United States Patent

Gauzza et al.

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[54] **HINGED STABILITY AND CONTROL FIN ASSEMBLY**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

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[52] **U.S. Cl.**.....**244/3.29,** 244/3.28

[51] **Int. Cl.**.....**F42b 13/24,** F42b 15/16

[58] **Field of Search**.....244/3.28, 3.29

[56] **References Cited**

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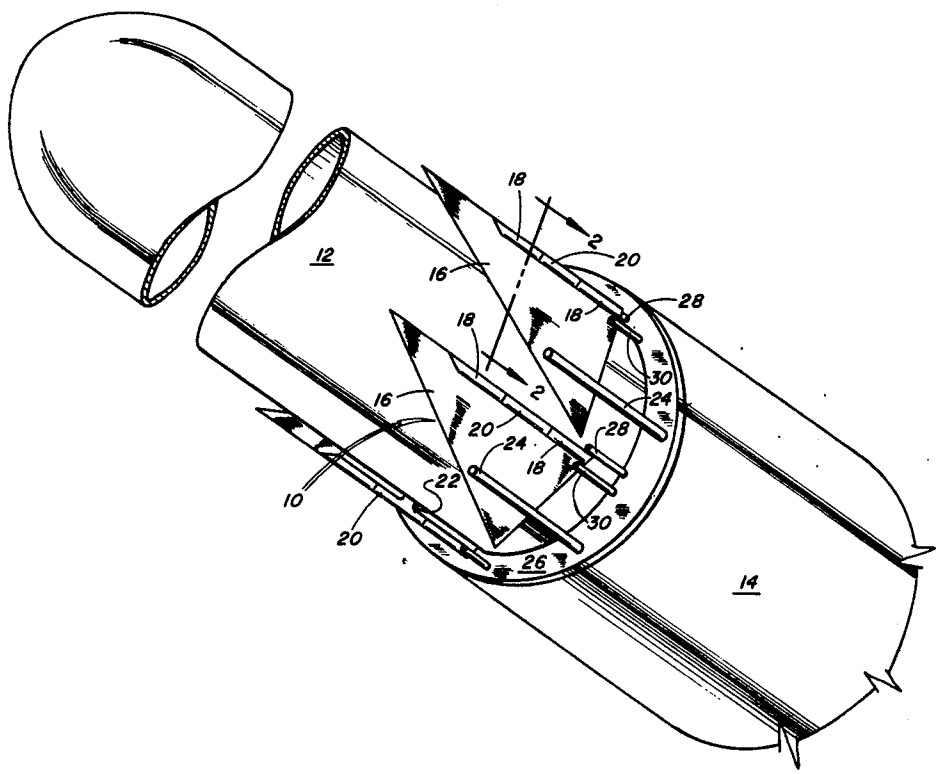
[57] **ABSTRACT**

A hinged fin assembly for an ordnance vehicle wherein each fin is pivotally mounted for rotational movement about two mutually perpendicular axes. Upon separation of a booster motor from the vehicle, a fin holding mechanism disengages from the fins to permit resilient biasing springs to pivot the fins about axes parallel to the longitudinal axis of the vehicle from a folded position to an erected position and to be locked in the erected position. When erected, the fins are controllably rotated about axes perpendicular to the vehicle's longitudinal axis to directionally control the flight of the vehicle.

3 Claims, 4 Drawing Figures



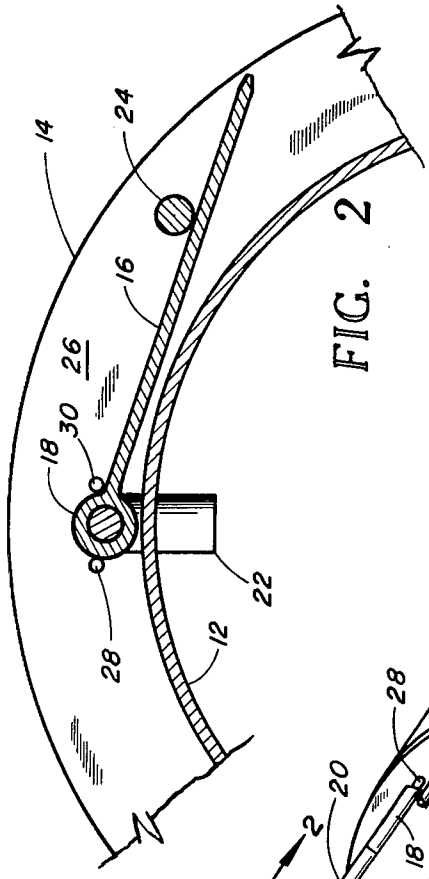


FIG. 2

FIG. 1

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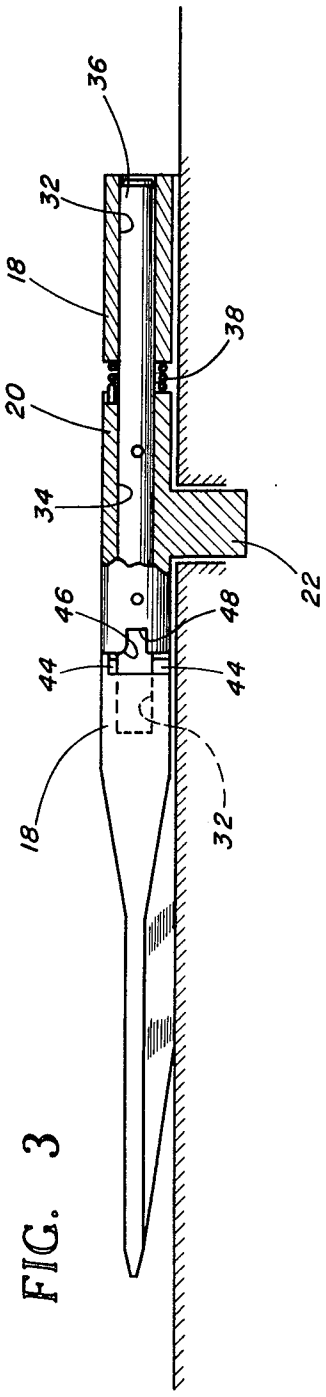

FIG. 3

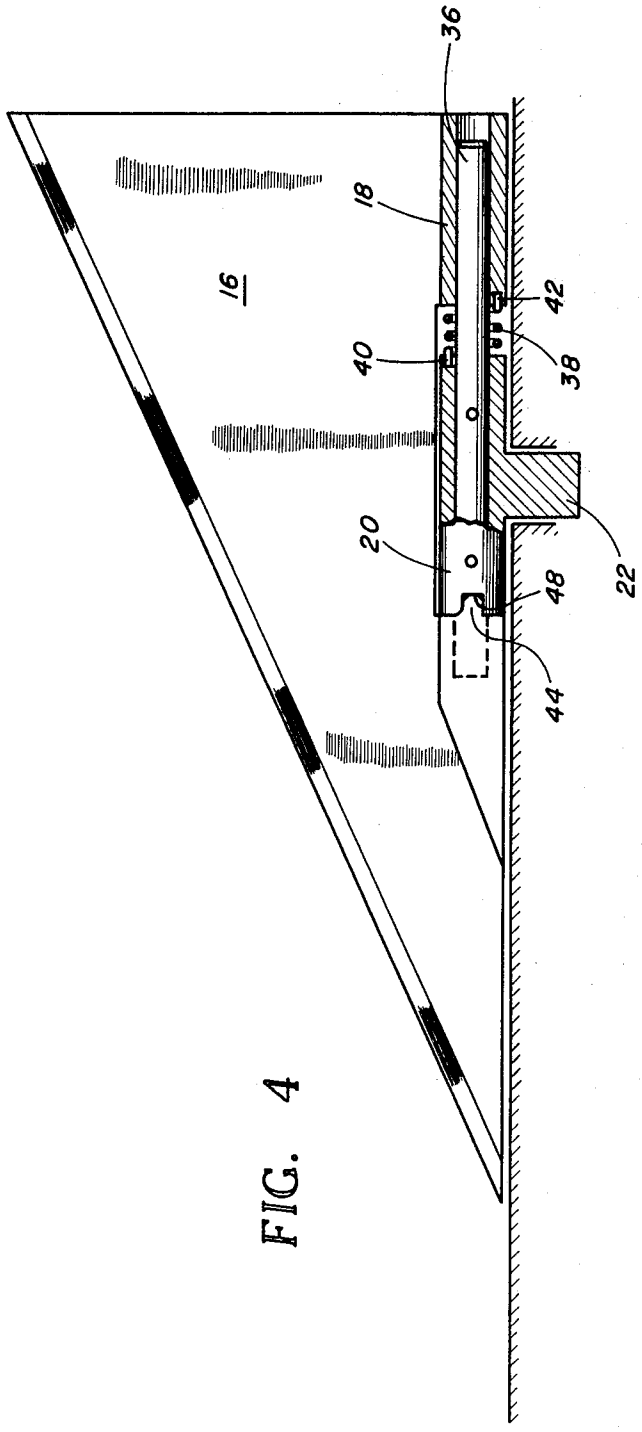

FIG. 4

HINGED STABILITY AND CONTROL FIN ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates generally to propelled ordnance vehicle stabilizing and steering fin assemblies and more particularly to a foldable and erectable fin assembly of the aforementioned type.

Many propelled aerial and underwater ordnance vehicles, such as torpedoes, rockets, guided missiles and the like, are customarily fitted with fins which are rotatable about axes perpendicular to the vehicle's longitudinal axis for stabilizing and controlling the vehicle's direction of travel. Previously existing fin assemblies have included fins which are permanently erected on the vehicle, fins which are detachable from the vehicle to conserve space during storage but which are permanently erected when mounted on the vehicle, and permanently attached fins which are foldable to conserve storage space and are manually erected from their folded position to their operative position prior to launching of the vehicle. Although the previously existing fin assemblies were satisfactory for some operating conditions, they extended substantially beyond the external diameter of the vehicle during launching of the vehicle.

In some applications, an ordnance vehicle is launched from a tube by a propulsive motor or booster motor which subsequently separates from the vehicle en route to the target and, after separation, the vehicle's direction of travel is stabilized and directionally controlled solely by the vehicle's fin assembly. To optimize the capability of such an ordnance vehicle, it is desirable to provide the vehicle with an external diameter approximating that of its booster motor, i.e. substantially as large as the diameter of its launching tube. The previously existing fin assemblies, all of which extended substantially beyond the external diameter of the vehicle during launch, would be unsuitable for such tube-launched applications since the diameter of a vehicle equipped with such fins would have to be drastically reduced to provide space within the launching tube for the fin assembly. A large reduction of the diameter of the vehicle to accommodate such fin assemblies would degrade the effectiveness of the vehicle. Although certain ballistic projectiles which are fired from tubes and gun bores are provided with foldable fins which erect during flight of the projectile, such fins provide only a stabilizing function and are incapable of steering the projectile because, when erected, such fins are locked against movement in any direction. Consequently, a need has existed for a compact folding fin assembly which is rotatable by a suitable guidance system to provide directional steering of an ordnance vehicle.

SUMMARY OF THE INVENTION

Accordingly, one object of this invention is to provide a new and improved fin assembly for ordnance vehicles.

Another object of the invention is the provision of a compact ordnance vehicle fin assembly for controlling the direction of a vehicle in flight.

A further object of the invention is to provide a compact foldable fin assembly for an aerial or underwater propelled vehicle actuatable to an unfolded position after launching of the vehicle and operable to control the direction of flight of the vehicle.

Briefly, in accordance with one embodiment of this invention, these and other objects are attained by providing on an ordnance vehicle a plurality of fins symmetrically positioned about the periphery of the vehicle and each being mounted for pivotal movement about two mutually perpendicular axes. The assembly includes a separable member for holding the fins in a folded position against pivotal movement until the separable member is jettisoned in travel, after which the fins are resiliently freed for movement about a first axis to their erected positions and are also freed for rotatable movement about a second axis to control the direction of travel of the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. **1** is a perspective view of the fin assembly, in accordance with a preferred embodiment of this invention, mounted upon an ordnance vehicle;

FIG. **2** is a sectional view taken on line **2**—**2** of FIG. **1**;

FIG. **3** is a side elevation view, partially in section, of a fin in its folded position; and

FIG. **4** is a side elevation view, partially in section, of a fin in its erected position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters designate identical or corresponding parts throughout the several views, and more particularly to FIG. **1** thereof wherein the fin assembly of the present invention, designated generally by reference character **10**, is shown mounted upon an ordnance vehicle **12**, such for example, as a torpedo, a rocket, guided missile, or the like. Coupled to the aft end of the ordnance vehicle is a propulsive motor or booster motor **14** of a conventional type which accelerates a vehicle to a predetermined velocity or propels the ordnance vehicle for a predetermined period of time and then is jettisoned from the ordnance vehicle. In accordance with this embodiment of the invention, fin assembly **10** includes four tapered fins symmetrically disposed around the periphery of the ordnance vehicle, each fin having a vane portion **16** and a base portion **18**. It is to be understood that a larger or lesser number of vanes are contemplated within the scope of this invention. Each of the vanes is supported at its base portion by a sleeve **20** for pivotal movement from the folded position shown in FIG. **1** to an erected position in which the vanes lie in planes coincident with radii of the vehicle. Each of support sleeves **20** is mounted upon a shaft **22** rotatably mounted on the vehicle **12** for rotating the vanes about the axis of shaft **22** perpendicular to the longitudinal axis of the vehicle. The erection of the vanes and the rotatable movement of the vanes will be hereinafter described in greater detail with reference to FIGS. **3** and **4**.

As seen in FIGS. 1 and 2, each vane is held in its normally folded position by a rod 24 which is secured at one end to an annular ring 26 which, in turn, is mounted upon the booster motor by any suitable means. Similarly, to prevent the folded fins from rotating about the shaft 22 while in their folded position, each fin is held in place by a pair of parallel rods 28 and 30 which are also mounted upon the annular ring 26 on opposite sides of each of shafts 22 and adapted to engage opposed sides of the fin base portion 18. Upon separation of the booster motor 14 from the ordnance vehicle 12, rods 24, 28 and 30 are disengaged from the fins to thereby free the fins for movement.

Referring now to FIG. 3 and FIG. 4, it will be seen that the base portion 18 of each fin is defined by two sleeves which are longitudinally spaced apart and have longitudinally aligned bores 32 formed therein. The longitudinally spaced base sleeves are both secured to the vane portion of the fins. The support sleeve 20 is interleaved between the longitudinally spaced sleeves of the fin base portion 18 and has a longitudinal bore 34 extending therethrough in alignment with bores 32 to receive a common hinge pin 36. The hinge pin is fixedly secured to the support sleeve 20 by any suitable means, such as for example, pins, welding, screws or the like, to prevent relative rotational movement between the sleeve 20 and the pin 36 and to further prevent relative longitudinal sliding movement between the sleeve and the pin.

To automatically erect the fins, a helical resilient spring 38 is disposed within a longitudinal space between support sleeve 20 and the rearward base portion 18, with the spring circumscribing the hinge pin 36. Spring 38 is maintained under both torsional stress and compressive stress by securing end tab portions 40 and 42 of the spring within suitably provided detents formed in the sleeve 20 and base portion 18, respectively. In the folded position as seen in FIGS. 1, 2 and 3, the fin is held by rod 24 against the force of the spring 38 in a position substantially tangential to the circumference of the vehicle 12. When rods 24 are disengaged from the fins upon separation of the booster motor 14 from vehicle 12, the torsional stress of springs 38 causes the fins to rotate to an erected position as shown in FIG. 4. As each fin rotates from its folded to erected position, a pair of locking keys 44 formed on diametrically opposed sides of the rearward edge of the forward base sleeve 18 ride on a cam surface 46 and, when the fin reaches its erected position, the keys 44 come to rest within a locking slot 48 formed in the forward edge of support sleeve 20 to lock the fin on the support sleeve in its erected position. As the fin rotates from the folded position to the erected position and rides on cam surface 46 into the slot 48, the compressive stress of spring 38 forces the fin to slide rearwardly on hinge pin 36 to firmly seat the key 44 in the locking slot 48. In this position, the fin is rigidly held in its erected position and is free for rotational movement about the axis of shaft 22 to directionally steer the vehicle.

It should be apparent from the foregoing that the present invention provides an improved fin assembly in which the fins may be controllably rotated to directionally steer the vehicle and yet the fins are additionally hinged at their base portion to minimize the space occupied by the fin assembly within a launching tube. The fins of this invention are hinged at their lowermost base portion 18 and held in a folded position in which the fins are substantially tangential to the circumference of the ordnance vehicle. With this arrangement, it will be seen that the fins are provided with relatively large vane portions without exceeding the outer diameter of the vehicle's booster motor 14, thus rendering the device suitable for launching from a tube. The compact hinged fin assembly of this invention permits fin-guided ordnance vehicles to be launched from launching tubes of diameters only slightly larger than the diameter of the vehicle itself.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A hinged fin assembly for a propelled vehicle comprising:
- a plurality of fins, each having a vane portion and a base portion;
- fin support means coupled to said base portion for pivotally supporting each fin for rotational movement about two mutually perpendicular axes; and including
  - shaft means for rotating each of said fins about one of said axes,
  - first and second longitudinally spaced-apart sleeves having aligned longitudinal bores formed in said base portions,
  - a third sleeve having a longitudinal bore extending through said fin support means and being interleaved with said first and second sleeves,
  - hinge pin means extending through said aligned longitudinal bores and being fixedly secured to said third sleeve to prevent relative movement between said third sleeve and said hinge pin means, and
  - resilient means for biasing said fins for rotational movement about the other of said axes;
- fin locking means for locking said fins in an erected position after said fins have been rotated about said other axis from a folded position to an erected position; and
- fin holding means for releasably engaging each of said fins including
  - pairs of rods engaging opposed sides of said base portion of each fin to prevent rotation of said fin about said one axis,
  - a rod engaging said vane portion of each fin to prevent rotation of said fin about said other axis,
  - an annular ring mountable upon a vehicle propulsive motor separable from the vehicle in flight, said rods being mounted upon said annular ring.

2. The device of claim 1 wherein said fin locking means comprises:
- at least one locking key formed on said base portion of each fin, and
- at least one slot formed in said fin support means for each fin for receiving said locking key when said fin is in an erected position.

3. The device of claim 1 wherein said resilient means comprises:

a helical spring circumscribing a portion of said hinge pin means between said third sleeve and one of said other sleeves and being maintained under torsional stress and compressive stress.

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