

Nov. 28, 1944.

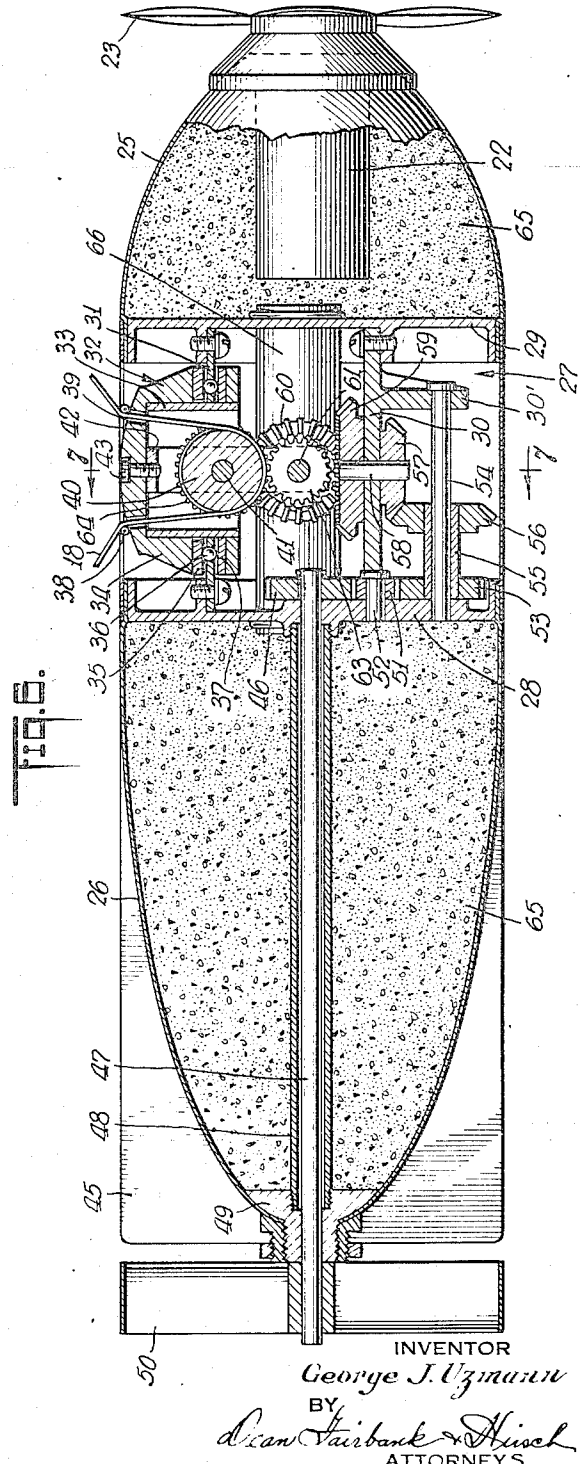
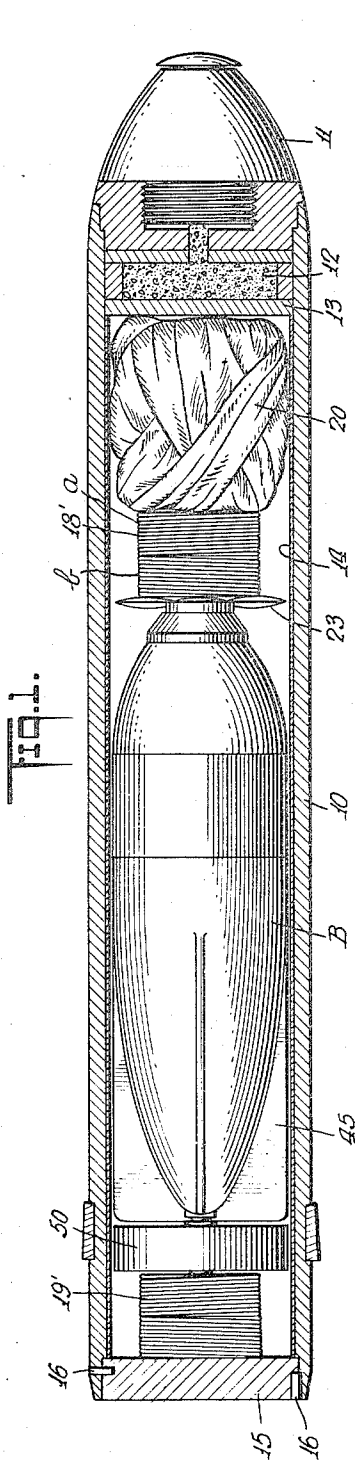
G. J. UZMANN

2,363,626

ART OF AERIAL WARFARE

Filed Aug. 14, 1941

2 Sheets-Sheet 1



INVENTOR  
George J. Uzmann  
BY  
Dean Fairbank & Hise  
ATTORNEYS

Nov. 28, 1944.

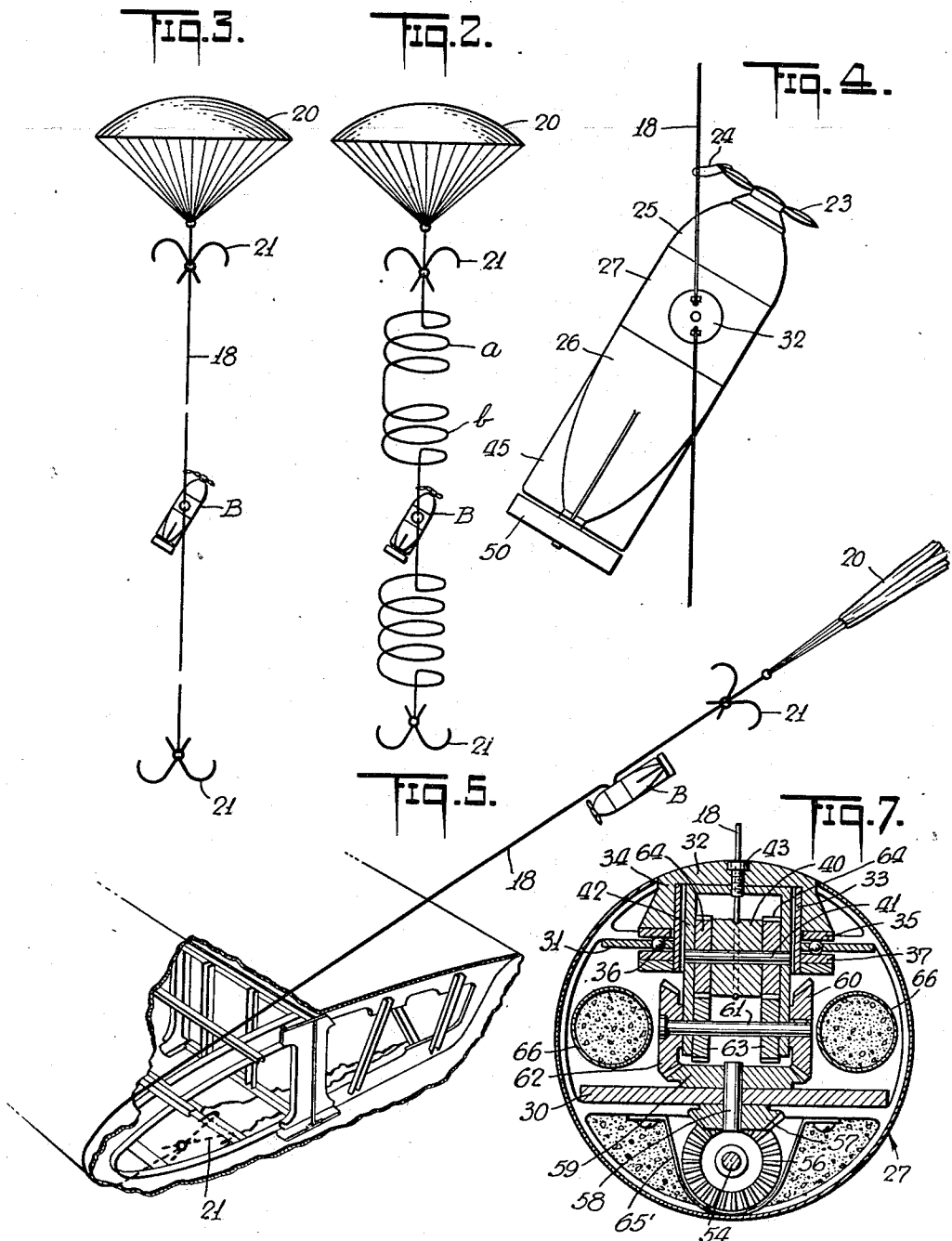
G. J. UZMANN

2,363,626

ART OF AERIAL WARFARE

Filed Aug. 14, 1941

2 Sheets-Sheet 2



INVENTOR

George J. Uzmann

BY

Dean Fairbank & Birch  
ATTORNEYS

# UNITED STATES PATENT OFFICE

2,363,626

## ART OF AERIAL WARFARE

George J. Uzman, Rockville Centre, N. Y., assignor to Aerovox Corporation, New Bedford, Mass., a corporation of New York

Application August 14, 1941, Serial No. 406,794

12 Claims. (Cl. 102—9)

The present invention relates to the art of aerial warfare and is concerned particularly with air defense equipment.

Defensive barrage balloons require the use of ground equipment and a suitable ground maintenance crew and are used only in favorable weather, for they must be grounded during storms, in order to avoid destruction thereof and possible damage to the community to be defended. Furthermore such balloons are of great initial cost, are limited in the protective heights realized and since they are mostly hydrogen inflated their destruction by the enemy is relatively easy, and since they are conspicuous and fixed in position hostile craft encounter no great difficulty in avoiding them.

The usual methods of anti-aircraft defense involving the use of guns, locaters, directors and search lights are also costly and have, as experience has shown, not proved especially efficacious, since in practice many shells are wasted for the relatively few that reach their target.

It is an object of the invention to provide simple and reliable means for launching or laying an anti-aircraft barrage where and when desired, which shall be highly equally effective at all levels between ground and ceiling in day as well as in night raids, and regardless of the weather, which cannot be effectively shot down by the enemy, which is economical of ammunition, the explosive shell being detonated only by direct contact with the craft to be destroyed, a large portion of the shells used in the barrage that do not reach such contact being salvaged intact for re-use.

Another object is to provide means of the above type, dispensing with the need for accurate marksmanship on the part of an anti-aircraft gun, but utilizing the tractive force of the hostile craft itself as the agency for causing a bomb unerringly to move forward along a lead line fouled by the aircraft, until it reaches detonating contact with such aircraft.

Another object is to provide equipment of the above type which may be manufactured in large scale quantity production at relatively low cost, which requires no specialized launching equipment and which greatly reduces the hazard to life of the defending force and of the civilian population, incurred in conventional pursuit plane combat over inhabited areas.

A feature of the invention is the guiding and propulsion of an aerial bomb along a floating barrage cable having one or more fouling hooks to intercept hostile aircraft, the bomb having means arranged automatically to propel it forward along

the entrained cable under the tractive force of the aircraft fouled thereby, for detonation of the bomb only by impact with said craft.

According to the invention in a desirable embodiment, each barrage cable is suspended, preferably from a parachute, and the bomb includes a sheave wheel, around which the cable is led, said sheave wheel being mounted on a turret within the bomb, whose axis extends radially of the bomb, so that the directional vanes of the bomb will cause the axis thereof to point lengthwise of the cable toward the fouled aircraft target. The bomb includes a rotor, desirably an air driven rotor propelled in the air stream of the entraining hostile craft and includes a suitable transmission to the sheave wheel for propulsion of the bomb along the cable to the target. Under the rapid propulsion of the cable entrained by the craft with the parachute at the rear end thus blown out and serving as a towed windsock, the cable trails substantially horizontally and in taut relation so that the sheave wheel is propelled therealong as on a track by the action of said rotor and carries the bomb forward therewith until it strikes said craft with the desired devastating effect.

In the accompanying drawings in which is shown one of various possible embodiments of the several features of the invention,

Fig. 1 is a view in longitudinal cross-section showing the complete bomb assemblage in form to be launched by an anti-aircraft gun,

Fig. 2 is a view in side elevation of the launched bomb assemblage prior to complete extension of the cable,

Fig. 3 is a view similar to Fig. 2 of the completely extended launched assemblage,

Fig. 4 is a view similar to Figs. 2 and 3 of the bomb element shown on a larger scale,

Fig. 5 is a fragmentary perspective view showing the action of the unit immediately after it is fouled by aircraft,

Fig. 6 is a view in longitudinal cross-section of the explosive bomb, and

Fig. 7 is a view in transverse cross-section taken on line 7—7 of Fig. 6.

Referring now to the drawings, the complete aerial discharge device or barrage assemblage includes an outer shell 10 with a timed fuse head 11 and associated small explosive charge 12 which may be of the same type used in flare bombs. The disk or piston plate 13 at the inner end of the time fuse rests against the rim of a thin horizontal liner shell 14 closed at the rear end of the assembly in conventional manner by a capping disk 15

retained in place by one or more shear pins 16. Within the shell 10 is the assemblage, which makes up the operative barrage unit shown in Fig. 3, and which is to be released from the barrage assemblage at the desired level. This unit comprises two lengths of cable 18 coiled into compact reels 18' and 19' and an intervening explosive bomb B to be more fully described hereinafter, slidably arranged upon the length of cable intervening between the two reels, all in manner to be described hereinafter. The upper end of the reel 18' is attached to a packed parachute 20 within the shell 14. Self-adjusting fouling hooks 21 are anchored to the cable near the opposite ends thereof and are desirably within the respective reels 18' and 19' in the assembly of Fig. 1.

It will be readily understood that the barrage assemblage of Fig. 1 of any desired caliber, such as 3 inch, 4 inch or 5 inch, may be lofted from a corresponding anti-aircraft gun to desired level and upon explosion of the charge 12 under the action of the time fuse, when the unit has reached the desired level, the plate 13 is urged downward along the shell 10 to expel the lining shell 14, causing shearing of the shear pins 16 and expulsion of the contents of inner shell 14. As the released parachute 20 opens up in the position shown in Fig. 2, the cable is played out from reels 18' and 19' with the fouling hooks 21 exposed as shown in Fig. 3 and the bomb B rests in mid-position on the cable 18 as shown.

Desirably each reel 18', 19' is wound in two, or if desired a greater number of reel segments *a* and *b*, desirably oppositely wound, so that the reel segments *a* and *b* will be played out simultaneously, as suggested in Fig. 2 and the barrage assemblage will distend more quickly upon launching thereof, than if the entire length of cable had to be played out from continuously wound reels.

The bomb desirably has an armed percussion fuse 22 desirably an ordnance standard type of detonating nose fuse at its forward end, including a releasable propeller 23 retained by a silk loop 24 against rotation, said loop preferably encircling the cable 18. The shell is conformed with directing vanes 45 near the rear thereof to direct it axially when in motion.

The bomb desirably comprises a pair of shell caps 25 and 26, telescoped over a transmission case 27 and welded thereto. The two end caps 28 and 29 of said case are connected by a pair of transverse plates 30 and 31 screwed or otherwise secured thereto. Upon plate 31 there is lodged a turret 32 whose outer part extends substantially flush with the face of the shell for minimum interference with the streamlining thereof. The axis of the turret 32 extends radially. The turret of the shell includes a metal sleeve liner 33 over which is telescoped the rotary turret cap 34 with the upper race 35 of a ball bearing 36, the balls of which are lodged in spacer plate 31. The lower race 37 is telescoped over the lower end of sleeve 33 for supporting the turret 32. The cable 18 extends over rollers 38 at corresponding ports 39 in the turret cap and is lodged in a corresponding groove in a sheave wheel 40 on a shaft 41 transversely across and carried by the turret. To this end a U-bracket 42 is secured by screw 43 to the top of turret, and shaft 41 is mounted in the arms thereof.

A driving pinion 46 lodged against the face cap 28 of the transmission case is rigid with a propeller shaft 47 extending rearward axially of the shell, and desirably enclosed by a protective sleeve

48, attached at its forward end to the plate 28, and at its rear end to tail plug 49 on the shell. The shaft 47 protrudes beyond the end of the shell and mounts an air driven fan bladed rotor 50 thereon.

While any of a variety of driving transmissions might be interposed between the propeller shaft 47 and the sheave wheel 40, there is shown in the drawings one desirable embodiment thereof. This comprises in addition to the driving pinion 46 an idler pinion 51, mounted upon the end of a stud shaft 52 protruding from plate 28, which meshes with a gear 53 therebelow upon a transverse shaft 54 mounted at one end in plate 28 and at the other in bracket 30' depending from connecting plate 30. Gear 53 is connected by a sleeve 55 upon shaft 54 with a bevelled gear 56, meshing with bevelled gear 57 mounted on the lower end of a vertical stud shaft 58 through the plate 30. The upper end of shaft 58 mounts a bevelled gear 59, meshing with a fourth bevelled gear 60 on the end of a transverse shaft 61 which is supported in the arms of U-bracket 42 and below shaft 41. Gear 60 is desirably counterbalanced by a companion gear 62 at its outer end loosely mounted on shaft 61 and freely rotatable thereabout. Rigid with shaft 61 are a pair of gears 63 which mesh with gears 64 about the shaft 41 that mounts the sheave wheel 40, and rigid with said sheave wheel.

The shells 25 and 26 are filled with explosive 65 such as trinitrotoluol, as are also a pair of open tubular connectors 66 intervening between the chambers defined by the two cups which make up the shell, as is also the cavity therebelow about enclosure 65' around the drive gearing.

In practical operation the invention functions substantially as follows:

The complete aerial discharge device or barrage assemblage of Fig. 1 is sent aloft from a ground fired standard anti-aircraft gun. The fuse 11 may be so timed that its charge 12 is detonated at a predetermined altitude, ordinarily at approximately maximum elevation to which the gun lofts the assemblage. Upon such detonation the inner shell 14 is expelled by the piston plate 13, the pin 16 being sheared in the process and the contents become released. The packed parachute 20 promptly becomes inflated, the cable reels 18' and 19' become promptly unwound to the entire length thereof, which unwinding is assisted by the weight of the bomb B and of the grappling hooks 21. Thus as shown in Fig. 2 the cable will extend substantially vertically downward from the parachute and the bomb will hang generally about midway of the length thereof. Since the turret is ordinarily so set as to bring the axis of the shell at an acute angle to the length of the distended cable, the cable is snubbed by the sheave wheel 40 and the bomb will not slide downward. In this relation the rotor element 50 remains inoperative and its explosive charge remains harmless because the operating fuse thereof remains armed by means of silk thread 24.

The floating unit with its parachute thus inflated and its cable dragging will readily be ensnared by an approaching aircraft. For even the most modern design of aircraft offers a multiplicity of fouling projections, including the various appendages thereof such as motor nacelles, radio antennae, struts, Pitot tubes, machine guns, cannons, out-riggers, landing gears and the like. Where the cable is of flat steel it is capable of doing considerable damage to the oncoming

plane; sometimes it will afford a means of cutting through portions of wing covering to serve as a direct anchorage, but should the cable slip past an obstruction on the plane it can only slip as far as its fouling hook 21 which will securely anchor it in place.

The parachute member promptly becomes blown out under the tremendous speed of propulsion of the snagged airplane and excessive drag is thus eliminated. The trailing blown out parachute together with the associated fouling hook act in the manner of a towed windsock and the cable is thus kept taut in a relatively horizontal position. The cable must be of high tensile strength and is desirably of wire or strip steel, or in some applications of textile or synthetic fabric.

Under the tremendous acceleration of the cable when it thus becomes snagged by the rapidly moving aircraft, vanes 45 cause the bomb B promptly to become aligned axially of the cable as shown in Fig. 4. The air driven rotor 50 spinning in the air slip stream will transmit its torque through propeller shaft 47, pinion 46, idler pinion 51, gear 53, sleeve 55, gear 56, gear 57, shaft 58, gears 59 and 60 to shaft 61 and gears 63 and gears 64 to the sheave wheel 40. The sheave wheel 40 accordingly will ride upon the cable 18 forwardly, to cause the bomb rapidly to advance toward the aircraft. Early in this operation the fuse 22 will become unarmed by the rotation of its propeller 23 to break the silk thread 24 and to unscrew itself. Accordingly the bomb will explode when it strikes the craft at the forward end of the cable.

In practice a multiplicity of the units as shown distended in Fig. 2 might be lofted to constitute a truly effective barrage. When sent aloft in the form of a recurring vertical barrage, the devices afford complete anti-aircraft protection over all levels between ground level and ceiling, the units at each level affording protection for the length of the cable thereof, say 1000 feet. Accordingly both high altitude raiding and dive bombing become equally hazardous as far as the enemy is concerned. Wave flying formations that have heretofore been difficult to combat are especially vulnerable to the present invention. Thus the invention offers complete protection over relatively large areas, exactly where and when desired. The device may be sent aloft to any elevation regardless of weather conditions between ground level and ceiling. According to the invention the freely suspended light weight parachute is so designed as to drop slowly to a lower level, so that under barrage fire it will be difficult for enemy bombers to establish proper travel and drift angles or lines of sight to maintain their flying course as required for proper bomb sight operation. Lofting of the barrage requires only the normal anti-aircraft gun battery with its regular personnel and necessitates no new equipment.

Where the invention is applied as an anti-aircraft weapon for home defense the use of the completely armed fuse 22 renders such devices as fail to be snagged by aircraft, harmless when they reach the ground. Aside from the deadliness and effectiveness of the units, their economy is thus manifest and innumerable bombs could be used for a lavish barrage with the assurance of considerable salvage. The bomb assemblies are reclaimed and used over again. Where the device is employed over enemy territory a dual type of fuse may be resorted to for

affording both contact and time detonation to effect serious ground damage as a result of automatic detonation for such bombs as are not detonated against flying aircraft. The use of the steel suspending cable 18 over enemy territory is advantageous from yet another standpoint. As the drifting unit approaches ground level, a lengthy metal cable will be caused to drag over a considerable distance with consequent damage, including particularly the short circuiting of electric power circuits. Much damage and annoyance can thereby be caused until the cables are cut apart. Where used over home territory these cables might be of non-metallic character to do little material ground surface damage in dragging over the ground.

It will be understood that the device may be launched by means other than anti-aircraft guns. For instance it might be used aboard fighting aircraft from which it might be discharged mechanically or even manually during tactical operations. In that use it either fouls and destroys hostile aircraft in the manner previously set forth or serves to confuse the enemy and his fire.

Because of the small dimensions of the distended unit, high speed aircraft would have difficulty in detecting the same, particularly in darkness or overcast weather. In practice the inner and outer parachute surfaces are moreover suitably colored, further to elude detection by approaching aircraft, whether viewed from above or below parachute level. The cable also is preferably sprayed or finished so as to minimize reflection of light and to render detection more difficult if not impossible. The devices when laid in a barrage also tend to confuse hostile aircraft whose pilots might be led to believe that their fire had so damaged their target that pilots and crew had been forced to abandon their craft and were parachuting to earth. Such illusion would be created because the apparently small, descending parachutes would be assumed to be much larger and to have fallen a much greater distance than is actually the case.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An anti-aircraft device, comprising a hollow shell having a time fuse at its advance end, and an explosive aircraft fouling equipment enclosed therein, including a packed parachute, a length of cable and a bomb slidably mounted upon said cable having self-directing means and having rotor means actuated under the high speed of propulsion of the cable when fouled by moving aircraft, for advancing the bomb toward the propelling end of the cable.

2. An anti-aircraft device comprising a hollow shell having a time fuse at its forward end, a hollow piston-driven lining shell therein to be expelled by the action of said time fuse, releasable means near the opposite end of the shell to permit discharge of the contents by said action of the time fuse, said contents comprising a packed parachute, a length of cable, one or more

fouling hooks thereon and a bomb having an armed percussion fuse, said bomb being slidably mounted with respect to said cable and having rotor means set into action under the high propulsive speed of the cable when entrained by aircraft fouled thereby for propulsion of such bomb toward the entraining end of the cable.

3. Anti-aircraft equipment comprising a parachute, a cable suspended therefrom, having one or more fouling hooks thereon, a bomb unit having a sheave wheel therein around which said cable extends, said bomb having vanes for automatically directing the same toward a fouled airplane, means for directing said sheave wheel to lie in the plane of movement of the fouled craft, said bomb including a rotor actuated under the entraining impulse and a transmission on said bomb between said rotor and said sheave wheel for causing the bomb to be propelled forward along the taut entrained cable toward the fouled aircraft to be destroyed.

4. The combination recited in claim 3 in which the bomb has an armed percussion fuse, retained by the cable and automatically released under the impulse upon the cable when it fouls hostile craft.

5. An anti-aircraft bomb comprising a shell having directional vanes, a turret built into said shell and having a sheave wheel thereon, a cable extending about said sheave wheel, a rotor at the rear of said bomb and a transmission between said rotor and said sheave wheel.

6. An anti-aircraft bomb comprising a shell, a fuse at the advance end thereof, directional vanes at the rear thereof, a turret between the front and rear thereof having an axis radially of the bomb and having a ball bearing mount, and a sheave wheel carried by said turret and adapted for propulsion thereof along a cable about said sheave wheel, an air driven rotor carried by said bomb and a transmission between said rotor and said sheave wheel.

7. An anti-aircraft bomb having a shell, a transmission case within said shell and between the ends thereof, said case including a sheave wheel, a ball bearing mount therefor having its axis radially of said bomb, and directional vanes unitary with said bomb for orienting the same with reference to said sheave wheel.

8. An aerial bomb having an armed fuse at the advance end thereof, longitudinal directional vanes at the rear thereof, a transmission case between the front and rear of said bomb, said case including a pair of plates, a gear system mounted between said plates, a sheave wheel propelled through said gear system, a propeller shaft longitudinally of said bomb and in driving rela-

tion to said gear system and an air driven rotor therefor at the rear of said bomb.

9. An aerial bomb comprising a shell, an armed fuse at the forward end thereof, an air driven rotor at the rear thereof, directional vanes, a sheave wheel and a turret mount therefor within said bomb, the axis of said turret being radially of said bomb, said sheave wheel being adapted to have a cable extended therearound, and a transmission between said rotor and said sheave wheel, said transmission including a propeller rod extending forward from the rotor into said transmission case and transmission gears within said case operated from said propeller, for driving said sheave wheel.

10. An aerial bomb comprising a generally cylindrical transmission case including a ball bearing mounted turret having its axis radially of said cylindrical case, a sheave wheel carried by said turret, a bomb shell comprising two shell cup elements, telescoped with respect to said transmission case, tubes longitudinally of said transmission case clear of the transmission therein, establishing communication for the explosive chambers in the respective cups, an air driven rotor at the rear end of the shell and a propeller shaft extending axially of said shell into said transmission case for driving connection.

11. An aerial bomb comprising a pair of bomb shell cups, a transmission case over which said cups are telescoped, said case having a turret therein with a low friction bearing mount, the axis of which extends radially of said bomb, the top of said turret extending substantially flush with the surface of said bomb, a sheave wheel carried by said turret, driving gear teeth rigid therewith, and a gear system within said transmission case including a driving pinion axially of said bomb, a propeller shaft connected to and extending rearward from said driving pinion and axially of said bomb and an air driven rotor at the rear end of said bomb connected to said propeller shaft.

12. An anti-aircraft device comprising a hollow shell having a time fuse at its advance end, and an explosive aircraft fouling equipment enclosed therein, including a packed parachute, a length of cable and a bomb slidably mounted upon said cable having self-directing means and having rotor means actuated under the high speed of propulsion of the cable when fouled by moving aircraft, for advancing the bomb toward the propelling end of the cable, the length of cable being wound in a plurality of reel segments to be played out concurrently for prompt distention of the launched device.

GEORGE J. UZMANN.