Oct. 31, 1939. H. H. RAYMOND 2,177,996

LOCK

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Fig. 1,

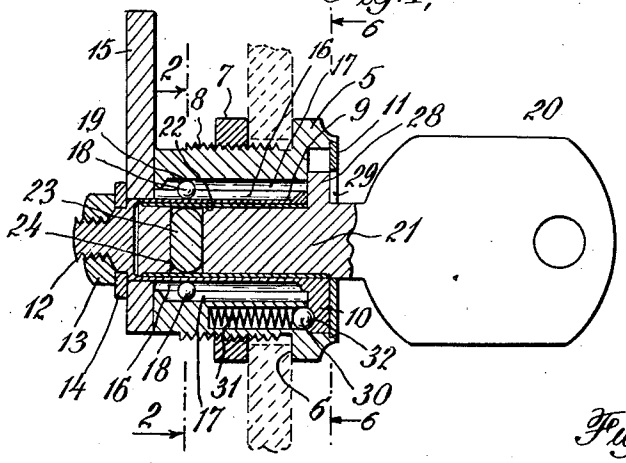


Fig. 2,

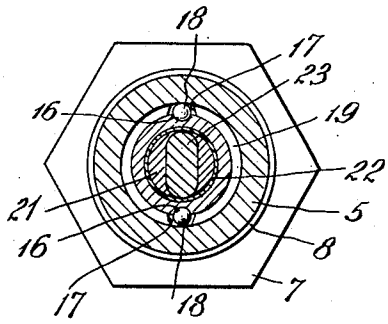


Fig. 3,

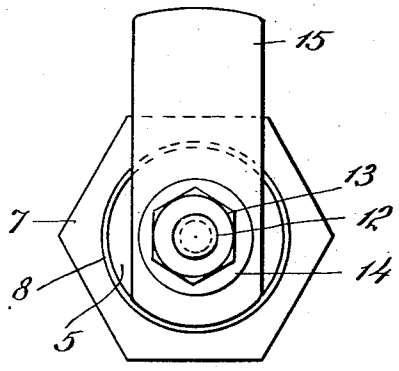


Fig. 4,

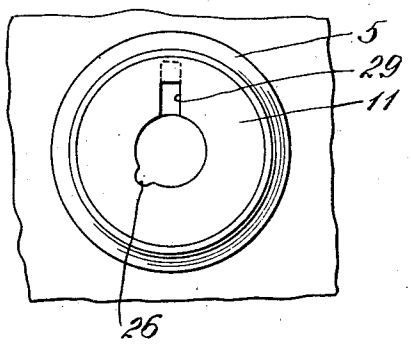
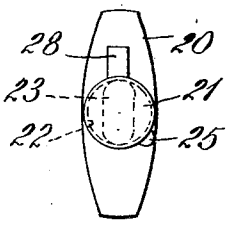


Fig. 5.



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Fig. 6,

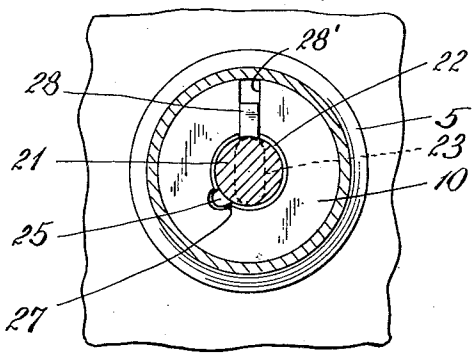


Fig. 7,

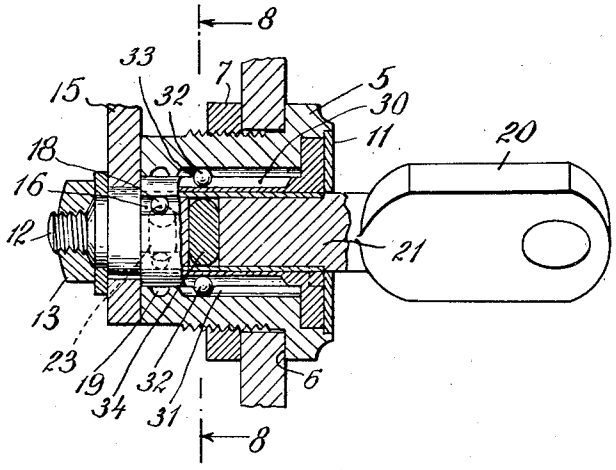
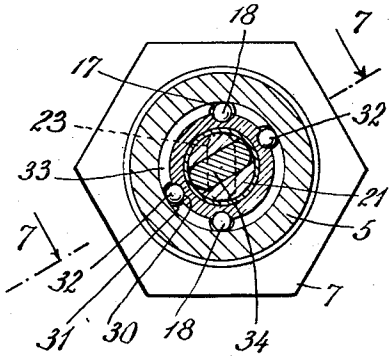


Fig. 8.



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UNITED STATES PATENT OFFICE

2,177,996

LOCK

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Application July 29, 1938, Serial No. 221,901

9 Claims. (Cl. 70—386)

This invention relates to locks and particularly to locks of the cylinder type embodying improvements which substantially avoid the possibility of picking or otherwise releasing the lock without the key.

Cylinder locks as usually constructed are of two types, usually referred to as "pin tumbler" and "disc tumbler" locks. Both types can be released without a properly fitting key by persons sufficiently skilled who are able to manipulate the pins or discs by means of various instruments inserted through the keyhole. All such locks can be picked because the pins or discs are exposed in the keyhole and are, therefore, accessible.

It is the object of the prevent invention to afford a substantially pick-proof lock in which the movable locking elements cannot be reached through the keyhole or otherwise without dismantling the lock.

Another object of the invention is to afford a simple and secure lock of the cylinder type in which the locking elements are controlled by magnetic means.

Other objects and advantages of the invention will be apparent as it is better understood by reference to the following specification and the accompanying drawings, in which:

Fig. 1 is a sectional view through the lock cylinder and key;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a rear end elevation of the lock;

Fig. 4 is a front end elevation showing the face plate;

Fig. 5 is an end elevation of the key;

Fig. 6 is a section on the line 6—6 of Fig. 1;

Fig. 7 is a section on the line 7—7 of Fig. 8, illustrating a further application of the principles of the invention; and

Fig. 8 is a section on the line 8—8 of Fig. 7.

For the purpose of illustration, a simple form of lock embodying the principles of the invention will be described in detail. The principles can be applied in more complicated locks to afford additional security, although in its simplest form the lock as described is much more secure than the types of cylinder locks which have been available heretofore.

Referring to the drawings, 5 indicates the lock cylinder which is adapted to be disposed in a suitable opening in the closure which is to be secured, for example, a door. It is provided with a shoulder 6 and a movable nut 7 mounted on threads 8 to firmly clamp the cylinder to the closure. A hollow cylindrical plug 9 is rotatably supported in the cylinder and is provided with a flange 10 disposed in a recess at the front of the cylinder, behind the face plate 11 which is secured to the cylinder. The plug has a threaded extension 12 to receive a nut 13 and washer 14 whereby the plug and cylinder are held in assembled relation. A cam 15 is mounted on the plug and adapted to rotate therewith. The cam may actuate any suitable latch or bolt mechanism (not shown) such as is commonly used in connection with cylinder locks. The details of the latch or bolt mechanism form no part of the present invention.

The plug 9 is provided with semi-cylindrical grooves 16 diametrically opposite each other, and the cylinder is provided with matching grooves 17 which are slightly enlarged, and balls 18 are disposed in the two sets of grooves and are adapted to move freely therein. The cylinder is also provided with a circumferential groove 19, and when the balls 18 are disposed as indicated in Fig. 1, the plug can be rotated with respect to the cylinder, that is to say, the lock is released. The balls travel in the circumferential groove 19 as the plug rotates. Such movement of the plug is possible only, however, when both of the balls are precisely in the position to enter the groove 19. When the plug is returned to its normal position, the balls will move away from the circumferential groove 19 as hereinafter described, and it is impossible to again bring them into proper conjunction with the groove except with a key designed to effect this result.

The key is provided with a suitable head 20 and a cylindrical shank 21 which is adapted to be inserted in the lock. A sleeve 22 surrounds the shank of the key and is permanently secured thereto in any suitable manner. To effect the desired movement of the balls 18, a magnet 23 is disposed in a transverse opening 24 in the shank of the key, the magnet being enclosed by the sleeve and therefore invisible.

The balls 18 are attracted to the poles of the magnet 23, so that as the key is inserted in the lock the balls will move in the grooves 16 and 17 to the position indicated in Fig. 1, in which they are in alignment with the circumferential groove 19, thus permitting the lock to be opened. When the key is withdrawn, the attraction of the magnet will cause the balls to move away from the circumferential groove 19, and it is practically impossible to cause the balls to again return to the position indicated in Fig. 1 simultaneously, so that the lock can be opened, unless the key

carrying the magnet in the position indicated is again inserted in the lock.

Because the magnet is necessarily very small, it is essential to use a highly magnetic material. For this purpose, I prefer to employ an alloy of aluminum, nickel and cobalt, known as "Alnico", although any sufficiently magnetic material may be substituted therefor. "Alnico" is a special alloy having magnetic qualities which far surpass the corresponding characteristics of ordinary magnetic steel. See, for example, the patent to Ruder No. 1,968,569 which describes one form of "Alnico". Owing to the high magnetic quality of this alloy, very small pieces are capable of attracting and moving steel objects such as the balls employed in the device herein described. The magnetic characteristic of ordinary magnet steel is relatively low compared with that of "Alnico". Ordinary magnet steel is not sufficiently magnetic to effect the desired result, and it is not possible to manipulate the balls 18 effectively by inserting an ordinary magnetized strip of metal in the keyhole, since it will not attract both of the balls simultaneously to the necessary position in alignment with the circumferential groove 19. Unless the balls 18 are drawn by the magnetic force to the precise position required, the plug cannot be turned, and practical experience has indicated that a strip of magnetised metal does not concentrate the magnetic lines of force sufficiently to accomplish the purpose of properly centering the balls.

It is necessary, of course, in manufacturing locks, to provide numerous combinations. This may be effected in a lock of the type described by varying the position of the magnet 23 and the corresponding position of the circumferential groove 19. By shifting the magnet longitudinally of the key, by as little as half the diameter of the balls 19, a new combination is secured, and at least ten such combinations can be made available by this simple change.

To further multiply the combinations, the key may be provided with a projecting lug 25 which is adapted to register with a recess 26 in the face plate 11, and a corresponding groove 27 in the plug 9. I also provide the key with a spur 28 which is adapted to register with an opening 29 in the face plate and with the recess 28' in the plug. The primary function of the spur 28 is to turn the plug when the plug is released. However, by varying the angular position of the projecting lug 25 with reference to the spur 28, an additional number of combinations are provided, since the key will fit only a lock having recesses corresponding to the lug and spur. These variations may be utilized in connection with various positions of the magnet to multiply the available combinations to a hundred or more.

It is essential that the balls 18 move freely in the grooves and in order to prevent possibility of binding, the grooves 17 in the cylinder are, as already indicated, wider than the grooves 16 in the plug. As a further assurance, a ball 30, biased by a spring 31, is mounted in the cylinder and is adapted to engage a recess 32 in the flange 10 of the plug. Thus, when the key is turned to locking position, the grooves 16 and 17 will be in proper registration to permit the balls 18 to move freely, and as the key is withdrawn, the balls will follow the magnet to the forward ends of the grooves. Thereafter the balls can be moved to the proper position to permit releasing of the lock only under the influence of a magnet suitably disposed in a key which is so formed that it may be inserted in the keyhole. The ball 30 has the additional function of preventing rattling of the cam 15, since it holds the plug firmly in its relation to the lock cylinder until the key is inserted and the lock is released.

The structure and principles may be applied in more complicated forms of locks, as for example by providing another set of grooves in the cylinder and plug parallel to but spaced from the grooves as described. Such grooves will be provided with balls, and the key in that case will have two magnets so disposed as to bring the balls into proper registration with circumferential grooves in the cylinder so that the plug may be turned when a proper key is inserted. Without such a key, the lock will be held securely, because of the impossibility of manipulating the balls except through the medium of the key.

Referring to Figs. 7 and 8 of the drawings, the structure of the lock is identical with that illustrated in Fig. 1 of the drawings, except for the provision of additional grooves and balls as described in the preceding paragraph. The same reference characters have been applied, therefore, to the various parts, and the description need not be repeated. In addition to the grooves 16, 17 and 19, and the balls 18, as shown in Fig. 1 of the drawings, I provide the plug 9 with a second set of semi-cylindrical grooves 30 diametrically opposed to each other. The cylinder is provided with matching grooves 31, and balls 32 are disposed in the two sets of grooves and are adapted to move freely therein. A circumferential groove 33 is provided in the cylinder, and when the balls 32 are disposed as indicated in Fig. 7, the balls 18 being likewise disposed to register with the circumferential groove 19, the plug can be rotated with respect to the cylinder to release the lock. To accomplish this, the key is provided, in addition to the magnet 23 as in Fig. 1, with a similar magnet 34 which influences the balls 33. The magnet 34 is disposed in angular relation to the magnet 23, as clearly indicated in Figs. 7 and 8. The lock can be opened, therefore, only when a key having two magnets in proper relation is inserted in the lock to move the balls 18 and 33 to their proper respective positions to register with the circumferential grooves 19 and 33.

The lock may be simplified by omitting one set of longitudinal grooves and one ball. As in the preferred embodiment, the lock can be released only when the remaining ball registers with the circumferential groove under the influence of the magnet. Instead of arranging the circumferential groove in the cylinder, it may be disposed in the plug with the same result. The groove, instead of circumferential, may be disposed helically in either the cylinder or plug.

Instead of a lug on the key, the plug may be provided with one or more projections adapted to register with grooves in the key. Only a key having the necessary grooves in properly spaced relation can be inserted in the plug.

"Alnico", which is the best available material for small magnets of high power adapted for the purpose of the invention, is manufactured by General Electric Company under Patents Nos. 1,633,805, 1,947,274, 1,968,569, and 2,027,994 to 2,028,000, inclusive.

The structure as illustrated and described is one which is admirably suited to the purpose and embodies the principle of controlling the lock through magnetic means. Many modifications may be made in the structure, especially in adapt-

ing it to a variety of uses in connection with different types of closures, without departing from the invention or sacrificing any of the advantages thereof.

I claim:

1. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having a longitudinal groove on its inner face, a cylindrical plug member having a longitudinal groove adapted to register with the longitudinal groove in the cylinder and a key opening, one of the members having a circumferential groove, and a ball freely movable in the longitudinal grooves.

2. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having a longitudinal groove and a circumferential groove on its inner face, a cylindrical plug member having a longitudinal groove adapted to register with the longitudinal groove in the cylinder and a key opening, and a ball freely movable in the longitudinal grooves.

3. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having a longitudinal groove on its inner face, a cylindrical plug member having a longitudinal groove adapted to register with the longitudinal groove in the cylinder, a circumferential groove and a key opening, and a ball freely movable in the longitudinal grooves.

4. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having spaced longitudinal grooves on its inner face, a cylindrical plug member having longitudinal grooves adapted to register with the longitudinal grooves in the cylinder and a key opening, one of the members having a circumferential groove, and balls freely movable in the longitudinal grooves.

5. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having spaced longitudinal grooves and a circumferential groove on its inner face, a cylindrical plug member having longitudinal grooves adapted to register with the longitudinal grooves in the cylinder and a key opening, and balls freely movable in the longitudinal grooves.

6. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having spaced longitudinal grooves on its inner face, a cylindrical plug member having longitudinal grooves adapted to register with the longitudinal grooves in the cylinder, a circumferential groove and a key opening, and balls freely movable in the longitudinal grooves.

7. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having diametrically disposed longitudinal grooves on its inner face, a cylindrical plug member having longitudinal grooves adapted to register with the longitudinal grooves in the cylinder and a key opening, one of the members having a circumferential groove, and balls freely movable in the longitudinal grooves.

8. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having diametrically disposed longitudinal grooves and a circumferential groove on its inner face, a cylindrical plug member having longitudinal grooves adapted to register with the longitudinal grooves in the cylinder and a key opening, and balls freely movable in the longitudinal grooves.

9. A lock adapted to be manipulated by a magnetic key comprising a hollow cylinder member having diametrically disposed longitudinal grooves on its inner face, a cylindrical plug member having longitudinal grooves adapted to register with the longitudinal grooves in the cylinder, a circumferential groove and a key opening, and balls freely movable in the longitudinal grooves.

HORACE H. RAYMOND.