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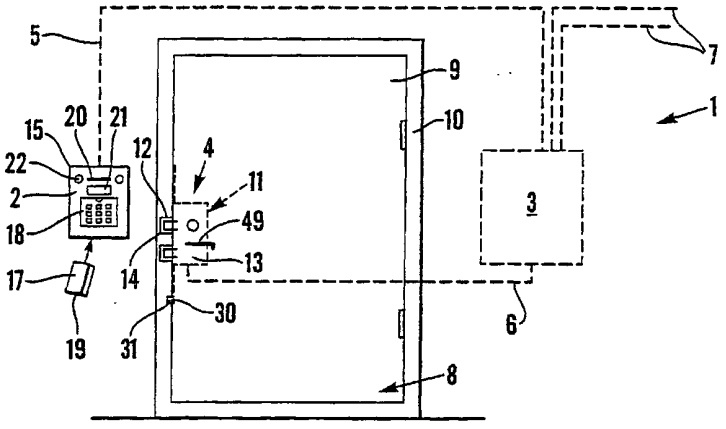
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(54) **Title:** A METHOD FOR CONTROL OF IN AND OUT PASSAGE BY MEANS OF A LOCKING SYSTEM, A LOCKING SYSTEM FOR PERFORMING THE METHOD AND A MOTOR-LOCK INTEGRATED INTO SAID LOCKING SYSTEM



(57) **Abstract:** The invention relates to a method in which in and out passage to or from a certain room or area, preferably a building or an enclosure, is controlled via an automatic door system, in which automatic door system a locking system (1) is provided, which comprises at least three main components including at least an operating panel (2), a control unit (3) and a motor-lock (4). The method is characterized in that a random code (H1, H2, H3) is transmitted from one main component (2, 3, 4) to another after a user has entered an authorization code (B1) via a registration device (16), which code is converted in an activation circuit card (23) to a first random code (H1), which varies randomly between each such main component (2, 3, 4) and in addition each time an authorization code (B1, B2) etc. is entered, which random code (H1) is received and verified by the control unit (3), following which another random code (H2) is transmitted to the motor-lock (4), which transmits its current status back to the control unit (3), following which a third random code (H3) is transmitted to the motor-lock (4) for opening its latch bolt (14) by means of an electric motor (47).

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A METHOD FOR CONTROL OF IN AND OUT PASSAGE BY MEANS OF A LOCKING SYSTEM, A LOCKING SYSTEM FOR PERFORMING THE METHOD AND A MOTOR-LOCK INTEGRATED INTO SAID LOCKING SYSTEM

TECHNICAL FIELD

The invention relates to a method, in which in and out passage to or from a certain room or area, preferably a building or enclosure, is controlled via an automatic door system, in which automatic door system a locking system is provided, which comprises at least three main components including at least an operating panel, a control unit and a motor-lock.

The invention also relates to a locking system comprising at least three main components including at least an operating panel, a control unit and a motor-lock.

Furthermore, the invention relates to an electromechanical motor-lock for use in a method or in a motor-locking system according to claims 1 or 2, which motor-lock is intended to be fitted to a device closing an opening, preferably a door, which motor-lock comprises a rotary lock mechanism and a motor-lock mechanism.

PROBLEM AND BACKGROUND TO THE INVENTION

Several different designs of locking systems are known, by means of which control of in and out passage through an opening into or out of a closed room or defined area, for example a building or an enclosure, can be executed via an automatic door system. A typical feature of such locking systems is that they comprise three main components, to be precise an operating panel, which comprises a receiver for registration via transmission, reading or entry of an authorization code, for example a card reader or key set, a control unit with a microprocessor, which receives the signal from the operating panel for verifying that an approved authorization code has been entered, and one or more electromechanical motor-locks, which are fitted to at least a door, outer door or the like at said room or enclosure. Motor-locks are distinguished from normal locks in that they have an electric motor for retracting and extending a latch bolt, usually in the form of a catch bolt. Motor-

locks can also have a further catch bolt, the open and locking position of which is controlled via a key-operable cylinder mechanism, a handle and/or a turning door handle, and in addition more often than not a normal spring bolt. Catch bolt means a bolt with a generally rectangular cross-section and a level end face, which bolt has at least two fixed end positions, which consist of a position barring and a position releasing the door, while a spring bolt is understood to mean a bolt, likewise with a usually rectangular cross-section but with a bevel-cut end face, which bolt is adjusted by means of the door handle between two end positions, which consist of a retracted and a projected spring end position. The function of the control unit's microprocessor is to emit a signal following checking and possible approval of the authorization code received to put the latch bolt of the motor-lock into its open or locking position.

One problem is that all locks which are intended to be used in type-approved doors, outer doors or the like must have a lock compartment of which the outer dimensions have an upper limit in accordance with the prefabricated and thus standardized recesses of the type-approved door or outer door for the lock compartment, in order thereby to always fit into these recesses. The lock compartment thus has a set, limited inner space, which cannot be filled completely without reservations as to what can or must be included. The contents of the lock compartment must therefore be optimized according to the intended use of the lock, where a compromise has to be made between the desired requirements for the strength of the lock compartment and for example the number of latch bolts included, etc. Hitherto it has thus proved difficult to combine both a considerable content, comprising followers, cylinders, springs, several latch bolts, a number of other necessary or at least desirable electrical and mechanical components etc. with a satisfactory capacity for resisting external damage. To meet the requirements for Swedish standards and for the lock to be approved by insurance companies, it is required for example that the projected latch bolt withstands a pressure of 500 kg and that the lock compartment is able to withstand a side load of 700 kg. To increase the strength of the lock compartment by using thicker sheet metal for the lock compartment's walls, bottom and cover only results in the already very limited inner space being limited further owing to the fact that the external dimensions of the lock compartment

are fixed. The inner space in a motor-lock, compared with a normal mechanical lock, is also filled by components required for the function, such as an electric motor and other necessary components for this, such as cabling, which is why there is no motor-lock on the market up to now which meets all the requirements set for Swedish standards and for approval by the insurance companies for mounting in a conventional lock compartment for a type-approved door.

Another significant problem is that the electrical signals transmitted in the cables between the individual main components forming part of the locking system, the components being arranged at a distance from one another and suitably protected against break-in, can be read relatively easily by an unauthorized person. The door lock can then be tampered with in that the signals read are quite simply repeated, the latch bolt being caused to move to an unlocked position for the door. In this case, whether the signal is coded or not makes no difference, since it only needs to be compared with a signal approved for opening the lock which has already been previously stored in a memory for illegal entry to be possible.

A further problem is that in all previously known and comparable motor-locks, the user has had to wait a relatively long time for the latch bolt to reach the appropriate end position before the door can be opened, or is locked. The required locking time, i.e. the bolt movement from the unlocked to the locked position and vice versa, takes up to several seconds in many known motor-locks. The reason for this is that the electric motor for these locks has been optimized for extending and retracting the latch bolt even when the door panel is not in the fully closed position, i.e. the door panel continues to stand slightly ajar so that the recess for the latch bolt in the door frame is not exactly in line with the latch bolt, for which reason the friction forces which occur in this case have to be overcome by the electric motor. A lock of this kind requires a larger and slower electric motor, on the one hand to overcome said friction forces and on the other to prevent the lock from jamming fast if pushed in too quickly. However, it is desirable for opening and locking to be able to be executed much more quickly, even up to 10 times faster. Even a wait of just 2-3 seconds can be found to be highly irritating by certain users, especially if passage in

and out takes place often. The latch bolt is therefore often set to the open (unlocked) position during the daytime, as doors of this kind otherwise tend to be set in the open position by means of an obstruction in the door spring by certain users, resulting in the lock not only being unlawfully disabled but also in the risk of the lock being forgotten altogether in the open position, or of the alarm being triggered unnecessarily if one is installed. Owing to the problems of the known motor-locks with latching times which are too long, it is thus common for them rather to be used only in the capacity of "night locks".

Finally, there is a potential problem if motor-locks with a higher speed should be used, since there is a risk of damage occurring to the motor shaft and to the transmission of power to the latch bolt, i.e. to the gear unit and pinions, due to the forces which arise at high speeds of the latch bolt when opening and locking the lock.

PURPOSE AND CHARACTERISTICS OF THE INVENTION

The object of the present invention is to eliminate or at least reduce the aforementioned problems.

The method according to the present invention is characterized in that a random code is sent from one main component to another after a user has entered an authorization code at a registration device, which code is converted in an activation circuit card to a first random code, which varies randomly between each such main component and also each time an authorization code is entered, which random code is received and checked by the control unit, following which yet another random code is sent to the motor-lock, which transmits its current status back to the control unit, following which a third random code is transmitted to the motor-lock to open its latch bolt by means of an electric motor.

The locking system according to the present invention is characterized in that each main component comprises at least an activation circuit card for receiving authorization codes and/or random codes, for conversion between these authorization codes and random codes

and for transmitting random code from one main component to another, which motor-lock includes reinforcement plates for reinforcing the lock compartment of the motor-lock.

The motor-lock according to the present invention is characterized in that the motor-lock furthermore comprises reinforcement plates, a blocking arm for blocking of a latch bolt, which is disposed via an operating device to be guided in a linear movement between a projected position latching the device and a retracted position releasing the device by means of an electric motor, which movement is controlled by the control unit, which is disposed to transmit a random code based on an authorization code from one main component to another, and that each such main component comprises at least one activation circuit card for conversion between authorization codes and said random codes.

ADVANTAGES OF THE SOLUTION

A locking system is achieved due to the present invention in which the motor-lock cannot be tampered with only by repeating a read signal in one of the cables between the main components forming part of the locking system, i.e. the operating panel, control unit and motor-lock, to achieve unauthorized lock opening.

Since the locking system always senses that the device which closes the opening to the lock-protected room or area, for example a door, is really in the correct position before the electric motor is started, the motor latch bolt does not need to align the door panel in relation to the door frame, for which reason no greater strength of the electric motor is required. The electric motor is therefore a considerably smaller model than that of the motor-locks otherwise obtainable on the market, and it is also specially adapted to guide the latch bolt forwards and backwards between its end positions considerably more quickly than in comparable motor-locks. It has been possible surprisingly to reduce the locking time to approx. 10 % of the corresponding locking time for comparable motor-lock designs, i.e. it has virtually been eliminated.

Thanks to the use of the much smaller and also considerably cheaper electric motor, the invention solves not only the problem of the extremely long locking time of up to several seconds at present, but also the problem of the minimal space inside the lock compartment is solved, as the smaller motor automatically gives extra space for greater reinforcement of the lock housing to make breaking in more difficult, which is achieved by the fitting of reinforcement plates, which are specially formed according to the components to be found in the lock compartment. In a conventional motor-lock, there is no space for extra protection in the form of reinforcement plates around the most essential design components of the lock with regard to protection against break-in, since its large electric motor takes up far too much room. The extended latch bolt is also blocked by a locking device which resists a pressure of over 500 kg, for which reason the lock can be approved by the insurance companies. Further "night locks" are thus not required.

By laminating several reinforcement plates of mutually diverging width, thickness and length on top of and/or at a set distance adjacent to one another, the advantage is also gained that predetermined geometrical spaces, tracks, surfaces or ducts can be created with optional extension in all directions for laying cables or for accurate three-dimensional mounting of defined components or sliding surfaces. The stationary or moving parts arranged in the lock compartment can thus be formed to be considerably thinner than previously, as they do not need to have the same thickness as the lock compartment to obtain the required supporting and /or sliding surfaces, at the same time as all the previously unutilized empty space is now filled with reinforcement material. The present motor-lock therefore copes with considerably greater loads in all directions than the corresponding conventional lock compartments, in spite of the external dimensions being essentially identical to one another to fit in the same recess.

LIST OF DIAGRAMS

The invention will be described in greater detail below with reference to the enclosed diagrams:

Fig. 1 shows a door in diagrammatic form with parts of a locking system according to the present invention, which locking system comprises a motor-lock, an operating panel and a central control unit with cables laid between the integral components.

Fig. 2 is a block diagram, which shows the connection between certain essential parts of the locking system shown in Figure 1.

Fig. 3 is a diagrammatic plan view of parts of a lock compartment for a motor-lock according to the present invention, with the cover of the lock compartment removed, in which the latch bolt of the motor-lock is in its outer, fully projected position blocked by means of a locking block.

Fig. 4 is a diagrammatic plan view of parts of the lock compartment for the motor-lock according to Figure 3, but with the latch bolt in a position partly retracted into the lock compartment.

Fig. 5 is a diagrammatic side view of parts of the lock compartment for the motor-lock according to Figure 3, but with the latch bolt in a position almost fully retracted into the lock compartment.

Fig. 6 is a flow chart, which shows in diagrammatic form the sequence of events when opening the lock according to the present invention.

DETAILED DESCRIPTION OF EXECUTION

Fig. 1 shows a locking system 1 according to the present invention, which is intended to control in and out passage through an opening to or from a certain closed room or defined area, for example a building or an enclosure. The locking system 1 comprises three separate main components, to be precise an operating panel 2, a control unit 3 and an electromechanical motor-lock 4, between which main components 2, 3, 4 suitable cables 5, 6, 7 are laid for transmitting signals and a power supply. The main components 2, 3, 4,

which can be more than one of each type, together constitute a complete system 1 in which all main components 2, 3, 4 are integrated with one another. Each main component 2, 3, 4 is unique in such a way that it is prepared so that if one or more of them need to be exchanged, the new component 2, 3 or 4, plus those remaining, can be adapted easily and without the aid of an external computer to function together directly following connection to the system 1 by means of "button pressing", described in greater detail below.

The room or area has a device 8 for closing said opening, such as a door, outer door, window or gate, preferably a type-approved door 8. Type-approved door 8 means a prefabricated door, which comprises a door panel 9, which is fitted in a door frame 10, and in which door panel 9 and door frame 10 predetermined recesses 11, 12 are included for the motor-lock 4, which is standardized with regard to its outer dimensions. The motor-lock 4 comprises a lock compartment 13 and at least one latch bolt 14, for which said recesses 11, 12 of set dimensions are thus provided with a good fit with regard to the height, depth and thickness of the lock compartment 13 and the latch bolt 14 respectively.

The operating panel 2 is arranged outside and at best closely adjacent to the opening through which in and out passage to or from the lock-protected room or area is to take place. The operating panel 2, which is advantageously arranged in an enclosure reinforced against break-in, at best a metal box 15, comprises a registration device 16 for receiving or reading a defined and unique authorization code B1, B2, B3 etc. via an information carrier 17 or via a key set 18 for manual entry of said authorization code B1, B2, B3 etc., see Figure 1. The information carrier 17 can consist for example of an electromechanical key of a known type, which has been personalized in some suitable manner, or, in the case of a registration device 16 consisting of a card reader, of a card with a magnetic strip 19, a bar code, microcircuit or the like, which card is inserted in a known manner into a slit 20 for registering the authorization code B1, B2, B3 etc. The registration device 16 can also consist of an IR receiver for registering the authorization code B1, B2, B3 etc. via remote transmission from the information carrier 17. The main thing is that the distinct authorization code B1, B2, B3 etc., which is at best unique to each user, is disposed in

some way to be transmitted to the registration device 16 of the locking system 1 to generate a first signal S1. The operating panel 2 can also comprise for example display windows 21 and / or lamps 22 for indicating such information as is considered essential for the user, for example that the door 6 is open or locked, that an incorrect authorization code Bx has been registered etc.

Furthermore, a transmitter 23 is provided in the form of an activation circuit card in the enclosure 15 of the operating panel 2 in a manner which is safeguarded against outer damage and against external reading of said first signal S1 generated. The activation circuit card 23 comprises a signal converter 24, for example a microprocessor or a circuit card of the type KEELOQ, for converting the first signal S1 generated in the registration device 16 into a variable, "random" code H1. Random code H1 means a code which is always changed on each new registration of an authorization code B1, B2, B3 etc. in the registration device 16, regardless of whether the authorization code B1, B2, B3 etc. is incorrect, correct, the same or new. The random code H1, which in the embodiment described consists of a 66-bit code, thus varies between each new passage in or out through the opening, including between each attempt to register an authorization code B1, B2, B3 etc., thereby eliminating the risk of unlawful opening of the door 8 by repeating a code H1 which has been read. The signal converter 24 for converting an incoming first signal S1 to a second signal S2 in the form of a random code H1 is a known electrical component, which is freely obtainable on the market. A diagrammatic example of the possible construction of a signal converter 24 is however as follows.

The signal converter 24 comprises a built-in random number generator 25 for generating a binary number of a certain length, which number varies randomly each time the activation circuit card 23 is activated by said first signal S1 from the registration device 16. The signal converter 24 of the activation circuit card 23 is set to utilize the binary number and the first signal S1 for a predetermined numerical calculation, a new, second signal S2, based on the read or entered authorization code B1, B2, B3 etc. and the binary random number provided by the random number generator 25, being set to be generated, which thus

forms the both coded and constantly changed "random" code H1 for each activation occurrence. The activation circuit card 23 can generate at least a million possible random codes H1 in separate combinations for each activation occurrence. Each activation is disposed to last for approx. 3 seconds. An external cable 5 is arranged from the activation circuit card 23 for transmitting the random code H1 to the control unit 3, disposed at a distance from the operating panel 2 inside the lock-protected room or area. This external cable 5 thus does not need to be protected against reading or signal repetition owing to the random codes H1 numbering at least a million, which are varied randomly in time.

The control unit 3, see Figure 2, comprises a receiver in the form of a second activation circuit card 26, which is set to receive the random code H1 from the activation circuit card 23 of the operating panel 2 for "decoding" to the factual authorization code B1 presently entered or read via the registration device 16, a main processor 27 for processing incoming and outgoing signals, for example checking the decoded authorization code B1 against approved authorization codes B1, B2, B3 etc. stored previously in a memory 28 of the main processor 27, and a transmitter in the form of a third activation circuit card 29 for converting a first and a second opening signal S3, S5 from the main processor 27 to a second or third random code H2, H3 (which are changed on each new opening signal S3, S5, and consequently also the code between the control unit 3 and the motor-lock 4 is protected against reading and repetition to achieve unlawful opening of the motor-lock 4 in the manner described in greater detail below), for forwarding via the cable 6 to the motor-lock 4 following completed and approved verification of the decoded authorization code B1. The main processor 27 can consist for example of one of several advanced electrical components, such as circuit cards, microprocessors etc. or of a computer. The main processor 27 is also provided for simultaneous or separate control of other functions of the motor-locking system 1 and the closing device or devices 8 which are arranged therein. Such functions include detection of the open or closed door position, detection of the projected position of the latch bolt 14 barring the door 8 and its retracted position releasing the door 8, locking of one or more motor-locks 4 etc. For this purpose, there are a number of magnetic sensors 30 and/or magnets 31, see Figure 1 and 3, placed for example on the

door frame 10, door panel 9 and/or the lock compartment 13 of the motor-lock. A rectifier, which is not shown, for converting alternating current to direct current is also provided in the control unit 3, thus it makes no difference whether the control unit 3 is supplied with alternating current or direct current.

The motor-lock 4, see Figure 3, comprises a receiver in the form of an activation circuit card 32 for the random codes H2, H3 from the control unit 3. The motor-lock 4 is connected via a connector 33 by means of electric cable 6 to the control unit 3 and to an external power source, which can consist of both an alternating current and a direct current source, the motor-lock 4 being disposed to set itself automatically to different voltages in the voltage ranges normal for motor-locks 4. In embodiments not shown, an internal power source such as a battery can also be located if necessary in the locking system 1 or the motor-lock 4 at one or more suitable points. Furthermore, the motor-lock 4 and its activation circuit card 32 comprise several electrical components and sensors such as magnetic sensors 30, relay 34, signal converter 35 and a microprocessor 36 for control and verification of the function of the lock 4 and for combining separate sub-signals SS1, SS2 etc., which represent the current status of the lock 4 with regard to the positions of the constituent mechanical parts.

All the delicate parts of the motor-lock 4 are arranged inside the protective case of the lock compartment 13, which consists of the box 37 of the lock compartment 13, a cover closing this, not shown, and a lock post 38 for fitting of the lock compartment 13 to the closing device 8, for example the type-approved door with a recess for the standardized lock compartment. The lock compartment 13 therefore has the necessary external dimensions required for said fitting. The lock post 38 has recesses 39, 40 for a spring bolt 41 and/or at least a latch bolt 14. The box 37 and cover of the lock compartment 13 include openings 42, 43, for cabling purposes and for a cylinder or handle follower 44, 45, which forms part of each lock mechanism. The motor-lock 4 shown in Figures 3 to 5 comprises two locking mechanisms, which consist of a motor-lock mechanism 46, which has an electric motor 47

for retraction and extension of the linearly movable latch bolt 14, and a conventional rotary lock mechanism 48.

The rotary lock mechanism 48 comprises a handle or knob 49 for operating the conventional spring bolt 41 via the handle follower 45, which is fitted rotatably at one end of the lock compartment 13. The handle follower 45 comprises a carrier arm 50, which is inserted into a groove 51 in the rear end part 52 of the spring bolt 41 to interact with this groove 51 in the linear inward and outward movements of the spring bolt 41. One or more springs 53, 54 are arranged inside the lock compartment 13, which springs 53, 54 lie close to the spring bolt 41 and the carrier arm 50 under tension, the springs 53, 54 being provided to hold the spring bolt 41 normally in a position partly projected outside the lock compartment 13, until the handle or knob 49 is used. The spring bolt 41 ensures that the door panel 9 and thereby the latch bolt 14 end up in the right position before the electric motor 47 is started. A door closer, not shown, can also be provided suitably on the door 8 for closing it, following which also said magnets 31 and magnetic sensors 30 detect that the correct position has been assumed. At least one further magnetic sensor 31 and magnet 30 are fitted in the lock compartment 13 and on the spring bolt 41 for detecting the position of the spring bolt 41, i.e. whether it is in its projected or retracted position, which positions provide two of the sub-signals SS1, SS2 etc., which the microprocessor 36 is set to collect and transmit to the control unit 3.

Apart from said cylinder follower 44 and electric motor 47, the motor-lock mechanism 46 comprises an operating device 55 for interaction with the electric motor 47 for said retraction and extension of the latch bolt 14. The operating device 55 comprises an oblong, linearly movable carrier 56, which has an essentially rectangular cross-section. The carrier 56 has a rectilinear cog rail in the form of a rack 57 disposed at its one end and an oblong, continuous recess 58 disposed at its opposite, other end. A cogwheel 59 is mounted on the revolving axle 60 of the electric motor 47 for bearing on the cog rail 57 for said retraction and extension of the linearly movable latch bolt 14. The carrier 56 also comprises a cog segment 61 and two hooks 62, 63 arranged on opposing sides of the recess end 58 of the

carrier 56, where the two hooks 62, 63, which are arranged at a set distance from one another, are turned towards the cylinder follower 44 to engage with a peg 64 raised from the follower 44, turning of the cylinder follower 44, via its knob or via a traditional locking cylinder by means of a main key, offering an opportunity for manual opening of the motor-lock 4, for example in an emergency situation or if the power supply is interrupted. The carrier 56 also has two level sliding surfaces 65, which are at right angles to the two sides which comprise said cog segment 61 and hooks 62, 63, one of which sliding surfaces 65 extends from the cog rail 57 to the end of the recess end 58 and the other, not shown, extends the whole of the carrier's 56 longitudinal extension on the opposite side in relation to the cog rail 57. The cog rail 57 is sunk here in relation to the sliding surface 65 disposed on the same side.

An oblong blocking arm 66 is arranged rotatably at one of its ends by a semicircular cog segment 67 on a pivot 68. The cog segment 61 of the carrier 56 extends in the longitudinal direction of the carrier 56 and has a length which corresponds to at least the peripheral length of the essentially semicircular cog segment 67 of the blocking arm 66. The pivot 68 is arranged to the side of the carrier 56 and at such a distance from it that on activation of the electric motor 47, the two cog segments 61, 67 interact with one another in a movement which is linear for the carrier 56 and rotational for the blocking arm 66. At its free end the blocking arm 66 has a carrier pin 69, which is inserted into an essentially triangular recess 70 in the rear part of the latch bolt 14, termed the operating part 71 below, while the front part of the latch bolt 14 is termed the engagement part 72. On the turning movement forwards and backwards of the blocking arm 66, the carrier pin 69 is disposed to guide the latch bolt 14 forwards and backwards in three stages due to the carrier pin 69 being guided from corner to corner in said triangular recess 70. The engagement part 72 and the operating part 71 both have a rectangular cross-section, the cross-section of the operating part 71 however being thinner than that of the engagement part 72, which parts 71, 72 forming in the present embodiment two level parts 71, 72 fixedly connected to one another, which have a front and a rear part 73, 74, which are disposed in the same plane but displaced laterally in relation to one another, thus basically in the form of a Z. The front

parts 73 of the two parts 71, 72 form the projection of the latch bolt 14, which passes into the recess 12 of the door frame 10. Two magnetic sensors 30 are arranged following one another in the direction of movement of the latch bolt 14 in the lock compartment 13 for sensing the current position of the latch bolt 14 by means of a magnet 31 attached to the latch bolt 14.

The blocking arm 66 is provided to block the projected latch bolt 14, which blocking arm 66 withstands the pressure of 500 kg (applied to the latch bolt 14) required for approval by the insurance companies. A further "night lock", i.e. a manual locking mechanism with a manually operated latch bolt, is thus not needed. The blocking arm 66 comprises a locking surface 75 arranged at the front end of the blocking arm 66 of the latch bolt 14, which locking surface 75 is provided to bear on and interact with a stop ledge 76 in the projected position of the latch bolt 14, see Figure 3. The stop ledge 14 is disposed by the engagement part 72 of the latch bolt 14, more precisely by its rear part 74, the stop ledge 76 and locking surface 75 being arranged parallel to one another in said projected position of the latch bolt 14.

To obtain type approval for the motor-lock 1, this has to conform to certain standardized dimensions and qualifications, i.e. the lock compartment 13 must fit into the standardized recess 12 in the likewise standardized door panel 9. This makes it impractical, for example, to only add further reinforcement to a normal lock to thereby increase its strength. By providing the lock construction with sensors, for example magnetic sensors 30, and a control unit 3 which verifies that the motor-lock 4 is in the correct position before the electric motor 47 is activated, in which case the latch bolt 14 does not have to align the door panel 9 in relation to the recess for the latch bolt 14, which calls for a strong motor 47 which presses the bolt 14 into the recess 12 even if the door panel 9 is in any open position, the lock 4 according to the invention can have an electric motor 47 model which is smaller, creating extra space inside the lock compartment 13.

Disposed inside the lock compartment 13 are a number of reinforcement plates 77 in the form of thin metal plates, which reinforcement plates 77 have each been cut very precisely with regard to cross-section and with varying extension in the plane to fit according to the construction elements to be found inside the lock compartment 13. The reinforcement plates 77 are placed on top of and at a set distance adjacent to one another to form channels and spaces 78 for components of the motor-lock 4 and cables 6 and to fill up essentially the rest of all the empty space inside the lock compartment 13, or to fill one or more defined parts of the lock compartment 13 to thereby increase the resistance capacity over essentially the entire lock compartment 13, or here and there in specially selected places, against external damage by means for example of breaking, drilling or striking tools. One such special place is appropriately around the blocking arm 66, the cog rail 57 and the cylinder follower 44. Considerably better protection is thereby achieved, for which reason the lock compartment 13 is able to withstand loads of over 700 kg, which is one of the requirements set for approval by the insurance companies and to obtain a Swedish standard. A number of pins 79 extend between the box 37 of the lock compartment 13 and its cover, for which pins 79 a number of holes 80 have been made through the reinforcement plates 77.

Since all the main components 2, 3, 4 of the locking system 1 have built-in transmitters and receivers, i.e. the activation circuit cards 23, 26, 29, 32, for the random code H1, H2, H3, they are all prepared to be able to be exchanged easily for a new one, following which the new component 2, 3, 4 is easily integrated into the coded locking system 1 in that necessary data are transferred between the old components 2, 3 and/or 4 and the new ones, for example quite simply by pressing an activation button, not shown, for activating said data transfer, due to which all components 2, 3, 4 are set to be adapted to function only for the same coded and variably random codes H1, H2, H3. The main processor 27 is preprogrammed together with said activation circuit cards 23, 26, 29, 32, which preprogramming is carried out initially by the necessary data being transmitted between the activation circuit cards 23, 26, 29, 32 forming part of the locking system 1 and the main processor 27.

FUNCTIONAL DESCRIPTION

Fig. 6 shows diagrammatically by means of a flow chart a method according to the present invention for opening of the motor-lock 4 belonging to the locking system 1 described above for controlling in and out passage to or from a certain room or area, preferably a building or an enclosure, via an automatic door system.

The procedure is initiated by a user, via the registration device 16 on the operating panel 2 outside said room or area, registering his defined and unique authorization code B1, which consists of one of several approved authorization codes B1, B2, B3 etc. stored previously in the memory 28 of the control unit 3. If the registration device 16 consists of a card reader, registration is effected for example by an information carrier 17 being guided through the card slot 20 of the card reader 16 to read said code B1, or the current authorization code B1 is entered manually via the key set 18 of the operating panel 2. A first signal S1 containing the read or entered authorization code B1 is generated, which first signal S1 is transmitted to the activation circuit card 23, where a random number generator 25 is activated, so that a binary number of a set length is generated, which number varies randomly each time the activation card 23 is activated by said first signal S1.

The signal converter 24 of the activation circuit card 23, for example a microprocessor, converts by means of a predetermined numerical calculation the first signal S1 and the binary random number to a new and second signal S2, namely the above so-called "random" code H1, which code H1 is thus changed randomly for each activation event, thanks to the effect of the random number generator 25 on the calculation.

The random code H1 is then transmitted via cable 5 to the control unit 3 situated at a distance from the operating panel 2, which unit consists of a personal computer, an advanced microprocessor or similar. The electric cable 5 does not need to be protected against reading, since the random code H1 is always both coded and changed between each attempt to open the door, regardless of whether an incorrect or correct authorization code B1 was originally used.

The random code H1 is received by the receiver 26 of the control unit 3, i.e. the second activation circuit, where it is decoded and then transmitted to the main processor 27. In the main processor 27, the thus recreated authorization code B1 is compared with the database stored in the memory 28 to verify whether the random code H1 received is a calculation result which is based on and agrees with one of the authorization codes B1, B2, B3 etc. stored in the memory 28 and, if such a one is found, that it has approved the authorization for the current motor-lock 4.

If this is the case, a first opening signal S3 , which either consists of the originally received authorization code B1 or a new such code B2, is sent to the transmitter of the control unit 3, i.e. its third activation circuit card 29, which performs a new numerical calculation based on the opening signal S3 and a new binary random number, so that a new, second random code H2 is generated, which is transmitted via cable 6 to the motor-lock 4. In the same way as with the earlier cable 5 between the operating panel 2 and the control unit 3, this cable 6 does not need to be shielded or protected either against reading of this, now second, random code H2.

The second random code H2 is received by the receiver 32 of the motor-lock 4, i.e. the fourth activation circuit card of the locking system 1, which activation circuit card 32 verifies that the incoming random code H2 has the correct authorization, which is carried out in the same way as at the receiving activation circuit card 26 of the control unit 3. In the case of an approved random code H2, the motor-lock 4 sends back a fourth signal S4 to the main processor 27 of the control unit 3, which signal S4 is first combined with several of the sub-signals SS1, SS2, SS3 etc., which together describe the current status of the motor-lock 4 with regard to desired and/or necessary information about the current settings and state of the motor-lock 4.

For example, it is detected by means of the magnetic sensors 30 and the magnets 31 whether the spring bolt 41 or the latch bolt 14 are projected or retracted, whether the latch

bolt 14 has been locked by means of the blocking arm 66 or not (detected by a sensor not shown), whether the movement of the latch bolt 14 is blocked in any direction, so that the electric motor 47 after three closing attempts continues to be prevented from pushing the latch bolt 14 into the recess 12, following which an alarm is triggered, whether the door panel 9 is in the open or closed position, which is simply registered by means of magnets 31 and magnetic sensors 30 arranged on the door panel 9 and on the door frame 10, etc. The combined signal S4 is uncoded in the embodiment described, but can if necessary easily be converted to a random signal by means of a further activation circuit card disposed inside the motor-lock 4.

The combined signal S4 is received by the main processor 27 of the control unit 3, processed by this and if all sub-signals SS1, SS2 etc are correct for door opening, a second opening signal S5 is sent anew to the transmitter 29 of the control unit 3, coded to give a new random code H3, which is transmitted to the motor-lock 4 via cable 6. This time the electric motor 47 of the motor-lock 4 is activated in a direction of rotation which retracts the latch bolt 14.

The function for instead placing the motor-lock 4 in the locking position is executed in a similar manner by means of an authorization code B1, by means of a timer, which triggers locking, via a circuit-breaker inside the protected area or room, for example at the control unit 3, or by means of mechanical projection of the latch bolt 4 by means of a key or knob.

To ensure that the motor axle 60 including power transmission, i.e. the gear unit and pinion 59 etc., shall manage the high speed on opening and locking without being broken, the latch bolt 14 should be braked softly prior to its two end positions, i.e. bolt out/bolt in. Braking is effected preferably by short-circuiting the motor winding and thereby giving the motor 47 the same function as a generator, which means that the desired effect, efficient deceleration, is achieved.

Damage of the type described above can likewise occur in connection with opening/ closing the lock 4 via key or knob 49. This applies both before and after the lock 4 has been connected to a power source. In new buildings under construction, electric locks 4 are often used as a mechanical lock until electrical cables 6 are laid. This means that even before the lock 4 is connected to the power, the electric motor 47 should be short-circuited to thereby keep its braking function.

ALTERNATIVE EMBODIMENTS

The invention is not restricted to the embodiment shown, but can be varied in different ways within the framework of the claims. It is perceived for example that the measures taken and arrangements made to obtain considerably improved protection against break-in, namely the reinforcement plates 77, blocking arm 66 and the fact that the authorization code B1 and all other essential signals S2, S3, S5 in the system outside the protective envelope of the main components always consist of a random code H1, H2, H3, are applicable in a locking system essentially comprising an unlimited number of motor-locks, and that these motor-locks can be formed in different ways with regard to the requirements for standardized dimensions, the number of locking mechanisms and which closing device they are arranged on.

It is also perceived that, if not only a normal relay or electromagnet is used, which only activates or deactivates some type of mechanical block for the latch bolt 14, but if several microprocessors are located in the locking system 1, which code signals using a continuously random code, which cannot be read and then repeated to open the door, considerably better protection is obtained with great security. The combination options of the locking and passage system's random code described above are basically unlimited, as on each new activation of the activation card a new code variable of up to 1 million possible and separate combinations of unique codes is sent off to the respective receiver unit, which can consist of either the lock unit or the control unit.

With the construction described above, a break-in must take place in one of the three main components, i.e. the operating panel 2, control unit 3 or the motor-lock 4, to get at uncoded

signals, and it is only the first signal S1 from the registration device 16 to the activation card 23 inside the operating panel 2 which actually contains an uncoded and correct authorization code B1. Other signals, if they are based in some way on an authorization code, all consist of random codes or only of information regarding the status of the door 8, for example, with regard to its open or closed position in relation to the door frame 10 etc., information which is important in itself but not sufficient to open the motor-lock 4.

None of the electric motor-locks on the market today have utilized the method of increasing the strength of the lock compartment 13 by several layers of reinforcement plates 77 and the shear strength between these and the incorporated, interacting pins 79 to withstand 700 kg of lateral load (Swedish standard requirement), which no existing motor-lock manages today. In the same way, the locking of the latch bolt 14 of the electric motor-lock 4 by means of the blocking arm 66 is unique as it meets the requirements of the standard for 500 kgs of pressure.

The invention is not restricted to what has been described above, but can be varied within the scope of the claims. Thus it is perceived amongst other things that braking mechanisms other than the motor winding can be used to avoid any damage to the motor axle/power transmission, such as mechanical braking devices which take effect close to the respective end position. Furthermore, it is perceived that means other than magnetism, e.g. optical sensors, can be used to detect that the door is in the correct position to be able to be locked. Finally, it is perceived that many of the new functions described in the lock can be utilized in themselves without necessarily being combined with all the other functions described, e.g. it is not necessary to use random codes to exploit the advantages of the new combination of having a fast, smaller motor/ transmission and a mechanism which detects that the door panel is in the correct position, so that the latch bolt can move into the recess quickly and without difficulty.

CLAIMS

1. Method in which in and out passage to or from a certain room or area, preferably a building or an enclosure, is controlled via an automatic door system, in which automatic door system a locking system (1) is provided, which comprises at least three main components including at least an operating panel (2), a control unit (3) and a motor-lock (4), characterized in that a random code (H1, H2, H3) is transmitted from one main component (2, 3, 4) to another after a user has entered an authorization code (B1) via a registration device (16), which code is converted in an activation circuit card (23) to a first random code (H1), which varies randomly between each such main component (2, 3, 4) and in addition each time an authorization code (B1, B2) etc. is entered, which random code (H1) is received and verified by the control unit (3), following which another random code (H2) is transmitted to the motor-lock (4), which transmits its current status back to the control unit (3), following which a third random code (H3) is transmitted to the motor-lock (4) for opening its latch bolt (14) by means of an electric motor (47).

2. Method according to claim 1, characterized in that the latch bolt (14) is braked softly before its two end positions, preferably by the motor winding being short-circuited and the motor (47) thereby being given the same function as a generator.

3. Method according to claim 1, characterized by means (30, 31) for detecting that the latch bolt (14) is in a correct position to be able to be guided into a lock recess (12), incorrect positioning preferably being signalled automatically to the user so that a correction of the door's position is executed by the user before the latch bolt (14) is permitted to be guided into the lock recess.

4. Locking system comprising at least three main components including at least an operating panel (2), a control unit (3) and a motor-lock (4), characterized in that each main component (2, 3, 4) comprises at least an activation circuit card (23, 26, 29, 32) for receiving authorization codes (B1, B2) and/or random codes (H1, H2, H3) for conversion

between these authorization codes (B1, B2) and random codes (H1, H2, H3) and for transmission of random code (H1, H2, H3) from one main component to another, which motor-lock (4) comprises reinforcement plates (77) for reinforcement of the lock compartment (13) of the motor-lock (4).

5. Electromechanical motor-lock (4) for use in a method or a motor-locking system according to claim 1 or 2, which motor-lock (4) is intended to be fitted to a device (8) closing an opening, preferably a door, which motor-lock (4) comprises a rotary lock mechanism (48) and a motor-lock mechanism (46), characterized in that the motor-lock also comprises reinforcement plates (77), a blocking arm (66) for blocking a latch bolt (14), which is disposed via an operating device (55) to be guided in a linear movement between a projected position blocking the device (8) and a retracted position releasing the device (8) by means of an electric motor (47), which movement is controlled by the control unit (3), which is set to transmit a random code (H1, H3) based on an authorization code (B1, B2) from one main component (2, 3, 4) to another and that each such main component (2, 3, 4) comprises at least an activation circuit card (23, 26, 29, 32) for conversion between authorization codes (B1, B2) and said random codes (H1, H2, H3).

6. Electromechanical motor-lock (4) for use in a method or a motor-locking system according to claim 1 or 2, which motor-lock (4) is intended to be fitted to a device (8) closing an opening, preferably a door, which motor-lock (4) comprises a linearly movable latch bolt (14) and a motor-lock mechanism (47), characterized in that a first means (31) is arranged on said device (8) and a second means (31) in connection with said opening provided with a recess (12) for the bolt (14), which means (30, 31) interact to detect and signal at least a predetermined given position between said device (8) and opening, with the aim of ensuring that unobstructed movement of said bolt (14) can take place into said recess (12).

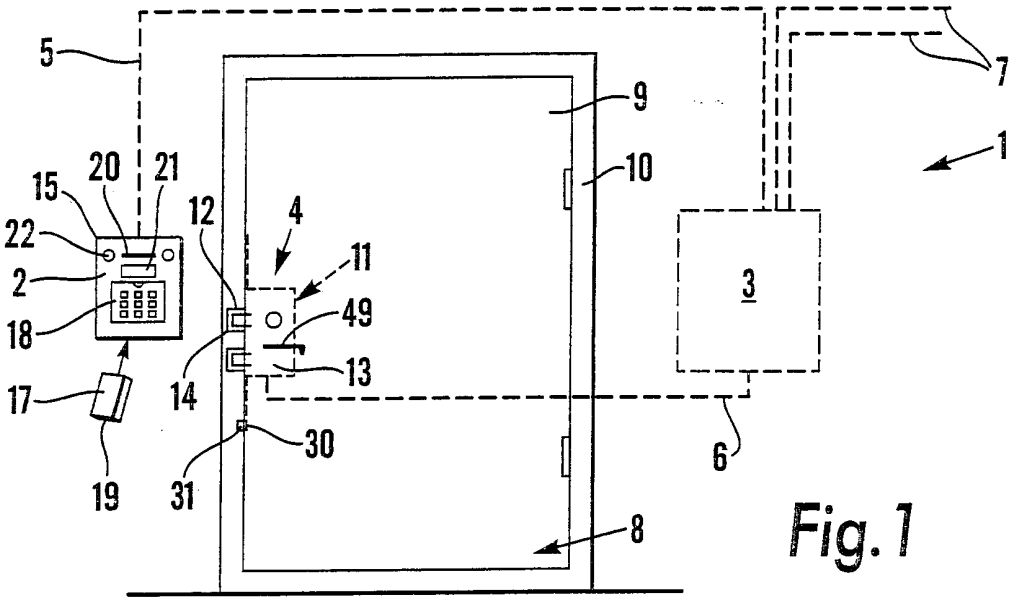

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Fig.1

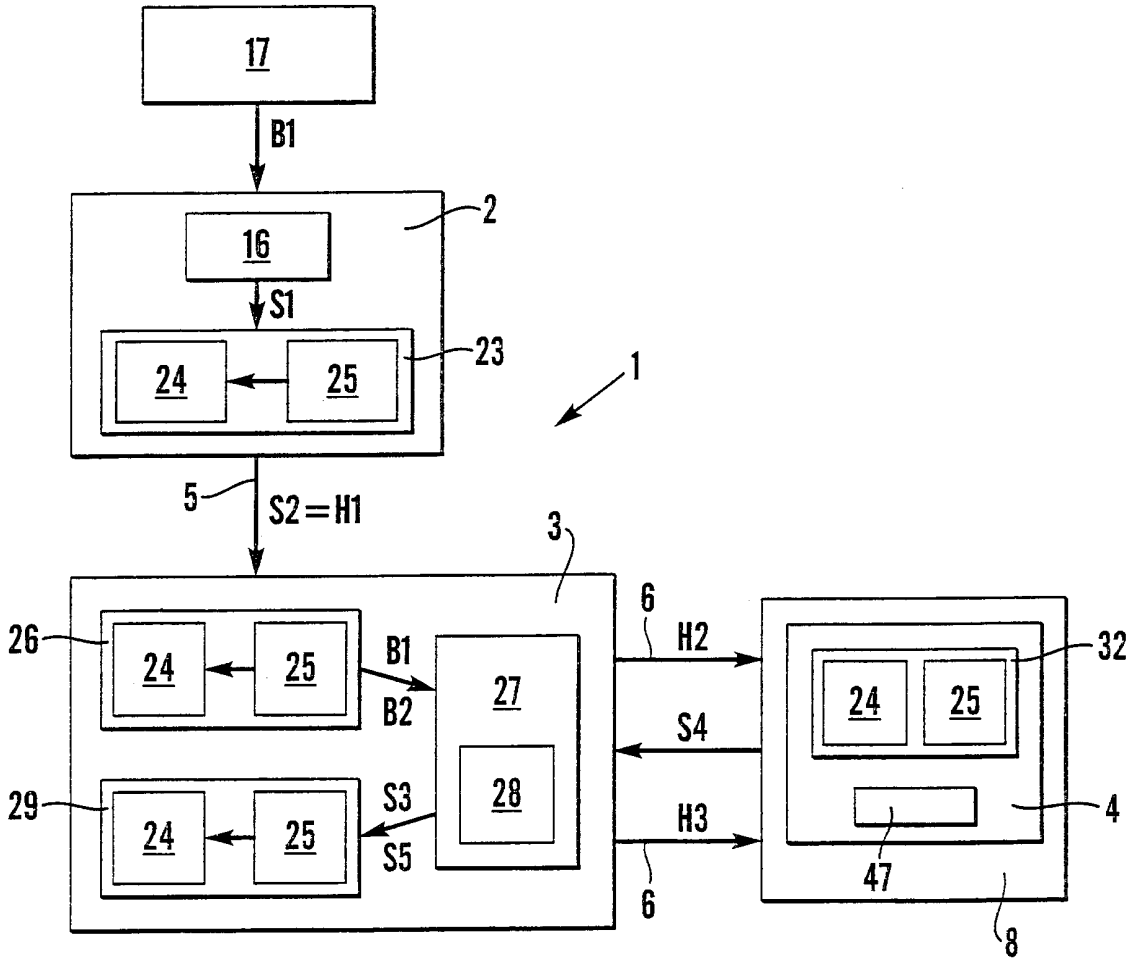

17
B1
2
16
S1
24
25
23
1
5
S2=H1
3
6
26
24
25
B1
B2
27
H2
32
S4
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S3
S5
28
H3
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Fig.2

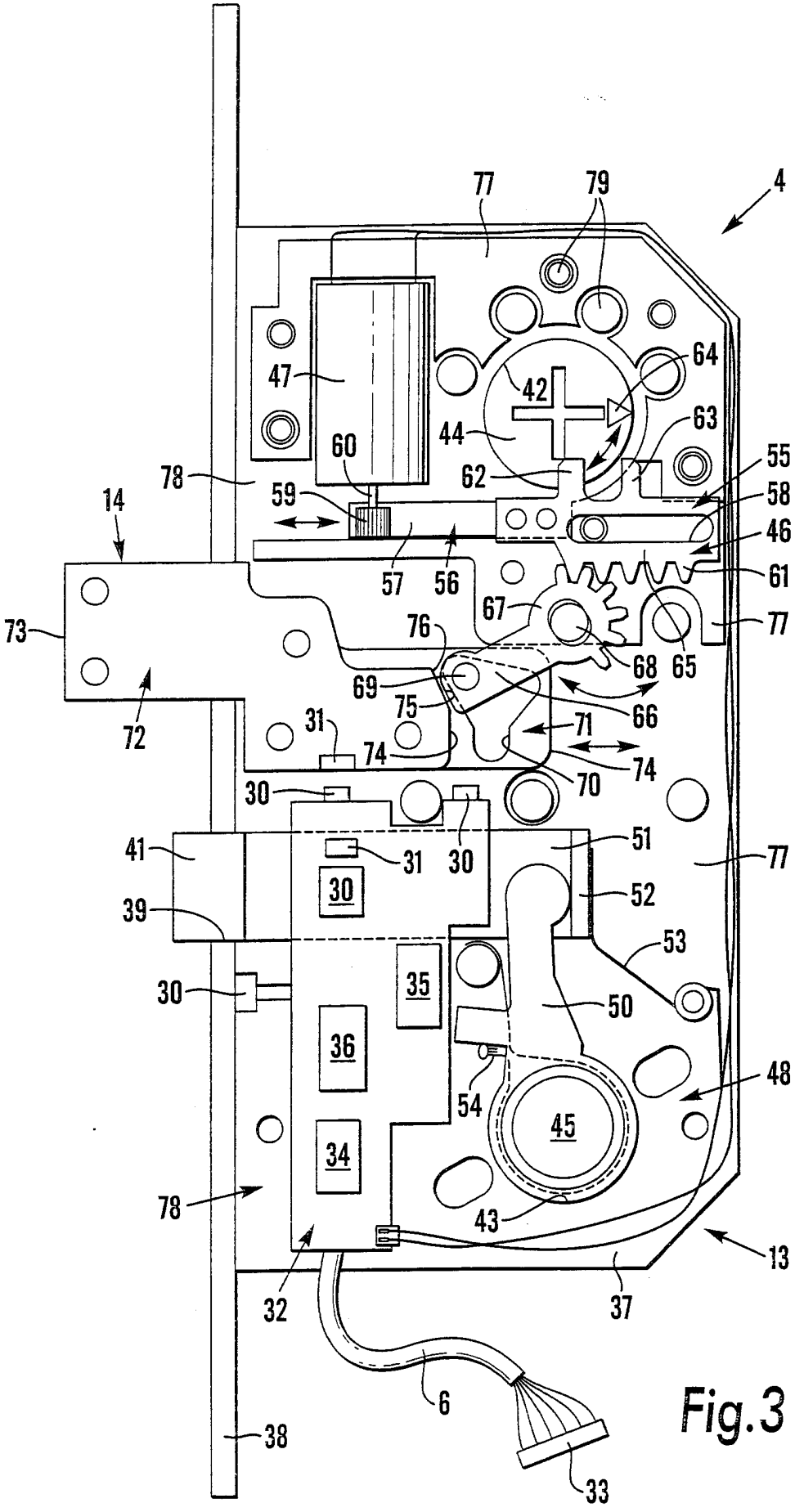

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Fig.3

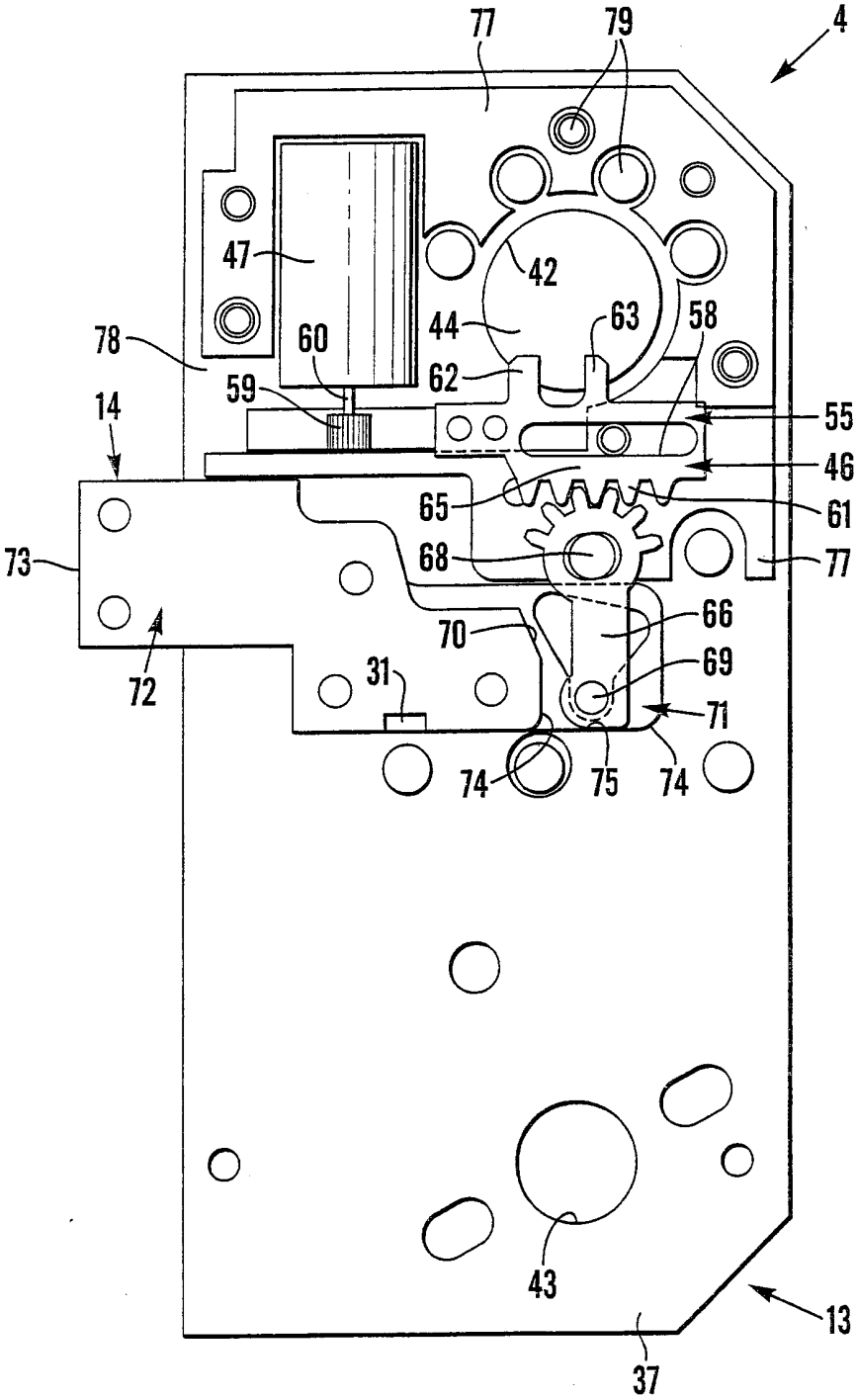

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Fig.4

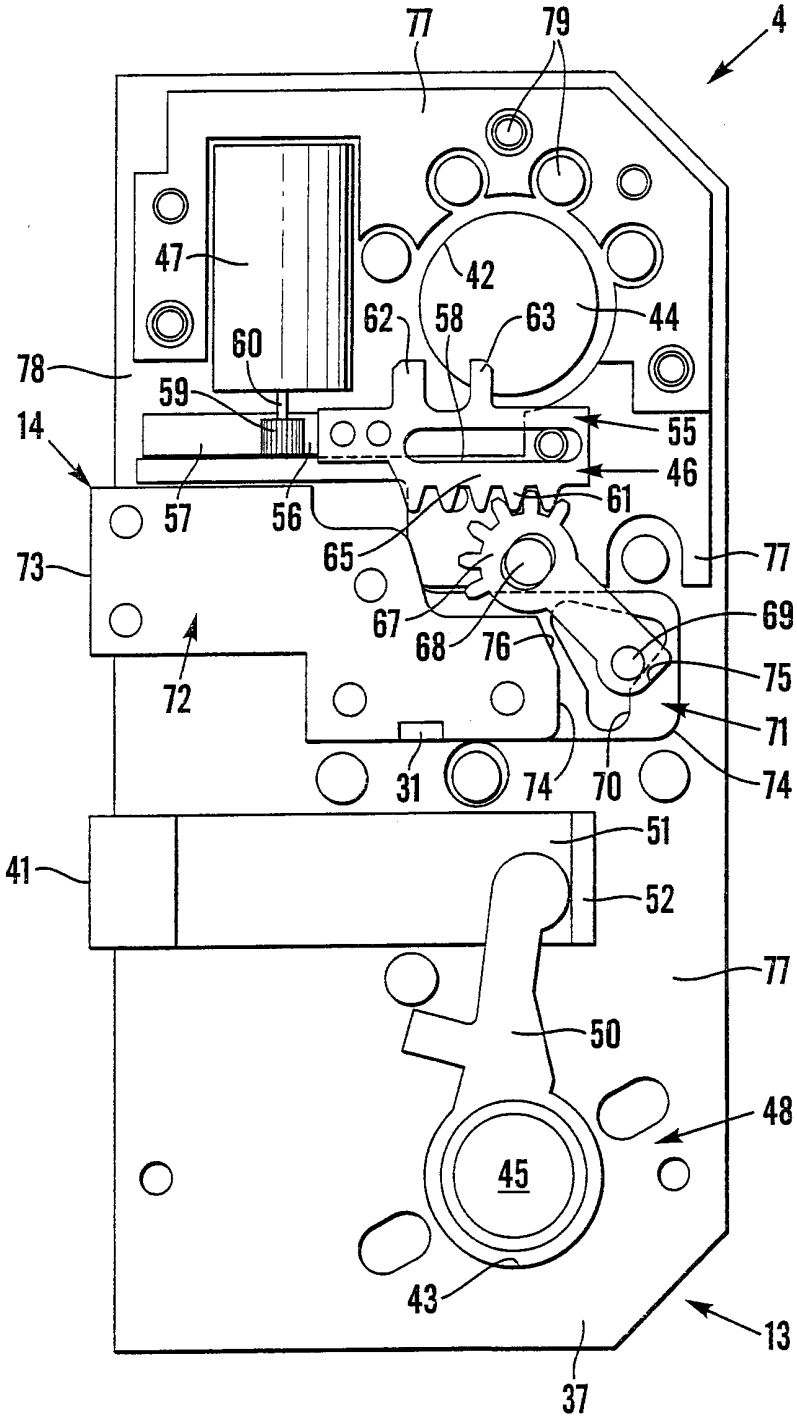

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13
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Fig.5

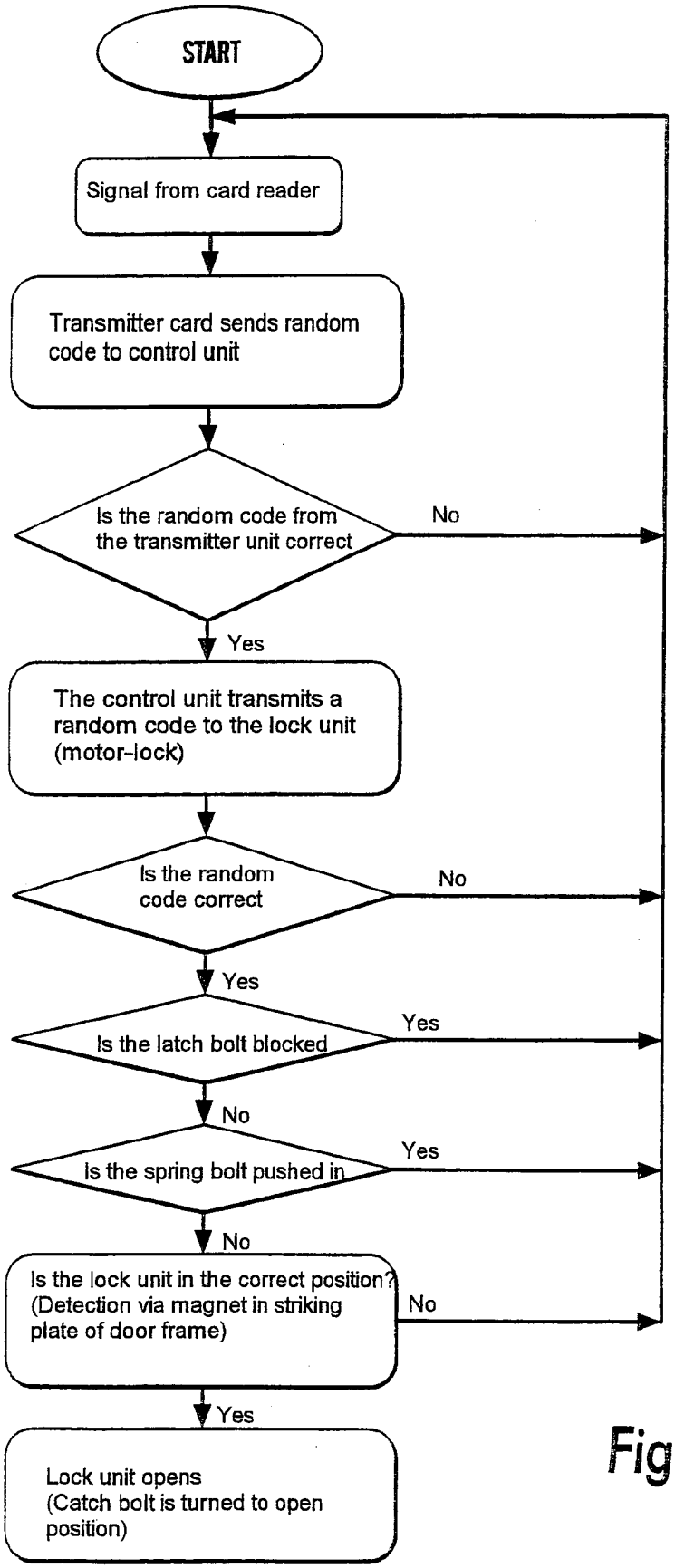

START
Signal from card reader
Transmitter card sends random code to control unit
Is the random code from the transmitter unit correct
No
Yes
The control unit transmits a random code to the lock unit (motor-lock)
Is the random code correct
No
Yes
Is the latch bolt blocked
Yes
No
Is the spring bolt pushed in
Yes
No
Is the lock unit in the correct position? (Detection via magnet in striking plate of door frame)
No
Yes
Lock unit opens (Catch bolt is turned to open position)

Fig.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00949

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E05B 41/00, E05B 47/00, E05B 41/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	DE 4213141 A1 (VDO ADOLF SCHINDLING AG), 28 October 1993 (28.10.93) --	1-6
A	EP 0733759 A1 (SUMITOMO WIRING SYSTEMS, LTD.), 25 March 1996 (25.03.96) --	1-6
A	EP 0861959 A2 (TALLERES DE ESCORIAZA, S.A.), 2 Sept 1998 (02.09.98) --	1-6

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 July 2000	16 -08- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christer Wendenius/MN Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00949

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
PCT/SE 00/00949

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EP 0861959 A2	02/09/98	ES 1036491 U,Y	16/08/97
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