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ORDNANCE ALLIED

TABLE OF CONTENTS

	Page
BOMBS:	
Incendiary Bombs:	
AN-M52	2
AN-M50	2
AN-M50X	4
AN-M50A1	4
AN-M50X-A1	4
AN-M50A2	4
AN-M50T-A2	4
AN-M50X-A2	6
AN-M50X-A3	6
AN-M54	6
AN-M54X	9
AN-M54X-A1	9
AN-M69	9
M74 (E5)	13
AN-M47A1	16
AN-M47A2	16
Mk 28	17
M70	17
AN-M76	17
Incendiary Clusters:	
AN-M6	20
M7	20
AN-M8	21
M9	21
M10	22
M11	22
AN-M12	22
AN-M13	22
M17A1	23
E6R2	25
Incendiaries - Tactical Use of Chemical Bombs:	27
M78	30
AN-M79	32
FUZES:	
M1 Fuze for AN-M69 Incendiary	11
M3 Fuze for M74 Incendiary	13
Mk 243	36
MISCELLANEOUS:	
Needle Valve M1 for M78 and AN-M79 Bombs	32
Rockets - Tactical Use of	38
Zero Length Rocket Launcher, Mk 5 Mod 1	38

BOMBS

INCENDIARY BOMBS

INTRODUCTION

With this issue of the Bulletin, an effort has been made to compile as complete a picture as possible on all incendiary bombs and their tactical use which are currently being used by both the Army and the Navy. For the benefit of Bomb Disposal personnel in the field, some of the obsolescent or obsolete bombs are covered in the event that it becomes necessary for such personnel to handle them.

Incendiary bombs are of two types, those released in clusters for area bombing and those released individually for point bombing. In some of the smaller bombs such as the magnesium alloy incendiaries, the metal case serves as the main charge, while in others the charge is contained in a sheet metal body and requires an explosive burster to open the body and distribute the charge.

BOMBS RELEASED IN CLUSTERS

Bombs designed for use in clusters are similar in the following respects:

1. Their size ranges from two to ten pounds.
2. They are usually hexagonal in shape rather than round to permit solid packing in the cluster.
3. In most cases they use an integral inertia type fuze which is armed when the bombs are released from the cluster. The arming mechanism of the fuze consists of a safety plunger or arming plunger which is held depressed against spring action by the adjacent bomb in the cluster. When depressed, the plunger prevents freedom of the firing pin to move toward the primer.

If a cluster should break up in handling or otherwise accidentally release its bombs, it is to be noted that such bombs are armed and deserve considerable respect. Dropping them from several feet may cause the fuze to ignite the bomb.

Shipping and Packing:

Small incendiaries are usually clustered in 100 lb. and 500 lb. size adapters. Clusters completely assembled are packed one per crate. A detailed discussion of the clusters will be taken up later.

BOMBS RELEASED INDIVIDUALLY

Bombs released individually for specific targets are 100 lb. size and larger. They have better flight characteristics than the typical cluster arrangement. They are adapted for either a nose fuze or both a nose and a tail fuze. The fins may be attached to the bomb body (100 lb. bombs) or issued separately. Since bursters for large incendiary bombs are always shipped separately, each bomb contains a burster well, which is a tube opening into the fuze seats and extending the length of the bomb body.

Shipping and Packing:

One hundred pound incendiary bombs with fin attached are packed in a wooden box. Larger bombs, without fin assembly are shipped with lug protection or shipping bands. Fin assembly and arming wire are packed one each per carton, 8 cartons per box. Fuses and bursters are each packed separately in wooden boxes.

BOMB DESIGNATIONS:

The majority of small incendiary bombs are AN-M standard types. If an explosive head is incorporated, the bomb designation will include an "X". For example, the bomb with the body constructed of magnesium alloy without an explosive head is designated AN-M50A1. This same bomb with the explosive head becomes the AN-M50X-A1.

TWO POUND INCENDIARIES

AN-M52

Status: Army - Standard
Navy - Obsolete

Description:

The AN-M52, 2 lb. incendiary bomb, Fig. 1, has a hexagonal body 9 13/16 long and a sheet metal tail. The bomb is 14 22/32 long overall and 1 9/16 across the flats. The main charge consists of the magnesium alloy body which weighs 1.13 lbs. Inside the body is a 0.4 lb. charge of thermate* and the first fire charge.

The sheet metal tail is fixed to the body by three screws. Three holes are drilled through the upper part of the body which act as a vent for initial burning. The body has a circumferential purple band and lettering.

Operation:

While in the cluster, the spring loaded safety plunger is depressed by the adjacent bomb thereby preventing freedom of the striker. Upon release from the cluster, the spring loaded safety plunger jumps out. On impact the weight of the striker causes the thin brass cross to collapse and thus allow the striker to hit the primer cap which in turn ignites the first fire charge and subsequently the thermate and the magnesium case. The thermate burns for 65 seconds, melting and igniting the magnesium alloy case which continues to burn for a total burning time of 8 minutes. This bomb requires a drop of 30 feet or more to insure functioning.

FOUR POUND INCENDIARIES

AN-M50

Status: Army - Obsolete
Navy - Obsolete

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*Thermate is a composition of 80% Thermite and 20% First Fire Charge.

Thermite		First Fire Charge		
Iron Oxide	76%	Sodium Nitrate	50%	
Aluminum Powder	24%	Aluminum Powder	45%	75%
		Sulphur	4%	
		Boiled Linseed Oil	1%	
		Black Powder		25%

U.S. AN-M52 INCENDIARY BOMB

FIG. 1

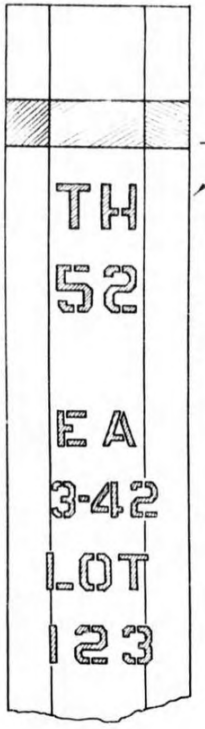
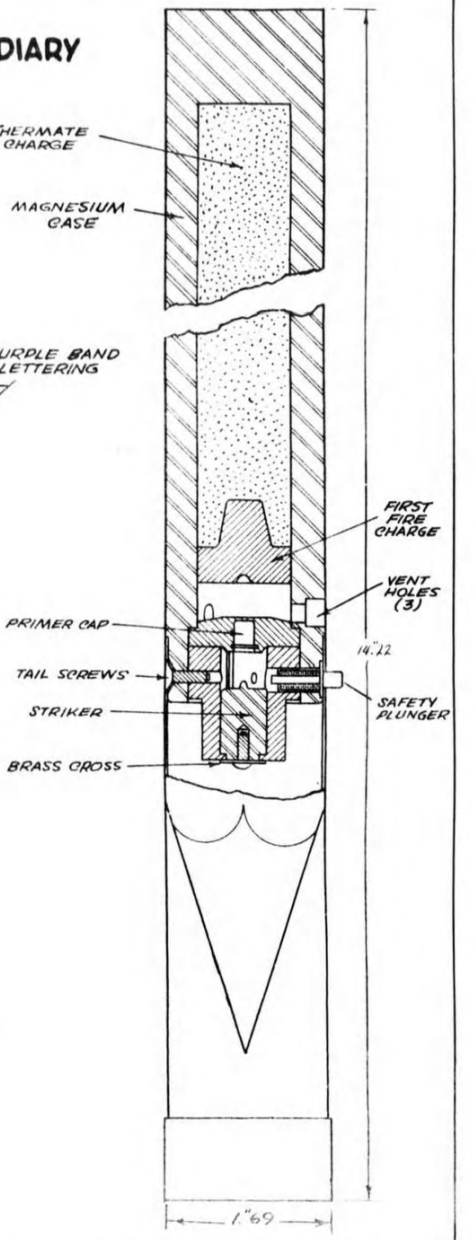


DIAGRAM OF EXTERIOR MARKINGS ON AN-M52 BODY



AN-M50X

Status: Army - Obsolete
Navy - Obsolete

AN-M50A1

Status: Army - Obsolete
Navy - Obsolescent

Description:

This bomb, Fig. 2, has a hexagonal body of magnesium alloy, an iron nose plug and a sheet metal tail. The bomb is 21.3 long overall and 1.69 across the flats. The bomb weighs 3.6 lbs. The main charge, or the magnesium alloy body, weighs 1.25 lbs. and contains 0.63 lbs. of thermate and the first fire charge. An integral type fuze acts as the igniter.

The hexagonal sheet metal tail is fitted to the body by three screws. There are three vent holes below the primer cap assembly to assist in initial burning.

Operation:

The operation of this bomb is the same as that of the AN-M52 in that the safety plunger jumps out and on impact the weight of the striker causes the thin brass cross to collapse and allow the striker to hit the primer cap. Upon ignition, the thermate burns approximately 1.5 minutes, melting and igniting the magnesium alloy case which burns for 8 to 9 minutes longer.

AN-M50X-A1

Status: Army - Limited Standard
Navy - Obsolescent

Description:

The AN-M50X-A1 is the same as the AN-M50A1 except that it contains a steel capsule at the nose containing 170 grains of black powder replacing a portion of the thermate charge.

Operation:

Ignition on impact is the same as that of the AN-M50A1. The bomb burns for approximately 1.5 minutes, then explodes, scattering the burning magnesium over a wide radius.

AN-M50A2

Status: Army - Standard
Navy - Service

Description:

The AN-M50A2 bomb, Fig. 2, is identical to the AN-M50A1 with one minor exception: The assembly around the primer cap and first fire charge has been waterproofed.

Operation:

Same as the AN-M50A1.

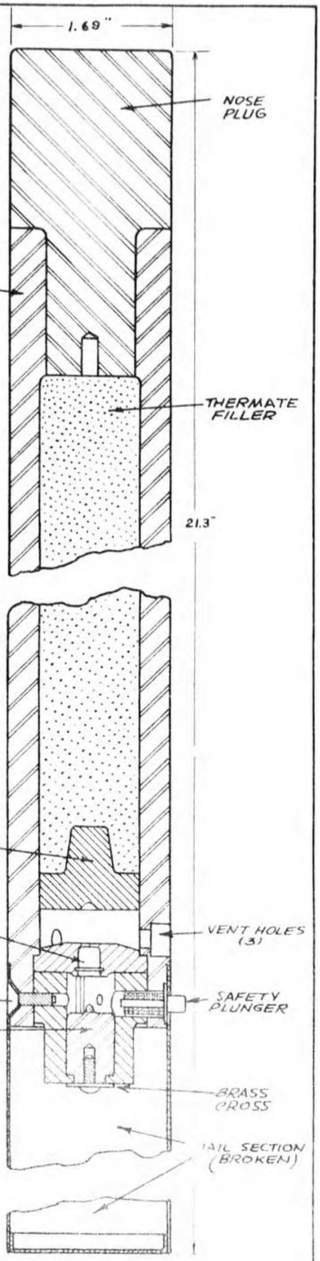
AN-M50T-A2

Status: Army - Standard
Navy - Service

The Chemical Warfare Service has carried on a considerable amount of development work to find a satisfactory toxic agent for

FIG. 2
U.S. 4LB. INCENDIARY BOMB AN-M50 A1 (& A2)

BODY MARKING DIAGRAM



incorporation in incendiary bombs. The chemical components of this new bomb are classified as SECRET and hence, cannot be discussed here. The bomb has been designated AN-M50T-A2 and is identical in appearance to the standard AN-M50A2, from which it cannot be distinguished.

Observations from tests while burning indicate that the incendiary properties are not appreciably different from those of the standard AN-M50A2.

The bombs will be clustered in the M14 cluster which will comprise of 95% AN-M50T-A2 and 5% AN-M50X-A3 bombs. The only distinguishing feature of the cluster containing these toxic bombs will be a green and a purple band painted around the assembly.

(NOTE: It is hoped that more details on this bomb will be publishable in the near future.)

AN-M50X-A2

Status: Army - Limited Standard
Navy - Service

Description:

The AN-M50X-A2, Fig. 3, is the same as the AN-M50A1 with the addition of an explosive head. The magnesium alloy body filled with thermate, the sheet metal tail and integral fuse are of the same construction as the AN-M50A1 bomb. The explosive head consists of a steel nose cap which houses three tetryl pellets, a detonator and a delay fuse. Types A and B indicate minor manufacturing differences and are marked accordingly on the outside of the body.

Operation:

After impact the bomb burns for about 1.5 minutes at which time the delay fuse is ignited. The burning fuse provides a delay ranging from a few seconds to several minutes and ignites the detonator which explodes the tetryl pellets and projects fragments of the steel shell and particles of burning magnesium.

AN-M50X-A3

Status: Army - Standard
Navy - Service

Description:

The AN-M50X-A3, Fig. 3, is the latest modification used by both Army and Navy. It is identical to the AN-M50X-A2 except that the assembly around the primer cap and the first fire charge has been waterproofed for extra protection.

Besides the minor manufacturing differences between Types A and B, the length of burning varies. From the time of impact until the explosion of the head, the Type A bomb burns for from two to four minutes Type B, burns for only 60 to 70 seconds. Note the differences in arrangement of the explosive heads in Fig. 3.

Operation:

Same as the AN-M50X-A2.

SUBSTITUTE FOUR POUND INCENDIARIES

AN-M54

Status: Army - Substitute Standard
Navy - Obsolescent

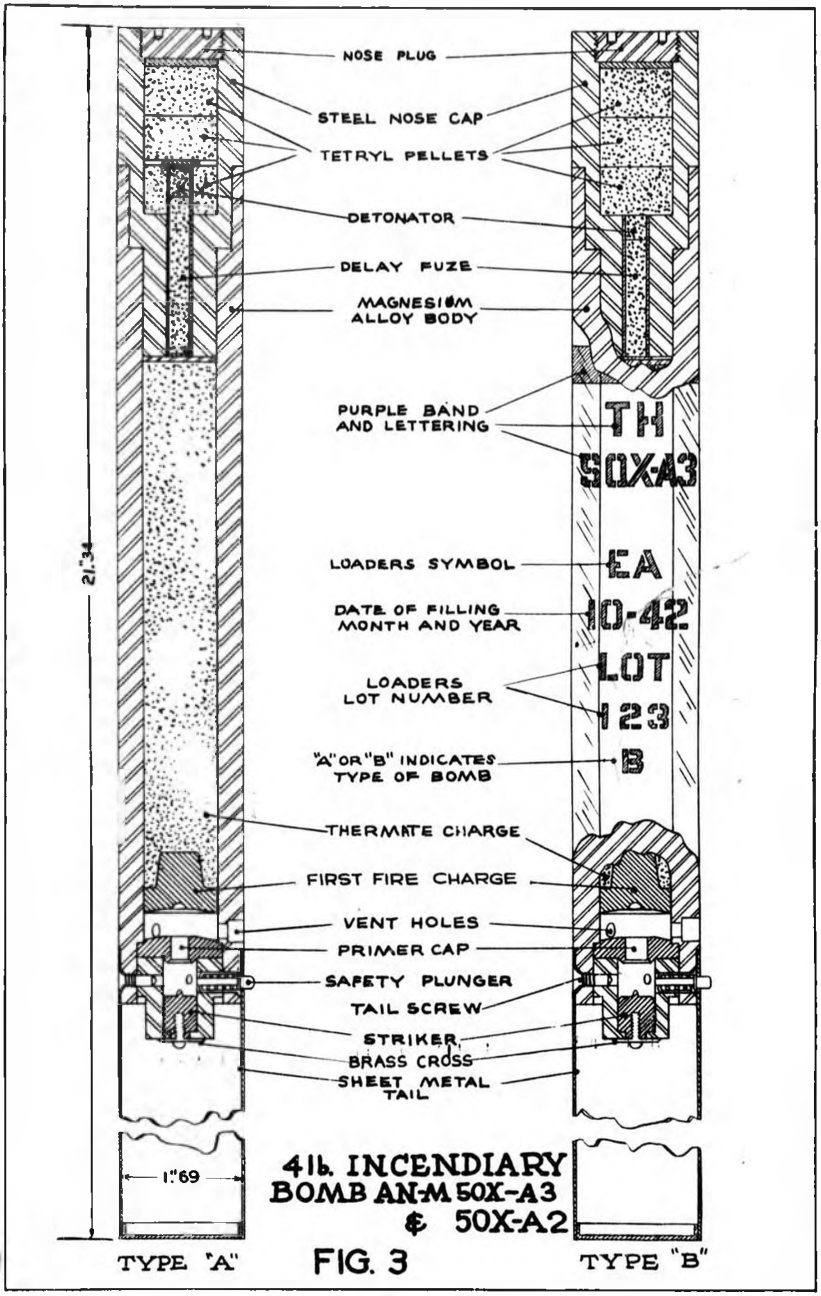
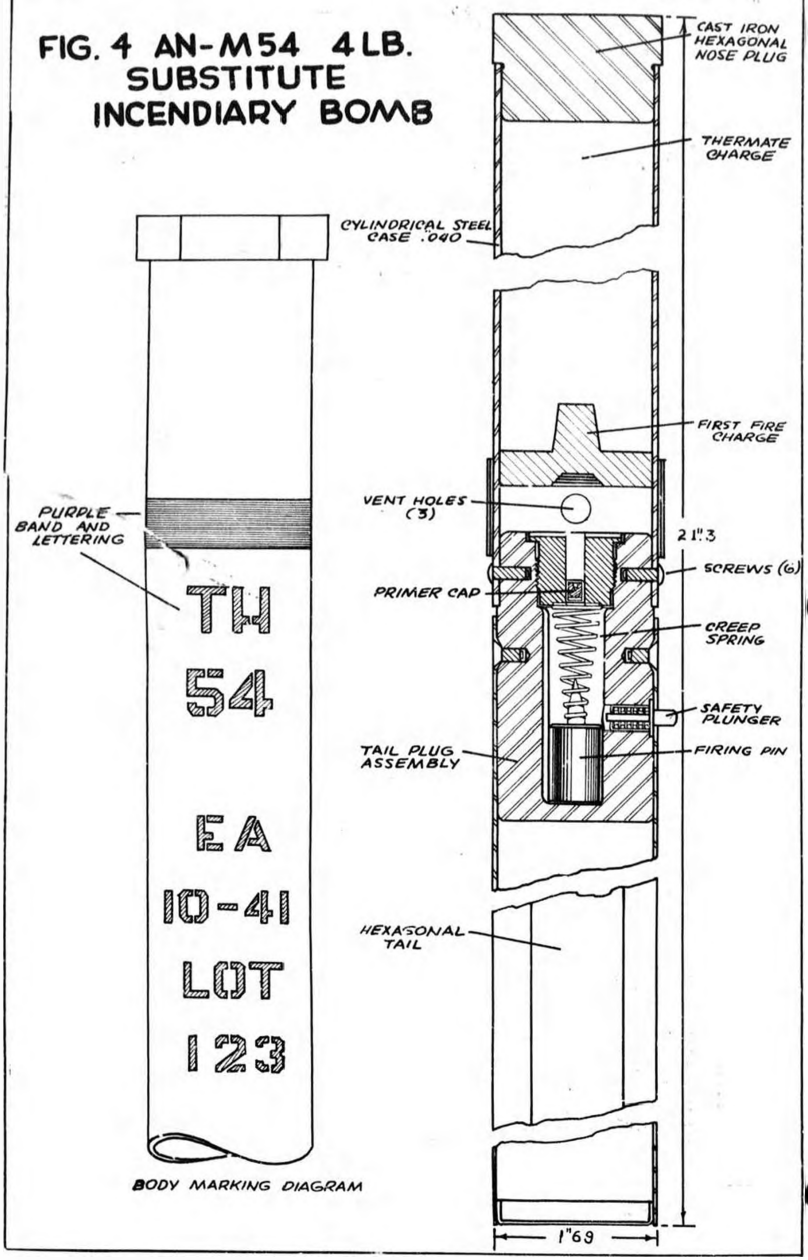

NOSE PLUG
STEEL NOSE CAP
TETRYL PELLETS
DETONATOR
DELAY FUZE
MAGNESIUM ALLOY BODY
PURPLE BAND AND LETTERING
TH
50X-A3
21.34
LOADERS SYMBOL
EA
DATE OF FILLING MONTH AND YEAR
10-42
LOT
LOADERS LOT NUMBER
123
"A" OR "B" INDICATES TYPE OF BOMB
B
THERMITE CHARGE
FIRST FIRE CHARGE
VENT HOLES
PRIMER CAP
SAFETY PLUNGER
TAIL SCREW
STRIKER
BRASS CROSS
SHEET METAL TAIL
1.69
4lb. INCENDIARY BOMB AN-M 50X-A3 & 50X-A2
TYPE "A"
TYPE "B"

FIG. 3

FIG. 4 AN-M54 4 LB. SUBSTITUTE INCENDIARY BOMB



Description:

The AN-M54, 4 lb. incendiary bombs, Fig. 4, are called "substitute" because they were pressed into service as a result of a shortage of magnesium some time ago. For naval use, they are considered obsolescent.

The body is a steel cylinder having a hexagonal nose plug and hexagonal hollow sheet metal tail. The bomb is 21⅝ long overall and 1⅞9 in diameter. The body is filled with 1.6 lbs. of thermate and the first fire charge. The fuze is installed in the tail plug assembly located between the end of the body and the hexagonal tail. The tail plug assembly is fitted to the bomb by means of screws as indicated in Fig. 4.

Operation:

When the safety plunger is released, the firing pin rides on its creep spring. On impact, the firing pin overcomes the spring and strikes the primer cap which sets off the first fire charge and subsequently the thermate. After its ignition, the thermate burns for about one minute at a temperature of 4,330° Farenheit. This heat melts the steel body and releases molten iron.

Use:

Since the AN-M54 bombs are no longer being procured for the naval service, they should not be used except in emergencies when the AN-M50A2 or AN-M69 bombs are not available.

AN-M54X

Status: Army - Limited Standard
Navy - Obsolescent

Description:

This is a substitute bomb similar to the AN-M54 except that next to the hexagonal nose plug a small portion of the thermate charge is replaced by a steel capsule containing 170 grains of black powder.

Operation:

The ignition is the same as that of the AN-M54. After the bomb has burned for approximately one minute, the black powder charge explodes, scattering the molten iron.

AN-M54X-A1

Status: Army - Substitute Standard
Navy - Obsolete

Description:

The AN-M54X-A1 is a substitute bomb similar to the AN-M54 except that just inside the hexagonal nose plug there is a steel cylinder containing a tetryl high explosive charge with a delay fuze and a detonator. A thin spacer of magnesium is placed between the thermate and the fuze opening of the explosive cylinder.

Operation:

Ignition is the same as the AN-M54. After one minute of burning, the fuze is ignited and after a delay of several seconds, the explosive is detonated.

AN-M69, 6 lb. OIL INCENDIARY

Status: Army - Standard
Navy - Service

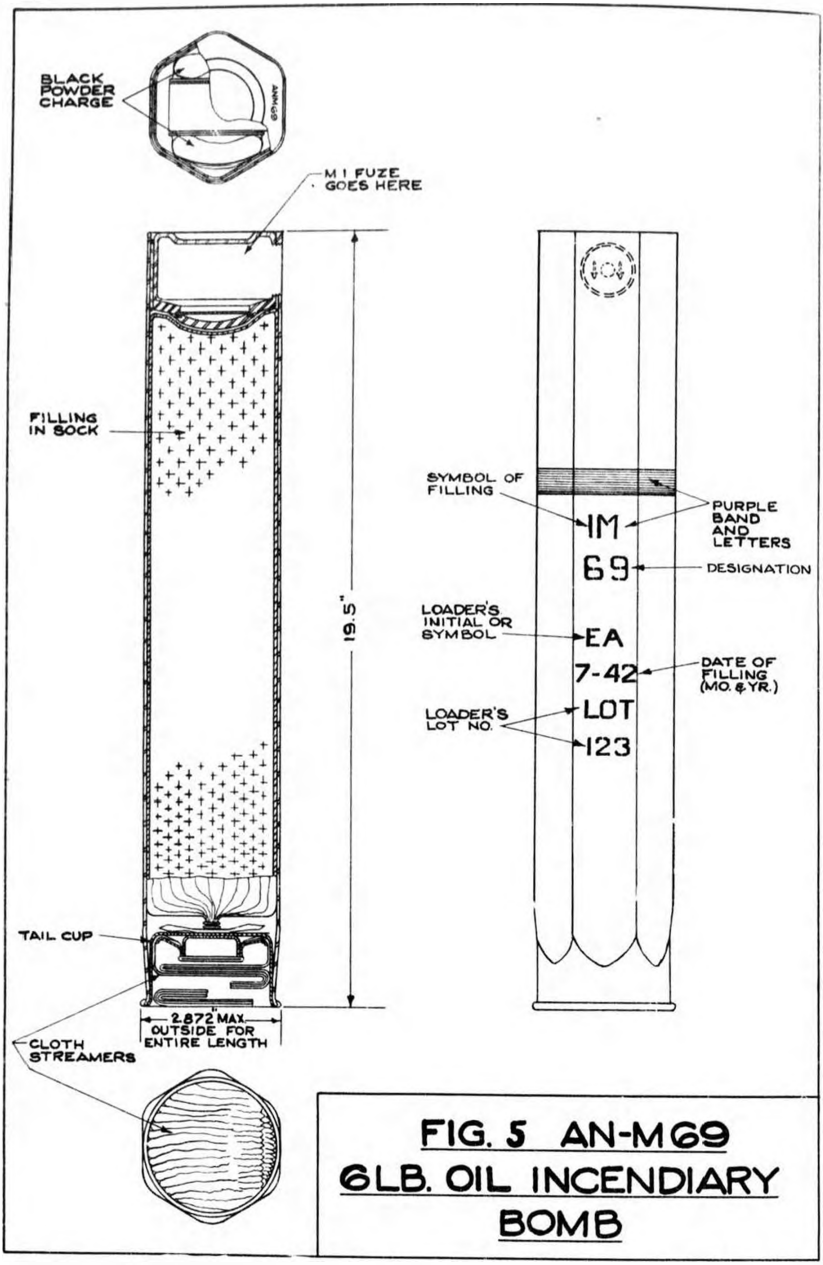


FIG. 5 AN-M69
6LB. OIL INCENDIARY
BOMB

Description:

The AN-M69 incendiary bomb, Fig. 5, is a six-pound oil filled, tail ejection type bomb which consists primarily of a bomb case, fuze and incendiary filling.

The hexagonal case, which forms the outer shell of the bomb is 19⅞ long and 2⅞72 wide across the flats of its hexagonal cross section. The case is formed from three inch, 19 gauge (0.042 inch wall) electrically butt welded steel tubing. A blunt, stamped steel nose cup, into which the fuze and ignition ejector powder charges are inserted, is welded to the forward end of the bomb case. The nose cup and likewise the fuze and powder charges are sealed off from the remainder of the case by an impact diaphragm and plug held in a cup-shaped sealing diaphragm. The after end of the bomb case is closed by the tail assembly, consisting of a tail cup, tail retainer and disc. Four gauze streamers, each 54 inches long, are attached to the tail retainer by means of a tail disc. The tail cup is secured to the hexagonal case by beading, crimping and heating.

The incendiary oil filling (a gelled gasoline, either IM, isobutyl methyl-methacrylate, or NP, napalm), weighing approximately 2.6 lbs., is held in a cheesecloth sock situated between the forward sealing diaphragm and the tail cup.

M1 Fuze:

The AN-M69 bomb uses the M1 inertia type fuze, Fig. 6. This fuze consists of five main parts, namely a die cast aluminum fuze base, a striker of the same material, a primer cap, a lead coated spitter fuze (60% black powder - 40% collodion) and a booster charge consisting of 1.2 grams of black powder. The booster cup is a clear, transparent, nitro-cellulose composition. The entire fuze assembly is contained in a

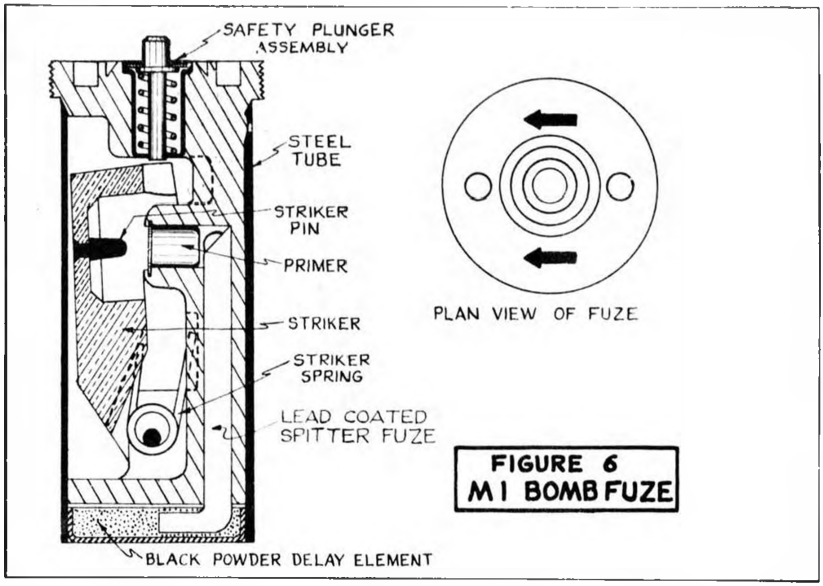


FIGURE 6
M1 BOMB FUZE

fuse case of steel tubing. A safety plunger (arming pin) prevents the striker from detonating the primer cap while the bomb is clustered. The fuse case, containing the entire assembly is screwed into the side of the hexagonal bomb case. When assembled, the two arrows on the top of the fuse case must be parallel to the longitudinal centerline and point aft. This is obviously necessary in order that the fuse may fire on nose impact. Two powder bags, each containing a mixture of five grams of black powder and two grams of oiled magnesium, are carried in the nose cup of the bomb next to the fuse to assist in ejection of the incendiary filler.

Operation of AN-M69 Bomb and M1 Fuse:

The AN-M69 bombs are carried in a cluster. Upon release from the cluster, the tail streamers are disengaged from the tail cup to stabilize the flight of the bomb. The streamers are of sufficient length to both stabilize the bomb and reduce its terminal velocity to permit optimum structure penetration. (If the bomb were not slowed down somewhat in its fall, the terminal velocity would be high enough to cause the bomb to penetrate too deeply into an average structure, or bury itself so far into fairly resistant earth as to be ineffective.) Upon release from the cluster, the spring operated fuse safety plunger in each bomb moves outward thereby arming the fuse. Upon impact, the momentum of the striker carries it forward and causes the striker pin to detonate the primer cap which in turn ignites the lead coated spitter fuse. The latter requires from three to five seconds to burn and this delay normally allows the bomb to penetrate and come to rest within the structure of the target. The spitter fuse ignites the booster charge of black powder contained in a celluloid cup in the end of the fuse case. This ignites the igniter-ejector charge of black powder and oiled magnesium powder. The resulting combustion lifts the unsecured plug in the impact diaphragm, ruptures the thin sealing diaphragm (.008 inches thick), blows off the tail cup and ignites the incendiary filling as it is ejected from the tail end of the case in a mass. Burning time is from twelve to fifteen minutes.

Performance Data:

In general, tests have shown the following performance characteristics of the AN-M69:

(a) The area (pattern) covered by 14 AN-M69 bombs released with the 100 lb. cluster from various altitudes (220 M.P.H. air speed) is from 150 to 230 yards in length and 34 to 140 yards in width. Sixty bombs released with the 500 lb. cluster covered an area 300 to 450 yards in length and 150 to 225 yards in width. These patterns were obtained with release altitudes up to 20,000 feet and with surface wind velocities of 8 to 20 M.P.H. While the higher altitudes of release tended, in some instances, to increase the size of the pattern, the effect of surface and intermediate winds caused the most noticeable variation in pattern size and in the accuracy of the bombs.

(b) The incendiary filling contained in a cheese cloth sock will be ejected for a maximum distance of approximately 75 yards from the bomb case. This distance will vary from zero to the maximum depending on the attitude of the bomb and surrounding obstructions at the moment of initiation of action.

(c) The fuse will not function reliably when the AN-M69 bomb is dropped from an altitude of less than 500 feet nor from higher altitudes when the bomb strikes soft or swampy soil.

(d) Fires started by this type of incendiary bomb are propagated by convention and radiation of heat as contrasted to thermate-magnesium type incendiary bombs which depend on conduction and radiation for continuation of burning of the target. The degree of combustibility and probability of continued fire propagation for any target are functions of so many variables -- kind of material and construction, dampness, wind conditions, etc., that the probable action of any one type of incendiary bomb on any given target cannot be stated with certainty.

M74 (E5) TEN POUND INCENDIARY

Status: Army - (Undergoing Service Tests)
Navy - (Undergoing Service Tests)

Description:

The M74, Fig. 7, formerly the E5, is a ten-pound incendiary, the same size and shape of the AN-M69 6 lb. oil incendiary. It is hexagonal in shape, 19⅝6 long and 2⅝872 in diameter measured across the flats. This bomb has a telescope type tail which is ejected under spring pressure when the bombs are released from the cluster. In addition to having an incendiary filling of IM or NP, the bomb may also be filled with mustard gas (H), or white phosphorus (WP) with internal structural variations as indicated in Fig. 7. The bomb uses the all-ways action fuze M3, which, unlike the M1 fuze in the AN-M69, screws into the nose along the axis of the bomb. Components of the bomb are as follows:

1. A sheet steel leak-proof casing extending the entire length of the bomb.

2. A nose cup which fits into the front of the casing, having a dome which in turn houses the fuze.

3. In bombs filled with IM or NP, a small chemical container located immediately behind the dome, filled with white phosphorus. This serves the double purpose of aiding ignition and producing smoke.

4. Filling. In bombs filled with IM or NP, the filling is enclosed in a cheesecloth sock. In bombs filled with white phosphorus the filling is enclosed in impregnated paper tubes inside the casing.

5. A tail cup which fits inside the rear end of the casing. A threaded hub inside this cup retains a well extending five inches into the body of the bomb. This well in turn holds the tail sleeve of the fin when the tail is compressed for clustering. In the compressed position, the fin portion fits inside the tail cup.

6. M3 Nose Fuze, Fig. 8. This is an all-ways action type fuze. Its safety features consist of a spring loaded arming pin and a safety pin. The body and head are zinc alloy casting. This fuze incorporates the M29 percussion primer and a built-in delay charge comprised of 60% black powder and 40% collodion, offering a delay of from one to two seconds. The booster cup is made of clear, transparent cellulose nitrate and is filled with one gram of fuze powder. The body is 3⅝032 long and 1⅝0 in diameter.

Operation:

The retaining pin is removed when the fuzed bombs are assembled in the cluster. While the bombs are in the cluster, their proximity holds the arming pin in the body of the fuze. When the bombs are released, the arming pin is forced out by its spring, permitting the safety pin to enter the cavity in the striker. Impact forces the striker and sleeve together, piercing the M29 percussion primer, which initiates the delay charge and subsequently, the fuze powder in the booster cup.

CAUTION: ONCE THE ARMING PIN JUMPS OUT, THE FUZE IS ARMED AND ANY ATTEMPT TO REINSERT IT MAY CAUSE THE FUZE TO FIRE.

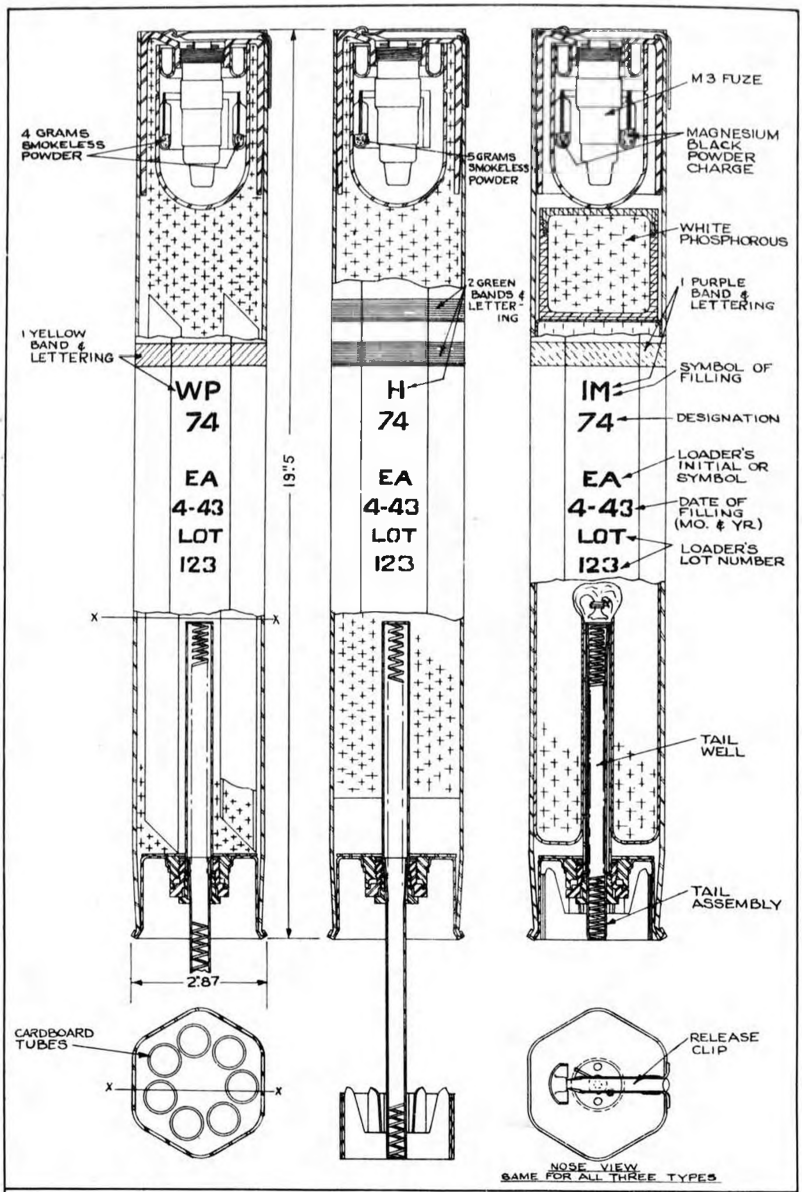


FIG. 7 M74 10 LB. CHEMICAL BOMB

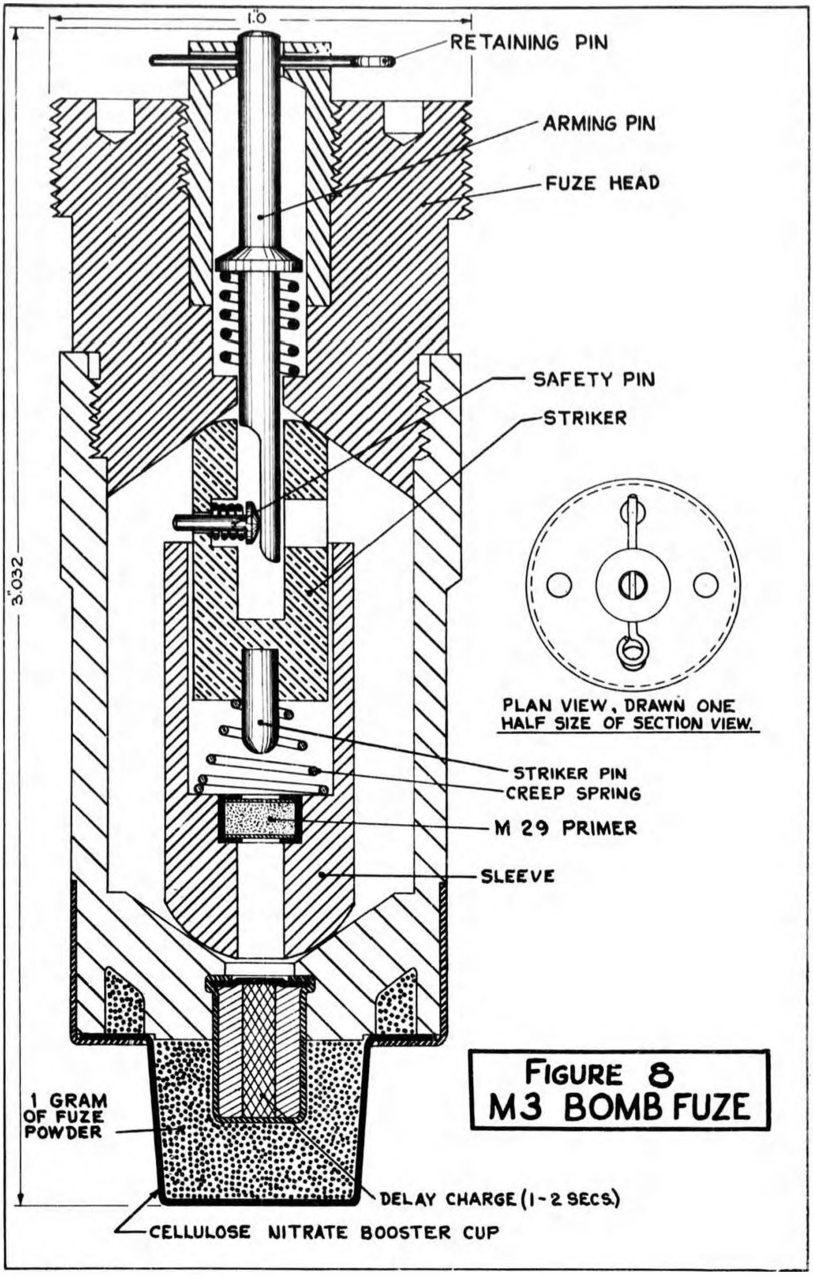


FIGURE 8
M3 BOMB FUZE

THE AN-M47A2 100-POUND CHEMICAL BOMB

Status: Army - Standard
Navy - Service

AN-M47A2 is the designation of the bomb case before it is loaded with gas, smoke or incendiary filler. It is a round nose cylindrical type with fins attached. The bomb is 48.92 maximum overall length and 8.125 in diameter. The body is constructed of sheet steel. The interior of the bomb is coated with oil.

The AN-M47A2 uses either the AN-M126 or the AN-M126A1 nose fuzes.

AN-M47A2 Incendiary:

As an incendiary bomb the AN-M47A2 is loaded with 40 lbs of gelled gasoline, either IM or NP. The complete round weighs 66 lbs. Several bursters may be used interchangeably with this bomb, including the M12 burster which is a long tube containing magnesium powder and black powder, or the M13 burster which is a long double walled tube containing T.N.T. in the inner tube, and white phosphorus in the outer tube. The M13 burster is preferred, however, because it gives better ignition of the gasoline gell incendiary mixture over a wider range of conditions than the M12 burster does. A special burster consisting of the M13 burster with T.N.T. in the inner tube and sodium in the outer tube instead of white phosphorus has recently been developed for this bomb. When the AN-M47A2 bomb is equipped with the latter burster, it may be used as an all-purpose incendiary bomb; i.e., against land targets or on water to ignite oil slicks. Because it can be accurately aimed and because of its concentrated incendiary effect, the AN-M47A2 type bomb is considered a satisfactory incendiary bomb for use against single isolated targets.

M47A1 Incendiary:

The M47A1 100-lb. incendiary differs from the AN-M47A2 only in that the interior coating is acid-proof paint instead of oil.

AN-M47A2 Smoke Bomb (Phosphorus):

This bomb has a main filling of white phosphorus. The complete round weighs 126.5 lbs. The M7 burster, containing black powder, is used in the AN-M47A2 when loaded with white phosphorus.

M47A1 Smoke Bomb (Phosphorus):

The M47A1 100-lb. phosphorus smoke bomb differs from the AN-M47A2 only in that it carries a charge of 103 lbs. of phosphorus and weighs 129.5 lbs.

AN-M47A2 Gas Bomb:

The AN-M47A2 bomb holds 68 pounds of H (Mustard) and is equipped with a T.N.T. M4 burster. When the bomb is loaded with mustard its resistance to leakage in handling and stowage aboard ship is not considered entirely satisfactory due to its thin case. The inside of the body is coated with oil.

M47A1 Gas Bomb:

The M47A1 differs only from the AN-M47A2 in that the interior is coated with acid proof black paint instead of oil.

MARK 1 100-POUND NAVY INCENDIARY

Status: Navy - Obsolete

(See Page 57,"U. S. Bombs and Fuzes")

MARK 28 100 POUND NAVY INCENDIARY

Status: Navy - Obsolete

(See Page 57, "U. S. Bombs & Fuzes")

M70 115-POUND CHEMICAL BOMB

Status: Army - Standard
Navy - None Procured

Although this bomb is usually filled with a charge of 57.1 lb. of mustard gas (H) (See page 35, "U. S. Bombs and Fuzes"), it is included here because it may also be filled with Lewisite, white phosphorus or gelled gasoline.

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AN-M76 500-POUND INCENDIARY BOMB

Status: Army - Standard
Navy - Service

Description:

In outward appearances the 500-pound AN-M76, Fig. 9, resembles the 500-pound AN-M64 G. P. bomb. It is 59 7/2 long overall and 14 7/18 in diameter. The body itself is 45 7/3 long.

The filler consists of a thick oil gel weighing 180 pounds. The mixture is called PT_1 and liberates heat at a rate about four times that of IM (isobutyl methyl methacrylate). The composition of PT_1 is:

Component	Parts by Weight
Crude magnesium dust paste	49.0
Isobutyl methacrylate, palmer AE	3.0
Coarse magnesium scrap (20 to 60 mesh)	10.0
Petroleum oil extract	1.7
Petroleum pressure distillate	3.3
Gasoline	27.0
Barium Nitrate	5.0
Ammonium perchlorate	1.0

A burster well, 3 5/5 in diameter and 35 7/75 long runs through the center of the bomb. Inside the well is an AN-M5 igniter holding 9 lbs. of white phosphorus. Enclosed in the AN-M5 igniter tube is the AN-M14 tetrytol burster (1.25 lbs).

The base plate is welded to the bomb body as seen in Fig. 9. Furnished with each bomb is an adapter booster holder assembly fitted with the M115 adapter booster. This assembly is shipped separately and screws into the base plate.

The bomb is olive drab overall. Marking on the bomb body may be seen in Fig. 9.

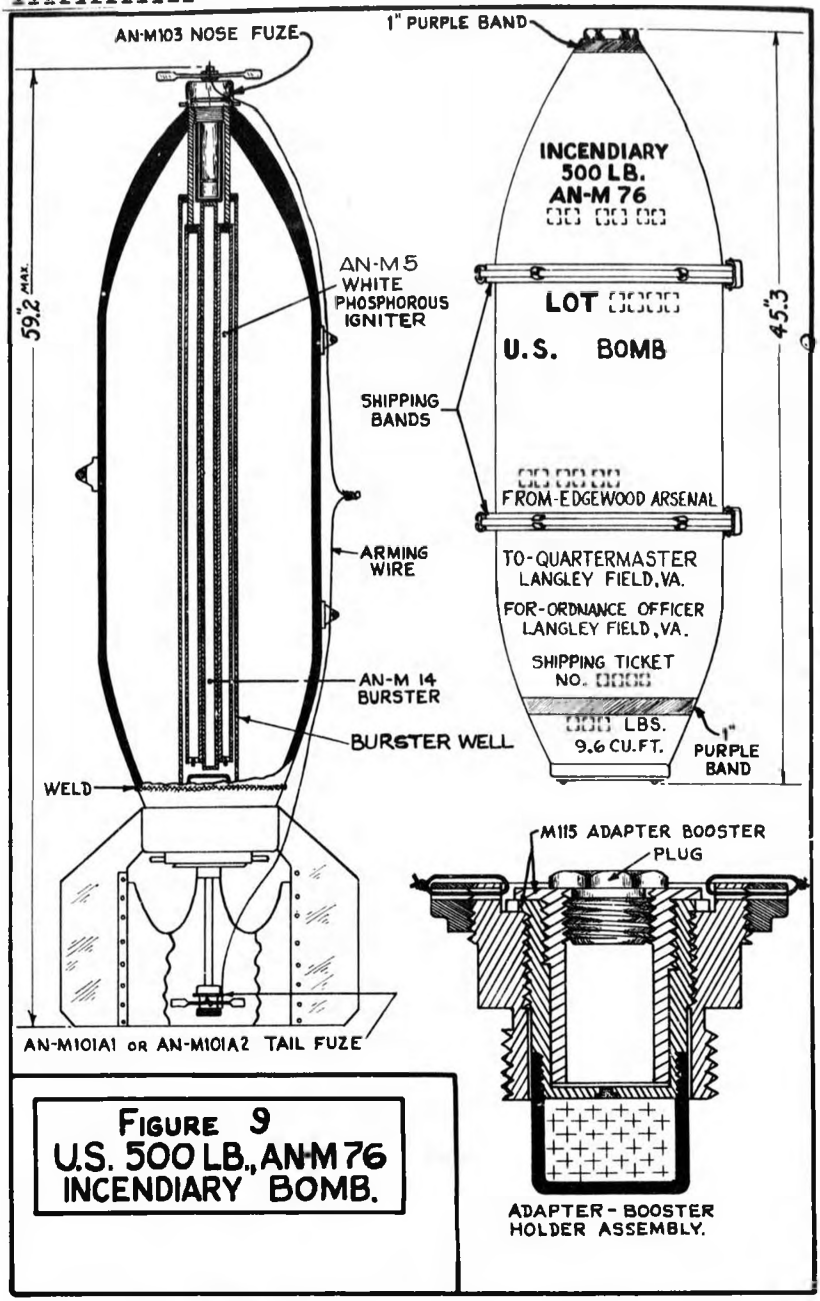

FIGURE 9
U.S. 500 LB., AN-M 76
INCENDIARY BOMB.

ASSEMBLY OF COMPLETE ROUND

The bomb is shipped unfused and without the tail fin. It is sealed with a nose plug and a metal plate over the base plate. Prior to assembly, all mating parts such as fuses, fuze cavities and the adapter booster holder assembly should be examined for burrs, dirt, etc. All surfaces must be clean. Assemble the bomb as follows:

1. Remove the shipping bands from around the bomb.
2. Remove the rear plate from the body and insert the AN-M5 white phosphorus igniter.
3. Insert the AN-M14 tetrytol burster into the igniter tube.
4. Screw the adapter booster holder assembly firmly into the base plate.
5. Slip the fin assembly over the tail end of the bomb and align the fins in the proper manner for the suspension lugs. Tighten fin lock nut.
6. Install the AN-M101A1 or AN-M101A2 tail fuze. Make sure that the fuze is fitted with an M14 non-delay primer detonator.
7. Install the AN-M103 nose fuze (Instantaneous setting).
8. Install the arming wire in the normal manner.

PRECAUTIONS:

Make certain that both the nose and tail fuze will function with instantaneous action.

The AN-M5 igniter should be handled with reasonable care. Under no circumstances should the filling plugs in the igniter or the filling plugs in the bomb be removed.

No disassembly of any of the bomb components should be permitted.

SHIPPING AND PACKING:

The complete round components are shipped as follows:

1 Bomb, AN-M76, unfuzed and without fin, having two shipping bands

4 Igniters, AN-M5 per box.

6 Adapter booster holder assemblies with the M115 adapter boosters and fin lock nuts in a box.

25 Nose fuzes AN-M103 in a box.

25 Tail Fuzes AN-M101A2 in a box.

25 Bursters AN-M14 in a box.

1 Fin assembly in standard G. P. fin crate.

1 Package arming wire assemblies (not shipped in tail fin crate).

TACTICAL USE:

The AN-M76 500-pound incendiary bomb was originally requested by the Eighth Air Force to serve two main objectives:

1. Penetration. A bomb of this kind, due to its comparatively heavy case, can be used effectively

against industrial targets or concrete construction with heavy roofs, etc.

2. Aimability. This bomb, having the same flight characteristics as a standard G. P. bomb can be used for precision bombing. While clustered, small type incendiaries are released a brief interval after dropping G. P.'s, the AN-M76 can be dropped simultaneously with G. P.'s, thus affording a quicker escape for the aircraft. This bomb has a dispersion area of about 600 x 800 feet.

INCENDIARY BOMB CLUSTERS

INTRODUCTION:

Incendiary bomb clusters may be divided into two types:

1. Quick Opening Clusters:

This type cluster consists of a steel framework adapter inside which the bombs are packed in such a manner that the safety plunger of each bomb is held depressed, or in the unarmed position, by an adjacent bomb until such time as the cluster breaks open upon release from the aircraft. These clusters require no fuze to burst the assembly but use instead a simple arming wire arrangement. The arming wires are inserted through several release latches located on top of the cluster and are withdrawn upon release of the cluster from the aircraft, permitting the bombs to fall free of the cluster. These clusters are available in both 100 and 500 lb. sizes.

2. Aimable Clusters:

Aimable clusters are relatively new. They fit a 500 lb. bomb station and were designed for precision bombing and use an aerial burst nose fuze, which can be set to function at any desired altitude, to burst open the cluster. By this means the dispersion pattern of the bombs is more concentrated than it is possible to achieve with the quick opening type cluster when dropped from altitudes above 5000 feet. The aimable cluster is streamlined, using a standard G. P. bomb fin.

QUICK OPENING TYPE CLUSTERS

AN-M6, 100-lb., and M7 500-lb.

These two clusters are shown in Fig. 10.

Cluster	Bombs Used	No. of Bombs	Wt.(lbs)	Length	Width
AN-M6	AN-M50A2	28	140	43⅞0	8⅞0
	AN-M50XA3	6			
M-7	AN-M50A2	102	545	43⅞0	13⅞7
	AN-M50X-A3	26			

Other Bombs Used:

These clusters may also be filled with AN-M50A1, AN-M50X-A1, AN-M50X.

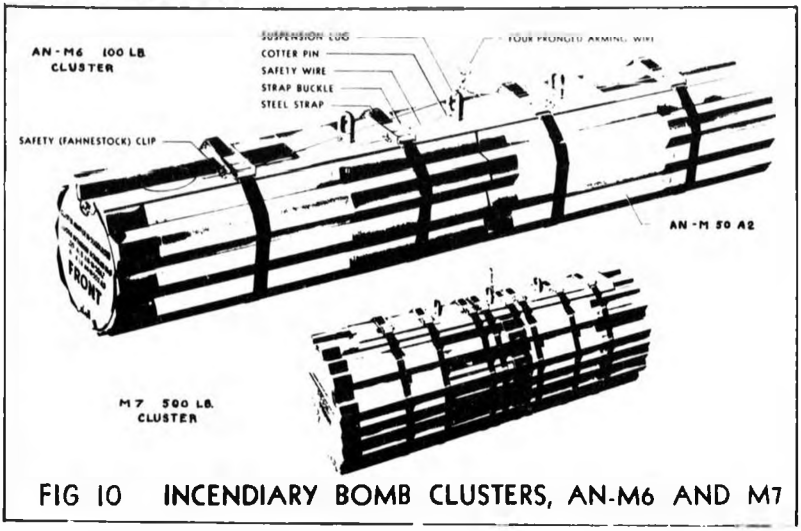

FIG 10 INCENDIARY BOMB CLUSTERS, AN-M6 AND M7

AN-M8, 100-lb. and M9 500-lb.

These clusters are shown in Fig. 11

Cluster	Bombs Used	No. of Bombs	Wt(lbs)	Length	Width
AN-M8	AN-M54	27	135	43"0	8"0
	AN-M54X	7			
M-9	AN-M54	102	540	43"0	13"7
	AN-M54X	26			

Other Bombs Used: AN-M54X-A1

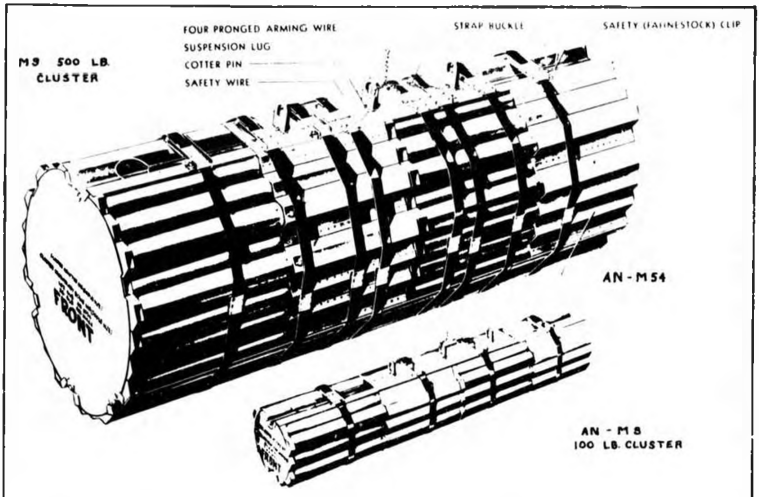

FIG 11 INCENDIARY BOMB CLUSTERS, AN-M8 AND M9

M10 100-lb, and M11 500-lb

These clusters are designed for the 2-lb. incendiaries. The Navy is not procuring these items.

Cluster	Bombs Used	No. of Bombs	Wt.(lbs)	Length	Width
M10	AN-M52A1	42			
	AN-M52X-A1	9			
M11	AN-M52A1	153		42"98	13"75
	AN-M52X-A1	39			

Other Bombs Used: AN-M52

AN-M12 100-lb. and AN-M13 500-lb.

These clusters, Fig. 13, are filled with AN-M69 6-lb oil incendiaries.

The AN-M12 holds 14 bombs arranged in two groups of 7 each. This cluster is 39"4 long and 8"6 in diameter and weighs 105 lbs.

The AN-M13 holds 60 bombs and is 59"2 long and is 17"4 in diameter. Total weight, 417 lbs.

Some difficulty will be experienced in hoisting the earlier lots of the 500 lb. clusters to bomb racks as no hoisting lug was provided. Some sort of a hoisting lug might be improvised but it is believed that in the majority of cases it will be quicker to "man-handle" the cluster into place. Later clusters are being provided with a satisfactory hoisting lug. Double cable hoisting of these clusters or, single cable hoisting with shackles, may be accomplished by means of the Mark 8 hoisting band.

The sway braces on the majority of naval aircraft are so located that they fail to contact the sides of the 500 lb. cluster. (The semi-octagonal frame members on either side of the cluster result in "open spaces" at the points where the sway brace pads normally would rest). It is, therefore, necessary to provide areas upon which the sway brace pads may rest. This can most easily be accomplished by making four suitable wooden blocks which fit into the semi-octagonal frame members and which may be positioned at the appropriate locations.

Later lots of clusters are equipped with adjustable plates upon which the sway braces can rest.

The arming wires currently furnished with these clusters have been found to be too short for use with many types of Navy bomb racks and shackles. Difficulty is encountered when trying to insert the swivel loop into the arming mechanism. In the majority of cases, the loop will not reach the arming mechanism and when an attempt is made to pull the loop out further, the ends of the arming wires slip out of the retaining buckle mechanism.

To overcome this difficulty, it is suggested that an extension in the form of a standard arming wire be used. Normally, this extension will need to be only about five inches long. Securely attach the free end of the extension to the swivel loop of the cluster arming wire and insert the other end (to which is attached an arming plate or swivel loop) into the arming mechanism of the rack or shackle.

In the future longer arming wires or extensions will be shipped with the clusters.

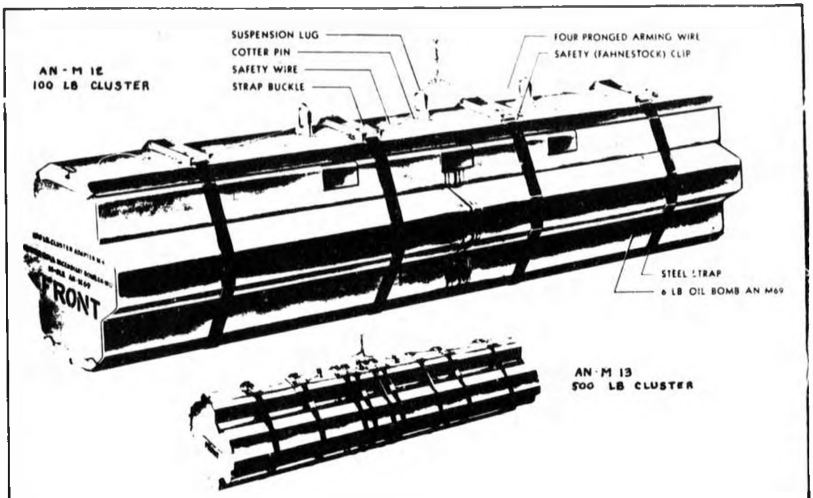

FIG 13 INCENDIARY BOMB CLUSTERS, AN-M12 AND AN-M13

M17A1 500 lb. AIMABLE CLUSTER

DESCRIPTION:

The M17A1 500-lb. aimable cluster, Fig. 14, is a streamlined cluster 56⅞ long overall (less nose fuze) and 15⅝ in diameter. The cluster has a channel bar around which the bombs are packed and the assembly is held together with nine metal straps. A standard tail fin is fixed to the aft end plate by means of a single, heavy bolt. At the forward end, a rounded nose fairing is fastened to the end plate. From the fuze seat, a PETN primacord is led through a thin metal tube for the entire length of the cluster. The cluster is equipped with three suspension lugs, the center one added for use in connection with British aircraft. The cluster is olive drab overall.

An aerial burst nose fuze, the M127 (see page 18, AFAEO Bulletin No. 3)* is used.

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* NOTE: A correction should be made in AFEO Bulletin No. 3 on Page 18. Change the fuze designation "T39E1" to "T39". The T39, standardized as the M127, differs from the T39E1 in that the T39 has a tetryl booster charge weighing 18 grams while the T39E1 has a tetryl booster weighing only 7 grams. The T39E1, when it becomes standardized, will be known as the M138 and is designed for use in the E6R2 500-lb. aimable cluster, where the booster charge of the M127 is too powerful for bursting the cluster and damage to the contents results.

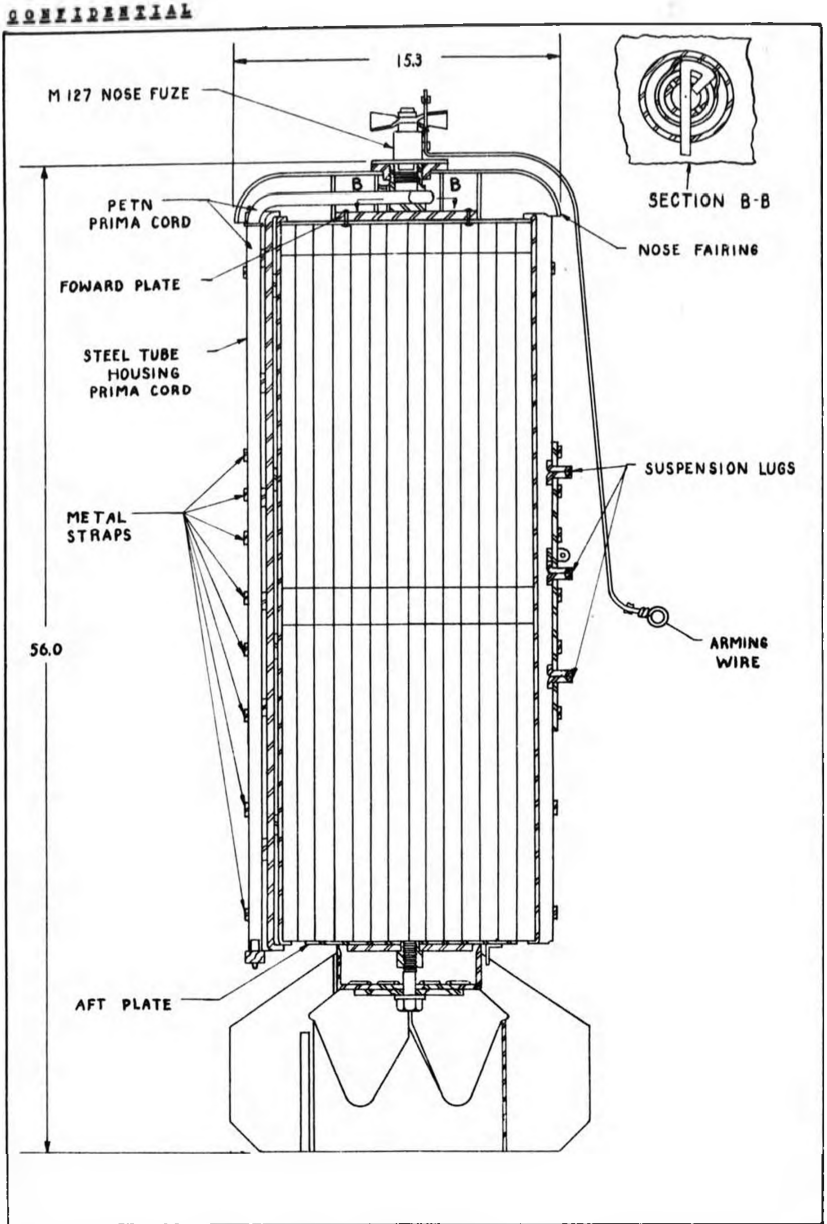

FIG. 14 M17A1
AIMABLE CLUSTER

OPERATION:

The M127 nose fuze is pre-set to the desired air burst. This permits the cluster to be dropped accurately from high altitudes; i.e., above 5000 feet. When the fuse detonates, the primacord is ignited and as it detonates, bursts the metal straps holding the assembly together and permitting the bombs to fall free. Because of their increased velocity, the penetration of the bombs is greater than the penetration of bombs from a quick opening type cluster. As mentioned previously, the bomb patterns produced by aimable clusters are more dense than the pattern produced by quick opening clusters.

REMARKS:

This cluster is shipped to the field complete in one crate, filled with 110 AN-M50A2 and AN-M50X-A3 incendiary bombs in the following proportions:

88 AN-M50A2
16 AN-M50X-A3, Type A
6 AN-M50X-A3, Type B

Assembly consists primarily of fixing the tail in place and installing the M127 nose fuze and the arming wire. It is to be noted that the fuze is to be installed after the cluster has been loaded in the aircraft.

E6R2 500-lb. AIMABLE CLUSTER

DESCRIPTION:

The E6R2 500-lb. aimable cluster, Fig. 15, is a new cluster designed for use with AN-M69 and M74 (E5) incendiary bombs. The cluster has an over-all length of 59⅝6 and a diameter of 14⅛69. It weighs 350 lbs.completely assembled. A standard type bomb fin is affixed to the rear of the cluster. The cluster holds 38 bombs which are packed nose forward, 19 in the front half of the cluster and 19 in the rear. A cross-section of each group is circular, the bombs being held in this position by cluster bars. The bombs and cluster bars are covered with a two-piece steel cluster wall. One-half of this wall wraps around each side of the cluster. At the top of the cluster the two sections are clamped under the suspension bar, while the two lower ends are clamped under the lowest cluster bar.

Nine steel straps, each 3/4 inch wide, are fitted around the entire cluster assembly at intervals. These straps hold the cluster together.

An L-shaped angle bar runs the entire length of the cluster along the bottom cluster bar. Into the angle is fitted a light steel tube which encloses a length of .202 inch primacord. This cord is channeled up into the front head of the cluster, where it ends inside the nose fuze adapter. Here it contacts the tetryl cup of the nose fuse when the fuze is screwed into the adapter. It is the primacord which, when detonated by the fuze burster, breaks the steel straps and thereby permits the cluster to open.

Eyes for three suspension lugs are located at the top of the bomb along the suspension bar. Lugs are attached to the front and rear eyes when the American bomb shackle is used. A lug will be attached to the center eye for use with the British bomb shackle. A Navy hoisting lug is placed between the center and rear suspension lugs. All suspension lugs are removed when the cluster is packed, and only those which are to be used need be installed when the cluster is prepared for use.

Added weight is given to the front of the cluster by a ballast plate located immediately in front of the front end plate. The ballast plate is covered with a dish-shaped nose fairing.

A rear end plate fits over the back of the cluster. The tail fin assembly is screwed into place immediately behind it but is removed for shipping.

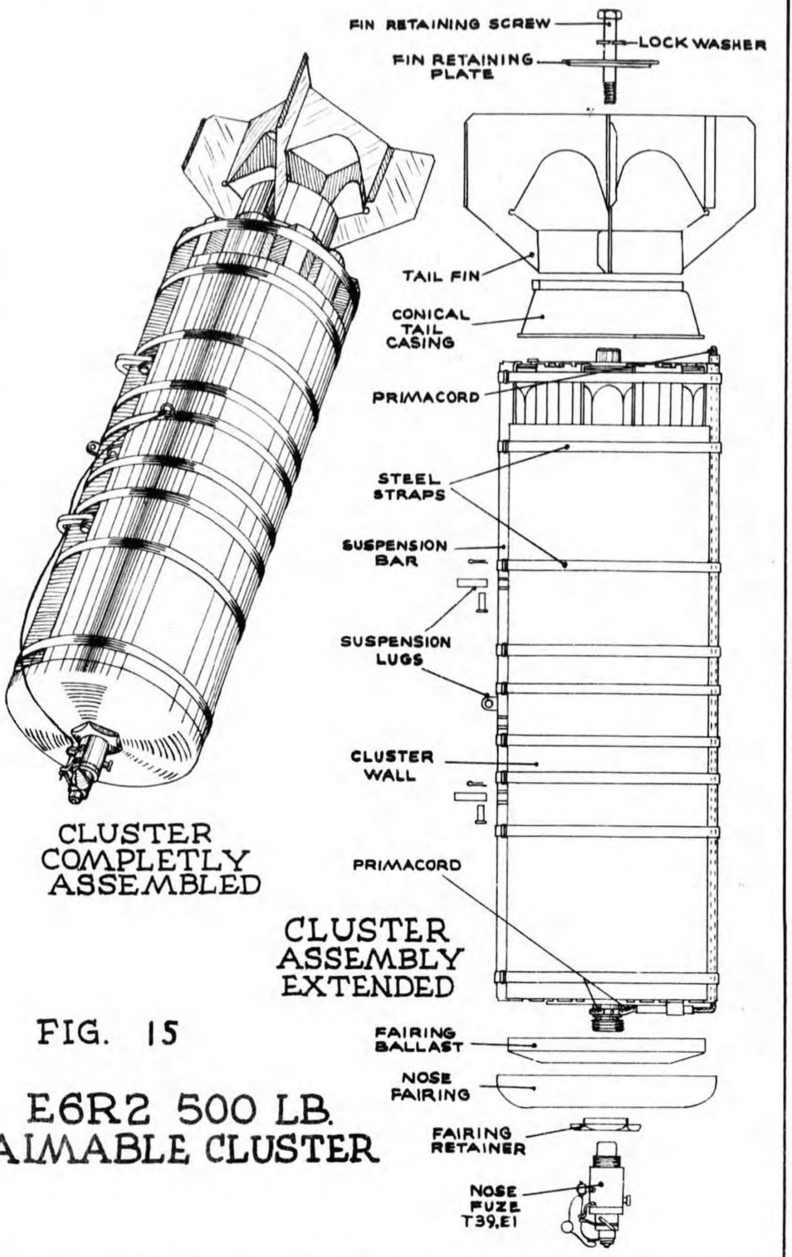

FIG. 15

E6R2 500 LB. AIMABLE CLUSTER

At present the clusters shipped to the field will have a T39E1 nose fuze, which is a modification of the M127 aerial burst nose fuze. (See footnote, page 23.) The fuze screws into the nose of the cluster so that the booster well at its rear fits securely against the primacord

OPERATION:

The arming wire is pulled from the fuze as the cluster leaves the airplane, and the fuze begins to arm. After the desired delay, provided by the clockwork mechanism in the fuze has expired, the fuze fires at the predetermined altitude and the explosion of the tetryl booster detonates the primacord which runs the full length of the cluster. Explosion of the primacord breaks the nine steel straps, allowing the cluster wall to open. The bombs then scatter.

PREPARATION FOR USE:

Fasten the suspension lugs as needed to the eyes on the suspension bar of the cluster. Use either one or two lugs in the correct position, depending on whether a British or an American bomb shackle is to be used. Make certain that cotter pins are inserted and opened.

Install the tail fin assembly by fitting it against the rear end plate. Make certain the slot in the conical tail casing is engaged in the protrusion at the top of the end plate. Bolt the fin assembly in place by running the fin retaining screw (with washer) first through the fin retaining plate and then screwing it into the center plate lug.

After loading the cluster in the plane, install the fuze. Under no circumstances should the fuze be screwed into place until after the cluster has been loaded. The arming wire must be threaded through the top hole of the arming pin and then through the top holes of the two protrusions which lock the vane. The wire is pulled forward to a point parallel to the end of the fuze. NO SAFETY CLIP IS TO BE ATTACHED TO THE ARMING WIRE.

REMARKS:

For current procurement the E6R2 cluster will be available with only an aerial burst nose fuze, the T39E1. Edgewood Arsenal is working on a modification of the E6R2 which will incorporate a tail fuze in addition to the nose fuze. This tail fuze, presently known as the T53E1 is still undergoing tests and until such time as it is available, the E6R2 will be used with the T39E1 only.

TACTICAL USE OF INCENDIARIES

The effectiveness of incendiary munitions against specific targets has recently been evaluated by exhaustive tests. The Chemical Warfare Services conducted the tests at Dugway Proving Ground, Tooele, Utah, using full scale structures complete with furnishings to simulate typical dwellings found in the industrial areas of German and Japanese cities. The test structures used as targets were designed following special studies to determine what construction was most typical of the majority of roof areas in the leading enemy cities.

The effective use of incendiaries requires a careful study of the target to be attacked. The quantity of munitions to be used should be based on the roof coverage of the target area. A survey indicates that approximately 210 square miles of industrial area in seventeen major German cities have a roof coverage of 40% or higher, and that at least 80% of this roof area consists of tile or slate supported by heavy wood framing members. Analysis of roof coverage in the larger industrial cities of Japan indicates that: (a) approximately 60% of the industrial area of the larger Japanese cities is covered by roofs; (b) the predominant part of this roof area consists of dwelling units - of these units at least 80% are of tile or sheet metal roof construction; and (c) tile and sheet metal roofs are typical of at least 65% of all roof construction over the entire area of the larger Japanese cities. On the basis of a study of selected targets in twenty major Japanese cities, it has been arbitrarily

established that to initiate a conflagration capable of certain destruction of the target in a single operation, 864 separate fires of the appliance type (i.e., beyond householder control) must be set per square mile of target area. Combustible buildings, industrial areas with 30% or better roof area per square mile, supply dumps, barracks areas, refineries, oil and gasoline storages above ground, docks, and warehouses are especially susceptible to incendiary attack.

To simulate the actual dwellings that would be found in Japanese and German cities, 19 separate two-story buildings were constructed on a plot 252' by 140' as the target group for the Dugway Proving Ground experiments. The roof area of approximately 15,000 sq. ft. was distributed in the proportion 43% German to 57% Japanese construction, and occupied about 50% of the target plot. The remainder consisted of 40' alleyway spacing between the buildings to serve both as fire breaks and as streets to allow entry of fire fighting equipment. The materials of construction were faithfully reproduced as regards wood and moisture content to guarantee structural and burning properties equivalent to those found in Japan and Germany. The size and weight of movable materials found in dwellings were authentically reproduced.

The munitions used in the tests were 500-lb. quick opening clusters of AN-M50A1, AN-M52, AN-M54, and AN-M69 incendiary bombs, and simable clusters of the AN-M69 incendiary bomb.* The bombs were of latest manufacture. The tests were conducted in three phases as follows: phase (A) - dispersion, flight stability, and functioning tests of the bombs; phase (B) - penetration of inert bombs into the target structures. In this case, 500-lb. clusters of incendiary bombs, complete, but rendered inert insofar as incendiary action was concerned, were dropped singly on to the target group from various altitudes; and phase (C) - incendiary tests. The conduct of the operations under phase (C) was similar to phase (A) though on an expanded basis, and live bombs were used. Fire fighting equipment was used to simulate the enemy's defense against an incendiary attack under service conditions. Altitudes of releases for all phases were 3,500', 10,000' and 20,000' respectively. Formations of three planes were used for the dropping tests. The leading plane was equipped with an M series bombsight and established the time of release for the other planes. Prior to the release of each cluster, the bombardier was given clearance by radio and supplied with the mean wind velocity and direction. This procedure did not simulate service conditions but was necessary to evaluate fully complete bomb data and cluster functioning data for the tests.

In phase (A) it was found that of all the bombs tested, the AN-M69 was superior in dispersion, flight stability, and functioning, and that 95% bomb functioning could be expected. In phase (B) it was found that from the standpoint of penetration the AN-M69 was the most suitable bomb for incendiary attack on Japanese targets (dwellings). In phase (C), it was established, by arithmetical evaluation of the incendiary tests, that the expenditures of AN-M69 incendiary bombs required to produce 864 appliance type fires which would initiate a conflagretion capable of destroying an area target in a single operation is as follows:

Roof area	AN-M69 bomb expenditure - tons per sq. mile of target area
30%	94
50%	42
80%	36

*NOTE: At the time these tests were conducted, the M74 (E5) had not yet been developed sufficiently to be included in the tests. Hence, this article omits mention of this 10 lb incendiary. When details of its tactical uses are available, they will be published in the Bulletin.

Dispersion areas obtained from the tests indicate that the following pattern densities may be obtained when 500-lb. quick opening clusters are dropped from 10,000':

Type Bomb	No. Bombs	Length Pattern (yds)	Width Pattern (yds)	Area (Sq. Yds.)	Pattern Density (Bombs per sq. yd.)
AN-M69	69	365	200	73,000	.0082
AN-M50	128	900	300	270,000	.000473
AN-M52	192	940	525	493,000	.000389
AN-M54*	92	260	165	42,900	.00210

* 72% bomb recovery only.

All the bombs tested are susceptible to drift under the influence of winds.

The new type of aimable incendiary bomb cluster has marked advantages over standard quick opening clusters which cannot be accurately aimed from altitudes above 5,000' - 8,000'. There are two aimable incendiary bomb clusters now available which are approximately the size of a 500-lb. G. P. bomb and can be suspended from any 500-lb. bomb station. They are the aimable cluster M-17A1 (Page 24), and the aimable cluster E6R2 (Page 26). These clusters are suitable for accurate bombing from altitudes above 5,000'. It is reported by the Chemical Warfare Service that 90% overall functioning can be expected for these clusters and bombs.

Recent action reports indicate that the use of incendiaries as target markers for night attacks on island targets has met with little success. In one instance, the incendiary bombs were dropped on an airstrip for the purpose of marking the target for later waves of dive bombers, but the incendiaries were ineffective. It is recommended that land flares be used instead of incendiary bombs for target markers.

The AN-M69 incendiary bomb appears to be the best bomb available for air attack on Japanese slate, tile, or sheet metal roofed dwellings or any combustible structures of relatively light construction. The incendiary oil filling, which is ejected from the tail of the bomb some three to five seconds after fuze action is initiated by impact, is of a very sticky composition and will ordinarily adhere to any objects, including vertical walls, against which it may be thrown. Because incendiary action can usually be initiated on a wall with much greater effectiveness than on an open floor, the three to five second delay of the fuze is provided in order to give the bomb an opportunity to fall over on its side, after coming to rest, before the action which ejects the filling is initiated.

Against heavier type targets such as factory buildings and warehouses which resist penetration, AN-M50A2 magnesium bombs, M47A1 or AN-M47A2 gasoline gel incendiary bombs are more effective than AN-M69 bombs. The AN-M54 4-lb. thermite incendiary bombs were found to have a relatively poor incendiary effect in the tests; this bomb is now considered obsolescent. Quick opening clusters of incendiary bombs should not be used against isolated targets of small roof area. For isolated targets, either aimable clusters or the incendiary bomb M47A1 or AN-M47A2 equipped with the AN-M126A1 instantaneous nose fuze is recommended. With this fuze either the M47A1 or the AN-M47A2 bomb is suitable for dive bombing. The AN-M76, 500 lb. incendiary, may also be used effectively in this connection.

It should be borne in mind that incendiary bombs need a sufficient amount of combustible material to be effective as a destructive weapon. The target should be carefully studied to ascertain the roof area coverage of combustible structure per square mile in order to determine the quantity and type of munitions to use. Where roof areas are 30% or greater, a heavy incendiary attack following a high explosive attack would be more effective than high explosives alone. Against non-

combustible targets, or widely scattered targets, as may be found on small islands, incendiary bombs will not be as effective generally as a corresponding weight of high explosive munitions. Incendiaries are not effective against parked aircraft; for such missions, strafing and the use of fragmentation bombs is recommended.

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BIBLIOGRAPHY - MATERIAL COVERING INCENDIARIES

Drawings:

AN-M58	Chem.	Warfare	Drawing	No.	C14-8-188
AN-M50A1 & A2	"	"	"	"	C14-8-107
AN-M50A1A2 & XA2	"	"	"	"	1614-8-271
AN-M54	"	"	"	"	C14-8-64
AN-M69 & M1 Fuze	"	"	"	"	C14-8-188; R14-15-8
AN-M74 & M3 Fuze	"	"	"	"	C14-8-465; C14-8-252; C14-8-378; R14-15-32
AN-M76	Ordnance	Dept.	Drawing	No.	82-0-180; 82-14-47
Clusters - AN-M5 and M7	Bu Ord	Chart	No.		AV-13-43
AN-M8 and M9	"	"	"		AV-14-43
AN-M12 & AN-M15	"	"	"		AV-15-43
M17A1	Chem.	Warfare	Drawing	No.	C14-23-250
E6R2	"	"	"	"	C8-279

Tactical Use of Incendiaries:

Bulletin of Ordnance Info., No 1-44

Other Written Material:

TBC MI "Aimable Cluster E6R2"
BuOrd Circ. Ltr. AV129-43, "AN-M69"
TBX-23, "AN-M76, Preliminary Instruction"

* * * * * * * * * * *

M78 500-lb. CHEMICAL BOMB

Status: Army - Standard
Navy - _____

DESCRIPTION:

The M78, 500 lb. chemical bomb, Fig. 16, resembles the 500 lb. G. P. AN-M64 bomb in appearance. Construction is similar to that of the 1000 lb. AN-M79, and it has a base plate consisting of a special forging welded to the case containing the M_1 needle valve, Figs. 18 and 19. The bomb is 59⅞25 long overall, and 14⅞16 in diameter. The body itself is 46⅞7 long. Standard fusing consists of the AN-M103 nose fuze, and the AN-M101A2 tail fuse (with M14 non-delay primer detonator). As an alternative, the M127 nose fuze may be used in conjunction with the M117 adapter booster. A standard box type fin assembly is fitted to the bomb in the usual manner.

The bomb has an axial steel weld 2⅞5 in diameter which runs through the bomb. The M_1 needle valve is inserted into the base plate (See detail sketch, Fig. 16), and serves a two-fold purpose -- (1) as an air vent when filling the bomb with the chemical agent; and (2) for surveillance tests while in storage (for further details of its use see Page 32).

Other accessories consist of the M15 burster which is inserted into the burster well, and the M115 or M115A1 adapter booster inserted into the aft end to accomodate the tail fuze.

This bomb uses the same fillers as the AN-M79 1000 lb. chemical bomb:

Filler	Wt. of Filler	Total Wt. of Bomb
AC (Hydrocyanic Acid)	100 lbs	359 lbs
CG (Phosgene)	205 lbs	464 lbs

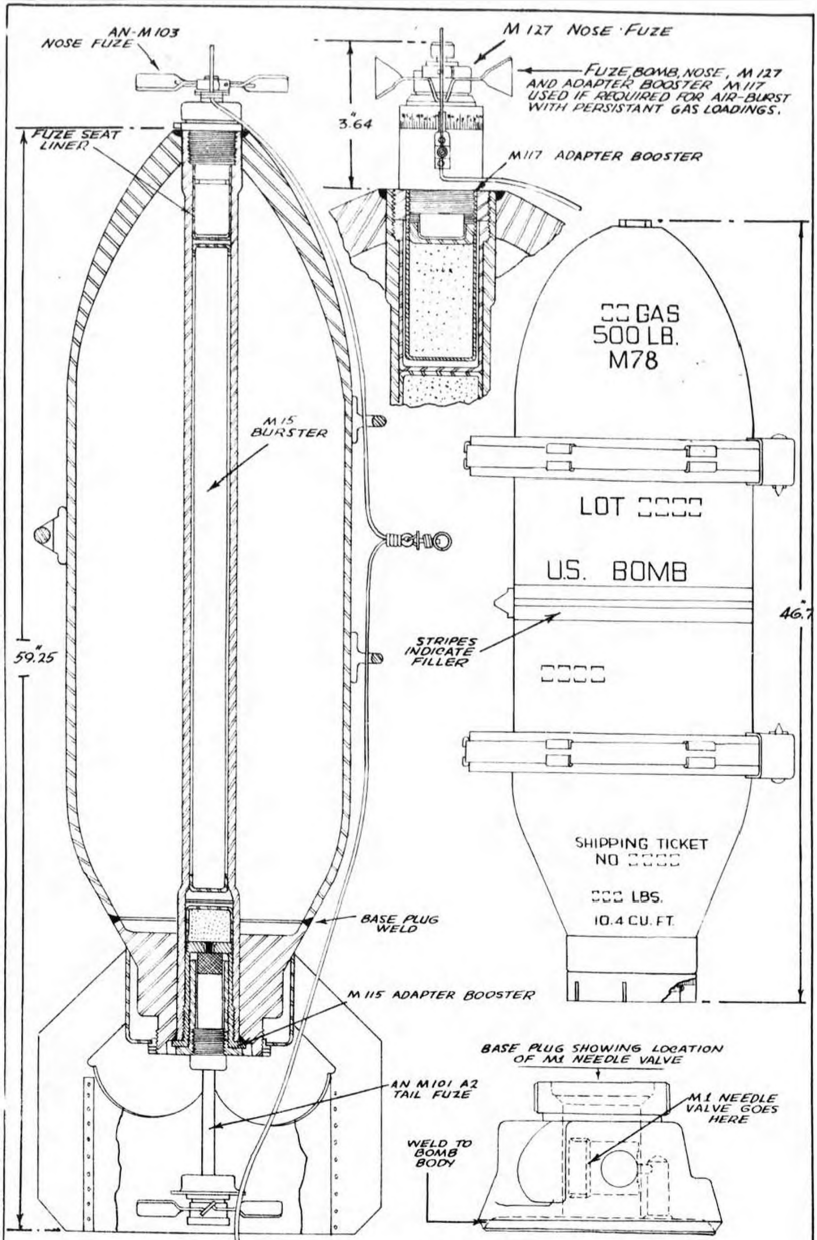

FIG. 16 M78 500 LB. CHEMICAL BOMB

The body is painted blue-gray overall with stencilled green lettering. One or two bands are painted around the body in accordance with the filler used.

All the bomb accessories, including the nose fuze seat liner, the M15 burster, the M115 adapter booster, tail fin, and arming wire assembly, are shipped separately for assembly in the field. Assembly instructions are the same as those for the AN-M79 on Page 34.

Safety precautions for this bomb are also the same as those for the AN-M79 (See Page 35).

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AN-M79 1000-lb. CHEMICAL BOMB

Status: Army - Standard
Navy - Service

DESCRIPTION:

In outward appearance, except for the base plate, the AN-M79 bomb, Fig. 17, resembles the AN-M65, 1000-lb G. P. bomb and takes the same tail assembly, arming wires and fuzes, namely, the AN-M103 in the nose and the AN-M102A2 in the tail. The M127 aerial burst nose fuze may be used as an alternative but it requires the M117 adapter booster. The bomb is 69⅞ long overall, and 16⅜8 in diameter. The bomb body itself is 53⅜6 long. The bomb has a steel burster well 2⅜5 in diameter running axially through it, which is expanded in both the nose and base plate before welding. The purpose of expanding the weld is to eliminate any possibility of decomposition of chemical fillers due to the presence of crevices. The base plate differs from that of the standard G. P. bomb in that it is a special forging welded to the case and containing the M1 needle valve, Figs. 18 and 19, and a 1⅞25 filling hole closed by a soft iron gasket, a hard steel gasket plug, and a threaded closing plug.

This bomb uses the M16 burster which consists of a waterproof fiber tube filled with 4.45 pounds of tetrytol. This amount of tetrytol is sufficient to break the bomb case into a few large pieces without causing the chemical agent to "flash".

The chemical filler may be either AC (hydrocyanic acid) or CG (phosgene). Although the bomb is classified as a 1000 lb. chemical bomb, total weight varies with the filler used.

Filler	Wt. of Filler	Total Wt. of Bomb
AC	200 lbs.	722 lbs.
CG	417 lbs.	939 lbs.

The bomb body is blue-gray overall with one or two stripes in accordance with the filler used. Marking is as seen in Fig. 17.

M1 NEEDLE VALVE:

This valve has been tested by the Chemical Warfare Service and is reported to be satisfactory under all conditions. During shipment, the valve is protected by a sheet steel cup over which is fitted a paper fin lock nut protector. It serves a two-fold purpose:

1. As an air vent when filling the bomb with the chemical agent; and

2. For surveillance tests while in storage. By unscrewing the pipe plug or the valve and attaching in its place a two or three inch nipple, a sample of the filling may be drawn off in a test tube. The guard cup must be unscrewed and the valve stem turned back to permit the gas to escape. (For further details on surveillance tests, see O.P. #1030, "Non-Persistant Gas Munitions")

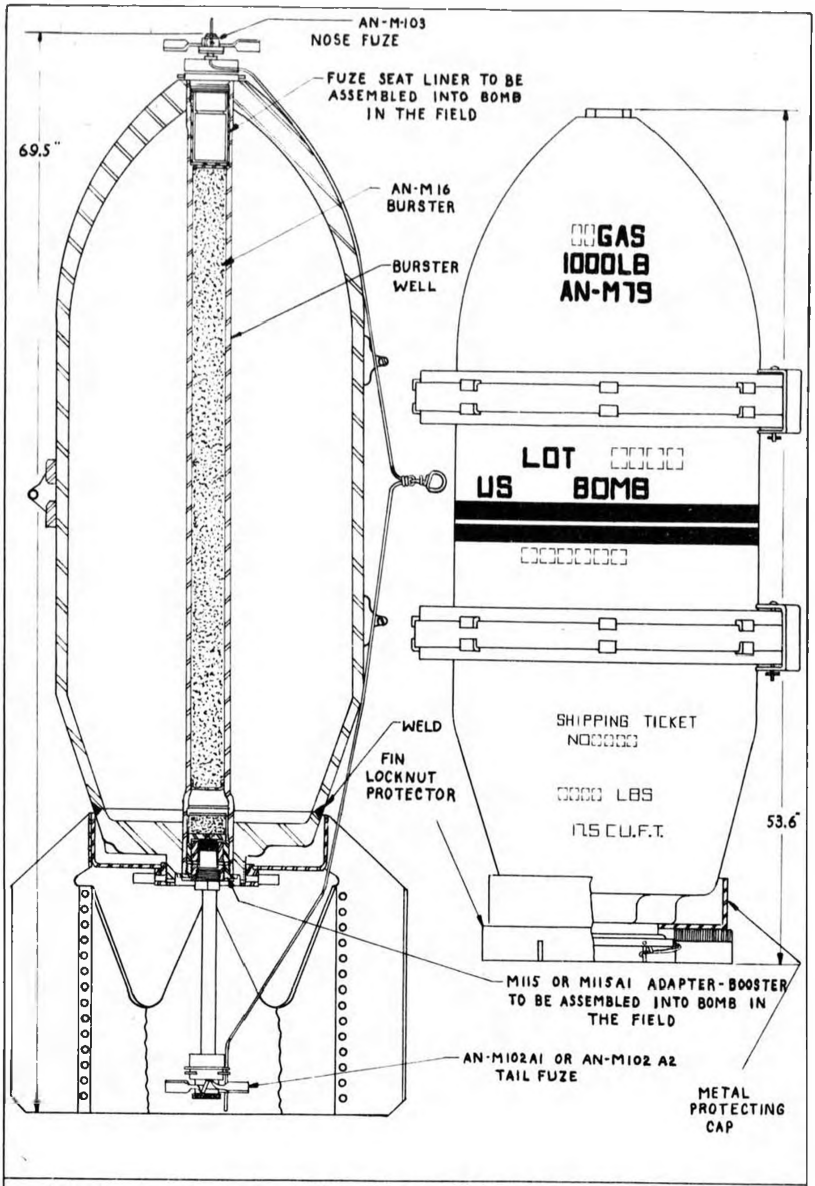

FIG. 17 US 1000 LB CHEMICAL BOMB AN - M79

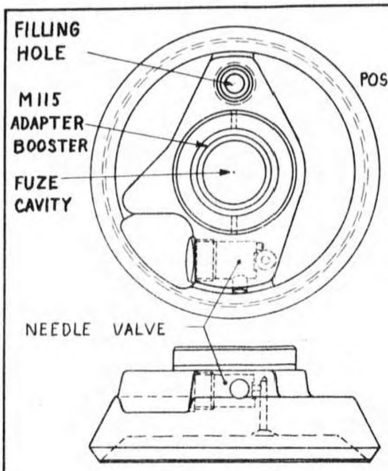

FIG. 18 BASE PLUG SHOWING LOCATION OF MI NEEDLE VALVE

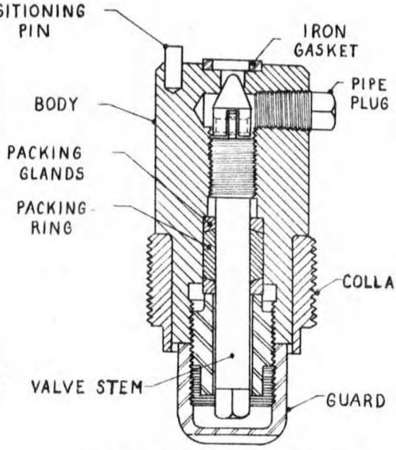

FIG. 19 CROSS SECTION MI NEEDLE VALVE & COLLAR

ASSEMBLY OF COMPLETE ROUND:

(1) Remove shipping bands from the bomb.

(2) Remove sealing wire from fin lock nut protector and unscrew protector together with the fin lock nut. Remove protector from fin lock nut.

(3) Remove the metal protecting cap and slip the fin assembly over the tail end of the bomb so that one of the fins will be in alignment with the suspension lugs. Reassemble and tighten the fin lock nut to secure the fin assembly to the bomb.

(4) Remove the nose plug. Look through burster well to see whether it is clear and free from foreign matter. Place the fuze seat liner in the nose fuze cavity, making certain that it is fully seated.

(5) Slip the burster M16 into the burster well from the tail end of the bomb.

(6) Screw the adapter booster M115 or M115A1 into the tail fuze cavity, making certain that it is fully seated.

(7) Installation may now be completed exactly the same as for a G. P. bomb as follows:

(a) Remove the closing plug from the adapter booster and screw in the AN-M102A2 tail fuze. Make certain that it has the non-delay primer-detonator (M14).

(b) Set Fuze, bomb AN-M103 (nose) for instantaneous action and screw into the nose cavity in the usual manner.

(c) Install the arming wire in the usual manner.

PERFORMANCE DATA:

The AN-M79 functions well on impact on both hard and soft ground, with negligible loss of the chemical agent in the crater. The initial cloud formed by the burst of this bomb charged with CG covers an area of 100 yards in diameter within approximately eight to ten seconds, apparently independently of meteorlogical conditions.

SHIPPING AND PACKING:

When snipped to the field the bomb accessories, including the fuze seat liner, the M16 burster, the M115 adapter booster, and the tail fin assembly are shipped separately packed. The purpose of shipping the fuse seat liner and the adapter booster separately rather than assembled to the bomb is to aid inspection of the burster well.

SAFETY PRECAUTIONS:

Attempts to disassemble the bomb or any of its components are to be avoided except for the fuzes, which may be removed provided it is necessary to return the bomb to storage. Release of the filler is dangerous and should not be undertaken except under exceptional circumstances and, if possible, under the supervision of a Chemical Warfare Officer. When conducting surveillance tests by means of the M1 needle valve, personnel should be equipped with a gas mask.

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REFERENCES:

M78 - (1) TB 9X-36
(2) Ordnance Dept. Drawings 82-14-51, 82-3-489, and 82-0-115

AN-M79 - (1) TB 9X-27
(2) Ordnance Committee Item No. 23072
(3) Ordnance Dept. Drawing No. 82-14-46
(4) Ordnance Dept. Drawing No. 82-0-98

FUZES

MARK 243 NOSE FUZE

DESCRIPTION:

The Mk 243 nose fuze, Fig. 20, is a new Navy fuze of the arming vane type with a mechanical delay. The fuze has an appearance somewhat similar to the AN-M103. The vanes are set at an angle of 45° (NOTE: The modified AN-M103 vane has a 60° pitch). The vane assembly consists of an upper gear (23 teeth), a lower gear (22 teeth), and an idler gear. The arming screw is double threaded (L.H. thread) for quick arming. A glance at Fig. 20 will show the unusual striker which consists of a long shoulder which hits a blunt firing pin built into the top of the delay element. As the vanes rotate, the arming screw threads up while the arming stem spring exerts an upward force on the arming stem. The fuze incorporates a safety feature in the form of a sliding detonator. It may be termed a "discriminating fuze" since it is designed to function upon impact with a steel plate, i.e., a submarine or deck plate, while it will not function upon impact with water at altitudes of release up to 10,000 ft. The AN-Mk 230 hydrostatic fuze may be used in the tail to function in case of a near miss. For Navy G. P. bombs, the Mk 229 should be used as a companion fuze.

OPERATION:

Upon withdrawal of the arming wire, the vanes and the vane cup rotate. The pinion gear runs around both the upper and lower gears. As the vane assembly turns, the arming screw moves up and the arming stem moves up accordingly under pressure of the arming stem spring. After 130 turns of the vanes, requiring approximately 400 feet of air travel, the fuze is fully armed; that is, the arming vanes fall away, the arming stem has moved out of its cavity in the detonator slider permitting the detonator slider to align itself below the delay element. The detonator slider is then locked in place by a spring loaded detent (See detail section XX), and the slider locking pin. Upon impact, the striker body is forced inward, shearing both the locating pin and the shear threads and permitting the striker to hit the blunt firing pin. The delay element affords a delay of .015 seconds and initiates the firing train, consisting of the detonator, booster lead-in, and the booster.

REMARKS:

This fuze is designed for use in the following bombs:

Army		Navy	
AN-M64	500 lbs. G. P.	Mark 12 Mod 2	600 lb. G. P.
AN-M65	1000 lb. G. P.	Mark 13 Mod 2	1000 lb. G. P.
AN-M66	2000 lb. G. P.		

When using this fuze the vanes should be checked by simply turning back and forth a few times in order to determine that the arming mechanism operates easily. The fuze may be considered armed if the space between the vane cup and the vane cup support is 5/16 inch.

The fuze will serve its purpose best when used against submarines or ships, but it is to be noted that the fuze may not function if the angle of obliquity on impact is less than 45°.

It is recommended that this fuze should not be disassembled in the field.

The Bureau of Ordnance will prepare a curcular letter covering this fuze, and further details concerning it will be included in the Bulletin as soon as they are made available.

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REFERENCE: Naval Ordnance Laboratory Drawing No. 344638

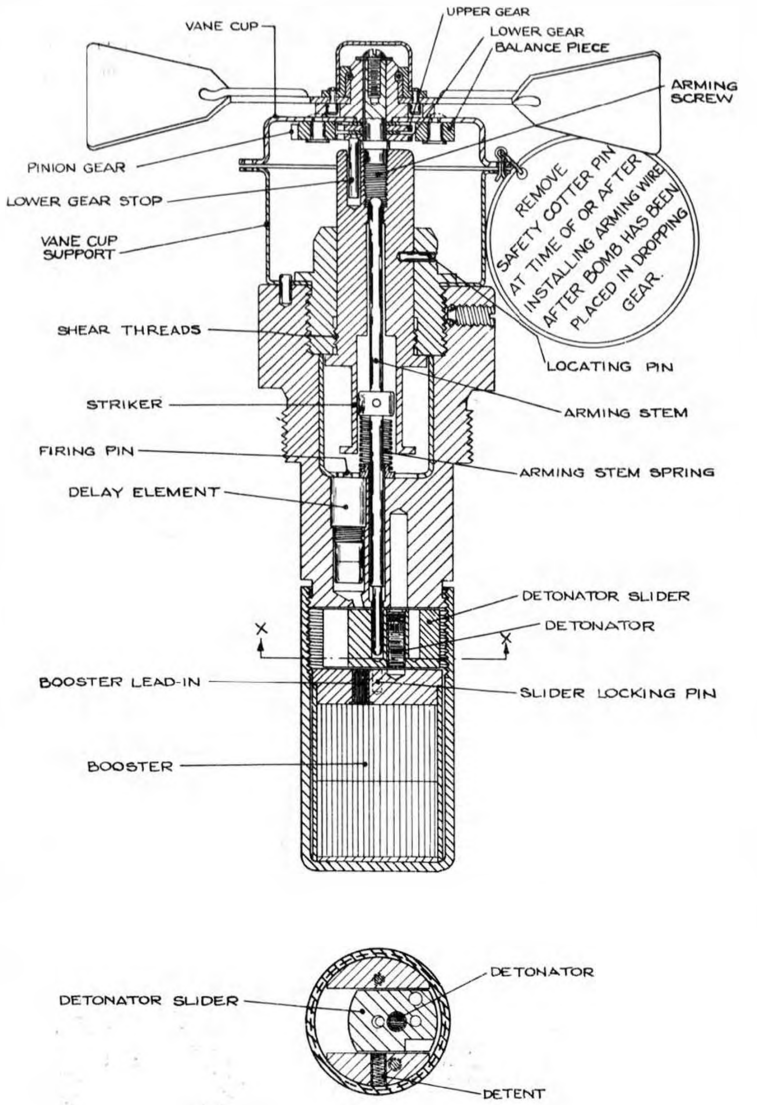

FIG. 20, MARK 243 NOSE FUZE

MISCELLANEOUS

MARK 5 MOD 1 ZERO LENGTH LAUNCHER

The type of Zero Length Launcher which BuAer has approved for current procurement has been designated Mark 5 Mod 1. The installation is relatively simple compared to the older Mark 4, 90 inch rail as described in AFEO Bulletin No. 2. Each launcher consists of two streamlined posts, Figs. 21 and 22, about 6 inches long, which hold the ammunition by its support bands. The aft stud, Fig. 27, contains a latch with provisions for a shear wire and has an electrical receptacle for the ammunition plug mounted on it. This receptacle faces aft and two spring clips are provided to hold the ammunition plug. When the round is fired, the backward forces on the pigtail eject the plug from the receptacle. The forward stud contains a fuzing control. Support posts are mounted on 1/8 inch dural plates in groups of three or four, as seen in the artists' sketch, Fig. 23, and are secured to the wing as units by small screws through the plates. Where adequate internal wing structure is missing, additional structure must be added.

The Mark 5 Mod 1 installed on an F6F will only reduce the air speed between one and two knots at 200 knots I.A.S., while the drag caused by the use of the 90 inch, non-jettisonable Mark 4 launcher reduces speed by between eight and ten knots I.A.S. BuAer intends using the Zero Length Launcher on all service aircraft except those larger types such as the PB4Y, PBY and PBM, which of necessity must attack at slower speeds.

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REFERENCE: CIT PMC 2.28 Part 2 "Airborne Rockets"
U. S. Naval Air Station, San Diego, Drawing No. 4-7917, 5-7960, 4-7940, and 4-7936.

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TACTICAL USE OF ROCKETS

The subject of tactical use of forward firing aircraft rockets is still in the developmental stage and many of the following notes reflect the experience of merely one individual or a group of individuals. It should therefore be borne in mind that this material is not intended to constitute doctrine, but it is hoped that the information will prove to be helpful until such time as tactical use of rockets has undergone thorough testing.

ANTI-SUBMARINE:

The first eight attacks on submarine with the British 25 lb. solid head produced four certain kills, two probables, one sub damaged and one miss due to violent skidding of the aircraft. Subsequent scores, though not so brilliant, have been roughly twice as successful as the conventional depth bomb attack. Current data on the tactical use of rockets in anti-submarine warfare is periodically published in USF Anti-Submarine Bulletin (Secret) and consequently does not warrant discussion here. However, some of the tactical suggestions promulgated by ASDEVLANT

ZERO LENGTH LAUNCHER STUDS

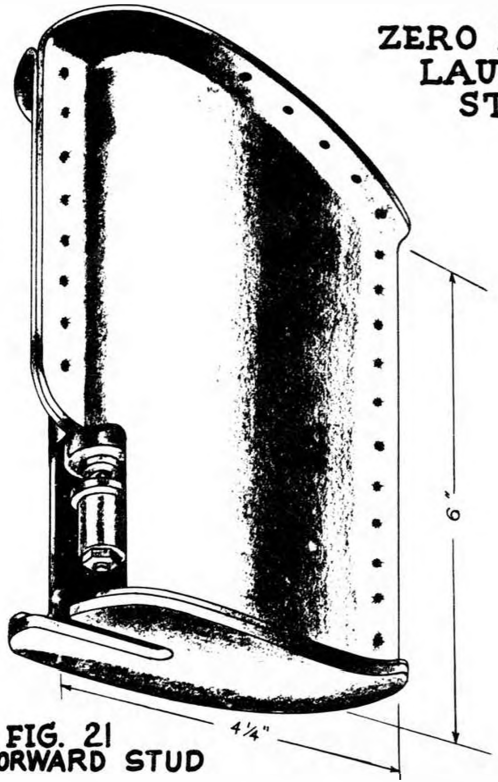


FIG. 21
FORWARD STUD

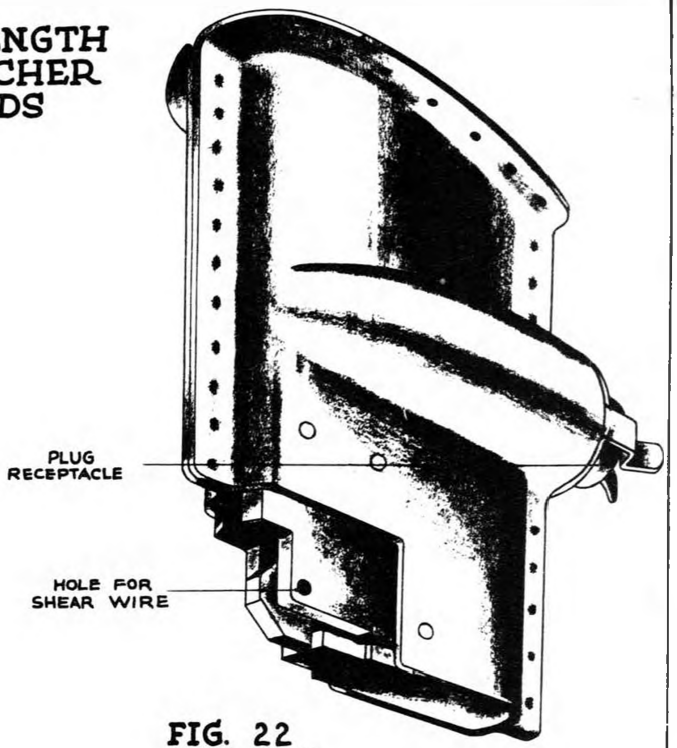
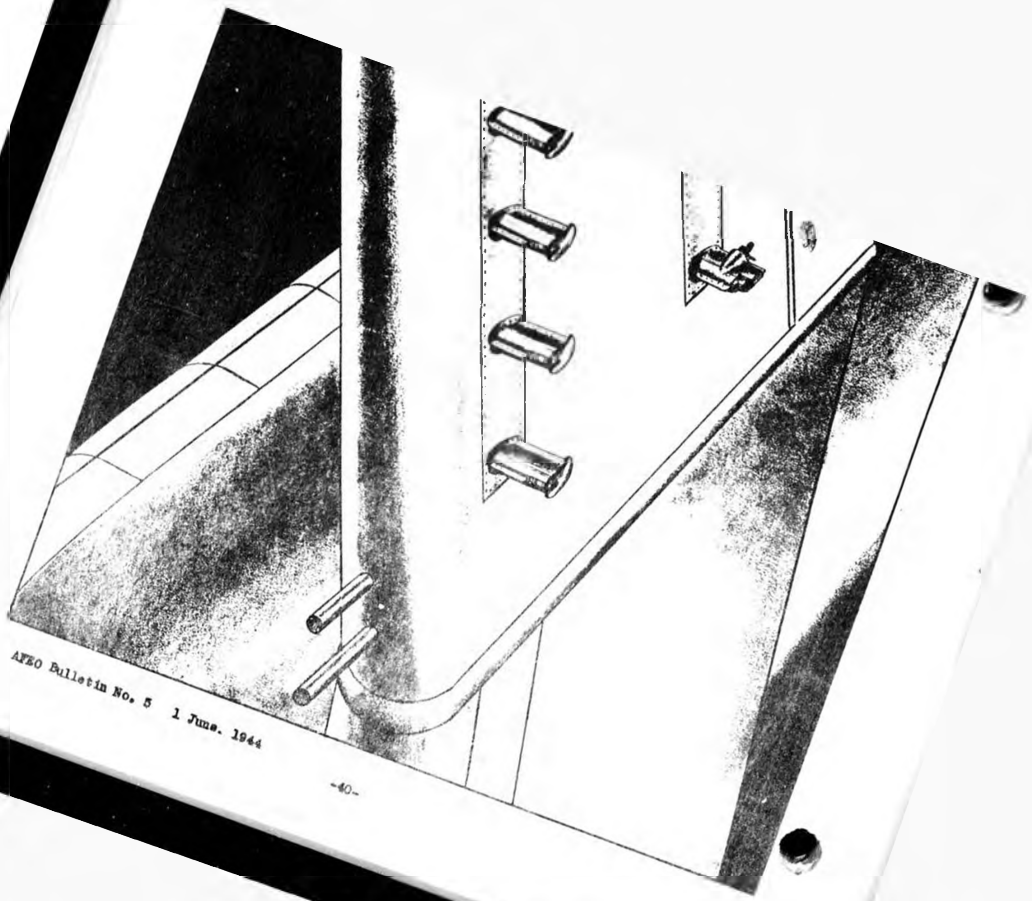
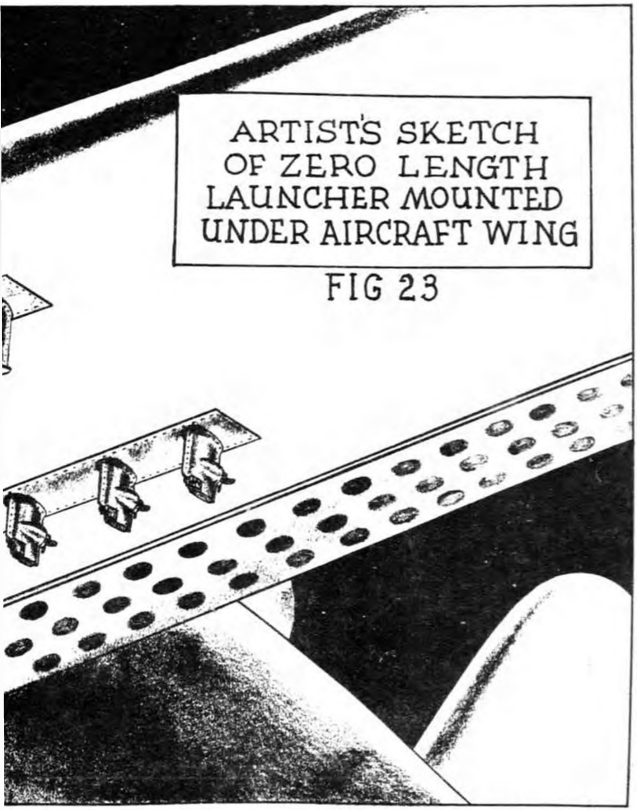


FIG. 22
AFT STUD





ARTIST'S SKETCH
OF ZERO LENGTH
LAUNCHER MOUNTED
UNDER AIRCRAFT WING

FIG 23

in its memorandum of 24 September 1943 (Presently in the process of revision) are set forth below as matters of general information.

Tactics governing the use of aircraft rockets conform in general to the pattern of anti-submarine tactics by aircraft. A pilot with good training and common sense need anticipate little difficulty in handling his new weapon. On the other hand, special tactics for rockets will unquestionably develop as the peculiarities of rocket behavior become better known. Many tests are necessary before a full set of data is assembled. The British freely admit that their information is still imperfect, and we, with our shorter experience, are only recently beginning to speak with certainty of the air trajectory of the U. S. Navy rocket, its underwater characteristics, or its penetrating power.

The aiming problem is much the same as that in glide bombing. The trajectory of a rocket is different from that of a bomb, and the rocket demands successive acts of sighting and firing rather than one, but the principles are similar. The point of aim will naturally be the waterline of a fully surfaced submarine. In view of the underwater travel of the projectile, it would be better to err by aiming under than by aiming over. If the submarine is at partial or nearly complete submergence, the point of aim should be brought down a trifle. This is accomplished by holding the visible target on the sight slightly above the reticule mark used for a normal shot.

Sighting accuracy will be more likely if the sight is held on the target for a few seconds, without letting the plane deviate from the standard glide angle. It is also necessary to maintain steady flight for two seconds before firing in order to avoid throwing the rockets and destroying the aim. Firing when bringing the sight up on the target produces an effect on the rocket which destroys its accuracy. The lag between pressing the firing key and the take-off of the rocket is one-tenth of a second, so the plane should be held steady for at least that instant.

Rockets now in service have too much disperaion and gravity drop to be an effective long-range weapon. Although the chances of hits at 1200 yards or more are not too good, it is recommended that a pair be fired at that distance to disorganize the submarine's crew and secondarily in the hope of a lucky hit or ricochet. To be truly effective, rockets must be fired from short ranges. The first two pairs, fired from 1200 and 800 yards, only lead the way to the final salvo at 400 yards, which is intended to be the real killer. Range estimation must be practiced on land and water targets. It may help TBF pilots to remember that in a 20 degree glide altitude in feet roughly equals range in yards. The usual 50-foot lag in the altimeter nearly offsets the errors in this rule of thumb.

A steep glide on the approach will contribute to greater accuracy in aiming and stability of the rocket in flight, but if the angle of entry is too great the favorable underwater characteristics of the weapon will be lost. Thus the optimum angle of entry has been tentatively set at 20 degrees or less. Under these circumstances the 3⅝ solid head rocket has a lethal underwater range of 50-60 feet. Within this range the projectile maintains a velocity of at least 800 feet per second, which should be sufficient to penetrate the pressure hull or saddle tanks of a submarine.

Depth bombs generally should not be released on the same run in which rockets are fired, since there is not sufficient time during the approach to utilize both weapons effectively. Also, an effective rocket attack requires a low pull out and there is consequently danger that the aircraft will be damaged by debris or blast if depth bombs are dropped. Strafing during a rocket attack may be useful, but it should be borne in mind that if the MK 8 or MK 9 sight is adjusted for rockets they are worthless for machine gun fire.

When wind is known, a suitable aiming allowance is desirable. The flight of a rocket is slower than that of a bullet or shell, and in a normal approach a wind of 30 knots will cause it to strike 40 or 50 feet away from the point of aim. Relative motion of the target may be important if it is added to wind drift. Ordinarily

it need cause little trouble, since standard dispersion for the rocket is a six-mil circle (50% of rounds fall into a circle 12 feet in diameter at 1,000 yards).

The chief danger to be apprehended from the use of rockets is accidental firing. Pilots and air and ground crews must learn all safety rules and obey them scrupulously. At high temperatures rockets are likely to explode instead of burning. The safe temperature range is marked on the rocket case. An explosion is likely to damage the wing, but is unlikely to prevent the aircraft from reaching its base.

SURFACE TARGETS AND LAND INSTALLATIONS:

1. Types of Aircraft

Present plans call for equipping all types of operational aircraft with rocket launchers. If rockets are thought of merely as additional heavy fire power which can conveniently be added to practically any plane, it is apparent that their uses will become varied and wide-spread.

2. Rocket Load

This will of course vary with the type plane involved, but generally the load to date has consisted of six or eight rockets mounted three or four on each wing. The F6F has been used operationally in the South Pacific with a load of eight plus two 500 lb. bombs. Although pilots of VC-7 after the Marshalls Operation reported the TBF as sluggish with eight H. E. Rockets plus three 500 lb. bombs, the plane has been successfully flown on short missions with the same rocket load plus four quarter-ton bombs.

Reports on early operations of VMTB-134 have shown that TBF's carried loads of half 3.5 (solid head) and half 5.0 H. E. Rockets. Although there may be good reason for carrying both solid and H. E. Rockets, it is recommended that each plane be limited to one type because of the different trajectories when released at anything more than point blank range. Of course this difference is not a factor at minimum range, but since the various contingencies dictating release range cannot be foreseen in every case, it is believed that mixed loads should be avoided.

3. Sights

Some of the more pressing problems to be worked out in connection with the aiming of rockets are estimation of range, angle of glide, speed and temperature. To date, the MK 8 and MK 9 sights have proved reasonably satisfactory and it is the consensus of five squadrons recently training with rockets in the Pacific that an adjustable tilt sight offers little or no advantages since it merely complicates the pilot's work during the attack. However, extensive experimentation is being carried on in this field and it is believed that the next few months will see important developments.

At the present effective ranges of rockets, the MK 8 and MK 9 sights equipped with the new 10 mil ladder-type reticules should prove satisfactory. Tilting reflector plate attachments are being made available for both these sights, which will be useful as effective ranges become greater.

4. Approach and Release

The firing of rockets is really a combination of strafing and glide bombing, with the resultant increase in accuracy which the forward speed of the rocket gives. Successful approaches have been made at glide angles of from 20 to 55 degrees, which is generally steeper than that used in anti-submarine attacks where the underwater trajectory is a primary consideration. It has been found that if the glide is begun at about a 4000 foot altitude the pilot should have sufficient opportunity to line up his target and release at the optimum slant range of 750-1000 yards. There should be no limitation on the approach altitude except that the speed in the glide must not exceed the speed prescribed for the aircraft.

Tests with the F6F appear to indicate that rockets will land in the machine gun pattern when released at 2000 foot altitude with slant ranges of 1000-1500 yards in glides of 35° or more. As the glide angle is decreased, compensation must be made from drop of the rockets. With the proper approach, rockets can thus be used as short range cannon to supplement strafing attacks. Even in those cases in which rockets are intended to be the primary weapon, strafing is of great value in knocking out anti-aircraft fire and permitting sufficiently close approaches to get the desired accuracy with the rockets.

Since rockets upon release stream into the line of flight of the aircraft, a steady on-target course prior to release is imperative. Skidding will spoil the attack. Wind is of course another factor which will influence the rocket path and individual pilots should be encouraged to work out proper wind allowances under various conditions and using the different standard approaches.

In coordinated attacks, reports have indicated the difficulty experienced by some pilots as a result of preceding planes blanketing the target. The interval between planes must be sufficient to permit each plane to steady on target, release and withdraw. And along this same line, the high speed of the approach and closeness of the opening range make it very difficult for the pilot to fire rockets and release bombs, doing justice to either. If a pilot is to conduct such an attack satisfactorily, he must go through a period of training which will so familiarize him with the necessary steps that they become automatic.

5. Targets

There has been a marked inability on the part of pilots to identify the pin-point targets which are so frequently labeled for destruction by rockets. Since accuracy, rather than the weight of the explosive, is one of the major assets of the weapon, an attack on such a target as an AA gun emplacement is wasted unless the pilot can spot the target and lay on it during his approach. To supplement the very thorough briefing which must precede such an attack, low level reconnaissance prior to attack is recommended when feasible, or, in the alternative, pushing over from an altitude which will permit definite identification.

Coordinated attacks on shipping similar to torpedo attacks but at a steep angle of glide, strafing during glide and masthead bombing attacks, and shooting up elements of the screen during torpedo runs are a few of the uses suggested for rockets in attacks on surface vessels.

In attacks on land installations they can be used as cannon, released in conjunction with incendiary clusters to scatter fires, and otherwise used by bombers to supplement their attacks. Fighters equipped with rockets can perform their escort functions and still have the means of delivering an effective rocket barrage in conjunction with strafing attacks. And during amphibious operations the great accuracy of the weapon makes it invaluable in close support and in destroying obstacles such as pill boxes and machine gun nests.

6. Effect of AA on Rockets and Launchers

In tests conducted by the British, rocket equipped aircraft were subjected to accurate .303 fire. In general, the rocket installation was found to be not particularly dangerous. If hit in a vital spot, the rockets fired normally and ran off the launcher; in other cases the rockets exploded. These explosions were not severe enough to damage more than the rails and blast plates. If the rails are bent or damaged by AA the rockets will normally be sufficiently powerful to ride over or straighten out the damaged section; however, it is recommended that rockets not be fired if it is known that AA hits on the installations have been scored.

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REFERENCE: Tactical Use of Aircraft Rocket Projectiles
OpNav-16-V-E#43 15 April 1944

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