UNITED STATES BOMB FUZES

This is a brief introduction to US bomb fuzes. It is an incomplete but ongoing work. As I prepare more pages I will add them to this section.

Army fuzes

The US Army designates its bomb fuzes with the letter M followed by a number then any modification to the fuze is indicated by the addition of the letter A followed by a number. Thus:

M113A2 indicates the second model of fuze number 113

Fuzes under development are designated by the letter T followed by a number then any modification to the fuze is indicated by the addition of the letter E followed by a number. Thus:

T114E3 indicates the third modification to the development fuze number 114.

Naval fuzes

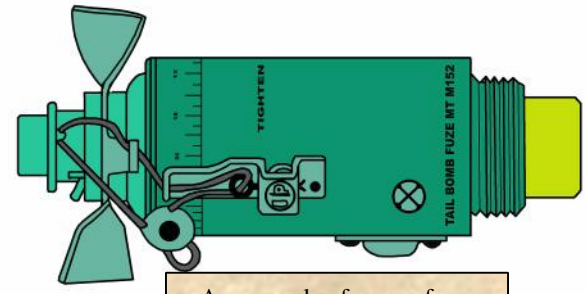
The USN designates its fuzes with the abbreviation for Mark, Mk followed by a number then any modification to the fuze is indicated by the addition of the abbreviation Mod followed by a number. Thus

Mk 415Mod3 indicates the third modification to the fuze mark number 415.

Standardised fuzes

Any fuze accepted as one that can be used by both services is designated by the prefix AN. Thus:

AN-M220A2 indicates a standard army fuze Model number 220 with two modifications that can be used in naval bombs
AN-Mk 218Mod3 indicates a standard naval fuze 218 with three modifications that can be used in army bombs.



An example of a nose fuze.

Fuze markings

Fuzes in American usage are marked with the following information:

Fuze designation
Manufacturing details:

- Lot number
- Manufacturing codes letters
- Inspectors Initials
- Inspection date

Firing delay
Arming delay
Time scale (if any)
Coloured paint to indicate some special characteristic of the fuze (if any)

Fuze hole gauge

American fuze hole gauges are as follows:

For large bombs 50.8mm (2inch)
For smaller bombs 38.1mm (1.5inch), Smaller bombs include fragmentation, clusters, photoflash or practice.

Where it is desired to fit a small gauge fuze to a large bomb adapters are provided.

Naval bombs are usually 50.8mm fuze hole gauge.
Army bombs are usually 38.1mm fuze hole gauge.

Fuze actions

In American services fuzes are classified according to fuze action and these are:

Impact

- Direct. These fuzes are always nose fuzes
    1. protruding striker
    2. Non-protruding striker
    3. Electric
    4. Piezoelectric
    5. Superquick or instantaneous. This is the fastest of all fuzes as the fuze is in front of all the components and thus operates before the bomb has really struck its target.
    6. Sensitive. This is a variety of the superquick with the striker retained by a very light spring. Contact with any light target material will cause detonation. They are used in parachute fragmentation bombs.

- Inertia, Some of these types have what are called “Cocked strikers” that are released by inertial forces.
    1. All ways operation

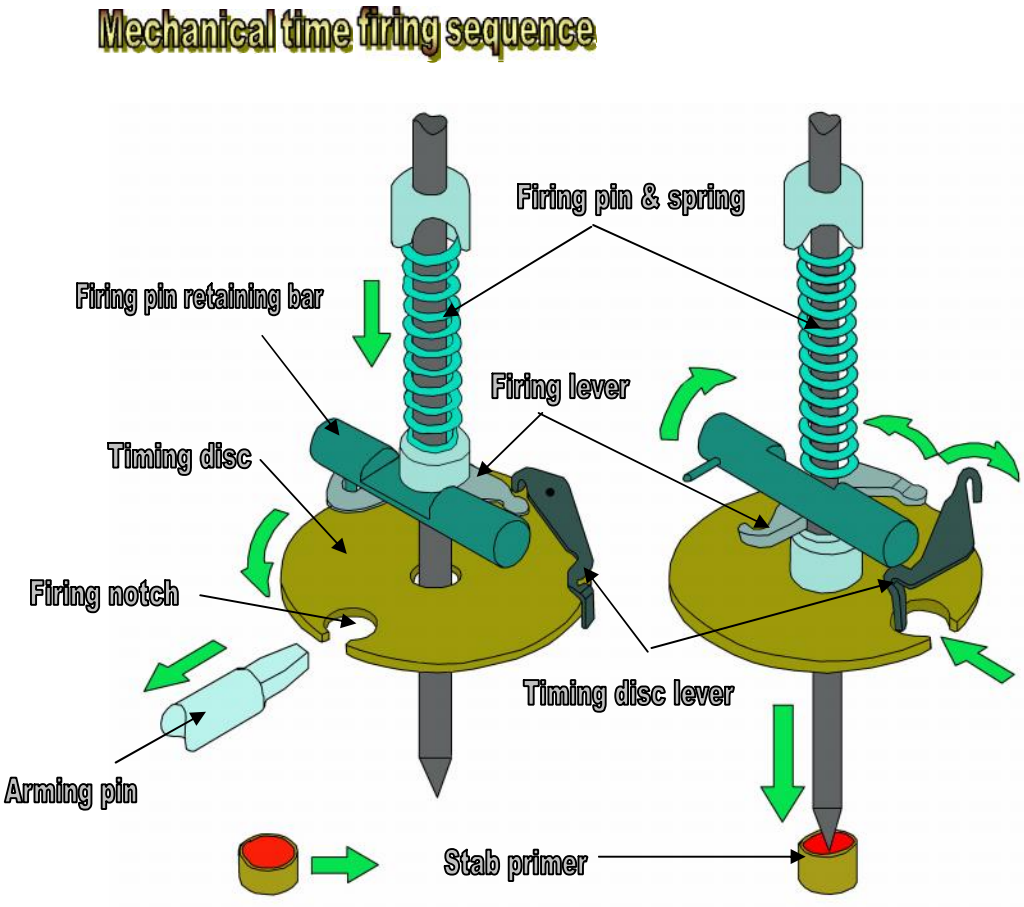
2.Electric
3. Semi-allways operation

- A combination of both the above.

Time

- Mechanical
- Pyrotechnic
- Barometric
- Instantaneous (non-delay)
- Delay
    1. Chemical
    2. Material creep
    3. Clockwork
    4. Electric

Short delay .01 to 4 seconds.
Medium delay 4 to 15 seconds. These are fitted to tail fuzes only as the impact on a nose fuze will smash the delay element thus preventing its operation.
Long delay 6 minutes to 144 hours. These are usually chemical in operation although blasting time fuze has been used as a delay medium.
The fastest action that can be built into a tail fuze is the non-delay. It is to be noted that it is much slower than superquick or instantaneous.



ACTION.
When the fuze is loaded into the bomb the time ring is adjusted to the required time. This action rotates the timing disc so that the distance between the firing notch and timing disc lever represents the time to operation. On dropping from the A/C the arming pin flies out and releases the clockwork mechanism to commence driving the timing disc. When the notch rotates to a position where the timing disc lever can move into the notch the timing disc lever does so. This action releases the firing lever which allows the firing pin retaining bar to rotate under the pressure from the firing pin. The firing pin drives into the stab primer commencing the detonation process of the bomb.

Anti-disturbance or Protective

These devices were used in conjunction with long delay fuzes to prevent movement of the fuze. They are in fact a booby trap as any attempt to remove the fuze will result in the bomb exploding. It is to be noted that ALL chemical long delay fuzes incorporated anti-withdrawal features, which are designed to defeat any attempt to remove the fuze. These devices would operate regardless of whether the fuze is armed or unarmed.

Fuze	Type	Nominal delay	Delay operation requires
M123	Chemical	1 to 144 hours	75 to 190 vane revolutions
M124	ditto	ditto	ditto
M125	ditto	ditto	ditto
M123A1	ditto	ditto	4 to 6 vane revolutions
M124A1	itto	ditto	ditto
M125A1	ditto	ditto	ditto
M130	Clockwork	10 to 60 minutes	3 to 5 wing revolutions
M131	Anti-disturbance	Indefinite	3 to 5 wing revolutions and impact
M132	Chemical	6 to 80 minutes	75 vane revolutions
M133	ditto	ditto	ditto
M134	ditto	ditto	ditto

Influence

- Proximity. These were a late development during WWII and were a remarkable fuze in all ways; they ensured that your bomb exploded at the optimum point above the target.

Hydrostatic

- Hydrostatic
- Electric
- Impact, water discriminating (it would detonate on impact with a submarine but not water.)

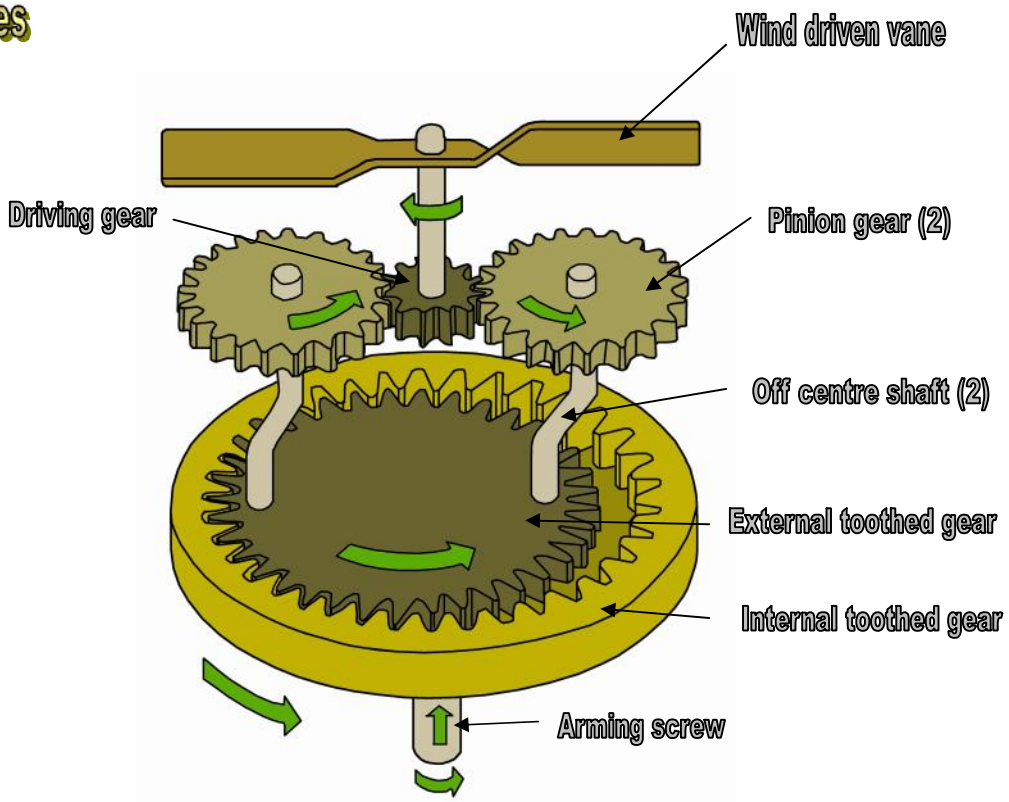
Air burst or Air pressure

These fuzes were used as a method of achieving air bursts by using a Belleville spring type of fuze mechanism in the nose of the fuze. The theory being that when a salvo of bombs armed with these fuzes is dropped the first bomb that hits the ground and explodes causes the other bombs to explode while still in the air. This increases their effects.

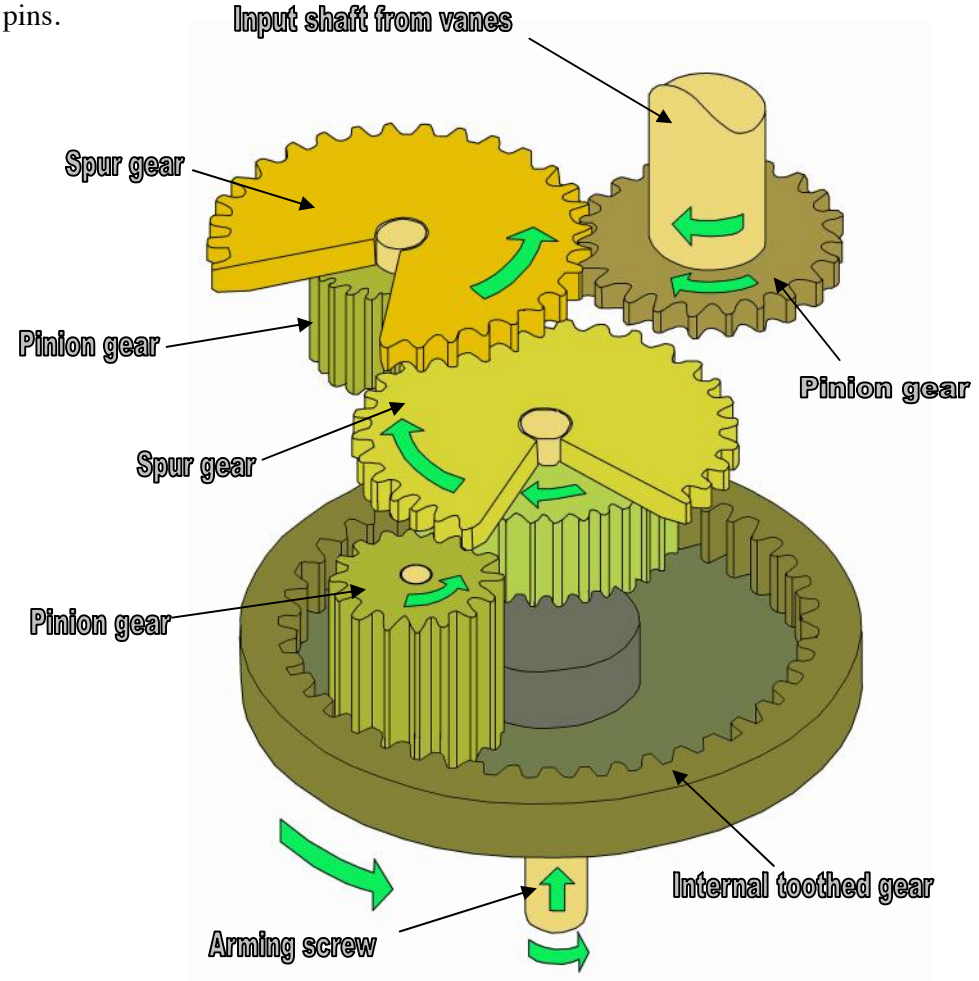
Arming devices

The Americans use the following types of arming devices:

- Wind driven vanes
- Anemometer vanes, connected by flexible shaft to the arming screw.
- Reduction gear assembly, early models were 20:1 and 65:1 ratios and later models were 1000:1.
- Jump out pins.

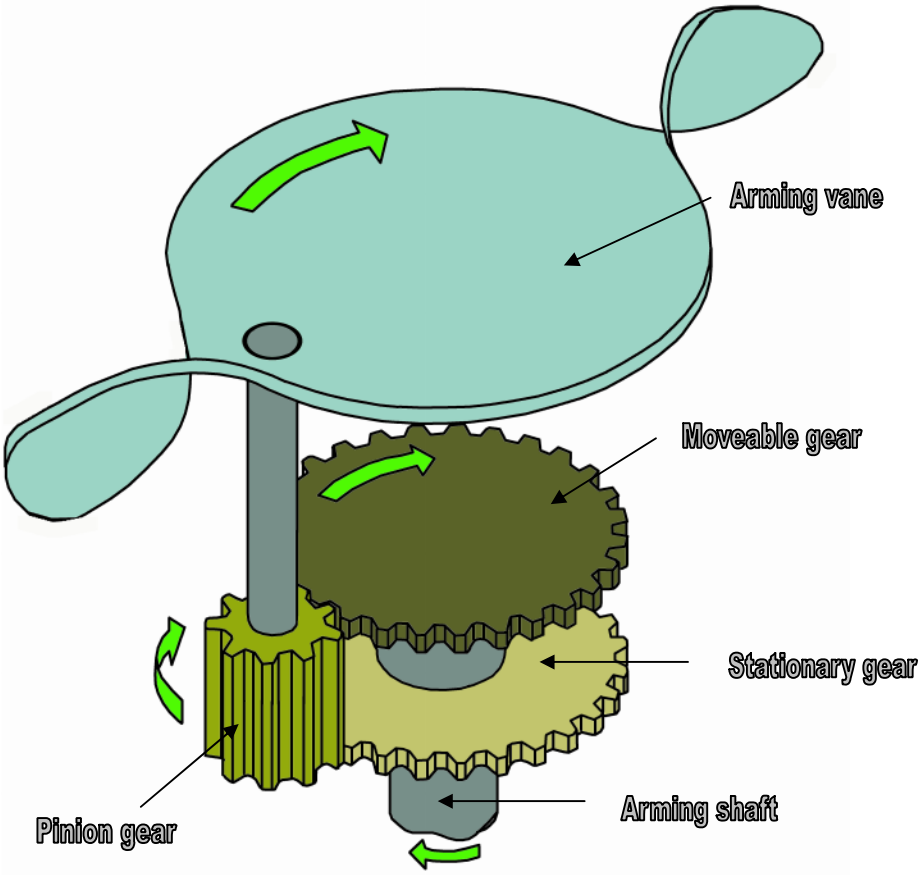


An example of a reduction gear

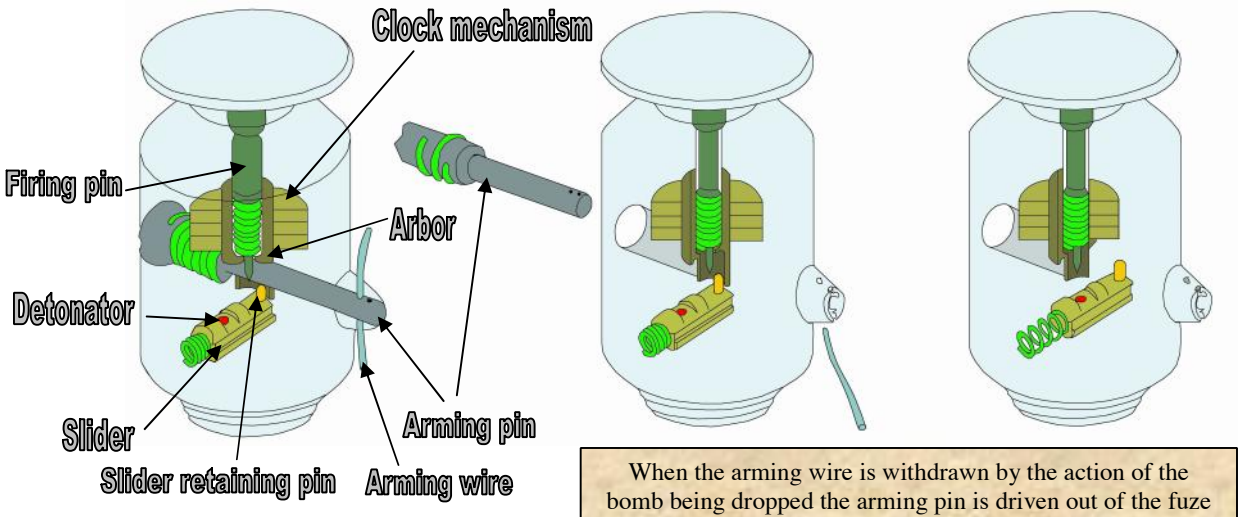


An example of a constant speed reduction gear train

An example of a planetary pinion reduction gear

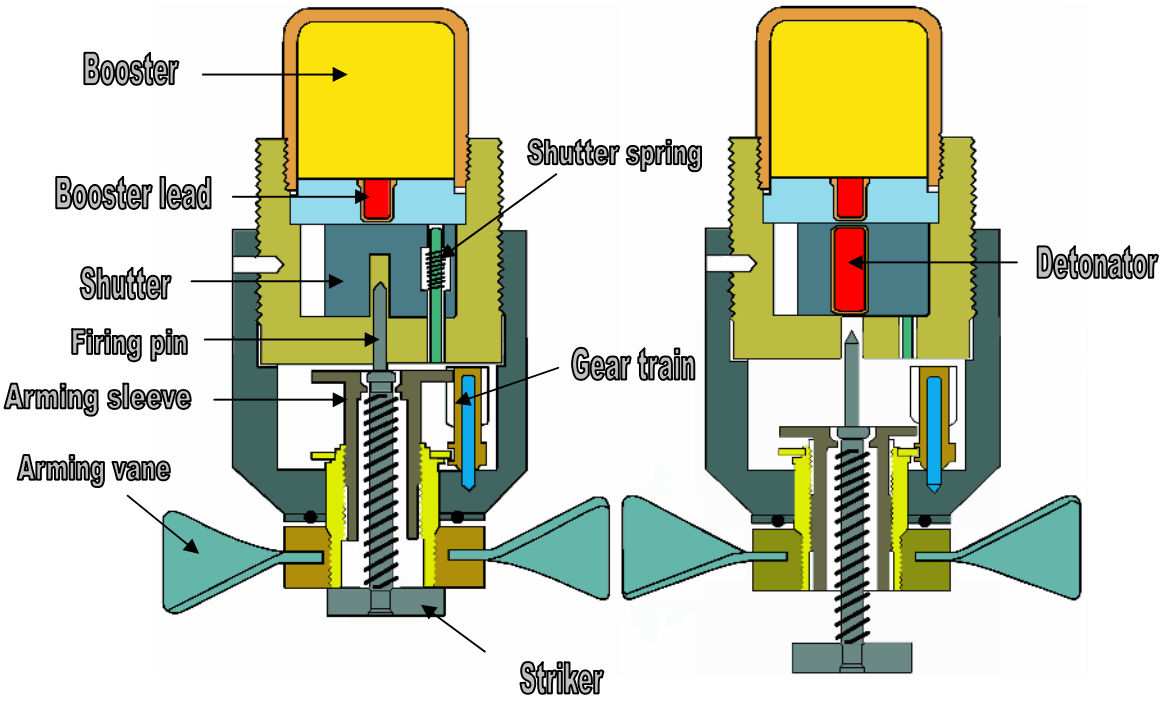


An example of a jump-out pin arming device.



When the arming wire is withdrawn by the action of the bomb being dropped the arming pin is driven out of the fuze by the action of its spring. This action frees the arbor of the clockwork mechanism, which allows the clock to start running. At the end of the time set the arbour rotates and sets free the slider this action allows the slider spring to drive the slider into the armed position. On impact the firing pin is driven into the detonator thus commencing the detonation process.

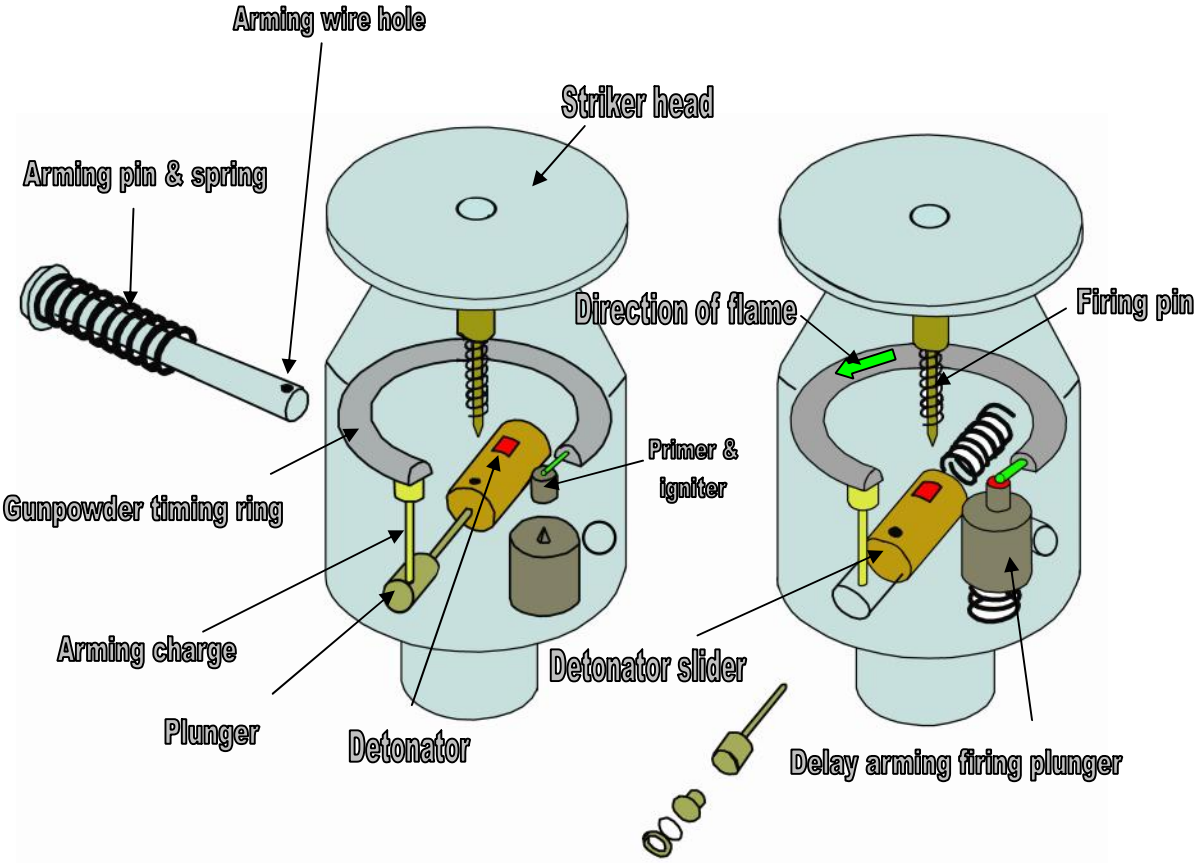
An example of a vane arming system.



ACTION.

After leaving the aircraft the arming vane commences to rotate in the air stream. This action drives the gear train which begins to drive the arming sleeve towards the top of the fuze. This action withdraws the firing pin from the shutter; this releases the shutter to move into the armed position under the influence of its spring. This action brings the detonator into line with the booster lead. The fuze is now fully armed. On impact with the target the striker drives the firing pin into the detonator thus commences the detonation process.

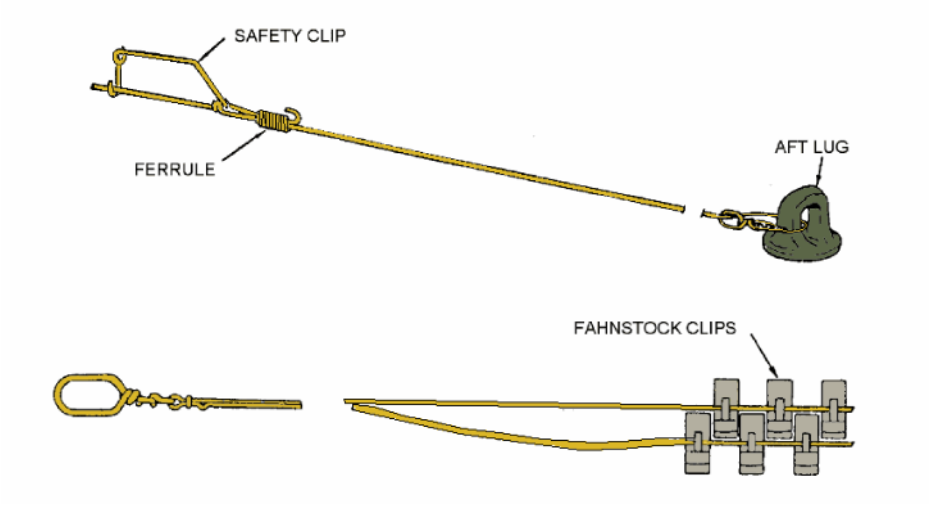
AN EXAMPLE OF A PYROTECHNIC DELAY ARMING SYSTEM



ACTION.
On leaving the aircraft the arming wire is pulled out of the arming pin. This allows the pin to fly out of the fuze body. This allows the delay firing plunger to drive up into the primer and igniter. The flash from this ignites the timing ring, which burns around to the arming charge. When the flame reaches this, it ignites the arming charge which explodes blowing the plunger out of the body of the fuze. This action allows the detonator slider to move into the armed position. On impact the striker head drives firing pin into the detonator commencing the detonation process in the bomb.

Almost all American bomb fuzes were provided with cotter pin safety pins to prevent movement of the vanes during storage transport and handling. This cotter pin was removed at loading and was replaced with the arming wire. It is to be noted that very early in WWII partial arming of bomb fuzes was carried out by armourers by rotating the arming vanes a few revolutions thus reducing the arming times. It was done for bombing at low altitude. It was discontinued as a practice with later fuzes.

Arming wires



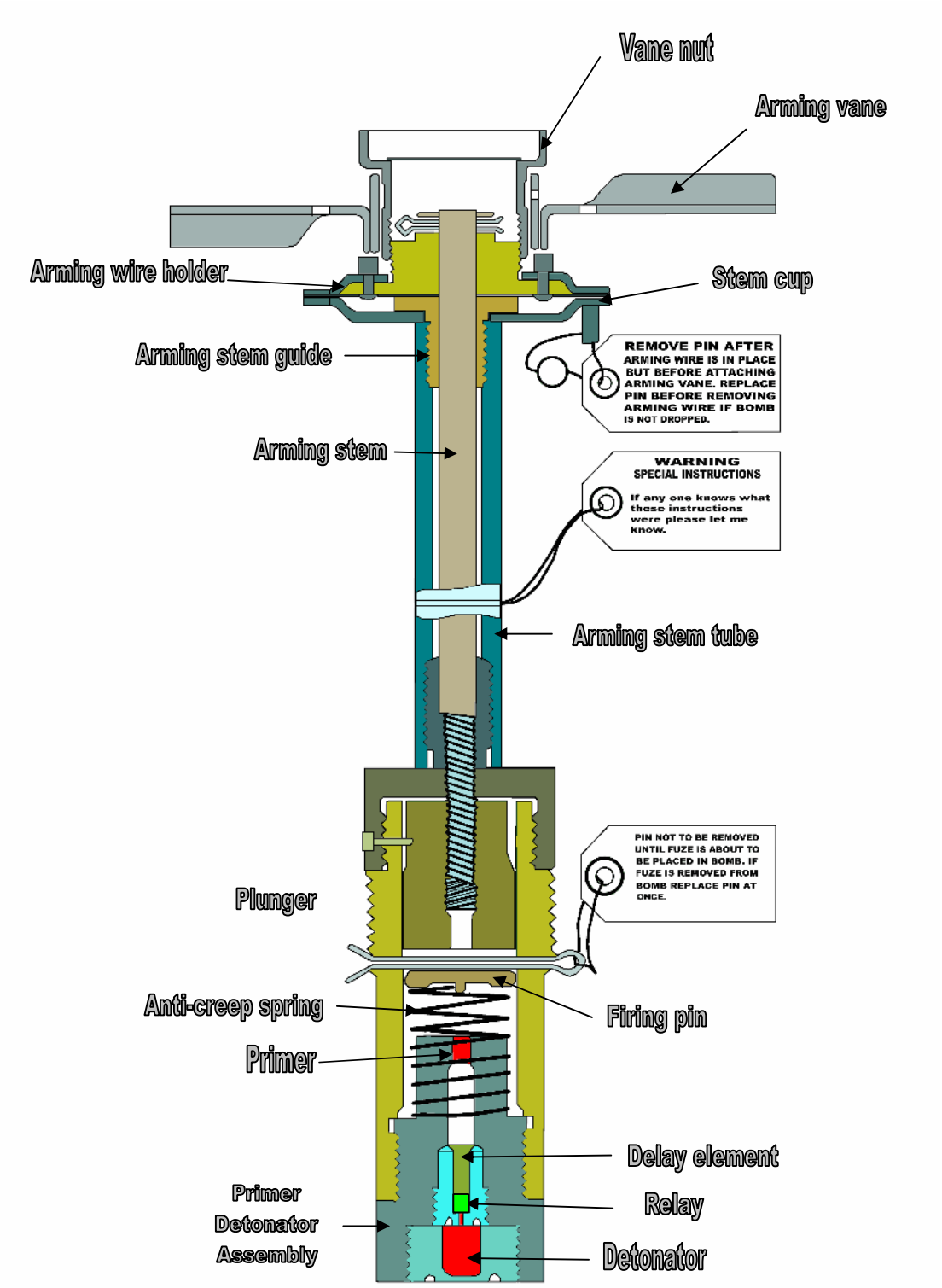
US standard arming wires were single or double stranded steel, brass or bronze usually 1.6mm thick and provided with fahnestock clips. They were attached to the fuze arming vanes and the aircraft so that as the bomb fell away the wire was withdrawn from the arming vane. This action freed the vane to commence rotating in the airstream thus arming the bomb. The wires were so arranged that they could be dropped with the bomb thus dropping it in a safe condition.

Arming wire data

Model No.	Type	Material	Dia (mm)	Leg length (mm)
Mk 1 Mod 0	Single	Brass	1.6	1447.8
Mk 2 Mod 0	Double	Brass	1.6	1447.8
Mk 3 Mod 0	Single	Steel	.81	1447.8
Mk 4 Mod 0	Double	Brass	1.6	2438.4
Mk 9 Mod 0	Single	Brass	1.6	2286
MAU-166 swivel & loop assembly only	Arming wire accessory kit			

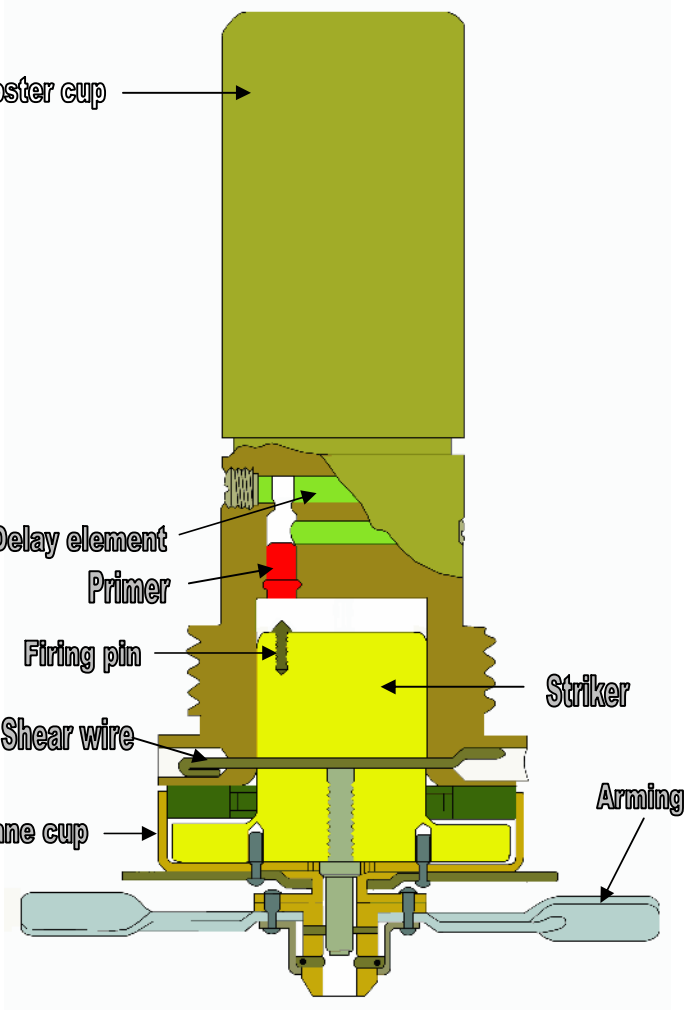
Tail fuzes

The fuze itself consists of a firing mechanism, a detonator and a booster that is part of the adaptor. They are attached to an adaptor booster that is attached to a base plug. The base plug closes the end of the bomb by joining with the tail cone.
Arming vane tail fuzes are longer than nose fuzes so that the air stream may operate the vane.
Three standard lengths became standard and these were:
228.6mm (9”) for use with 100lb to 250lb bombs. Designated as Fuze bomb tail AN-M100A2
304.8mm (12”) for use with 500lb bombs. Designated as Fuze bomb tail AN-M101A2
406.4mm (16”) for use with 1000lb and larger bombs. Designated as Fuze bomb tail AN-M102A2



Nose fuzes

Nose fuzes are the fastest acting of all the fuzes



Electronic impact fuzes

Everything nowadays is electronic, so too with fuzes in the US service. Their electronic fuzes consist of the following components:

- An electronic assembly containing
    1. Fuze arming circuit
    2. Fuze firing circuit
- A rotor, moved by an explosive actuator
- A booster
- An electronic charging assembly that replaces the old arming vane assembly.

The arming and firing circuits are energised as the bomb leaves the aircraft.

The firing circuit isn't actuated until the bomb impacts with the target. Delays are built in and are usually of the order of .004 to 20 seconds. Some fuzes are provided with delays of 5 minutes.

The entire fuze is installed in the bomb so that it isn't visible externally.

In some fuzes a mechanical arming device is included to prevent movement of the rotor to the armed position.

Time fuzes

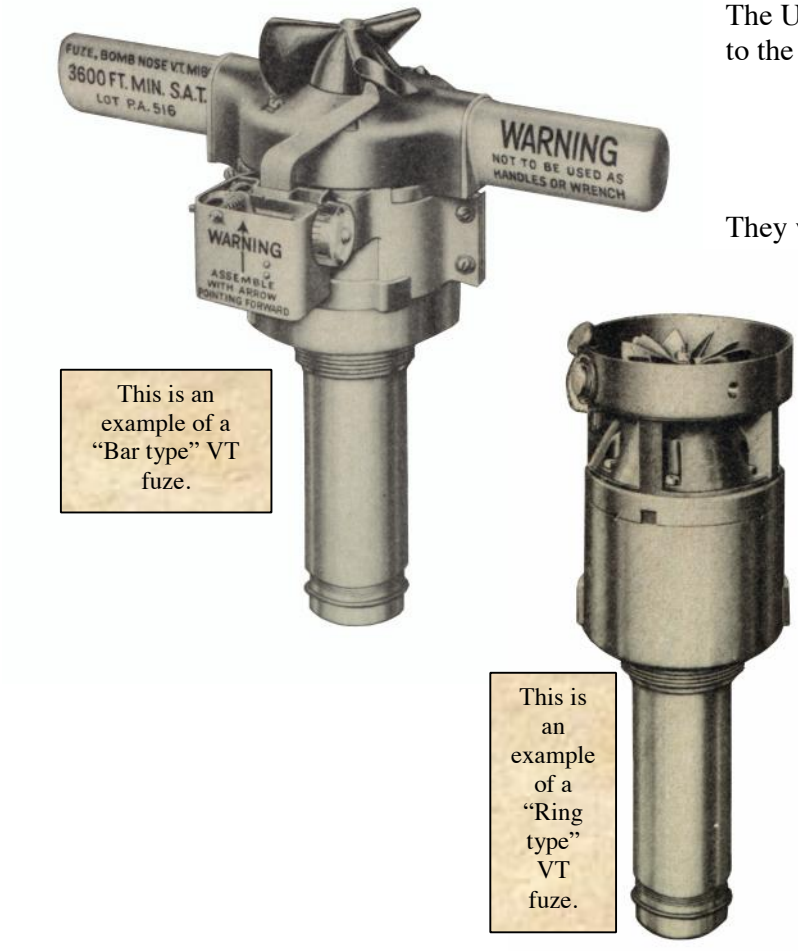
All US time fuzes were clockwork operated. They were sometimes called “Airburst” fuzes.

All clockwork mechanisms were:

- Vane and pin armed
- Cocked striker fired
- Detonator safe because the detonator was out of alignment until the fuze armed
- Fitted with reduction gear arming
- Wound up prior to assembly in the fuze

They ran at such high speed that they hummed instead of ticking. It wouldn’t be a good place to be if you could hear the fuze arming.

Proximity fuzes



This is an example of a “Bar type” VT fuze.

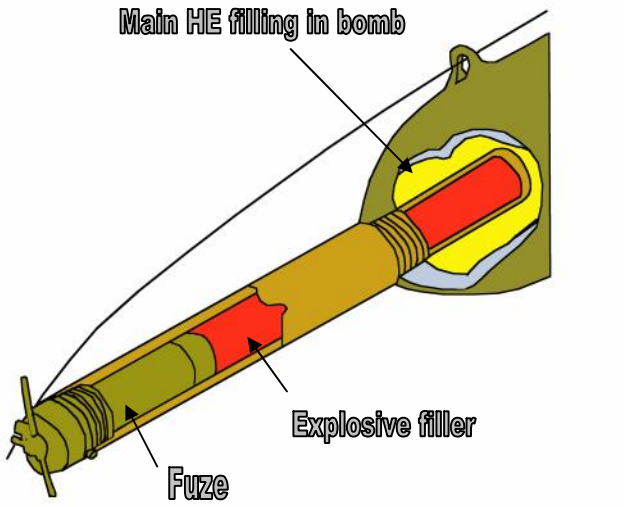
This is an example of a “Ring type” VT fuze.

The US classified their proximity fuzes according to the type of antennae and these were:

- Bar type
- Ring type

They were both fitted with an arming vane that drove a generator to provide electric power to the electronic circuits and at the same time it arms the fuze by moving the rotor into the armed position.

Fuze extensions



These devices are a method of getting the bomb to explode above the ground thus improving the lethal radius of the contents. They are exactly what their name implies in that they are an explosive filled tube with the fuze inserted in the front end. The rear of the tube is inserted into the nose cavity and is connected with the main filling.

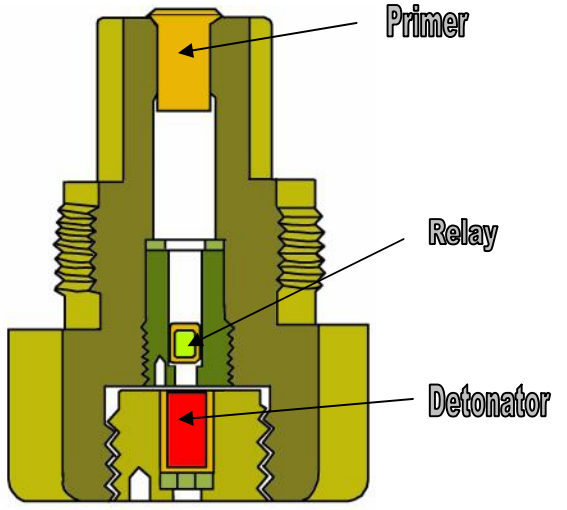
On impact with the ground the fuze detonates and passes the detonation wave through the explosive filled tube into the bomb filling.

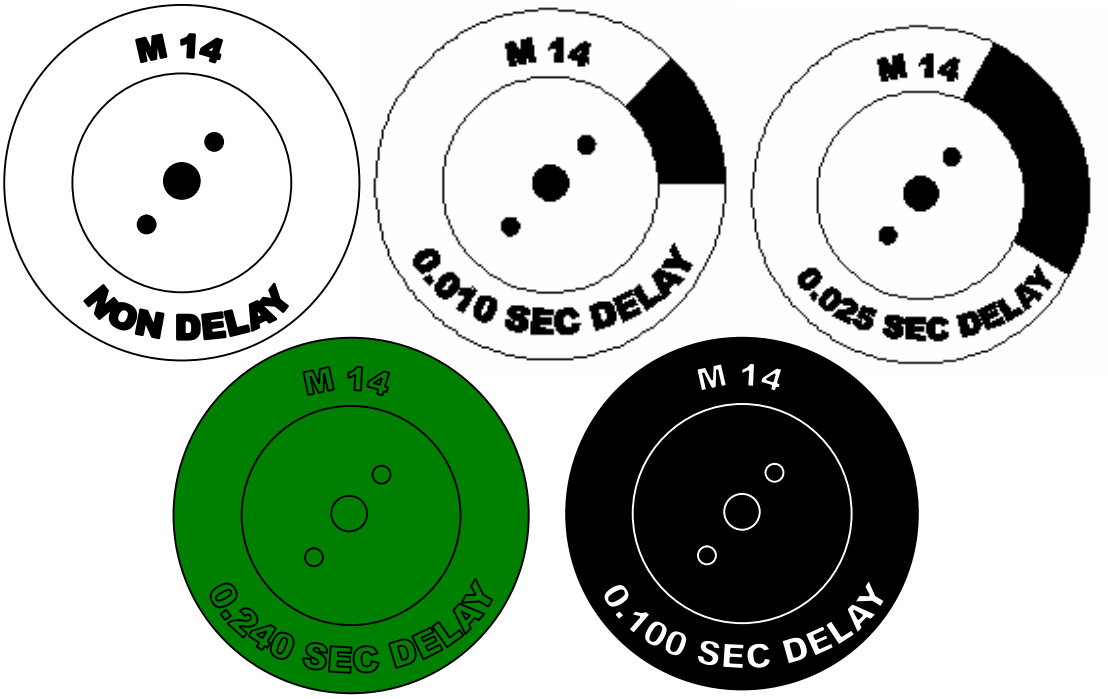
Explosive data for fuze extensions

Model	Length in mm	Diameter in mm	M1 Filling & wt.	M1A1 filling & wt
M1 6" & M1A1 6"	170.2	63.5	.14kg Tetrytol	1.4kg Comp B
M1 9" & M1A1 9"	246.4	ditto	.2kg Tetrytol	.2kg ditto
M1 12" & M1A1 12"	322.6	ditto	.23kg Tetrytol	.23kg ditto
M1 18" & M1A1 18"	475	ditto	.45kg Tetryl	.45kg ditto
M1 24 " & M1A1 24"	627.4	ditto	.6kg Tetryl	.6kg ditto
M1 30" & M1A1 30"	780	ditto	.75kg Tetrytol	.75kg ditto
M1 36" & M1A1 36"	932.2	ditto	.9kg Tetryl	.9kg ditto

Explosive components

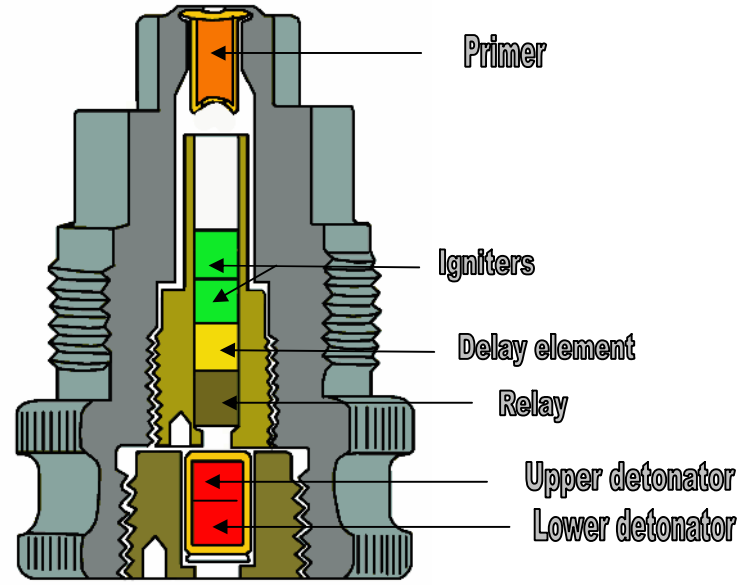
M14 non-delay detonator assembly

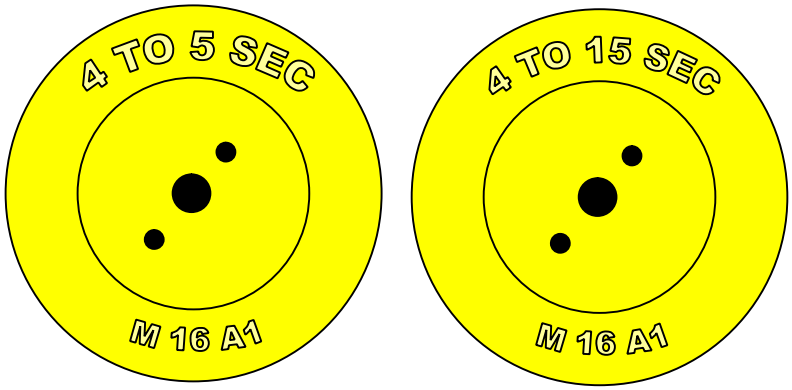




The delay colour coding for the M14.

M16A1 Delay detonator assembly

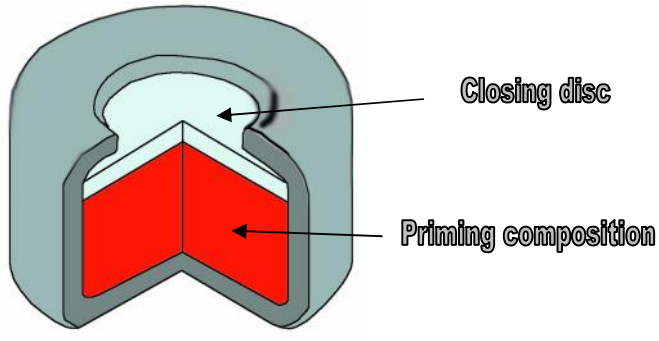




The colour coding for the M16

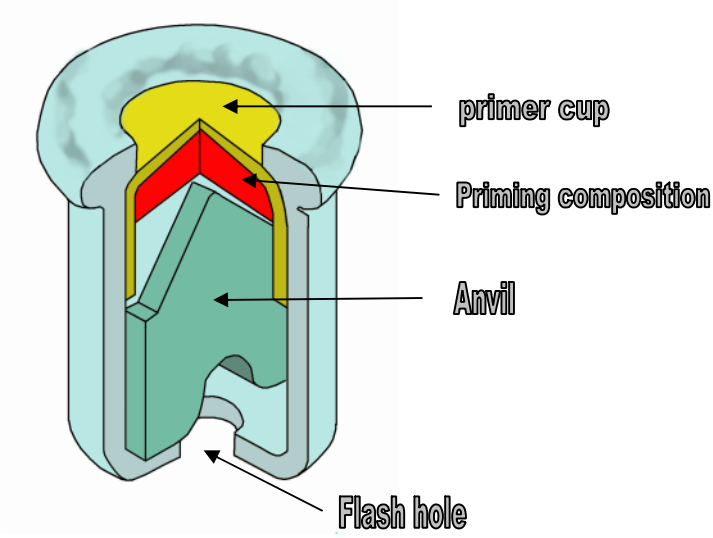
PRIMERS

Stab primers



These are as described. The priming composition is contained in a small metal capsule with a hole in the top through which a firing pin is driven into the composition. The composition having been selected for its sensitivity to friction simply detonates and commences the detonation of the bomb. Some of them have no seal over the composition. All of these types of primers are reasonably small but should not be treated with anything less than great caution as they are extremely violent little devices.

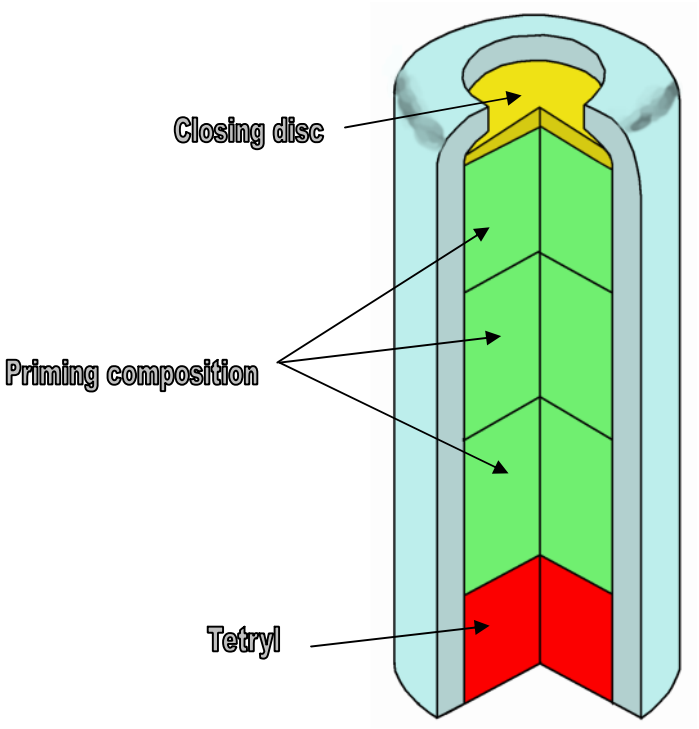
Percussion primers



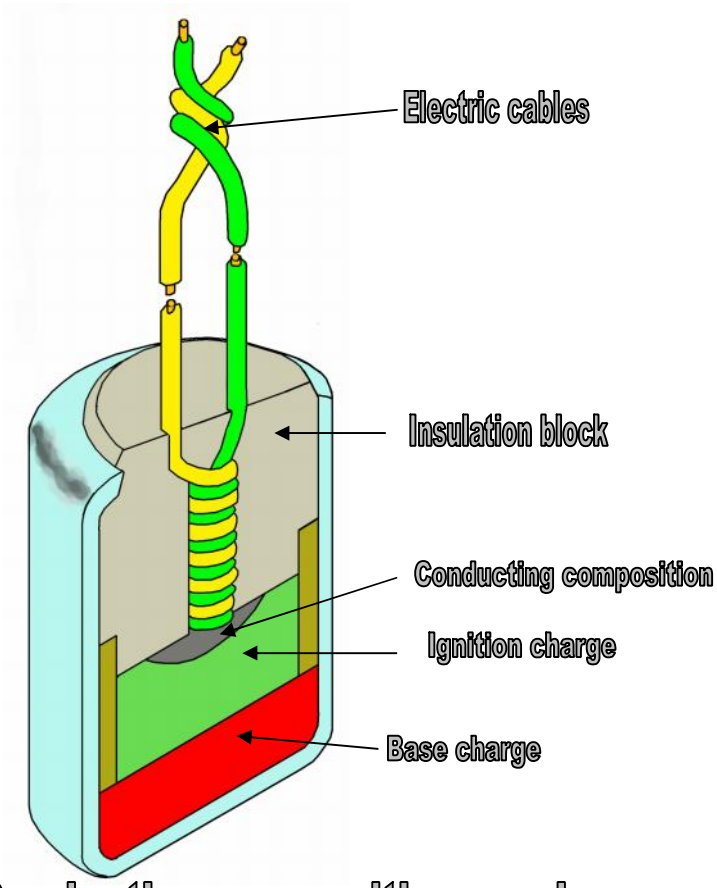
These are similar to the percussion primer used in small arms ammunition. They have an anvil sitting just below the priming composition that is contained in a cup. When the striker impinges on the primer cup it pinches the composition between it and the anvil. The composition detonates and the flash from it commences the detonation process in the bomb.

Stab detonators

These are a combination of a detonator and a primer. They have a stab primer that passes its flash into an HE filling. The detonation from this is passed to the explosive train of the bomb.

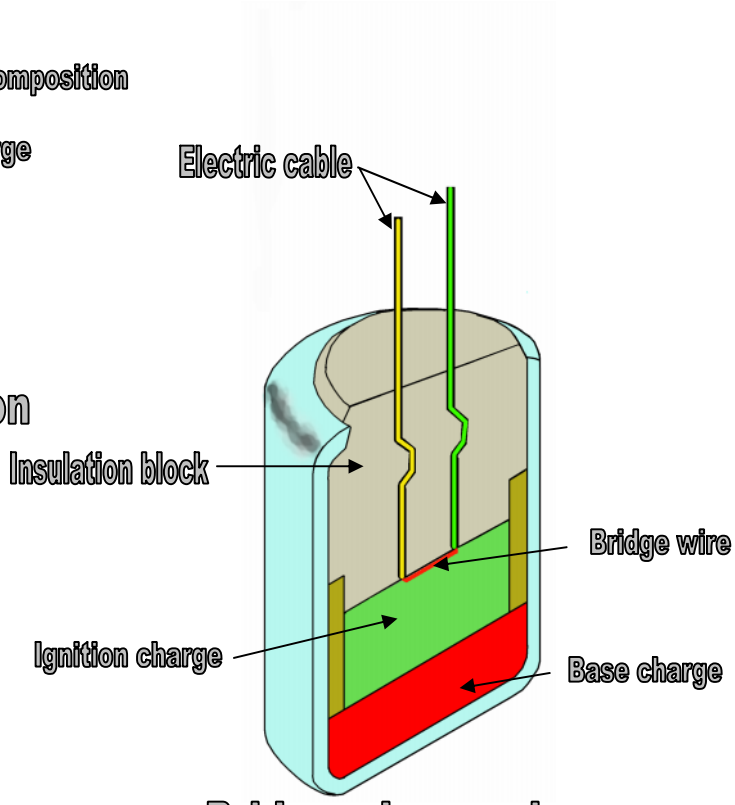


Electric primers



Conducting composition version

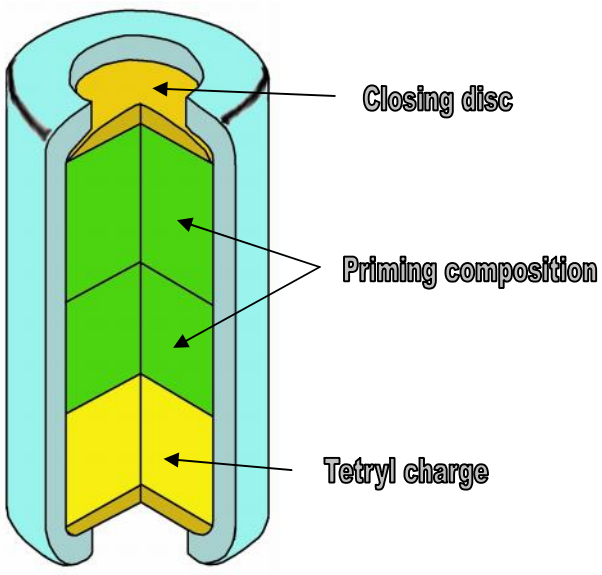
Electric primers come in two varieties and these are the conducting composition and the bridge wire. The conducting composition is selected for its electrical ability to conduct and in doing so it incandesces and passes the flash to the ignition charge. The conducting wire does exactly the same except that the wire incandesces as the current passes through it in the same manner as an electric light filament. The flash from this is passed to the ignition charge and thence into the base charge. This commences the detonation process of the bomb.



Bridge wire version

Flash detonators

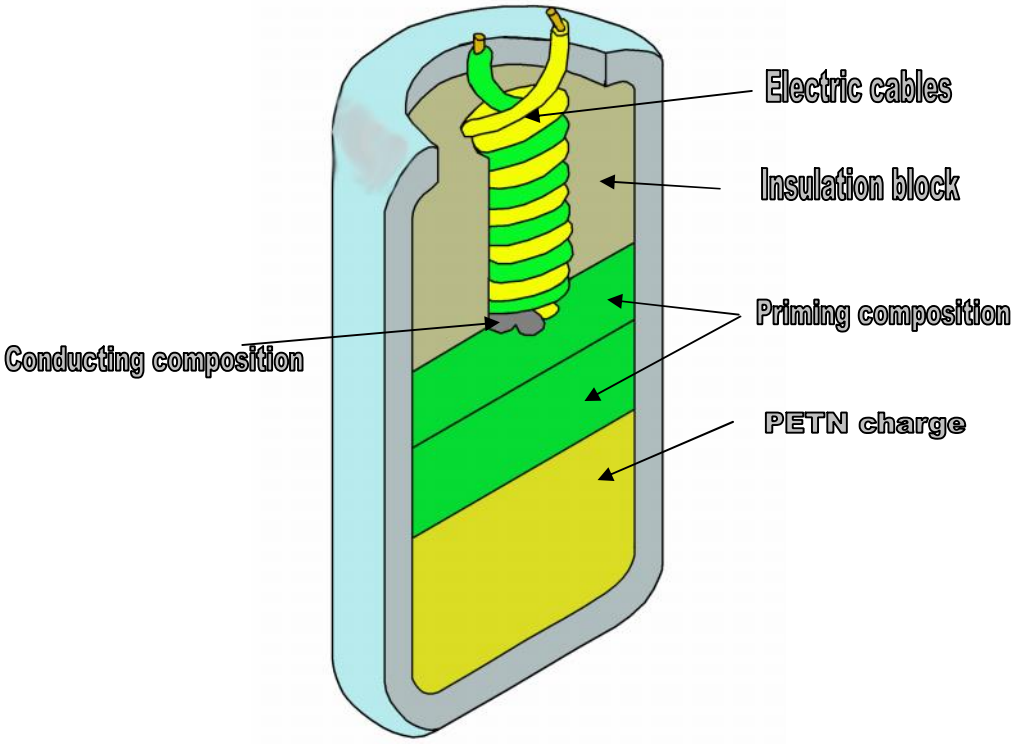
These little devices use the flash from another primer to ignite a priming composition that detonates a small charge of high explosive such as RDX or TETRYL. Some of them use LEAD AZIDE to pick up the flash instead of a priming composition.



Electric detonators

Electric detonators will be found in three different types and these are:

- Conducting composition
- Bridge wire
- Contact type

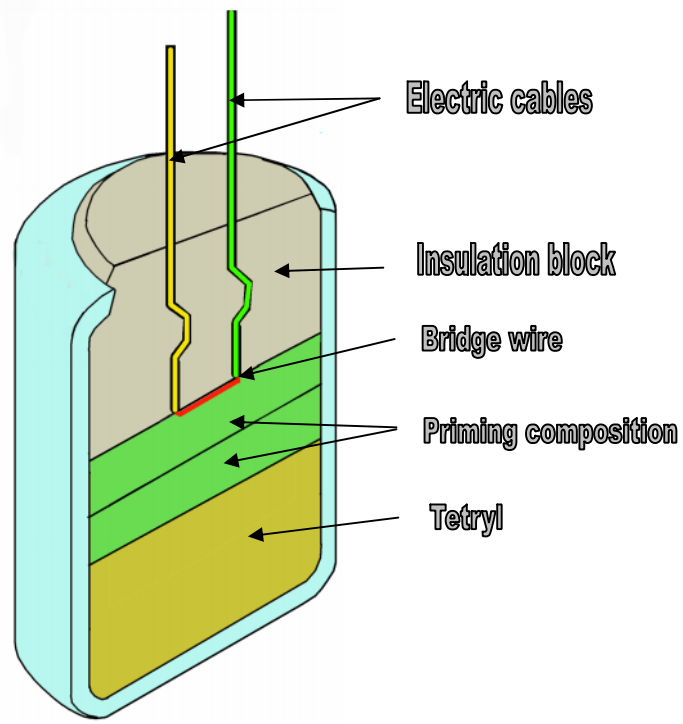


Conducting composition type:

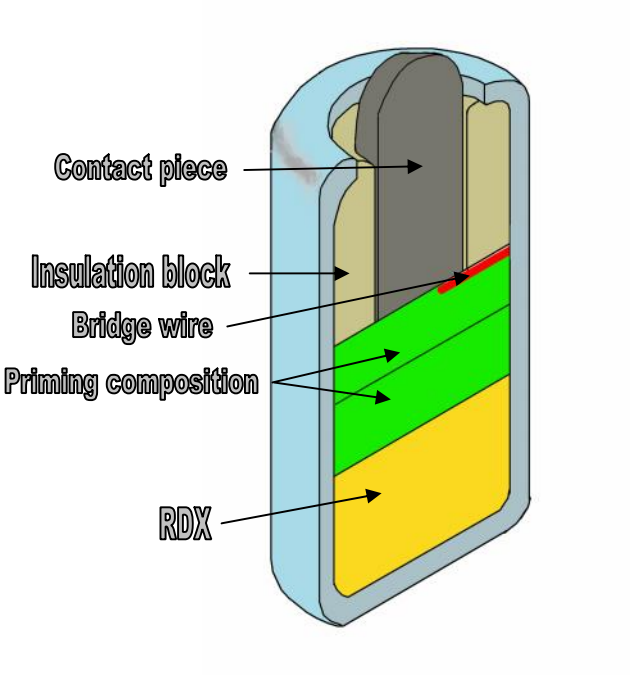
This type acts in the same manner as the conducting composition type of electric primer.

Bridge wire type

This type operates in the same manner as the bridge wire type of electric primer.



Contact type.



These devices use a contact piece built into the body of the detonator. The firing pin of the fuze makes contact with this piece thus completing a circuit between the firing pin, contact piece, bridge wire and the body of the detonator. When the fuze mechanism is triggered a current flows through this circuit making the wire incandesce which ignites the priming composition. This commences the detonation process in the bomb.

It is to be noted that when an unexploded bomb or bomb fuze is found all or some of the above devices may be present in the bomb fuze, depending on its type. All of the electrical types may have the circuits intact, any of the stab type primers will possibly have the firing pin still embedded in the priming composition. All in all these situations are extremely hazardous and should be borne in mind when contemplating dismantling unexploded bombs and bomb fuzes.