United States Patent

[11] 3,633,846

[72] Inventor **Lawrence M. Biggs, Jr.**
Annandale, Va.

[21] Appl. No. **41,461**
[22] Filed **May 28, 1970**
[45] Patented **Jan. 11, 1972**
[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] **EXPANDABLE AERODYNAMIC FIN**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **244/3.27,** 102/4
[51] **Int. Cl.** **F42b 25/00**
[50] **Field of Search** 244/3.27, 3.28, 3.29; 102/2–4

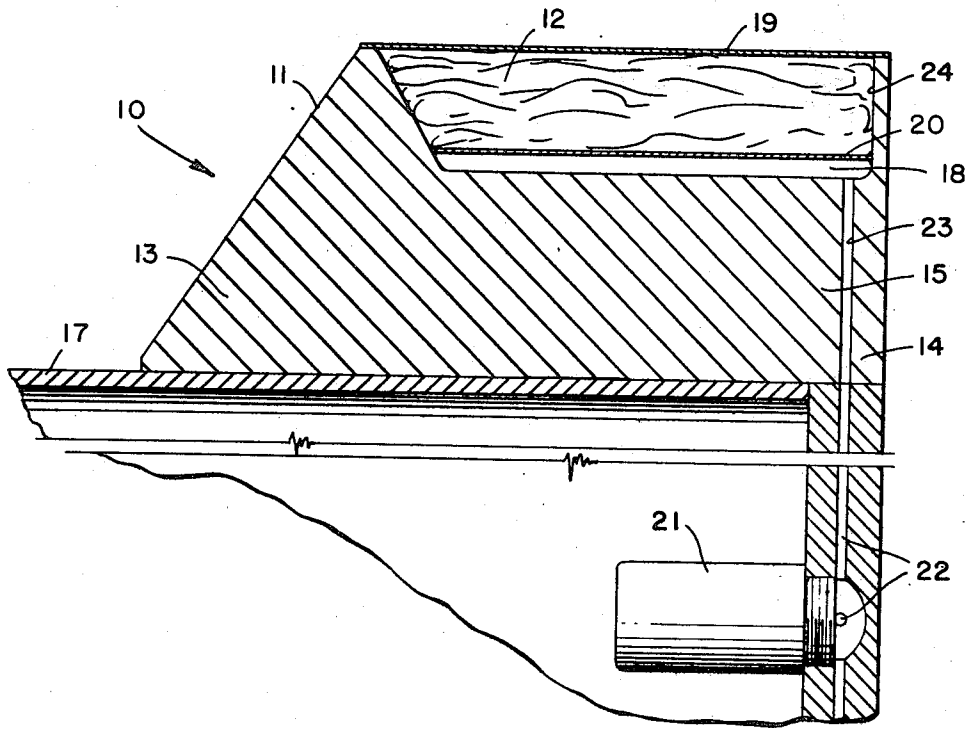
[56] **References Cited**

UNITED STATES PATENTS

1,339,188	5/1920	Frecska	244/3.27 X
2,959,143	11/1960	Endrezze	244/3.27 X
2,969,211	1/1961	Von Saurma	102/4 X
3,053,488	9/1962	Cox, Jr.	89/1.817
3,136,250	6/1964	Humphrey	244/3.27

Primary Examiner—Verlin R. Pendegrass
Attorneys—R. S. Sciascia and Roy Miller

ABSTRACT: An expandable aerodynamic fin comprising a hollow primary fin housing provided with a recess within which is sealed a secondary fin composed of a flexible membrane in the form of a pouch being attached at its edges to the periphery of the inner wall of said primary fin. A pressurization device is positioned adjacent the primary fin base with gas pressure lines leading through the base to the recess. Upon actuation of this device sufficient gas pressure is created to fill the secondary fin and force it to expand thereby rupturing the seal and fanning out to become an integral part of the primary fin.



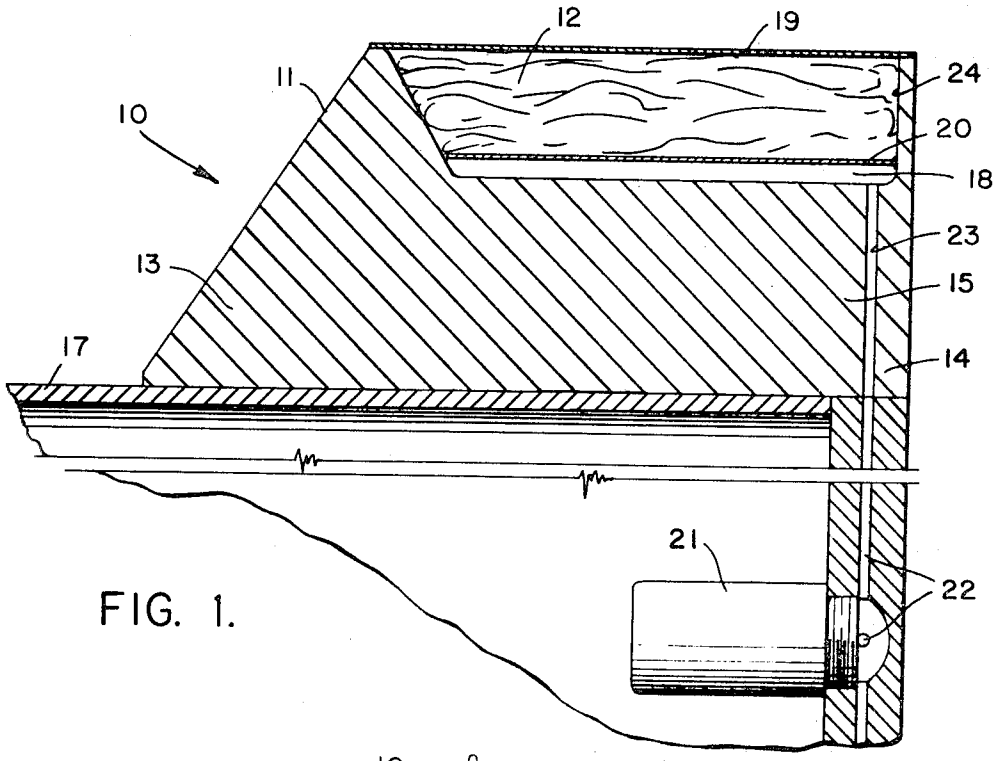


FIG. 1.

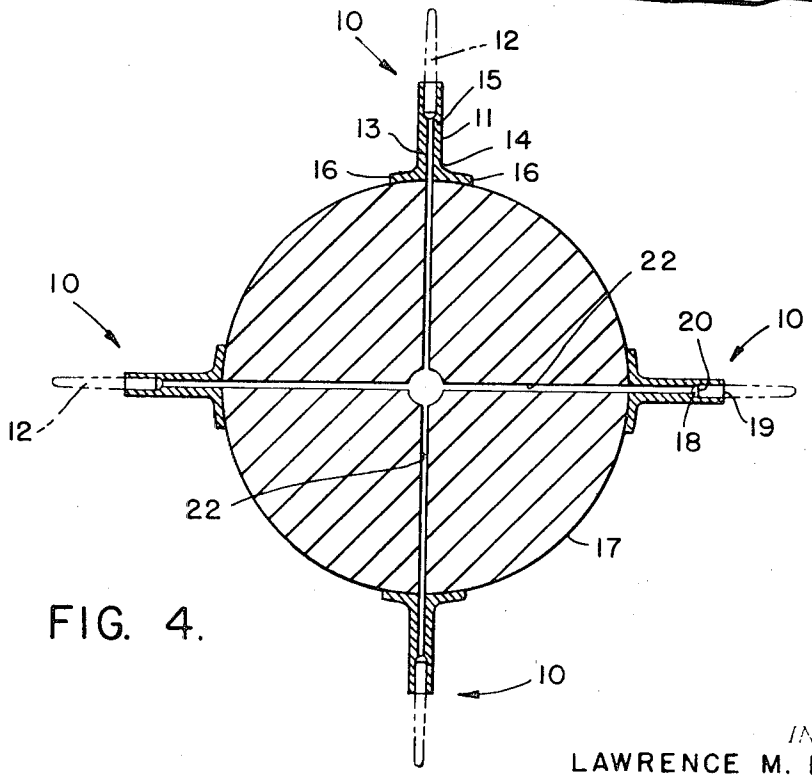


FIG. 4.

INVENTOR.
LAWRENCE M. BIGGS, JR.
BY
ROY MILLER
ATTORNEY.

FIG. 2.

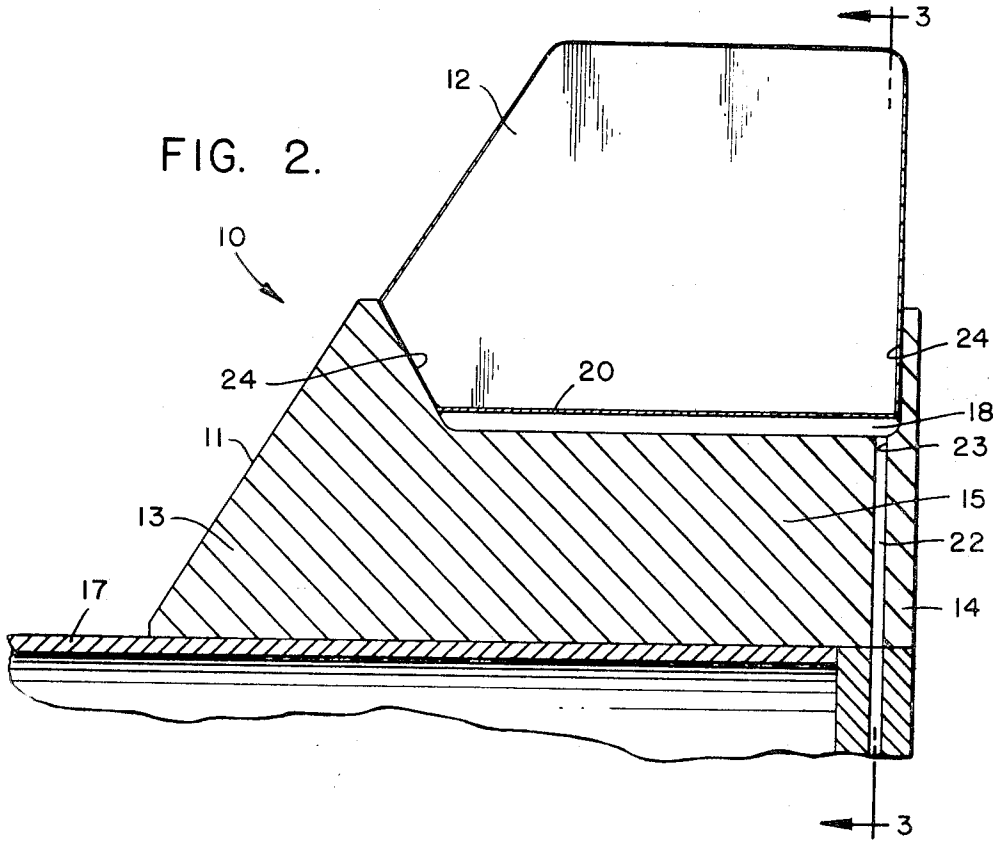
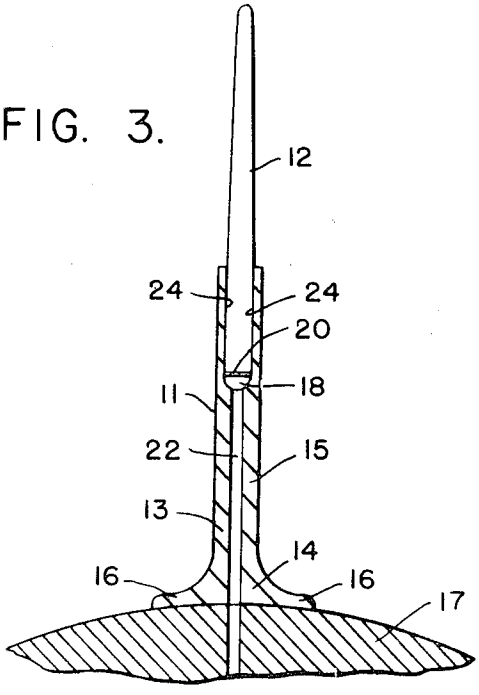

3
12
10
24
20
24
18
11
23
15
13
22
17
14
3

FIG. 3.


12
24
24
20
11
18
22
15
13
14
16
16
17

EXPANDABLE AERODYNAMIC FIN

GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for The Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

The present invention is for an expandable aerodynamic fin.

The conventional method of achieving aerodynamic stability for guided or unguided missiles is to design a fin system of large caliber. Utilization of multiple carriage-type bomb racks to carry several bombs in clusters on the rack impose a maximum limit on fin caliber size. Folding fins are used and are usually designed into the missile to allow clustering of several missiles on a bomb rack. They are heavy and use spring and locking mechanisms which do not always respond to environmental conditions. Aerodynamic stability to a missile is also achieved by use of a retardation device or a drag parachute, but such a system allows a time lag which does not provide initial stability of the missile upon immediate separation of the missile from the bomb rack. Parachute fabrics are subject to deterioration under adverse environmental conditions and are not very reliable along with the fact portions of this device may threaten the safety of the missile. The present invention is comparatively light weight and provides increased safety to the pilot, aircraft, and personnel working on the ground. The system also provides a faster response time which will allow improved separation characteristics.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an enlarged view in cross section of the invention in collapsed condition;

FIG. 2 is an enlarged view in cross section of the invention in expanded condition;

FIG. 3 is a longitudinal section of the fin taken through 3—3 of FIG. 2; and

FIG. 4 is a transverse section showing a multiple fin assembly in accordance with the instant invention.

BRIEF DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

In an embodiment which illustrates this invention a plurality of expandable aerodynamic fins are affixed to the outside circumference of the aft portion of a hollow cylindrical missile casing. The construction of one of the fins **10** is shown in cross section in FIG. **1** in collapsed condition and in FIG. **2** in expanded condition. Fin **10** comprises a primary fixed fin **11** and a secondary fin **12** which nests within said primary fin. Fin **11** comprises a hollow housing **13** fabricated of thin gauge metal such as steel or aluminum. Other suitable materials may be used. Housing **13** is formed of two preformed pieces of metal having an arcuate cross section, much like metallic blind slats, and secured to one another by well-known means such as seam welding. Fin housing **13** which forms primary fin **11** includes a hollow root or base portion **14** and a hollow body portion **15**, the base portion having laterally projecting flanges **16** and being secured to missile casing **17** by suitable means such as adhesives or fasteners. The aft end of body portion **15** has a cutout section forming a recess **18** which is provided with a cap or closure **19** to hermetically seal housing **13**. A pressure baffle plate **20** formed to fit the bottom of recess **18** from a gas permeable plastic or other suitable material is cemented to the walls of said recess. Secondary fin **12** which nests within recess **18** of the primary fin is fabricated from two pieces of nonporous nylon which are hermetically sealed along three edges to form a pouch or envelope. The edges of the open side of said pouch or envelope are sealed at **24** to the inner walls of recess **18**. A gas pressurization means **21** is mounted on the missile casing **17** adjacent the root or base portion **14** which is provided with a gas pressure lead line **22** extending from said

gas pressurization means **21** through a bore **23** in base portion **14** to the bottom of recess **18** adjacent pressure baffle plate **20**. Plate **20** acts to equalize the pressure of the gas as it enters the bottom of pouchlike secondary fin **12**. In operation when pressure means **21** is actuated, the gas therefrom moves through lead line **22** into recess **18** via porous baffle plate **20**. When sufficient pressure builds up in recess **18**, cap **19** pops off releasing air-filled secondary fin **12** which fans out forming a semirigid aerodynamic member which is an integral part of primary fin **11**.

The material used for the telescoping secondary fin was an impermeable material such as pretreated nylon, dacron, cotton, etc. The pressure gas means was a carbon dioxide cartridge, but a quick-acting pyrotechnic gas generating cartridge may be located at some central point on the missile afterbody with gas pressure lines leading into the fin base housing.

The soft secondary fin extends from the hard primary fin housing to become a semirigid aerodynamic body and thus has several advantages over that of a metal or hard surface projected or telescoped fin. It allows faster response time and being of light mass will reduce dynamic shock loads when used. This expanding aerodynamic fin can also be used as an in-flight emergency replacement for the vertical and horizontal stabilizers of aircraft. Its collapsed condition offers advantages in storage or parking. Such a fin may also be used as an extension of an air foil such as adding to the span of a wing or of changing the shape of a wing to obtain predetermined aerodynamic characteristics of a temporary nature.

What is claimed is:

1. Expandable aerodynamic fins which comprise in combination with a hollow cylindrical casing
   - a plurality of radially extending fins affixed to the outside circumference of the aft end of said casing each of said fins comprising
     - a fixed primary fin consisting of a hollow housing having a base and body portion; said base having laterally projecting flanges secured to the outer circumference of said casing;
     - a recess provided in the aft portion of said body portion of said primary fin;
     - a pressure baffle plate secured to the inner walls of said recess and forming the bottom of said recess;
     - a secondary fin nested within the recess provided in said primary fin;
     - said secondary fin being in the shape of a pouch open at one end the edges of which are sealed to the inner walls of said recess adjacent said baffle plate;
     - a closure cap mounted atop said recess adapted to hermetically seal said secondary fin within said primary fin housing;
     - a gas pressurization means mounted on the outside of said casing adjacent said primary fin base portion and provided with a gas lead extending through said base portion into the recess of said primary fin housing whereby gas produced upon the actuation of said pressure means fills said secondary fin and creates sufficient pressure to rupture said cap thereby releasing said secondary fin which fans out as an integral part of said primary fin.

2. The fin in accordance with claim 1 wherein the primary fin housing is aluminum and the secondary fin is nonporous nylon.

3. An expandable aerodynamic fin which comprises
   - a primary fin consisting of a hollow housing having a base and body portion; said base having laterally projecting flanges;
   - a recess located in the aft portion of said body portion of the primary fin;
   - a gas permeable pressure baffle plate secured to the inner walls of said recess;
   - a secondary fin composed of an impermeable membraneous pouch nested within the recess; said pouch being open at one end with the edges sealed to the inner walls of said recess adjacent the baffle plate;

a closure cap mounted atop said recess adapted to hermetically seal said primary fin housing; and

a gas pressurization means mounted adjacent the base of said fin whereby gas produced therefrom passes through said baffle plate filling said secondary fin and creating sufficient pressure to pop said cap thereby releasing the secondary fin which fans out forming an extension of primary fin.

* * * * *