SELF-PROPELLED HOLLOW CHARGE HAVING CONCAVE LINER WITH PROPELLANT CONTAINED THEREIN

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10 Claims

This invention relates in general to a flying body or self-propelled missile, and in particular to a new and useful flying body having a hollow explosive charge and with a thrust engine permitting it to be launched under its own power.

A particular feature of the present invention is the construction of a flying body in a manner so that its range or flying distance can be increased. The present invention is an improvement over the prior art, particularly in respect to the construction which includes a hollow charge which forms a lining or boundary for the combustion chamber for the thrust engine or rocket. By such a construction considerable weight and volume of the flying body are saved, and with this saving it is possible to increase the range of the flying body or its flying speed using the same fuel amounts as prior art constructions.

In accordance with one embodiment of the invention, a portion of the driving fuel charge is accommodated in a hollow space formed by the lining of the hollow explosive charge, and this portion is of a material and location permitting it to be burned first. The arrangement is such that the burning will not materially shift the center of gravity of the flying body during the burning of the driving charge. The construction also insures that a minimum of heat insulating material will be required in order to enclose the combustion chamber and to insure that the hollow charge is not subjected to high temperatures. The construction advantageously includes an additional driving charge arranged at a spaced distance from the driving charge held within the lining of the hollow explosive charge. The two driving charges are spaced apart so that when they burn there is a minimum amount of disturbance at the center of gravity of the flying body.

In a preferred embodiment of the invention, the lining charge is made up of several layers. The lining advantageously consists of a partly broken up material in granulated or crumb form.

The complete flying body advantageously includes igniting current wires which are arranged in the hollow charge embedded in the lining of the charge. The igniting current lines are arranged so that they make an angle in respect to the longitudinal axis of the hollow explosive charge which is three quarters to two thirds of the angle which is defined by the hollow charge lining relative to its longitudinal axis. Any deviation of the arrangement of the igniting wires within the hollow space of the hollow explosive charge lining from this requirement results in a poorer effect of the hollow charge, as compared to a hollow charge in whose lining no wires are arranged. However, in the described arrangement of the igniting current wires, the igniting effect of the hollow explosive charge can be maintained. By this measure, the dead weight, that is the weight of the flying body which does not partake of the drive, is further decreased.

Further savings in weight and thus an increase in range of the flying body are obtained when the lining of the hollow charge is extended through the charge body and carries a guide rod. The extension of the hollow charge lining may advantageously be a pipe provided with bores, and the pipe may advantageously be embedded in the explosive. By this measure, additional holding means for the guide rods are not necessary.

An advantageous modification of the invention is the provision of means for stabilizing the flying body. In this embodiment, the drive charge which supplies the forward drive is divided and is accommodated in a front combustion chamber and in a rear combustion chamber. The lining of the hollow explosive charges which are arranged between the two combustion chambers forms a portion of the front combustion chamber. A further combustion chamber is arranged between the hollow charge and the rear combustion chamber and is provided with arrangements which impart a spin to the flying body. The igniting device for the drive charges are constructed in such a manner that they are only releasable when the flying body rotates about its longitudinal axis.

Accordingly, it is an object of this invention to provide a flying body having a rocket engine and provided with a lined hollow explosive charge with the inner lining of the charge forming a boundary for a rocket combustion engine combustion chamber.

A further object of the invention is to provide a flying body having a rocket engine with a plurality of driving charges arranged so that they burn in a manner in which they do not materially disturb the center of gravity of the flying body.

A further object of the invention is to provide a flying body with a rocket engine propulsion means which carries an explosive hollow charge having a forward concavity formed by a lining which extends through the center of a charge in a tubular manner.

A further object of the invention is to provide a flying body having a rocket engine with driving charges for the engine which are arranged in a front combustion chamber and in a rear combustion chamber and carries a hollow explosive charge which forms a lining for at least one of the combustion chambers, and which further includes means associated with one of the drives for imparting a spin to the flying body, when the charge is being burned.

A further object of the invention is to provide a flying body having its own propulsion system and carrying an explosive charge which is simple in design, rugged in construction, has a very long range, and is economical to manufacture and to operate.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

In the drawings:

FIG. 1 is a schematic longitudinal sectional view of a flying body constructed in accordance with the invention;

FIG. 2 is a view similar to FIG. 1 but with a burned-out drive charge;

FIG. 3 is a partial side elevational and partial sectional view of a flying body in accordance with another embodiment of the invention; and

FIG. 4 is a view taken on the line 4—4 of FIG. 3.

Referring to the drawings in particular, the invention as embodied in FIGS. 1 and 2 comprises a flying body
generally designated 1 having a lined hollow explosive charge generally designated 2 arranged toward the rear thereof. The flying body 1 is driven by rocket engines having nozzle means such as thrust nozzles 3, 3 for the discharge of thrust gases, which gases are generated by burning of solid fuel in the combustion chamber 5. The forward end of the hollow explosive charge 2 is formed with a conical recess defined by linings 4 which define the rear portion of the combustion chamber 5 for the rocket engines. In the embodiment illustrated, there are two-part drive charges 6 and 7 which are arranged in the front of the hollow charge 2 in respect to the direct firing direction. The driving charge 6, as indicated, occupies the complete forward portion of the flying body, and the driving charge 7 fills the conical space defined by the forward end of the explosive charge 2. After the driving charges 6 and 7 are ignited, the charge 7 in the hollow space designated 8 burns more rapidly than the charge 6 in the forward portion or bow 9 of the flying body 1. Thus, the hollow charge 2 is therefore fully active when the flying body flies only a short distance, that is, even if the flying body is not utilized over its full range. Because the drive charges 6 and 7 burn in opposite directions, the center of gravity of the flying body remains in a relatively stable position.

The linings 4 of the hollow explosive charge 2 consist of the layers 10, 11, 12, 13 and 14. The layer 10 which faces the combustion chamber 5 is a lacquer layer which, under the influence of the drive charges 6 and 7, is also burned and which prevents adhering of the combustion residue of the drive charges 6 and 7 to the remaining portion of the linings 4. The next following layer 11 consists of steel, copper, brass, zinc, glass, cast iron, silicon carbides or sinter metals and is decomposed under the action of the hollow charge into very fine metallic particles. The layer 12 serves as a gliding layer and prevents reaction or compounds of the preceding layer 11 with the following layer 13. The layer 12 may consist of any suitable material which is to be chosen in dependence on the layers 11 and 13 to be separated. The following layer 13 opposes evaporation of the layer 11. This layer 13 may therefore consist of lead, aluminum, magnesium or titanium. A further insulation layer is provided on the hollow charge lining 4 and protects the explosive charge 2 from too much heat caused by the combustion gases of the drive charges 6 and 7 during the burning of the latter. Thus, for example, carbonized coats, oxide or water glass layers are suitable, for this insulating layer. In a preferred arrangement, the lining 4 of the hollow explosive charge 2 is extended through the explosive material 15 in the form of a tube 16 provided with a neck 17 which is embedded directly in the explosive material 15. At the stern or tail 18 of the flying body, a guide rod 19 is secured in the pipe or tube 16. With such a construction of the hollow charge 2 it may advantageously form the tail or stern of the flying body 1. Moreover, in such a construction the outer enclosure or jacketing of the hollow charge 2 may be dispensed with. By means of the guide rods 19 which are insertable, for example, into the barrel of a weapon, such as a gun or rifle, the flying body is guided during launching. The launching of the flying body 1 is caused by its own drive and is accomplished by igniting the drive charges 6 and 7 by means of an igniting device (not shown). From the head igniter 22 to the detonator 23 of the hollow charge 2 there extend current bearing ignition wires 21 and 22 which are arranged at a distance from the lining 4 when passing through the drive charge 7 within the conical space enclosed by the lining. The wires 20 and 21 provide ignition current lines and they may be uncovered or insulated iron wires. They are embedded in such a manner that their longitudinal axes include an angle which is about one fourth to one third smaller than the opening angle of the hollow charge lining 4, in order to ensure that they will not interfere with the functioning of the explosive charge 2.

In FIGS. 3 and 4 there is indicated a spin stabilized flying body generally designated 30 which is propelled by driving charges located in a forward flight combustion chamber 33 and a rear flight combustion chamber 34. In addition, spin is imparted to the flying body 30 by means of a driving charge acting in a centrally arranged combustion chamber 35.

The forward part of the flying body 30 includes a front enclosure or ring element 39 having an inner nozzle ring 38 secured to its forward end over the front end of which is secured an outer nozzle ring 40 which is connected with a hood 41. The front forward drive combustion chamber 33 is closed frontwardly by means of a lid 42 which is secured at the inner nozzle ring 38. The rings 38 and 40 define therebetween an annular channel 36 which leads from the front forward drive combustion chamber 33 into an annular gap nozzle 37. Thrust gases exit from the combustion chamber 33 through one or more openings 33' and are discharged through the annular gap nozzle 37. The inner nozzle ring 38 has a knurling 77 by means of which the outer nozzle ring 40 can be centered.

The rear of the combustion chamber 33 is closed by a funnel-shaped recess defined in the forward end of the hollow explosive charge 51 and is defined by the charge lining 43.

In the front combustion chamber 33, there is accomodated a drive charge 44 which projects into the funnel-shaped cavity 45 in order to stop the rapidly decelerated flying body 30. The drive charge 44 is provided with channels or passages 45 which extend in the direction of the longitudinal axis of the charge. The channels 45 establish communication between the hollow spaces of the combustion chamber 33 at the forward and rear ends thereof. An intermediate casing member 53 is threaded into the front enclosure 39 of the flying body 30 at the location of the central combustion chamber 35. The casing 53 is provided with extensions forming guide nozzles or guide vanes 54 which cause the tangential discharge of the thrust gases at the circumference of the flying body 30 to impart the flying body with a spin (see FIG. 4).

In order to prevent impermissible high heat conduction from the central combustion chamber 35 to the explosive charge 51 or to an explosive charge 52 at the rear thereof, there is provided a heat insulation element 55 between the forward combustion chamber 33 and the intermediate or central combustion chamber 35. In the central combustion chamber 35 there are arranged holding pins 56 which extend parallel to the longitudinal axis of the flying body and concentric thereto. A plurality of powder foils 57 is placed in the central combustion chamber 35. The powder foils 57 contain a charge which burns very rapidly. Distance plates or spacers 58 are arranged between the foils 57.

The combustion chamber 35 is closed rearwardly by a box-shaped lid 59 of a material which is heat-conducting. A sealing element 60 is arranged around the circumference of the lid 59. A combustible charge or tracer igniter 61 is accommodated in this box-shaped lid or cover 59 and upon burning of the charge 61, the powder foil 57 is ignited in a delayed manner, for example by the heat conduction through the lid 59. The temperature of the lid 59 and the intermediate or central combustion chamber 35 causes in turn the ignition of the drive charge 62 which is contained in the after-combustion chamber 34. The ignition of the drive charge 2 is effected by heat conducted through the openings 63 which are defined in the lid 59.

The ignition of the powder foils 57 in the central combustion chamber 35 is accomplished by means of an igniting capsule 65 and a booster charge 66 which are arranged in a pipe 67 extending coaxially in respect to the longitudinal axis of the flying body 30. Pipe 67 is embedded in the drive charge 62 and the rear combustion chamber 34. The rear end of the pipe 67 is provided with a sleeve extension 68 which can be placed or pushed onto the barrels of a weapon or shooting device (not shown).
through which the igniting capsule 65 is ignitable, either electrically or by impact. At the forward end of the pipe 67, there is a bushing 69 having radial perforations 70 which are distributed uniformly over the length and circumference. This bushing is arranged so that the longitudinal axis of the central combustion chamber 35 and is mounted to extend through the chamber. Through this arrangement the igniting booster charge 66 causes the ignition of the powder foils 57. A tubular enclosure or casing 71 is threaded onto the intermediate casing 52 and forms the outer casing of the rocket combustion chamber 34. A ring-shaped insert 72 is welded to the rear of the enclosure 71. The insert 72 has a ring-shaped guide vane 73 which forms an annular gap nozzle 74 with the casing 71 which communicates with the combustion chamber 34 by the means of a gas discharge opening 75. The thrust gases from the combustion chamber 34 are deflected away from the operator of the weapon to fire the flying body by the guide vane 73. The annular insert 74 has a knurling 78 which facilitates its centering in the rear enclosure 71 of the flying body. A bottom 76 encloses the rear of a combustion chamber 34 and is welded on the inner side of the annular ring 72 and to the sleeve 68.

In order to launch or shoot the flying body 30, the flying body is pushed downwardly into the barrel of a weapon or launching device to center its sleeve 68 on a firing device (not shown) which causes the ignition of the capsule 65. The capsule 65 then ignites the booster charge 66 to cause ignition of the powder foils 57 in the central combustion chamber 35. Thrust gases are therefore discharged between the guide vanes 54 in a tangential direction and they cause the spinning of the flying body in the barrel of the weapon or launching device.

Because of the burning of the charge in the combustion chamber 35, the igniting charge 61 is ignited in a pyrotechnically delayed manner, for example by the heat which acts on the charge which comes from the central combustion chamber 35. The ignition of the charge drives 62 which burns for a relatively long period is thus accomplished. The combustion gases of this drive charge 62 flow from the annular gap nozzle 73 whereby the flying body is imparted with a forward acceleration and list from the launching device. Due to the rotation of the flying body 30, centrifugal force fuses 49 are activated to cause the igniting device 48 and the igniting charge 40 to be fired. The igniting device 48 and the fuses 49 are surrounded by an insert of synthetic material 50. This causes ignition of the charge 44 in the forward combustion chamber 33 which burns for a short time only and takes place only after the charge in the combustion chamber 34 has imparted a certain speed to the projectile. In this manner the missile operator is not subjected to exiting gases from the forward combustion chamber 33.

Upon impact of the flying body 30, the hood 41 is deformed to cause an impact igniting means 79 arranged in the hood to become operative to ignite the hollow explosive charges 51 and 52. This may be accomplished, for example, through an igniting line or cable (not shown). Instead of electrical ignition, a small hollow charge may be arranged at the igniting means 79 having jets directed rearwardly. Due to such jets, the detenator 52 is actuated so that the main hollow charge 51 is detonated.

All of the components of this invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A flying body comprising an explosive charge having a recess formed adjacent one end by a lining wall, said lining wall also forming a boundary for a rocket combustion chamber, thrust nozzle means connected to said combustion chamber for the discharge of thrust gases, and a driving charge in said combustion chamber located within the recess of said explosive charge.

2. A flying body comprising an explosive charge having a recess formed adjacent one end by a lining wall, said lining wall also forming a boundary for a rocket combustion chamber, thrust nozzle means connected to said combustion chamber for the discharge of thrust gases, a driving charge in said combustion chamber located within the recess of said explosive charge, and an additional driving charge within said combustion chamber at a spaced location from said driving charge.

3. A flying body comprising an explosive charge having a recess formed adjacent one end by a lining wall, said lining wall also forming a boundary for a rocket combustion chamber, thrust nozzle means connected to said combustion chamber for the discharge of thrust gases, a driving charge in said combustion chamber located within the recess of said explosive charge, an additional driving charge within said combustion chamber at a spaced location from said driving charge, and means for igniting the driving charge within the hollow cavity at said explosive charge before the additional driving charge.

4. A flying body comprising an explosive charge having walls forming a portion of the rear of said flying body and a forward lining defining a cavity at the forward end of said explosive charge, wall means defining the forward end of said flying body and enclosing a combustion chamber bounded at least partially by said lining of said explosive charge, at least one thrust nozzle for discharging driving thrust gases from said combustion chamber, a first driving charge in said combustion chamber located within the recess of said explosive charge, and at least one second driving charge in said combustion chamber, said driving and additional charges being ignitable and burnable at rates such that the center of gravity of the flying body will not be materially shifted during their combustion.

5. A flying body comprising an explosive charge having walls forming a portion of the rear of said flying body and a forward lining defining a cavity at the forward end of said explosive charge, wall means defining the forward end of said flying body and enclosing a combustion chamber bounded at least partially by said lining of said explosive charge, at least one thrust nozzle for discharging driving thrust gases from said combustion chamber, a first driving charge in said combustion chamber located within the recess of said explosive charge, and at least one second driving charge in said combustion chamber, said first and second charges being ignitable and burnable at rates such that the center of gravity of the flying body will not be materially shifted during their combustion, and a guide rod secured to the rear of said tube and extending outwardly from said flying body.

6. A flying body comprising an explosive charge having walls forming a portion of the rear of said flying body and a forward lining defining a cavity at the forward end of said explosive charge, wall means defining the forward end of said flying body and enclosing a combustion chamber bounded at least partially by said lining of said explosive charge, at least one thrust nozzle for discharging driving thrust gases from said combustion chamber, a first driving charge in said combustion chamber located within the recess of said explosive charge, and at least one second driving charge in said combustion chamber, said first and second charges being ignitable and burnable at rates such that the center of gravity of the flying body will not be materially shifted during their combustion, and means for igniting said first and second driving charges including current bearing ignition wires disposed in the recess of said explosive charge and arranged at an angle in respect to the axis of said flying body which is two
thirds to three quarters as great as the angle included by the lining of said explosive charge.

7. A flying body comprising an explosive charge having walls forming a portion of the rear of said flying body and a forward lining defining a cavity at the forward end of said explosive charge, wall means defining the forward end of said flying body and enclosing a combustion chamber bounded at least partially by said lining of said explosive charge, at least one thrust nozzle for discharging driving thrust gases from said combustion chamber, a first driving charge in said combustion chamber located within the recess of said explosive charge, and at least one second driving charge in said combustion chamber, said first and second charges being ignitable and burnable at rates such that the center of gravity of the flying body will not be materially shifted during their combustion, said lining forming a conical recess disposed concentrically in respect to the axis of the flying body and defining a cone opening angle in respect to said axis, and ignition wire means for igniting said driving charges disposed in the conical recess and making an angle with said axis which is less than said cone angle.

8. A flying body comprising an explosive charge having walls forming a portion of the rear of said flying body and a forward lining defining a cavity at the forward end of said explosive charge, wall means defining the forward end of said flying body and enclosing a combustion chamber bounded at least partially by said lining of said explosive charge, at least one thrust nozzle for discharging driving thrust gases from said combustion chamber, a first driving charge in said combustion chamber located within the recess of said explosive charge, and at least one additional driving charge in said combustion chamber, said lining being extended through said explosive charge and forming a tube centrally within said explosive charge, and a guide rod secured to the rear of said tube and extending outwardly from said flying body, said tube having a plurality of openings therein communicating directly with said explosive charge.

9. A flying body comprising an explosive charge having walls forming a portion of the rear of said flying body and a forward lining defining a cavity at the forward end of said explosive charge, wall means defining the forward end of said flying body and enclosing a combustion chamber bounded at least partially by said lining of said explosive charge, at least one thrust nozzle for discharging driving thrust gases from said combustion chamber, a first driving charge in said combustion chamber located within the recess of said explosive charge, and at least one additional driving charge in said combustion chamber, means defining an intermediate combustion chamber intermediate the length of said missile, and guide vane means for said intermediate combustion chamber for directing gases outwardly in a tangential manner for causing spinning of said flying body.

10. A flying body comprising an explosive charge having walls forming a portion of the rear of said flying body and a forward lining defining a cavity at the forward end of said explosive charge, wall means defining the forward end of said flying body and enclosing a combustion chamber bounded at least partially by said lining of said explosive charge, at least one thrust nozzle for discharging driving thrust gases from said combustion chamber, a first driving charge in said combustion chamber located within the recess of said explosive charge, and at least one additional driving charge in said combustion chamber, means defining an intermediate combustion chamber intermediate the length of said missile, guide vane means for said intermediate combustion chamber for directing gases outwardly in a tangential manner for causing spinning of said flying body, wall means defining an after-combustion chamber located behind said intermediate combustion chamber, and nozzle means associated with said after-combustion chamber for discharging thrust gases generated by combustion in said after-combustion chamber.

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