(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 395 596 A2**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: **90830168.2**

(51) Int. Cl.5: **E05B 49/00, B60R 25/00**

(22) Date of filing: **17.04.90**

(30) Priority: **28.04.89 IT 6731589**

(43) Date of publication of application:
**31.10.90 Bulletin 90/44**

(84) Designated Contracting States:
**AT BE CH DE ES FR GB GR IT LI LU NL SE**

(71) Applicant: **AUTONIX S.R.L.**
***Via Don Caustico* 123**
**I-10095 Grugliasco (Torino)(IT)**

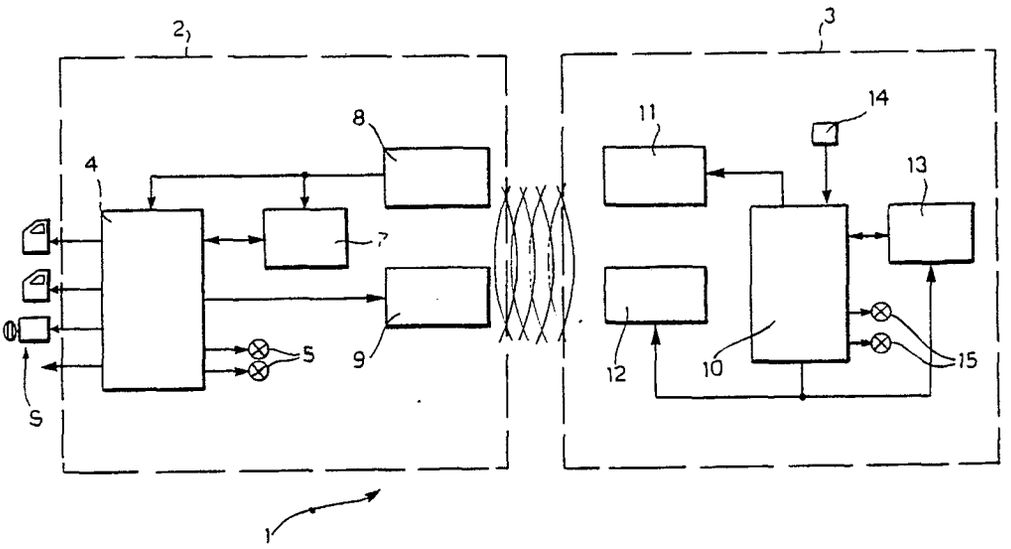
(72) Inventor: **Bianco, Luigi**
**Corso Monte Cucco,, 76/1**
**I-10141 Torino(IT)**

(74) Representative: **Bosotti, Luciano et al**
**c/o Jacobacci-Casetta & Perani S.p.A. Via Alfieri, 17**
**I-10121 Torino(IT)**

## (54) An improved anti-theft system, particularly for motor vehicles.

(57) The improvements relate to:
- the provision of a transmitter (9) in the unit (2) installed in the vehicle for sending to the control unit (3) carried by the user a signal which confirms the activation of the system and can be stored by the control unit (3);
- the alternating use of two different messages for activating and deactivating the system so that any recording of the activation message by a third party with a view to its possible use as a deactivation message is rendered useless, and
- the temporary shut-down of the activated system upon receipt of successive different messages approximating to the valid deactivation message so as to prevent its possible deactivation.

FIG. 1




EP 0 395 596 A2

# An improved anti-theft system, particularly for motor vehicles

The present invention relates in general to anti-theft systems and has been developed with particular attention to its possible use in anti-theft systems for motor vehicles.

In general terms, the present invention is for use in an anti-theft system including a main unit for installation in a motor vehicle to control the anti-theft functions (the locking of the doors, the switching off of the ignition or the fuel supply, the switching on of audible and/or optical warning devices, etc.) and a mobile or control unit which enables the owner to activate and deactivate the anti-theft functions remotely.

According to solutions widely known in the art, the control unit communicates with the main unit by the emission of coded messages on radio-frequency, optical (infrared) or even ultrasound carriers. There is usually no provision for the transmission of similar acknowledging messages from the main unit to the control unit: in fact, the emission of acoustic or optical messages by the motor vehicle (typically a "flash" of the headlights and/or a short audible message) are preferably used for this purpose.

Recently, the need has been felt, particularly for insurance purposes, to demonstrate that, in the event of a theft, the protection system was effectively activated when the thief took the vehicle.

Another requirement is to frustrate attempted thefts carried out by recording the message used for communication from the control unit to the main unit. It is actually possible, particularly for someone carrying out systematic thefts of motor vehicles, to obtain receiving and recording means which can detect the messages in question (for example, by being positioned near a car park) and record them for subsequent use for deactivating the anti-theft system and stealing the vehicle.

Moreover, it is possible for organisations devoted to the theft of motor vehicles to provide themselves with so-called scanners, that is, devices which can generate in quick succession a very large number of messages with different contents in the formats accepted by commercial anti-theft devices.

These scanning devices can thus very quickly explore all the possible combinations of a particular anti-theft system, so as to identify the message which deactivates the anti-theft system of a motor vehicle which is to be stolen.

Thus, there is a need to provide anti-theft systems which can detect an attempted theft carried out by means of a scanner so as to render such devices useless.

The object of the present invention is to provide an anti-theft system which satisfies all the requirements mentioned above perfectly.

According to the present invention, this object is achieved by virtue of an anti-theft system having the characteristics recited specifically in the claims which follow.

In summary, the system according to the invention provides for at least one of the following measures:

- the main unit is provided with a transmitter which can send the control unit a suitable message confirming the fact that the anti-theft system has been activated; this confirmation message is recorded in a memory in the control unit: this is a non-volatile memory (typically an EEPROM) produced by the manufacturer of the system in such a way that its state cannot be modified by the user acting only on the control unit; confirmation of the fact that the anti-theft system has been activated is therefore securely recorded in this memory whose contents can easily be displayed, for example, by means of an LED; if the vehicle is stolen, the owner can then demonstrate to his insurance company that the theft was perpetrated with the anti-theft system activated;
- the control unit and the main unit use at least two different messages alternately for their intercommunication: the control unit sends the main unit a first message which activates the anti-theft system and sets it so that it can be deactivated only as result of the receipt of a second predetermined message which, together with the first, is characteristic of the main unit-control unit pair in question; anyone who has surreptitiously recorded the first activation message cannot therefore make use of it to deactivate the anti-theft system since deactivation can only be achieved by the transmission of the second message which was not emitted when the system was activated;
- the main unit is sensitive not only to the prearranged message or messages for its deactivation, but also to messages within a given tolerance band (for example, differing by only 5 bits or less); in particular, the main unit is sensitive to the receipt, in succession and within a short period of time, of two or more such messages which are different from each other, this being indicative of the fact that someone is trying to find the combination of the system with the use of a scanner: in these circumstances, the system shuts itself down for a given period of time (for example, 30 seconds) so as to be resistant to any message received from outside; theft by means of a scanner is thus rendered impossible whilst the use of the system by the owner of the motor vehicle is not prejudiced.

The invention will now be described, purely by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 shows the structure of an anti-theft system according to the invention in the form of a block diagram, and

Figure 2 shows, in its various parts, a possible flow chart for controlling the operation of a system according to the invention.

In Figure 1, an anti-theft system for motor vehicles is generally indicated 1.

According to a widely-known solution, the system is constituted essentially by two parts, that is:
- a main unit 2 for installation in the protected vehicle, and
- a control unit 3 to be carried by the owner of the motor vehicle for the remote activation and deactivation of the anti-theft system.

According to a known functional solution, the main unit 2 includes a processing module 4 (typically a microprocessor) which controls the anti-theft functions (the locking and unlocking of the door locks, the switching off of the ignition or the fuel injection, the switching on of any bells, etc.) generally indicated S. Any display or warning members 5 (an LED in the passenger compartment, the vehicle headlights, etc.) are associated with the module 4.

The processing module 4 is also associated with a memory unit 7 in which at least one message corresponding to the message used for the dialogue with the control unit 3 is recorded in the form of strings of binary numbers. As will be made clearer below, at least two different binary messages are preferably stored in the memory 7 for use alternately.

The processing module 4 also has an input connected to a receiver 8 for receiving the messages transmitted by the control unit 3 and an output connected to a transmitter 9 for sending respective messages to the control unit 3, according to criteria which will be explained further below.

In the preferred embodiment of the invention, the receiver 8 and the transmitter 9 operate at radio frequency (UHF) using a binary code of the "on-off" type, usually comprising 24 bits plus an 8-bit introduction for synchronisation and a 6-bit check (check sum).

Naturally, it is also possible to use transmitter-receiver pairs operating with optical carriers (infrared) or with ultrasound carriers. A hybrid form of communication is also possible with the use of different kinds of carriers for the two directions of transmission.

The above description is also substantially true of the control unit 3 which also includes a processing module 10 (typically a microporcessor) with an output connected to a transmitter 11 and an input connected to a receiver 12. The latter components naturally have characteristics complementary to those of the receiver 8 and the transmitter 9 of the main unit 2 so as to ensure two-way communication.

The processing module 10 is also associated with a respective memory 13 and at least one activation button 14. The latter is used to activate and deactivate the system. One or more display units 15 (typically LEDs) are also provided for giving the owner carrying the control unit 3 an indication of the state of the system.

The memory 13 is preferably constituted by an EEPROM-type unit, that is, a non-volatile memory formed so that it cannot be manipulated directly by anyone carrying the control unit 3 unless the unit 3 itself is broken into (which is immediately recognisable).

At least two messages are preferably stored in the memory 13, as in the memory 7 of the main unit 2, for use alternately for communication with the main unit 2.

The operation of the system according to the invention is described with reference to the flow chart of Figure 2 and it is assumed that one starts (by means of a starting step 100 and a selection step 101 whose function will be explained below) from an initial condition in which the anti-theft system is deactivated whilst the driver parks the motor vehicle and prepares to activate the system.

For this purpose, he pushes the activation button 14 of the control unit 3. The latter distinguishes, in a step 102, whether the system is activated or not and, having recognised that it is initiallly deactivated, arranges for the transmitter to emit (step 103) one of the two messages recorded in the memory 13 (the first message).

This message is received and recognised by the receiver 8 (step 104) which transfers it to the processing module 4, and this in turn carries out several substantially simultaneous operations:
- the recognition of the code received as the activation code (step 105),
- the activation of the anti-theft system with the emission (according to known criteria) of respective control signals to the unit S,
- the switching of the main unit 2 to the second message stored in the memories 7 and 13 so that the main unit 2 is arranged to deactivate the anti-theft system (unit S) only after receipt of the second message, and
- the deactivation of the transmitter 9 with the emission of a confirmation message (constituted by the first message or by a suitable message different from the two messages stored in the memories 7 and 13) to the control unit 3 (step 106).

The confirmation message is received and recognised by the receiver 12 (step 107) which trans-

fers it to the processing module 10. The latter in turn causes the switching of the control unit 3 to the second message so that it is set to emit the second message when the button 14 is operated subsequently, the recording of the receipt of the confirmation message (or the equivalent setting to operate with the second message) in the memory 13, preferably with a corresponding display on one of the LEDs 15 (step 108), and the subsequent switching off of the supply to the control unit (step 109).

At this point, the memory 13 acts as a witness of the fact that the anti-theft system has been activated. If the motor vehicle with the main unit 2 installed therein is stolen, the owner can at any rate demonstrate that the theft was perpetrated with the anti-theft system activated (the motor vehicle as whole being taken).

The control unit 3 is also arranged to wait a certain period of time (e.g. 1-5 seconds) for the response of the main unit 2 (this is achieved by making the unit 3 cycle through a selection stage 110 when the outcome of the reception test of step 107 is negative) and then to go directly to the switching-off step 109 (without carrying out the confirmation functions of step 108) when a confirmation message has not been received.

Someone who has recorded the message emitted by the transmitter 11 when the system was activated (that is, the first message), however, will not be able to deactivate the system. In fact, this can only be achieved by the emission by the control unit of the second message which is recorded in the memories 7, 13 and is characteristic of the pair of units 2, 3 in question, and the receipt thereof by the main unit 2. This message is not available and cannot be recorded since it is not emitted when the system is activated.

The system can be deactivated only by the owner pushing the button 14 of the control unit 3 so as to cause (step 111) the emission of the second message. This message is received and recognised by the main unit 2 (step 112) with the consequent deactivation of the system, together with the switching of the modules 4 and 10 back to the state in which they are set to operate with the first message and the cancellation of the information relating the activation of the system in the witness memory 13 (step 113).

By way of further security, the main unit 2, and particularly the functions of the processing module 4 which interfaces with the receiver 8,is formed so as to be sensitive not only to the prescribed deactivation message or messages, but also to messages quite close to them, for example, messages which differ by 5 bits or less.

The receipt of a "close" message is detected (step 114) and stored in a memory of the module 4.

If, within a certain period of time (for example, 1-5 seconds - test 115 negative), no other "close" message is received, or the same message is received repeatedly, the module 4 takes no action.

In fact, this is a situation which arises when, quite by chance, the vehicle in which the system is installed is near a vehicle with a similar anti-theft system which has a similar combination and is being activated or deactivated by its owner at the time.

However, the situation is different when, having received a first message close to the combination, the main unit 2 detects the emission of another message which is also close to its own combination but different from the message received previously (test 115 positive).

Since it is highly improbable that two other vehicles with anti-theft systems having very similar combinations are in the vicinity at the time, this situation represents a clear indication that a theft is being attempted by means of a scanner. The indication becomes even clearer if a third message similar to the combination and different from the first two messages is received.

When at least two different close messages have been received in sequence, the processing module 4 shuts down the main unit 2 (step 116), that is, it makes it insensitive to all messages received from the outside for a predetermined period of time, for example 30 seconds.

A theft attempted by means of a scanner is thus safely prevented: the power of a scanner actually lies in its ability to explore a large number of different possible combinations quickly in sequence and the shutting down of the system for at least 30 seconds makes this solution impracticable.

At the same time, the temporary shut-down does not cause any inconvenience to the legitimate owner, even if (which is extremely improbable, as has been seen) the receipt of two different close messages in sequence results from the chance presence in the vicinity of two or more anti-theft systems with very similar combinations.

The selection stage 101 at the beginning of the flow chart of Figure 2 enables a single component (microprocessor) to be used for both the module 4 of the control unit and the module 10 of the main unit in the system according to the invention. When this component is activated, the step 101 enables it to recognise which of the two different functions has been assigned to it.

## Claims

1. An anti-theft system comprising a main unit (2) which is provided with receiver means (8) and

is intended to be associated with means (S) for protecting an object, and which is switchable selectively between a state in which the protection means (S) are activated and a state in which they are deactivated, and a control unit (3) provided with transmitter means (11) which can be activated selectively (14) to send to the receiver means (8) of the main unit (2) respective coded messages for switching the main unit (2) between the activated state and the deactivated state,
characterised in that it includes:
- further transmitter means (9) associated with the main unit (2) for sending the control unit (3) at least one message confirming that the main unit (2) has switched to the state in which the protection means (S) are activated,
- further receiver means (12) associated with the control unit (3) for receiving the at least one confirmation message, and
- non-volatile memory means (13) associated with the control unit (3) and connected to the further receiver means (12) for storing the confirmation message.

2. A system according to Claim 1, characterised in that the memory means (13) associated with the control unit (3) are constituted by an EEPROM.

3. A system according to Claim 1 or Claim 2, characterised in that the memory means (13) associated with the control unit (3) are resistant to any operation carried out exclusively on the control unit (3).

4. A system according to any one of Claims 1 to 3, characterised in that the memory means (13) associated with the control unit (3) have associated indicator means (15) for showing externally that the confirmation message has been received and stored.

5. An anti-theft system comprising a main unit (2) which is provided with receiver means (8) and is intended to be associated with means (S) for protecting an object, and which is switchable selectively between a state in which the protection means (S) are activated and a state in which they are deactivated, and a control unit (3) provided with transmitter means (11) which can be activated selectively (14) to send the receiver means (8) of the main unit (2) respective coded messages for switching the main unit (2) between the activated state and the deactivated state,
characterised in that the transmitter (11) and receiver means (8) of the main unit (2) and of the control unit (3) are arranged to operate in an alternating sequence with at least one first coded message and one second coded message which are different from each other so that, once the main unit (2) has been switched to the activated state by means of a said first coded message emitted by the control unit (3), the main unit (2) can only subsequently be switched to the deactived state as a result of the emission of the second coded message by the control unit (3).

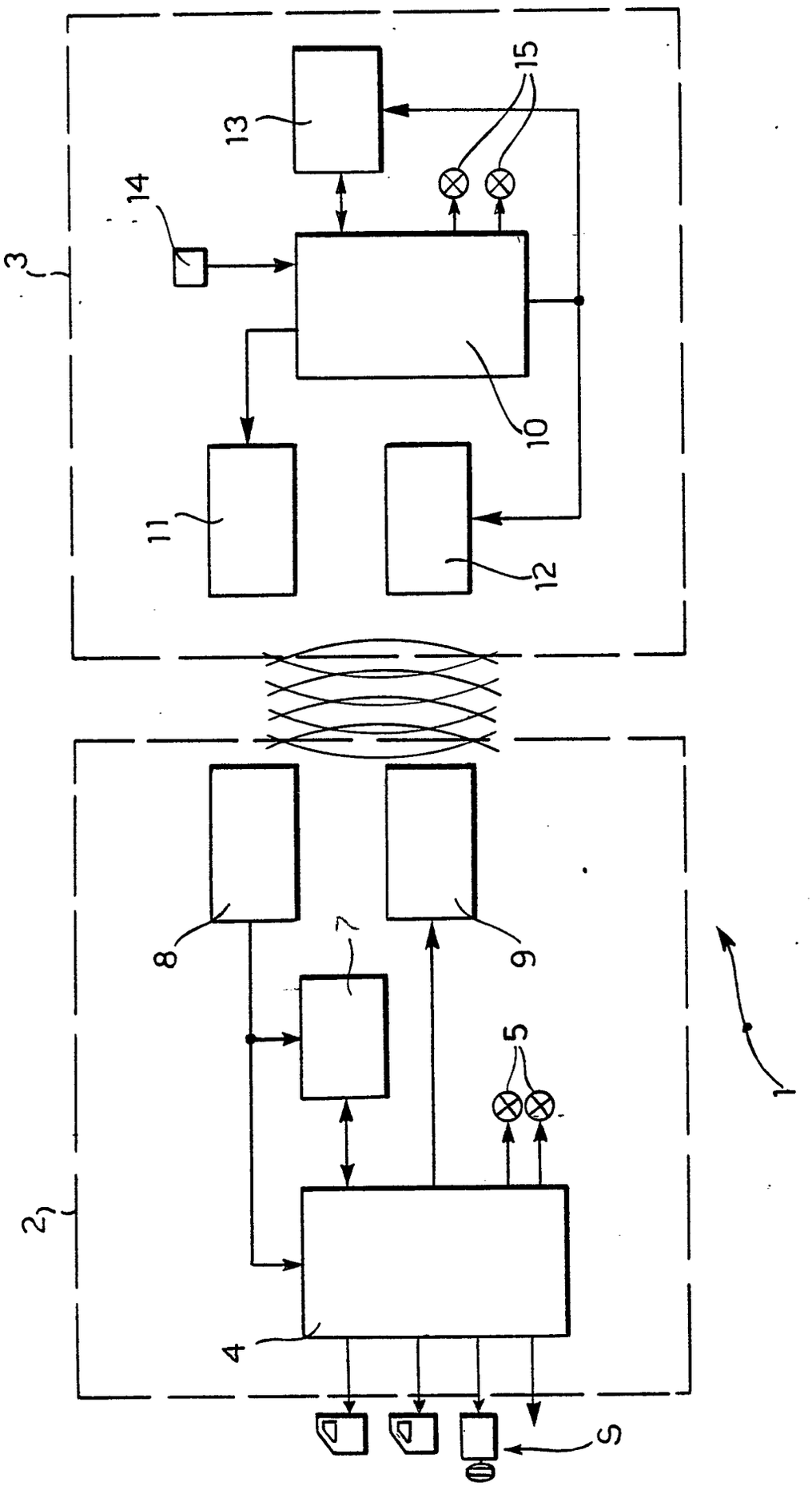
6. A system according to Claim 5, characterised in that the first and second coded messages are logic messages consisting of binary symbols.

7. An anti-theft system including a main unit (2) which is provided with receiver means (8) and is intended to be associated with means (S) for protecting an object, and which is switchable selectively between a state in which the protection means (S) are activated and a state in which they are deactivated, and a control unit (3) provided with transmitter means (11) which can be activated selectively (14) to send to the receiver means (8) of the main unit (2) respective coded messages for switching the main unit (2) between the activated state and the deactivated state,
characterised in that, as well as being sensitive to at least one coded message which can cause it to switch from the activated state to the deactivated state, the main unit (2) is also sensitive to a group of similar coded messages, and in that the main unit (2) is arranged to become resistant to any message for a predetermined period of time as a result of the receipt of at least two different coded messages from the group in sequence.

8. A system according to Claim 7, characterised in that the coded messages are constituted by strings of binary symbols, and in that the group includes coded messages which differ from the coded message which can cause the switching from the activated state to the deactivated state by a predetermined number of binary symols.

9. A system according to Claim 8, characterised in that the predetermined number selected is five.

FIG. 1



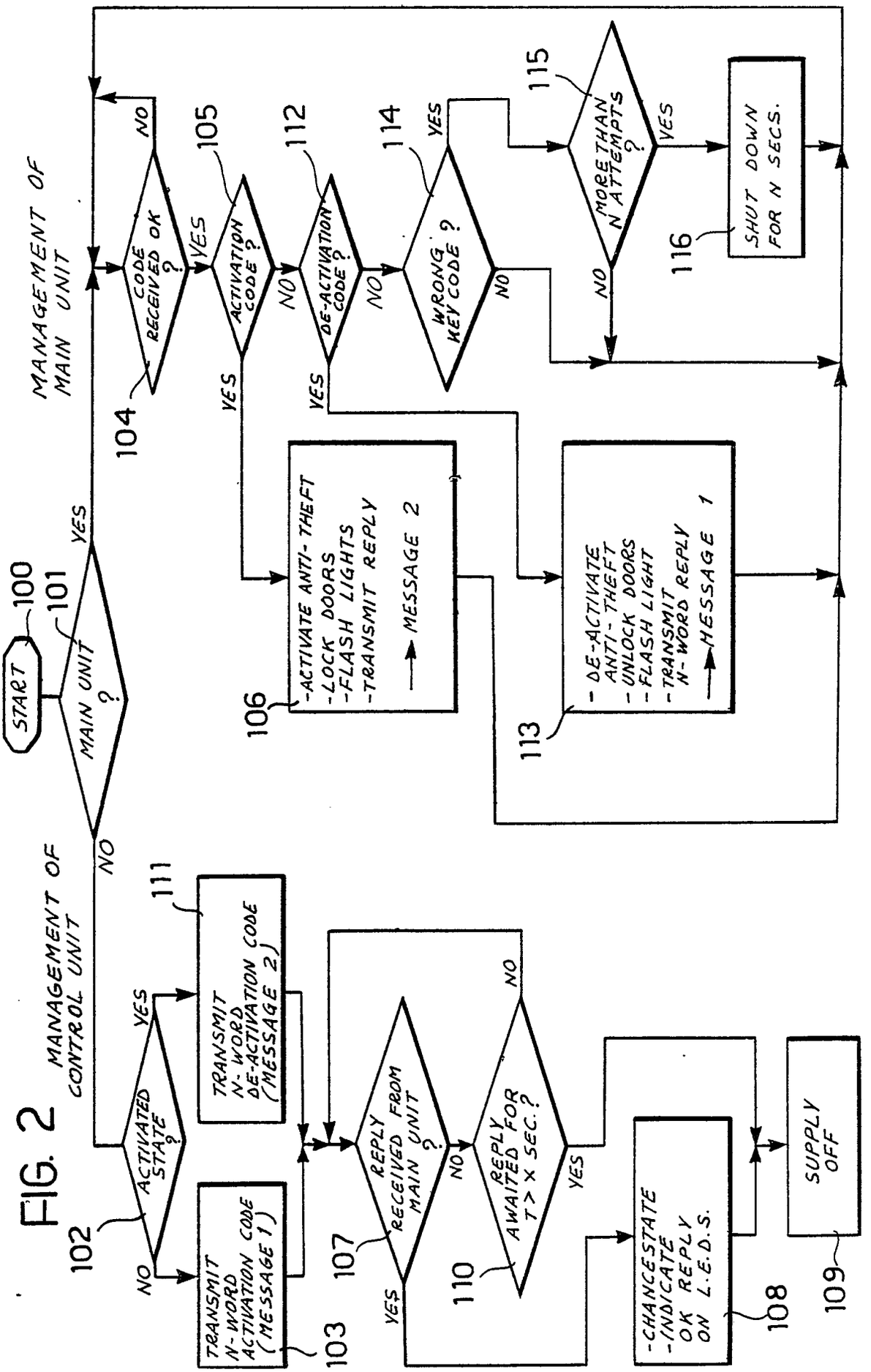

START
100
MAIN UNIT ?
101
YES
NO
MANAGEMENT OF MAIN UNIT
CODE RECEIVED OK ?
104
NO
YES
105
ACTIVATION CODE ?
112
DE-ACTIVATION CODE ?
114
WRONG KEY CODE ?
115
MORE THAN N ATTEMPTS ?
116
SHUT DOWN FOR N SECS.
-ACTIVATE ANTI-THEFT
-LOCK DOORS
-FLASH LIGHTS
-TRANSMIT REPLY
→ MESSAGE 2
106
- DE-ACTIVATE ANTI-THEFT
- UNLOCK DOORS
- FLASH LIGHT
- TRANSMIT N-WORD REPLY
→ MESSAGE 1
113
MANAGEMENT OF CONTROL UNIT
ACTIVATED STATE ?
102
TRANSMIT N-WORD ACTIVATION CODE (MESSAGE 1)
103
TRANSMIT N-WORD DE-ACTIVATION CODE (MESSAGE 2)
111
REPLY RECEIVED FROM MAIN UNIT ?
107
AWAITED REPLY FOR T > X SEC.?
110
-CHANGE STATE
-INDICATE OK REPLY ON L.E.D.S.
108
SUPPLY OFF
109

FIG. 2