

[54] **CARD READING METHOD AND APPARATUS**

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[52] U.S. Cl. .... **235/61.11 D**, 200/46, 235/61.12 M, 340/174 PM

[51] Int. Cl. .... **G06k 19/06**, G06k 7/08, H01h 43/08

[58] Field of Search ..... 235/61.11 D, 61.12 M; 200/46; 340/174 PM

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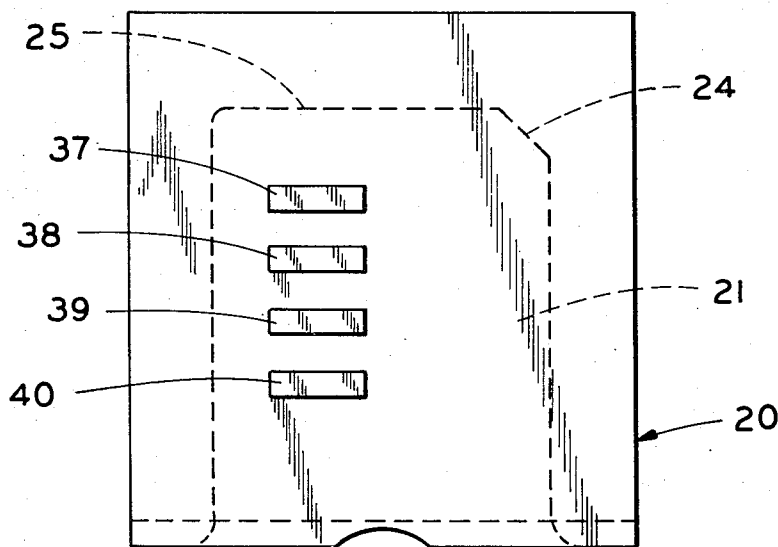
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[57]

**ABSTRACT**

A card having spots of paramagnetic material is inserted in a pocket in a card reader. At one side of the pocket opposite each of the spots is a magnet and at the other side is a reed switch. The magnetic material in the card acts as a shunt for the magnetic field of the magnet. In one embodiment it prevents that magnetic field from reaching the switch in sufficient strength to operate the switch. In another embodiment it increases the magnetic field to the switch by providing a paramagnetic path to the switch, with the switch being open in the absence of that path. In another embodiment it interferes with a repulsion between two magnets on opposite sides of the card so that the magnet on the side adjacent the switch moves toward the card and away from the switch to thereby open the switch contact.

**16 Claims, 15 Drawing Figures**



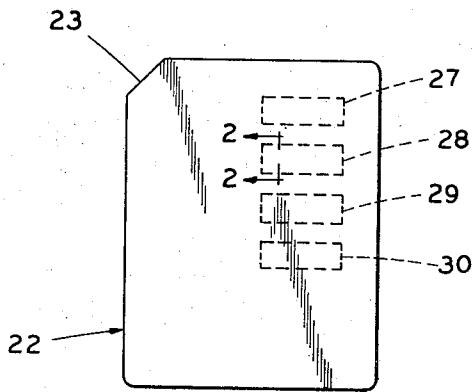


FIG. 1

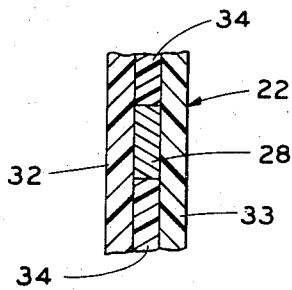


FIG. 2

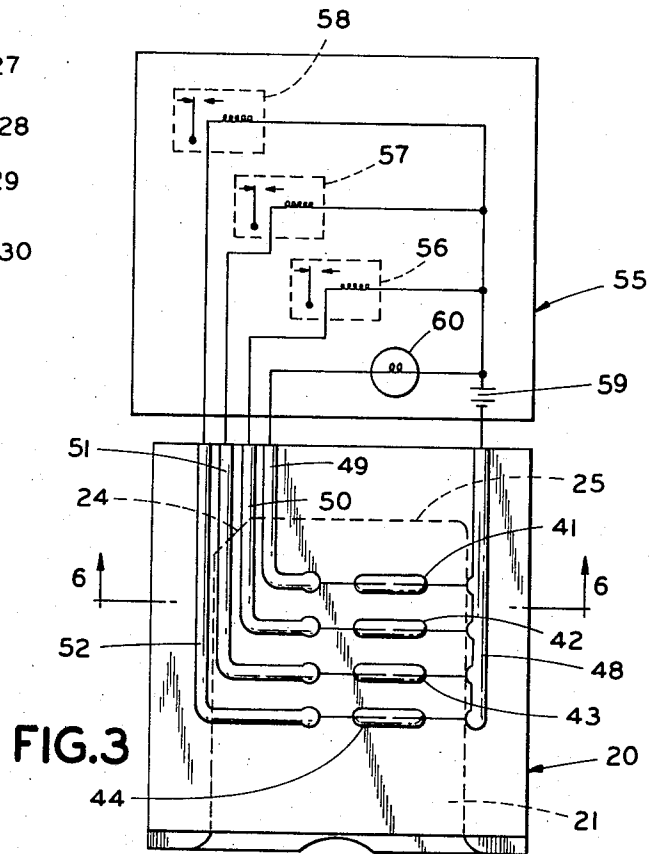


FIG. 3

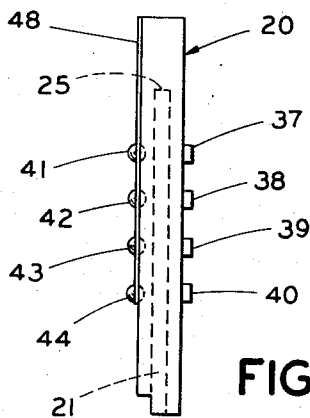


FIG. 4

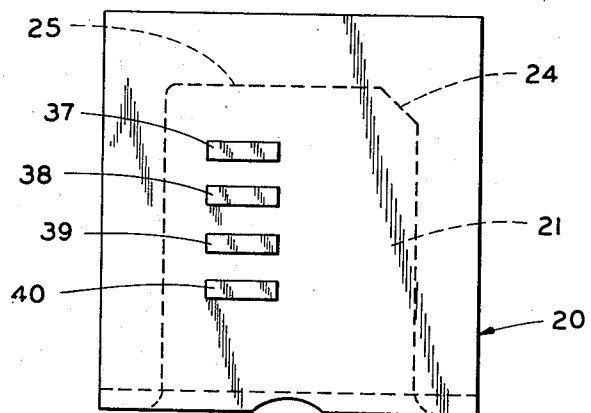


FIG. 5

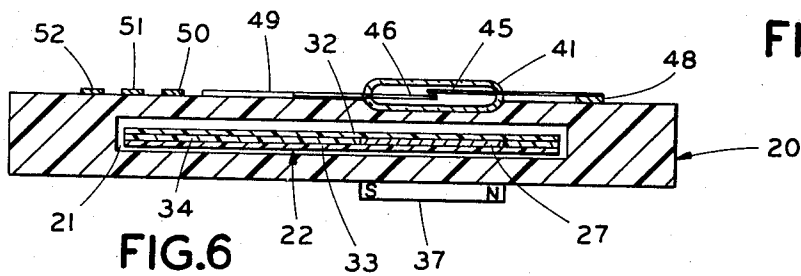


FIG. 6

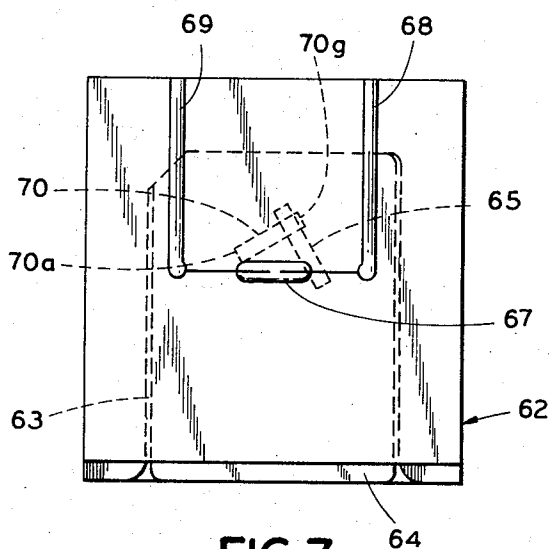


FIG. 7

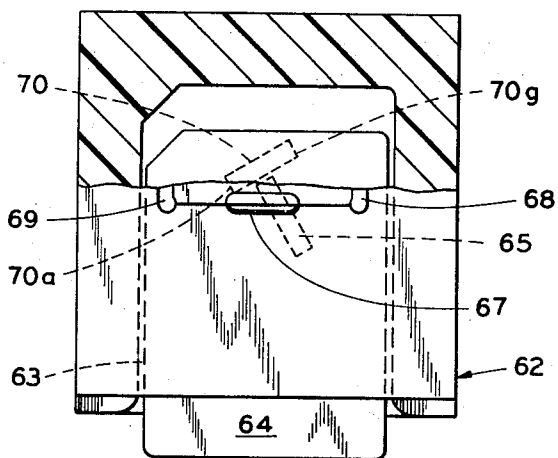


FIG. 8

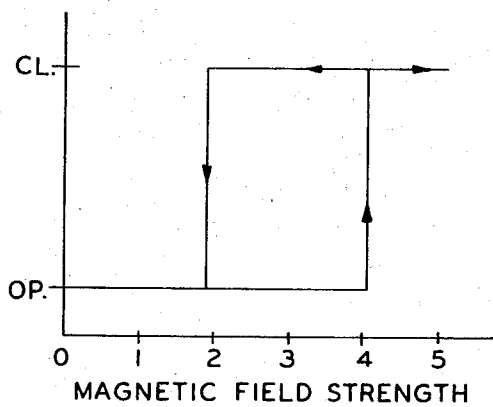


FIG. 9

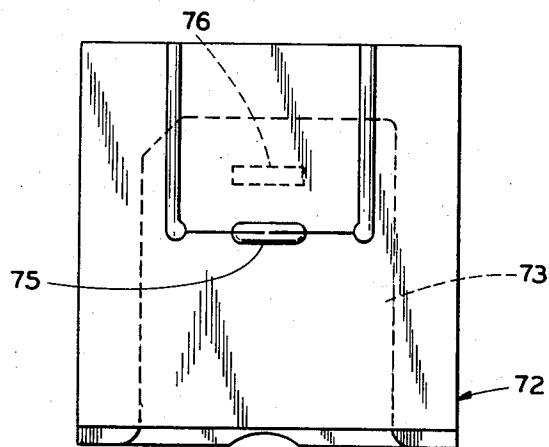


FIG. 10

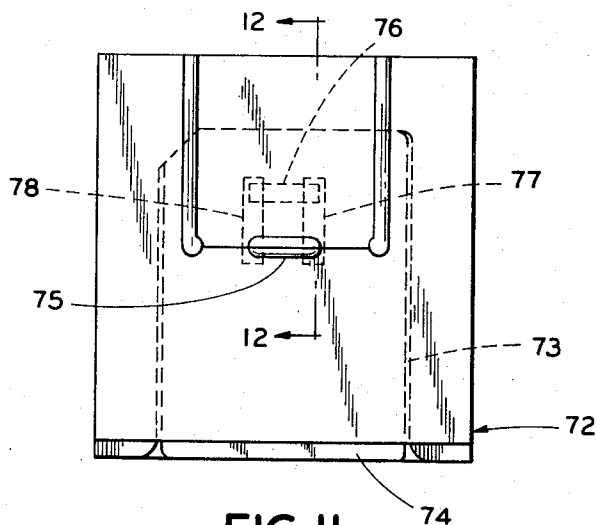


FIG. 11

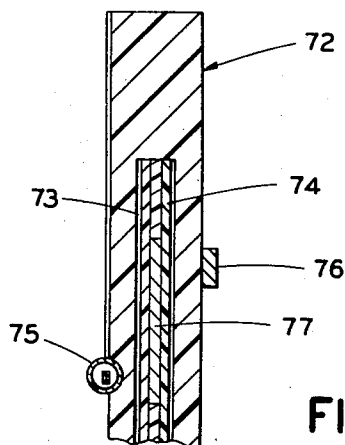
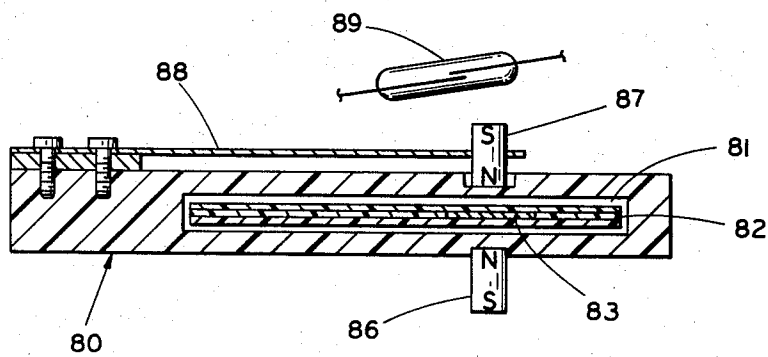
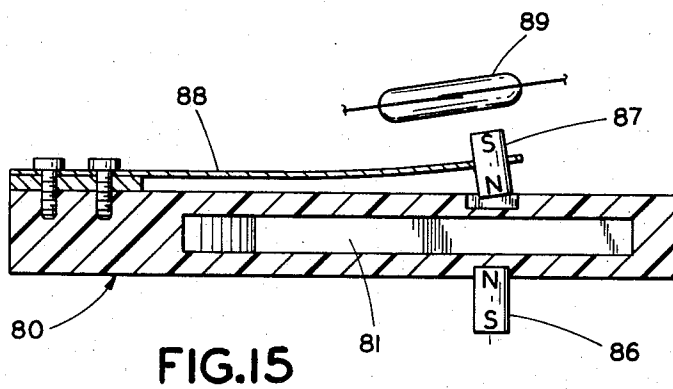
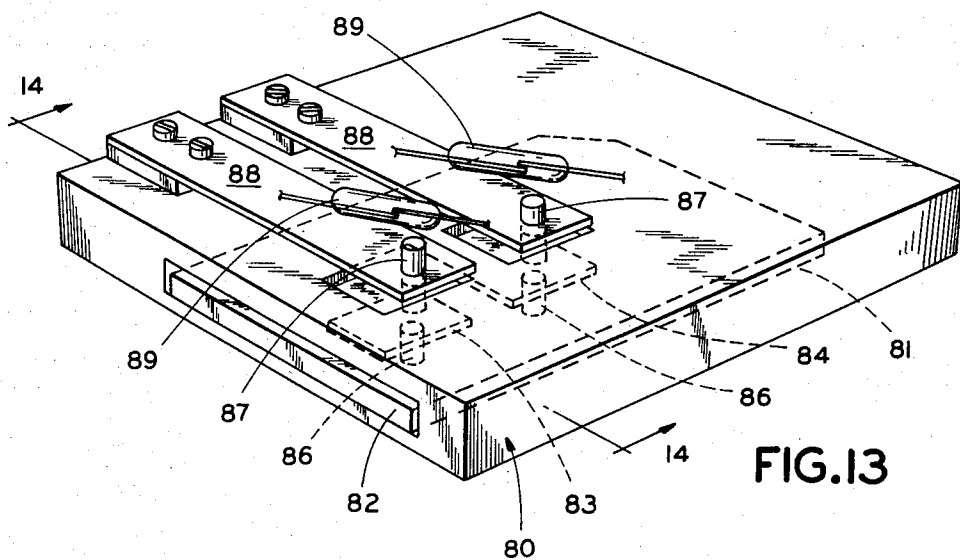


FIG. 12



## CARD READING METHOD AND APPARATUS

## SUMMARY OF THE INVENTION

The present invention relates to a provision of a simple and inexpensive card reading device to supply information from a card invisibly coded by a magnetic material embedded therein.

## DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of an identification card or the like used in conjunction with the present invention;

FIG. 2 is an enlarged partial section as seen at line 2—2 of FIG. 1;

FIG. 3 is a schematic plan view of a card reading device;

FIG. 4 is a side elevation of the reading device;

FIG. 5 is a bottom view of the card reading device;

FIG. 6 is a section seen at line 6—6 of FIG. 3;

FIG. 7 is a plan view of an alternative form of card and reading device therefor;

FIG. 8 is a view corresponding to FIG. 7, with a portion of the device broken away and with the card partially displaced from the reading device;

FIG. 9 is a diagram used in illustrating the operation of the reading devices;

FIG. 10 is a plan view of another alternate reading device;

FIG. 11 is a plan view of the reading device of FIG. 10 showing a card positioned therein;

FIG. 12 is a partial section as seen at line 12—12 of FIG. 11;

FIG. 13 is a perspective view of a further embodiment of the invention;

FIG. 14 is a section seen at line 14—14 of FIG. 13; and

FIG. 15 is a view corresponding to FIG. 14 with the card removed.

## DESCRIPTION OF SPECIFIC EMBODIMENTS

The following disclosure is offered for public dissemination in return for the grant of a patent. Although it is detailed to ensure adequacy and aid understanding, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how others may later disguise it by variations in form or additions or further improvements.

## EMBODIMENT OF FIGURES 1-6

FIGS. 3-6 illustrate a reading device of the present invention. It comprises a frame or holder, generally 20, which defines a pocket or way 21 for receiving a card, generally 22. The card has one corner 23 cut away and the pocket has a corresponding obstructed corner 24. Thus the card can be inserted into the pocket with only one orientation if the card is to be fully received in the pocket with the end of the card abutting the rear wall 25 of the pocket. The card has a plurality of pieces 27 through 30 of magnetic material embedded therein. The term magnetic material is employed herein to refer to material that has a magnetic permeability somewhat greater than that of a vacuum. As used in the present invention, this magnetic material is not magnetized, other than such inconsequential residual magnetism as might exist. The material is used in the invention in the nature of a shunt rather than in the nature of a mag-

netic. Numerous such materials are known to those skilled in the art, the most common generally being iron.

The remainder of the card is a non-magnetic material, such as a plastic. Various procedures may be employed for embedding the magnetic material units 27-30 therein. For example, the card may be outer layers 32 and 33 of plastic with fillers 34 therein. After these components have been positioned as desired the thermoplastic material employed is fused together by heat. Thus the magnetic units 27-30 are securely embedded therein at predetermined locations with respect to the borders of the card, with the units being invisible from the exterior of the card. Obviously, components of the card also can be assembled with an adhesive.

Thus when the card 22 is inserted into the pocket 21 the magnetic material units 27-30 are positioned at particular respective locations in the pocket. At one side of the holder at each of the respective locations is a magnet, the magnets being 37-40 respectively. At the opposite side of the holder at each of the respective locations is a reed switch, the switches being 41-44 respectively. The term "reed switch" is used herein to refer to those switches which are actuated by the presence of a magnetic field. When the magnetic field at the switch is below a predetermined strength the switch contacts are open and with a relatively strong field at the switch the switch contacts are closed. The arrangement of the respective pairs of magnets and switches are such that the magnet holds the switch closed so long as a card is not in the pocket. However, when a card is in the pocket the respective units of magnetic material 27-30 are positioned between the respective magnets and switches. The magnetic field instead of reaching to the switch in sufficient strength to operate the switch is shunted through the respective paramagnetic unit. Thus in FIG. 5 the field between the north and south poles of the magnet 37 passes mainly through the shunt 27 and very little 45 that field extends above the shunt. Thus the contacts 46 and 46 of the switch 41 are open. Removal of the card would result in the switch contacts closing.

The face of the holder 20 at which the switches 41-44 are mounted is formed like a printed circuit board. There is a common conductor 48 connected to one side of each of the switches (e.g., contact 45) and there are separate conductors 49-50 connected to the other side of each of the switches 41-44 respectively (e.g., contact 46).

Various control devices can be connected to the switches to indicate which of the switches are open and which are closed at a particular time and to provide suitable automatic reaction depending upon the existing setting of the switches. Just by way of illustration the detecting device, generally 55, is illustrated in FIG. 3. Here there are relays 56, 57 and 58 connected in series with switches 42-44 respectively and a source of electric power 59. Also by way of illustration a light 60 is connected in series with switch 41 and battery 59. If, for example, a card having only magnetic units 28 through 30 were inserted into the holder 20 the relays 56-58 would all drop out because of the respective switches being opened by the units 28-30, but the light 60 would remain lit. Various combinations of coded cards can thus be provided and the coding on the card can be determined from the position of the switches. The cards are not limited to having four units of mag-

netic material therein as in the illustrated embodiment.

#### EMBODIMENT OF FIGURES 7-8

Here the holder or frame, generally 62, has a pocket 63 for receiving a card 64. The card has a unit 65 of magnetic material embedded therein.

At one side of the holder is a reed switch 67 connected to two conductors 68 and 69. At the other side of the holder is a bar magnet 70. The magnet is positioned at an angle with respect to the reed switch and in a location such that one of its poles, e.g., the pole at end 70a is relatively close to the reed switch while the pole at end 70g is relatively remote from the reed switch. Thus if there is not a card in the pocket the strength of the magnetic field from the magnet 70 being impressed on the reed switch 67 is insufficient to cause a closing of the contacts of the switch. The switch thus remains in the open position. However, when the card 64 is fully inserted into the pocket 63, the unit 65 forms a paramagnetic path between the pole at end 70g and the reed switch 67 so as to operate the switch and the switch is in the closed position. As the card is withdrawn slightly to the position illustrated in FIG. 8, the function of the magnetic unit 65 changes from that of providing a path to the switch and the unit again commences to act as a shunt to the magnetic field of the magnet causing the switch to open. Of course, further removal of the card will also cause the switch to be in the open position.

#### EMBODIMENT OF FIGURES 10-12

Here there is a frame or holder, generally 72. It has a pocket 73 for receiving a card 74. At one side of the holder is a reed switch 75. At the opposite side is a bar magnet 76. Here again the magnet is sufficiently remote from the switch 75 so that the extent of the magnetic field reaching the switch is insufficient to close the contacts of the switch. However, the card 74 has two units 77 and 78 of magnetic material embedded therein. When the card 74 is fully in the pocket, as illustrated in FIGS. 11 and 12, the units 77 and 78 each form a paramagnetic path between respective ends of the magnet and switch. This causes a substantial increase in the strength of the magnetic field occurring at the switch so that that field is now sufficiently strong to cause the switch to close. Of course, in this embodiment, as well as in the embodiment of FIGS. 7 and 8, a plurality of pairs of switches and magnets could be employed. Only one pair is illustrated and described since this is sufficient to convey the concept involved.

#### EMBODIMENT OF FIGURES 13-15

In this embodiment there is a holder or frame, generally 80. It has a pocket or way 81 to receive a card 82. This card has two units 83 and 84 of magnetic material embedded therein. Of course, these units are at a particular location in the pocket when the card is fully inserted into the pocket. The switch operating mechanisms are identical so that only that associated with unit 83 will be described.

At one side of the holder at the location of unit 83 is a magnet 86. This magnet is fixed in place. At the opposite side of the holder is a magnet 87 mounted on a spring arm 88. The arrangement is such that the magnet 87 is biased to its position against the holder, as illustrated in FIG. 14. This biasing could either be by

gravity or by the spring action of arm 88. Above the magnet 87 is a reed switch 89. This is mounted to holder 80 by suitable means, not shown.

The magnets have the poles closest to each other of the same polarity (north in the illustrated embodiment) so that these magnets repel each other. When a card is not in the pocket, as shown in FIG. 15, the repulsion of the magnets raises magnet 87 so that it approaches reed switch 89. Magnet 87 is now sufficiently close to switch 89 so that its magnetic field is sufficient to close the contacts of the switch. However, when card 82 is inserted into the pocket, as illustrated in FIG. 14, the unit 83 is positioned between the two magnets and serves as a shunt to the magnetic field of each of the magnets. This shunt reduces the repulsion effect between the like poles of the magnet and the biasing of the mounting of magnet 87 causes it to descend to the FIG. 14 position. In doing so, magnet 87 moved away from switch 89 to an extent such that its magnetic field is no longer sufficient to hold the switch contacts in the closed position. Thus the switch contacts are open.

FIG. 9 illustrates the general concept of the operation of a reed switch. If the switch is open and the magnetic field strength is relatively low, the switch remains open. Thus, starting at the lower left the switch remains open in the magnetic field strengths indicated by the numbers 1, 2 and 3. However, upon reaching the field strength indicated by the number 4, the switch suddenly closes and remains closed with further increases in the magnetic field strength. Going in the opposite direction and starting with the switch contacts closed (the upper line) the contacts remain closed though the field strength decreases from 5 to 4 and then to 3. However, when the field strength diminishes to 2 the switch contacts suddenly open and continue to stay open with further decreases in the field strength.

The embodiments of this invention are particularly advantageous because of their simplicity and low cost. While perhaps not as much data can be coded (stored) in a card as in some other systems, it is more than adequate for many applications (e.g., a key to a door). Furthermore, the coding is not revealed upon an ordinary visual examination.

I claim:

1. In the combination of a card and a card reading device, the improvement comprising:

said device defining a way for receiving said card, said device including a reed switch positioned at one side of said way, said reed switch being closed when a magnetic field of a relatively strong strength condition is applied thereto and being open when a relatively weak magnetic field strength condition is applied thereto, said device including magnet means including a magnet mounted on the opposite side of said way, said card being positioned at a given location in said way, being mainly non-magnetic material and including magnetic material means of inconsequential residual magnetism, said magnetic material means being positioned between the magnet and the switch and intercepting the magnetic lines of force emanating from said magnet so that said magnetic means applies a magnetic field of one of said conditions to said reed switch, said card being removable from said way whereby said magnetic material means no longer intercepts the lines of force from said magnet and said magnetic means applies a magnetic

field of the other of said conditions to said reed switch.

2. In the combination set forth in claim 1, wherein said reed switch and said magnetic means form a pair with which said magnetic material means cooperates as described, said device including a plurality of said pairs, said card including a plurality of said magnetic material means positioned at different locations on the card to correspondingly cooperate with a respective pair.

3. In the combination of claim 2, wherein said magnetic material means is obscured from visual examination of the exterior of said card.

4. In the combination of claim 2, wherein said device and said card include means restricting the insertion of said card into said way to said location to a single orientation of said card.

5. In the combination of claim 2, wherein said device includes detecting means connected to said switches to determine which of the switches are open and which are closed.

6. In the combination of claim 1, wherein said magnet is positioned to hold said reed switch closed in the absence of said card, when said card is in said position said magnetic material means shunting the magnetic field from said magnet whereby said switch then is open.

7. In the combination of claim 6, wherein said device includes sensing means connected to said switch to determine whether said switch is open or closed.

8. In the combination of claim 1, wherein said magnet and said reed switch are oriented with respect to each other such that, in the absence of a card in said way, the magnetic field from the magnet is so weak at the switch that the switch is then open, said magnetic material being so positioned that when the card is in said position the magnetic material forms a paramagnetic path over a substantial part of the distance between the switch and the magnet to thereby increase the magnetic field at the switch to an extent sufficient to close the switch.

9. In the combination of claim 8, wherein said switch and said magnet are in planes parallel to and at opposite sides of said way, with one respective ends of the switch and magnet being in juxtaposition and the other respective ends being spaced from each other, said magnetic material means being positioned to link said other respective ends.

10. In the combination of claim 8, wherein said switch and said magnet are in planes parallel to and at opposite sides of said way, as viewed at right angles to said planes the respective ends of the switch and magnet being spaced from each other, said magnetic material means being positioned to link said respective ends when said card is in said position.

11. In the combination of claim 1, wherein said magnet means includes a second magnet positioned at said one side of said way between the way and said switch, means mounting said second magnet for movement toward and away from said way and biasing it toward said way, the two magnets being so oriented that in the absence of a card their magnetic fields repel and the second magnet is thereby moved, against said biasing, away from said way and toward said switch so that the magnetic field of the second magnet closes said switch, said magnetic material means being positioned, when said card is in said position, between said magnets

thereby shunting their magnetic fields to reduce said repulsion and allowing said second magnet to move away from the switch under the influence of said biasing thereby reducing the magnetic field at the switch sufficiently to allow said switch to open.

12. In a card for use with a card reading device defining a way for receiving said card at a given location in said way, which device includes a reed switch positioned at one side of said way, said reed switch being closed when a magnetic field of a relatively strong strength condition is applied thereto and being open when a relatively weak magnetic field strength condition is applied thereto, magnet means including a magnet mounted on the opposite side of said way, when said card is not in said way said magnetic material means applies a magnetic field of one of said conditions to said reed switch, the improvement wherein

said card being mainly non-magnetic material and including magnetic material means of inconsequential residual magnetism, when said card is at said location said magnetic material means being positioned between the magnet and the switch and intercepting the magnetic lines of force emanating from said magnet so that said magnetic means applies a magnetic field of the other of said conditions to said reed switch.

13. In the combination of claim 12, wherein said magnetic material means is obscured from visual examination of the exterior of said card.

14. A card reading device for use with a card formed primarily of non-magnetic material and including a predetermined area of magnetic material means at a particular location on the card, said magnetic material means having inconsequential residual magnetism, said device comprising:

frame means defining a pocket for said card such that when said card is in said pocket said location is at a given position in said pocket, magnet means mounted on said frame means and including a magnet positioned at one side of said pocket adjacent said location, said magnet means establishing a magnetic field of a first strength at a point to the other side of said pocket when said card is in said pocket and a magnetic field of a second, different strength at said point when said card is displaced from said pocket, and a reed switch positioned at said point, said switch having an open condition when a relatively weak magnetic field is applied thereto and a closed condition when a relatively strong magnetic field is applied thereto, one of said first and second strengths corresponding to said relatively strong magnetic field and the other of said first and second strengths corresponding to said relatively weak magnetic field, whereby when said card is in said pocket said magnetic material means serves as a shunt for a magnetic field between said magnet and said point so that the magnetic field at said point will be different depending on whether said shunt is present thereby causing the condition of said switch to indicate whether said card is in said pocket.

15. A card reading device as set forth in claim 14, wherein said device includes detecting means connected to said switch to determine whether said switch is open or closed.

16. A card reading device as set forth in claim 15, for use with said card wherein the card includes a plurality

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of said magnetic material means at a plurality of locations on said card, said device being characterized by:  
a plurality of said magnet means each having said magnets positioned respectively adjacent the locations of the magnetic material means when said 5

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card is in said pocket, and a plurality of said reed switches respectively positioned at the respective points.

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