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[54] **STABILIZATION FINS FOR PROJECTILES**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.** **F42b 15/16,** B64c 5/06

[58] **Field of Search** 244/3.24, 3.25, 3.26, 244/3.27, 3.28, 3.29, 3.3, 91; D22/11, 17; 102/7, 3, 49.2

[56] **References Cited**

UNITED STATES PATENTS

2,597,703	5/1952	Busacker	244/3.25
1,879,840	9/1932	Brandt	244/3.28

FOREIGN PATENTS OR APPLICATIONS

802,042	8/1936	France	244/3.20
431,551	7/1935	Great Britain	244/91

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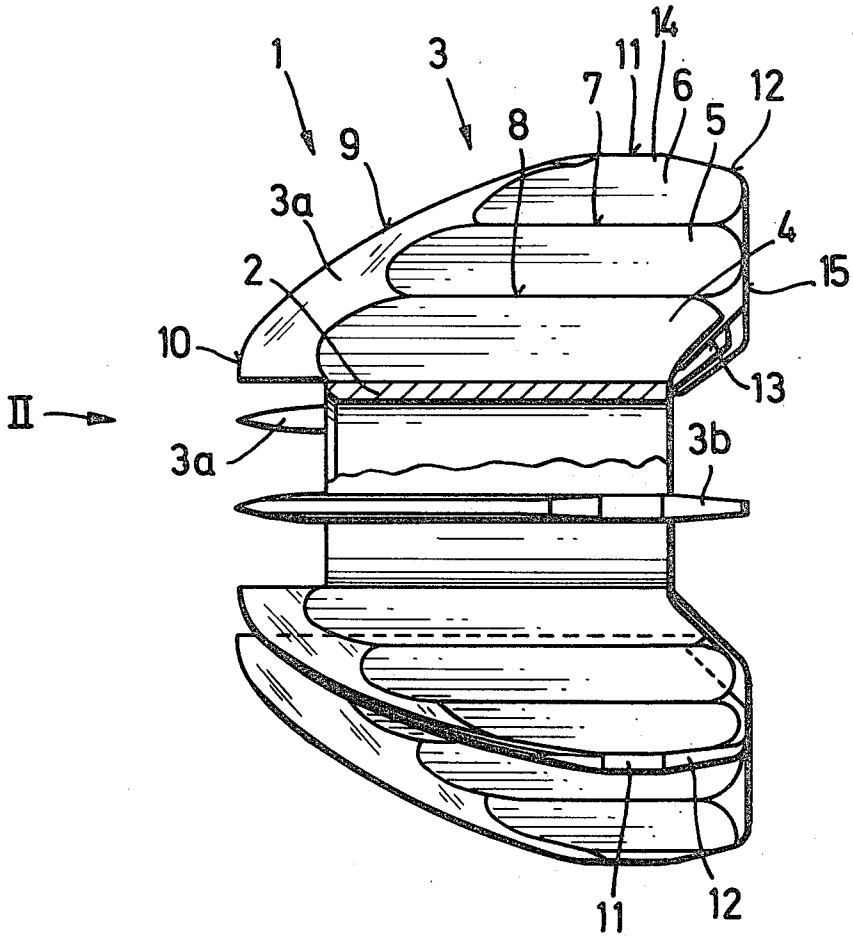
[57] **ABSTRACT**

A stabilization fin for use with projectiles which demonstrates improved aerodynamic stability as a result of unique cross-section and profile. The fin assembly is defined by multiple fins extending radially from a carrier tube. Each fin has a precisely tapered outer profile while the sides incorporate longitudinal depressions. A series of these depressions extend radially along the side of each fin and each depression originates at a point to the rear of the leading edge of the fin profile and terminates at a point ahead of the trailing edge.

12 Claims, 3 Drawing Figures



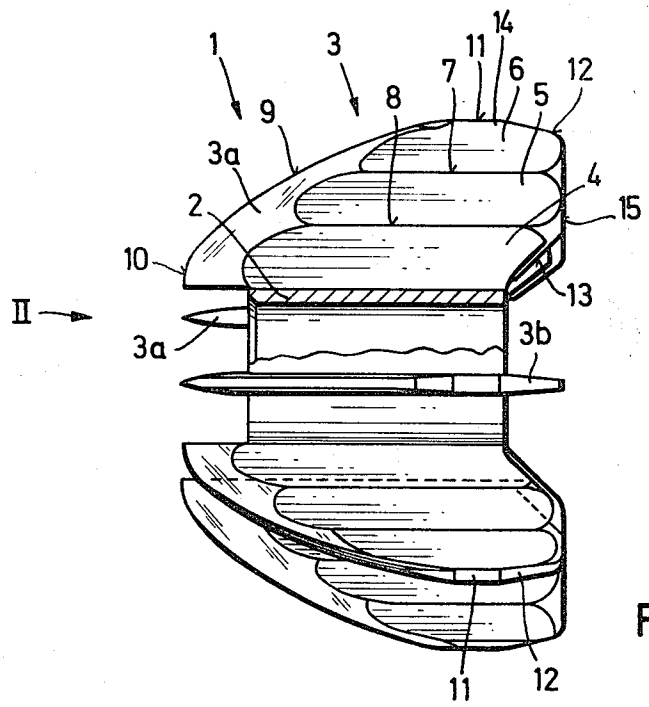


FIG. 1

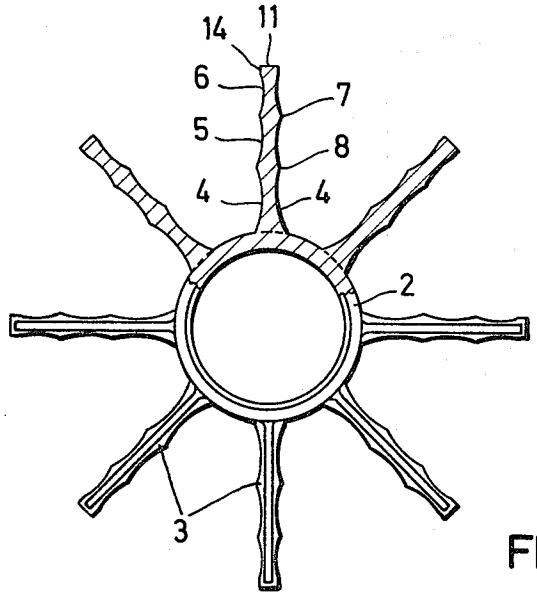


FIG. 2

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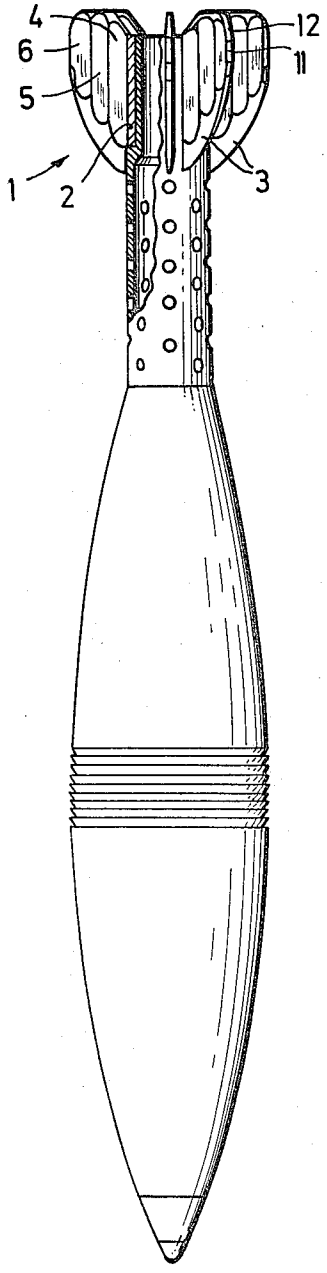

FIG.3

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STABILIZATION FINS FOR PROJECTILES

BACKGROUND OF THE INVENTION

This invention relates to an aerodynamic fin assembly for improved stabilization of objects in motion. In particular the invention is intended for use on projectiles such as launcher grenades and the like.

In the prior art the stabilization fins for projectiles usually are fabricated by attaching a number of fins to a carrier tube. These fins are positioned so that they extend radially from the tube and are fabricated from lightweight sheet metal or molded plastic and provide only a minimal cross section which is not conducive to strength and rigidity. Thus, fins sometimes become damaged during handling or are caused to bend by the high pressure combustion gases generated during the projectile firing.

Deformations in the stabilization fins at the time the projectile is fired cause instability while the projectile is still in the launching barrel and during its flight. Thus, the projectile's trajectory becomes erratic and accuracy is greatly minimized.

SUMMARY OF THE INVENTION

The fins of the present invention have been found to provide improved rigidity and strength and to be able to withstand normal abuse during handling. In addition, these fins are capable of withstanding without deformation the high pressure and high temperature combustion gases that are generated during the firing operation. Thus, it is an object of this invention to provide a more rigid and strengthened projectile fin which will withstand the damage and deformation normally associated with handling and firing of the projectile.

A further object of this invention is to provide a stabilization fin which will greatly improve the aerodynamic characteristics of the projectile. The longitudinally extending ridges and hollows on the side surfaces of the fins of this invention in conjunction with the leading edge taper of the fin produce a minimum drag effect on the adjacent gas or air flow. Thus, the projectile's motion is stabilized during its flight by the more streamlined gas flow directed along the fine assembly axis.

Vibrations or flutter in the fin material which can cause turbulence in the air flowing past the fin is minimized by the rigidity of the fin of the present invention. The undulating cross section design of the present fin demonstrates unusual strength characteristics and dampening of the vibrations originating in the projectile during firing and caused by the air flow during flight. Therefore, a further object of this invention is to provide a stabilization fin arrangement which reduces or eliminates vibrations thereby making the projectile aerodynamically stable and thus capable of following an accurate trajectory.

BRIEF DESCRIPTION OF DRAWINGS

An embodiment of the invention will now be described by way of example, with reference to the accompanying drawing, in which:

FIG. 1 shows an elevational view in partial section of a fin assembly for fin stabilized projectiles according to the present invention,

FIG. 2 shows an end view in partial section of the fin assembly in FIG. 1 looking in the direction of arrow II,

FIG. 3 shows a fin-stabilized projectile having the fin-assembly according to the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS

In the present invention, as shown in FIG. 1, fin assembly 1 has a carrier tube 2 for mounting on the tail pipe of a fin-stabilized projectile and a number of fins 3 which extend radially from the outer surface of the carrier tube 2. Any number of fins can be attached, while in the present embodiment eight fins are shown. Each fin 3 is provided on its side surface with a plurality of longitudinal depressions 4, 5 and 6 and ridges 7 and 8 between said depressions, each extending parallel to the carrier tube's longitudinal axis which corresponds to the longitudinal axis of the projectile as shown in FIG. 3. The fin 3 has a leading edge portion 9, which extends outwardly and sharply rearward from a short forward projection 10. The leading edge surface 9 extends for a distance equal to at least one-half to three-quarters of the fin length. This distance is considered to be necessary in order to obtain the desired fin stabilization results. The leading edge section 9 blends into a relatively short, straight edge 11 defining the greatest height of the fin and which extends parallel to the longitudinal axis of the carrier tube 2. The trailing edge 12 of the fin extends rearwardly from the section 11 in a gentle inward slope to a blunt aft end 15. At both ends, the fin 3 projects beyond the length of the carrier tube 2 by a predetermined proportion. At the rear end, fin 3 is provided with a connecting section 13 which extends obliquely from the aft blunt section 15 to the rear of the carrier tube 2. When the fin assembly of this invention is attached to the end of a projectile, the blunt aft end 15 can provide a flattened support section for supporting the projectile during storage or for preparation for launching.

The fin 3 of this invention has been disclosed to project beyond the front and rear edges of the carrier tube 2. The fin projecting beyond the carrier tube 2 can be proportioned in any desired amount between the leading edge and the trailing edge but the total length of the projections should be limited to about 15 percent of the overall length of the fin attaching edge. This limitation is desirable to maintain proper strength in the joint between the fin and the carrier tube. By varying the proportion of the projections, the position of the carrier tube with respect to the fin can be adjusted. In turn, the position of the fin with respect to the projectile on which it is intended to be used can be determined.

As seen in cross section of FIG. 2, depressions 4, 5 and 6 are of a shallow arcuate form. The intermediate ridges 7 and 8 are formed by the intersection of the juxtaposed shallow arcs. The outer depression 14 can be made slightly wider than the other depressions, if desired. Any number of depressions may be used depending upon the height of the individual fins. However, a range of three to six depressions has been found to provide satisfactory aerodynamic results. In this embodiment each side of fin 3 is shown with three depressions. The width of each depression must be sufficient to prevent disturbance in the aerodynamic characteristics of the adjacent gas or air flow. It is desirable to make the depressions of relatively large width in relation to the fin height and to restrict the number of depressions used to a minimum. Each depression is intentionally designed to begin and end at a predetermined distance from the leading edge 9 and the trailing edge 15, thus producing a shoulder area which results in improved strength of the fin.

As seen in cross section of FIG. **1**, the fin **3** is of a relatively narrow or thin cross section, while the leading edge **9** and the trailing edge **15** form a knife-like cross section **3***a* and **3***b*.

The carrier tube and the fins may be formed as an integral unit or in separate sections. The individual fins can then be attached to the carrier tube in any fashion that is desired; such as welding, T-slots, adhesives, etc. Any materials can be used but it would be advantageous to select material that would be both lightweight and yet provide sufficient strength. Materials in this category would be aluminum alloy, magnesium or various lightweight plastics or resins.

As can be seen in FIG. **1**, the leading edge taper of the fin **3** extends in an extremely sharp upward and rearward taper to the highest portion of fin **11**. The sharp taper in the fin profile results in considerably improved gas and air flow characteristics, contributing to prevention of vibrations or flutter in the fins. In addition, air pulsations and turbulence are reduced, thus improving flight stability of the projectile. If desired, the fin trailing edge profile can be modified to provide a continuous curve from the flat surface **11** to the rear of the carrier tube **2**. Also, the depressions and ridges on the sides of the fins can be terminated at a distance from the trailing edge of the fin and thus create additional strength in this area.

In the present invention, it has been found that maximum strength and rigidity for the fin **3** can be maintained by starting the elongated depressions **4, 5, 6** at a distance from the leading edge **9** of approximately 12 percent of the overall longitudinal length of the fin at that location. Thus, this distance would decrease for those depressions which are closer to the outer edge **11** because of the reduction in the overall length of the fin **3** due to the taper of the leading edge **9**. This same percentage would also apply to the stopping of the depressions at the trailing edge. The actual dimension being determined by the configuration of the trailing edge **15**.

As can be seen in FIG. **3**, the carrier tube **2** is sized to fit a mating portion on the projectile. Attachment to the projectile is accomplished very simply and easily by sliding the carrier tube of the fin assembly over the mating portion and securing or locking the tube **2** to the projectile by any means desired (not shown). Thus, if the projectile is not used the fin assembly can be removed and the projectile returned to storage by reversing the assembly procedure.

While an improved projectile stabilizing fin has been shown and described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed, and that changes in detail and construction may be made therein within the scope of the invention, without departing from the spirit thereof.

What we claim is:

1. A fin assembly for stabilizing a projectile in motion comprising:

a. a plurality of elongated fin members having two opposing sides, a leading edge, a trailing edge, and an outer edge

b. the surface of each opposing side having elongated, hollow arcuate depressions extending generally parallel to the longitudinal axis of the projectile,

c. the width of each depression being sufficient to prevent disturbance in the aerodynamic characteristics of the adjacent gas flow,

d. whereby the fluid flowing past the body is guided in a streamlined fashion to minimized turbulence and provide stabilized motion.

2. A fin assembly as described in claim **1**, wherein the leading edge of the fin member is tapered upwardly and rearwardly forming an acute angle with respect to the longitudinal axis of the projectile and blending smoothly with the outer edge of said member.

3. A fin assembly as described in claim **2**, wherein the leading edge extends for a distance of from one-half to two-thirds of the length of the fin member.

4. A fin assembly as described in claim **1**, wherein the trailing edge has a flat portion and said flat portion is arranged perpendicular to the longitudinal dimensions attaching edge of the member.

5. A fin assembly as described in claim **1**, wherein said depressions on each side of said member are disposed oppositely and complementary to each other.

6. A fin assembly as described in claim **1** wherein the plurality of fin members are equally spaced with respect to each other around the perimeter of a carrier member and extend radially therefrom.

7. A fin assembly as described in claim **6**, wherein the carrier member comprises a hollow cylindrical tube to which said plurality of fin members is attached.

8. A fin assembly as described in claim **6**, wherein the carrier member comprises a closed, hollow cylindrical tube that is shorter in length than the fin members and

each fin member extends beyond the ends of the carrier tube member.

9. A fin assembly as described in claim **1**, wherein there are three to six depressions extending over the surfaces of the opposing sides on each fin.

10. A fin assembly for stabilizing a body in motion comprising:

a. a plurality of elongated fin members having two opposing sides, a leading edge, a trailing edge and an outer edge,

b. the surface of each opposing side having elongated, shallow arcuate recesses extending generally parallel to the longitudinal axis of the body,

c. ridges being formed by the crest lines between adjacent recesses,

d. whereby the fluid flowing past the body is guided in a streamlined fashion to minimize turbulence and provide stabilized motion.

11. A fin assembly for stabilizing a body in motion comprising:

a. a plurality of elongated fin members having two opposing sides, a leading edge, a trailing edge and an outer edge,

b. the surface of each opposing side having elongated, hollow depressions extending generally parallel to the longitudinal axis of the body,

c. whereby the fluid flowing past the body is guided in a streamlined fashion to minimize turbulence and provide stabilized motion,

d. said depressions begin and end at a predetermined distance from the leading and trailing edges, respectively, thereby leaving a shoulder area of increased thickness at the leading and trailing edge to provide additional fin strength and rigidity.

12. A fin assembly for stabilizing a body in motion comprising:

a. a plurality of elongated fin members having two opposing sides, a leading edge, a trailing edge and an outer edge,

b. the surface of each opposing side having three elongated, hollow depressions having an equal width with respect to each other and extending generally parallel to the longitudinal axis of the body and over the side surfaces of each fin,

c. whereby the fluid flowing past the body is guided in a streamlined fashion to minimize turbulence and provide stabilized motion.

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