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(54) A lock management system

(57) A lock management system comprising a control unit and a plurality of locks, said control unit comprising an address generator, provided for generating addresses for addressing each of said locks, said control unit being further provided for generating control signals for controlling the operation of said locks, each of said locks being provided with a status generator, said control unit being connected to a communication bus to which each of said locks are connected in parallel, each of said locks comprising an address decoder, provided for decoding addresses supplied to said bus and for generating an enabling signal upon decoding among said supplied addresses an address, assigned to the lock to which said address decoder belongs, and wherein said control signals comprise a code word annexed to the address assigned to the lock to which the control signal is addressed, said locks further comprising a code word decoder, provided for retrieving said code word from said control signal, said code word decoder being further provided for decoding said code word and for generating moreover a command signal for operating said lock.

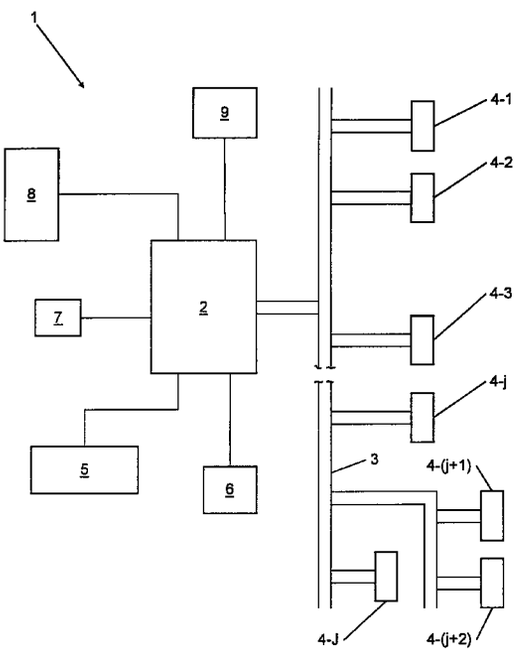

Fig.1

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Description

[0001] The present invention relates to a lock management system, comprising a control unit and a plurality of locks connected to said control unit, said control unit comprising an address generator, provided for generating addresses for addressing each of said locks, said control unit being further provided for generating control signals for controlling the operation of said locks, each of said locks being provided with a status generator, provided for indicating their actual status and for communicating their actual status to said control unit.

[0002] Such a lock management system is known from EP-A-0700555. In the known system the status generator is formed by a microswitch, which indicates whether the lock is in an open or closed position. That information is communicated to the control unit, which in such a manner knows whether or not the box to which the considered lock belongs, is available or not. The latter enables the control unit to assign a free box to a user, who wishes to use a box in order to store therein some of his goods. In the known system the locks are individually connected to the control unit, each lock having his own address within the unit, so that the latter can manage the availability of each box.

[0003] Lock management systems are used for example in swimming pools, airports, railway stations, hotels, business plants etc., and everywhere where lockable boxes are available to users in order to store therein their personal goods.

[0004] A drawback of the known system is that its installation and any further modification are rather cumbersome. Each lock requires his own wiring to the control unit, as the status information of a dedicated lock has to be supplied to a dedicated input of the control unit, since nearly no intelligence is available at the level of the lock, which is formed by a microswitch. The addition of locks thus requires the placement of additional wiring and of sufficient inputs at the control unit's side.

[0005] It is an object of the present invention to realise a lock management system which is more easy to be modified without requiring additional wiring.

[0006] A lock management system according to the present invention is therefore characterised in that said control unit is connected to a communication bus to which each of said locks are connected in parallel, each of said locks comprising an address decoder provided for decoding addresses supplied to said bus by said address generator and for generating an enabling signal upon decoding among said supplied addresses an address assigned to the lock to which said address decoder belongs, and wherein said control signals comprise a code word annexed to the address assigned to the lock to which the control signal is addressed, said locks further comprising a code word decoder, having an input for receiving said enabling signal and provided for retrieving said code word from said control signal under control of said enabling signal, said code word decoder being further provided for decoding said code word and for generating a command signal based on said code word for operating said lock. Since the locks are connected to a communication bus, the addition of supplementary locks simply requires to connect the latter locks to the bus and no additional separate wiring connecting the lock to the control unit is required. As all locks are now linked to a common bus, the communication between the control unit and each of the locks is realised by means of the addressing of each of the locks. Because each lock has its own address decoder, the address generated by the address generator is decoded by the address decoder which in such a manner can recognise whether or not the code word annexed to the address is destined to the lock to which the address decoder belongs. The enabling signal generated upon recognition of the address enables to retrieve the code word, which is then used to generate the command signals, operating the lock. Contrary to the locks according to the state of the art, intelligence is now available at the level of the lock which enables a communication requiring less wiring and thus less cumbersome to modify.

[0007] A first preferred embodiment of a lock management system according to the present invention is characterised in that each lock is provided with a lock address generator, provided for assigning an address to the lock to which it belongs. This enables to assign the address to each lock in a sequence such as desired by the operator of the system.

[0008] A second preferred embodiment of a lock management system according to the present invention is characterised in that said control unit is provided for generating a series of three successive code words, said code word decoder being provided for generating respective command signals upon decoding of said three respective code words, said lock being provided for being set in a locked mode, a standby mode and a free mode, under control of said first respective command signals. The switching to a standby and a free mode enables to safe power.

[0009] The invention will now be described in more detail by means of the annexed drawings showing an example of a lock management system according to the present invention. In the drawings :

figure 1 shows schematically an example of a lock management system according to the present invention;
figure 2 shows a cross-sectional view through a lock as part of the system;
figure 3 shows a top view of a lock catch as part of the lock;
figure 4 shows an electrical connection scheme of a lock as part of the system; and
figure 5 shows schematically an electrical set-up of a control unit as part of the system according to the present invention.

[0010] In the drawings a same reference sign has been assigned to a same or analogous element.

[0011] The lock management system 1 according to the present invention and illustrated in figure 1 comprises a control unit 2, for example formed by a PC, connected to a communication bus 3. According to an alternative embodiment, the PC is connected to a modem and is part of a network. Preferably the communication bus only comprises four wires, two for power supply and two for data communication. A three wire bus could also be applied if the different components are connected to a same earth. A plurality of locks 4-j ($j \leq 1 \leq J$) are connected in parallel to the communication bus 3. The total number J of locks to be connected to the bus 3, is determined by the address generating capacity of the address generator, which is part of control unit 2. If for example the address generator is provided for generating an n-bits address, then $J=2^n$ locks can be connected to the bus.

[0012] A token collector 6 is connected to the control unit 2. This token collector is provided for collecting tokens, for example pieces of money or for reading credit cards in such a manner as to determine how much money has been introduced and for communicating the input credit to the control unit.

[0013] A user keyboard 5, a printer 7 and a monitor 8, are also connected to the control unit. The monitor serves to display messages addressed to the user, in order to help him in supplying his instructions or requests via the keyboard 5 to the system. According to another embodiment the keyboard and the monitor could be combined into a touch-screen. The printer serves to furnish tags to the user, indicating him which box has been assigned to him.

[0014] In order to enable the operator to monitor the working of the system, an operator command unit 9, comprising for example a monitor, a printer and a further keyboard, is also connected to the control unit 2. Alarm messages or other relevant information such as the malfunctioning of a lock are also displayed on the command unit. The operator can interfere by means i.a. of his own keyboard.

[0015] Figure 2 shows a cross-sectional view through a lock 4-j, fixed to a box as part of a system according to the present invention. The lock comprises a housing 10, fixed to an inner wall of the box. A lock catch 12 is fixed to the door 11 of the box, in such a manner that upon closing the door, the lock cooperates with the lock catch 12, so as to lock the door. The lock catch 12 has an inclined front side in such a manner that upon closing the door 11, and when the magnet 15 with plunger 16 is not energised, the inclined front side of the lock catch pushes the plunger in the magnet.

[0016] The electro-magnet 15 with the plunger 16 is mounted in said housing in such a manner that the plunger 16 engages into a perforation 14 (figure 3), present in said lock catch 12, when the door is closed. The lock catch is further provided with a cavity 13, wherein a first element 20 of a status generator is housed. A second element 21 of said status generator is mounted on a mounting plate 19, in such a manner that the first and second element co-operate when the door is closed. The first element 20 is for example formed by a permanent magnet, whereas the second element 21 is formed by a reed contact provided for detecting a magnetic field. When the door 11 is closed, the magnet 20 is situated near the reed contact 21, so that the latter detects the presence of the magnet and generates a first status signal, indicating the closed status of said lock. When on the other hand the door is open, the reed contact can not detect the magnet 21, and a second status signal indicating the open door status is generated. The status signals are transmitted to the control unit, as will be described hereinafter. Instead of using a magnet and a reed contact, other alternatives are possible such as optical detection or mechanical contacts. The magnetic solution is preferred as it is less vulnerable for vandalism.

[0017] A lock address generator 18, for example formed by a DIP switch is also mounted on the mounting plate 19 as well as a processing member 17. The use of a DIP switch enables to assign to each lock a dedicated address, taking of course into account that a same address is not assigned twice to different locks. The assignment of a dedicated address to each lock enables the operator to assign the addresses in a sequence which fits with the numbers assigned to the boxes to which the locks belong.

[0018] Figure 4 shows an example of an embodiment of the electronic circuit of the lock 4. The electro-magnet 15 is formed by a solenoid, connected in parallel with a diode 26, for protection purpose. The solenoid has one pole connected to a supply source and the other pole connected to the collector of a transistor 25, which operates as a switch. The base of transistor 25 is connected, via a resistor for current limiting purpose, to a connector RA1 of the processing member 17. The connector RAO of the processing member 17 is connected to the second element 21 of the status generator. The connectors RA2 respectively RA3 of the processing member 17, are connected via a capacitor 31 and a diode circuitry 34, respectively a resistor 33 to the base respectively the collector of a transistor 32. The collector and the emitter of transistor 32 are connected to a respective data communication line of the bus 3. A diode 35 is connected in parallel over the collector and emitter of transistor 32. A clock circuit 27, provided with a crystal 28, is also connected to the processing member.

[0019] The lock address generator 18, formed by the DIP-switch is connected to the RB inputs of the processing member 17. In the shown embodiment the DIP-switch is an 8 bits address generator.

[0020] The resistor 33 preferably has a value of 1 MΩ, in order to limit the current which streams from the bus 3 to the processing member 17. As the different locks are connected in parallel to the bus, the parallel switch-

ing of the resistors 33 does not form a too high impedance for the bus and consequently does not affect adversely the data traffic on the bus.

[0021] The capacitor 31 preferably has a value of 10 μ F for keeping the signal high, even when no signal is available on the bus. The capacitor thus not only provides a galvanic dissociation, but also protects the bus for failure of the processing member.

[0022] Figure 5 illustrates schematically the control unit as part of a lock management system according to the present invention. The control unit comprises an internal bus 30 to which a microprocessor 31 and a memory 32 are connected. An address generator 34 and an interface 33 are also connected to the internal bus 30. The communication bus 3 is connected to the interface 33.

[0023] When a user wants to hire a box, he enters a token or a credit card into the token collector 6. A welcome message followed by a message inviting the user to enter his code word will consequently be displayed on the monitor 8 and the user is invited to select a free box. Either the control unit selects among the available boxes a free one or presents to the user a number of free boxes inviting him to select one. The control unit knows which boxes are free as the status of each lock, such as issued by the status generator 20, 21 is stored in the memory 32.

[0024] The user selects one of the proposed boxes or confirms the prepared box by means of the keyboard 5 or the touch screen, if the latter embodiment is available. The microprocessor 31 will now generate an activation signal, which is supplied to the address generator 34, in such a manner that the latter can generate the address of the selected or proposed box. Suppose that the user selects box j, then the address generator will generate address j and supply it to the microprocessor, which will temporarily store it.

[0025] If the boxes are open, when not occupied, the microprocessor will wait until he receives the information from the status generator that the door is closed. If on the other hand the boxes are closed when not occupied, the microprocessor will generate a control signal for opening the selected box. That latter control signal is then annexed to the address j and sent via the interface 33 and the bus 3 to the lock j. The control unit will also activate the printer in order to print a tag indicating the selected box j and if a time limit is set, also the time at which it expires.

[0026] In the present embodiment the data slots transmitted to the communication bus 3 have a fixed time period and 2/3 of the time period is reserved for data originating from the control unit, whereas the remaining 1/3 of the time period is used for data inserted by the addressed lock. Such a set-up facilitates the transmission protocols over the communication bus and at the level of the control unit and the lock.

[0027] When the user has placed his personal goods in box j, he will close the latter. The inclined front side of the lock catch 12 will push plunger 16 inside the magnet 15, so that the plunger end reaches the upper side of the lock catch. When, due to the inward movement of the door, the plunger 16 faces perforation 14, the plunger will fall into the perforation 14. The cavity 13 of the lock catch 12 will now be faced opposite the second element 21 of the status generator. The second element 21 will thus detect the presence of the first one 20 in cavity 13. The second element will moreover generate a signal which is supplied to connector RAO of the processing member 17. The latter will consequently establish that the actual status of lock j has changed into closed status.

[0028] Upon assigning lock j to box j to the user, the control unit 2 has generated address j and has annexed a first code word to said address, indicating the selection of lock j. The address j and the first code word are put on the bus 3 and received by all the locks. The processing member 17 of each lock comprises an address decoder, provided for decoding the address transmitted to the bus and comparing the latter with the address of the lock, such as set on the DIP switch 18. The address decoders of each of the locks will decode the address available on the bus. However only the address decoder of lock j will recognise address j as his own address and will generate an enabling signal upon decoding said address j. The other address decoders will upon decoding establish that they are not addressed as it is not their own address which is decoded.

[0029] The processing member 17 of each lock also comprises a code word decoder, which is enabled by said enabling signal, generated by the address decoder. The code word decoder is provided for decoding the code word annexed to the address. Thus once the code word decoder has received the enabling signal, the code word annexed to address j will be retrieved and decoded. The decoding of said code word leads to the generation of a command signal based on the received code word so as to operate the lock.

[0030] Upon decoding of the first code word, a first command signal is generated, under control of which, the status such as indicated by the status generator, will be read. The actual status i.e. closed door, will now be inserted as a second code word in the message containing the address j, i.e. in the one third time period of the slot allocated to the lock to insert code words.

[0031] The message now comprising address j and the second code word are output at connectors RA3 and 2 in order to be transmitted via the communication bus 3 and reach the control unit. Upon receipt of that message the control unit will decode the address j and the second code word. The control unit is thus informed that door j of box j is closed. The latter information is stored in memory 32, in order to memorise that box j has been assigned and is thus no longer available.

[0032] Under operating conditions the control unit regularly checks the actual status of each lock in order to

verify if their actual status corresponds with the one memorised in memory 32. For that purpose the control unit has the address generator 34 generating subsequently the addresses of each of the J locks. To each j^{th} address the control unit adds a third code word, requesting a read of the status, such as indicated by the processing member 17. Each of the locks then has to communicate his actual status to the control unit, which can then compare the latter with the one stored in memory. Upon establishing a non-correspondence between the status of a lock i, such as indicated by the processing member, and the one stored in memory 32, the control unit generates an alarm message, which is presented to the operator command unit 9, in order to inform the operator that lock j presents an abnormal situation.

[0033] When the user now wants to open box j, which has been assigned to him, he will enter his code word and the number j of the lock which has been assigned to him. The control unit checks if the box j has indeed been assigned to the user having presented that code word, in the negative, an error message will be presented to the user, inviting him to try again. The number of attempts is of course limited. If the control unit establishes correspondence between the user and the assigned box j, a message will be presented to the user indicating that box j will be opened.

[0034] The control unit then generates a fourth code word and instructs the address generator 34 to generate address j. Address j and the fourth code word are then transmitted to the communication bus 3, in order to reach box j. Upon decoding address j, the address decoder of lock j will activate the code word decoder of lock j, which will decode the fourth code word. The decoding of the fourth code word will cause the creation of a control signal output on connector RA1, causing transistor 25 to become conductive. As transistor 25 is now conductive, the solenoid 15 is energised and the plunger 16 is pulled out of perforation 14, thus causing the unlocking of lock j. The opening of the door will cause the first element 20 of the status generator to move away from the immediate neighbourhood of the second element 21. The status generator will thus indicate the status "door open", which status is communicated to the control unit by introduction of this message in the time slot allocated to address j. The control unit will, upon receipt of the message that door j is open, change the status in memory 32 so that box j can now be allocated to another user.

[0035] The fourth code word will lead to the production of a high level control signal output at RA1 so as to provide sufficient current to pull-up the plunger and switch the lock in an unlocked mode. The control unit however generates thereafter a fifth code word which is also annexed to address j upon decoding the fifth code word, the code word decoder generates a low level control signal, which is sufficient to hold the plunger in the magnet and switch the lock in a standby mode. The plunger is in such a manner lifted up in the magnet for a predetermined time, for example 60's in order to provide the user sufficient time to open box j. After lapse of the predetermined time, the control unit generates a sixth code word, which is also annexed then to address j. Decoding of the sixth code word causes the production of a control signal output at RA1, in order to block transistor 25 and switch the lock in a free mode. The latter will lead to an interruption of the current through solenoid 15, causing the plunger 16 to drop down due to gravity. In such a manner no current is consumed when the door of box j is open. Thus the successive production of the fourth, fifth and sixth code word leads to a minimum power consumption.

Claims

1. A lock management system comprising a control unit and a plurality of locks connected to said control unit, said control unit comprising an address generator, provided for generating addresses for addressing each of said locks, said control unit being further provided for generating control signals for controlling the operation of said locks, each of said locks being provided with a status generator, provided for indicating their actual status and for communicating their actual status to said control unit, characterised in that said control unit is connected to a communication bus to which each of said locks are connected in parallel, each of said locks comprising an address decoder, provided for decoding addresses supplied to said bus by said address generator, and for generating an enabling signal upon decoding among said supplied addresses an address, assigned to the lock to which said address decoder belongs, and wherein said control signals comprise a code word annexed to the address assigned to the lock to which the control signal is addressed, said locks further comprising a code word decoder, having an input for receiving said enabling signal and provided for retrieving said code word from said control signal under control of said enabling signal, said code word decoder being further provided for decoding said code word and for generating a command signal based on said code word for operating said lock.

2. A lock management system as claimed in claim 1, characterised in that each lock is provided with a lock address generator, provided for assigning an address to the lock to which it belongs.

3. A lock management system as claimed in claim 1 or 2, characterised in that said control unit is provided for generating a series of three successive code words, said code word decoder being provided for generating respective command signals upon decoding of said three respective code words, said

lock being provided for being set in a locked mode, a standby mode and a free mode, under control of said first respective command signals.

4. A lock management system as claimed in anyone of the preceding claims, characterised in that said communication bus comprises two wires for power supply purposes and two wires for data communication.

5. A lock management system as claimed in anyone of the preceding claims, characterised in that said status generator comprises a detector for detecting that said lock is switched in a closed position.

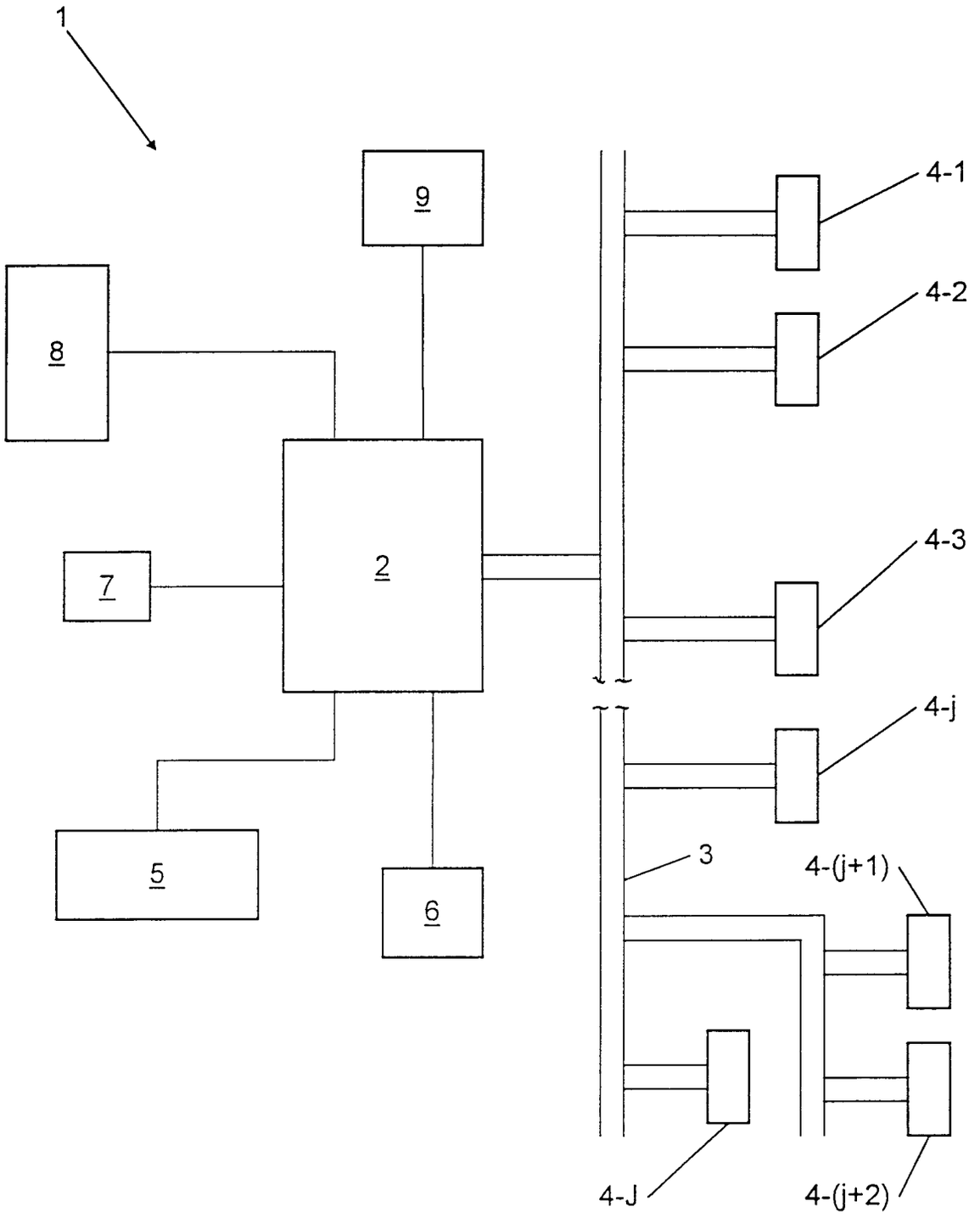

Fig.1

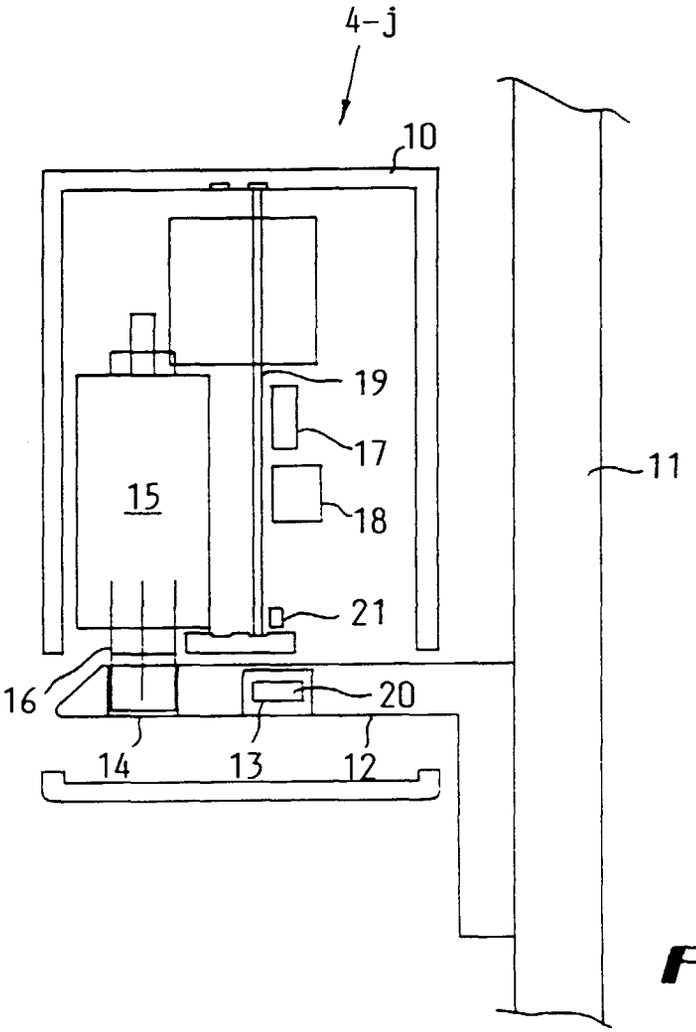

Fig.2

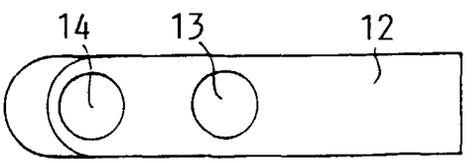

Fig.3

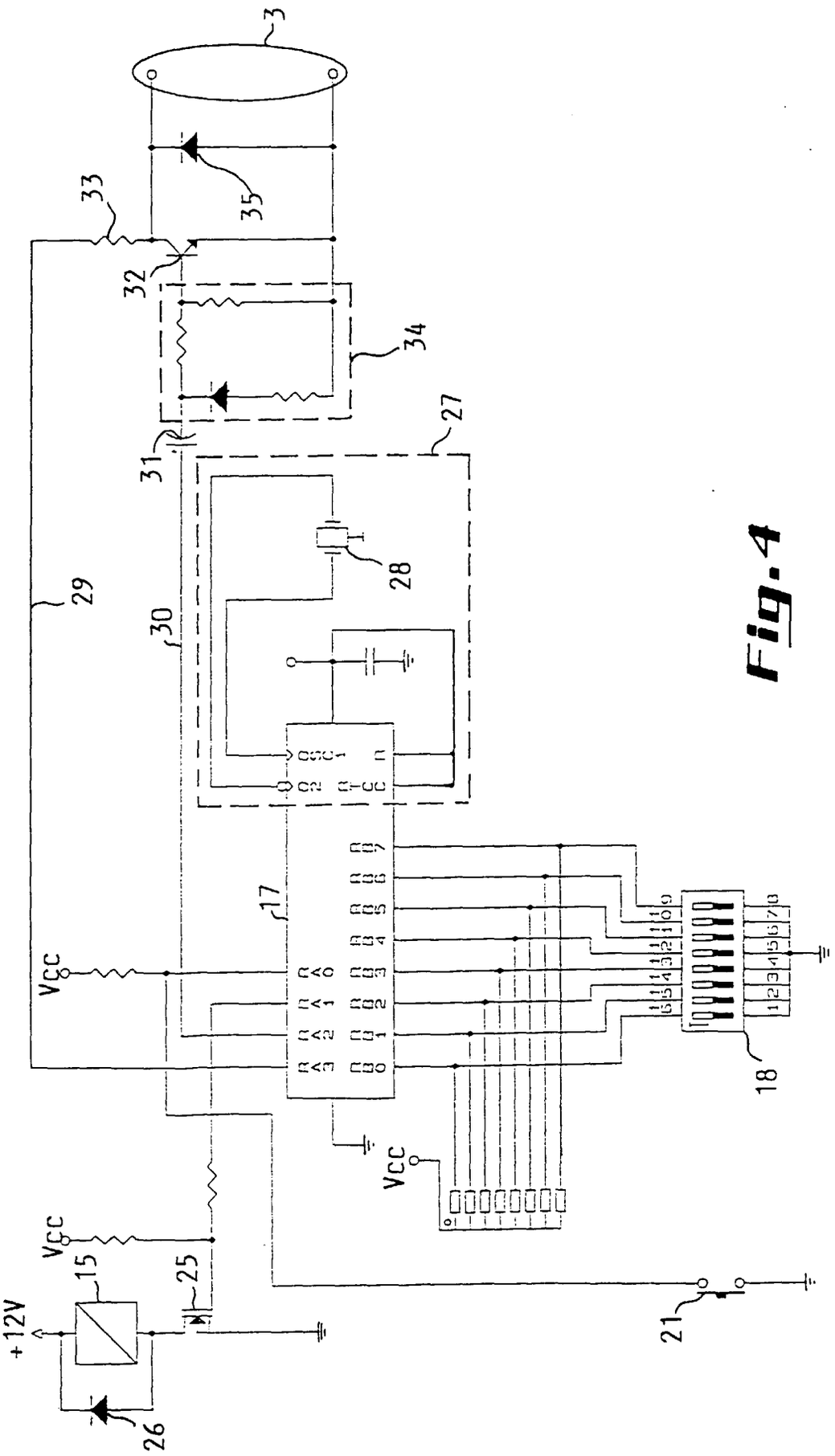

Fig.4

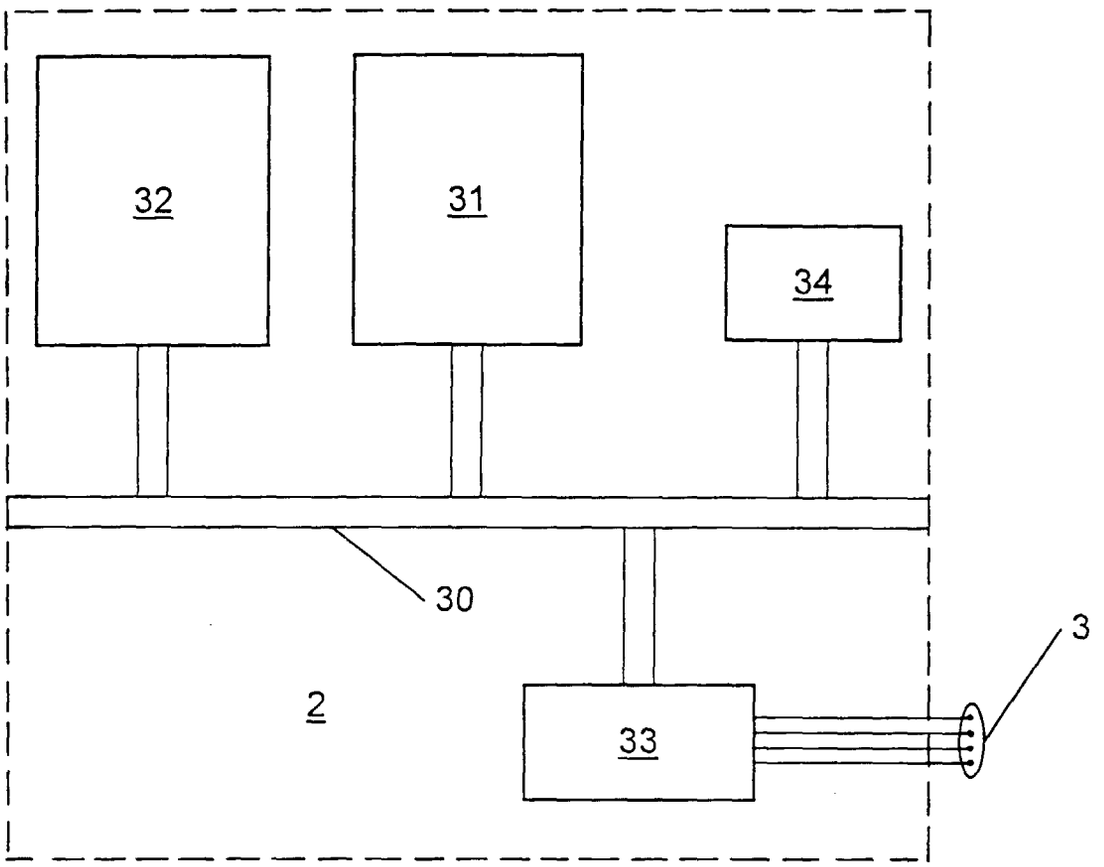

Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 20 3404

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	FR 2 732 139 A (LPE) * abstract; claims; figures * * page 9, line 3 - page 10, line 35 *	1,2,5 3,4	G07F17/12 G07C9/00
Y	US 4 893 705 A (L.C. BROWN) * the whole document *	1,2,5	
A	EP 0 570 195 A (ABLOY SECURITY) * abstract; claims; figures * * column 3, line 15 - column 4, line 48 *	1-3,5	
A	DE 44 43 391 A (AEG SENSORSYSTEME) * abstract; claims; figures 1-3 *	1-5	
A	US 3 838 395 A (F.J. SUTTILL) * abstract; claims; figures 1-3,9 * * column 1, line 53 - column 5, line 63 *	1-3	
A	EP 0 205 691 A (L.C. BROWN)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G07F
G06F
G07C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 April 1998	David, J

CATEGORY OF CITED DOCUMENTS

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