OPI DATE 11/11/98 APPLN. ID 70366/98
AOJP DATE 24/12/98 PCT NUMBER PCT/EP98/01561

AU9870366

(51) Internationale Patentklassifikation 6 :
F42C 11/06

A1

(11) Internationale Veröffentlichungsnummer: WO 98/46965

(43) Internationales Veröffentlichungsdatum: 22. Oktober 1998 (22.10.98)

(21) Internationales Aktenzeichen: PCT/EP98/01561

(22) Internationales Anmeldedatum: 18. März 1998 (18.03.98)

(30) Prioritätsdaten:
197 15 635.5 15. April 1997 (15.04.97) DE
197 21 839.3 24. Mai 1997 (24.05.97) DE

(71) Anmelder *(für alle Bestimmungsstaaten ausser US)*: DYNAMIT NOBEL GMBH EXPLOSIVSTOFF- UND SYSTEMTECHNIK [DE/DE]; Kaiserstrasse 1, D-53840 Troisdorf (DE).

(72) Erfinder; und
(75) Erfinder/Anmelder *(nur für US)*: KUHLA, Matthias [DE/DE]; Im grünen Anger 5, D-53844 Troisdorf (DE). SCHÄFER, Heinz [DE/DE]; Combahnstrasse 50, D-53225 Bonn (DE). STEINER, Ulrich [DE/DE]; Maarstrasse 31b, D-53842 Troisdorf (DE).

(74) Anwälte: SCHERZBERG, Andreas usw.; Dynamit Nobel Aktiengesellschaft, Patentabteilung, D-53839 Troisdorf (DE).

(81) Bestimmungsstaaten: AU, CA, IL, JP, NO, US, europäisches Patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

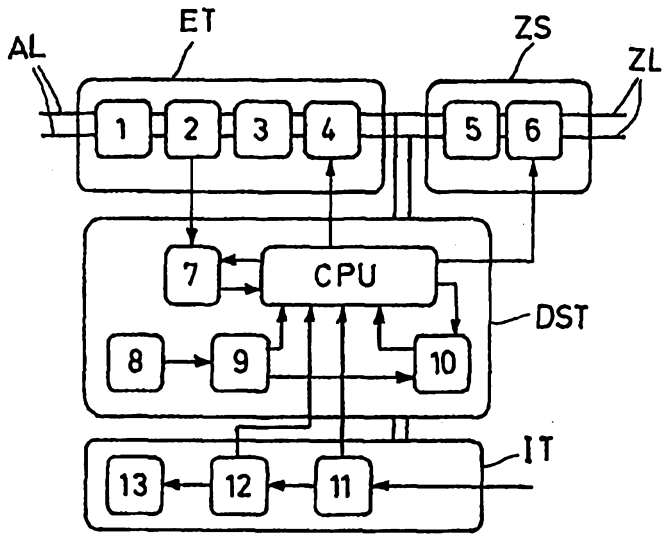
Veröffentlicht
Mit internationalem Recherchenbericht.
Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist; Veröffentlichung wird wiederholt falls Änderungen eintreffen.

(54) Title: ELECTRONIC IGNITER

(54) Bezeichnung: ELEKTRONISCHER ZÜNDER

(57) Abstract

The invention relates to an electronic igniter, containing an energy storage element (5) which can be released onto a detonating agent by means of an actuator (6) to initiate ignition. The energy storage element (5) is supplied by a power supply (4) which provides a low voltage when not activated, said low voltage supplying a data control part (DST). In a standby mode, the power supply (4) voltage is increased to a level sufficient for ignition to take place. A safety release is stored in an information part (IT) in a non-volatile memory (11). The standby mode can only be initiated if the signal conveyed via the connecting line (AL) matches the safety release code. The invention therefore ensures that unauthorised persons who do not know the safety release code are unable to use the igniter.



(57) Zusammenfassung

Der Zünder enthält einen Energiespeicher (5), der über einen Schalter (6) auf ein Zündmittel entladen werden kann, um die Zündung auszulösen. Der Energiespeicher (5) wird von einer Spannungsversorgung (4) gespeist, die im nichtscharfen Zustand eine niedrige Versorgungsspannung liefert, mit der ein Datensteuerteil (DST) versorgt wird. In einem Bereitschaftsmodus wird die Spannung der Spannungsversorgung (4) auf einen zum Zünden ausreichenden Wert erhöht. In einem Informationsteil (IT) ist in einem nichtflüchtigen Speicher (11) ein Entsicherungscode hinterlegt. Voraussetzung für die Einstellung des Bereitschaftsmodus ist, daß das über eine Anschlußleitung (AL) zugeführte Signal dem Entsicherungscode entspricht. Mit der Erfindung wird erreicht, daß unbefugte Personen, die den Entsicherungscode nicht kennen, den Zünder nicht benutzen können.

ELECTRONIC IGNITER

The invention relates to an electronic igniter for igniting an explosive charge, with the igniter containing a data control part which evaluates data supplied by way of a connecting lead and actuates a switch for initiation of ignition in dependence upon this data.

Explosive attacks on installations and people have increased in recent times. This is not least because the culprits can acquire explosives and igniters relatively easily. The detonation of explosives in commercial use is preferably started with electronic igniters. In ordinary use this takes place with special ignition devices which are, however, not particularly protected. Likewise - with little physical knowledge assumed - ignition is possible with an appropriate voltage source. After terrorist attacks or finds of explosives it is extremely difficult for the investigating authorities to obtain clear circumstantial evidence in order to locate the group of people involved in the crime.

Electronic igniters are known which contain an energy store and which, to start the ignition, require that an electric detonator emits a pulse sequence with a certain make-up (EP 0 147 688 A2). Moreover, igniters are known where a safety-release code is permanently specified by the type of chip used. A change of the safety-release code requires the replacement of the chip and the use of a new chip with changed layout. This involves great expenditure. The ignition devices used in this system are to be switched on by means of key-operated switches. If the key-operated switch is

short-circuited, the protective function is lost and the igniter can be ignited. Moreover, it is possible that, with igniters of the same construction, the code can be analysed and decoded and is therefore available for misuse.

The object of the invention is to create an electronic igniter which offers increased protection against unauthorized use of the igniter.

The object is achieved with the invention indicated in claim 1.

With the igniter in accordance with the invention a safety-release code is deposited in a non-volatile memory, for example in an EEPROM capable of serial communication. In this way, with igniters which are constructed to be identical to each other, different safety-release codes can be entered into the respective memory during the production phase by the manufacturer. In this way, each igniter could receive its own safety-release code which does not occur with any other igniter. The igniter can only be ignited if the data supplied by the ignition device corresponds to this safety-release code. As a result of initiation not being possible with simple power (ignition device or battery), a substantial source of danger is excluded. In addition, the igniter is protected in such a way that it can only be initiated with knowledge of the safety-release code contained therein. In this way, an unauthorized use of the igniter is largely prevented. The large number of different safety-release codes which can be entered into igniters of the same construction is an advantage.

If the safety-release code has been entered incorrectly

a certain number of times, the ignition circuit of the igniter can be interrupted or blocked and the igniter can therefore be made useless. This measure ensures that hackers have no possibility of cracking the safety-release code.

Moreover, it is possible for each user to obtain his own safety-release code as access identifier. In this respect, the ignition devices of this user can be set to this safety-release code.

Moreover, it is possible for the ignition device to be activated only by a PIN code. If three attempts are made to determine the code, the ignition device blocks all functions. Release is only possible by the manufacturer.

Finally, it is possible, with the actuation of a light key - not visible to the user - to deposit the ignition data in a non-volatile manner in a memory, with statement of date, time and explosive display. This data can only be accessed by the manufacturer.

For the complete improvement of an ignition system consisting of ignition device and igniter, the following conditions must be fulfilled for authorized use:

a) an igniter with set safety-release code must be present;

b) an ignition device with key-operated switch for transmission of the safety-release code to the igniter must be present and

c) the user must know the PIN code of the ignition

device in order to activate it.

Even if unauthorized people gain possession of igniter, ignition device and ignition device PIN code, the manufacture of "time bombs" can be prevented by way of particular control requirements of the ignition device which are only known to specially trained people.

An exemplifying embodiment of the invention will be explained in more detail in the following with reference to the single figure of the drawing.

The drawing shows a diagrammatic block diagram of the electronic igniter.

The igniter can be connected by way of a bifilar connecting lead AL to an ignition device (not shown). The connecting lead AL leads to the input part ET which contains the following components: an input protection device 1, a signal decoupling 2, a rectifier circuit 3 and a power supply 4. The input protection device 1 forms a filter circuit and safety circuit. It contains an HF fuse and an overload fuse and a voltage limiting circuit which only allows low voltages through. By way of the input protection device 1 it is ensured that

- high-frequency influences do not cause the igniter to be initiated,

- electrostatic couplings are supported,

- with engagement of very high interference voltage a protective resistor is destroyed in a defined manner in order to separate the igniter from the ignition device,

- with engagement of low-energy interference voltage a limiting of the input voltage by electronic suppressor circuits takes place.

Only signals with permitted amplitude swing and frequency band are relayed to the signal decoupling 2.

The signal decoupling 2 forms an interface for decoupling the filtered signals and for converting the analog signals into digital signals.

The rectifier circuit 3 is supplied with the analog signals coming from the input protection device 1 and generates from them a direct voltage of defined polarity. The user-friendliness includes the fact that the user can connect the igniter in any polarity.

The d.c. voltage is supplied to the power supply 4 which consists of a 2-stage voltage regulator. In the initial state, after the switching-on, the power supply 4 generates a low supply voltage which is not sufficient for the ignition of the ignition charge or ignition pellet connected to the ignition circuit ZL. The electronic components of the igniter are supplied with this low supply voltage so that in particular the data control part DST is operable. This ensures the operation of the igniter logic. The low supply voltage lies below the no-fire threshold.

The supply voltage of the power supply 4 is further supplied to the ignition stage ZS. This contains an energy store 5, preferably in the form of a capacitor. A capacitor has the advantage that, in the non-connected state, a de-energized ignition system is available. After the safety-release code has been identified, the capacitor is charged by the higher

supply voltage of the power supply 4 to a value which is sufficient for igniting the explosive charge.

An electronic switch 6 in the form of a switching transistor is connected downstream of the energy store 5, the switch being controlled by the data control part DST and, in the conducting state, discharging the energy store 5 to the detonating means connected to the ignition circuit ZL.

The data control part DST contains a central control unit CPU which carries out all control processes and logic switching functions. An input counter 7 counts the digital signals decoupled from the input part ET, to be evaluated then by the CPU. The first data protocol to be examined relates to the safety-release code. This is examined for identity. If there is correspondence, the CPU transmits a reset signal to all components of the data control part, a release command to the power supply to adjust the high supply voltage, a synchronization command to the input counter 7 for the reception of delay time data and a synchronization command to a reference counter 10.

The data control part DST contains an oscillator 8 which supplies a clock generator 9 for generating the clock frequency. The clock frequency is supplied to the CPU and, in addition, to the reference counter 10, in which the delay times are deposited as real time by counting up. The delay time data supplied by the ignition device has the effect that the reference counter 10 is counted up to a value specified by this data. At the beginning of the start command transmitted to all igniters at the same time, the reference counter 10 runs backwards and, upon reaching the count "0", the switch 6 is activated and the

detonating means are ignited.

The information part IT contains various non-volatile memories 11, 12, 13. The data necessary for the safety philosophy of the detonator is deposited in these memories. The safety-release code is stored in the memory 11 and an igniter address in the memory 12. The igniter address is a value between 0 and N, for example 60, according to the user's need. The memory 13 contains customer data. The relevant data is entered into the information part IT during the production of the igniter and is not to be changed any more after the final assembly. There are no possibilities for manipulation from the outside.

Upon the switching-on of the ignition device (not shown), the igniter is supplied with voltage. When the power supply 4 has built up the low supply voltage the information part IT transfers the safety-release code contained in the memory 11 and the igniter address contained in the memory 12 to the CPU. The latter is then ready to receive the data supplied by the ignition device.

The ignition device first of all emits the safety-release code. The CPU examines whether this safety-release code is identical to the stored safety-release code. If they are identical, the supply voltage is increased from the safety level (no-fire) to the ignition level (all-fire). The igniter is now in the stand-by mode in which an ignition is possible.

In the stand-by mode, the programming of the delay time takes place first of all. For this purpose, the igniter address is transmitted by way of the connecting lead AL. If this igniter address corresponds with the

igniter address deposited in the memory 12, the reference counter 10 is counted up with a subsequent start-stop sequence. The start-stop sequence consists of a start signal and a stop signal at the connecting lead AL. In the interval between these two signals the reference counter 10 counts the pulses of the clock generator 9. The final value of the reference counter 10 which is finally reached indicates the measure of the subsequently expiring delay time. The reference counter 10 is counted backwards in this delay time and, upon reaching the count "0", the switch 6 is actuated.

Production data and customer data is deposited in a further memory 13 of the information part IT. Production order, batch name, manufacturing date etc. belong to the production data. The customer data comprises customer name, order data and delivery data. The production data and customer data can be read by the manufacturer if necessary, but is not accessible to the user. The igniter address contained in the memory 12, which igniter address has a value of 0 to N, establishes the ignition sequence. With delayed detonators the igniters must be activated with different delays in order to implement a certain explosion sequence. The igniter address indicates to a certain extent the delay type of the relevant igniter. Subsequent to the igniter address, the ignition device then supplies the delay time to be allocated to this address. The delay time can therefore be set by the user separately for each igniter address.

In order to make the igniter address on the igniter identifiable, it can be printed at the connecting lead AL or at another position on a plastics moulded part.

CLAIMS

1. Electronic igniter with an energy store (5), which can be discharged by way of a switch (6) on to connected detonating means, and with a data control part (DST) which evaluates signals supplied by way of a connecting lead (AL) and actuates the switch (6) in dependence upon these signals,

c h a r a c t e r i z e d i n t h a t

an information part (IT) is provided which contains a safety-release code in a non-volatile memory (11), in that the data control part (DST) compares the signals supplied by way of the connecting lead (AL) with the safety-release code and, in the event of agreement, sets a stand-by mode in which the ignition can be started when at least one further condition is fulfilled.

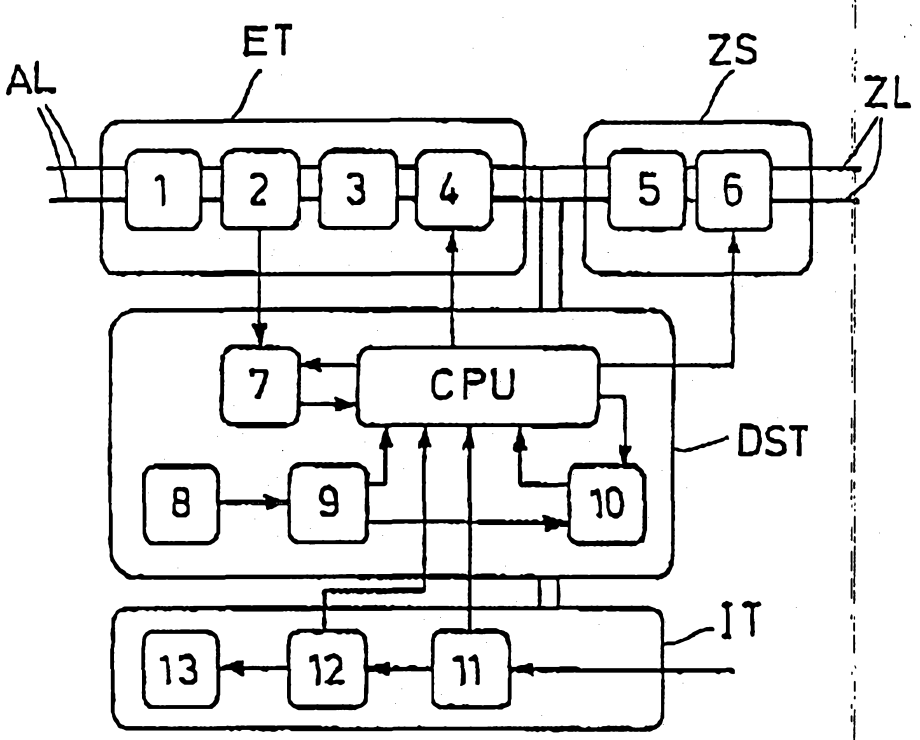
2. Igniter according to claim 1, characterized in that the energy store (5) is connected to a power supply (4) which generates a low supply voltage which is insufficient for ignition as long as the stand-by mode is not set, and a high supply voltage sufficient for ignition if the stand-by mode is set.

3. Igniter according to claim 1 or 2, characterized in that the information part (IT) additionally contains production data and/or customer data in a non-volatile memory (13).

4. Igniter according to one of claims 1-3, characterized in that the information part (IT) contains an igniter address in a non-volatile memory (12), and in that the data control part (DST) sets an

ignition delay, to be set, in dependence upon the igniter address.

5. Igniter according to claim 4, characterized in that the information part (IT) sets the ignition delay according to a signal which follows an address signal received by way of the connecting lead (AL), if the address signal corresponds to the igniter address.


AL
ET
ZS
ZL
1
2
3
4
5
6
7
CPU
DST
8
9
10
IT
13
12
11