(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 January 2006 (05.01.2006)

PCT

(10) International Publication Number
WO 2006/001856 A2

(51) International Patent Classification:
F41G 7/00 (2006.01)

(21) International Application Number:
PCT/US2005/008569

(22) International Filing Date: 15 March 2005 (15.03.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/553,177 15 March 2004 (15.03.2004) US

(71) Applicant *(for all designated States except US)*: **GEORGIA TECH RESEARCH CORPORATION** [US/US]; 505 Tenth Street, NW, Atlanta, GA 30332-0415 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **STANCIL, Charles, M.** [US/US]; 3587 Jefferson Township Parkway, Marietta, GA 30066 (US).

(74) Agent: **MARQUIS, Harold, L.**; Thomas, Kayden, Horstemeyer & Risley, LLP, Suite 1750, 100 Galleria Parkway, NW, Atlanta, GA 30339-5948 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2006/001856 A2

(54) Title: A PROJECTILE AND SYSTEM FOR PROVIDING AIR-TO-SURFACE RECONNAISSANCE

(57) Abstract: An aerial reconnaissance projectile, such as a mortar, is launched for viewing a battlefield scene. A reconnaissance section is released from the projectile and conveys back pictures of the battlefield scene taken by a camera and transmitted by radio to a ground position for viewing on a video screen. The reconnaissance section; may have an inertia measurement unit for determining its position over the battlefield scene. The projectile containing the reconnaissance equipment may be a convention mortar round or a rocket projectile. This aerial reconnaissance projectile is capable of carrying sensors for chemical, biological or nuclear activity on the surface area being traversed or intercepting radio signals from the ground and conveying this information by radio to a ground position with a radio receiver.

TITLE OF THE INVENTION

A PROJECTILE AND SYSTEM FOR PROVIDING AIR–TO-SURFACE RECONNAISSANCE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to copending U.S. provisional application entitled, "**Exiting Projectile Alternative Payload For Air-To-Ground Reconnaissance**," having ser. no. **60/553,177**, filed ***March 15, 2004***, which is entirely incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] A projectile for providing air to surface reconnaissance with a camera or other type of sensor that conveys the images or other data by a radio transmitter to a radio receiver that may be connected to a viewing screen at a remote location is provided.

2. Prior Art

[0003] Big strides have been made in the reconnaissance capability of the land battlefield in the last few decades with the advent of cameras carried on aircraft, drone vehicles and satellites. However, the available technology does not have the practical capability of providing close range reconnaissance to small combat units, such as the squad. A small infantry unit, such as the squad or platoon, needs to know everything about the enemy disposition or obstacles in front of them. A small unit, such as a squad, may move from one fighting position to another where the field of view may be less than a hundred meters due to the presence of buildings or hills. If enemy positions on the other side of a hill or on the top of a building are undetected the chances of incurring casualties is significant. Cameras on satellites, aircraft, and drones are usually either not capable or available to be utilized to meet the needs of an individual infantry squad or platoon, but are focused on a larger battlefield scene. A small infantry unit also needs up-to the minute information about the deployment of enemy units close to them. A reconnaissance system is needed for a small infantry

unit to view what is over the next hill or on top of or behind the next building. This reconnaissance capability needs to be controlled by the small infantry unit so that it can have a reconnaissance view immediately prior to a planned advance of the unit. All infantry units also need the capability of determining any enemy buildup that cannot be viewed from the ground level.

SUMMARY OF THE INVENTION

[0004] This invention provides real time reconnaissance information to small infantry units such as the squad. Aerial reconnaissance pictures are provided by a camera or other sensors, such as radio frequency detectors, chemical or biological detectors, that are housed and conveyed in a projectile, such as a mortar round, deployed in the air over the battlefield. The reconnaissance equipment is housed in a separable section of the projectile and separated at a control point in the air over the battlefield. A parachute is provided to slow the descent of the separable section to allow the camera to take a number of pictures of the battlefield, or any other sensor to collect data, during its descent.

[0005] The reconnaissance equipment consists of a camera, or other type of sensor, for sensing images of the surface area or contaminates such as nuclear, chemical and biological agents. A radio transmitter is connected to the sensor or camera for transmitting images or digital data at a selected radio frequency. An antenna is connected to the radio transmitter and a power source, such as a battery, is included for powering the sensor and the transmitter and any other equipment. A timer can be included for timing the separation of the separable section from the rest of the projectile.

[0006] Images taken by the camera or data collected by other types of sensors are conveyed by the radio transmitter to a remote radio receiver usually located with the infantry unit that fired the projectile. A remote radio receiver may be connected to a viewing screen for viewing the images or displaying data transmitted to it. A number of different reconnaissance projectiles may be used as a vehicle for the reconnaissance equipment disclosed in this invention. Among these are mortar rounds launched by an explosive propellant or gas, artillery shells, rockets and bombs.

[0007] Using a mortar round as an example, the separable section can be separated by a number of different means. A simple means is to provide an explosive charge to

separate the separable section. An ignition delay element can be set to detonate the charge at a specified time from the launch of the projectile. This time can be preset in manufacture or preferably set just prior to launch.

[0008] The descent of the reconnaissance equipment is slowed to permit a camera to take a number of photographs or other sensors collected data before reaching the surface of the earth. This descent can be regulated by a parachute, which is preferably vented to control the descent and prevent the spinning of the parachute and the reconnaissance equipment. The parachute and the reconnaissance equipment are housed in the separable section. A drogue, such as a simple aluminum plate, can be used to facilitate the parachute being deployed and filled with air. A camera can be set to commence taking pictures as soon as the separable unit is separated from the rest of the projectile or it can be delayed for a few seconds. The camera is preferably a CMOS on a chip. It can be either a still picture camera or a video. A wide angle lens is preferably provided. The image recorded by the digital camera is delivered via electronic data link to the ground as a digital stream which is processed by the receiver unit for display. Analog to digital conversion take place in the reconnaissance equipment. Once received, the scenes can then be transmitted in digital format to a receiver as normal jpeg images. A power source, such as a small battery, is provided to supply all the electrical power requirements for the reconnaissance equipment.

[0009] A miniature inertia measuring unit can be provided as a part of the reconnaissance equipment. This unit will measure the body acceleration and attitude of the separable section. A microprocessor can be provided to process this information for conveying back to the remote radio receiver.

[0010] The reconnaissance equipment provided by this invention is capable of being placed in a regular mortar illumination round in which flare material is normally contained. This aerial reconnaissance projectile can be a conventional mortar round, artillery round, or rocket. A parachute or other means, such as braking fins on the reconnaissance equipment can be used to slow and control its descent over the surface to be viewed. The remote radio receiver is capable of receiving radio transmissions from the radio transmitter in the reconnaissance equipment. The radio receiver is usually located where, in the case of a mortar, it has a line of sight to the reconnaissance equipment during its descent. This radio receiver is connected to a

viewing screen, such as in a personal computer. A specially adapted hand held viewing device that has a screen can be used. The trajectory model of the projectile can be stored in the personal computer or hand held video device so that the position of the view is displayed on the screen with appropriate scaling applied. An on-board inertia measuring unit (IMU) can be used to improve the position estimation in respect to the view displayed on the screen.

[0011] The reconnaissance projectile of this invention can be used on battlefields with poor visibility conditions, such as darkness. It can be used in conjunction with an illumination mortar which can launch an illumination round over the battlefield scene to be viewed so the battlefield scene is illuminated by either visible light or IR light while the reconnaissance projectile is over the battlefield scene.

[0012] A reconnaissance projectile can carry other types of sensors such as a radio receiver for detecting radio frequency transmissions from the ground, and chemical, biological or nuclear sensors. This information can be processed by a microprocessor in the reconnaissance section and transmitted to a receiver on the ground for processing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a perspective view of the reconnaissance equipment attached to a parachute over a scene with obstructions to visibility and radio receiver connected to a personal computer for receiving and displaying images from the reconnaissance equipment..

[0014] FIG. 2 is perspective view of a mortar projectile.

[0015] FIG. 3 is a perspective view of the mortar projectile of FIG. 2 showing its components.

[0016] FIG. 4 is a cross-sectional view of the reconnaissance section housed in the mortar projectile of FIG. 3.

[0017] FIG. 5 is a graph that shows the nominal trajectory of a 40mm recon round with different degrees of elevation of the mortar tube.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] A perspective view of the method of this invention by which the reconnaissance equipment is used to view a scene that is obstructed from view is

illustrated in FIG. 1. In this case the perspective view 10 is a view of a batttlefield scene. In this situation a mortar round has just been launched from the rocket tube 38 over the battlefield scene. The mortar round has been separated into a nose section 12 and a tail section 14 by a small explosion within the rocket round that cuts the pins (not shown) that hold the nose section 12 and the tail section 14 together. The reconnaissance section 16 has been pulled from the rocket round and is slowly descending over the scene to be viewed 24. This descent is slowed by a parachute 18. The reconnaissance section 16 has a camera 20 for viewing the battlefield scene 24 and transmitting the view by radio back to a radio receiver and computer 34 on the ground which is connected to a viewing screen 36 which can be viewed by the soldier 32. The soldier 32 needs to be on a line of sight 40 with the reconnaissance section 16 in order to receive the radio waves from the transmitter in the reconnaissance section 16. While the soldier's view of the battlefield scene 24 is obstructed by hill 30, he is on a line of sight 40 with the reconnaissance section 16.

[0019] Once the soldier 32 has a view of the battlefield scene 24 transmitted to him, he can accurately direct the firing of high explosive mortar round onto the battlefield scene 24. Thus, the reconnaissance projectile can be used for target acquisition and fire control. The mortar can fire either a reconnaissance round or a high explosive round. The mortar can be operated by the soldier 32 that operates the computer and radio receiver 34 or by another soldier who operates a nearby mortar. The soldier 32 can give directions to the soldier operating the nearby mortar over a radio or by voice over a telephone line. It is normally preferable that the mortar be located near the soldier 32 operating the computer and radio receiver 34, but it should be realized that they could be separated by some distance. It is obvious that the mortar needs to be located close to the battlefield scene 24 in order to fire reconnaissance rounds and armed rounds if necessary. The reconnaissance information can be conveyed to an artillery battery or aircraft for firing on the battlefield scene 24 if desired. This invention allows a single weapon, such as a mortar, rocket launcher, or rocket propelled grenade to conduct both reconnaissance and to fire an armed projectile on the target.

[0020] The mortar can be a conventional mortar or it can be a mortar where the mortar round is launched by a gas propellant. The mortar tube 38 would be basically the same in both cases.

[0021] A perspective view of a mortar projectile is illustrated in FIG. 2. Bags of explosives can be placed between the fins 22 of the mortar projectile 42 for launching from a mortar. The fuse 44 can be set by turning to time an explosion in the nose 12 of the round for cutting shear pins holding the nose section 12 and tail section 14 together.

[0022] As shown in the disassembled form in FIG. 3, the reconnaissance section 16 is housed in the nose section 12 of the mortar round 42. A parachute 18 is attached to the reconnaissance section 16 by lines 68 as shown in FIG. 1. A pusher plate 46 is placed in front of the reconnaissance section 16 so that the small explosion in the nose section 12 will push the reconnaissance section 16 and parachute 18 from the nose section as shown in FIGs. 3 and 4. A drogue 70, which may be a small aluminum plate, may be attached to the parachute 18 to aid in the parachute being properly deployed. The parachute 18 may have a vent in the top or vents on all four sides of the parachute near the bottom of the canopy to stabilize its descent.

[0023] A cross-sectional view of the reconnaissance section 16 is illustrated in FIG. 4. The location of the pusher plate 46 and reconnaissance section 16 in the nose section 12 of the rocket round 42 is illustrated in FIGs. 3 and 4. The O-rings 72 that hold the pusher plate 46 in position in the nose section 12 are illustrated. The reconnaissance section 16 has a lens assembly 50 through which images of the scene 24 being viewed are projected onto the imaging board 52. This lens assembly 50 can be a single lens, such as a 4 mm f/2 lens. This lens would provide a 75° by 60° field of view which would cover 306 by 230 meter area from an altitude of 200 meters. Other types of lens can be used depending upon the reconnaissance situation. The imaging board 52 is basically a CCD array. The size of this array could be 312 pixels in the horizontal direction and 287 pixels in the vertical direction with each pixel measuring 19.6 by 16 microns. The camera system used can be a basic black and white still-frame. If desired, the images could be captured in color. A video camera arrangement can be used by the addition of a Charge Couple Device (CCD), a timing crystal and voltage regulator and a chip to supply a standard video, such as RS-170 standard video. Filters such as an infra red cut filter 66 can be used over the lens in the same way that they are used with normal cameras.

[0024] The imaging board 52 is shown connected to a sensor board 54 which in turn is connected to a transmitter board 56 which is connected to an antenna 48. The

image recorded by the imaging board 52 is delivered to the sensor board 54 as an analog signal. This signal is digitized and stored in a frame buffer. Eight-bit digitization is sufficient for many applications.

[0025] The digital signal is delivered to the transmitter board 56 for transmission to the antenna 48 for broadcast. The antenna 48 is a small omni-directional antenna. The antenna may be designed to transmit on a lower UHF or a high VHF (in the range of 200 to 400 MHz). These bandwidths may offer the best combination of foliage penetration and multi-path tolerance which can be compatible with using a small antenna and low transmitter power. The antenna could be a metallic slot, a shot monopole, or a short dipole. The antenna could possible be integrated into the parachute itself. The entire operation of the reconnaissance equipment can be controlled by a small processor housed in the reconnaissance section 16.

[0026] Small batteries 58 can be used to furnish the power for the reconnaissance section 16. The batteries 58 can be held in place by a battery holder 64.

[0027] To maintain the integrity of the reconnaissance section it may be encapsulated with an encapsulant 62. The reconnaissance section 16 has a parachute attachment plate 60 to which the parachute lines 68 are attached.

[0028] In operation on the battlefield, the mortar or rocket is launched through a mortar tube 38 over the scene 24 to be viewed. The mortar or rocket round will be launched according to the normal trajectory for that particular weapon. The trajectory for a 40mm round is illustrated in FIG. 5. If desired, the reconnaissance section 16 can be the same weight as the explosives or flare material it replaces so the weight of the mortar round is the same and the trajectory is the same. In this way the trajectory of the reconnaissance mortar round need not be recomputed. Prior to launching the fuse 44 is turned and set to denote the explosive in the nose section 12 at the right altitude. As illustrated in FIG.5 the time is set at 5 seconds. That time will be different depending on the trajectory and attitude of the mortar. The reconnaissance section 16 of this invention can be used with other mortar sizes, such as 60 and 81mm. It could also be used with bombs and certain shoulder fired rockets and artillery.

[0029] As illustrated in FIG. 1 the explosion separates the nose section 12 from the tail section 14. It also pushes the reconnaissance section 16 out of the nose section 12 by pushing the pusher plate 46. The drogue 70 pulls out the parachute 18 and ensures

that it is properly deployed. The reconnaissance section 16 can be designed so that the images are transmitted from the time the reconnaissance section 16 is separated from the nose section 12. A processor can be used in the reconnaissance section 16 to control the operation of the camera 20 and transmitter board 56. If the height of the trajectory of the projectile is 100 meters the parachute can be designed so that the descent takes approximately 45 seconds. The images are transmitted from the reconnaissance unit 16 to a computer and radio receiver 34 operated by a soldier 32 on the ground. The computer and receiver 34 are connected to a viewing screen 36. Preferably the computer and radio receiver 34 receives a GPS signal for displaying on the viewing screen 36. This will enable the scene 24 being viewed to be properly positioned in the landscape. This positioning can be based upon the trajectory projection as illustrated in FIG. 5, which is essentially a dead-reckoning estimate of a projectile trajectory. A miniature inertia measuring unit (IMU) can be installed in the reconnaissance section 16 to compensate for errors in the dead-reckoning computation so that the scene 24 is properly displayed in relation to the geographical setting.

[0030] While a computer is shown in FIG. 1, it should be realized that a small hand held viewing device could be used to display the imagery and indicate its origination. The trajectory model of the projectile could be stored in the hand held viewing device so that the position can be estimated through dead-reckoning. The trajectory of a projectile, such as a 40mm round is based upon a set of ballistic equations which starts with the elevation of the launching tube. The muzzle velocity is a known quantity for various sizes of projectiles. Of course, feed back from an IMU would improve the position estimation whether a computer or hand held viewing device is used. It should be realized that specialized software can be installed on the computer or hand held viewing device to facilitate the viewing and positioning of the battlefield scene being surveyed.

[0031] It is also possible for this system to be employed on a vehicle with the projectile being launched from the vehicle and having a receiver for a GPS system in the vehicle.

[0032] It should be realized that a transmitter may be located with the computer and radio receiver 34 to convey the information of the scene viewed to some other location for firing of artillery or air strikes. This could also be done by wire.

[0033] While this system is primary designed for the battlefield scene, it could have other uses where the view of a scene is obstructed as sometime occurs during natural disasters such as hurricanes and earthquakes. It could also be used to assess battlefield damage.

[0034] The reconnaissance equipment of this invention can be used to conduct aerial reconnaissance surveillance of a ground surface under conditions of poor visibility, such as at night time. This can be accomplished by first launching an illumination shell on a trajectory course over the surface to be viewed. A reconnaissance shell containing the reconnaissance equipment is then launched over the surface area to be viewed so that it arrive and can take pictures during the period of illumination provided by the illumination shell. Both the illumination shell and the reconnaissance shell can be launched from the same mortar or from different mortars.

[0035] The reconnaissance section 16 can carry a variety of other sensors either in addition to or in lieu of the camera 20. For example, the reconnaissance section may carry a chemical sensor to detect the presence of poison gas on the battlefield. This information can be conveyed from the sensor to the processor in the reconnaissance section for transmission back to the computer and radio receiver 34. This data could also be displayed on the viewing screen 36 or simply transmitted as a radio signal which the soldier 32 could hear. A sensor could be installed in the reconnaissance section 16 to test for the presence of various biological agents which also could be conveyed to a processor in the reconnaissance section for transmission back to the computer and radio receiver 34. A Geiger counter, or other type of radiation detector, could also be included in the reconnaissance section 16 for transmission back through the computer and radio receiver 34 on the ground. A radio receiver could be included in the reconnaissance section 16 to determine radio transmissions in the battlefield scene for transmission back to the computer and receiver 34.

[0036] Other systems, methods, features, and advantages of the present invention will be or become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional systems, methods, features, and advantages be included within this description, be within the scope of the present invention, and be protected by the accompanying claims.

CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. An aerial reconnaissance projectile for viewing and transmitting images of a surface area from an aerial perspective which comprises:

a. a projectile body for housing and conveying the reconnaissance equipment in the air to the surface area to be viewed, said body having a separable section capable of being separated from the projectile body, said body having means for separating the separable section from the projectile body at a controlled point in the aerial trajectory;

b. said separable section comprising reconnaissance equipment comprising a sensor for sensing images of the surface area, a radio transmitter for transmitting images viewed by the sensor on a selected radio frequency, an antennae for transmitting the images to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the sensor at the desired point after separation of the separable section from the projectile body; and

said separable section having means for regulating the descent of the section to the surface after separation.

2. The aerial reconnaissance projectile of claim 1, in which the projectile is a tube launched mortar round.

3. The aerial reconnaissance projectile of claim 1, in which a parachute is used to regulate the descent of the separable section after separation.

4. The aerial reconnaissance projectile of claim 3, in which the parachute has vents to control the descent of the separable section after separation and a drogue to help deploy the parachute after separation of the separable section.

5. The aerial reconnaissance projectile of claim 1, in which the projectile is a finned rocket.

6. The aerial reconnaissance projectile of claim 1, in which the projectile is a bomb.

7. The aerial reconnaissance projectile of claim 1, in which the reconnaissance equipment also comprises an inertia measurement unit for estimating the location of the reconnaissance equipment for conveying to the remote receiver.

8. The aerial reconnaissance projectile of claim 1, in which the sensor is a camera.

9. The aerial reconnaissance projectile of claim 1, in which the sensor is an infrared sensor.

10. The aerial reconnaissance projectile of claim 1, in which the means to activate the sensor is a microprocessor which also controls the transmission of the images to the remote receiver.

11. An aerial reconnaissance system for viewing images of a surface area from an aerial perspective at a remote location which comprises:

a. a reconnaissance projectile for viewing and transmitting images of a surface area from an aerial perspective, said projectile having a projectile body for housing and conveying the reconnaissance equipment in the air to the surface area to be viewed, said body having a separable section capable of being separated from the projectile body, said body having means for separating the separable section from the projectile body at a controlled point in the aerial trajectory, said separable section comprising reconnaissance equipment comprising a sensor for sensing images of the surface area, a radio transmitter for transmitting images viewed by the sensor on a selected radio frequency, an antennae for transmitting the images to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the sensor at the desired point after separation of the separable section from the projectile body, and said separable section having means for regulating the descent of the section to the surface after separation; and

b. a remote radio receiving station comprising a radio receiver capable of receiving radio transmissions from the radio transmitter in the separable section, and having a viewing screen for viewing images received by the remote radio receiver and a power source for the radio receiver and viewing screen.

12. The aerial reconnaissance system of claim 11, in which the remote radio receiving station also comprises a computer programmed to compute the trajectory of the projectile using an algorithm based upon the type of projectile and launch location, said computer being capable of directing the display on the viewing screen of both the trajectory of the projectile and the view of the surface transmitted from the sensor.

13. The aerial reconnaissance system of claim of claim 12, in which the reconnaissance equipment also comprises an inertia measurement unit for estimating the location of the reconnaissance equipment for conveying to the remote radio receiving station and the computer in the remote radio receiving station is programmed to refine the computation of the trajectory of the projectile based upon the information received from the inertia measurement unit.

14. The aerial reconnaissance system of claim 13, in which the projectile is a tube launched mortar round.

15. An aerial reconnaissance tube launched shell for viewing and transmitting images of a surface area from an aerial perspective which comprises:

a. said shell housing and conveying the reconnaissance equipment in the air to the surface area to be viewed, said shell having a separable section capable of separating from the shell, said shell having means for separating the separable section from the shell at a controlled point in the aerial trajectory;

b. said separable section comprising reconnaissance equipment comprising a sensor for sensing images of the surface area, a radio transmitter for transmitting images viewed by the sensor on a selected radio frequency, an antennae for transmitting the images to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the sensor at the desired point after separation of the separable section from the projectile body; and said separable section having means for regulating the descent of the section to the surface after separation.

16. The aerial reconnaissance tube launched shell of claim 15, in which the means to activate the sensor is a microprocessor which also controls the transmission of the images to the remote receiver.

17. An aerial reconnaissance system for viewing images of a surface area from an aerial perspective at a remote location which comprises:

a. a reconnaissance tube launched shell for viewing and transmitting images of a surface area from an aerial perspective, said shell housing and conveying the reconnaissance equipment in the air to the surface area to be viewed, said shell having a separable section capable of being separated from the shell, said shell having means for separating the separable section from the shell at a controlled point in the aerial trajectory, said separable section comprising reconnaissance equipment having a sensor for sensing images of the surface area, a radio transmitter for transmitting the images viewed by the sensor on a selected radio frequency, an antennae for transmitting the images to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the reconnaissance equipment at the desired point after separation of the separable section from the projectile body, and said separable section having means for regulating the descent of the section to the surface after separation; and

b. a remote radio receiving station comprising a radio receiver capable of receiving radio transmissions from the radio transmitter in the separable section, said receiver connected to a viewing screen for viewing images received by the remote radio receiver and a power source for the radio receiver and viewing screen.

18. The aerial reconnaissance system of claim 17 in which the means to activate the sensor in the reconnaissance equipment is a microprocessor which also controls the transmission of the images to the remote receiver.

19. The aerial reconnaissance system of claim 17, in which a parachute is used to regulate the descent of the separable section after separation.

20. The aerial reconnaissance system of claim 18, in which the remote radio receiving station also comprises a computer programmed to compute the trajectory of the projectile using an algorithm based upon the type of projectile and launch location, said computer being capable of directing the display on the viewing screen of both the trajectory of the projectile and the view of the surface transmitted from the sensor.

21. The aerial reconnaissance system of claim 20, in which the reconnaissance equipment also comprises an inertia measurement unit for estimating the location of the reconnaissance equipment for conveying to the remote radio receiving station and the computer in the remote radio receiving station is programmed to refine the computation of the trajectory of the projectile based upon the information received from the inertia measurement unit.

22. The aerial reconnaissance system of claim 21, in which a parachute with vents is used to regulate the descent of the separable section after separation and a drogue to help deploy the parachute after separation of the separable section.

23 A method of conducting unmanned aerial reconnaissance of a surface area comprising:

a. launching a aerial reconnaissance shell from a tube over the surface area to be viewed, said shell housing and conveying the reconnaissance equipment in the air over the surface area, said reconnaissance shell having a separable section capable of separating from the shell, said shell having means for separating the separable section from the shell at a controlled point in the aerial trajectory, and separating said separable section from the shell at the desired point over the surface area to be viewed, said separable section comprising reconnaissance equipment having a sensor for viewing images of the surface area, a radio transmitter for transmitting images viewed by the sensor on a selected radio frequency, an antennae for transmitting the images to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the reconnaissance equipment, and activating said reconnaissance equipment at the desired point so that images of the surface area are conveyed from the sensor to the radio transmitter and transmitted, said separable section having means for regulating the descent of the section to the surface after separation, and activating said means after separation of the separable section to control its descent.; and

b. a remote radio receiver capable of receiving radio transmissions from the radio transmitter in the separable section, said receiver connected to a viewing screen for viewing images received by the remote radio receiver and a power source for the radio receiver and viewing screen, and said images being transmitted from the sensor in the separable unit and conveyed to the remote radio receiver and displayed on the screen.

24. A method of conducting unmanned aerial reconnaissance of a surface area under conditions of poor visibility comprising:

a. first launching an illumination shell from a tube on a trajectory course over the surface area to be viewed, said shell having means to illuminate the surface area, and activating the illumination over the surface area to be viewed;

b. launching an aerial reconnaissance shell from a tube over the surface area to be viewed so that the reconnaissance shell is over the area to be viewed within the period of illumination by the illumination shell, said shell housing and conveying the reconnaissance equipment in the air over the surface area, said reconnaissance shell having a separable section capable of separating from the shell, said shell having means for separating the separable section from the shell at a controlled point in the aerial trajectory, and separating said separable section from the shell at the desired point over the surface area to be viewed, said separable section comprising reconnaissance equipment having a camera for viewing images of the surface area, a radio transmitter for transmitting images viewed by the camera on a selected radio frequency, an antennae for transmitting the images to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the reconnaissance equipment, and activating said reconnaissance equipment at the desired point so that images of the surface area are conveyed from the camera to the radio transmitter and transmitted, said separable section having means for regulating the descent of the section to the surface after separation, and activating said means after separation of the separable section to control its descent.; and

c. a remote radio receiver capable of receiving radio transmissions from the radio transmitter in the separable section, said receiver connected to a viewing screen for viewing images received by the remote radio receiver and a power source for the radio receiver and viewing screen, and said images being transmitted from the sensor in the separable unit and conveyed to the remote radio receiver and displayed on the screen.

25. An aerial reconnaissance projectile for sensing information and transmitting the information about a surface area from an aerial perspective which comprises:

a. a projectile body for housing and conveying the reconnaissance equipment in the air to the surface area to be sensed, said body having a separable section capable of being separated from the projectile body, said body having means for separating the separable section from the projectile body at a controlled point in the aerial trajectory;

b. said separable section comprising reconnaissance equipment comprising a sensor for sensing images of the surface area, a processor for processing the information, a radio transmitter for transmitting information on a selected radio frequency, an antennae for transmitting the information to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the sensor at the desired point after separation of the separable section from the projectile body; and

said separable section having means for regulating the descent of the section to the surface after separation.

26. An aerial reconnaissance system for sensing information about a surface area from an aerial perspective at a remote location which comprises:

a. a reconnaissance projectile for sensing information about a surface area from an aerial perspective, said projectile having a projectile body for housing and conveying the reconnaissance equipment in the air to the surface area to be sensed, said body having a separable section capable of being separated from the projectile body, said body having means for separating the separable section from the projectile body at a controlled point in the aerial trajectory, said separable section comprising reconnaissance equipment comprising a sensor for sensing information about surface area, a processor for processing the information, a radio transmitter for transmitting information on a selected radio frequency, an antennae for transmitting the information to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the sensor at the desired point after separation of the separable section from the projectile body, and said separable section having means for regulating the descent of the section to the surface after separation; and

b. a remote radio receiving station comprising a radio receiver capable of receiving radio transmissions from the radio transmitter in the separable section, and a power source for the radio receiver.

27. An aerial reconnaissance system for sensing information about a surface area from an aerial perspective at a remote location which comprises:

a. a reconnaissance tube launched shell for sensing and transmitting information about a surface area from an aerial perspective, said shell housing and conveying the reconnaissance equipment in the air to the surface area to be sensed, said shell having a separable section capable of being separated from the shell, said shell having means for separating the separable section from the shell at a controlled point in the aerial trajectory, said separable section comprising reconnaissance equipment having a sensor for sensing the surface area, a processor for processing the information, a radio transmitter for transmitting the information on a selected radio frequency, an antennae for transmitting the information to a remote receiver, a power source for powering the reconnaissance equipment and means for activating the reconnaissance equipment at the desired point after separation of the separable section from the projectile body, and said separable section having means for regulating the descent of the section to the surface after separation; and

b. a remote radio receiving station comprising a radio receiver capable of receiving radio transmissions from the radio transmitter in the separable section, and a power source for the radio receiver.

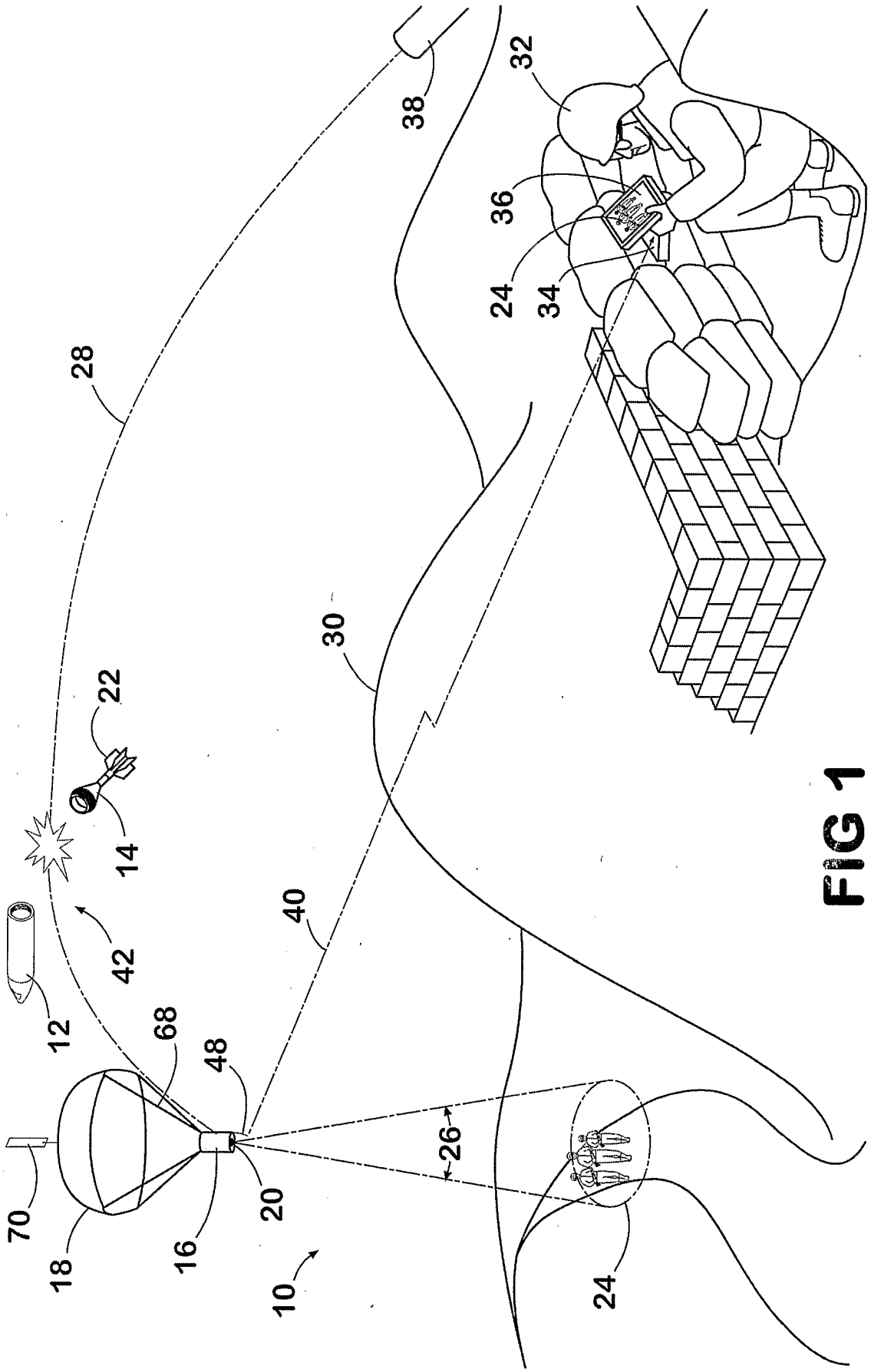

FIG 1

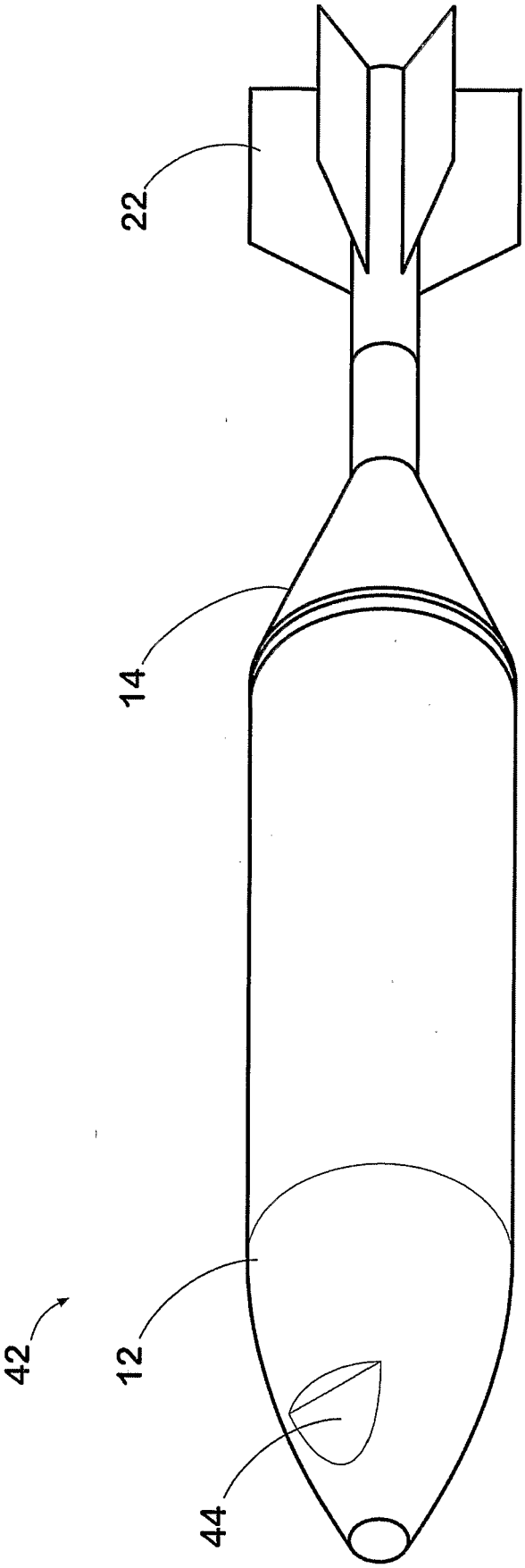

FIG 2

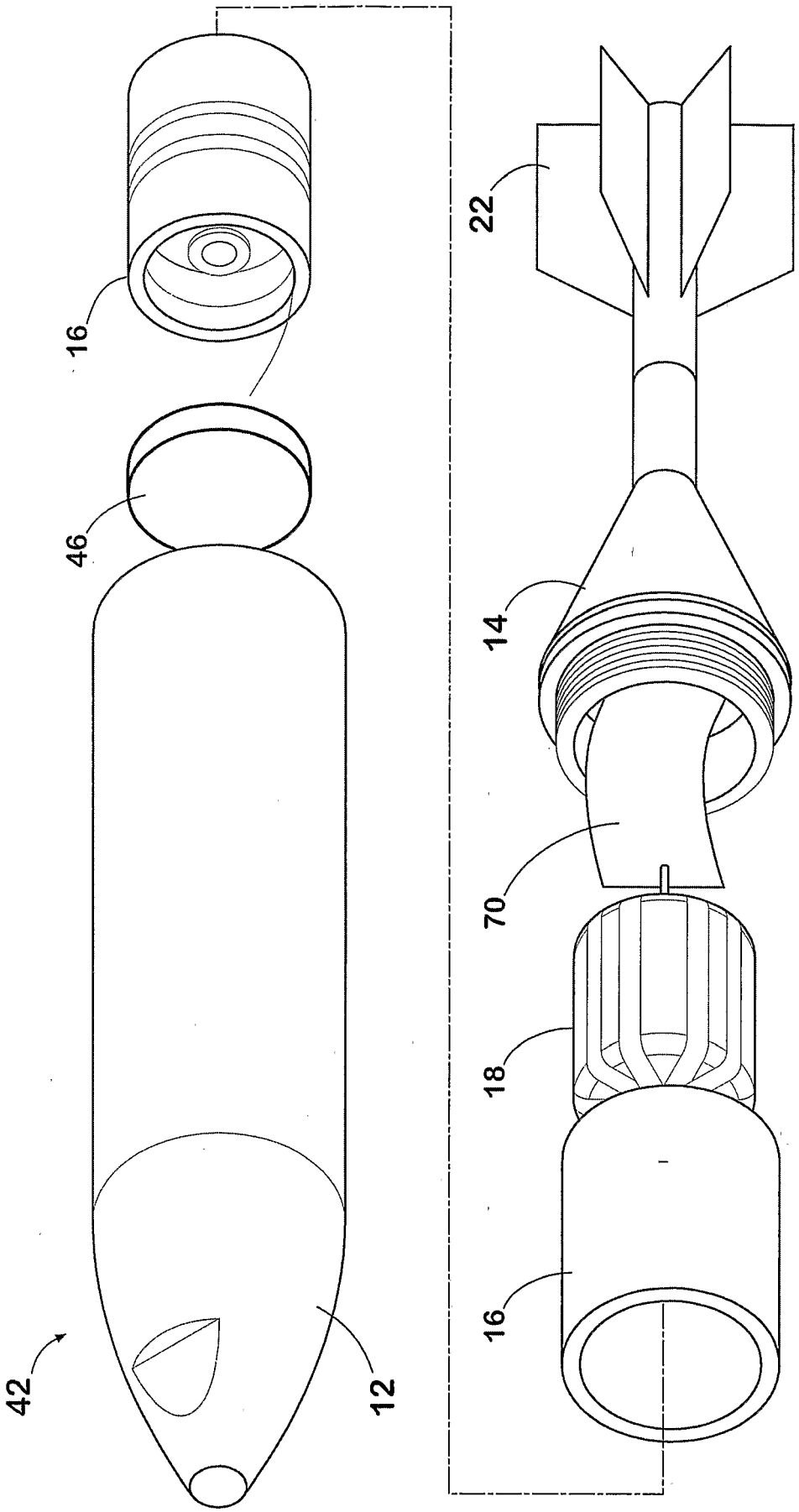

FIG 3

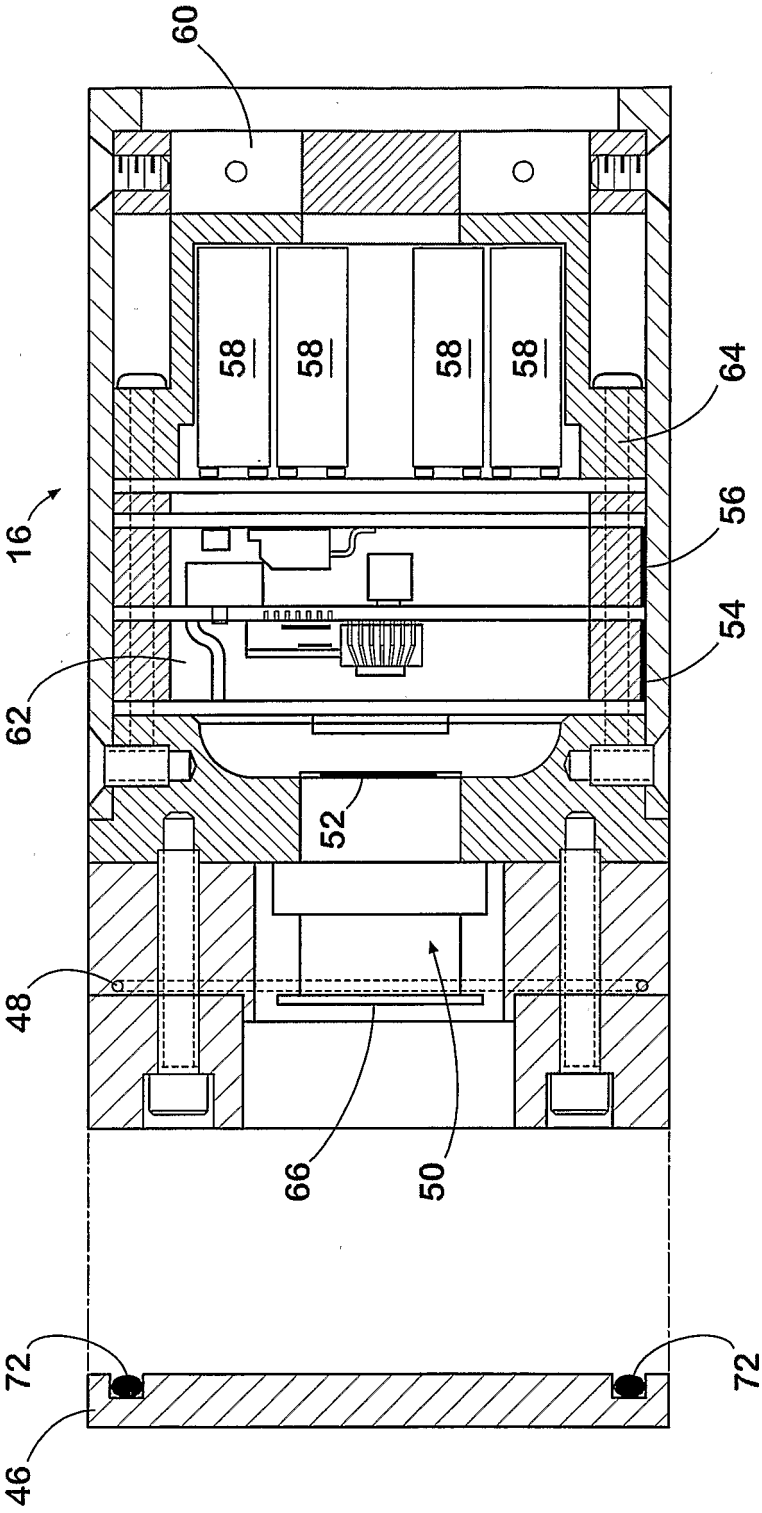

FIG 4

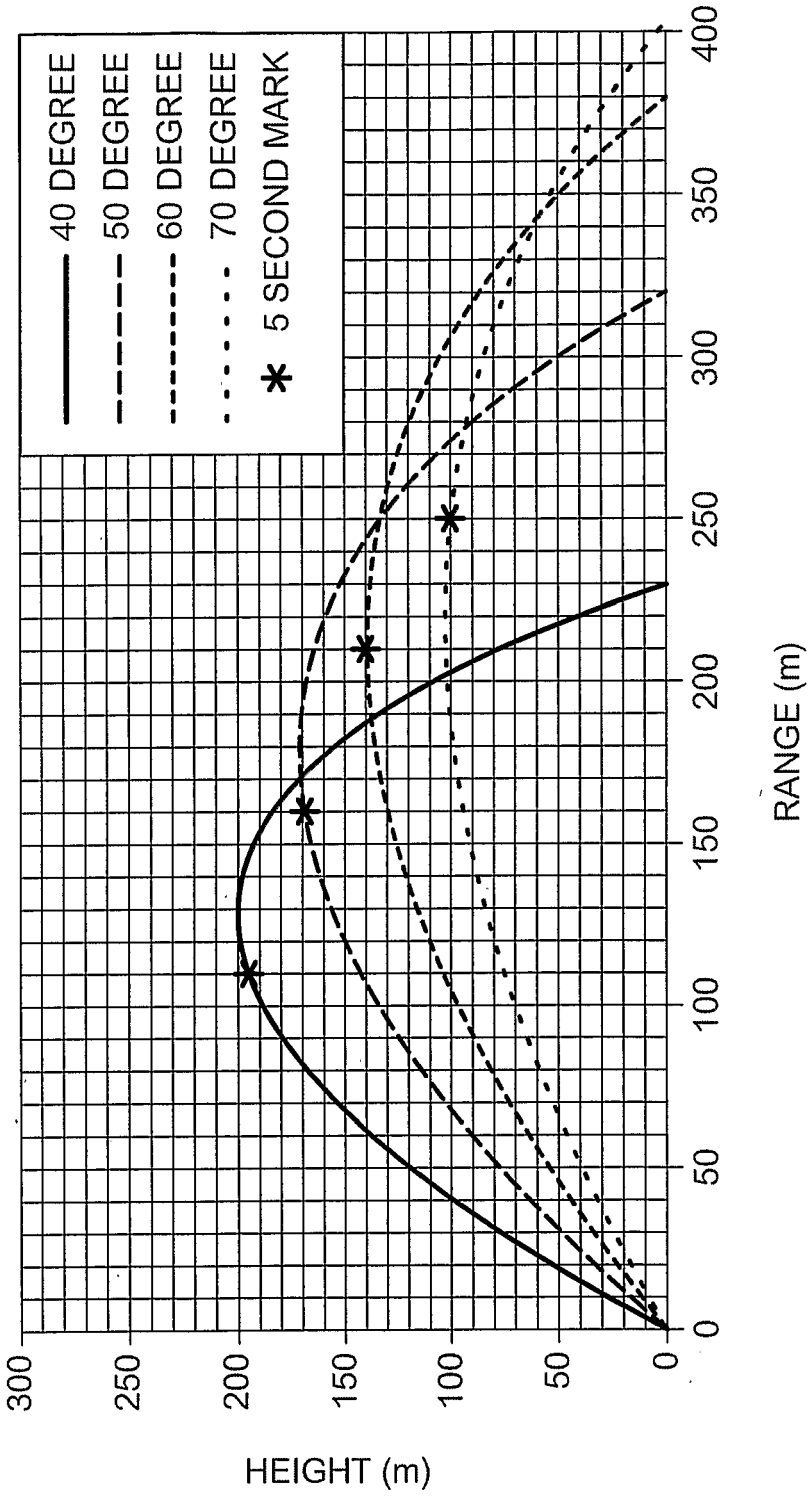
40 DEGREE
50 DEGREE
60 DEGREE
70 DEGREE
5 SECOND MARK
HEIGHT (m)
RANGE (m)
0
50
100
150
200
250
300
350
400

FIG 5