TECHNICAL REGULATIONS
No. 1355–240A

WAR DEPARTMENT,
WASHINGTON, *November 28, 1927.*

MOBILE ARTILLERY AMMUNITION

AMMUNITION FOR 240-MM. HOWITZER, M1918 (SCHNEIDER)

Prepared under direction of the
Chief of Ordnance

SECTION I

GENERAL

1. Purpose and scope.—These regulations are intended for the using branches. They give all necessary information regarding the construction, functioning, and identification of 240-mm. howitzer ammunition and the components thereof.

2. References.—*a.* Before attempting to handle ammunition of any type, personnel should be thoroughly familiar with TR 1370–A.

b. Proper nomenclature for ammunition described herein is given in Standard Nomenclature List (S. N. L.) No. D–4, "Material, Howitzer, 240-mm., Model 1918." This nomenclature is mandatory and will be used in all requisitions.

c. Firing table 240-B–1 is based upon the use of the ammunition herein described.

d. TR 1305–240A and TR 1405–240A describe the operation, care, and maintenance of the howitzer and carriage for which this ammunition is designed.

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SECTION II

GENERAL DISCUSSION

3. General.—The ammunition used in the 240-mm. howitzer is known as separate loading ammunition, in that the loading of the howitzer is accomplished in three separate operations: First, inserting the projectile in the howitzer; second, inserting the propelling charge; and, third, inserting the primer in the breech mechanism of the howitzer.

4. Types of ammunition.—*a. Characteristics.*—High-explosive shell ammunition is the only type of ammunition provided for service use in this howitzer. For training purposes, a subcaliber gun and dummy drill ammunition are provided. The ammunition for the subcaliber gun is described in TR 1370–C. The dummy projectile and dummy propelling charge are described in TR 1370–D.

b. Projectile.—The high-explosive shell are issued unfuzed, an eyebolt lifting plug or an adapter plug being shipped assembled in the fuze seat. These shell are also issued unboxed, and the rotating bands are protected by rope grommets. To prepare a high-explosive shell for firing, it is necessary to remove the rope grommet, the plug in the nose of the shell, and then insert a fuze.

c. Propelling charge.—Propelling charges are shipped complete with the necessary igniting charges in waterproof metal containers, known as cartridge storage cases, two complete charges and two extra igniters usually being packed in each cartridge storage case.

d. Primers.—Primers for the propelling charges are packed in waterproof cans, containing 50 primers to the can. For quantity shipment, these cans in turn are packed in wooden packing boxes, which contain 48 cans.

e. Round of ammunition.—(1) A complete round of ammunition is made up of the following components:

Projectile	H. E. shell, Mk. III.
Bursting charge	T. N. T.
Adapter and booster	Mk. II-A.
Fuze	P. D., Mk. III or IV.
Primer	21-grain percussion, Mk. II-A.
Propelling charge	Nitrocellulose smokeless powder.

(2) It will be noted that a complete round of ammunition may be received in four distinct shipments, as follows:

(*a*) Projectile.
(*b*) Fuze.
(*c*) Propelling charge.
(*d*) Primer.

(3) In order that the using branches be informed of what constitutes a round of ammunition in instances such as this, where a round may be received in several different shipments, complete round labels were adopted in 1924. In this system a complete round label is attached to the projectile, being wired to the rope grommet, the plug in the nose of the shell, or other convenient place, and being printed with full information as to what other components are required to complete the round. A typical complete round label is shown in Figure 1.

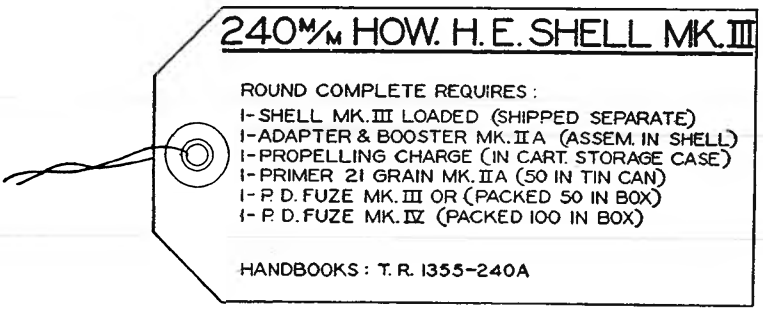

FIG. 1.—Complete round label, 240-mm. howitzer high-explosive shell, Mk. III

f. Weights.—The weights of the various components of a round of ammunition are approximately as follows:

Component	Weight in pounds
Projectile (empty)	292. 9
Bursting charge	49. 2
Adapter and booster (loaded)	2. 5
Fuze	. 95
Primer	. 025
Propelling charge	38
Total weight of round	383. 575

5. Identification of components.—For identification purposes practically all assembled units or components are given a mark number or model. The mark number form of identification was adopted about 1917, and in this system the first design of a certain component

was called "Mark I," abbreviated as Mk. I or, in some cases, MI; the second design, "Mark II," abbreviated as Mk. II or, in some cases, MII, and so on. The previous method was to designate the component as the model of a certain year, for instance, "M1916" indicating that it was designed in the year 1916.

SECTION III

PROJECTILE

6. **Type.**—The only type of projectile authorized for use in this howitzer is made of forged steel and is known as the common steel or high-explosive shell, Mk. III.

7. **General.**—*a. Base cover.*—All projectiles containing high explosive are fitted with base covers, which are designed to prevent the gases from the propelling charge coming in contact with the high-explosive charge of the projectile through possible defects in the base of the projectile. The standard base cover for 240-mm. high-explosive shell, Mk. III, is shown in Figure 2. It consists of a shallow copper cup, covering a lead disk, the copper cup being held in a groove in the base of the shell by means of a strip of lead calking wire, which is hammered or pressed down to completely fill the groove and to bend in the flange of the copper cup.

b. Rotating band.—(1) The functions of the rotating band are to impart rotation and thus to maintain the stability of the projectile during flight, to prevent the propelling charge gases from escaping past the projectile when the howitzer is fired, to seat the projectile properly in the bore of the howitzer, and to maintain this position when the howitzer is elevated.

(2) The rotating band is a cylindrical ring of copper, pressed into a groove near the base of the projectile. The surface of this groove is formed with a number of inverted V-shaped, waved, circumferential ribs or ridges, which prevent the rotating band from slipping while the projectile is being rotated in the bore of the howitzer.

(3) When the howitzer is fired the rotating band engages the rifling, which is spiral or screw shaped, in the howitzer barrel. The projectile thus is forced out of the barrel of the howitzer with a rotating motion. Since the diameter of the rotating band is greater than the greatest diameter of the rifling in the howitzer barrel, the rotating band completely fills the bore of the howitzer barrel and prevents the propelling charge gases from escaping past the projectile.

(4) Rotating bands must be made of a comparatively soft metal that will flow readily and fill the rifling grooves in the howitzer barrel. The material must be sufficiently soft to prevent excessive

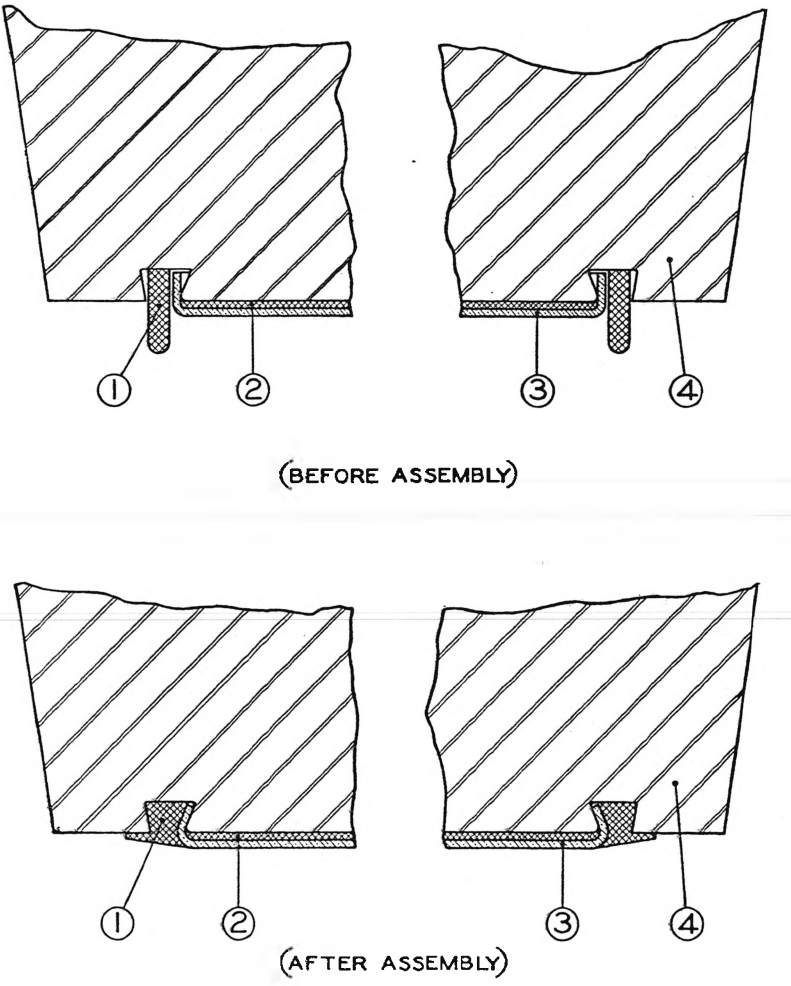

FIG. 2.—Base cover

1. Lead calking wire. 2. Lead disk. 3. Copper cup. 4. Base of shell.

wear of the lands in the howitzer barrel, and at the same time, not so soft as to shear under the resistance met in rotating the projectile. The rotating band material should have a high melting point. Cop-

per is probably the best available material and is used for all rotating bands. Figure 3 shows a cross section of the rotating band of the 240-mm. high-explosive shell, Mk. III.

(5) It is necessary that the projectile be firmly seated in the howitzer, so that the rotating band fits tightly in the forcing cone of the howitzer barrel and thus have sufficient sticking power to hold the projectile in place when the howitzer is laid to fire at high elevations. Considerable trouble has been encountered by projectiles slipping back from their seats before firing, with much inaccuracy in range as the result.

(6) Care should be exercised to avoid rough handling of the projectile so as not to deform the rotating band. Such handling may result in deformation to such an extent that the projectile can not be seated properly in the howitzer.

c. Painting and marking.—All projectiles are painted, both as a means of ready identification and as a rust preventive. Projectiles containing high explosive (T. N. T.) such as the Mk. III high-explo-

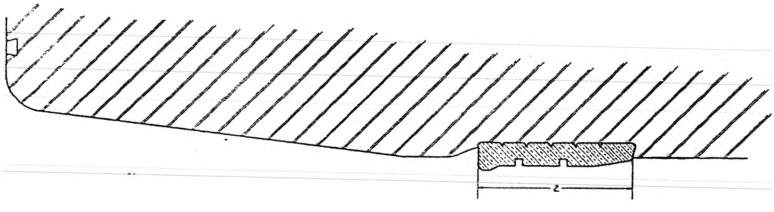

FIG. 3.—Rotating band, 240-mm. high-explosive shell, Mk. III

sive shell are painted yellow. Projectiles are also stenciled to show the caliber, type of cannon used in, ammunition lot number, kind of filling, etc.

8. Common steel or high-explosive shell, Mk. III.—*a. Description.*—The common steel or high-explosive shell, Mk. III (fig. 4), has a fairly sharp nose, the radius of the ogive being approximately 4½ calibers.[1] This shell has a boat-tail base, tapered off at an angle of 7°. This combination of sharp nose and tapered base adds to the efficiency of the projectile in flight. The explosive charge is about 49 pounds of T. N. T. This shell is marked for identification as shown in Figure 5.

b. Weights.—The weights of loaded Mk. III shell, assembled with the adapter and booster, but without fuze, vary from approximately

[1] By "caliber" is meant the diameter of the bore of the howitzer (240-mm.) A radius of ogive of 4½ calibers is therefore a radius of 4½×240 mm. or 1,080 mm.

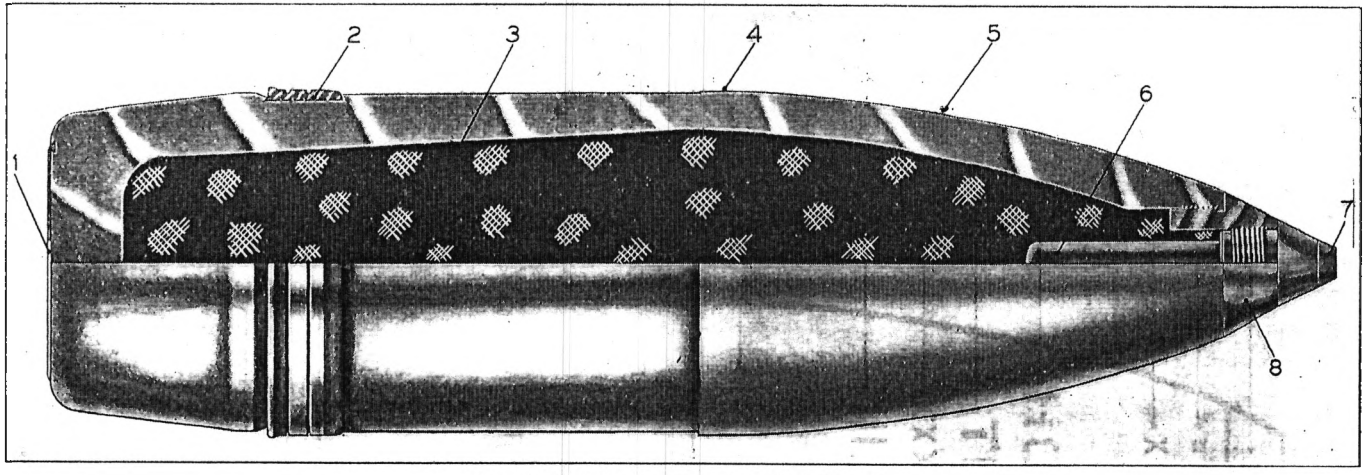

FIG. 4.—240-mm. common steel shell, Mk. III

1. Base cover.
2. Rotating band.
3. Bursting charge (T. N. T.).
4. Bourrelet.
5. Ogive.
6. Adapter and booster, Mk. II-A.
7. Point detonating fuze, Mk. IV.
8. Nose bushing.

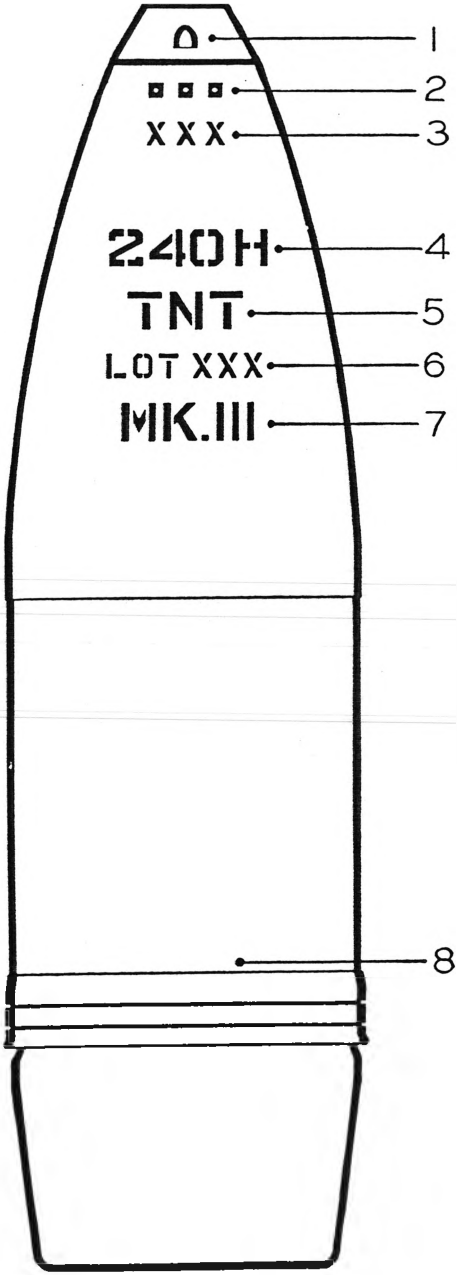

FIG. 5.—Marking for 240-mm. high-explosive shell

1. Adapter may or may not be painted. (For stamping on adapter, see fig. 6.)
2. Weight zone marks (⊡, ⊡ ⊡, or ⊡ ⊡ ⊡). (See par. 8*b*.)
3. Mean or normal weight in pounds. (See par. 8 *b*.)
4. Caliber and type of cannon (H = howitzer).
5. Filler—Initials indicate kind of explosive.
6. Lot number of filled shell.
7. Mark number of shell.
8. Caliber and type of cannon, mark number, lot number of unfilled shell, initials or symbol of machining plant, and inspection marks (stamped on shell under paint).

337 pounds to approximately 352 pounds, and obviously this variation in weight will result in considerable variation in range. In order that these variations in weight may be conveniently noted by the service the shell are divided into three weight zones. Each particular lot number of ammunition contains only shell of one weight zone and more uniform ballistic results should be obtained by firing groups containing shell of the same weight zone. The weight zones and the identification marks which are placed on the shell to indicate the particular weight zone are as follows:

Weight, loaded, and unfuzed		Normal weight (fuzed)	Mark
From—	To—		
Pounds	*Pounds*	*Pounds*	
337	342	339.85	⊡
342	347	344.85	⊡⊡
347	352	349.85	⊡⊡⊡

These weight zone marks are made with a prick punch and are in the center of one-half inch squares that are stenciled in black on the projectile. The mean or normal weight, in pounds, which is stenciled directly below the weight zone marks is the mean weight of that particular weight zone, plus the weight of a Mk. IV point detonating fuze.

SECTION IV

ADAPTER AND BOOSTER

9. Function.—In general, the adapter is a bushing that fits into the nose of the shell, thus adapting the shell to fit the fuze. Attached to the adapter is a booster casing, containing high explosive, which acts as a booster for the fuze, since the detonator of the fuze is not powerful enough to dependably detonate the charge of T. N. T. in the high-explosive shell. These two assembled components are known as the "adapter and booster." The adapter and booster is issued assembled to the shell.

10. Adapter and booster, Mk. II–A.—The adapter and booster, Mk. II–A, is used in the 240-mm. high-explosive shell, Mk. III. Figure 6 shows this adapter and booster and gives the names of the principal parts, together with the stamping identifications. A

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fuze socket protects the booster charge from moisture. As fuzes are never assembled in the shell until just prior to firing, an eyebolt lifting plug is supplied which acts as a protection against the entrance of foreign substances, prevents injury to the fuze seat threads in the adapter and facilitates handling of the shell. This lifting plug is made of steel and a ring or eye is formed on one end, through which a hook or bar may be passed in handling the shell. Some shell may be received in which a die-cast white metal plug or a felt adapter plug is used, instead of the eyebolt lifting plug. The booster charge consists of approximately 4.4 ounces of tetryl. Some boosters are loaded with half tetryl and half T. N. T., the tetryl being placed around the fuze socket.

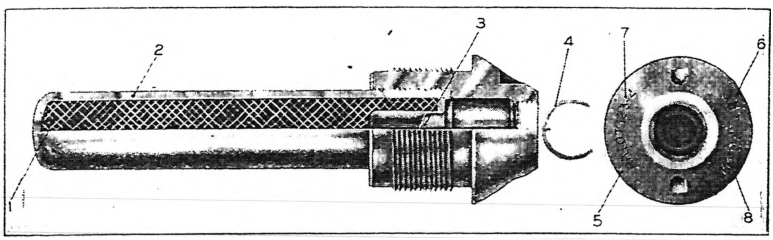

FIG. 6.—Adapter and booster, Mk. II–A

1. Booster charge (approx. 4 oz. tetryl).
2. Booster casing.
3. Fuze socket.
4. Adapter plug.
5. Initials or symbol of loader.
6. Initials or symbol of metal parts manufacturer.
7. Lot number of loaded adapter and booster.
8. Mark number.

SECTION V

FUZES

11. Types.—*a.* A fuze is a device inserted in a projectile and used to detonate the bursting charge at the time and under the circumstances desired. The following types of fuzes are authorized for use with 240-mm. howitzer projectiles:

(1) Point detonating fuze, Mk. III or III–A.

(2) Point detonating fuze, Mk. IV (short and long delay).

b. General instructions prescribing the percentage of the several types of authorized fuzes to be used can not be given. The allowances depend on the availability of supply, and since stocks of all types may not always be available, the use of certain other types of fuzes

than those authorized is permitted. The permissible fuzes for 240-mm. howitzer high-explosive shell, Mk. III, are as follows:

Projectile	Permissible fuzes			
	Mk. III or III–A	Mk. IV	Mk. IV-star	Mk. V
Mk. III H. E. shell.	Yes.	Yes.	*	No.

"Yes" indicates that this fuze is prescribed for this projectile.
"No" indicates that this fuze is either unsafe for use or that it will not function in this howitzer.
"*" indicates that this fuze is not prescribed, but that there is no reason against its use from the standpoint of safety or certainty of functioning.

12. **Point detonating fuze, Mk. III.**—*a. Description.*—(1) The point detonating fuze, Mk. III (P. D. F., Mk. III), is a superquick fuze and is used when it is desired to secure a quick burst above the ground, with the least possible penetration of the projectile. The design of this fuze is practically the same as that of the French 24/31 I. A. L., M1916 (Instante Allongé Lefevre, or the instantaneous elongated fuze of the Lefevre design). Figure 7 shows this fuze together with the names of the principal parts.

(2) The Mk. III–A fuze differs from the Mk. III fuze only in the arrangement of the upper detonator. These two fuzes are very similar in appearance and are fully interchangeable in use. The centrifugal plunger or interrupter (11) is a safety feature incorporated in the American design. Mk. III and III–A fuzes both with and without this feature are in service. The Mk. III fuze weighs approximately 0.95 pound. Some failures to function may be expected in firing these fuzes in the inner zones of the 240-mm. howitzer, where the rotation of the projectile falls to 3,000 revolutions per minute, or less.

b. Safety device.—The centrifugal plunger or interrupter (11) constitutes a partial bore safety device[1] and is operated by centrifugal force. It is placed at an angle so that linear acceleration tends to oppose centrifugal force while the shell is being accelerated in the bore of the howitzer, the plunger remaining in the safe position and preventing any premature action of the upper detonator (8) or primer (7) from reaching the lower detonator (14), thus making the fuze bore safe to that extent. After linear acceleration ceases

[1] A bore safe fuze is one in which the detonating train is interrupted between the detonator and the shell charge until the projectile has cleared the muzzle of the howitzer. This prevents premature action of the shell charge in the bore of the howitzer due to mal-functioning of the more sensitive elements of the fuze.

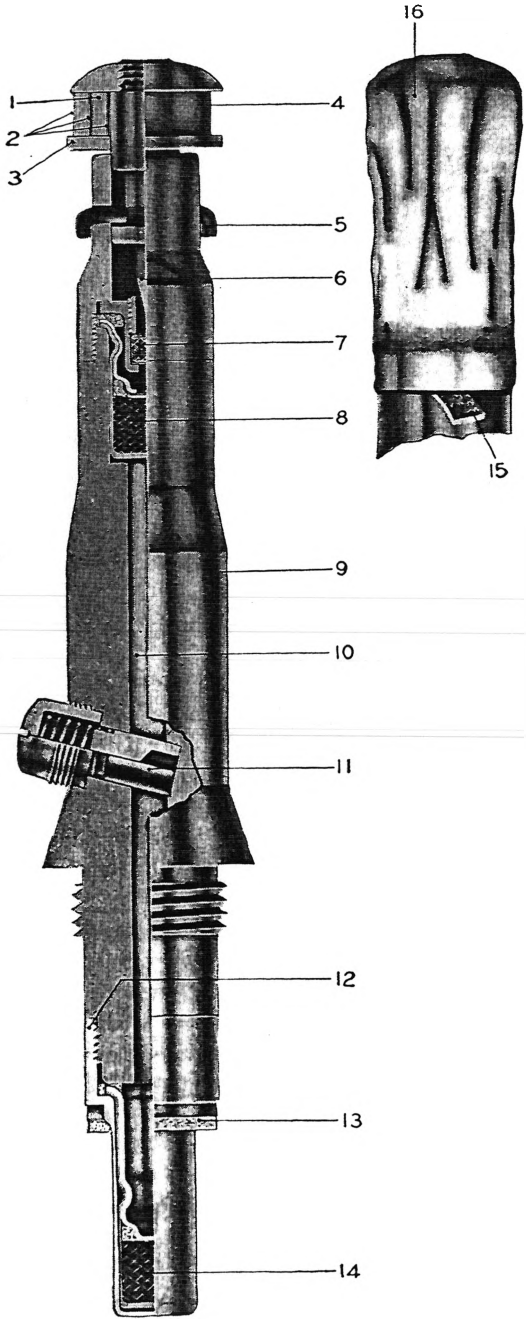

FIG. 7.—Point detonating fuze, Mk. III

1. Half ring or split ring.
2. Spiral.
3. Supporting washer.
4. Brass ribbon.
5. Safety pin.
6. Firing pin.
7. Primer.
8. Upper detonator.
9. Fuze body.
10. Central channel.
11. Centrifugal plunger or interrupter.
12. Detonator socket.
13. Felt washer.
14. Lower detonator.
15. Tape.
16. Waterproof cover.

centrifugal force moves the plunger (11) outward and opens the channel (10) between the two detonators (8 and 14).

c. Action upon firing.—The firing pin (6) is held away from the primer (7) by means of a spiral (2) and a safety pin (5). The spiral (2) is composed of a split ring (1) assembled to a brass ribbon (4) having a weighted end. This ribbon (4) will not unwind until after the shell is out of the bore of the howitzer. At this time centrifugal force acting upon the weighted end of the ribbon unwinds it, taking the split ring (1) with it. The safety pin (5) holds the firing pin (6) during flight.

d. Action at target.—Upon impact with the target the safety pin (5) bends or breaks, and the firing pin (6) functions the primer (7). The primer (7) causes the upper detonator (8) to explode. The flame from this explosion passes through the open channel (10) to the lower detonator (14), causing it to function. This detonation is transmitted to the booster charge and, in turn, is transmitted to the explosive charge of the shell. These explosions follow in such rapid succession as to make the bursting of the shell practically simultaneous with the first impact of the firing-pin head.

e. Shipment.—These fuzes are never assembled in projectiles before shipping, but are packed in waterproof boxes, 50 fuzes to each box, and form a separate shipment. The spiral is held in position during shipment by means of a piece of tarred tape (15). A lead foil cap is fitted over this tape as a waterproof cover and is cemented to the fuze with a mixture of tar and rubber or other waterproofing compound.

f. General information.—(1) Previous to placing the projectile in the howitzer, the fuze is screwed tightly into the adapter, using the wrench provided, and the tape and waterproof cap are removed by pulling on the loose end of the tape, which is exposed.

(2) Never screw a fuze into a shell if the tarred tape and lead-foil cap are not in their proper places.

(3) After the fuze is screwed into the shell and the tape removed from the neck of the fuze, examine the spiral (brass ribbon) and safety pin to see that they are in their proper places. If the ribbon is broken the fuze can not function, for centrifugal force is not sufficient to arm the fuze unless the weighted end of the ribbon is in place. If the spiral is not in place, there is danger of a premature explosion in the howitzer. In either case the fuze will be removed and destroyed. The howitzer personnel must become familiar with the appearance of this fuze, when the spiral is in place and when it is not in place, so that the possibility of firing a defective fuze will be reduced to a minimum.

g. Marking.—The point detonating fuze, Mk. III, is identified by a one-half-inch blue-gray band painted just below the waterproof cover. In addition, it has the following stamping on the body:

(1) Initials or symbol of metal parts manufacturer.
(2) P. D. F., Mk. III (mark number of fuze).
(3) Lot number of loaded fuze.
(4) SQ (superquick).
(5) Initials or symbol of loading plant.
(6) Month and year of loading.

13. Point detonating fuze, Mk. IV.—*a. Description.*—(1) The point detonating fuze, Mk. IV (P. D. F., Mk. IV), is for use in

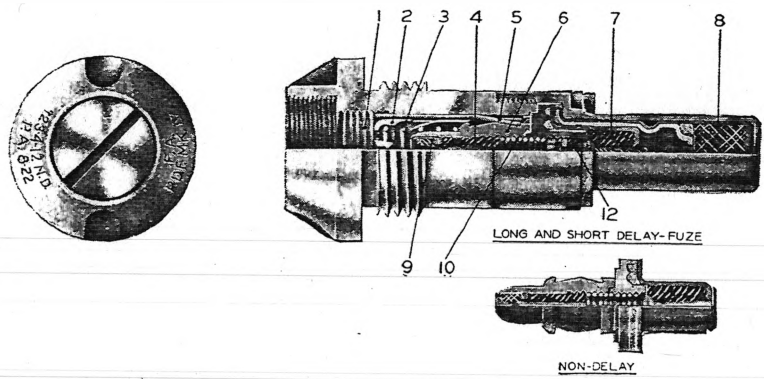

FIG. 8.—Point detonating fuze, Mks. IV and IV-Star

1. Firing pin.
2. Arming casing.
3. Arming spring.
4. Black-powder pellet.
5. Safety casing.
6. Percussion plunger.
7. Relay powder.
8. Detonator.
9. Percussion primer.
10. Retard spring.
12. Delay pellet.

howitzers only and is used when delay action is desired. It is authorized for use in the Mk. III high-explosive shell. The design was practically copied from the French fuze (24/31, models 1899–1915). Figure 8 shows this fuze, together with the names of the principal parts. This fuze weighs approximately 0.35 pound.

(2) This fuze should not be confused with the point detonating fuzes, Mks. IV star and V, which are similar in design and appearance, except that the Mk. IV and Mk. IV star fuzes have flat heads. The difference in design between the Mk. IV and the Mk. V fuze is that the Mk. V fuze is provided with an additional arming device, known as the head safety feature. The Mk. V fuze is designed for use in 75-mm. field guns, and must not be used in 240-mm. howitzer

projectiles. The Mks. IV and IV star fuzes are exactly alike in every way, except that the Mk. IV star fuze has a stronger retard spring and is made primarily for use in guns of comparatively high muzzle velocity. To distinguish the Mk. IV star fuze from the Mk. IV fuze, the bevel edge of the head of the Mk. IV star fuze is painted green; also a star is stamped on the head of the Mk. IV star fuze immediately following the mark number. The Mk. IV star fuze is not prescribed for use in 240-mm. howitzer projectiles, but, as noted in paragraph 11 *b*, its use is permitted.

(3) The following types of Mk. IV fuzes have been manufactured, but the short delay is the only type now on hand, although both short and long delay types are authorized for use in 240-mm. howitzer Mk. III shell. The amount of delay is indicated by color markings, as follows:

(*a*) Nondelay (N. D.), white head.
(*b*) Short delay (S. D.), approximately 0.05 second; black head.
(*c*) Long delay (L. D.), approximately 0.15 second; black head and violet detonator socket.

b. Action upon firing.—In action, the arming casing (2) through its inertia or setback,[3] at the impulse of the propelling charge gases, compresses the arming spring (3). The sides of the arming casing disengage the prongs of the safety casing (5) from the percussion plunger (6), while the prongs of the arming casing (2) engage the collar on the sides of the percussion plunger (6). The arming casing (2) is thus held back, exposing the percussion primer (9) and completing the arming of the fuze. The percussion plunger (6) is held from creeping forward during flight by the retard spring (10).

c. Action at target.—On impact, the percussion plunger (6) moves forward and the primer (9) is exploded by the firing pin (1). The flame of this explosion is transmitted to the powder pellet (4) below the primer (9), to the delay pellet (12) or to the relay powder (7) in

[3] The term "setback" is the name given to the reaction to the force required to give any part of the projectile a forward movement in the howitzer. The total "setback" of a projectile is equivalent (frictional and rotational components neglected) to the total pressure exerted by the propelling charge gases on the base of the projectile. In other words, the expansion of the gases from the propelling charge creates a pressure in the chamber and bore of the howitzer, which results in an acceleration of the projectile. The projectile, due to its inertia, resists this acceleration and tends to remain stationary. This resistance to the pressure on the base is "setback." Any part not rigidly supported in the projectile will be given a relative motion toward the base of the projectile by this force, when the projectile is being accelerated in the bore of the howitzer.

the case of nondelay. The gases from powder pellet (4) are necessary to carry ignition to the relay powder (7) after the delay pellet (12) has burned. The relay powder (7) supplies hot gases which explode the detonator (8) consisting of approximately 30 grains of mercury fulminate. This detonates the booster which in turn detonates the shell filler.

d. Shipment.—These fuzes are never assembled in projectiles for shipment, but are packed in waterproof boxes, 100 fuzes to each box, and form a separate shipment. When the shell is ready to be placed in the howitzer, the fuze is screwed tightly into the adapter, using the wrench provided. It is essential that a felt washer be under the detonator socket flange to hold the fuze in the adapter properly.

e. Marking.—The point detonating fuze, Mk. IV, is identified by the following markings:

(1) Stamping—
- (*a*) Initials or symbol of metal parts manufacturer.
- (*b*) P. D. F. Mk. IV (mark number of fuze).
- (*c*) Lot number of loaded fuze.
- (*d*) NON (for nondelay).
  S. D. (for short delay, 0.05 second).
  L. D. (for long delay, 0.15 second).
- (*e*) Initials or symbol of loading plant.
- (*f*) Month and year of loading of fuze.

(2) Marking—
- (*a*) The head of the nondelay fuze is painted white.
- (*b*) The head of the short delay fuze is painted black.
- (*c*) The head of the long delay fuze is painted black and the detonator socket is painted violet.

Section VI

PRIMER

14. 21-grain percussion primer, Mk. II–A.—*a. Type.*—The 240-mm. howitzer uses a percussion primer, that is, the howitzer is fired by the primer being struck by the point of the firing pin of the howitzer in a manner similar to the way that a rifle cartridge is fired. The primer is called a "21-grain percussion primer (Mk. II–A)" because it contains 21 grains of black powder. Figure 9 shows the 21-grain percussion primer, Mk. II–A.

b. Action.—When the firing pin strikes the percussion cup (1) it indents the cup and crushes the percussion composition (2) against

the anvil (3), causing this composition to explode. The flame from the explosion of the percussion composition passes through a hole and ignites the black powder charge (7) which in turn ignites the igniter of the propelling charge. The percussion composition (2) is sensitive and care must be taken that the cup (1) is not struck by any hard object. A blow simulating that of a firing pin attached to a one-pound weight and dropped through a height of 3 inches may cause it to function.

c. Marking.—Identification marks are stamped on the bottom of the primer case as shown in Figure 9.

d. Shipment.—Primers are shipped packed in waterproof tin packing cans, 50 primers to each can. They are affected by moisture and care should be taken that they are kept dry after the can has been opened.

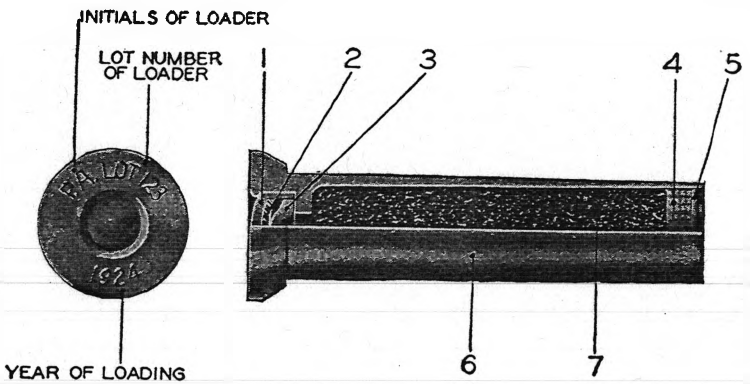

FIG. 9.—21-grain percussion primer, Mk. II–A

1. Percussion cup.
2. Percussion composition.
3. Anvil.
4. Wax.
5. Shellac.
6. Case.
7. Black powder.

SECTION VII

PROPELLING CHARGE

15. Propelling charge.—*a. General.*—The propelling charge for the 240-mm. howitzer is nitrocellulose smokeless powder. A grain of this powder will burn freely in the open and has none of the char-

acteristics of an explosive until it is confined. If the powder is confined in a chamber, the rate of burning is very rapid, as the rate of burning increases as the gases are liberated and the pressure in the chamber increases.

b. Action.—(1) The pressure of the gases from the burning powder expels the projectile from the howitzer. If these gases are created too rapidly, too much pressure will be developed and the howitzer may burst. On the other hand, if the gases are not generated rapidly enough, the projectile will leave the muzzle before the powder grains are entirely burned and at a lowered velocity. It is therefore necessary to make the grains of powder of such size that when the projectile has reached the muzzle of the howitzer they will have completely burned and the pressure will not have exceeded a certain prescribed limit. To meet this condition it has been found conven-

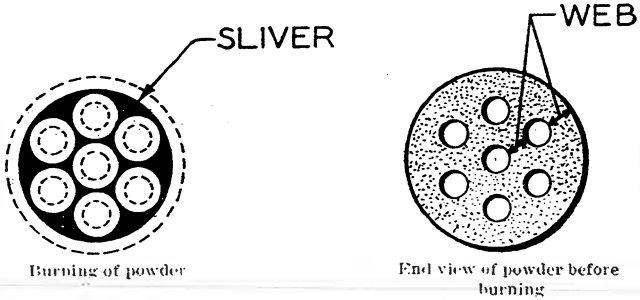

FIG. 10. Grain of powder

ient to make the grains of powder with a number of holes or perforations running lengthwise of the grain. Since the grain is perforated, it will burn on the inside and outside surfaces at the same time, and gas will be created much faster than if the grain were solid. The size of the grain of powder for the 240-mm. howitzer propelling charge is about $\frac{5}{16}$ inch in diameter by about $\frac{13}{16}$ inch long, with seven perforations running lengthwise of the grain. The color varies from a light brown to a black.

(2) It is assumed that all the exposed surfaces of the grain of powder begin to burn at the same time. Figure 10 shows the end view of a typical grain of powder and also the progressive burning action until the grain is practically consumed. The dotted lines show the original shape of the grain of powder. The small triangular sections are called "slivers." These slivers will burn if the powder is properly designed.

(3) The maximum allowable powder pressure in the 240-mm. howitzer is 32,000 pounds per square inch and the muzzle velocity of the 345-pound projectile is 1,700 feet per second with the full charge.

16. Cartridge bags.—*a. Use.*—Cartridge bags are used with separate loading ammunition, forming a suitable and convenient means of containing the smokeless powder propelling charge. Two classes of cloth are used in the manufacture of cartridge bags, known as cartridge-bag cloth and cartridge-igniter cloth. These two classes of cloth are both divided into five grades, according to their respective tensile strengths. The grades are lettered "A" to "E," "A" being the strongest grade and "E" the weakest. For the 240-mm. howitzer propelling charge, grade "E" cartridge-bag cloth and grade "D" cartridge-igniter cloth are ordinarily used, since the bags are relatively small in size. The tying straps are usually made of grade "D" cartridge-bag cloth.

b. Cartridge-bag cloth.—Cartridge-bag cloth is made of pure silk, wool or mohair, raw silk having been found to be the most practical material. This cloth is used in the manufacture of all components of the bags, except those components containing the black igniting powder. It is necessary that the cartridge-bag cloth have sufficient strength to withstand service conditions of handling and at the same time it must be entirely consumed during combustion of the propelling charge.

c. Cartridge-igniter cloth.—Cartridge-igniter cloth is made of pure silk and has properties similar to cartridge-bag cloth, but is more closely woven to prevent the igniting powder from sifting through the cloth. All igniters used with cartridge bags are manufactured from cartridge-igniter cloth. In order to avoid any possibility of error and to clearly indicate that they contain black powder, all igniters are dyed bright red.

17. Type of charge.—*a. Description.*—(1) The cartridge bags containing the propelling charge for the 240-mm. howitzer are known as aliquot-part cartridge bags, in that the charge is divided into five equal increments, each of which has the same ballistic energy, each containing the same amount of powder for a given lot number of powder. A base pad igniter is used, which contains 5 ounces of black igniting powder and is placed to the rear of the charge. Four tying straps are sewed to the igniter bag, by means of which the increments are attached to the igniter, thus forming a unit of the propelling charge. One igniter is used with each charge, irrespective of the number of increments used in making up the charge. Two igniters are furnished with each full charge in order that increments

left over from firings with less than the full charge may be used up. The full charge or zone 5 is shown in Figure 11.

(2) When it is desired to use other than the full charge, the tying straps are untied, the required number of increments are removed and the tying straps are again tied over the remaining increments. The igniter and all five increments constitute zone 5. The zone is determined by the number of increments used in making up the charge, one increment with the igniter being zone 1, two increments with the igniter being zone 2, etc.

(3) The weights of powder used in the different zones, together with the velocity and pressure obtained with the various zones, are as follows:

Zone	Total weight of charge (5-ounce igniter not included)		Pressure (pounds per square inch)	Velocity (feet per second)
	Pounds	Ounces		
1	7	4.6	2,200	630
2	14	9.2	7,500	930
3	21	13.8	12,500	1,180
4	29	2.4	18,000	1,435
5	36	7	26,500	1,700

NOTE.—A modification in the method of zoning is being considered with a view to obtaining more favorable angles of fall at elevations below 45° and more effectively covering the gaps when used at elevations above 45°. This may result in providing one-tenth sections of the charge to be used with the one-fifth sections.

The weights of powder and the pressures given in this table vary slightly with different lots of powder, since the powder charge is so adjusted as to give the specified muzzle velocity.

b. Marking.—(1) The igniter pad is dyed bright red. It is stenciled on both ends with the words "IGNITING POWDER" and "240-MM. HOW."

(2) The increment sections are stenciled on both ends with the words "ALIQUOT PART—240-MM. HOW."

(3) Each full charge has a tag attached to it, usually tied to one of the tying straps, containing the following information:

(*a*) Name of loading plant.
(*b*) Date loaded (day, month, and year).
(*c*) Caliber and model of howitzer.
(*d*) Weight of projectile that the charge is to be used with.
(*e*) Powder lot number.
(*f*) Name of manufacturer of powder.

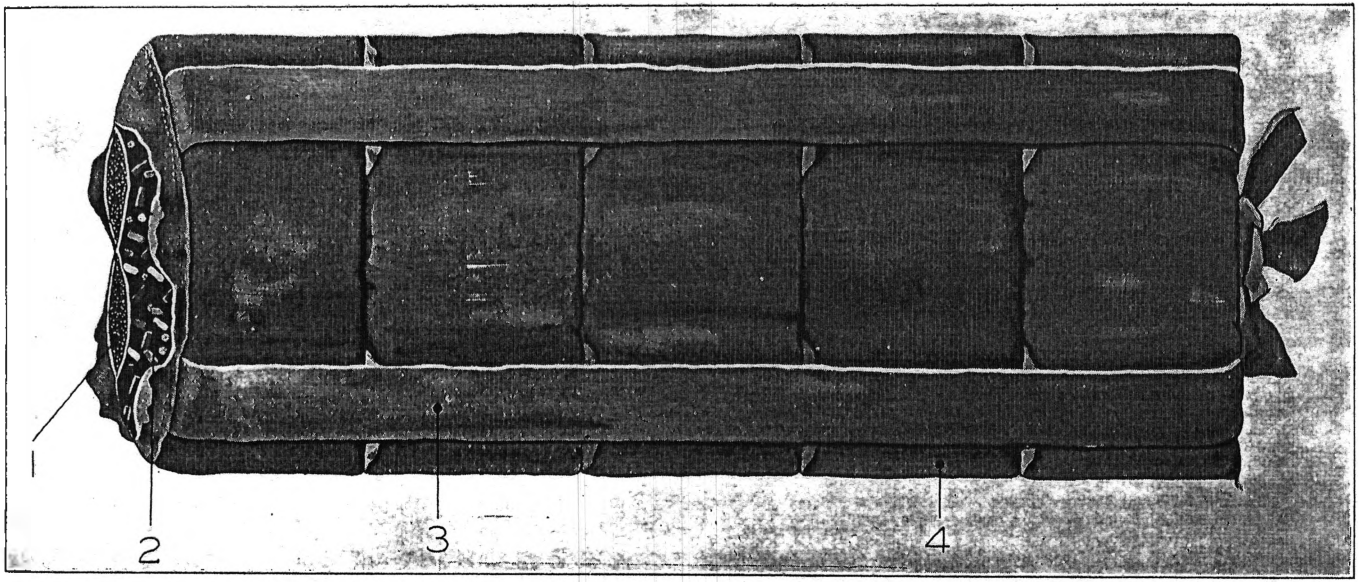

FIG. 11.—240-mm. howitzer cartridge bag

1. Igniter (black powder). 2. Propelling charge (smokeless powder). 3. Tying straps. 4. Zones or increments.

(*g*) Size and model of gun or howitzer for which the powder was made, in case of a lot of powder being used in a different gun or howitzer from the one for which it was originally intended.

(*h*) Weight of powder charge in all zones of the complete charge, weight of igniter, and total velocity and pressure obtained with each zone.

(4) Before inserting the charge in the howitzer, this tag must be removed.

c. Primer protector cap.—In order to protect the igniter pad containing black powder, at the rear end of the charge, a primer protector cap is furnished. This consists of a cup shaped cloth cover about 5 inches deep which fits over the rear end of the charge and is fastened to the charge by means of a drawstring. The primer protector cap is made of heavy cloth with a disk of felt sewed on the inside of the bottom. A cloth handle is sewed on the outside of the bottom, to facilitate the removal of the primer protector cap. The primer protector cap must be removed from the charge before loading the charge in the howitzer. Stenciled on the bottom of the primer protector cap in two places and on the side in one place are the words "REMOVE CAP BEFORE INSERTING IN GUN." The words "PRIMER PROTECTOR CAP" and the size and model of the howitzer are also stenciled on the side of the primer protector cap. In cases where more than one charge is packed in a cartridge storage case, such as is usually the case with 240-mm. howitzer charges, the bottom charge in the cartridge storage case only is fitted with a primer protector cap.

18. Storage.—All propelling charges are stored and shipped in cartridge storage cases. A full description of the cartridge storage cases, their markings, and the method of their shipment is contained in paragraph 21. Storage should be in places where the temperature is as near 60° F. as possible, and in no case should the temperature be above 100° F. Extreme care must be taken that no moisture enters the cartridge storage cases. The powder should be tested from time to time to determine its characteristics and stability. The temperature of the powder and its moisture content materially affect the pressure when the charge is fired.

SECTION VIII

PACKING

19. Projectiles.—*a.* The common steel or high-explosive shell, Mk. III, are usually shipped without being crated or boxed. An eyebolt lifting plug or an adapter plug is fitted in the fuze seat in the adapter of the shell to facilitate handling and to protect the fuze seat. The rotating band is protected by a rope grommet, as shown in Figure 12. The shell must be firmly secured against movement for transportation.

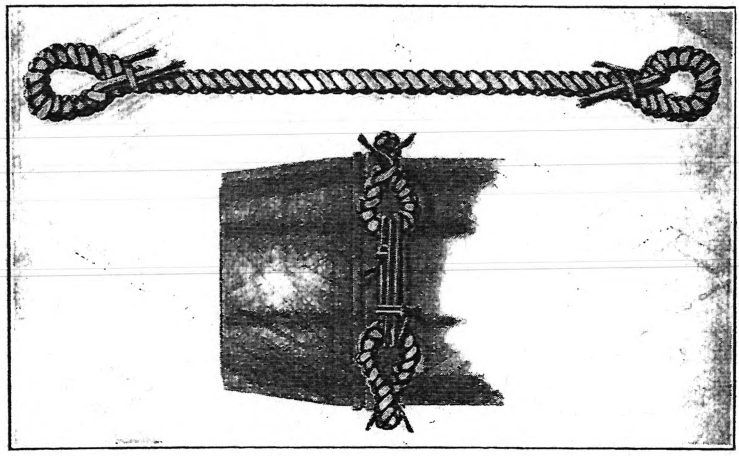

FIG. 12.—Rope grommet

b. Figure 13 shows a satisfactory method of packing these shell in freight cars for shipment. In this method of shipment the shell should preferably be stood on their bases and they must be properly braced to prevent excessive movement. Rows of shell should be separated by pieces of board to prevent the rotating bands from being damaged should the rope grommet slip out of place. If the shell are shipped on their side, they must be separated by pieces of board so as to prevent the rotating bands coming in contact with each other.

20. Packing boxes for fuzes.—*a. Type.*—The point detonating fuzes, Mk. III and Mk. IV, are never assembled in projectiles for

shipment. They are shipped in separate metal-lined wooden boxes. The fuzes are packed in trays which prevent excessive movement in shipment. There are 50 Mk. III or 100 Mk. IV fuzes in a box. The exterior dimensions of the boxes are exactly alike for both fuzes, the difference being in the trays. The cover of the wooden box is hinged and is held in placed by two thumb nuts. A wire is tacked to the lid and to the side of the box and sealed, thus preventing

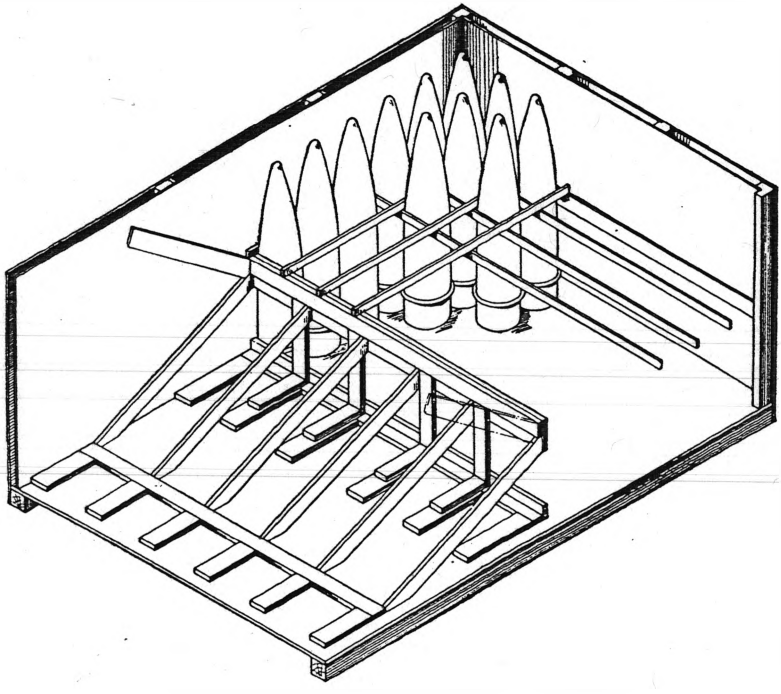

FIG. 13.—Method of packing projectiles in freight cars

tampering with the contents of the box without destroying the seal. The marking on this packing box is shown in Figures 14 and 15.

b. Metal lining.—The boxes have a metal lining which makes them waterproof, this lining being a complete box in itself. The cover is secured by a soldering strip which must be entirely removed before removing the cover. After the fuzes have been packed in the lining and the cover soldered on, the lining is tested for leaks by applying an internal air pressure of 4 pounds per square inch through a test hole in the cover. Leaks are indicated by an air-pressure gauge. After satisfactorily passing this test, the test hole is soldered over.

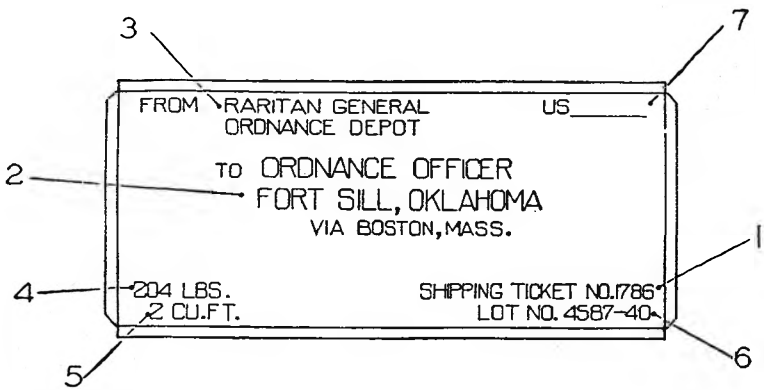

FIG. 14.—Address side for all packing boxes

1. Number of shipping ticket.
2. Designation and address of consignee (as shown on shipping instructions).
3. Consignor.
4. Gross weight, in pounds.
5. Cubic displacement, in cubic feet.
6. Ammunition lot number.
7. To indicate United States property.

NOTE.—Shipping officer may omit 2 and 3 in carload shipments.

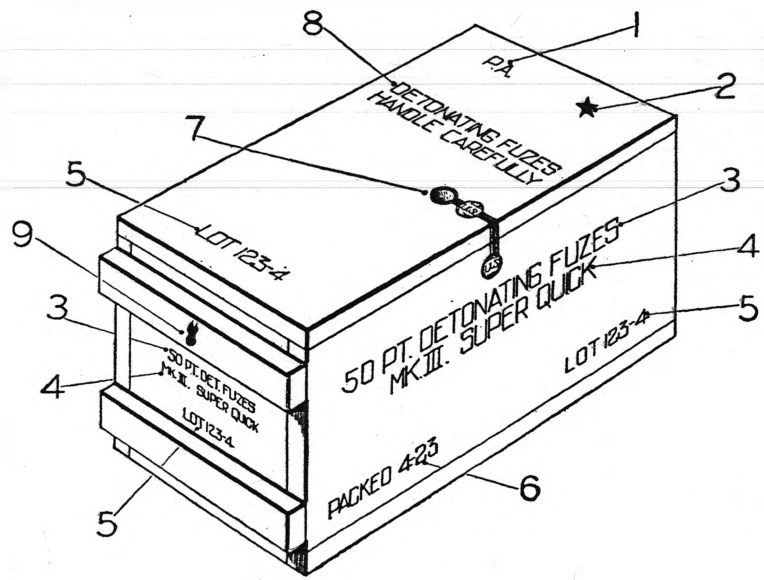

FIG. 15.—Packing box for point detonating fuze

1. Name of place where packed.
2. Inspector's stamp.
3. Quantity and kind of fuze.
4. Mark number and type of fuze.
5. Lot number.
6. Month and year of packing.
7. Seal.
8. To comply with I. C. C. regulations.
9. Ordnance insignia.

NOTE.—Both ends of box are marked alike.

If a box of fuzes is opened and for any reason part of the fuzes only are used during the season, the tin soldering strip should not be resoldered, but the wood cover should be securely fastened in place and the box appropriately marked, so that the remaining fuzes may be used at the first opportunity.

c. Size and weight.—The outside dimensions of the wooden box are approximately as follows: 9⅝ inches by 8¾ inches by 17$\frac{3}{16}$ inches. It occupies about 0.9 cubic foot of space. The total weight packed with Mk. III fuzes is about 80 pounds and with Mk. IV fuzes about 70 pounds.

21. Cartridge storage case.—*a. Purpose.*—The storage of the propelling charge is important and, since moisture affects the smokeless powder, all charges are packed in waterproof containers known as cartridge storage cases. The cartridge storage case contains two full propelling charges and two extra igniters.

b. Description.—(1) The cartridge storage case, Mk. III, is made of metal and is shown in Figure 16. The cartridge storage case for 240-mm. howitzer propelling charges is exactly the same as that for 8-inch gun propelling charges. It is approximately 10 inches in diameter by approximately 53 inches long and is made of heavy gauge sheet steel, the seam in the body and the joint where the bottom attaches to the body being welded. The cover (2) is clamped to the body (4) by a clamping spider (1), the hooked ends of which engage under the flange at the mouth of the body. The cover is sealed to the body against the entrance of moisture by a rubber gasket (3). The clamp screw (7) is used to compress the rubber gasket between the cover and the body, thus insuring an air-tight seal. This rubber gasket should be examined frequently and it should be replaced by a fresh rubber gasket when it has stretched or dried out to such an extent as to render leakage possible. To remove the charges, it is necessary to break the wire seal (5) between the clamp screw and the clamping spider, unscrew the clamp screw until the clamping spider is free to slide off, which will permit the cover to be removed.

(2) After the charges have been packed in this metal cartridge storage case and the cover clamped in place, the cartridge storage case is tested for leaks, by applying an internal air pressure of 5 pounds per square inch through the test hole in the cover. Leaks are indicated by an air pressure gauge. After satisfactorily passing this test, a pipe plug is screwed into the test hole to seal it.

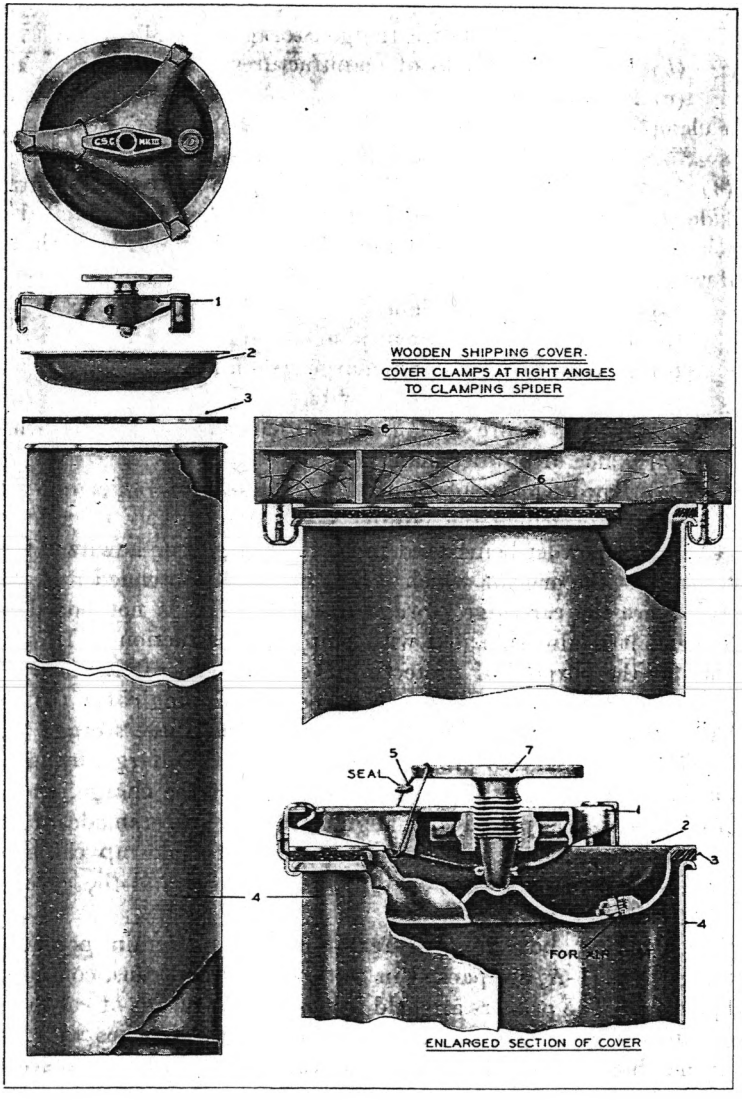

FIG. 16.—Storage case for propellent charge

1. Clamping spider.
2. Cover.
3. Rubber gasket.
4. Body.
5. Seal.
6. Wooden shipping cover.
7. Clamp screw.

(3) The body, cover, and clamping spider are embossed with the following information:

(*a*) C. S. C. Mk. III (Cartridge Storage Case Mk. III).
(*b*) Initials or symbols of manufacturer.
(*c*) 240-mm. HOW.

The clamp screw is embossed as follows:

C. S. C. Mk. III (Cartridge Storage Case Mk. III).

(4) Cartridge storage cases, Mk. III, are painted battleship gray. Besides the marking mentioned in (3) above, they are stenciled in black paint or have a printed tag glued to the outside with the following information:

(*a*) Name of loading plant.
(*b*) Date loaded (day, month, and year).
(*c*) Number of propelling charges contained.
(*d*) Caliber and model of howitzer.
(*e*) Weight of projectile that the charge is to be used with.
(*f*) Name of powder manufacturer.
(*g*) Powder lot number and size and model of gun or howitzer for which the powder was made, in case of a lot of powder being used in a different gun or howitzer from the one for which it was originally intended.

(5) Since the cartridge storage case, Mk. III, is not boxed for shipment, it is also stenciled with shipping instructions. In shipment, for the purpose of protecting the cover end of the cartridge storage case, this end is fitted with a wooden shipping cover (6).

(6) The propelling charge is held in the cartridge storage case, Mk. III, if necessary to prevent movement of the charge, by means of a disk of heavy cardboard, placed on top of the charge, and on top of this disk is placed a triangular-shaped spacer made of this same heavy cardboard, of a length sufficient to take up the space between the cardboard disk on top of the charge and the cover of the cartridge storage case.

22. Packing box for primers.—Twenty-one-grain percussion primers, Mk. II–A, are packed in waterproof metal cans, containing 50 primers. The primers are held in position by means of cardboard separators. These cans are about 5.7 inches long, 3 inches wide, and 2 inches high. The covers of these cans are secured in place by means of soldering strips. The marking on the packing cans is shown in Figure 17. The packing cans are packed in wooden packing boxes for quantity shipment. The standard wooden box contains 48 packing cans and 2,400 primers. This wooden box is ap-

proximately 26½ inches long, 10⅞ inches wide, and 9⅞ inches high. It occupies about 1.57 cubic feet of space and weighs about 85 pounds.

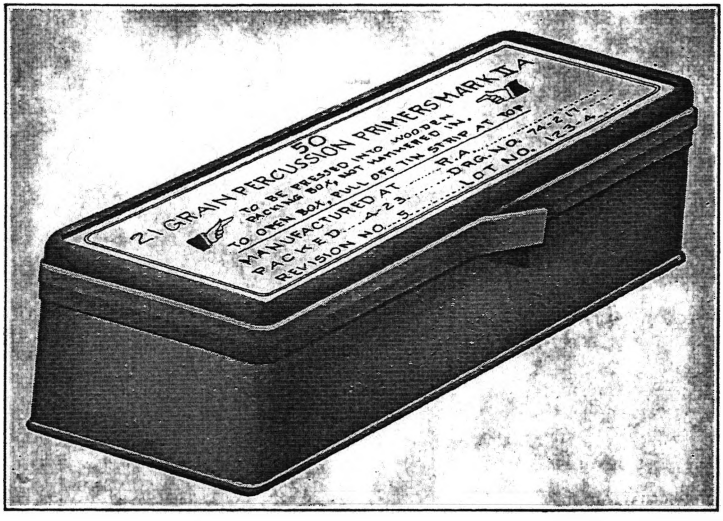

FIG. 17.—Packing can for 21-grain percussion primers, Mk. II–A

Primers must always be stored in a dry place, as excessive moisture may cause them to fail to function.

[A. G. 062.12 (11–20–26).]

By ORDER OF THE SECRETARY OF WAR:

C. P. SUMMERALL,
Major General,
Chief of Staff.

OFFICIAL:

LUTZ WAHL,
Major General,
The Adjutant General.

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