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*PA
Salmon*

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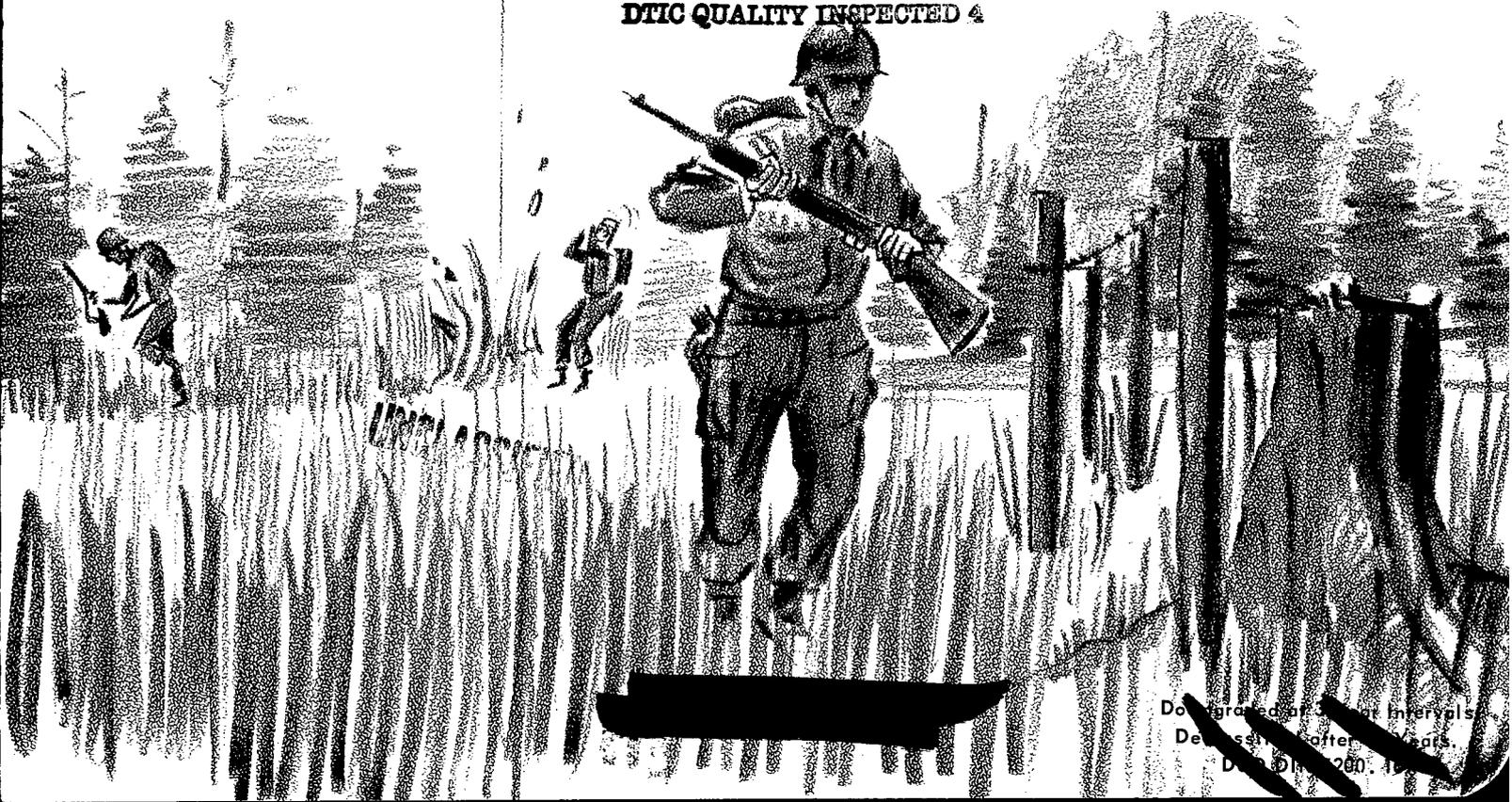
**Adapter
for the
M23 Chemical
Land Mine (U)**

PA 26, 989

over

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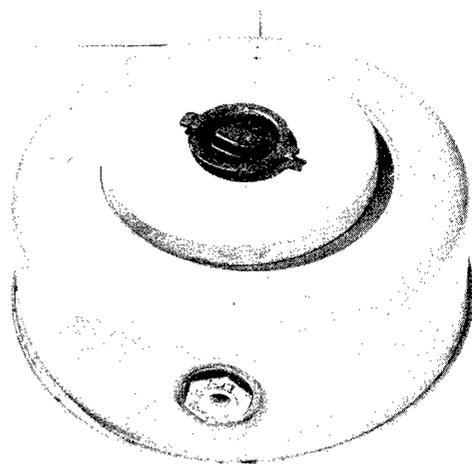
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Prepared by Cornell Aeronautical Laboratory, Inc.
for the U.S. Army Chemical Research and Development
Laboratory under Contract No. DA-18-108-CML-6628(A);
Project CHORD

CAL Report No. GM-1592-G-101.

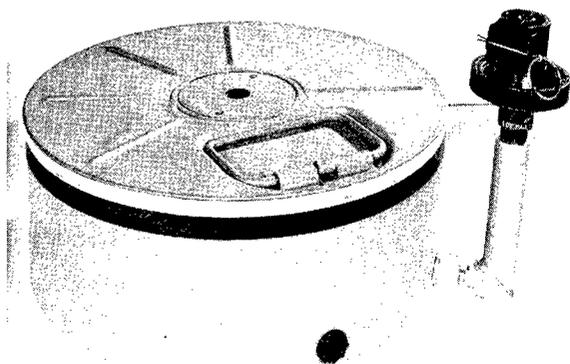
FOREWORD

SECRET



The Chemical Land Mine M23 contains 12 lbs of chemical agent VX. Agent is disseminated at ground level by a central explosive burster initiated by any one of several standard fuzes. The item is standard and currently in stock.

It is a well-recognized fact that considerable improvement in agent dissemination efficiency results when a chemical munition is air-burst rather than ground burst.



The "Pop-Up" adapter to the M23 Chemical Land Mine is an approach to the attainment of an air burst of a normally ground functioning device to obtain significant improvement in over-all munition efficiency.

Weapons, chemical

end

REC'D MAY 1 1967
Cornell Aeronautical Lab.

BACKGROUND

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Mines of all types are, and have been, an integral and indispensable element of all combat operations and are of particular interest in the present-day, limited-type war. Until the mine is replaced by other devices, tactics, or techniques of superior over-all performance, there will be a continuing interest in methods for the improvement of the capabilities of mines.

The ground-functioning M23 Chemical Land Mine has been type classified, Standard A Type. Tests by the Army Chemical Center have shown a coverage capability of 1100 square meters to a contamination level of 400 mg/sq meter, when there is no constraint such as a tank over the mine. Clearly, in the ground-functioning condition, it is over contaminating at the center with a marginal capability at a distance of 30 meters from the mine. In both the casualty production (400 mg/sq meter) and the barrier and harrassment (100 mg/sq meter) roles, a large expenditure in M23 mines would be required to be militarily effective.

The military characteristics covering this mine state: "This mine shall provide for the efficient dissemination of the agent in a persistent form".

The "Pop-Up" adapter to the M23 Chemical Land Mine has been developed as an addition to this Standard A Type item which will improve its efficiency by a factor of up to 4 or more without modifying the shipping or handling burden. The "Pop-Up" adapter provides for air burst of the standard M23 Mine, resulting in greatly increased area coverage to a useful level, because of:

- (a) The reduction of over-concentration at the center,
- (b) The reduction of ground losses associated with a ground-level burst.

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The M23 Mine with "Pop-Up" adapter may be actuated:

- a) upon contact by personnel and vehicles,
- b) by remote control, and
- c) by booby-trap devices.



COMMAND DETONATION OF A BARRIER MINE FIELD

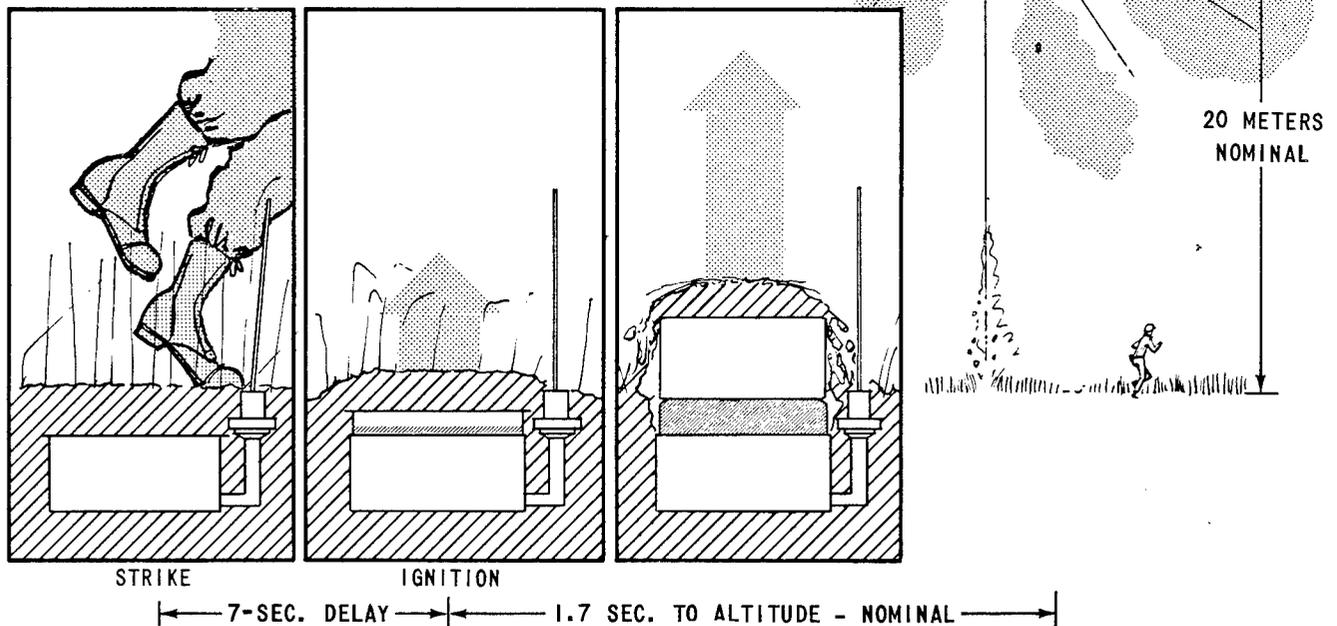
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EMPLOYMENT

The "Pop-Up" adapter is suitable for operational use in any area where chemical mine warfare is conducted. The mine can be actuated by personnel and vehicles.

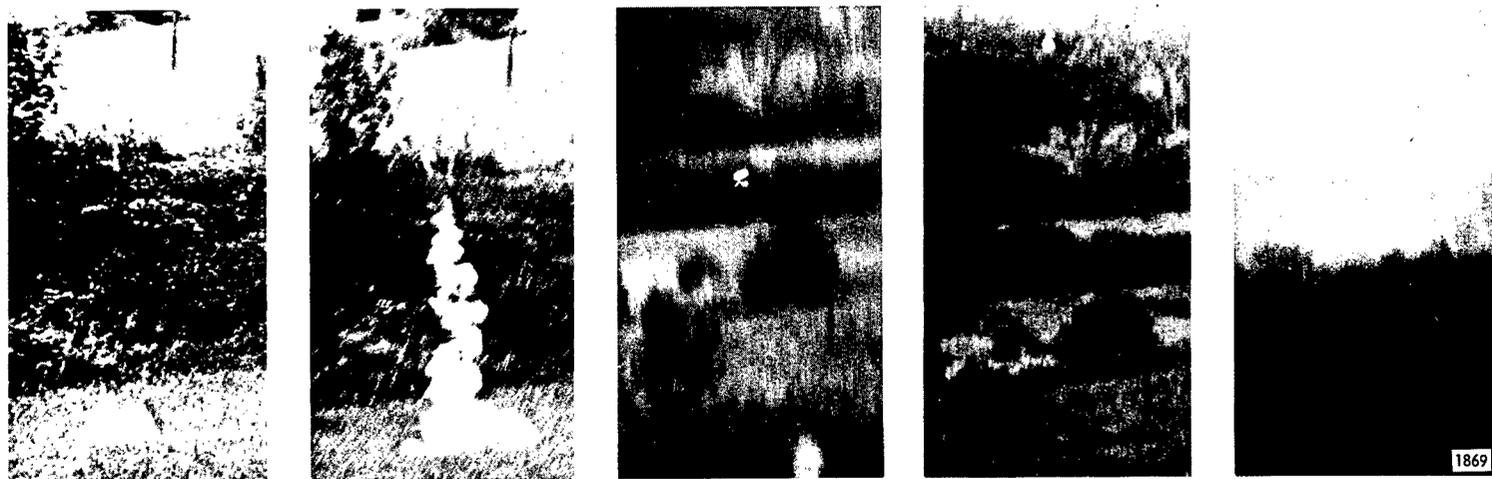
Depicted below is a typical mine placement wherein the mine is actuated by an enemy foot-soldier. The operational sequence provides for two delays in the firing chain as follows:

- 1) A delayed initiation to insure an unobstructed ascent of the mine, and
- 2) A delayed burster to permit the mine to attain the desired altitude before functioning.



OPERATIONAL SEQUENCE OF M23 MINE EQUIPPED FOR AIR BURST

Emplacement of the M23 Mine with "Pop-Up" adapter in conditions simulating operational use is depicted below. When actuated, the buried mine breaks through the sod and ascends to the height where the predetermined delay initiates the explosion, dispersing chemical agent over a large area (as a coarse aerosol). The height of burst can be varied by modifying the delay element which activates the detonator.



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OPERATIONAL SEQUENCE OF M23 MINE
SHOWING AIR-BURST CAPABILITY

CONFIGURATION

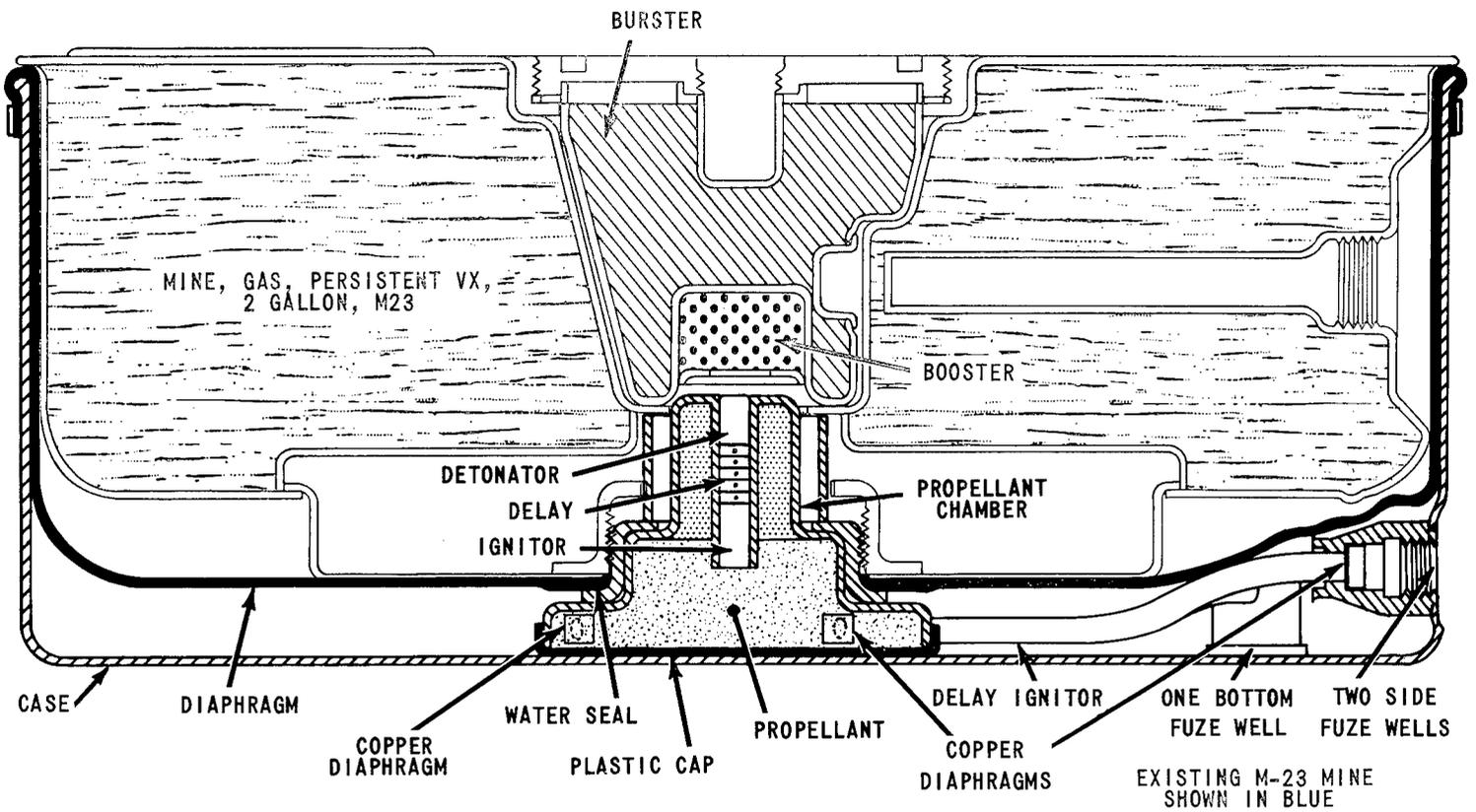
Applied research has demonstrated that an air-burst configuration of the M23 Chemical Land Mine can be achieved by the attachment of a simple, low-cost, light-weight "Pop-Up" adapter. The M23 mine may be placed in the adapter by field personnel. The adapter can be activated using standard APERS fuzes such as the M6A1 or the experimental XM611, command fuzing utilizing the M1A4 adapter with an electric squib, and booby-trap fuzes such as the M-5. Three fuze wells are provided to permit maximum flexibility. The adapter consists of a rigid outer shell, slightly larger than the mine, which contains a deflagrating propellant and appropriate firing chain; a flexible plastic diaphragm; and a delay burster initiator. The mine can be actuated by personnel, tracked vehicles, or wheeled vehicles.

The operational sequence of the M23 mine equipped with the "Pop-Up" adapter is as follows:

- 1) A conventional fuze is initiated by a target. The fuze ignites a 7-second delay element before firing the propellant, which insures an unobstructed ascent of the mine.
- 2) The propellant initiates a second delay which, in turn, functions the burster at the desired altitude. This delay is less than the time required for the mine to reach the peak of its trajectory.

The combustion of a deflagrating propellant within the confined area of the "Pop-Up" adapter generates a gas pressure which extends the diaphragm and accelerates the mine upward. The velocity of the mine at the time of separation from the diaphragm - or at the end of the stroke - is about 100 feet per second. This technique has been named "the explosive-spring principle."

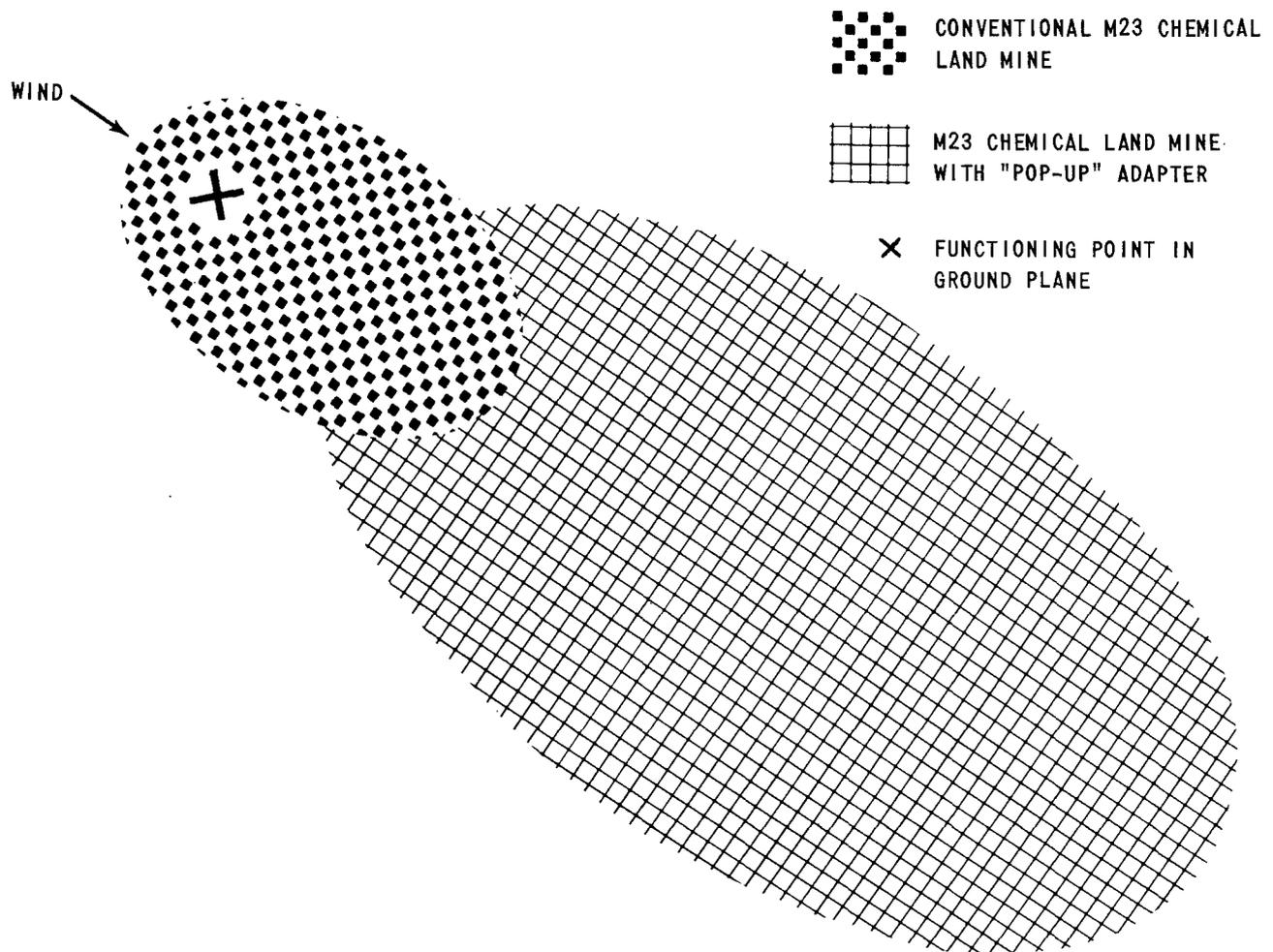
The optimum height of burst, calculated to be within the limits of 20 and 35 meters above the earth's surface, will be determined by further systems analysis and field tests.



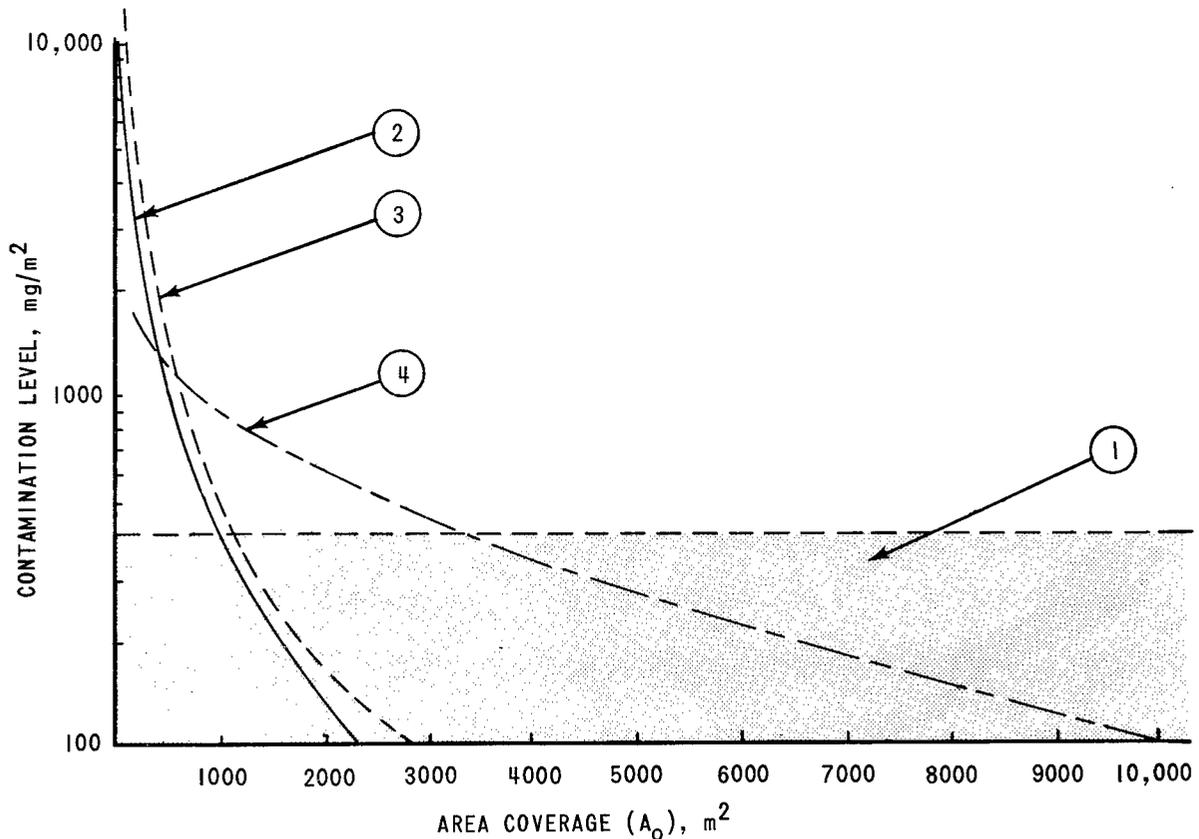
"POP-UP" ADAPTER FOR THE M23 CHEMICAL MINE

(C) EFFECTIVENESS (U)

The addition of the "Pop-Up" adapter will enhance the effectiveness of the existing M23 mine by a factor of up to 4 or more depending upon the desired contamination level and height of burst. In production quantities, the "Pop-Up" adapter is estimated to cost about one-fourth the cost of the mine itself.



(U) COMPARATIVE AREA TO THE SAME CONTAMINATION LEVEL
BASED ON LIMITED TESTING AND FEASIBILITY STUDIES



(C) ESTIMATED CONTAMINATION LEVEL vs AREA COVERAGE FOR THE M23 LAND MINE WITH AND WITHOUT "POP-UP" ADAPTER (U)

- (C) 1. Region of Contamination Levels of Interest:
- (a) 100 mg/m² acceptable level of ground contamination for barrier and harrassment operations.
 - (b) A resultant 400 mg/m² ground-contamination level assumed adequate to deposit a 200-mg dose on a standing man exposed to the aerosol during ground deposition.
- (C) 2. Ground Burst of M23 Chemical Land Mine based upon data from CRDL Report No. CMLRD-CW-D(T), dated 18 August 1958.
- (C) 3. Calculated ground-burst capability based upon a scale-up of CRDL/Porton model estimates.
- (C) 4. Calculated air burst capability using a modified Porton model:
- (a) Burst Height: 24 meters
 - (b) Wind Speed: 5 mph
 - (c) Fill: 5200 grams
 - (d) Particle Size: 200-micron mmd

(C) TYPICAL GROUND CONTAMINATION PATTERN (U)

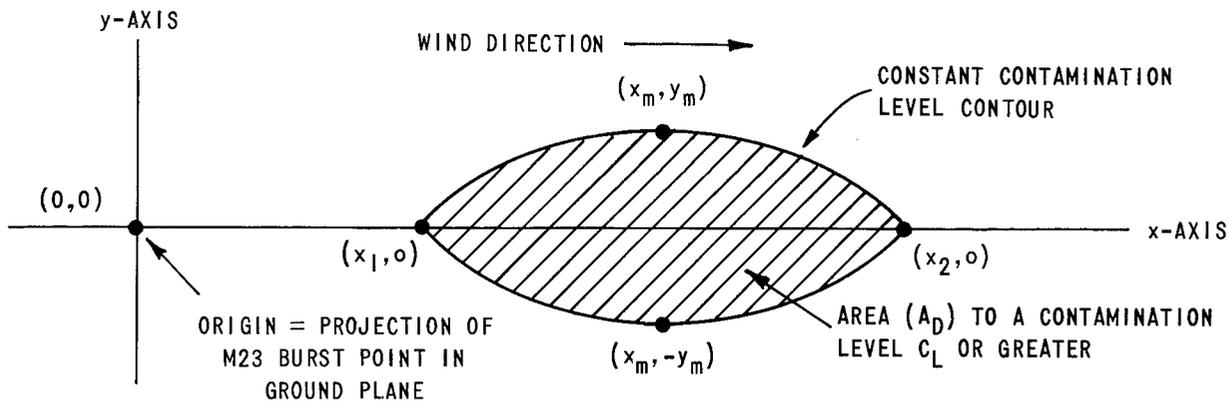
(C) An analysis was conducted to determine the change in location and size of the contamination area to a given level as a function of height of burst and wind speed. It is seen from the examples below that, as the height of burst is lowered, the contamination area is reduced and tends to occur closer to the point of initiation.

(C) Example: Influence of height of burst on the pattern size to a given contamination level:

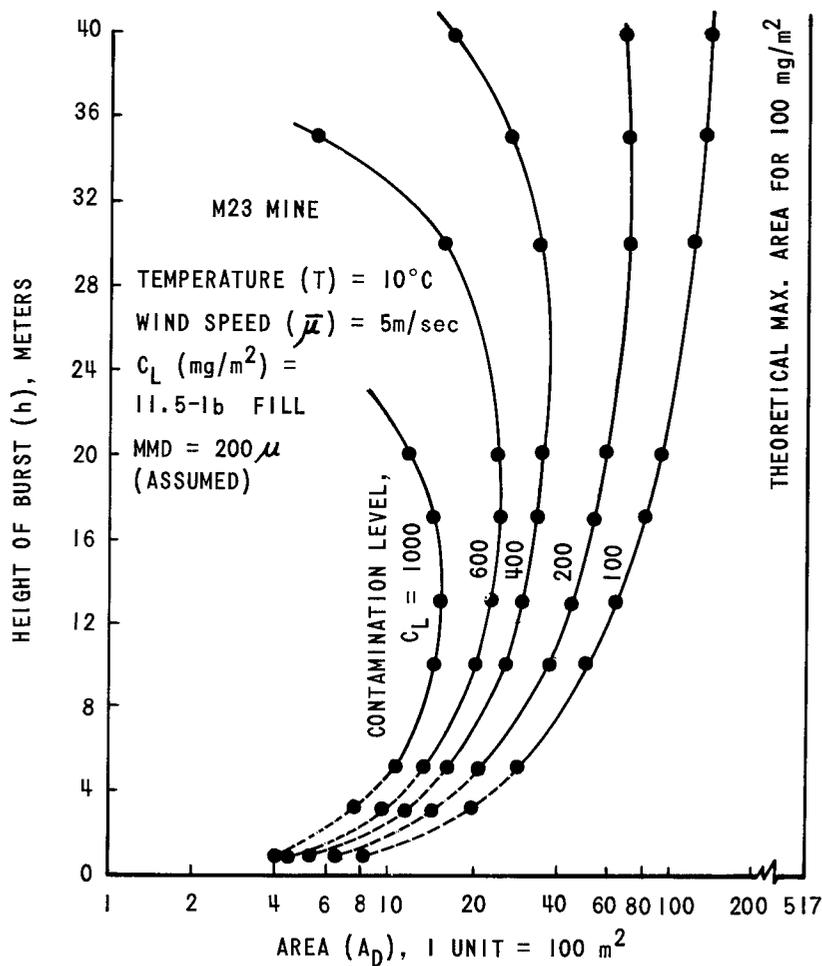
| HEIGHT OF BURST (METERS) | WIND SPEED (m/sec) | CONTAMINATION LEVEL (mg/m ²) | RANGE | | | AZIMUTH Y _m (m) | AREA (m ²) |
|-----------------------------|-----------------------|---|-----------------------|-----------------------|-----------------------|----------------------------------|---------------------------|
| | | | X ₁ (m) | X _m (m) | X ₂ (m) | | |
| 8 | 5 | 400 | 15 | 66 | 123 | +12.7 | 2280 |
| 16 | 5 | 400 | 35 | 120 | 176 | +14.4 | 3264 |
| 24 | 5 | 400 | 54 | 150 | 220 | +14.8 | 3600 |

(C) Example: Influence of wind speed on the location of the ground pattern to a given contamination level:

| HEIGHT OF BURST (METERS) | WIND SPEED (m/sec) | CONTAMINATION LEVEL (mg/m ²) | RANGE | | | AZIMUTH Y _m (m) | AREA (m ²) |
|-----------------------------|-----------------------|---|-----------------------|-----------------------|-----------------------|----------------------------------|---------------------------|
| | | | X ₁ (m) | X _m (m) | X ₂ (m) | | |
| 24 | 2 | 400 | 25 | 80 | 126 | +16.1 | 2850 |
| 24 | 5 | 400 | 54 | 150 | 220 | +14.83 | 3600 |
| 24 | 8 | 400 | 110 | 190 | 260 | +11.9 | 2610 |

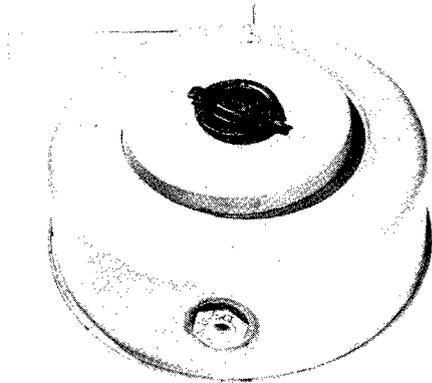


(U) TYPICAL GROUND PLANE CONTAMINATION PATTERN



(C) HEIGHT OF BURST vs AREA (IN THE GROUND PLANE) TO A GIVEN CONTAMINATION LEVEL (U)

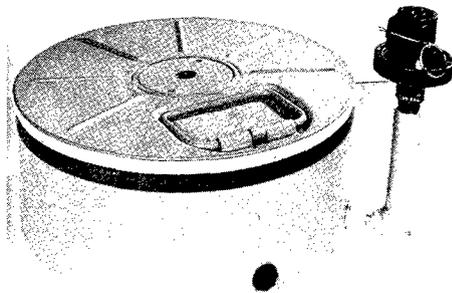
MAJOR COMPONENTS



**M23 CHEMICAL LAND MINE
(CURRENT CONFIGURATION)**

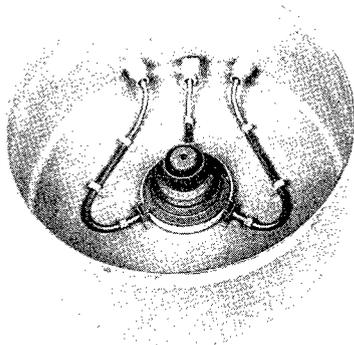
The M23 Chemical Land Mine consists of a mine body with an integral Belleville spring assembly. The mine has a 2-gallon VX agent capacity.

When used in antitank mine fields, an M603 mine fuze is used in the primary fuze well. When used as an antipersonnel mine, it is fuze in either the side or the bottom fuze well.



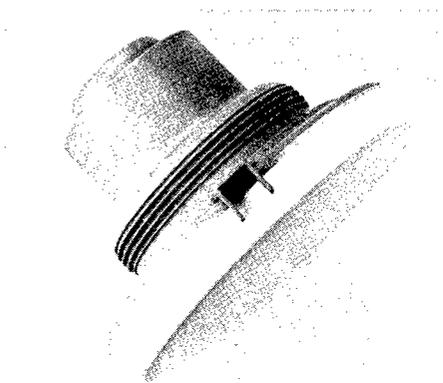
AIR-BURST CHEMICAL LAND MINE

M23 Mine with "Pop-Up" adapter, fuze well extension, and standard APERS fuze. The mine is inverted when used with the "Pop-Up" adapter.



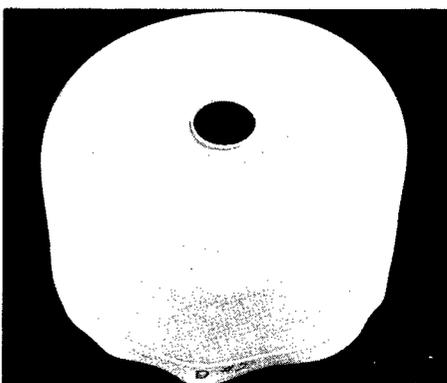
**CASE FOR "POP-UP" ADAPTER
(INTERNAL VIEW)**

The case is a rigid external shell deep-drawn from .036-inch, cold-rolled, carbon steel. Dimensions: 13-inch outside diameter; 5-inch depth. Three fuze adapters are provided to permit contact, command, and booby-trap fuzing.



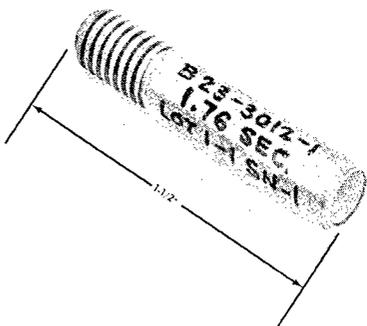
PROPELLANT CHAMBER ASSEMBLY

The propellant chamber consists of a water-tight compartment to retain the propellant and delay detonator subassembly. The structure consists of a propellant case with a delay detonator adapter spot-welded to the lower rim. The cavity contains black powder in a hermetically sealed packet.



DIAPHRAGM

The cup-shaped diaphragm is molded from EP rubber with Dacron reinforcement. It is 13 inches in diameter and 5-1/2 inches deep with a 2-3/16-inch-diameter hole in the center. The diaphragm is bonded to the steel case.



DELAY DETONATOR SUBASSEMBLY

The delay detonator subassembly includes a tube with a threaded end which can be screwed into the delay detonator adapter of the propellant case. This component is composed of first fire composition, a delay train, initiator mix, and detonating material (RDX or PETN), all contained within a water-tight aluminum case.

DESIGN CONSIDERATIONS

The M23 Chemical Land Mine is a standard item currently in stock in large quantities. Storage, handling, and use concepts have been developed and implemented. The standard mine is capable of being laid by the Dan Patch mine layer.

The "Pop-Up" adapter was designed to be added to the standard mine to enhance its effectiveness and improve its utility without costly rework of the mine or obsolescence of material. To convert the mine to "Pop-Up" operation, the arming plug is unscrewed from the mine. The mine body is inverted and screwed into the "Pop-Up" adapter. All standard APERS fuzing, as normally applied to the mine, is now applied to the adapter case. The antitank Belleville spring fuze actuator assembly, which is self-contained within the mine, is not used in this application.

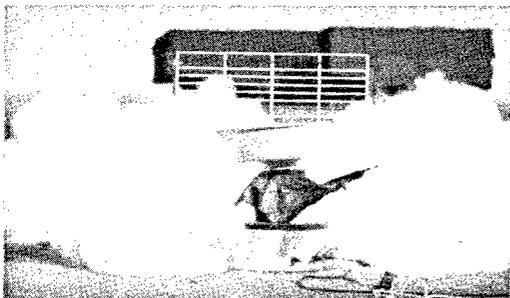
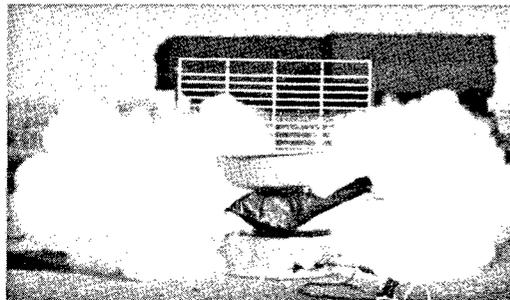
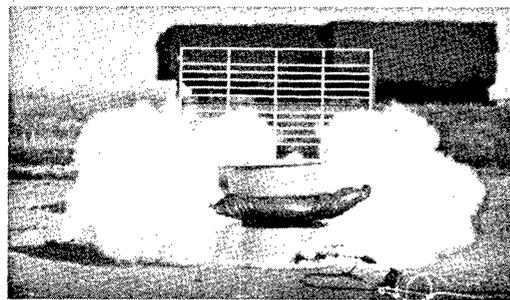
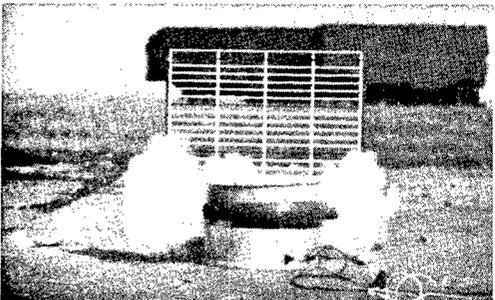
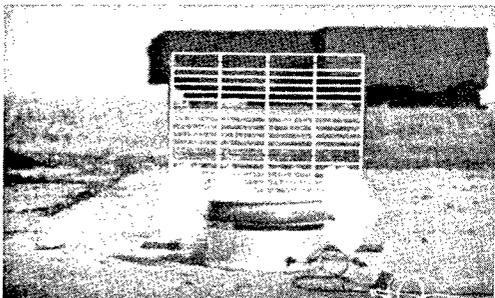
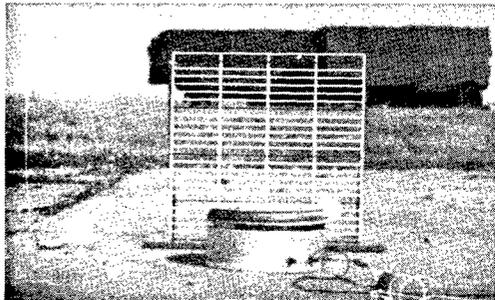
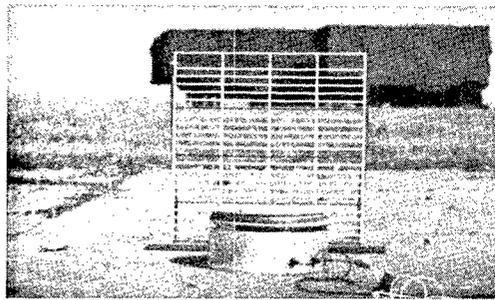
The M23 mine with "Pop-Up" adapter may be used with the Dan Patch mine layer.

The M23 mine, with or without the "Pop-Up" adapter, cannot be laid with the Dan Patch mine layer complete with APERS fuzing. Since current doctrine requires that all chemical mines be APERS fuzed, they must be unearthed, fuzed, and recovered. A special fuze well extension is included as an ancillary item to ease the task of adding the APERS fuze to the mine.

The M23 mine may be converted in the field, in the depot, or at the point of manufacture.

The M23 mine complete with "Pop-Up" adapter is shipped in the same container as the basic M23 mine.

The "Pop-Up" adapter has undergone considerable proof testing to date. The high-speed photographs shown on the opposite page depict a typical test.



POP-UP ACTION OF THE AIR-BURST M23 CHEMICAL LAND MINE
(TIME INTERVALS 1.45 MILLISECONDS BETWEEN PICTURES)

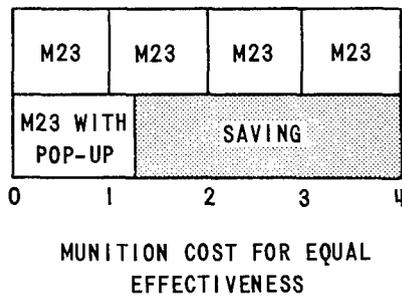
RELATIVE COSTS

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Detailed cost/effectiveness estimates have not been derived for the M23 with "Pop-Up" adapter. However, effectiveness estimates have shown that an improvement factor of up to 4 or more in the area contaminated to tactically useful levels can be expected.

In the following illustrations, a nominal improvement factor of 4 in effectiveness has been translated into dollar costs and personnel and shipping requirements. These illustrations indicate, in relative terms, the advantages which would accompany such an improvement in effectiveness.

DOLLAR COSTS



The production cost of the adapter is estimated to be 25% of the cost of the basic mine.

PERSONNEL REQUIREMENTS



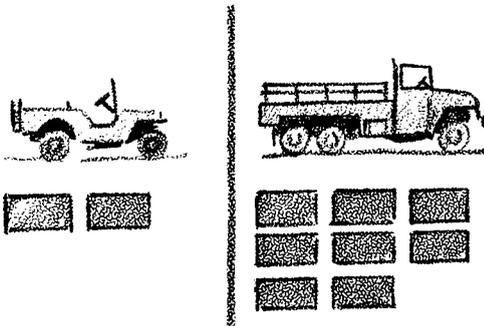
A mine field containing M23 mines with "Pop-Up" adapters can be laid in a fraction of the time normally required for the conventional field. As a result, more personnel will be available at an earlier hour for other combat duties.

Fewer mines will have to be laid initially by our delaying forces and neutralized subsequently by friendly mine-clearing personnel.

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SHIPPING AND STORAGE REQUIREMENTS



Based upon the four-to-one advantage over the standard M23 mine, fewer mines will be required for a specific area; hence, shipping and storage requirements will be significantly reduced for any specific task. For example, as a complete assembly, shipping and storage requirements for the mine with adapter are no greater than for the mine alone; hence, only 25% of the total shipping and storage requirements exist for a given operation.

STATUS

The prototype model, designed by Cornell Aeronautical Laboratory, Inc., has proven the feasibility of this approach to obtaining an airburst. At the request of the Chemical Research and Development Laboratories, one hundred models of this adapter are being fabricated by CAL for CRDL evaluation during FY64.

The M23 mine with "Pop-Up" adapter and filled with VX agent or simulant has not been functioned at altitude; hence, actual coverage data are not available at this time.

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