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ORDNANCE PAMPHLET 1203

U. S. NAVY CAVITY CHARGES

A BUREAU OF ORDNANCE PUBLICATION

26 JUNE 1944

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NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON, D. C.

26 JUNE 1944.

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U. S. NAVY CAVITY CHARGES, DESCRIPTION AND INSTRUCTIONS FOR USE

1. This pamphlet contains a description of the Cavity Charge effect and the Cavity Charges Mark 1, 2, 3 and their use.

2. This pamphlet does not supersede any existing publications.

3. This publication is *RESTRICTED* and should be handled in accordance with the provisions of Article 76, U. S. Navy Regulations, 1920.

G. F. HUSSEY, JR.
Rear Admiral, U. S. Navy
Chief of the Bureau of Ordnance

CONTENTS

ILLUSTRATIONS

U. S. NAVY CAVITY CHARGES

CHAPTER 1

HISTORY

Cavity charges utilize the phenomenon once known as the Munroe effect. In 1885 Charles E. Munroe, for many years associated with the Naval Torpedo Station, Alexandria, Virginia, one time professor of Chemistry at the U. S. Naval Academy and author of a Naval Academy text book on explosives, ran a series of tests with gun cotton blocks. He pressed designs on the face of the blocks, placed the design against an iron target, and detonated the block. Each indented place on the gun cotton block had caused an indention on the target, rather than a raised place as would have been expected. It was as a result of these experiments, that this effect became known as the "Munroe effect", but it remained little more than a laboratory curiosity until recent years.

Recent research with the cavity effect has been along two lines:—the application to service weapons and the application to demolition. The most outstanding use as a weapon has been the Army's "bazooka" projectile, which derives its penetrating effect from a cavity charge in the nose. The Army also has several demolition charges, designed to blow a hole through reinforced concrete structures. These charges utilize the cavity effect.

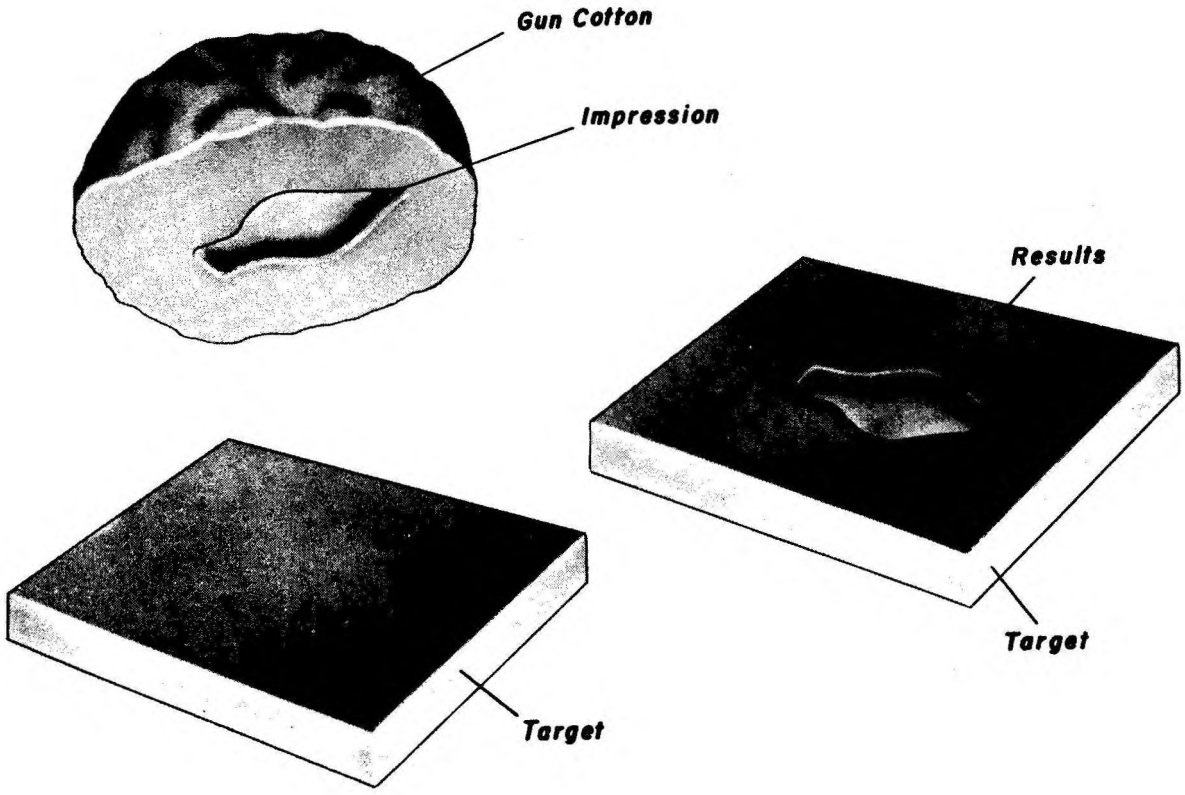

FIGURE 1-1. Munroe's Experiments

CHAPTER 2

GENERAL REMARKS

Experiments show that if a geometrically regular cavity is formed in the side of an explosive charge nearest the target, the effect on the target is increased over the effect obtained with the same charge without a cavity.

The cavity effect seems to be a concentration of a part of the explosive power in one spot, much as light may be focused into a small, intense beam by a magnifying glass. The "beam" of very hot gas is called the "jet". The velocity of the gas in the jet is extremely rapid, exceeding the detonation velocity of the explosive. If the cavity is lined with some material that can be broken into small pieces or melted by the explosion, the efficiency of the cavity charge is greatly increased. The small particles are incorporated into the jet, making it heavier. The jet achieves its penetration of the target somewhat in the manner of a needle. There is very little loss of weight in the target, as the material is forced away on each side of, and in front of, the jet. The target becomes much more dense along the surface of the hole. The metal of the liner in excess of that used in the jet forms a slug. The slug being heavier than the jet, follows it at a slower rate of speed, and is usually found lodged in the hole.

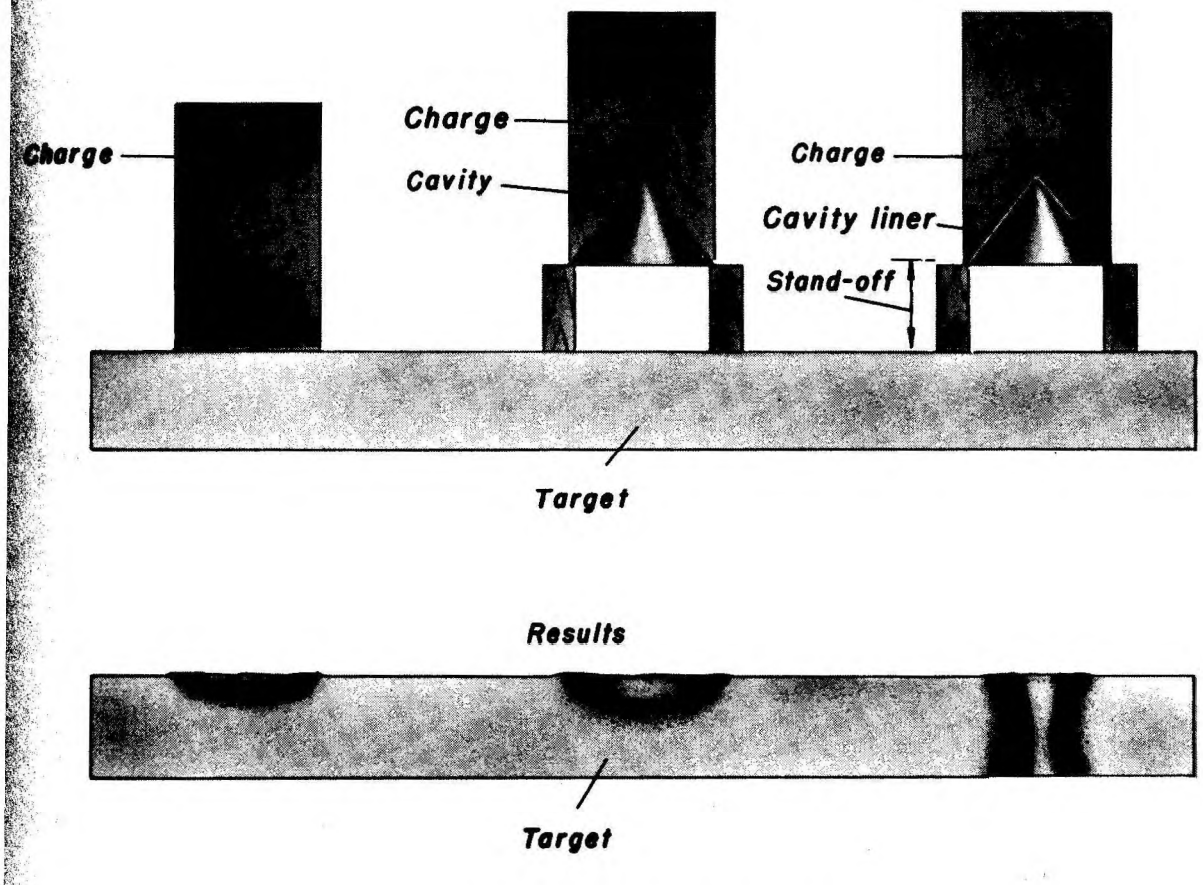

FIGURE 2-2. Charge Comparison

Figure 3-2, taken from X-ray pictures made at extremely high speed, shows the steps in the collapse of a steel liner (conical) into a jet and slug. It will be noticed by observing the relative position of the linear to the reference line (heavy black line) that before the final formation of the jet and slug, the liner has moved forward toward the target. A "stand-off" distance, determined by the size and shape of the cavity, is required. The stand-off allows room for the jet to form before contact with the target is made.

A regular geometric cavity, a suitable liner and a stand-off are required for the most efficient results with a cavity charge. The U. S. Navy Cavity Charge Containers are containers for explosive which provide these features.

The explosive recommended is Composition C-2 which is more powerful than TNT. Composition C-2 is a plastic explosive, putty like in consistency and light tan in color. The plastic explosive is packed by hand into the container just prior to use, making certain that all crevices are filled. (Note: Care must be taken to clean the hands thoroughly within an hour after handling Composition C-2, as it may cause dermatitis). The detonator used may be either a knot of primacord or a U. S. Army Engineers Corps Special Detonator, inserted $\frac{3}{8}$ of an inch into the explosive.

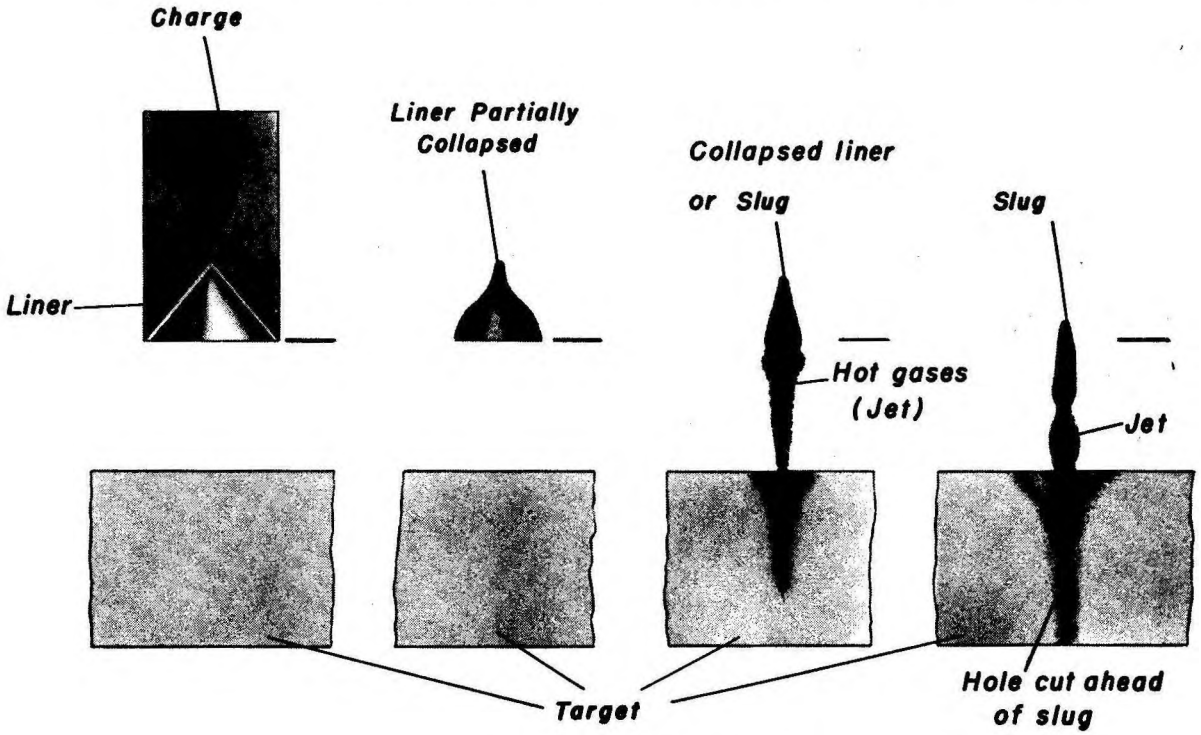

FIGURE 3-2. Jet Formation

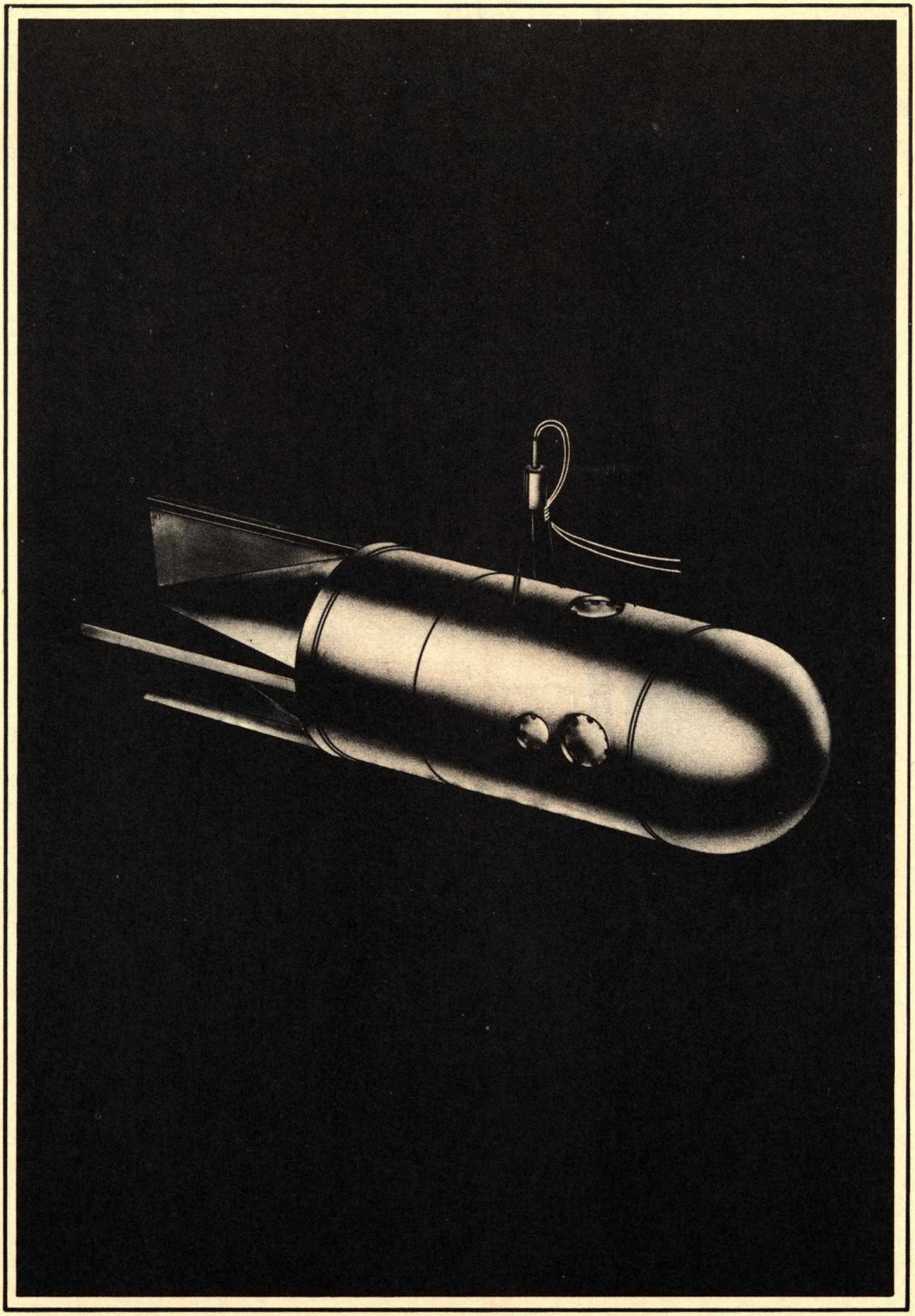

FIGURE 4-2. Cavity Charge

Detonator:	One U. S. Army Engineers Corps Special Detonator or one knot of Primacord.
Explosive:	⅔-pound of Composition C-2.
Stand-off:	Three inches.
Container:	2¼" Diameter, 4 5/32 High. (Bureau Ordnance Drawing No. 422108.)

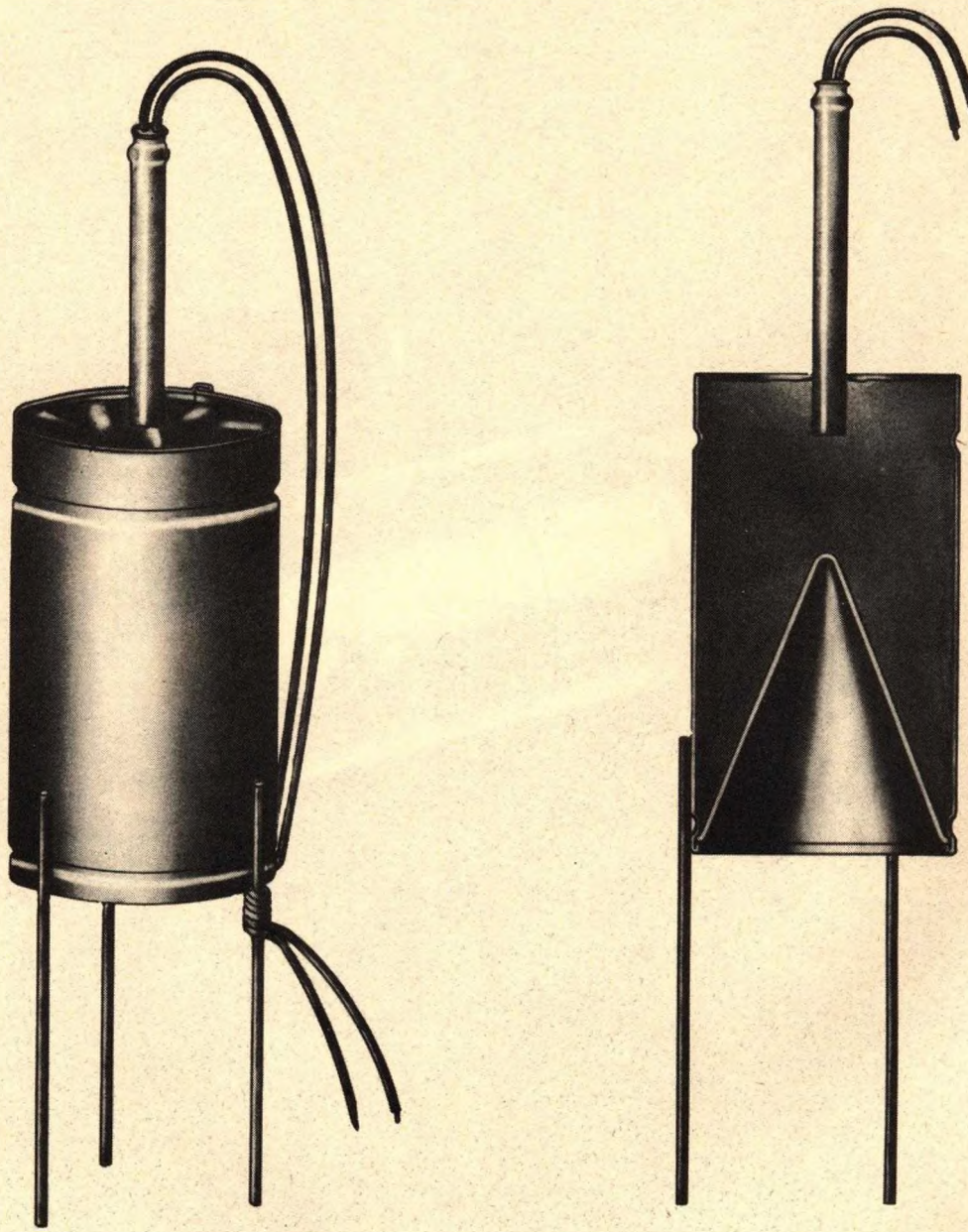

FIGURE 5-3. Cavity Charge Container Mark 1

CHAPTER 3

CAVITY CHARGE CONTAINER MARK I

The Cavity Charge Container Mark 1, is a container for a cylindrical charge with a conical cavity. The cylindrical side walls mold and support the body of the charge of plastic explosive. The cavity is formed by the steel cone which becomes the cavity liner. The cone is made of 0.06-inch steel with an apex angle of forty-two degrees and a base diameter of 2¼ inches. The stand-off is allowed by the three three-inch wire legs.

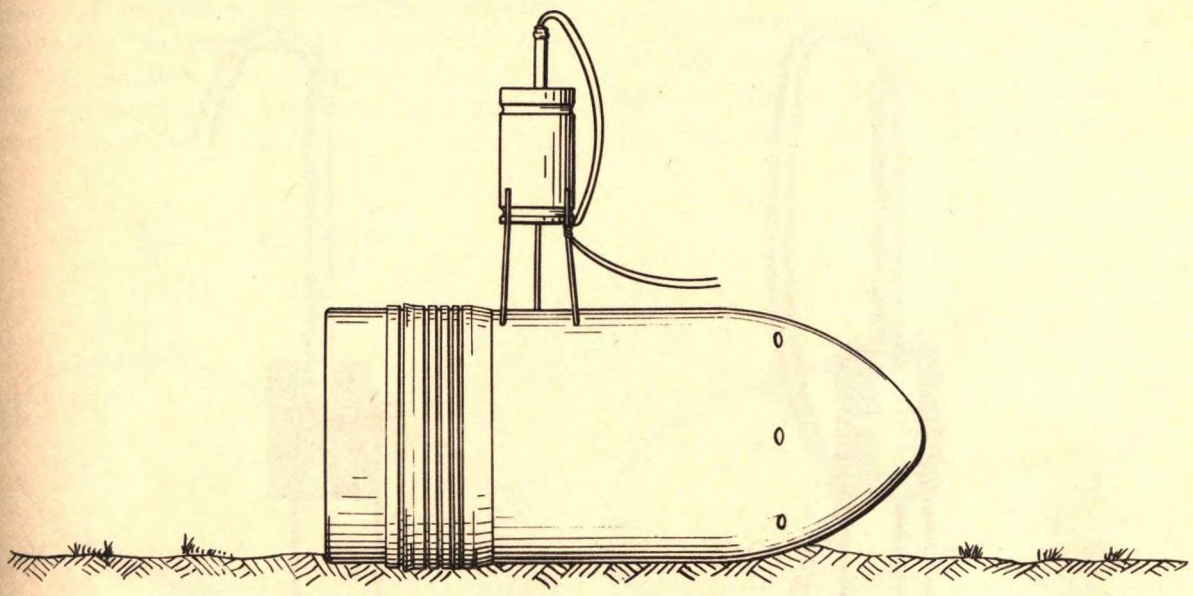

FIGURE 6-3. Use of Cavity Charge Mark 1

The Cavity Charge Mark 1 (the Cavity Charge Container Mark 1 when filled with plastic explosive and fitted with detonators) is designed for countermining projectiles. This is done by placing the charge just forward of the rotating band and detonating. WARNING: High order detonation may be expected and necessary precautions for the protection of personnel and material must be taken.

The Cavity Charge Mark 1 may have uses other than against explosive ordnance. Circumstances may warrant its use as a demolition tool. It may be expected to penetrate four (4) inches of armor plate or twelve (12) inches of reinforced concrete.

Detonator:	One U. S. Army Engineers Corps Special Detonator.
Explosive:	¾-ounce of Composition C-2.
Stand-off:	Eight inches.
Container:	1″ Diameter, 1¼″ High. (Bureau of Ordnance Drawing No. 422394.)

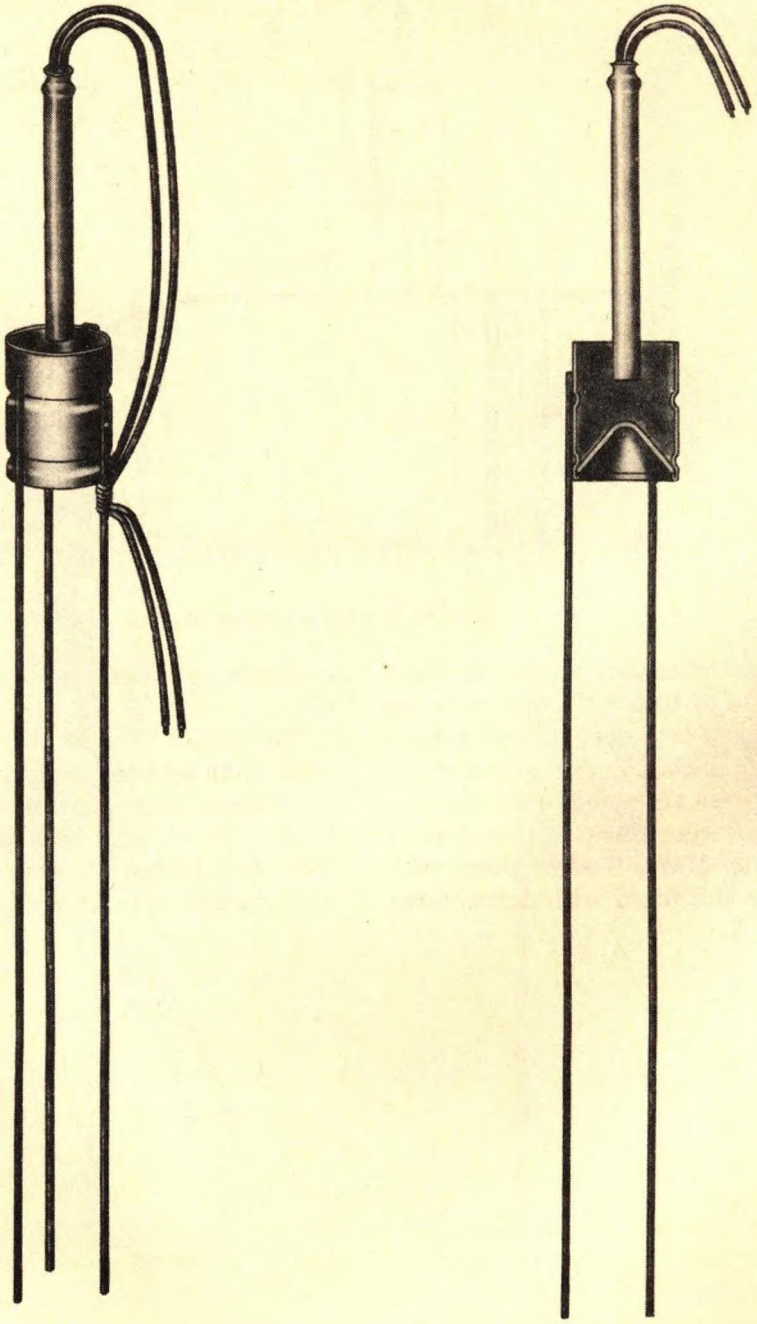

FIGURE 7-4. Cavity Charge Container Mark 2

CHAPTER 4

CAVITY CHARGE CONTAINER MARK 2

The Cavity Charge Container Mark 2 is a container which, when packed with plastic explosive, forms a cylindrical charge with a conical cavity. The cavity liner is the eighty degree cone in the container bottom which is made of 00.03-inch steel with a one-inch diameter. Attached to the cylindrical wall of the container are three eight-inch wire legs which may be used both for stand-off and support for the charge.

A stand-off of eight inches is recommended as the one most likely to give, consistantly, low order detonation on a thin-skinned explosive ordnance target. If the first shot should fail to penetrate and give detonation the recommended procedure is to take a second shot with a stand-off of eight inches at a different spot on the target ordnance. If this, too, should fail, the stand-off distance

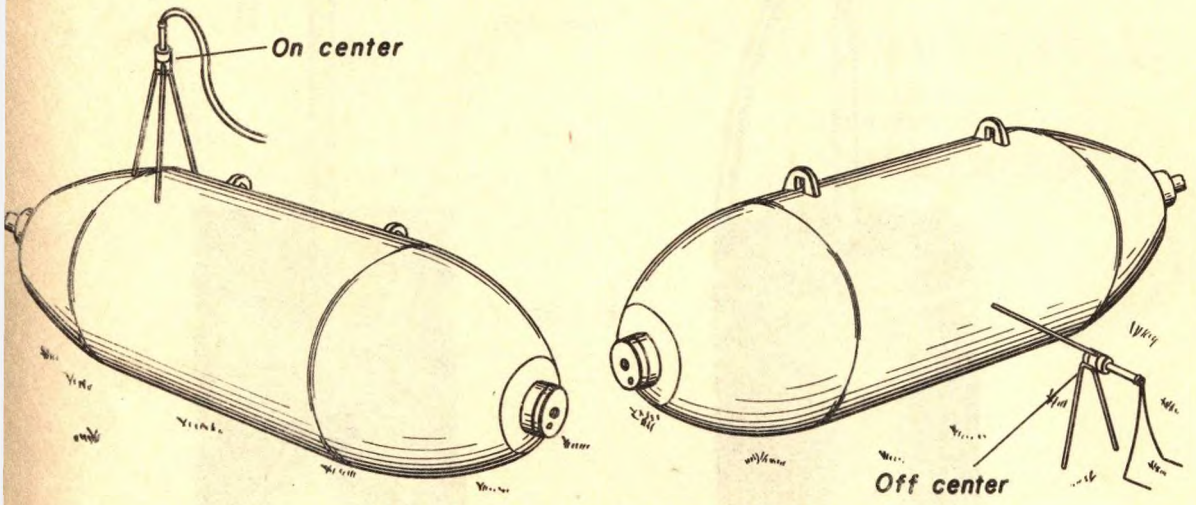

FIGURE 8-4.

The Cavity Charge Container Mark 2 is designed to open thin-skinned ordnance, that is, ordnance with a wall 3/8 of an inch thick or less, so that it may be destroyed by burning. The charge may be placed directly atop the ordnance to be opened, thus attacking it along the diameter or placed a little above or below the center line, attacking it off center.

If the latter method is used the force of the explosion tends to peel off a portion of the target ordnance near the hole of entry of the jet in an outboard direction. Two of the legs are bent to form an "A frame" support and the third to measure the stand-off. By varying the position of the charge, some of the characteristics of the damage to the ordnance may be varied.

should be lessened with each shot until the ordnance is opened. DO NOT TAKE TWO SHOTS AT ONE PLACE ON THE TARGET ORDNANCE, as this assures high order detonation.

Low order detonation may be expected from a shot at a thin-skinned ordnance target only when the fuze system has been removed from the ordnance. The shock of the impact and low order detonation is likely to actuate the fuze, especially a fuze which has been armed, and some mechanical failure has kept from firing. Although low order detonation may be expected with the use of the Cavity Charge Mark 2, PRECAUTIONS FOR HIGH ORDER DETONATION MUST ALWAYS BE TAKEN.

Detonator: One U. S. Army Engineers Corps Special Detonator or one knot of Primacord.

Explosive: 1 1/3 pounds of Composition C-2.

Stand-off: Six inches.

Container: 3″ Diameter, 4″ High. (Bureau of Ordnance Drawing No. 422394.)

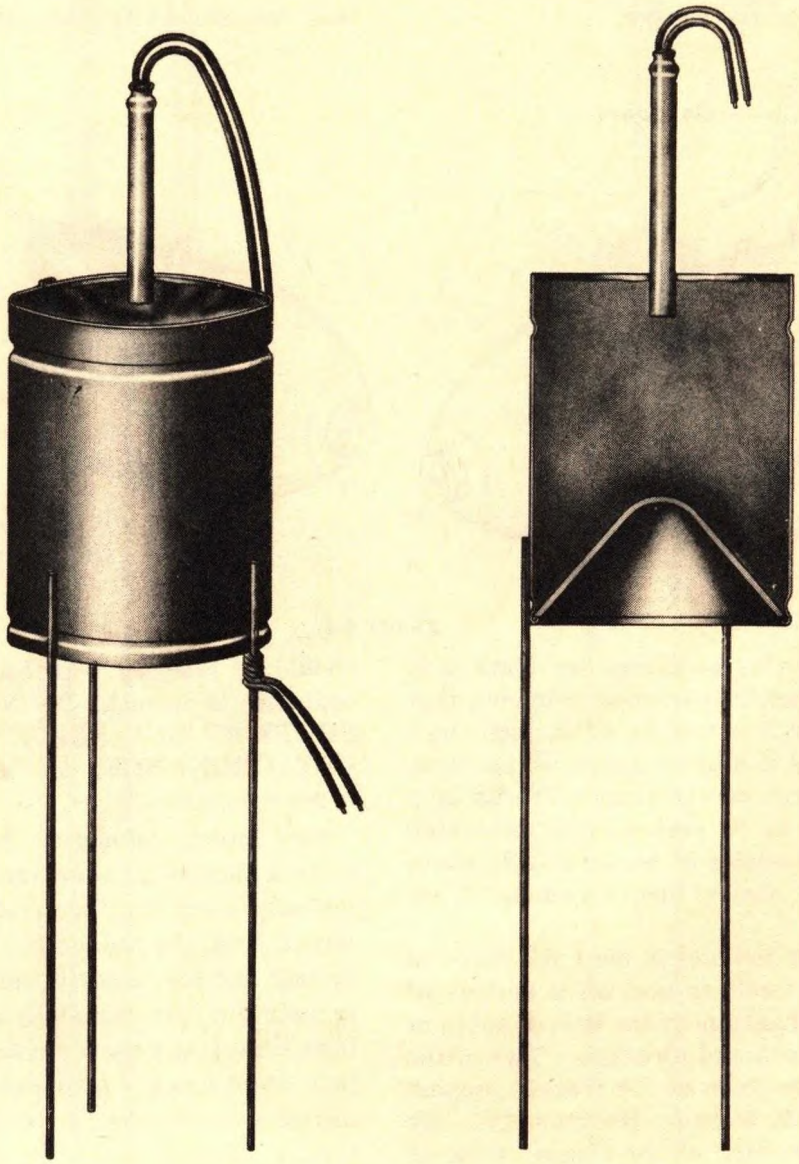

FIGURE 9-5. Cavity Charge Container Mark 3

CHAPTER 5

CAVITY CHARGE CONTAINER MARK 3

The Cavity Charge Container Mark 3, when packed with plastic explosive, forms a cylindrical charge with a conical cavity. The steel cone of the container which becomes the cavity liner is made of 0.09-inch steel with an apex angle of eighty degrees and a base diameter of three inches. The three six-inch wire legs provide for the stand-off.

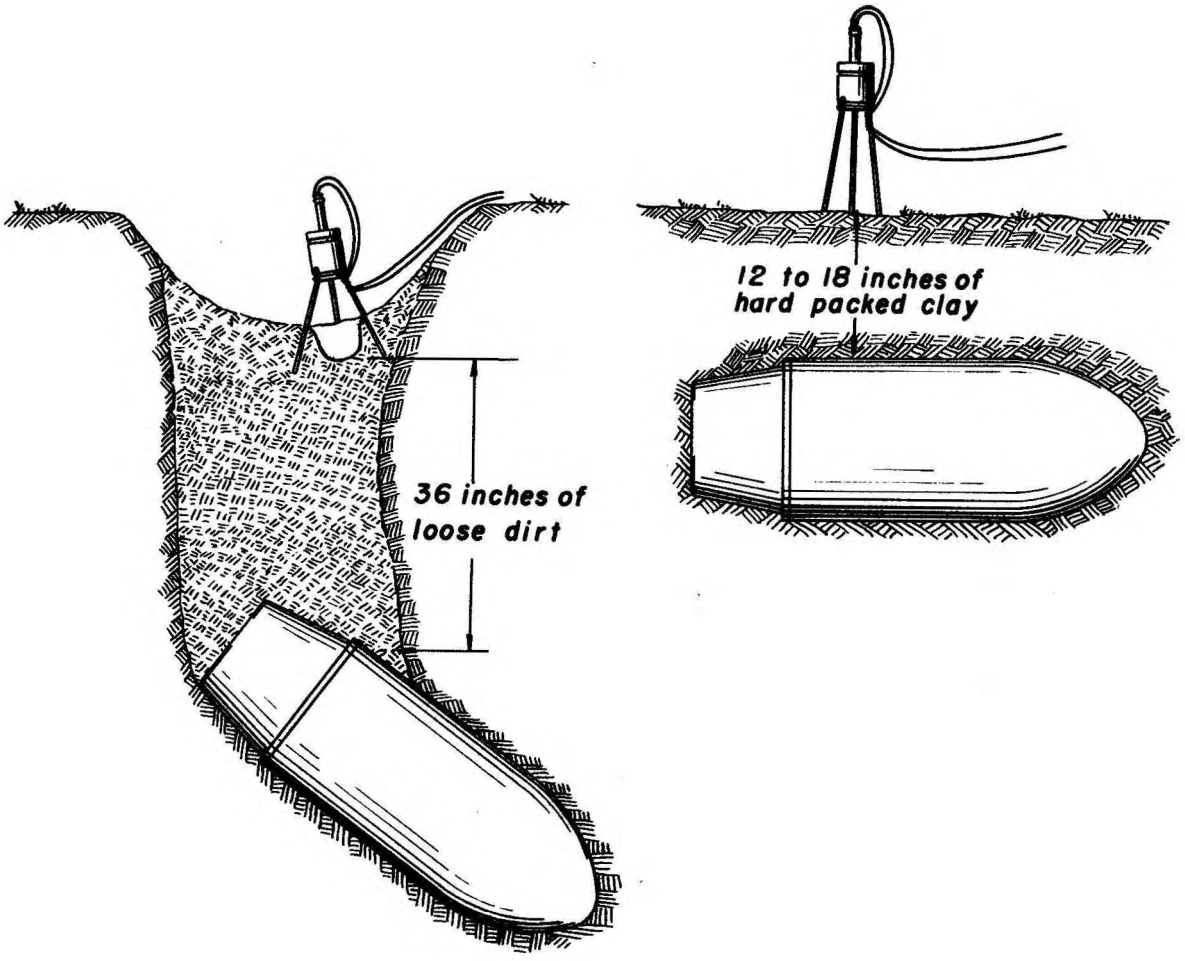

FIGURE 10-5.

The principal use of the Cavity Charge Mark 3 is against buried thin-skinned explosive ordnance. The jet and slug will penetrate one foot of tightly packed earth and still retain enough speed and heat to give low order detonation. Where the underground trajectory of the target ordnance was such that a part of the bomb is accessable to the jet and slug through loosely packed earth, detonation of the bomb may be expected through a yard of loose dirt. Low order detonation generally will occur unless a booster or fuze is hit. The shock of jet impact may cause the firing of an armed faulty fuze. PRECAUTIONS FOR HIGH ORDER DETONATION MUST ALWAYS BE TAKEN.

Certain demolition uses may be found for the Cavity Charges Mark 3. It may be expected to penetrate six inches of armor plate and eighteen inches of reinforced concrete.

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