Jan. 2, 1962 J. H. POTTS, JR 3,015,269

STABILIZING FIN

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FIG.1.

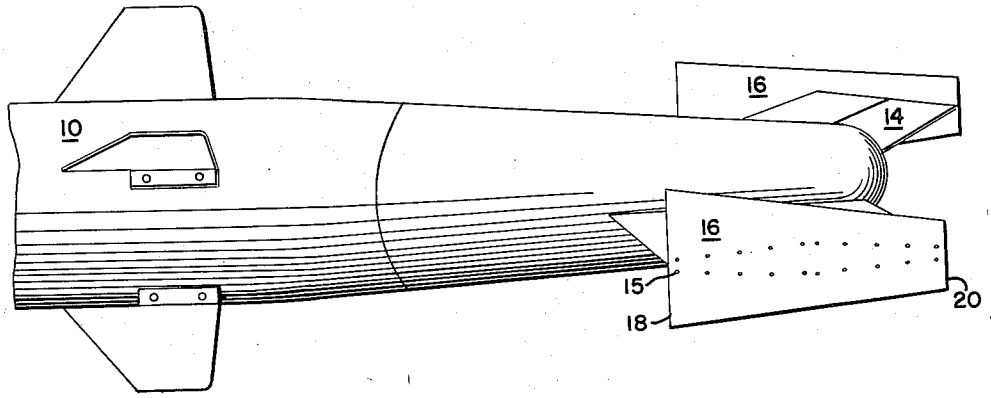
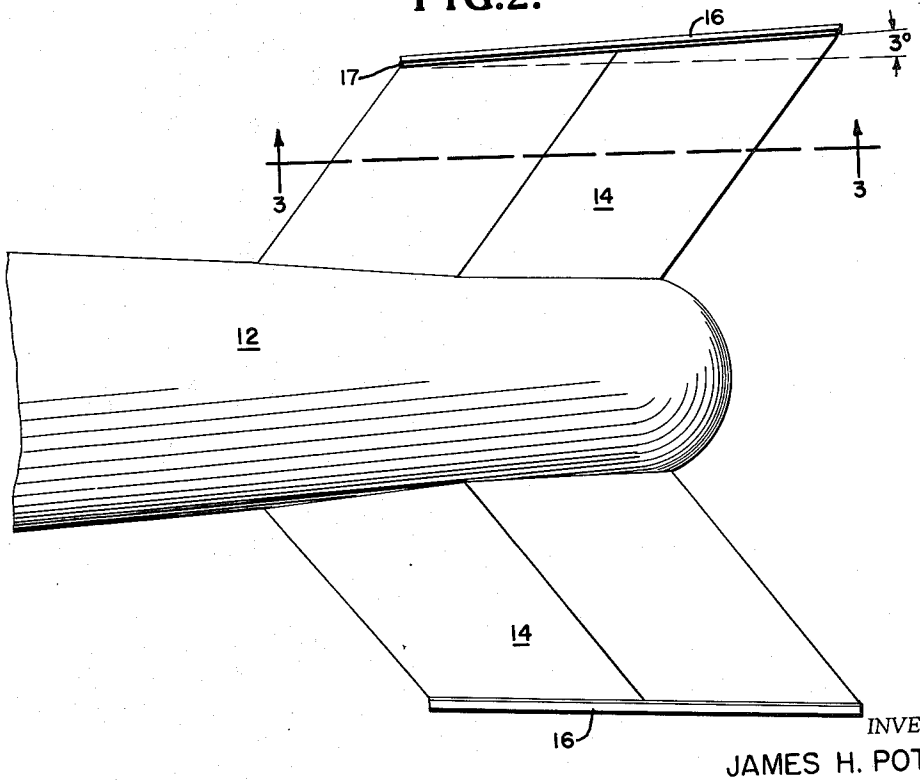


FIG.2.



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FIG.3.

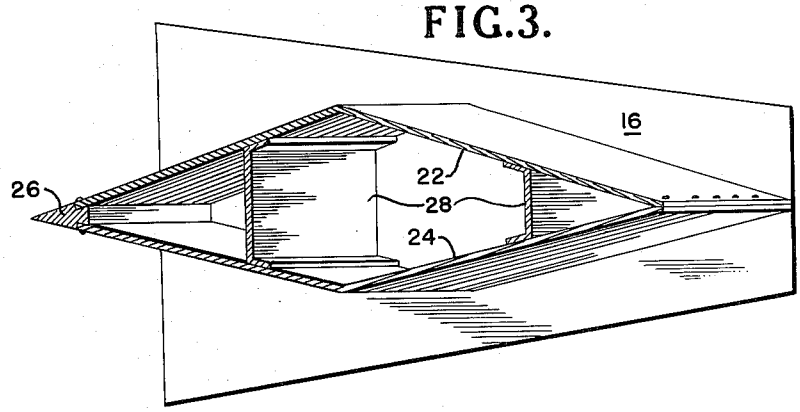


FIG.4.

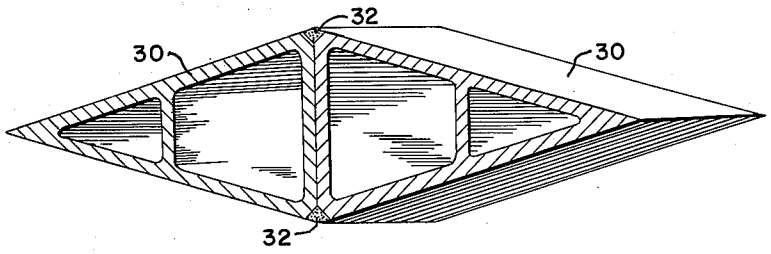


FIG.5.

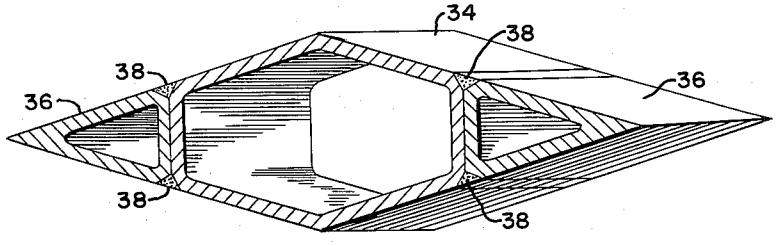
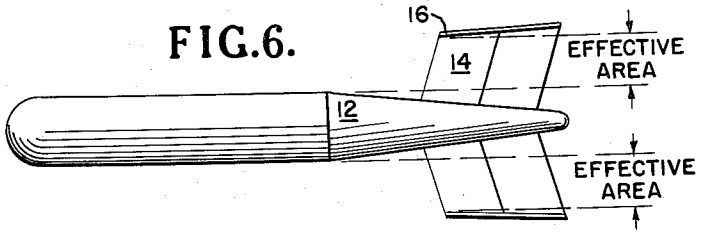


FIG.6.



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3,015,269

STABILIZING FIN

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4 Claims. (Cl. 102—3)
(Granted under Title 35, U.S. Code (1952), sec. 266)

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.

This invention relates to an improvement in a stabilizing fin for bombs of the type generally carried under the wing of an aircraft.

Bombs of this type have heretofore been provided with stabilizing fins which have been less than satisfactory. They were generally in the form of four or more flat or wedge fins which projected beyond the maximum diameter of the bomb. The flat fins, to be effective were too large to allow the bomb to be placed under the wing of the plane without touching the ground, the wedge type provided too much aerodynamic drag, which would slow down and buffet the aircraft. Box fins were also used but the structural integrity of the box fin is not sufficient to withstand the aerodynamic flutter incident to high speed carriage. There was a definite need for a fin which would stabilize the bomb during the initial dropping and which would not buffet the carrier plane while transporting the bomb at high speeds.

One object of the present invention is to provide a stabilizing fin for bombs, of the type to be carried under a wing of a high speed carrier plane and which would not buffet the plane at high speeds.

Another object is to provide a stabilizing fin for a bomb which would quickly react to any small deviation in the free flight of the bomb and return the bomb to course.

Still another object is to provide a stabilizing fin which would prevent both pitching and yawing of a free falling body and which would be of such dimensions as to fit in the space available while being carried by a high speed carrier plane.

A further object is to provide an H-type fin which during bomb flight presents an angled surface to the air stream to provide a high degree of stability both in a horizontal and vertical direction.

It is a still further object to provide pairs of angled surfaces or planes which, when the bomb is in correct flight, present surfaces which are at an angle to the air stream and which are opposite and balance each other and cause sufficient drag to provide a stabilizing force to maintain the bomb continuously in correct flight.

It is a still further object of the invention to provide pairs of surfaces angled to the line of normal flight of the bomb, the angles of each of the surfaces forming a pair to be equal and opposite to the other surface of the pair to provide equal drag and to further provide these pairs in both vertical and horizontal planes to act to prevent pitching and yawing of the bomb during free flight.

It is a still further object to provide a horizontal fin which can be attached to bombs of various sizes and shapes to prevent pitching and to balance these fins by various size tip plates making the damping coefficient in the yawing plane equal to the damping coefficient in the pitching plane.

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 wherein:

FIG. 1 is a perspective view of the fin and a portion of the bomb;

FIG. 2 is a top plan view showing a portion of the bomb;

FIG. 3 is a view through the horizontal portion of the fin taken on line 3—3 of FIG. 2;

FIGS. 4 and 5 are cross sectional views, similar to FIG. 2 of modified forms of the invention; and

FIG. 6 is a diagrammatic representation of the effective air stream.

Referring to the drawings wherein like parts are designated by like numerals there is shown a portion of a bomb 10 having a detachable rear section 12. The rear section has attached thereto an H type stabilizing fin which is the subject of this invention according to a preferred embodiment thereof.

With particular reference to FIG. 2 the rear section 12 has affixed to its side at opposite points the horizontal sections 14 which are diamond shaped in cross section and are arranged at a swept back angle of approximately 50° to the center line of the bomb, substantially as shown. The fins which are affixed to a narrowed portion of the tail fairing or rear section of the bomb are preferably approximately 32 inches wide or in a direction normal to the center line and 20 inches long. Secured to the outer edges of the horizontal sections are flat detachable vertical tip plates 16. These plates are attached to the horizontal sections by countersunk screws 15 extending through flanges 17 on the horizontal sections, or into threaded openings of the sections when said sections are cast, and are set at an angle of 3° to the center line of the bomb to provide angled inclined faces at the ends of the horizontal sections which produce drag and stabilize the bomb both in free flight and while the bomb is attached to the plane. These inclined surfaces prevent yawing and should the bomb deviate from its course by turning to the right or left present one surface which is at a greater angle and another surface which is at a lesser angle to the air stream. This increased pressure on one side and decreased pressure on the other quickly restores the bomb to its course. While it is attached to the plane these edge plates stabilize the bomb and prevent buffeting of the plane when the plane is moving at high velocity.

The tip plates are carefully contoured, being 20 inches high at the leading edge 18, and 10 inches high at the trailing edge 20, and 20 inches long. These dimensions are critical for a bomb 12 feet long, the proportions being maintained for other length bombs. The leading edge of the vertical tip plate is approximately equal to the greatest diameter of the bomb.

The effective area of the horizontal fin is a function of the body diameter of the bomb (see FIG. 6). The damping coefficient in the pitching plane must equal the damping coefficient in the yawing plane. The damping coefficient is a function of the pitching moment induced by the effective area of the horizontal fin. The damping coefficient in the yawing plane is made equal to the pitch damping coefficient by making the yawing moment equal to the pitching moment. This is accomplished by varying the area of the flat vertical tip plates. This is determined by experimentation in a wind tunnel and different size tip plates can be quickly and easily affixed to the horizontal fins. If the design of the bomb shields more of the horizontal fins the pitching moment and the damping coefficient will decrease thereby requiring smaller tip plates. Should the design of the bomb expose more of the horizontal fins, larger tip plates are required. These tip plates are relatively inexpensive and comparatively easy to change. By making a horizontal fin with interchangeable tip plates a great range of sizes of bombs and changes of design of the bomb body can be stabilized without exces-

sive cost. The tail fairing structure can be modified by different size tip plates for approximately 1/50 the cost of the tail fairing.

The horizontal sections are formed of a top plate 22 and a bottom plate 24 riveted together at the trailing edge, FIG. 3. The leading edge is a nose piece 26 which is formed to receive the leading edges of the top and bottom plates in a manner to present a smooth exterior surface. The plates are bent at the center and spaced about 2 inches apart. Braces 28 set between the center and the edges serve to hold the horizontal sections in desired shape. The leading surfaces of the top and bottom plates are at equal and opposite angles to the air stream and stabilize the bomb in a horizontal plane serving to prevent pitching. Should the bomb pitch up or down slightly, the increased angle increases the pressure on the leading surface to return the bomb to level flight. This construction also serves to prevent buffeting when attached to the plane and traveling at high velocity.

There is shown on FIG. 4 a modified form of construction of the horizontal sections wherein the sections are formed from two identical halves 30 of extruded aluminum and welded together at 32. With this construction a nose piece is not needed.

FIG. 5 is still another modification using extruded portions. A central part 34 has identical end parts 36 welded thereto at 38. Both of the modified forms produce a horizontal section which is made with less labor and is more easily made uniform.

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 as new and desired to be secured by Letters Patent of the United States is:

1. A stabilizing fin for elongated bombs comprising a pair of rigid horizontal sections attached to and extending from diametrically opposite sides of the bomb body to stabilize the bomb in the pitch attitude, each of said horizontal sections having rhombus-shaped cross section at a right angle to the principal axis thereof and in a plane parallel to the axis of the bomb, the leading surfaces of said horizontal sections having like acute adjacent angles to the center line of the bomb, a pair of flat vertical tip plates to stabilize the bomb in the yaw attitude, a different one of said pair of plates being rigidly attached to the end of each of said horizontal sections, each of said plates having a greater vertical width at the leading edge than at the trailing edge and being throughout its length at an acute adjacent angle to the center line of the bomb.

2. The stabilizing fin of claim 1 wherein the area of the tip plate is such that the damping coefficient of the yaw moment is equal to the damping coefficient of the pitch moment.

3. The stabilizing fin of claim 2 wherein the tip plates are at a 3° angle to the center line of the bomb.

4. The stabilizing fin of claim 3 wherein the vertical width of the leading edge of said plate is less than the maximum diameter of the bomb.

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