

Sept. 26, 1967

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3,343,486

PRACTICE BOMB

Filed Jan. 11, 1966

2 Sheets-Sheet 1

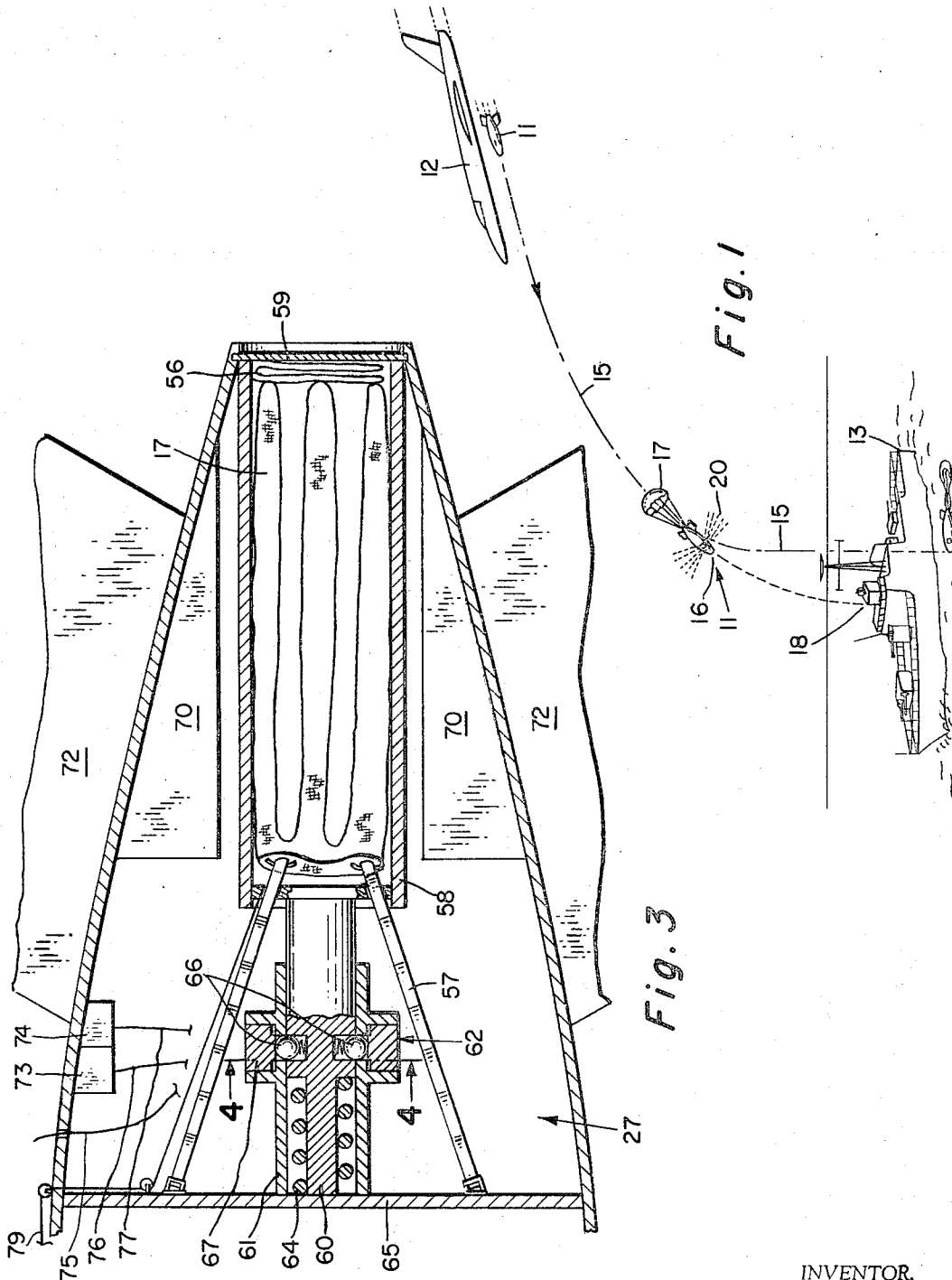


Fig. 3

Fig. 1

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2 Sheets-Sheet 2

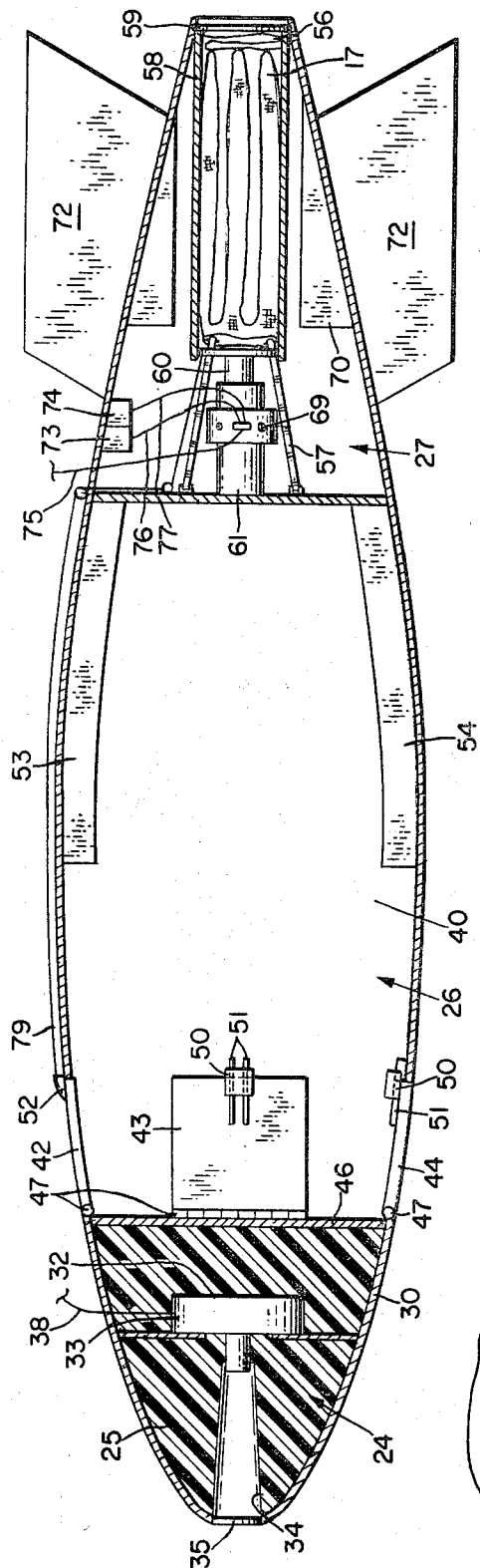


Fig. 2

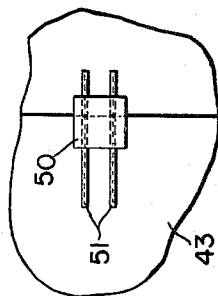


Fig. 6

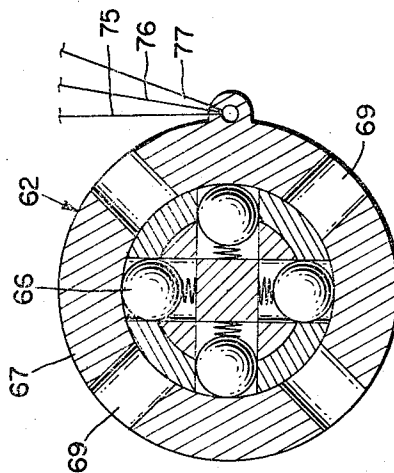


Fig. 4

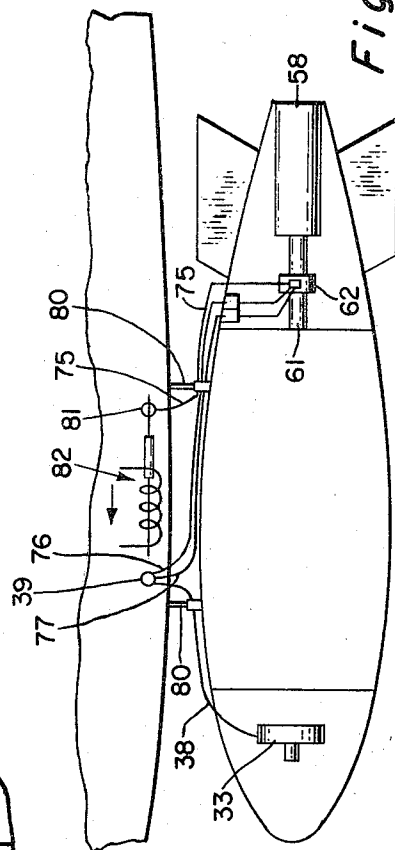


Fig. 5

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PRACTICE BOMB

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ABSTRACT OF THE DISCLOSURE

A practice bomb which simulates an actual bomb and follows a normal trajectory to a point close to the object under simulated attack, at which point a major portion of the ballast is jettisoned, leaving a substantially hollow bomb having low kinetic energy to be parachute to impact on or close to the target. The nose section of the bomb contains means for photographically recording its flight and material for cushioning its impact. A projected impact point is extrapolated from flight data acquired up to the instant of parachute release and jettisoning of the ballast.

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 practice bombs and more particularly to a recoverable practice bomb which may be released in simulated bombing runs on real objects in lieu of targets with the point of impact extrapolated from trajectory data.

In the training of aircraft pilots among other operators of special vehicles experience under actual conditions of the problems and situations to be met has long been recognized as more effective than practice on artificial targets or in ground based simulating devices. The use of air and surface towed targets limits the training derived therefrom because among other reasons it is virtually impossible to maneuver a towed target in the manner in which vessels or vehicles may be evasively maneuvered. Practice bombing of simulated surface targets such as airfields, bridges and the like is also of limited value due first to the impossibility of using terrain which reasonably resembles that surrounding the actual target and second the impracticality of reasonably defining the limits of the simulated target in relation to the actual. Further, weather conditions in the land waste areas usually used for such target practice are generally unlike those encountered in the environment of the actual targets. These and other reasons have long established a need for more realistic training targets for bombing and other weapons practice.

Present and former practice bombs generally have a high kinetic energy at impact and are dropped on targets located in remote areas for obvious reasons related to safety. Such bombs are made either entirely of metal or of stabilized metal casings filled with water, wet sand or the like. Using such heavy objects for practice bombing runs has necessitated the use of targets which could not be damaged such as ring-outlined areas on cleared earth, heavily armored obsolete ships or tanks or discarded military equipment of various types. A result of the inadequacies of such targets is that very few pilots or air crews have had the opportunity to make bombing runs on a resemblance of an actual target such as an airfield,

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bridge, maneuvering Naval vessel etc. until hostilities begin. The present invention provides a means and method of permitting pilots and air crews to make bombing runs on actual, maneuverable or still targets, and further provides a bomb which will not damage the real targets if it accidentally strikes them and is recoverable for reuse.

Accordingly, it is an object of the present invention to provide a method of and means for accomplishing bombing practice by pilots and air crews on operational land or water targets.

It is another object to provide a method of and means for enabling pilots and air crews to practice bombing of evasive targets in preparation for actual bombing runs under war conditions.

It is a further object to provide pilots and air crews means for obtaining bombing practice on evasive or stationary real targets wherein bomb attempts may be evaluated by recorded bomb trajectory data.

A still further object of the invention is to provide means for enabling pilots and air crews to obtain training in actual bombing runs on real targets wherein the means are recoverable for reuse and the accuracy of the runs is readily determinable by data recorded during each run.

According to the present invention, the foregoing and additional objects are attained by providing a practice bomb which simulates an actual bomb and follows a normal trajectory to a point close to the vehicle, vessel or structure under simulated attack at which point a major portion of the weight is jettisoned leaving a substantially hollow bomb having low kinetic energy to be parachuted to impact on the real target. The nose of the bomb contains means for recording its flight and material for cushioning its impact. A projected impact point is extrapolated from flight data up to the point of parachute release and jettisoning of the ballast.

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 like numerals designate like parts throughout and in which:

FIG. 1 is a view showing use of the invention in a practice bombing of a maneuvering vessel;

FIG. 2 is a longitudinal sectional view partly in elevation of one embodiment of the invention wherein the components of the device are shown accommodated in three principal sections;

FIG. 3 is an enlarged view partly sectioned of the tail section of the embodiment of FIGS. 1 and 2;

FIG. 4 is a section taken along line 4-4 of FIG. 3;

FIG. 5 is a schematic view showing a preferred manner of mounting the device on an aircraft; and

FIG. 6 is an enlarged view of an inertia actuated release mechanism used in the embodiment shown in FIGS. 1 and 2.

Referring now to FIG. 1, a recoverable practice bomb 11 is shown shortly after release from an aircraft 12 during a training bombing run on an evasively maneuverable surface vessel 13. The bomb trajectory 15 is presented from the time of release of the bomb 11 through a point 16 of deployment of its contained parachute 17 to a projected point of impact 18. When the parachute is deployed a fluid or other dispersible ballast 20 is jettisoned substantially reducing the kinetic energy of the bomb at

impact and altering its trajectory from the point of jettisoning so that it may avoid landing on the target but will land at a point nearby where it may be quickly retrieved. Flotation material is included in the device under circumstances where recovery from a body of water is reasonably to be expected.

In FIG. 2 the practice bomb is shown divided into three major sections, a nose section 24 containing a shock absorbing material 25 for cushioning impact, a central section 26 to contain the jettisonable ballast 20 and a tail section 27 containing descent arresting means such as parachute. For protection against wind blast, "G" and other forces, each section preferably is enclosed or encased in a skin 30 of lightweight 17 high-strength material such as aluminum. The structural cross members of the sections may be made of similar material. To distribute and absorb the shock of impact on the more solid surfaces the nose 24 preferably is filled with cellular or other material of microspace structure such as Styrofoam, deformable honeycomb, foam rubber or the like which material may be provided with central recess 32 to accommodate a flight data recording device such as a camera 33 and an aperture 34 communicating with the external environment of the bomb for receiving visual information of the flight and the target. The recording device may be structurally supported as necessary, and the aperture may be sealed by transparent means such as a clear plastic cap 35. The camera 33 preferably is actuated by mechanical means such as a wire or cable 38 connected to a control point 39, shown in FIG. 5, on the aircraft carrying the device.

The central section 26 of the practice bomb is devoted substantially entirely to a space 40 for storing ballast sufficient in weight to confer on the practice bomb the characteristics of a real bomb. To protect personnel and equipment in the vicinity of the drop from injury and damage the ballast preferably is a fluid or particulate solid which may be quickly dispersed when desired through openings in the skin of the central section. A very high degree of reliability is required in the means for releasing the ballast since failure of such release means coupled with failure of the parachute to deploy could result in a direct hit of a heavy object on the vehicle, vessel or structure used as a target. One manner of providing for high ballast release reliability is to employ several outlets for dispersion of the ballast with the outlets secured and released for opening by alternate closure means. In furtherance of this safety requirement, the central section is provided with a plurality of doors 42, 43 and 44 preferably connected to a panel or bulkhead 46 separating the nose section and the central section by bias means, not shown, associated with hinges 47 wherein the doors are normally open in the unbiased condition. Two of the doors seen in FIG. 2, 43 and 44, are shown secured in the closed condition by slidable inertia actuated latches 50 which may be coated with Teflon or other suitable material if desired to protect against corrosion. The latches may be mounted on guide means such as tracks 51 which are broken at the door edge and likewise may be coated to promote sliding and protect against corrosion. Other doors such as 42 may be held closed by latch means 52 actuated by the parachute release mechanism as will be discussed more fully hereinafter. The central section also may contain flotation material such as strips 53 and 54 of Styrofoam for buoyancy where necessary. The volume 40 available for ballast is determined, of course, by the bomb characteristics to be simulated and the density of the preferred ballast material.

The tail section is shown in greater detail in FIG. 3 and provides space for means for retarding descent of the practice bomb such as parachute 17 a drogue parachute 56 for deploying the parachute and suspension lines or risers 57 connecting the parachute and the bomb. The parachute preferably is enclosed in a cannister 58

which is sealed at one end by a frangible tail section end cover 59 and at the other end by parachute ejection means such as a piston 60 operating in cylinder 61 and having suitable retention and actuating means 62. In the embodiment shown, a piston ejection spring 64 is held compressed against the panel or bulkhead 65 separating the central section and the tail section by a plurality of spring-loaded balls 66, preferably made of metal and show in greater detail in FIG. 4. In the position shown in FIG. 4, the balls are maintained in positions blocking movement of the parachute ejector cylinder in response to pressure of the ejector spring by a rotatable collar 67. Collar 67 retains the balls 66 in a blocked position until rotated, under conditions to be discussed more fully hereinafter, so as to bring a plurality of receiving recesses 69 into register with the balls thereby releasing them and the parachute ejector piston 60. Available space in the tail section may be utilized to accommodate additional flotation material 70. On its exterior, the tail section carries a plurality of fins 72 to provide aerodynamic stability for the bomb. Parachute actuating means such as a barometric pressure actuator 73 and a timer actuator 74 may be mounted in the tail section in proximity to piston release means 61 for providing alternate conditions under which the parachute may be released. Additional safety release means such as wire or cable 75 may be provided if desired to cause parachute deployment under emergency conditions such as accidental dropping of the practice bomb from an aircraft. Cables 76 and 77 connect the barometric and timer actuators to rotatable retention collar 67. At least one of the ballast door release latches 52 preferably is connected to some part of the parachute ejection piston 60 by positive acting means such as a cable 79 to provide for ballast release when the parachute is deployed under emergency conditions. Such a positive acting door release is also operable under normal conditions and in addition to other door release means increases the reliability of ballast jettison over that based upon a single form of door release device.

FIG. 5 illustrates a preferred manner of attaching the bomb and its release actuating means to an aircraft. Conventional means such as hooks 80 are used to hang the bomb and release it; however, to assure actuation of the components and also to assure parachute deployment in the event the bomb is accidentally dropped, mechanical connections 75, 76 and 77 from the components are coupled to control points 39 and 81 on the aircraft and a solenoid 82 actuated from 38, 76 and 77 the aircraft. The mechanical connectors 38, 76 and 77 extend from common control point 39 on the aircraft to the nose section camera and the tail section barometric pressure and timing devices. Connector 75 extends from control point 81 on the aircraft to the ball release device to provide for safety release. The two control points are positioned at opposite ends of solenoid 82 in such a manner that in the standby position the safety release connection 75 is engaged and the connections to the camera, barometric pressure device and timing device are disengaged, while in the armed or ready position the safety release connection is disengaged and the camera, barometric pressure and timing device connectors are engaged.

Operation of the device encompasses the preparatory steps of detachable securing the practice bomb to the aircraft 12, disengaging the safety release connector 75 and engaging the camera, barometric pressure and timing device connectors, 38, 76 and 77, respectively, these actions being accomplished by energizing the control solenoid 82 on the aircraft. It will be appreciated that before the control solenoid 72 is actuated the safety release connector 75 is engaged so that in the event the bomb is accidentally released from the aircraft the safety connector wire will exert a turning torque on the rotatable constraining collar 67 bringing the ball receiving means 61 into registry with the balls 66, releasing the balls and

permitting actuation of the parachute ejector piston 60 and deployment of the parachute.

When the bomb is dropped, the camera 33 is set into operation and then barometric pressure and timing devices 73 and 74, respectively, are armed by the connectors thereto physically actuating switches or other means, not shown, in these components. With the bomb in its flight, the camera makes a photographic record of the flight at least to the point of release 16 of the parachute and preferably to the point of impact 18 or landing of the bomb. Either the barometric pressure device or the timing device, or both, may effect release of the parachute ejector piston 60 and consequent deployment of the parachute 17 by causing rotation of the rotatable constraining collar 67 through suitable means in the devices, not shown, for exerting tension on their respective connectors to the rotatable retaining collar. When this collar is rotated one-eighth of a revolution from the position shown in FIG. 4, the balls 66 are expelled into respective passages 69 thereby freeing the parachute ejector piston 60 causing the parachute 17 and drogue parachute 56 to be discharged from the parachute cannister 58. Displacement of the parachute ejection cylinder 60 also causes movement aft of the positive mechanical latch 52 of one of the ballast release doors 42 in the central section releasing that door and permitting release of ballast through that door usually before the parachute 17 has been fully deployed. The shock sustained when the parachute is fully opened will cause forward movement of the inertia latches 50 along their guide tracks 51 a distance sufficient to permit opening of the respective doors 43 and 44 normally held closed by the inertia latches. With these and other ballast release doors opened the ballast 20 is quickly jettisoned lightening the practice bomb to such a degree that it may land on a solid object or in water without significant damage to the bomb or the object. After retrieval of the bomb, the camera film is recovered and reviewed to determine the projected point of impact 18 of the practice bomb. The bomb thus not only provides a record of its complete trajectory 15 but may be reused and in this respect presents an obvious savings in cost as well as incidental savings in the storage space required to sustain the bomb requirements of a training program.

The practice bombing device of the present invention may be used to improve the combat readiness of combat air crews through more realistic and more frequent training practice. A bomb made in accordance with the principles of this invention also could be used as a missile warhead for the training of crews for air, surface or sub-surface launched missiles.

By use of the present device an aircraft division could plan, brief and execute a very realistic attack using for targets such real objects as airfields, bridges, gun emplacements, POL storage facilities, and maneuvering Naval vessels, employing attack tactics that would normally be employed against such objects. After completion of such attack missions a permanent record is available for assessing estimated damage, miss distances and overall attack techniques. More realistic training also is provided for ordnance crews, photograph interpretation personnel, air intelligence officers and other support personnel. And perhaps most important air defense exercises can be made more realistic and can be scheduled concurrently with Strike exercises to provide more realistic war games.

Obviously numerous modifications and variations of the present invention are possible in the light of the above teachings. For example, the skin and main structural members of the device may be made of plastic or other lightweight high-strength resilient structural material, the dissimilar latches may be actuated electrically or by explosive means, buoyancy may be provided by inflatable bags, and other quick release means for ejecting the parachute such as electrical or explosive means may be substituted for the means discussed. It is therefore to be understood that within the scope of the appended claims the invention may

be practiced otherwise than as specifically described herein.

I claim:

1. A recoverable practice bomb which may be used in practice bombing runs on targets such as vessels, vehicles and structures, said bomb comprising:

a nose section provided with means for recording bombing run data, said nose section being otherwise primarily composed of lightweight filler material to absorb shock on landing;

a central section of hollow configuration containing a ballast material in the form of water jettisonable during flight, said central section having formed therein at least two ballast release openings respectively closed by doors biased when in closed position; and a tail section having a parachute housed in the rear portion thereof, said tail section also containing therein buoyant material for assisting in recovery of said bomb from bodies of water;

said bomb further including latch means for holding said doors closed;

individual door latch means operable by differing force applications so that all latch means may not be rendered inoperable by a common malfunction.

2. The device as defined in claim 1 wherein said recording means is a scoring camera;

said camera recoverable so that the data recorded may be used to extrapolate the bomb trajectory to a projected point of impact of said practice bomb.

3. The device as defined in claim 2 and further including parachute ejection means;

said parachute ejection means armed upon release of the practice bomb from an aircraft;

said parachute ejection means actuated upon the occurrence of a predetermined condition related to altitude or time;

said parachute ejection means further actuated before arming upon the accidental release of said practice bomb.

4. A recoverable practice bomb which may be used in practice bombing runs on targets such as vessels, vehicles and structures, said bomb comprising:

a nose section containing a camera and being otherwise composed primarily of lightweight filler material to absorb shock on landing;

a hollow central section containing ballast in fluid form which is jettisonable during flight, said central section being designed with at least one normally closed door through which said ballast is jettisonable; and a tail section housing a parachute and a release mechanism connected both to said parachute and to the door of said central section,

said release mechanism being operable upon the occurrence of a predetermined condition during flight of said bomb and prior to impact thereof on a target to simultaneously deploy said parachute and open said door to permit said fluid ballast to be jettisoned therethrough,

said camera acting to record data concerning the trajectory of said bomb up to the instant of operation of said release mechanism.

5. A recoverable practice bomb which may be used in practice bombing runs on targets such as vessels, vehicles and structures, said bomb comprising:

a nose section containing a camera and being otherwise composed primarily of lightweight filler material to absorb shock on landing;

a hollow central section containing ballast in the form of a particulate solid which is jettisonable during flight, said central section being designed with at least one normally closed door through which said ballast is jettisonable; and

a tail section housing a parachute and a release mechanism connected both to said parachute and to the door of said central section,

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said release mechanism being operable upon the occurrence of a predetermined condition during flight of said bomb and prior to impact thereof on a target to simultaneously deploy said parachute and open said door to permit said fluid ballast to be jettisoned therethrough, 5
said camera acting to record data concerning the trajectory of said bomb up to the instant of operation of said release mechanism.

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