April 10, 1956 F. R. RUSSELL ET AL 2,741,178

TAIL EJECTION BOMB LOADING

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Fig. 1

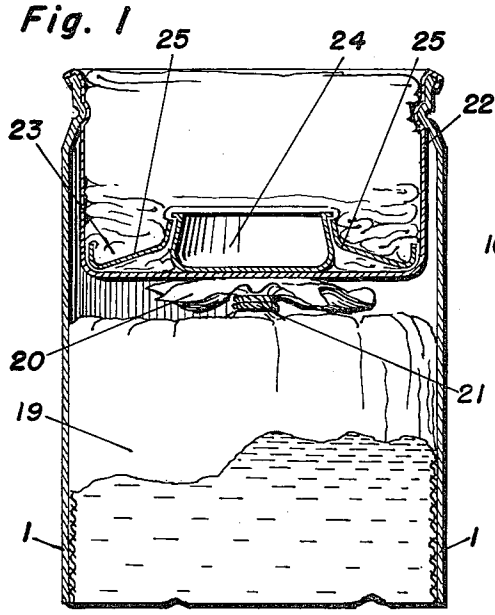
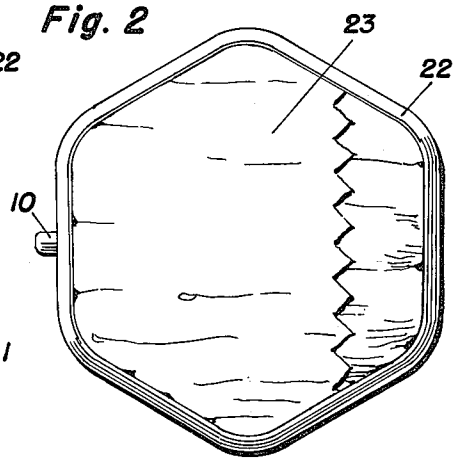


Fig. 2



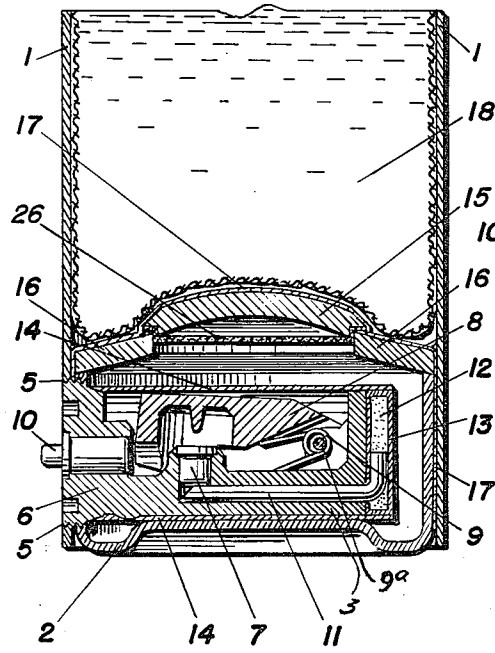
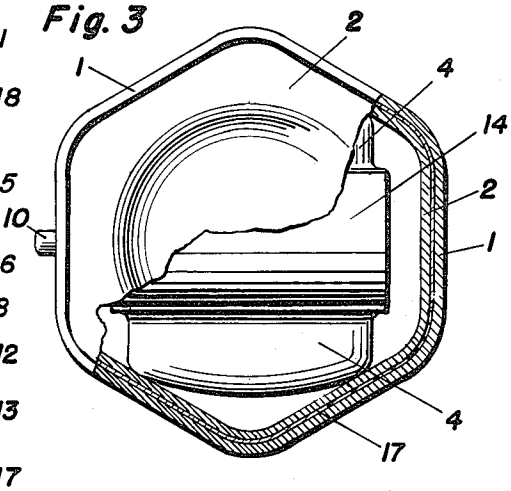


Fig. 3



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TAIL EJECTION BOMB LOADING

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Application November 7, 1944, Serial No. 562,369

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 particularly to means for loading a tail ejection incendiary oil bomb with a thickened or gelled oil fuel incendiary agent.

Through the development of an efficient ejection mechanism, tail ejection incendiary oil bombs have become important standardized weapons of warfare as a replacement of thermit type incendiary bombs, although at the end of the last war, the use of incendiary oil bombs was practically abandoned.

As a result of the present invention is was determined that the manner in which a thickened or gelled fuel is loaded into the casing of the tail ejection bomb is an important factor in the ejection, ignition, and distribution characteristics of the bomb for all types of such viscid materials employed.

A primary object of this invention is to provide a method and means of loading by which a dependable ignition, efficient ejection, efficient distribution and satisfactory incendiary action are obtained.

Another object is to provide an improvement in loading of the bombs which is expeditious, simple, and economical. Further objects will be understood from the ensuing description.

Broadly, for accomplishing the objects of the present invention, a cloth sock or bag is used to enclose the fuel within the bomb casing and during ejection.

The improvement will be described in further detail with reference to an illustration of a standardized incendiary oil bomb as shown in the drawing forming a part of this specification.

In the drawing:

Figure 1 shows a vertical sectional view of a standardized-type oil tail-ejection incendiary bomb charged with a thickened fuel enclosed in a cloth sock;

Fig. 2 shows a view of the tail end of the bomb in elevation;

Fig. 3 shows a view of the nose end of the bomb in elevation and partly in section.

Referring to the drawing, 1 is a casing made of sheet steel extending substantially the entire length of the bomb and providing a leakproof container. A nose cup 2 made of sheet steel, preferably somewhat thicker than the casing 1, fits into the nose (bottom) end of casing 1, forming a blunt nose and housing a suitable combination percussion and time fuze assembly 3 together with a charge of propellant powder, 4. The propellant powder 4 may be inclosed in cellulose nitrate plastic containers and fitted into the nose cup adjacent the fuze 3.

The fuze assembly 3 is screwed at its head end into a threaded hole 5 in the casing 1 and nose cup 2. The fuze shown comprises a firing mechanism assembly of a die cast aluminum base alloy 6 having a well for holding a primer cap 7, a hinged striker 8, a torsion spring 9 for restraining movement of the striker prior to a

predetermined adequate impact force, a safety plunger assembly 10, and a lead spitter fuse 11 leading from the primer cup well to a booster charge 12 contained in a cellulose nitrate plastic cap 13. This firing mechanism assembly is encased in a steel tubing 14.

A disc shaped steel impact diaphragm plug 15 is mounted over a central hole in diaphragm 16 brazed to the nose cup 2 above the fuze 3. The diaphragm 16 and plug 15 act as a reinforcement for a thin sheet steel diaphragm 17, that is brazed to the casing 1 to act as a seal between the nose cup and the gel filling 18. The gelled fuel filling 18, occupying the major part of the bomb, is held in a cheese-cloth sock 19, the end 20 of which is tied securely by a short piece of string or twine 21.

In a standardized 6-lb. incendiary oil bomb of the type shown in Fig. 1 the casing is 19½" long, hexagonal in shape, 2⅞" wide across the flats, and weighs complete, filled and fuzed, about 6 lbs. Over 2 lbs. of this weight is gelled gasoline.

A tail cup 22, made of sheet steel, is mounted at the tail or upper end of the casing and crimped to the casing to form a leakproof seal.

As a simplified stabilizing means, tail streamers 23, which are lengths of mildew-proof cloth, are held at one end in the tail cup 22 by a retainer cup 24, and the streamer 23 is folded loosely in the cup which is opened outwardly at the end. A tail retainer disc 25 fits over the small retainer cup 24 spot-welded to the bottom of the tail cup proper 22. When the bomb falls, the free ends of streamers 23 fly out, retarding and stabilizing descent of the bomb.

In operation, when the bomb is separated from a cluster dropped by aircraft, a plunger in the safety plunger assembly 10 becomes retracted by a coiled spring to arm the fuze, the plunger being no longer pressed inwardly by an adjacent bomb in the cluster. The bomb drops in a generally vertical position, and upon impact of the bomb at its nose end on a target surface, inertia in a weighted portion of the striker 8 forces the striker to overcome the restraint of the torsion spring 9 and to swing on hingepin 9*a* in the direction of the primer cap 7. The firing pin of the striker, thereupon driven into the primer charge, flashes the primer material, which in turn ignites an underlying end of the lead spitter fuse 11. The lead spitter fuse burns to its opposite end in a period of about 1 to 5 seconds, giving a desired delay action, which permits the bomb to penetrate the target and fall to rest on its side; then the booster or first fire charge 12 is set off in the plastic cup 13. The ignited first fire charge ignites the propellant charge 4 adjacent the fuze unit to cause an immediate increase in pressure which lifts the impact diaphragm plug 15, rupturing the sealing diaphragm 17, forcing out the releasable tail cup 22, and violently ejecting the mass of ignited thickened fuel enclosed in the cloth sock as a single projectile with sufficient force to send it 25 to 200 feet and farther, or to where it strikes an upright structure in its trajectory.

The ejection mechanism depends on the ability of the propellant powder charge to create sufficient pressure in the confining chamber within the nose cup to shear the sealing diaphragm and shoot out the fuel charge and the cup from the tail end of the bomb so that the bomb acts like a small mortar without depending on any piston action of the diaphragm plug. It has been found that if the impact diaphragm plug 15 is made wide enough to fit snugly in the casing so as to have a piston action, that it tends to disrupt the casing when it is lifted by the propellant charge explosion, also, a close fitting plug is prevented from moving by small deformations in casing 1, such as may result from slight buckling. With the thickened fuel enclosed by a cloth sock, and with substantial clear-

ıce between the diaphragm plug **15** and the wall or the ısing **1**, the sock enclosed mass of incendiary oil is ejected / its own piston action with much better results. Satis-ctory performance is obtained by having the impact aphragm plug **15** in the form of a dished plate about 0.2 ch thick, resting over the centrally located hole (about 5 inches in diameter) in the diaphragm disc **16**, to re-force the bottom of the thin partitioning diaphragm, **17**. n asbestos gasket **26** may be placed under diaphragm ug **15** to keep it from being fused to its seat on dia-ıragm **16**.

The cloth sock made of cheesecloth has adequate me-ıanical strength to remain as an intact enclosure of the ıtire incendiary oil charge during ejection; moreover, ıe sock improves ignition and gives desirable distribu-on, since on impact the sock breaks and allows the fuel) spread in a large gob. From a large number of tests has been determined that the use of the cloth sock is ghly essential for desired complete ejections, good igni-on, and proper distribution of the fuel charge.

For comparison, using the same type of bomb as-mbly and materials but without a cloth sock enclosing ıe fuel, tests showed a frequent failure of ignition, in-mplete ejection of the sticky fuel, short range of ejection ıd shattering of the fuel into numerous small particles nong which even the ignited particles were incapable f causing the desired incendiary action. Although vari-ıs fabrics may be used for making the cloth sock, it is referably made from a loosely woven material, such as, etting, gauze, or cheesecloth. A suitable cheesecloth covered in Federal Specification CCC–C–271; type 1 ınbleached) of warp thread count 36, filling thread count 2; approximate weight of 14 yds. per lb.; width 36 inches; ıd known commercially as Grade 70. A double thick-ess of Grade 50 has equivalent strength. The size of ıe sock depends upon the measurements of the bomb. he sock is simply made and is preferably oversized rela-ve to the volume of the filling, and it is desirable that the ock be of such length so that its top can be folded over ıe top of the bomb case during filling operations.

For 5-lb. bombs, 14½ inches long and 3 inches in di-meter, the cheesecloth is cut into swatches of 18 inches by 2½ inches. The cloth is folded once lengthwise and ıachine stitched along the bottom and along one side) form a long bag having a distance of about 5⅜ inches om fold to seam. The sock need not be turned inside ut. After filling with fuel in the bomb, leaving an out-ge of about 5% to 8%, the top of the bag is tied closed y string **21**.

Many types of thickened and gelled fuels may be used ith the sock enclosure in tail ejection bombs. The fuels ıould have a consistency which is not too thin with a ndency to excessive flash burning, nor too hard with a ndency to rebound on striking a hard surface. Briefly, mong types of viscid fuels which may be used are:

Fuels gelled by soaps; fuels gelled or thickened by resins, g., rubber, polybutenes, isobutyl methacrylate, etc.; ıels thickened by gums and other resinous materials, e. g., ısin, asphalt; and fuels thickened by mixtures of soaps nd resins.

A preferred type of gelled fuel is made up by mixing ith naphtha hydrocarbons about 7 to 14% by weight of oprecipitated aluminum soaps of other fatty acids, such s, cocoanut oil fatty acids and naphthenic acids. The elled or thickened fuels may include fuel oils relatively ss volatile than gasoline, such as, kerosene, and even s heavy as asphaltic residua. They may contain in sus-ension finely divided pyrophoric metals, such as powdered ıagnesium, oxidizing agents, wood meal, carbon, sodium, tc.

Although fibrous materials, such as, cotton waste, sisal, owdered wood, excelsior, dried moss, or the like, to some xtent act as binders, they tend to lower the burning tem-erature, reduce the heating value, and lessen the ignita-ility of the fuel when used in sufficient amounts to have a substantial binding action. The use of the cloth sock eliminates any necessity of having such binding action by fibrous materials.

In demonstration tests and in practical bombs, a No. 4 primer cap was used in the fuze with a 1 to 5 second time delay lead spitter fuse, the first fire charge was 1 gram of Army Grade A–4 powder, and the propellant charge was about 4 to 7 g. powdered magnesium coated with about 3% linseed oil and about 4 to 7 g. of Grade A No. 4 Army black powder. The primer cap is covered in U. S. Army Spec. "Primer, New No. 4" and is of a type commercially manufactured for smokeless powder paper shot shells. The lead spitter fuse used in about ⅞" lengths is also commercially available.

From studies of many tests, it was determined that between about 2 and 2½ lbs. of thickened fuel is an optimum quantity in each bomb for starting fires in typical structures. The incident of an effective fire starting decreases rapidly with decreasing of fuel quantities below this range, whereas the use of larger quantities was found unnecessary. The case and the firing mechanism of the bomb can be appropriately designed for efficient clustering, suitable ballistics and target penetration with an optimum quantity of the thickened fuel enveloped by a cloth sock in the bomb.

Efficient ejection is obtained generally with the following relationship of powder charge, diaphragm strength, fuel gelled viscosity and tail cup release pressure:

Diaphragm thickness—about 0.008 inch (about 400 to 500 lb./sq. in. rupture pressure).
Tail cup release pressure—about 100 to 150 lb./sq. in. maximum.
Black powder charge—about 4 to 14 g.
Magnesium powder charge—about 4 to 7 g.
Fuel viscosity for sock inclosed charge—about 300 to 2000 g. Gardner.

The kind of ejection may be varied with the amount and type of propellant powder. Generally, black powder is typified by the composition: potassium nitrate, about 75 weight percent, charcoal about 15%, and sulfur about 10%. Differences in granulation make a change in the speed of burning and rate of pressure development. In practical bombs weighing about 5 to 7 pounds, too low an amount of powder, less than 4 g., the pressure developed is insufficient to properly eject the incendiary agent charge; amounts of powder much larger than 14 g. tend to develop excessive pressure. Various igniting material may be added to the propellant powder charge to act as a source of hot particles for igniting the fuel charge as it is being ejected. Powdered magnesium was found to be a satisfactory igniting material, particularly when coated with boiled linseed oil, giving close to 100% ignition over a complete temperature range. It is possible, however, to use other materials, such as, powdered aluminum in admixture with oxidizing and promoting substances, such as, barium nitrate and sulfur.

Observations of numerous tests indicate that the use of the cloth sock for enclosing the incendiary charge assures proper ignition and ejection, the charge being capable of conforming to the shape of the casing even if the bomb casing becomes crumpled. The cloth sock in holding the charge together during ejection permits the charge to adhere to any surface that it strikes. When the sock becomes torn upon striking the surface at which the charge is hurled, the sticky incendiary fuel undergoes complete ignition and spreads out as a highly destructive, large, flaming wad.

The efficient functioning of the bomb was demonstrated by many tests in which bombs of the nature described and modifications thereof were simply emplaced on the ground, statically fired, and aimed at small targets set at varying distances from the emplacements, as well as, by actual bombing from aircraft in flight. The tests showed that a munition device using the underlying

principles of this invention is adapted to deliver a chemical agent charge enclosed by a cloth sock as an intact mass on a target, thus avoiding waste such as occurs when an unenclosed agent traverses ground from the place of release in being projected toward a target. In this sense, a modification of the bomb may be used to serve as a ground emplacement statically fired projector munition or weapon having a number of important tactical capabilities, as for example, for attacking a pill-box or trench. Projectiles thrown from such projectors may be in the form of various chemical agents contained in suitable sock or bag enclosures, thus dispensing with the use of a metal shell.

In further developed bombs the enclosure of a fuel charge in a cloth sock has also proved to be a valuable asset, as for example, in a standardized 6 lb. bomb, 19½ inches long, hexagonal in shape, 2⅞ inches wide across the flats, and containing about 2.2 pounds of gelled gasoline. This type was designed for use in a 350 lb. amiable cluster. The cloth sock inclosure of the fuel is similarly advantageous in a clustering bomb of about the same dimensions but designed to have an extensible metal tail fin, instead of the cloth tail streamers, for stabilizing flight and to have a dome housed explosion chamber with a vertically disposed all-way fuze therein. The bomb may also contain charges of other agents, as for example, white phosphorous preferably enclosed in a plastic container between the sock enclosed oil and diaphragm partition, and may contain a high explosive fired by a time fuze at the nose end as an anti-personnel element.

It is to be understood that the invention is not to be limited by the specific examples given for the purpose of illustration, and that the principle of this invention is useful in various chemical bombs and similar munitions and with various modifications.

We claim:

In a tail ejection bomb comprising a casing extending substantially the length of the bomb, a releasable tail cup closure fitted at one end of said casing arranged to require a maximum releasing pressure of about 100 to 150 lbs. per sq. in., an explosion chamber enclosing nose cup fitted more firmly to the other end of said casing, about 2 to 2½ pounds of a viscid incendiary oil charge enclosed by a cloth sock in the casing between the tail cup and the nose cup, a thin diaphragm making a liquid tight seal with the casing adjacent the nose cup, said diaphragm being subject to rupturing by a pressure of about 400 to 500 lbs. per sq. in., an impact activated fuze in the nose cup, and a charge disposed in said nose cup for firing by said fuze; said charge comprising about 4 to 14 grams of black powder together with a charge of about 4 to 7 grams of powdered magnesium coated with boiled linseed oil.

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