

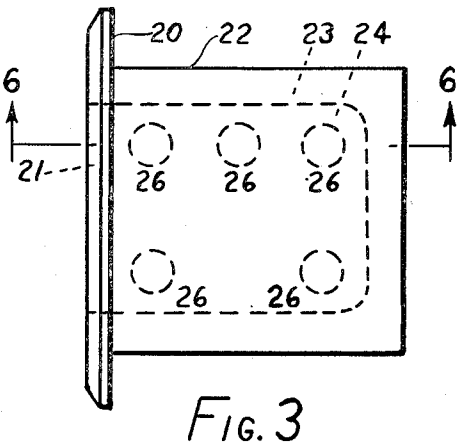
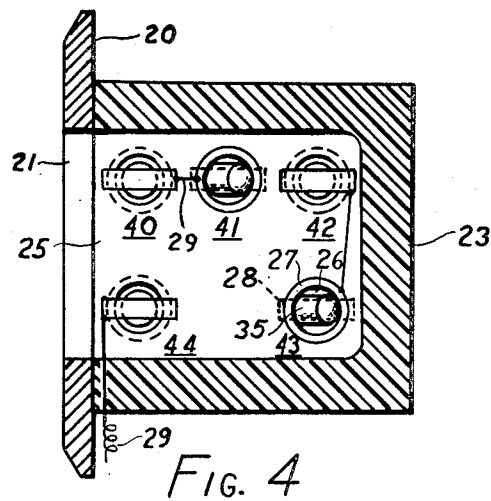
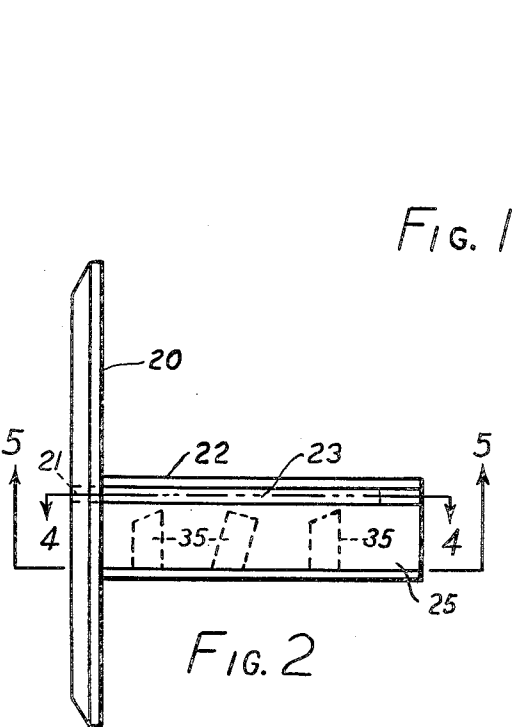
May 6, 1952

H. COOLEY
MAGNET OPERATED SWITCH

2,595,769

Filed July 5, 1947

4 Sheets-Sheet 1



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MAGNET OPERATED SWITCH

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4 Sheets-Sheet 2

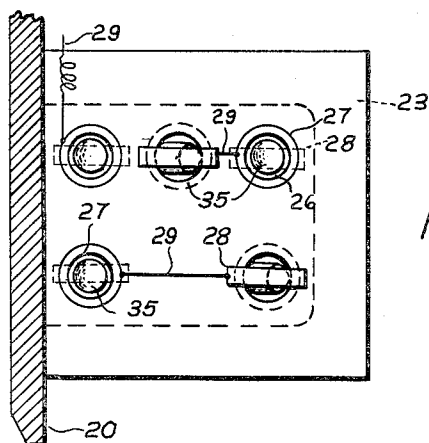


FIG. 5

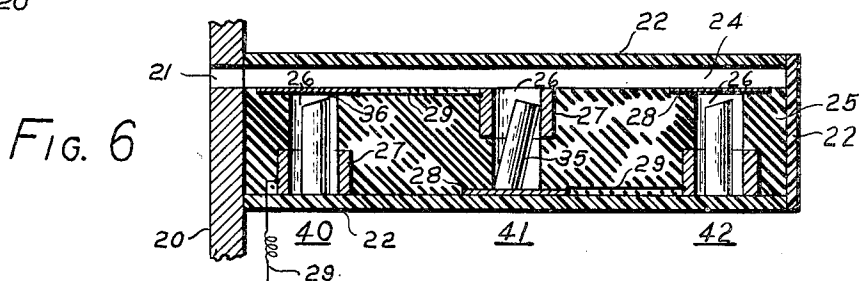


FIG. 6

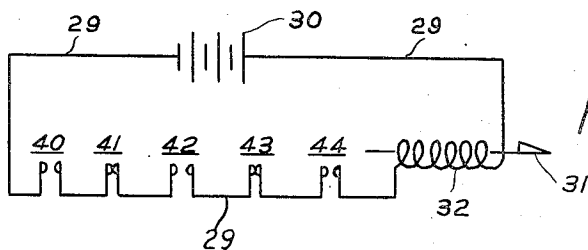


FIG. 7

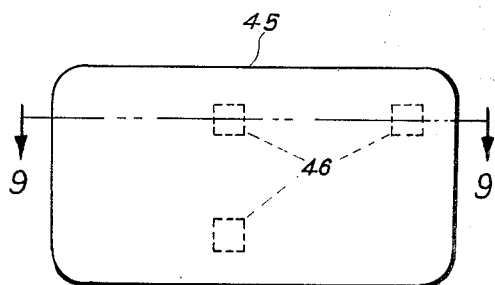


FIG. 8

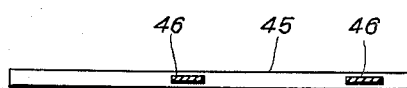


FIG. 9

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4 Sheets-Sheet 4

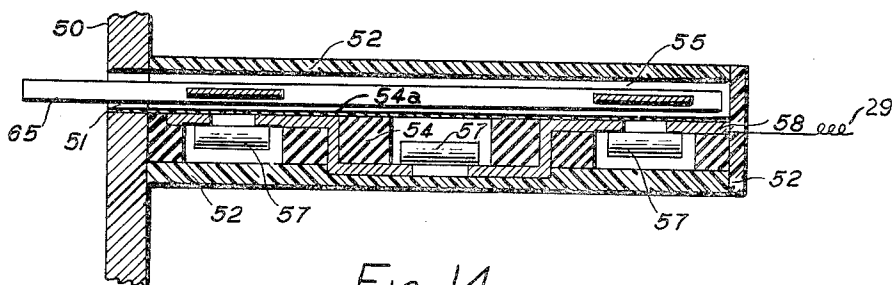


FIG. 14

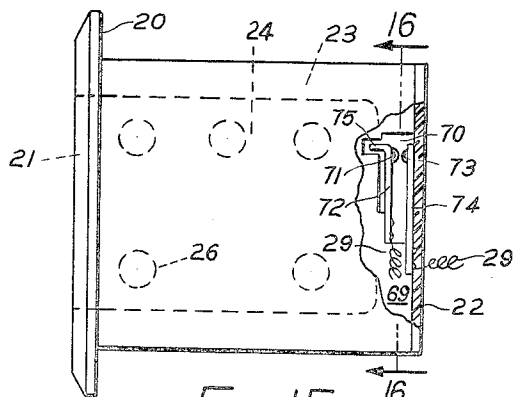


FIG. 15

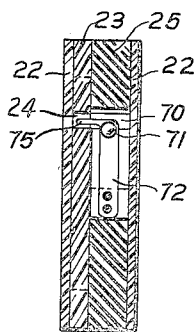


FIG. 16

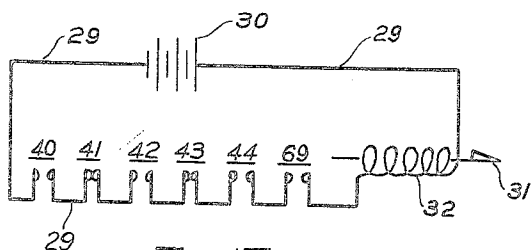


FIG. 17

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2,595,769

MAGNET OPERATED SWITCH

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Application July 5, 1947, Serial No. 759,049

16 Claims. (Cl. 200—87)

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This invention relates to a magnet-actuated switch for controlling an electrical circuit and pertains particularly to a magnet-actuated switch for use in conjunction with electrically operated latch apparatus. It is an improved modification of the key-operated switch of my invention, which is described in the copending application for United States Letters Patent, Serial No. 688,748, filed August 6, 1946, now Patent No. 2,566,017, August 28, 1951.

The general object of the invention is the provision of a key-controlled, magnet-actuated switch which is simple in construction, durable, inexpensive and easy to operate.

It is a further object of the invention to provide a switch for controlling an electrical circuit, which switch is operated by the movement of magnets contained therein as they are attracted by pieces of magnetic material contained in a key used in conjunction with the switch.

A further object of the invention is the provision of an electric switch actuated by a plurality of magnets disposed in a given pattern, which may be operated only by the use of a key containing magnetic elements arranged in a corresponding pattern.

A further object of the invention is the provision of a key-operated electric switch actuated by the movement of a plurality of floating magnets disposed within the switch in a pattern corresponding to that of magnetic elements in the key, the design of the switch being such as to make possible the construction of a large number of switch units each having a different magnet pattern and hence requiring for its operation a distinctive key which may not successfully be used for operating switches having a different pattern of magnets.

A further object of the invention is the provision of a switch which is particularly adapted for use in controlling an electric circuit governing the operation of an electromagnetic latch.

A further object of the invention is the provision of a switch which may be used in an electrical circuit with a solenoid-operated latch in order to impart pickproof qualities to the same.

A further object of the invention is the provision of a switch for controlling an electrical circuit and adapted to be operated by a key in the form of a flat card having concealed magnetic elements incorporated therein.

The manner in which the foregoing and other objects of the invention are accomplished will be apparent from the following specification and claims considered together with the accompanying drawings wherein,

Figure 1 is a front elevation of the switch of the invention;

Figure 2 is a side elevation of the switch of the invention;

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Figure 3 is a top plan view of the switch of the invention;

Figure 4 is a sectional view taken along the line 4—4 of Figure 2;

Figure 5 is a sectional view taken along the line 5—5 of Figure 2;

Figure 6 is a sectional view taken along the line 6—6 of Figure 3;

Figure 7 is a schematic wiring diagram illustrating the electrical connections for the switch illustrated in Figures 1 to 6 inclusive;

Figure 8 is a top plan view of a key for use with the switch of the invention;

Figure 9 is a sectional view taken along the line 9—9 of Figure 8;

Figure 10 is a sectional view indicating the operation of the switch by means of the key illustrated in Figure 8;

Figure 11 is a sectional view illustrating the behavior of the switch when its operation is attempted by means of a magnetic element other than the key adapted for use therewith;

Figure 12 is a top view (similar to Figure 4) of the switch of the invention in an alternative embodiment;

Figure 13 is a sectional view (similar to Figure 6) of the switch of Figure 12;

Figure 14 is a sectional view (similar to Figure 10) illustrating the operation of the switch of Figures 12 and 13;

Figure 15 is a fragmentary plan view of a modification of the switch of the invention including means which make possible operation of the switch only when the key is fully inserted and in proper position, thereby enhancing the pickproof qualities of the mechanism and increasing the number of combinations of magnets which may be embodied in the switch;

Figure 16 is a sectional view taken along the line 16—16 of Figure 15; and

Figure 17 is a diagrammatic view illustrating the electrical connections for the switch illustrated in Figures 15 and 16.

In its broadest aspect, the switch apparatus of the invention comprises one or more freely movable magnets, i. e. "floating" magnets, suitably housed and slidably mounted on guide means adjacent electrical contacts which are in series circuit relationship with a source of electric energy and with an electromagnetic lock or other device adapted to operate when the circuit is closed. The switch is operated by bringing in proximity thereto a key containing one or more magnetic elements corresponding in number and position to the magnets embodied in the lock. When the key is placed in a position so that each magnetic element is within the field of force of the corresponding magnet, the magnets will be lifted or moved from their normally retracted position of rest out of contact with the electrical

contacts hereinabove referred to and moved into an advanced position in which they touch the contacts. This completes the electrical circuit and causes the operation of whatever device is to be operated thereby. When the key is removed, the magnets in the switch fall back or are forced back by appropriate means to their normally retracted position so that the circuit is broken.

Referring now more particularly to the drawings, the invention will be described with particular reference to its application in the construction and operation of electromagnetic latch apparatus, although it is to be understood that such description is merely by way of illustration and not of limitation. Such apparatus may comprise for example a latch mounted in the casing of a door or other suitable place. The latch is operated by means of a spring mechanism and normally is held rigidly by a dog or catch which bears against the latch and prevents its movement. The dog, in turn, is operated by means of a solenoid connected in series with a source of electrical energy so that upon energization of the solenoid, the catch is tripped, permitting movement of the latch and opening of the door. However, when the door is closed and the solenoid de-energized, the dog again bears against the latch and prevents its movement.

The switch of the invention broadly comprises a face plate and a body portion. The face plate 20 is adapted to be affixed to any convenient support member, as a door casing, and may be of any appropriate shape. It is provided with a relatively narrow slit 21 through which the key operating the switch is inserted.

The body portion of the switch containing the operating mechanism lies behind the face plate opposite the slit 21. It is constructed of non-magnetic material and is roughly rectangular in shape. For reasons which will appear hereinafter, it preferably is disposed horizontally. It is enclosed by a plurality of surface sheets 22 which, together with the key guide 23 define an aperture or slot 24 which is in substantial registration with the slit 21 to enable introduction of the key through the face plate and into the body of the switch.

Also within the body portion of the switch is the centrally disposed structural member or core 25. This is made from non-conducting, non-magnetic material, e. g. Bakelite or other plastic, and is placed so that its bottom face lies substantially flush against the bottom wall of the housing while its top face forms the lower boundary of the slot 24. In the core are a plurality of chamber-forming perforations 26 extending transversely therethrough and arranged in any suitable pattern. Each of these perforations is adapted to contain a magnet and therefore is of a size and shape determined by the size and shape of the magnet to be used. Since cylindrical magnets preferably are employed, the perforations preferably are circular in shape and have a diameter somewhat greater than that of the magnet, in order to enable the latter to move freely. Electrical contacts are positioned at both ends of each perforation. In the form illustrated, these are of two types. One type 27 comprises a substantially continuous tubular piece of conducting material embedded in the core so that the inner surface of the contact is substantially flush with the wall of the perforation and thus forms a continuation thereof. The other type 28, which is placed at the opposite end of the perforation, comprises a flat piece or strip of conducting ma-

terial preferably embedded in the core so that its outer surface is flush with a surface thereof, but disposed across and at least partly closing one opening of the perforation.

The contacts 27 and 28 of each perforation are connected in series in the electrical circuit by the conductors indicated at 29 and through these to a source of electrical energy such as the battery 30, or the secondary of a transformer. Also in series circuit relationship to the contacts and the source of electrical energy is the device to be operated by the switch, e. g. a latch indicated generally at 31, which may be operated only upon energization of the solenoid 32 (Figure 7).

Disposed within each of the perforations in the core 25 is a permanent magnet 35. This may be of any suitable shape but as indicated above preferably is cylindrical. It may be of any suitable magnetized material, especially the highly magnetic alloy of aluminum, nickel and cobalt known as "Alnico" alloy. Although such materials have a certain natural electrical conductivity, it is preferred to enhance this by plating the surface of the magnet with a highly conducting material such as silver or copper.

The body of each magnet is adapted to form an interconnecting link between the two contacts 27 and 28 present at opposite ends of each perforation. Means therefore are provided for insuring that the magnet will under proper conditions touch both contacts and make the electrical circuit. Such means may comprise an irregularity on the surface of the strip contact 28, so that when the magnet rests upon or is forced against this surface, the body of the magnet is tilted at an angle so that the end opposite to that touching the contact 28 is pressed firmly against the tubular contact 27. Alternately and preferably however, the means for causing tilting of the magnet and consequent making of the circuit comprise a projection on one end of the magnet. Although such a projection may assume various forms, it conveniently may be in the form of a protruding edge 36 made by beveling one end surface of the magnet. Then when the beveled surface is held or pressed against the strip contact 28, the body of the magnet is thrown on a bias as described above so that the other end touches and is held against the tubular contact 27.

The position of each magnet within its perforation is determined by the position of the strip contact 28. When the latter is embedded in the top surface of the core, the magnet will be disposed so that the projection 36 will be pointed upwardly but not touching the strip. This unit of the switch therefore will be in a normally open position. When the strip contact 28 is present on the lower surface of the core, however, the magnet will be placed within the perforation so that the projection 36 is pointed downwardly. The weight of the magnet then will cause it to tilt and lean against the tubular contact 27. This unit of the switch therefore normally will be in a closed position. Each switch thus is made up of a number of magnetic units or stations (e. g. 40, 41, 42, 43 and 44) connected in series, some of which normally are open (40, 42 and 44) and some of which normally are closed (41 and 43). This lends versatility to the switch by increasing the number of combinations possible with a given number of magnets and enhances the pickproof character of the device. These aspects of the invention are more fully discussed hereinafter.

The switch is controlled by means of a key 45

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adapted to be inserted through the slit 21 in the face plate into the aperture 24 within the body of the switch. The key may be of any suitable size and shape, conforming generally to the size and shape of the slit and aperture. It normally will be substantially rectangular and relatively thin, as a card or wafer. It is made of non-magnetic material and has affixed thereon or embedded therein small pieces or shims 46 of magnetic material. These are of approximately the same size or slightly larger than the openings of the perforations in the core and are disposed in a pattern corresponding to that of the perforations containing normally open contact units.

Thus, in its simplest embodiment, the key may comprise a card made of fibrous or other non-magnetic material having affixed thereto or preferably concealed therein pieces of magnetic material such as shim steel. To lend durability to the key and to improve its appearance, the card may be sealed within a transparent plastic cover by any of the standard card-sealing techniques.

The manner in which the switch of the invention operates is illustrated in Figures 10 and 11. When the key 45 is inserted in the slot 24, the magnetic elements 46 are adjacent to and in the field of force of the magnets in units 40, 42 and 44 which normally are in the open position. These magnets are attracted by the shims, and, being free to move or "floating," move from their normally retracted position of rest on the bottom of the perforation upwardly in the direction of the shims, the side walls of the perforation acting as guide means during this movement. When the projection on the upper surface of the magnet, as the beveled edge 36, touches the strip contact 28, the magnet is tilted, thereby throwing the lower portion thereof against the tubular contact 27 in the bottom portion of the perforation, where it is held snugly in place by the magnetic forces. This makes the circuit in units 40, 42 and 44. Since the magnets in units 41 and 43, which normally are in the closed position, are unaffected by the introduction of the card into the slot, the entire circuit is closed and the solenoid 32 in series therewith is energized, thereby tripping the latch mechanism.

Upon withdrawal of the key from the slot, the magnets in units 40, 42 and 44 no longer are held by magnetic forces in their advanced positions against the contacts, whereupon they drop back by gravity to their normal positions of rest. This breaks the circuit, de-energizes the solenoid and locks the latch mechanism in place so that the door cannot be opened. Thus, by alternately inserting the key into the slot and removing it therefrom, there is imparted to the magnets in the perforations a reciprocal motion operating to make and break the circuit.

Units 41 and 43, although not normally active when the proper key is introduced into the slot, will be activated upon introduction into the slot of magnetic material in a position such as to come within the sphere of influence or field of force of the magnets contained therein. Thus upon the introduction of a card made for a switch having a different combination of magnetic units, or of a solid piece of magnetic material, as a knife blade 48, the magnets will be attracted thereto. This lifts them free of the strip contacts 28 upon which they normally rest and breaks the circuit. Hence even though the circuit is made in other units, as in one or all of units 40, 42 and 44, it still is incomplete and the solenoid of the lock will remain de-energized.

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It will be apparent to one skilled in the art that although the switch mechanism of the invention is illustrated and described as being in a horizontal position, whereby to enable retraction of the magnets by force of gravity, it also may be installed and utilized in positions other than horizontal, as in a vertical position provided suitable means are supplied for urging the magnet in a direction away from the slot upon removal of the key therefrom. Such means may comprise suitably positioned expansion or compression springs, secondary magnets disposed so as to attract or repel the primary magnets responsible for circuit closures back to their original positions, and the like.

An embodiment of the switch of the invention wherein the arrangement of the electrical contacts is simplified is illustrated in Figures 12 to 14 inclusive. In this embodiment, the switch comprises a face plate 50 having a slit 51, and a body portion enclosed by a plurality of sheets of non-conducting, non-magnetic material 52. Within the body portion is the key guide 53 and the core member 54, also fabricated from non-conducting, non-magnetic material, which, together with the surface sheets 52, define a slot 55. This is in substantial registration with the slit 51, so that a key may be inserted therethrough into the body of the switch.

The core 54 is provided with a plurality of recesses or perforations 56, each of which is of a size and shape adapted to receive and contain a permanent magnet 57, held in place and protected by the core cover sheet 54a. The magnets may be placed either horizontally or vertically, although it is preferred to place them horizontally in order to increase the available contact surface and to make full use of the attractive forces exerted by both magnetic poles. The body of each magnet is adapted to form a connecting link between electrical contacts 58. These are connected in series with a source of electrical energy and with an electric latch or other device to be operated upon closing the circuit. Some of them are placed normally separated from the body of the magnet so that the circuit is incomplete until the magnet is moved into contact therewith; some are placed normally touching the magnet, so that the circuit is completed by the physical contact. In this case, therefore, as in the embodiment described above, the switch is made up of a number of units (59, 60, 61, 62 and 63) some of which normally are open (59, 61 and 63) and some of which normally are closed (60 and 62).

Operation of this form of switch is similar to that of the previously described embodiment. When a key 65 (Figure 14) having a pattern of magnetic elements corresponding to the pattern of magnets within the body of the switch is inserted into the slot 55, the magnets in units 59, 61 and 63 are attracted upwardly until they touch the contacts 58. Since the magnets in units 60 and 62 are not affected by the magnetic elements of the key and remain in their normal position in contact with their respective contacts, the entire electrical circuit is completed and the latch or other mechanism in series therein is operated. However, if the pattern of magnets on the key is such that the magnets in all of units 59, 61 and 63 are not activated, or if there is used a key or implement having magnetic elements in such a position that the magnets in units 60 or 62 are attracted thereto, the circuit will be broken in one or more of these

units and the mechanism will remain inoperative.

In order to make available the entire surface of the key for possible combinations of shims and to insure against operation of the switch by partial insertion of a key, it is of value to provide means for making mandatory the insertion of the key a predetermined distance into the slot, preferably the full depth thereof, before the switch will operate. Such means are illustrated in the embodiment illustrated in Figures 15 to 17 inclusive. In these figures is depicted a switch mechanism analogous to that shown in Figures 1 to 11 inclusive, with the exception that it embodies an additional contact unit 69. This unit, which is connected in series circuit with the magnet-operated contacts, is located in the recess 70 in the back portion of the core. It comprises the contact member 71 affixed to a suitable spring conductor 72 and the contact member 73, similarly affixed to a conductor 74. On the conductor 72 is an extension or projection 75 which is adapted to extend into the slot 24 in the manner shown particularly in Figure 16. A key inserted into the slot the full depth thereof will contact this projection, thereby forcing the contact 71 against the contact 73 and making the circuit. If, however, the key is not of sufficient length to reach to the end of the slot, or if it is not completely inserted into the same, it will not close the contact and the switch will remain open even though the pattern of the shims on the key fortuitously may correspond with that of the magnets in the lock. In order to operate the switch, therefore, a key not only must have the requisite number of magnetic shims disposed in a pattern corresponding to that of the magnets within the body of the lock, but also must be of a size and shape adapted to extend completely into the slot and bear against the contact at the rear end thereof.

Since the magnets employed in the switch of the invention may be of small cross-section, e. g. a cross-section of from $\frac{1}{8}$ inch to $\frac{1}{4}$ inch, it is possible to incorporate a substantial number of them in a switch of average size operated by a key of convenient dimensions, e. g. $2\frac{1}{2}$ inches by 4 inches. This fact, coupled with the possibility of varying the number and positions of normally open and normally closed contact units in the switch assembly, makes possible the use of a vast number of combinations so that the switch has substantially the versatility and pickproof character of a high grade mechanical tumbler lock. This makes it suitable for use in a diversity of applications. Of particular interest is its use in operating electro-magnetic locks on the doors of club rooms, institutions, and other establishments where keys to the same lock are to be held by a large number of persons. Such persons may carry a card of membership containing personal data, identification marks etc. sealed in a plastic case and having concealed within the body of it a pattern of magnetic shims corresponding to the pattern of the magnets present in the switch operating the lock on the door. The card may be issued for a given time period at the end of which it may be rendered ineffective by changing the pattern of the magnets in the switch, or by inserting a new body portion prefabricated and containing a new combination of magnets. The apparatus has a multiplicity of other applications, however, as in the operation of automobile ignition systems, where the operator's driver's license may be incorporated in the card operating the switch, in locks for the doors of hotel

rooms, in circuits adapted to actuate coin-operated telephones and the like.

Having now described my invention, what I claim as new and desire to protect by Letters Patent is:

1. A magnet actuated switch for use with a key having attached thereto a plurality of magnetic elements arranged in a characteristic pattern, said switch comprising a plurality of reciprocable magnets arranged in a pattern corresponding to that of said magnetic elements on said key, guide means for directing the movement of said key so that said magnetic elements are placed within the fields of force of said magnets, means for guiding said magnets as they reciprocate to advanced stations when said key is placed in proximity thereto and to retracted stations when said key is removed, and a plurality of electrical contact means in series circuit relationship with each other and so disposed as to be in and out of contact with said magnets as said magnets move to advanced and retracted stations, thereby alternately making and breaking the electrical circuit.

2. A magnet-actuated switch for use with a key having attached thereto magnetic elements arranged in a characteristic pattern, said switch comprising a housing having in one face thereof an opening corresponding in shape substantially to the cross-sectional dimensions of said key, floating magnets within said housing, the pattern of said magnets corresponding to the pattern of said magnetic elements on said key, said opening forming with the inner walls of said housing a guide whereby to enable positioning said magnetic elements adjacent the corresponding ones of said magnets, means for guiding said magnets as they reciprocate to advanced stations when the key is placed in proximity thereto and to retracted stations when the key is removed, and electrical contacts in series circuit relationship with each other and with a source of electric current and so disposed as to be in and out of contact with said magnets as said magnets move to said advanced and retracted stations, thereby alternately making and breaking the electrical circuit.

3. An electric switch which comprises an elongated permanent magnet having an off center projection on one end thereof, guide means within which said magnet is slidably mounted, a tubular electrical contact forming one end of said guide means, and a second electrical contact disposed across the other end of said guide means, said second electrical contact being adapted to be touched by said projection on said magnet upon attraction of said magnet theretoward by the approach of a piece of magnetic material, whereby to tilt said magnet and force one end thereof against said tubular electrical contact, thereby completing the electric circuit.

4. An electric switch comprising a housing in one face of which there is an opening adapted to receive a key containing magnetic elements arranged in a characteristic pattern, within said housing, a body portion having a plurality of perforations therethrough, the pattern of the perforations in the body portion corresponding to the pattern of the magnetic elements in the key, permanent magnets slidably mounted one in each of said perforations, means for guiding said key as it is inserted through said opening until each of the magnetic elements thereon is stationed within the field of force of the corresponding magnet in the body portion and electrical contacts connected in series circuit relationship with

each other and with a source of electric energy, two of said contacts being located adjacent each of said perforations, said magnets being adapted to move from normally retracted positions upon the approach of said magnetic elements within their fields of force into advanced positions touching said electrical contacts, thereby completing an electrical circuit, and to return to said retracted positions separated from said electrical contacts upon the withdrawal of said magnetic elements, thereby breaking said electrical circuit.

5. An electric switch comprising a body portion having a plurality of cavities therein, floating permanent magnets disposed one in each of said cavities, electrical contacts connected in series with a source of electrical energy and arranged in pairs, one pair being disposed adjacent each of said cavities, and a key for operating said switch having a characteristic pattern of magnetic elements thereon; at least one of said magnets in said switch being adapted to move upon the approach of a corresponding magnetic element in said key from a retracted position not touching one pair of said contacts to an advanced position touching the same, thereby closing the electrical circuit, and at least one of said magnets in said switch being adapted to move upon the approach of a magnetic element other than that designed to operate the switch from a normally retracted position touching a second pair of said contacts to an advanced position not touching the same, thereby breaking the electrical circuit.

6. An electric switch comprising a housing, in said housing a core having a plurality of recesses therein, floating permanent magnets disposed one in each of said recesses, electrical contacts connected in series with a source of electrical energy, and arranged in pairs, one pair being disposed adjacent each of said recesses and forming with the magnets contained therein normally open contact units wherein the magnet is apart from the contacts, and normally closed contact units wherein the magnet touches the contacts; and to operate said switch a key having thereon pieces of magnetic material arranged in a pattern corresponding to the pattern of the magnets in said normally open contact units, said key being adapted to be inserted into said housing and to attract the magnets in said normally open contact units without disturbing the magnets in said normally closed contact units, thereby completing the electrical circuit.

7. An electric switch comprising a housing, in said housing a core having therein a plurality of recesses, floating permanent magnets disposed one in each of said recesses, a plurality of electrical contacts connected in series with a source of electrical energy, a pair of said contacts being disposed beneath at least one of said magnets and touching the same to form a normally closed contact unit, and a pair of said contacts being disposed above at least one of said magnets and separated from the same to form a normally open contact unit, and to operate said switch a key having thereon pieces of magnetic material arranged in a pattern corresponding to the pattern of the magnets in said normally open contact units, said key being adapted to be inserted into said housing and to cause the magnets in said normally open contact units to move against the contacts therein to complete the electric circuit without disturbing the position of the magnets in said normally closed contact units.

8. An electric switch comprising a housing, in said housing a core having a plurality of trans-

verse perforations therethrough, freely movable permanent magnets having an off center projection on one end thereof disposed one in each of said perforations, a plurality of electrical contacts connected in series with each other and with a source of electrical energy, said electrical contacts being disposed so as to form at least one normally open contact unit comprising a perforation having one of said contacts across the top portion thereof, another of said contacts encircling the bottom portion thereof, and a magnet resting therebetween with the projection adjacent but not touching said one of said contacts; and to form at least one normally closed contact unit comprising a perforation having one of said contacts across the bottom portion thereof, another of said contacts encircling the top portion thereof, and a magnet resting therebetween with the projection touching said one of said elongated contacts and interconnecting it with said another contact; and to operate said switch a key having thereon pieces of magnetic material arranged in a pattern corresponding to the pattern of the said normally open contact units, said key being adapted to be inserted into said housing so that said pieces are within the fields of force of the magnets in said normally open contact units, thereby causing them to touch their respective contacts and close the electric circuit.

9. An electric switch comprising a housing, a plurality of guide means in said housing, a plurality of floating permanent magnets disposed one in each of said guide means, a plurality of electrical contacts connected in series with a source of electric energy and disposed in such a manner that two of said contacts are adjacent each of said magnets, a key adapted to be inserted in said housing and having thereon a plurality of pieces of magnetic material arranged in spaced apart relationship corresponding to the spacing of the said magnets, thereby attracting said magnets from their normal positions out of contact with said contacts to advanced positions touching the same, and a pair of electrical contacts connected in series with said plurality of electrical contacts and adapted to be closed by pressure exerted thereon by said key, thereby making mandatory for the operation of said switch the positioning of said key at a predetermined station.

10. An electric switch comprising in combination a housing, in said housing a core having a plurality of recesses therein, a plurality of floating permanent magnets disposed one in each of said recesses, a plurality of electrical contacts connected in series with each other and with a source of electrical energy and placed so that a pair of said contacts is adjacent each of said magnets, said magnets and said contacts forming at least one normally open contact unit wherein the magnet does not touch the pair of contacts adjacent thereto and at least one normally closed contact unit wherein the magnet touches the pair of contacts adjacent thereto, a key adapted to be inserted in said housing and embodying a plurality of pieces of magnetic material spaced apart to correspond to the spacing of the magnets in said normally open contact units, thereby enabling upon the insertion of said key in said housing the attraction of the magnets in said normally open contact units into contact with the electrical contacts adjacent thereto to complete the circuit, without disturbing the magnets in said normally closed contact units, and in said housing a pair of electrical contacts connected in series with

said plurality of electrical contacts and adapted to be closed by pressure exerted thereon by said key, thereby requiring for operation of said switch the insertion of said key a predetermined distance into said housing.

11. An electric switch comprising a housing having a slit in one face thereof, in said housing a plurality of floating magnets in spaced apart relationship to each other, a substantially flat key adapted to be inserted through said slit and carrying a plurality of magnetic elements having a spacing corresponding to that of said floating magnets, said slit forming together with the walls of said housing a guide for directing the movement of said key to a position in which each of the magnetic elements thereon is within the field of force of the corresponding magnet, and a plurality of electrical contacts connected in series with each other and arranged in pairs, each pair being beneath the guide for said key but above the floating magnets, so that, upon introduction of said key within said housing, said floating magnets are drawn into contact with said electrical contacts to complete the circuit, and, upon retraction of said key from said housing, said floating magnets fall back by gravity out of contact with said electrical contact, thereby breaking the electrical circuit.

12. An electric switch which comprises a permanent magnet having an off center projection on one end thereof, guide means within which said magnet is slidably mounted, a first electric contact adjacent one end of said guide means, and a second electric contact disposed adjacent the other end of said guide means, the second electric contact being adapted to be touched by the projection on the magnet upon attraction of the magnet theretoward by the approach of a piece of magnetic material, tilting the magnet and forcing one end thereof against the first electrical contact, thereby completing the electric circuit.

13. A switch comprising a housing having in one face thereof an opening adapted to receive a key carrying a piece of magnetic material, a plurality of floating magnets within said housing, a plurality of electrical contact pairs connected in series with each other and with a source of electric energy, one pair being positioned adjacent each of said floating magnets; at least one of said magnets being normally positioned to move upon the approach of magnetic material from a retracted position apart from the contact pair adjacent thereto to an advanced position touching the same, thereby completing an electrical circuit, and to return to said retracted position upon withdrawal of said magnetic material, thereby breaking the electric circuit; and at least one of said magnets being normally positioned to move upon the approach of magnetic material from a normally retracted position touching the contact pair adjacent thereto to an advanced position apart from the source, thereby breaking the circuit, and to return to said retracted position upon withdrawal of said magnetic material, thereby making the electric circuit.

14. An electric switch adapted operable by a key having thereon a plurality of pieces of magnetic material arranged in spaced apart relationship to each other and comprising a housing, a plurality of guide means in the housing, a plurality of floating magnets disposed one in each of the guide means the magnets having a spacing corresponding to the spacing of the magnetic elements in the key, a plurality of electric

contacts connected in series with a source of electric energy and disposed with two of the contacts adjacent each of the magnets, the magnets being adapted to move within the guide means to advanced positions touching the said electric contacts when the magnetic elements in the key are placed within their fields of force, and a pair of electric contacts connected in series with said plurality of electric contacts and adapted to be closed by pressure exerted thereupon by the key, thereby making mandatory for the operation of the switch the placing of the key at a predetermined station therein.

15. An electric switch operable by a key having thereon a magnetic element, and comprising a floating magnet, a first pair of electric contacts connected in series with a source of electric energy and placed adjacent the floating magnet, the floating magnet being adapted to move against the first pair of contacts when the magnetic element on the key is introduced within its field of force, and a second pair of electric contacts connected in series with the first pair and adapted to be closed by pressure exerted thereon by the key, thereby making mandatory for the operation of the switch the positioning of the key at a predetermined station.

16. An electric switch operable by a key having thereon a characteristic pattern of magnetic elements, the switch comprising a plurality of floating magnets, a plurality of pairs of electric contacts connected in series with each other and with a source of electric energy, one pair being positioned adjacent each of the floating magnets; at least one of the magnets being positioned to move upon the approach of a magnetic element in the key from a retracted position apart from the contacts adjacent it to an advanced position touching the same, thereby completing an electric circuit, and to return to its retracted position upon withdrawal of said magnetic element, thereby breaking the electric circuit; and at least one of the magnets being positioned to move upon the approach of a magnetic element in the key from a normally retracted position touching the contacts adjacent thereto to an advanced position apart from the same thereby breaking the circuit, and to return to its retracted position upon withdrawal of the magnetic element, thereby making the circuit; and another pair of electric contacts connected in series with said plurality of pairs of electric contacts and positioned to be closed by pressure exerted thereon by the key, thereby preventing operation of the switch until the key has been placed in a predetermined position with respect thereto.

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