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[54] **RETRACTABLE BLADE UNIT FOR PROJECTILES**
6 Claims, 6 Drawing Figs.

- [52] U.S. Cl..... 244/3.27
- [51] Int. Cl..... F42b 13/32
- [50] Field of Search..... 244/3.23,
3.27, 3.29

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ABSTRACT: A retractable tail unit for guiding projectiles, which unit includes an idle bushing mounted in the rear part of the cylindrical body of the projectile. The bushing has the same diameter as the outer diameter of convergent and divergent composite body portions of said cylindrical body, all being axially aligned with said body. A plurality of substantially trapezoidal shaped blades are pivot mounted at one end on a pivot pin mounted slantwise on the bushing, with the blades in their "closed" position lying flat tangentially to coextensive portions of the bushing and of the convergent portion of the cylindrical body of the projectile, and parallel to the axis thereof. The blades, when in their "closed" position, are contained within a circular ring area or recess defined by or between a combination of the body of the convergent portion and of the bushing, and by the outer diameter of the cylindrical body of the projectile. The center of gravity of these blades, as a result of the axial acceleration in the initial launching stage, is so displaced as to cause a moment on the blades which effects the opening and the extension of each blade about the slanting or canted pivot pin, the blades thus placing themselves radially with respect to the axis of the cylindrical body of the projectile, at the desired attachment angle.

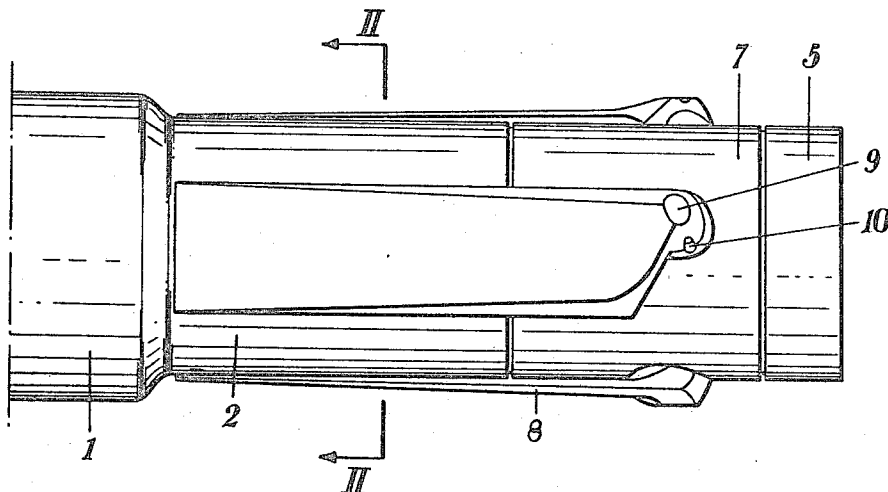


Fig. 2

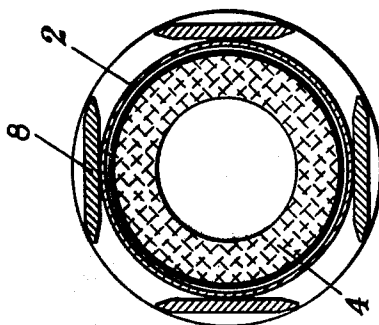
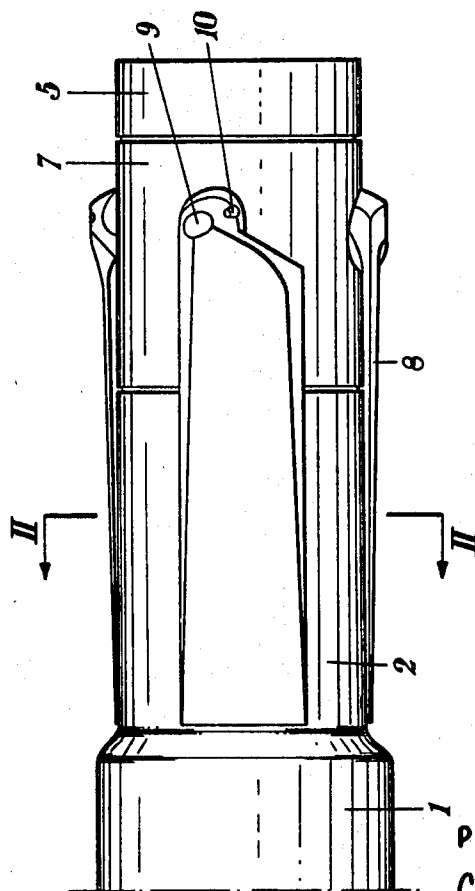


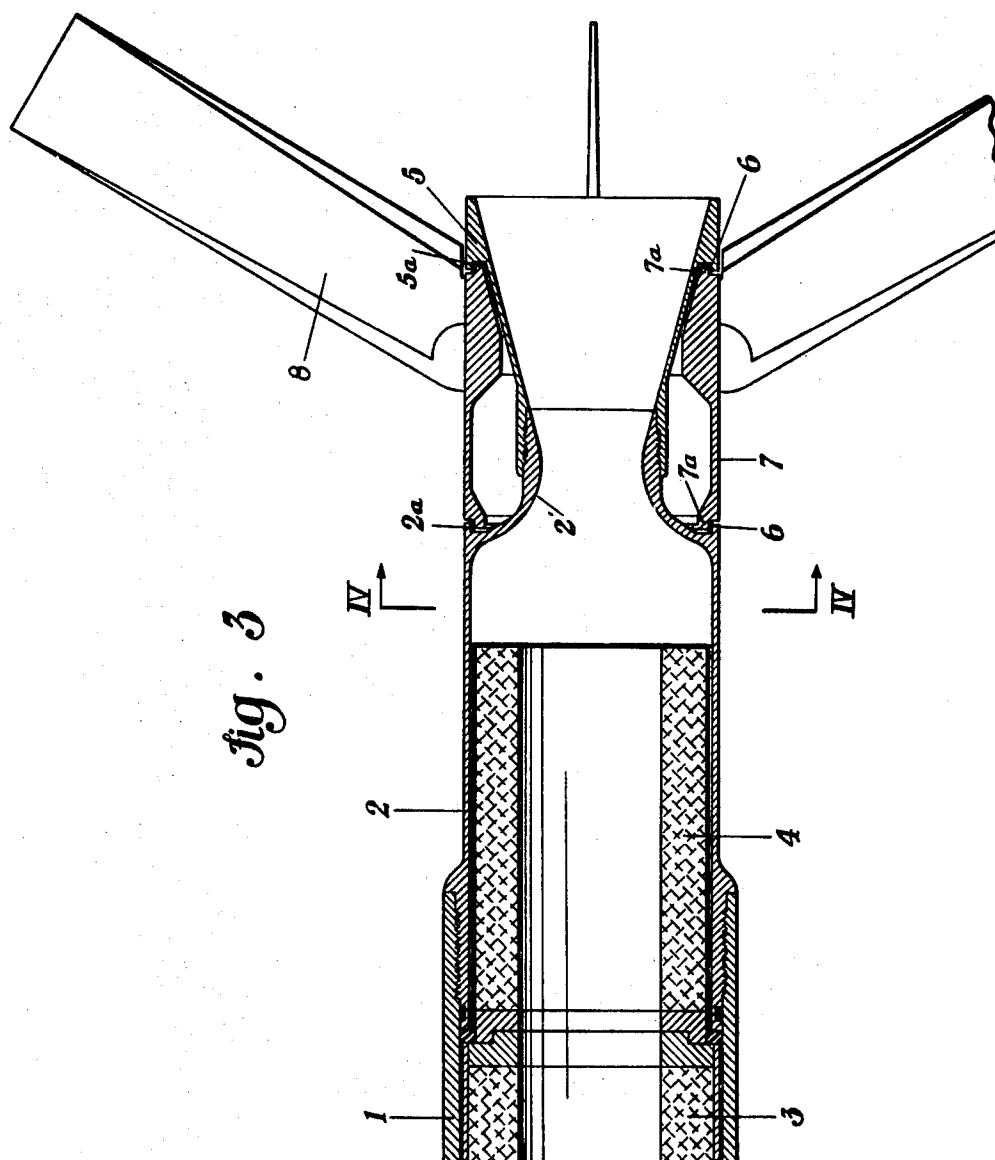
Fig. 1



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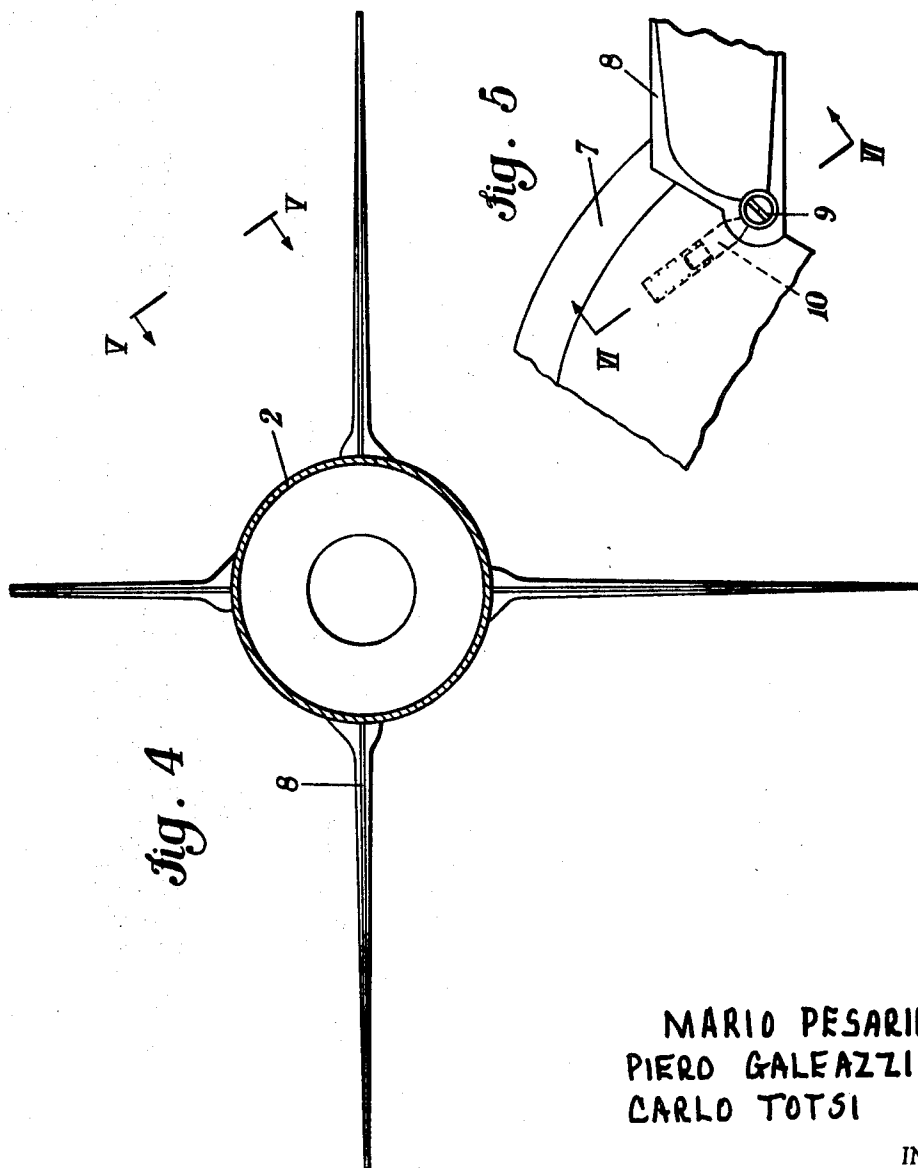
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RETRACTABLE BLADE UNIT FOR PROJECTILES

This application is a continuation-in-part of our application Ser. No. 690,625 filed Dec. 14, 1967.

BACKGROUND OF THE INVENTION

The present invention relates to a retractable blade tail unit for guiding projectiles of various caliber of either the self-propelled or nonself-propelled type, having a low drag.

The use of tail units of the retractable type, the blades of which are, when in the closed position, located within simple geometrical shapes, and, as in the instant invention, are capable of being inscribed within a cylinder coextensive with the cylindrical body, is preferable for various reasons, including: (a) simplicity of transport and storage; (b) possibility of use of tubular launching devices which are easily embodied, nonexpensive, and which have a minimum bulk; (c) maximum concentration of destroying power available at parity of occupied volume; and (d) safe handling.

Heretofore, retractable blade tail units for use with such missiles have embodied plural recesses for the plural blades, thus increasing the overall drag, and further have embodied a plurality of springs and other related means in association with the respective blades to urge them into their extended operative positions.

A primary object of the present invention is to provide an improved tail unit embodying a fin or blade carrying idle bushing arranged relative to the projectile body in a simple supporting manner as to permit rotation of said projectile body around the longitudinal axis with respect to said bushing, and essentially without any undue increase of weight.

A further important object of the present invention is to provide a bushing and blade assembly unit in which the blades are moved from their "closed" inoperative position to their extended or "open" operative position by their own inertia moments created during launching acceleration.

Another object is to provide an improved tail unit of the foregoing character wherein the bushing forms a continuous smooth cylindrical surface with a rearward portion of the projectile body to reduce drag thereof.

These and other objects and advantages of the present tail unit will become more apparent from the following more detailed description.

SUMMARY OF THE INVENTION

More specifically, the objects of the present invention are achieved by the provision of a retractable tail unit which comprises an idle bushing concentrically mounted on a reduced diameter rearward portion of the cylindrical body of the projectile, said bushing having the same outer diameter as a pair of interconnected composite elements constituting the intermediate and extreme rearward portions of said reduced diameter portion of the cylindrical body and being axially aligned with the latter. A plurality of substantially flat, trapezoidal shaped blades or fins are pivotally mounted at one of their ends, each on a pivot pin fitted on said bushing at an incline with respect to the axis thereof, said blades when in their retracted or "closed" position lying flat tangentially to the bushing and to said reduced diameter rearward portion of the projectile's cylindrical body, and in planes parallel to the longitudinal axis of said body. Said blades, when in the closed condition, are disposed so as to be inscribed within a circular ring or cylindrical extension defined by a coextensive extension of the main cylindrical projectile body. The center of gravity of said blades is such that responsive to the axial acceleration during the initial launching stage, an inertia moment on each of said blades effects the opening and the pivotal rotation of each blade on the said inclined pin, said blades thus placing themselves radially with respect to the axis of the cylindrical body of the projectile, at the desired attachment angle, without the aid of any special devices, such as expander springs.

FIGURE DESCRIPTION

This invention will now be described with reference to the attached drawings, wherein:

FIG. 1 is a longitudinal elevational view of the new tail unit arranged in the rear terminal part of the self-propelled projectile, with its blades in the "closed" position;

FIG. 2 is a cross-sectional view taken substantially on the line II—II of FIG. 1;

FIG. 3 is an axial cross-sectional view of the device, with its blades in their "open" position, after the projectile launching;

FIG. 4 is a front elevational view taken along the line IV—IV of FIG. 3;

FIG. 5 is a detail view according to the line V—V of FIG. 4; and

FIG. 6 is a cross-sectional view taken according to the line VI—VI of FIG. 5.

PREFERRED EMBODIMENT

With reference to the figures, reference number 1 generally designates the cylindrical motor casing to which the slightly reduced diameter sleeve element 2 having a rearwardly and further constricted or Venturi portion 2' is preferably threadedly affixed, and which Venturi portion 2' is, in turn, preferably threadedly connected to the rearwardly diverging frustoconical nozzle element 5, and the latter of which is of the same outside diameter rearwardly as the intermediate portion of the element 2.

The propellant grain 3 including a portion designated 4, which extends into the first or forward part of the sleeve element 2, is contained in the motor casing 1.

A cylindrical idle bushing 7, the outer diameter of which is equal to and coextensive with the outer diameter of said element 2 and with the outside diameter of the outlet section of the nozzle 5, is intended to be idle or relatively stationary with respect to both the Venturi containing element 2 and to the nozzle or frustoconical element 5 as compositely joined with the body 1 of the projectile.

The bearing arrangement which enables the bushing 7 to remain idle consists primarily of two circular preferably self-lubricating type endless bands 6, for example of "Teflon" material, which thereby inherently reduce the sliding or rotary friction, and permit the rest of the body to freely rotate relative to said idle bushing which is intended to and does remain relatively stationary by not rotating when the projectile is in flight. The bands 6 seat in complementary formed recesses 7a formed in opposite ends of the bushing 7 and in the respectively adjacent portions of the elements 2 and 5 as at 2a and 5a, respectively.

With particular reference to FIG. 3, the mounting and the arrangement of the bushing 7 are such that thermal expansion tends to increase the play or clearance instead of reducing it, so as to avoid the risk of jamming of the tail unit as a result of the nozzle heating.

With particular reference to FIGS. 1 and 3, respectively, four generally trapezoidal shaped flat blades 8 are mounted on the bushing 7 and are disposed both in a tangential manner when in the closed condition, and in a radial manner when in the open or extended condition.

Each blade 8 is free to rotate about a pivot pin 9 mounted at an inclined or canted manner on the bushing 7, and in the retracted position (FIGS. 1 and 2) each blade lies flat tangentially with respect to the intermediate portion of the sleeve 2 and in a plane parallel to the longitudinal axis of the projectile.

The blades 8 are specially mounted on the pivot pins 9 so that their center of gravity is such that the effect of the axial acceleration during the initial stage of launching initiates an inertia moment on the blades which causes them to commence opening without the aid of any particular device, such as springs and the like, as often required in prior art devices.

After their opening, by simple pivotal rotation due to said moment generated in the initial launching stage, the blades ex-

tend from their "closed" position to their radial fully "open" position (FIGS. 3 and 4), at the desired attachment angle, which is determined by the shape of the end rests of the blades on the bushing 7.

The blades 8, in their "open" position, are each locked by a locking pin 10 (FIGS. 1, 5 and 6) disposed within the bushing 7 perpendicularly to said pivot. When the blades are in their "closed" position, said locking pins 10 are covered and held in their retracted positions by the adjacent portions of the attachment ends of the blades, while when in their radial "open" position they rest on the surface of the bushing 7 and said locking pins 10 are spring biased by the locking springs 11, with each pin penetrating into a conical hole located in the attachment ends of the blades. The bushing 7 generally remains stationary by means of the uncanted disposition of said tail fins during the flight of the projectile, with the body thereof free to rotate on the ring bearings 6 around the longitudinal axis of the projectile. The rotation of said body may be achieved by a plurality of nozzles suitably arranged on the end portion of element 5. Because said nozzle arrangements are well known in the prior art and do not constitute a part of the present invention, they have not been specially shown or further described. Also the rotation may be imparted by the specific form of launch mechanism.

The arrangement of the tail unit according to this invention, by retaining the continuity of a generally uniform outer diameter of the various component parts, displays a better aerodynamic shape.

Moreover, since particular prior art devices, such as springs and the like, for starting the opening rotation of the blades are excluded, the unit is much simpler and lighter in construction; particularly, there is a reduction in size both in the blade attachment and in the bushing, which consists substantially of a circular ring or a cylindrical sleeve.

Furthermore, the relatively increased diameter of the element 2 compared to prior art devices allows a reduction of the gas speed, and therefore a reduction of the thickness of the thermal protection, if any is chosen to be utilized.

While in the above described example the tail unit comprises four retractable blades, the number of the blades can be increased, provided that the symmetry conditions will be maintained.

The present invention has been illustrated and described in one preferred embodiment, it being understood that constructive changes might be practically adopted without thereby departing from the scope of the present inventive concept set forth in the appended claims.

What is claimed is:

1. A retractable tail unit for projectiles comprising, in combination, a substantially cylindrical element 2 screw fastened at its forward end with the rear portion of a projectile body; said element 2 having a uniform diameter intermediate portion between the forward screw fastened end and a reduced diameter rearward end 2', a substantially frustoconical element 5 having a forward reduced diameter cylindrical end threadedly connected with said rearward end of said cylindrical element 2 and having an enlarged substantially cylindrical rearward end corresponding to the outside diameter of said reduced diameter portion of said element 2, a cylindrical idle bushing 7 having an outside diameter commonly equal to that of said intermediate portion of said cylindrical element 2 and to that of the enlarged rearward end of said frustoconical element 5 and means freely mounting same therebetween; said cylindrical element 2 and said rearward end of said frustoconical element 5 having annular axially directed projections corresponding to and mating with generally complementary annular notches 7a formed at both ends of said bushing 7; a ring bearing 6 interposed between each of said annular projections and said annular notches to allow relative rotation to occur between said idle bushing and said cylindrical element 2 and

its attached frustoconical element 5, a plurality of generally relatively flat blades 8 having attachment ends, and being movably mounted and radially extendable upon said bushing at an equal distance from one another and mounting means for mounting said attachment ends of said blades on said bushing.

2. A retractable tail unit for projectiles as defined in claim 1 wherein said blade-mounting means comprises a pivot pin 9 secured to said attachment end of each of said blades 8 and slantingly mounted on said bushing, a locking pin 10 arranged within a recess formed in said bushing perpendicularly to said pivot, a locking spring 11 acting on each of said locking pins 10, said locking spring 11 being retained in its retracted position by said attachment end of the blade when the latter is in the closed position thereof, and urging said locking pin into a conical hole of said attachment end of the blade in the open position thereof.

3. A retractable tail unit for mounting on projectile bodies of projectiles comprising in combination;

a. a substantially cylindrical element 2 having male screw fastening means at its forward end for threaded insertion into a complementary female threaded rearward portion of a projectile body, said element 2 having a reduced intermediate portion and further reduced rearwardly extending nozzle portion 2' with male threads on the exterior of the latter portion;

b. a generally frustoconical element 5 having a rearward end of a larger diameter than the forward end of reduced diameter, said forward end having a female-threaded portion and being screwed onto the complementary male-threaded rearward portion of said nozzle portion;

c. a cylindrical idle bushing 7 having an outside diameter coextensive with that of said intermediate portion of said cylindrical element 2 and with that of said rearward end of said frustoconical element 5;

d. means freely mounting said idle bushing on and between the intermediate portion of the cylindrical element 2 and the rearward end portion of said frustoconical element 5, including the latter two having axially spaced and axially directed annular projections corresponding to and disposed for rotation in and relative to complementary annular recesses or notches 7a formed at both opposite ends of said idle bushing 7;

e. said means for freely mounting said idle bushing further including a ring bearing member 6 interposed between each of said annular projections and recesses 7a to allow relative rotation to occur between said idle bushing 2 and the said cylindrical element 2 and its attached frustoconical element 5; and

f. a plurality of generally trapezoidal flat blades 8 having attachment ends and means for radially extendibly mounting same upon said bushing at equal circumferentially spaced distances.

4. A retractable tail unit as defined in claim 3 wherein said reduced diameter rearward end of said element 2 includes a Venturi-shaped formation 2' on the radial inside thereof.

5. A retractable tail unit as defined in claim 4 wherein the idle bushing 7 of paragraph (c) (of parent claim 3) includes an intermediate portion having an inside diameter spaced a substantial radial distance from a substantial axial portion of the Venturi formation 2' and forward portion of the frustoconical element 5, to provide a cooling chamber and reduce the amount of thermal protection which would otherwise be required.

6. A retractable tail unit as defined in claim 1 wherein the arrangement and means mounting of said idle bushing are such that thermal expansion responsive to projectile operation tends to increase the tolerance or play between the relative parts, thereby precluding the danger of jamming or inoperativeness of the tail unit as a result of nozzle heating.