a pivotal locking piece of magnetizable material cooperating with said latch means to retain said latch means in a locked position, said pivotal locking piece comprising a pair of connected shanks at an angle of less than 90° to each other.

(g) said magnetic means exerting a magnetic field force large enough to include said magnetizable movable means, the length of said force being only slightly longer than said predetermined distance of said latch head whereby said magnetizable movable means is pulled toward the center of the magnetic field of said magnetic means.

2. A magnetically operable locking device comprising:

(a) a housing,

(b) a latch means of non-magnetic material movable within said housing,

(c) a first magnetizable movable member abutting against said latch means for effecting movement thereof upon the application of a magnetic field to said first member,

(d) means comprising a pivotal shank of magnetizable material for abutting said latch means to lock same in a predeterminded position and being movable by the application of a magnetic field thereto,

(e) and means located adjacent said latch means and said means comprising a pivotal shank for positively locating a magnetic field applying means, whereby the presence of said magnetic field applying means provides a magnetic field force capable of controlling both the position of said first magnetizable movable member and said means comprising a pivotal shank to effect actuation of said magnetically operable locking device.

3. A magnetically operable locking device as defined in claim **2** wherein said magnetizable movable member is a roller.

4. A magnetically operable locking device as defined in claim **2** including spring biasing means operating on said latch means biasing said latch means into a locked position.

5. A magnetically operable locking device as defined in claim **2** wherein said magnetizable movable member is a roller, said latch means includes an angularly shaped recess conforming to said roller and opening toward a base plate having said design recesses therein, said roller positioned in said angularly shaped recess.

6. A magnetically operable locking device comprising:

(a) a housing.

(b) a latch means within said housing,

(c) spring biasing means for forcing said latch means into one position,

(d) a recess in said latch means,

(e) locking means having a pair of shanks connected to each other at an angle of less than 90°,

(f) said spring biasing means having one end within said latch means and another end against one of said shanks,

(g) the other of said shanks being engagable with said recess,

(h) said shank being of magnetizable material,

(i) magnetic means for moving said other shank out of engagement with said recess, and moving said latch to an unlocked position.

7. A magnetically operable locking device as defined in claim **2** wherein said means for positively locating a magnetic field applying means comprises a pair of recesses in said housing.

8. A magnetically operable locking device as defined in claim **2** wherein said means comprising a pivotal shank includes a pair of connected shanks at an angle of less than 90° to each other.

9. A magnetically operable locking device as defined in claim **2** further including a magnetic field applying means for moving said pivotal shank to a release position and for moving said first magnetizable movable member to enable said latch into an unlocked position.

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