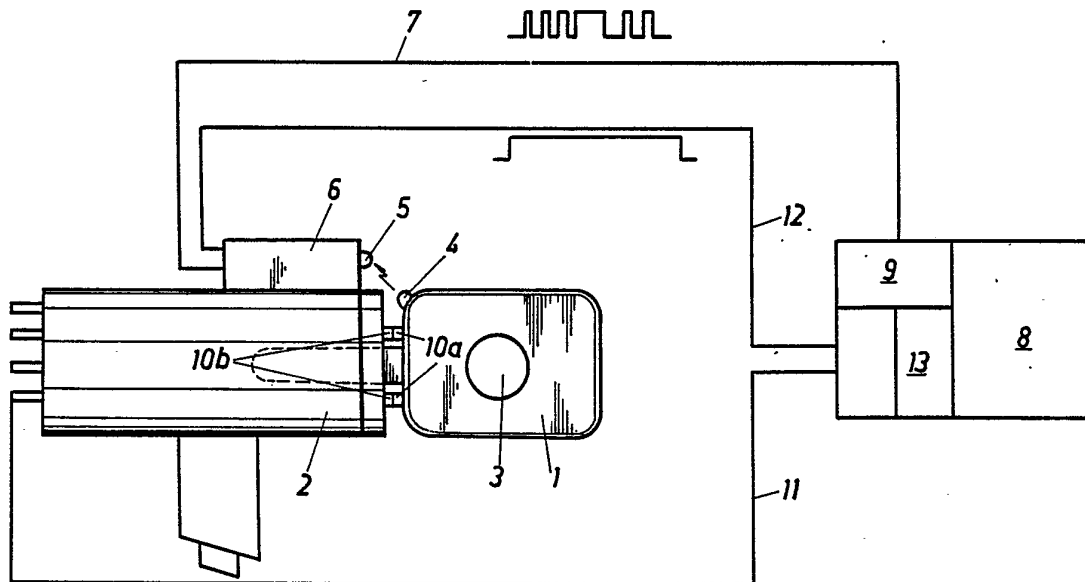




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/SE86/00316 <b>(22) International Filing Date:</b> 27 June 1986 (27.06.86)  <b>(31) Priority Application Number:</b> 8503257-1 <b>(32) Priority Date:</b> 1 July 1985 (01.07.85) <b>(33) Priority Country:</b> SE  <b>(71) Applicant (for all designated States except US):</b> AB VOLVO [SE/SE]; S-405 08 Göteborg (SE).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only) :</b> HAGBERG, Anders, Peter, Gösta [SE/SE]; Klarinettvägen, S-434 00 Kungsbacka (SE). KNUTSSON, Evan, Albert [SE/SE]; Dr Forselius gata 58, S-413 26 Göteborg (SE). NYSTRÖM, Mats, Olof, Gunnar [SE/SE]; Studiegången 10-113, S-416 81 Göteborg (SE).	<b>(74) Agents:</b> RYRLÉN, E. et al.; Alföns Hedbergs Patentbyrå AB, Aschebergsgatan 35, S-411 33 Göteborg (SE).  <b>(81) Designated States:</b> DE (European patent), FR (European patent); GB (European patent), IT (European patent), JP, US.  <b>Published</b> <i>With international search report.</i>	

**(54) Title:** ELECTRONIC LOCKING SYSTEM**(57) Abstract**

An electronic locking system including a conventional mechanical lock (2) and a key (1) associated therewith, said key having a built-in code transmitter (3). A receiver, preferably an infrared sensitive photo-detector (5) cooperates with the code transmitter (3). The receiver is connected to an electronic unit (8) which is arranged to register a coded signal emitted from the key (1) and transmitted via the receiver (5). When the signal is acceptable the electronic unit (8) is activated. The electronic unit (8) is provided with a memory element (13). When the latter is built into the electronic unit (8) it contains no information on any coded signal. After transmission of the coded signal of the associated key (1) the coded signal is stored permanently in the memory element (13), whereafter the electronic unit (8) will accept only precisely this coded signal in order to be activated.

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Electronic Locking System

The subject invention concerns an electronic locking system which is intended to serve as theft-protection.

5 In order to prevent unauthorized persons from gaining access to premises e.g. through a locked door increasingly ingenious mechanical locks have been devised which are considerably more difficult to force or pick than locks of earlier types.

10 In order to avoid the problem of having to create mechanical locks fitted with more and more sophisticated lock combinations, electronic locking devices have been developed in recent years. Such systems are intended for and are used particularly in motor cars and other vehicles. Motor cars present the problem of not only allowing unauthorized persons to gain access thereto comparatively easily, even when the car is fitted with very advanced door locks. In addition  
15 thereto, in most types of cars, the ignition lock, for which one and the same key is usually used to start the motor and to open the door lock, can as a rule be forced very easily by an unauthorized person, irrespective of the construction of the lock by simply shunt connecting the electric cables. In such cases, the problem therefore is not solved  
20 even when the lock is of a non-force type.

From DE Offenlegungsschrift 30 05 890 is known an electronic locking device which is intended to be used in motor cars. The key pertaining to the motor car ignition lock is provided with a transmitter which transmits a coded signal. In addition, the motor car is fitted  
25 with an electronic unit comprising a detector designed to receive the coded signal, a decoder means and an electronic coupling means which allows the motor to be started upon registration of an authorized or valid signal.

The subject invention concerns a further development of an  
30 electronic locking system of this general type. The system comprises an electronic unit of an initially general nature and a mechanical lock which may be used in the conventional manner until such a time when the user chooses to tie the electronic unit to a predetermined coded signal which may be transmitted from a transmitter means lodged in the key  
35 pertaining to the mechanical lock. This is achieved in accordance

with the teachings of the subject invention in that the electronic unit is provided with a memory element which initially lacks information on any coded signal and which is devised in such a manner that under pre-determined conditions after emission of the coded signal of the key be-  
5 longing to the lock said memory element stores the coded signal permanently and thereafter it accepts only this coded signal in order to activate the electronic unit.

The invention will be described in closer detail in the following with reference to the embodiments illustrated in the accompanying  
10 drawing.

The embodiment which is chosen to describe the invention is the ignition lock of a motor vehicle. Fig. 1 illustrates a key 1 fitting the locking cylinder 2 of the ignition lock. The key is provided with a built-in coded signal transmitter 3 and with an infrared-light emitting  
15 diode 4. On or adjacent the locking cylinder 2 are provided a receiver, a photo-detector 5, and connected to the latter a pre-amplifier 6. A wire 7 connects the pre-amplifier 6 with an electronic unit 8 which is intended to control the engine and which has a decoder 9 integrated therewith. The key 1 is provided with two electrodes 10a for connection  
20 to two slip ring contacts 10b on the ignition lock 2.

When the key 1 is inserted into the ignition lock 2 and is turned to igniting position battery voltage is supplied to the electronic unit 8 via a wire 11. This energizes the contacts 10b and via a wire 12 a request is made from the electronic unit 8 to the key 1 to transmit a  
25 number of coded signals. The code is transmitted from the light-emitting diode 4 in the form of infrared signals which are received by the photo detector 5 and after amplification in the pre-amplifier 6 these signals are transmitted via the wire 7 to the decoder 9 in the electronic unit 8. The coded signals of the key are compared with a key  
30 code which is stored in the memory element 13 in the electronic unit 8. Upon agreement between the code of the signal received and the stored code the electronic unit 8 is activated and the engine of the vehicle can be started. Upon lack of agreement, this is not possible.

In accordance with the invention the electronic unit 8 is  
35 provided with a memory element 13 of a particular kind. Initially, no

5 coded signal is stored in the memory. All electronic units 8 which are mounted in the motor vehicles therefore are absolutely identical originally and consequently the ignition locks may be used in the conventional manner when operated by means of their associated key. The electronic unit 8 is provided with a seal in the form of a yoke. When this yoke is in position the memory element 13 cannot be programmed and therefore there is no theft protection. As soon as the yoke is broken or cut off, the key code will be stored in the memory element 13 the next time thereafter that the vehicle is started.

10 Several advantages are gained by using such general electronic units. As a rule, the manufacture of the electronic units is not the same as the manufacturer of the ignition locks. Consequently, these components are delivered to the car plant from different suppliers. Usually, they are also mounted into the car at different assembly  
15 stations along the car assembly line. Storage of the electronic units also is facilitated because at this stage of the car production they are still universal and therefore not tied to an individual ignition lock.

20 A further advantage provided by the invention is that should the electronic unit 8 of the vehicle after a period of use not function for some reason it can quite simply be replaced by a fresh universal electronic unit and only after having been mounted in the vehicle need the replacement unit be tied to the code of the ignition key belonging to this vehicle.

25 Fig. 2 shows a modification of the embodiment of Fig. 1. The electrodes 10a, the slip ring contacts 10b and the wire 12 are omitted and instead a battery is built into the key 1. The battery supplies the electronic unit 8 with the current required to allow it to receive and register coded signals transmitted from the key 1.

30 The invention is not limited to use together with the ignition locks in motor vehicles. The electronic locking system could advantageously be used for the ignition locks of motor cycles, motor boats or utility machines and also for instance in premises in which the doors are controlled by electronic units.

C l a i m s

- 5 1. An electronic locking system comprising a conventional mechanical lock (2) and a key (1) associated therewith, a code transmitter (3) built into the key and a receiver (5, 6) cooperating with the code transmitter (3), said receiver being connected to an electronic unit (8) which is arranged to register a coded signal which is emitted from the key (1) and transmitted via the receiver (5) and which, upon agreement with an authorized signal, activates said electronic unit (8),  
10 c h a r a c t e r i z e d t h e r e i n t h a t t h e e l e c t r o n i c u n i t (8) is provided with a memory element (13) which initially lacks information on any coded signal and which is devised in such a manner that under predetermined conditions after emission of the coded signal of the key (1) belonging to the lock (2) said memory element stores said coded signal permanently and thereafter it accepts only this coded  
15 signal in order to activate the electronic unit (8).
2. An electronic locking system in accordance with claim 1,  
c h a r a c t e r i z e d t h e r e i n t h a t t h e l o c k (2) and the key (1) are provided with means (10a, 10b) for transmission of electric current to the key (1).
- 20 3. An electronic locking system in accordance with claim 1 or 2,  
c h a r a c t e r i z e d t h e r e i n t h a t t h e e l e c t r o n i c u n i t is provided with a removable seal and in that said electronic unit is arranged to store permanently the first coded signal received by it after removal of said seal.
- 25 4. An electronic locking system in accordance with claim 1 or 2,  
c h a r a c t e r i z e d t h e r e i n t h a t t h e e l e c t r o n i c u n i t is pre-programmed to store a coded signal at a preselected occasion.

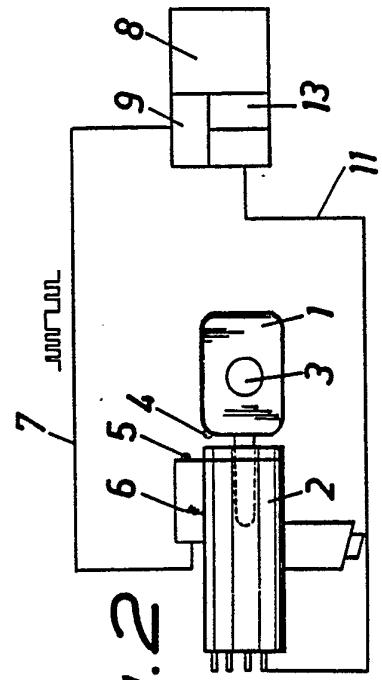
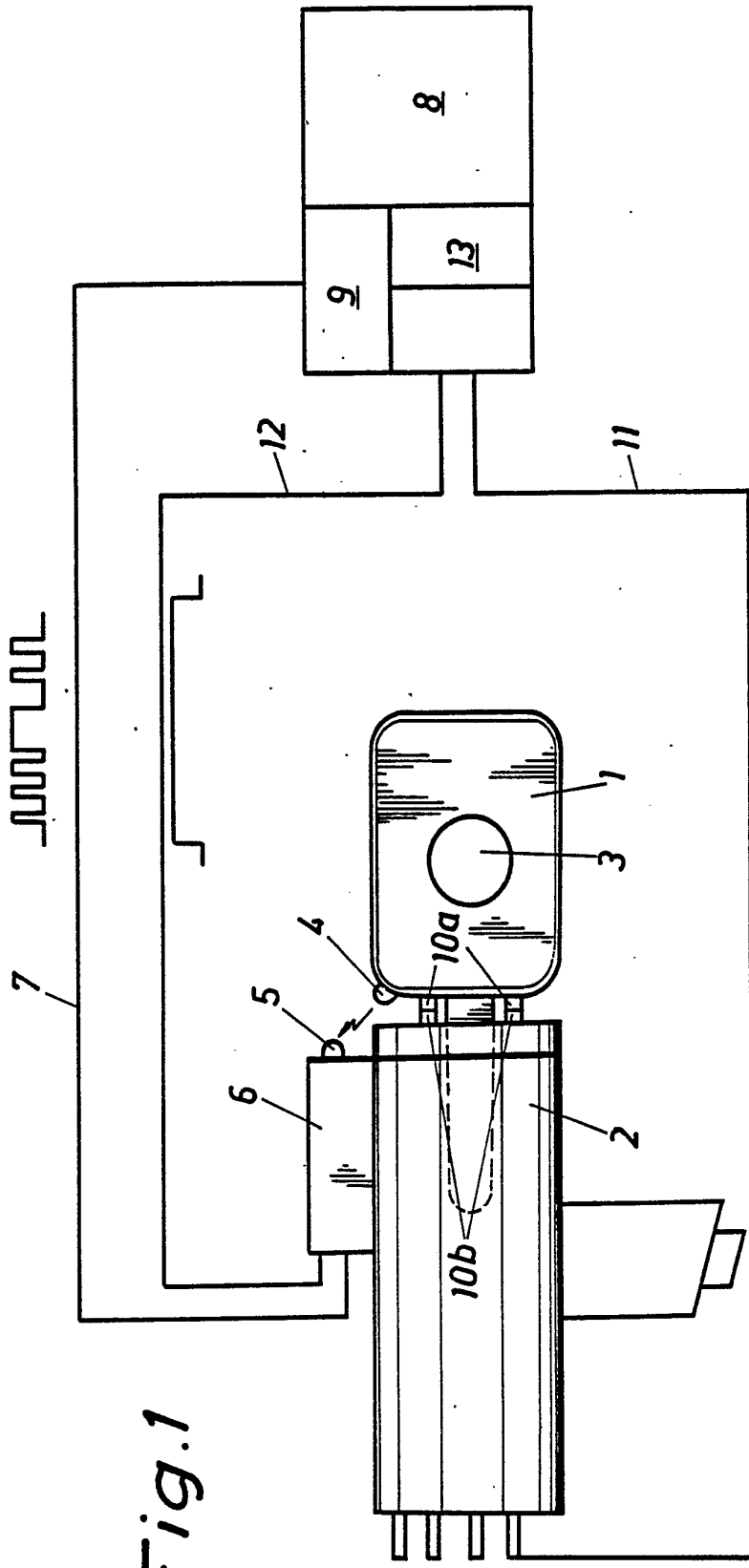
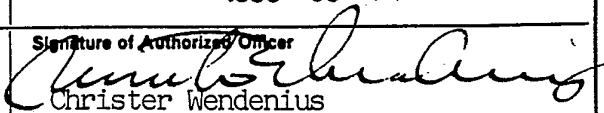


Fig. 2

Fig. 1

# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE86/00316

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC 4		
E 05 B 49/00, B 60 R 25/00, E 05 B 65/12		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
<b>Classification System</b>	<b>Classification Symbols</b>	
IPC 4 US Cl	E 05 B 65/12, /20, 47/00, 49/00-02; B 60 R 25/00, /04, /10 70: 237-239, 278, 256; 180: 114; 200: 42; 340: 64, 164, 149, 825.31; 307: 10	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
SE, NO, DK, FI classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b>		
<b>Category <sup>10</sup></b>	<b>Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></b>	<b>Relevant to Claim No. <sup>13</sup></b>
Y	DE, C, 2 906 665 (APAG ELEKTRONIK AG) 28 August 1980 & FR, 2449771 GB, 2051211 CH, 647297	1-4
Y	DE, A, 3 005 890 (AMCOR LTD) 11 September 1980 & GB, 2046827	1-4
Y	US, A, 4 274 080 (G BRUNKEN) 16 June 1981 & FR, 2441036 DE, 2847730 GB, 2035441 JP, 55065679	1-4
Y	GB, A, 2 069 207 (G ROSSI) 19 August 1981 & FR, 2474727 JP, 56155497 DE, 3102991 US, 4342024	1-4
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<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1986-09-11	1986 -09- 17	
International Searching Authority	Signature of Authorized Officer	
Swedish Patent Office	 Christer Wendenius	



## III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	DE, B, 2 928 913 (BAYERISCHE MOTOREN WERKE AG) 25 September 1980 & GB, 2056544 FR, 2461798 US, 4347545	1-4
Y	EP, A, 10 084 (R GRIEVELDINGER) 16 April 1980 & LU, 80321 AT, 2057	1-4