

Group H. S. Steele

Class 80

MINE DISPOSAL UNIT TWO ⁴²
Mine Disposal Unit #2

FILE COPY

FUZE STRIPPING

GUIDE

REGISTERED
NO. *49*.....



MARCH 1945

CONFIDENTIAL

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The following is a group of letters and directives pertaining to fuze stripping that have been issued by Chief of Naval Operations and the Chief of the Bureau of Ordnance.

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OFFICE OF THE CHIEF OF NAVAL OPERATIONS
Op-3C-3M3-amn Navy Department
(SC)S78-1 Washington, D.C.
Serial 027530

CONFIDENTIAL

25 January 1945.

From: The Chief of Naval Operations
To: All Ships and Stations
Subject: Fuze-Stripping, General Instructions on.

1. Experience has shown that it is often necessary, for research, intelligence, or disposal purposes, to disassemble and examine the fuzes and explosive trains of Allied and enemy bombs, projectiles, rockets, and other land ordnance. This process, known as fuze-stripping, is the main source of intelligence on enemy fuzes and of information on the causes of malfunctioning in U.S. and other Allied fuzes.

2. Fuze-stripping is extremely dangerous when undertaken by untrained personnel. A highly specialized knowledge of fuzes, explosives, and safety procedures is required in order to strip fuzes with a minimum of risk. For this reason, fuzes should be stripped only by qualified personnel. Those qualified are bomb disposal personnel, personnel who have completed a fuze-stripping course at the Mobile Explosive Investigation Units, and such other personnel as the Bureau of Ordnance may certify.

-- OpNav. F. J. HORNE.

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NAVY DEPARTMENT
BUREAU OF ORDNANCE
Washington, D.C.

(Re2b)
F41-6 (L)

10 November 1944

From: The Chief of the Bureau of Ordnance.
To: Officer-in-Charge, Bomb Disposal School,
Navy Yard, Washington, D.C.

Subject: Examination of Dud Fuzes to Ascertain Causes for Failure.

Reference: (a) BuOrd conf. ltr. F41-6(L) Re2b dtd 19 Aug. 1944.

1. Reference (a) requested the Bomb Disposal School to initiate a program which would enable field officers in bomb disposal work to remove the fuzes from dud ammunition and strip these fuzes so as to determine the reason for malfunctioning. In that letter, it was stated that this need not apply to projectile mechanical time fuzes. Since this leaves the status of many other fuzes unsettled, it is proposed to list only those fuzes in which the Bureau of Ordnance has a current active interest in determining the reason for malfunctioning. Certain fuzes such as projectile, bomb and rocket mechanical time fuzes, which contain extremely dangerous (when armed) cocked firing pin type of construction, are considered to entail excessive hazard for the information which may be gained by stripping duds. Since this list can be expanded almost indefinitely, the following list will cover all those fuzes of which analysis of duds is desired. Examination of fuzes other than those listed is not desired because of either danger or security reasons.

(a) U.S.N. Projectile Fuzes

1. P.D.F. Mark 29 and Mark 30.
2. B.D.F. Mark 19, 20, 21, 28, 31, 36, 39 and 48 and Army B.D.F. M66 (used in Navy 3rd).
3. A.D.F. Mark 44, 54, 55.

(b) U.S.N. Rocket Fuzes

1. Mark 137, 139, 145, 146, 147, 148, 149, 152, 154, 157, 159 and 100 (Mark 29 with M48A2 delay assembly).

(c) U.S.N. Bomb Fuzes

1. Nose Fuze Mark 219, 221, 227, 243, athwartship Mark 224, 234, tail Mark 223, 228, 229, 230.

(d) AN and U.S. Army Bomb Fuzes

1. AN-M 100A2, AN-M101A2, AN-M 102A2, AN-M103, AN-M103A1, AN-M 110A1, M112, M113, M114, M116, M116, M117 series. AN-M 120A1, AN-M126A1.

2. It may become necessary in the future, due to the adoption of new fuzes, to supplement this above mentioned list. If such occasion does arise, the Bomb Disposal School will be informed and will be given all necessary information required for the proper instruction in fuze stripping.

G. F. HUSSEY, Jr.

WCC/ikm

CC: NOL, Navy Yard
NPG, Dahlgren
C. of O., War Dept.

F. I. ENTWISTLE
By direction

CONFIDENTIAL

Op-30-SMS-SP
(3C)F41-6
Ser. 01257330

End.-1
on BuOrd conf. ltr.
F41-6 (L) Re2b of 19 Aug. '44
to USN Bomb Disposal School.

9 September 1944

From: CNO
To: Officer-in-Charge, Bomb Disposal School,
Washington, D.C.

Subj: Examination of Dud Fuzes to Ascertain Causes for Failure.

1. Forwarded.

2. It is requested that the Bomb Disposal School incorporate instruction on fuze stripping and examination in the bomb disposal course and that a publication on this subject suitable for field use be prepared. The course of instruction and the publication should be submitted to BuOrd for approval.

3. By copy of this endorsement, it is requested that BuOrd inform CNO of such approval. CNO will then promulgate a policy stating the conditions under which fuzes may be stripped and examined in the field.

W. R. PURNELL
By direction

CC: CominCh
CinCPac
BuOrd
BuPers
Army Ordnance
NOL (Navy Yard)
NPO, Dahlgren

CONFIDENTIAL

P41-6(L)
(Re2b)

NAVY DEPARTMENT
BUREAU OF ORDNANCE
Washington, D.C.

19 August 1944

From: The Chief of the Bureau of Ordnance.
To: Officer-in-Charge, Bomb Disposal School,
Navy Yard, Washington, D.C.
Via: Chief of Naval Operations

Subj: Examination of Dud Fuzes to Ascertain Causes for Failures.

Encl: (A) Sample Form for Reporting Data.

1. During the several bombardments of this war there have been a large quantity of dud projectiles, bombs and rockets which had to be disposed of by Bomb Disposal personnel. In some cases the reasons for the dud action of the fuzes concerned have been reported or conjectured upon by disposal officers in their formal or informal reports. The field of battle is the ideal proving ground for all ammunition and it is felt that the actual reasons for as many duds as possible should be positively ascertained. It was previously contemplated asking the Bomb Disposal School to direct officers in the field to defuze dud ammunition wherever practicable and send the fuzes to the Naval Ordnance Laboratory for examination. However, this has been deemed impractical because of the shipping problem and inability to predict what quantity of fuzes this would represent. It is fully realized that in many cases Bomb Disposal Officers have to destroy duds in place so that military operations may proceed without delay. However, it is felt that in many cases where ammunition was dumped in deep water or otherwise disposed of a valuable opportunity was lost to obtain data for improving naval fuzes. It is believed such ammunition could be stowed in a revetment of bomb crater under guard until there is sufficient time to defuze it.

2. Accordingly, it is requested that the Bomb Disposal School instruct all field officers to make every effort to defuze dud ammunition, break down the fuzes, and report the conditions found. This need not apply to Mechanical Time Fuzes on projectiles. Enclosure (A) is a suggested form to simplify paper work. Fuzes whose reasons for failure are doubtful or unknown should be sent to the Naval Ordnance Laboratory, Washington Navy Yard with all available data. It is also considered advisable to send in samples of other recovered fuzes periodically to the Naval Ordnance Laboratory.

3. Special tools may be necessary for defuzing projectiles. If additional or detailed instructions for disassembling and examining the various fuzes are desired, they will be furnished by the Naval Ordnance Laboratory.

4. It is emphasized that the foregoing applies only to conventional fuzes of the mechanical types. Fuzes Mark 32 and associated types are not to be considered as being covered by this request. Representatives of the Bomb Disposal School have been instructed and have worked out specialized techniques for these latter types of fuzes, and specific instructions, as issued by the School, shall apply to disposal problems in this case. No attempts to disassemble these fuzes shall be made under any circumstances and adequate security measures shall be enforced in those cases where it is found mandatory, as a matter of urgent military necessity, that a projectile be defuzed.

G. F. HUSSEY, Jr.

WBM/ikm

CC: Army Ordnance
NOL (Navy Yard)
NPG (Dahlgren)
COMINCH
CinCPac

C. I. TYLER
By direction

CONFIDENTIAL

PROJECTILE BOMB OR ROCKET DUD DATA

1. Identification of Projectile, Bomb, or Rocket (delete 2) - (Include caliber and type of projectile; size, type and M number of bomb; size, type and Mark of rocket. In general include all identification markings still legible on the ammunition.)
2. Type of Impact.
3. Condition of Projectile, Bomb or Rocket Head -
4. Fuze identification (Mark and Mod, or M number, and Lot No.
(Include all legible markings).
 - (a) Nose _____
 - (b) Base _____
 - (c) Aux. Det. (If applicable) _____
5. Setting of Bomb Fuzes (Delay or instantaneous if adjustable. Primer detonator used, if applicable).
6. Conditions in Fuzes conducive to dud action (Include degree of arming for bomb fuzes, position of detonator rotors, sliders or carriers, position of detents, general corrosion conditions, whether primer caps had been impinged upon and resulting action, condition of boosters (intact, low order, or high order), etc.
7. Opinion as to Cause of Dud Action _____
8. Remarks or Recommendations _____

ENCLOSURE (A)

U.S. NAVY BOMB DISPOSAL SCHOOL
Washington 16, D. C.

NC118/F41-6
(APR:GBS)
Serial 134

21 February 1945

CONFIDENTIAL

To: Chief, Bureau of Ordnance

Subject: Publication on Examination of Dud Fuses to Ascertain Causes for failure; submission of.

References: (a) BuOrd conf ltr F41-6(L) Re2b, of 19 Aug 44.
(b) CNO conf end-1 on reference (a).

1. In compliance with reference (b), subject publication is submitted to BuOrd for approval.

J. P. DAVID
Lieut. Comdr. USNR
Officer in Charge

Encl: (HW)
1. Subject publication.

F41-6(L)
(Re7b)

1st Endorsement on BDS, Wash, D.C. conf
ltr NC118/F41-6 (APR:GBS) Serial 134 to
BuOrd dated 21 February 1945.

CONFIDENTIAL

12 March 1945.

From: The Chief of the Bureau of Ordnance
To: Officer in Charge, Bomb Disposal School.

Via: The Chief of Naval Operations,
(Attn: OP-30-3M3)

Subject: Publication on Examination of Dud Fuses to Ascertain Causes for failure; submission of.

1. Returned.

2. In accordance with reference (b) of basic letter, Enclosure 1 is approved for publication subject to corrections and recommendations attached to the manuscript.

G. F. HUSKEY, Jr.

RDE/lca
022545 0097

RICHARD D. HILL
By direction.

Op-30-3M31-SP
(SC)F41-6
Doc.No. 158965
Ser.0124330

End-2 on BDS, Wash, D.C. conf ltr
NC118/F41-6 (APR:GBS) Ser 134 to BuOrd
dated 21 February 1945.

20 March 1945

CONFIDENTIAL

From: CNO
To: Officer in Charge, US Navy Bomb Disposal School.

Subj: Publication on Examination of Dud Fuses to Ascertain Causes for failure - Submission of.

Ref: (c) CNO conf ltr Ser 027530 of 25 Jan 45 to All Ships & Stations.

1. Returned, recommending early publication. Appropriate distribution should be made to all personnel authorized to strip fuses under reference (c); to appropriate principal commands; and to such other addressees as the Bureau of Ordnance may authorize.

2. It is assumed that supplemental information on this subject will be distributed periodically.

J. P. COMPTON
By direction

cc: BuOrd

INTRODUCTION

The purpose of this publication is to illustrate and explain a quick and safe method of disassembling fuzes in the field to determine the cause of malfunctions. Mechanical reasons for failure can be determined in the field by those with a knowledge of fuzes and fuze stripping. Chemical reasons for failure usually must be determined in a laboratory, but the field operation can determine which of the explosive components failed to function and segregate it so that it may be sent to a laboratory in its carrier. The removal of explosive components from their metal containers is a dangerous operation at all times. It cannot be done with any degree of success in the field and must not be done by field operators. Throughout this publication, the term "explosive components" will refer not only to the explosive element but also to its carrier.

A fuze will be stripped so that its components can be inspected as quickly and safely as possible. However, it must be remembered at all times that fuze stripping always presents the possibility of an explosion. Fuzes are not made to be taken apart. Separating the different components of a fuze is a dangerous job. The possibility of an explosion can never be completely eliminated, but the probability of an explosion and the damage caused by one can be minimized by intelligent operators. This must be done, not only as a safety measure but also to save the specimen. All possible information is wanted on the specimen on which you will be working.

Condition of the Fuze

A fuze is either in an armed or unarmed condition. If it is unarmed, the reason for failure will have nothing to do with the explosive components. (An exception to this would be a fuze which after it failed to operate, reverts to an unarmed position.) The reason will in this case be one of three: (1) the fuze did not have sufficient time to arm; (2) something is wrong mechanically with the construction of the fuze; (3) rust, corrosion, ice, or something else has kept an otherwise good fuze from arming. If any of the above are the cause for the failure of a fuze, a thorough knowledge of the operation of the fuze is necessary in analyzing the reason. Bombs and Fuzes (U.S. Navy and U.S. Army), published by the Navy Bomb Disposal School, is a very helpful book to use as reference in this regard.

If the fuze was in an armed condition before impact, the cause of failure can be either chemical or mechanical. The approach to each fuze will be to examine the chemical elements first to get them separated and away from the rest of the fuze. While breaking down a fuze to examine the explosive components, a look-out should be kept for mechanical defects. If the explosive components are all exposed and the reason for failure is not determined, it will be necessary to break the fuze down further and examine all of the mechanical components.

This book will deal with stripping an armed fuze. It is impossible to foretell in what condition each and every fuze will be found. Many of the fuzes will be battered. What parts will be mangled cannot be accurately predicted. Thus, this publication will deal with stripping of fuzes in an ideal condition. Ingenuity and personal initiative will have to be used to fit your fuze into the pattern explained herein. This point cannot be over-emphasized. It will be very infrequently that you will come upon a fuze that is in the condition described in this book. The method of stripping described in this book is only a guide. In the majority of cases you will have to deviate from the steps set forth in this book. This will mean that before stripping any fuze you should do two things. Study the fuze at hand in Bombs and Fuzes and make absolutely certain that you know how it operates. Study the method of stripping outlined in this book to see how closely you can approximate it. This book assumes that the fuze is not battered which may not be true of your fuze. Thus your own initiative and sense of safety is heavily relied upon in fuze stripping.

The stripping technique outlined herein assumes that the sharp striker is not impinged on the detonator or primer. If your fuze is in this dangerous condition, special care and thought should be taken. Rocket nose fuzes with their sharp strikers imbedded in unfired detonators illustrate such a circumstance. Any separation of the sharp striker and detonator in this situation must take into account the possibility of firing the detonator. DO NOT WITH-

INTRODUCTION

Condition of the Fuse (cont'd)

DRAW A SHARP STRIKER FROM A DETONATOR OR VICE VERSA IN SUCH A MANNER THAT A DETONATION WOULD INJURE THE OPERATOR. If this condition is encountered, it is obvious that the reason for failure is a faulty detonator. The only reason for progressing any further is to segregate the detonator carrier so that it may be sent back to the laboratory for analysis. Immersing the detonator in water while withdrawing the sharp striker will undoubtedly reduce the possibility of an explosion but it will also make a chemical analysis of the detonator difficult if not impossible.

It must be remembered that your fuse may be a later modification than the one described herein and as a result have different construction features. Check to see if the proper drawings are in Bombs and Fuses or in the A.F.E.O. Bulletins. These will help you to disassemble your fuse.

Remember that the fuse should not be taken apart as a museum piece. The quest for cause of failure is the only reason for dismantling a fuse. If it is safer to disassemble a fuse in one way which will mar a particular piece, do so. It is safety that counts and not the condition of the fuse after it is disassembled.

Technique

Various tricks of the trade will be explained in this section to help you in disassembling fuses. It is hoped that these suggestions will encourage your initiative in applying the pattern set forth in this publication to your own particular fuse.

1. The case of the fuse with a sharp striker imbedded in a detonator.

One method of trying to disengage a sharp striker from a detonator is explained here. It takes into account the possibility of the detonator firing when the striker is withdrawn. Such a possibility must always be reckoned with.

Take a length of fairly heavy wire and form the end of it into a hook. Engage the hook under the top hinge arm of the detonator shutter at the spring. Grasp the wire with a pair of pliers or wrap the wire around a bar. Make sure that your hands are not over the fuse. By pulling up on the wire the detonator will be lifted off the sharp striker. If the detonator fires, the force of the explosion and the fragments will not rupture the case of the fuse but will fly upwards.

2. Staking and Crimping.

A stake has been arbitrarily defined for the purpose of this book as the method of locking two pieces together whereby both pieces are defaced in some manner. Depending upon its position and strength, a stake should usually be broken by drilling or filing.

When drilling a stake, use a drill of appropriate size and use it in the manner of a dentist. This creates less heat than using a larger drill. Be careful not to drill too deeply. ALWAYS CONSULT A DRAWING OF THE FUSE BEFORE DRILLING OUT A STAKE.

When filing away a stake, it should be borne in mind that this technique is only preferable if the metal is soft or if it would be too difficult to locate a drill at the proper point. A crimp has arbitrarily been defined as a method of locking two pieces together whereby only one of the two pieces is defaced in the process.

The usual methods of removing a crimp are to pry the defaced piece away from the other one or to ignore it and proceed as if there were no crimp. This latter technique can only be used if the crimp is a light one.

3. Wrenches and Spanners.

1. Probably the most useful wrench in fuse disassembly is the Stillson wrench. You should have a complete assortment of these wrenches.

INTRODUCTION - continued
Technique (Wrenches and Spanners) cont'd.

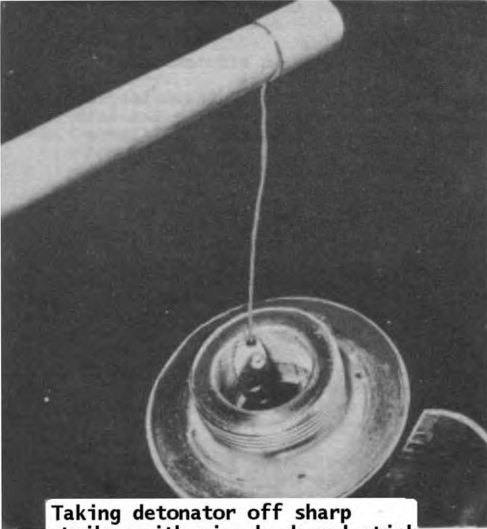
2. A C-spanner is a handy tool in many cases where spanner holes are either available or easy to drill.

3. A Y-spanner is almost essential in fuze stripping. However, many times adaptations and innovations have to be used. A pair of pointed-nose pliers is very useful in doing this work. Two spikes and a tommy bar can also be used to get more leverage. For very small work Y-spanners usually have to be made to measure. The end of a hacksaw blade makes a good Y-spanner when a slot of proper dimensions is cut into it. It can be turned with a wrench. Do not make the points too long or they will bend or break off when force is applied.

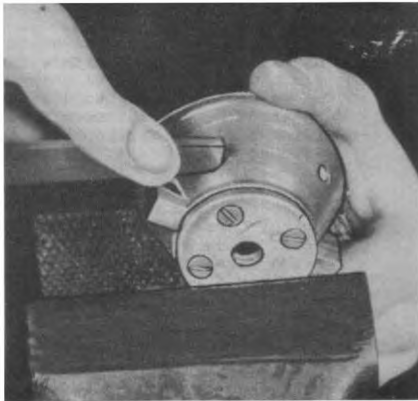
4. Drilling and Punching.

1. If drilling at a spot near explosive, take your time and do not try to cut too much at one time. Stop and examine the hole every few turns of the drill. Use a bit of the correct size, and make sure that your bits are sharp.

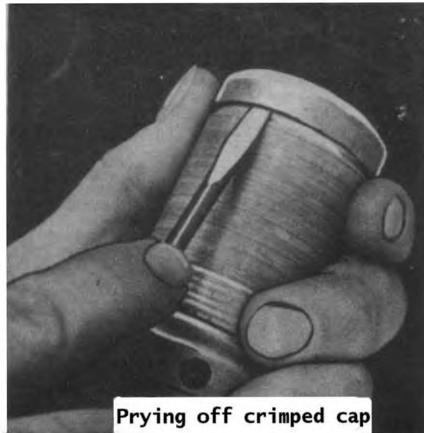
2. Use a punch of constant diameter for a necessary distance. This will avoid having a punch stuck in the hole from which the pin was punched.



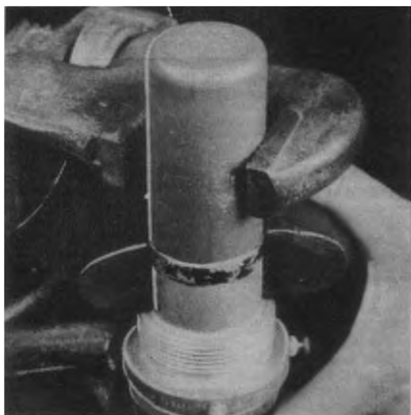
Taking detonator off sharp
striker with wire hook and stick



Filing away crimp



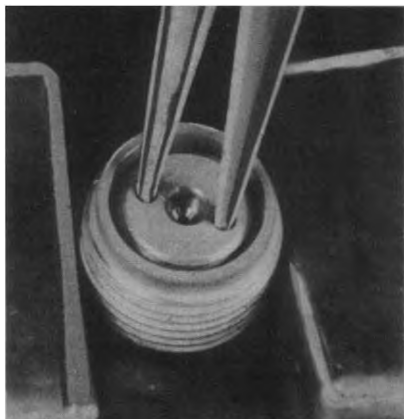
Prying off crimped cap



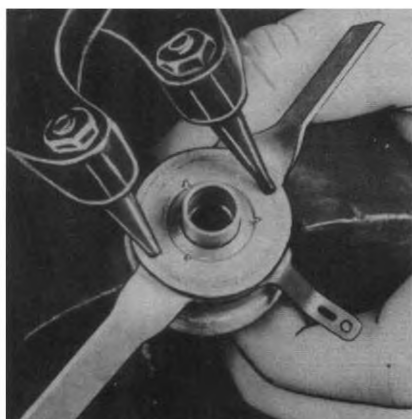
Breaking a stake with a Stillson.



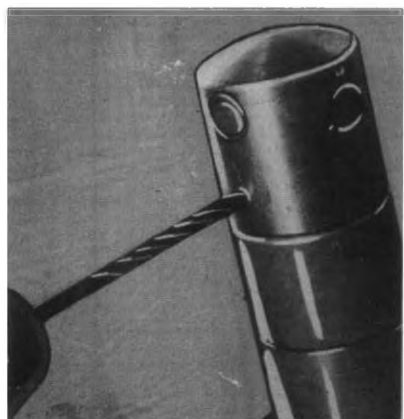
Using a C-spanner.



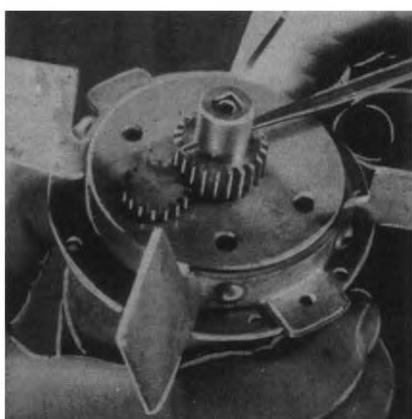
Adaption of a Y-spanner.



Using a Y-spanner.

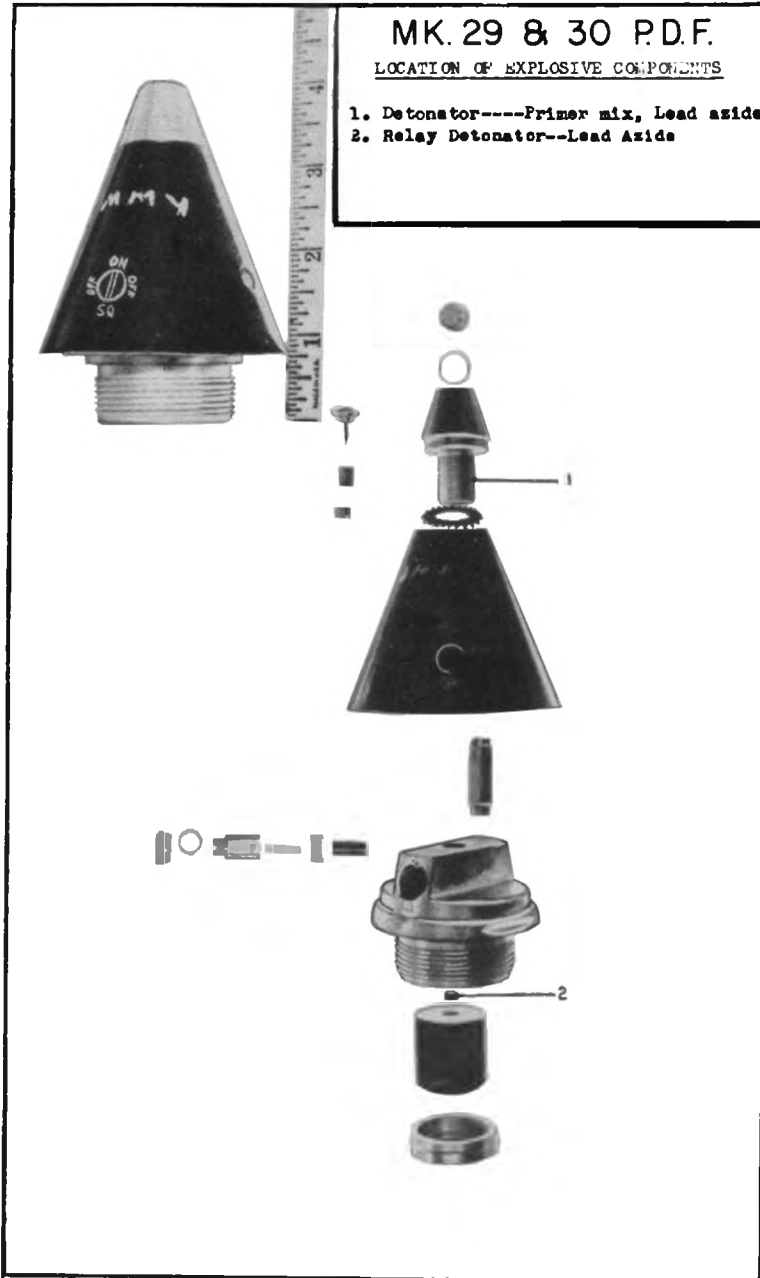


Drilling out a stake pin.



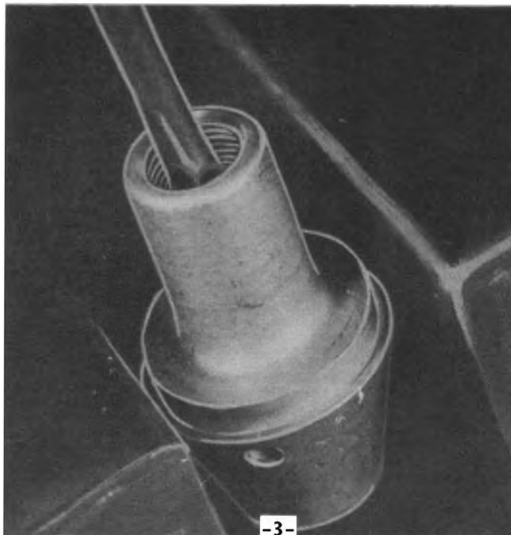
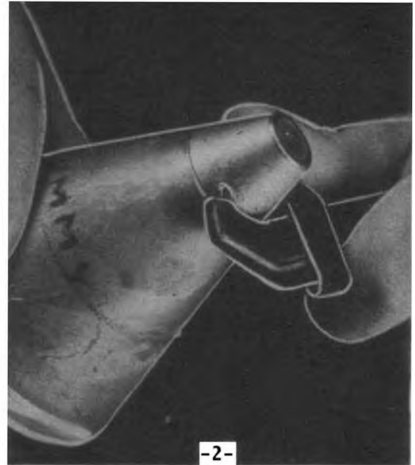
Using a punch of constant diameter.

RESTRICTED



COMMON REASON FOR FAILURE**MK. 29 & 30 P. D.F.**

1. Unscrew the bottom closing disc. This has a left hand thread and is staked. The stakes, in all probability, will have to be drilled out in spite of the spanner holes which are present. (Fig. 1).
2. Withdraw the relay detonator housing.
3. Unscrew the nose of the fuze with a "C" spanner. This has a right hand thread. (Fig. 2).
4. Take out the closing screw from the underside of the nose piece. This had a left hand thread. (Fig. 3). The detonator can now be inspected.

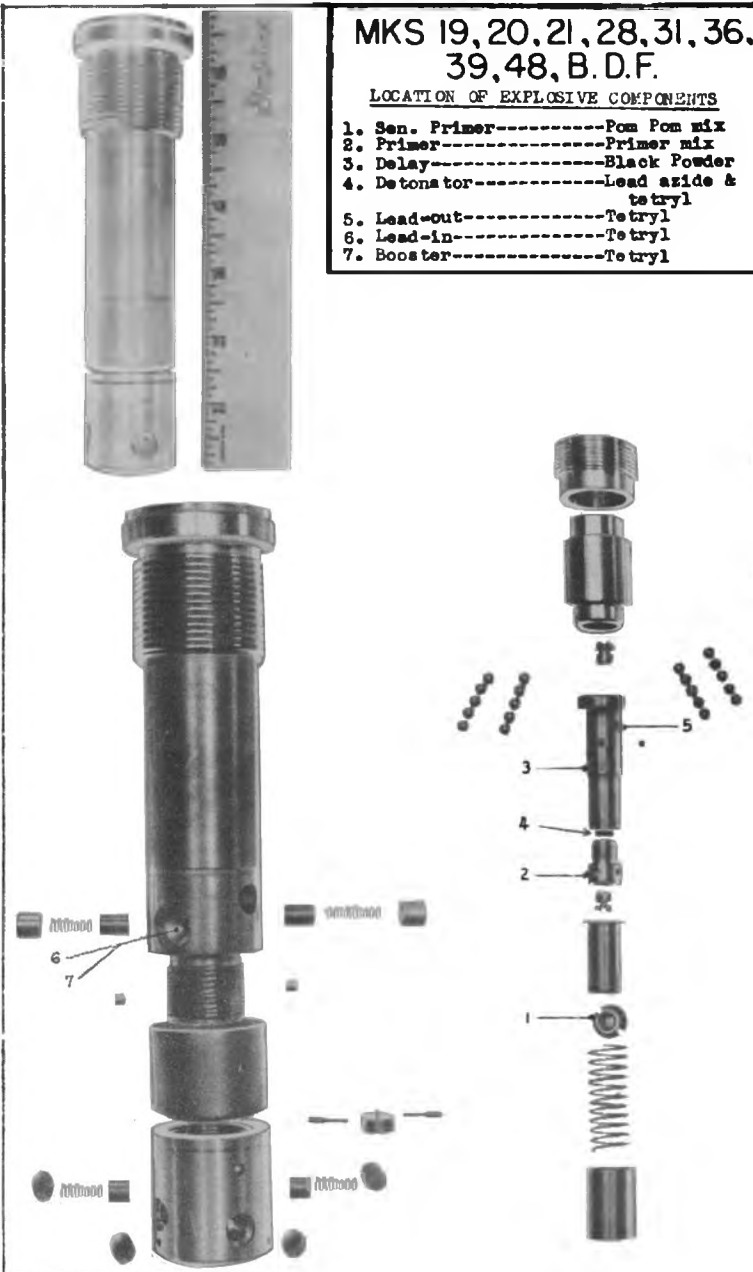


RESTRICTED

MKS 19, 20, 21, 28, 31, 36, 39, 48, B.D.F.

LOCATION OF EXPLOSIVE COMPONENTS

1. Sen. Primer-----Pom Pom mix
2. Primer-----Primer mix
3. Delay-----Black Powder
4. Detonator-----Lead azide & tetryl
5. Lead-out-----Tetryl
6. Lead-in-----Tetryl
7. Booster-----Tetryl

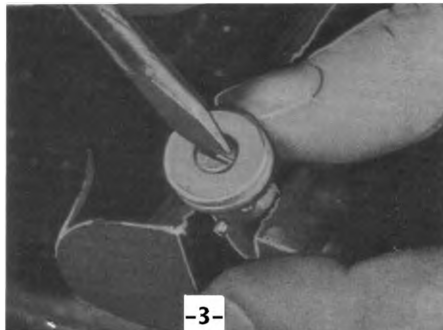
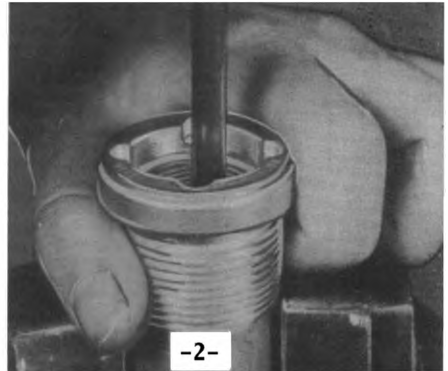
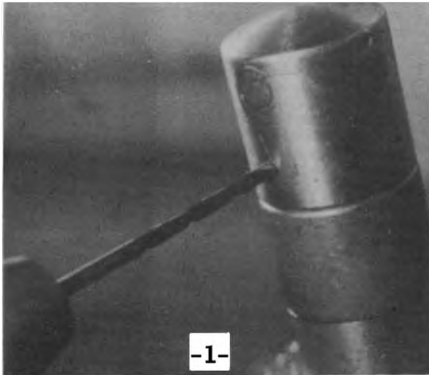


COMMON REASON FOR FAILURE

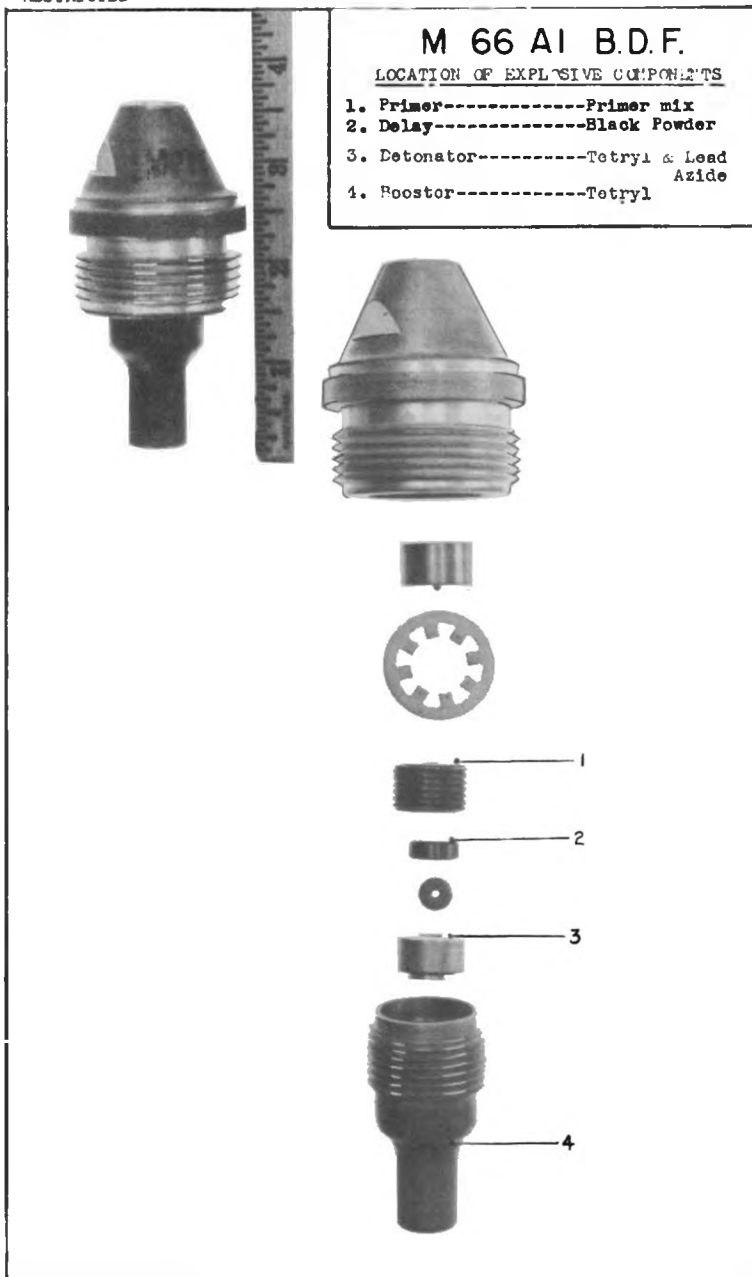
Failure of delay primer

**MKS. 19,20,21,28,31,
36,39,48 B.D.F.**

1. Drill out the stake pin in the nose cap. Use a drill that is slightly larger than the pin being certain to drill out all of the pin. Remove the nose cap which has right hand threads. (Fig. 1).
2. If the sensitive primer has not fired or if it has fired low order, it will be found in its assembled condition when the nose cap comes off. It can be determined that the sensitive primer has detonated low order by the fact that the primer carrier is dented, or the temper color caused by the heat of the explosion or by the odor. If the sensitive primer has not fired the firing pin detents in the nose cap should be inspected for possible corrosion.
3. If the sensitive primer has fired the explosive train components will undoubtedly unscrew at one of two points and come out with the nose cap.
4. Looking down into the nose cap you will see either one or the other explosive components depending on where the train unscrewed.
 - (a) Sensitive primer - if you see this when you look into the spring housing now held in the nose cap, then by looking into the end of the fuze body, the delay firing pin will be visible. This firing pin should fall out exposing the delay primer.
 - (b) Delay primer - if you see this when you look into the spring housing now held in the nose cap, then the flash channel with the delay train below it will be visible in the fuze body.
5. If the cause for failure is still undetermined, it is necessary to remove the closing plug at the other end of the fuze body. This plug has left hand threads and is staked. (Fig. 2).
6. After the closing plug is removed the auxiliary plunger and its bearings will fall out. The detonator plunger can also be withdrawn from this end.
7. The screw on the bottom of this plunger can be removed. An increment of tetryl beneath this screw covers the detonator; the tetryl will probably fire if the detonator fires.
8. If the delay carrier for the delay primer is still in position at the other end of the detonator plunger it should be unscrewed. A small Stillson wrench can be used for this operation after the delay firing pin is removed and the staking is filed off.
9. Further stripping of the element containing the delay primer, delay, detonator and lead-outs is not recommended by the Bomb Disposal School because of the danger involved.

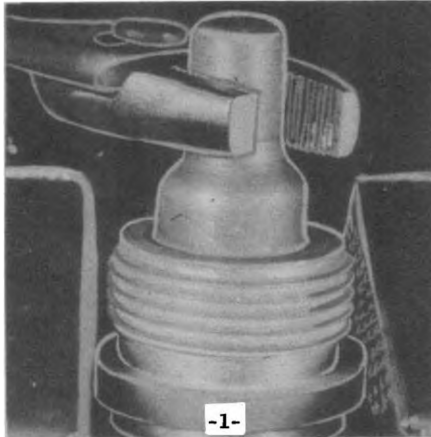


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COMMON REASON FOR FAILURE**M66A1 B.D.F.**

1. Unscrew the booster from the fuze body. These are held together with a right hand thread. (Fig. 1).
2. The shear washer and striker will now fall out of the fuze body.
3. An inspection of the primer will reveal whether or not the striker has struck the primer. If the primer cap has been dented, it is recommended that the booster be sent to N.O.L. for further examination.
4. Examine shear washer also to see if deformed.

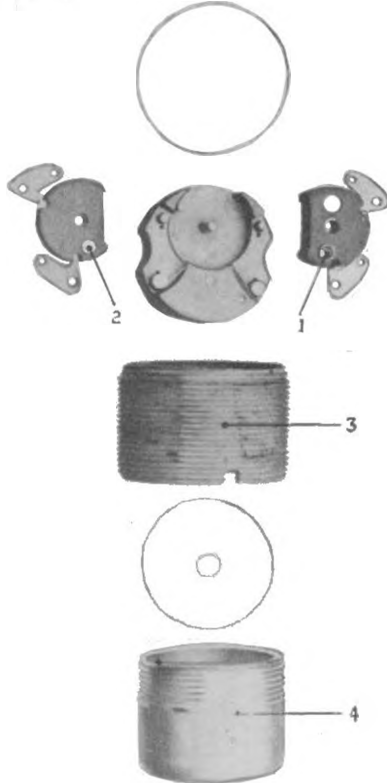


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MK 44 A.D.F.

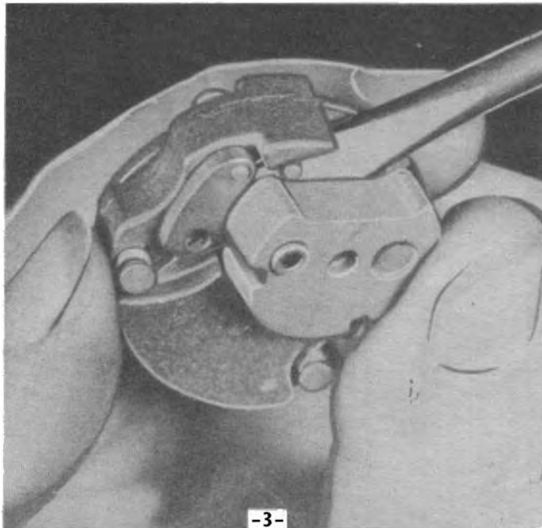
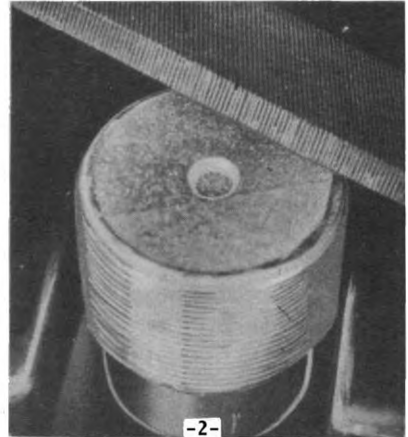
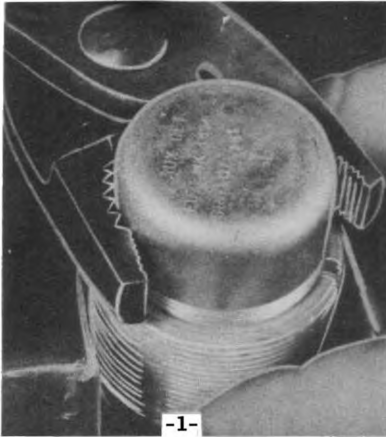
LOCATION OF EXPLOSIVE COMPONENTS

1. Detonator-----Tetryl & Lead Azide
2. Rotor lead-in-----Tetryl
3. Body lead-in-----Tetryl
4. Booster-----Tetryl



COMMON REASON FOR FAILURE**MK. 44 A.D.F.**

1. Unscrew the booster. This has a left hand thread. (Fig. 1)
2. File away the circular crimp holding the closing disc in the top of the fuze. (Fig. 2).
3. Lift out the closing discs and the rotor carrier plate.
4. Lift the primer carrier off of its hinge. Do the same for the detonator carrier on the other side of the plate. (Fig. 3).
5. All explosive components are now exposed.

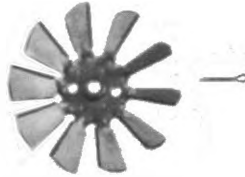
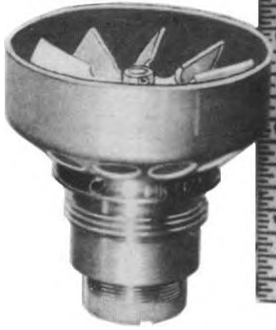


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MK 137, MK 145, MK 154

LOCATION OF EXPLOSIVE COMPONENTS

- | | |
|-----------------------------------|----------------|
| Mks 137, 154 | Mk 145 |
| 1. Detonator--Lead Azide & Tetryl | 1a. Primer mix |
| | B.P. delay |
| 2. Lead-in---Tetryl | Lead Azide |
| 3. booster---Tetryl | Det. |



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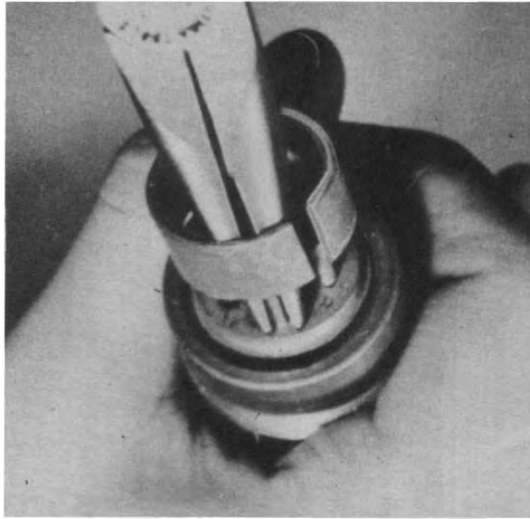
COMMON REASON FOR FAILURE

MK.137, MK.145, MK.154

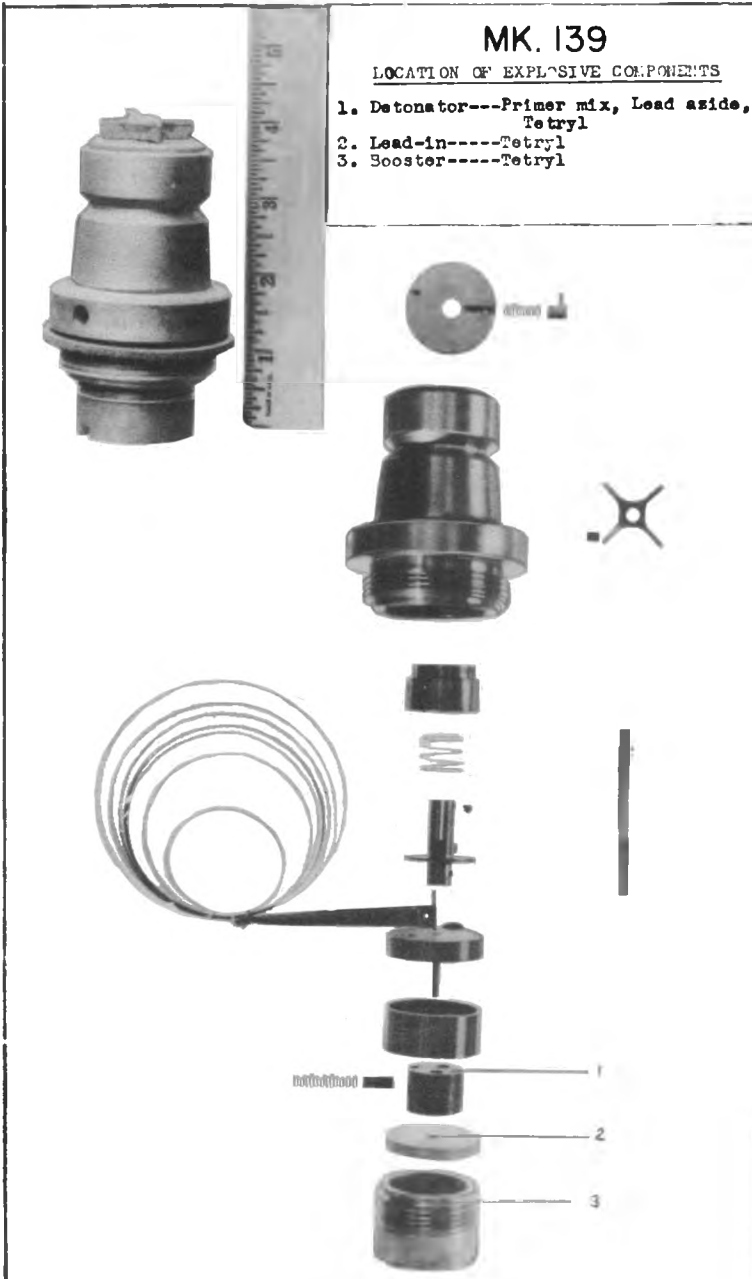
1. Unscrew the booster magazine, or burster tube on the Mk 154 and remove burster tube adapter.
2. Lift out the lead-in disc.
3. Pull out detonator shutter employing a hooked wire placed in the cut-out section when the shutter is hinged to plate.
4. Take out the cotter pin holding the vanes on. Remove vanes.
5. Take out the four screws holding the vane guard to the fuze.
6. Grasp the shutter stop pin and remove firing pin guide and sleeve. (Remove assembly screw in side if present). (Fig. 1).
7. Unscrew the firing pin from the body from inside. All parts are now exposed.

The Mk 145 differs from the Mk 137 only in that the Mk 145 has a blunt firing pin and a delay in the shutter.

The Mk 154 differs from the Mk 137 only in that the Mk 154 is fitted with a burster tube instead of the standard booster.



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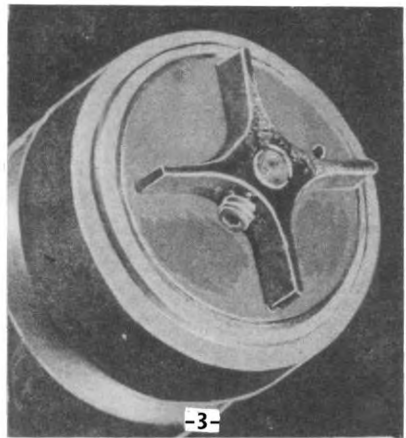
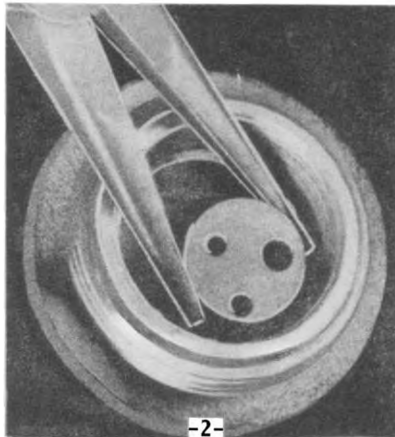
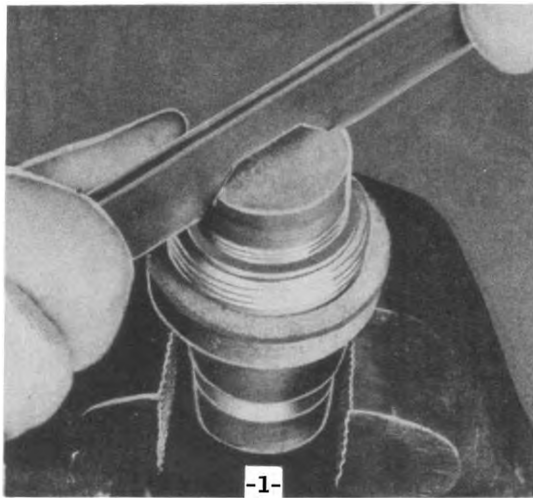
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HAVE YOU READ THE INTRODUCTION?

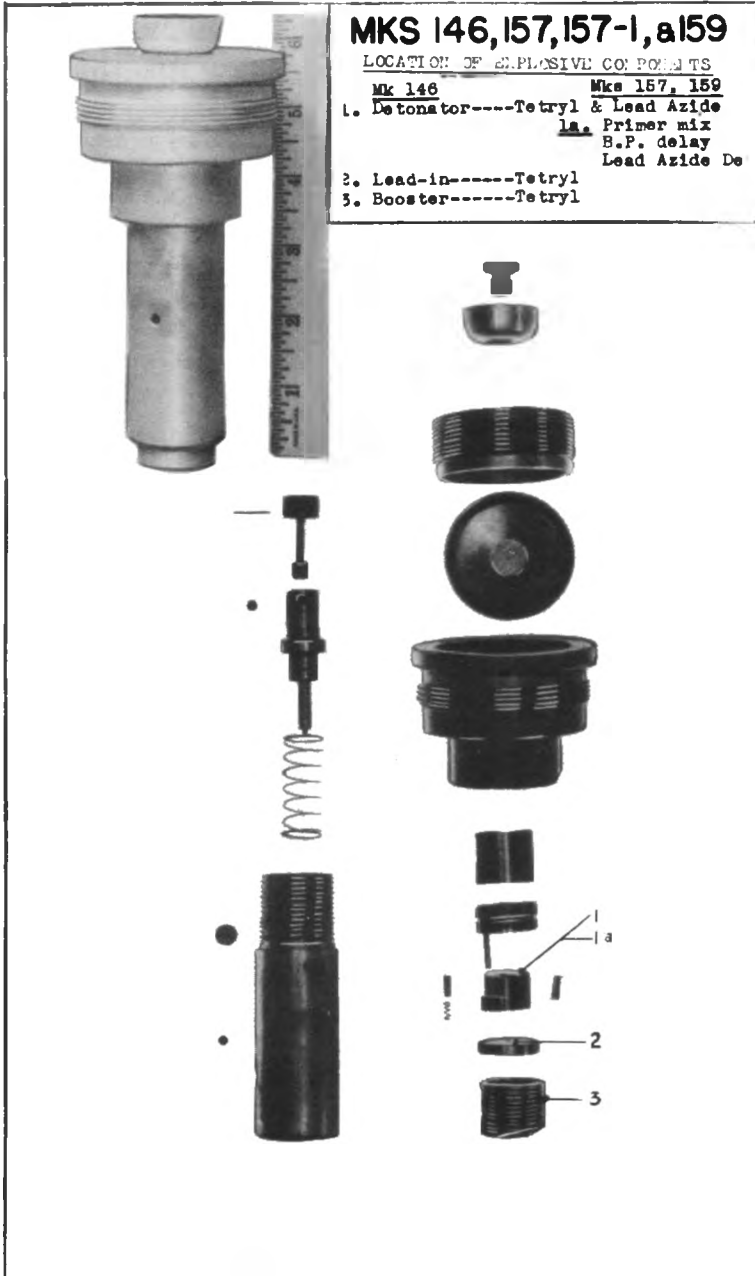
COMMON REASON FOR FAILURE

MK. 139

1. Unscrew the booster magazine.
2. Remove the lead-in disc.
3. Lift out the detonator shutter. (Fig. 2).
4. Lift out the spacer ring.
5. Lift out the closure disc, clock-spring, and fly wheel.
6. Remove the screw holding the striker to the firing pin. This screw takes an Allen wrench. (Fig. 3)
7. Remove the firing pin through the bottom of the fuze. Now all of the parts are exposed.



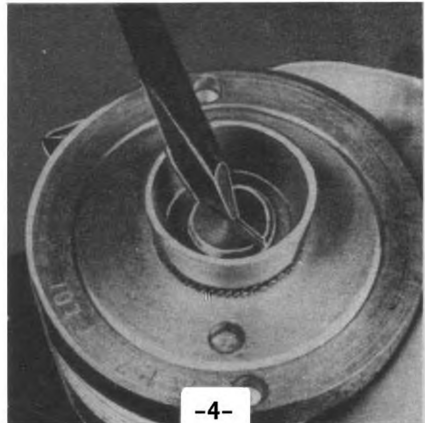
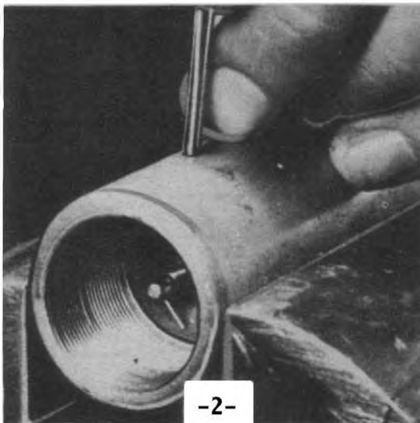
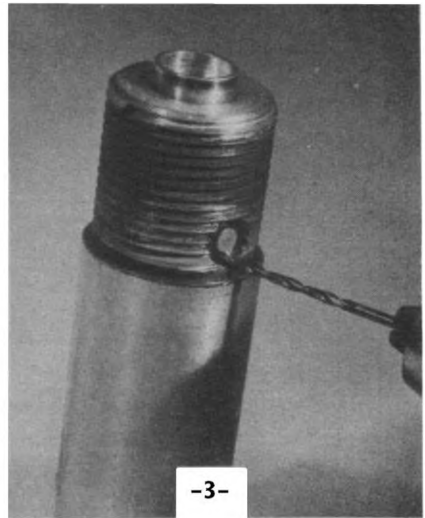
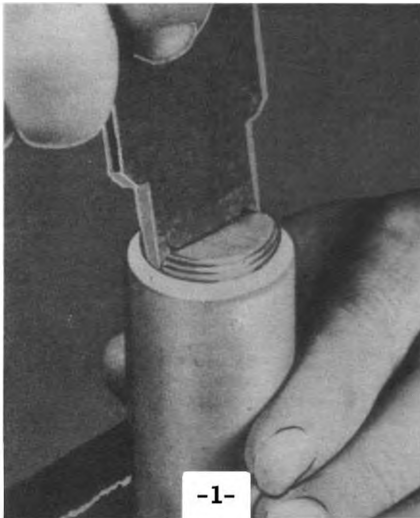
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COMMON REASON FOR FAILURE**MKS.146,157,157-1, & 159**

1. Unscrew booster magazine which has right hand threads (Fig. 1).
2. Be careful that the spring does not throw out the lead-in and shutter assembly. Lift out the lead in disc and shutter.
3. Punch out the assembly pin in the side of the fuze. (Fig. 2).
4. Remove firing pin guide and spring. (It may be necessary to loosen a set screw in the side of the fuze with an Allen wrench to do this).
5. Unscrew the head of the fuze. (Right hand thread)
6. Drill out stakes and remove ball retaining plug in the top screw threads of the body (Fig. 3).
7. Pull out the firing pin with a pair of point nose pliers. This can be done since the locking ball can come out of the hole where you have removed the ball retaining plug.
8. Drill out the staking and remove the shear wire holding the arming plunger to the body. Remove the arming plunger.
9. Remove the inlet screw holding the inlet shield and inlet screw to the plug.
10. Use a spanner to remove the plug from the head.
11. The pressure diaphragm will now fall out.

These three fuzes are alike in external appearances. They differ essentially in the length of delay and minor manufacturing differences.

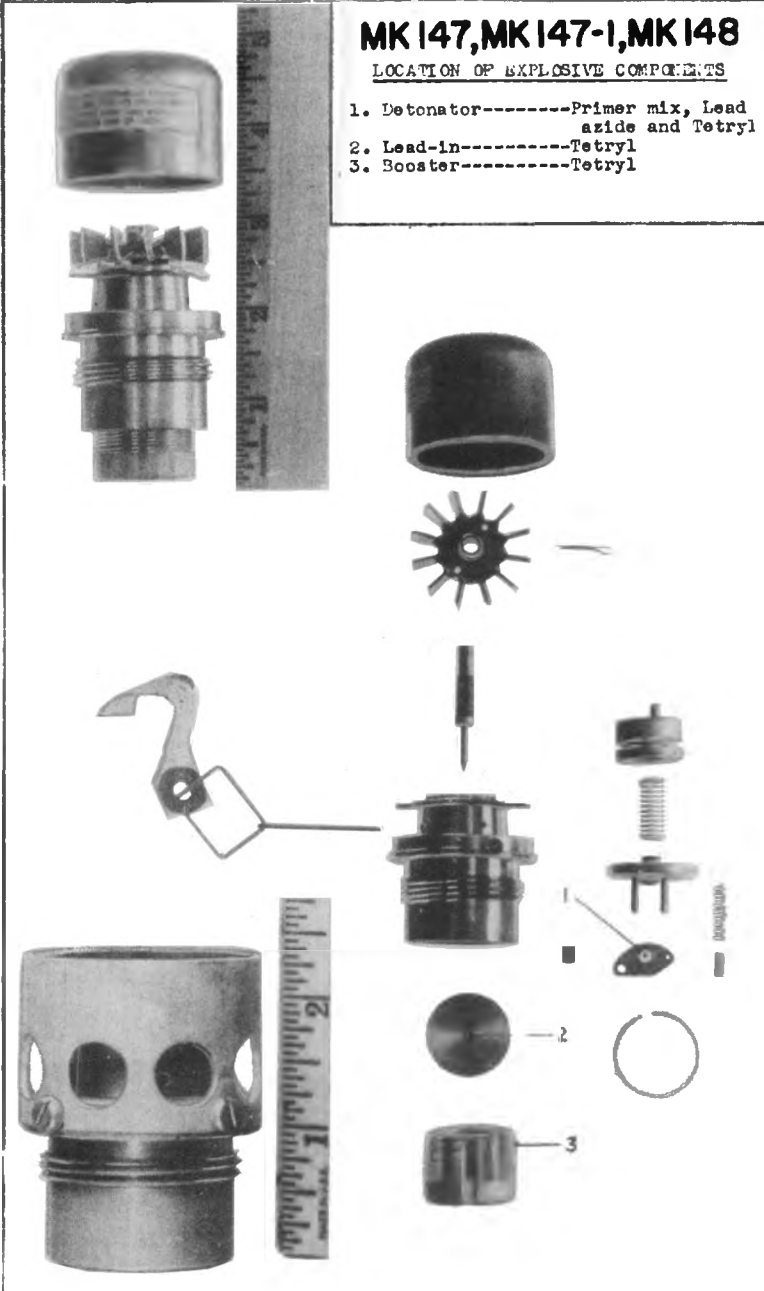


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MK 147, MK 147-1, MK 148

LOCATION OF EXPLOSIVE COMPONENTS

1. Detonator-----Primer mix, Lead azide and Tetryl
2. Lead-in-----Tetryl
3. Booster-----Tetryl



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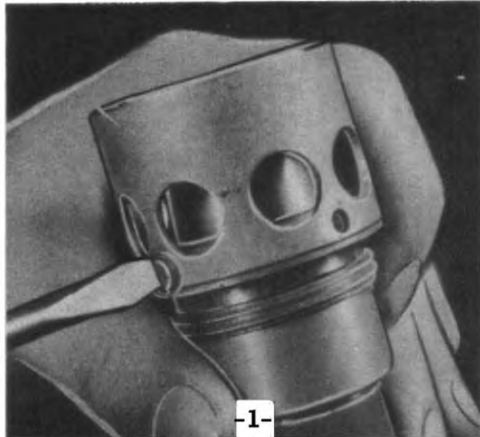
COMMON REASON FOR FAILURE

MK. 147, MK. 147-1, MK. 148

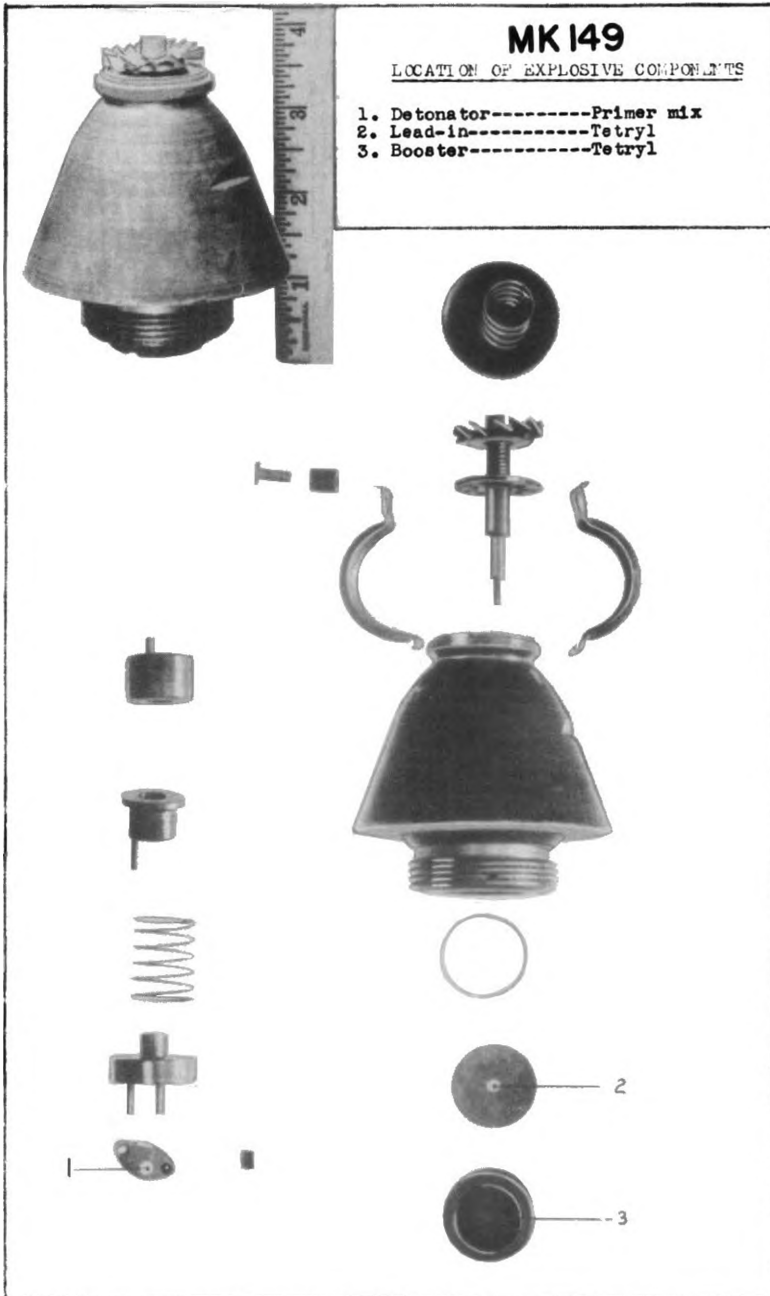
1. The disassembly of these fuzes is the same as for the Mk 137 with the exception of the assembly screw in the side of the fuze body.
2. After the booster container (magazine) and lead-in disc are removed, hook the shutter with wire as shown in Fig. 9 on the Mk 149.
3. Grasp the shutter stop pin and drag out the sleeve and firing pin guide.
4. Remove vane guard by unscrewing the four holding screws. (Fig. 1.)
5. Inspect the propeller locking pin for its presence and freedom of motion of setback block

The Mk 147 has straight vane guard, and the Mk 147-1 has a shipping cap instead of a guard.

The Mk 148 differs from the Mk 147 only in that the Mk 148 has a booster instead of an adapter for a burster charge.

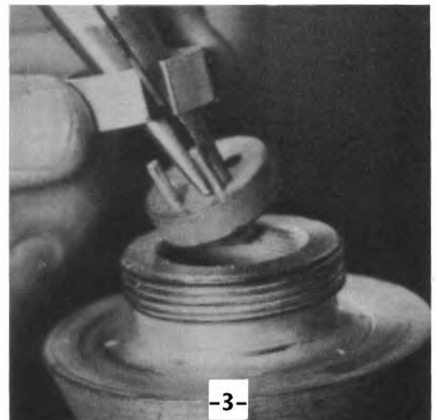


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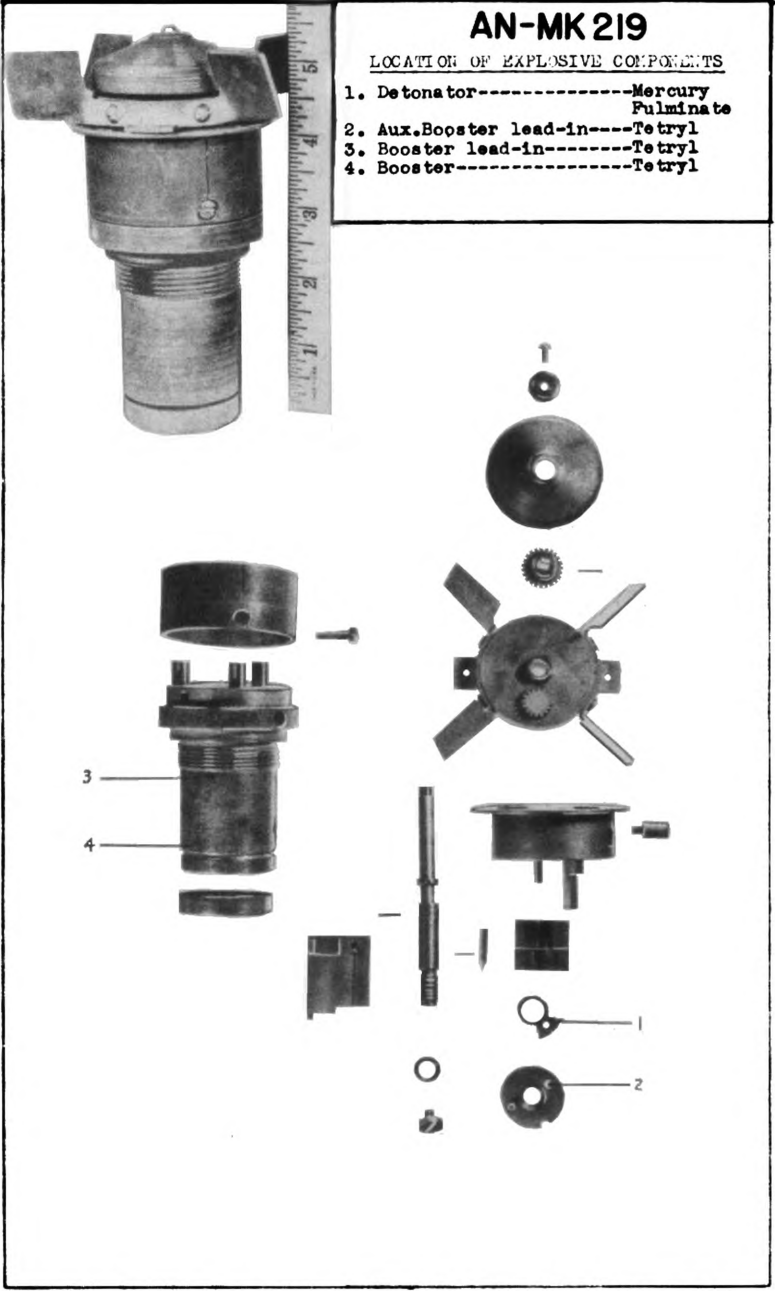


COMMON REASON FOR FAILURE**MK. 149**

1. Unscrew the booster magazine. (Fig. 1).
2. Lift out the booster lead-in disc. (Fig. 2.)
3. Pull out the detonator shutter by dragging it off its hinge, using a wire hook. (Fig. 3.)
4. Lift out the split sleeve, the firing pin guide by grasping the detonator shutter stop pin with a pair of long nose pliers. (Fig. 3).

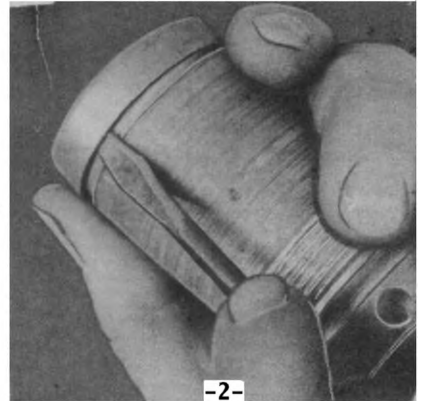
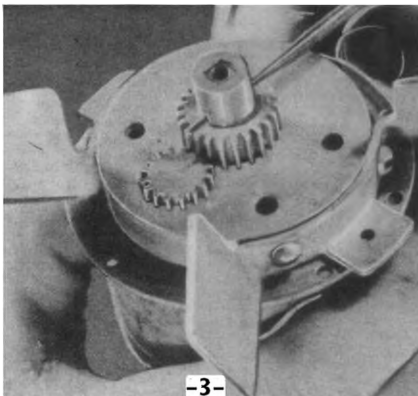
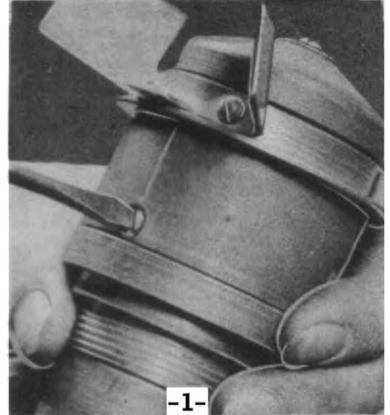


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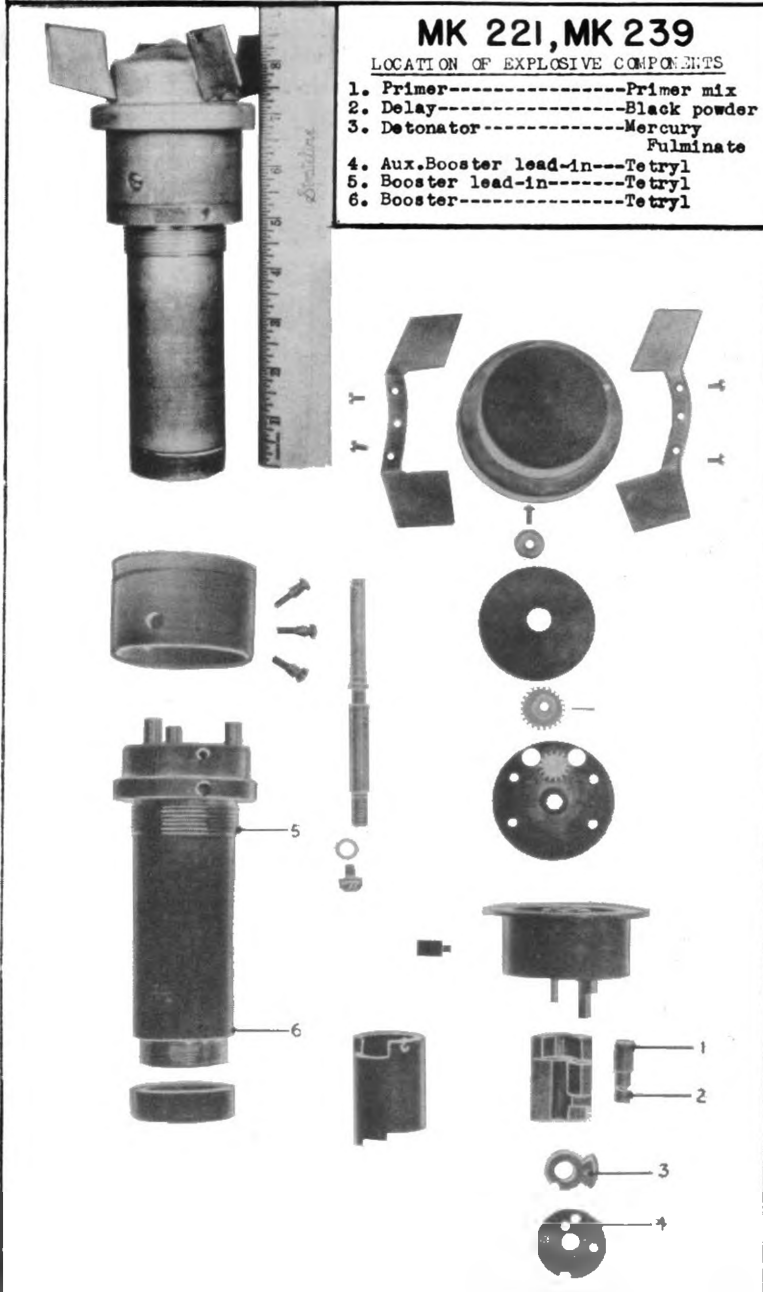


COMMON REASON FOR FAILURE**AN-MK.219**

1. Remove the key grub screw (Fig. 1). This releases the rotor mechanism from the fuze body. The booster and booster lead-in are in the fuze body and the other two components are in the rotor mechanism. A visual inspection can immediately be made of the booster lead-in and the auxiliary booster lead-in.
2. Pry off the booster cover (Fig. 2). This is affixed with a circular crimp and is not threaded. This should only be done if the booster lead-in is the defective part and it is necessary to send it back to a laboratory. The fuze body should be sent with this component in place but with the booster removed. The booster is a pressed tetryl pellet which will fall out after the cover has been removed. If the auxiliary booster lead-in has not fired, it will be necessary to break down the rotor mechanism. While doing this, check to see that the components are in alignment. If they are not, it is a reason for failure of the fuze to operate. Two methods can be used to accomplish this.
From the bottom:
3. This method can only be used if the first stage of arming has been completed. If it has not, hold the auxiliary booster lead-in carrier stationary and by rotating the vanes you can raise the head of the fuze a sufficient distance to allow the inner sleeve to become disengaged from the auxiliary booster lead-in carrier.
4. Remove the screw on the bottom of the central spindle. The screw has a right hand thread. This may be difficult as the lead washer may be jammed between the head of the screw and the auxiliary booster lead-in carrier. Care must be taken to insure that the screw driver does not slip off onto the auxiliary booster lead-in.
5. If it is difficult to hold the central spindle stationary while turning out this screw, it will be necessary to remove the screw on the head of the fuze and to pry off the upper cap so that the top of the central spindle is exposed. By securing the upper gear the central spindle will be fixed.
6. The auxiliary booster lead-in carrier can be unscrewed after the screw is removed. It has a left hand thread. Care must be taken so that the detonator carrier which is free does not fall out inadvertently. Now all of the components are exposed.
From the top:
3. Expose the upper gear as explained in #5 above.
4. Punch out the shear wire holding the upper gear to the central spindle (Fig.3).
5. Lift off the upper gear, idler gear carrier, lower gear carrier and hammer head, inner sleeve, striker carrier and detonator carrier in that order. All parts of the explosive train are now exposed. Many times it is difficult to disassemble a fuze in this manner. The movements that are to be particularly noted are these:
(a) the screw at the top of the fuze is difficult to remove. Be sure a screw driver of the right size is used as the screw head can easily be fouled. If the latter is true, file off the head of the screw.
(b) a very thin punch must be used on the shear wire in the upper gear. After an end of this wire is exposed it is probably easier to pull it out with a pair of pliers rather than to punch it the whole way out.

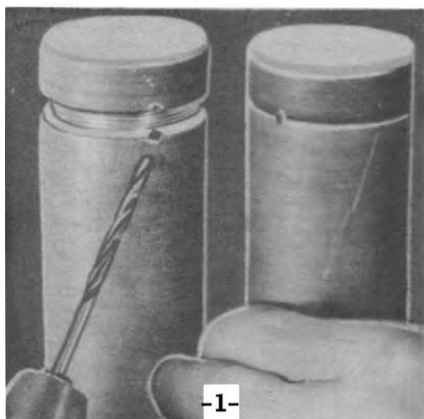


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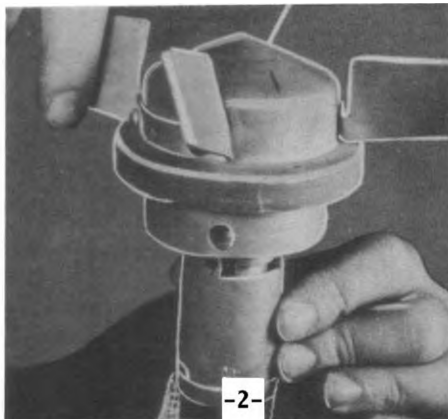


COMMON REASON FOR FAILURE**MK.221, MK.239**

1. Remove booster cap and take out tetryl pellets.
 2. Remove the three grub screws. This releases the rotor mechanism so that it may be withdrawn from the fuze body.
 3. If the auxiliary booster lead-in has fired and the booster lead-in has not, it will be necessary to send the fuze body to a laboratory. Take out the booster before shipping. The booster cap is screwed and staked onto the fuze body. These are right hand threads. (Fig. 1).
 4. If the first stage of arming has not been completed, spin the vanes of the fuze, holding the auxiliary booster lead-in carrier stationary until the head is raised a sufficient distance to disengage the nub on the bottom of the inner collar from the auxiliary booster lead-in carrier. (Fig. 2 & 3).
 5. Remove the four screws holding the vanes to the cap. This also frees the vane cap.
 6. Remove the screw at the top of the upper cap.
 7. Pry off the upper cap.
If the auxiliary booster lead-in has not fired, it will be necessary to break down the rotor mechanism. While doing this, check to see that the components are in alignment. If they are not, it is a reason for failure. Two methods can be used to accomplish this operation.
- From the bottom:
8. By holding the upper gear stationary the central spindle will also be fixed, so that the screw on the bottom of the central spindle can be removed. This is a right hand thread.
 9. Unscrew the auxiliary booster lead-in carrier from the spindle. This is a left hand thread.
 10. Lift out the detonator carrier.
 11. Lift out the delay carrier. (This corresponds to the striker carrier in the Mk 219). All parts of the explosive train are now exposed.
- From the top:
12. Punch out the shear wire holding the upper gear to the central spindle.
 13. Lift off the upper gear, idler carrier, lower gear carrier and hammer head, inner sleeve, delay carrier, and detonator carrier, in that order. All parts of the explosive train are now exposed.



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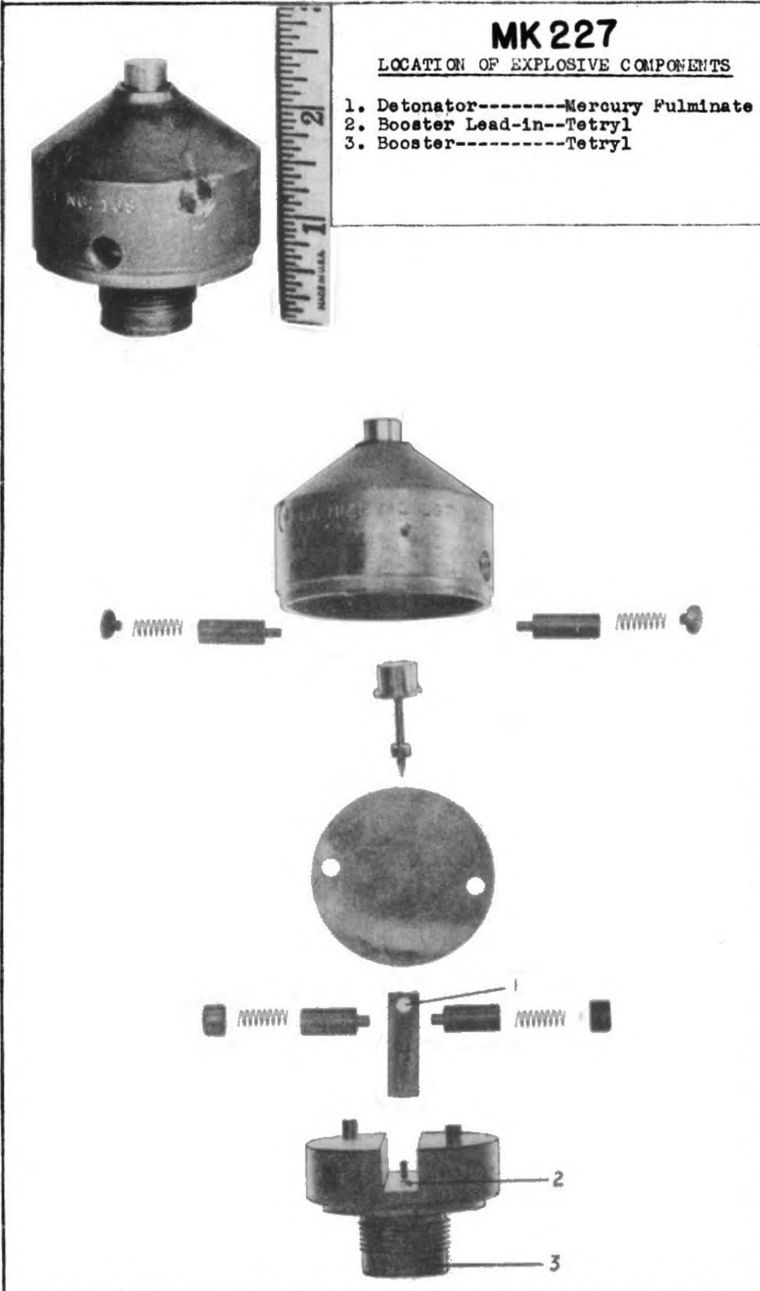


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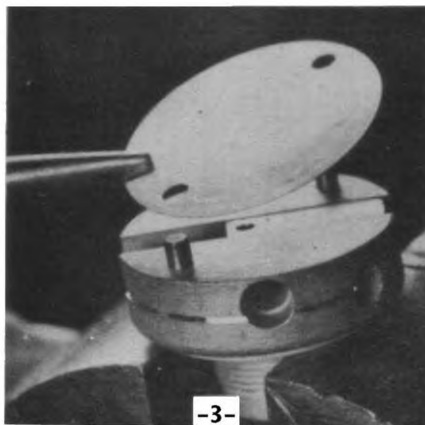
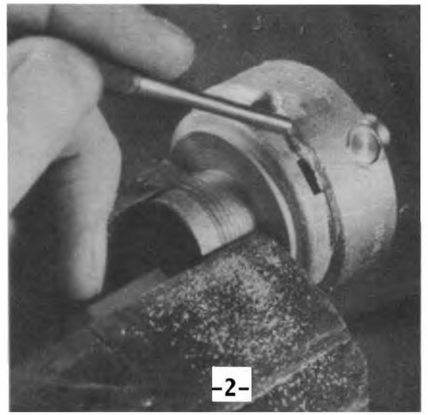
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COMMON REASON FOR FAILURE**MK. 227**

1. Place fuze, striker down, in a vise and file away the crimp holding the closing disc over the booster. This is a dangerous operation and care should be taken not to file too rashly. File just deep enough to enable the closing disc to be taken out. Then remove the booster pellet.
2. Using a hack saw, cut around the fuze body starting the cut at the center of the spanner holes. Cut through the outer fuze body down to the inner fuze body which is about 1/8 inch. (Fig. 1).
3. Place booster cup in vise with detonator carrier parallel to the deck. Force the outer body off the inner body by means of a punch. (Fig. 2).
4. Lift off the cover disc so that the detonator carrier may be lifted out of the fuze. (Fig. 3).
5. Inspection should be made of the striker retaining detents by looking at the pointed end of the striker in the under side of the top of the fuze if there is evidence the striker did not dent the detonator.

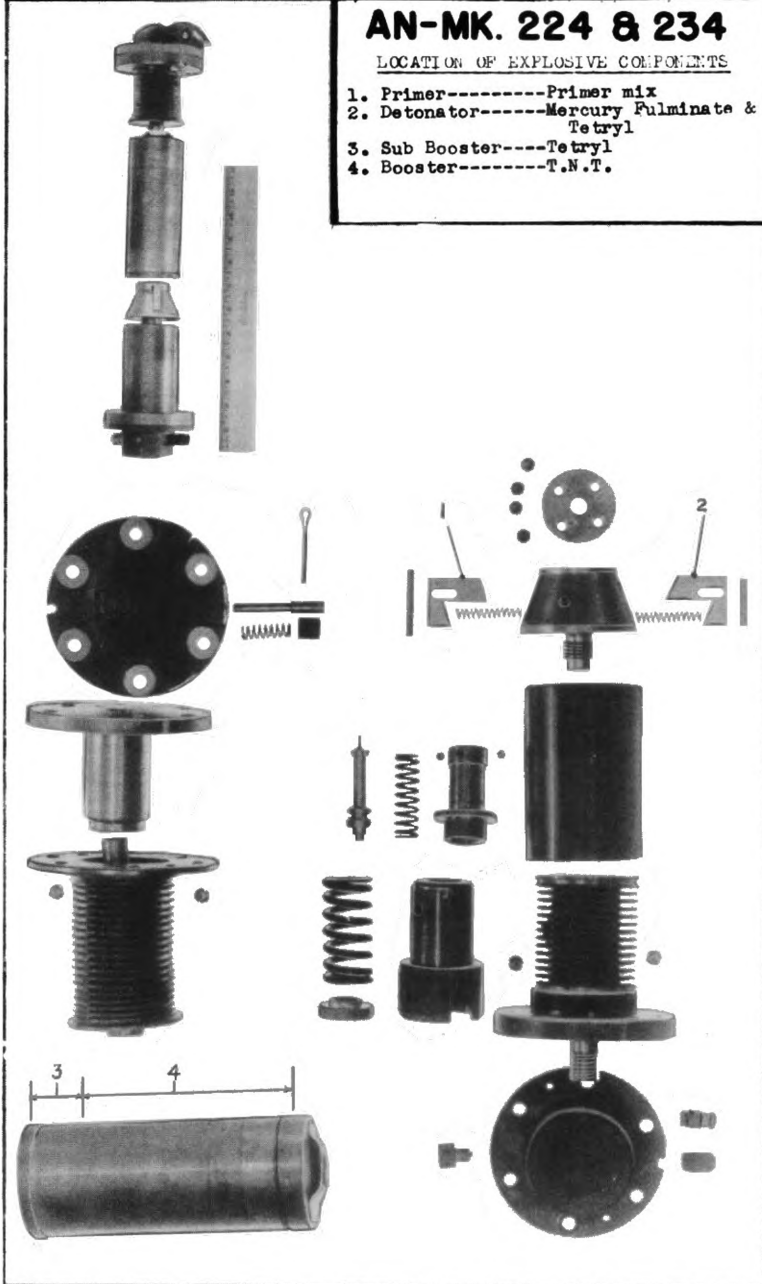


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AN-MK. 224 & 234

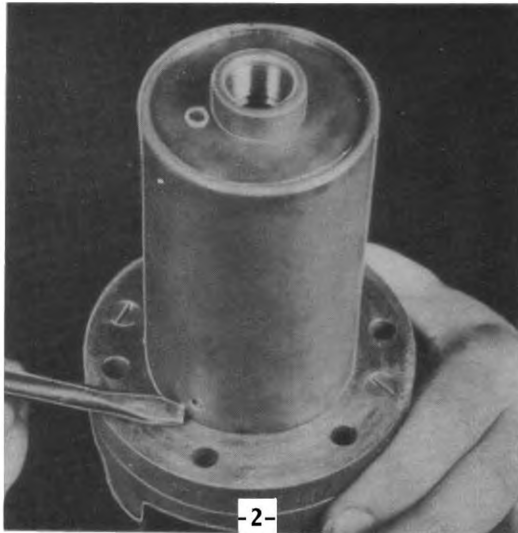
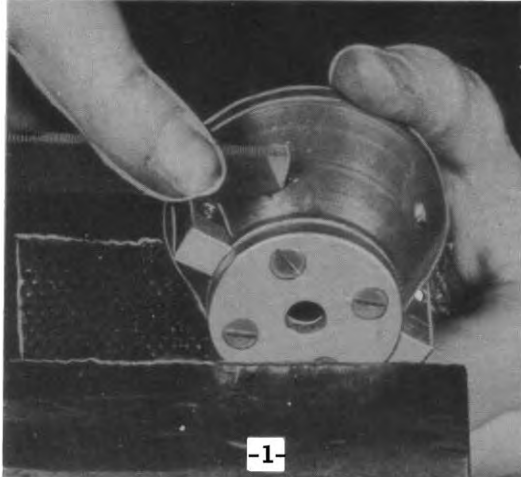
LOCATION OF EXPLOSIVE COMPONENTS

1. Primer-----Primer mix
2. Detonator-----Mercury Fulminate & Tetryl
3. Sub Booster----Tetryl
4. Booster-----T.N.T.



COMMON REASON FOR FAILURE**AN-MK. 224 & 234**

1. Unscrew primer-detonator carrier from the pistol. These are screwed together with a right hand thread and staked. The stakes can easily be broken by applying pressure to the wrench.
2. Punch out the carrier locking pins. These are crimped in. Most times the crimp can be broken by hitting the punch with a hammer. If they will not break then the crimps must be filed away. (Fig. 1).
3. Remove the primer and detonator carriers. Now all of the explosive components are exposed.
4. Unscrew the mechanism casing from the fuze head. These are screwed together with a right hand thread and secured with a grub screw. An Allen (internal) wrench must be used to remove this screw. If one is not available a nail can easily be filed to the necessary shape. (Fig. 2).
5. Lift out the guide piece and the striker and the depth springs.
6. Remove the two screws on the under side of the fuze head.
7. If the jump out pin is still held in by a cotter pin or a wire (only on the Mk 224), remove the cotter pin holding the jump out pin in with your finger and allow it to come out slowly. There is a strong spring behind this pin.
8. The depth setting knob and the stop lock must be unscrewed on the Mk 234 before lifting the fuze head off.
9. The fuze head can now be lifted off of the bellows head. All parts of the pistol are now exposed.

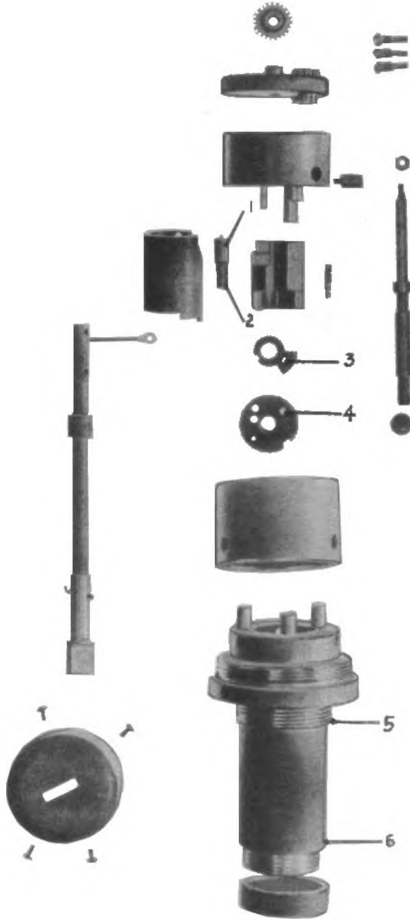
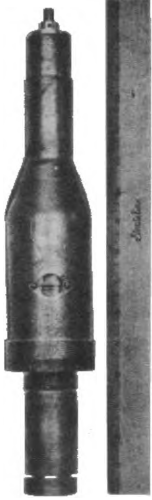


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MK 223

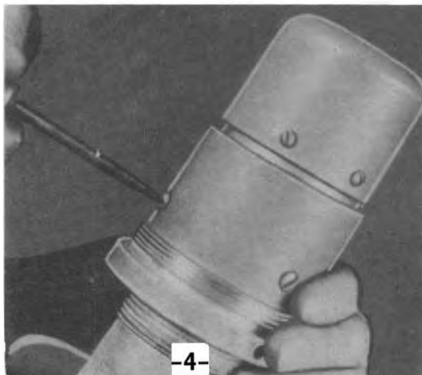
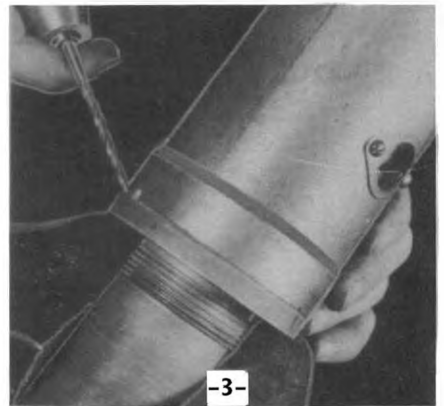
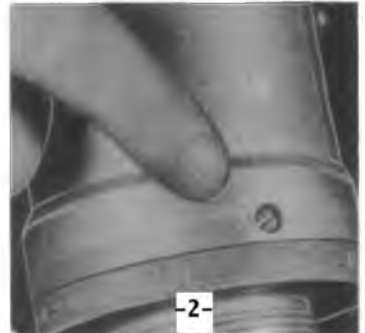
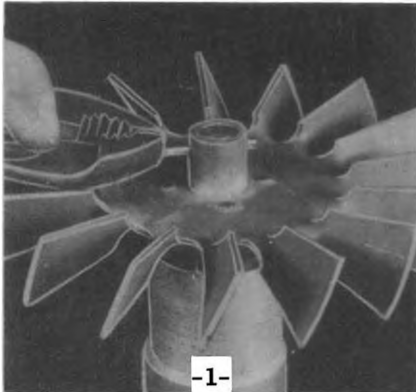
LOCATION OF EXPLOSIVE COMPONENTS

1. Primer-----Primer mix
2. Delay-----Black powder
3. Detonator -----Mercury Fulminate
4. Aux.Booster Lead-in-Tetryl
5. Booster lead-in-----Tetryl
6. Booster-----Tetryl



COMMON REASON FOR FAILURE**MK. 223**

1. Remove booster cap and booster.
2. Remove the cotter pin holding the vanes to the arming spindle. (Fig. 1).
3. Remove the external cover. This is screwed to the fuze body with a right hand thread. In the older modifications, it is also held by grub screws which must be unscrewed before the cover can be removed. In the newer modifications, it is staked after being screwed on. (Figs. 2 & 3).
4. Remove the arming stem.
5. Remove the three grub screws in the outer collar. This releases the rotor mechanism so that it may be withdrawn from the fuze body. (Fig. 4). The disassembly from here on is the same as for the Mk 221 with the following two exceptions.
 - (a) The four screws holding the fuze cap to the idler gear in the Mk 223 correspond to the four screws holding the vanes to the vane cap in the Mk 221.
 - (b) The upper gear in the Mk 223 is held onto the central spindle by a nut instead of a shear wire. (Fig.5).
 - (c) The shear collar prevents the delay carrier from being lifted off the top of the central spindle. This shear collar can be removed either by breaking the shear wire by which it is secured with a wrench or by punching out the shear wire.

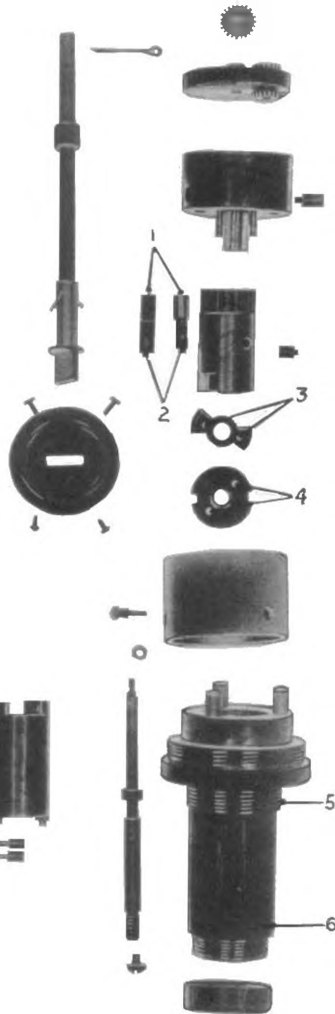


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AN-MK 228

LOCATION OF EXPLOSIVE COMPONENTS

1. Primers-----Primer mix.
2. Delays-----Black powder
3. Detonators-----Mercury Fulminate
4. Aux.Booster Lead-ins-Tetryl
5. Booster Lead-ins----Tetryl
6. Booster-----Tetryl



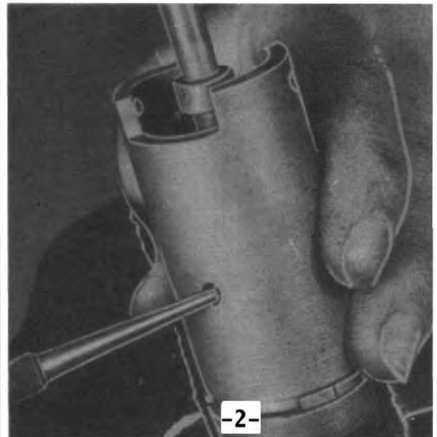
COMMON REASON FOR FAILURE**AN-MK. 228**

The disassembly of the Mk 228 is the same as for the Mk 223 with the following exceptions:

- (a) There are two grub screws in the outer collar of the Mk 228 instead of 3.
- (b) The upper gear is secured to the central spindle by a nut and a shear wire. The nut has to be removed first, then a small cup is lifted off, after which the shear wire is punched out. (Fig. 1.)
- (c) There is a spring loaded detent in the delay carrier which secures it to the inner sleeve in the armed position. The two can be separated by depressing the detent. (Figs. 2 & 3).
- (d) There are two separate explosive trains each containing one of the explosive components, with the exception of the booster, in this fuze.
- (e) The outer cover of this fuze is screwed to the fuze body and is always secured with grub screws. It is not staked as some of the Mk 223's are.



-1-



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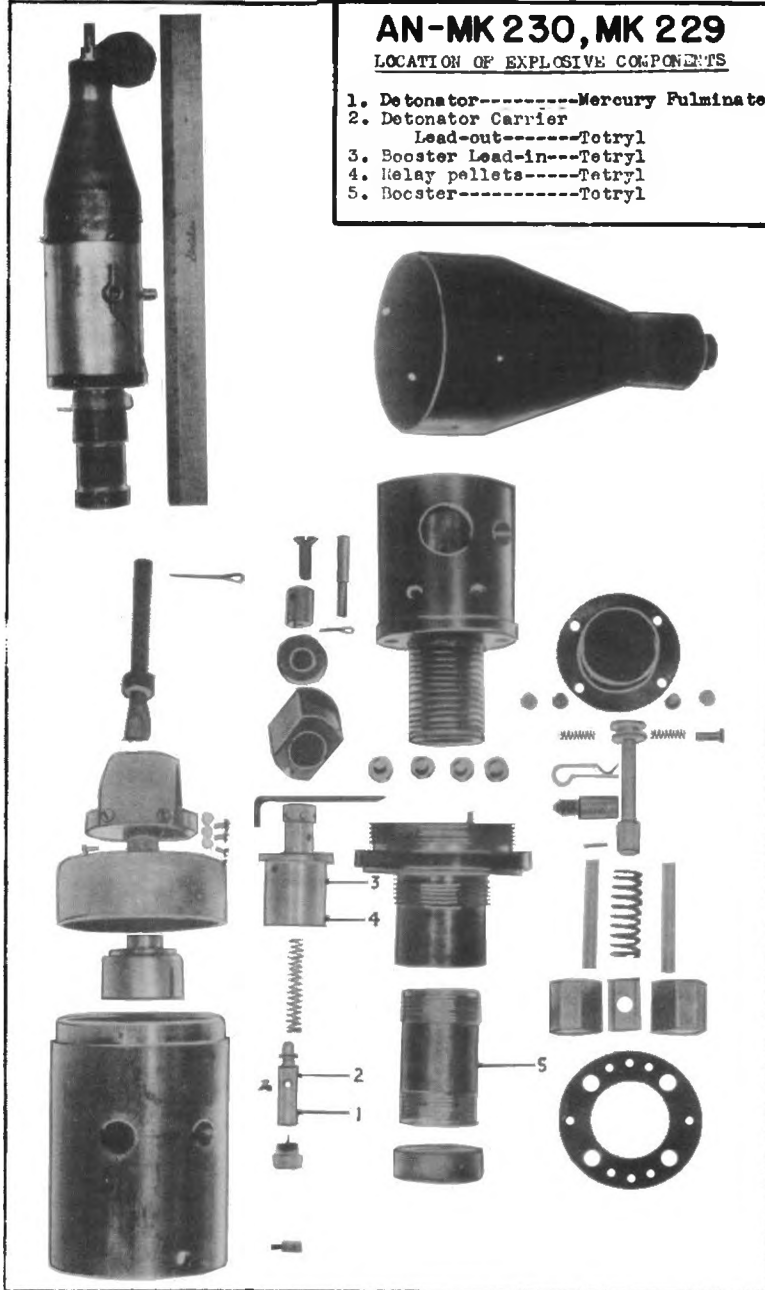
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AN-MK 230, MK 229

LOCATION OF EXPLOSIVE COMPONENTS

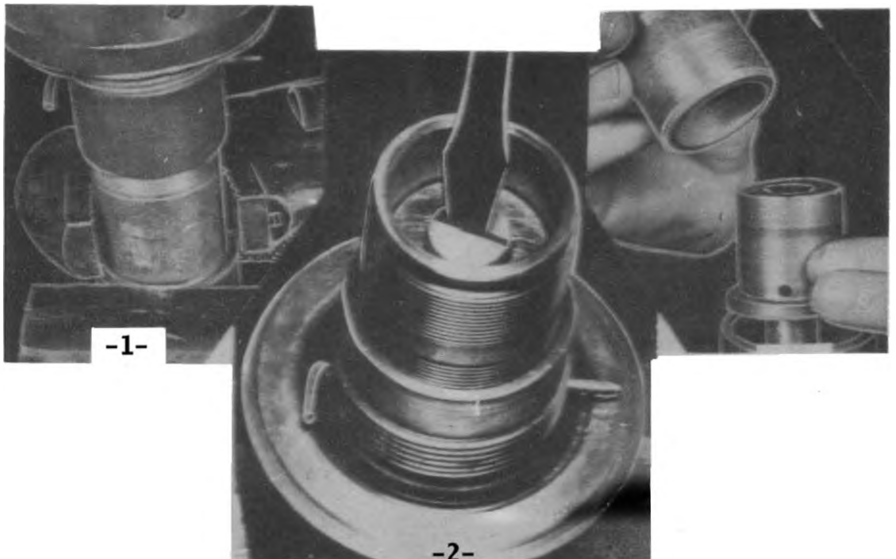
1. Detonator-----Mercury Fulminate
2. Detonator Carrier
Lead-out-----Tetryl
3. Booster Lead-in---Tetryl
4. Relay pellets----Tetryl
5. Booster-----Tetryl



COMMON REASON FOR FAILURE**AN-MK. 230, MK. 229**

1. PUT A SAFETY PIN THROUGH THE FUZE BODY AND THE DETONATOR CARRIER.
2. Unscrew the booster cap. This has a right hand thread. Be sure the booster container does not turn in relation to the fuze body. (Fig. 1). The fuze will fire if the safety pin is not through the detonator carrier and the booster container is unscrewed from the fuze body. The pressed tetryl pellet will fall out after cap is removed.
3. Unscrew the fixed firing point IF THE SAFETY PIN IS IN PLACE. (Fig. 2). If the safety pin is not in place, hold the plunger housing stationary while unscrewing the fixed firing point.
4. After the fixed firing point is removed, unscrew the booster container. NEVER TAKE OFF THE BOOSTER HOUSING UNTIL THE STRIKER HAS BEEN EXTRACTED.
5. Take out the safety pin and withdraw the plunger housing carefully making sure that the detonator carrier does not fall out. (Fig. 3).
6. Withdraw the detonator carrier from the top of the plunger housing. All of the explosive components are now exposed.
7. Remove the screws which secure the vane shaft housing to the body sleeve and also take out the delay arming sub-assembly.
8. Remove four screws holding detent carrier to depth setting mechanism housing.
9. Remove setting pin lock screw. It has a right hand thread.
10. Remove the cotter pin holding the setting lever, pull out setting lever and remove screw securing the setting spindle to cam block.
11. Remove body sleeve. This is screwed to the fuze body with a right hand thread and then is stamp staked and also has a grub screw. This is most easily accomplished by putting the fuze body in the vise and using a large Stillson wrench on the body sleeve.
12. Remove nut on the top of the depth spring stem. This has a right hand thread.
13. Lift out depth spring.
14. The setting cam will fall out of the side of the fuze which will then allow the depth adjusting sleeve to be lifted off the spindle.
15. Push out inertia counter balance shafts. The stakes holding these can easily be broken with slight pressure or filed away.
16. Take out the two inertia counter balances.
17. Push out the depth adjusting sleeve pin in the side of the fuze in the Mk 229 only.
18. Remove the four screws holding the depth setting mechanism housing to the fuze body. These are staked and considerable pressure will be needed to loosen them. It is a right hand thread.
19. Pry off the depth setting mechanism housing. This is located in the fuze body by a locating pin.
20. To remove the inertia blocks hinge plate, punch out the shear wire just above it on the depth spring stem and unscrew the top of the depth spring stem from the bottom.

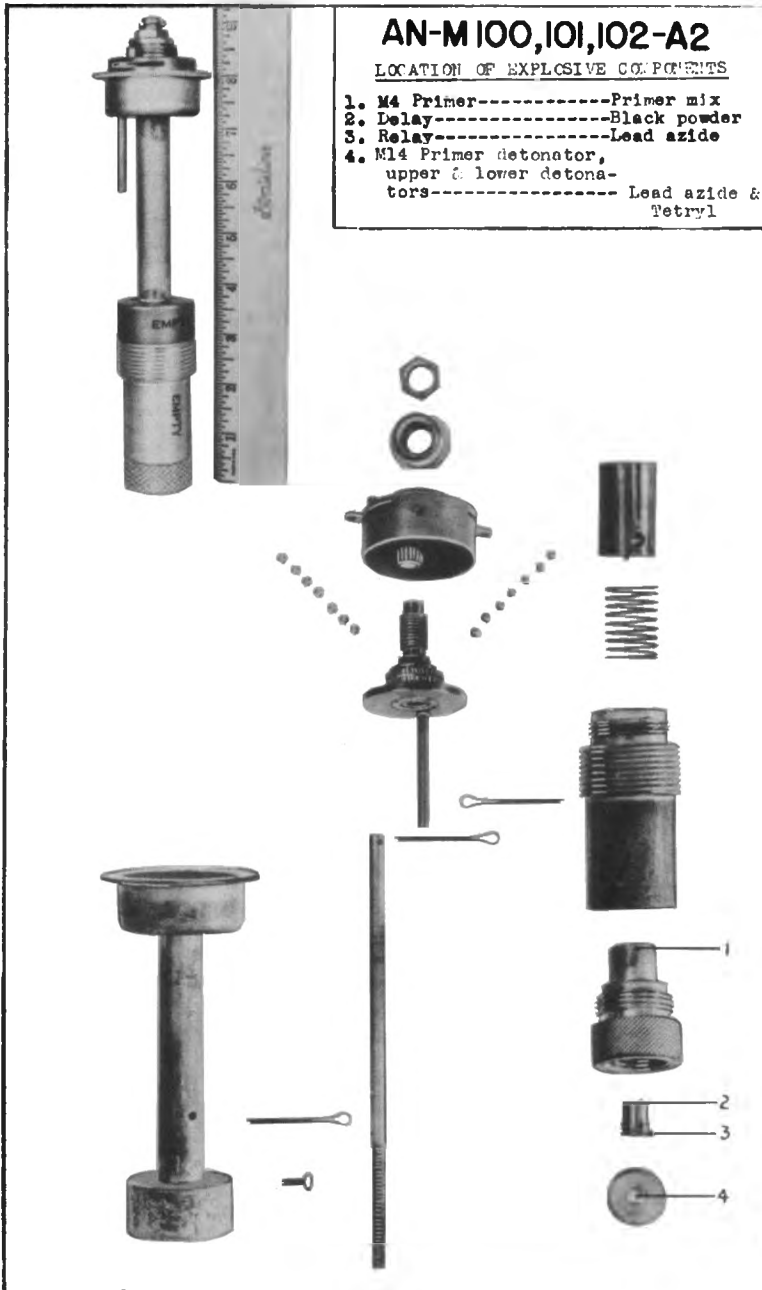
The Mk 229 differs only in that the booster is slightly longer than the Mk 230. The Mk 229 has a depth adjusting sleeve pin in the side of the fuze.



-1-

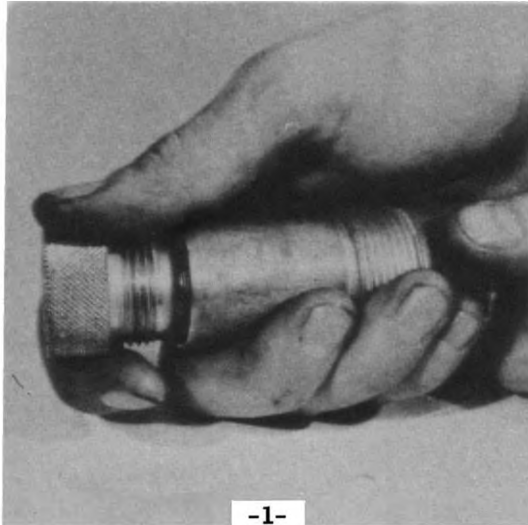
-2-

RESTRICTED



COMMON REASON FOR FAILURE**AN-M100,101,102-A2**

1. Unscrew the primer-detonator, making sure that no motion is imparted to the fuze in a longitudinal direction. (Fig. 1). Do not hold primer-detonator cupped in palm. Let wrench or finger tips only touch the primer-detonator and point it away from the operator at all times.
2. Inspect the primer-detonator to see:
 - (a) If the striker has dented the primer.
 - (b) If the detonator has fired.There can only be three reasons for failure that are not visible in the delay-relay firing train. The primer did not ignite and delay train did not burn or the relay did not fire.
3. The arming stem cover is screwed to the fuze body with a right hand thread, and is staked. This can be removed with a wrench.
4. The reduction gear system is disassembled by removing the nuts on the top of the spindle. They all have right hand threads.

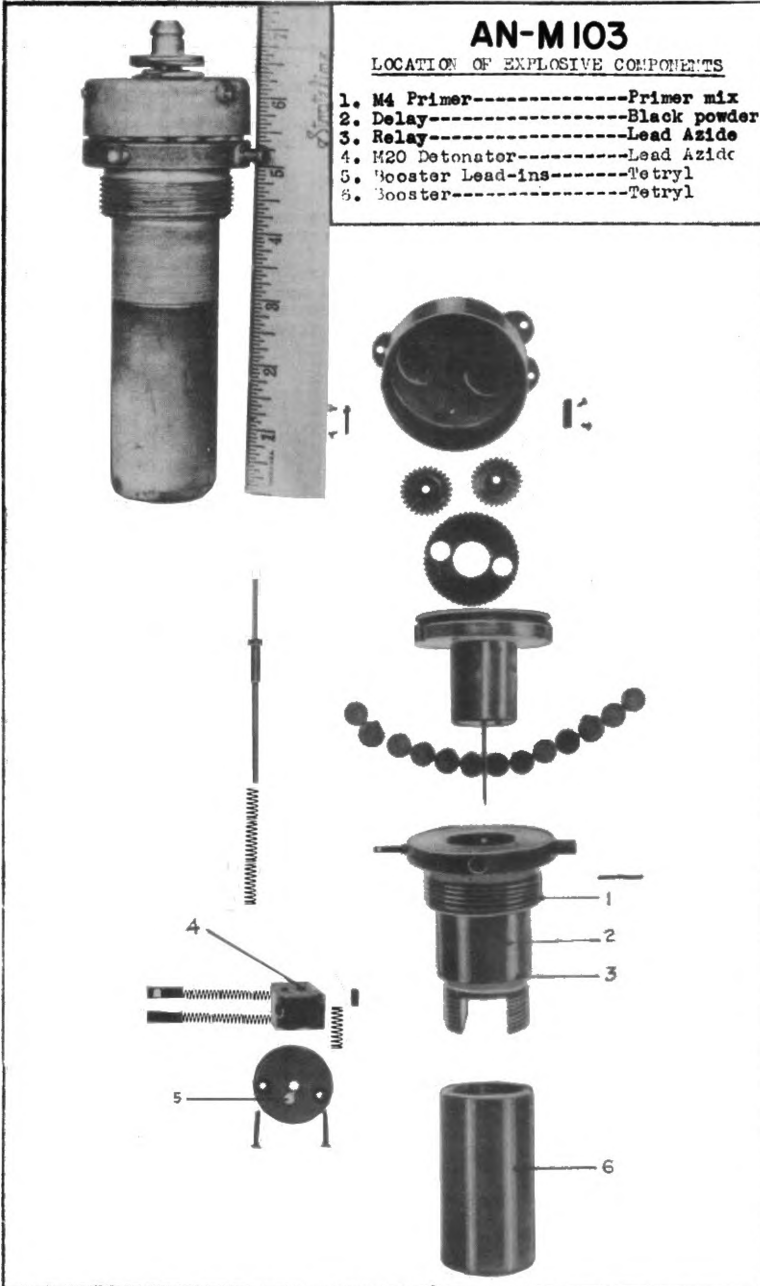


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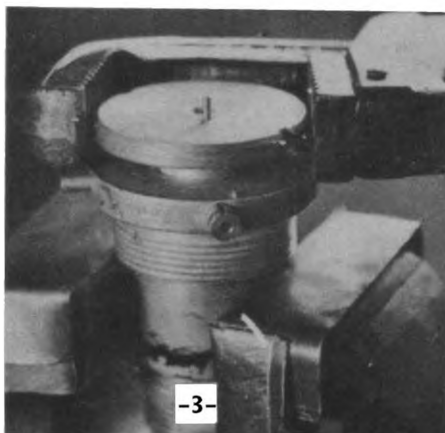
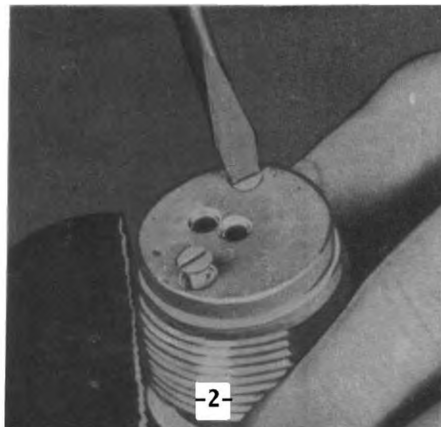
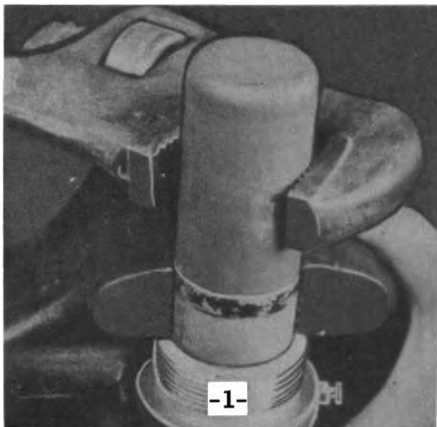


COMMON REASON FOR FAILURE

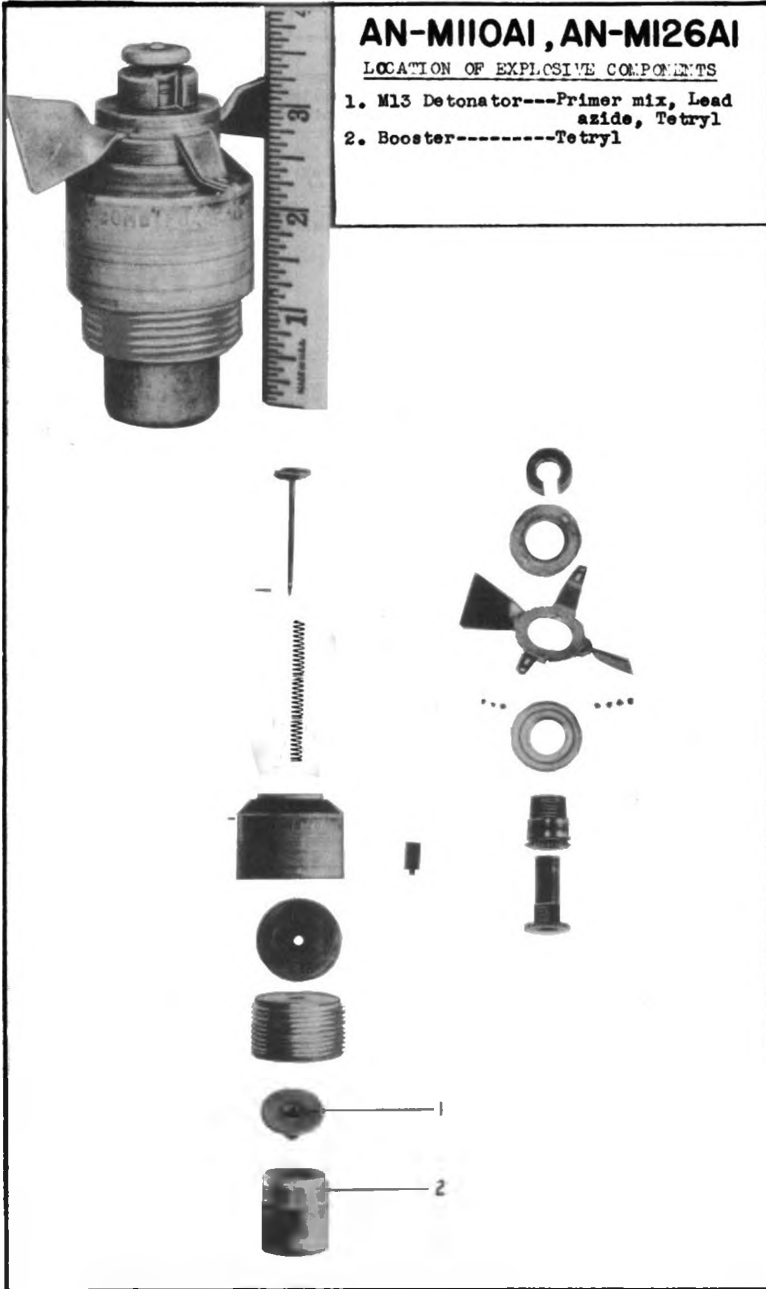
Failure of delay element

AN-M103

1. Unscrew the booster. This is screwed onto the fuze body with a right hand thread and is staked. This can easily be broken with a wrench. (Fig. 1).
2. Remove the detonator slider by pushing it out of the fuze body transversely.
3. Remove the two screws holding the lead-in plate to the fuze body. (Fig. 2).
4. If the fuze is not armed, arm it and then take off the vane cap.
5. Put the fuze in a vise and by putting at least a 24" inch Stillson wrench on the head of the striker carrier block the stakes and shear wires can easily be broken so that the head of the fuze may be withdrawn. Now all of the components of the fuze are exposed. (Fig. 3).

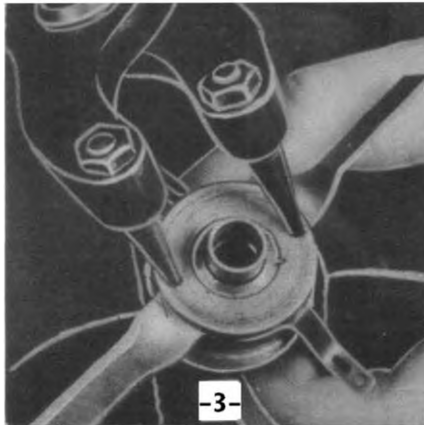
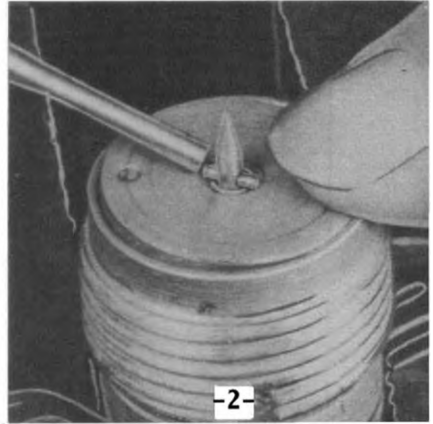
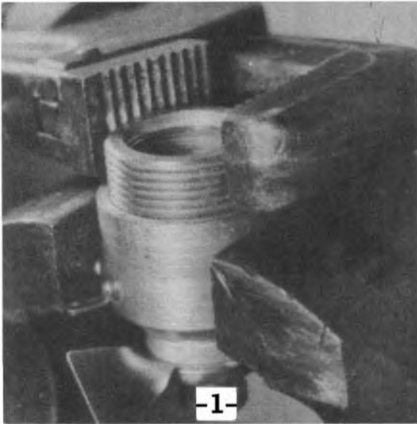


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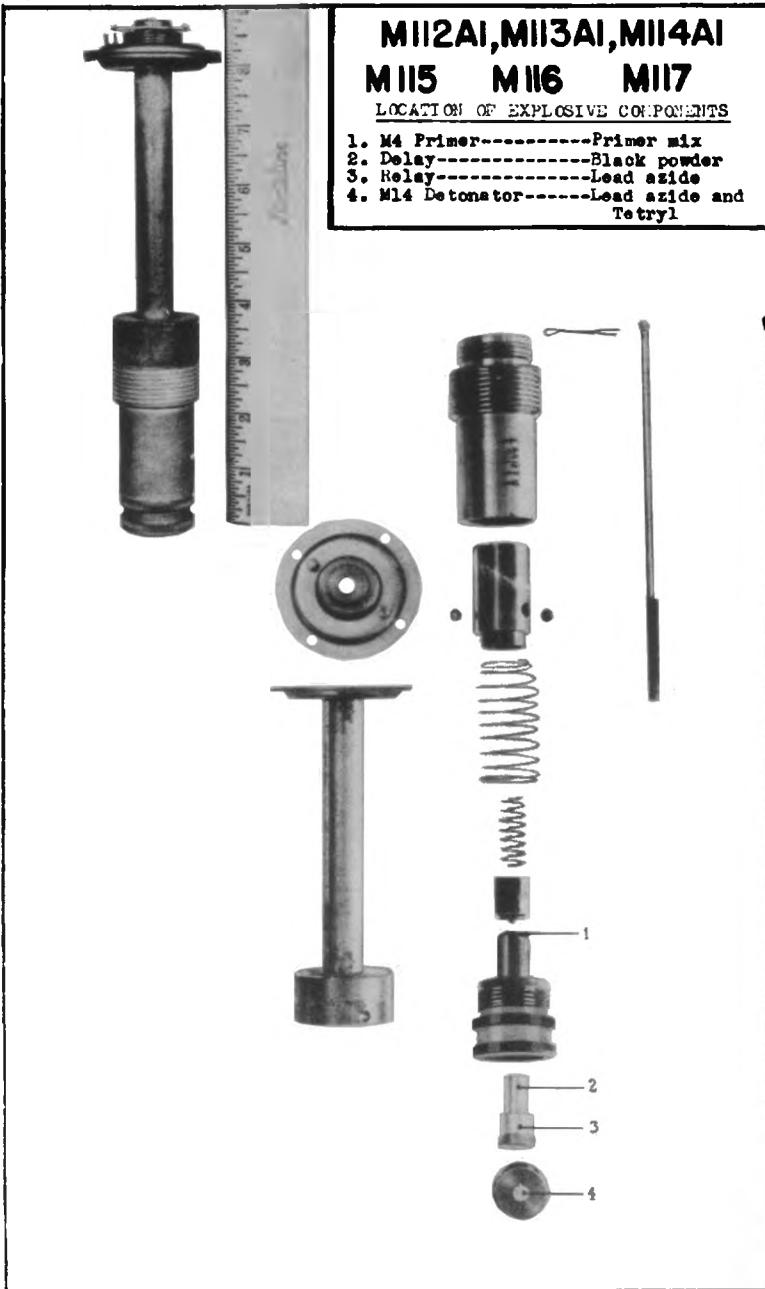


COMMON REASON FOR FAILURE**AN-M110A1, AN-M126A1**

1. Unscrew the booster container and lift out the detonator.
2. Place outer fuze body in vise and unscrew lower fuze body with a Stillson. This section is staked and has right hand threads.
3. Press in the disc surrounding the point of the firing pin so that the firing pin retaining wire may be pushed out. When this is out the firing pin can be withdrawn from the top along with firing pin spring. (Fig. 2).
4. The reduction gear mechanism is broken down by unscrewing the washer on the top of the outer sleeve. This has two spanner holes to facilitate the operation. It has right hand threads. (Fig. 3).
5. The inner sleeve can be unscrewed from the outer sleeve. They are screwed together with left hand threads.
6. The top bearing race is threaded to the outer sleeve with right hand threads. There is a hole in this upper race to facilitate this operation.



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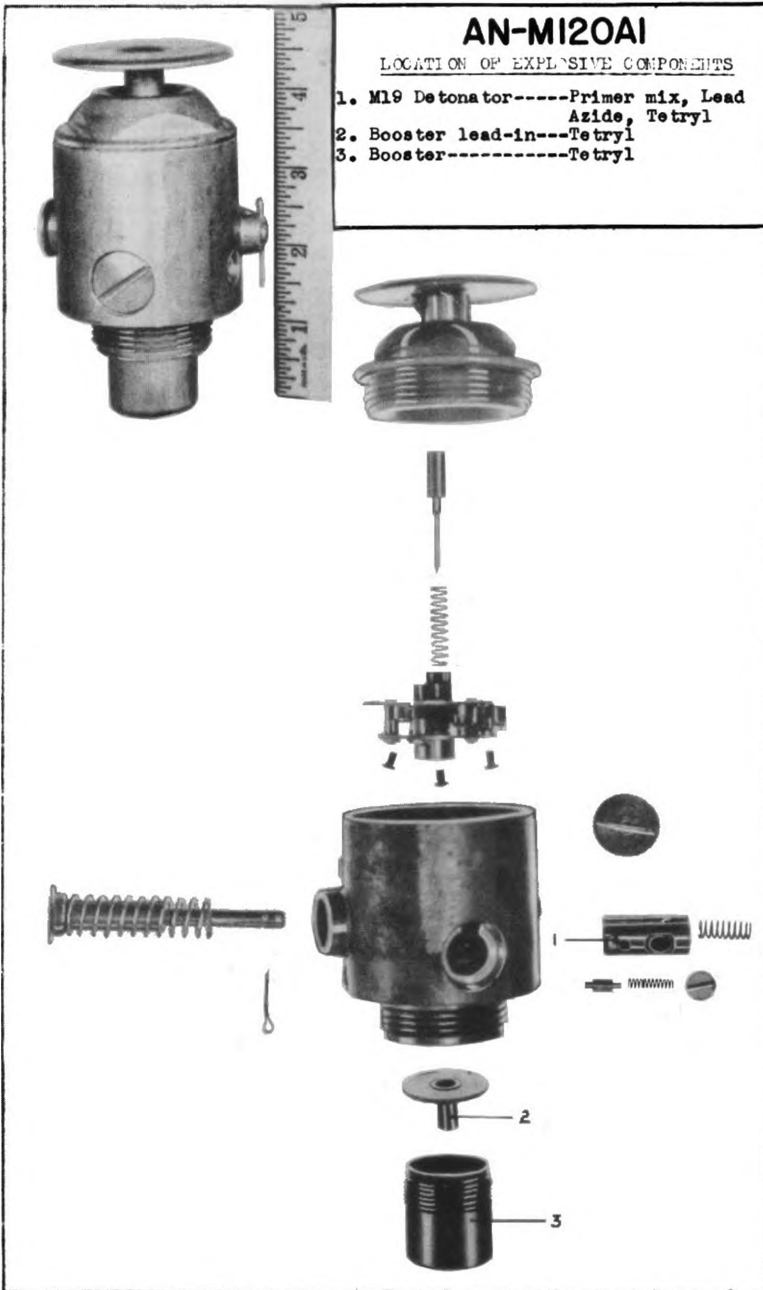


COMMON REASON FOR FAILURE**M112A1, M113A1, M114A1
M115, M116, M117**

1. The M 16A1 primer detonator carrier is removed exactly the same as the M 14 primer detonator carrier in the AN-M 100A2 series fuzes. Keep pointed away from operator when testing the fuze.
2. Put the fuze in a vise and unscrew the top part of the fuze from the bottom half (Fig. 1). This is a right hand thread and is staked. Stay away from the bottom of the fuze as it contains a cocked firing pin.
3. Place the fuze on a table with the striker aimed down and by applying a little pressure on the inertia block, the fuze will be fired and the striker assembly will fall out exposing all of the mechanical parts. (Fig.2).
4. NOTE:- DO NOT pick up fuze with M 16A1 primer detonators until well after expiration of delay time.

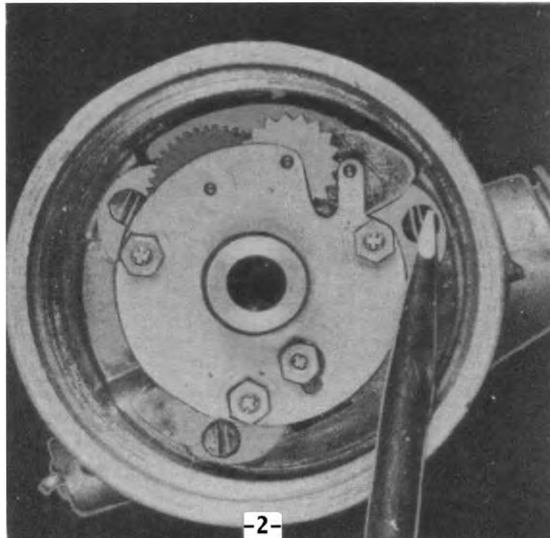


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COMMON REASON FOR FAILURE**AN-M120A1**

1. Unscrew the booster.
2. Drill out the grub pin holding the top of the fuze to the fuze body.
3. Unscrew the top of the fuze body. This has a right hand thread. Grips are provided on the top of the fuze to receive a wrench. (Fig. 1.)
4. Lift out the firing pin and firing pin spring, using long-handled plier, since the striker might be stuck in the primer.
5. Remove the smaller of the two screws on the side of the fuze which is staked.
6. Lift out the detent spring and the side of the fuze.
7. Remove the larger screw on the side of the fuze.
8. Lift out the slider spring and the detonator carrier.
9. Remove the three screws holding the cl.ckwork mechanism to the fuze body. (Fig. 2.)



HERE IS A SAMPLE OF A GOOD REPORT:

MOBILE EXPLOSIVES INVESTIGATION UNIT #4
c/o Fleet Post Office
San Francisco, Calif.

S78-1
(RAW:grp)

28 December 1944.

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INTELLIGENCE REPORT U.S. ORD 2

From: Officer-in-Charge.
To: Distribution List.
Subject: U.S. Ordnance - malfunction of.

1. Introduction

This report covers the material recovered by M.E.I.U. #4 personnel at the target range on Kahoolawe Island in the period 27 Nov. through 2 Dec. The report is concerned only with malfunction of U.S. Ordnance. Other reports are being prepared on the following subjects:

- (a) Experimentation with cone charge Mk 2.
- (b) Bomb and projectile disposal technique.
- (c) Malfunction of projectiles fuzed with Mk 32 units.

2. Summary

The following quantities of unexploded ordnance have been examined to determine cause of malfunction:

98 5" projectiles
3 6" projectiles
2 8" projectiles
60 415 barrage rockets
1 325# AN-Mk 17-2 depth bomb
1 500# AN-M 64 general purpose bomb
1 1000# Mk 13-2 general purpose bomb.

Detailed analysis of failures are given below.

3. Projectiles and Fuzes

The table below indicates the number and type of projectiles recovered, and the number of fuzes recovered from these projectiles.

	TYPE	MARK NO.	NUMBER RECOVERED	B.D.F. REMOVED	AUX. DET. REMOVED	NOSE FUZE REMOVED
5"	AAC	35	68	56	28	0
	AAC	31	6	0	3	0
	AAC	38	2	1	1	0
	AAC	28	3	0	2	0
	Com.	32	13	10		
	SpCm.	38	5	3		
	Ill.	30	1			1
6"	H.C.	34	3	2	1	0
8"	H.C.	24	1	0	0	0
	Com	17	1	0	0	0
	Totals		103	72	35	1

Enclosure (A) with this report is a table giving Mark number, lot numbers and other information recorded on each round of ammunition. Causes for failure of individual components are given wherever it was possible to determine them.

An analysis of the malfunctions follows:

A. Base Detonating Fuzes.

(1) Mark 28 Summary. Fifty-nine (59) Mk 28 fuzes were removed and broken down to determine malfunction. A summary of the results shows:

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- (a) Forty-two (42) failures of the secondary primer.
- (b) Twelve (12) failures due to corrosion.
- (c) Four (4) failures of the sensitive primer.
- (d) One (1) failure because of poor impact angle (fuze in perfect condition).

(2) Mark 20 Summary. Thirteen (13) Mk 20 fuzes were removed and broken down to determine malfunction. A summary of the failures shows:

- (a) Seven (7) failures of the secondary primer.
- (b) Four (4) failures due to corrosion.
- (c) Two (2) failures of the sensitive primer.

(3) Failures of secondary primers.

A total of forty-nine (49) fuzes failed because of deterioration of the secondary primer. In the majority of these, the primer cover was dented, indicating proper functioning of the sensitive primer and plunger firing pin. In seven (7) fuzes the primer was not clearly marked, and a possibility exists that the plunger firing pin was not driven against the primer hard enough to initiate it. A chemical analysis has been made of some of these primers, and the remainder were impact tested to determine their condition. Examination of the secondary primers made by the Explosive Section of the Yard Testing Laboratory indicate that failure was due to scouring of the primer mixture, the presence of mercury fulminate confirms the opinion that the primers had not fired. The mixture burns slowly, giving off small sputtering sparks when a flame is applied, but would not go off when struck a sharp blow. This was confirmed in the impact tests performed at this station, where only two (2) of the total number tested smoked and sputtered feebly, with no reaction from the other forty (40).

(4) Mechanical failures due to corrosion.

Sixteen (16) base fuzes failed because of interior corrosion. Of this total, fifteen (15) fuzes had one or both firing pin detents corroded and frozen in the unarmed position. The other failure was due to corrosion of the inner and outer sleeves and plunger firing pin. In this fuze the sensitive primer fired, but had insufficient force to overcome the corroded plunger firing pin. In the fuzes in which firing pin detents were corroded, the moisture causing corrosion most likely got into the fuze during assembly, because only the contents of the nose cap were affected, the main fuze body, plunger and auxiliary plunger were in good condition, with no trace of corrosion.

(5) Failures of sensitive primers.

A total of six (6) fuzes failed because of sensitive primer failure. Two (2) fuzes had sensitive primers that were struck, but did not fire. On two (2) fuzes, the sensitive primer fired, but failed to lock the inner sleeve in the forward position, with the consequent mal-alignment of the booster lead-outs and lead-ins interrupting the explosive train. On these fuzes, the secondary primer, detonator, and booster lead-outs fired. The last two (2) failures were apparent low order detonations of the sensitive primer, since the inner sleeves were not locked and the secondary primers were not struck by the plunger firing pins.

(6) Failure because of impact angles.

One (1) failure has been assigned as poor impact angle, because the fuze was in perfect condition, with all movable parts in working order and no other explanation seems plausible.

B. Auxiliary Detonating Fuzes.

(1) Mark 17 Summary.

Thirty-one (31) Mk 17 fuzes were removed and examined to determine cause of failure.

- (a) Nineteen (19) did not detonate because the nose fuze did not fire.
- (b) Eight (8) failed because of primer failure.
- (c) Four (4) failed because of corrosion.

(2) Mark 46 Summary.

Four (4) Mk 46 fuzes were removed, all of which did not detonate because their nose fuzes did not fire.

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(3) Failures due to non-firing of nose fuzes.

Twenty-three (23) auxiliary detonating fuzes performed exactly as intended; that is, they did not detonate since their respective nose fuzes did not fire. Of this total, all but one were in good working order and should have functioned properly. In this single instance, the aux. det. rotor did not properly align the primer. All Mk 46 aux. det. were in good condition and armed properly.

(4) Failures due to primers.

Eight (8) fuzes failed because of primer scouring. In each of these fuzes, the firing pin had dented the primer, but had not caused the primer to ignite. Impact tests on these primers had no effects.

(5) Failures due to corrosion.

Four (4) fuzes failed because of corrosion. One (1) fuze failed because of a corroded striker detent. Two (2) fuzes failed because the rotor was corroded, with the primer held out of alignment. The fourth (4th) fuze failed because of general corrosion. The rotor was corroded, but had aligned in spite of the corrosion, the striker was corroded, and the detents were slightly corroded. The primer on this fuze was not struck, indicating that the striker had been frozen.

C. Nose Time Fuzes.

One (1) nose time fuze Mk 18-4 was recovered from a 5" Ill. projectile. The reason for failure of this projectile was impact before expiration of the set time. The fuze had been set for 15-seconds and impact occurred after approximately 13 seconds. In the remainder of the projectiles the nose fuze was either crushed, sheared or completely missing. In general, little can be said positively on the performance of nose fuzes, since many of them were undoubtedly set on safe, and in the condition in which they were recovered, the settings could not be determined.

In connection with nose fuzes and auxiliary detonating fuzes, one phenomena was observed in a large number of projectiles. Figures 1 through 11 should be studied in connection with this discussion. As seen in Fig. 1 and 2, the nose fuze and auxiliary detonating fuze have functioned, but failed to detonate the explosive D. The force of detonation has simply blown the two (2) fuze bodies out of the projectile. The threads of the adapter ring were not stripped, indicating that the fuze body threads gave way first. Fig. 3 shows the same phenomena, except that in this projectile, some of the explosive D detonated. The projectile has later been deformed by hard impact. Figures 3 through 10 show the progressive stages of the same phenomena. In each of these projectiles the nose time fuze and auxiliary detonating fuze have functioned, and the explosive D has only partially detonated. The projectiles shown in Fig. 1-10 are all 5" AA Common, while Fig. 11 shows an 8" H.C. projectile which failed in the same way. These photos show some of the typical instances, but represent only a small percentage of the total number observed.

The failure of these projectiles cannot be attributed to the nose time fuze, since it obviously fired; nor is the base detonating fuze at fault, since the true flight of the projectile ceases when the nose fuze fires, with a resultant faulty impact. It is the opinion of this unit that the failures may have been a result of one or more of the following factors:

- (1) The auxiliary detonating fuze did not have enough power to properly initiate the explosive D.
- (2) The clearance between the auxiliary det. and the explosive D was too great for the tetryl booster to initiate the main filling at its optimum rate of detonation.
- (3) The density of loading of the explosive D was such that it would not sustain a detonating wave.

The first possibility, by itself, does not appear to explain the majority of the failures. The projectiles shown in Fig. 4 through 11 have been at least partially detonated, indicating that the auxiliary detonating booster fired with considerable force. The same thing is borne out in Figs. 1 through 3, where the force of detonation of the auxiliary detonating booster was sufficient to strip the fuze body threads and expell both the aux. det. and nose time fuzes. However, in these last three (3) projectiles, it must be remembered that the explosive D had scarcely been disturbed, so the first factor cannot be entirely ruled out.

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The second possibility unfortunately cannot be proven or disproven, with the data available to this unit. In the failure illustrated by Figures 3-11, detonation was interrupted. This interruption may have been caused by an initial low rate of detonation, as a result of a gap between the aux. det. and the main filling. The evidence to prove this point has been destroyed by the partial detonation. In Figs. 1 and 2, the "head" on the explosive D is almost perfect, and taking into account the effect of weather, the clearance was not excessive, indicating that this was not the reason for failure in these two (2) projectiles.

The third (3rd) factor would seem to explain certain features of these failures not explained by the previous factors. In view of the type of loading employed in U.S. Navy projectiles, i.e., powdered explosive D loaded by increments under pressure, it may be expected that the main filling is not homogenous, nor is every projectile loaded to exact density specifications. This is particularly true in projectiles loaded through the nose opening, where the diameter of the rammer head cannot be the same as the maximum diameter of the projectile cavity. To obtain satisfactory density near the sidewalls, the explosive beneath the rammer head must be packed to a higher density, especially the final increment. If the final increment has too high a density, its sensitivity may be such that it will be initiated at a detonating rate less the rate necessary to sustain detonation, or it may be so insensitive that it cannot be initiated with the present aux. det. fuze booster. Because this unit does not have density testing apparatus, it was impossible to obtain the necessary data to prove this point. However, it is possible that current production practice in taking density tests of only one projectile from each production shift may not adequately control loading densities, especially when the projectiles are loaded through the nose opening.

D. Tracers.

Of the total of ninety-three (93) tracers on which information was recorded, seventy-five (75) had failed to burn, sixteen (16) had functioned properly, and two (2) had partially burned.

E. Miscellaneous Projectile Failures.

(1) Illuminating projectiles.

In addition to the illuminating projectile mentioned in connection with nose time fuzes, one other failure was observed. This is illustrated by Fig. 12, in which it may be seen that the ejection charge failed to expel the illuminating candle, probably because the force of the ejection charge was vented when the projectile case ruptured at the nose. The illuminating charge, in burning, has contributed further to the rupturing of the case.

(2) Minor caliber projectiles.

A large number of 40 mm projectile failures were observed. The nature of these failures was the same in each instance. The self-destruction element functioned in such a way that the H.E. filler had succeeded only in blowing the Mk 27 nose fuze out of the projectile, with no damage to the body of the shell, even the threads remained intact. The projectiles were completely devoid of explosive content when found. A number of Mk 27 nose fuzes were found in the area, and their condition was excellent, with no traces of explosive action apparent on any surfaces. In a few instances, the fuze body threads were in sufficiently good condition to be reinserted into the empty projectile bodies.

This phenomena could be caused by the self-destruction element of the tracer setting off the TNT filler low order.

The same phenomena was observed in 40 mm H.E. and H.E.I.T. rounds.

This report was accompanied by an enclosure in chart form giving the following information on each projectile:

- (a) Projectile No.
 - (b) Type of Projectile
 - (c) Mark - Mod.
 - (d) Lot No.
 - (e) Mfg.
 - (f) Mark-Mod, Lot No., Markings, Failure of Base Det.
 - (g) Mark, Color, Lot No., Markings, Condition of Tracer
 - (h) Mark-Mod, Lot No., Markings, Failure of Aux. Det.
 - (i) Remarks.
-