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

(11) EP 4 553 445 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**14.05.2025 Bulletin 2025/20**

(21) Application number: **23306928.5**

(22) Date of filing: **09.11.2023**

(51) International Patent Classification (IPC):
***F42C 15/18*** *(2006.01)* ***F42C 15/34*** *(2006.01)*
***F42C 15/40*** *(2006.01)* ***F42C 15/42*** *(2006.01)*
***F42C 15/44*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
**F42C 15/18; F42C 15/34; F42C 15/40; F42C 15/42; F42C 15/44**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA**
Designated Validation States:
**KH MA MD TN**

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## (54) METHOD FOR SELECTIVELY DE-ARMING, ARMING AND/OR FUZING OF REMOTELY CONTROLLABLE MUNITION, AND MUNITION CONTROLLER

(57) The present invention relates to a method for selectively de-arming, arming and/or fuzing of remotely controllable munition (12). The method is applied to a munition controller (100) coupleable or coupled to the munition (12) and operable in multiple modes. The method comprises in a first mode (310), disabling a fuzing mechanism (120) of the munition controller (100) by separating a booster charge (122) and a detonator (124) from each other, wherein an electrical power supply (110) of the munition controller (100) is disconnected. The method further comprises in at least one intermediate mode, establishing operational readiness of the munition controller (100) with the electrical power supply (110) being connected and at least partly arming the fuzing mechanism (120). Further, the method comprises in a second mode, enabling triggering of the at least partly armed fuzing mechanism based on a sensor signal indicative for a detected target. The transitioning from the first mode towards the at least one intermediate mode comprises connecting of the electrical power supply (110) and receiving manual operator input on-site.

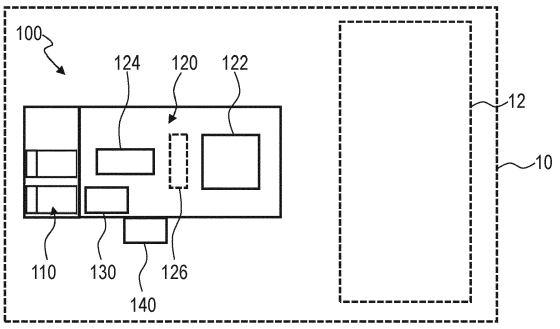


Fig. 1

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## Description

### TECHNICAL FIELD OF THE INVENTION

**[0001]** The present invention relates to a method for selectively de-arming, arming and/or fuzing of remotely controllable munition, and a corresponding munition controller.

### TECHNICAL BACKGROUND

**[0002]** A munition system, in particular a remotely controllable munition system, may comprise munition and an on-board munition controller including a fuzing mechanism for detonating the munition, in which a triggerable detonator is configured to ignite a booster charge that in turn is configured to detonate the munition. Such a munition system may be, for example, a guided weapon, a self-guided missile, a missile, a bomb, a grenade, a mine, or the like.

**[0003]** Such a munition system is subject to certain safety requirements during its entire product life cycle. This applies, for example, to the storage, handling and/or use of such a munition system. It should be ensured that the munition system is in a safe state or mode or that a safe state or mode can be achieved if necessary.

### SUMMARY OF THE INVENTION

**[0004]** It is therefore an object of the present invention to enable safe handling of munition with simple measures.

**[0005]** This object is solved by the subject-matter of the appended independent claims. Further embodiments are defined in the appended dependent claims and the following description.

**[0006]** According to a first aspect, there is provided a method for selectively de-arming, arming and/or fuzing of remotely controllable and/or detonatable munition. The method is applied to a munition controller coupleable or coupled to the munition and operable in multiple modes. The method comprises in a first mode, disabling a fuzing mechanism of the munition controller by separating a booster charge and a detonator from each other, wherein an electrical power supply of the munition controller is disconnected. The method further comprises in at least one intermediate mode, establishing operational readiness of the munition controller with the electrical power supply being connected and at least partly arming the fuzing mechanism. In addition, the method comprises in a second mode, enabling triggering of the at least partly armed fuzing mechanism based on a sensor signal indicative for a detected target. Thereby, transitioning from the first mode towards the at least one intermediate mode comprises connecting of the electrical power supply and receiving manual operator input on-site.

**[0007]** The proposed method, and likewise the corresponding munition controller, allows for reducing and/or minimizing energy consumption within active munition lifetime. It enables remote and/or manual arming, de-arming, and re-arming of the munition controller and/or the munition to which the munition controller may be applied. The method and/or the munition controller may thus meet the requirements of the NATO standard STANAG 4187 (Edition A, Version 1, June 2022), for example. In the first mode, the method and/or the munition controller allows for long-time storage, transportation, and safe handling of the munition, as the munition controller and/or the munition is in a safe status and electrical power is disconnected. In the at least one intermediate mode, the method and/or the munition controller allows for e.g. initializing, standby, and at least partly arming of the munition controller and/or its fuzing mechanism. In the second mode, the method and/or the munition controller allows for detonating the munition, wherein de-arming, or a reset to the first mode is possible.

**[0008]** As used herein, the munition controller may be any type of controller at least comprising the fuzing mechanism with a booster charge and a detonator. The munition controller may comprise or may be coupled to at least one actuator configured to displace, move, or the like the booster charge and the detonator relative to each other. In the first mode, the munition controller may be configured to displace, move, or the like the booster charge and the detonator relative to each other by controlling the at least one actuator accordingly. The munition controller may comprise or may be coupled to the electrical power supply. For example, the munition controller may include or be formed as: circuit, logic circuit, microprocessor, microcontroller, programmable controller, field programmable gate array (FPGA), application specific integrated circuits (ASIC), programmable logic controller (PLC), or the like.

**[0009]** The electrical power supply may comprise at least one energy storage. The at least one energy storage may be configured to provide electrical energy for displacing, moving, or the like at least one of the booster charge and the detonator in case of failure, interruption, drop, etc. of the energy supply. In other words, the electrical energy supply may be configured, by providing an energy reserve, to always separate the booster charge and the detonator from each other, even in case of a failure, interruption, drop, etc. of the energy supply. This may comprise, for example, by charging one or more capacitors.

**[0010]** The method may be understood as a kind of or a state machine or may be implemented as a logic circuit, state machine, or the like. Each mode described herein may be or may correspond to a state of the state machine. A transition between the individual modes as described herein may therefore also refer to a change from one state to another, in a corresponding forward or backward direction. A respective transition between the modes may be triggered by at least one of operator input, e.g. remotely or manually, sensor input, e.g. from an onboard sensor or external and/or connected sensor, and internal

logics, e.g. switches, position sensors for the fuzing mechanism, e.g. for detonator and/or the booster charge, or the like. The number of different modes is not fixed herein but is variable. The two end modes or end states, i.e. the first mode and the second mode, may be fixed. Multiple intermediate modes or intermediate states arranged between the first mode and the second mode may be provided. As part of the at least one intermediate mode, an arming procedure should be completed before or by the second mode.

**[0011]** Further, as used herein, the first mode may also be referred to as storage mode, in in which the munition controller is in a safe status, i.e. the detonator and the booster charge are separated from each other, wherein the electric power supply is disconnected for long-time storage, transportation and safe handling. The second mode may also be referred to as engagement mode, in which the munition controller, e.g. the fuzing mechanism, is in partly armed or armed mode, operational and the sensor signal indicates a target. A detonator capacitor or the like may be charged. As mentioned above, transitioning from the first mode towards the at least one intermediate mode, e.g. forward transition, comprises connecting of the electrical power supply and receiving manual operator input on-site. For example, the manual input for transitioning from the first mode towards the at least one intermediate mode comprises at least one of a removal of a securing element, e.g. a securing pin or the like, from the munition controller, a button actuation, and a lever actuation. As the first mode is an end mode or end state, there is no backward transition. From the second mode, e.g. engagement mode, forward transition may comprise activating the fuzing mechanism, e.g. closing a fuzing circuit, and initiating the detonator, thereby detonating the munition, via the booster charge. Further, from the second mode, e.g. engagement mode, backward transition may comprise at least one of receiving a de-arming command from remote, receiving a manual de-arming procedure, e.g. by NFC controller, key code, or the like, and automatic de-arming due to lack of electric power, e.g. by low or depleted battery power. Automatic de-arming may comprise automatic reset to first mode, e.g. storage mode, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0012]** Further, for example, the at least one intermediate mode may comprise at least one of an initialization mode, a standby mode, a manual arming mode, a remote arming mode, an arming execution mode, a lurking and/or loitering mode, and a preparation mode.

**[0013]** By way of example, in the initialization mode, munition controller may be in a safe status, i.e. the detonator and the booster charge are separated from each other, with connected power supply and initializes itself. The initialization procedure may comprise at least one of a built-in test or self-check, a check for remote data links and/or connections, battery levels, or the like, to provide operational readiness. Results of the tests and/or checks may be displayed at the munition controller, e.g. by a display, LEDs, or remotely. In the initialization mode, forward transition may be performed if the initialization procedure is successful. Backward transition to the first mode, e.g. storage mode, may comprise at least one of an operator input, e.g. power off, or lack of electric power, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0014]** Further, by way of example, in the standby mode, the munition controller may be in a safe status, i.e. the detonator and the booster charge are separated from each other, with connected power supply and properly initialized. The munition controller may be configured to wait for further commands in form of e.g. a manual arming command, a remote network link for remote arming, or the like. In the standby mode, forward transition to the arming mode may comprise receiving a respective arming command for manual or remote arming, wherein the arming command may comprise an operator input, establishing a network link and/or connection, an arming command verification, or the like. Backward transition to the first mode, e.g. storage mode, may comprise at least one of an operator input, e.g. power off, a lack of power, e.g. low or depleted battery, an automatic rule-based transition, e.g. automatic transition or shutdown to the first mode, e.g. storage, mode after a predefined time elapsed, e.g. 60 minutes without network connection, 200 days with network connection), wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0015]** By way of example, in the manual arming mode, the munition controller may be in a safe status, i.e. the detonator and the booster charge are separated from each other, with connected power supply and operational. An operator may select manual arming by input, e.g. by a push button, lever, or the like, by a pre-defined hardware setup, e.g. by an internal switch to deactivate the remote link or capability. In the remote arming mode, the munition controller may be in a safe status, i.e. the detonator and the booster charge are separated from each other, with connected power supply and operational. The operator may select remote arming by e.g. activating, linking and/or pairing the munition controller with a remote controller or the like. In contrast to the manual arming mode, the munition controller will neither automatically, nor by manual input jump back to standby mode. This ensures that the munition controller can be controlled exclusively by the remote controller and tampering or hijacking of the munition is not possible by jamming or manual recovery. In the manual arming mode, forward transition may comprise meeting at least one manual arming criterion comprising at least one of a manual operator input indicating a manual arming command, a hardware configuration of the munition controller, and a ruled-based manual arming criterion. Backward

transition to the first mode, e.g. storage mode, may comprise automatic rule-based transition, e.g. if manual arming procedure is not competed successfully, e.g. with a predefined time, e.g. 60 min or at a lack of electric power, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode. In the remote arming mode, forward transition to the arming execution mode, may comprise meeting a remote arming criterion is met comprising at least one of receiving a remote arming command and completing verification and a rule-based arming criterion, e.g. low-acceleration for a predefined time, or the like. Backward transition to the first mode, e.g. storage mode may comprise at least one Backward transition to the first mode, e.g. storage mode, may comprise automatic rule-based transition, e.g. if remote arming exceeds operational endurance limitation (e. g. 120 days), or at a lack of electric power, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0016]** Further, by way of example, in the arming execution mode, the munition controller may be in a safe status, i.e. the detonator and the booster charge are separated from each other, with connected power supply and operational, wherein the manual arming or remote arming procedure was completed successfully. In the arming execution mode, forward transition may comprise charging capacitors to store the required power to de-arm in case of lack of power and/or for transitioning to partly-armed status or fully armed status. Backward transition to the manual or remote arming mode may be performed if the desired status cannot be achieved, e.g. due to component failure or the like. Backward transition or reset to the first mode, e.g. storage mode, may be performed at lack of electric energy, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0017]** By way of example, in the lurking and/or loitering mode, the munition controller may be in a partly armed or armed status and operational. In this mode, at least one sensor of the munition controller may be activated to detect nearby targets. In the lurking and/or loitering mode, forward transition may be performed if a target is in range. Backward transition to the remote arming mode may comprise receiving a remote de-arming command. Backward transition to the manual arming mode may comprise receiving a manual de-arming procedure, e.g. by NFC controller, key code, or the like, and automatic de-arming due to lack of electric power, e.g. by low or depleted battery power. Backward transition or automatic de-arming to and/or reset to the first mode, e.g. storage mode, may be performed at lack of electric energy, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0018]** Further, by way of example, in the preparation mode, the munition controller may be in a partly armed or armed status, operational, and the at least one sensor detected a nearby target. In the preparation mode, forward transition to the second mode may comprise at least one of enabling fully armed status, if required, and charging a fuzing capacitor. Backward transition to the lurking and/or loitering mode may be performed a predefined time elapsed, e.g. 120 s. Backward transition to the remote arming mode may comprise receiving a remote de-arming command. Backward transition to the manual arming mode may comprise receiving a manual de-arming procedure, e.g. by NFC controller, key code, or the like, and automatic de-arming due to lack of electric power, e.g. by low or depleted battery power. Backward transition or automatic de-arming to and/or reset to the first mode, e.g. storage mode, may be performed at lack of electric energy, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0019]** According to an embodiment, the first mode, the at least one intermediate mode and the second mode may be in sequential order and/or arranged sequentially. For example, the method and/or the modes may be implemented by a state machine having sequenced states. The first mode, e.g. storage mode, may be reachable from all modes. Sequential implementation can be easily implemented in simple logic, electronics, or the like. In addition, the transitions between the states allow safe operation.

**[0020]** In an embodiment, in case of lack of electrical power of the munition controller automatic transition to the first mode is performed. That is, the munition controller can always be set to a safe state.

**[0021]** According to an embodiment, the at least partly arming of the fuzing mechanism comprises at least one of bringing the booster charge and the detonator together and removing an interrupter arranged between the booster charge and the detonator. For example, the booster charge and the detonator may be movable relative to each other by at least one actuator controllable by the munition controller. In the partly armed status, at least one of the booster charge and the detonator may be in a safe state, e.g. a safe position, while the other is already in an operational state, e.g. operational position. In the fully armed state, both the booster charge and the detonator may be in an operational state, e.g. operational position.

**[0022]** In an embodiment, establishing operational readiness comprises performing at least one self-check of the munition controller, wherein proceeding with the at least partly arming depends on the at least one self-check being successful. For example, the at least one self-check may comprise checking operability of actuators, checking battery level, checking for remote link and/or connection, or the like. The result of the at least on self-check may be displayed, e.g. by a display, LEDs, or the like.

**[0023]** According to an embodiment, the at least partly arming may selected from manual arming and remote arming, based on whether at least one manual arming criterion or at least one remote arming criterion is met.

**[0024]** In an embodiment, the at least one manual arming criterion may comprise at least one of a manual operator input indicating a manual arming command, a hardware configuration of the munition controller, and a ruled-based manual arming criterion. For example, the manual operator input may comprise a button actuation or the like. The hardware configuration may comprise an internal switch to deactivate the remote link and/or remote capability.

**[0025]** According to an embodiment, the at least one remote arming criterion may comprise at least one of receiving a remote arming command signal, a hardware configuration of the munition controller, and availability of a remote communication link.

**[0026]** In an embodiment, if manual arming is selected, transitioning from the at least partly arming towards operational readiness and/or the first mode is triggered by at least one of receiving an operator input, a lack of electrical power, and a rule-based automatic transition.

**[0027]** According to an embodiment, if remote arming is selected, transitioning from the at least partly arming towards operational readiness is prevented.

**[0028]** In an embodiment, if remote arming is selected, transitioning from the at least partly arming towards the first mode is triggered by at least one of a lack of electrical power and a rule-based automatic transition.

**[0029]** According to an embodiment, transitioning from the at least partly arming towards the second mode comprises charging at least one energy storage of the electrical power supply for providing power for de-arming.

**[0030]** In an embodiment, transitioning from the second mode towards the at least one intermediate mode and/or the first mode comprises at least one of receiving of an operator input, receiving a de-arming command, and a rule-based automatic transition.

**[0031]** According to a further aspect, there is provided a munition controller for selectively de-arming, arming and/or detonating of remotely controllable munition. The munition controller comprises an electrical power supply. The munition controller further comprises a fuzing mechanism coupled to the electrical power supply. The munition controller is configured to enable carrying out the method described herein.

**[0032]** According to another aspect, there is provided a munition system. The munition system comprises a remotely detonable munition and a munition controller described herein.

## BRIEF SUMMARY OF THE DRAWINGS

**[0033]** The present invention is explained in more detail below with reference to the embodiments shown in the schematic figures:

Fig. 1 schematically illustrates an exemplary munition system comprising a munition and a munition controller for selectively de-arming, arming and/or detonating of remotely controllable munition according to an embodiment.

Fig. 2 schematically illustrates an exemplary munition system comprising a munition and a munition controller for selectively de-arming, arming and/or detonating of remotely controllable munition according to an embodiment.

Fig. 3 illustrates in a diagram a state machine of a munition controller according to an embodiment.

Fig. 4 illustrates in a flow chart a method for selectively de-arming, arming and/or detonating of remotely controllable munition according to an embodiment.

**[0034]** In the figures of the drawing, elements, features, and components which are identical, functionally identical and of identical action are denoted in each case by the same reference designations unless stated otherwise.

## DESCRIPTION OF EXEMPLARY EMBODIMENTS

**[0035]** Fig. 1 schematically illustrates in a top view an exemplary munition controller 100 for selectively de-arming, arming and/or detonating of remotely controllable munition 12. The munition controller 100 may be coupled to, e.g., attached to, the munition to detonate the munition when needed. The munition controller100 may be operated in several different states or modes of operation. The munition 12 may be, for example, a guided weapon, a self-guided missile, a rocket, a bomb, a grenade, a mine, a "lurking weapon" (Loitering Weapon), or the like. The munition controller 100 and the munition may form a munition system.

**[0036]** The munition controller 100 comprises an electrical power supply 110. The munition controller 100 further comprises a fuzing mechanism 120 coupled to the electrical power supply 110. The fuzing mechanism 120 comprises a booster charge 122 and a detonator 124. The detonator 124 may be configured to ignite the booster charge 112 that in turn may be configured to detonate the munition 12. Optionally, the fuzing mechanism 120 may comprise an interrupter or like that can be selectively arranged between the booster charge and the detonator. For example, for control functions, the munition controller 100 may comprise control circuitry 130 including at least one of: a circuit, a logic circuit, a microprocessor, a microcontroller, a programmable controller, a field programmable gate array (FPGA), an application specific integrated circuits (ASIC), a programmable logic controller (PLC), or the like, coupled to the electrical

power supply 110 and the fuzing mechanism 120. Further, the munition controller 100 may comprise or may be coupled to at least one sensor element 140 configured to detect targets in the vicinity of the munition controller 100 and/or the munition 12.

**[0037]** The munition controller 100 is coupleable to the munition 12 and operable in multiple modes. The modes may be implemented by a logic circuit, state machine or the like. Operation of the ammunition controller 12 may be as described below.

**[0038]** In a first mode, the fuzing mechanism 120 of the munition controller 100 may be disabled by separating the booster charge 122 and the detonator from each other, wherein the electrical power supply 110 of the munition controller 100 is disconnected. The electrical power supply 110 may be disconnected by manual operation, e.g. by removing at least part of the electrical power supply 110, by a power switch, or the like, or automatically by power shutdown.

**[0039]** In at least one intermediate mode, operational readiness of the munition controller 100 may be established with the electrical power supply 110 being connected and at least partly arming the fuzing mechanism 120. The transitioning from the first mode towards the at least one intermediate mode may comprise connecting of the electrical power supply 110 and receiving manual operator input on-site. For example, the manual input for transitioning from the first mode towards the at least one intermediate mode comprises at least one of a removal of a securing element, e.g. a securing pin or the like, from the munition controller, a button actuation, and a lever actuation.

**[0040]** In a second mode, enabling triggering of the at least partly armed fuzing mechanism 120 based on a sensor signal indicative for a detected target. The sensor signal may be provided by the at least one sensor 140 and/or by other sensors, such as remote sensors, wherein the munition controller 100 may be configured to receive signals and/or data from remote.

**[0041]** For example, the first mode, the at least one intermediate mode and the second mode are in sequential order. In at least some embodiments, in case of lack of electrical power of the munition controller 100, automatic transition to the first mode may be performed.

**[0042]** Fig. 2 schematically illustrates the munition system 10 comprising the munition 12 and the munition controller 100 in another view. It should be noted that the munition system 10 illustrated is merely exemplary and may be designed otherwise.

**[0043]** With reference to Fig. 3, which illustrates in a diagram 200 a number of different modes 210 to 280, the operation of the munition controller 100 will now be described in another embodiment. The number here is merely exemplary, as the functions can also be combined into fewer modes or split into further ones.

**[0044]** The different modes 210 to 280 may correspond to states of a state machine implemented in or by the munition controller 100. Mode 210 may correspond to the above-described first mode, mode 220 to an initialization mode, mode 230 to a standby mode, mode 240A to a manual arming mode, mode 240B to a remote arming mode, mode 250 to an arming execution mode, mode 260 to a lurking and/or loitering mode, mode 270 to a preparation mode, and mode 280 to the second mode. Each mode 210 to 280 may be or may correspond to a state of the state machine. A transition between the individual modes may therefore also refer to a change from one state to another, in a corresponding forward or backward direction. A respective transition between the modes may be triggered by at least one of operator input, e.g. remotely or manually, sensor input, e.g. from an onboard sensor or external and/or connected sensor, and internal logics, e.g. switches, position sensors for the fuzing mechanism, e.g. for detonator and/or the booster charge, or the like.

**[0045]** The mode 210, i.e. the first mode, may also be referred to as storage mode, in in which the munition controller 100 is in a safe status, i.e. the detonator 124 and the booster charge 122 are separated from each other, wherein the electric power supply 110 is disconnected for long-time storage, transportation and safe handling. The mode 280, i.e. the second mode, may also be referred to as engagement mode, in which the munition controller 100 is in partly armed or armed mode, operational and the sensor signal indicates a target. A detonator capacitor or the like may be charged. Transitioning from the first mode towards the at least one intermediate mode, e.g. forward transition, comprises connecting of the electrical power supply 110 and receiving manual operator input on-site. For example, the manual input for transitioning from the first mode towards the at least one intermediate mode comprises at least one of a removal of a securing element, e.g. a securing pin or the like, from the munition controller, a button actuation, and a lever actuation. As the first mode is an end mode or end state, there is no backward transition. From the second mode, e.g. engagement mode, forward transition may comprise activating the fuzing mechanism, e.g. closing a fuzing circuit, and initiating the detonator 124, thereby detonating the munition 12 via the booster charge 122. Further, from the second mode, e.g. engagement mode, backward transition may comprise at least one of receiving a de-arming command from remote, receiving a manual de-arming procedure, e.g. by NFC controller, key code, or the like, and automatic de-arming due to lack of electric power, e.g. by low or depleted battery power. Automatic de-arming may comprise automatic reset to first mode, e.g. storage mode, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0046]** In mode 220, i.e. the initialization mode, the munition controller 100 may be in a safe status, i.e. the detonator 124 and the booster charge 122 are separated from each other, with connected power supply 110 and initializes itself. The initialization procedure may com-

prise at least one of a built-in test or self-check, a check for remote data links and/or connections, battery levels, or the like, to provide operational readiness. Results of the tests and/or checks may be displayed at the munition controller, e.g. by a display, LEDs, or remotely. In mode 220, i.e. the initialization mode, forward transition may be performed if the initialization procedure is successful. Backward transition to the first mode, e.g. storage mode, may comprise at least one of an operator input, e.g. power off, or lack of electric power, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0047]** In mode 230, i.e. in the standby mode, the munition controller 100 may be in a safe status, i.e. the detonator 124 and the booster charge 122 are separated from each other, with connected power supply 110 and successfully initialized. The munition controller 100 may be configured to wait for further commands in form of e.g. a manual arming command, a remote network link for remote arming, or the like. In the standby mode, forward transition to the arming mode may comprise receiving a respective arming command for manual or remote arming, wherein the arming command may comprise an operator input, establishing a network link and/or connection, an arming command verification, or the like. Backward transition to the first mode, e.g. storage mode, may comprise at least one of an operator input, e.g. power off, a lack of power, e.g. low or depleted battery, an automatic rule-based transition, e.g. automatic transition or shutdown to the first mode, e.g. storage, mode after a predefined time elapsed, e.g. 60 minutes without network connection, 200 days with network connection), wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0048]** In mode 240A, i.e. in the manual arming mode, the munition controller 100 may be in a safe status, i.e. the detonator 124 and the booster charge 122 are separated from each other, with connected power supply 110 and operational. An operator may select manual arming by input, e.g. by a push button, lever, or the like, by a predefined hardware setup, e.g. by an internal switch to deactivate the remote link or capability. In mode 240B, i.e. the remote arming mode, the munition controller 100 may be in a safe status, i.e. the detonator 1224 and the booster charge 122 are separated from each other, with connected power supply 110 and operational. The operator may select remote arming by e.g. activating, linking and/or pairing the munition controller with a remote controller or the like. In contrast to the manual arming mode, the munition controller will neither automatically, nor by manual input jump back to standby mode. This ensures that the munition controller can be controlled exclusively by the remote controller and tampering or hijacking of the munition is not possible by jamming or manual recovery. In the manual arming mode, forward transition may comprise meeting at least one manual arming criterion comprising at least one of a manual operator input indicating a manual arming command, a hardware configuration of the munition controller, and a ruled-based manual arming criterion. Backward transition to the first mode, e.g. storage mode, may comprise automatic rule-based transition, e.g. if manual arming procedure is not competed successfully, e.g. with a predefined time, e.g. 60 min or at a lack of electric power, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode. In the remote arming mode, forward transition to the arming execution mode, may comprise meeting a remote arming criterion is met comprising at least one of receiving a remote arming command and completing verification and a rule-based arming criterion, e.g. low-acceleration for a predefined time, or the like. Backward transition to the first mode, e.g. storage mode may comprise at least one Backward transition to the first mode, e.g. storage mode, may comprise automatic rule-based transition, e.g. if remote arming exceeds operational endurance limitation (e. g. 120 days), or at a lack of electric power, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0049]** In mode 250, i.e. in the arming execution mode, the munition controller 100 may be in a safe status, i.e. the detonator 124 and the booster charge 122 are separated from each other, with connected power supply 110 and operational, wherein the manual arming or remote arming procedure was completed successfully. In mode 250, i.e. the arming execution mode, forward transition may comprise charging at least one capacitor to store the required power to de-arm in case of lack of power and/or for transitioning to partly armed status or fully armed status. Backward transition to the manual or remote arming mode, i.e. mode 240A or mode 240B, may be performed if the desired status cannot be achieved, e.g. due to component failure or the like. Backward transition or reset to the first mode, e.g. storage mode, i.e. mode 210, may be performed at lack of electric energy, e.g. low or depleted battery, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0050]** In mode 260, i.e. in the lurking and/or loitering mode, the munition controller 100 may be in a partly armed or armed status and operational. In this mode, the at least one sensor 140 may be activated to detect nearby targets. In mode 260, i.e. the lurking and/or loitering mode, forward transition may be performed if a target is in range. Backward transition to the remote arming mode, i.e. mode 240B, may comprise receiving a remote de-arming command. Backward transition to the manual arming mode, i.e. mode 240A, may comprise receiving a manual de-arming procedure, e.g. by NFC controller, key code, or the like, and automatic de-arming due to lack of electric power, e.g. by low or depleted battery power. Backward transition or automatic de-arming to and/or

reset to the first mode, e.g. storage mode, i.e. mode 210, may be performed at lack of electric energy, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode.

**[0051]** In mode 270, i.e. in the preparation mode, the munition controller 100 may be in a partly armed or armed status, operational, and the at least one sensor 140 detected a nearby target. In mode 270, i.e. the preparation mode, forward transition to the second mode, i.e. mode 280, may comprise at least one of enabling fully armed status, if required, and charging a fuzing capacitor. Backward transition to the lurking and/or loitering mode, i.e. mode 260, may be performed a predefined time elapsed, e.g. 120 s. Backward transition to the remote arming mode, i.e. mode 240B, may comprise receiving a remote de-arming command. Backward transition to the manual arming mode, i.e. mode 240A, may comprise receiving a manual de-arming procedure, e.g. by NFC controller, key code, or the like, and automatic de-arming due to lack of electric power, e.g. by low or depleted battery power. Backward transition or automatic de-arming to and/or reset to the first mode, e.g. storage mode, i.e. mode 210, may be performed at lack of electric energy, wherein the electric power supply connection may be maintained and can be disconnected afterwards for the fully first mode, e.g. storage mode, i.e. mode 210.

**[0052]** Fig. 4 illustrates in a flow chart a method 300 for selectively de-arming, arming and/or fuzing of remotely controllable munition. The method comprises, 310, in a first mode, disabling a fuzing mechanism of the munition controller by separating a booster charge and a detonator from each other, wherein an electrical power supply of the munition controller is disconnected. The method further comprises, 320, in at least one intermediate mode, establishing operational readiness of the munition controller with the electrical power supply being connected and at least partly arming the fuzing mechanism. In addition, the method comprises, 330, in a second mode, enabling triggering of the at least partly armed fuzing mechanism based on a sensor signal indicative for a detected target. The transitioning from the first mode towards the at least one intermediate mode comprises connecting of the electrical power supply and receiving manual operator input on-site.

**[0053]** In the foregoing detailed description, various features are grouped together in one or more examples or examples with the purpose of streamlining the disclosure. It is to be understood that the above description is intended to be illustrative, and not restrictive. It is intended to cover all alternatives, modifications and equivalents. Many other examples will be apparent to one skilled in the art upon reviewing the above specification. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated.

LIST OF REFERENCE SIGNS

**[0054]**

| | |
|---|---|
| 10 | munition system |
| 12 | munition |
| 100 | munition controller |
| 110 | electrical power supply |
| 120 | fuzing mechanism |
| 122 | booster charge |
| 124 | detonator |
| 130 | control circuitry |
| 140 | sensor |
| 200 | diagram (e.g. state machine) |
| 210-280 | modes and/or states |
| 300 | method |
| 310-330 | method step(s) |

**Claims**

1. A method (300) for selectively de-arming, arming and/or fuzing of remotely controllable munition (12), the method being applied to a munition controller (100) coupleable or coupled to the munition and operable in multiple modes, and the method comprising:

   in a first mode (310), disabling a fuzing mechanism (120) of the munition controller (100) by separating a booster charge (122) and a detonator (124) from each other, wherein an electrical power supply (110) of the munition controller (100) is disconnected;
   in at least one intermediate mode (320), establishing operational readiness of the munition controller (100) with the electrical power supply (110) being connected and at least partly arming the fuzing mechanism (120); and
   in a second mode (330), enabling triggering of the at least partly armed fuzing mechanism based on a sensor signal indicative for a detected ta rg et;
   wherein transitioning from the first mode towards the at least one intermediate mode comprises connecting of the electrical power supply (110) and receiving manual operator input on-site.

2. The method of claim 1, wherein the first mode, the at least one intermediate mode and the second mode are in sequential order.

3. The method of claim 1 or 2, wherein in case of lack of electrical power of the munition controller (100) automatic transition to the first mode is performed.

4. The method of any one of the preceding claims, wherein the at least partly arming of the fuzing mechanism (120) comprises at least one of bringing the booster charge (122) and the detonator (124) together and removing an interrupter arranged between the booster charge (122) and the detonator (124).

5. The method of any one of the preceding claims, wherein establishing operational readiness comprises performing at least one self-check of the munition controller (100), wherein proceeding with the at least partly arming depends on the at least one self-check being successful.

6. The method of any one of the preceding claims, wherein the at least partly arming is selected from manual arming and remote arming, based on whether at least one manual arming criterion or at least one remote arming criterion is met.

7. The method of claim 6, wherein the at least one manual arming criterion comprises at least one of a manual operator input indicating a manual arming command, a hardware configuration of the munition controller, and a ruled-based manual arming criterion.

8. The method of claim 6 or 7, wherein the at least one remote arming criterion comprises at least one of receiving a remote arming command signal, a hardware configuration of the munition controller, and availability of a remote communication link.

9. The method of any one of claims 6 to 8, wherein, if manual arming is selected, transitioning from the at least partly arming towards operational readiness and/or the first mode is triggered by at least one of receiving an operator input, a lack of electrical power, and a rule-based automatic transition.

10. The method of any one of claims 6 to 9, wherein, if remote arming is selected, transitioning from the at least partly arming towards operational readiness is prevented.

11. The method of any one of claims 8 to 10, wherein, if remote arming is selected, transitioning from the at least partly arming towards the first mode is triggered by at least one of a lack of electrical power and a rule-based automatic transition.

12. The method of any one of the preceding claims, wherein transitioning from the at least partly arming towards the second mode comprises charging at least one energy storage of the electrical power supply for providing power for de-arming.

13. The method of any one of the preceding claims, wherein transitioning from the second mode towards the at least one intermediate mode and/or the first mode comprises at least one of receiving of an operator input, receiving a de-arming command, and a rule-based automatic transition.

14. A munition controller for selectively de-arming, arming and/or detonating of remotely controllable munition, the munition controller comprising:

an electrical power supply (110); and
a fuzing mechanism (120) coupled to the electrical power supply (110);
wherein the munition controller (100) is configured to enable carrying out the method according to any one of the preceding claims.

15. A munition system (10), comprising a remotely detonable munition (12) and a munition controller (100) according to claim 14.

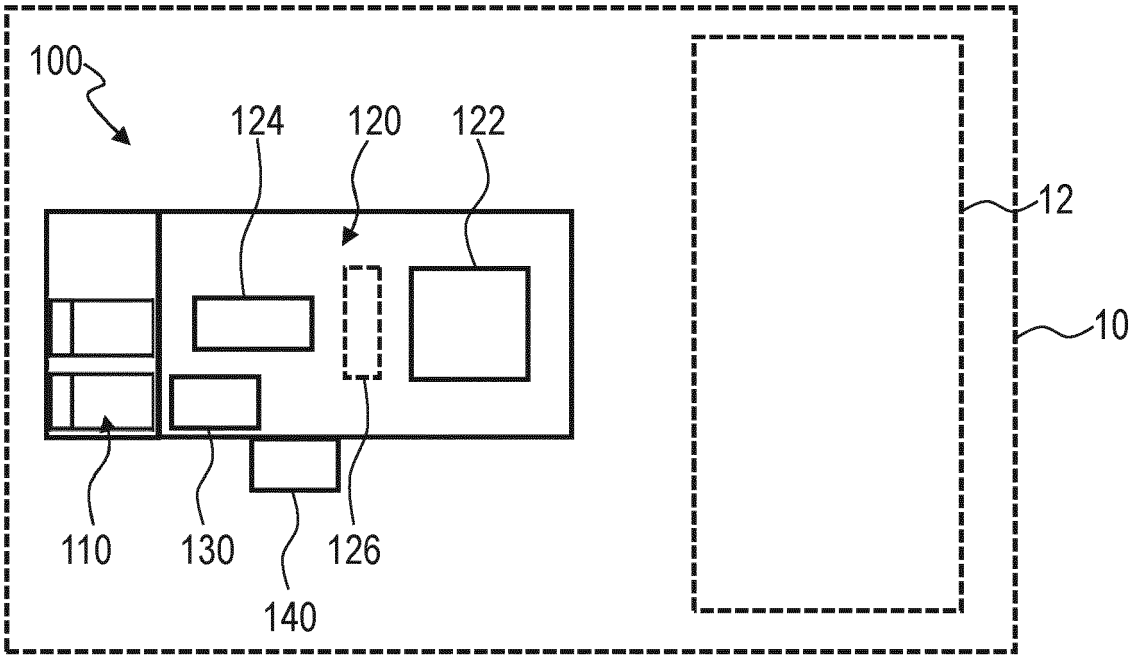


Fig. 1

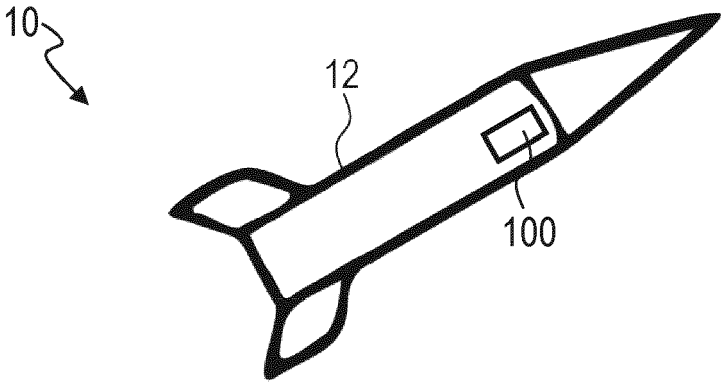


Fig. 2

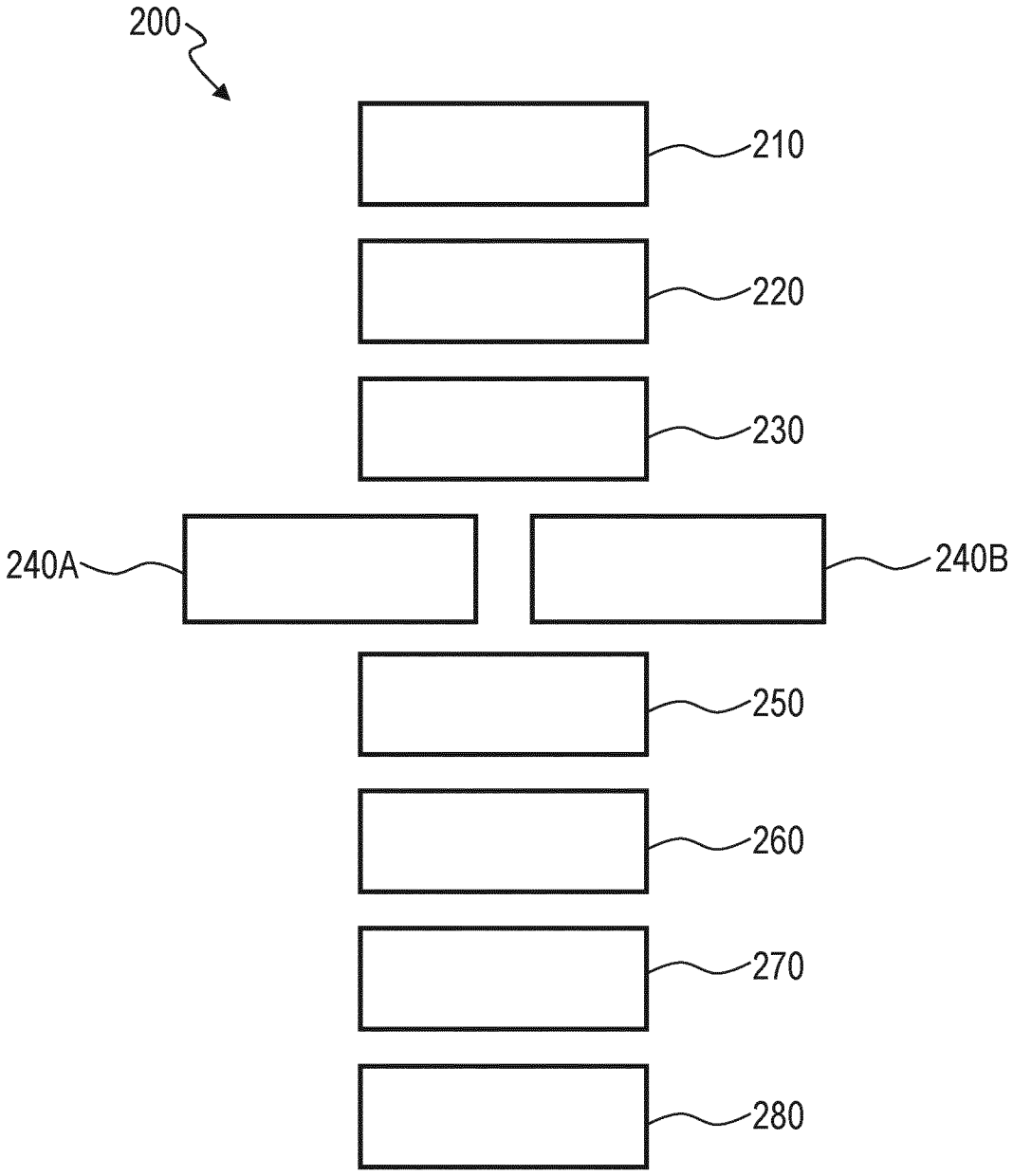


Fig. 3

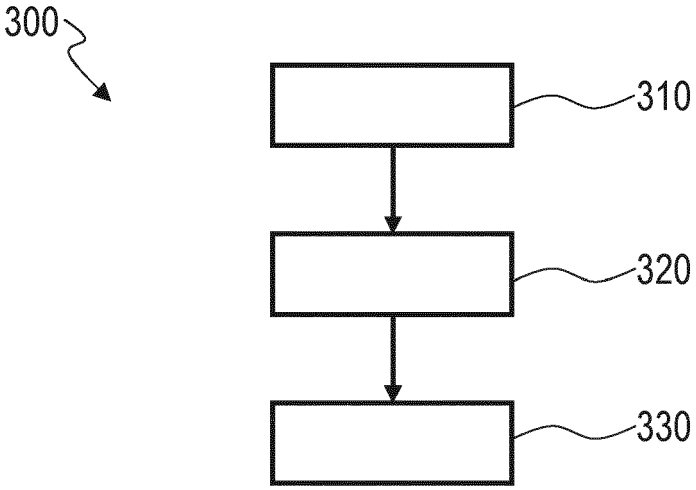


Fig. 4

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# EUROPEAN SEARCH REPORT

Application Number
EP 23 30 6928

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br><br>A | FR 2 679 325 A1 (GIAT IND SA [FR])<br>22 January 1993 (1993-01-22)<br>* abstract; figures *<br>* page 3, line 16 - page 12, line 29 *<br>----- | 1-5,<br>12-15<br>6-11 | INV.<br>F42C15/18<br>F42C15/34<br>F42C15/40<br>F42C15/42 |
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| TECHNICAL FIELDS SEARCHED (IPC) |
|---|
| F42C |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 2 April 2024 | Schwingel, Dirk |

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# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 30 6928

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82