United States Patent [19]

Schnabele et al.

[11] **3,869,101**

[45] **Mar. 4, 1975**

[54] **INFANTRY MISSILE FOR COMBAT AGAINST GROUND TARGETS**

[75] Inventors: **Werner Schnabele,** Wolfratshausen; **Georg Knoche,** Furth; **Fritz Zeyher,** Ottobrunn, all of Germany

[73] Assignee: **Messerschmitt-Bolkow-Blohm GmbH,** Munich, Postfach, Germany

[22] Filed: **May 7, 1973**

[21] Appl. No.: **358,079**

[30] **Foreign Application Priority Data**

May 10, 1972 Germany 2222785

[52] **U.S. Cl.** **244/3.1**

[51] **Int. Cl.** .. **F42b 15/18,** F42b 15/10, F42b 13/00

[58] **Field of Search** 244/3.1

[56] **References Cited**

UNITED STATES PATENTS

1,459,198	6/1923	Dunejeff	244/3.1
1,896,515	2/1933	Huffman	244/3.1
3,086,467	4/1963	Gallagher et al.	244/3.1
3,132,587	5/1964	Fuller	244/3.1
3,401,637	9/1968	Briscoe	244/3.1

Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—Thomas H. Webb
Attorney, Agent, or Firm—Woodhams, Blanchard and Flynn

[57] **ABSTRACT**

Infantry missile for combat against ground targets. For a missile which is to have an essentially flat trajectory, there is provided a smooth cylindrical body portion and associated therewith a forwardly sloped surface which during flight will cause the missile to assume a trim angle capable of guiding it in a substantially horizontal flight path. In one embodiment, said forwardly sloping surface is at the forward end of a forwardly projecting horn-like detonator, in another embodiment the forwardly sloping surface is at the end of the otherwise cylindrical body part and in a still further embodiment said surface is on the lower side of the missile body as diverging upwardly flared surfaces. To assure that the missile promptly assumes the desired attitude, means are also provided for guiding it from the launching tube in an attitude whereby its central longitudinal axis is already at the desired trim angle with the central longitudinal axis of the launching tube.

13 Claims, 5 Drawing Figures

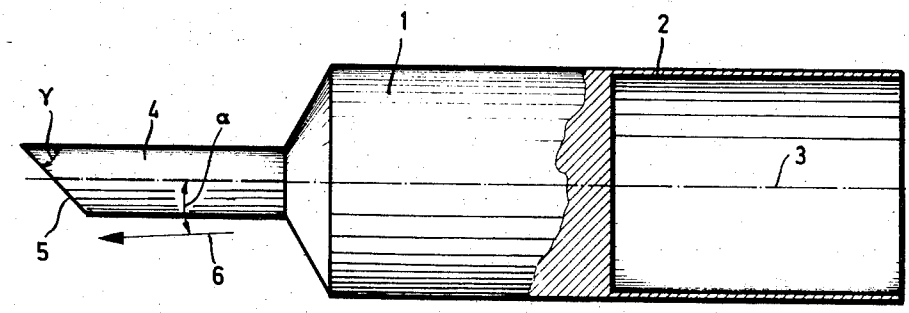


Fig.1

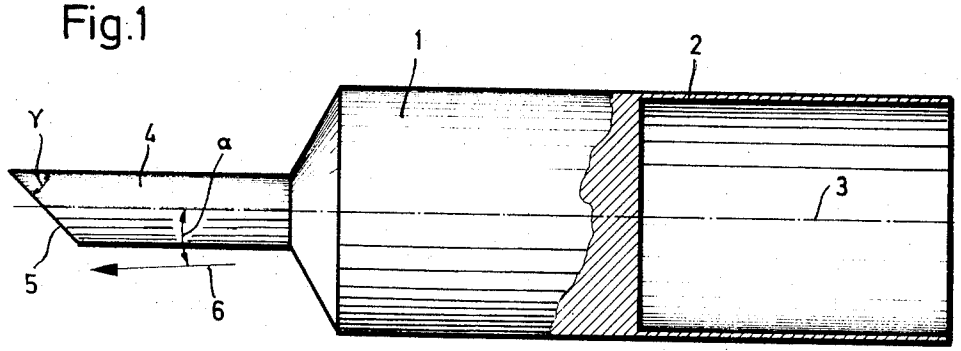


Fig.2

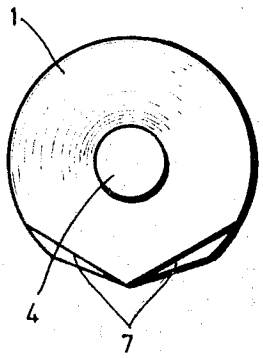


Fig. 4

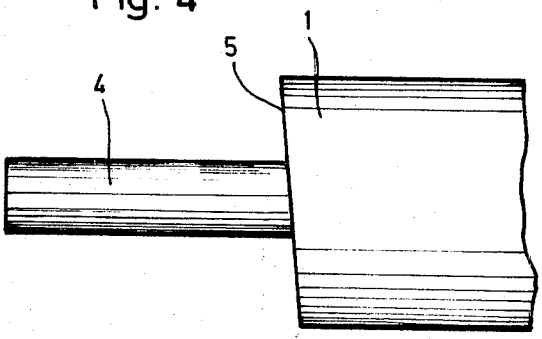


Fig. 5

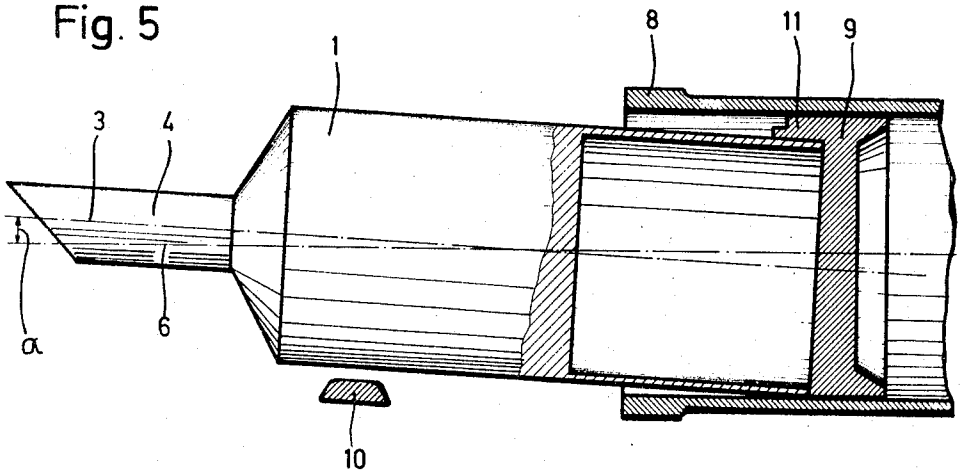
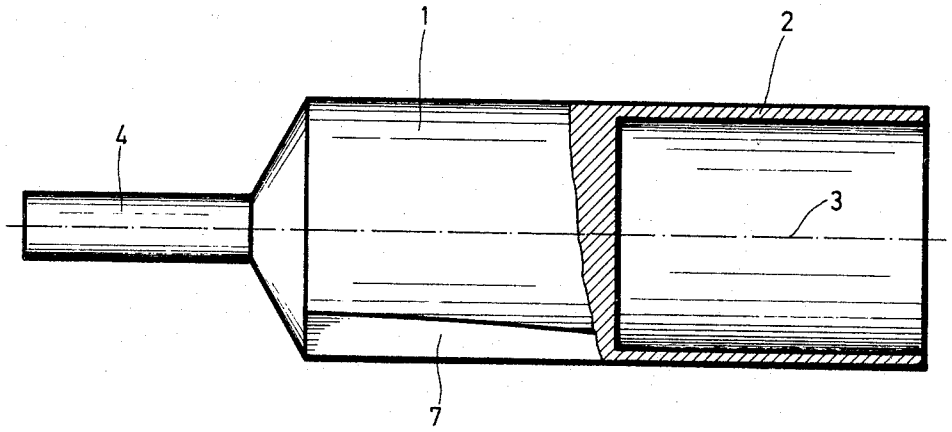


Fig. 3



INFANTRY MISSILE FOR COMBAT AGAINST GROUND TARGETS

The invention relates to an infantry missile for combat against ground targets.

Such missiles may be constructed symmetrically with respect to rotation and may be stabilized on their path of flight by a rotational movement about their longitudinal axis. In addition, wing-stabilized and nonrotating missiles are known, as for example described in the Oerlikon-Taschenbuch, Zurich-Oerlikon 1956, Page 134 and the following and Page 151 and the following.

Particularly for infantry combat with ground targets at distances up to 500 meters it is desired to simplify the sight and directive tasks for the launching personnel by straightening the path of flight of the missile substantially and as much as possible up to an approximately straight line. Thus, with such a path of flight of the missile, there is no necessity for adjusting the sight or the directive angle of the launching device, even for different distances to the target.

However in using the above-mentioned missiles, it is not possible to obtain an almost rectilinear path of flight even within this distance range, unless the launching speed of the missile is greatly increased over present practice. This, however, would mean that an extremely high gas pressure would be needed in the launching device which would result in the launching device becoming at once heavier and more bulky. This in turn would make it impossible for a single person to operate and transport the launching device and/or the missile. Nevertheless, the requirements of infantry are strongly for an easily manageable weapon so that troops can react flexibly to quickly changing combat conditions.

German Auslegeschrift No. 1,094,159 discloses a missile which is aerodynamically stabilized by an annular wing and rotates about its longitudinal axis, on which missile is secured a pendulum which is not affected by the rotation of the missile and which is aligned according to the plumb line. This pendulum is itself connected to a trim means constructed as an interference surface. Dependent on the position and the size of the interference surface, it is intended that a straight path of flight of the missile will be obtained and that this will minimize the sight and directive tasks of the operating personnel.

However, a complete movement neutralization between pendulum and missile body is only limitedly possible even with accurately manufactured ball bearings — the manufacture of which in addition is complicated and expensive. Due to the frictional forces in the bearing, variations in the interference surface with respect to its zero position will occur so that the aerodynamic moments which act on the interference surface outside of its zero position may move the missile from its desired path of flight.

Since in addition the annular wing of this missile is connected to the missile body through struts, pressure differences can occur on these struts which here lead to aerodynamic lateral moments and to a lateral acceleration of the missile. Since, however, this lateral acceleration is superposed to the earth acceleration which aligns the pendulum, the pendulum which carries the interference surface is adjusted into the direction resulting from these two accelerations so that the missile

— as above described — is again deflected from its desired path of flight.

Further, as a result of such deflections, additional lateral accelerations act onto the missile and the pendulum whereby the pendulum will be continuously newly aligned following one of the described corrections of the flight of the missile so that the direction of the pendulum no longer coincides with the direction of earth acceleration. As a result of this, the pendulum will adjust itself according to an "apparent perpendicular" and the missile will describe a spiral around the actual nominal flight path.

It will be apparent that such a construction of a missile is not desirable since it cannot provide a controllable accuracy of fire.

Furthermore it is known from German Patent No. 931,267 to mount at the head of a rotationally stabilized missile an interference surface which can intermittently be extended from the missile body. By controlling the frequency of appearance of this interference surface a desired, including rectilinear, flight path can be obtained. However, in this system a constant rolling frequency of the missile is absolutely necessary because the extending frequency of the interference surface is coupled with it. Thus, inaccuracies in the rolling frequency again cause deviations of the missile from its nominal flight path. In addition the control of the interference surface itself — particularly after a long period of storage of the missile — is a possible source of trouble.

A missile is known from Austrian Patent No. 57,039 which has at its front part extendable stabilizing surfaces which also serve for straightening the flight path. However, this device, due to the required extending mechanism, is mechanically expensive and also after a long period of storage the missile may no longer be fully operative.

The purpose of the invention is to construct a simple and at the same time sturdy infantry missile for combat with ground targets in such a manner with respect to its shape and operation that it cannot be deflected by aerodynamic interference forces from a straight, preferably rectilinear, path of flight. Furthermore such a missile should be easy to handle and continue operative even after a long period of storage.

This purpose is attained according to the invention by providing a missile body which is symmetrical with respect to rotation, the rear part of which is constructed as a cylinder or cone jacket in order to achieve a path of flight which is free of spiral movements and is aerodynamically stable and by providing fixed trim means for achieving a straight, preferably rectilinear path of flight.

The advantages of such a missile are obvious:

The basic form which is symmetrical with respect to rotation permits a recognizably simple manufacturing procedure for the missile. By not using movable parts, struts or stabilizing wings rough handling of same is also permissible without danger of damage. Furthermore, by this construction, storage is simplified in that it is now easy to stack the missiles.

Also the flight characteristics of the missle are improved compared with those of the known missiles because pressure differences which occur on the periphery of the missile body, which is symmetrical with respect to rotation during the flight, due to a lack of a point of application, cannot result in rolling or lateral

moments of the missile. In the meantime it has been proven during many firing tests that the missile does not change its rolling position after launching for a distance of several hundred meters, which corresponds approximately to the normal range for firing on tanks or similar targets. On the other hand, the trim means fixed to the missile always maintains the desired fixed reference position required for obtaining a straight flight path.

According to a further embodiment of the invention the trim means is constructed as a sloped forward end closure of a horn-like extension of the missile which horn-like extension extends forwardly in direction of the longitudinal axis of the missile.

The horn-like, in most cases an ignition device carrying, extension and sloped end can be manufactured easily with the highest precision in normal construction of the missile. The trim moments which must thereby be produced are sufficiently great to achieve a straight or rectilinear flight path, while the interference moments which cause a rolling interference of the missile act directly with respect to the rolling axis of the missile so that the lever arm for these disturbance forces is only very small.

In tests with such a missile, it has been shown that the flight path coincides for several hundred meters almost with the sight line. It can be seen that this substantially simplifies combat against tanks because the infantryman is able to aim accurately, though without sight adjustment, at targets which are located at varying distances.

In addition a simple manufacture of the missile is obtained, according to a further embodiment, in that the trim means is constructed as a forward sloped end for the front part of the missile body.

The stable rolling position of the missile which has been confirmed by the tests can according to a further embodiment of the invention be further maintained in that the missile has in at least a portion of the lower missile body keel means aligned in direction of the longitudinal axis. This principle of stabilization of rolling position is already known in other fields, for example, in aircraft construction in the V-position of aircraft wings. The keel means may of course itself be constructed as a trim surface.

The trim means affixed to the missile has the effect that after the launching from a launching device the missile is adjusted by aerodynamic moments which engage the trim means after a certain time of flight to a trim angle in relation to the tangent to its flight path. Since it is desirable, in view of the desired straight flight path, to achieve the adjustment of the missile to the required trim angle as early as possible, according to the invention the missile is guided within the launching device itself at an angle with respect to the longitudinal axis of the launching device, which angle corresponds to the trim angle. Thus, the missile leaves the launching device already at the desired trim angle.

The invention will be explained more in detail in connection with the three exemplary embodiments which are illustrated in the drawings, in which:

FIG. 1 is a partially cross-sectional side view of a missile according to a first embodiment of the invention;

FIG. 2 is a front view of a missile according to a second embodiment of the invention;

FIG. 3 is a side view of said second embodiment;

FIG. 4 is a fragmentary side view of a missile according to a third embodiment of the invention;

FIG. 5 is a partial cross-sectional side view of the missile according to the first exemplary embodiment during the launching from a launching device.

A missile **1** having a missile body which is symmetrical with respect to rotation is aerodynamically stabilized by a cylindrical jacket **2.** The front end of the missile **1** includes a cylindrically shaped horn-like extension **4** which is positioned symmetrically to its longitudinal axis **3,** which contains a not-illustrated impact detonator and which is closed in front by a sloped trim surface **5.** As soon as the missile has been launched, aerodynamic forces will act onto this trim surface **5,** which forces position the missile at the trim angle α with respect to the path of flight indicated by the arrow **6** in FIG. **1.** The angle γ, which the plane of the trim surface **5** defines, is so chosen with respect to the longitudinal axis **3** of the missile, that the path of flight of the missile is rectilinear within the projected range so that one sharpshooter can effectively aim for different distances without sight adjustment.

Since aerodynamic disturbance forces which could result in rolling movements of the missile **1** are only small because of the arrangement of the trim surface, which arrangement is symmetrical to the longitudinal axis **3** of the missile, a separate rolling position stabilization of the missile **1** is normally not necessary. Same can, however, be obtained in a simple manner by providing, as illustrated in FIG. **2,** the missile **1** in the lower area of its missile body with keel means which stabilizes it with respect to the earth gravitational field. The keel means **7** can thereby be slightly angled with respect to the longitudinal axis **3** of the missile so that it itself serves as a trim surface.

As is illustrated in FIG. **4,** the front end of the missile **1** can be sloped and serve as trim surface **5.** The horn-like extension **4** does not need to be sloped in this case and may be rounded off or — as illustrated — closed off rectangularly.

The specific arrangements and constructions of the trim surface are set forth above only as examples; other forms are, of course, possible and will be apparent to a man skilled in the art and working in this field.

In order that the missile immediately after launching assumes the trim angle with respect to its path of flight, two sliders **9** and **10** are provided in the launching device **8,** see FIG. **4.** The slider **9** has at its upper end an extension **11** which grips around the missile at its rear in the area of the cylinder jacket **2.** This causes the cylinder jacket to be urged in its lower part against the launching tube **8.** At the same time the slider **10** which in its thickness equals the extension **11** is mounted in the front zone of the missile **1** so that the forward part of the missile is urged against the upper wall of the launching tube **8.** As soon as the missile **1** leaves the launching tube the slider **10** is expelled from the launching tube and the missile **1** is already at the trim angle α with respect to its path of flight **6.**

Although a particular preferred embodiment of the invention has been disclosed above for illustrative purposes, it will be understood that variations or modifications thereof which lie within the scope of the appended claims are fully contemplated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A nonrotational infantry missile, launchable from a launching device primarily for combat against ground targets, comprising:

a cylindrical body, the rear part of said body comprising means for achieving an aerodynamically stable flight position without missile rotation, such means defining a hollow cylindrical jacket;

a cylindrical forward extension coaxially fixed to said body;

lift producing trim means fixed on the missile for straightening the flight path of the missile to make said path substantially rectilinear.

2. The apparatus of claim 1, in which said lift producing trim means is a forwardly facing but sloped planar face centered on the central axis of the missile and arranged for lifting the forward end of the missile to a trim angle with respect to the path of flight.

3. The apparatus of claim 2, in which said trim means comprises a sloped front end closure face on said fixed extension.

4. The apparatus of claim 2, in which said trim means comprises a sloped closure face defining the front of said cylindrical body and from which said extension forwardly extends.

5. The apparatus of claim 1 including keel means formed in a lower part of said cylindrical body and extending substantially parallel to the longitudinal axis of said missile.

6. The apparatus of claim 5, in which said keel means is somewhat inclined with respect to the longitudinal axis of the missile and has sloped, somewhat forwardly and laterally outwardly facing surfaces defining said lift producing trim means and converging keel-like for providing additional roll stability.

7. The apparatus of claim 2 in which said hollow cylindrical jacket has an open rear end, and including a substantially forwardly facing linear profile closing the front of said body outward of said forward extension and being angled somewhat from a radial plane of the missile, said lift producing trim face being sloped downwardly during missile flight, said trim face having a central portion at least close to the missile longitudinal axis, said face being disposed at least near the front of the missile and ahead of said jacket.

8. The apparatus of claim 7 in which said trim face is forwardly spaced along the missile axis from said sloped linear profile, said linear profile consisting of a shallow conical closure surface.

9. The apparatus of claim 7 in which said trim face defines said linear profile, said trim face being somewhat downwardly facing but predominately forwardly facing and extending the full cross section of said body outside the periphery of said forward extension to provide said body with a skewed forward end.

10. The apparatus of claim 5, in which lower forward portion of said cylindrical body has convergent planar relieved areas meeting at the bottom thereof to define said keel means for additionally stabilizing the missile against rolling motion while in flight.

11. The apparatus of claim 1, in which the launching device comprises a launching tube, and including holding means slidable axially within the launching tube and releaseably bearing on the missile body when in said launching tube for holding said missile body with its longitudinal axis inclined at an angle α to the longitudinal axis of the launching tube and with the forward end of said missile body thus elevated in the launching tube during launching, said holding means being adapted to fall away from said missile body when leaving the launching tube, said trim means comprising a surface oriented to maintain the missile axis forwardly elevated at a trim angle to the missile flight path after launching, said angle α being substantially equal to said trim angle whereby said missile is propelled from said launching tube already at said trim angle with respect to its flight path.

12. The apparatus of claim 11, in which said holding means comprises spaced rear and front sliders, said rear slider comprising a transverse member spanning the interior cross section of the launching tube and having a forwardly and upwardly sloped front face abutting the rear end of said jacket, said rear slider having at its upper end a forward extension which grips around the rear area of said jacket for urging the lower portion of such jacket against the bottom peripheral wall of the launching tube, said front slider being normally disposed between the bottom peripheral wall of the launching tube and a forward portion of the missile body and corresponding in thickness to said extension of said rear slider so as to urge the forward part of said missile body against the upper peripheral wall of the launching tube.

13. A method of launching a nonrotational missile from a launching device for achieving a rectilinear path of flight, comprising;

loading the missile in a tubular launching device with the longitudinal axis of the missile forwardly and upwardly inclined at an angle α with respect to the longitudinal axis of the launching device;

propelling the missile forceably toward the outlet end of the tubular launching device while maintaining said inclination angle α between the axes thereof and without rotation of the missile with respect to the launching device, said maintaining including radial holding of the rear end of the missile by a first holding member against one longitudinal portion of the interior of the launching device and holding a diametrically opposed and forwardly displaced portion of the missile against a diametrically opposed longitudinal portion of the interior of the launching device by a further holding member and propelling of said first and further members with said missile along said tubular launching device;

releasing said members from said missile as said missile and members leave said launching device and said missile starts upon its path of flight;

configuring a longitudinally short portion of the missile with a sloped trim surface having generally forwardly facing and downwardly facing components of slope for immediately and thereafter maintaining the missile axis inclined to its path of flight at a trim angle substantially equalling said inclination angle α.

* * * * *