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 EPC.

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(54) **System and method for the simulation of explosive devices**

(57) Explosive device simulation system comprising at least one explosive device simulator (1) having means to receive (4) and store (5) information concerning its position and means to communicate (4) said in-

formation and a method of laying at least one such explosive device simulator (1) comprising the step of providing the, or each explosive device simulator (1) with information concerning its position.

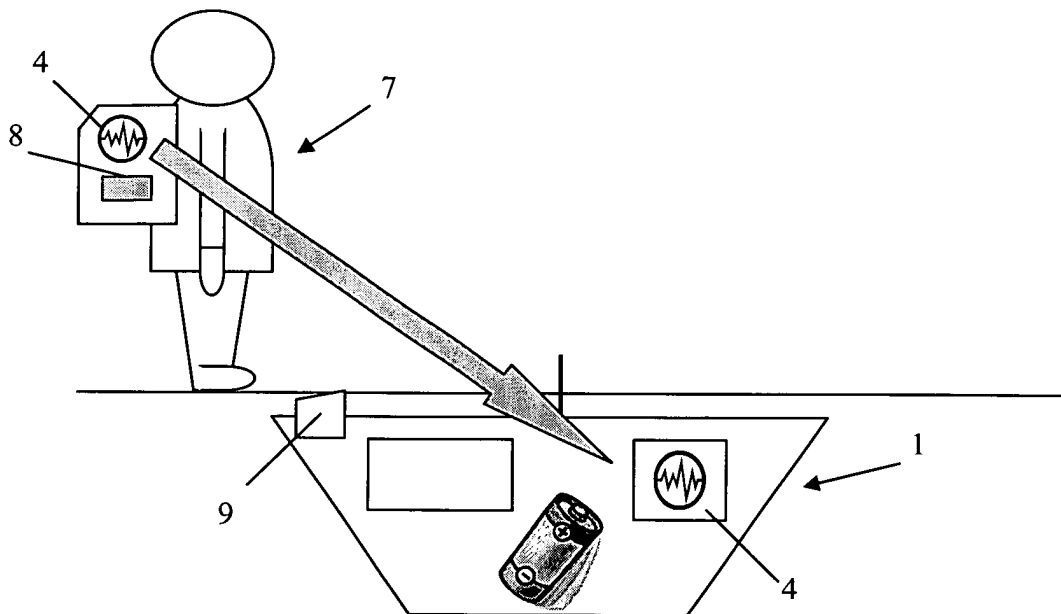


Fig. 2

Description

TECHNICAL FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention concerns an explosive device simulation system comprising at least one explosive device simulator that simulates the action of any of the following explosive devices: a land mine, a sea mine, a hand grenade, a nuclear, chemical or biological device. The invention also relates to a method for laying at least one such explosive device simulator.

[0002] Mines are explosive devices that are designed to detonate when triggered magnetically, by pressure, by tripwire or by remote detonation for example. These devices are widely used in warfare to prevent unauthorised access to a given geographical area on land or sea by disabling any person or vehicle that comes into contact with them by exploding or by releasing projectiles, such as metal or glass fragments or parts of the casing of the mine itself at high speeds. Land mines are typically found on, or just below the surface of the ground. The ability to identify a mine in a timely manner and circumvent it is of paramount importance and this ability can be gained and improved by training and exercising using a mine simulation system.

[0003] WO 01/11307 discloses a mine simulation system for training/exercising soldiers and civilians in the handling and use of anti-personnel/anti-tank mines and in realizing the danger that such mines represent. The mine simulators disclosed therein are equipped with passive transponders. Each participant in the simulation exercise is equipped with a radio transmitter. The mine simulator's transponder emits a signal to a participant when it receives a designated signal from that participant's transmitter indicating that he/she has entered the range of action of the mine that the simulator simulates. A signal is also sent from the mine simulator's transponder to any other participants located within its range to inform them that in reality they would have been killed/injured by the mine that the simulator simulates.

[0004] A disadvantage with such a system is that the, or each person or vehicle taking part in the simulation exercise has to carry an active radio transmitter in order to be able to transmit a designated signal to trigger the mine's transponder. Furthermore it is difficult to simulate the effect of a detonated mine if there are several participants taking part in a training exercise who are positioned beyond the range of the mine simulator's transponder but within the range of action of the mine that the simulator simulates and who would, in a real situation, have been killed/injured on detonation of said mine. It is also difficult to simulate the effect of a mine simulator that is detonated by remote control since the remote control signal would only be detected by the mine simulator's transponder if it were sent from within the range of the mine simulator's transponder.

SUMMARY OF THE INVENTION

[0005] The object of the present invention is to provide an explosive device simulation system that enables the realistic simulation of the effect of a real explosive device.

[0006] This object is fulfilled using an explosive device simulation system having the features described in the appended claim 1 namely a system comprising at least one explosive device simulator having means to receive and store information concerning its position and means to communicate said information. According to an embodiment of the invention the, or each explosive device simulator is arranged to be detonated in the same way as the explosive device it simulates, such as magnetically, by pressure, by tripwire or remote detonation and may be arranged to be detonated in any number of ways.

[0007] The, or each explosive device simulator communicates information concerning its position to all participants i.e. people, vehicles and/or objects within the range of action of the explosive device that the explosive device simulator simulates, when the simulator's detonator has been triggered. Such information may also be communicated to a monitoring unit, database or third party. By logging all of the events taking place during a simulation exercise an After Action Review of all of the participants' performance could be carried out to examine, analyze and judge their actions during the simulation exercise.

[0008] According to another embodiment of the invention the, or each explosive device simulator also comprises means to receive, store and communicate information concerning its identity i.e. mine type for example, and/or the identity of the explosive device simulator layer. Such an explosive device simulator can therefore be programmed to simulate any type of explosive device.

[0009] According to a further embodiment of the invention the means to receive and communicate said information comprises a radio transmitter/receiver. According to a further embodiment of the invention the range of the radio transmitter/receiver corresponds to the range of action of the explosive device that the simulator simulates. The means to receive and communicate said information can however be constituted of any sort wireless connection.

[0010] According to an embodiment of the invention the, or each explosive device simulator is arranged to communicate said information to any, or all of the people and/or vehicles taking part in a simulation exercise and optionally to a central database or third party.

[0011] According to another embodiment of the invention the explosive device simulation system comprises a global positioning system (GPS) or differential global positioning system (DGPS) transmitter/receiver that provides position information to the, or each explosive device simulator. According to a further embodiment of the invention the GPS or DGPS transmitter/receiver is

arranged to be carried by a human or mechanical explosive device simulator layer. The layer can be a human being or a mechanical layer such as an explosive device burier or a scatterer constituted by the carrier shell of a rocket or a scatterer comprising launcher tubes mounted onto a vehicle.

[0012] According to a further embodiment of the invention the, or each explosive device simulator comprises a power supply that is arranged to switch to an energy-saving inactive state once said information has been received and stored. According to an embodiment of the invention said power supply is arranged to power the information communicating means of an explosive device simulator on detonation of that explosive device simulator.

[0013] According to an embodiment of the invention the explosive device simulation system comprises calculation means to provide an assessment of injury/damage caused by the detonation of an explosive device simulator. The destructive power of a mine depends on the type of mine and on the distance of the objects from the detonated mine. According to another embodiment of the invention the calculation means contain range of action data for a certain type or for each type of explosive device versus distance of people/vehicles/objects from an explosive device simulator that has been detonated in order to be able to evaluate the degree of injury/damage that would have been caused by the detonation of such an explosive device in a real situation. Said means to provide an injury/damage assessment may be arranged to be carried by any, or all of the people, vehicles and/or objects taking part in a simulation exercise.

[0014] The present invention also relates to a method for laying at least one explosive device simulator. The method comprises the step of providing the, or each explosive device simulator with information concerning its position. According to an embodiment of the invention the method also comprises the step of providing the, or each explosive device simulator with information concerning its identity and/or the identity of the explosive device simulator layer.

[0015] According to another embodiment of the invention the method comprises the step of using a global positioning system (GPS) or differential global positioning system (DGPS) transmitter/receiver to provide position information to the, or each explosive device simulator.

[0016] According to a further embodiment of the invention the method comprises the step of activating the power system of the, or each explosive device simulator prior to providing the, or each explosive device simulator with said information. According to a yet further embodiment of the invention the method comprises the step of de-activating the power system of the, or each explosive device simulator after providing the, or each explosive device simulator with said information.

[0017] The present invention furthermore concerns a computer program containing computer program code means for making a computer or processor assess the

injury/damage caused by the detonation of an explosive device simulator of an explosive device simulation system according to any of the embodiments of the invention and such a computer program stored by means of a computer-readable medium.

[0018] The system, method and computer program according to the invention are intended for simulating the action of any of the following explosive devices: a land mine, a sea mine, a hand grenade, a nuclear, chemical or biological device.

[0019] The present invention also concerns a computer program containing computer program code means for making a computer or processor execute at least one of the steps of the inventive method and such a computer program stored by means of a computer-readable medium.

[0020] Further advantages as well as advantageous features of the invention appear from the following description and the other dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 shows a land mine simulator according to an embodiment of the invention,

Fig. 2 depicts a person laying a land mine simulator according to an embodiment of the invention,

Fig. 3 shows a tank approaching a land mine simulator according to an embodiment of the invention,

Fig. 4 is a flow chart describing the procedure of laying a land mine simulator according to an embodiment of the invention, and

Fig. 5 is a flow chart describing the sequence of events taking place once a land mine simulator according to an embodiment of the invention has been detonated.

[0022] The following description and drawings are not intended to limit the present invention to the embodiment disclosed. The embodiment disclosed merely exemplifies the principles of the present invention. It should be noted that the drawings are not drawn to scale and that the size of certain features has been exaggerated for the sake of clarity.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

[0023] Figure 1 shows a land mine simulator 1 that is buried just below the surface of the ground 2. A land mine simulator 1 can however be positioned in any location on or above the ground 2. The land mine simula-

tor 1 is triggered by means of an ignitor 3, i.e. a metal rod that protrudes from the ground 2 and which triggers the mine's detonator when depressed by a person or a vehicle. The detonation means could also be a trip wire or a pressure plate for example. The land mine simulator 1 comprises a radio transmitter/receiver 4, a memory unit 5 and a battery 6.

[0024] The procedure followed when laying a land mine simulator according to the present invention will now be explained with reference to figure 2. Figure 2 shows a person 7 that has just buried a land mine simulator 1. The mine-layer 7 carries a harness containing a radio transmitter/receiver 4 and a GPS transmitter/receiver 8. Once the land mine simulator 1 has been buried the mine-layer 7 activates the land mine simulator 1 using a manual start button 9 at the top of the land mine simulator for example.

[0025] The radio transmitter/receiver 4 and the memory unit 5 are then powered and the land mine simulator 1 asks for information concerning its position. Optionally the land mine simulator 1 asks for information concerning its identity, i.e. the type of anti-personnel or anti-tank land mine that it simulates, and/or the identity of the mine layer if this information has not already been stored in its memory unit 5. The mine-layer's 7 radio transmitter/receiver 4 transmits said information to the land mine simulator 1 including position data provided by the layer's GPS transmitter/receiver 8. The information is stored in the land mine simulator's memory unit 5 and the simulator is then switched to an inactive battery-saving state awaiting detonation.

[0026] Figure 3 shows a tank 10 approaching a land mine simulator 1. The tank 10, like every other person or vehicle taking part in the simulation exercise is equipped with a radio transmitter/receiver 4 and a GPS transmitter/receiver 8. When the tank 4 drives over the ignitor 3 the land mine simulator 1 is activated i.e. its memory unit 5 and radio transmitter/receiver 4 receive power from the battery 6. The land mine simulator 1 sends information concerning its position and type to a calculation unit contained in the tank 10 so that said calculation unit can evaluate the degree of damage to the tank 10 caused by the explosion of the land mine that the simulator simulates. Depending on the degree of damage the tank's 10 mobility and/or weaponry could be partly or totally disabled. The tank's calculation means contain range of action data for the type of mine that the simulator is simulating versus distance of targets from said mine in order to provide an accurate injury/damage assessment.

[0027] The position- and type-signal from the land mine simulator 1 is also transmitted to any other vehicle and person within the range of the radio transmitter/receiver 4 of the land mine simulator, which corresponds to the range of action of the land mine that the simulator is simulating, about 10-20m for example. It should be noted that the range of action can be of any form, such as a figure of eight or "hourglass" form. If there is another

person or vehicle with said range, their radio transmitter/receiver 4 receives the signal that the land mine has been detonated. Their position, provided by the GPS transmitter/receiver 8 they are carrying is then transmitted to the calculation unit incorporated in their equipment so that each person or vehicle can obtain an injury/damage assessment. Such an assessment may for example be a "dead" signal meaning that the person is "dead" for the remainder of the exercise and that his/her weapons are therefore disabled. Once a land mine simulator is detonated subsequent people or vehicles may pass that land mine simulator without being destroyed or disabled.

[0028] Any non-moving structure, such as a building, located near or in the simulated minefield and especially in the vicinity of the land mine simulators may also be provided with a radio transmitter/receiver, calculation unit and GPS transmitter/receiver so that damage resulting from an explosion that causes a shock wave to propagate in soil and air and to then interact with the structure, or damage resulting from fragments released from the mine can be assessed.

[0029] Figure 4 is a flow chart detailing the steps involved in laying a land mine simulator using a method according to an embodiment of the invention. Once the power supply of the land mine simulator has been activated its memory unit and radio transmitter/receiver are initiated causing the land mine to ask for information concerning its position and identity. Once this information is received it is stored and the land mine simulator is switched to an inactive energy-saving state awaiting detonation.

[0030] Figure 5 is a flow chart describing the sequence of events taking place once a land mine simulator according to an embodiment of the invention has been detonated i.e. immediately after a person or vehicle has triggered the land mine simulator's detonator or a certain time after the triggering, whichever would be the case with a land mine of that type in a real situation. Firstly the land mine simulator's powers supply is activated initiating its memory unit and radio transmitter/receiver.

[0031] The land mine simulator then sends out a signal informing all people, vehicles or objects in its range of action of its position and identity so that injury/damage assessments can be provided by the calculation units carried by all participants in the simulation exercise. Information may also be sent to an exercise monitoring system, database or third party to monitor and log the proceedings.

[0032] Optionally the land mine simulator may be equipped with visual and/or audio means 11 such as a flashlight, smoke grenade and/or audible alarm which go off when the land mine simulator has been detonated in order to provide mock explosions and consequently a more realistic detonation effect when a target has been hit.

[0033] The invention is of course not in any way re-

stricted to the embodiments thereof described above, but many possibilities to modifications thereof would be apparent to a man with ordinary skill in the art without departing from the basic idea of the invention as defined in the appended claims.

Claims

1. Explosive device simulation system comprising at least one explosive device simulator (1), **characterized in that** the, or each explosive device simulator (1) comprises means to receive (4) and store (5) information concerning its position and means to communicate (4) said information.
2. Explosive device simulation system according to claim 1, **characterized in that** the, or each explosive device simulator (1) also comprises means to receive (4), store (5) and communicate (4) information concerning its identity and/or the identity of the explosive device simulator layer (7).
3. Explosive device simulation system according to claim 1 or 2, **characterized in that** the, or each explosive device simulator (1) is arranged to communicate said information when it has been "detonated".
4. Explosive device simulation system according to any of the preceding claims, **characterized in that** the means to receive and communicate said information comprises a radio transmitter/receiver (4).
5. Explosive device simulation system according to any of the preceding claims, **characterized in that** the range of the radio transmitter/receiver (4) corresponds to the range of action of the explosive device that the simulator (1) simulates.
6. Explosive device simulation system according to any of the preceding claims, **characterized in that** the, or each explosive device simulator (1) is arranged to communicate said information to any, or all of the people and/or vehicles (10) taking part in a simulation exercise and optionally to a central database or third party.
7. Explosive device simulation system according to any of the preceding claims, **characterized in that** it comprises a global positioning system (GPS) or differential global positioning system (DGPS) transmitter/receiver (8) that provides position information to the, or each explosive device simulator (1).
8. Explosive device simulation system according to claim 7, **characterized in that** the GPS or DGPS transmitter/receiver (8) is arranged to be carried by a human or mechanical explosive device simulator layer (7).
9. Explosive device simulation system according to any of the preceding claims, **characterized in that** the, or each explosive device simulator (1) comprises a power supply (6) that is arranged to switch to an energy-saving inactive state once said information has been received and stored.
10. Explosive device simulation system according to claim 9, **characterized in that** said power supply (6) is arranged to power the information communicating means (4) of an explosive device simulator (1) on detonation of that explosive device simulator (1).
11. Explosive device simulation system according to any of the preceding claims, **characterized in that** the, or each explosive device simulator (1) is arranged to be detonated in the same way as the explosive device it simulates, such as magnetically, by pressure (3), tripwire or remote detonation.
12. Explosive device simulation system according to any of the preceding claims, **characterized in that** it comprises calculation means (5) to provide an assessment of injury/damage caused by the detonation of an explosive device simulator (1).
13. Explosive device simulation system according to claim 12, **characterized in that** the calculation means (5) contain range of action data for a certain type, or each type of explosive device that is simulated by said at least one explosive device simulator (1) versus distance of people/vehicles/non-movable structures from such an explosive device in order to assess the degree of injury/damage that would have been caused by detonation of the explosive device that the simulator is simulating in a real situation.
14. Explosive device simulation system according to claim 12 or 13, **characterized in that** the means to evaluate an injury/damage assessment are arranged to be carried any, or all of the people, vehicles (10) and/or objects taking part in a simulation exercise.
15. Method for laying at least one explosive device simulator (1), **characterized in that** it comprises the step of providing the, or each explosive device simulator (1) with information concerning its position.
16. Method according to claim 15, **characterized in that** it also comprises the step of providing the, or each explosive device simulator (1) with information concerning its identity and/or the identity of the ex-

plosive device simulator layer (7).

17. Method according to claim 15 or 16, **characterized in that** it comprises the step of using a global positioning system (GPS) or differential global positioning system (DGPS) transmitter/receiver (8) to provide position information to the, or each explosive device simulator (1). 5
18. Method according to any of claims 15-17, **characterized in that** it comprises the step of activating the power system (6) of the, or each explosive device simulator (1) prior to providing the, or each explosive device simulator (1) with said information. 10
19. Method according to any of claims 15-18, **characterized in that** it comprises the step of de-activating the power system (6) of the, or each explosive device simulator (1) after providing it with said information. 15
20. A computer program containing computer program code means for making a computer or processor assess the injury/damage caused by the detonation of an explosive device simulator (1) of a system according to any of claims 1-14. 20
21. A computer program according to claim 20 stored by means of a computer-readable medium. 25
22. Use of a system according to any of claims 1-14, a method according to any of claims 15-19, or a computer program according to claim 20 or 21 for simulating the action of any of the following explosive devices: a land mine, a sea mine, a hand grenade, a nuclear, chemical or biological device. 30

Amended claims in accordance with Rule 86(2) EPC. 35

1. Explosive device simulation system comprising at least one explosive device simulator (1), said or each explosive device simulator (1) comprising means to receive (4) and store (5) information concerning its position and means to communicate (4) said information **characterized in that** said means to receive information are arranged to receive the information from a human or mechanical explosive device simulator layer. 40
2. Explosive device simulation system according to claim 1, **characterized in that** the, or each explosive device simulator (1) also comprises means to receive (4) information from the human or mechanical explosive device simulator layer concerning its identity and/or the identity of the explosive device simulator layer (7), and means to store (5) and communicate (4) said identity information. 45

3. Explosive device simulation system according to claim 1 or 2, **characterized in that** the, or each explosive device simulator (1) is arranged to communicate said information when it has been "detonated".

4. Explosive device simulation system according to any of the preceding claims, **characterized in that** the means to receive and communicate said information comprises a radio transmitter/receiver (4).

5. Explosive device simulation system according to any of the preceding claims, **characterized in that** the range of the radio transmitter/receiver (4) corresponds to the range of action of the explosive device that the simulator (1) simulates.

6. Explosive device simulation system according to any of the preceding claims, **characterized in that** the, or each explosive device simulator (1) is arranged to communicate said information to any, or all of the people and/or vehicles (10) taking part in a simulation exercise and optionally to a central database or third party.

7. Explosive device simulation system according to any of the preceding claims, **characterized in that** it comprises a global positioning system (GPS) or differential global positioning system (DGPS) transmitter/receiver (8) that is carried by the human or mechanical explosive device simulator layer (7) and that provides position information to the, or each explosive device simulator (1).

8. Explosive device simulation system according to any of the preceding claims, **characterized in that** the, or each explosive device simulator (1) comprises a power supply (6) that is arranged to switch to an energy-saving inactive state once said information has been received and stored.

9. Explosive device simulation system according to claim 8, **characterized in that** said power supply (6) is arranged to power the information communicating means (4) of an explosive device simulator (1) on detonation of that explosive device simulator (1).

10. Explosive device simulation system according to any of the preceding claims, **characterized in that** the, or each explosive device simulator (1) is arranged to be detonated in the same way as the explosive device it simulates, such as magnetically, by pressure (3), tripwire or remote detonation.

11. Explosive device simulation system according to any of the preceding claims, **characterized in that** it comprises calculation means (5) to provide

an assessment of injury/damage caused by the detonation of an explosive device simulator (1).

12. Explosive device simulation system according to claim 11, **characterized in that** the calculation means (5) contain range of action data for a certain type, or each type of explosive device that is simulated by said at least one explosive device simulator (1) versus distance of people/vehicles/non-movable structures from such an explosive device in order to assess the degree of injury/damage that would have been caused by detonation of the explosive device that the simulator is simulating in a real situation.

13. Explosive device simulation system according to claim 11 or 12, **characterized in that** the means to evaluate an injury/damage assessment are arranged to be carried any, or all of the people, vehicles (10) and/or objects taking part in a simulation exercise.

14. Method for laying at least one explosive device simulator (1), comprising the step of providing the, or each explosive device simulator (1) with information concerning its position, **characterized in that** a human or mechanical explosive device simulator layer transmits the position information to the explosive device simulator (1).

15. Method according to claim 14, **characterized in that** the human or mechanical explosive device simulator layer provides information concerning the identity of the explosive device simulator (1) and/or the identity of the explosive device simulator layer (7) to the explosive device simulator.

16. Method according to claim 14 or 15, **characterized in that** it comprises the step of using a global positioning system (GPS) or differential global positioning system (DGPS) transmitter/receiver (8) to provide position information to the human or mechanical explosive device simulator layer.

17. Method according to any of claims 14-16, **characterized in that** it comprises the step of activating the power system (6) of the, or each explosive device simulator (1) prior to providing the, or each explosive device simulator (1) with said information.

18. Method according to any of claims 14-17, **characterized in that** it comprises the step of de-activating the power system (6) of the, or each explosive device simulator (1) after providing it with said information.

19. Use of a system according to any of claims 1-13 or a method according to any of claims 14-18 for

simulating the action of any of the following explosive devices: a land mine, a sea mine, a hand grenade, a nuclear, chemical or biological device.

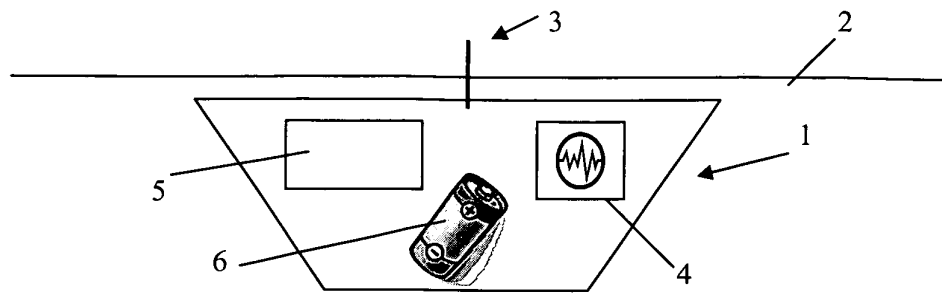


Fig. 1

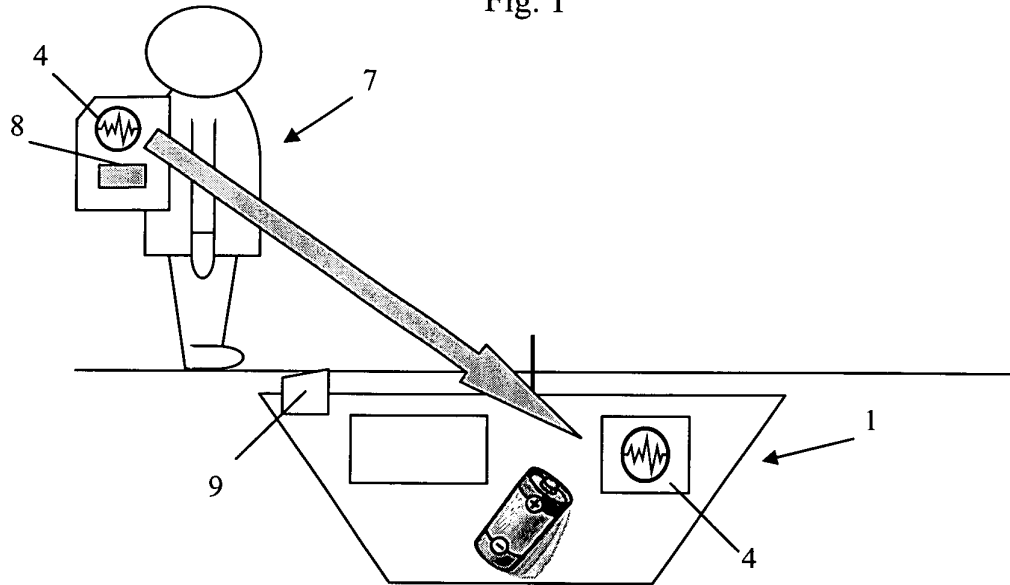


Fig. 2

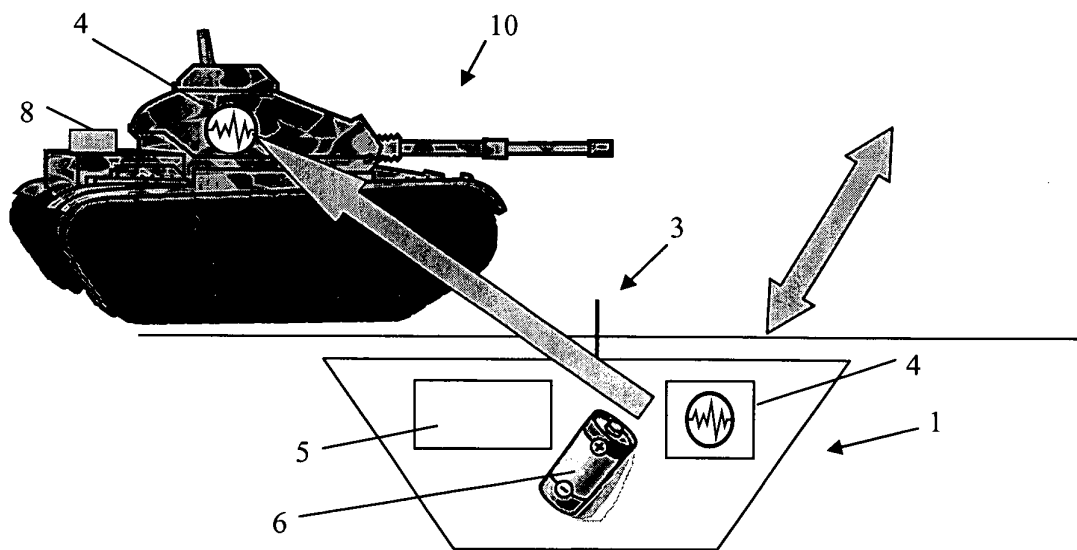


Fig. 3

Laying a land mine simulator

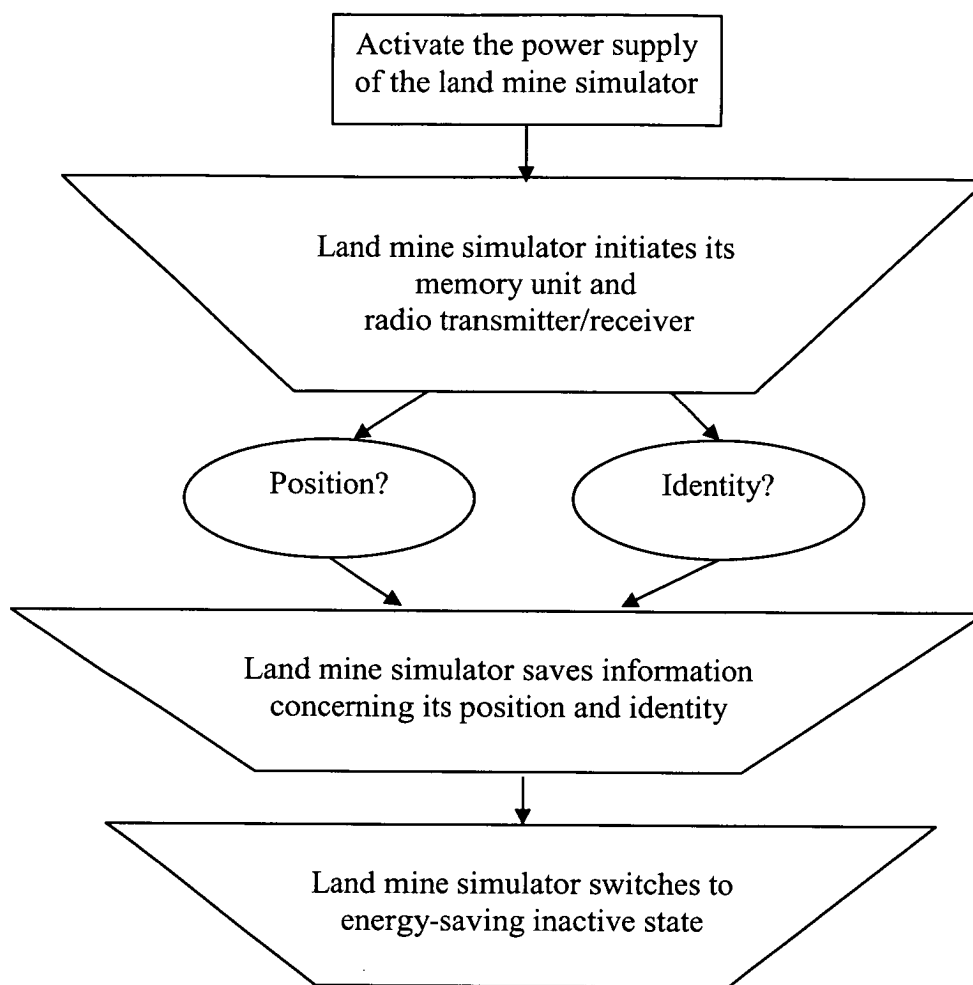


Fig. 4

Detonating a land mine simulator

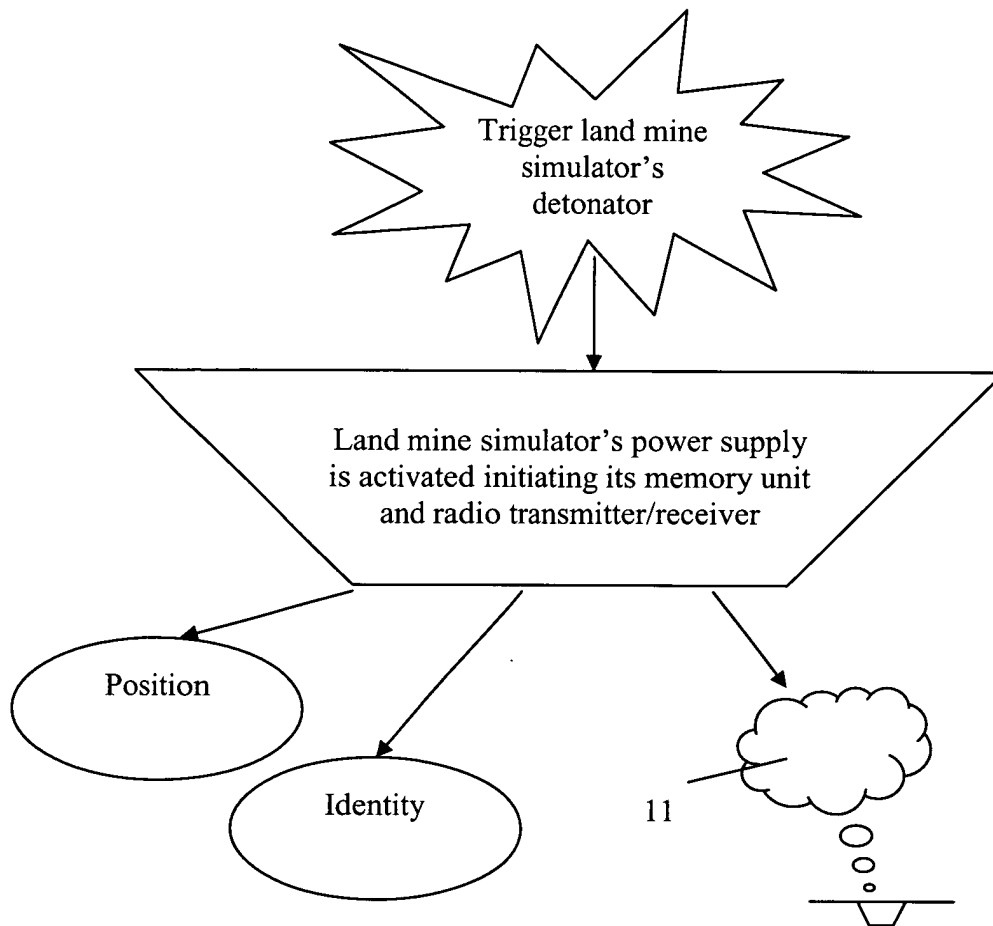


Fig. 5



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PARTIAL EUROPEAN SEARCH REPORT

Application Number

which under Rule 45 of the European Patent Convention EP 04 01 4429 shall be considered, for the purposes of subsequent proceedings, as the European search report

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X,D	WO 01/11307 A (BENGSSON JAN ; NYFELT LEIF (SE)) 15 February 2001 (2001-02-15) * page 2, line 21 - line 24 * * page 2, line 30 - page 3, line 23 * * page 4, line 6 - page 5, line 2 * * page 5, line 30 - page 7, line 2 * * page 7, line 18 - line 20 * * page 9, line 10 - line 13 * * figures 1-5 *	1-5, 15-17	F42B8/28
Y		6-11	
A		12-14,22	
Y	----- US 5 695 341 A (FITZGERALD MARK RICHARD ET AL) 9 December 1997 (1997-12-09) * column 1, line 54 - line 62 * * column 2, line 46 - line 51 *	6-11	
A	----- -/--	12-14,22	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F42B F41A
INCOMPLETE SEARCH			
The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims. Claims searched completely : Claims searched incompletely : Claims not searched : Reason for the limitation of the search: see sheet C			
Place of search		Date of completion of the search	Examiner
The Hague		1 December 2004	Gex-Collet, A-L
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

5

EPO FORM 1503 03.82 (P04C07)



European Patent
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PARTIAL EUROPEAN SEARCH REPORT

Application Number
EP 04 01 4429

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	DE 44 32 009 A (MAFO SYSTEMTECH GMBH & CO KG) 14 March 1996 (1996-03-14) * column 4, line 44 - line 49 * -----		TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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European Patent
Office

**INCOMPLETE SEARCH
SHEET C**

Application Number
EP 04 01 4429

Claim(s) searched completely:
1-19

Claim(s) searched incompletely:
22

Claim(s) not searched:
20,21

Reason for the limitation of the search (non-patentable invention(s)):

Article 52 (2)(c) EPC - Program for computers

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 01 4429

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-12-2004

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