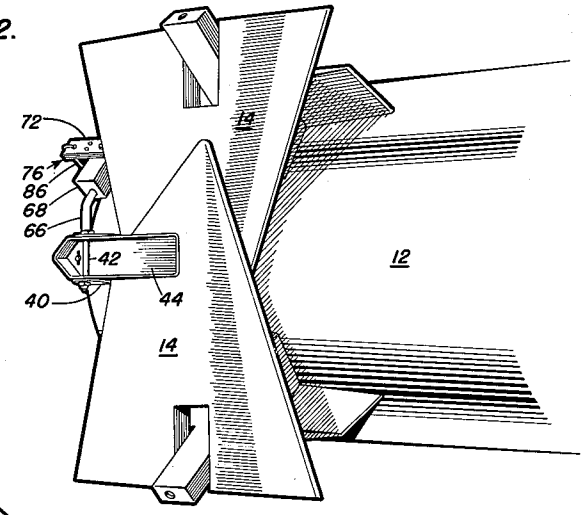
April 4, 1961 R. B. KERSHNER 2,977,880

FIN ERECTOR

Filed April 7, 1959 4 Sheets-Sheet 1

FIG. 2.



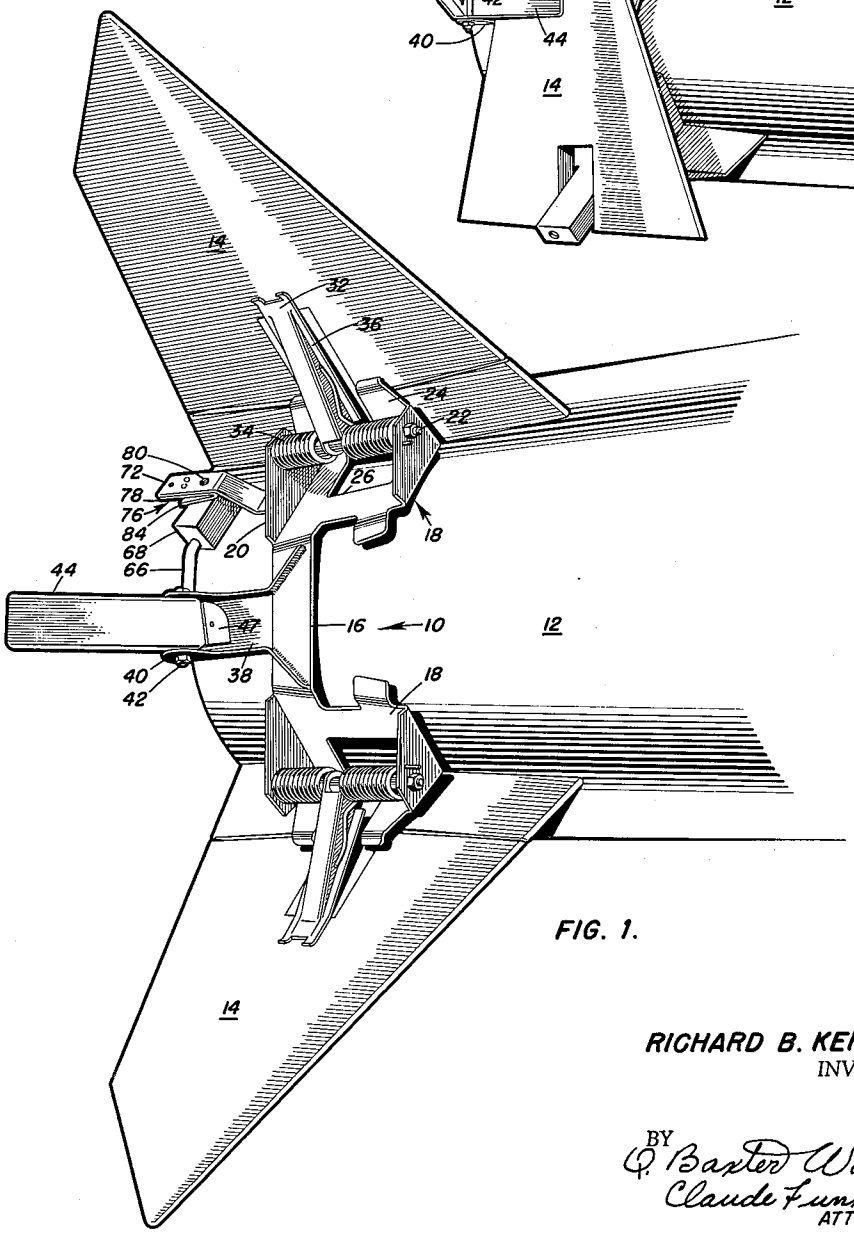


FIG. 1.

RICHARD B. KERSHNER
INVENTOR.

BY G. Baxter Warner
Claude Funkhouser
ATTORNEYS

April 4, 1961 R. B. KERSHNER 2,977,880

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Filed April 7, 1959 4 Sheets-Sheet 2

FIG. 4.

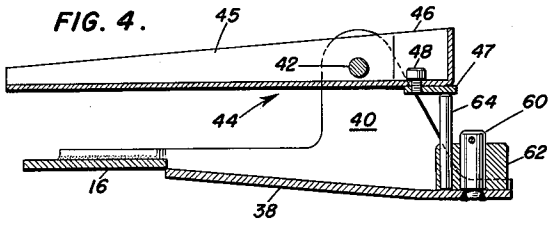


FIG. 3.

RICHARD B. KERSHNER
INVENTOR.

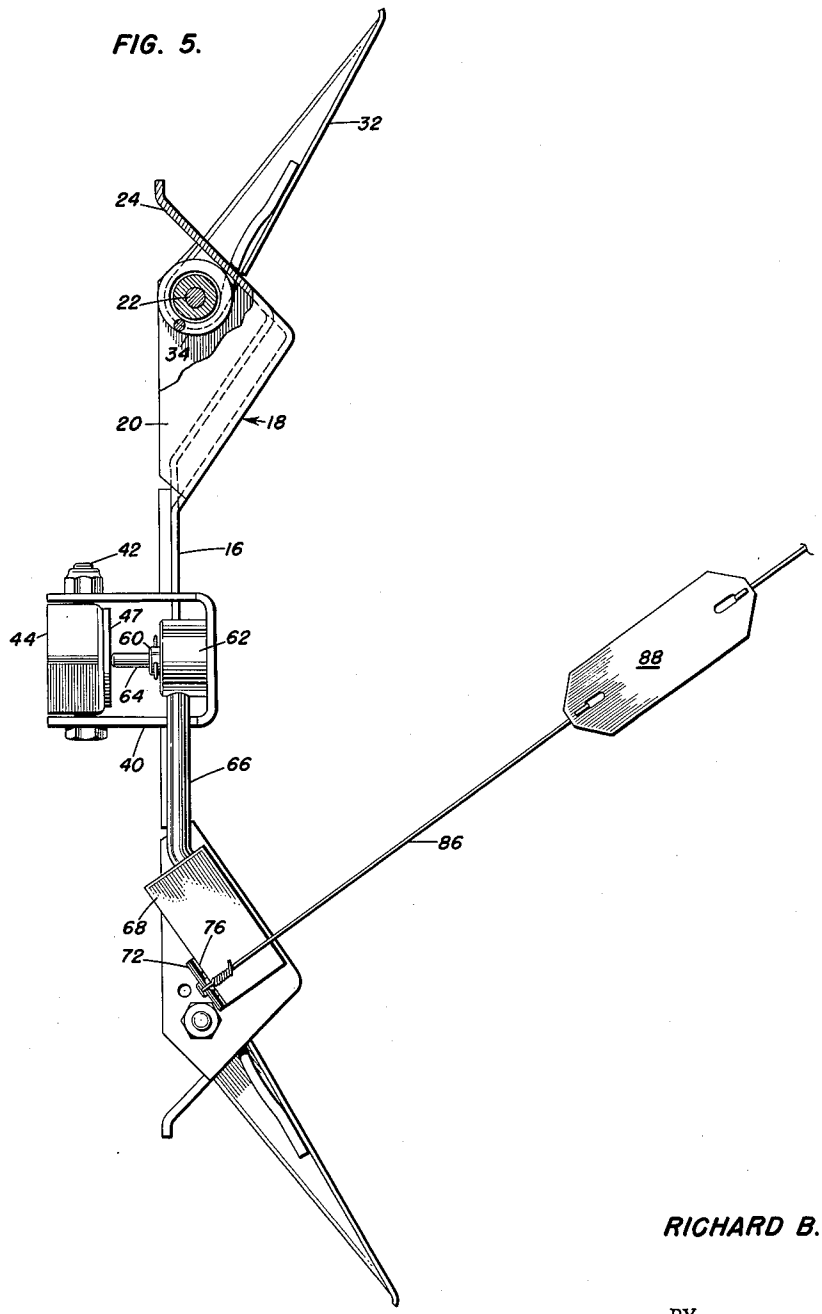
BY
Q. Baxter Warner
Claude Funkhouser
ATTORNEYS

April 4, 1961 R. B. KERSHNER 2,977,880

FIN ERECTOR

Filed April 7, 1959 4 Sheets-Sheet 3

FIG. 5.



RICHARD B. KERSHNER
INVENTOR.

BY
C. Baxter Warner
Claude Funkhouser
ATTORNEYS

April 4, 1961 R. B. KERSHNER 2,977,880

FIN ERECTOR

Filed April 7, 1959 4 Sheets-Sheet 4

FIG. 8.

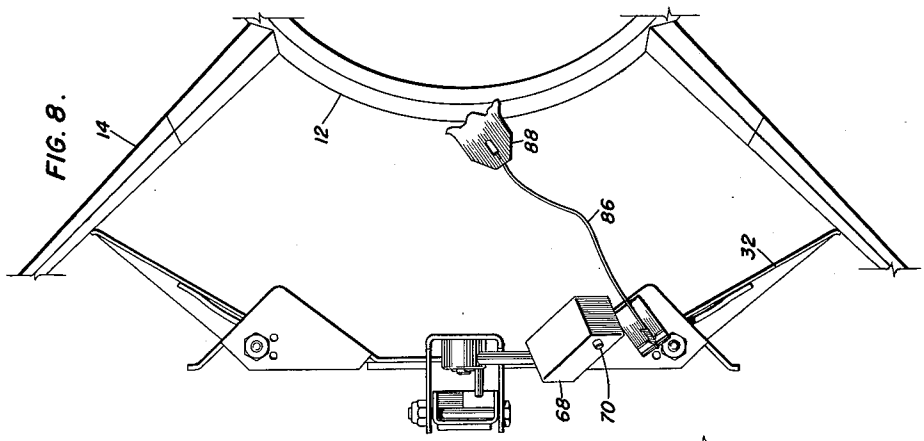


FIG. 7.

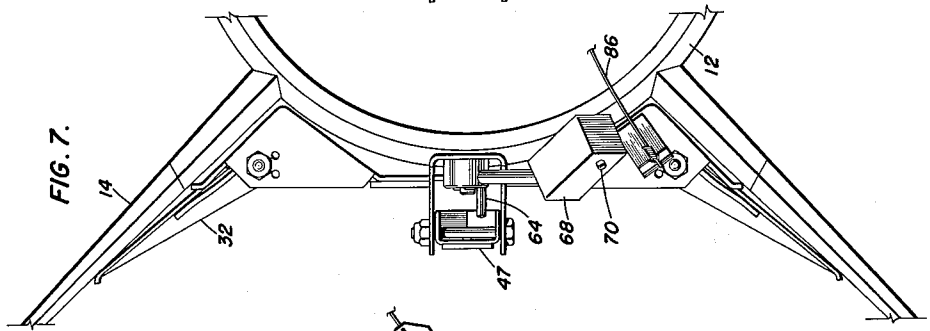
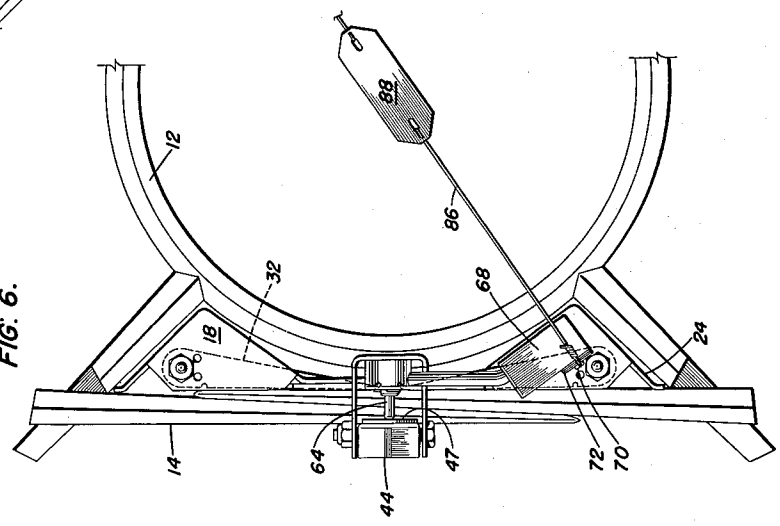


FIG. 6.



RICHARD B. KERSHNER
INVENTOR.

BY
Q. Baxter Warner
Claude F. Unkhouser
ATTORNEYS

United States Patent Office 2,977,880 Patented Apr. 4, 1961

2,977,880

FIN ERECTOR

Richard B. Kershner, Silver Spring, Md., assignor to the United States of America as represented by the Secretary of the Navy

Filed Apr. 7, 1959, Ser. No. 804,852

8 Claims. (Cl. 102—50)

This invention relates to a fin unfolding device and more particularly to a mechanism for effecting inflight erection of folding fins on an aerial missile.

There are many types of aerial missiles having folded fins. This particular invention relates to such a missile in which the fins, in normal operation, are folded while the missile is in magazine storage and during handling and loading procedures. Fin erection is then accomplished after the missile is on the launcher as part of the "ready to fire" procedure. If, however, for some reason it is decided that the missile is not or cannot be fired, the fins must be folded manually in order that handling mechanism may pick up and transfer the missile back to the magazine. The present invention provides means for erecting the fins after firing so that in case of a cease-fire order the manual folding operation is obviated for the missile strike down procedure. That is, by utilizing the present invention, the missile may be left on the launcher in a ready to fire condition with the fins folded so that if a last moment decision not to fire is made, the missile can be removed immediately without need for a fin folding operation.

In addition to eliminating the need for a fin unfolding mechanism on the launcher, the present invention also results in simplification of the missile design to the extent that two detents in the folding fin design would be eliminated (one detent retains the fins in the folded position prior to unfolding, and the other retains the fin orientation at zero and releases it after fin unfolding).

It will therefore be recognized that the object of the present invention is to provide a fin erecting device for a missile having folding fins which will automatically function after the missile is launched thereby eliminating the need for a manual operation of refolding in the event that the missile is not fired. Utilization of the present invention will also result in a simpler missile and launcher design.

Other objects and many of the attendant advantages of this invention 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.

Briefly, the present invention contemplates a fin erector in which a frame is positioned on the missile and provided with a plurality of spring loaded lifter arms hinged thereto. Each of the arms are located adjacent a folding fin and tend to urge the fin into an unfolded or erected position. When the fins are folded against the force of the spring loaded arms, a lever hinged to the frame engages the folded fins and clamps them in the folded position. An inertial actuator constrains the lever in the fin clamping position and is actuable during launch to permit the lever to allow the fins to be erected under the influence of the spring loaded arms.

In the drawings:

Fig. 1 is a perspective of the boattail of a missile having its folding fins erected by the fin erector of the present invention;

Fig. 2 is a perspective of the missile boattail in which the fins are clamped in the folded position by the fin erector;

Fig. 3 is an enlarged plan view of the fin erector;

Fig. 4 is a section taken on line 4—4 of Fig. 3;

Fig. 5 is a right end view of the fin erector of Fig. 3;

Fig. 6 is an end view of the missile boattail in which the fins are clamped in the folded position by the fin erector;

Fig. 7 is an end view of the missile boattail and fin erector of Fig. 6 showing the fins and erector at the instant of erection; and

Fig. 8 is an end view of the missile boattail and fin erector of Figs. 6 and 7 immediately after erection showing the erector being ejected from the missile.

Referring now to the drawings in greater detail, Fig. 1 shows a fin erector 10 constituting the present invention on a missile 12 having a plurality of folding fins 14. Generally, missiles of the folding fin type have an even number of such fins and the concept of the present invention is to provide one fin erector 10 for each pair of adjacent fins, although it will readily be seen that obvious modifications can be made to the present invention to adapt it for use to any number of fins.

The fin erector 10 comprises a frame 16 that straddles the missile 12 between two adjacent folding fins 14 and includes a bracket 18 on each end of the frame. Each bracket 18 is provided with a pair of side flanges 20 which journal a hinge pin 22 therebetween. End flanges 24 are formed on the brackets 18 at such an angle so as to be substantially parallel with the fins 14 and are spaced such that when the frame 16 is placed between the fins, the end flanges are abutting the fins. As can be seen in Figs. 1 and 3, a cutout 26 is made in the end flanges 24 and in the bottom of the bracket 18.

Pivotally mounted on each of the hinge pins 22 is a lifter arm 32 that is urged to swing outwardly by the force of a pair of strong torsion springs 34 also mounted on the hinge pin 22. One end of the springs 34 bear against a flange 36 on the lifter arms 32, the other end of the springs being engaged in an aperture in the side flange 20 of the bracket 18.

Extending rearward from the center of the frame 16 and attached thereto is a bracket 38 that is provided with apertured side flanges 40 journalling a hinge pin 42 therebetween. Pivotally mounted on the hinge pin 42 is a release lever 44 including a front arm 45 and a rear arm 46, and having a bearing plate 47 adjustably secured thereon. As best shown in Figs. 3 and 4 the bearing plate 47 is threadably engaged with a machine screw 48 that is constrained in a slot 50 in the rear arm 46.

Secured to the bottom and at the rear of the bracket 38 by welding or other suitable method is a post 60 on which is pivotally mounted an actuator 61 including a hub 62. A rod 64 is eccentrically carried on the hub 62 and is engageable with the bearing plate 47 on the release lever 44 when the latter is in a fin clamping position. Rigidly connected to the hub 62 and extending radially therefrom is an arm 66 having a mass 68 secured to the end thereof. Formed on the mass 68 is a pin 70 that is engageable with a leaf spring 72 fastened to and extending from one of the side flanges 20 of one of the brackets 18 on the frame 16. As seen in Figs. 1 and 3, spring 72 carries an auxiliary flat V spring 76 having one of its legs 78 riveted or otherwise suitably attached thereto. An aperture 80 extends through the leg 78 and the spring 72 for receiving the pin 70 on the mass 68. A slot is provided in the other leg 84 of the auxiliary spring 76 to permit access of the pin 70 to the aperture 80.

The spring 72 is located such that in its free position, there is no engagement between the pin 70 and the aperture 80; however, in order to effect such an engage-

ment, a cord or wire 86 is attached to the spring 72 and stretched across the exhaust opening of the missile 12 with enough tension to cause the spring 72 to deflect toward and bear against the mass 68. The other end of the cord or wire 86 is anchored or otherwise suitably attached to the diametrically opposite side of the exhaust opening. As can be seen in Fig. 5, a frangible link 88 is incorporated in the length of cord or wire 86 and is so positioned that it will be approximately in the center of the exhaust opening.

Installation of the fin erector 10 is accomplished by first placing the folded fins 14 in an erected position. As shown in Fig. 1, the fin erector 10 is then placed between the erected fins 14 and, with the spring loaded arms 32 bearing against the fins, urged toward the missile 12 until the frame 16 is in contact with the missile. With the release lever 44 in a raised position, the fins 14 are then folded, in opposition to the force of the spring loaded arms 32, until they and the arms are against the frame 16. As shown in Figs. 2 and 4, the release lever 44 is then brought to bear against the top of the now folded fins 14 and constrained to remain in this clamping condition by pivoting the hub 62 into such a position that the rod 64 is in contact under the bearing plate 47, thereby restraining any further movement of the lever. From Fig. 3, it can be seen that when the rod 64 is centered under the bearing plate 47, the mass 68 connected to the hub 62 by the arm 66 is in such position that the pin 70 on the mass is in alignment with the aperture 80 in the springs 72 and 76. Thus the mass 68 and consequently the hub 62 may be locked into a position which will cause the fins 14 to be clamped down by the lever 44 by exertion of a force along the cord or wire 86 to cause the spring 72 to deflect toward the mass so that engagement between the pin 70 and the aperture 80 is effected. As previously described, the cord or wire 86 is stretched across the missile exhaust opening to the opposite side and there anchored.

In discussing the operation of the present invention, it will be assumed that the fins 14 of the missile 12 have been folded and clamped by the fin erector 10 as above described and that the missile is on a launcher ready for firing. A rear view of the missile 12 and fin erector 10 in this condition is depicted in Fig. 6. As the rocket motor is ignited, the hot exhaust gases will rupture the frangible link 88 thereby relieving the tension on the cord or wire 86 to release the springs 72 and 76 from engagement with the mass 68. The fin erector 10 is now "armed" and the mass 68 is free to move to permit actuation of the release lever 44.

As the missile 12 begins to move under the power of its rocket motor the resulting forward thrust causes the mass 68 to swing to the rear thus turning the hub 62 so that the rod 64 is pivoted away and out of engagement with the bearing plate 47. This then removes the restraining action of the release lever 44 so that the spring loaded lifter arms 32 force the fins 14 to unfold outwardly until the latter are locked in the erected position. If desired, the time of disengagement of the rod 64 with the bearing plate 47 may be varied by changing the position of the bearing plate as permitted by the slot and screw, 50 and 48, respectively. Fig. 7 shows the fin erector 10 on the missile 12 at the instant the lifter arms 32 have unfolded the fins 14.

After the spring loaded lifter arms 32 erect the fins 14, they also act to eject the fin erector 10 from the missile 12. As seen in Fig. 8, which shows the fin erector and missile immediately after the fins have been erected, the lifter arms 32 continue to pivot under the force of the torsion springs 34 to push the fin erector away from the missile, thereby jettisoning the fin erector.

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. In combination with an aerial vehicle having a plurality of folding fins, a jettisonable fin erector for effecting inflight erection of a pair of said folding fins, comprising, a frame straddling said vehicle and positioned between said pair of fins, a plurality of spring loaded arms pivotally attached to said frame and engageable with said fins to urge said fins to unfold, a lever pivotally attached to said frame and movable into a clamping position to clamp said fins in a folded position against the force of said spring loaded arms, and an actuator including a mass on said frame for constraining said lever in said clamping position and responsive to the acceleration forces occurring at launch to release said lever from said clamping position, whereby said spring loaded arms will erect said fins and eject said fin erector from said vehicle.

2. The apparatus as recited in claim 1 wherein said actuator includes a rod engageable with said lever to constrain said lever in said clamping position, a hub for carrying said rod and pivotally mounted on said frame, and an arm secured to said hub and extending radially therefrom, said arm being positioned substantially transverse to the longitudinal axis of said vehicle when said rod is in engagement with said lever, said mass being secured to the end of said arm and remaining relatively inert upon the launching of said vehicle to cause said hub to pivot and thereby move said rod out of engagement with said lever.

3. The apparatus as recited in claim 2 with additionally means for constraining the movement of said hub while said hub is in such position that said rod is in engagement with said lever, comprising, a pin on said mass, a spring member on said frame and having an aperture therein engageable with said pin, a wire attached to said spring and urging said aperture into engagement with said mass, said wire being positioned across the exhaust opening of said vehicle and anchored on the opposite side thereof, and a frangible link in said wire and positioned approximately in the center of the exhaust opening.

4. In combination with an aerial vehicle having a plurality of folding fins, a jettisonable fin erector for effecting inflight release of a pair of said folding fins, comprising, a frame straddling said vehicle and positioned between said pair of fins, a pair of spring loaded arms pivotally attached to said frame, one of said arms being provided for each fin of said pair of fins and engageable therewith to urge said fins to unfold, a lever pivotally attached to said frame and movable into a clamping position to clamp said fins in a folded position against the force of said spring loaded arms, a bearing plate on said lever, a rod engageable with said bearing plate to constrain said lever in said clamping position, a hub for carrying said rod and pivotally mounted on said frame, an arm secured to said hub and extending radially therefrom, said arm being substantially transverse to the longitudinal axis of said vehicle when said rod is in engagement with said bearing plate, and a mass secured to the end of said arm, whereby said mass remains relatively inert upon the launching of said vehicle thereby causing said hub to pivot to disengage said rod from said bearing plate, whereupon said lever releases said fins from said folded position to permit said spring loaded arms to erect said fins and eject said fin erector from said vehicle.

5. The apparatus as recited in claim 4 with additionally means for placing said mass in an unarmed condition wherein said mass is locked in such position that said rod is in engagement with said bearing plate, said means being actuable upon firing of said vehicle to place said mass in an armed condition.

6. The apparatus as recited in claim 5 wherein said means includes a pin on said mass, a spring member on said frame and having an aperture therein engageable with said pin, a wire secured to said spring member and

urging said aperture into engagement with said pin, said wire being positioned across the exhaust opening of said vehicle and anchored on the opposite side thereof, and a frangible link in said wire and located approximately in the center of said exhaust opening.

7. The apparatus as recited in claim 4, with additionally means for varying the time of disengagement of said rod with said bearing plate and including an adjustable mounting for said bearing plate.

8. The apparatus as recited in claim 7 wherein said adjustable mounting includes a slot in said frame, and a screw constrained to move in said slot and threadably engageable with said bearing plate.

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