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STABILIZED SELF-PROPELLED MISSILE

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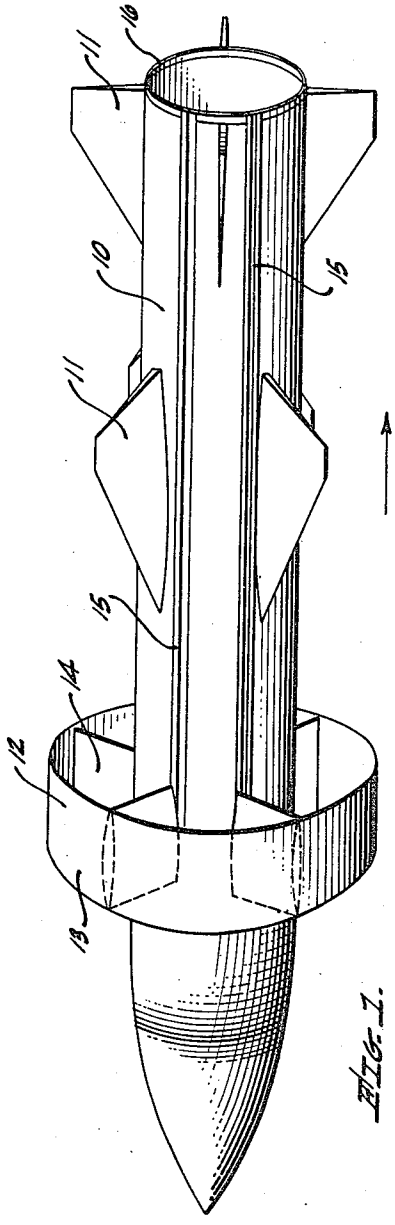


FIG. 1.

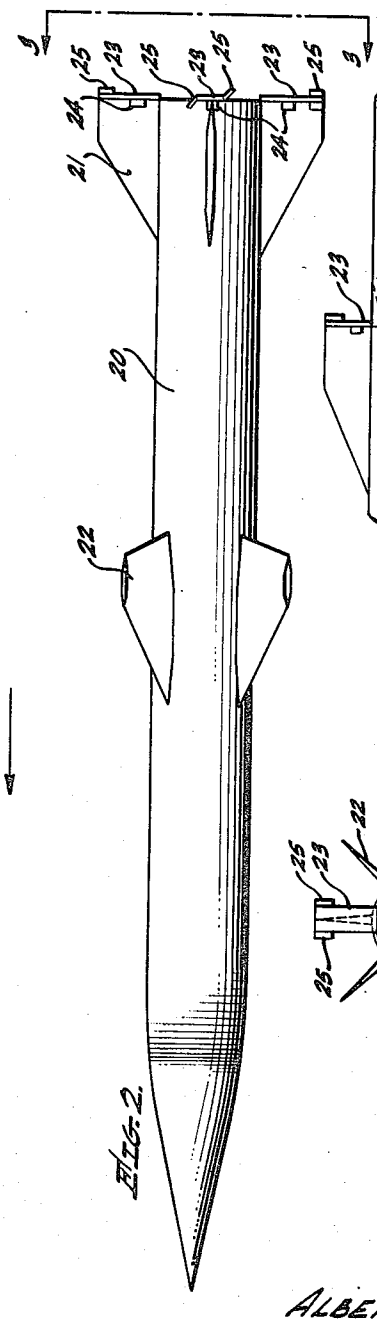


FIG. 2.

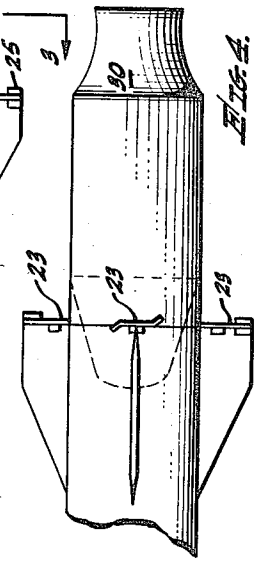


FIG. 4.

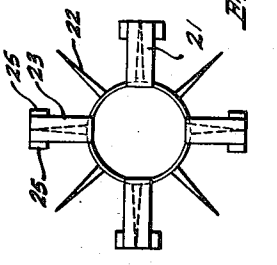


FIG. 3

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STABILIZED SELF-PROPELLED MISSILE

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1 Claim. (Cl. 102—50)

This invention relates to missiles and more particularly to a self-propelled missile which is aerodynamically stable when launched to the rear of a launching platform having a forward motion.

A self-propelled missile or flying vehicle to be aerodynamically stable must be so designed that its aerodynamic center of pressure is aft of the center of gravity of the missile with respect to the direction of ambient air flow. Thus, in rocket-powered missiles, the center of pressure is aft of the center of gravity when such missiles are designed for forward flight. That is, the lift surfaces of the rocket-powered missile are so designed and constucted that the center of gravity of the missile is toward the nose of the missile with respect to the center of pressure created by the lifting surfaces. If, however, a rocket-powered missile of the type well known to the art is launched to the rear of a forward moving platform, such as an airplane, the missile will be aerodynamically unstable. For example, if rocket-powered missiles are attempted to be launched from a high speed aircraft toward a target to the rear of the aircraft, the missile will be aerodynamically unstable and will tumble or be erratic. When launched to the rear in a direction opposed to the direction of the aircraft, the missile is initially moving in the direction of the aircraft although at a lower speed and opposed to the direction in which its nose is pointed. It is, therefore, subjected to ambient air flow from tail to nose until the rocket thrust acceleration becomes sufficient to move it in the direction in which it was originally fired. Thus, the missile fired rearward is subjected to tail-to-nose, or so-called negative, ambient air flow, and as acceleration increases due to rocket thrust, the missile momentarily attains a zero velocity with respect to the ambient air and then moves in the direction in which the ambient air flow is from nose to tail, or positive. However, during the portion of its trajectory in which it is subjected to rearward ambient air flow, the center of pressure is ahead of the center of gravity and the missile is aerodynamically unstable.

Accordingly, it is an object of the present invention to provide a self-propelled missile which is aerodynamically stable when subjected to ambient air flow which is opposed to the direction in which the projectile is directed.

It is another object of the present invention to provide a self-propelled missile which is aerodynamically stable when launched from a moving platform in the direction opposed to the direction of movement of the platform.

It is a further object of the present invention to provide a self-propelled missile having a center of pressure forward, or to the nose side, of the center of gravity of the missile during a period in which the ambient air flow about the missile is from rear to front, and having a center of pressure which is aft of the center of gravity during the period in which the ambient air flow relative to the missile is from front to rear.

It is a still further object of the present invention to provide means for aerodynamically stabilizing a self-

propelled missile during a part of its trajectory which is opposed to the direction of the trajectory for which the self-propelled missile was initially designed.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawing, herein made a part of this specification in which several embodiments of the invention are illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only, and is not intended as a definition of the limits of the invention.

Fig. 1 is a perspective view in elevation of a presently preferred embodiment of the present invention as applied to a rocket-powered missile of the type well known to the art;

Fig. 2 is a view in elevation of a rocket-powered missile showing an alternative embodiment of the present invention;

Fig. 3 is a view in elevation taken along line 3—3 of Fig. 2; and

Fig. 4 is a view in elevation of a tail portion of a rocket-powered missile showing another alternative embodiment of the present invention.

The stabilized self-propelled missile described herein utilizes auxiliary means which are detachably affixed to a self-propelled missile of the type well known to the art, which relatively positions the center of pressure and center of gravity of the missile such that the center of pressure is forward of the center of gravity during the portion of the missile trajectory in which it is subjected to tail-to-nose, or negative, ambient air flow; and which are detached from the missile substantially at the instant at which the missile, due to its self-propelled acceleration, reaches zero relative air speed, thus shifting the center of pressure and center of gravity of the missile to the relative positions in which the center of pressure is aft of the center of gravity during the portion of the missile trajectory in which the missile is exposed to nose-to-tail, or positive, ambient air flow.

Referring to the drawing, and particularly to Fig. 1, a rocket-type missile **10** of the type well known to the art is shown, in which two sets of fixed stabilizing fins **11** are spaced in quadrature about the tail section and center section of the missile **10**. The stabilizing fins **11** are so designed that the missile **10** is aerodynamically stable in the direction of flight in which the ambient air flow is positive; that is, from nose to tail of the missile. A jettisonable wing **12** is symmetrically positioned on the missile at a location toward the nose of the projectile and forward of the center of gravity of the projectile. The jettisonable wing, as illustrated, comprises a cylindrical wing **13**, having its axis coincident with the longitudinal axis of the missile, supported by a plurality of circumferentially spaced radial struts **14** which are in themselves aerodynamic lifting surfaces. The cylindrical wing **13** and radial struts **14** are designed and positioned by methods well known to the art to furnish lifting forces sufficient to shift the center of pressure of the missile to a point forward, or to the nose side, of the center of gravity of the missile. The missile is then aerodynamically stable during a direction of flight in which the ambient air flow is negative, or from tail to nose.

A plurality of rails **15** is circumferentially spaced about the surface of the missile parallel to the axis of the missile, corresponding in number and circumferential spacing to the number of radial struts **14**. The rails **15** are rigidly affixed to the struts **14** and extend from the struts to the tail of the missile where they are rigidly

affixed to a tail ring **16** which is similar in configuration to the tail surface of the missile, and abuts the tail surface. The cylindrical wing **13**, struts **14**, rails **15**, and tail ring **16** are thus an integral unit which is detachably affixed to the missile **10**.

The cylindrical wing and radial struts are used in the embodiment of Fig. 1 since these provide a high lift force for relatively small chord and span inasmuch as two sides of the wing and the struts all provide lifting surfaces. An added advantage is that the cylindrical wing has relatively high drag which adds stability and improves the effectiveness of the jettisonable wing.

Thus, in the operation of the presently preferred embodiment of the present invention, when the missile is launched with the nose in the direction opposed to the direction of movement of the aircraft, or other moving launching platform, the ambient air flow will initially be negative, at a velocity equal to the velocity of the aircraft. The drag of the cylindrical wing creates a force toward the nose of the missile which is transmitted through the rails and tail ring to the missile. While the ambient air flow is negative, the drag of the cylindrical wing maintains the jettisonable unit **12** comprising the cylindrical wing **13**, radial struts **14**, rails **15**, and tail ring **16** in place on the missile. The cylindrical wing creates a lifting force which is sufficient to move the center of pressure of the missile to a position to the nose side of the center of gravity of the missile, and the missile is therefore aerodynamically stable in rearward flight or during negative ambient air flow.

As the missile accelerates and approaches zero relative air velocity, the drag forces on the cylindrical wing holding the jettisonable unit in place on the missile approach zero. Shortly thereafter, the direction of the drag forces is shifted so that it is from front to rear such that the acceleration of the missile, together with the drag forces of the cylindrical wing, jettisons the cylindrical wing assembly by causing it to slide off the rear end of the missile. The center of pressure of the missile then shifts back to the proper location for forward flight and the missile is again aerodynamically stable.

It may be desirable in some applications to positively affix the jettisonable unit to the missile by detachable means of the type well known to the art. For example, friction pins or bolts may be used to interconnect the jettisonable unit and the missile, and delayed action squibs may be located adjacent the pins whereby detonation of the squibs will force the pins out of their interconnecting position to release the jettisonable unit. The drag on the cylindrical wing will then maintain the wing in place on the missile during rearward flight but cause it to slide off the rear end of the missile as it reaches zero relative air velocity and commences forward flight relative to the ambient air. Various methods of positively affixing the jettisonable unit to the missile and releasing it at or near zero relative air velocity will be apparent to one skilled in the art.

In an alternative embodiment of the present invention, illustrated in Figs. 2 and 3, a rocket-type missile **20** is provided with fixed radial stabilizing fins **21** spaced in quadrature about the rear end of the missile and with fixed radial stabilizing fins **22** spaced in quadrature about the circumference of the missile at an intermediate longitudinal position on the surface of the missile **20**. A lift spoiler **23** is releasably affixed to each of the tail fins **21** proximate the after edge of each tail fin. The lift spoilers **23** are positioned in a plane substantially normal to the plane of the tail fin **21**, and as shown in Figs. 2 and 3, are generally rectangular in shape, extending from the surface of the missile at least to the tip of the fin. The lift spoilers **23** are of finite width substantially greater than the thickness of the tail fins **21**. The exact configuration and area of the air surfaces of the lift spoilers is dependent upon the size of the missile **20** and the amount by which the center of pressure of the projectile is to be shifted, and is easily determined for a given application by one skilled in the art. In the embodiment shown in Figs. 2 and 3, the lift spoilers **23** are releasably affixed to the tail fins **21** by means of friction clamps **24** which are affixed to the lift spoilers **21** and engage the surface of the tail fin by friction.

Spin inducing vanes **25** are affixed to the lift spoilers **23** and are positioned at each edge of the lift spoilers to alternate sides of the spoilers in parallel planes.

Thus, when the missile of Figs. 2 and 3 is launched toward the rear of a moving platform, the missile is initially subjected to negative ambient air flow and the ambient air pressure exerts a force on the lift spoilers in the direction toward the nose of the missile and maintains the lift spoilers on the tail fins. The lifting force of the tail fins **21** is spoiled by the normal surfaces of the spoilers **23** and the center of pressure of the missile is shifted forward and to the nose side of the center of gravity. The missile is therefore aerodynamically stable in rearward flight or under negative ambient air conditions. During flight, the vanes **25** induce a gentle spin to the missile which is effective in allowing the missile to make the transition from rearward to forward relative flight with a minimum of erratic effects at the point at which its relative air speed is zero. As the missile accelerates and approaches zero relative air speed, the ambient air pressure holding the spoilers on the tail fins with the help of the friction clamps approaches zero and shortly thereafter, the direction of force on the spoilers is shifted and air pressure on the spoilers changes to be from front to rear and the spoilers are blown off of the tail fins. The missile is now aerodynamically stable in forward flight.

It may be advantageous in some applications of the present invention to add a releasable weight at the tail of the missile to comply with the requirement of having the center of pressure to the nose side of the center of gravity of the missile during rearward flight of the missile. For example, as illustrated in Fig. 4, a jettisonable weight in the form of a rocket booster **30** may be added to the tail of the missile of Fig. 2 symmetrically about the thrust axis of the missile, by affixing the rocket booster to the lift spoilers **23**, thus displacing the center of gravity of the missile rearward and aft of the center of pressure. It should be noted from the foregoing that if the center of gravity is displaced rearward, the center of pressure need not be displaced forward by as great a distance as is otherwise necessary, and if the rocket booster has sufficient weight, which may be easily determined by one skilled in the art, a spoiling of the lift over the fins is not necessary in this embodiment.

Thus, the present invention provides a self-propelled missile which is aerodynamically stable when launched from a moving platform in the direction opposed to the direction of movement of the platform, during the portion of its trajectory, in which it is subjected to rear-to-front ambient air flow, and during the portion in which it is subjected to front-to-rear ambient air flow.

What is claimed is:

A missile assembly comprising, an airframe, a cylindrical wing detachably affixed to and cooperating with said airframe having its axis coincident with the axis of said airframe, said wing being supported by a plurality of circumferentially spaced radial struts, said struts being positioned symmetrically about and proximate to the outer surface of said airframe at a position forward of the center of gravity of the airframe, a plurality of rigid longitudinal members equal in number to the number of struts, said longitudinal members being affixed to said struts and extending proximate the surfase of said airframe substantially parallel to the longitudinal axis of said airframe, and a circular tail ring substantially equal in diameter to the diameter of the tail surface of said airframe abutting the tail surface of said airframe, said longitudinal members being affixed to said tail ring, and means for jettisoning said wing, struts, rails and tail

ring from said airframe substantially as the ambient air flow past the airframe changes direction.

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