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J. E. WEIMHOLT ET AL.

3,304,030

## PYROTECHNIC-ACTUATED FOLDING FIN ASSEMBLY

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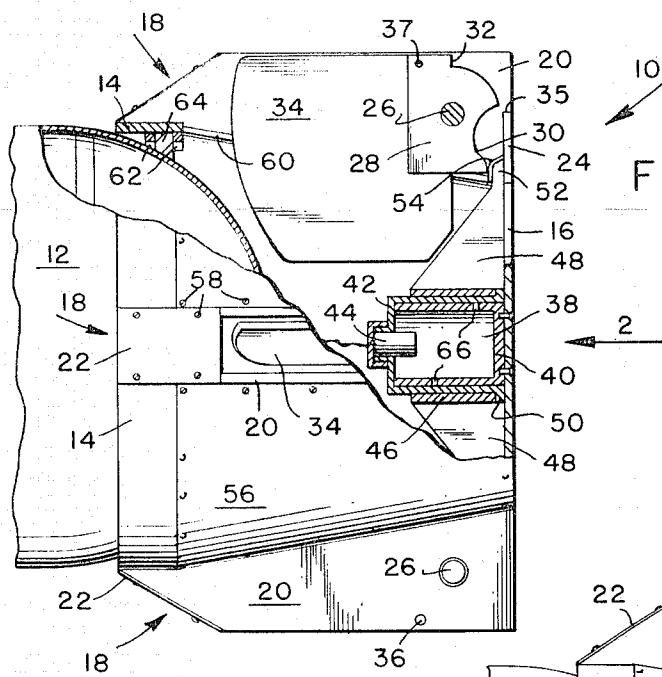


FIG. I.

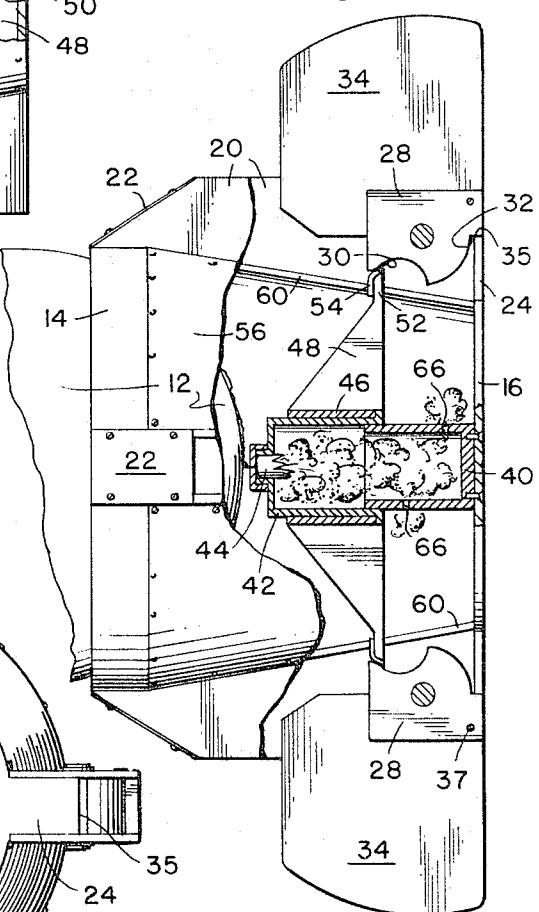
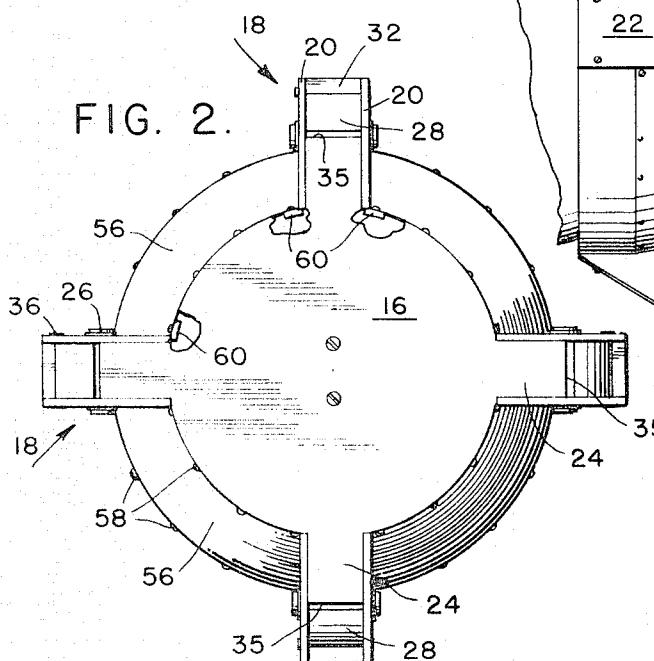


FIG. 2.



INVENTORS.  
JAMES E. WEIMHOLT  
LAWRENCE M. BIGGS, JR.  
BY

*P. H. Firstt*  
ATTORNEY.

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PYROTECHNIC-ACTUATED FOLDING FIN  
ASSEMBLY

James E. Weinholt and Lawrence M. Biggs, Jr., China  
Lake, Calif., assignors to the United States of America  
as represented by the Secretary of the Navy  
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6 Claims. (Cl. 244—3.28)

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.

The present invention relates to a folding fin assembly for an aerial missile and more particularly to means for effecting in-flight erection of the fins in a positive and reliable manner.

Folded fin assemblies have been employed on various types of aerial missiles in the interests of space limitations during storage in a magazine and carriage on an aircraft. Such assemblies have relied upon aerodynamic forces or used spring-loaded devices to effect erection after launching from the aircraft and have the disadvantage that the fins do not always unfold simultaneously with the result that the flight of the missile is unstable.

It is therefore a purpose and object of this invention to provide a folding fin assembly having spatial and other advantageous features while in storage or attached to the aircraft, yet also possessing aerodynamically advantageous features of large caliber stabilizing fins upon launching of the missile.

Another object is the provision of means for unfolding the fins in a rapid, positive and reliable manner.

A further object is to provide a folding fin assembly which is simple in construction, economical to manufacture and is reliable in its manner of operation.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a vertical elevation of the folding fin assembly of this invention, with parts broken away to illustrate certain structural details;

FIG. 2 is an end elevation of the assembly looking in the direction of the arrow 2, FIG. 1; and

FIG. 3 is a view similar to FIG. 1 but showing the fins in erect or unfolded position.

Referring now to the drawings, there is shown in FIG. 1 a folded fin assembly 10 attached to the aft end of a missile body 12, shown only in part. The assembly 10 comprises an attaching band 14 and an aft plate 16 interconnected by a plurality of fin housings 18.

Each housing 18 comprises a pair of elongated, generally triangular mounting plates 20 disposed spaced-apart and generally parallel to the longitudinal axis of the assembly and suitably secured at their fore and aft ends to band 14 and plate 16, as by welding or the like. Each pair of plates 20 has secured thereto at its forward portions a fairing plate 22.

Plate 16 is disposed substantially perpendicular to the longitudinal axis of the assembly and is provided with extensions or tabs 24, there being one such tab for each housing 18 into which the tab extends, for a reason hereinafter appearing, and which is secured to the rear ends of plates 20 thereof. Adjacent to plate 16, each housing 18 has a pivot pin 26 upon which is pivotally mounted a cam block 28. Each cam block is formed with a curved cam surface 30 and a shoulder 32 and carries a fin blade 34, the shoulder 32 engaging with the outer end 35 of the tab 24 associated therewith when the cam block has pivoted and the fin blade has been unfolded to erect position; see FIG. 3. Fins 34 may be retained in folded position by

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means of shear-pins 36, force-fitted into holes 37 in cam blocks 28.

The means for erecting the fin blades comprises an expandable chamber 38 including a pair of telescoping cup-like members 40 and 42, member 40 being suitably secured to aft plate 16 centrally thereof and extending forwardly, member 42 closing off the open end of member 40 and carrying a conventional gas generating pyrotechnic device 44 such as a cartridge or the like. Slidably mounted on member 42 is a sleeve 46 forming part of a pusher assembly comprising pusher arms 48 rigidly secured to the sleeve, member 42 being formed with a lip 50 for engaging sleeve 46 and moving the same. Each arm 48 is formed with a pusher element or finger 52 having a facing 54. The number of arms 48 is the same as the number of housings 18 with a pusher finger disposed adjacent the curved surface 30 of each cam block 28 when the fin blade associated therewith is in its folded position; FIG. 1.

For aerodynamic reasons, it is desirable to close the open spaces between housings 18 with sections 56 of metallic skin or the like secured to the attaching band 14, the aft plate 16 and plates 20 by screws 58 of the like, plates 20 being provided at their inner edges with narrow strips 60 extending laterally sufficiently to form supporting ledges for the adjacent edges of sections 56; FIG. 2.

Attaching band 14 may be secured to the missile body 12 by any suitable means. Such means may take the form, if desired, of a plurality of pairs of circumferentially spaced projections 62 on the inner periphery of the band 14, each pair of projections 62 being adapted to receive therebetween one of a plurality of circumferentially-spaced projections 64 on the body 12. In attachment, the fin assembly is slipped over the rear end of body 12 so that projections 64 are disposed in the circumferential spaces between pairs of projections 62 after which the assembly is rotated slightly to have the pairs of projections 62 receive the projections 64 and then locked in place.

In operation, the missile is launched and as it falls away from the aircraft the pyrotechnic device 44 is activated, the gas generated expanding chamber 38 and imparting movement to member 42, sleeve 46 and arms 48. Facings 54 on fingers 52 engage curved surfaces 30 of the cam blocks 28 and swing the blocks and fin blades 34 attached thereto to the unfolded or erect position. Facing 54 on each finger 52 is of a relatively hard material, for example, steel, while the material of each block 28 is relatively softer, for example, aluminum, and the structural dimensions are so chosen that in the unfolded position the facings wedge and dig into the respective cam blocks, thus locking the fin blades in erect position and arresting movement of the pusher assembly and member 42. The energy imparted to member 42 may be predetermined by selection of a pyrotechnic device 44 having an energy output of desired proportions and adjusted by the location of perforations 66 in member 40 which vent the gas in chamber 38 to the atmosphere as they are uncovered by movement of member 42.

There has thus been provided a folding fin assembly in which the fins are erected simultaneously in a rapid, positive and reliable manner.

Obviously many modifications and variations of the present invention are possible in the 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.

What is claimed is:

1. An unitary folding fin assembly comprising:  
a circular plate;  
a plurality of radially extending tabs on said plate ar-

ranged equi-angularly around the periphery thereof; a plurality of fin housings, each comprising a pair of parallel mounting plates having rear ends disposed on either side of one of said tabs and secured thereto; an attaching band disposed generally parallel to said circular plate and secured to the front portions of said mounting plates;

5 a plurality of pivot pins, one per fin housing supported in the mounting plates thereof adjacent the associated tab;

10 a plurality of cam blocks, one per pivot pin and supported thereon for swinging from a folded position to an erect position in which swinging is limited by engagement of the block with the end of the associated tab;

15 a plurality of fins, one per cam block and secured thereto for swinging therewith from folded to erect position; and

20 means engaging said cam blocks for swinging the same and the fins to erect position.

2. The fin assembly of claim 1, wherein said means comprises:

an unitary pusher structure disposed between said fin housings and having a plurality of pusher fingers, one per cam block and engageable therewith for 25 swinging the same upon movement of the structure; an expandable chamber supported on said circular plate and having a movable part carrying said pusher support structure; and

gas generating means in said chamber for expanding 30 the same and imparting movement to said movable part.

3. The fin assembly of claim 2, wherein:

each said pusher finger is provided with a facing of 35 a material harder than the material of the associated cam block and is dimensioned so that each facing digs into its associated cam block after said block has been swung to erect position for locking the blocks and fins in erect position.

4. A folding fin assembly for an aerial body comprising:

an attachment means adapted to receive one end of 40 said body;

a plurality of fin housings secured to said attachment means and extending rearwardly therefrom;

45 transverse means secured to said housings at the rear ends thereof;

each housing pivotally mounting a cam block, respectively;

each cam block carrying a fin disposed wholly within 50 its respective housing when said fin is in folded position;

an expandable chamber mounted centrally of said transverse means and having a forwardly movable part;

55 a structure carried by said part and movable thereby;

a plurality of pusher elements rigid with said structure, there being one element per cam block and engageable therewith for swinging the same and the fins to erect position.

fin carried thereby from unfolded to erect position; and

pyrotechnic means in said chamber for expanding said chamber and moving said part and structure for swinging said cam blocks and associated fins to erect position.

5 5. The fin assembly of claim 4, wherein: each of said pusher elements is of a material that is harder than the material of the cam block associated therewith.

6. In combination with an elongated aerial body having a longitudinal axis, a folding fin assembly comprising:

an attaching band attached to the rear end of said body;

a circular support plate disposed rearwardly of said band with said longitudinal axis passing through the center thereof perpendicular thereto;

a plurality of fin housings arranged around said band and plate, each housing including a pair of mounting plates rigidly secured at their front and rear ends to said band and support plate, respectively;

a plurality of pivot pins, one per housing and supported in the mounting plates thereof adjacent said support plate;

a plurality of fin members, one per housing and pivotally mounted on the pivot pin thereof for swinging from a folded position with the fin member disposed wholly within the housing to an erect position with a major portion of the fin member outside the housing;

a plurality of rigidly interconnected radially-extending arms mounted on said support plate for axial movement forwardly thereof;

the number of arms being equal to the number of fin members and associated therewith so that the radial end of each arm is engageable with its associated fin member for swinging the same to erect position in response to forward movement of said arms; and

means for imparting forward movement to said arms.

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BENJAMIN A. BORCHELT, Primary Examiner.

V. R. PENDEGRASS, Assistant Examiner.