

Oct. 16, 1956

D. COLLINS

2,767,278

MAGNETIC LOCK SWITCH FOR STARTER AND IGNITION CIRCUITS

Filed June 29, 1951

2 Sheets-Sheet 1

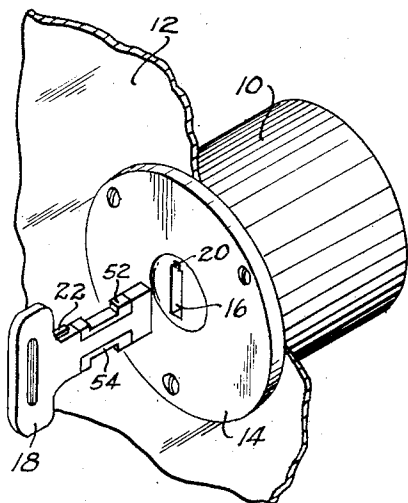


Fig. 1

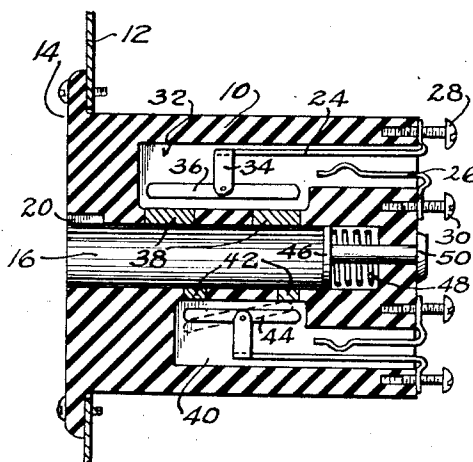


Fig. 2

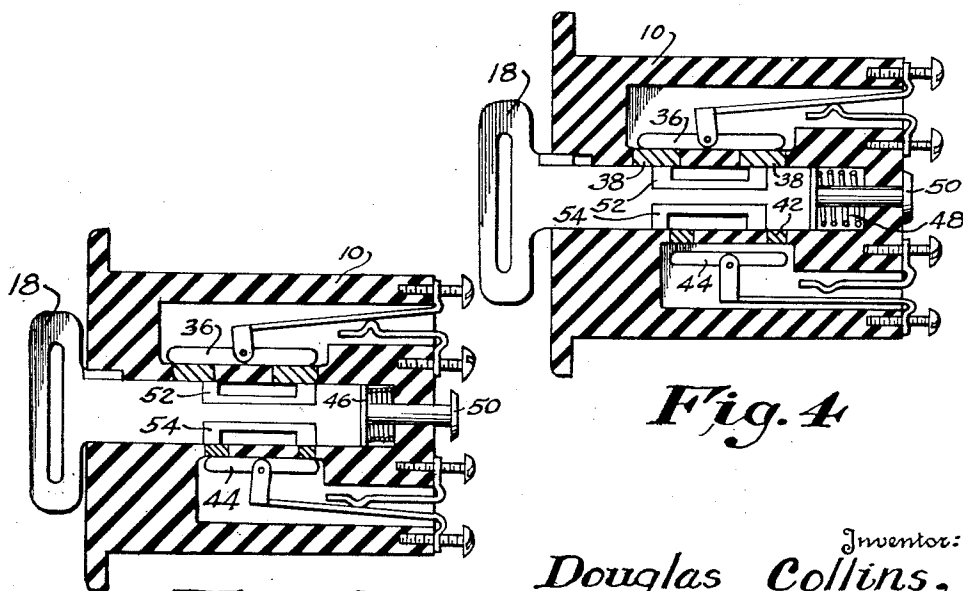


Fig. 3

Fig. 4

Inventor:
Douglas Collins,

By *Glascoep, Downing & Seebolt*

ATTORNEYS

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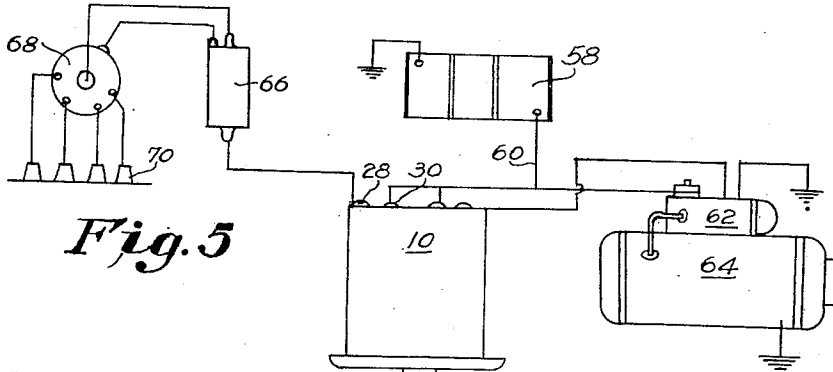


Fig. 5

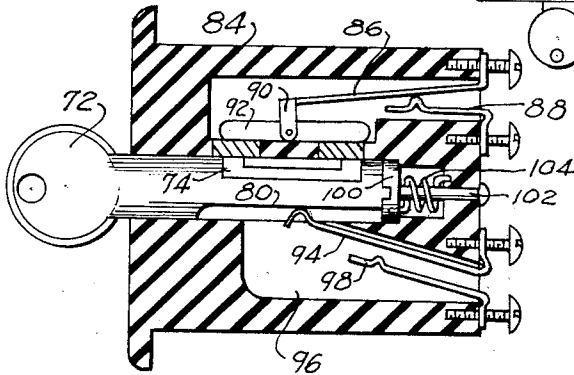


Fig. 6

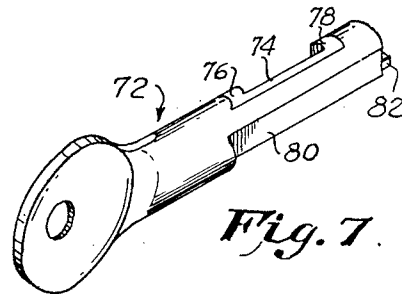


Fig. 7

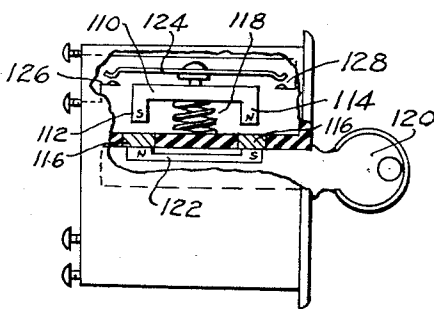


Fig. 8

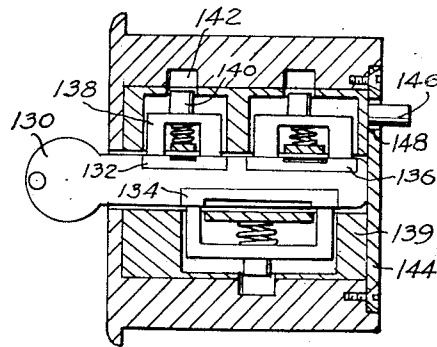


Fig. 9

Inventor:
Douglas Collins,

By *Glascock, Downing & Seibold,*

ATTORNEYS

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2,767,278

MAGNETIC LOCK SWITCH FOR STARTER AND IGNITION CIRCUITS

Douglas Collins, Salisbury, N. C.

Application June 29, 1951, Serial No. 234,172

17 Claims. (Cl. 200—87)

This invention pertains to a combined starting and ignition circuit control, especially for automotive vehicles or the like, and has for its principal object to provide a unitary control-switch mechanism and lock which will enable the starting and ignition circuits to be controlled by a single key, and to be energized in the desired relationship by a single manually operated instrumentality.

A further object of the invention is to provide a lock switch having means to prevent or discourage the unauthorized energization of the starting and ignition circuits, and hence of the vehicle, and which will be substantially immune to methods of lock picking and the like commonly employed by thieves.

Still another object of the invention is to provide a lock switch operated by a removable key and so arranged that the insertion of the proper key in the lock energizes the ignition circuit of the vehicle, and a further movement (of one kind or another) of the same key will energize the starter motor circuit, thus simplifying the operation of starting the engine of an automobile or other vehicle.

An additional object of the invention is to provide a device of the kind just described, so arranged that the key must be removed from the lock switch in order to deenergize the ignition circuit, and thus to minimize the possibility that the key will be inadvertently left in the lock when the owner leaves the vehicle.

Yet another object of my invention is to provide a switch and lock for operation by means of a key formed partly of magnetized elements or magnets, such magnets being so disposed that the lock switch nevertheless cannot be operated by an ordinary magnet or magnetized object in the hands of an unauthorized person.

A further object of the invention is to provide a lock switch whose interior working portions are completely sealed off from the keyhole slot, so that they cannot be manipulated by mechanical means inserted in the keyhole slot or groove.

An additional object of the invention is to provide a lock switch and magnetic key of such design that a large number of combinations can be obtained, and at very low cost, so that operation of a particular switch can be effected by a relatively small number of the total keys manufactured.

The above and other objects and advantages of the invention will best be understood from the following detailed specification of certain preferred and exemplary embodiments thereof, taken in connection with the appended drawings, in which:

Fig. 1 is a perspective view of one embodiment of the lock switch of the invention shown mounted upon the dashboard or instrument panel of a vehicle or the like, and with the control key shown withdrawn from the lock.

Fig. 2 is a longitudinal vertical sectional view of the lock shown in Fig. 1, and with the two electric switches in deenergized position,

Fig. 3 is a view similar to Fig. 2, but with the key inserted fully into the lock switch in condition for ener-

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gizing both the ignition circuit and the starting motor circuit,

Fig. 4 is a view similar to Fig. 3, but with the key retracted to a position in which the starting motor circuit has been deenergized, while the ignition circuit remains connected,

Fig. 5 is a schematic wiring diagram showing the relation between the lock switch of the invention to the usual control circuits of the vehicle,

Fig. 6 is a longitudinal sectional view of a modified form of lock switch embodying the principles of the invention,

Fig. 7 is a perspective view of a key used with the form of lock switch shown in Fig. 6,

Fig. 8 is a view, partly broken away, of a modified lock, and

Fig. 9 is a view similar to Fig. 6 but showing a magnetic control for a cylinder lock.

Referring now to Figs. 1 to 4 of the drawings, which illustrate a first embodiment of the invention, the lock switch is shown as comprising a cylindrical body of casing 10 shown as formed of electrically insulated material; the use of such material simplifies the provision of the necessary insulation for the electric switch elements contained in the casing, but it is perfectly feasible to form this casing of metallic material, so long as such material is non-magnetic in nature. Metals commonly used for die casting are suitable, and in such case, of course, the switch elements will be secured to the casing by suitable insulated supports in a manner well known in the electric switch art. As shown in Fig. 1, the body or casing 10 is adapted to be mounted in an aperture formed in the usual dashboard or instrument panel 12 of a motor vehicle or the like, and to this end the casing 10 may have an enlarged front plate or escutcheon 14, which may be secured to the panel 12 by screws or the like.

As best shown in Fig. 2, a key passageway 16 extends from the front of the device into its interior, and is formed of any suitable cross-section to receive a corresponding key 18. The forward end of passageway or slot 16 may be provided with a cut-out 20 adapted to receive a lug 22 on key 18, and by changing shape and location of the parts 20 and 22, and the shape and dimensions of the passageway 16 and the body of the key, a large number of combinations may be provided.

The lock switch of the invention provides for the control of both the ignition circuit and the starting motor circuit of the vehicle with which it is used, and in order to accomplish this double control by simple and easily operated means, the invention provides two separate circuit making and breaking switches in the lock switch, at least one of these being controlled by a permanent magnet incorporated in the structure of the key. In the form of the invention shown in Figs. 1 to 4, both of these switches are magnetically controlled, and the parts are so arranged that the insertion of the key into the switch to a first position (in which it will remain unless removed) energizes the ignition circuit, while a further movement of the key into the passageway (for example, against the tension of a spring) operates to energize the starter motor of the engine. Upon the release of the manual pressure required for this additional movement of the key, the key is restored by the spring pressure to its first condition, in which the starter circuit is deenergized while the ignition circuit remains in running condition. Since it is necessary to withdraw the key from the slot, or at least to initiate its withdrawal, in order to stop the engine by breaking the ignition circuit, the possibility that the key will accidentally be allowed to remain in the lock is greatly reduced. This feature is desirable in order to reduce thefts resulting from the thoughtless act of leaving the key in a conventional automobile lock after the ignition has been turned off.

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The switch elements which control the ignition circuit are shown in Figs. 2 to 4 as comprising a pair of spring blades 24 and 26, suitably secured to casing 10 and provided with connecting screws 28 and 30 for connection in series between the battery of the vehicle and the primary winding of the ignition coil. The switch consisting of contact elements 24 and 26 is contained within a recess 32 formed in the casing 10 but closed off from the key slot or passageway 16 for a reason to be described below. Contact spring 24, which is the "movable" contact of this switch, carries at its free end a yoke 34 between whose parallel arms is pivoted a magnetic armature 36, formed of some material such as soft iron which is attracted by a permanent magnet, but which does not retain substantial magnetization when the permanent magnet is removed from its vicinity. The pivotal mounting for armature 36 provides for see-saw motion with respect to the movable contact 24. The wall or partition which separates recess 32 from passageway 16 contains two slugs of similar soft iron, designated by numeral 38, which act to transmit the magnetic lines of force from the key (to be described below), to the two ends of the pivoted armature 36. Since the attractive forces on these two ends of the armature will be equal, the armature 36 will be moved bodily downward when the magnetic key is inserted in the lock to a position symmetrical with the slot, and will, therefore, deflect contact spring 24 until it touches contact spring 26, thereby completing the circuit to the ignition coil. If a key is used which has spaced poles not matched with the slugs 38—that is, not suitably constructed to operate the particular lock—the forces on opposite sides of the pivotal mounting for the armature will not be balanced, and the armature will tilt without producing any closing force on the contact 24.

The other switch shown in Fig. 2 also comprises contact springs and terminal screws which may be duplicates of those just described, but in this case the contact springs are located in another recess or cavity 40 which is separated from the passageway 16 by a wall structure which includes the magnetically permeable portions 42. In this case, the movable contact spring also terminates in a yoke carrying a pivoted armature numbered 44, and which is also adapted to be moved bodily upward when the key 18 is inserted in the lock, under the attraction of a second magnet carried by said key. Armature 44 is likewise pivoted for see-saw motion and, unless a key having properly spaced poles is provided, the forces acting around the pivot will not be substantially balanced, and the armature will tilt without closing the switch.

In order to permit this second switch to be closed only when the starter motor of the engine is to be energized, the invention provides for an additional movement of the key into the key slot to operate this second switch. As seen in Fig. 2, the inner end of slot 16 is closed by a spring-pressed stop plate 46 urged toward the left in that figure by a coil spring 48, for a distance determined by the engagement of the head 50, of a bolt or pin secured to plate 46, with the rear surface of the casing 10.

Fig. 3 illustrates the parts when key 18 has been inserted in the passageway 16 to the fullest extent possible, thus compressing spring 48 as the plate 46 is pushed to the right by the key, stop head 50 moving away from the rear wall of casing 10. The key 18 has integral therewith a pair of relatively strong permanent magnets 52 and 54 which may for example be made of permanently magnetized "Alnico" or similar highly magnetic material. As shown also in Fig. 1, each of the magnets 52 and 54 has active pole faces which are spaced along the length of the body of key 18. Thus, when the key is inserted fully in the lock as shown in Fig. 3, the two poles of magnet 52 lie against the soft iron slugs in the wall separating the key from upper

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pivoted armature 36, and the lines of magnetic force therefore pass through the armature 36 and draw it bodily downward, closing the ignition control switch in the manner described above in connection with Fig. 2. Also, with the key inserted to this maximum extent, the poles of magnet 54 are in alignment with the soft iron slugs adjacent armature 44 of the lower switch, and this armature is attracted upwardly so as to close the starter circuit and start the engine. Although in this position the poles 52 are not exerting equal forces about the pivot of armature 36, this is not necessary, because the armature cannot tilt with contacts 24 and 26 closed.

When key 18 is released, it will be moved slightly to the left under the pressure of spring 48, and thereafter will remain in the position shown in Fig. 4 of the drawings. In this position, and due to the length of the slugs 38 associated with the ignition switch, the magnetic attraction of magnet 52 upon armature 36 remains in effect, and the ignition circuit is maintained in its closed or energized condition. However, the size and positioning of slugs 42 associated with the starter switch is such that magnet 54 finds no magnetically permeable path for the flux which formerly attracted armature 44, and the latter is released, thereby deenergizing the starter motor of the vehicle.

From the above description it will be seen that neither of the switches of the device can be operated by any mechanical instrumentality inserted in the keyway 16, because all the movable portions of both switches are blocked off from this keyway. Also, the use of pivoted armatures such as 36 and 44, instead of simple non-pivoted armatures, prevents the operation of either switch by the insertion of a simple magnet, magnetized blade or the like. Any such device will operate upon one end only of either of the armatures 36 and 44, causing a simple tilting of the armatures upon its pivot yoke (as shown in dash lines in Fig. 2), and will be ineffective to cause movement of the armature as a unit or symmetrical displacement thereof, such as is required to produce circuit-closing motion of the movable contact spring. While I have described the use of permeable slugs 38 and 42 of different sizes to provide for the separate energization of the ignition and starter circuits, it is clear that the same separation of functions can also be achieved by the proper positioning of slugs of the same size, or by arranging the magnets 52 and 54 so that their pole pieces are of different lengths, and so on. Obviously, the material of which the key itself is made must be non-magnetic, such as a non-magnetic metal, and the permanent magnets 52 and 54 may be secured in place therein in any desired manner, or may even be imbedded in the material forming the body of the key.

Fig. 5 of the drawings illustrates by a schematic wiring diagram the way in which the lock switch of the invention is related to the conventional elements constituting the starting and ignition circuits of a vehicle or the like. In this figure, numeral 10 designates the casing of the lock switch, and numeral 18 again designates the control key. The main car battery, usually but not necessarily a six-volt storage battery, is shown at numeral 58, and has one side grounded, as by connection to the vehicle frame. The other side or terminal of this battery is connected by a lead 60 to one terminal of each of the switch elements of my invention, and also to the solenoid switch or control 62 of the starter motor 64. The other terminal of the starting motor control 62 is connected to the switch 10 at the terminal which is closed when the armature 44 (of Figs. 2 to 4) is attracted. Numeral 66 designates the usual high-tension coil or transformer of the ignition system, whose primary winding is connected to lead 60 through the other switch element of the lock switch; that is, to the terminals 28 and 30. The other side of the primary of coil or transformer 66 is connected to the battery 58 by being grounded through the ignition points in the usual

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way, and the secondary winding leads through the usual distributor 68 to the spark plugs of the engine, generally designated by numeral 70. The operation of the circuit will be clearly understood from the description already given of the manner in which the insertion of key 18 5 first energizes the ignition circuit, and then, upon a further movement thereof into the lock, energizes the starter motor. The system as described is constructed around the Bendix type of starter system, utilizing a self-engaging starter motor drive under control of a solenoid switch, but it is clearly equally well adapted for the control of the Delco-Remy or solenoid shift type of starter control, as well understood by those skilled in the art.

Figs. 6 and 7 of the drawing illustrate a modified embodiment of the invention, in which only one of the switches of the invention is magnetically operated, the other being of a mechanically or cam operated type. In these figures, numeral 72 designates the control key generally, the same having in this case a shank or body 20 portion which is approximately cylindrical, with a single magnet 74 on one side, and providing two spaced pole faces 76 and 78 in a manner similar to the magnet 52 of Figs. 1 to 4. The opposite side of the shank is flattened as indicated at 80, and the end face of the shank 25 has a rectangular extension or rib 82, for a purpose to be described.

As best shown in Fig. 6, the lock switch of this form of the invention comprises a casing 84 of generally the shape utilized in the first form of the invention. The switch elements for controlling the ignition circuit again comprise spring tongues or strips indicated by numerals 86 and 88, and provided with suitable screw or other terminals for connection to the external circuit. Switch spring 86 has a pivot yoke 90 carrying the magnetizable armature 92 as before, the same being attracted downward by the magnet 74 whenever the key 72 is inserted in the cylindrical keyway of the lock. In this embodiment, the starter circuit is energized, not by a further movement of the key into the keyway, but by a slight rotation of the key after it has been inserted. To this end, the movable contact spring of the other switch element, numbered 94, extends through an aperture from recess 96 into the keyway, and is arranged to be deflected into electrical contact with the spring 98 upon rotation of the key 72; normally, the flat portion 80 of the key passes over the spring 94 without deflecting the same, but when the key is rotated slightly from this position, the contact spring is of course moved into contact with the other spring 98 to energize the starter control circuit. In order to ensure that the key returns to its normal position after the starting operation, and with the ignition circuit still energized, the rectangular rib 82 at its end is disposed to enter a rectangular slot transverse to the circular plate 100 mounted for rotation at the end of the keyway, and secured in place as by a pin 102. A torsion spring 104 is connected between this disc 100 and the casing of the lock switch to return the plate 100 and key 72 to their normal positions, as shown in Fig. 6, upon release of the key after the starting operation has been completed.

In the embodiment just described, it is of course possible for the contact spring 94 to be engaged with the fixed contact 98 by means of an instrument inserted in the keyway, but since the ignition circuit cannot be so operated (as it requires the special magnetic key formation), this feature does not compromise the security of the system as against theft.

Fig. 8 of the drawings illustrates a modified form of lock switch in which the movable armature in the lock, and the key, both have permanently magnetized portions. In this modification, reference numeral 110 designates a yoke-shaped armature having permanent magnetic poles 112 and 114. These permanent poles are normally held away from the soft iron slugs 116 to pro-

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vide an air gap sufficient to prevent the yoke from attracting itself against these slugs. A compression spring 118 normally holds the yoke in the position shown, but obviously any equivalent spring arrangement could be provided for this purpose. The yoke 110 carries a spring contact blade 124 normally held away from the fixed contacts 126, 128.

The key 120 is again provided with an integral permanent magnet 122 having magnetic poles which are spaced to cooperate with the soft iron slugs. Thus, when the key is inserted in the position shown, its magnetic poles attract the yoke 110 downwardly to operate the contacts, the strengths of the magnetic poles on the yoke and on the key being sufficient, when added together, to attract the yoke or armature into contact with the soft iron slugs. The external circuit is thus completed through the terminals connected to the fixed contacts. It will be understood that another set of contacts can also be provided, it being deemed unnecessary to show these in the drawing.

The principal advantage of this construction is that the polarities on the key must be properly related to those of the yoke in order to operate the switch, otherwise the yoke would be repulsed. The use of additional magnets or poles would provide a greater number of combinations.

It is obvious that the principle of a magnetic key control can also be applied to a lock in such a way that a normally locked cylinder can be unlocked by the magnetic force when the proper key is inserted, thus freeing the cylinder for rotation to control the starting and ignition circuits by means of a connection from the cylinder to external contacts. Such a modification is illustrated schematically in Fig. 9, in which the key 130 is shown as provided with permanent magnetic portions 132, 134, and 136, each having a north and a south pole as described in connection with the other embodiments. Numeral 139 designates a cylinder which can be rotated within the lock casing, but is normally blocked against such rotation by the yokes such as 138, each having a locking pin of hardened steel or the like 140. The locking pin 140 is normally held in a recess 142 in the lock casing, by spring pressure in a manner similar to that already described. When the key 130 is inserted in the lock, the magnet portion 132 pulls yoke 138 downwardly, thus disengaging pin 140 from recess 142 and permitting the cylinder 139 to be rotated through a suitable angle.

In the particular embodiment shown in Fig. 9, there are three of these locking pins, together with their corresponding yokes and springs, and as will be clear from the figure, various combinations can readily be obtained by altering the number, position and dimensions of the yokes and the corresponding magnet portions of the key. Cylinder 139 may be retained against axial movement in the casing as by a rear plate 144 secured to the casing by screws or the like. The cylinder 139 is also provided with a pin 146 which extends through an arcuate slot 148 in the cover plate 144, and the motion of this pin when the cylinder is rotated can be utilized to control either the starting or ignition circuit, or preferably both, in a manner clear from the preceding description.

The invention has been described in connection with two preferred and exemplary embodiments thereof, but it is to be understood that these embodiments are given by way of illustration and not limitation; other changes and modification in the details of the system can also be made without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A lock switch comprising a housing, a pair of switches in said housing for controlling independent circuits, means including a magnetic key for operating one of said switches upon insertion of said key in said lock switch, and means responsive to a rotation of said key,

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after it has been completely inserted, for operating the other said switches.

2. The invention in accordance with claim 1, including means in said casing for resiliently biasing said key toward a position in which said other switch is returned to non-operated condition.

3. The invention in accordance with claim 2 in which the last-named means comprises a torsion spring, and means for connecting said spring with said key when the latter is fully inserted in said lock switch.

4. A magnetic lock switch comprising a housing, means forming a key slot in said housing, a switch having spaced contacts within said housing, an operating means for said switch including a tiltable armature mounted intermediate its ends for see-saw motion on said operating means and normally spaced from said slot means, the initial spacing between said switch contacts being less than the spacing of said tiltable armature from said slot means whereby said operating means is moved to close said switch in response to magnetic forces acting simultaneously along said armature to produce linear displacements of said tiltable armature with respect to said slot means, the space between said tiltable armature and said slot means being limited, whereby insufficient movement is imparted to said operating means to cause operation of said switch by tilting movement of said tiltable armature in the direction of said slot means.

5. A magnetic key operated switch comprising, in combination, a pair of spaced switch contacts including a movable contact, and a magnetically actuated member mounted intermediate its ends for see-saw motion on said movable contact and adapted to operate said switch through said mounting in response to spaced magnetic forces acting simultaneously along said member in substantial balance about said see-saw mounting, but not in response to magnetic forces applied on one end only to unbalance and tilt said magnetically actuated member.

6. A magnetic key operated switch comprising, in combination, a key slot, a pair of spaced switch contacts including a movable contact, and a magnetically actuated member mounted intermediate its ends for see-saw motion on said movable contact and adapted to operate said switch through said mounting in response to spaced magnetic forces acting simultaneously along said magnetically actuated member on opposite sides of said see-saw mounting, but not in response to magnetic forces applied at one end only of said magnetically actuated member, and means in said key slot to transmit magnetic forces of greater density to the ends of said magnetically actuated member.

7. A magnetic key operated switch comprising, in combination, a pair of spaced switch contacts including a movable contact, and a magnetically actuated member mounted intermediate its ends for see-saw motion on said movable contact and adapted to operate said switch through said see-saw mounting in response to spaced magnetic forces of opposite polarity acting simultaneously along said member on opposite sides of said see-saw mounting, but not in response to magnetic forces applied successively first to one end of said member and then to the opposite end of said member.

8. A magnetic key operated switch comprising, in combination, a pair of spaced switch contacts including a movable contact, and a magnetically actuated member mounted intermediate its ends for see-saw motion on said movable contact and adapted to operate said switch through said see-saw mounting in response to spaced magnetic forces of opposite polarity acting simultaneously along said member on opposite sides of said see-saw mounting, but not in response to magnetic forces applied successively first to one end of said member and then to the opposite end of said member, and spaced metal slugs to transmit magnetic forces to the ends of said member.

9. A magnetic key operated switch comprising, in

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combination, a pair of spaced switch contacts including a movable contact, and a magnetically actuated member mounted intermediate its ends for see-saw motion on said movable contact and adapted to operate said switch through said see-saw mounting in response to spaced magnetic forces of opposite polarity acting simultaneously along said member on opposite sides in substantial balance about said see-saw mounting, but not in response to magnetic forces of the same polarity applied to unbalance and tilt said member, and means to transmit magnetic forces of greater density to the ends of said member.

10. A magnetic lock switch comprising a housing, means forming a key slot in said housing, a plurality of switch means in said housing comprising pairs of spaced switch contacts including a movable contact in each of said pairs, and a magnetically actuated member mounted intermediate its ends for see-saw motion on each of said movable contacts and adapted to operate said switches through said mountings in response to magnetic forces acting simultaneously along said members, but not in response to magnetic forces acting on only one end of said magnetically actuated member, a key member receivable in said slot having spaced magnetic inserts to apply forces to said magnetically actuated member on both sides of said see-saw mounting for linearly displacing said member when said key is inserted through said slot to actuate said switch means.

11. The combination defined in claim 10 provided with means in said slot for properly positioning said key for actuation of said switches sequentially and for normally holding said key positioned to close one of said switch means.

12. A magnetic lock switch comprising a housing, means forming a key slot in said housing, a pair of switches in said housing for controlling independent circuits, one of said switches being a magnetic key operated switch comprising a pair of spaced switch contacts including a movable contact, and a magnetically actuated member mounted intermediate its ends for see-saw motion on said movable contact and adapted to operate said switch through said mounting in response to spaced magnetic forces acting simultaneously along said member but not in response to magnetic forces acting to unbalance and tilt said magnetically actuated member on said see-saw mounting, a magnetic key with spaced magnetic inserts for operating said first switch by applying magnetic forces to opposite ends of said magnetically actuated member upon insertion of said key in said slot, and means responsive to rotation of said key after it has been completely inserted for operating the other said switch.

13. The combination as defined in claim 12, including means in said casing for resiliently biasing said key toward a position in which the other said switch is returned to open condition.

14. The combination as defined in claim 13 in which the last named means comprises a torsion spring and means for connecting said spring with said key when the latter is fully inserted in said lock switch.

15. A lock switch comprising a housing, a magnetic key operated switch in said housing comprising a pair of spaced switch contact elements movable from open to closed position, and a magnetically actuated member mounted intermediate its ends for see-saw motion on one of said contacts and adapted to operate said switch through said mounting in response to magnetic forces acting simultaneously along said member but not in response to magnetic forces acting to unbalance and tilt said magnetically actuated member on said see-saw mounting, and a key for operating said switch when inserted in said housing including spaced magnetic inserts in said key for applying balanced operating forces to said opposite ends of said magnetically actuated member and for maintaining said switch closed until the key is removed from the housing.

16. The combination as defined in claim 15 wherein

said magnetically operated member is a magnet with spaced poles of opposite polarity.

17. A magnetic key operated switch comprising, in combination, a pair of laterally spaced switch contacts, a movable switch element adapted to bridge said switch contacts, a magnet secured to said movable contact having opposite poles spaced longitudinally of said contact on opposite sides of the mid portion thereof and acting as an actuator for said switch, and a resilient, compressible, and flexible spring member supporting said magnet actuator and said movable switch contact intermediate the ends thereof for limited angular and bodily movement in any direction on said resilient mounting and holding said switch element spaced from said switch contacts, said actuator being adapted to operate said switch in response to spaced magnetic forces of opposite polarity acting simultaneously along said member on opposite sides of said see-saw mounting but not in response to magnetic forces of the same polarity applied along said actuator.

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