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(5) Army Chemical Center, Md.

T.D.M.R. No. 903
Copy No. 93
Project: B 11.9-1

A Memorandum Report

(6) THE M126-A1 NOSE FUZE FOR THE M47-A2 100 LB. INCENDIARY BOMB

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DDC-IRA
25 Sep 64

Forwarded to Chief, Chemical Warfare Service

CONTROL NUMBER
5004-903

19

[redacted]

[redacted]

ABSTRACT

Object.

The object of Project B 11.9-1 is to develop large incendiary bombs.

The object of the work described in this report was to determine the performance of the M126-A1 nose fuze (modified M110-A1 fuze) when used with the M47 series, 100 lb. incendiary bombs.

Results.

A total of 733 M126-A1 nose fuzes were tested under various conditions of impact surface over an altitude range of 50 to 15,000 feet, and 49 experimental M126 fuzes were similarly tested over an altitude range of 1,000 to 5,000 feet.

Of the 733 M126-A1 fuzes tested, 563 were with the M47-A2, 100 lb. incendiary bombs. Over an altitude range of 500 to 15,000 feet and upon various impact surfaces, the percent functioning on basis of fuze-bomb performance was as follows; 95% on concrete slab and ground, 87% on a broken rock surface, and 98.3% on industrial roofs.

Of the 49 M126 fuzes tested, 37 were with the M47-A2, 100 lb. incendiary bomb over an altitude range of 1,000 to 5,000 feet. The percent functioning on basis of fuze-bomb performance was 83.9% on impact on ground and concrete slab and 100% on impact on industrial roofs.

The apparent arming height for the M126-A1 nose fuze with the M47-A2, 100 lb. incendiary bomb, at various airplane speeds was found to be 100 feet at 300 ~~miles per hour~~ mph, 200 feet at 250 ~~miles per hour~~ mph, 300 feet at 200 ~~miles per hour~~ mph and 350 feet at 150 ~~miles per hour~~ mph.

Both the M126 and M126-A1 nose fuzes were activated on impact on water or swampy terrain.

A total of 59 M126-A1 nose fuzes were tested with M47-A2, 100 lb. chemical bombs, WP filled. Over an altitude range of 300 to 7,500 feet fuze functioning was 100% when bombs impacted on the ground.

Twenty-one ~~(21)~~ M126-A1 fuzes were tested with bombs other than the M47 type, namely the M70, the E-2, 250 lb. incendiary bomb and a modified AN-M64, 500 lb. G.P. bomb.

Data are presented in Tables I through IX and twelve photographs which are included in the body of the report.

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Conclusions.

1. The overall fuze-bomb functioning of the M126-A1 fuze and the M47-A2, 100 lb. incendiary bomb is of the order of 96% over an altitude range of 500 to 15,000 feet.

2. Under impact conditions normally encountered with the use of the M47-A2, 100 lb. incendiary bomb and due to a mechanically weak firing pin and striker assembly over an altitude range of 500 to 15,000 feet, approximately 1.5% malfunctioning of the fuze is obtained.

3. Approximately 2% of the bombs became duds due to poor flight characteristics of the M47-A2, 100 lb. incendiary bombs.

4. The M126 and the M126-A1 fuzes are sufficiently sensitive to activate an M47-A2, 100 lb. incendiary bomb, when dropped on water or swampy terrain.

5. The approximate arming height of the M126-A1 fuze with the M47-A2, 100 lb. incendiary bomb, varies from 100 to 350 feet as the airplane speed decreases from 300 to 150 miles per hour.

6. The overall fuze-bomb performance can be improved by strengthening the firing pin and striker assembly of the fuze and by improving the flight characteristics of the M47-A2, 100 lb. incendiary bomb.

7. On rough terrain, such as may be encountered in the use of the M47-A2, 100 lb. chemical bomb, fuze functioning may be considerably lower than it is on smooth targets due to the mechanically weak firing pin and striker assembly.

Recommendations.

1. It is recommended that the firing pin and striker assembly of the M126-A1 nose fuze be improved to withstand impact on rocky terrain.

2. It is recommended that a more rigid inspection or a redesign of the tail assembly of the M47-A2, 100 lb. incendiary bomb be undertaken to improve its flight characteristics.

TABLE OF CONTENTS

No.	Title	Page
I.	Introduction	1
II.	Historical	1
III.	Theoretical	2
IV.	Experimental	3
V.	Discussion	19
VI.	Conclusions	22
VII.	Recommendations	23
	Appendix	23

GLOSSARY

M47-A1 or M47-A2 100 lb. Bomb - A thin case bomb 8 in. in diameter and approximately 47 in. long (unfuzed), constructed of sheet metal 1/16 in. thick and equipped with box type stabilizing fins. The bomb contains a burster well extending throughout the length of the bomb case. The interior of the M47-A1 bomb case is coated with an asphaltic paint whereas the M47-A2 is coated with oil. The bomb case weighs approximately 26 lb. The approximate weights of various fillings are as follows: IM or NP, 40 lb., PT, 60 lb. and WP, 91 lb.

E-2, 250 lb. Incendiary Bomb - A thin case bomb 11 in. in diameter and approximately 48 in. long (unfuzed) constructed of 12 gauge sheet metal and equipped with double box type stabilizing fins. An igniter-burster well assembly extends throughout the length of the bomb. The empty bomb weighs approximately 56 lb. When filled with IM the total weight is approximately 135 lb.

M70, 115-lb. Chemical Bomb - A bomb 8 in. in diameter and approximately 39 in. long constructed of forged steel (minimum wall thickness 1/8 in.) swaged to a heavier cross section at the nose. The tail fins are separate and fitted onto the bomb as a stage in preparing the bomb for use. The burster well extends the full length of the bomb and is press-fitted into the nose thus serving as a closure of the bomb. The bomb's total capacity for phosphorus (without void) is approximately 86 lb. and the bomb so filled weighs about 140 lb. without tail fins.

AN-M64, 500 lb. G.P. Bomb - Standard 500 lb. G.P. bomb modified by adapting the burster well of the M47-A2 bomb to serve as a closure and filled with WP. The weight of WP is 270 lb. and the filled bomb weighs approximatel 530 lb.

M4 Burster - An aluminum or plastic tube 38 in. long, 1 in. i.d for the M47-A2 bomb. It is charged with tetryl pellets to an approximate weight of 1.56 lb. Modifications of this burster consisted of varying the length or diameter of tetryl column.

M7 Burster - A burster tube of the same dimensions as the M4 burster, but filled with approximately 520 grams of A-1 black powder. Modifications of this burster consisted in varying the active length of the black powder charge, the remaining space was filled with sand and separated from the black powder by a cardboard disc.

M10 Burster - An aluminum or plastic burster tube for the M70 bomb filled with approximately 1.48 lb. of tetryl pellets. The tube is 36 in. long and 1 in. i.d. Modifications consisted in decreasing the active length of the tetryl column.

M12 Burster - A burster tube of same dimensions as the M4 burster. It is filled with approximately 450 grams of a 50-50 mixture of black powder and magnesium bonded with castor oil.

M13 Burster - A fiber tube 11/32 in. i.d. and 36 in. long filled with 5/16 in. tetryl and TNT pellets. Tetryl pellets are placed at both ends of the explosive column. In the M13 burster the TNT charge weighs 67 grams and the tetryl charge approximately 2 grams. The tetryl is used as a booster for the TNT charge. Modifications of this burster consisted of varying the diameter of the explosive column. The burster is normally used with the M9 igniter sodium or WP filled.

NP - Incendiary Oil thickened with Napalm, Type I.

IM - Incendiary Oil thickened with isobutyl methacrylate, Type I.

WP - White Phosphorus.

PT - Pyrotechnic mixture.

GRS - Incendiary Oil thickened with synthetic rubber.

PNP - Incendiary Oil thickened with peptized Napalm.

PMC - Permanente Metals Corp., Incendiary mixture.

THE M126-A1 NOSE FUZE FOR THE M47-A2 100 LB. INCENDIARY BOMB

Project B 11.9-1 - T.D.M.R. No. 903

I. INTRODUCTION.

A. Object.

The object of Project B 11.9-1 is to develop large incendiary bombs.

The object of the work described in this report was to determine the performance of the M126-A1 nose fuze (modified M110-A1 nose fuze) when used with the M47 series, 100 lb. incendiary bombs.

B. Authority.

The authority for this work is contained under Project B 11.9-1 in the 1944 Project Program.

II. HISTORICAL.

The M47 series 100 lb. bombs, chemical and incendiary, have heretofore been equipped with the modified M108 nose fuzes. This fuze is of the arming pin type with instantaneous functioning time upon impact after the withdrawal of the arming wire. The original M108 fuze was modified by inserting safety blocks between the firing pin head and the fuze body when it was found that the arming pin would shear and the fuze would function if the M47 bomb armed with the fuze was dropped onto concrete at a distance greater than six (6) inches. Photograph No. 12,601 shows the component parts of the modified M108 fuze.

At a meeting of the Joint Aircraft Committee in the latter part of 1942, the Chairman of the sub-committee on Bombs, Torpedoes, Mines, and Chemicals, Bureau of Ordnance, Navy Department, stated that the Navy will not consider the M47 type incendiary bomb as an AN standard until it is equipped with an arming vane type fuze. This requirement was made since there was a possibility of a bomb shaking loose on take off or landing on a carrier deck and being activated. Accordingly, the Ordnance Department was requested to prepare an arming vane type fuze for the M47-A2 type incendiary bomb and to furnish the Chemical Warfare Service with 100 fuzes for test purposes. The M110-A1 fuze, now standard for the 20 lb. M41 fragmentation bomb was selected for modification for use in the M47-A2 100 lb. incendiary bomb. The fuze was modified by removing the booster and primer-detonator used in the M110-A1 fuze and substituting an adapter containing a primer-detonator. It was designated as the M110-A1T1. The fuze was successfully tested in May 1943 and it was recommended to the Chief of Ordnance that it be standardized at the

earliest possible date. In June 1943, the fuze was standardized as the M126-A1 and a similar modification of the M110 fuze was standardized as the M126. Component parts of these fuzes are shown in Photographs Nos. 12,602, 12,603, 12,607 and 12,608.

The above fuzes can be used with the M47-A1 and M47-A2, 100 lb. incendiary bombs. The M47, 100 lb. incendiary bomb, having a different size burster well will not take either the M126 or M126-A1 fuze unless a special adapter is provided.

III. THEORETICAL.

The usage of an impact type nose fuze in a bomb implies that the bomb has reproducible flight characteristics to the extent that at the moment of impact the fuze is in a position to be activated. It also implies that the fuze attachment and the fuze are structurally strong enough to withstand the forces of impact and allow the train of firing sequences to take place. Fuzes which rely on vanes for delayed arming require a greater reproducibility of bomb flight characteristics. This is especially true when bombs are dropped at low altitudes where the minimum distance of travel of the bomb necessary to arm the fuze is approached. Therefore, in any overall evaluation of a fuze-bomb performance it is necessary to differentiate between the deficiencies in the fuze and the flight characteristics of the bomb in order to adopt any corrective measures that may be necessary.

The M47 series 100 lb. bomb, chemical and incendiary, may be used under a great number of impact conditions depending on the filling and the mission to be accomplished. The modified M108 fuze appeared to function properly under the required impact conditions since relatively few failures have been reported wherein duds were not caused by such mechanical failures as dropping the bomb safe or breakage of the arming wire. Such few failures as have been noted in tests with the M47 series 100 lb. incendiary bomb have all been attributed to fuze attachment. Two cases are known wherein a glancing hit prior to direct contact of the fuze with an object has caused the ball lock springs to disengage from the burster well of the bomb and result in separation of fuze and bomb and, therefore, in dud bombs. In another case the burster well head was shattered upon impact on rock pile, the fuze functioned but was sheared away from the burster at the time of activation of the fuze.

Although the modified M108 fuze is satisfactory in regard to functioning on various impact surfaces, its use in combat service is not satisfactory. The immediate arming of the fuze after the withdrawal of the arming wire is a hazard in that bombs may shake loose from the bomb rack, and be activated. The use of clustering devices to increase the bomb load further prohibits the use of an instantaneously arming fuze since bombs may tumble and collide in or under the airplane at the time of release and be activated.

Therefore, the arming vane type fuze which is to be substituted for the modified M108 fuze must function equally well under the impact conditions encountered in the use of the M47 series 100 lb. incendiary bomb and must arm properly when used with the above bomb. The M47 series 100 lb. incendiary bomb is used extensively in raids on industrial targets. It can also be used in special missions wherein the fuze must be activated on water or swampy terrain. Accordingly it is necessary that the fuze functions on such surfaces as roofs of industrial buildings, concrete, ground, water and swampy terrain. With the incorporation of a delay in the arming of the fuze, it is also necessary to determine at what combinations of altitudes and speeds of the airplane the fuze will arm. Since the fuze will arm in a given number of revolutions of the arming vanes, it is quite apparent that the rate at which the arming vanes rotate will be affected by the velocity and distance of travel of the bomb. With bombs having reproducible flight characteristics, the latter variables can be expressed in terms of the altitude and speed at which the bombs are dropped from an airplane.

The tests reported herein are principally on the functioning of the M126-A1 fuze when used with either the M47-A1 or M47-A2, 100 lb. incendiary bomb under conditions that will be encountered in the use of this bomb. Some tests are also reported with the M47-A2 bomb WP filled and experimental bombs. However, the results are complete only in the case of the M47 series 100 lb. incendiary bombs.

IV. EXPERIMENTAL.

A. Materials and Equipment.

1. Fuzes.

733 M126-A1 nose fuzes
49 M126 nose fuzes.

2. Bombs.

702- M47-A1 or M47-A2, 100 lb. Incendiary Bombs
59- M47-A1 or M47-A2, 100 lb. Bombs, WP filled
5- M70, 115-lb. Chemical Bombs, WP filled
14- E-2, 250 lb. Incendiary Bombs
2- Modified AN-M64, 500 lb. G.P. Bombs, WP filled.

3. Bursters.

367- M12, (50/50 Black Powder - Magnesium)
265- M13, (5/16" o.d. Column of tetryl-TNT)
16- 7/16" M13 (7/16" o.d. Column of tetryl-TNT)
37- 1/2" M13 (1/2" o.d. Column of tetryl-TNT)

9- 9/16" M13 (9/16" o.d. Column of tetryl-TNT)
2- 3/4" M13 (3/4" o.d. Column of tetryl-TNT)
29- M7 (1" Column of Black Powder - 520 grams)
21- 1/3 M7 (1" Column of Black Powder - 173 grams)
11- 1/2 M7 (1" Column of Black Powder - 260 grams)
6- M4 (1" Column of tetryl - 1.56 lb.)
2- 1/4 M4 (1" o.d. Column of tetryl - .39 lbs.)
5- 1/3 M4 (1" o.d. Column of tetryl - .52 lbs.)
5- 1/2 M4 (1" o.d. Column of tetryl - .78 lbs.)
2- 5/8" M4 (5/8" o.d. Column of tetryl)
2- 3/4" M4 (3/4" o.d. Column of tetryl)
1- M10 (1" o.d. Column of tetryl - 1.48 lbs.)
2- 1/2 M10 (1" o.d. Column of tetryl - .74 lbs.)

4. Impact Targets.

a. Target Building, "H" Field, Edgewood Arsenal, Md.

(1) Concrete-tile roof-promenade tile set in cement mortar, 4 ply built up roofing, pitch primer, 2 in. concrete slab reinforced with an expanded metal mesh and alternating 3/4 in. and 5/8 in. reinforcing rods. Roof supported by 2 x 6 in. reinforced concrete ribs.

(2) Sheet metal roof-asbestos capsheet, 4 ply built up roof of pitch and saturated felt upon 1/2" rigid insulation board, hot asphalt mopping, primer, and 20 gauge metal roofing. Roof supported by 8" [11.5 lb. purlins and 5/8 in. diameter tie rods. Tie rods and purlins mounted on 12" I beams weight 25 lb. resting on concrete columns.

(3) Sawtooth roof - 20 gauge corrugated galvanized roofing, supported by 8" [11.5 lb. purlins and 5/8 in. tie rods. Tie rods and purlins mounted onto 10 in. I beams - Wt. 26 lb. resting on concrete columns.

(4) Second floor - two way solid slab 7 in. reinforced concrete with 1/2 in. reinforcing bars - beams 22" square of reinforced concrete.

(5) Second floor - flat slab with capitals, 8 in. reinforced concrete slab, reinforced with 3/4 in. bars.

(6) Second floor - beam and girder floor, 4 in. concrete slab with expanded metal reinforcement. Beams are 11½ x 14 in. reinforced concrete. Girders are 15 x 22 in. and made of heavily reinforced concrete.

(7) Second floor - ribbed floor slab, 3 in. concrete slab with expanded metal reinforcement. Ribs, 6 x 12" reinforced concrete, integrated into floor construction.

b. Industrial Target, Eglin Field, Florida.

(1) Reinforced concrete roof - six inch reinforced concrete

(2) Prefabricated slag concrete roof - prefabricated slab nominally 6 x 4 ft. and 3 in. thick and reinforced with 1/4 in. rods. Slabs laid on I beams. Over prefabricated slab a layer of slag concrete 2 to 5 in. in thickness was poured. Roof covered with tar paper.

(3) Prefabricated slag concrete - tile roof - prefabricated slabs made out of tile and slag concrete with a cover of 2 to 5 in. of slag concrete as above.

(4) Sawtooth roof - nominal 1 in. matched pine.

c. Wooden Platform - Huntsville Arsenal, Alabama.

Nominal 2 in. oak planks supported by 2 x 6 in. stringers. Green oak columns on approximately 10 ft. centers supported the platform approximately 12 ft. above a broken limestone surface. The oak planking was not nailed securely and presented an irregular surface.

B. Procedure.

Upon clearance from the range crew, bombs were dropped at various altitudes and speeds onto the various targets. Special tests for fuze functioning were made on the initial lot of fifty experimental fuzes. Supplementary data were obtained in connection with tests wherein the performance of other components of the bomb were investigated. Wherever practicable duds were recovered and causes of failures were determined. In the course of this testing an A-20A airplane was used in tests wherein the airplane speed was of the order of 300 miles per hour, A B-25 airplane was used over an altitude range of 100 to 5,000 feet at speeds ranging from 150 to 250 miles per hour, (normally at 200 miles per hour); for high altitudes 10,000 to 15,000 feet a B-24 or a B 17 airplane was used. Several tests were also conducted using a Navy TB airplane flying at 115 miles per hour.

C. Results.

An overall summarization of all tests of M126 and M126-A1 fuzes with respect to altitude of drop is given in Table I.

Drop tests with M126-A1 fuzes and M47-A2, 100 lb. incendiary are summarized in Table II. Similar tests with M126 fuzes are compiled in Table III

Table IV presents the results of drop tests to determine the apparent arming height of the M126-A1 fuze when M47-A2, 100 lb. incendiary bombs were dropped at varying altitudes and airplane speeds.

In Table V details of drop tests on water and swampy terrain are presented.

Tables VI and VII contain test details pertinent to the summarization found in Tables II. and III.

Tests with M47-A2, 100 lb. chemical bomb, WP filled using the M126-A1 fuze are given in Table VIII..

Miscellaneous tests with bombs other than the M47 are summarized in Table IX.

Table VII - Continued

Point of Impact	Type Fuze	Type Burster	Type Gel	No. of Bombs Dropped	No. of Bombs Functioned	Comments
Ribbed floor slab 3" concrete slab	M126-A1	M12	PT	1	1	-
Concrete floor	M126	1/3M7	PMC	1	1	-
Flat slab with capitals 8" reinforced conc.	M126-A1	M12	PT	3	3	-
	M126-A1	M13	IM	2	2	-
	M126-A1	M13	PT	3	3	-
	M126-A1	M13	NP	1	1	-
			Total	10	Total 10	

B. Altitude 5000 ft. - Impact on Wooden platform, Huntsville Arsenal, Ala.

Wooden platform consisting of 2" oak planking	M126-A1	M12	IM	6	5	One dud due to broken firing pin.

C. Altitude 10,000 ft. - Impact on Industrial Target, Eglin Field, Fla.

1" matched pine sawtooth roof	M126-A1		M12 NP	8	8	-
	M126-A1		M12 IM	2	2	Bombs dropped by B17 or B24 airplane.
	M126-A1		M13 NP	10	10	
	M126-A1		M13 IM	4	4	-
	M126-A1	7/16"	M13 NP	2	2	-
	M126-A1	1/2"	M13 NP	3	3	-
	M126-A1	1/2"	M13 IM	2	2	-
			Total	31	Total 31	
Nominal 6" prefabricated slag concrete roof	M126-A1		M12 NP	1	1	Bombs dropped by B17 or B24 airplane
	M126-A1		M12 IM	2	2	
	M126-A1		M13 NP	5	5	-
	M126-A1		M13 IM	1	1	-
	M126-A1	7/16"	M13 NP	3	3	
			Total	12	Total 12	
Nominal 6" prefabricated slag concrete-tile roof	M126-A1		M12 NP	3	3	Bombs dropped by B17 or B24 airplane.
	M126-A1		M13 NP	4	4	
	M126-A1		M12 IM	3	3	-
			Total	10	Total 10	

Table VII - Continued

Point of Impact	Type Fuze	Type Burster	Type Gel	No. of Bombs Dropped	No. of Bombs functioned	Comments
Reinforced	M126-A1	M12	NP	3	3	Bombs dropped by B17 or
concrete roof.	M126-A1	M13	NP	1	1	B 24 airplane
Six inches of	M126-A1	M13	IM	3	3	-
of concrete	M126-A1	1/2"M13	NP	2	2	-
	M126-A1	1/2"M13	IM	1	1	-
				Total 10	Total 10	
D. Altitude 15,000 ft. - Impact on Industrial Target, Eglin Field, Fla.						
1" matched pine	M126-A1	M12	NP	3	3	Bombs dropped by B17 or
sawtooth roof	M126-A1	M13	NP	3	3	B 24 airplane
				Total 6	Total 6	
Nominal 6" pre-	M126-A1	M12	NP	1	1	Bombs dropped by B17 or
fabricated slag	M126-A1	M13	NP	2	2	B24 airplane
concrete roof				Total 3	Total 3	
Nominal 6" pre-	M126-A1	M13	NP	1	1	Bombs dropped by B17 or
fabricated slag concrete-tile roof						B 24 airplane
Reinforced con-	M126-A1	M12	NP	1	1	Bombs dropped by B17 or
crete roof. Six inches of con- crete						B24 airplane

Table VIII.
Drop Tests of M47-A2, 100 lb. Bombs, WP filled, with M126 A1 Nose Fuzes on Ground

Altitude in Feet	Type Burster	Number of Bombs Dropped	Number of Bombs Functioned	% Fuze Functioning	Comments
300	1/2 M7	3	3		-
	1/3 M7	3	3		-
	1/2 M4	3	3		-
	1/3 M4	3	3		Weak bursts
		Total 12	Total 12	100%	
500	9/16" M13	1	1	100%	-
800	7/16" M13	2	2		-
	9/16" M13	6	6		-
	3/4"o.d.Tetryl	2	2		-
	M4	2	2		-
		Total 12	Total 12	100%	
1000	1/3 M7	2	2		-
	1/3 M4	2	2		-
	1/4 M4	2	2		Incomplete detonation of burster.
	9/16" M13	1	1		-
		Total 7	Total 7	100%	
5000	1/3 M7	3	3		-
	1/2 M7	5	5		-
	M7	2	2		-
	1/2 M4	2	2		-
	M4	2	2		-
	1/2"M13	2	2	100%	-
	9/16" M13	1	1		-
	3/4" M13	2	2		-
	5/8" Tetryl	2	2		-
		Total 21	Total 21		
7500	1/3 M7	3	3		-
	1/2 M7	3	3	100%	-
		Total 6	Total 6		
Overall	-	59	59	100%	

Table IX.
Use of M126-A1 Nose Fuze in Drop Tests of Bombs Other than the M47, 100 Lb. Bomb

A. Impact on Ground

Type bomb	Altitude in Feet	Type Burster	Type Filling	No. of Bombs Dropped	No. of Bombs Functioned	Comments
M70	300	1/2 M10	WP	1	0	Safety block did not come off
M70	800	M10		1	1	-
		36"M7(mod.)	WP	1	1	-
		1/2"M1"		1	1	
			Total	3	Total 3	
M70	1000	1/2 M1	WP	1	1	-
250 lb. I.B. E-2	1000	1/2"M13	IM	2	2	-
250 lb. I.B. E-2	5000	1/2"M13	IM	9	6	Dud due to broken firing pin.
AN-M64 500 lb.G.P. Modified	5000	M4	WP	2	2	-

B. Impact on Target Building "H" Field.

Type Bomb	Altitude in Feet	Type Burster	Type Filling	Fuze Functioning	Point of Penetration
250 lb. I.B. E-2	5000	1/2"M.3	IM	O.K.	Bomb impacted on concrete floor underneath former wood roof. No penetration of 7" reinforced concrete.
250 lb. I.B. E-2	5000	1/2" M13	IM	O.K.	As above.
250 lb. I.B. E-2	5000	1/2" M13	IM	O.K.	Bomb impacted near old hole on floor underneath former wood roof. Fuze not activated until it hit first floor.

V. DISCUSSION.

A. Description of Fuzes.

The component parts of the M108 modified, the M126-A1 and the M126 nose fuzes and a description of their functioning are given under photographs nos. 12,601, 12,602, 12,603, 12,607 and 12,608. The following table summarizes the major differences in the construction and functioning of these nose fuzes:

Table X
Comparison of Fuzes

Type Fuze	M108	M126	M126-A1
Fuze body material	brass	aluminum	steel
Weight of fuze	0.55 lb.	0.62 lb.	1.1 lb.
Delay in arming	0	455 rev.	325 rev.
Diameter of arming wire	0.064 in.	0.056 in.	0.056 in.
Diameter of striker	1 1/4 in.	5/8 in.	5/8 in.
Dia. of firing pin	3/8 in.	1/8 in.	1/8 in.
Primer-Detonator	No. 13	M28	M28
Method of attachment to bomb	ball locked into an adapter	Screwed into burster well head	Screwed into burster well head
Used with bombs	M47,M47-A1,M47-A2	M47-A1, M47-A2	M47-A1, M47-A2
Special adapter required for	M47,M47-A1,M47-A2	M47 *	M47 *

* With M12 burster; M13 burster cannot be used.

From the above data it will be noted that the firing pin and striker assembly of the M108 modified fuze is considerably stronger in construction than that of either the M126 or M126-A1 fuzes. On the other hand, the method of fuze attachment is more secure for the M126 and the M126-A1 fuzes. The M126-A1 fuze is of heavier construction than the M126.

B. M126-A1 Nose Fuze Failures.

Table I summarizes all results obtained in the dropping of various type bombs with the M126-A1 fuze. Out of the 733 fuzes tested, there were 48 duds. The cause of these duds has been divided into the following five catagories; (1) The fuze was unarmed, (2) fuse armed but the safety block did not fall off, (3) the firing pin was bent and the striker assembly broken off, (4) the bomb landed flat and the fuze did not function, and (5) bombs were either not seen or could not be recovered so that the functioning was questionable.

Sixteen (33%) of the 48 duds were due to unarmed fuzes. As seen in Table I these failures were encountered over the altitude range of 50 to 200 feet within which duds to this cause may be expected depending on the speed of the airplane from which the bombs were dropped. It will be noted that there were no failures of this type encountered in the 696 bombs dropped from altitudes greater than 200 feet. As also shown in Table II, wherein only M47-A2, 100 lb. incendiary bombs are considered, there were no failures of this type when 563 bombs were dropped within the altitude range of 500 to 15,000 feet. Therefore, the arming assembly of the M126-A1 fuze can be considered satisfactory for use with the M47-A2 100 lb. incendiary bomb.

In Table I six (6),(12%) out of the 48 duds were due to the safety block not falling off. Four of these failures occurred at altitudes of 250-300 feet during tests wherein the apparent arming height of the fuze was being determined for various speeds of the airplane. Neglecting the tests within this altitude range, there were only two malfunctions of this type (0.3%) when 668 bombs were dropped over the altitude range of 350 to 15,000 feet. Again in Table II, wherein drop tests with M47-A2, 100 lb. incendiary bombs are considered, 2 failures of this type, or approximately 0.4%, were found in 563 bombs dropped over the altitude range of 500 to 15,000 feet.

In Table I, nine (9), (19%) of the 48 fuze failures were due to bent or broken firing pins and striker assembly. If bombs dropped over the altitude range of 350 to 15,000 feet are considered, the percent of fuze duds, due to this cause is 9/563 x 100 or 1.6%. Considering tests wherein the fuze was used in the M47-A2, 100 lb. incendiary bomb under various conditions of impact (Table II), the percent malfunctioning due to broken firing pins is as follows; On ground and concrete - 1.2%, rock target - 8.7%, and industrial targets - 0.3%. These data indicate that the firing pin and striker assembly function satisfactorily on smooth surfaces. However, it is indicated that on irregular surfaces, such as the broken rock (limestone) target the firing pin and the striker assembly require greater mechanical strength. Photograph no. 18,606 shows typical fuze failures due to bent firing pins and broken striker assemblies. During the course of loading M47-A2, 100 lb. chemical bombs, WP filled, into an airplane, three bombs accidentally fell off a loading

stand such as is shown in Photograph No. 12,187 and as result two striker assemblies were broken off the fuze as shown in Photograph No. 12,604. It is therefore indicated that a strengthening of the firing pin and striker assembly would be desirable when the use of the M47 series bomb is contemplated on especially irregular terrain and also as an additional safety factor in the handling of fuzed bombs.

Of the 48 duds listed in Table I, eight (8), (17%) were due to bombs landing flat. In some cases the fuze had had a chance to arm and in others it did not, depending on the degree of tumbling of the bomb, (see Photo. No. 12,609). This malfunction cannot be attributed to the fuze, but to the flight characteristics of the bomb. From Table II, it is indicated that over the altitude range of 500 to 15,000 feet, all of these tumbling bombs were of the incendiary type. It is also possible that the six bomb duds, listed under cause unknown under 15,000 feet altitude, may have also been due to tumbling bombs. Therefore the possible malfunctioning due to this factor may vary from a known percentage of $\frac{8}{563} \times 100 = 1.4\%$ to $\frac{14}{563} \times$ = 2.5% for the incendiary bombs tested with the M126-A1 nose fuze.

Of the nine (9), (19%) dud fuzes, the cause of malfunctioning unknown, six have been discussed above as probable tumblers. Of the remaining three, one occurred in a drop test on water and the others on ground; one was unrecoverable and the other burst into flame and later exploded.

In Table IV, data are given in regard to the arming of the M126-A1 fuze when bombs are dropped at various altitudes and speeds. As will be noted only a limited number of bombs were tested and the 100% functioning heights given can be only considered as the minimum at which bombs can be dropped for any degree of functioning.

Data are given in Table V on a limited number of tests performed to determine if the fuze was sufficiently sensitive to be activated on water and swampy terrain. The results are in the affirmative for both the M126 and M126-A1 nose fuzes.

Tables VI and VII give a break down in regard to bursters and fillings used in the drop tests of both the M126 and the M126-A1 fuzes on various impact surfaces. It will be noted that all standard bursters employed were properly activated by the M28 primer-detonator used in the fuzes.

A summary of drop tests with the M47-A2, 100 lb chemical bomb, WP filled, is given in Table VIII. Fuze functioning was 100% but several low order detonations were obtained with experimental tetryl bursters. It is not known whether the malfunctions were due to faulty bursters or the primer-detonator.

Tests of the M126-A1 fuze in bombs other than the M47 are given in Table IX. It will be noted that one dud fuze resulted from a weak firing pin and striker assembly when used with the E-2, 250 lb. incendiary bomb. The M126-A1 fuze could not be used with the E-2, 250 lb. incendiary bomb without the use of adapters or spacers to retain the proper distance between the primer-detonator and the burster.

It will be noted that satisfactory detonation of several experimental bursters was obtained with this fuze.

To summarize, the functioning of the M126-A1 fuze with the M47-A2, 100 lb. incendiary bomb, the fuze performance is of the order of 98% and the combined fuze - bomb performance is of the order of 96% over the altitude range of 500 to 15,000 feet. The overall percent functioning, it is indicated, will be slightly higher as the altitude of release is increased. Therefore, the M126-A1 fuze can be considered satisfactory for use with the M47-A2, 100 lb. incendiary bomb but can be improved with respect to strengthening the firing pin and striker assembly for use on terrain such as may be encountered in the release of M47-A2, 100 lb. chemical bombs.

A more rigid inspection or improvement in the design of the tail of the bomb would further improve the overall fuze-bomb functioning.

C. M126 Nose Fuze Failures.

Only a limited number of experimental M126 fuzes were available for test. The results are summarized in Table I and Table III. Of the 49 fuzes tested, three failures were obtained. Two were due to faulty gear train arming mechanism and in the other case the safety blocks did not fall off. Since the performance of the M126-A1 fuze was more satisfactory than that of the M126, the M126-A1 fuze was recommended for issue. Some M126 fuzes were manufactured for issue to fulfill orders in the theatres of operation before full production of the M126-A1 fuze would be achieved. In view of the above, no further testing of the M126 fuze was undertaken.

D. Fuze Attachments.

In photograph no. 12,610 are shown the two types of adapters that were used with the M108 modified fuze. Photograph 12,187 shows the assembly of the M126 and M126-A1 fuze in the M47-A1 or M47-A2 series 100 lb. bomb, chemical or incendiary. In photograph No. 12,606 are shown the effects of impact on a concrete slab on the fuze attachment. It will be noted that in both cases the primer-detonator adapter is firmly secured to the burster well head. Photograph no. 12,611 shows the adapter that is needed with the M47, 100 lb. incendiary bomb when the M126-A1 fuze is used with the M12 burster. An additional spacer is needed to maintain the proper distance between the burster and the primer-detonator of the fuze. The M13-M9 burster-igniter assembly cannot be used in the M47, 100 lb. incendiary bomb with the M126-A1 fuze, due to the increased length of the igniter.

VI. CONCLUSIONS.

1. The overall fuze-bomb functioning of the M126-A1 fuze and the M47-A2, 100 lb. incendiary bomb is of the order of 96% over an altitude range of 500 to 15,000 feet.

2. Under impact conditions normally encountered with the use of the M47-, 100 lb. incendiary bomb and due to a mechanically weak firing pin and striker assemb over an altitude range of 500 to 15,000 feet, approximately 1.8% malfunctioning of

the fuze is obtained.

3. Approximately 2% of the bombs became duds due to poor flight characteristics of the M47-A2, 100 lb. incendiary bombs.

4. The M126 and the M126-A1 fuzes are sufficiently sensitive to activate an M47-A2, 100 lb. incendiary bomb, when dropped on water or swampy terrain.

5. The approximate arming height of the M126-A1 fuze with the M47-A2, 100 lb. incendiary bomb, varies from 100 to 350 feet as the airplane speed decreases from 300 to 150 miles per hour.

6. The overall fuze-bomb performance can be improved by strengthening the firing pin and striker assembly of the fuze and by improving the flight characteristics of the M47-A2, 100 lb. incendiary bomb.

7. On rough terrain, such as may be encountered in the use of the M47-A2 100 lb. chemical bomb, fuze functioning may be considerably lower than it is on smooth targets due to the mechanically weak firing pin and striker assembly.

VII. RECOMMENDATIONS.

1. It is recommended that the firing pin and striker assembly of the M126-A1 nose fuze be improved to withstand impact on rocky terrain.

2. It is recommended that a more rigid inspection or a redesign of the tail assembly of the M47-A2, 100 lb. incendiary bomb be undertaken to improve its flight characteristics.

APPENDIX.

A. Photographs.

Photo. no. 12,601 - Fuze, Chemical Bomb, Nose, M108 Modified.
Photo. no. 12,602 - Nose Bomb Fuzes, M110-A1 and M126-A1.
Photo. no. 12,603 - Nose Bomb Fuzes, M126-A1.
Photo. no. 12,604 - Nose Bomb Fuze, M126-A1.
Photo. no. 12,605 - Nose Bomb Fuze, M126-A1.
Photo. no. 12,606 - Nose Bomb Fuze, M126-A1.
Photo. no. 12,607 - Nose Bomb Fuzes, M110 and M126.
Photo. no. 12,608 - Nose Bomb Fuze, M126.
Photo. no. 12,609 - M47-A2, 100 lb. Incendiary Bomb with M126 Nose Fuze.
Photo. no. 12,187 - M47-A2, 100 lb. Incendiary Bomb, with M126-A1 Fuze.
Photo. no. 12,610 - Adapters for Fuze, Chemical Bomb, Nose, M108 Modified.
Photo. no. 12,611 - Adapter for Nose Bomb Fuze, M126-A1.

APPENDIX A

Photographs - 12,601
12,602
12,603
12,604
12,605
12,606
12,607
12,608
12,609
12,610
12,611
12,187

TITLE SHEET

PHOTO. 12,601



RESTRICTED 12601

FUZE, CHEMICAL BOMB, NOSE, M106 MODIFIED

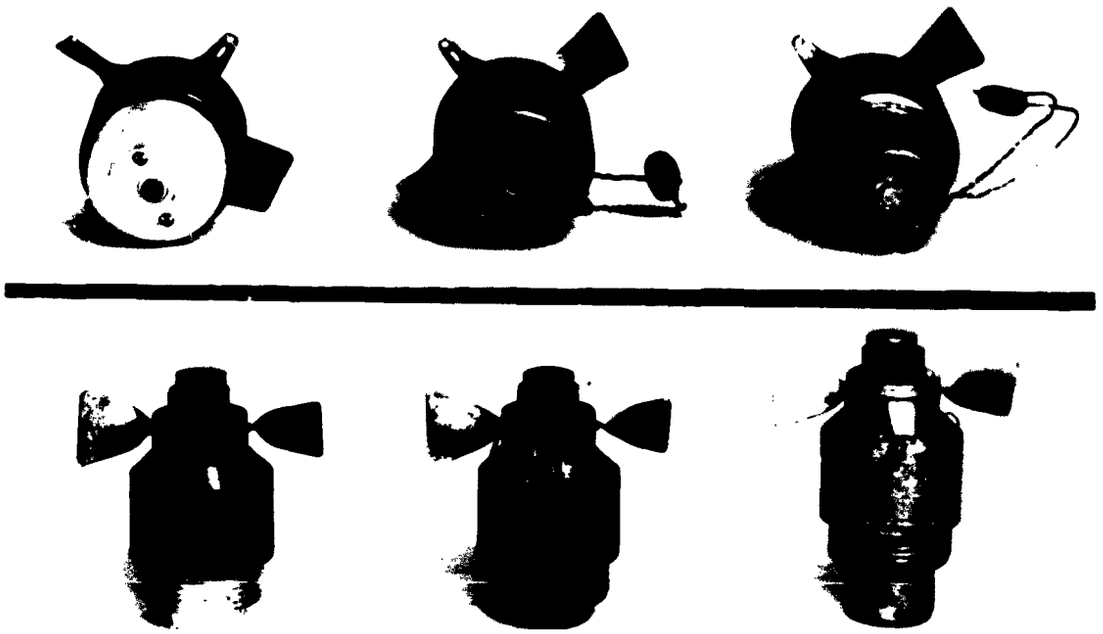
Photo. No. 12,601

OBJECT: To show the assembly and the component parts of the M108 modified nose fuze.

DESCRIPTION: The fuze has been used with the M47 series of 100 lb. chemical and incendiary bombs. It is instantaneously armed upon release from an airplane. The assembled fuze is shown in the photograph as item (5). The various component parts are as follows: Item (1) is the safety pin which is removed after the arming wire (diameter, .064 in.) has been inserted into the second hole of the arming pin (item 7). (Item (2) is the firing pin and striker assembly which fits into the body assembly (4). Item (3) is a copper shear wire which passes through the holes in the body assembly and the firing pin. Item (4) is the brass body assembly showing the ball locks which retain the fuze in a special adapter and the No. 13 primer-detonator. Item (6) is the safety block spring which helps to eject the safety block and the safety block holder (item 9). Item (7) is the arming pin which passes through the large holes in the body assembly (4) and the firing pin (2). Item (8) is the arming pin spring which ejects the arming pin upon the withdrawal of the arming wire. The fuze functions on nose impact, the firing pin being driven into the primer detonator after shearing the copper shear wire. The safety blocks were provided to prevent the fuze from firing if a bomb was accidentally dropped from the bomb bay of an airplane into the concrete apron. The fuze is snapped into an adapter and is held in place by the ball locks which are an integral part of the body assembly.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATES: Photographed at Edgewood Arsenal, Md., 9 May 1944, for T.D.M.R. No. 903.



RESTRICTED 12602

NOSE BOMB FUZES, M110-A1 AND M126-A1

OBJECT: To compare the bomb nose fuzes M110-A1 and M126-A1.

DESCRIPTION: The fuzes shown in the photograph are from right to left, the M110-A1, the early production M126-A1 and the later production M126-A1. The M110-A1 fuze which is used with the M41, 20 lb. fragmentation bomb, was modified by removing the tetryl booster and the M13 primer detonator from the lower part of the fuze and substituting an adapter containing an M28 primer-detonator. This modified fuze was the early production M126-A1. The latest production M126-A1 fuze contains the M28 primer detonator in a heavier adapter which screws in directly to the fuze housing and does away with the double adapter assembly previously used. The M110-A1 fuze cannot be used with the M47 series 100 lb. chemical or incendiary bomb.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Photographed at Edgewood Arsenal, Md. 9 May 1944, for T.D.M.R. No. 903.

TITLE SHEET

PHOTO. 12,603



RESTRICTED 12603

NOSE BOMB FUZE, M126-A1

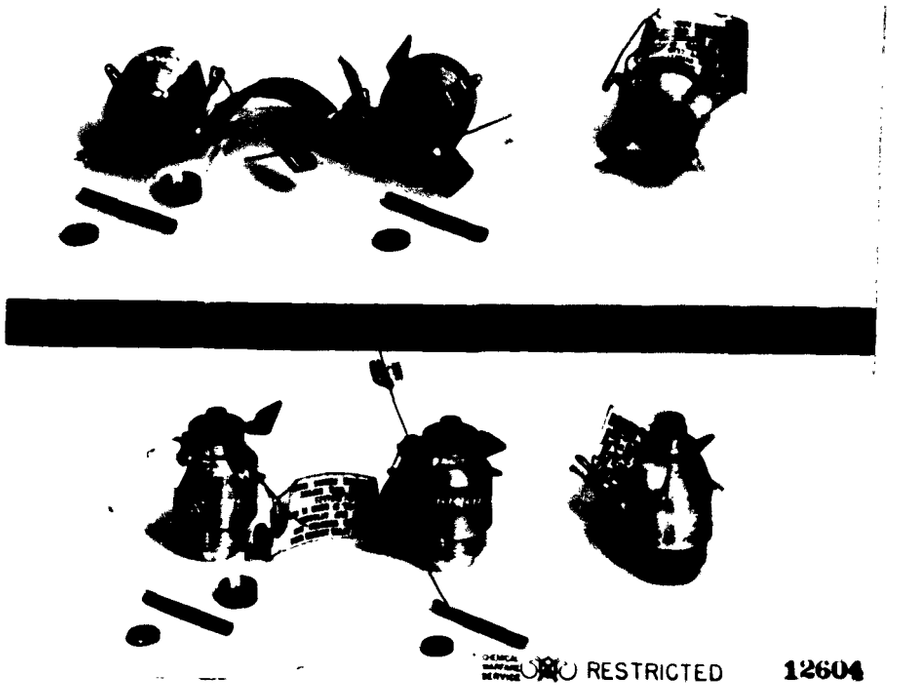
Photo. No. 12,603

OBJECT: To show the component parts of the nose bomb fuze, M126-A1.

DESCRIPTION: Item (1) is the fuze body, the arming vane and ball race assembly. Item (5) is the movable gear and arming sleeve and the pinion gear. The smooth portion of the movable gear and arming sleeve extends through the hole of item 1. The pinion gear is mounted on a shaft within the fuze body. Item (4) is the safety block which fits around the arming sleeve. Under item 3 are shown the firing pin spring, the firing pin and striker assembly, and the end plate pin. The spring and the firing pin and striker assembly are inserted through the hole in the arming sleeve. The end plate (item 2) is inserted through the bottom of the assembly (item 1) and the above component parts are held in place by inserting the end plate pin through a hole in the firing pin. The recess in the end plate (item 2) is to anchor the end plate pin. Item (6) is the M28 primer detonator and the adapter used in the early production fuze. Item (7) is the M28 primer detonator inserted in a large size adapter which eliminates extra machining. The fuze uses an 0.036 in. arming wire. When dropped from an airplane, 325 revolutions of the arming vane are necessary to withdraw the arming sleeve into the fuze body so that the safety block will be free to fall off. The fuze functions instantaneously on nose impact.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATES: Photographed at Edgewood Arsenal, Md., 9 May 1944, for T.D.M.R. No. 903.



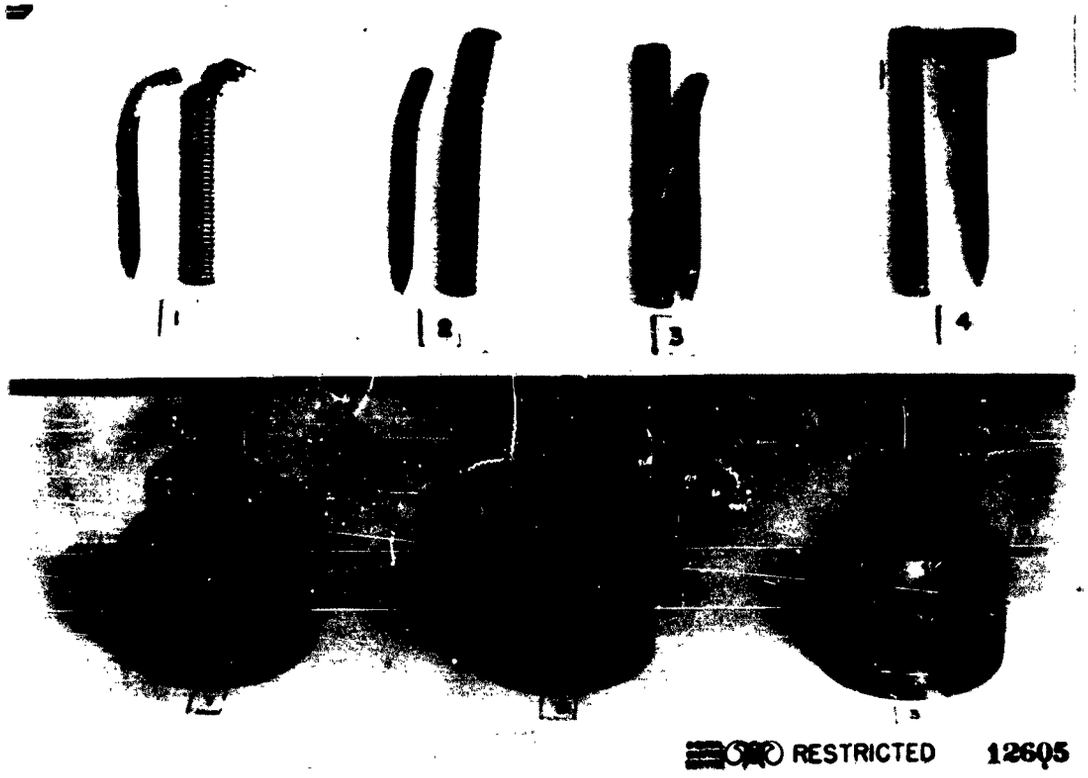
NOSE BOMB FUZE, M126-A1

OBJECT: To show damage done to nose bomb fuze, M126-A1.

DESCRIPTION: The photograph shows the damage done to three (3) M126-A1 fuzes when three (3) M47-A2, 100 lb. Chemical bombs, WP filled, and fuzed fell accidentally off an Air Corps bomb loading stand onto the concrete apron. The height of fall was approximately two (2) feet. The bombs skidded off the stand impacting on the nose end at an angle. The photograph shows that two (2) of the fuzes were hit with sufficient force to break off the head of the firing pin while the third fuze hitting at a lower angle only suffered damage to the arming vane.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Photographed at Edgewood Arsenal, Md., on 2 June 1944, for T.D.M.R. No. 903.



NOSE BOMB FUZE, M126-A1

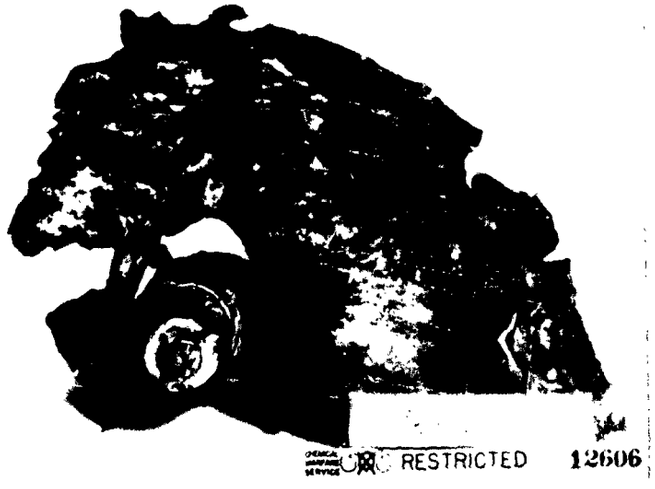
OBJECT: To show fuze failures due to broken firing pins.

DESCRIPTION: The photograph shows three fuzes representative of failures caused by the breaking and bending of the firing pin and striker assembly. Also shown are the firing pins and springs removed from the fuzes and compared with a spring and firing pin and striker assembly before impact. Note that all strikers are missing. The M47-A2, 100 lb. incendiary bombs were dropped from an altitude of 5,000 feet.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Bombs dropped at Edgewood Arsenal, Md., and fuzes photographed 9 May 1944, for T.D.M.R. No. 905.





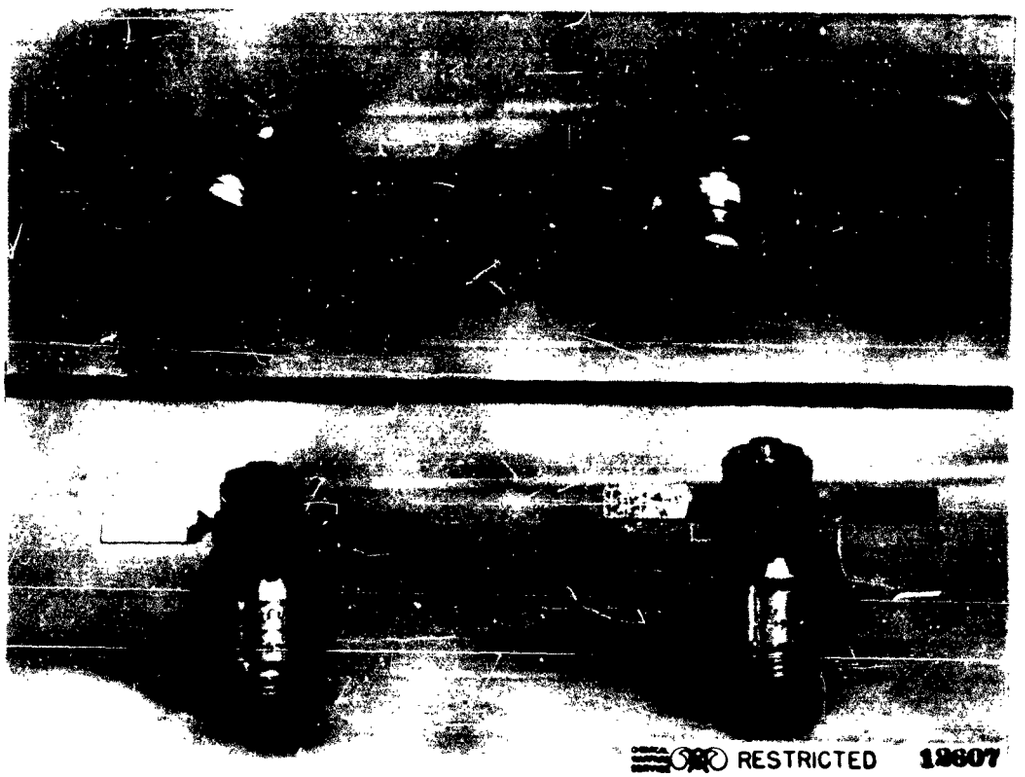
NOSE BOMB FUZE, M126-A1

OBJECT: To show the effect of impact on a concrete slab on the M126-A1 fuze.

DESCRIPTION: Bombs were dropped onto a concrete slab from an altitude of 4000 feet. Photograph shows two fuzes recovered after impact. Note that in both cases the adapter containing the primer detonator is undamaged and retained in the burster well head.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Bombs dropped at Edgewood Arsenal, Md., 11 August 1944 and photographed 15 August 1944 for T.D.M.R. No. 903.



NOSE BOMB FUZES, M110 AND M126

OBJECT: To compare the bomb nose fuzes, M110 and M126.

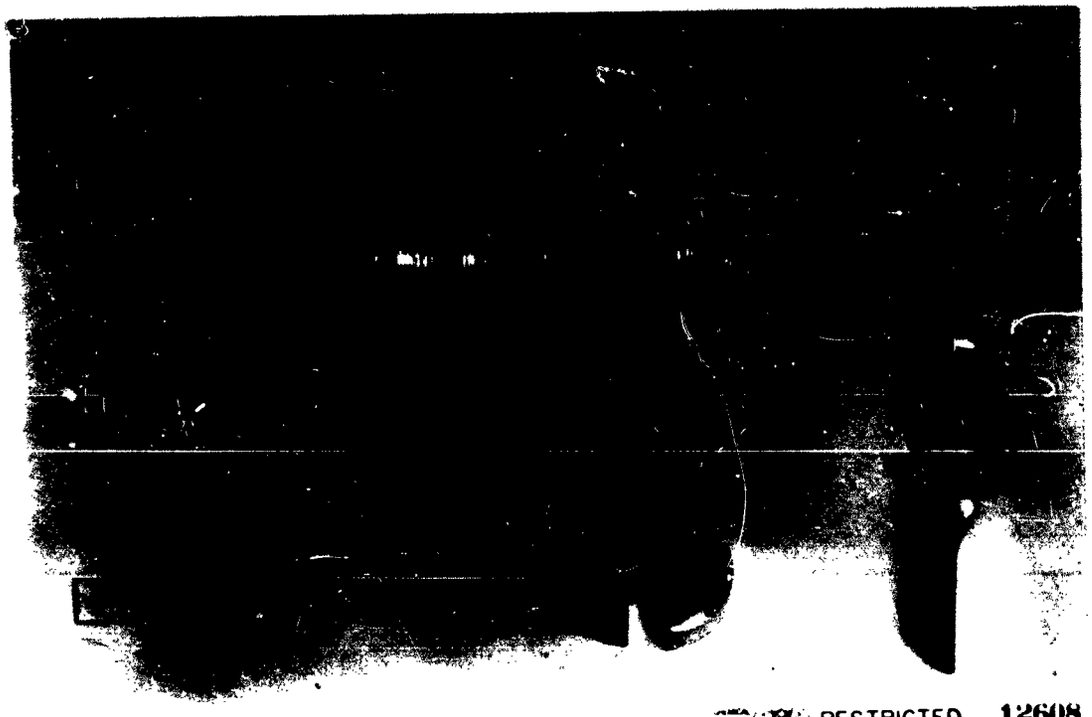
DESCRIPTION: The M110 nose fuze is shown on the right and the M126 nose fuze on the left. The M110 fuze was modified in the same manner as the M110-A1 to give the M126 fuze. The modification is described under Photo. No. 12,602.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATES: Photographed at Edgewood Arsenal, Md., 9 May 1944, for T.D.M.R. No. 903.

TITLE SHEET

PHOTO. 12,608



RESTRICTED 12608

NOSE BOMB FUZE, M126

Photo. No. 12,608

OBJECT: To show component parts of the M126 nose fuze.

DESCRIPTION: Item (1) shows the fuze body with the arming vane and ball race assembly, the firing pin and striker assembly, together with the firing pin spring all assembled. The safety blocks are shown as item 2. The arming vane (3) is snapped into place. Item (4) is the M28 primer detonator mounted in the adapter. This fuze differs from the M126-A1 in the following respects: (1) The arming vane is detachable, (2) three (3) safety blocks are used instead of one as shown in Photo. 12,603, (3) the M126-A1 fuze is of heavier construction and (4) the M126 fuze arms in approximately 455 revolutions of the arming vane.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Photographed at Edgewood Arsenal, Md., 9 May 1944, for T.D.M.R. No. 903.



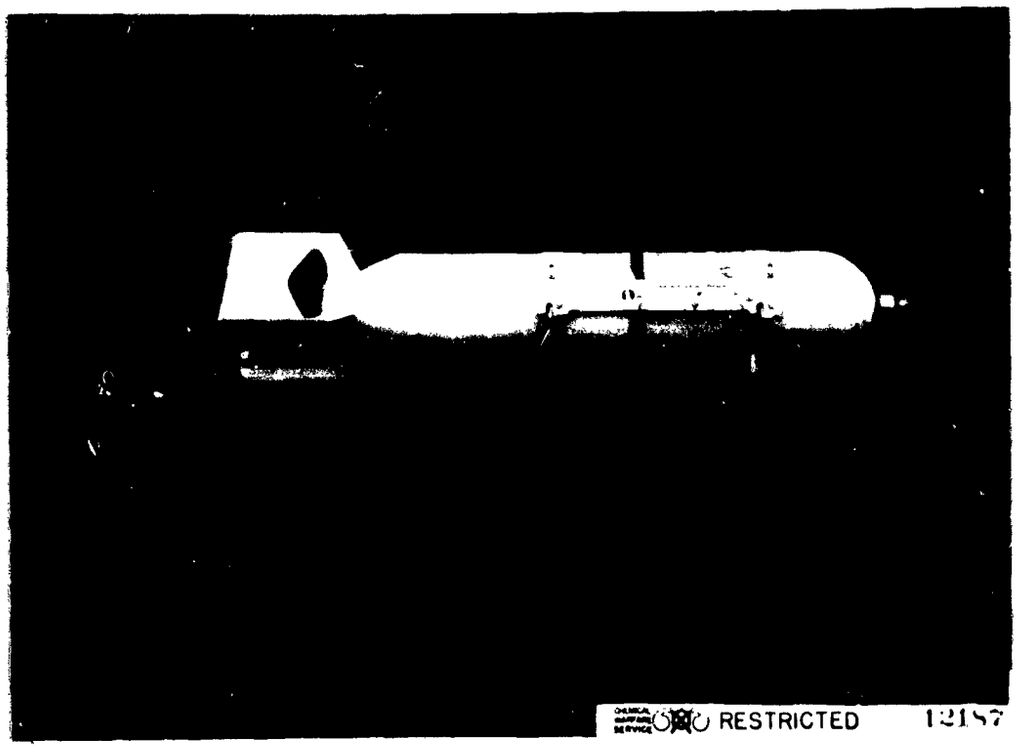
M47-A2, 100 LB. INCENDIARY BOMB WITH M126 NOSE FUZE

OBJECT: To show the condition of bomb and fuze after flat impact.

DESCRIPTION: The bomb was dropped from a B-25 airplane at an altitude of 5000 ft. The bomb tumbled in flight, fell short, and landed flat. The photograph shows the condition of the bomb and the M126 fuze. Note that the safety blocks are intact on the fuze. The fuze had not armed and the arming vane was lost on impact.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATES: Bomb dropped at Edgewood Arsenal, Md., and photographed October 1943 for T.D.M.R. No. 903.



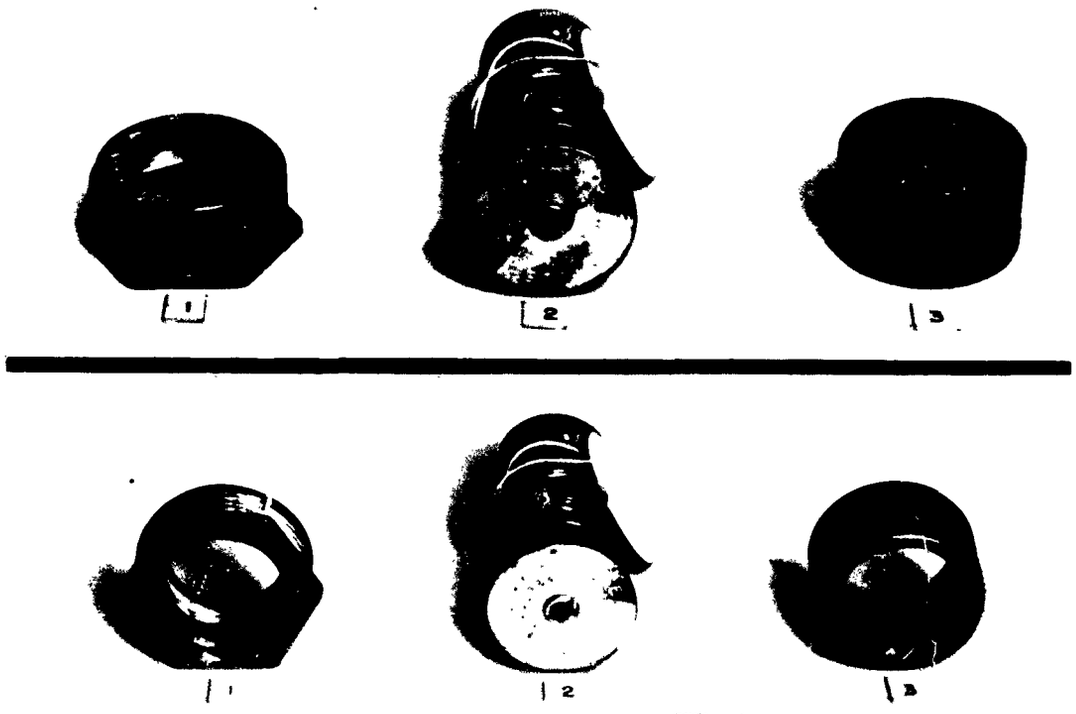
M47-A2, 100 LB. INCENDIARY BOMB, WITH M126-A1 FUZE

OBJECT: To show the assembly of the M126-A1 fuze in the M47-A2, 100 lb. incendiary bomb.

DESCRIPTION: The photograph shows the M126-A1 fuze assembled into an M47-A2 100 lb. incendiary bomb. The M12 burster or the M13-M9 burster-igniter assembly can be used in this bomb and fuze combination.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Photographed at Edgewood Arsenal, Md., 7 March 1944, for T.D.M.R. No. 903.



RESTRICTED 12610

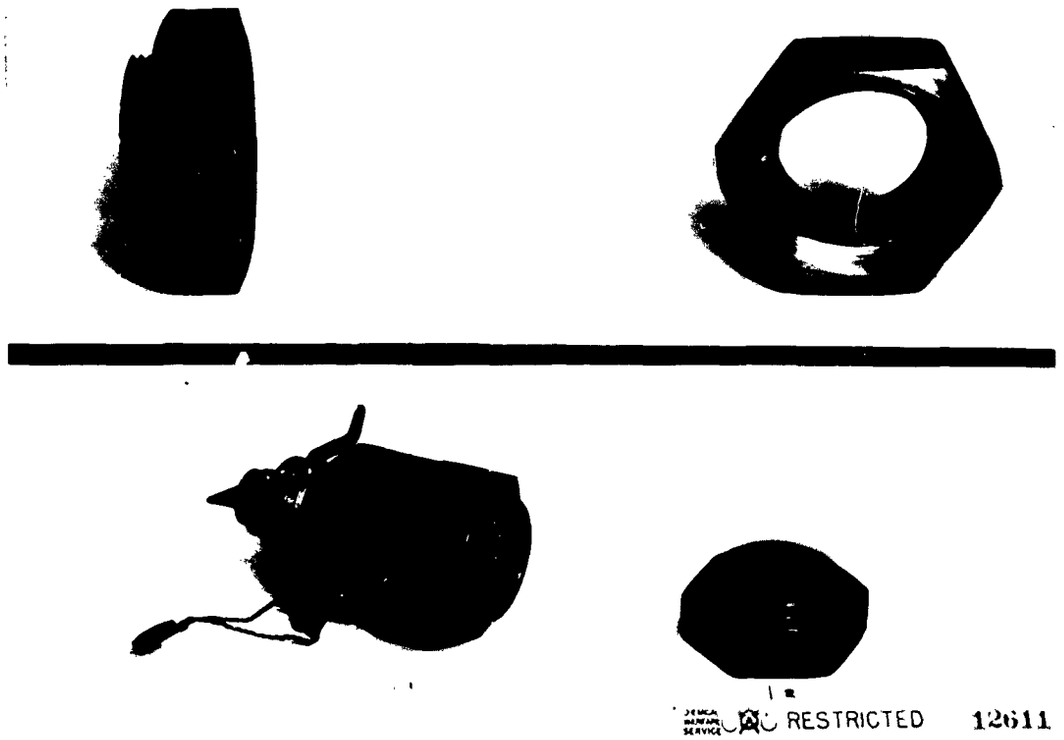
ADAPTERS FOR FUZE, CHEMICAL BOMB, NOSE, M108 MODIFIED

OBJECT: To show the adapters used with the M108 modified fuze for use in the M47 series, 100 lb. incendiary bomb.

DESCRIPTION: Item 1 is the adapter used on the M47-A1 or M47-A2, 100 lb. incendiary bomb. Item 2 is the modified M108 fuze showing one of the two ball locks which snap into the groove of the adapter and hold the fuze in place. Item 3 is the adapter used with the M47, 100 lb. incendiary bomb. It is not interchangeable with item 1.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Photographed at Edgewood Arsenal, Md., 9 May 1944, for T.D.M.R. No. 903.



RESTRICTED 12611

ADAPTER FOR NOSE BOMB FUZE, M126-A1

OBJECT: To show the adapter for nose bomb fuze M126-A1 for use in the M47, 100 lb. incendiary bomb.

DESCRIPTION: The M126 and M126-A1 nose fuzes can be used without the aid of an adapter in the M47-A1 and M47-A2, 100 lb. incendiary. However, the M47, 100 lb. incendiary bomb, because of the smaller diameter thread in the burster well head will not take either fuze without the aid of an adapter. The photograph shows end top and bottom views of the adapter and the assembly of the fuze and adapter. Only the M12 burster can be used with the M126-A1 fuze in the M47, 100 lb. incendiary bomb. A spacer under the collar of the burster is necessary for proper functioning.

PROJECT: B 11.9-1, Large Incendiary Bomb.

DATE: Photographed at Edgewood Arsenal, Md., 9 May 1944, for T.D.M.R. No. 903.