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(54) Improvements on safety lock systems

(57) The invention essentially comprises an electronic lock, which may be opened by means of an infrared transmitter for supplying power and transmitting prede-

termined codes to an infrared receiver which, after having checked the correspondence between the received safety codes and the ones set previously, enables the powering and subsequent opening of the lock system.

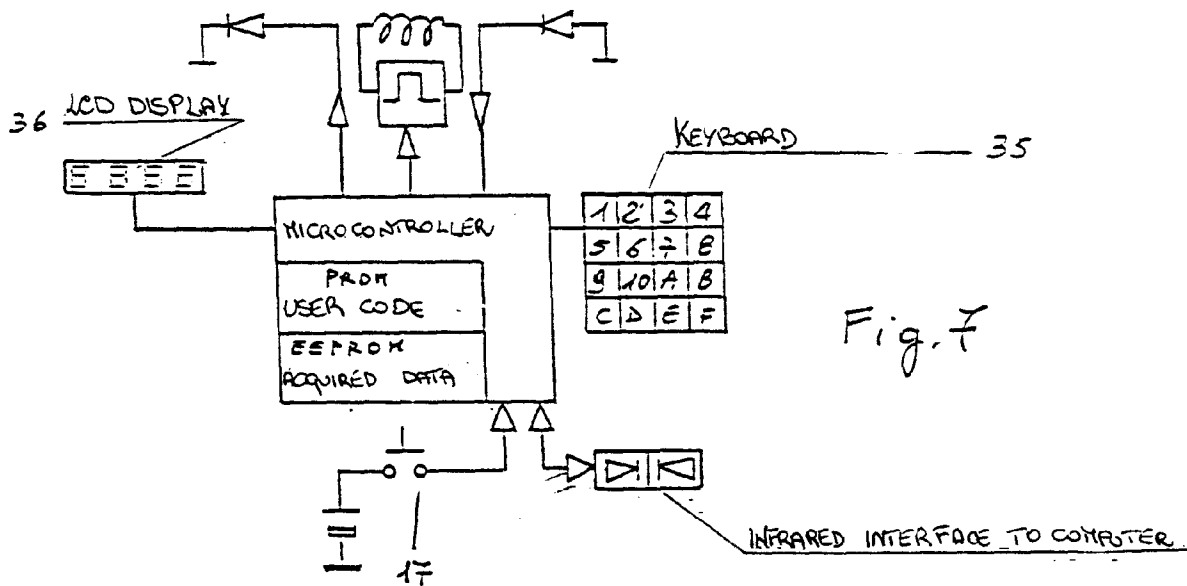


Fig. 7

Description

Technical field

The invention relates to a coded electronic lock system, of the type capable of sequentially storing events in a non-volatile memory and comprising an electronic lock and wireless power supply system for the lock or the code key; a coded infrared control for powering and opening the lock system and/or reading the stored data; a serial PC interface, with the relevant software for handling the data loaded through the infrared control.

The invention essentially comprises an electronic lock, which may be opened by means of an infrared transmitter for supplying power and transmitting predetermined codes to an infrared receiver which, after having checked the correspondence between the received safety codes and the ones set previously, enables the powering and subsequent opening of the lock system.

Background of Art

As a rule, electric/electronic lock system of the type mentioned above require the powering of mechanisms capable of releasing the lock when the user desires to open it. The lock may thus be opened with keys of various shapes and sizes, as well as with magnetic media, such as cards and the like, which are read by a specific device located inside the lock.

The lock systems currently commercially available are generally mains or battery powered and remote controlled, whose codes may be cloned with relative ease.

For instance, the Italian patent 1.229.098 describes a radio-controlled mains powered device suitable for motor-driven rolling shutters, wherein the energy is transferred by means of the two halves of a transformer; this lock does not allow the storage and transfer of data, nor is it capable of operating in case of power cuts. Patent 0 216 961 describes an electric lock actuator, which makes mention of an mains powered electronic lock system incapable of storing or transferring data relative to the opening/closing of the lock. The Italian industrial patent 1.233.961 describes an improved method and device for operating lock systems for safes, but which needs to be mains or battery powered for opening and closing and for recognizing the access code: it has no chronological system, nor non-volatile memory, and the code must be keyed in on the spot, thus obviously impairing security, besides the fact that keyed in on the spot, thus obviously impairing security, besides the fact that the key-pad may be easily damaged, if installed in places open to the public.

The industrial patent 0 217 516 and patent 1.229.638 describe a radio-controlled electric lock system with an attached indicator indicating the condition of the system; both the devices require a continuous supply of power from the mains and do not allow the storage and transmission of data relative to the operations per-

formed. The Italian patent 1.207.653 describes a radio-controlled electric lock system, incapable of transmitting/storing data and featuring a low degree of protection because the access code may be easily detected, at least judging from the attached wiring diagram. The Italian patent 1.224.772 describes an electronic/electromechanical lock system, wherein the codes are keyed in through a key-pad and which is provided with a manual rotor and contacts, which enable the door to be opened by means of the handle. The codes are stored in the memory by means of accumulators. the device presents a limited number of combinations for the type chosen, a low degree of protection, due to the presence of a key-pad, and does not allow the storage and transfer of data. Patent 1.231.551 describes an electronic time lock, which needs to be continuously powered, from the mains or by battery, and wherein the access codes are subject to frequent changes by means of manual controls and electrical counters, which, in any case, prevent the lock from opening outside of a predetermined interval of time. Patent 1.204.118 describes an electronic lock and key system, whose operation is based on the principle of the correspondence of the frequency of two signals, the lock opening only when the two signals coincide; a drawback of this technique is the impossibility to change the code, besides. the device must be continuously, powered and the constancy of the sample frequency is sometimes weakened, furthermore, there is no code digital system. Patent 0 0219 117 describes an electronic/mechanical lock system, which may be opened by means of a magnetic card, with a numerical key-pad, and other manual operations; this invention allows access at various hours, as long as the person knows the correct access code; the time of access of the holder of the correct code is guaranteed by a third user, who is authorized to set the access times, by means of the key-pad; this invention too is mains powered and does not provide for the storage and transmission of data.

The patent WO 87/ 04482 essentially describes a key operated device for opening/closing car doors, whereby there is no transfer of energy from the key, since the power for operating the lock is supplied by the car-battery or, in the case of domestic installation, by the mains.

The US patent 4.831.374 A describes a centralized remote door opening system. whereby the lock is powered by the mains and the data is transmitted by cable, preferably by phone.

The US patent 4.829.296 describes a mechanical key, but its level of safety is very low, also with regard to the codes.

The US patent 4.148.092 describes a door opening system, comprising a keyboard for entering the code, but powered by a battery of the mains.

The patent WO 95/ 11498 describes a remote control system powered by the vehicle, which only occasionally requires the power to be supplied by the receiver.

er battery.

Disclosure of Invention

The invention aims to remedy such drawbacks and provides and makes available a lock system which gives a high degree of protection.

In order to achieve this, a lock system according to the invention of the type mentioned above is characterized :

- in that it is powered only when it has to be opened and, therefore, does not require the continuous supply of power from the mains or batteries,
- in that its mechanical parts are interlocked with an electronic controller, capable of powering and opening the lock only after an access code, keyed in on the lock itself, has been recognized,
- in that it is capable of storing the following data: the sequence, date and time of each opening,
- in that it is provided with for a device for reading the data stored in the above mentioned memory and transferring it to a processor for decoding, processing and filing.

These and other objects have been achieved by the improvements on the lock system described in the present invention, consisting of an electric lock system essentially comprising:

A: A coil, for picking up the supplied power;

- a quartz clock and calendar unit, with lithium battery and automatic calibration to the temperature;
- an EEPROM type non-volatile memory, for storing the data concerning: the opening operations, operator code, month, day, hour and minutes;
- a CPU microprocessor;
- a power supply voltage monitoring unit, for the correct operation of the micro-controller;
- protection from incoming overvoltages;
- an infrared data transmitter;
- an infrared data receiver;
- an SCR for activating the electric lock;
- a low thermal drift condenser.

B: A coded remote control capable of powering and opening the lock, essentially composed of the following:

- a coil, for transmitting the supplied power;
- a battery indicator;
- an infrared transmitter, for validating the transmitted code;
- a micro-controller;
- a PROM memory for the operator code.

C: A coded remote control capable of powering the lock and reading the stored data, composed of:

- a coil, for transmitting the supplied power;
- a battery indicator;
- an infrared transmitter for transmitting the code;
- an infrared receiver for validating the code and loading the data;
- an end-of-operation display;
- a micro-controller;
- a PROM memory, for the operator code;
- an EEPROM non-volatile memory, for storing the loaded data;
- a function key-pad;
- an infrared serial interface, for sending data to the PC.

D: A serial PC interface, with the relevant software for handling the data loaded through C, composed of:

- an infrared serial interface, linked to the PC;
- software for handling the data and displaying it on the PC monitor.

Brief Description of the Drawings

Further characteristics and advantages are apparent in the description of the preferred, albeit non-exclusive, embodiment, with reference to the accompanying drawings, provided purely by way of example, in which:

Figure 1 shows an overall view of a possible application of the lock system according to the present invention.

Figure 2 shows an overall view of another possible application of the lock system to a container, such as a letter box, for example.

Figure 3 shows a block diagram of the data transmission from the lock to the PC and of the possible access keys.

Figure 4 shows a block diagram of the direct contact access keys.

Figures 5 to 7 show the diagrams of the keys from 14 to 16A.

Figures 8 to 10 show the diagrams of the contact keys 13, 15A and 16A.

Figure 11 shows a diagram of the electronics of the lock system.

Figure 12 shows a possible variation of the embodiment in figure 11.

Figure 13 shows the induction powering diagram, with the relative flow diagram.

Figure 14 shows the contact powering diagram, and the relative flow diagram shown in figure 13.

Figure 15 shows the diagram of the electronics of the lock system operation.

Figure 16 shows the diagram of the external pe-

ipherals of the control unit.

Figure 17 shows the lock system's management flow diagram, by means of the operator code.

Figure 18 shows the inspector code's management flow diagram.

Figure 19 shows the diagram of a flessible item counter and a flessible network power supply or solar panel supplying power to a battery.

Referring to the figures, the electric lock system (6) installed in a door(l) without a map, mounted onto a frame (2) or the lid (11) of a container (1.1), for example, a letter box, may be opened by means of the keys (14) and (15) shown in figure 3, and the keys (13,15A) shown in figure 4. enabling the powering of the electronic part (5) of the lock system (6), thanks to the transmission of the power stored in a battery (18), by means of a primary solenoid (2,2),also contained inside the keys (14 and 15), which connects the flow with a secondary solenoid (4) by pointing the key to a predetermined area, or the transmission of power may be achieved through the keys (13 and 15 A), shown in figure 4, by direct contact (25.1 and 26.1).

According to the present invention, the key (14) shown in figure 3, by activating the button (17) allows the transmission of power from the battery (18) to the micro-controller(19), which enables the square wave generator (21) to transmit the power to the primary solenoid (22), which then connects with the secondary solenoid (4) shown in figure 11, which in turn transmits the power to the electronic circuit (5), shown in figures 1, 2 and 3.

Once the secondary solenoid (4) has been powered, it converts the square wave into continuous voltage, by means of a rectifier diode (27), which is then stored inside the condenser (28).

A protection device (29) prevents the voltage from exceeding the allowed threshold and the voltage is simultaneously directed toward a voltage supervisor (30), which assesses its value, and the activation of the lock system (31).

The voltage supervisor (30) keeps the micro-controller (32) in the reset position until the voltage reaches the pre-determined value, after which the micro-controller (32) moves out of the reset position and, by means of the infrared transmitter (33), transmits the "ready" condition to the key (14), which receives it through the Rx receiver (23), which transmit the signal to the micro-controller, thus activating the user code sending procedure, through the Tx transmitter (24). This information is detected by the electromechanics (32) of the ock (5) shown in figure 1, by means of an RX IR (34), shown in figure 11, which transfers the user code to the micro-controller (32). The user code is compared with the n codes stored in the EEPROM memory (32.2) and if it corresponds with one of these, the micro-controller (32) reads the day and the time from the clock-calendar unit (32.4) and transfers this data, together with the code of the user who has enabled the opening, to the FIFO memory

(32.3), at this point it sends a control impulse to the SCR activator (31), which discharges all the power stored in the condenser (28) to the lock opening coil (6).

The key (15) shown in figure 3 operates in the same manner as the key (14), but allows the reading of the data stored in the non-volatile memory of the lock system electronics (5) and their transmission to the analysis computer, via infrared.

Other possiblr keys are key (13), which works like key (11), but in which the transfer of power occurs by contact with the pins (25.1, 26.1)) of the key with the pins (25, 26) with the lock system electronics shown in figure 12; another key is the key (15A), which works like key (15), but in which the transfer of power occurs by contact with the pins (25.1, 26.1)) connected to the lock system electronics shown in figure 12.

The key (16) shown in figure 3 is not generally enabled to open the locks.

Figure 7 shows the preferred configuration for the key (16), whereby pushing a button (17) enables the starting and self-stopping procedure and the supply of power, by means of a battery (18), activating the micro-controller (19), which sends the signal to the square wave generator (21), which transmit power to the primary solenoid (22), which connects the flow with a secondary solenoid (4) shown in figure 3, which is connected to the lock system electronics (5); when the ready signal returns, the key (16) sends the insepection code, which is analysed by the electronics (5) shown in figure 3 and if the insepection code corresponds to the one of the inspection code, the electronics (5) shown in figure 3 sends a further ready signal and stands by for the requested command, keyed in through the specific keypad (35) and displayed on the relative dispaly (36).Once the command has been sent, the electronics (5) shown in figure 3 puts itself at the disposal of the inspection to transmit the data stored in the non-volatile FIFO memory (32.3) or to midify one of the n operator codes, reset the clock or allow the opening of the lock system, if required. The set of data thus transmitted also includes the lock system code, which identifies the door or the container, such as a letter box, for example.

According to one of the possible embodiments, although substantially maintaining the same system architecture, the lock is powered by a battery located in the lock system electronics, or through the mains, thus depriving the invention of the advantage of a wireless power supply, but nonetheless enabling the lock system to work.

The present invention may achieve considerable economic benefits using state of the art technologies, which may be easily inferred and better understood by examining the diagram of the lock system electronics, shown in figure 15. In particular, advantages may be had from the customization of the components.

Figure 15 shows the architeteure of the lock system components. The various elements may be grouped together into a single component, or customized.

The advantages achieved through customization are a greater reliability, as a consequence of the reduction of human error during the assembly phase and the reduction of industrial costs. Another equally important advantage is due to a reduction of the dimensions of both the electronic keys and the lock system, thus obtaining a very compact device.

Figure 19 shows an embodiment of the electronics (4) power supply system, by means of a mains or solar panel (38) powered battery (37) placed inside the electronics.

Figure 19 also shows two infrared sensors (39,39.1), located in the proximity of the access to the metal container, enabling the counting of the number of items placed therein or, according to the preferred embodiment, the number of letters introduced in the letter box.

This number is then transferred to the non-volatile memory and, from here, to the computer, by means of the inspector's keys 16, 16A, who may zero the counter, thus enabling the determination of the number of withdrawn objects, besides the operator opening the box, the date and the hour of opening.

Claims

1. Improvements on electronic lock systems characterized in that a coded electronic lock with the sequential storage of the events in a non-volatile memory, including the installed electronics and wireless power system and an infrared remote control for powering the lock system and determining and/or reading the data stored in the memory ; the electronic lock system consists of an electric lock, a coil for picking up the supplied power, a clock-calendar unit with lithium battery and automatic calibration according to the variation of the temperature, an EEPROM memory for storing the lock opening data, a CPU micro-controller, a voltage monitoring unit, for the correct functioning of the micro-controller, a protection against overcharging from the outside, an infrared transmitter for data transmission, an infrared receiver for data acquisition, an SCR for activating the electric lock system, a low thermal drift condenser.
2. Improvements on electronic lock systems according to the preceding claims, characterized in that the remote control enabling the powering and opening of the lock system consists, in the preferred embodiment, in a coil for transmitting the power, a low battery indicator, an infrared transmitter for transmitting the codes, an infrared receiver for validating the codes, a code transmission indicator, a micro-controller, a PROM memory for the operator code.
3. Improvements on electronic lock systems according to the preceding claims, characterized in that the remote control enabling the powering of the lock system and reading the stored data comprises: a power supply coil, a low battery indicator, an infrared transmitter for code transmission, an infrared receiver for convalidating the received code and loading the data, a micro-controller, an operator code PROM memory, a non-volatile EEPROM memory for storing the loaded data, a function keypad, an infrared serial interface for transmitting the data to the PC.
4. Improvements on electronic lock systems according to the preceding claims, characterized in that the PC serial interface, with the software for handling the data transmitted by means of the remote control as per claim 4, consists an infrared serial interface connected to the PC and the relevant software for handling the data.
5. Improvements on electronic lock systems according to the preceding claims, characterized in that the control or key transmits power, without contact, to the electronics of an electric lock system, by means of the secondary solenoid which connects with the primary solenoid of the key and which, thanks to the power thus transmitted, enables its operation, allowing the enabled code control interface to open.
6. Improvements on electronic lock systems according to the preceding claims, characterized in that the control or key stores the opening data, allowing their transmission to a computer, by means of a serial interface.
7. Improvements on electronic lock systems according to the preceding claims, characterized in that the control or key transmits the data, by means of infrared, after having received them from the lock system electronics and stored them.
8. Improvements on electronic lock systems according to the preceding claims, characterized in that the control or key transmits power by means of contacts.
9. Improvements on electronic lock systems according to the preceding claims, characterized in that the control or keys transmits power and data by means of contacts and receives and stores the opening data.
10. Improvements on electronic lock system according to the preceding claims, characterized in that the control or key enabling the opening of the lock system transmits energy by means of contacts.
11. Improvements on electronic lock systems according to the preceding claims, characterized in that the remote control enabling the powering of the lock system and reading the stored data comprises: a power supply coil, a low battery indicator, an infrared transmitter for code transmission, an infrared receiver for convalidating the received code and loading the data, a micro-controller, an operator code PROM memory, a non-volatile EEPROM memory for storing the loaded data, a function keypad, an infrared serial interface for transmitting the data to the PC.

ing to the preceding claims, characterized in that it is equipped with a control or key transmitting power without contact and detecting the data stored in the non-volatile memory of the lock system electronics and transmits them to the computer by means of infrared rays. 5

12. Improvements on electronic lock systems according to the preceding claims, characterized in that the control or key usually set aside only for data detection purposes, may enable the opening of the lock system only if a specific code is keyed in on the key-pad, which transmits power without contact. 10

13. Improvements on electronic lock systems, characterized in that the key or control mentioned in claims 12 and 13 transmits power by means of contacts. 15

14. Improvements on electronic lock systems according to the preceding claims, characterized in that the codes may be set directly by the manufacturer, stored and never changed. 20

15. Improvements on electronic lock systems according to the preceding claims, characterized in that the lock system may be mains or battery powered. 25

16. Improvements on electronic lock systems according to the preceding claims, characterized in that the components may be customized. 30

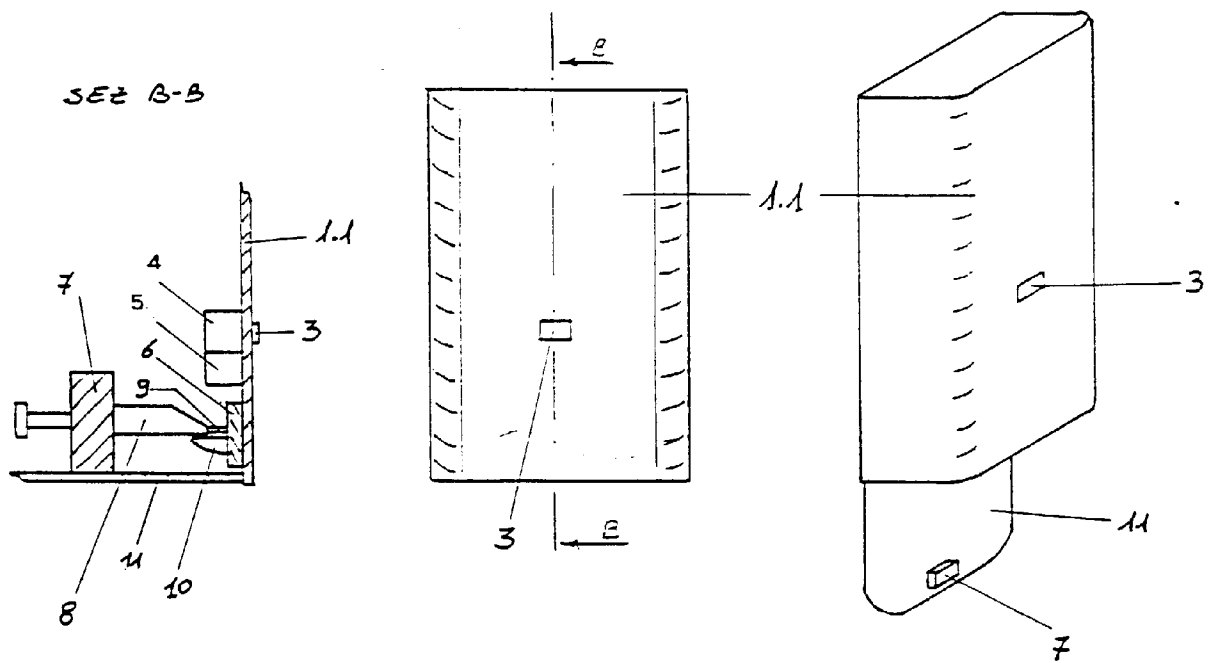
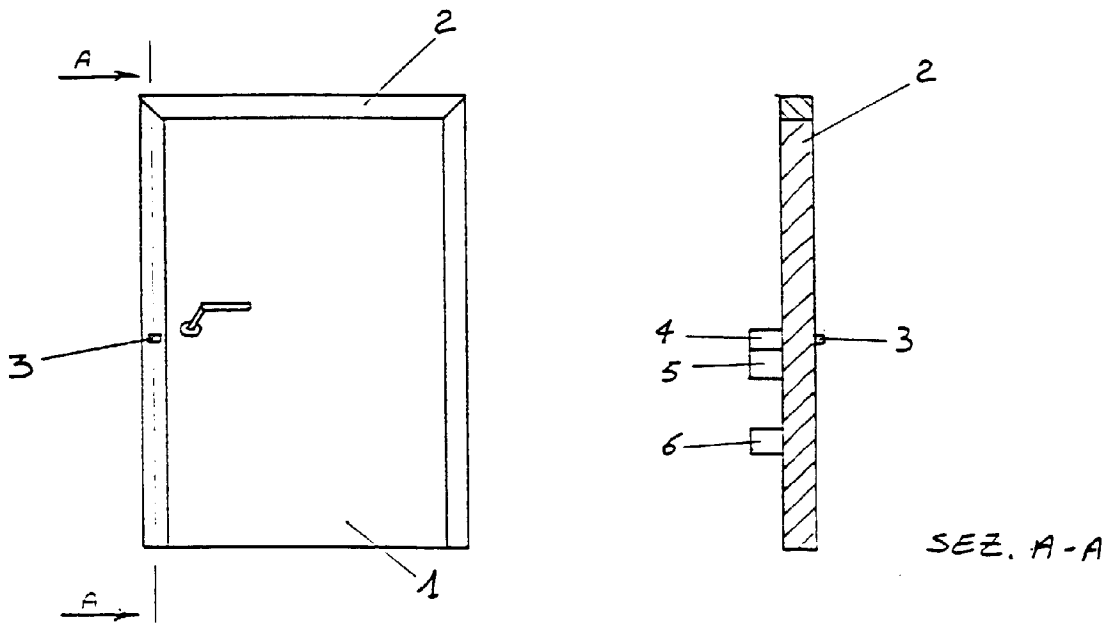
17. Improvements on electronic lock systems according to the preceding claims, characterized in that, if the lock system is used for letter boxes, a letter counting device may be installed. 35

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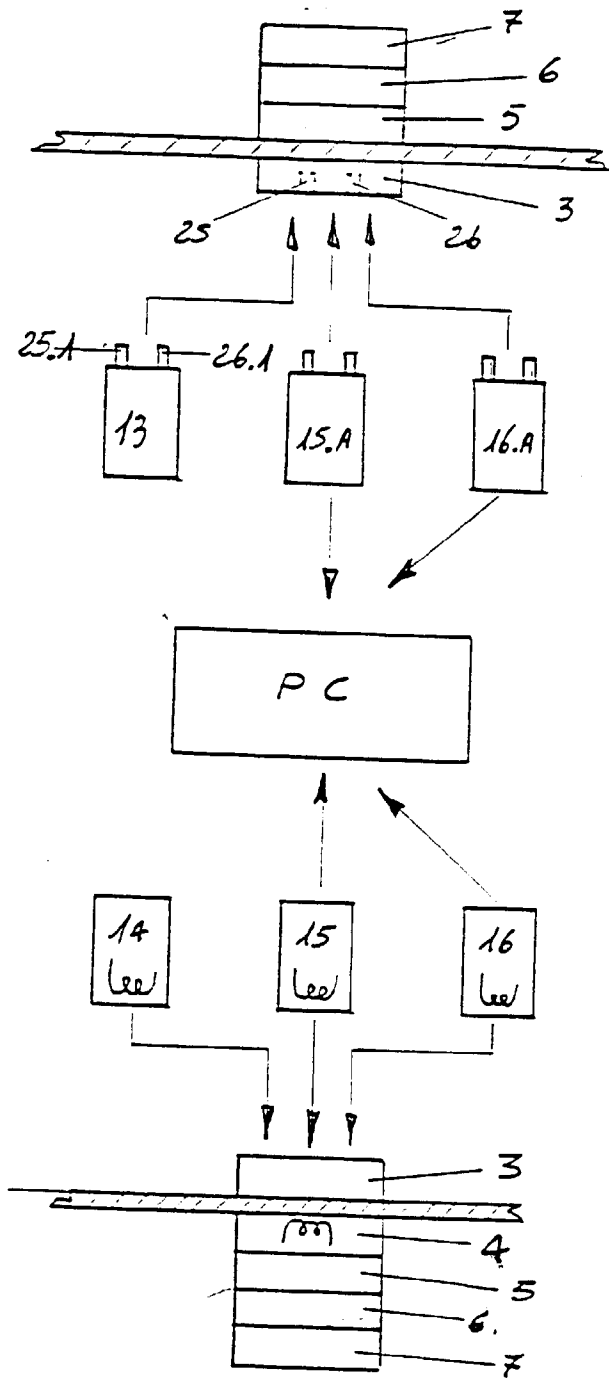


Fig. 4

Fig. 3

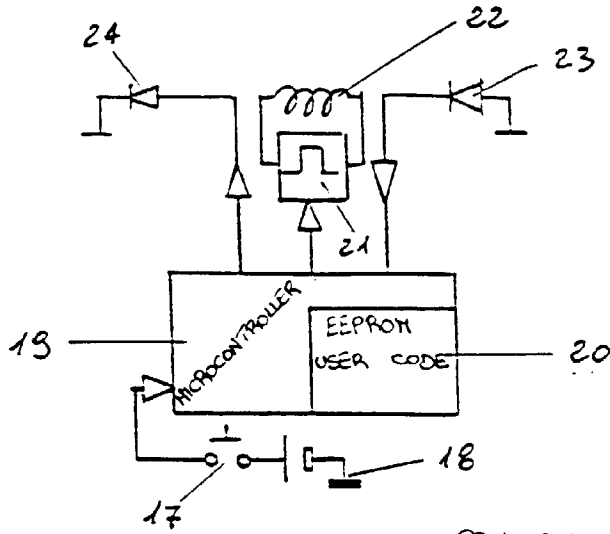


Fig. 5

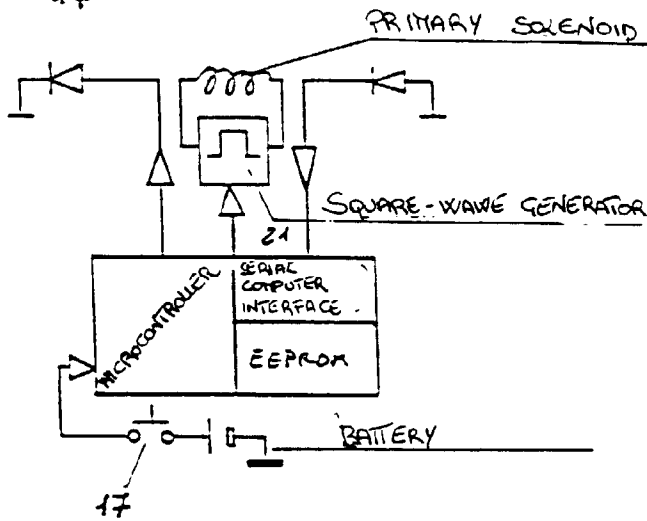


Fig. 6

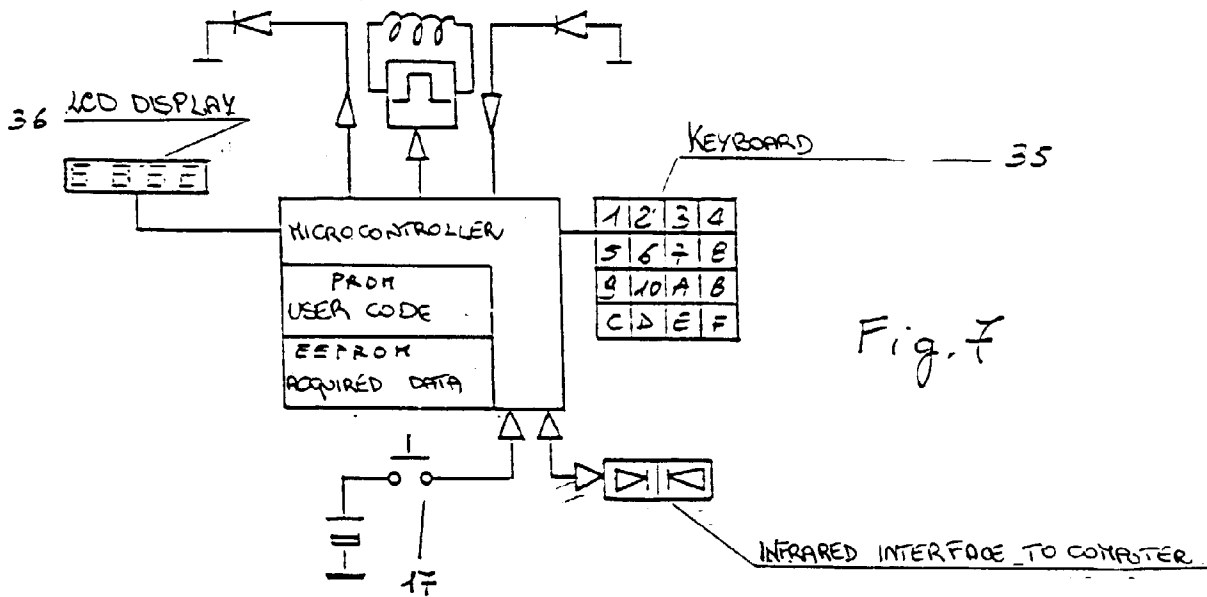


Fig. 7

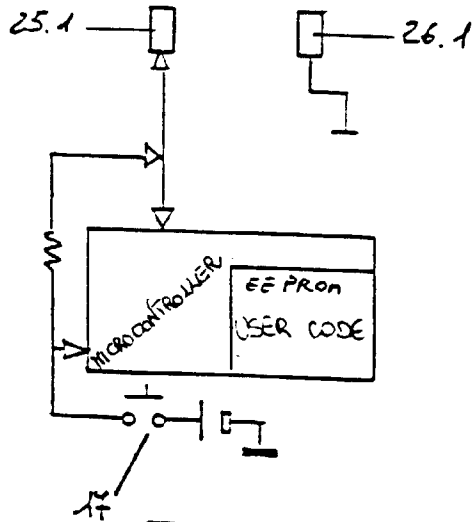


Fig. 8

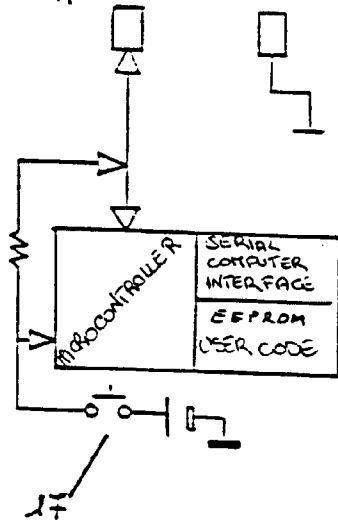


Fig. 9

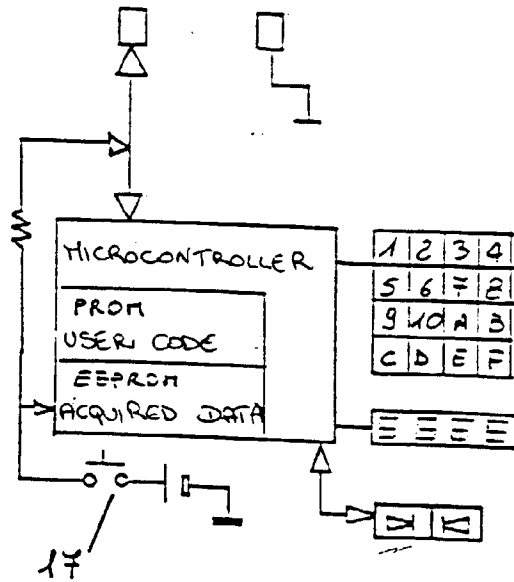
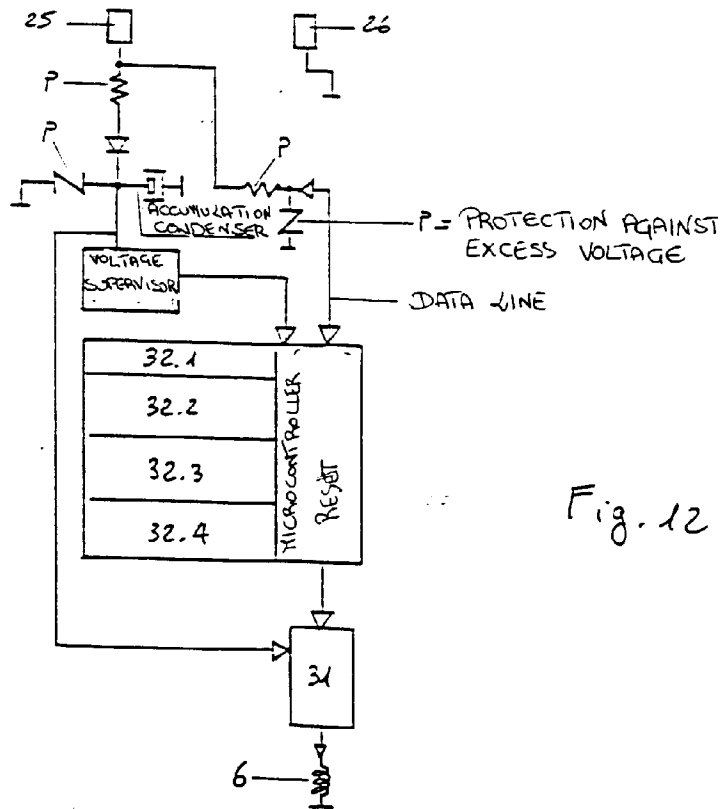
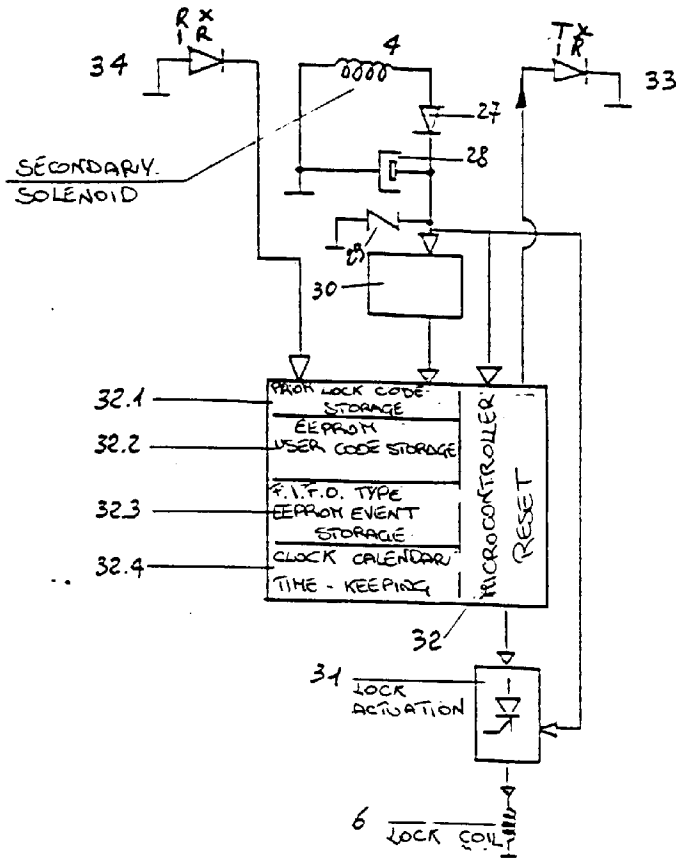


Fig. 10



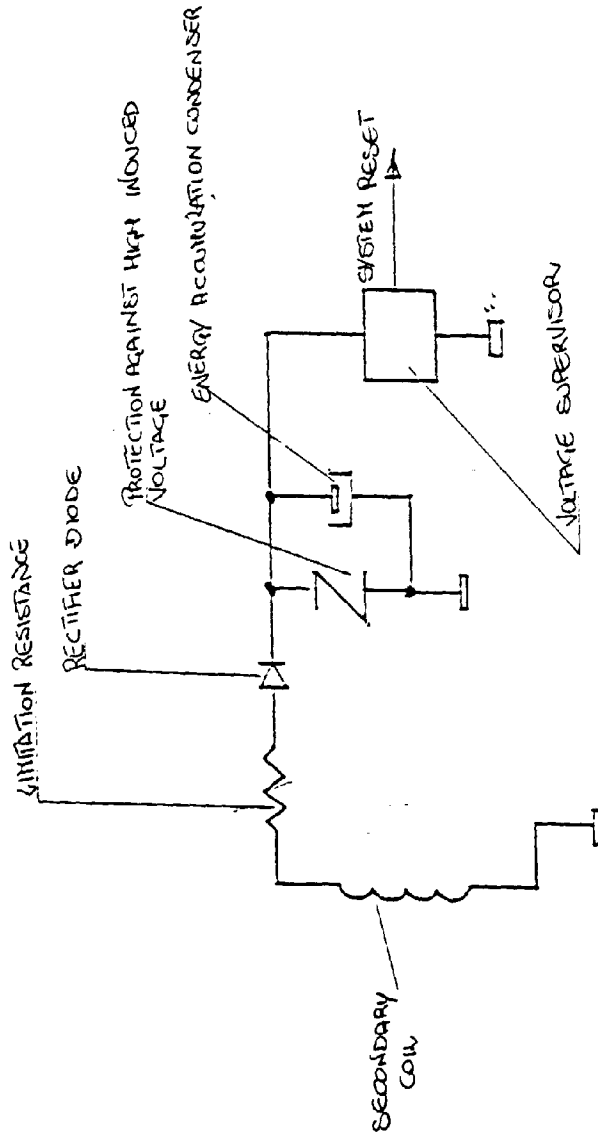
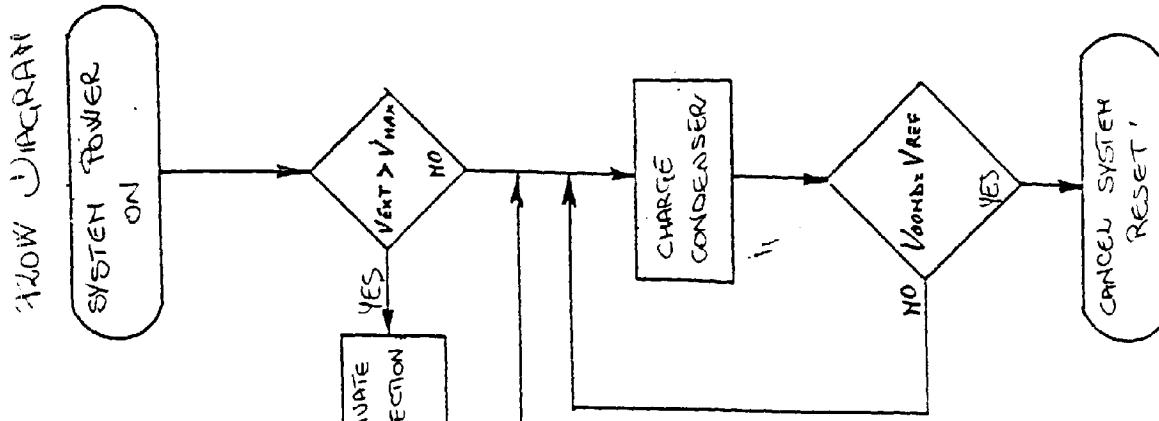


Fig. 13

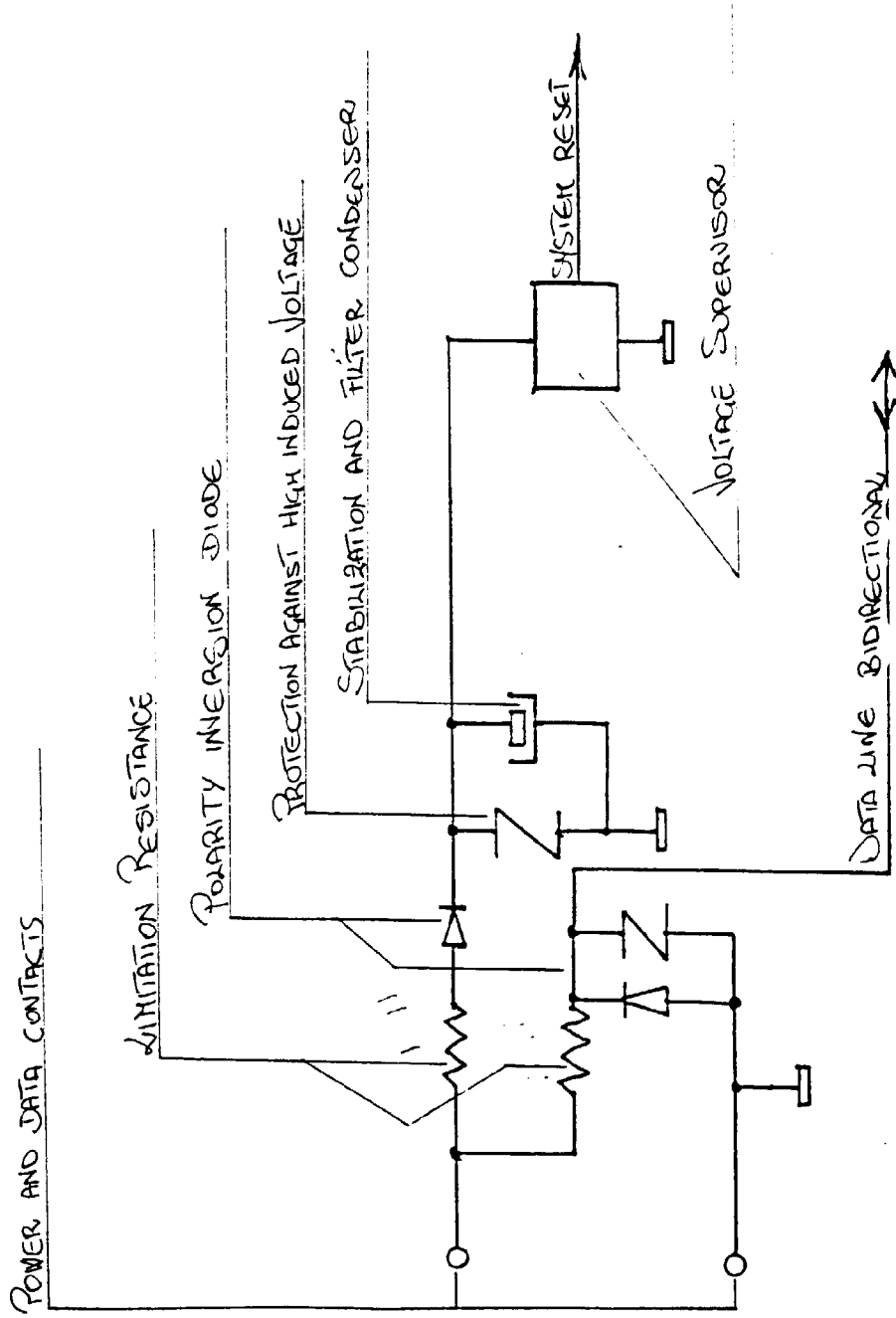


Fig. 14

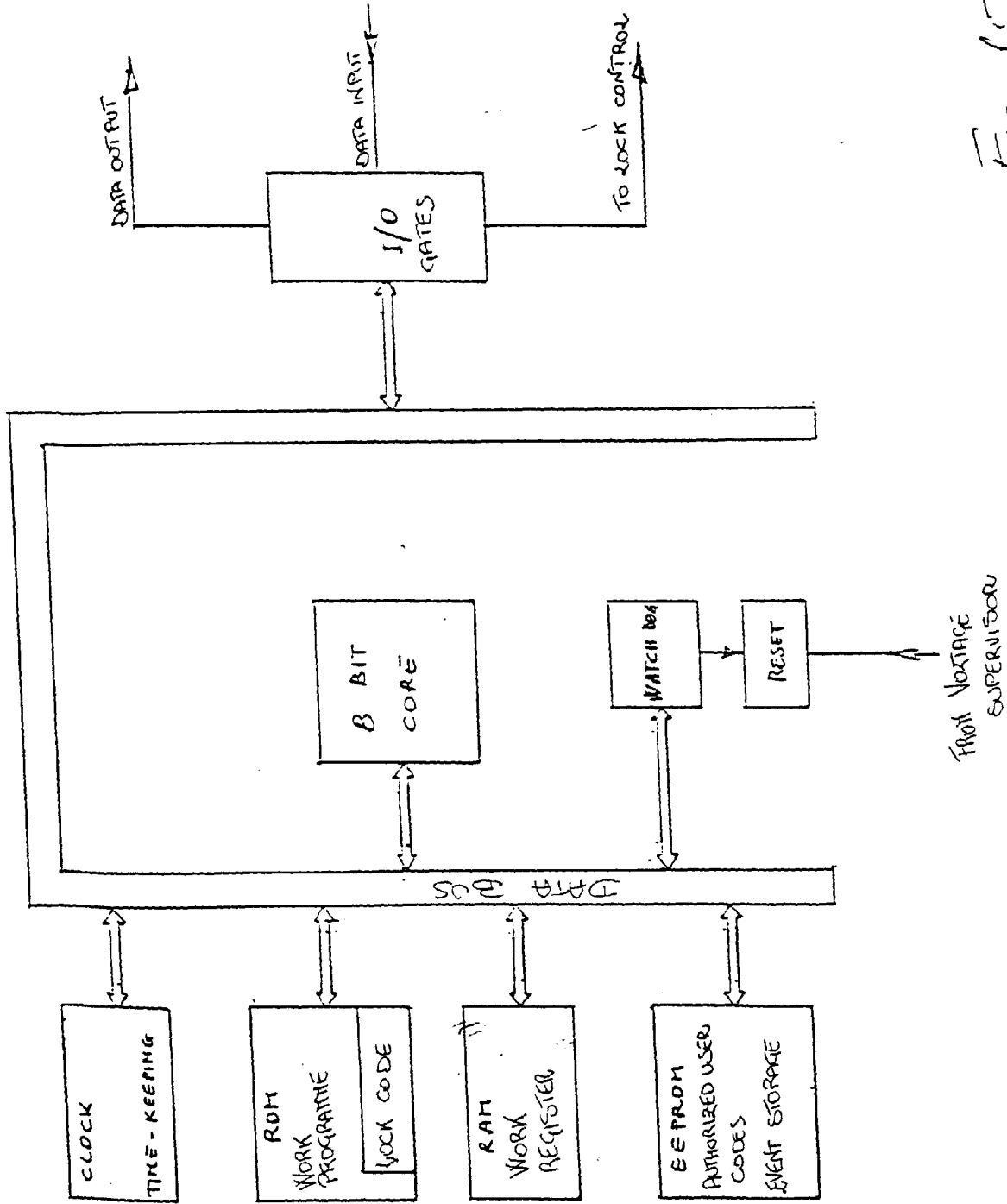


Fig. 15

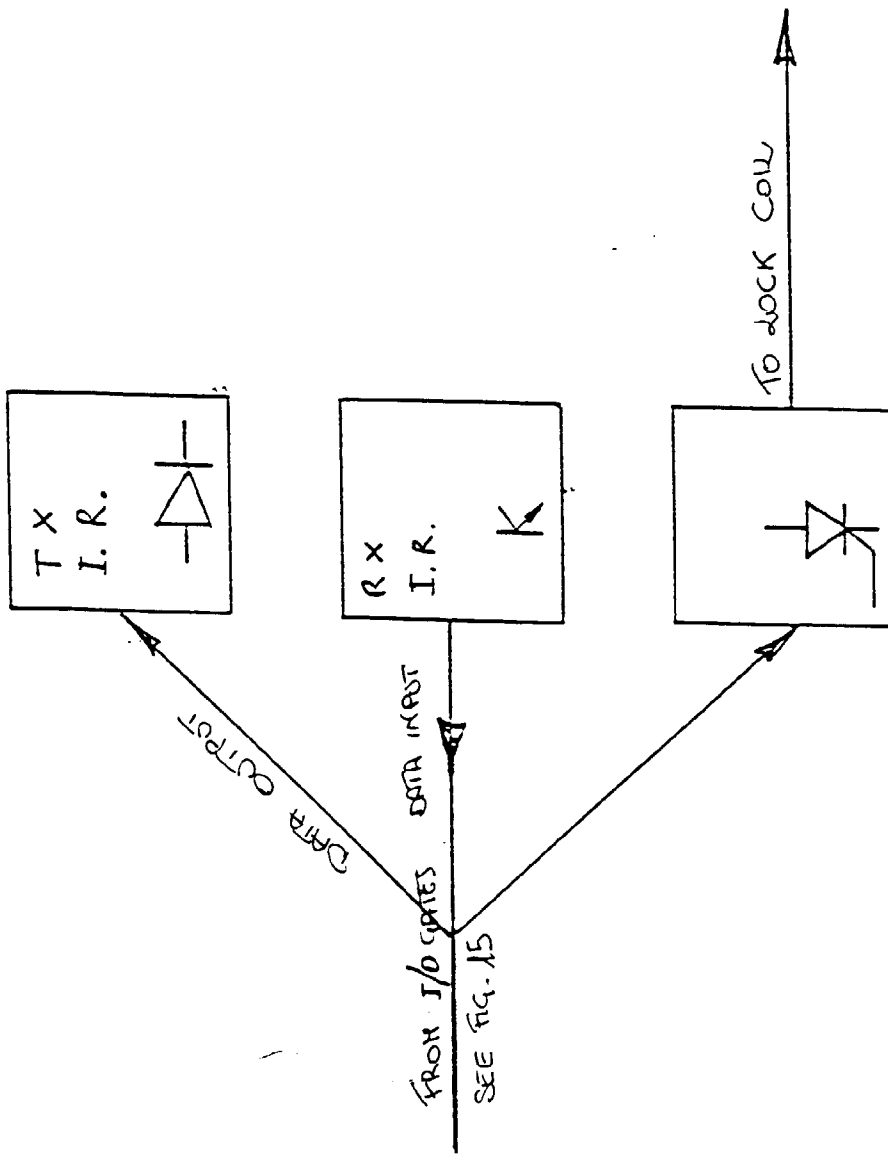


Fig. 16

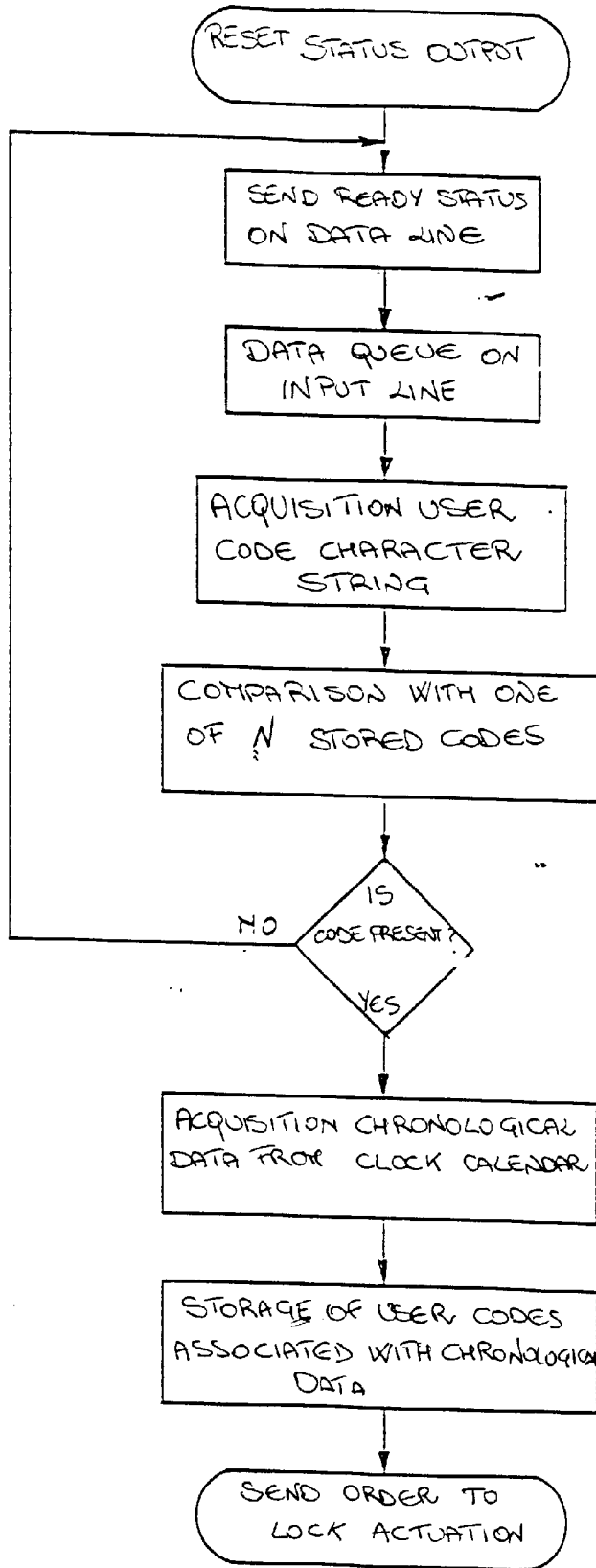


Fig. 17

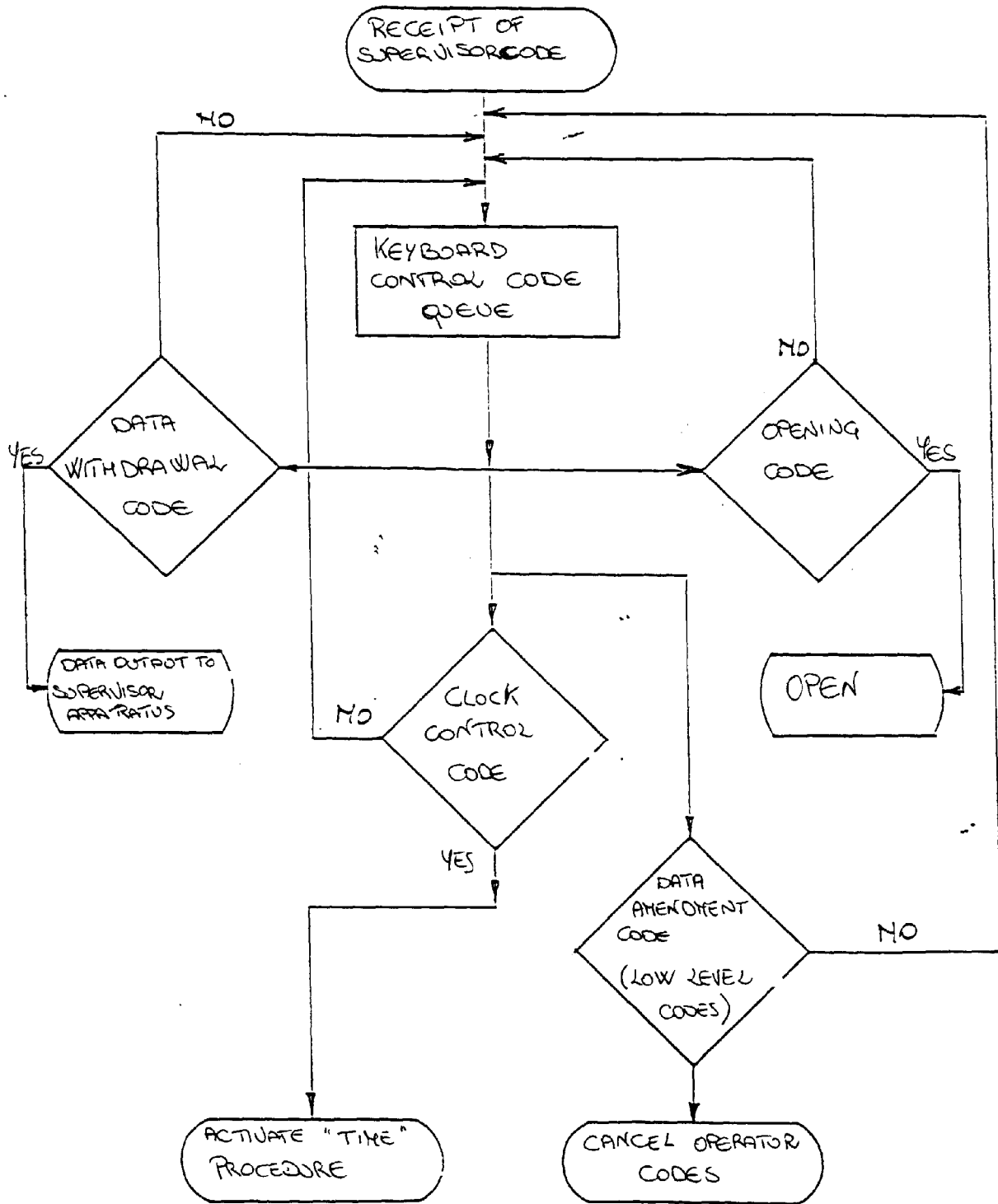


Fig. 18

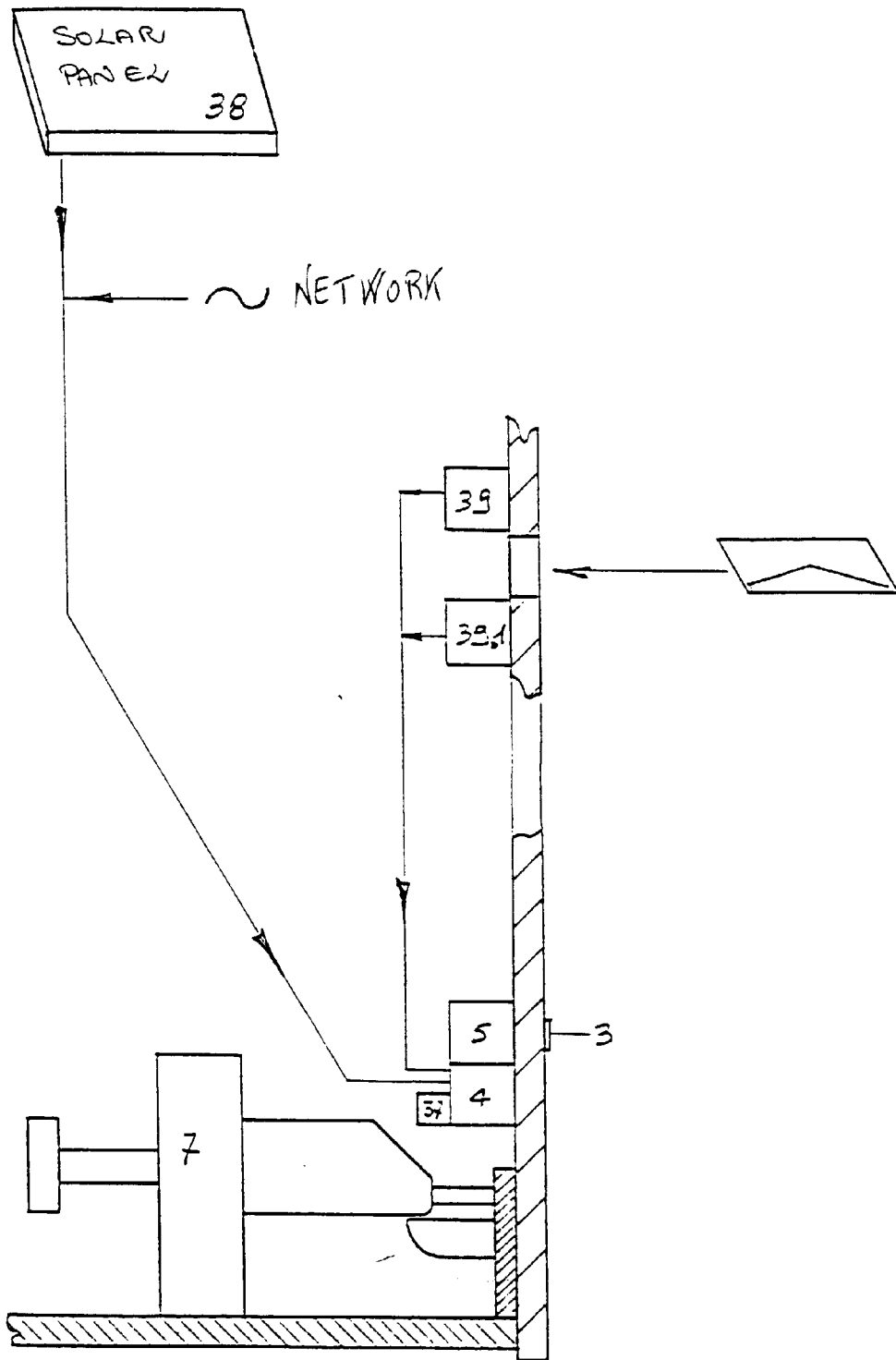


Fig. 19



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 83 0627

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)
A	WO 87 04482 A (BLOCH,HASKELL) * page 4, line 12 - page 7, line 8; figures 1-5 * ----	1,2,5,7, 11,16	E05B49/00
A	US 4 831 374 A (MASEL) * column 4, line 63 - column 5, line 10; figure 1 * ----	1,6,15	
A	WO 95 11498 A (NYFELT) * page 2, line 5 - page 3, line 34; figure 1 * ----	8-10,15	
A	US 4 148 092 A (MARTIN) * column 12, line 10 - line 43; figure 4 * ----	1-3, 8-10,12, 15	
A	US 4 829 296 A (CLARK,WINCH) * column 2, line 23 - column 3, line 27; figure 1 * -----	1,2,9,14	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			E05B
Place of search	Date of completion of the search	Examiner	
THE HAGUE	2 March 1998	Herbelet, J.C.	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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