P. W. FULLER.

MAGNETIC LOCK.

APPLICATION FILED JUNE 19, 1914.

1,172,203.

Patented Feb. 15, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

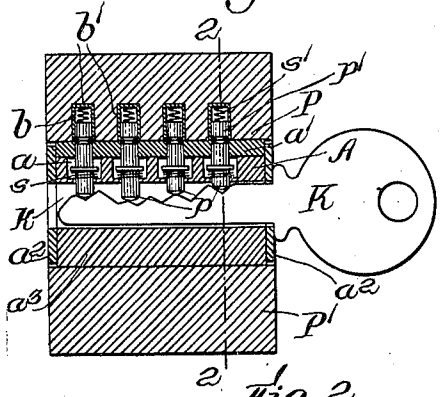


Fig. 3.

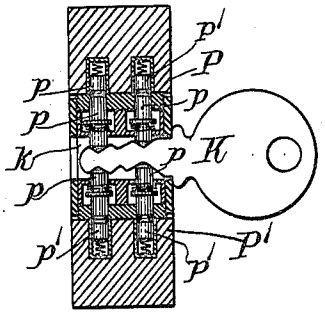


Fig. 2.

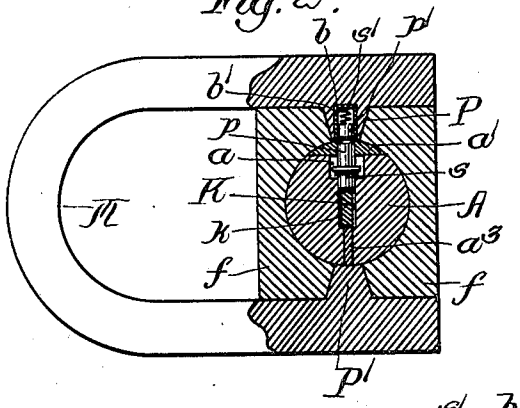


Fig. 4.

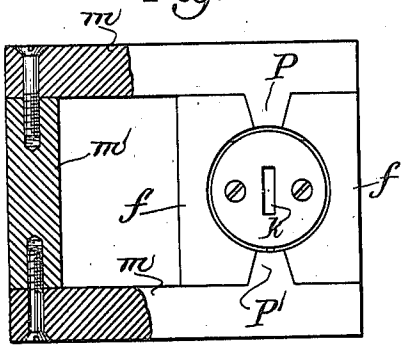


Fig. 5.

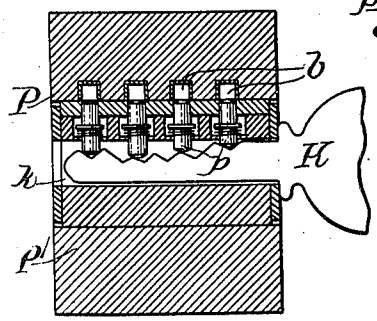
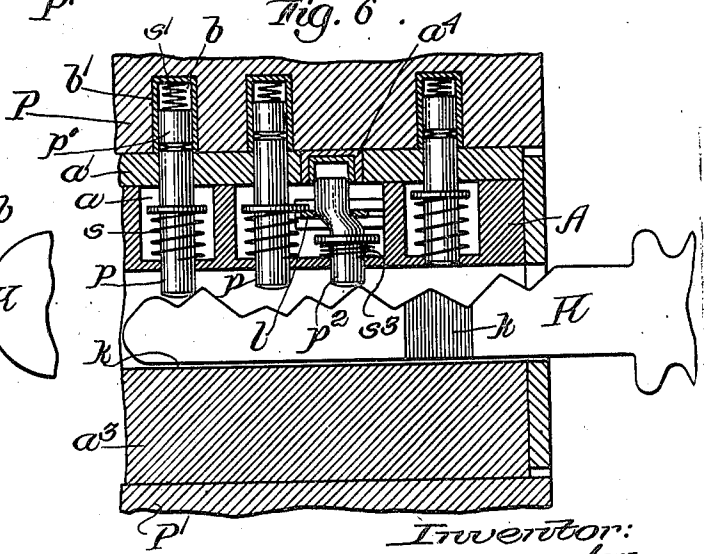


Fig. 6.



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2 SHEETS—SHEET 2.

Fig. 7.

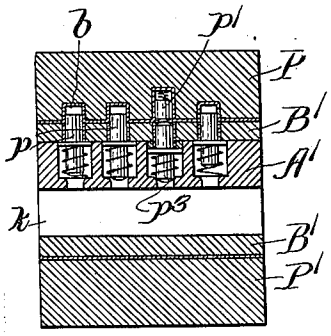


Fig. 8.

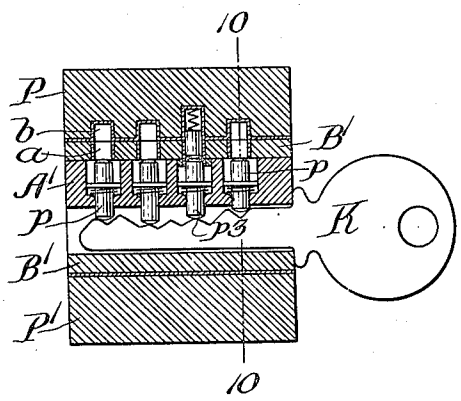


Fig. 9.

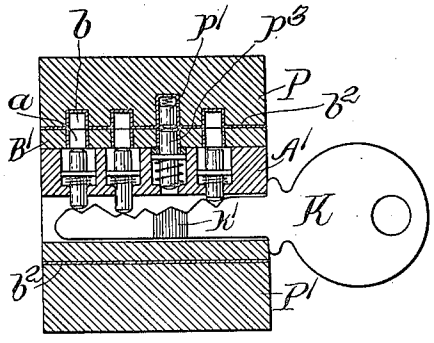
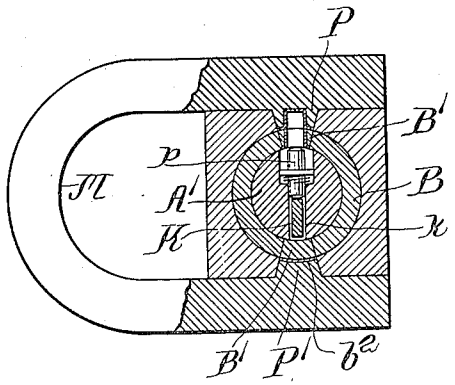


Fig. 10.



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UNITED STATES PATENT OFFICE.

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MAGNETIC LOCK.

1,172,203. Specification of Letters Patent. Patented Feb. 15, 1916.

Application filed June 19, 1914. Serial No. 846,156.

To all whom it may concern:

Be it known that I, PERCY WHEATON FULLER, a citizen of the United States, and resident of Boston, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Magnetic Locks, of which the following is a specification.

This invention relates to a lock, and comprises essentially two or more relatively movable lock-members, of which one is a magnet, and one or more movable catches or tumblers of magnetic material adapted normally to prevent relative movement between the lock-members, the relation between the movable tumbler or tumblers and the magnet being such that an air gap in the magnetic field, which acts upon the tumbler or tumblers, normally permits the lock-members to be coupled together by the tumbler or tumblers against relative movement, but when the air gap in said magnetic field is reduced by the insertion of a key containing magnetic material, the tumbler or tumblers will be operated so as to uncouple the lock-members one from the other and permit relative movement therebetween.

In the preferred form of the invention one lock-member is fixed and the other rotatable, although it is within the principle of the invention to provide other kinds of relative movement than rotative movement; also the movable tumblers are preferably of the pin tumbler type, but the invention is not limited to any particular form of catches or tumblers for preventing relative movement between the lock-members; and further the fixed lock-member is preferably the magnet, but the movable lock-member instead might contain the magnet without departing from the spirit of the invention; the essential condition being that the parts should be so organized that the reduction of the air gap in the magnetic field by the insertion of a key containing magnetic material, shall disengage the tumblers and thereby permit relative movement between the lock-members.

The bolts or latches actuated by the movable lock-members may be of any desired construction, and may be operated through any desired mechanism, and as such contrivances form no part of my invention, and are well understood by those skilled in the art, they will not be described nor further referred to, but only such parts of the lock will be illustrated in the drawings and hereinafter described as have to do directly with my invention.

The invention is applicable to locks where there is a single fixed lock-member and a single movable lock-member, or more than one movable lock-member; and in case more than two relatively movable lock-members are employed, the invention may be so applied as to couple the several lock-members to one another in various combinations. It is also possible with my invention, when several pin tumblers or other forms of catches are used, to vary still further the possible combinations and permutations of the action of the tumblers, by providing a key having magnetic and non-magnetic sections by which the air gap in the magnetic field acting upon some of the tumblers is reduced, and those catches thereby operated, while other tumblers, in the field including the non-magnetic key sections, remain unaffected magnetically by the presence of the key.

These and other features will hereinafter be more fully described and particularly pointed out in the claims.

The word "tumbler" is used throughout the specification and claims to denote any form of catch performing the functions described and is not to be construed as limiting the invention to pin tumblers or any other particular form of tumblers of the kinds now commonly used in pin tumbler locks.

In the accompanying drawings which exemplify certain embodiments of the invention,—Figure 1 is a vertical longitudinal section of a lock containing the invention; Fig. 2 is a cross-sectional view on line 2—2 of Fig. 1; Fig. 3 is a vertical longitudinal section of a modified form of the lock; Fig. 4 is a front elevation, partly in section, of the lock shown in Fig. 3; Fig. 5 is a vertical longitudinal section of still another form of the lock; Fig. 6 is a vertical longitudinal section of a further modification of the lock shown in Fig. 1; Fig. 7 is a vertical longitudinal section of still another form of lock; Figs. 8 and 9 are similar views of the lock shown in Fig. 7, illustrating respectively the effect of an all magnetic key and of a key

containing magnetic and non-magnetic sections; and Fig. 10 is a cross-sectional view on line 10—10 of Fig. 8.

Referring first to the form of the invention shown in Figs. 1 and 2, P and P′ are the poles of a magnet M, which constitutes one of the two relatively movable lock-members, and in this embodiment of the invention, is the fixed member, and forms part of the housing of the lock. The magnet may be a permanent magnet of the horseshoe type, as shown, or it may be an electromagnet energized from a suitable source of electrical energy. The poles P and P′ face each other and are preferably narrowed and tapered as best shown in Fig. 2, so as to concentrate the lines of magnetic force in the field between the two poles. The other lock-member in this embodiment consists of the rotatable block or barrel A, located between the poles of the magnet, and made of non-magnetic material such as brass. The rotatable lock-member A is provided with a key way *k*, adapted to receive a key K, and is inclosed between filler blocks *f*, *f*, of brass or other non-magnetic material, which insure the retention of the barrel A in position between the magnet poles.

At one side of the key way *k* is a series of pin holes, *a*, opening into the key way and extending through the barrel A; and in the pole P is a corresponding series of pin engaging sockets *b*, registering with the pin holes *a*. A plurality of catch pins or tumblers *p* of magnetic material such as steel, are mounted to slide in said pin holes and sockets, and are normally held by the magnetism of the pole P, assisted by coil springs *s* contained in enlargements of the pin holes, with their upper or outer ends projected into the sockets *b*, thereby coupling the two lock-members together and preventing relative movement therebetween. Said enlargements or spring chambers containing springs *s* are preferably formed, and the assembling of the parts facilitated, by making the barrel A flattened at the side through which the pin holes pass, and then securing over the springs and spring chambers a segment *a′* of non-magnetic material formed with a cylindrical outer surface. At each end of the block A may be secured a keeper plate a^2 of magnetic material, substantially spanning the space between the poles P and P′, to prevent loss of the magnetic force. The plates a^2 are preferably of hardened steel and serve as guards to prevent drilling into or tampering with the lock.

The key way might extend completely through the side of the barrel opposite the pin holes, so that when the key is inserted it would close the air gap next to the pole P′, but in the form now being considered the key way *k* is some distance removed from the pole P′, and a plate a^3 of magnetic material is set into the barrel A to insure the closing of the gap between the pole P′ and the key K.

In each pin engaging socket *b* is a follower pin *p′*, held by a spring *s′* against tumbler pin *p*. The relative strength of the springs *s* and *s′* is such that springs *s* will overcome springs *s′*, so as normally to hold the tumbler pins in position to couple the lock-members together, the sole function of the spring *s′* being to hold the follower *p′* in engagement with pin *p* in all of its positions.

When the key is out of the lock the tumbler pins will all be projected into sockets *b*, thereby preventing relative movement between the lock-members, and it will be practically impossible to pick the lock by means commonly employed in pin tumbler locks of the ordinary kind, that is, by lifting the pins one at a time with suitable implements, because the pins are already projected to their extreme positions away from the key way, which is their locked position, and they cannot be reached by any implement to pull them down.

The tumbler pins *p* are preferably made of different lengths, and the key K is notched or corrugated so that its transverse dimensions will vary to correspond with the varying dimensions of the tumblers, whereby when the inner or lower ends of the pins *p* are drawn into engagement with their appropriate key surfaces as shown in Figs. 1 and 2, the outer or upper ends of the pins will have been withdrawn from the sockets *b*, but the divisions or points of separation between the pins *p* and followers *p′* will coincide with the plane of the relatively movable surfaces of the lock-members, thus preventing the followers from entering the pin holes in block A, and permitting relative movement between the lock-members.

When a key K, appropriate to the form and arrangement of the tumblers *p*, and composed of magnetic material, is inserted into the lock, the air gap in the magnetic field adjacent to the catches *p* is so reduced that the movable tumblers of magnetic material, by reason of their tendency to close the air gap, are drawn downward to the position described, and are arrested by the key at the precise points where the pins *p* are fully withdrawn from the sockets *b* and the follower pins *p′* have not entered the pin holes *a*. Thus the lock-member A is free to be turned.

If a key of identical form but of non-magnetic material were used the tumblers would remain unaffected. Or, if an effort were made to use a magnetic key of such dimensions as to withdraw all the tumblers from their sockets, but not of such dimensions as to arrest them all at exactly the right positions, the key would fail to open

the lock, because if any pin p were drawn inward too far by ever so little, the pin follower p' would enter the pin hole a and recouple the lock-members together again.

In order to prevent the magnetic force from causing the pins to "stick" in their sockets, or from interfering with their free movement, the sockets should be lined with a thin lining b' of brass or other non-magnetic material.

In Figs. 3 and 4 there is shown a lock having a series of pins p and followers p' at each side of the key way, operated by a key having appropriate corrugations on both edges. In other respects the construction and operation of the lock is substantially the same as that already described. This form of lock admits of the use of the same number of pin tumblers in half the space, and is designed for thin doors or similar situations where there is not room for a lock having the desired number of pins all at one side of the key way. In Fig. 4 in place of the usual form of horseshoe magnet, I have shown another form, which possesses certain advantages from the standpoint of construction, consisting of the two magnet steel arms m, connected by a cast iron piece m'.

The modification illustrated in Fig. 5 is like that in Figs. 1 and 2, save that the followers are omitted, and apart from the action of the followers the operation of this form of lock is the same as that above described.

Fig. 6 illustrates a device which will prevent the lock from being operated even by a key consisting of magnetic material, and having exactly the contour, form and dimensions of the correct key. This lock can be opened only with a special key having properly disposed magnetic and non-magnetic sections. The two relatively movable lock-members, the key way, the pin holes, pin sockets, tumbler pins and followers, may all be substantially as hereinbefore described in connection with Figs. 1 and 2. Alongside of one of the tumbler pins p is a cam pin or latch pin p^2 mounted in a suitable recess in barrel A with its inner end projecting into the key way k. Said pin p^2 is formed with a cam surface adapted to reciprocate a latch l, mounted to slide in the barrel A. A spring s^3 normally urges pin p^2 upward or outward, in which position latch l is withdrawn into inoperative position away from the tumbler pin p which it controls. When the cam pin p^2 is moved downward or inward, its cam surface throws latch l toward pin p with which it coöperates, and engages the underside of a lug or collar on said pin p, thus preventing it from being withdrawn from its pin engaging socket in the pole P.

The special key K for use with this lock is provided with a non-magneto section k', disposed so as to come opposite the cam pin p^2 when the key is thrust home. The rest of the key is of magnetic material such as iron or steel, and the non-magnetic section k' may be a section of brass welded between the iron or steel sections. In operation, as the key is inserted into the key way, when the entering or leading end of the key, which is a magnetic section, comes opposite the latch pin p^2, which is of magnetic material, the latter is drawn down, as already explained, by reason of its tendency to close the air gap in the magnetic field, and throws latch l under the collar on the next succeeding pin p, which has not yet come under the influence of the key, thereby locking or latching that pin p in operative position as shown in Fig. 6, to prevent rotation of the barrel A. If the entire key were of magnetic material it will be seen that the latch would be retained in operative or locking position and the key could not possibly operate the lock. As soon, however, as the special key is thrust completely home, the non-magnetic section k' comes opposite the latch pin p^2, thereby again in effect opening the air gap, and permitting the pin p^2 to return to normal position under the influence of spring s^3 and the magnet pole P, which movement withdraws the latch l and permits the pin p, theretofore restrained by the latch, to move downward to its proper corrugation on the key, and to uncouple the lock-members. In order to prevent the inward or downward movement of the pin p^2 from opening up another air gap at its top, which would prevent its further movement, a socket piece a^4 of magnetic material should be inserted into the barrel A, surrounding the end of pin p^2, so that in all positions of pin p^2 the magnetic flux may pass directly from pole P tc pin p^2.

In the forms of the invention thus far referred to, locks containing only two relatively movable lock-members have been described. If it should be desired to apply the invention to locks comprising more than two relatively movable lock-members, this may be accomplished in the manner illustrated in Figs. 7 to 10 inclusive. The lock shown in these figures comprises three relatively movable lock-members, of which one is fixed and the other two movable. The two movable members may be actuated by separate and different keys, and may be suitably connected to separate latches or bolts, whereby the holder of one key can operate only one latch or bolt and the holder of the other key can operate the other latch or bolt. In this lock the two poles P, P', of the magnet M are the same as before. Between the poles is a rotatable sleeve B (Fig. 10) constituting one of the movable lock-members; and within the sleeve B is a ro-

tatable block or barrel A′, substantially like the barrel A, excepting that the key way *k*, as shown in the present modification, opens through the periphery of the barrel opposite the pole P′. The body of the sleeve B is of brass or other non-magnetic material, and lengthwise extending sections B′ of iron or other magnetic material are set in to the sleeve at points normally opposite the poles of the magnet. The pin holes *a* extend not only through the barrel member A′ but also through the magnetic section of the sleeve member B, and register as before with sockets *b*. Both the sockets *b* and the pin holes in the sleeve B are lined with non-magnetic material, as are also the faces of the poles P and P′, as shown at b^2, to permit the sleeve to turn freely between the poles.

In normal position with the key removed, as shown in Fig. 7, the tumbler pins *p* project from the barrel A′ through the sleeve B and into the sockets *b*, thereby coupling all three members together. It will be observed that another pin p^3 connects the movable members A′ and B, but does not enter the socket in P. Assuming now that an all magnetic key K (Fig. 8) having appropriate corrugations, is inserted into the key way, thereby reducing the air gap in the magnetic field adjacent to the several pins, which are of magnetic material, the pins *p* will all be withdrawn from the sockets *b* and also from the pin holes in sleeve B, thereby uncoupling the three relatively movable members so far as the pins *p* are concerned; but although pin p^3 is also withdrawn from its pin hole in sleeve B, so as to uncouple A′ and B, the spring pressed follower pin *p′*, coöperating with pin p^3 has moved downward in position to couple together the sleeve B and pole member P. Thus with all the magnetic key, the lock-member A′ may be turned, but the lock-member B remains connected to the stationary or magnet member. Assuming now that a special key be used having a non-magnetic section *k′* (Fig. 9) disposed opposite the pin p^3, when the key is thrust home, the pins *p* will be withdrawn as before from both P and B, but the pin p^3 will remain unaffected by the presence of the key, and will connect the two lock-members A′ and B, but will leave member B free to rotate between the poles P, P′. Thus with the special key containing the magnetic and non-magnetic sections, the two lock-members A and B may be moved together as a single part relatively to the fixed magnet member.

I claim:

1. In a lock, two relatively movable lock-members of which one is a magnet, and a movable tumbler of magnetic material normally preventing relative movement between said lock-members, one of said lock members being adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to the movable tumbler, and thereby to operate the tumbler to permit relative movement between said lock-members.

2. In a lock, two relatively movable lock-members, of which one is a magnet and the other is located between the poles of the magnet, a movable tumbler of magnetic material normally preventing relative movement between said lock-members, the lock-member located between the poles of the magnet being adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to the movable tumbler, and thereby to operate the tumbler to permit relative movement between said lock-members.

3. In a lock, a fixed lock-member and a rotatable lock-member, one of said lock-members being a magnet, and a movable tumbler of magnetic material normally preventing movement of the rotable lock-member, one of said lock-members being adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to the movable tumbler, and thereby to operate the tumbler to permit the rotation of the rotatable member.

4. In a lock, a fixed lock-member comprising a magnet, a rotatable lock-member of non-magnetic material located between the poles of the magnet, and a movable tumbler of magnetic material normally preventing rotation of said rotatable lock-member, said rotatable lock-member being adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to the tumbler, and thereby to actuate the tumbler and permit rotation of said rotatable lock-member.

5. In a lock, a fixed lock-member comprising a magnet, a movable lock-member of non-magnetic material located between the poles of the magnet, one at least of the poles of said magnet being provided with a pin engaging socket, and said movable lock-member being provided with a key way and a pin hole opening into said key way, a tumbler pin of magnetic material movable in said pin hole and pin socket normally holding said movable lock-member against movement, said key way adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to the tumbler pin and thereby to withdraw the pin from said pin engaging socket.

6. In a lock, a fixed lock-member comprising a magnet, a movable lock-member of non-magnetic material located between the poles of the magnet, one at least of the poles of said magnet being provided with a

pin engaging socket, and said movable lock-member being provided with a key way and a pin hole opening into said key way, a tumbler pin of magnetic material movable in said pin hole and pin socket normally holding said movable lock-member against movement, a follower in said socket, and a key containing magnetic material, adapted when inserted in said key to reduce the air gap in the magnetic field adjacent to the tumbler pin and thereby to withdraw the tumbler pin from the pin engaging socket, and also adapted to arrest said pin and follower before the follower enters said pin hole.

7. In a lock, a fixed lock-member comprising a magnet, a movable lock-member of non-magnetic material located between the poles of the magnet, one at least of the poles of said magnet being provided with a pin engaging socket, and said movable lock-member being provided with a key way and a pin hole opening into said key way, a tumbler pin of magnetic material movable in said pin hole and pin socket normally holding said movable lock-member against movement, a follower in said socket, said key way adapted to receive a key containing magnetic material, adapted when inserted in said key way, to reduce the air gap in the magnetic field adjacent to the tumbler pin and thereby to withdraw the pin from said pin engaging socket, a spring normally urging said tumbler pin and follower into said socket, and an opposed spring adapted to hold the follower against the pin.

8. In a lock, two relatively movable lock-members, of which one is a magnet, a plurality of movable tumblers of magnetic material normally coupling said lock-members together so as to prevent relative movement between said lock-members, one of said lock-members being provided with a key way, and a key containing magnetic material adapted when inserted in said key way to reduce the air gap in the magnetic field adjacent to the movable tumblers and thereby to operate the catches to uncouple said lock-members.

9. In a lock, two relatively movable lock-members, of which one is a magnet, a plurality of movable magnetic tumblers of varying dimensions normally coupling said lock-members together so as to prevent relative movement therebetween, one of said lock-members being provided with a key way, and a key containing magnetic material and having parts whose transverse dimensions vary inversely as the dimensions of the corresponding tumblers, adapted when inserted in said key way to reduce the air gap in the magnetic field adjacent to the movable tumblers and thereby to operate the tumblers to uncouple said lock-members.

10. In a lock, a fixed lock-member comprising a magnet, a movable lock-member of non-magnetic material located between the poles of the magnet, one at least of the poles of said magnet being provided with a series of pin engaging sockets, and said movable lock-member being provided with a key way and a series of pin engaging holes opening into said key way and registering with said sockets, a series of tumbler pins of magnetic material movable in said several pin holes and sockets, normally holding said movable lock-member against movement, said tumbler pins being of varying lengths, followers in said sockets, and a key containing magnetic material and having parts whose transverse dimensions vary inversely as the lengths of the corresponding tumbler pins, adapted when inserted in said key way to reduce the air gap in the magnetic field adjacent to said tumbler pins and thereby to withdraw said tumbler pins from said sockets, and also adapted to arrest said pins and followers before the followers enter the pin holes.

11. In a lock, two relatively movable lock-members of which one is a magnet, a plurality of movable pins of magnetic material, one of said members being provided with a key way, and a key comprising magnetic and non-magnetic sections, adapted when inserted in the key way to reduce the air gap in the magnetic field adjacent to the pin or pins opposite the magnetic part of the key and thereby to operate the same, but to leave the pin or pins opposite the non-magnetic part of the key magnetically unaffected by the presence of the key.

12. In a lock, three relatively movable lock-members of which one is a magnet, a plurality of movable tumbler pins of magnetic material normally preventing relative movement between said three lock-members, one of said lock-members being adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to one or more of said pins, said pins being adapted to be moved in a manner to uncouple one of said lock-members from either one of the other lock-members, but to leave it coupled to the third lock-member.

13. In a lock, a fixed lock-member comprising a magnet, two movable lock-members located between the poles of the magnet, a plurality of movable tumbler pins of magnetic material normally preventing relative movement between said three lock-members, one of said movable lock-members being adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to one or more of said tumbler pins, said pins being adapted to be moved in a manner to uncouple one of said movable members from either the fixed lock-member or the other movable

lock-member but to leave it coupled to the other.

14. In a lock, a fixed lock-member comprising a magnet, a movable lock-member located between the poles of the magnet, and consisting of a sleeve containing magnetic material opposite the poles of the magnet, another movable lock-member within said sleeve, and a series of movable tumbler pins of magnetic material normally preventing relative movement between said three lock-members, said inner lock-member being adapted to receive a key containing magnetic material in position to reduce the air gap in the magnetic field adjacent to one or more of said tumbler pins, and said pins being adapted to be moved in a manner to uncouple the sleeve lock-member from either the fixed lock-member or the inner lock-member, but to leave it coupled to the other.

Signed by me at Boston, Massachusetts, this sixteenth day of June, 1914.

PERCY WHEATON FULLER.

Witnesses:

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FLORENCE A. COLLINS.