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

(11) EP 1 637 827 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.03.2006 Bulletin 2006/12

(51) Int Cl.:
F41G 3/02 *(2006.01)*

(21) Application number: **05108690.8**

(22) Date of filing: **21.09.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **21.09.2004 IT TO20040632**

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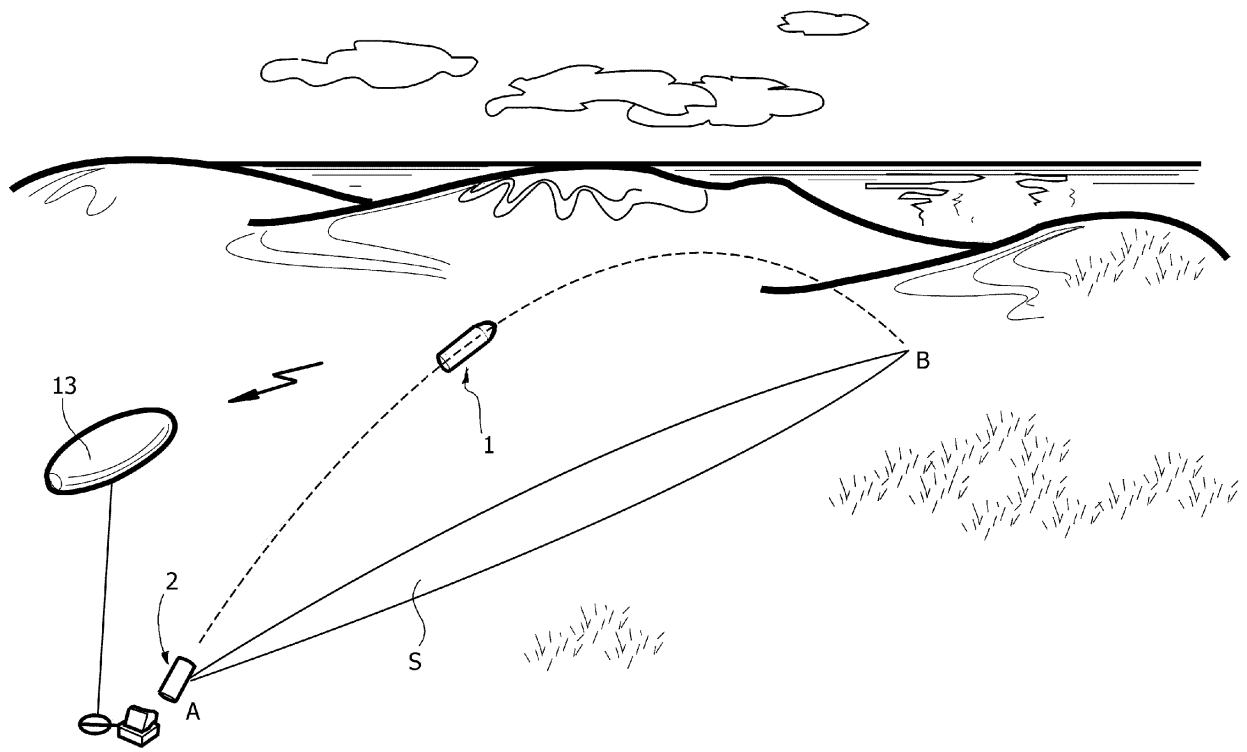
(54) Ballistically launched, remote reconnaissance device

(57) A device for the remote reconnaissance, without engine, is launched so as to perform a ballistic trajectory. The device is equipped with a side observation window which allows a vision system installed in the device to carry out a reconnaissance of a strip of territory extending from the point of launching to the point of ground impact.

FIG. 1



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Description

[0001] The present invention relates to devices for the remote reconnaissance of territory areas, of the type including a bullet to be launched with launching means of any type, a camera vision system installed in the bullet, and a transmission system installed in the bullet, for remotely transmitting data emitted by said vision system.

[0002] Under the existing circumstances, RPV aircrafts of the most different types, both with respect to the propulsion (rotary wing-, propeller and reaction propulsion) and with respect to the aerodynamic form have been proposed. In all the known solutions of RPV aircrafts, the effort of ensuring the longest flight permanence of the aircraft on the scene of the operations, ensuring a reduced radar visibility of the aircraft through the reduction of the dimensions and ensuring an even minimum offensive ability with the installation of suitable devices of the "stand-off" types seems to be prevailing. The so-called UAV aircrafts of large dimensions (such as, for example, the Global Hawk ex Northrop Grumman) which are forerunners of real robotized aeroplanes, equipped with all the functions required for a wide-spectrum operational mission, are not taken into account herein, as they belong to a different class.

[0003] A careful reading of the data relating to the cost-effectiveness ratio which arrive from the various operational scenes spreaded all over the world, allows the following considerations.

[0004] The increase of the permanence time on the operational scene is normally obtained with aircrafts having flight abilities at high-altitude and low-velocity or at low-altitude and high-velocity. In both cases, the on-board equipments make the object sophisticated and expensive, both with respect to the aircraft itself and with respect to the launching and control system.

[0005] The validity of use of a RPV aircraft resides, beyond the humanitarian and strategic considerations, in the possibility of having a dynamic depiction of the operational scene, i.e. wherein data relating to the same observations at regular following intervals of time are provided. Such result can also be obtained through observation from a geostationary satellite, which involves however well greater structures and investments.

[0006] The request of RPV aircrafts is remarkably increasing, with the result that in some cases non-technologically vanguard solutions, which are in practice equivalent to advanced model aircrafts, have been carried out.

[0007] On the other hand, the level of the request of using a means capable of preventive reconnaissance, which in the past was an exclusive of the strategic command of the operations, is, for some time decreasing, by also interesting, sometimes, the command for instance of a single battalion. For example, RPV aircrafts constituted by model aircrafts made of polyurethane foam with engine and radio control typical of the amusement model aircrafts have been proposed. The performances and the duty time of such aircrafts are obviously limited, but however sufficient for the local use. Moreover, such solutions have the advantage of being extremely inexpensive, an advantage which is not completely negligible as reconnaissance aircrafts of this type hardly return to the base. The Achilles'heel of these systems is, however, the possibility of being shot down also by a simple carabine shot because of the poor altitude and velocity performances.

[0008] The object of the present invention is to propose a new remote reconnaissance device which is able to obviate to the drawbacks above-mentioned and which results, in particular, of a relatively reduced cost, so as to make conceivable a use thereof of the "fire and forget" type (that is of the "disposable" type) and which shows however high characteristics from the point of view of the width of the area which can be subjected to reconnaissance, the low interceptability and the low visibility.

[0009] As already stated at the beginning of the present description, remote reconnaissance devices have already been proposed, which instead of being constituted of aircrafts having an own engine and remotely piloted, are, on the contrary, only in the form of bullets which are shot by a gun and which have an on-board system of vision which can remotely transmit the data emitted from it. However, in such known solutions, the territory area which can be subjected to reconnaissance substantially corresponds to the base of a theoretical lighting cone with which the vision system sees the territory once it has been parachuted, for example after having left the transport bullet (US-A-5 467 681), or after the ballistic trajectory of the bullet has interrupted itself with the exit of the parachute and the system vision placed on the tip of the bullet is directed downwards (US-A-3 962 537). Therefore, in all the known solutions, the ballistic trajectory of the bullet is not used for a reconnaissance purpose, and the bullet has the only task of bringing the vision system in place, after which the reconnaissance is carried out during a step of parachuted fall. Therefore, such known solutions involve some limits from the point of view of the width of the area which can be subjected to reconnaissance and also from the point of view of the invulnerability.

[0010] In view of attaining the purposes above-mentioned, the object of the present invention is a remote reconnaissance device of a territory area, of the type including:

- a bullet to be launched with launching means of any type,
- a camera vision system installed in the bullet,
- a transmission system installed in the bullet, for remotely transmitting data emitted by said vision system,

characterized in that the above vision system is arranged for observing the scene from a window placed on a side of the body of the bullet, such that said vision system is able to observe, at least in an intermittent way, a strip of territory flew over by the bullet during at least a substantial

part of its ballistic trajectory.

[0011] Therefore, the main advantage of the present invention is that the reconnaissance is carried out while the bullet covers its normal parabolic ballistic trajectory. In each moment of the bullet flight along said ballistic trajectory, the vision system is able to observe the territory area subtended by the vision cone leaving the side window of the bullet, which leads, at the completion of the trajectory, to the observation of a whole strip of territory, extending from the launching point to the point of final impact of the bullet and having a progressively decreasing width from the center towards the ends of the strip (since the area subtended by the vision cone increases with the increase of the bullet altitude).

[0012] Therefore, from one side the device according to the invention differs itself from RPV aircrafts in that it is not an aircraft equipped with an own engine, nor is remotely piloted. This allows to reduce of a great extent the cost of the device with respect to such RPV aircrafts, so as to render conceivable a use of the ""disposable" type. From the other side, the device according to the invention differs itself from the known solutions already using ballistically launched bullets in that therein the ballistic trajectory of the bullet is exploited for executing the reconnaissance.

[0013] Of course, having to carry out the reconnaissance from a side window of the bullet, there is the problem of ensuring that the window is pointed towards the ground at least for a substantial part of the flight time. Such result can be obtained in different ways. In a first embodiment, it can be foreseen the use of a launching gun of the conventional type with a rifled barrel, which imparts to the bullet a rotation around its longitudinal axis. In this case, of course, during the flight of the bullet, the window will continue to rotate around the longitudinal axis of the bullet. A first simple solution of the problem is that the system of data processing exiting from the vision system is programmed in order to use the data emitted in the steps wherein the window is substantially pointed towards the ground, rejecting the data emitted in the remaining time intervals. A second, more sophisticaded solution, which always relates to the use of a rifled barrel launching gun, foresees the arrangement of the vision window on a part of the body of the bullet which is rotatably mounted around the longitudinal axis of the bullet with respect to a second part of said body. In this case, motor means for controlling the rotation of the part having the vision window, if necessary with the help of a gyroscopic system are further foreseen, for the purpose of constantly maintaining the vision window substantially pointed towards the ground, despite the remaining part of the body of the bullet is rotating.

[0014] According to a variation, the launching of the bullet with a smooth-barrel gun can be, on the contrary, foreseen for the purpose of launching the bullet without imparting it a rotation around its axis. In this case, the bullet is arranged with wings which spread themselves in an operating position immediately after the launching.

[0015] According to a further feature of the invention, the bullet can be however arranged with spreadable and rotary wings, for the purpose of imparting a glided trajectory to the bullet which differs itself from the theoretical parabolic trajectory in the end step preceding the ground impact.

[0016] These and further features and advantages of the invention will result from the following description with reference to the enclosed drawings, which are given by mere way of not limiting example, wherein:

- figure 1 is a perspective view showing the way of use of the device according to the invention,
- figure 2 is a sectional view of a first embodiment of the device according to the invention,
- figure 3 is an elevational view showing the principle of functioning of the device according to the invention,
- figure 4 is a sectional view of a second embodiment of the device according to the invention, and
- figure 5 is a side view of the trajectory followed by the device of figure 5.

[0017] Referring to figure 1, the device according to the invention includes a bullet 1 which is launched through a launching means of any type, for example through a gun 2, so as to cover a ballistic parabolic trajectory from the launching point A to the point of ground impact B. Referring to figure 2, the bullet 1 includes a body made of a plastic material having a longitudinal axis 3, an ogive 4 and a back base equipped with a heat shield 5 which protects the body of the bullet 1 from a ballistic charge 6 (shown with a dashed line in figure 2) which is used for the launching from the gun 2.

[0018] In the plastic material forming the body of the bullet, the electronic components of the device are drowned, which in this way are protected from the risk of damaging due to the high acceleration in the launching step. Numeral 7 shows an array of optical sensors, for example of the CCD type, constituting a camera forming part of the vision system of the device. The camera 7 observes the scene exterior to the bullet through a lens 8 placed in a side window 9 of the ogive 4, and further thanks to a reflecting mirror 10. Numeral 11 shows the electron control system of the camera 7, and numeral 12 shows the electron system for the processing and the remote transmission of the data exiting from the camera 7. Such data are remotely transmitted, on an appropriate frequency, to a receiving antenna which can be, for example, carried by an air balloon 13 anchored to the ground close to the launching point A (figure 1).

[0019] The embodiment shown in the figure 2 relates to the case in which the launching is carried out with a rifled barrel gun 2, which imparts a rotation to the body of the bullet 1 around its longitudinal axis 3. With such an embodiment, the ogive 4 constitutes a body separated from the remaining part of the bullet (shown by 13) which is rotatably mounted on the part 13 around the longitu-

dinal axis 3 through bearings 14. An engine (not shown) is installed in the part 13 of the bullet body and drives the rotation of a pinion which engages a crown wheel carried by the ogive 4, so as to drive a rotation of such ogive. Numeral 15 shows the electron control system of the rotation of the ogive 4. The system 15 can be programmed for imparting to the ogive 4 a rotation relative to the part 13 of the bullet which undergoes the rotation imparted by the gun, so as to annul or at least reduce the rotation speed of the ogive 4 relative to a fixed observer. This can also be obtained, in case, with the help of a gyroscopic system.

[0020] If the system is able to annul the rotation of the ogive 4, the vision window will result permanently pointed towards the ground, so as to allow a continuous observation of the strip of territory covered by the window. Such strip is shown by 5 in figure 1 and corresponds to the envelope of the areas "illuminated" by the vision cone exiting from the window during the ballistic trajectory of the bullet. This can also be observed with reference to the figure 3, wherein the theoretical vision cones of the window of the bullet 1 are diagrammatically shown in the course of the trajectory. Since the territory area covered by the vision cone increases in the diameter with the increase of the bullet altitude, it results that the strip of territory S subjected to reconnaissance (figure 1) exhibits a decreasing width of its central zone, corresponding to the point of highest altitude of the bullet, towards its ends A, B.

[0021] If the rotation speed of the ogive 4 relative to the fixed observer is not null, the processing system of the data emitted from the camera will be able, however, to use the data emitted in the time intervals in which the window is substantially pointed downwards, by rejecting the data emitted in the remaining time intervals.

[0022] In theory, it is also possible to foresee the use of a rifled barrel gun for the launching of the bullet with a bullet lacking in a rotary ogive of the type shown in figure 2, that is with a bullet having a monolithic body which rotates around its axis because of the launching. Also in this case, the processing system of the data emitted by the camera will be able to use the data emitted in the effective time intervals, wherein the vision window is pointed downwards, by rejecting the remaining data.

[0023] Figure 4 shows a bullet intended for being launched with a smooth-barrel gun 2. In this case, the bullet will not undergo a rotation around its axis because of the launching. The body of the bullet 1 is, in this case, monolithic but for the rest the components arranged therein are completely similar to those described in figure 2 and therefore they have been shown by the same reference number. The difference with respect to the case shown in figure 2, beside the lack of a rotary ogive, is that the bullet is equipped with stabilizing wings (for example three or four wings angularly spaced) which automatically spread themselves after the launching. Figure 4 shows two wings 16 which are swingingly mounted on the body of the bullet 1 around two axis 17. According to a techinque per se known, the wings 16 can automatically be returned towards the operating spreaded position, which is shown in figure 4, starting from a retracted position shown with a dashed line in figure 4 by resilient means (not shown). The wings 16 can be hold in the retracted position by a hooking system which is automatically disconnected by a timer after the launching. Also the structure and the arrangement of the hooking device of the timer are not described nor shown herein, as such components are per se known and can be carried out according any additional configuration. Therefore, such details have been eliminated from the drawings both as they do not lie, per se, in the ambit of the present invention and as their elimination makes the drawings of a simpler and easier comprehension.

[0024] In the example of embodiment shown in figure 4, furthermore, the spreadable wings 16 have a body 16a which can be orientated around its longitudinal axis 16b in the direction of the arrows R, relative to the base part 16c. Such oscillation can be controlled in order to confer to the bullet a glided trajectory, which differs from the parabolic theoretical trajectory in the final part preceding the ground impact. Referring to figure 5, the final part of the glided trajectory P, that in this way the bullet follows in the final part of its path, is shown therein. In this way, the ground impact will not occur in position B, but in correspondence with a point B' more distant from A.

[0025] Obviously, without prejudice to the principle of the invention, the construction details and the embodiments could widely vary with respect to what has been described and shown by mere way of example, however without leaving the scope of the present invention.

Claims

1. Device for the remote reconnaissance of a territory area, including:

   a bullet (1) to be launched with launching means (2) of any type,
   a camera vision system (7) installed in the bullet (1),
   a transmission system (12) installed in the bullet (1), for remotely transmitting data emitted by said vision system (7), **characterized in that** the vision system (7) is arranged for observing the scene from a window (9) placed on a side of the body of the bullet (1), such that said vision system (7) is able to observe, at least in an intermittent way, a strip of territory (S) flew over by the bullet (1) during at least a substantial part of its ballistic trajectory.

2. Reconnaissance device according to claim 1, **characterized in that** the vision system includes an array of optical sensors (7) arranged within the bullet (1), according to an axis of vision coinciding with the lon-

gitudinal axis (3) of the bullet, and optical means (10) for deviating towards said array (7) the light radiation entering the body of the bullet through said side window (9).

3. Reconnaissance device according to claim 1, **characterized in that** it is equipped with an electronic control system of the array of optical sensors (7) and an electronic system (12) for the remote processing and transmission of the data exiting from said array of sensors.

4. Reconnaissance device according to claim 2 or 3, **characterized in that** the electronic components installed in the bullet (1) are drowned in a body made of a plastic material forming part of the bullet.

5. Reconnaissance device according to claim 1, intended for being launched by a rifled barrel gun suitable for imparting a rotation to the bullet (1) around its axis (3), **characterized in that** said bullet is equipped with electronic processing and control means fitted for rejecting the data emitted from the vision system in the time intervals in which the side window (9) is not substantially directed towards the ground.

6. Reconnaissance device according to claim 5, **characterized in that** said window (9) is placed on a part (4) of the body of the bullet (1) which is rotatable relative to the remaining part of the body of the bullet (1) around the longitudinal axis (3) of the bullet, and that motor means, controlled for imparting a rotation to said rotatable part (4) are foreseen, for the purpose of maintaining the side window (9) substantially pointed towards the ground for a substantial part of the flight time of the bullet.

7. Reconnaissance device according to claim 1, apt to be launched by a smooth-barrel gun (2), **characterized in that** it is equipped with stabilizing wings (16).

8. Reconnaissance device according to claim 7, **characterized in that** said wings are automatically spreadable from a non operating retracted position to an operating spreaded position after the launching of the bullet (1).

9. Reconnaissance device according to claim 8, **characterized in that** said spreadable wings (16) are returned back by resilient means towards their operating position and are hold in their retracted position by a hooking system which is automatically disconnected through a timer after the launching of the bullet (1).

10. Reconnaissance device according to claim 9, **characterized in that** each wing (16) presents an orientable body (16a) around the longitudinal axis (16b) of the wing relative to a part of root (16c) of the wing for the purpose of imparting a control ability of the flight trajectory of the bullet.

11. Reconnaissance device according to claim 10, **characterized in that** said oscillating parts of the wings are controlled in order to impart to the bullet a glided trajectory which differs from the parabolic theoretical trajectory in the final part of the bullet flight.

FIG. 1

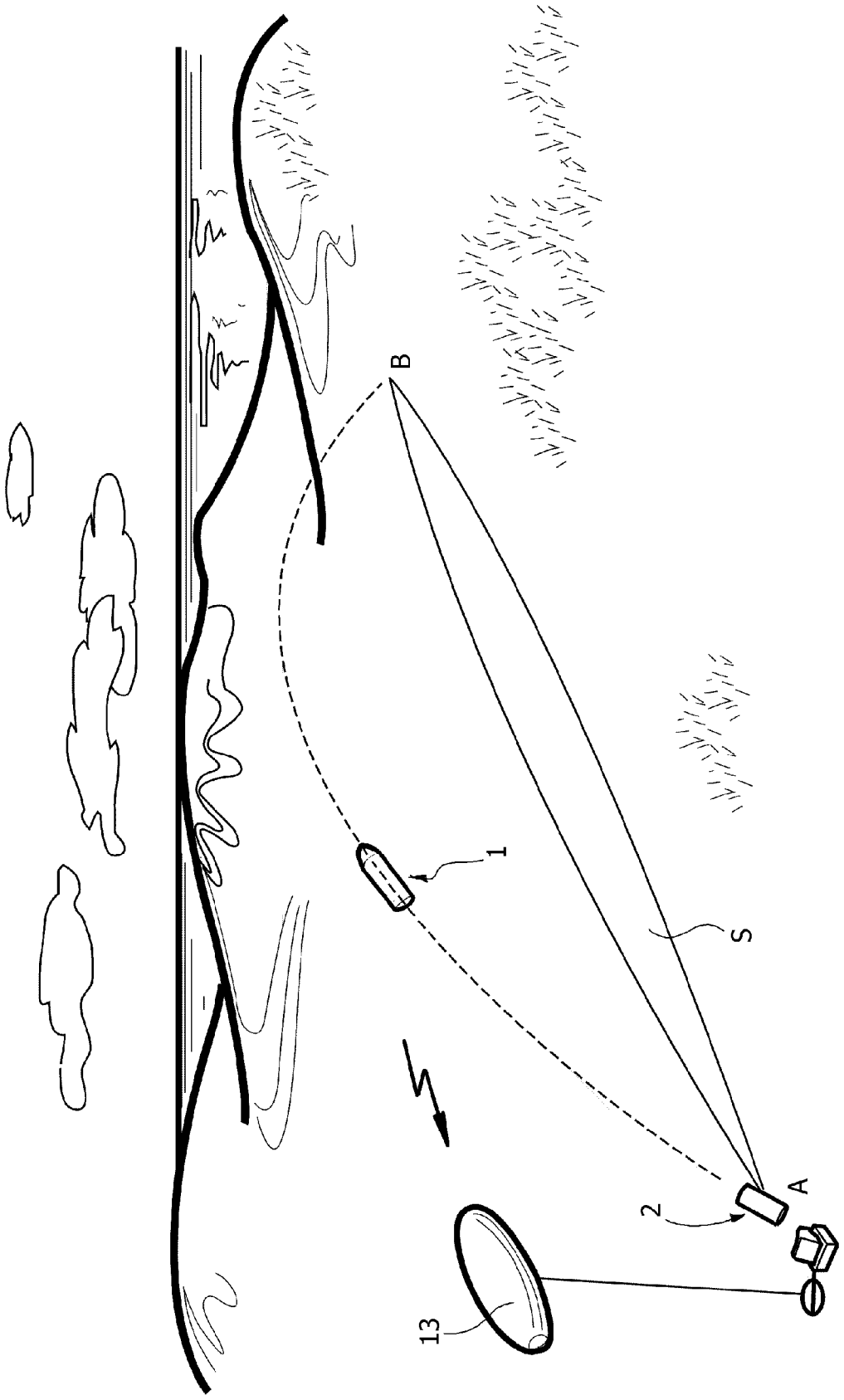


FIG. 2

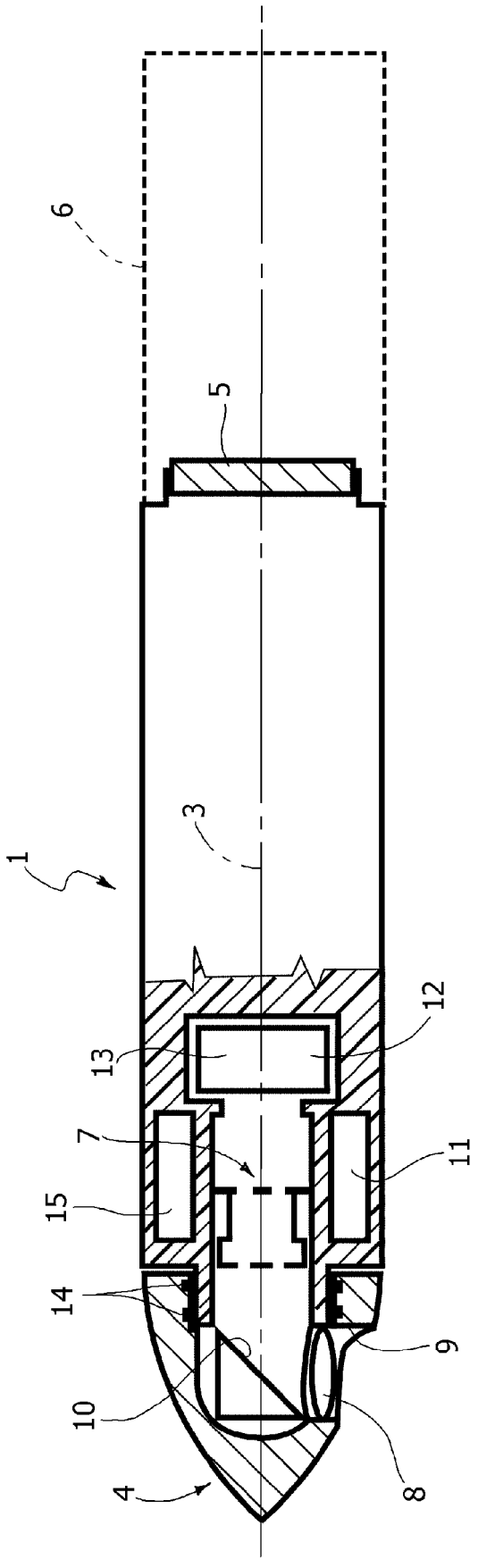


FIG. 3

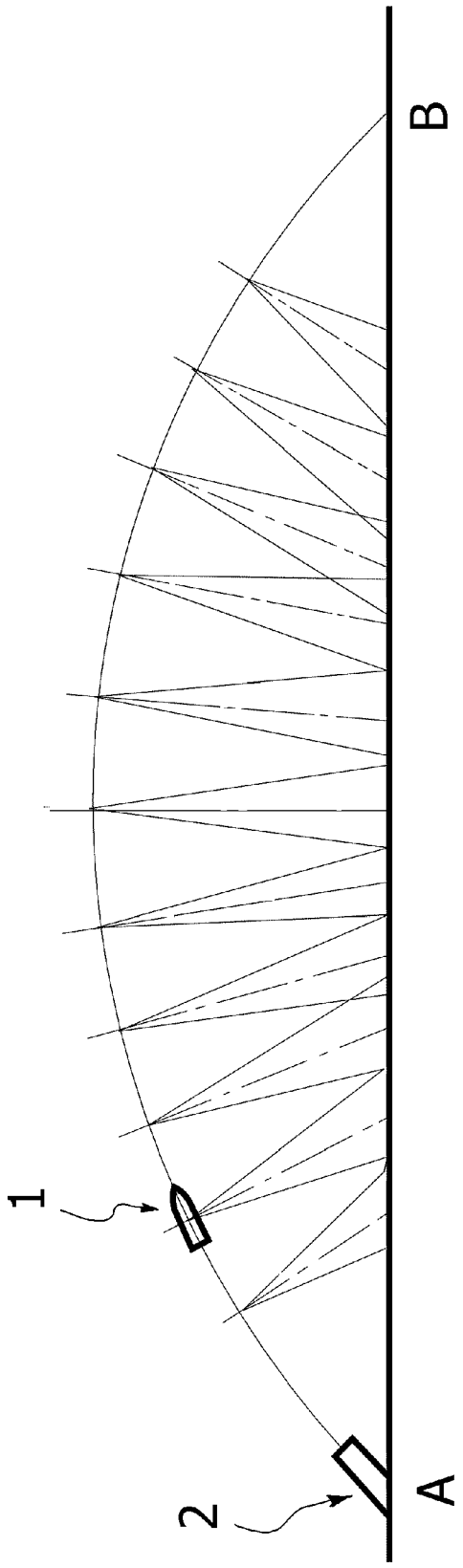


FIG. 4

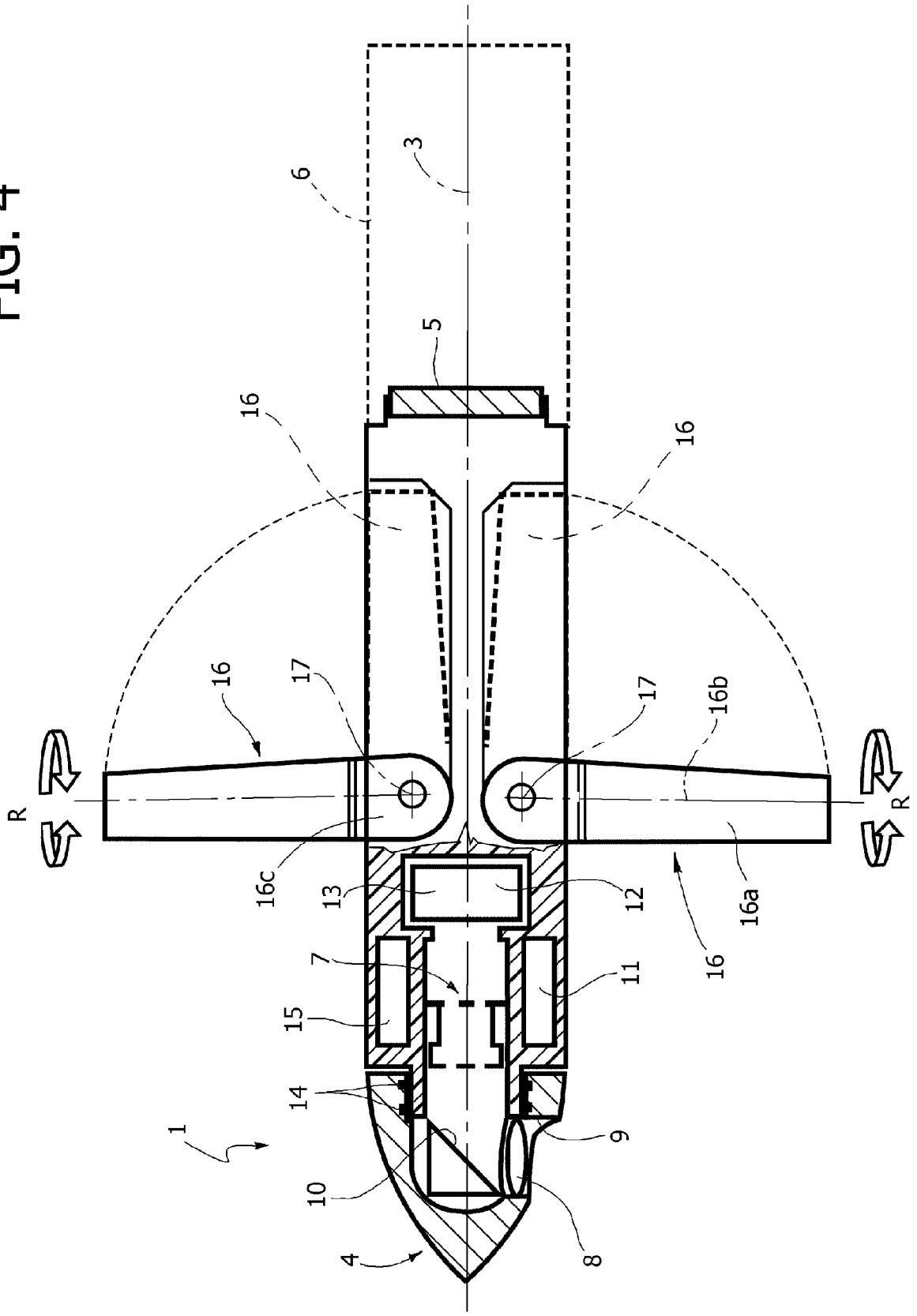
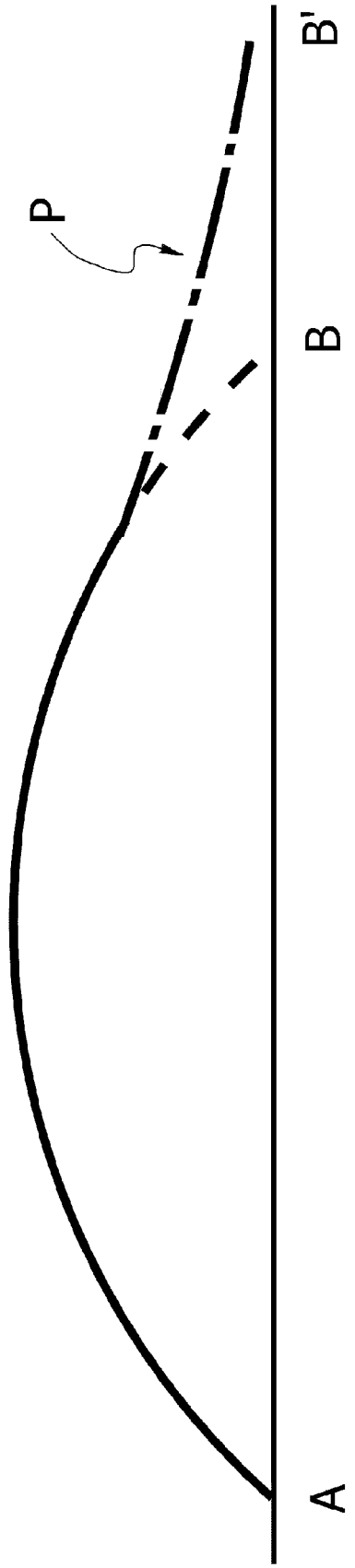


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 05 10 8690

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A	* page 2, left-hand column, line 59 - page 3, left-hand column, line 57; figures 1-7 *	4-11	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 January 2006	Blondel, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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