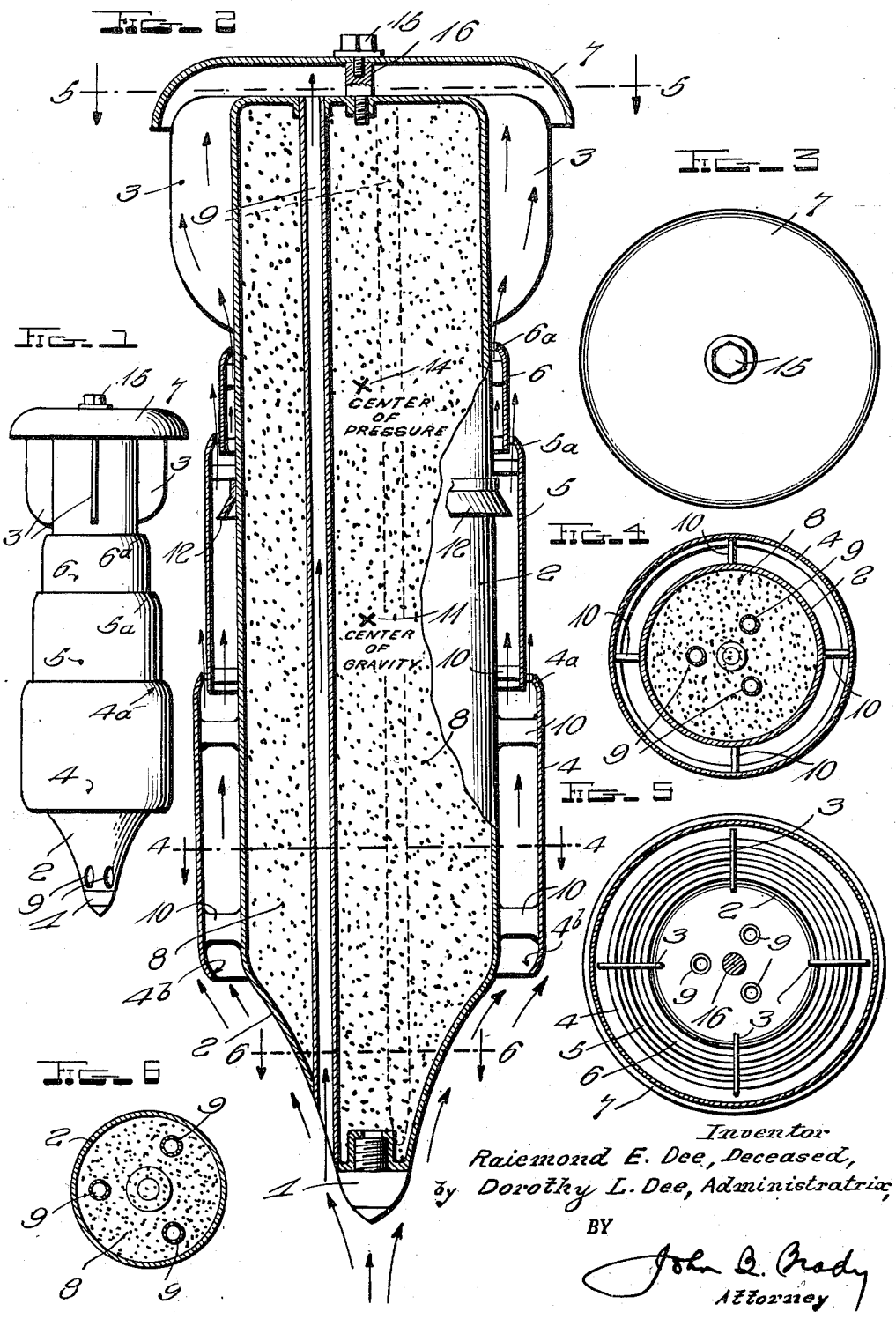
Dec. 5, 1944. R. E. DEE 2,364,197

BOMB STABILIZING MEANS

Filed April 23, 1941 2 Sheets-Sheet 1



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BOMB STABILIZING MEANS

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FIG. 8

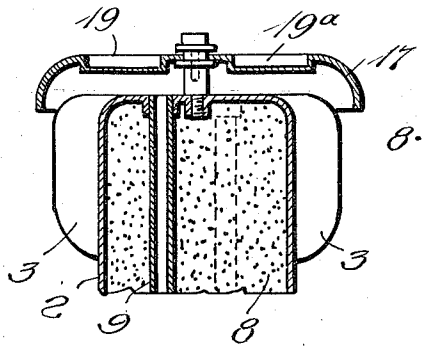


FIG. 7

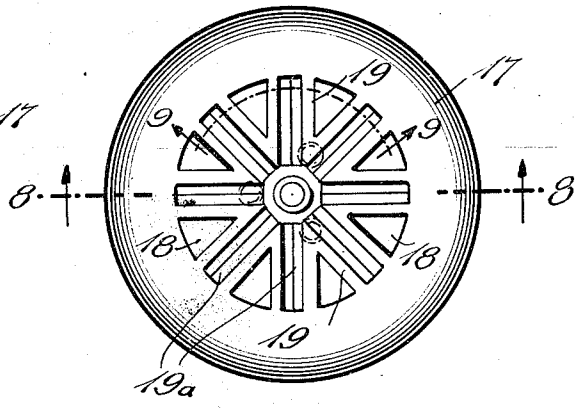


FIG. 9

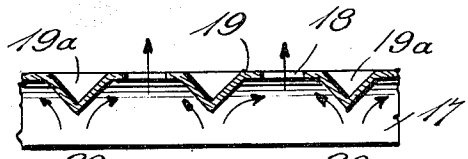


FIG. 10

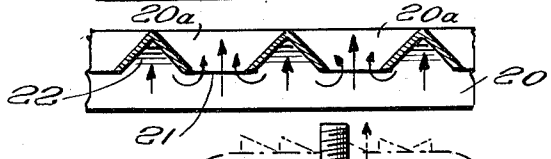


FIG. 11

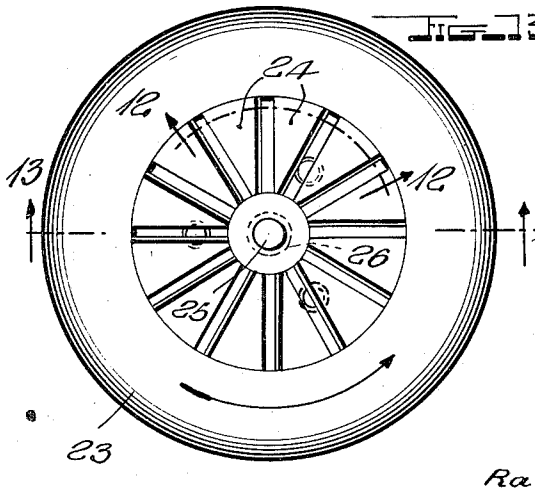
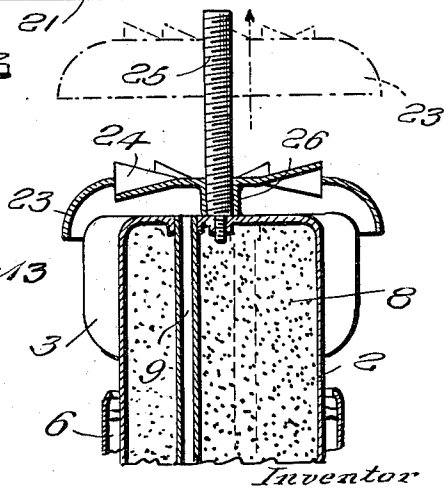


FIG. 13



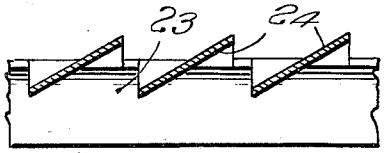


FIG. 12

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UNITED STATES PATENT OFFICE

2,364,197

BOMB STABILIZING MEANS

Raiemond E. Dee, deceased, late of New York, N. Y., by Dorothy L. Dee, administratrix, New York, N. Y.

Application April 23, 1941, Serial No. 389,969

6 Claims. (Cl. 102—2)

The invention relates broadly to aerial bombs and more particularly to bomb stabilizing means for straightening the bomb in its descent and maintaining it in substantially vertical striking position.

It is estimated by Rougeron (Aviation de Bombardement) that between one-half and two-thirds of all bombs released from aircraft are intended to and do burst in the open—the proportion varying with the nature of the targets in the area attacked. The same authority points out that the maximum explosive effect is obtained when a bomb within the above classification strikes the plane of its objective in a vertical position. The effective force of such a bomb is decreased if the burst is not instantaneous on contact, as an underground explosion absorbs without useful effect a half or two-thirds of the demolition energy.

A bomb discharged from an airplane flying at high speed at an altitude of 4,000 feet strikes the objective plane at an angle of 70°. As the altitude is increased the angle of contact rises slowly until a maximum of about 80° is reached. The angle of impact affects the fuse action to some extent, the percentage of non-explosions attributable to this cause being largely a matter of guesswork. Partly to increase the velocity of the bomb, partly to obtain greater accuracy, and partly to increase the angle of contact, the practice of discharging bombs in the course of precedural dives has been developed and employed very extensively.

At an altitude of 4,000 feet, an airplane is in a danger zone of anti-aircraft defense. With recent improvements effected in such defense and those being developed, the air force is being relegated to higher bombing altitudes. To cause a bomb, discharged at an altitude of 4,000 feet from an airplane traveling at high speed, to strike in a vertical position it is necessary to increase the angle of contact from 70° to 90°. As the altitude of discharge increases, the required angular increment is reduced from 20° to 10° above the present results.

One of the objects of the invention therefore is to provide means for insuring vertical contact of aerial bombs at the objective plane for maximum effectiveness.

Another object of the invention is to provide an aerial bomb with stabilizing means effective not only to maintain the bomb in relatively direct flight along its trajectory but so to modify the trajectory that the actual position of the bomb is vertical at the objective plane.

A further object of the invention is to provide an aerial bomb with stabilizing means of novel construction for decreasing the velocity of the bomb in relation to the force of gravity, so that the position of the bomb becomes substantially vertical to the objective plane prior to contact.

A still further object of the invention is to provide stabilizing means for an aerial bomb so constructed that an induced drag is effective at the upper end of the bomb to permit the lower end to fall by gravity and bring the bomb into substantially vertical striking position.

Another object of the invention is to provide stabilizing means for an aerial bomb effective to increase both the parasitic and the induced drag on the bomb, and further to provide for the removal of the induced drag when the bomb has assumed a substantially vertical striking position.

Other and further objects of my invention reside in the construction and arrangement of bomb stabilizing means hereinafter described in more detail and with reference to the accompanying drawings, in which:

Figure 1 is a vertical elevational view of a bomb provided with the stabilizing means of the invention; Fig. 2 is a vertical longitudinal sectional view on an enlarged scale showing the construction of the invention, with parts in elevation; Fig. 3 is a top plan view of the bomb showing part of the stabilizing means of the invention; Figs. 4, 5 and 6 are horizontal sectional views taken on lines 4—4, 5—5 and 6—6, respectively, in Fig. 2; Fig. 7 is a view similar to Fig. 3 showing a modified form of that part of the stabilizing means; Fig. 8 is a partial vertical sectional view of the bomb taken on line 8—8 in Fig. 7; Fig. 9 is a partial sectional view taken on line 9—9 in Fig. 7; Fig. 10 is a view similar to Fig. 9 of a different configuration which may be applied to the modified part; Fig. 11 is a view similar to Figs. 3 and 7 showing a further modified form of that part of the stabilizing means; Fig. 12 is a partial sectional view taken on line 12—12 in Fig. 11; and Fig. 13 is a partial vertical sectional view of the bomb taken on line 13—13 in Fig. 11.

To accomplish vertical contact, the construction of the bomb here referred to provides an increase in both the parasitic drag and the induced drag during the moments of greatest forward velocity immediately after discharge of the bomb. The parasitic drag is increased by the bluntness of the contact nose and by increase of skin surfaces. The induced drag results from the following features of construction:

(a) Internal longitudinal air flow tubes.

(b) External air chamber shells which expose additional surfaces to skin friction and shearing.

(c) A retarding turbulator ring attached to the exterior of the explosive casing.

(d) A rear retarding dome blocking the air streams from the three internal tubes and the air stream from the external air shells.

(e) Arrangement of forward external shells to direct an air stream along rearward surfaces and thus increase the shearing friction in that area.

(f) The modification permitting the retarding dome to travel outward to the point of carrying away, which increases the drag in proportion to the decrease in velocity of the bomb and the movement of the retarding dome to the separation point.

With the reduction of forward velocity effected by the parasitic and induced drag, gravity is enabled over a greater vertical distance to pull the nose down and thus bring the bomb into vertical position.

After the retarding dome is carried away, in one modified form of the invention, the induced drag is decreased because the inner air tubes then have free discharge and the air streams flowing from the rear of the external air chambers also have free passage. The effective increased drag is sufficient in any event to cause the bomb to assume a vertical position, and after such position is attained it is relatively immaterial whether or not the retarding dome is allowed to separate. In some instances the dome itself may constitute a formidable missile and serve to better advantage when carried away. On the other hand, the dome may be so proportioned as to require practically the entire period of descent for the bomb to shift to substantially vertical striking position, wherefore it is preferably fixed to the bomb to remain a part thereof.

Referring to the drawings in more detail, Fig. 1 shows the firing cap 1 and the bomb casing 2 provided with stabilizing means including fins 3 of somewhat less than conventional size, external shells 4, 5 and 6 and a retarding dome 7. In Fig. 2, these elements are shown in more detail, the bomb proper comprising the casing 2 which encloses the explosive charge 8. The internal construction of the bomb is such as to permit the passage of a plurality of air tubes 9 longitudinally through the bomb from openings in the nose of the bomb adjacent the firing cap 1 to the opposite end of the bomb where they open into a partially enclosed chamber formed by the retarding dome 7 and the walls of the bomb casing 2.

The shell 4 is mounted on the bomb casing 2 through supports 10 by rivets, screws, spot welds or any suitable device, in substantially the relation shown, that is, from a position where the air stream along the nose of the bomb can be deflected along the surface of the body of the bomb to a position approximately one-third the distance to the upper end of the bomb. Shell 5 is similarly mounted on the bomb casing 2 and is of smaller diameter than shell 4 so as to telescope partially within shell 4. The third shell 6 is of similar form but of smallest diameter and partially telescopes within shell 5. The lengths of shells 5 and 6 are progressively less, as the diameters are less, in relation to shell 4. The upper peripheral edges of the shells 4, 5 and 6 are curved inwardly to decrease but not close the space between the respective outer and inner surfaces, as indicated at 4a, 5a and 6a. The leading peripheral edge 4b of shell 4 is also curved inwardly to conform partially with the curvature of the bomb casing 2 at the nose portion.

The outer shells 4, 5 and 6 carry air currents to regions along the bomb casing which otherwise would be below atmospheric pressure, thus directing positive air currents along the fins 3 and increasing the directional effect thereof; as a result, the fins may be and are of less than conventional size. The air currents passing the fins 3 are thus directed also into the retarding dome 7 for reducing the velocity of the bomb. In the usual type of bomb, not provided with external shells, there is a substantial region of sub-atmospheric pressure along the bomb necessitating unusually wide stabilizing fins, whereas in the construction of the invention this sub-atmospheric region is reduced to only a small space outside the shell 4. The openings between lip 4a and shell 5, and between lip 5a and shell 6, constitute bleeder openings sufficient to counteract the usually sub-atmospheric conditions outside shells 5 and 6.

To increase the drag substantially above the center of gravity of the bomb, which is indicated approximately at 11, Fig. 2, a turbulator ring 12 is mounted directly on the bomb casing 2 in spaced relation to the surrounding shell 5. The form of the ring 12 may be varied as desired to effect the desired degree of turbulence, which acts on the bomb above the center of gravity and thus aids in establishing the bomb in substantially vertical striking position.

The retarding dome 7 receives air conducted through the bomb by the air tubes 9, which are equally spaced about and with respect to the longitudinal axis of the bomb, and also catches air currents conducted outside the bomb casing by the shells 4, 5 and 6, after such currents pass the fins 3 which are likewise equally spaced about the bomb. There will, therefore, be turbulence of air currents beneath the dome 7 effective to delay the descent of the bomb. Due to the combined forces of the air currents on fins 3, on turbulator ring 12 and on the dome 7, the center of air pressure on the bomb—indicated approximately at 14, Fig. 2—lies well above the center of gravity 11, so that gravity acts with increased effectiveness substantially at the point 11 to move the bomb about its center of pressure 14 into substantially vertical striking position during the prolonged period of descent resulting from the increased drag on the bomb.

Various modifications may be made in the form and disposition of the elements comprising the stabilizing means of the invention according to the size and shape of the bomb. The dome 7 is shown in the plan view, Fig. 3, as an imperforate inverted cup-shaped member secured by bolt 15 and spacer 16 to the bomb casing 2 axially of the bomb. This member may be provided with apertures as shown in Figs. 7–9, wherein the dome member is indicated at 17 with apertures at 18 and spoke-like portions 19 depressed at 19a to provide interior deflecting surfaces as indicated especially in Fig. 9. This form of dome member produces a less pronounced drag on the bomb due to the lessening of the turbulence somewhat by allowing the escape of air with less resistance through the openings 18. The depressed portions 19a may be formed in reverse manner as indicated in Fig. 10, wherein dome member 20 has apertures 21 at the base of depressions 20a, thereby forming recesses 22 in the under surface of the dome which results in a greater impedance

to the escape of air than the construction of Fig. 9 provides, but still less than the form of Fig. 3 imposes.

Another modification of the dome member, including modification of the mounting means, is shown in Figs. 11–13, wherein a dome member **23** is provided with fan blades **24** operative under the action of the air currents directed under the dome, to apply a turning moment to the member. To permit rotation, the dome member **23** is not fixedly mounted as in the arrangements shown in Figs. 2 and 8, but rather an extended bolt **25**, screw-threaded at a small pitch, is mounted axially in the bomb and projects above the bomb in its downward flight. A hub portion **26** formed on the dome member **23** is screw-threaded for engagement with bolt **25** so that as the dome member rotates under action of the air current, during descent of the bomb, it will move progressively towards the end of the supporting bolt **25** and eventually be freed therefrom. It is intended that the dome member **23** be effective, in connection with bolt **25**, for a time sufficient for the bomb to attain a substantially vertical striking position, in the manner already described, whereupon the dome member and the drag induced thereby may be dispensed with.

The outer shells **4**, **5** and **6** need not be of the separate construction illustrated, but may be of equivalent integrated form for effecting like results, and other modifications of varied scope may be employed. Thus, while the invention has been disclosed in certain preferred embodiments, no limitations upon the invention are intended thereby but only such as are imposed by the appended claims.

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

1. In combination with a bomb having a firing cap, stabilizing means for establishing said bomb in substantially vertical firing position comprising means for creating an induced drag at the upper end of said bomb, and means for increasing the parasitic drag longitudinally of said bomb, cooperative to delay the descent of the bomb and permit gravitational movement of the bomb into a substantially vertical firing position comprising a multiplicity of coaxial cylindrical shells surrounding said bomb in spaced relation to its external wall and overlapping at adjacent ends to form a confined stream of air adjacent the surface of said bomb during the descent thereof.

2. In combination with a bomb having a firing cap, stabilizing means secured to the end of the bomb for increasing the effective drag on said bomb to delay the descent of the bomb and permit gravitational movement of the bomb into a substantially vertical firing position and means for directing the bomb in a substantially vertical path of descent comprising a plurality of coaxial cylindrical shells of different diameters overlapping each other at adjacent ends and forming annular zones decreasing in section from the firing cap toward the rear of the bomb for confining streams of air about the external surface of the bomb and controlling the descent thereof.

3. In combination with an aerial bomb having stabilizing fins, a disc-like retarding member secured to the end of the bomb and means connected with the body of said bomb for directing air longitudinally adjacent the body of the bomb and against said stabilizing fins for establishing the bomb in a substantially vertical striking position, said means comprising coaxial shells of differing diameters spacially related to the external surface of said bomb and overlapping at adjacent ends with annular gaps therebetween for release of pressure established by streams of air between the external surface of the bomb and the internal surface of said shells.

4. In combination with an aerial bomb having a firing cap and stabilizing fins, a plurality of external shell members coaxially mounted on said bomb in spaced relation to the surface of the bomb and providing air passages for directing air against said stabilizing fins in the course of the descent of the bomb for establishing the bomb in a substantially vertical striking position, said shell members' varying in diameter and length from a maximum adjacent the firing cap end of the bomb to a minimum adjacent the stabilizing fins.

5. The combination set forth in claim 4 and including a turbulator ring mounted on said bomb substantially above the center of gravity of the bomb in falling position, said turbulator ring being surrounded by one of said external shell members and limited in radial projection to less than the clearance between said bomb surface and the surrounding shell member, and effective to increase the drag on said bomb.

6. An aerial bomb comprising a body portion having a firing cap on one end and stabilizing fins adjacent the opposite end and a multiplicity of coaxially arranged shell members distributed along said body portion intermediate the firing cap and said stabilizing fins, said shell members each differing in diameter from a maximum adjacent the firing cap end of the bomb to a minimum adjacent the stabilizing fins and each being spacially related to the external surface of said body portion and overlapping each other at adjacent ends, the trailing edge of one shell tapering in the direction of the leading edge of the adjacent shell and terminating in spaced relation thereto.

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