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- (54) Title: METHOD AND ASSEMBLY FOR DETERMINING THE FLIGHT DIRECTION OF A BULLET

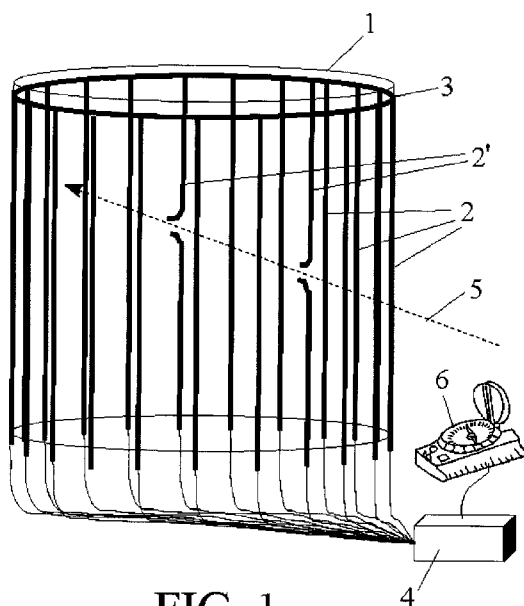


FIG. 1

(57) **Abstract:** Method for determining the flight direction of a bullet within an area, comprising : providing a hollow spatial body (1) of electrically non-conductive material, provided with a large number of parallel conductors (2) which extend from top to bottom on or near the surface of the spatial body, each conductor is connected to an electric power source, and to current detection means adapted to detect through which conductors a current flows, and through which conductors no current flows. Furthermore computing means (4) are provided, which are configured to calculate the flight direction of the bullet from the position of the two conductors (2') of which the current flow, as detected by the current detection means, was interrupted by a bullet. If the device is complemented with sound detection means, it is possible to make a rough estimate of the distance to the shooting location.

Title: Method and assembly for determining the flight direction of a bullet

DESCRIPTION

5 The invention relates to a method and an assembly for determining the flight direction of a bullet originating from e.g. gunfire or machine-gun fire.

During a gunfight, it is often difficult to determine where the enemy is. Sometimes bullets come from several directions. It is an object of the present invention to provide
10 a tool for use in such chaotic circumstances, the tool being able to determine the flight direction of the bullets originating from the gunfire or machine-gun fire etc.

According to the present invention, a method is provided for determining the flight direction of a bullet within an area, comprising

- 15 – providing a detection device comprising a spatial body of electrically non-conductive material, provided with a large number of parallel conductors which extend from top to bottom on or near the surface of the spatial body and which are each connected to an electric power source, and current detection means adapted to detect conductors through which a current flows, and to detect conductors through
20 which no current flows;
- providing computing means, which are configured to calculate the flight direction R of the bullet from the position of the two conductors of which the current flow, as detected by the current detection means, was interrupted by a bullet;
- positioning of said body in said area.

25

The invention also includes an assembly (or configuration or system) for determining the flight direction of a bullet within an area, comprising a spatial body of electrically non-conductive material, provided with a large number of parallel conductors which extend from top to bottom on or near the surface of the spatial body and which are
30 each connected to an electric power source, and current detection means adapted to detect the conductors through which a current flows, and to detect the conductors through which no current flows, and furthermore computing means, which are configured to calculate the flight direction R of the bullet from the position of the two conductors of which the current flow, as detected by the current detection means, was
35 interrupted by a bullet.

The invention can be complemented with sound detection means (for example, one or more microphones) for detecting the sound (the "crack") of firing the bullet, and for detecting the time moment T_{crack} on which that sound was received by the sound detection means. This enables determining the distance S_{bul} between the shooting
 5 location and the detection device.

This is achieved by:

- determining the mutual distance ΔX between the two interrupted conductors, the time interval ΔT between the successive time moments T_1 and T_2 onto which the current was interrupted in the two conductors, and calculating the velocity of the
 10 bullet from the mutual distance ΔX and the time interval ΔT ;
- calculating the location of firing the bullet from:
 - (a) the known position L of the detection body or of the interrupted conductors,
 - (b) the direction R from which the bullet was fired, calculated by the computing means, and moreover
 - 15 (c) the time moment T_{crack} on which the sound of firing (the "shotgun crack") was detected and
 - (d) the interruption time moments T_1 and T_2 and the therefrom calculated velocity V_{bul} of the bullet.

20 The invention will now be further discussed based on the figure description following hereinafter.

Figure 1 shows an embodiment of an assembly according to the invention.

25 Figure 1 shows an embodiment of an assembly for determining the flight direction of a bullet originating from e.g. gunfire or machine-gun fire within an area. Preferably, the assembly comprises a hollow, optionally inflatable, spatial body 1 of an electrically non-conductive material, e.g. a plastic film, provided with a large number of parallel conductors 2 (for example 128) extending from top to bottom on or near the surface of
 30 said spatial body 1. The conductors 1 are interconnected at the top to each other by means of, for example, a connecting ring 3 and are each connected at the bottom to a module 4 having an electrical power source and current detection means adapted to detect through which conductors a current flows, and to detect through which conductors no current flows. Furthermore, the module 4 comprises computing means
 35 with, for example, a current detection matrix monitor and a digital processor, which module 4 is arranged to determine the direction of the bullet trajectory 5, from the position of the two conductors 2' of which is detected at a moment in time by the

current detection means that no current flows anymore, as a result of interruption by a bullet. Optionally, the module 4 uses a (conventional or electronic) compass 6.

Determination of the distance to the shooter

5

If a bullet hits and travels through the spatial body 1 of the detection device, usually two conductors 2 are broken as a result. If the points in time are determined accurately at which the conductors 2 are interrupted, then the time difference (ΔT) is known between the breakage of the conductors 2. If the mutual distance between the conductors 2 (ΔX) is also known, then it is easy to calculate the speed of the bullet (V_{bul}).

10

$$V_{bul} = \Delta X / \Delta T$$

15

If, for example, by means of a microphone the sound of the shot (crack) is detected, then the time difference (ΔT_{crack}) is known between the crack and the breakage T_1 of the first (conductor) wire.

The speed of sound (V_{sou}) is about 340 meters per second.

20

The bullet has flown through the air T_{bul} seconds and has travelled in that time a distance X of:

$$S_{bul} = V_{bul} * T_{bul}$$

25

The sound has travelled the same distance S_{bul} in a different time:

$$S_{bul} = V_{sou} * (T_{bul} + \Delta T_{crack})$$

30

So true:

$$V_{sou} * (T_{bul} + \Delta T_{crack}) = V_{bul} * T_{bul}$$

$$(T_{bul} + \Delta T_{crack}) = (V_{bul} * T_{bul}) / V_{sou}$$

35

$$T_{bul} = (V_{bul} * T_{kog}) / V_{sou} - \Delta T_{crack}$$

4

$$T_{bul} - T_{bul} * (V_{bul} / V_{sou}) = -\Delta T_{crack}$$

$$T_{bul} * (1 - (V_{bul} / V_{sou})) = -\Delta T_{crack}$$

$$5 \quad T_{bul} = \Delta T_{crack} / ((V_{bul} / V_{sou}) - 1)$$

Example:

$$\Delta T_{crack} = 1 \text{ second (bullet is faster than sound)}$$

$$10 \quad V_{sou} = 340 \text{ meter per second.}$$

$$V_{bul} = 500 \text{ meter per second.}$$

$$T_{bul} = 1 / ((500 / 340) - 1)$$

$$15 \quad T_{bul} = 2,125 \text{ seconds}$$

En dus geldt:

$$S_{bul} = V_{sou} * (T_{bul} + \Delta T_{crack})$$

$$S_{bul} = 340 * (2,125 + 1)$$

$$20 \quad S_{bul} = 282,5 \text{ meter}$$

It should be noted that there are some factors that may influence the accuracy:

- The bullet has not a constant speed, but slows down a bit during the flight.
- The speed of sound slightly depends on the atmospheric conditions.

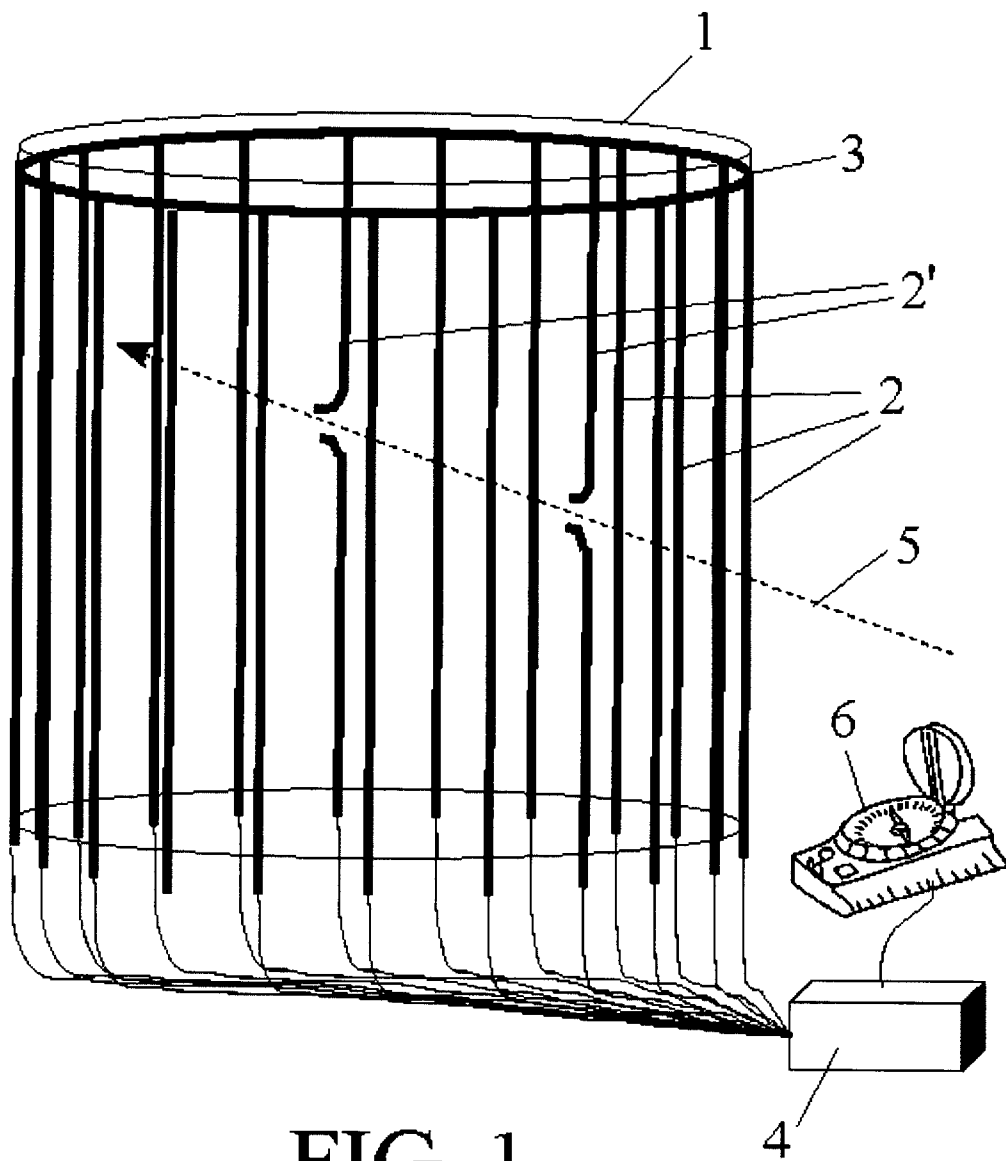
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CLAIMS

1. Method for determining the flight direction of a bullet within an area, comprising
- providing a detection device comprising a spatial body of electrically non-conductive material, provided with a large number of parallel conductors which extend from top to bottom on or near the surface of the spatial body, each conductor is connected to an electric power source, and to current detection means adapted to detect conductors through which a current flows, and to detect conductors through which no current flows;
 - providing computing means, which are configured to calculate the flight direction R of the bullet from the position of the two conductors of which the current flow, as detected by the current detection means, was interrupted by a bullet;
 - positioning of said body in said area.
2. Method according to claim 1, comprising:
- detecting the sound of firing the bullet by sound detection means and detecting the time moment T_{crack} on which the sound was received by the sound detection means;
 - determining the mutual distance ΔX between the two interrupted conductors, the time interval ΔT between the successive time moments T_1 and T_2 onto which the current was interrupted in the two conductors, and calculating the velocity V_{bul} of the bullet from the mutual distance ΔX and the time interval ΔT ;
 - calculating the location of firing the bullet from:
 - (a) the known position L of the detection body or of the interrupted conductors,
 - (b) the direction R from which the bullet was fired, calculated by the computing means, and furthermore
 - (c) the time moment T_{crack} on which the sound of firing was detected and
 - (d) the interruption time moments T_1 and T_2 and the therefrom calculated velocity V_{bul} of the bullet.

3. Assembly for determining the flight direction of a bullet within an area, comprising a spatial body (1) of electrically non-conductive material, provided with a large number of parallel conductors (2) which extend from top to bottom on or near the surface of the spatial body, and which are each connected to an electric power source, and to current detection means adapted to detect conductors through which a current flows, and to detect conductors through which no current flows, and furthermore computing means, which are configured to calculate the flight direction R of the bullet from the position of the two conductors of which the current flow, as detected by the current detection means, was interrupted by a bullet.
4. Assembly according to claim 3, comprising sound detection means for detecting the sound of firing the bullet and for detecting the time moment T_{crack} on which that sound was received by the sound detection means;
- wherein said computing means calculate the velocity V_{bul} of the bullet from the mutual distance ΔX between the two interrupted conductors, and from the time interval ΔT between the successive time moments T_1 and T_2 onto which the current was interrupted in the two conductors, and wherein the computing means calculate the location of firing the bullet from:
- (a) the known position L of the detection body or of the interrupted conductors,
 - (b) the direction R from which the bullet was fired, calculated by the computing means, and furthermore
 - (c) the time moment T_{crack} on which the sound of firing was detected and
 - (d) the interruption time moments T_1 and T_2 and the therefrom calculated velocity V_{bul} of the bullet.

1/1

FIG. 1

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

INV. F41J5/04 F41G3/14
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F41J F41G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	paragraphs [0048] - [0057], [0075] - [0078]; figures 1-4,7	2,4
Y	----- US 2012/188078 A1 (SOLES ALEXANDER M [US] ET AL) 26 July 2012 (2012-07-26) paragraphs [0087] - [0102], [0156] - [0162]; figures 4A,4B,6A,6B,6C	1-4
Y	----- US 2014/091816 A1 (HODGE BRUCE [US]) 3 April 2014 (2014-04-03) paragraph [0015]	1,3
A	----- US 2006/053534 A1 (MULLEN JEFFREY D [US]) 16 March 2006 (2006-03-16) paragraph [0043]; figure 2	1-4



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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