April 24, 1956 L. F. FIESER ET AL 2,742,856

BURSTER

Filed Nov. 6, 1944 2 Sheets-Sheet 1

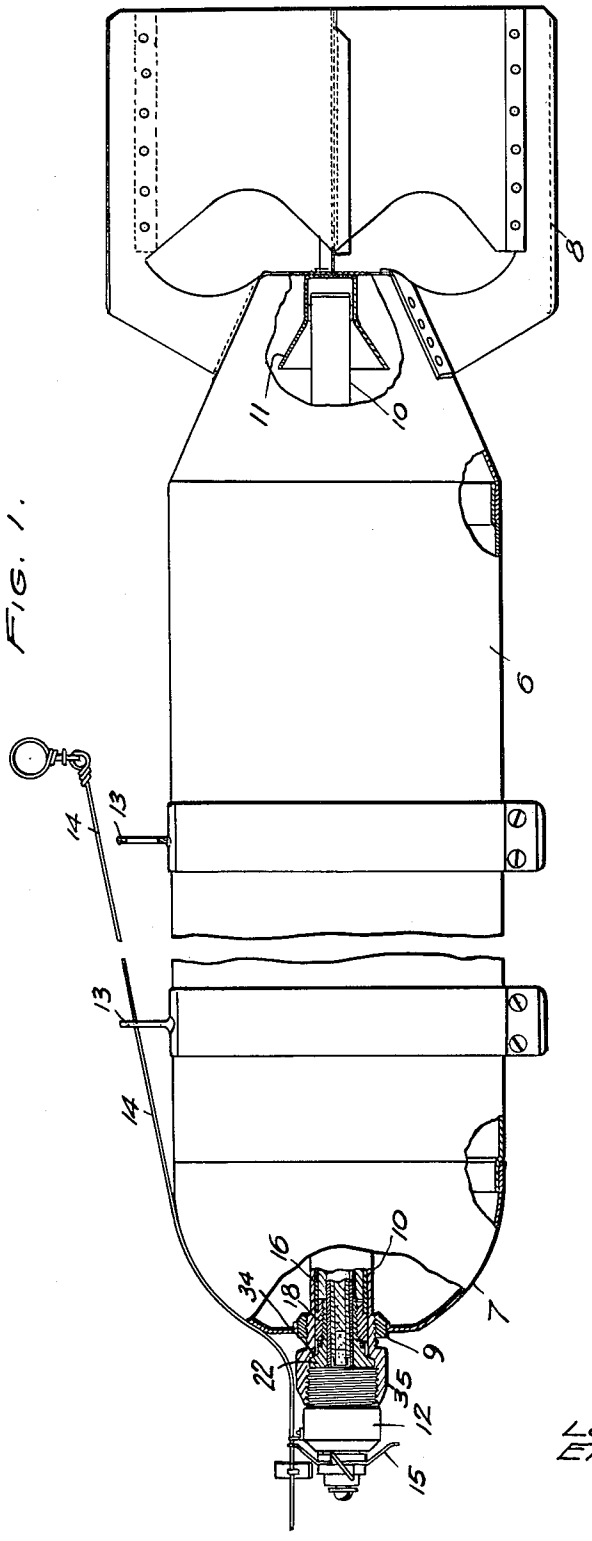


FIG. 1.

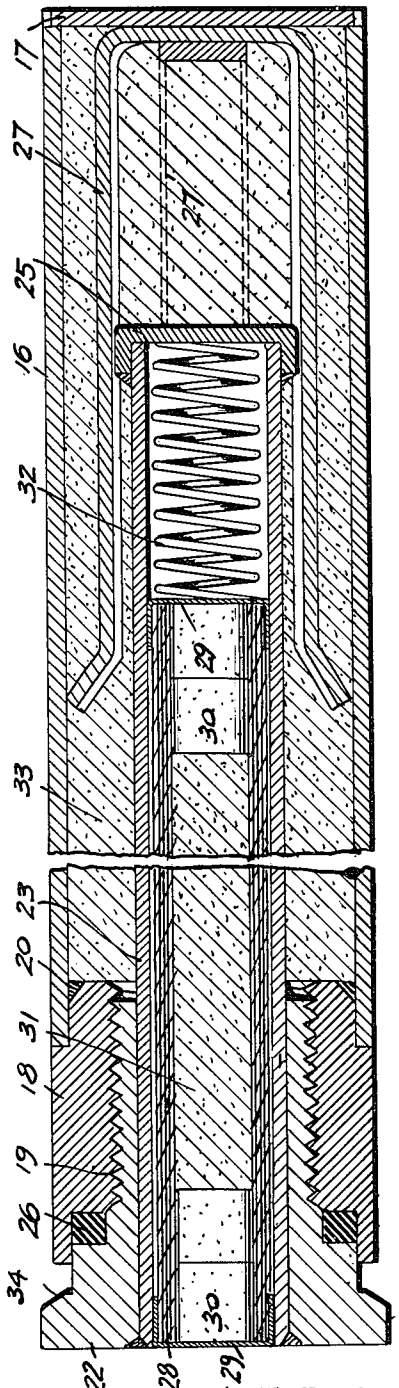


FIG. 2.

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BURSTER

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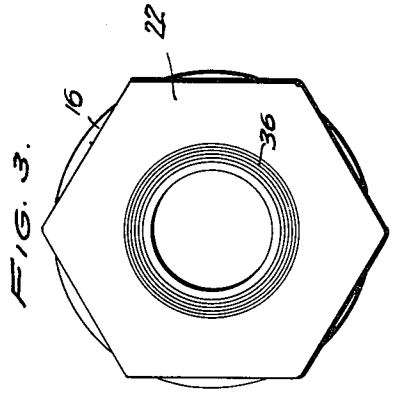


FIG. 3.

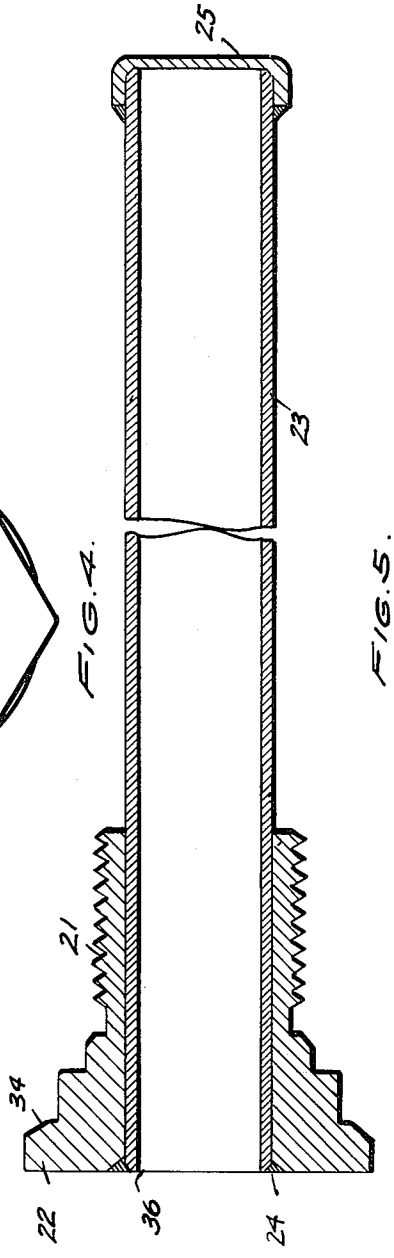


FIG. 4.

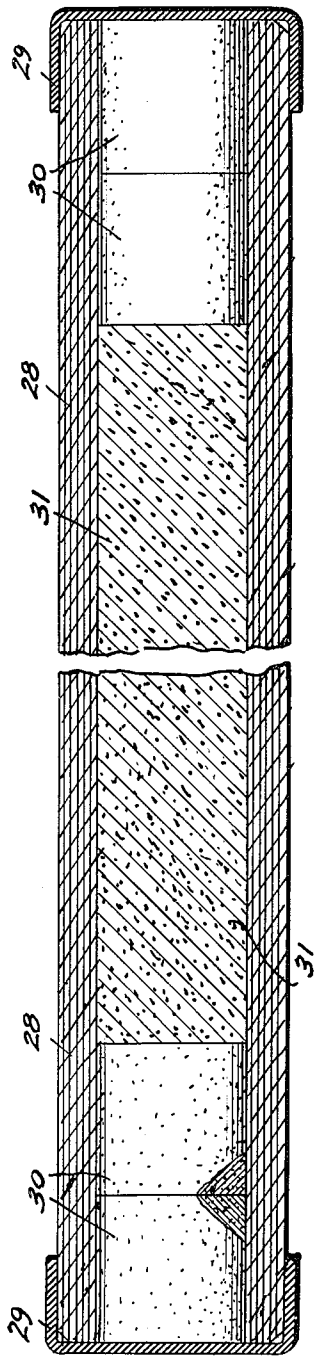


FIG. 5.

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2,742,856

BURSTER

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Application November 6, 1944, Serial No. 562,220

1 Claim. (Cl. 102—6)

The invention described herein may be manufactured and used by or for the Government, for governmental purposes, without the payment to us of any royalty thereon.

This invention relates to a burster for scatter type chemical bombs and particularly for incendiary oil bombs.

The known incendiary bombs can be classified as belonging to one or the other of two broad types. One type, called the intensive type, is exemplified by the 2 to 4-lb. solid magnesium and thermite bombs, and is designed to remain substantially intact after the firing of the fuze and to burn progressively as a unit. The second type embodies a metal casing, usually made of steel, which serves primarily as a container for an incendiary filling of combustible material such as gelled gasoline, cotton waste or other fibrous material saturated with a hydrocarbon fuel, or a pyrotechnic paste or gel incorporating a light metal, an organic fuel, and an oxygen-containing compound; the characteristic feature of the bombs of the second type is that on functioning of the fuse the incendiary filling is ejected from the casing and distributed over a certain area of the target in the form of a number of burning masses. The distribution and ignition of the incendiary charge has been effected either by ejection from the tail of the intact bomb or by burster principle, wherein an explosive charge contained in a burster tube, or central tube extending down the center of the bomb, ruptures the metal casing and hurls masses of the ignited filling in all directions.

A primary object of the present invention is to provide improvement of the known devices for igniting and distributing the charge of burster-type incendiary bombs. One widely used burster is a central tube charged with black powder, but this has definite disadvantages and limitations. The distribution of the incendiary charge varies widely from bomb to bomb and is often very irregular; the charge is sometimes thrown in one direction only, and is sometimes all forced out of either the nose or tail of the bomb. The relatively slow-acting black powder builds up pressure in the container until a bursting point is reached, and the container then gives way at some one point of least resistance, which may vary from unit to unit. The percentage ignition is poor, and a considerable portion of the incendiary charge usually is lost in the form of a "flash burn": an explosive combustion of incendiary material which is vaporized or fragmented by the powder burster. The percentage ignition is improved somewhat by the incorporation of a certain amount of magnesium or other metal into the black powder burster charge, but this variation does not correct the faulty distribution or the irregularity of operation of the black powder burster.

The new preferred method of firing burster-type incendiary bombs consists in the use of a central steel burster tube charged with a high explosive surrounded by a steel burster casing or body containing a material or composition capable of igniting the incendiary filling

of the bomb. A high explosive of the type exemplified by TNT (trinitrotoluene), tetryl, PETN (pentaerythritetranitrate), or cyclonite acts entirely differently from black powder, or other relatively slow operating explosives. The steel tubes of the burster unit assembly, also, the burster well are shredded into ribbons over their entire length, and the casing of the bomb is opened evenly from nose to tail, for the bursting force of the high explosive is exerted sideways and at such a high velocity that a clean side burst results even if there is a weak point at the nose or tail. The igniting composition is thus driven evenly into all parts of the incendiary filling, which is distributed uniformly over a wide area in a fully ignited form. A distinct advantage is that the detonation wave apparently opens the casing so rapidly that an excessive pressure is not developed and the explosion has relatively little damaging effect upon the filling, for example upon the gel structure of a thickened gasoline. The loss of fuel in the form of a flash burn is thereby reduced considerably, and the percentage of fuel delivered in an effective form represents a high degree of efficiency.

The well, confined between the inner and outer tubes of the burster unit, for example, can be charged with phosphorus, either white or red; with a pyrophoric metal of the group including lead, iron, nickel, and the alkali metals; with magnesium or a mixture of magnesium and black powder; with a spontaneously inflammable liquid of the group exemplified by diethylzinc, triethylboron, sodium-potassium alloy, phosphorus in phosphorus sesquisulfide. In short any material or composition that is either spontaneously inflammable or capable of reaching its kindling temperature under the action of a high explosive is capable of functioning as an igniter. White phosphorus is one of the simplest, and is a generally satisfactory igniting agent. It is highly fragmented by the detonation of the high explosive and the fragments ignite readily and burn progressively as they are hurled through the air. The resulting ignition of the main incendiary charge is excellent, even when the bomb is fired after exposure to low temperatures encountered in high-altitude bombing operations (—40° F.).

Since phosphorus itself is an incendiary substance, albeit of rather low effectiveness, this igniter increases the total incendiary load carried. Of much more significance is the fact that the phosphorus gives rise to a dense smoke which has a screening and irritating effect consituting a distinct deterrent to the fire-fighter. A further advantage is that pieces of phosphorus imbedded in ejected masses of a gasoline gel frequently lead to reignition after the initial fire has been put out. Bombing tests on house structures have shown that reignition of the charge, with consequent firing of the target, occurs after irregular periods as long as 10–12 hours. For these reasons, white phosphorus is a preferred igniter, just as TNT, with a booster charge of tetryl, is a preferred burster element because of its insensitivity to premature detonation on impact of a bullet. The combination of these two preferred elements is illustrated in the examples, but other combinations, as mentioned above, also fall within the scope of the invention. Furthermore, there is no known limitation with respect to the incendiary filling; all fillings capable of being distributed and ignited by a black powder burster, with or without the incorporation of a light metal, can be distributed and ignited with the present burster, usually with markedly improved results.

In general design, a burster unit constructed in accordance with the present invention for insertion into a burster well of a standardized chemical bomb may be characterized as comprising an outer metallic tube closed at its rear end, i. e. the end near the tail end of the bomb, and sealed at its other end where it is engaged with an inner

concentric metallic tube which serves as a container for an explosive burster charge, said inner tube being opened at its end engaged to the outer tube, closed at its opposite end, and being spaced from the outer tube, so that the confined space in between can be charged with a suitable amount of an igniting composition. The formation and position of the two metallic tubes are such as to facilitate filling and assembling, to provide satisfactory functioning in cooperation with a fuse placed adjacent the open end of the inner tube, and to make a leakproof container for the igniting composition. The explosive burster charge is advantageously loaded as a unit in a container relatively thinner or weaker than the inner metallic tube into which it is inserted. To aid in having each of the components in the burster unit properly positioned, an aligning structure is disposed at the closed tail end of the outer tube and a coiled spring may be placed in the inner tube to be compressed between the closed end of the inner tube and the explosive burster container. A more detailed description of these components and other features of the invention will be given with reference to the accompanying drawings which illustrate a practical embodiment of the improved burster unit adapted for a 100-lb. oil filled bomb.

In the drawing:

Figure 1 illustrate an elevational side view of a standardized 100-lb. chemical bomb, known as the M47, with parts cut away to show the positioning of the fuse and burster;

Figure 2 shows a cross-sectional view along the longitudinal axis of the burster unit on a relatively enlarged scale with reference to Fig. 1 and with an intermediate portion broken away;

Fig. 3 shows in elevation a front end view of the burster unit where a nose fuse is seated;

Fig. 4 is a cross-sectional view of the inner metallic tube component of the burster unit taken along its longitudinal axis;

Fig. 5 is a longitudinal cross-sectional view of the explosive burster container which fits into the inner metallic tube and is on an enlarged scale with reference to Figs. 3 and 4.

Referring to Fig. 1, the bomb has a cylindrical body **6**, a spherical nose **7**, and a box tail fin assembly **8**. The cylindrical portion is about 8 inches in diameter and the overall length is approximately 48 inches. The body may be made of rolled and lap-welded sheet steel, 1/32 inch thick. When empty, the bomb weighs about 20 pounds, and when filled with an incendiary oil, it weighs about 85 pounds. An adapter **9** at the nose end connects to the burster well **10**, which extends centrally through the length of the bomb to the closed end, supported in an aligner **11** at the tail end of the bomb body. The burster unit fits into this well and the fuse **12** fits in the adapter **9** adjacent the open end of the burster unit so that the explosive burster charge in the burster unit is detonated by the firing of the primer in the fuse **12**.

It is not intended to explain in detail the construction of the fuse and the bomb body, but simply to show their relationship to the positioning of the burster unit, since the burster unit with which this invention is concerned may be utilized with various types of fuses and bombs.

In general, chemical scatter type bombs requiring the use of the burster may be filled with chemical agents which produce a toxic or irritating physiological effect, a screening smoke, an incendiary action, or a combination of these effects. Chemical bombs are most effective when they function above ground; therefore they are fitted with nose fuses which give super-quick action or time fuses for giving an air burst. Generally, the burster is desired to rupture the bomb body for releasing the filler so that the released filler spreads out over the ground without being too widely diffused, and this is particularly true of incendiary bombs, smoke bombs, non-persistent agent bombs, and to some extent, of persistent agent bombs.

Chemical bombs are designed for single suspension in either horizontal or vertical bomb racks. The suspension lugs **13** on the side of the bomb are for horizontal suspension by shackles. When ready for release, the bombardier manipulates a control which immediately frees the bomb from the shackles. The arming wire **14**, securely attached to the aircraft, snaps taut and pulls free of the nose fuse **12**, allowing the arming vane **15** to be rotated by the air stream when the released bomb is falling. After a number of rotations of the arming vane **15** the safety pin becomes removed so that the fuse becomes armed, and upon impact, a firing pin is driven into a primer, which in turn initiates detonation of the burster explosive. The detonation of the explosive should be instantaneous for effective scattering of the chemical filler.

For convenience and safety in shipment or handling, it is generally desirable to be able to ship the bomb bodies unfused, unfilled, and without the burster inserted in the burster well; therefore, it is important that the burster components be designed to simplify the filling and assembling of the complete bomb in the field. For filling, the burster well **10** is unscrewed and removed, and the filler is put into the empty bomb, nose up, until the level of the filler is about 6 inches below the mouth of the filling hole, so that the burster well can be reinserted with allowance of suitable outage.

Referring to Figures 2, 3, 4 and 5, the outer tube **16** of the burster unit which is to be inserted into the burster well **10**, is of suitable diameter to have a closed fit in the well **10** and of sufficient length to extend approximately to the end of the well **10**. The outer tube **16** may be made from hot rolled steel, pickled, or cold rolled steel with a soft skin-rolled temper and dull finish. The tube diameter is 1⅛ inches, the wall thickness is about 0.0598 inch (No. 16 Std. gage) the end closure disc **17** may be attached by a spot-welding followed by brazing and welding around the entire periphery. Into the front (nose end) of the tube of the outer tube **16** is mortised a collar **18** having an internally threaded center hole **19**. This collar may be sealed tightly by silver brazing to the inner wall of outer tube **16** at the periphery **20** of the narrow neck portion extending into tube **16**. The thread **19** engages the thread **21** on the plug **22**, which is secured to the open end of the inner metal tube **23**. The plug **22** may be secured to the tube **23** by silver brazing at the juncture **24**. The opposite end of the metallic tube **23** may be closed by a cup shaped disc **25** also fixed by silver brazing. When this inner tube **23** is inserted into the outer tube **16** with its plug attachment **22** screwed tightly into the collar **18**, the closed end **25** extends to about 1 to 2 inches from the closed end **17** of the outer tube **16**. The threading **19** and **21** on the collar and plug may be tapered, and it is preferred that a gasket **26** be inserted between a shoulder on the collar **18** and a corresponding shoulder on the plug **22**.

A socket arrangement of two, generally U-shaped, strips of metal **27**, about No. 16 Std. gage and spot-welded to the adjacent end closure **17** of the outer tube **16** where they cross, serves as an aligner for keeping the inner tube **23** centrally spaced throughout its length inside the outer tube **16**.

A preferred form of the unit explosive burster container which is to be inserted into the open end of the inner tube **23** is shown in Fig. 5. This container comprises a tube **28** made of laminated paper impregnated with a suitable resin to increase its strength and impart moisture-resistant qualities, with two soft metal caps **29** to close both ends. The caps **29** may be sealed tightly to the ends of the tube **28** with a suitable cement, such as a thermo-setting resin cement of the alkyd type. A suitable charge to form the core of container **28** is made by placing two pellets **30** of

tetryl at both ends of the tube **28** and intermediate these pellets a main charge **31** of TNT.

The explosive burster container may be varied in character. The shell **28** of the container may be made of any relatively light material which is readily ruptured, as for example, thin walled aluminum tubing or brass, or the outer covering of the explosive charge may be simply a waterproof textile such as encloses PETN (pentaerythritetranitrate) in detonating cord, known commercially as Primacord. The symmetrical arrangement of the burster and main burster explosive inside the container **28** is beneficial for preventing mistakes in loading the container into the inner tube **23** and also for insuring instantaneous explosion.

To further facilitate assembling of the burster unit, a coiled spring **32** is inserted into the inner tube **23** so that one end rests against the bottom closure **25** and the other end is pressed by the inner (rear) end **29** of the explosive burster container **28** when it is inserted into the inner metallic tube **23**, the explosive container **28** being pushed into position so that its outer (front) end **29** is substantially flush with the front (nose end) of the burster unit where the gaine of fuse **12** seats contiguously when the burster unit and the fuse are assembled with the burster well **10** in the bomb.

The space **33** between the inner tube **23** and outer tube **16** and surrounding the aligner members **27** may be considered to be the igniting substance well for filling with the materials such as WP or others mentioned. The assembled burster unit including the closed outer tube **16** and the inner tube **23** with its one end closed, should have adequate pressure resistance for safe use; they should be fabricated, in general, to avoid rupture, distortion, or leakage when subjected to an internal air pressure of 200 pounds per square inch.

In assembling the burster unit for shipment, first the outer tube **16**, having closed end **17** and the collar **18** attached but with inner tube **23** removed, is partially filled as a container for the igniting substance, such as WP, leaving enough room so that the inner tube **23** can be inserted and screwed in tightly. This container may be filled approximately one-half full with hot water at about 120°–130° F. The water is preferably buffered with sodium-hydrophosphate, sodium carbonate, or any other suitable alkaline salt to maintain a pH value between about 6.5 and 8.0. The WP is melted and maintained at a temperature no higher than about 55° C. and no less than about 50° C. during the filling operation. The partially filled container should allow room for inserting the inner tube **23** for closing. It is desirable that the depth of residual water on the WP in the container not exceed 0.25 inch.

The thus filled WP container is closed by placing a lead gasket **26** on the shoulder in the container collar **18**, inserting the inner tube **23**, and screwing the plug **22** tightly into the collar **18** so as to compress the lead gasket **26** and tightly seal off the threaded juncture between the plug **22** and the collar **18**, the threads **21** on the plug **22** first being advantageously luted with basic carbonate white lead paste-in-oil, or equivalent luting material. The thus filled and sealed WP container portion of the burster unit may be shipped separately from the loaded burster explosive container **28**, which is to be inserted into the inner tube **23** when the entire burster unit is to be placed in the burster well of a bomb at an airdrome or complete bomb assembly point.

The burster unit is kept properly positioned in the burster well by having the bevelled flange **34** on the plug **22** seat in the fuse socket **35** of the burster well **10** so that the front end of the burster unit is close to the nose fuse **12**. For some forms of fuses, the front opening **36** of the inner tube **23** may be chamfered also to provide a fuse seat. It is to be noted that it is desirable to have the explosive charge as close as possible to the fuse when the fuse functions.

EXAMPLE 1

WP–TNT burster for a "100-lb." oil-filled bomb with a 0.050-in. steel casing (M–47A1)

In a suitable combination of parts, as illustrated in Figs. 1 to 5, the outer tube **16** is filled with enough WP (white phosphorus) to provide a 5% outage and the inner tube **23** is screwed into the outer tube **16** while the charge is still molten; the unit subsequently is screwed into the bomb after this has been loaded, for example with gasoline gelled with an aluminum soap, with an isobutyl methacrylate composition, or other thickener. The high explosive charge is loaded into the burster container **28**, conveniently in the form of pellets, and the bomb is armed by inserting this explosive container **28** into the inner tube **23** and attaching the nose fuse **12**. In this design, closure of the phosphorus well between outer tube **16** and inner tube **23**, is effected by means of a tapered thread **19**. A preferred method of closure employs a lead gasket **26**.

The burster tube is preferably made of laminated paper-Bakelite (phenol-formaldehyde resin). Fibre tube can be used, but variation in length with ageing, or under changing conditions of humidity, renders this material less certain of satisfactory performance. A suitable explosive charge is obtained with a 36 inch tube 9/16 inch O. D. and 21/64 inch I. D. filled with 1/4 inch pellets molded at a compression of approximately 5,000 pounds sq. inch (density, 1.52–1.55) in a 5/16 inch die; TNT is pelleted in flake form, and tetryl is mixed with 2% graphite for pelleting. The main charge **31** is TNT, and two or three pellets **30** of tetryl are introduced at each end to act as a booster. The pellets are thrust in lightly with a wooden rod and the last one is left extending about 1/8 inch. The end of the tube is painted with "Glyptal" cement and the metal cap is put in place and forced on flush with the end of the tube, thus compressing slightly the column of pellets. The total charge is approximately 70 g.

The phosphorus chamber can be filled by displacement of water at 55° C., but a simpler and more efficient method which provides complete insurance against corrosion by the action of phosphorized water consists in dry loading. Phosphorus is melted under water, drawn off from the lower layer and run into a well that has been flushed with an inert gas; the charge is metered conveniently by measurement of the fall in the water level.

The phosphorus charge does not constitute a significant source of hazard in the shipping or handling of an oil-filled bomb, or in carrying it on a bombing mission. Experiment has shown that a direct hit on the central burster tube by a 50-calibre armor-piercing machine gun shell from a range of 50 yards may rupture the burster and lay open a 3/8 inch section of white phosphorus without producing a fire. Apparently the incendiary oil charge forms a thin film providing protection against air.

In a typical static test with a bomb loaded with 42 lbs. of Napalm gasoline gel the gum was distributed evenly in large globs over an area 64 x 81 yards, ignition was approximately 98%, and the fire count was as follows:

175–200 initial fires
150 fires burned 3 minutes
60 fires burned 5 minutes
50 fires burned 8 minutes
25 fires burned 10 minutes
17 fires burned 12 minutes

In further tests, bombs were fired statically over a water pond. Those few globs that were not extinguished by dropping onto water were extinguished by operators within 1 minute. Of a total of 4210 pounds of soap gelled gasoline fired, 40 lbs. 2 oz. was recovered (95.6%), which indicates that there is no appreciable loss due to a flash burn. The results were substantially the same when the bomb was filled with gasoline gelled with isobutylmethacrylate.

EXAMPLE 2

WP–TNT burster for "100-lb." oil-filled bomb with a 0.032 in. steel casing (M–47)

A suitable design of the inner wall is illustrated in Figs. 1, 2 and 5. The 36 inch burster tube has the dimensions 9/16 inch O. D. 9/32 inch I. D. and is charged with TNT and tetryl pellets made in a 17/64 inch die. The total explosive charge is approximately 50 g. In a typical test with gelled gasoline (42 lbs.) 12 small pieces were collected unignited (ignition 98%), the area of distribution was 52 x 65 yds., many 6–8 inch globs of gel were found, even at the periphery of the burning area, and the fire count was as follows:

200 fires burned 3 min.
150 fires burned 6 min.
40 fires burned 9 min.
18 fires burned 10 min.
10 fires burned 13 min.
6 fires burned 15 min.
3 fires burned 18 min.

OTHER EXAMPLES

Burster assemblies of design similar to those illustrated and containing approximately the same ratio of WP to incendiary charge and an amount of high explosive sufficient to burst the series of concentric tubes and to open the bomb casing are applicable to a wide variety of bombs of both smaller and larger size. Thus a 30-lb. bomb (M–46A1) loaded with 11.6 lbs. of an aluminum soap gel in gasoline can be fired satisfactorily with a burster containing 24–72 inches of PETN Primacord in a tube surrounded by 220 g. of white phosphorus (ignition 99%, distribution area 27 x 37 yds.). A gel filled 500-lb. bomb with a cast-iron casing can be fired satisfactorily with a burster containing 7.5 lbs. of WP and a 9/16 inch I. D. tube containing 228 g. of a eutectic mixture of TNT and tetryl. If the casing of the 500-lb. bomb is made of steel, a 1-inch tube of the same material provides adequate opening and distribution.

The "100-lb." bomb, charged with a gel of 8% crepe rubber in gasoline, can be fired satisfactorily with a two-strand Primacord burster surrounded by 230 g. of a mixture of black powder (1 part) and magnesium powder (1 part). The charge is distributed in ½ lb. globs over an area having a maximum radius of 41 yds., and ignition is at least 90%.

Many tests have been made with bombs charged with a variety of gelled gasolines and other incendiary filled and equipped with bursters designed in accordance with the present invention. The results of these tests proved that the bursters were entirely satisfactory for standardization. These bursters permit safe and easy shipment of spontaneously ignitable substances such as WP, are easily assembled to chemical bombs in the field and function satisfactorily in rupturing the bomb casings. Although the bursters are particularly useful in incendiary bombs they may be used with obvious modifications in various other types of chemical bombs. For example, they may be used with or without the WP or igniting substance for bursting smoke bombs, e. g., bombs charged with an FS mixture (sulfur trioxide and chlorosulfonic acid) or FM (titanium tetrachloride), or bombs loaded with toxic agents. In the latter use WP or some similar agent may be desired in the burster unit for making the bomb simulate a non-injurious smoke bomb or to mark the hit of the bomb on bursting.

It is to be understood that although the invention has been described in detail with reference to specific embodiments, other modifications come within the spirit and scope thereof.

We claim:

In a burster-type oil incendiary bomb, a burster unit comprising an elongated outer steel tube dimensioned to fit contiguously into a tubular burster well, a relatively shorter inner steel tube concentrically spaced within said outer steel tube, closures at rear ends of said tubes, a threaded attachment between front ends of the said outer and inner tubes, a tubular container loaded with a central core of TNT compressed between pellets of tetryl disposed in the inner tube, and a coiled spring in the inner tube between its closed rear end and the tubular container pressing against said tubular container so that its front end is pushed flush with the front end of the inner steel tube.

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