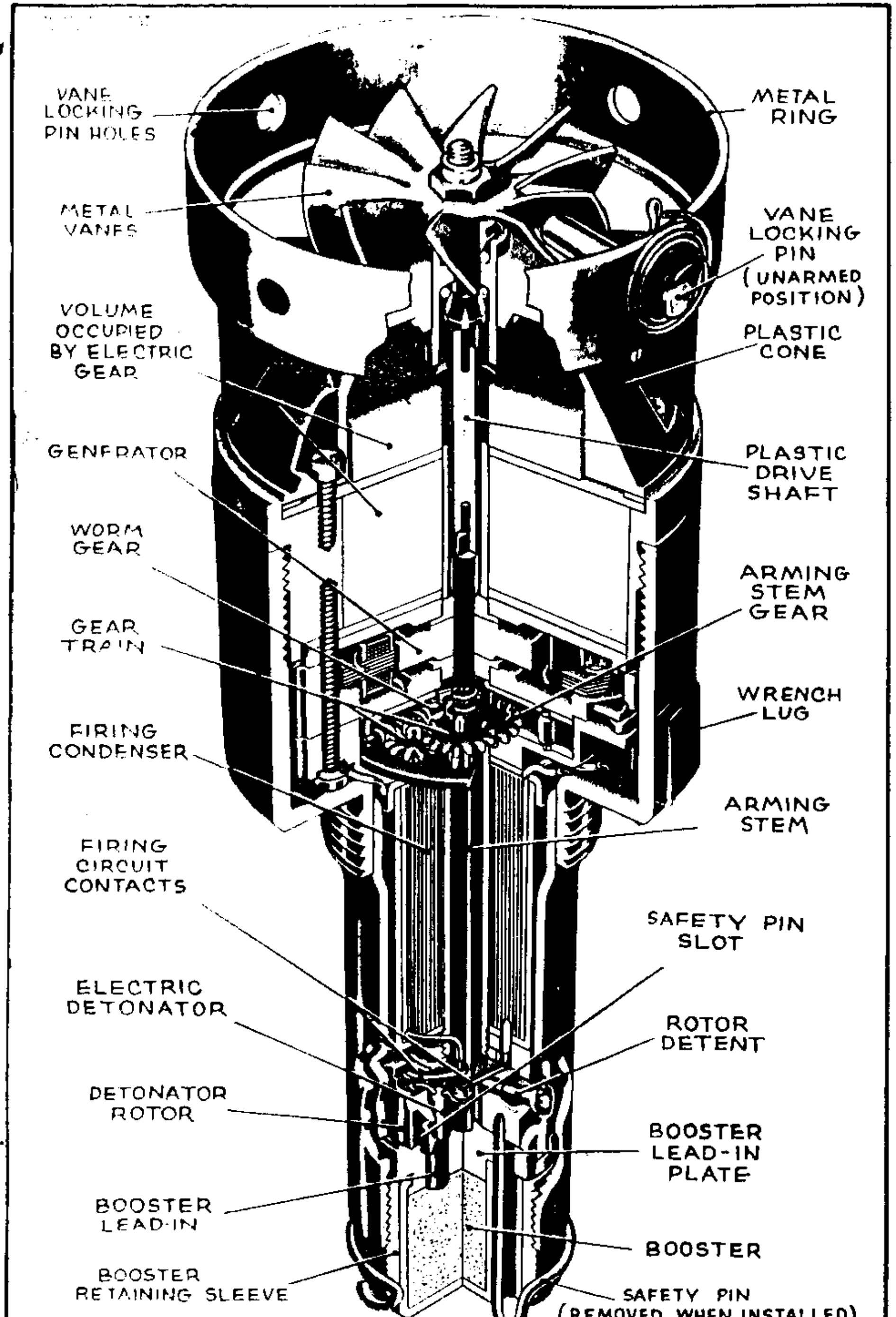


T91-T92 VT BOMB NOSE FUZE (ARMED)

CONFIDENTIAL

U. S. ARMY-NAVY NOSE FUZES

T 91
T 92

Aerial Burst, VT Type
(For Low Level, Medium Level, and Dive Bombing Use)

BOMBS USED IN . . . . . T91: 100, 250, 2000 lb. G.P.
220, 260 lb. Frag.
4000 lb. L.C.
T92: 500, 1000 lb. G.P.
500, 1000 lb. Chem.

FUNCTIONING . . . . . Automatic aerial burst, 30-60 ft. above ground when released below 10,000 ft.

ARMED CONDITION . . . . If vanes free to rotate, assume armed unless safety pin can be inserted.

ARMING TIME . . . . . T91 - 2000 ft Min. SAT
T92 - 2600 ft Min. SAT

FUZES USED WITH . . . . AN-M100A2 series tail fuzes

OVERALL LENGTH . . . . 10.4 in.

EXTERNAL LENGTH . . . . 5.0 in.

EXTERNAL DIAMETER . . . 3.4 in.

MATERIAL . . . . Steel body, plastic top, metal ring, steel or plastic vanes.

DESCRIPTION: Automatic aerial burst VT fuze designed to initiate detonation on approach to earth. Burst heights depend on size of bomb, release altitude and speed, and type of target (See Introduction). Average burst heights obtained with common bombs dropped from 8000 ft. at 200 mph true air speed, over average land are:

Fuze	AN-M30	AN-M57	AN-M81	AN-M64	AN-M65	AN-M66
T91	25	30	30	low	low	37
T92	low	low	low	35	45	low

"Low" indicates bursts between 3 - 10 feet. Values will usually be higher when dropped from lower altitudes and when released at higher plane speeds. Ring type fuzes are especially sensitive to "passing" objects so are useful in defoliating trees and obtaining roof top bursts.

At present about 80% will operate properly upon approach to the target, 15% may function spontaneously after arming, and 5% will be inoperative. These fuzes have Min. SAT reduced to 2000 or 2600 for use in low, medium, and dive bombing. Aircraft must pull away from bomb after release to provide safety. Figures of Min. SAT are based on tests with the AN-M30, 100 lb. bomb. All fuzes will arm within 600 ft. after the Min. SAT, in this bomb. SAT in larger bombs is increased by the reduction in air velocity over the vanes as follows: AN-M81 - 3%, AN-M57 - 12%, AN-M64 - 24%, AN-M65-33%, AN-M66 - 43%. SAT can be extended by use of the T2E1 delayed arming device (see TB-9X-106). Bombs should not be dropped above 10,000 ft. as approach velocities will be too great to obtain effective burst heights. T89 or T90 fuzes should be used for high level bombing.

The following fuzes have been issued: T91, T91E1, T92, T92E1, T92E2, T92E3. They differ in that the 91, 92, and 92E2 have a booster safety pin, making them identical in appearance to the T89 and T90. The T92E2 and 3 are modified electrically to give slightly better operating efficiency. Vanes may be either 10 bladed steel vanes or 3 bladed plastic vanes.

OPERATION: When the bomb is dropped, the arming wire is pulled, releasing the spring loaded vane locking pin which jumps out, freeing the vanes to rotate. The vanes rotate and drive the electric generator and the worm and spur gear reduction train. After the required number of vane revolutions, the detonator lines up with the booster lead in and at the same time becomes electrically connected to the firing circuit. The rotor detent in the detonator rotor snaps into the socket in the rotor housing, locking the detonator in the armed position and at the same time withdrawing from the keyway in the arming stem. The vanes continue to rotate, driving the generator which has in the meantime activated the VT element and charged the firing condenser. The fuze is armed.

Upon approach to a target under the proper conditions, the VT element activates the firing circuit which discharges the firing condenser through the electric detonator, initiating the explosive train.

REMARKS: These fuzes are mechanically interchangeable with the AN-M103 series nose fuzes but are not tactically interchangeable with impact fuzes or with each other. If the T91 fuze is used in bomb sizes for which the T92 fuze is specified, very low air bursts will result. The same is true for transposition in the other direction.

These fuzes are not to be used for horizontal bombing runs because the Min. SAT is such that the fuzes may be completely armed when only 250 ft. below the carrying aircraft and early bursts in this position would cause damage to the plane.

ATTACK: See ATTACK on T50E1 and T50E4 Nose Fuzes, page 9.

VT ROCKET FUZES

Certain problems unique to rockets occur in applying VT fuzes to this weapon. The major problem is the effect of after-burning or chuffing of the rocket motor upon fuze operation. Burning of the motor gases causes spontaneous functioning of the VT fuze. Arming of these fuzes is therefore delayed by a mechanical setback feature until the motor has stopped burning. However, if the motor spontaneously re-ignites at some later time during flight after the fuze has armed, it will cause the fuze to initiate detonation immediately.

There are two methods of dealing with this problem, either prevent arming until the probability of after burning is past or prevent after-burning. The first method has the disadvantage that it reduces the useful part of the trajectory of the rocket by preventing arming for the first 5 - 10 seconds of flight time. The second method is more practical and work is being done to reduce the tendency toward after-burning in those rockets which have this problem to a serious degree. The Navy 3.25" rocket motor Mk 7 and the Army 4.5" fin stabilized rocket have proved satisfactory but the Navy 5" rocket motor is not entirely satisfactory yet because of after-burning.

Another problem in the application of VT fuzes to rockets is the range dispersion of air bursts due to variation in burst heights at low angles of fire. Since the variation in burst heights may be from 15' to 60', at very low angles the range dispersion of bursts may vary by 200'. To minimize this effect, dive angles in rocket fire from aircraft are recommended to be 20° or over, and tables of correction in aim point, for various dive angles, have been issued to allow centering of the probable burst point over the target. The steeper the dive angle, the less the range dispersion in bursts so steeper dives are recommended in VT rocket work.

RING TYPE ROCKET FUZES

The ring type bomb fuzes have been adapted for use in the Navy fin stabilized 5" rockets by inclusion of a setback arming delay. There are two fuzes in this series, one of which is in production:

Fuze	Use	Status
Mk 171 Mod 0 (T 30)	Air to Air, Navy 5" Rocket, 3.25" Motor	Development
Mk 172 Mod 0 (T 2004)	Air to Ground, Navy 5" Rocket Head Mk 1 Mod 1, 3.25" Motor	Service

These fuzes require special deeply cavitized rocket heads to accommodate the long fuze stem. This is the Mk 1 Mod 1, 5" rocket head. They are used only with the 3.25", Mk 7 rocket motor.

M8 ROCKET FUZES

Three VT type fuzes have been developed for use in the Army 4.5" fin stabilized rockets. These are dry battery powered fuzes instead of generator powered and therefore subject to troubles incident to stowage and handling of perishable dry batteries whose power output and voltage declines with age, especially in warm climates. The M8 rocket is obsolescent and these fuzes are also classed as obsolescent but are included because of the quantities of them available for use in operational theaters. The fuzes are:

Fuze	Use	Status
T4 (Photoelectric)	Aircraft to Aircraft	Not on issue
T5	Aircraft to Aircraft; Aircraft to ground or water.	Service
T6	Ground to ground	Service

The photoelectric fuze has not been issued to the service because of certain limits in time of day and angle of fire in which it is useful because of the light intensity necessary to make it function. It is not discussed in detail in this bulletin because it will probably not be encountered in the field. Complete information on it is available in U.S.Army TB 9X-94.

The T5 and T6 fuzes are identical except for arming time and self destruction

T 82

Aerial Burst, VT Type

BOMBS USED IN	All GP, SAP, Frag., Chem., Incend. or Depth bombs which take the AN-M103 nose fuze.
FUNCTIONING	Automatic aerial burst 40'-60' above ground.
ARMED CONDITION	If turbine lock pin is gone, assume armed unless safety pin can be inserted.
ARMING TIME	3600 ft. Min. SAT
FUZES USED WITH	AN-M100A2 series tail fuzes normally.
OVERALL LENGTH	8.4 in.
EXTERNAL LENGTH	3 in.
EXTERNAL MAX. WIDTH	10 in.
MATERIAL	Steel body, plastic top, two aluminum bars athwartships

DESCRIPTION: This is an automatic aerial burst nose fuze of the general class designated as VT. It is designed to initiate detonation of the bomb on approach to the earth at heights to give effective fragmentation and blast damage to the target. Burst heights vary with the size of the bomb and the type of target but are more or less independent of altitude and air speed at time of release when above 5000 feet. (For explanation of these factors, see "Introduction".) Following are average burst heights in feet obtained in common bombs when dropped from 10,000 ft. at 200 mph true air speed over average land with the T51E1 fuze. Accurate data on burst heights with the T82 are not available but will be slightly higher than these figures.

	AN-M30	AN-M57	AN-M81	AN-M64	AN-M65	AN-M66
T51E1	60	60	60	40	40	25

This fuze is more sensitive to head on approach to a target than the ring type and less sensitive to "passing objects". It can be used interchangeably in any bomb which takes the AN-M103 fuze when air burst is desired.

At the present stage of development, approximately 90% of the fuzes will function properly upon approach to the target and the remainder will either function spontaneously after arming but before approaching a target or will be inoperative.

This fuze has a Min. SAT (Minimum Safe Air Travel) of 3600 ft. which may be extended by use of the T2E1 delay arming device which clamps onto a bracket around the body of the fuze and prevents the spring loaded turbine locking pin from jumping out and freeing the turbine until the preset air travel of the T2E1 device has been completed.

The booster safety pin in this fuze locks the detonator rotor in the unarmed position. Before installation of the fuze in a bomb, the pin should be pulled and reinserted. If it cannot be reinserted, the fuze is armed or partially armed and should be destroyed.

OPERATION: When the bomb is dropped, the arming wire is pulled, releasing the spring loaded turbine locking pin which jumps out, freeing the turbine to rotate. The air stream enters the cavity in the fuze head, blows over the air turbine and leaves through the lower ports, around the turbine. The air turbine drives the electric generator mounted in the fuze stem and the gear reduction system. After a minimum number of turbine revolutions (3600 ft. Min. air travel), the detonator lines up with the booster lead in and at the same time becomes electrically connected to the firing circuit. The rotor detent in the detonator rotor snaps out into a hole in the rotor housing, locking the detonator in the armed position and at the same time withdrawing from the keyway in the arming stem. The turbine continues to rotate at high speed, driving the generator which has in the meantime activated the VT element and charged the firing condenser. The fuze is armed.

Upon approach to a target under the proper conditions, the VT element activates the firing circuit which discharges the firing condenser through the electric detonator, initiating the explosive train.

REMARKS: This fuze differs from previous generator energized bomb nose fuzes in that the entire generator and arming system is mounted inside of the fuze stem which fits inside of the fuze well. The firing condenser is carried in that part of the body section which is outside of the bomb and will usually be demolished.

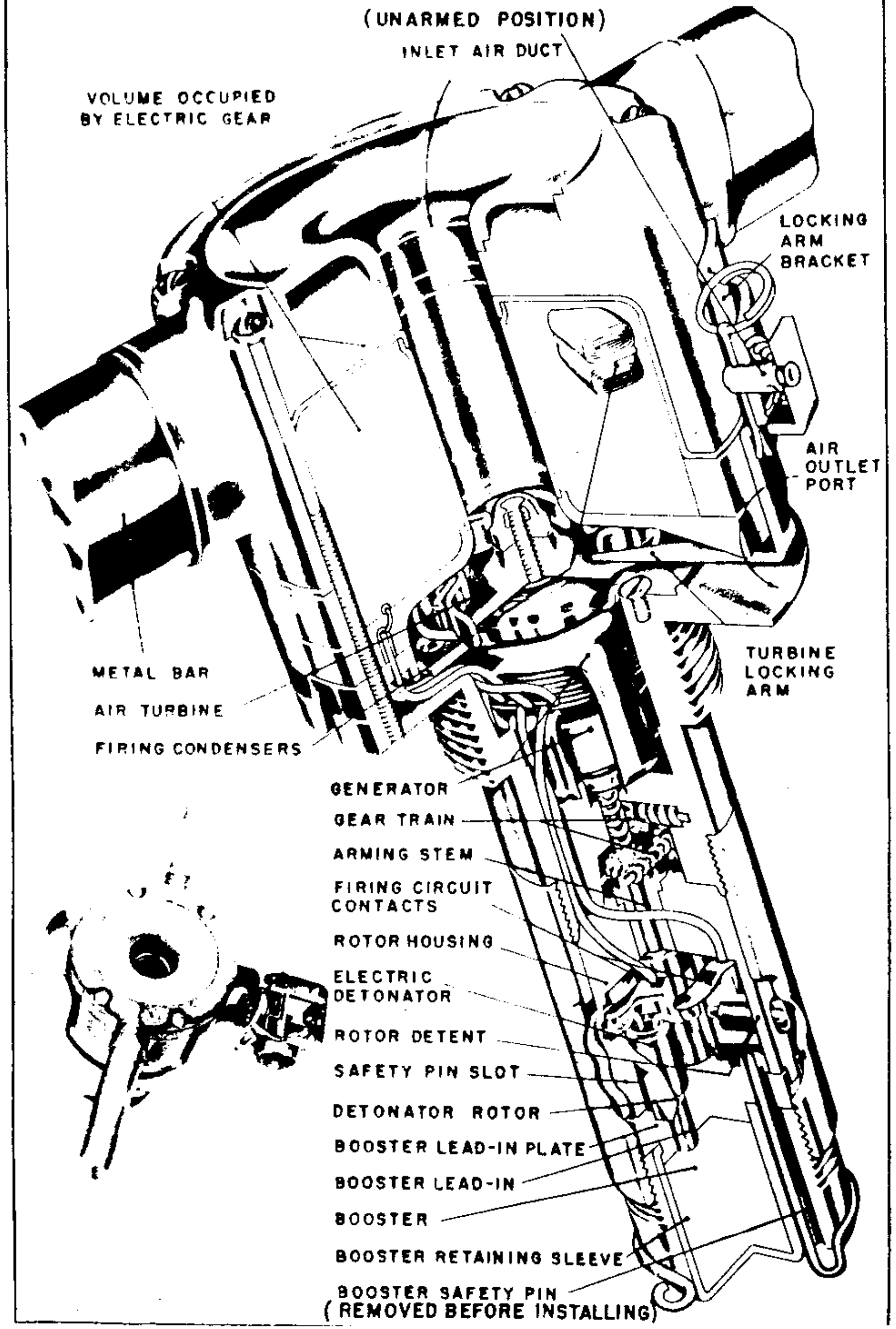
ATTACK: (1) If fuze is complete or generally intact:

(a) It is safe to approach unless turbine is rotating at high speed. If wind velocity of more than 100 mph is blowing directly into air entry ports, stop or deflect wind source before approaching.

(b) Fuze is safe to move or extract after turbine is secured against rotation by insertion of safety pin.

(2) If fuze is demolished except for portion in fuze well, it is completely safe to approach or move immediately.

T82 VT BOMB NOSE FUZE (ARMED)



feature. The T5, launched from aircraft, arms after one second and is self destroyed after 6 - 12 seconds to protect friendly installations below. The T6, launched from the ground against enemy installations, has the self destruction element shorted out and does not arm for 5 seconds after firing to prevent possible early bursts from affecting friendly troops before it has reached enemy territory.

VT FUZES FOR SPINNER ROCKETS

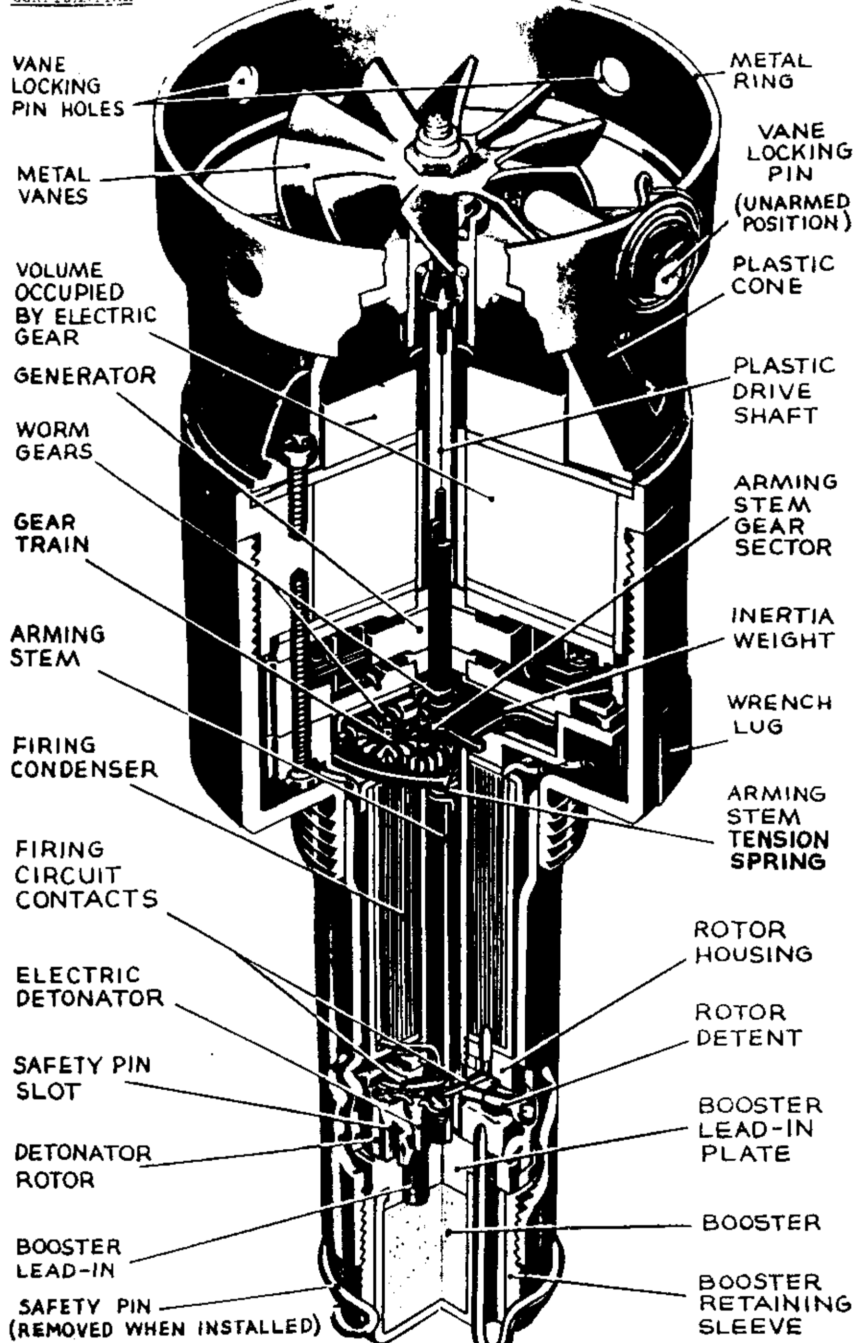
VT projectile fuzes are being adapted to use in spinner rockets as follows:

Fuze	Rocket	Status
Mk 170 Mod 0	Army 4.5" Spinner T 38	Development
Mk 173 Mod 0	Navy 5" Spin Stabilized Rocket	"

These fuzes are wet energized, similar to the projectile fuzes but include a breaker, activated by spin, to break the electrolyte vial to energize the fuze. They do not incorporate the setback delay to prevent arming until the motor has burned out but instead utilize a long arming time so that the motor will be exhausted before the fuze is armed. These fuzes are identical in appearance to the T80 or Mk 58 projectile fuzes and will be ready for issue with the spin rockets when they are released for service. Attack on these fuzes is identical to the attack on the Mk 58 and T80E6 fuzes. NOTE: The Mk 170 fuze for the Army T38, 4.5" spin stabilized rocket is also designated the T31 fuze in Army terminology.

OTHER VT ROCKET FUZES

A small generator powered VT fuze which is mechanically interchangeable with Navy fin stabilized rocket nose fuzes (Mk 149) is under development. This fuze is known as the T32 or the T2005, depending on the type of internal construction. Its design is not entirely stabilized to date but it should be ready for production and issue about December 1945. It is also to be modified for use in the 81 mm, 105 mm, and 155 mm non-rotating mortars. These fuzes for mortar application will probably contain a separate mechanical impact firing train in addition to the VT element and electrical firing circuit. An attack on these fuzes will be issued when the fuzes are available to the service.



MK 172 MOD. 0 VT ROCKET NOSE FUZE (ARMED)

T 51 E1

Aerial Burst, VT Type

BOMBS USED IN	All GP, SAP, Frag., Chem., Incend., or Depth bombs which take the AN-M103 nose fuze.
FUNCTIONING	Automatic aerial burst, 40'-60' above ground for common bombs.
ARMED CONDITION	If vanes free to rotate, assume armed unless safety pin can be inserted.
ARMING TIME	3600 ft. Min. SAT
FUZES USED WITH	AN-M100A2 series tail fuzes, normally.
OVERALL LENGTH	10.4 in.
EXTERNAL LENGTH	5.0 in.
EXTERNAL MAX. WIDTH . .	10.0 in.
MATERIAL	Steel body, plastic top, two aluminum bars athwartships, plastic vanes.

DESCRIPTION: This is an automatic aerial burst bomb nose fuze of the general class designated as VT. It is designed to initiate detonation of the bomb on approach to the earth at heights to give effective fragmentation to the target. Burst heights vary with the size of the bomb and the type of target but are more or less independent of altitude and air speed at time of release above 5000 ft. (For explanation of these factors, see "Introduction"). Following are average burst heights in feet obtained in common bombs when dropped from 10,000 ft. at 200 mph true air speed over average land:

AN-M30	AN-M57	AN-M81	AN-M64	AN-M65	AN-M66
60	60	60	40	40	25

This fuze is more sensitive to head on approach to a target than the ring type and less sensitive to "passing" objects. It can be used interchangeably in any bomb which takes the AN-M103 fuze when air burst is desired except in the 325# flat nose depth bomb where the air stream does not give sufficient velocity to the vanes.

At the present stage of development, approximately 85% of the fuzes will function properly on approach to the target, a small percent will be inoperative, and the remainder will function spontaneously after arming but before approaching a target.

These fuzes have a Min. SAT (Minimum Safe Air Travel) of 3600 ft. in the AN-M30 bomb and therefore are armed between 3600 ft. and 4200 ft. In larger bombs, SAT is increased by the following amounts, due to decreased air velocity over the vanes; AN-M81 - 3%, AN-M57 - 12%, AN-M64 - 24%, AN-M65 - 33%, AN-M66 - 43%. Arming may be further delayed by use of T2E1 delayed arming device. Setting tables for use of this arming delay on various bombs can be found in TB-9X-106. The device clamps onto the bracket, preventing the vane locking arm from releasing the vanes until the preset air travel on the T2E1 device has been completed.

This fuze has a safety pin running alongside the booster to secure the detonator rotor in the unarmed position. Before installation in a bomb, the safety pin should be removed and reinserted. If it cannot be reinserted, the fuze is armed or partially armed and should be destroyed.

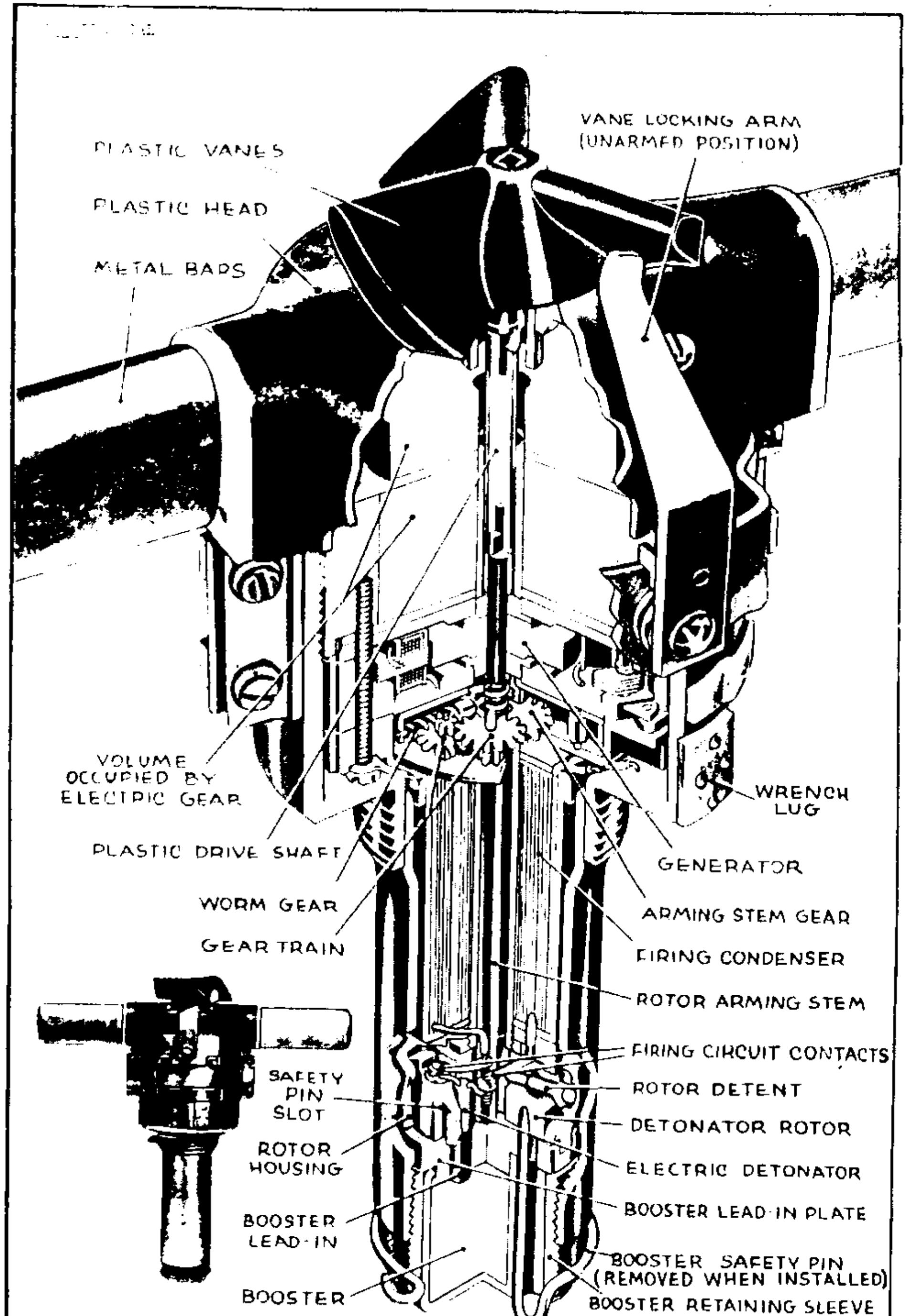
OPERATION: When the bomb is dropped, the arming wire is pulled, releasing the spring loaded vane locking arm which jumps off, freeing the vanes to rotate. The vanes rotate and drive the electric generator and worm and spur gear reduction train. After a minimum number of vane revolutions, the detonator lines up with the booster lead in and at the same time becomes electrically connected to the firing circuit. The rotor detent in the detonator rotor snaps into a hole in the rotor housing, locking the detonator in the armed position and at the same time withdrawing from the keyway in the arming stem. The vanes continue to rotate driving the generator which in the meantime has activated the VT element and charged the firing condenser. The fuze is armed.

Upon approach to a target under the proper conditions, the VT element activates the firing circuit which discharges the firing condenser through the electric detonator, initiating the explosive train.

REMARKS: The bars of this fuze should not be used to tighten fuze into bomb and should be carefully protected from strain or shock.

This fuze is not generally recommended for use in bombs less than 10 inches in diameter because of possibility of damaging the bars in bombing up the plane and in releasing the bombs. Damage to the bars will cause a malfunctioning of the fuze. A few fuzes of this type were issued as the T51 with a 4500 ft. Min. SAT but with other characteristics identical to the T51E1.

ATTACK: Refer to ATTACK on T50E1 and T50E4, page 9.



T51E1 VT BOMB NOSE FUZE (ARMED)

CONFIDENTIAL

U.S. ARMY-NAVY ROCKET NOSE FUZE

MK. 172

Aerial Burst, VT Type
Air to Ground Application

ROCKETS USED IN	Navy 5"0 Head, 3"25 Motor (AR)
FUNCTIONING	Automatic aerial burst 30'-40' above ground
ARMED CONDITION	If vanes free to rotate, assume armed unless safety pin can be inserted.
ARMING TIME	0.7 to 1.4 sec. after motor burns out
FUZES USED WITH	Mk 157 Mod 0 PIR, Mk 165 Mod 0 PIR
OVERALL LENGTH	10.4 in.
EXTERNAL LENGTH	5.0 in.
EXTERNAL DIAMETER . . .	3.4 in.
MATERIAL	Steel body, plastic top, metal ring, steel or plastic vanes

DESCRIPTION: The Mk 172 Mod 0 fuze is an automatic aerial burst rocket nose fuze for use in aircraft launched rockets fired at ground or water targets. It is an adaptation of the ring type VT bomb nose fuze and has been released to the service. Another fuze, the Mk 171 Mod 0, identical in appearance and mechanical structure to the Mk 172 Mod 0, is being developed for use in the same aircraft launched rockets fired at air targets. No specific information can be given about it at this time.

The Mk 172 Mod 0 fuze is designed to function 30' - 40' above average ground. Being a ring type fuze, it is more sensitive to "passing" targets and causes higher air bursts at low angles of approach to the earth and lower bursts at higher angles of approach. This variation plus differences of sensitivity between individual fuzes results in a range of burst heights from 15 ft. to 60 ft. At low angle fire, the wide spread in burst heights causes a greater spread in burst range with respect to the target. Recommendations are to fire from the steepest practical dive angles to reduce range dispersion, preferably above 30°. In addition, tables of correction in aim point have been set up to allow centering of bursts over the target at various dive angles. (See OP 1470 for tables on aim point correction).

The arming time of these fuzes fluctuates with burning time of the rocket motor. The Mk 172 is ready to fire by VT action from 0.7 to 1.4 second after setback ceases upon completion of motor burning. Minimum release ranges vary from 1000 yds at 0° F to 750 yds at 110° F at 280 knot plane speed.

These fuzes incorporate the booster safety pin to give positive assurance of an unarmed fuze when installing. Before installing the fuze in the rocket, the safety pin should be removed and reinserted. If it cannot be reinserted, the fuze is armed or partially armed and should be destroyed.

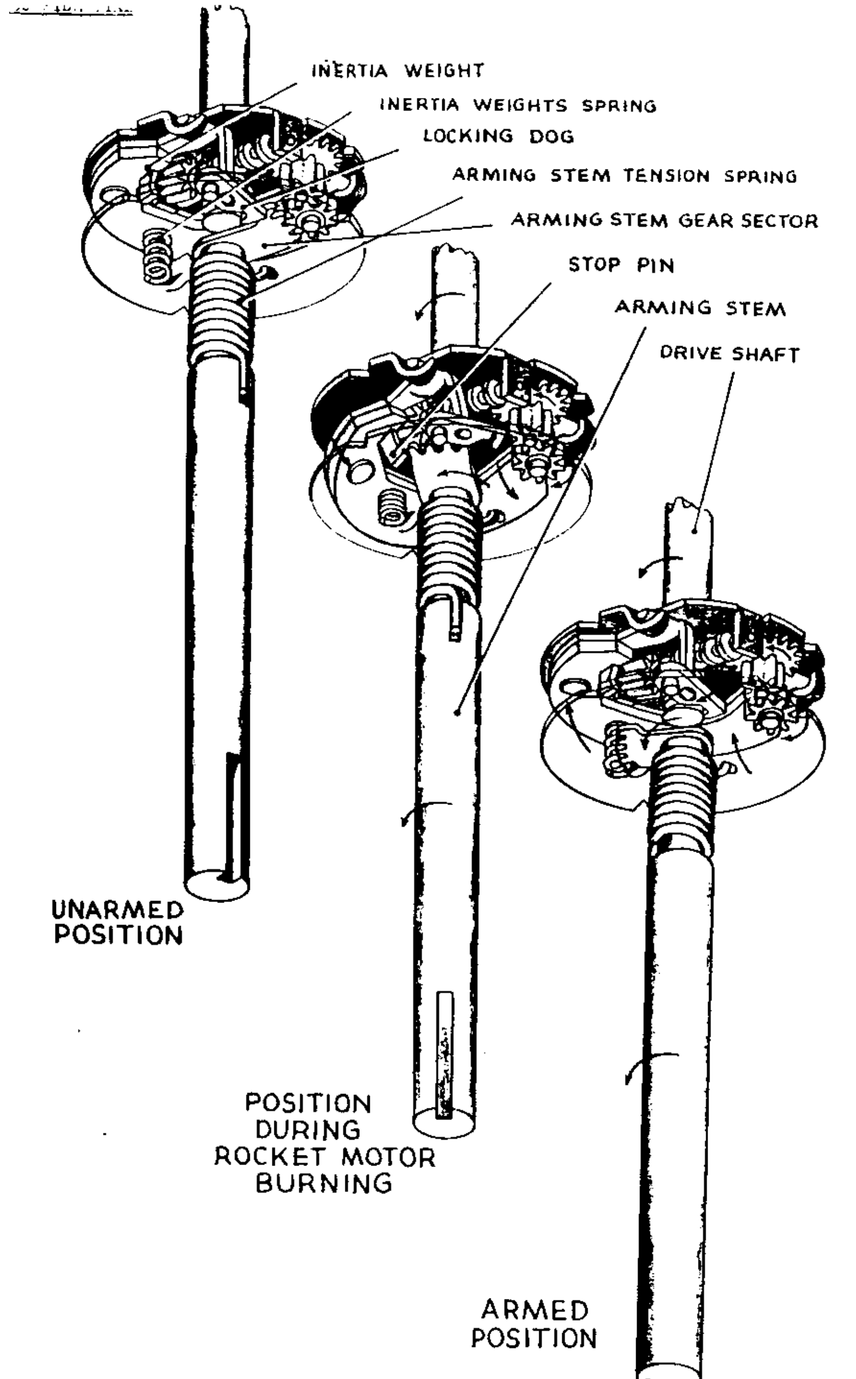
The 5" rocket carries an impact base fuze to detonate on impact those units in which the VT action was inoperable.

OPERATION: When the rocket is launched, the arming wire is pulled, releasing the vane locking pin which jumps out, freeing the vanes to rotate. Acceleration of the rocket of more than 10 "g" forces the hinged inertia weight aft, against its spring. The inertia weight forces the locking dog away from the arming stem gear sector by means of its lever linkage, freeing the gear train to move. The vanes rotate driving the electric generator and the worm and spur gear reduction train. After approximately 100 vane revolutions, the gear sector on the arming stem has rotated 25° clockwise and becomes free of the gear train. As the gear sector moves clear of the gear train, the arming stem tension spring snaps it 75° clockwise where it is detained by the stop pin on the hinged inertia weight. Since the arming stem and detonator rotor are fastened to the gear sector, they also move 25° by vane rotation and 75° by spring action. The vanes continue to rotate, driving the electric generator and gear train, which is now disconnected from the arming stem. When acceleration ceases due to the motor burning out, the inertia weight spring forces the hinged inertia weight forward, pulling the stop pin from in front of the gear sector. The spring tension on the arming stem snaps the gear sector 80° around into the armed position, lining up the detonator with the booster lead in and making electrical connection to the firing circuit. The spring loaded detent in the detonator rotor snaps into a cavity in the rotor housing, locking the detonator in the armed position. In the meantime the electric generator is furnishing power to the VT element. When the electric detonator is connected to the firing circuit, a charge starts accumulating in the firing condenser. After 0.7 to 1.4 sec. the condenser is charged sufficiently and the fuze is armed.

Upon approach to a target under the proper conditions, the VT element activates the firing circuit which discharges the firing condenser through the electric detonator, initiating the explosive train.

REMARKS: These fuzes fit the 5"0 Rocket Head, Mk 1 Mod 1, and are mechanically interchangeable with the AN-M103 fuze and with VT bomb fuzes. They are not tactically interchangeable with any other fuze and cannot be used in other rocket heads or in any bomb. VT bomb fuzes cannot be used in this rocket head for automatic air burst action.

Rotation of the vanes without accompanying setback should not be attempted as it will jam the gear train and make the fuze inoperative.



MK 172 MOD. O MECHANICAL ARMING DEVICE

T50E1, T50E4 - T89, T90 - continued.

REMARKS: These fuzes are mechanically interchangeable with the AN-M103 series nose fuzes but are not tactically interchangeable with impact fuzes or with each other. If the T50E1 or T89 fuzes are used in bomb sizes for which the T50E4 or T90 fuzes are specified, very low air bursts will result. The same is true for transposition in the other direction.

ATTACK:

1. If fuze is complete and generally intact:

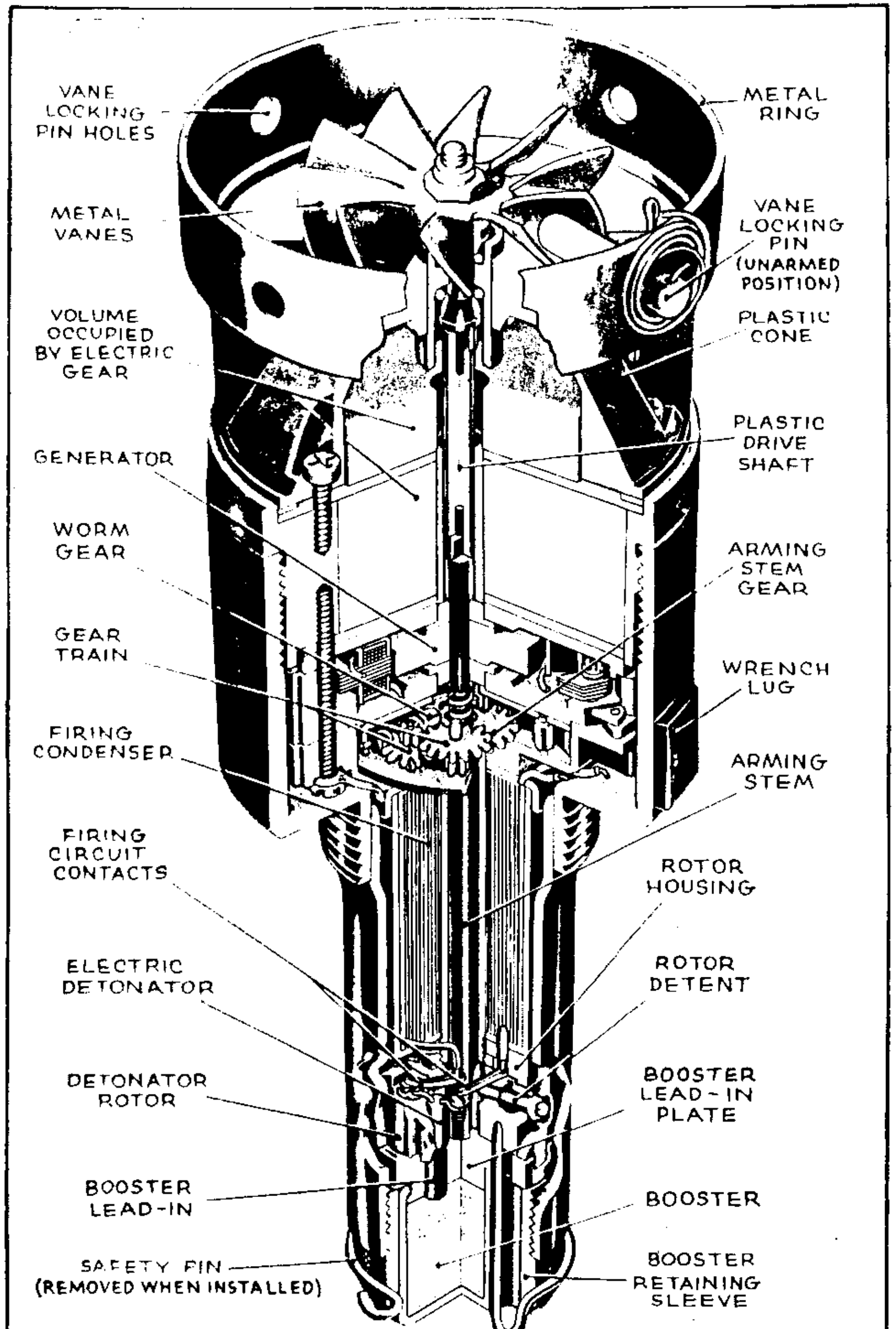
(a) It is safe to approach unless vanes are rotating at high speed. If wind velocity of more than 60 mph is turning vanes, deflect wind or remove air stream source before approaching.

(b) It is safe to move after vanes have been secured against rotation. It is also safe to extract from bomb.

2. If fuze is damaged or demolished except for portion remaining in fuze well:

(a) It is safe to approach.

(b) It is safe to move bomb after 24 hours from the time it was dropped. It is safe to move bomb immediately if bomb nose is in average or moist soil or if pail of water has been poured around nose fuze pocket to assure complete discharge of firing condenser.



T89-T90 VT BOMB NOSE FUZE (ARMED)

ATTACK:

1. If fuze is complete and generally intact:

(a) It is safe to approach unless vanes are rotating at high speed. If wind velocity of more than 60 mph is turning vanes, deflect wind or remove air stream source before approaching.

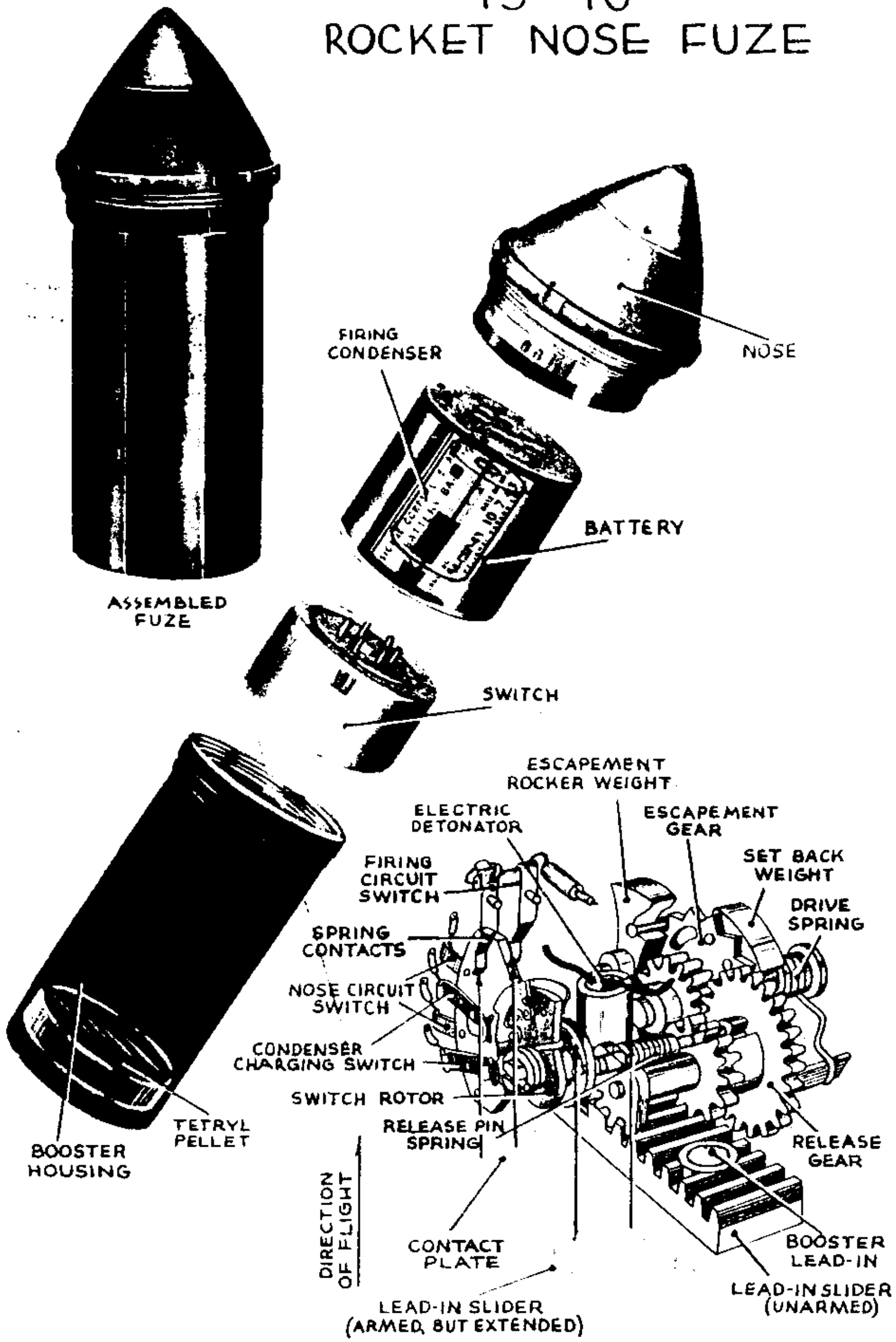
(b) It is safe to move after vanes have been secured against rotation. It is also safe to extract from rocket.

2. If fuze is damaged or demolished except for portion remaining in fuze well:

(a) It is safe to approach.

(b) It is safe to move rocket after 24 hours from the time it was dropped. It is safe to move rocket immediately if bomb nose is in average or moist soil or if pail of water has been poured around nose fuze pocket to assure complete discharge of firing condenser.

T5 – T6 ROCKET NOSE FUZE



U. S. ARMY-NAVY NOSE FUZES

T 50 E1
T 50 E4
T 89
T 90

Aerial Burst, VT Type

BOMBS USED IN . . . . . T50E1 and T89:
100, 250, 2000 lb. G.P.
220, 260 lb. Frag.

T50E4 and T90:
500, 1000 lb. G.P.
500, 1000 lb. Chem.

FUNCTIONING . . . . . Automatic aerial burst, 10' - 40' above the ground.

ARMED CONDITION . . . . If vanes free to rotate, assume armed (Unless in T89 or T90, the safety pin can be inserted).

ARMING TIME T50E1, T89, T90:
3600 ft. Min. SAT
T50E4: 3600 ft. Min. SAT. (Some lots 3100 ft. Min. SAT)

FUZES USED WITH . . . . AN-M100A2 series tail fuzes
OVERALL LENGTH . . . . 10.4"
EXTERNAL LENGTH . . . . 5.0"
EXTERNAL DIAMETER . . . 3.4"
MATERIAL . . . . Steel body, plastic top, metal ring, steel or plastic vanes.

DESCRIPTION: This is an automatic aerial burst bomb nose fuze of the general class designated as VT. It is designed to initiate detonation of the bomb upon approach to the earth at heights to give effective fragmentation damage to the target. Burst heights are dependent on size of bomb, altitude and speed at time of release, and the type of target. (For explanation of these factors, see Introduction). Following are average burst heights in feet obtained in common bombs when dropped from 10,000 ft. at 200 mph true air speed over average land:

Fuze	AN-M30	AN-M57	AN-M81	AN-M64	AN-M65	AN-M66
T50E1, T89	15	20	20	low	low	15
T50E4, T90	low	low	low	20	25	low

"Low" indicates bursts between 3 - 10 feet. Values will usually be higher when dropped from lower altitudes and when released at higher plane speeds. These ring type fuzes are especially sensitive to "passing" objects so are useful in defoliating by blast and in getting roof top bursts in city areas.

At the present stage of development, approximately 80% of the fuzes will operate properly upon approach to the target, up to 15% may function spontaneously after arming but before approaching the target, and 5% will be inoperative.

These fuzes have a Min. SAT (Minimum Safe Air Travel) of 3600 ft. in the AN-M30 bomb and therefore are armed between 3600 ft. and 4200 ft. In larger bombs, SAT is increased by the following amounts, due to decreased air velocity over the vanes; AN-M81 - 3%, AN-M57 - 12%, AN-M 64 - 24%, AN-M65 - 33%, AN-M66 - 43%. Arming may be further delayed by use of T2E1 delayed arming device. Setting tables for use of this arming delay on various bombs can be found in TB-9X-106.

Some lots of the T50E4 cannot accommodate the T2E1 delayed arming device because of a much heavier steel ring around the vanes. No delayed arming can be accomplished on these lots of fuzes.

The T89 and T90 have a safety pin running alongside the booster to secure the detonator rotor in the unarmed position. Before installation in a bomb, the safety pin should be removed and reinserted. If it cannot be reinserted, the fuze is armed or partially armed and should be destroyed.

The T50E1 and T50E4 do not have the booster safety pin so if a fuze is found with the vane locking pin gone and the vanes free to rotate, it must be considered armed and should not be used.

Vanes may be either 10 bladed steel vanes or 3 bladed plastic vanes, interchangeably.

OPERATION: When the bomb is dropped, the arming wire is pulled, releasing the spring loaded vane locking pin which jumps out, freeing the vanes to rotate. The vanes rotate and drive the electric generator and the worm and spur gear reduction train. After the required number of vane revolutions, the detonator lines up with the booster lead in and at the same time becomes electrically connected to the firing circuit. The rotor detent in the detonator rotor snaps into a hole in the rotor housing, locking the detonator in the armed position and at the same time withdrawing from the keyway in the arming stem. The vanes continue to rotate at high speed, driving the generator which in the meantime has activated the VT element and charged the firing condenser. The fuze is armed.

Upon approach to a target under the proper conditions, the VT element activates the firing circuit which discharges the firing condenser through the electric detonator, initiating the explosive train.

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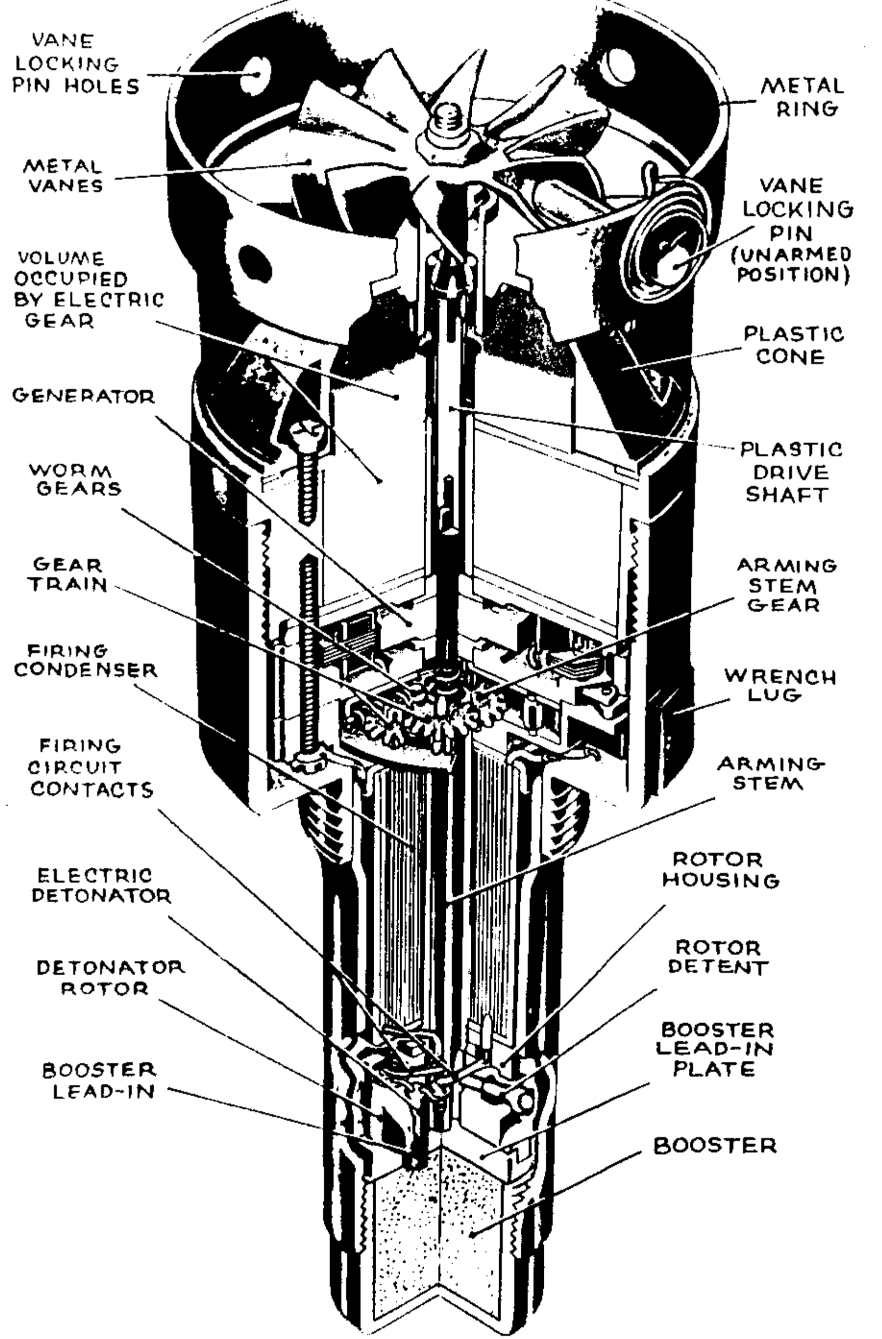

T50E1-T50E4 VT BOMB NOSE FUZE (ARMED)

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U. S. ARMY ROCKET NOSE FUZE

T5
T6

Aerial Burst, VT Fuze

ROCKETS USED IN	4"5 Army Rockets: M8, M8A1, M8A1F1, M8A2, M8A3, T22, T74.
FUNCTIONING	T5: Automatic aerial burst, 60-70 ft. from target aircraft or 30-60 ft. above ground. T6: Automatic aerial burst, 20-60 ft. above ground.
ARMED CONDITION	No external evidence of arming. If rocket has been fired, assume fuze to be armed.
ARMING TIME	T5: 0.76 - 1.0 sec.; T6: 3 - 6 sec.
FUZES USED WITH	None
EXTERNAL LENGTH	2.31 in.
OVERALL LENGTH	7.56 in.
BODY DIAMETER	2.66 in.
NOSE DIAMETER	3.14 in. (max.)
MATERIAL	Plastic nose cone with metal nose cap. Sheet metal can enclosing body inside of rocket.
MARKINGS	None visible from outside of rocket. MC382 stamped on nose inside of can.

DESCRIPTION: These are automatic aerial burst rocket nose fuzes of the general class designated as VT. The T5 fuze is designed for aircraft carried rockets. It has a relatively short arming delay, being armed within 1 second after launching at which time it is approximately 185 yards away from the firing aircraft. It also contains a self destruction element which initiates detonation of the round after 6 to 12 seconds of flight to prevent damage to friendly troops and installations by rounds which missed the target.

The T6 is designed for use from ground launchers against ground targets. Arming of this fuze is delayed from 3 - 6 seconds to allow the round to clear friendly territory and gain altitude before it is completely armed. Minimum usable range (at 8° quadrant elevation) is 1600 yards. It contains no self destruction feature. These two fuzes are identical in construction and appearance except for very minor modifications.

These fuzes consist of 4 parts; nose, dry battery, switch, and booster housing complete with booster. The batteries are issued separately from the fuzes and fresh batteries must be installed when fuzing the rounds. The switch is issued with a safety key in it. This key must be removed before assembly of the unit and if it can be removed, gives positive assurance of an unarmed switch. The nose, battery, and switch are aligned by means of colored markings, plugged together with pins fitting in appropriate sockets, and inserted in the booster housing which threads directly onto the smaller diameter threads on the fuze nose. The assembled fuze then threads directly into the rocket head.

A special test set is issued with the fuzes to determine operability of all elements before assembly. (See TB9X-93, TB9X-94). Testing of all components before use is not essential but the batteries (BA-75) should be tested if more than 4 months old.

OPERATION: Upon acceleration of the rocket, the setback weight fastened to the escapement gear moves aft, rotating the gear clockwise against the tension of the gear train driving spring. This motion is retarded by the escapement rocket weight which is forced to reciprocate to allow the teeth of the escapement gear to pass by. (This prevents the system from arming on a sudden shock of short duration as when dropped against the deck, a continuous acceleration of relatively long duration being necessary to cause arming). Clockwise motion of the escapement gear causes counter clockwise motion of the release gear. After a few degrees rotation of the release gear, the release pin springs into a slot in the release gear hub and at the same time withdraws from the switch rotor to release it and the gear train. The switch rotor snaps counter clockwise due to its spring, closing two switches mounted on its edge. One of these switches connects the electrical gear in the nose to the battery and the other allows the firing condenser to start charging through its high resistance electrical delay. During the remainder of burning of the rocket motor, the arming system remains in this position

U. S. ARMY ROCKET NOSE FUZE - continued. (T5, T6).

OPERATION (cont'd):

with the setback weight held at the bottom of the cycle against the force of the gear train drive spring by the acceleration of the rocket. At the end of the acceleration, the gear train spring overcomes the reduced resistance of the setback weight and drives the escapement gear in a counter clockwise direction. The gear train has been released by withdrawal of the release pin and therefore rotates, moving the lead-in slider over to line up with the electric detonator. When the slider moves into the armed position its insulated contact plate closes the circuit across the spring contacts and thereby puts the electric detonator in the circuit, arming the fuze.

Upon approach to a target under the proper conditions, the VT element closes the firing circuit and discharges the firing condensor through the electric detonator, initiating the explosive train.

REMARKS: Looseness of the rocket fins will cause premature detonation of the round due to vibration in flight. Before installation, the fins should be checked for looseness in the opened position and if looseness is noted (especially in the M8A1, M8A1B1, and M8A2 rockets) the fins should be notched with a special tool provided with the fuzes.

All fuze components except batteries can be stowed between -20° and 120° F. Batteries can be stowed between -20° and +70° F, 0° to 40° F being recommended. Batteries must be above +20° F. at time of firing. Storage life of batteries at temperatures between 0° and +40° F. is 6 - 8 months while at temperatures between 40° and 70° F. is 3 - 6 months.

ATTACK: 1. Wait four hours before approaching. This will assure the fuze not firing upon approach or contact with metal objects. Blow in situ, high order. Never remove fuze or move rocket except remotely as detonation will result in a definite percentage of attempts.

Start of fuze arming may be delayed by use of this device through air travel distances up to an additional 20,000 ft. Tables are necessary to obtain the correct setting for any desired safe vertical drop on a particular bomb. (See TB-9X-106). These tables also give minimum release altitudes under various conditions.

These fuzes are not to be partially prearmed by turning the vanes to make possible use from lower release altitudes. Casualties to the carrying aircraft will usually result. Bombs fuzed with VT fuzes may be jettisoned safely unarmed and detonation will not occur.

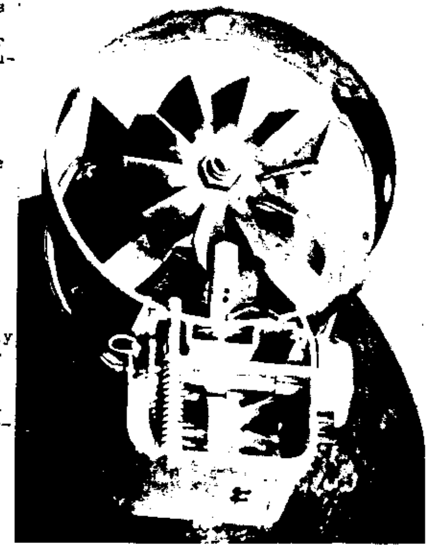

Fig.1-T2E1 Arming delay installed on T50E1 fuze.

MALFUNCTIONS & LIMITATIONS

Because of their sensitive electrical nature, it has not been possible to completely eliminate malfunctions of these fuzes. Malfunctions may be of two types; "earlies", fuzes which function spontaneously after arming but before approaching a target, and duds, fuzes which do not function. The preponderance of malfunctions are "earlies", which may amount to 7% - 20% of the fuzes dropped, depending on the type of fuze and the lot. The later fuzes are giving better performance. Duds account for a small percent of the fuzes but are partially compensated for by use of tail fuzes to give impact burst of those bombs in which the VT fuze was inoperative.

Salvo release of armed VT fuzed bombs is not recommended because an early function of one fuze will cause detonation of all bombs of the group by interaction. These fuzes are designed to function upon a sudden change in their surroundings and detonation of one bomb of a salvoed group will cause them all to function. For the same reason, minimum train spacing should be greater than 50 feet for 100 lb. bombs and 100 feet for 500 lb. bombs to assure that early functions of one bomb of the group will not cause interaction on other fuzes of the "stick".

INSTALLATION, HANDLING & TESTING

These fuzes are generally used with AN-M100A2 series tail fuzes in the bombs to get impact detonation of the 5% of bombs in which the VT fuzes were inoperable. VT fuzes are installed using special lock washers provided with the fuze and are put in wrench tight. The bomb fins must also be wrench tight or a high percentage of early bursts (after arming but before approaching the target) will result. If the VT nose fuze is armed, the tail fuze should also be armed, otherwise the vibrating arming wire for the tail fuze will probably cause an early function of the VT fuze. The fuzes are supplied in hermetically sealed containers and should be unpacked only as required for use.

These fuzes are effective when used in the temperature range of -40° to 140° F. They can be tested in the field only by observation of test droppings in appropriate bombs. There is no other way of determining operability and the fuzes should not be stripped for examination of working parts as no indication of operability can be obtained from visual inspection.

S E C U R I T Y

The classification of VT fuzes and descriptive literature concerning them has been reduced by action of Combined Chiefs of Staff, reference, Cominch Confidential dispatch to CinCPOA 272010 Nov. 44. This reclassification has been permitted to implement use of the fuzes in theaters of operation and should not be construed to mean that there has been a reduction in the basic need for security. Phases of reclassification of interest to theaters of operation are as follows:

(a) Equipment when stockpiled and in operational use . . . . . . RESTRICTED

(b) Operational information and instructions, including technical document & manuals . CONFIDENTIAL

(c) AA action reports listing expenditures of ammunition by Mark of fuze and giving results of engagement . . . . CONFIDENTIAL

(d) Technical information such as diagrams, frequencies, specifications, research & development, countermeasures and publication of information not listed above as CONFIDENTIAL . . . . SECRET

All fuzes of this type regardless of application or missile in which employed are considered to fall into the classification of VT fuzes. No publicity whatsoever regarding this equipment may be released.

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VT BOMB FUZES

GENERAL:

Two different types of VT bomb fuzes are in production and use; the ring type (see T50E1) and the bar type (see T51E1). They are similar in operation but somewhat different in behavior. The ring type is more sensitive to passing targets and generally gives lower bursts upon direct frontal approach to a target. The bar type is quite sensitive to targets directly in front of it and correspondingly less sensitive to passing targets. This gives the possibility of selecting a fuze to give burst heights where desired for a specific target. The ring type is excellent for defoliating trees because it is more sensitive to tree tops; it is also good for roof top bursts against tall city buildings. The bar type gives higher bursts over flat ground and tends to pass tall trees or buildings, waiting to burst on approach to the surface.

The bar type fuze can be used effectively in any bomb with a fuze well that will accommodate the AN-M103 nose fuze while the ring type, although it fits the same fuze well, can be used only in the bomb sizes for which it is specified. When used in improper bombs, very low bursts, 3' - 10' will generally be obtained with ring type fuzes.

MECHANICAL FEATURES

All VT bomb fuzes are powered with wind driven generators. The means of applying torque to the generator may be through vanes on the forward end of the fuze or by an air turbine mounted deep in the fuze body in one bar type fuze.

All VT bomb fuzes utilize an electric detonator which is disconnected electrically from the firing circuit in the unarmed condition and also is out of line with the explosive train of the fuze. Upon arming, the electric detonator is lined up with the booster lead-in and electric connections are made to the firing circuit. In some models a safety pin inserted alongside the booster gives positive mechanical indication of the out of line detonator in the unarmed fuze.

ARMING

Arming of these fuzes is caused by rotation of the vanes through a 7800:1 gear reduction system. After a minimum number of revolutions (depending on fuze model) the detonator rotor has rotated through the necessary number of degrees required to arm it and locks in place, releasing the arming shaft so that the vanes may continue to rotate to drive the generator.

A spring-loaded vane locking pin or arm prevents the vanes from rotating until the arming wire is pulled. No Fahnestock clips are used on the arming wires as they may foul the vanes and cause malfunctions of the fuze. The tension on the spring loaded vane locking pin is so adjusted that Fahnestock clips are unnecessary.

The air travel necessary to cause a VT bomb fuze to arm is designated as SAT (Safe Air Travel). Min. SAT, the minimum safe air travel, of any fuze in a lot is stencilled as part of the ordnance nomenclature on each fuze of the lot. No fuze will arm at less air travel in any bomb than the figure specified as Min. SAT on the fuze. These figures of Min.SAT are obtained from test droppings of representative samples of the lot in 100 lb. bombs. All fuzes of the lot will be armed in a spread of 600' after Min. SAT. That is, if a Min. SAT of 3600 feet were specified on a lot of fuzes, none would be armed at 3600 feet of air travel and they would all be armed at 4200', Min. SAT will be longer for larger bomb sizes due to reduced air-stream velocity over the vanes. These increases are as follows for various bomb sizes; 260 lb. AN-M81 - 3%, 250 Lb. AN-M57 - 12%, 500 lb. AN-M64 - 24%, 1000 lb. AN-M65 - 33%, 2000 lb. AN-M66 - 43%.

Under certain conditions, it is desirable to delay arming of VT fuzes longer then the Min. SAT provided in the fuze. When flying stack formation with other units of the formation flying 2000' or more below, or with a large fighter cover working below, if the fuzes were armed in the normal time and passed near the lower friendly aircraft, influence bursts would occur causing casualties to friendly craft. To prevent this, mechanical arming delays for attachment to these fuzes have been developed. These T2E1 arming delays are so installed that they prevent the spring loaded arming pin from releasing the fuze vanes for a preset air travel distance. (See Figure 1, Pg. 5).

RECOGNITION AND DISPOSAL
V.T. BOMB FUZES

CONFIDENTIAL

T50, T51, T89, T90, T91, and T92:

Upon impact with average terrain VT bomb nose fuzes shear off at the nose of the bomb and leave only those parts that were housed in the fuze well. The parts remaining in the fuze well consist of the booster, the booster lead-in, the electric detonator (normally armed), the firing condensor, and the arming stem complete with gear train housing on its upper end.

Examination of condensers recovered from unarmed VT fuzed bombs dropped onto frozen earth has shown that the condensers were undamaged by this treatment although the fuzes were sheared off at the bomb nose. The condensers recovered from these bombs were charged and found to be capable of holding a charge sufficient to fire a squib, for 15 hours. Further investigation of firing condensers indicated that they could not hold an effective charge for more than 24 hours under the most advantageous conditions and usually would be discharged well before the 24 hours. The following periods for discharge were noted when condensers were subjected to the conditions specified below:

(a) Fuze is intact and all resistors are in place: the condenser is discharged within a fraction of a second after the vane stops turning;
(b) External fuze is sheared off and firing condenser is open circuited: the condenser is discharged within a few seconds in average soil, within a few hours in dry soil, and within 24 hours in very dry soil or dry air.

Because of these facts, only in very rare cases will it be necessary to attack VT bomb nose fuzes in bomb disposal work. Almost all UXB's will be found in soil containing some moisture. They, therefore, will discharge themselves within a few seconds. Even when located in very dry soil or sand, the probability of having to move the bomb within 24 hours after it was dropped is also remote. If the condition does occur, it is only necessary to pour a pail of water (fresh or salt) over the nose of the bomb, being sure it thoroughly dampens the earth packed into the fuze well, before moving the bomb. This gives positive assurance that the condenser is discharged and the VT fuze is safe for movement.

With regard to disposal of VT fuzed bombs aboard an aircraft carrier, slightly different conditions may exist. If a VT fuzed bomb is jostled free of the shackles in a rough carrier landing, it may drop onto the flight deck and at the same time pull loose from the arming wire. Propeller wash may cause the vanes of the fuze to revolve. In this condition, it is dangerous to approach and handle only if the vanes are rotating at high speed - such as when a 60 mph wind is directed across them. The course of the air stream should be stopped or deflected before approaching. It is safe to approach if the vanes are idling over slowly. The fuze is safe to move or extract when the vanes have been secured against rotation. The fuze is not safe for re-use and should be destroyed or dropped into deep water.

Under the same theoretical conditions as above, except that the external portion of the fuze has been knocked off the bomb or badly damaged when falling from the plane the fuze is safe to approach and move because the vanes will not have rotated a sufficient number of times for the fuze to arm.

If VT bomb fuzes on wingracks on planes returning from abortive missions are found with arming wires withdrawn and the vanes free to rotate, deflect the air stream so that the vanes stop rotating, approach, secure the vanes with a locking pin, and extract the fuzes. These fuzes will be armed and should be destroyed or dropped in deep water.

T82:

Disposal of T82 fuzed bombs is simplified by the location of the firing condenser in the portion of the fuze external to the bomb. Upon impact with the target, the external portion of the fuze is sheared off, leaving it safe to approach and move to disposal areas immediately.

The same conditions apply for disposal on carriers as with the T50 type fuzes described above.

V.T. ROCKET FUZES

Mk 171 and Mk 172:

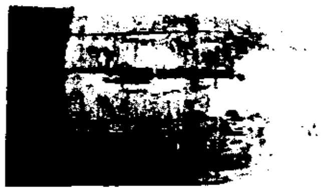
These fuzes are identical to the ring type bomb fuzes except for the following features:

(a) Electrical modification: The discharging resistor for the firing condenser is absent.
(b) Mechanical modification: A setback lock is included in the arming system requiring simultaneous acceleration and vane rotation to arm.

T5 Before Impact

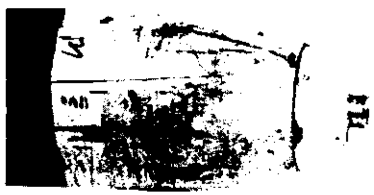
M4A2 Before Impact

T5 After Impact with Soft Ground



M4A2 After Impact with Soft Ground

T5 After Impact with Hard Clay



M4A2 After Impact with Timber

FIG. 2. T5 VT AND M4A2 IMPACT FUZES BEFORE AND AFTER IMPACT

INTRODUCTION - continued.

The size of the bomb in which the fuze is used will vary burst heights widely, but in no predictable pattern. Burst heights are tabulated for various bomb sizes with different VT fuzes and the tables must be followed in predicting burst heights.

The height of release and air speed at time of release affect burst heights by controlling the rate and angle of approach of the fuze to the target. In general the ring and cap type fuzes are influenced by angle and rate of approach while the bar type fuzes are rather insensitive to these differences. Bursts with ring type fuzes are generally lower as the angle of approach nears the vertical. However, burst heights of ring type fuzes increase with approach speed up to a certain point. By balancing these factors of approach speed and approach angle, fairly constant burst heights have been obtained for straight bombing at altitudes of less than 10,000 feet. At altitudes of release above 10,000 feet, burst heights are reduced somewhat. However, for any given altitude of release on level bombing runs, bursts will be higher with greater plane speeds when using ring type fuzes because approach angle will be less vertical.

In the use of VT fuzed aircraft rockets, burst heights are lower at greater dive angles against surface targets, thereby assisting in reducing range dispersion.

For detailed figures on burst heights to be obtained under various conditions, see TB9X106.

CNFIDENTIAL

INTRODUCTION

(Disposal Bulletin on VT Bomb & Rocket Fuzes)

The VT Principle of Fuzing.

The VT principle of fuzing makes possible the detonation of explosive ordnance in such a position upon approach to a target that maximum fragmentation damage is obtained. Fuzes utilizing this principle of operation initiate detonation by electrical interaction involving closeness of the target, and rate of approach of the fuze to the target, both factors necessarily being present to a certain definite degree before the fuze operates. These fuzes operate entirely automatically, no time setting being necessary or possible. Each fuze is designed to operate at the most effective point for the specific weapon in which it is to be used and is not effective in other weapons.

In a previous pamphlet (VT Projectile Fuzes - Recognition & Disposal), the application of the VT principle of fuzing to projectiles was discussed. This pamphlet covers the application to bombs and rockets.

Advantages of Airburst.

It has been found that air bursts 20' - 60' above the ground greatly increase the fragmentation area and thereby increase the lethal effectiveness against troops in foxholes and slit trenches by 3 - 20 times. This is equivalent to having many more pieces of ordnance bearing on the target. Controlled air burst will also cover a much larger area with chemicals than will impact fuzing, so VT fuzing is effective for distributing persistent gases and chemical smoke.

VT fuzing is not useful in destruction of heavily armored or reinforced targets which require impact or short delay fuzing to allow penetration. It will not produce cratering, and therefore becomes useful in countermining mine fields, due to an increase in blast strength.

Factors Affecting Burst Height.

The burst height that will be obtained depends on certain factors which may be tabulated as follows:

Factors over which user has no control:

1. Fuze Sensitivity
2. Nature of Target
3. Size and height of the Target

Factors over which user has control:

1. Size of Bomb or Vehicle
2. Height of release (or angle of fire in case of rockets)
3. Aircraft speed at time of release

Fuze sensitivity is adjusted in design and manufacture to give the most effective burst heights for the particular ordnance items for which the fuze is to be used; i.e., a fuze for use against ground targets will have a lower sensitivity than a fuze for use against aircraft because the target is larger and therefore influences the fuze more strongly. No changes in sensitivity can be made after manufacture is complete.

The size and type of target will effect burst heights. A larger target will naturally have a greater effect on the fuze and cause it to operate earlier. A wet target has more influence on the fuze. Burst heights over water will be approximately double those over average land. Marshy land will fall in between these figures. Very dry land or dry sand will cause burst heights about 2/3 as high as average land. Burst heights are normally given in relation to average land unless specifically indicated otherwise.

A mass of tall trees or large buildings will increase burst heights over land in their vicinity but the increase in burst height will be somewhat less than the height of objects, the degree of influence being dependent on the density of the object.

Attack on these fuzes is identical to attack on the ring type bomb fuzes except that if a dud Mk 171 Mod 0 or Mk 172 Mod 0 fuze is found intact, it should not be moved for 24 hours. This condition will probably never occur because the high velocity with which rockets hit the target will destroy an inoperative nose fuze and the base fuze will normally detonate the rocket on impact.

T4, T5, and T6 Rocket Fuzes:

These rocket fuzes present one of the most difficult disposal jobs in bomb disposal work because of the dry battery power supply and the inaccessible firing condenser. The firing condenser is mounted inside of the dry battery. Both the battery and firing condenser are protected from damage upon impact with the target by the fuze nose. The fuze is armed by setback and does not disarm upon hitting a target. The condenser may retain a charge for a year or so after firing and is susceptible to detonation upon movement at any time.

Within 4 hours after the rocket has been fired, the "A" power supply has been exhausted to the point where approach to the rocket and touching with disposal gear cannot cause the round to detonate. However, it is unsafe to move because the power supply which charges the firing condenser is still intact and will keep the condenser charged for months.

No attack on this fuze has proved both practical and safe in experimental work to date. Injection of a conducting liquid to make the unit electrically inoperative is impractical because of the construction of the fuze and round. Extensive work has been done with circulinear (ring type) shape charges designed to separate the electric power supply of the fuze from the electric squib by blasting off the forward 2.5" of rocket nose. However, this procedure produces high order detonations frequently enough that it cannot be recommended for use where fragmentation damage cannot be accepted.

If fragmentation can be accepted, it is safer to blow high order with a Mk 1 or Mk 3 shape charge cone directed approximately 1-1/2" forward of where the rocket motor attaches to the high explosive head. It is preferable to place charge without touching or moving rocket.

If fragmentation from blowing in situ would allow the possibility of considerable damage to adjacent installations, the rocket should be sandbagged or rolled into a pit by remote control before detonating high order.

Never attempt to remove fuze and never attempt to move rocket except remotely as high order detonation may result at any time upon movement, as much as a year after firing.

Because of the danger involved in mistakenly handling rockets fuzed with T5 and/or T6 fuzes, recognition should be positive. Figure 2 shows photographic views of the T5 VT fuze before and after firing as well as the M4A2 impact fuze in the M8 rocket.

REFERENCES

BOMB FUZES:

U. S. Navy O.P. 1444 (Preliminary) V.T. Bomb Fuzes
U. S. Army TB 9X-106 (Preliminary) V.T. Bomb Nose Fuzes

ROCKET FUZES:

U. S. Navy O.P. 1470 V.T. Rocket Fuzes (for aircraft rockets)
U. S. Army TB 9X-94 Fuze, Rocket P.D. T4 & T5
U. S. Army TB 9X-93 Fuze, Rocket P.D. T6

INDEX

VT
BOMB & ROCKET FUZES

(RECOGNITION AND DISPOSAL)

U.S.N.B.D.

(SUPPLEMENT TO USNBDS "TOOLS AND METHODS")

JULY 1945

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