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EUROPEAN QUALIFYING EXAMINATION 2025

Paper B

This paper comprises:

Description of the application

[001] The present invention relates to a magnetically coded locking or access system having a key or keycard comprising magnets and a reading appliance which reads a locking code of the key or keycard based on its magnets and which is used to electrically operate a latch.

[002] It is generally known, see Fig. 1, to use a magnet acting as a key 1 to magnetically operate a switch 3. When the magnet key 1 is introduced into the housing 2, the contacts 3a and 3b of the switch 3 are attracted to each other. This creates a conductive electrical path between the terminals 4 and 5 of the switch, thereby closing it. When the key 1 is taken out of the housing 2, the spring force of contacts 3a and 3b allows them to separate again. Hence, the electrical path between the terminals 4 and 5 is broken and the switch is then open again. This arrangement is known to be used together with electrical circuitry to operate a latch to lock or authorise access to a device.

[003] This type of locking system is very simple and effective. However, it is also very easy to tamper with the locking device as any kind of magnet that is strong enough and brought into proximity to the switch can actuate it. This may lead to unauthorised access to the device.

[004] It is therefore an object of the present invention to provide a novel system that allows only authorised individual access to a locked or deactivated device and improves the security of said device.

[005] This object is achieved by a locking system according to a first embodiment as defined in claim 1.

[006] The object is also achieved by an access system according to a second embodiment as defined in claim 7.

[007] Brief description of the drawings

Fig. 1 is a schematic view of a generally known magnetic key and a switch.

Fig. 2 is a perspective view of parts of a locking system according to a first main embodiment of the invention using a magnet key.

Fig. 3 is a perspective view of the key as shown in the locking system of Fig. 2.

Fig. 4 shows some exemplary embodiments of the discs used to build the key.

Fig. 5 shows a sectional view of an example of the key inserted in the cylinder of the locking system of Fig. 2.

Fig. 6 is a perspective view of parts of a keycard according to a second main embodiment of the invention.

Fig. 7 shows a schematic view of an assembled keycard as described in Fig. 6 and a corresponding keycard housing.

[008] A locking or access system as generally envisaged in the present disclosure comprises a key comprising magnets and a receiving part for the key comprising magnetic field detectors which detect the presence or absence of magnets in the key and generate corresponding electrical signals. These signals are received and analysed by a processing circuit (not shown in the figures) which actuates a latch of the locking system based on those signals. The processing circuit compares the received signals with an expected signature which allows the latch to be actuated.

[009] Fig. 2 shows parts of a locking system 50 of a first main embodiment with a key 10 having an elongated insertion portion 11 and a holding portion 12, and a cylinder 30 acting as a housing and defining a cylindrical passage 34. This passage 34 is open so that the key 10 can be inserted into the cylinder 30. Magnetic field detectors 37 are positioned along the axis of the cylindrical passage (only three of them being shown in Fig. 2).

[010] A magnetic field detector is a sensor which uses an arrangement capable of sensing the direction and strength of a magnetic field to which the arrangement is exposed. For instance, by knowing the direction of the magnetic field and the location of a magnet generating that field, it is possible to determine if the pole of the magnet which is nearest to the sensing arrangement is the north pole or south pole. Reference is also made in the present disclosure to the polarity of the magnetic field sensed by the magnetic field detector, i.e. positive or negative. It is furthermore noted that although the example described above uses a Hall-effect sensor to detect magnetic fields, it is also possible in the present invention to use any other suitable type of magnetic field sensor.

[011] Fig. 3 shows an embodiment of the key 10 including magnets 15 disposed at different axial and angular positions along the elongated insertion portion 11. The magnets are disposed in recesses located on circular discs 14. The discs can also alternatively be polygonal, as explained in connection with Fig. 4.

[012] Fig. 4 shows different alternatives for the discs 14. The discs may be hexagonal 14a with six radially outwardly open recesses 16. The circular disc 14b of Fig. 4 corresponds to that used in the arrangement of Fig. 3. A square disc 14c having four recesses 16, or a T-shaped disc 14d having three recesses 16 may also be alternatively used. The elongated insertion portion 11 may accordingly have a hexagon-, circular-, square-, T- or any other polygon-shaped section.

[013] Fig. 5 shows a sectional view of an example of the key 10 inserted in the cylinder 30. The key 10 has an outer sleeve 13 forming the elongated insertion portion 11 and provided with a stack of discs 14 as described above in connection with Fig. 4. In addition, spacers 26 not carrying magnets may be used. As can be seen in Fig. 5, each of the two permanent magnets 15 is aligned with a corresponding magnetic field detector 37 of the Hall-effect type. Furthermore, for example, one further detector 37' is provided at a location that is not aligned with a permanent magnet 15 in the shown configuration. Obviously, both the axial and angular spacing of the magnets 15 and of the detectors 37 and 37' can be varied depending on the shape of the disc 14. Conductors 38 lead from the various magnetic field detectors 37 and 37' to an electronic circuit (not shown), which analyses the signals received from the detectors.

[014] By placing many detectors at fixed positions along the axis of the cylinder 30 and at different angular locations, it is possible to detect any corresponding configuration of presence of magnets and absence of magnets on the elongated insertion portion 11. In such an embodiment it is preferable to have as many magnetic field detectors 37 as recesses 16. A coding of the key can then take place by having a combination of recesses with magnets and recesses without magnets. Hence, the magnetic field detectors 37 detect either the presence of a magnetic field or its absence, leading to a combination of signals read by the processing circuit from the detectors. This combination increases the security of the locking system as compared to the simple case of Fig. 1.

[015] Another way to increase the number of combinations is to vary the orientation of the magnets in the recesses such that the polarity detected by the detectors 37 is also varied. This again increases the security of the locking system as the field sensed by the detectors in this case can be positive, negative or null.

[016] A further variant uses two consecutive discs 14 in which all the magnets 15 on one disc 14 have a different polarity to all the magnets 15 on the other consecutive disc 14. The fact that such consecutive magnets are of opposite polarity makes it easier to recognise their presence as the magnetic field detector 37 cannot confuse from which of two neighbouring magnets the magnetic field detected originates. Therefore, with such a configuration it is possible to mount magnets closer to each other without jeopardising the magnetic field detection and, hence, the lock coding reading. This variant allows the locking system to be miniaturised or to increase the number of magnets and/or empty recesses for a given size of the key 10.

[017] The presence of all the detectors 37 necessary to decode the key in the variants described above makes the locking system complicated to manufacture and requires many components. To improve this, it is also possible to provide what we call a serial reading function of the sequence of magnets.

[018] The principle is as follows: At least one specific magnetic field detector is used to detect the sequence of magnets on the row along the axis of the key that passes in proximity of this detector as it is being inserted into the cylinder 30 until fully inserted. That is, a single specific detector 37 is configured to detect the presence of the magnets which are downstream along that row, as well as their polarity, while the key is being introduced into the passage. This produces a series of electrical signals which are analysed by the processing circuit and compared with the expected series corresponding to the lock system. Of course, the specific magnetic field detector should preferably be positioned at the entrance to the passage 34 of the cylinder 30 so that no further downstream magnetic field detectors are required.

[019] In such an embodiment, it is not necessary to use other magnetic field detectors along the same row and so the number of magnetic field detectors in the locking system can be reduced.

[020] All the methods and variants described above can of course be used independently or in combination according to the needs of the locking system. For instance, it is advantageous to combine the serial reading function together with a further variant having consecutive magnets of different polarities. This is however not necessary and both variant and serial reading function could be implemented independently of each other.

[021] A second main embodiment of the present invention concerns an access system comprising a keycard instead of a key as in the first main embodiment of Figs. 2 to 5. Here also, the system includes an actuatable latch and a processing circuit, neither of which are further explained herein.

[022] Fig. 6 shows an assembly view of a keycard 110, including a top section 112 and a bottom section 114. Top section 112 and bottom section 114 are sized and shaped to mate with each other at a common plane 116 and will eventually (after assembly) be bonded to each other at this plane. The top section 112 and/or bottom section 114 include several recesses 118a-118f, each sized and shaped to receive a magnet 120. In the example shown in Fig. 6, the keycard 110 includes six recesses 118a-118f that are arranged in the shape of a "T".

[023] Fig. 7 shows an access system 150 with an assembled keycard 110 as described in Fig. 6, together with a schematic view of a corresponding keycard housing 140, the arrow indicating the direction of insertion of the keycard into the housing. Also indicated are Hall-effect transducers 162a-162f, which form a sensing circuit that allows, as for the first main embodiment, detection of the presence and optionally the polarity of a magnet positioned in proximity to it when the keycard is inserted.

[024] As a further variant, it is also possible to use magnets having different properties, i.e. wherein the magnetic field generated is of a substantially different strength. The expression "substantially different" should be understood in the present context as meaning that the magnetic field strengths differ by at least 20% in order that the transducer can reliably distinguish the different strengths. This further raises the security of the access system as more combinations are possible. In addition, tampering becomes more difficult as it is not sufficient to check for the presence of a magnet and to know the polarity of the magnet to illegally reproduce the keycard; rather, complicated measurements are required to determine the field intensity of the magnets used in the keycard to be tampered with.

[025] As a final variant, it is also possible to implement a serial reading function of the magnet combination as has been explained above in connection with the key of the first main embodiment. All the possibilities envisaged above for the second main embodiment can of course be used independently or together.

Claims

1. A locking system (50) comprising:

an elongated key (10) extending along a key axis and having a plurality of permanent magnets (15) spaced axially apart in a predetermined magnet arrangement;

a housing (30) defining a passage (34) complementary to said key and extending along an insertion axis of said key;

one or a plurality of magnetic field detectors (37, 37') spaced axially apart in said housing relative to said insertion axis in a detector arrangement positioned in relation to said magnet arrangement, each of said one or plurality of detectors being configured to change state on juxtaposition with a magnet and to generate one or several electrical signals in accordance therewith;

an actuatable latch; and

electronic circuit means connected to said latch and said one or plurality of detectors for actuating said latch based on the one or several electrical signals generated by the one or plurality of magnetic field detectors.

2. A locking system according to claim 1 wherein the elongated key has a circular-shaped section.

3. A locking system according to claim 1 wherein the elongated key has a square-, T-, hexagon- or any other polygon-shaped section.

4. A locking system according to claim 2 or 3 wherein the elongated key further comprises a plurality of radially outwardly open recesses (16) to position and attach the permanent magnets.

5. A locking system according to any of claims 1 to 4 wherein the locking system comprises at least two magnetic field detectors and two corresponding consecutive magnets positioned along the insertion axis, the magnetic fields of said magnets as sensed by corresponding magnetic field detectors differing in polarity.

6. A locking system according to claim 5 wherein there are fewer magnetic field detectors than magnets and wherein the electronic circuit means are configured to implement a serial reading of said detectors' electric signals as the key is being inserted into the housing and a plurality of magnets pass in proximity to one of the magnetic field detectors.

7. An access system (150) comprising:

a portable keycard (110) having a plurality of permanent magnets (120) embedded therein, said magnets being located at predetermined locations within said keycard;

a housing (140) having an external surface and an interior chamber, said interior chamber including a channel which is sized and shaped to receive according to an insertion direction said keycard to a fully inserted position;

a sensing circuit disposed within said interior chamber, said sensing circuit including at least one Hall-effect transducer (162a-162f) positioned adjacent to said channel, each of said at least one Hall-effect transducer being configured to change state on juxtaposition with a magnet and to generate one or several output signals in accordance therewith;

an actuatable latch; and

a processing circuit disposed within said interior chamber, said processing circuit being electrically connected to said sensing circuit and said processing circuit actuating said latch in response to said one or several output signals.

8. An access system according to claim 7 wherein the keycard comprises a top section and a bottom section sized and shaped to mate and be attached to each other.

9. An access system according to claim 8 wherein the top and/or bottom section further comprise(s) a plurality of recesses to position and attach the permanent magnets.

10. An access system according to any of claims 7 to 9 wherein the magnetic field of at least one of the plurality of magnets substantially differs in strength from another of the plurality of magnets.

11. An access system according to claim 10 wherein there are fewer magnetic field detectors than magnets and wherein the processing circuit is configured to implement a serial reading of said detectors' electric signals as the keycard is being inserted into the housing and a plurality of magnets pass in proximity to one of the magnetic field detectors.

Drawings of the application

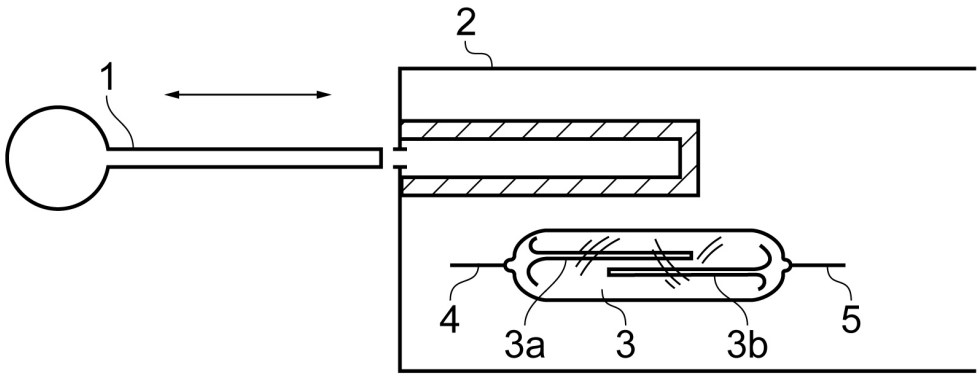

FIG 1

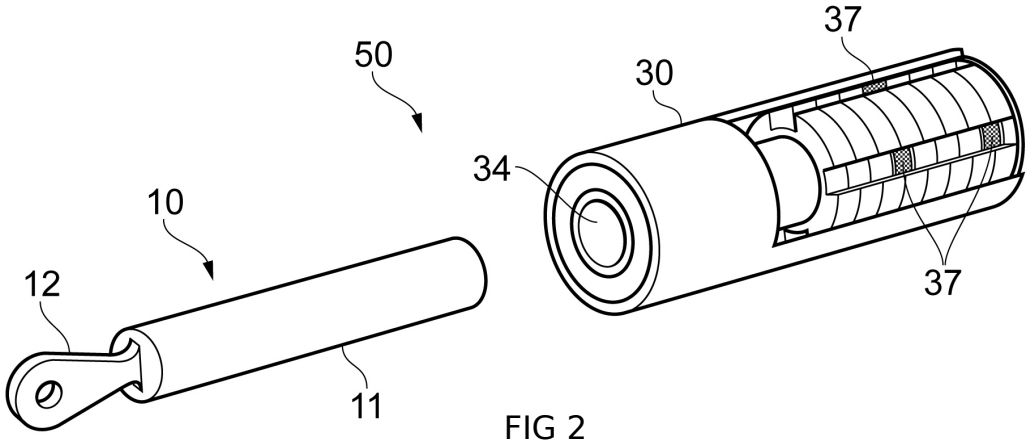

FIG 2

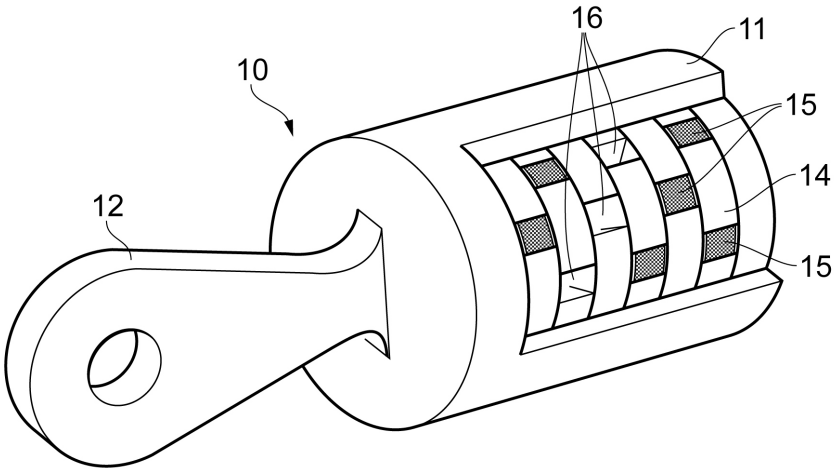

FIG 3

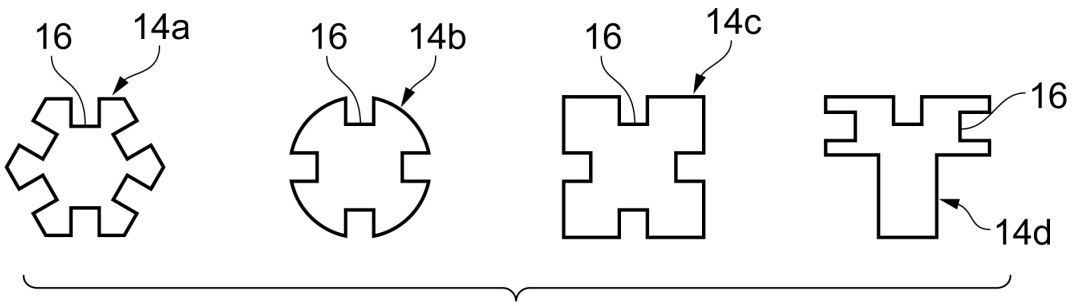
16
14a
16
14b
16
14c
16
14d

FIG 4

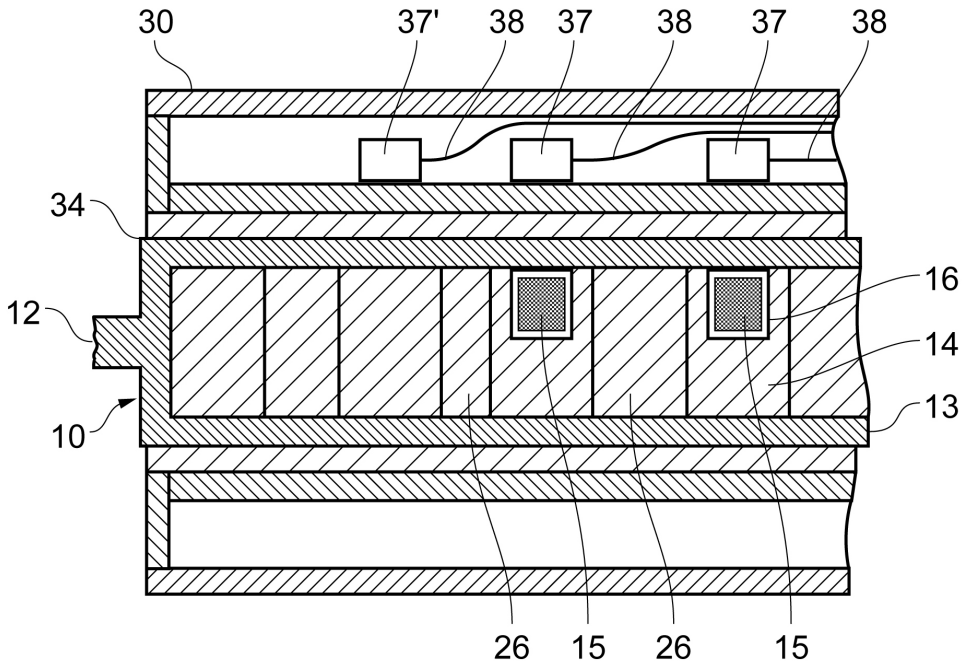
30
37'
38
37
38
37
38
34
12
10
16
14
13
26
15
26
15

FIG 5

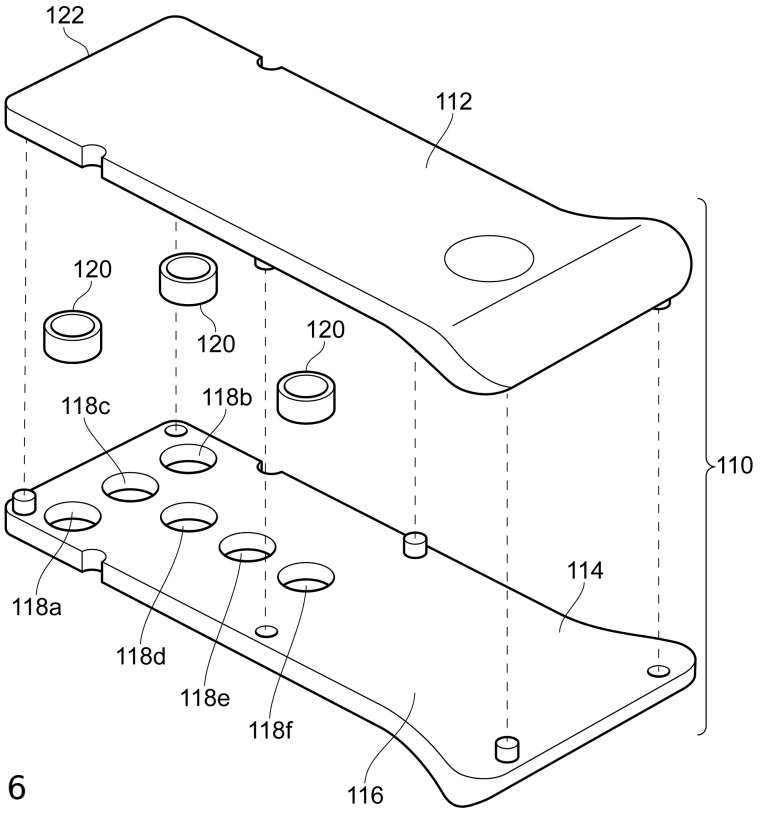
122
112
120
120
120
118c
118b
110
118a
114
118d
118e
118f
116

FIG 6

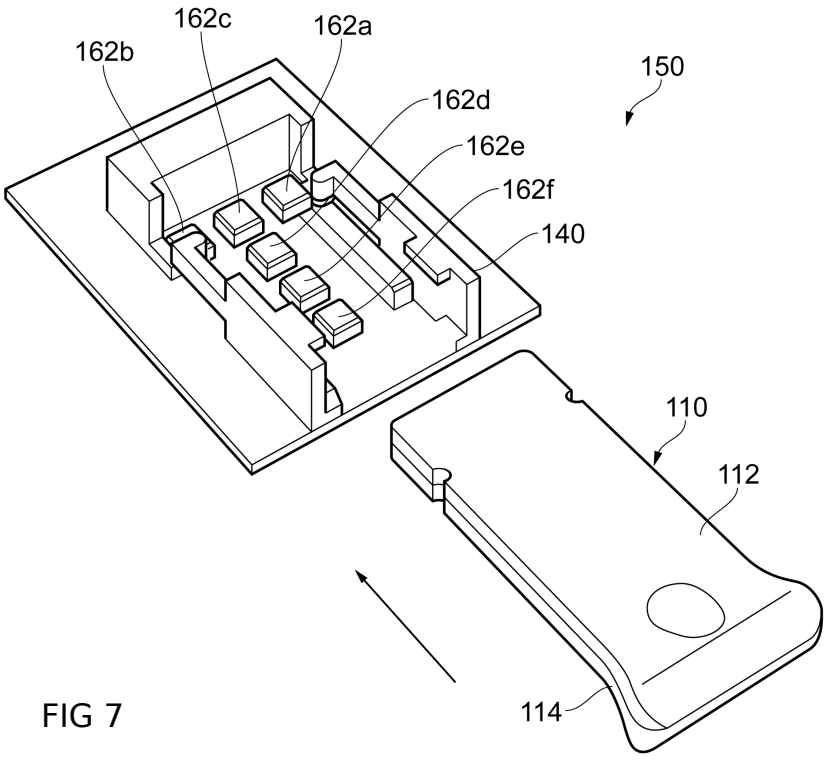
162c
162a
162b
150
162d
162e
162f
140
110
112
114

FIG 7

Communication

1. The examination is based on the application as originally filed. Documents D1 (DE123321A), D2 (EP987789A1), D3 (US45653223A) are prior art within the meaning of Art. 54(2) EPC.

2. The subject-matter of independent claim 1 is not new within the meaning of Art. 54(1) and (2) EPC because it is known from D1 or D3:

2.1. D1 discloses a locking system (Fig. 1) as claimed comprising: an elongated key (137, 139, 140) having a plurality of magnets ([003]), a housing (133) defining a passage (135) for the key, one or several magnetic field detectors ([003]), an actuatable latch ([002]) and an electronic circuit for actuating the latch ([002]) based on the signals from the detectors ([003]).

2.2. The subject-matter of claim 1 is also disclosed in D3, see the locking system (Fig. 1b, [001]). The locking system of D3 also comprises an elongated key (the push-button 2) having a plurality of magnets along the axis of the key ([004]), a housing (21, [002]), one or several magnetic field detectors (the Hall-effect transducer 15, [004]), an actuatable latch ([002], last sentence) and an electronic circuit for actuating the latch based on the signals from the detectors (25, [002], last sentence).

3. The subject-matter of independent claim 7 is not new within the meaning of Art. 54(1) and (2) EPC because it is known from D2:

D2 discloses an access system (Fig. 1b, [001]) comprising a portable keycard (Fig. 1a) with several magnets (6) positioned at predetermined locations (5). The access system comprises a housing (11) with a channel (12) and a sensing circuit with Hall-effect transducers (14, [003]). A processing circuit (15) to actuate a latch based on the signals from the Hall-effect transducers is also disclosed (Fig. 1b, [003]).

4. The following is noted concerning the dependent claims:

4.1. D3 discloses the subject-matter of claim 2, see [002].

4.2. D1 discloses the subject-matter of claims 3 and 4, see the section of the shape 139 and [002] mentioning the recess in the light of [003] for the plurality.

4.3. The subject-matter of claim 5 and the subject-matter of claim 6, which depends on claim 5, appear to be patentable in view of the available prior art.

4.4. D2 discloses the subject-matter of claims 8 and 9, see Fig. 1a and [002].

4.5. The subject-matter of claim 10 and the subject-matter claim 11, which depends on claim 10, appear to be patentable in view of the available prior art.

5. Claims 7 and 11: the inconsistent use of the terms Hall-effect transducer and magnetic field detector leads to a lack of clarity (Art. 84 EPC). It is further noted that the term "substantially" as used in dependent claim 10 also lacks clarity as it is vague and undefined (Art. 84 EPC).

6. Furthermore, it is noted that at present the set of claims does not appear to be unitary (Art. 82 EPC), as claim 5, on the one hand, and claim 10, on the other hand, are directed to two different aspects (miniaturisation and tamper prevention) which appear to form different groups of inventions. It is also noted that, despite this lack of unity, a complete search has been performed (GL, B-VII, 2.2). The applicant is therefore invited to limit the set of claims to one of these aspects and to file a divisional application for the other aspect or to submit arguments as to why the set of claims is unitary.

7. If the applicant wishes to maintain the application, new claims should be filed that take the above objections into account and fulfil the requirements of Rule 43(1) and (7) EPC.

8. Care should also be taken that the dependency of the amended dependent claims is correct.

9. To facilitate the examination of whether the new claims contain subject-matter that extends beyond the content of the application as originally filed, the applicant is requested to indicate precisely where in the application documents any amendments proposed find a basis (Art. 123(2) EPC and Rule 137(4) EPC). This also applies to the deletion of features.

10. Care should be taken to ensure that the new claims comply with the requirements of the EPC with respect to clarity, novelty, inventive step and, if relevant, unity (Arts. 84, 54, 56 and 82 EPC).

11. In the letter of reply, the problem-and-solution approach should be followed. In particular, the difference between the independent claim and the prior art (D1-D3) should be indicated. The technical problem underlying the invention in view of the closest prior art and the solution to this problem should be readily derivable from the applicant's reply.

Document D1: DE123321A

[001] The present invention relates to an electrical switching apparatus having a test function. This function may only be activated by an authorised user who is in possession of an appropriate key.

[002] Fig. 1 shows an electrical apparatus 131 with a housing 133 and an opening 135 adapted to receive a key 137 having a specific corresponding end shape 139 with a recess and a magnet 140 positioned in it (only shown schematically). A magnetic field detector and a processing circuit (not shown) are located within the housing 133. When the key 137 is inserted into the opening 135, the magnetic field detector detects the presence of the magnet 140 and sends a corresponding signal to the processing circuit, which validates that an authorised user wants to start a test function. The circuit then actuates a latch allowing the test function to be executed.

[003] The security can be improved with more complicated geometry for the shape 139, which section can take any polygonal form. The security can be further improved by using several magnets having different polarities inside corresponding radially outwardly open recesses of the shape 139 and positioned about the axis of the key 137. Several detectors are then used in correspondence with these magnets and send respective signals to the processing circuit for validation.

D1 Drawing:

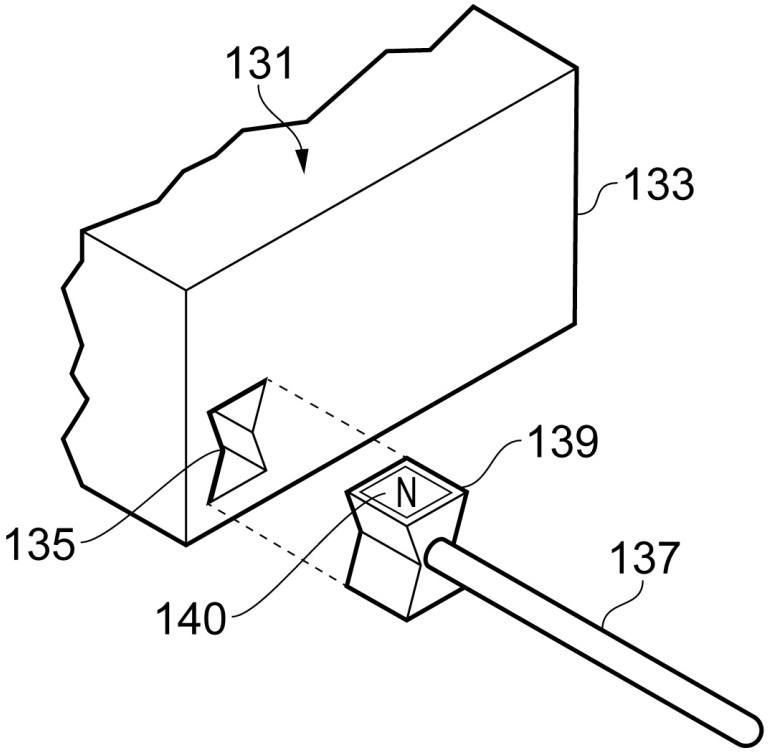

Fig 1

Document D2: EP987789A1

[001] The present invention is directed to improvements in keycards including magnets and of related locks, where the introduction of the keycard into the lock provides a signal related to a combination of magnetic poles of the magnets that is used to actuate a latch of the lock.

[002] Referring to Fig. 1a, the keycard 1 is composed of a body 2 linked to a lid 4. The body 2 has a set of recesses 5 in which respective magnets 6 are positioned or that can be left empty. As shown in Fig. 1a, the orientation of the magnets (north and south poles) may be different. Once a configuration of magnets positioned in the recesses is chosen, the keycard is built by sliding and fixing the body 2 into the lid 4.

[003] Fig. 1b shows a lock 10 including a case 11 with slot 12 and internal canal 13 adapted to receive the keycard 1. At one side of canal 13 are arranged magnetic sensors 14 (for instance Hall-effect transducers) in correspondence to the recesses 5 of keycard 1. The sensors 14 (not all shown) each generate a signal based on the polarity of the magnets 6, said signal being processed using a circuit 15. The result of this processing is a code which corresponds to the polarity or absence of a magnet in each recess of the keycard 1. This code is compared with a pre-established combination. If the code coincides with the pre-established combination, the circuit 15 activates a latch that will drive a member operating a door, access, alarm, etc. (not shown).

D2 Drawings:

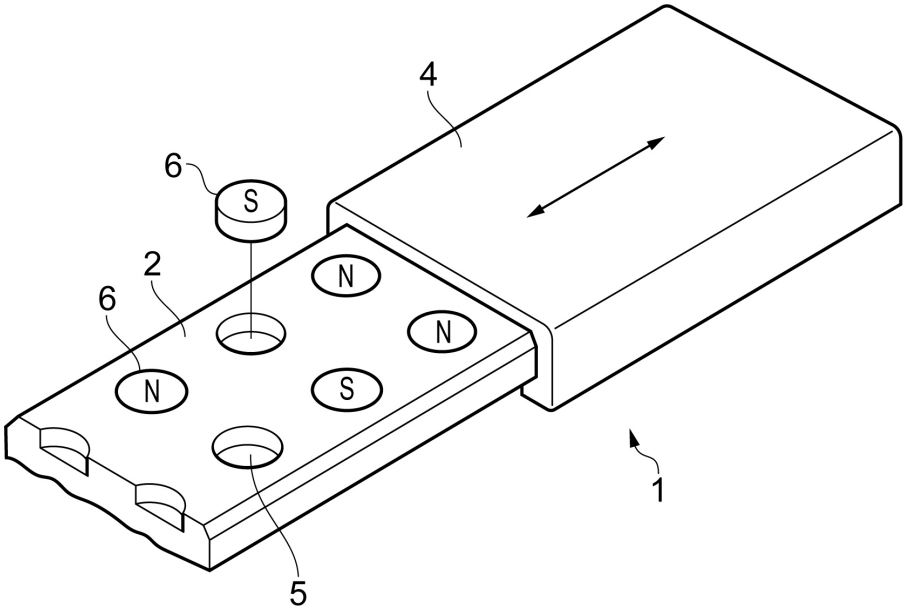

Fig 1a

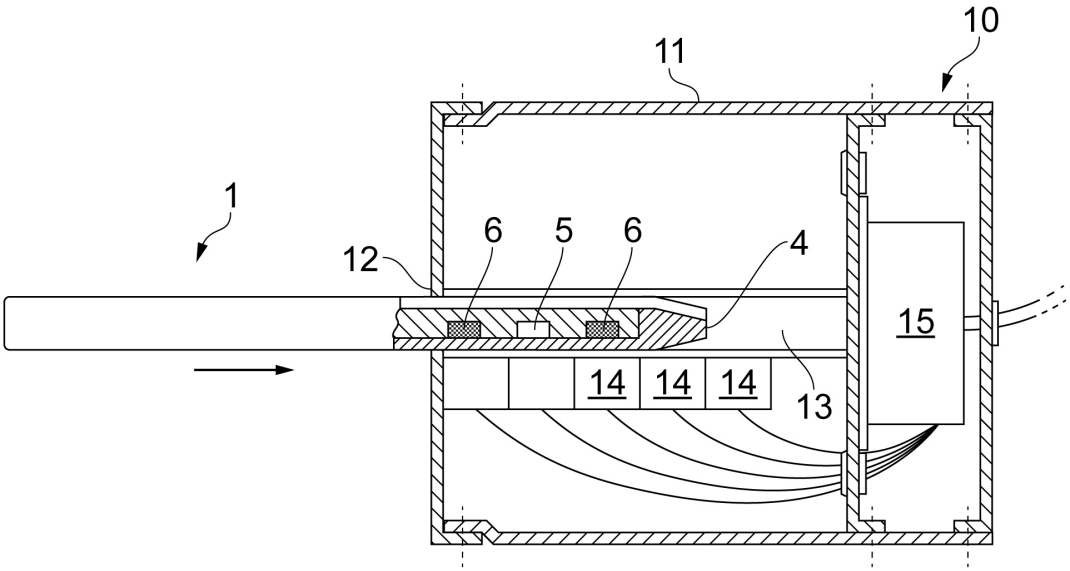

Fig 1b

Document D3: US45653223A

[001] The present invention relates to a contactless switching device which can be used to start/open or stop/lock a vehicle or apparatus.

[002] A first embodiment is shown in Fig. 1a wherein a contactless programmable push-button 1 comprises a push-button element 2 arranged in a housing 21. The push-button element 2 has an exterior part 3 and an interior mounting part 5. The push-button element 2 is linearly displaceable along an axis 8 between a first and second position and has a generally cylindrical shape with a circular section. A magnet 10 is mounted in the interior part 5. A Hall-effect transducer 15 is mounted in line with the linear displacement direction of the push-button element, i.e. the transducer is mounted along the line 8. The spring 18 biases the push-button element 2 toward the first position. When the push-button element 2 is depressed, the magnet 10 moves closer toward the Hall-effect transducer 15, which detects its proximity and transmits a signal to a microprocessor 25 located inside the housing 21. Hence, the microprocessor 25 is configured to determine when the push-button element 2 is depressed or not. Depending on the assessment of the microprocessor 25, a latch (not shown) can be actuated to execute the start/open or stop/lock function.

[003] In an alternative embodiment shown in Fig. 1b, the transducer is positioned within the housing 21 at its periphery along the axis 8 while the magnet is positioned in the interior part 5 also along the axis 8 and such that the transducer can detect the magnet when it passes at proximity during the operation of pressing.

[004] In another alternative embodiment (not shown in the figures), it is also possible to use several transducers 15 and one magnet along the axis 8 so that the transducers can detect several positions of the push-button. Similarly, it is possible to use several magnets and one transducer along the axis 8. Such alternative arrangements make it possible to detect whether the push-button is in an open position, a closed position or any intermediate position (depending on the geometric arrangement and the number of transducers or magnets).

[005] In a further alternative embodiment, the contactless switching device of the present invention may take other forms than a push-button switch. For instance, it may take the form of a lever-operated rotary switch or key-operated rotary switch wherein the push-button element is replaced by a rotary disc containing magnets. A rotary switch, unlike the single magnet/sensor combination switch described above, can be configured so that it cannot be fooled by an external magnetic field that is stronger than the magnet in the button.

[006] As is shown in Fig. 2, the rotary switch may use three Hall-effect transducers 150, 155 and 160 that are connected to the microprocessor 25. These transducers are mounted on a planar surface 200 located within the housing 21. A first set of magnets comprising magnets 115, 117 and 125 is mounted on a surface of a rotary disc 100 that is parallel to the planar surface 200 and is mounted on the interior mounting part 5. The Hall-effect transducers 150, 155 and 160 are located and aligned below magnets 115, 117 and 125 respectively when the disc 100 is in a first neutral position. Additional magnets 110, 112, 120 and 122 are also mounted on the surface of the rotary disc 100. The rotary disc 100 can rotate clockwise and anticlockwise from the first position so that altogether three positions are possible.

[007] The arrangement of the magnetic polarities (designated with N and S) is such that in each of the three positions, the pattern of magnets detected by the three transducers is different and all three of the magnets do not have their polarities oriented in the same direction. When the disc 100 rotates, a second set of magnets aligns over the transducers 150, 155 and 160. For example, if the disc 100 rotates clockwise from the first position (Fig. 2) to a second position (Fig. 3), the magnet 122 aligns over transducer 155, the magnet 117 aligns over transducer 150 and the magnet 112 aligns over transducer 160. Since the magnets in the second set do not all have the same polarity orientation as the magnets in the first set, the combination of Hall-effect signals generated by the transducers is different.

[008] Hence, the new position of the disc 100 (and therefore of the rotary switch) can be determined by the microprocessor 25 based on the combination of signals detected. Moreover, since the rotary switch uses a plurality of magnets having their polarities oriented in different directions, an external magnet cannot fool the switch because the external magnet would bias all sensors in the same manner. This further alternative embodiment allows the construction of the switching device to be simplified as fewer detectors than magnets are used.

D3 Drawings:

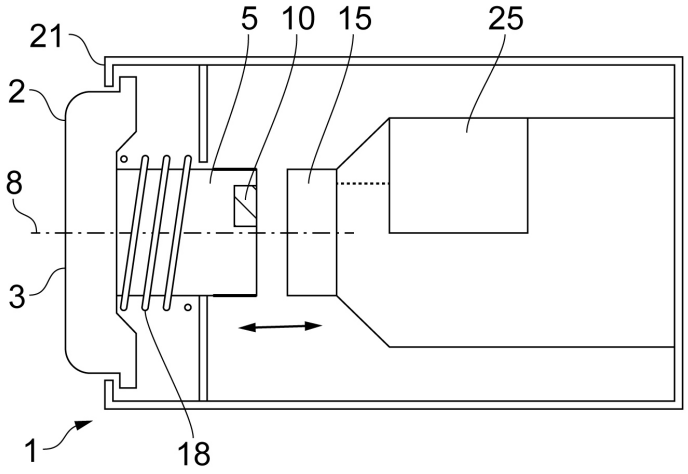

Fig 1a

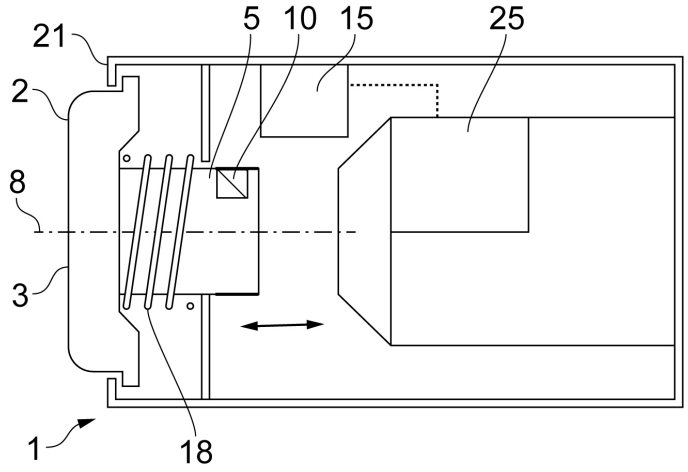

Fig 1b

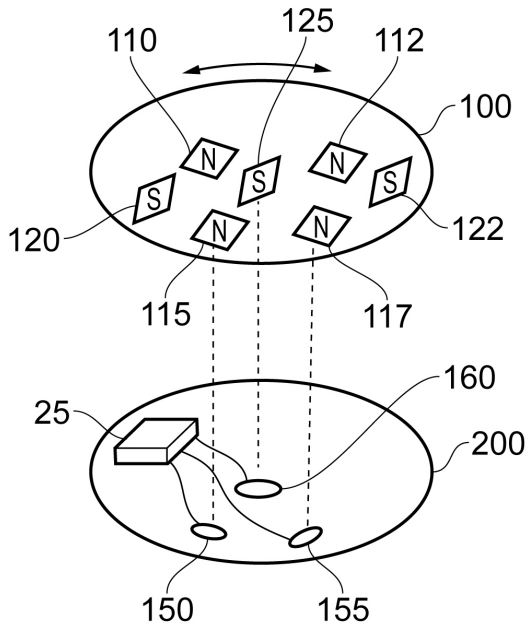

Fig 2

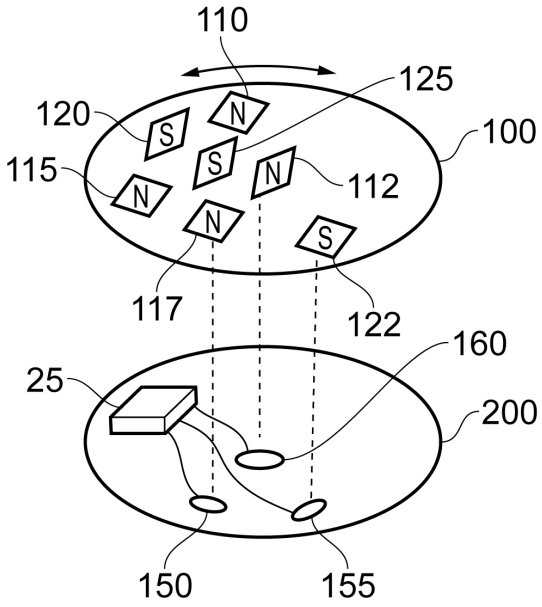

Fig 3

Client's letter

Dear Mr Mend-Ater,

[001] We are pleased that the EPO examiner is suggesting patentable subject-matter for our invention. For your information, we cannot afford to file a divisional application due to the further costs involved and have drafted an amended set of claims which should overcome all the objections and is unitary.

[002] However, we are disappointed to find the scope of protection of our draft very limited. Our whole production is focused on the serial reading function of the locking and access system, which is enjoying great commercial success due to the reduced cost of fewer magnetic field detectors. The embodiments with consecutive magnets having different polarities or magnets of different strength are of secondary importance to us.

[003] Please make any amendments to the proposed set of claims that you consider necessary for the claims to fulfil the requirements of the EPC, whilst giving us the broadest possible scope of protection for our invention. Please also note that we do not want you to add dependent claims directed to features that were not originally claimed.

[004] New claim 1 is a combination of original claims 5 and 6, while new claim 5 is a combination of original claims 10 and 11.

Best regards,
Cléa Aimand

Enclosure: Draft set of claims

Draft set of claims (marked up)

1. A locking system (50) comprising:

an elongated key (10) extending along a key axis and having a plurality of permanent magnets (15) spaced axially apart in a predetermined magnet arrangement;

a housing (30) defining a passage (34) complementary to said key and extending along an insertion axis of said key;

one or a plurality of magnetic field detectors (37, 37') spaced axially apart in said housing relative to said insertion axis in a detector arrangement positioned in relation to said magnet arrangement, each of said one or plurality of detectors being configured to change state on juxtaposition with a magnet and to generate one or several electrical signals in accordance therewith;

an actuatable latch; and

electronic circuit means connected to said latch and said one or plurality of detectors for actuating said latch based on the one or several electrical signals generated by the one or plurality of magnetic field detectors,

wherein the locking system comprises at least two magnetic field detectors and two corresponding consecutive magnets positioned along the insertion axis, the magnetic fields of said magnets as sensed by corresponding magnetic field detectors differing in polarity, and

wherein there are fewer magnetic field detectors than magnets and wherein the electronic circuit means are configured to implement a serial reading of said detectors' electric signals as the key is being inserted into the housing and a plurality of magnets pass in proximity to one of the magnetic field detectors.

2. A locking system according to claim 1 wherein the elongated key has a circular-shaped section.

3. A locking system according to claim 1 wherein the elongated key has a square-, T-, hexagon- or any other polygon-shaped section.

4. A locking system according to claim 2 or 3 wherein the elongated key further comprises a plurality of radially outwardly open recesses (16) to position and attach the permanent magnets.

~~5. A locking system according to any of claims 1 to 4 wherein the locking system comprises at least two magnetic field detectors and two corresponding consecutive magnets positioned along the insertion axis, the magnetic fields of said magnets as sensed by corresponding magnetic field detectors differing in polarity.~~

~~6. A locking system according to claim 5 wherein there are fewer magnetic field detectors than magnets and wherein the electronic circuit means are configured to implement a serial reading of said detectors' electric signals as the key is being inserted into the housing and a plurality of magnets pass in proximity to one of the magnetic field detectors.~~

~~7.~~ 5. An access system (150) comprising:

a portable keycard (110) having a plurality of permanent magnets (120) embedded therein, said magnets being located at predetermined locations within said keycard;

a housing (140) having an external surface and an interior chamber, said interior chamber including a channel which is sized and shaped to receive according to an insertion direction said keycard to a fully inserted position;

a sensing circuit disposed within said interior chamber, said sensing circuit including at least one Hall-effect transducer (162a-162f) positioned adjacent to said channel, each of said at least one Hall-effect transducer being configured to change state on juxtaposition with a magnet and to generate one or several output signals in accordance therewith;

an actuatable latch; and

a processing circuit disposed within said interior chamber, said processing circuit being electrically connected to said sensing circuit and said processing circuit actuating said latch in response to said one or several output signals;

wherein the magnetic field of at least one of the plurality of magnets substantially differs in strength from another of the plurality of magnets; and

wherein there are fewer magnetic field detectors than magnets and wherein the electronic circuit is configured to implement a serial reading of said detectors' electric signals as the keycard is being inserted into the housing.

8. An access system according to claim 7 wherein the keycard comprises a top section and a bottom section sized and shaped to mate and be attached to each other.

9. An access system according to claim 8 wherein the top and/or bottom section further comprise(s) a plurality of recesses to position and attach the permanent magnets.

~~10. An access system according to any of claims 7 to 9 wherein the magnetic field of at least one of the plurality of magnets substantially differs in strength from another of the plurality of magnets.~~

~~11. An access system according to claim 10 wherein there are fewer magnetic field detectors than magnets and wherein the processing circuit is configured to implement a serial reading of said detectors' electric signals as the keycard is being inserted into the housing and a plurality of magnets pass in proximity to one of the magnetic field detectors.~~

Draft set of claims (clean copy)

1. A locking system (50) comprising:

an elongated key (10) extending along a key axis and having a plurality of permanent magnets (15) spaced axially apart in a predetermined magnet arrangement;

a housing (30) defining a passage (34) complementary to said key and extending along an insertion axis of said key;

one or a plurality of magnetic field detectors (37, 37') spaced axially apart in said housing relative to said insertion axis in a detector arrangement positioned in relation to said magnet arrangement, each of said one or plurality of detectors being configured to change state on juxtaposition with a magnet and to generate one or several electrical signals in accordance therewith;

an actuatable latch; and

electronic circuit means connected to said latch and said one or plurality of detectors for actuating said latch based on the one or several electrical signals generated by the one or plurality of magnetic field detectors,

wherein the locking system comprises at least two magnetic field detectors and two corresponding consecutive magnets positioned along the insertion axis, the magnetic fields of said magnets as sensed by corresponding magnetic field detectors differing in polarity, and

wherein there are fewer magnetic field detectors than magnets and wherein the electronic circuit means are configured to implement a serial reading of said detectors' electric signals as the key is being inserted into the housing and a plurality of magnets pass in proximity to one of the magnetic field detectors.

2. A locking system according to claim 1 wherein the elongated key has a circular-shaped section.

3. A locking system according to claim 1 wherein the elongated key has a square-, T-, hexagon- or any other polygon-shaped section.

4. A locking system according to claim 2 or 3 wherein the elongated key further comprises a plurality of radially outwardly open recesses (16) to position and attach the permanent magnets.

5. An access system (150) comprising:

a portable keycard (110) having a plurality of permanent magnets (120) embedded therein, said magnets being located at predetermined locations within said keycard;

a housing (140) having an external surface and an interior chamber, said interior chamber including a channel which is sized and shaped to receive according to an insertion direction said keycard to a fully inserted position;

a sensing circuit disposed within said interior chamber, said sensing circuit including at least one Hall-effect transducer (162a-162f) positioned adjacent to said channel, each of said at least one Hall-effect transducer being configured to change state on juxtaposition with a magnet and to generate one or several output signals in accordance therewith;

an actuatable latch; and

a processing circuit disposed within said interior chamber, said processing circuit being electrically connected to said sensing circuit and said processing circuit actuating said latch in response to said corresponding output signals;

wherein the magnetic field of at least one of the plurality of magnets substantially differs in strength from another of the plurality of magnets; and

wherein there are fewer magnetic field detectors than magnets and wherein the processing circuit is configured to implement a serial reading of said detectors' electric signals as the keycard is being inserted into the housing.

8. An access system according to claim 7 wherein the keycard comprises a top section and a bottom section sized and shaped to mate and be attached to each other.

9. An access system according to claim 8 wherein the top and/or bottom section further comprise(s) a plurality of recesses to position and attach the permanent magnets.