No. 1727

FUZES

FOR USE IN

MOUNTAIN, FIELD, SIEGE, AND SEACOAST PROJECTILES

AND IN

DETONATING FUZES

(15 PLATES)

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FUZES FOR MOUNTAIN, FIELD, SIEGE. AND SEACOAST PROJECTILES.

The following tables give a complete list of the fuzes now used in the service.

They are classified under four heads in accordance with their types, as follows: Table I, Ring-resistance fuzes; Table II, Centrifugal fuzes; Table III, Combination time and percussion fuzes; Table IV, Detonating fuzes.

The first column of each table gives the designation of the fuze. The other columns give all the necessary data in connection with the fuzes, including the projectile or fuze stock in which used.

Drawings are appended hereto of each fuze sufficiently in detail to show clearly the construction and method of assembling the fuze when examined in connection with description given in the text.

The following elements are common to all fuzes of whatever class and are essential: The plunger, the firing pin, and the percussion primer.

The composition of the percussion primer of all fuzes manufactured at Frankford Arsenal for the service is the same, and consists of the following ingredients in the proportions named:

Chlorate of potash, 50.54.
Sulphide of antimony, 26.31.
Sulphur, 8.76.
Ground glass, 12.39.
Shellac, 2.00.

The thoroughly pulverized ingredients are mixed dry, and alcohol is added to dissolve the shellac. The percussion pellets are formed by pressing the mixture while in a plastic state into the percussion-primer recess. Upon the evaporation of the alcohol the shellac causes the pellet to adhere strongly to the metal of the recess.

A mercuric fulminate primer composition was formerly used in fuze primers, but on account of the danger incident to handling this compound it has been abandoned as a primer ingredient.

It is still used abroad, and the percussion composition of both the Ehrhardt and Krupp combination time and percussion fuzes contains mercuric fulminate.

RING-RESISTANCE FUZES.

Ring-resistance fuzes are made both base and point insertion, and consist essentially of the following parts: The fuze stock or body, the firing-pin sleeve, the split-ring spring, the firing pin, the percussion primer, and the fuze cap.

In general, an auxiliary charge of powder is added to increase the flame from the ignition of the percussion primer.

All ring-resistance fuzes are constructed in accordance with the same general principles.

The plunger, consisting of the firing-pin sleeve and firing pin, is maintained in its normal or unarmed position by the resistance of a split-ring spring of brass.

If sufficient force is applied to the sleeve in the direction of its axis the split ring will be expanded, the sleeve forced to the rear, the firing pin exposed, and the plunger armed.

To insure arming of the plunger when fired, the resistance of the split-ring spring is made less than the force necessary to give the sleeve the maximum acceleration of the projectile.

There are two classes of ring-resistance fuzes manufactured, the "high resistance" and the "low resistance," so called because the arming resistance of the ring is relatively "high" or "low."

High-resistance fuzes are safe under all ordinary conditions of handling and transportation, and are transported fixed in the projectiles in which used.

Low-resistance fuzes can not, on account of the danger of premature arming, be transported inserted in projectiles.

The low-resistance fuzes are transported packed in hermetically sealed boxes, and, to prevent premature arming of the plunger in handling, the firing-pin sleeve and the firing pin are locked together by means of a safety wire passing through them and the body of the fuze. Just before using this wire must be pulled out, after which the fuze may be screwed into the projectile.

All of the fuzes enumerated in Table I belong to the high-resistance class, the only low-resistance fuzes at present issued to the service being the 28-second combination fuze, low resistance, for use in 7-inch mortar shrapnel.

The numbers given in Table I, under the column headed $\frac{W}{R}$, are the numerical values of the ratio of the weight of the firing-pin sleeve in grains to the resistance of the split-ring spring to arming in pounds. This ratio is a measure of the safety of the fuze in handling and transportation; the smaller the value of the ratio the greater the safety of the fuze, and vice versa.

These ratios, for various pieces in service, have been determined by actual firing tests, by means of a specially designed apparatus

assembled in shell of different calibers and involving fuze plungers with varying ratios. These plungers were assembled in a way to permit arming in the usual way, and to prevent inverse arming by impact. By inverse arming is meant the forcing of the firing pin forward through the sleeve instead of the sleeve rearward over the pin.

All service fuzes are stamped to show the distinguishing letter of designation and place of manufacture. All service point fuzes have a right-hand thread, which, in connection with the right-hand twist of the rifling, causes a tendency of the fuze to tighten in its seat on discharge. For the same reason all base fuzes have a left-hand thread. All point combination time fuzes are staked to the shrapnel to prevent unscrewing. This is accomplished by cutting several notches in the forward end of the shrapnel and forcing metal of the fuze body into these notches. Base fuzes for all mobile artillery are similarly staked.

Just before screwing a fuze into a loaded black-powder shell a thick coat of rubberine paint, or such other paint as the Ordnance Department may furnish for the purpose, should be applied with a small brush to the fuze thread, and the fuze should then be wrenched up tight in its seat. The paint assists to make a gas-tight joint and may serve to prevent a premature explosion in case of failure to remove all loose grains of powder from the fuze-seat thread.

The arming resistance of ring-resistance fuzes is tested in the course of manufacture with a static machine, which gives the weight necessary to force the sleeve over the firing pin against the resistance of the split-ring spring. They are also tested by assembling them in shell and dropping the shell upon a steel plate.

The following description in detail of the "point percussion fuze for 1-pounder and 1.65-inch shell, standard type," applies generally to all ring-resistance fuzes, so far as the important details are concerned:

Minor-Caliber Point Percussion Fuze for 1-pounder and 2-pounder Shell, Standard Type (Plate I, figs. 1 and 2).

a, body, brass.
b, percussion-primer cup, brass.
c, percussion-primer screw, brass.
d, tin-foil disk.
d', primer charge, black powder.
e, percussion composition.
e', primer shield, brass.
f, firing pin, brass.
g, firing-pin sleeve, brass.

h, split-ring spring, brass.
i, locking groove.
j, closing screw, brass.
k, closing disk, brass.

Assembled as shown on the drawing.

The fuze is made principally of hard-rolled brass. The body, which forms a housing for the parts of the fuze, is struck at the head with a radius corresponding to that of the 1-pounder and 1.65-inch shell in which used. Two slots are formed in the head for a spanner wrench for insertion and removal of the fuzes from projectiles.

The outside of the body is turned and threaded and the interior, after being bored out for the plunger and primer parts, is threaded for the closing screw *j*.

The front end of the plunger cavity is bored out to form a recess for the primer and is threaded with a left-hand thread on the interior for the primer screw. A hole in the top of the primer screw permits the firing pin to strike the primer on impact, and allows the flame from the primer to come to the rear and ignite the shell charge. The primer screw holds the primer cup in place and is provided with two holes for a spanner wrench for insertion and removal. It is locked in place by upsetting a portion of the metal of the primer screw into the thread in the fuze body. The primer cup is 0.03 inch longer than the recess in the primer screw, so that when the later is screwed down hard it bears upon the bottom of the primer recess.

The primer cup is the standard type used in percussion fuzes. It has two chambers separated by a solid-vented partition. The lower chamber, 0.03 inch deep, holds the percussion composition, and is under-cut to assist in holding it in place. The primer shield *e'* prevents any dislodgment of the composition during transportation or by shock of discharge and also restrains the firing pin during flight of the projectile.

In the unarmed or safe condition of the fuze, the split ring rests on the conical slope on the firing pin and sustains the firing-pin sleeve. The resistance of this ring to the expansion necessary to force it over the slope is less than the force required to transmit the maximum acceleration of the projectile to the sleeve. This insures, as already stated, the arming of the fuze in the bore of the gun on discharge.

The counterbored ring recess in the rear of the sleeve requires careful adjustment of dimensions. The diameter at the rear will just receive the unexpanded ring and the diameter of the counterbore will just receive the expanded ring. When the ring rests in the locking groove it has an intermediate expansion sufficient to

prevent its withdrawal from the sleeve, and this locks the sleeve and the firing pin together.

The plunger is assembled by slipping the split ring over the firing pin until it rests on the conical slope, and then inserting the pin into the sleeve from the rear. The plunger is then placed in the fuze body, pin to the front, and the closing screw screwed down hard and keyed by driving a portion of the sharp lip into a notch in the end of the body of the fuze.

To insure ready passage of the flame from the primer to the rear the front end of the sleeve is counterbored, a hole is drilled through the firing pin at right angles to its axis meeting a hole drilled through its axis. The closing screw is also drilled centrally and closed by the closing disk, which is held in place by a crimping wall at its edge.

The length of the unarmed plunger is shorter than that of the plunger cavity by from 0.01 to 0.02 inch, so that a slight movement of the plunger is discernible when the assembled fuze is held to the ear and shaken. This is required to insure that the screwing down of the closing screw to its shoulder shall not apply pressure to the upper end of the sleeve, which would tend to force the ring over the slope and arm the fuze.

The act of arming shortens the plunger and increases materially the longitudinal play of the plunger in its cavity. This fact permits a ready and simple means of inspecting for premature arming without dismantling the fuze. A very little practice in holding to the ear and shaking two fuzes, one armed and the other not, will serve to distinguish the marked difference in the play of the plunger.

The action of the fuze when the piece is discharged is as follows: The firing-pin sleeve moves relatively to the rear, for the reason previously stated, and is locked to the firing pin as explained. The point of the firing pin now projects above the sleeve and the fuze is armed, or " ready," as shown in the figure.

As the projectile meets with atmospheric retardation the plunger creeps forward until stopped by the primer shield. When the projectile strikes, the pin pierces the shield and the thin layer of percussion composition. The small portion of this composition caught between the point of the pin and the anvil is ignited, firing the primer charge.

Point Percussion Fuze for 1.65-inch Shell of Hotchkiss Manufacture, Frankford Arsenal Fuze Elements (Plate II, figs. 3 and 4).

This fuze differs from the standard type just described in the diameter of the outside thread, over-all length, and in the closing screw and primer details.

It consists of the following parts, arranged as shown on the drawing:

a, fuze body, brass.
b, primer screw, brass.
c, closing screw, brass.
d, tin-foil disk.
d', primer cup, brass.
e, primer charge, powder.
f, percussion composition.
g, primer shield, brass.
h, firing-pin sleeve, brass.
i, firing pin, brass.
j, split-ring spring, brass.
k, locking groove.
l, closing disk, brass.

The material used in this fuze is the same as that in the standard type just described.

The fuze body in this case is bored out from the front and threaded for the closing screw, the base being left solid and drilled centrally. The closing screw is bored out to form a recess for the primer cup and threaded for the primer screw, which holds the cup in place.

The number of these fuzes manufactured is limited by the number of 1.65-inch Hotchkiss shell on hand requiring the 0.838 thread, about 3,800.

Point Percussion Fuze for 1.65-inch Shell of Winchester Repeating Arms Company Manufacture, Frankford Arsenal Fuze Elements (Plate II, figs. 1 and 2).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, primer screw, brass.
c, closing screw, brass.
d, tin-foil disk.
d', primer cup, brass.
e, primer charge, powder.
f, percussion composition.
g, primer shield, brass.
h, firing-pin sleeve, brass.
i, firing-pin, brass.
j, split-ring spring, brass.
k, locking groove.
l, closing disk, brass.

A small number of these fuzes was manufactured for test in 1-pounder maximum capacity subcaliber shell, for which shell it was originally designed; a sufficient number has also been furnished for the number of 1.65-inch Hotchkiss shell of Winchester Repeating Arms Company manufacture requiring this thread, about 4,600. It is superseded by the 1-pounder and 1.65-inch point percussion fuze, the contour of the latter being superior ballistically.

Point Percussion Fuze for 1.65-inch Shell, Former Standard Type (Plate I, figs. 3 and 4).

This fuze consists or parts corresponding to those given in the description of the fuze for 1.65-inch shell of Hotchkiss manufacture. A sufficient number of these fuzes has been manufactured for the number of 1.65-inch Hotchkiss shell on hand requiring this thread, about 5,000. It is superseded by the minor-caliber point percussion fuze for 1-pounder and 1.65-inch shell, standard type.

Base Percussion Fuze for 1.65-inch Shell, Former Type (Plate III, figs. 1 and 2).

This fuze consists of the following parts assembled as shown on the drawing:

a, body, brass.
b, cap, brass.
c, closing disk, brass.
d, primer screw, brass.
e, primer charge.
f, percussion composition.
g, primer shield, brass.
h, firing-pin sleeve, brass.
i, firing pin, brass.
j, split-ring spring, brass.
k, locking groove.

The action of the base fuze and the functions of its parts are the same as those of the point fuzes, the only essential point of difference being the position of the primer with reference to the shell charge. In the case of the point fuze the flame from the primer has to pass either through or around the plunger from front to rear. In base fuzes the flame does not have to cross any intervening space.

Base Percussion Fuze for 1-pounder Shell, Former Standard Type (Plate III, figs. 3 and 4).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, closing disk, brass.
c, closing cap.
d, percussion-primer cup, brass.
e, percussion composition.
f, primer shield.
g, firing-pin sleeve, brass.
h, split-ring spring, brass.
i, firing pin, brass.

A limited number of these fuzes was made for use in 1-pounder base-tapped shell. In order to secure uniformity in the fuzes for use in small-caliber shell and at the same time secure greater weight of plunger this fuze is superseded by the standard type of base fuze for 1-pounder and 1.65-inch shell just described.

Minor-Caliber Base Percussion Fuze for 2.38-inch and 6-Pounder Shell, Standard Type (Plate IV, figs. 1 and 2).

This fuze supersedes all those previously manufactured for 2.38-inch and 6-pounder powder charged shell.

Base Percussion Fuze, "High C" (Plate IV, figs. 3 and 4).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, primer-closing screw, brass.
b', closing cap, brass.
c, tin-foil disk.
d, primer cup, brass.
e, percussion composition.
f, primer shield.
g, firing-pin sleeve, brass.
h, firing-pin, brass.
i, split-ring spring, brass.

The principal difference between this fuze and those just described is that the primer cup is not threaded. The fuze cap is counterbored for the primer cup and threaded for the primer-closing screw. The latter is vented as shown to permit the passage of the flame from the primer to the shell charge.

There are no fuzes of this type on hand; there are about 28,000 plungers, consisting of the firing pin, the firing-pin sleeve, and the split-ring spring, for which fuze bodies may be manufactured from time to time, when required for projectiles of older manufacture tapped for this fuze.

Base Percusion Fuze, " High A" Model (Plate V, figs. 1 and 2).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, primer-closing screw, brass.
c, tin-foil disk.
d, primer cup, brass.
e, percussion composition.
f, primer shield, brass.
g, firing-pin sleeve, brass.
h, firing pin, brass.
i, split-ring spring.
j, locking groove.
k, closing disk, brass.
l, reenforcing charge.

This is an obsolete type of fuze, a few of which still remain in service.

Base Percussion Fuze, Medium and Major Caliber (Ring-Resistance Type).

This fuze is shown on PlateV, figures 3 and 4. It does not differ in principle from the ring-resistance fuzes " High A" or " High C." It is intended for use in powder charged shell from 2.95-inch to 7-inch, in caliber, when fired from guns giving high accelerations.

CENTRIFUGAL FUZES.

The centrifugal fuze of service pattern is the result of a long series of experiments with a view to obtaining a design embracing all the conditions of absolute safety in handling and transportation and certainty of action.

In the case of ring-resistance fuzes, or any fuze the action of which depends on the longitudinal stresses developed by the pressure of the powder gases in the gun on discharge, the conditions of safety in handling and certainty of action are opposing ones.

It was impossible to meet successfully both sets of conditions in all cases, the stress developed in the direction of the axis by accidental dropping of a fuze being in many cases higher than those developed in the gun.

As already stated under " Ring-resistance fuzes," two classes were necessary, the " low resistance " and the " high resistance," the former being transported in hermetically sealed boxes and a retaining wire used to prevent premature arming, it being necessary to remove the wire before inserting the fuze.

Rapid-fire conditions have rendered it necessary that all fuzes be transported fixed in projectiles, as too much time would be lost under war conditions if fuzes had to be unpacked and inserted during an engagement.

A fuze depending on the centrifugal force developed by the rotation of the projectile was the only solution in case of fuzes for the howitzer and mortar projectiles, the acceleration of which is relatively low.

The centrifugal plunger has been retained also for use in seacoast rifles of calibers larger than 7-inch, owing to the difficulty of designing a ring resistance plunger which would be safe in handling, and at the same time certain of arming with the accelerations obtainable from those guns.

The greater simplicity and cheapness of the ring-resistance fuze, and the greater certainty of its action, make it more suitable for use wherever practicable.

The fuze body and the primer parts of the centrifugal fuze do not differ from those of the ring-resistance fuze.

The centrifugal plunger is in two halves which move outward, arming the plunger, under centrifugal force, keeping their faces parallel to each other. The outward motion of the halves is resisted by a spring, the strength of which is governed by the number of revolutions per minute required by the prescribed resistance to arming.

The design of centrifugal plunger adopted for service is known as the " link lift " design.

In this plunger the firing pin is mounted upon an axis, and in the closed position of the plunger points away from the primer, making an angle of almost 90° with the axis of the fuze; in the armed position the pin revolves to a position coincident with the axis of the plunger and points directly at the primer. As soon as the force which causes the plunger to arm ceases to act, the plunger halves close and the pin folds down to its normal or unarmed position.

To cause the centrifugal plunger to take up readily the rotation of the projectile due to the rifling, centrifugal fuzes are provided with a rotating device consisting of a stud or fin screwing into the base of the fuze, and engaging in a slot in the plunger, or of a pair of jaws in the bottom of the plunger cavity which engage over corresponding flat surfaces on the plunger.

All centrifugal fuzes manufactured are tested in a rotating machine to verify their resistance to arming. Samples from each lot are also tested in specially designed jumbling and jolting machines to detect any defects in manufacture or design.

Centrifugal plungers are used in service in the base percussion fuze "F;" in the base percussion fuze, medium and major caliber, when that fuze is used in mountain guns, howitzers, and mortars; in the base detonating fuze, medium caliber, when similarly used; in all base detonating fuzes, major caliber, and as the percussion plunger in about 15,000 of the Frankford Arsenal 21-second combination fuzes and in all 31-second combination fuzes.

The following description of the centrifugal fuze "F" is applicable in its general features to the other fuzes of this design.

The Centrifugal Fuze "F" (Plate VI, figs. 1 and 2).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, brass.
b, closing cap screw, brass.
c, restraining disk, brass.
d, primer cup, brass.
e, primer disk, tin foil.
f, primer-closing screw.
g, percussion plunger, brass.
h, percussion-plunger bushing, brass.
i, *j*, arming resistance bolt and nut, brass.
k, arming resistance spring.
l, firing-pin link, brass.
m, firing pin, brass.
n, rotating fin, brass.

The material used in the manufacture of this fuze is principally hard-rolled brass. The fuze body *a* is the same as that of the "High C" fuze. The closing cap screw and the primer parts are identical with those of the "High C" fuze. The two figures show the plunger before arming and after arming. The plunger *g* is seen to be composed of two pieces of brass almost semicircular in cross section. From the upper part of the right-hand half a lug projects which fits into a corresponding recess in the other. The firing pin *m* is mounted upon an axis passing through the projecting lug on the right-hand half, as shown on the figure.

The upper end of each half is slotted to receive the firing-pin link and the firing pin. The firing-pin link is pivoted upon an axis in the left half parallel to the firing-pin axis. The other end of the

firing-pin link is connected to the firing pin by a crank pin, the center of which is 0.095 inch from the center of the firing-pin axis.

With this arrangement, moving the halves of the plunger outward causes the pin to revolve upward, and vice versa. The radius 0.095 inch of the arc described by the center of the crank pin, limits the outward movement of the halves to 0.09 inch to bring the firing pin to an upright position. When in this position the end of the firing-pin link bears on the firing-pin axis, giving rigid support to the firing pin when it strikes the percussion primer.

The outward movement of the halves of the plunger is resisted by the arming resistance spring *k*, which is assembled in the percussion-plunger bushing *h*, under initial compression. One end of the spring bears against the bottom of the bushing *h* and the other against the nut *j* on the end of the arming resistance bolt *i*, so that the tendency is to keep the halves together all the time. When the plunger is in its open or armed position, the nut *j* comes to a bearing against the shoulder shown in the percussion-plunger bushing, limiting the outward movement of the halves to 0.09 inch.

The percussion-plunger bushing *h* is a drive fit in the left-hand half of the plunger and an easy fit in the right-hand half, the clearance in the latter case being 0.001 inch.

The rotating fin *n* engages in the corresponding slot in the plunger halves and causes them to take up at once the rotation due to rifling.

Base Percussion Fuze, Medium and Major Caliber (Plate VI, figs. 3 and 4).

This fuze is similar to the "F" fuze, except that the plunger is shorter and heavier. The device for causing the plunger of this fuze to take up the rotation of the projectile consists of a brass piece in the shape of a pair of jaws fastened in the bottom of the fuze cavity. This fuze is for use in powder-charged shell from the 2.95-inch to the 12-inch, inclusive, when used in guns giving low accelerations.

Centrifugal Fuze, 12 M (Plate VII, figs. 1 and 2).

This fuze is used in torpedo detonating fuzes, Peirce stocks, tapped therefor, to the number of 2,200. There are also under manufacture 3,404 fuzes similar to the above, but with cylindrical heads, for use in a like number of armor-piercing detonating fuzes, Peirce stocks tapped therefor. No other fuzes of this design are to be manufactured.

COMBINATION FUZES.

All combination fuzes used in the service are point insertion and combine the elements of time and percussion arranged to act independently in one fuze body.

Combination fuzes contain two plungers and two primers, arming and firing by concussion and percussion respectively.

The concussion plunger arms and fires the concussion primer by shock of discharge in the bore of the piece and ignites the time element. The percussion plunger is armed by the shock of discharge and fires its primer on impact.

There are at present two general classes of combination fuzes in service, differing principally in the details of the time-train elements. In the first class this element consists of a wire-drawn lead tube filled with meal powder wound in a spiral groove around a lead cone. In the second class this element consists of two superposed trains of meal powder compressed under heavy pressure into annular grooves in disks of brass.

The first class is represented by the following Frankford Arsenal combination fuzes, of which there are a considerable number on hand: The 15-second, the 28-second high-resistance, and the 28-second low-resistance combination fuzes. No more fuzes of this class are to be manufactured.

Combination fuzes belonging to the first class can not be reset, while those belonging to the second class may be reset as many times as may be desired.

The second class is represented by the Frankford Arsenal 21-second combination fuze. The method of preparing the time train of this fuze insures much greater uniformity in the action of the fuze than in the case of the lead-train fuze. It has, therefore, been adopted for use.

The Ehrhardt and the Krupp combination fuzes, of which there are a limited number at present in service, belong to the second class. They differ from the Frankford Arsenal 21-second combination fuze and from each other principally in the details of the plunger and primer elements, as is indicated in the description and the drawings.

All fuzes belonging to the second class, Frankford Arsenal combination fuze, Krupp combination fuze, and Ehrhardt combination fuze, are provided with a stud fitting in the movable time-train disk, and a slot in the fuze body to enable them to be set for a given range by means of a fuze setter.

The 15-Second Combination Fuze (Plate VIII, figs. 1 to 5).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, bronze.
b, powder ring.
b', retaining ring, brass.

b^2, brass washer.
b^3, gas-check cup.
b^4, felt gas check.
c, time train.
d, time-train cone, lead.
e, cone cover, brass.
f, cap, brass.
g, clamping nut, brass.
h, concussion or time plunger, brass.
h', split-ring spring, brass.
i, safety pin, brass.
j, connecting tube.
k, closing screw, brass.
k', powder magazine.
l, percussion primer.
m, concussion firing pin, steel.
n, percussion firing-pin sleeve, brass.
o, percussion firing pin, brass.
p, cone dowel pins, brass.
q, cover dowel pins, brass.
r, percussion composition.
r', tin-foil disk.
s, vents (4).
t, split-ring spring percussion plunger, brass.
u, wrench hole.
z, bottom closing screw, brass.
z', paper disk.
z^2, base cover, brass.

The time element is composed of the concussion or time plunger h, the firing pin m, the cone d, the time train c, the cone cover e, the cap f, and the clamping nut g.

The plunger h is cylindrical in shape and contains the fulminate primer r in a recess at its base. Its upper extremity is pierced to receive a safety pin, i, which retains the plunger in its safe or unarmed position in handling and transportation. When the safety pin is removed, which is done just before firing, the weight of the plunger rests on the split-ring spring h'.

The action of the latter on discharge is similar to that of the split-ring spring of other ring-resistance fuzes already described.

The cone d is an alloy of soft metal held in place on the fuze body by the clamping nut g and a groove at the bottom, and is prevented from turning by four steel dowel pins, p.

The lip on the bottom of the cone, entering the groove in the body, acts as a gas check to prevent ignition of the powder in the connecting tube. On the exterior of the cone d is a left-handed groove which

carries the time train c, and this time train communicates at its lower end with the priming charge in the tube j and thence with the magazine k'.

The time train c is formed of a lead tube filled with meal powder and wire drawn.

The cone cover e is of brass, and is held in place by the cap f, and prevented from turning by a small pin, q, projecting from the body a, and fitting in a slot in its lower edge. On the exterior of the cone is a left-handed groove corresponding to that on the time cone d, and this groove is pierced with holes numbered from 1 to 15, corresponding to the number of seconds, the spaces between the holes being divided into five equal parts.

The percussion element of this fuze consists of a ring-resistance plunger and an ordinary percussion primer.

ACTION OF THE FUZE.

As a Time Fuze.—A hole is punched through the cover, time train, and lead cone at the point in the cover corresponding to the number of seconds desired. Just before loading, the safety pin i is removed. This allows the time plunger h to rest on the fuze body, where it is held by the split-ring spring h'. The projectile is now inserted in the gun. By shock of discharge the split-ring spring is expanded and the plunger forced to the rear, the primer r striking the firing pin and exploding. The flame from the primer passes through the four radial holes s and ignites the ring of compressed powder b. The only vent for these gases is the punched hole, and they ignite the time train at that point. The latter burns and ignites the powder in the tube j and the magazine k. The flame from the magazine charge passes through the percussion primer and percussion-plunger chamber and ignites the bursting charge in the shrapnel.

As a Percussion Fuze.—The percussion plunger arms by shock of discharge and fires the percussion primer on impact as in other percussion fuzes. The percussion plunger is grooved or fluted to permit ready passage of the flame from the front to the rear. In order to use this fuze in base-charge shrapnel an extension piece of the form shown on the drawing is screwed into the base of the fuze in place of the bottom closing screw z. The ignition of the pellet of compressed powder in the extension piece transmits the flame through the central tube to the base charge.

The 28-Second Combination Fuze, High and Low Resistance.

These fuzes do not differ essentially from the 15-second combination fuze except that the low-resistance fuze is provided with a

wire passing though the walls of the fuze and the percussion plunger to prevent the latter from arming prematurely in transportation or handling. An outside view of this fuze is shown on Plate VIII, fig. 3.

Frankford Arsenal 21-Second Combination Fuze (Plate IX, figs. 1, 2, 3, and 4).

This fuze consists of the following parts, assembled as shown on the drawing:

a, body, bronze.
b, front closing cap, bronze.
c, upper time-train ring, bronze.
c', cloth washer.
d, lower time-train ring, bronze.
d', cloth washer.
d^2, fuze setter stud, brass.
e, time or concussion plunger.
e', split-ring spring, brass.
f, firing pin, brass.
g, vent leading to upper time train.
h, compressed-powder pellet.
i, upper time train, compressed powder.
j, compressed-powder pellet, in vent leading to lower time train.
k, lower time train, compressed powder.
l, compressed-powder pellet in lower time-train vent.
l', brass disk crimped in place.
m, compressed-powder pellet in vent *o*.
o, vent leading to magazine.
p, powder magazine.
q, centrifugal percussion plunger.
r, percussion primer.
s, vents leading from percussion primer to magazine.
t, closing cup, brass.
u, bottom closing screw, brass.
v, linen gauze.
w, washer, brass.
x, rotating device, brass.

The body *a* and the front closing cap *b* of this fuze are machined from bronze castings. The upper and lower time-train rings *c* and *d* are turned from hard-rolled rods of Tobin bronze. An annular groove in the shape of a horseshoe is milled in the lower face of each of the time-train rings. Meal powder is compressed into these grooves under a pressure of 70,000 pounds per square inch, forming a time train the total length of which is 7 inches.

The time element of this fuze is composed principally of the following parts: The time or concussion plunger *e*, the split-ring spring *e'*, the firing pin *f*, the vent *g* leading to the upper time train, the compressed-powder pellet *h*, the upper time train *i*, the compressed-powder pellet *j*, the lower time train *k*, the compressed-powder pellet *m* in the vent *o*, leading to the powder magazine *p*.

As stated above, the annular grooves into which the meal powder of the time train is pressed are in the shape of a horseshoe, a solid portion being left between the ends of the groove in each ring or disk.

The upper ring *c* is prevented from rotating by pins, which are halved into the fuze body and the inner circumference of the ring.

The vent *g* is drilled through the walls of the concussion-plunger chamber and is exactly opposite a hole in the inner surface of the upper time train leading to the end of the train from which the direction of burning is anticlockwise.

The hole *j* is drilled through the upper face of the lower time-train ring *d*, to the end of the lower time-train groove from which the direction of burning is clockwise. The lower time-train ring is movable and is graduated on its outer edge in a clockwise direction from 0 to 21, each full division corresponding to one second time of burning in flight; these divisions are subdivided into five equal parts corresponding to one-fifth second. A fixed pin or stud is provided on the lower or graduated time-train ring, which enters a notch in the corrector ring of the fuze setter when setting the fuze. An arrow on the lower flange of the fuze stock is the datum line for fuze settings.

The vent *o* is drilled through the flange of the fuze stock to the powder magazine *p*, and leads to the same end of the lower time train as the vent *j*—that end from which the direction of burning is clockwise—when the fuze is at its " zero " setting.

The action of the fuze as a time fuze is as follows:

Assume first the " zero " setting as shown on the figure. The time plunger arms and fires the primer which it carries as in the case of the 15-second fuze described. The flame from the primer passes out through the vent *g*, igniting the pellet *h*, the end of the upper time train *i*, down through the vent *j*, to the end of the lower time train *k*, and thence through the vent *o*, to the magazine *p*, the flame from which is transmitted to the base charge in the shrapnel. It will be seen that for the " zero " setting of the fuze the origin of both upper and lower time trains are in juxtaposition. Assume any other setting, say twelve seconds: The vent *j* has now changed its position with respect to the vent *h*, leading to the beginning of the upper time train and the vent *o*, leading to the powder magazine *p*, both of which points are fixed by the angle subtended between the 0 and the 12-second settings. The flame now passes out through vent *g* and burns along the upper time train in an anticlockwise direction until

the vent *j* is reached, where it passes down to the beginning of the lower time train and burns back in a clockwise direction to the position of the vent *o*, whence it is transmitted by the pellet of compressed powder *m* to the powder magazine *p*.

For the 21-second setting the vent *j*, leading to the beginning of the lower time train, is opposite the end of the upper time train and the end of the lower time train is opposite the vent *o*, leading to the powder magazine. It will now be seen that to reach the magazine *p* and burst the shrapnel, the entire length of time train in both rings must be burned.

As already stated, the annular grooves in the lower face of each ring for the powder trains do not form complete circles, a solid portion being left between the ends of the grooves in each. This solid portion is utilized to obtain a setting at which the fuze can not be exploded, known as the "safety point."

This point is marked by a line on the outer edge of the movable time train, surmounted by an "S," and is located about halfway between the 0 and the 21-second graduations. When this point is brought opposite the arrow on the lower flange of the fuze body the vent *j* is covered by the solid metal between the ends of the upper train; and the vent *o*, leading to the powder magazine *p*, is covered by the solid metal between the ends of the lower or movable time train.

At the safety setting it will be seen that the upper train may burn entirely out in case of accidental firing of the time plunger, or in case it may be desired to burst the shrapnel by impact or percussion, without the flame being able to reach the magazine *p*.

The cloth washers *c'* and *d'* are glued to the upper face of the time-train ring and to the upper face of the flange on the fuze stock. These surfaces are corrugated as shown to make the washers adhere more strongly. The function of the washers is to make a gas check and prevent premature action of the fuzes.

The compressed pellet *l*, in the vent leading from the outside to the beginning of the lower time train, is to release the pressure of the gases due to the burning train. A corresponding vent for the upper train is shown in fig. 1.

The percussion element of this fuze consists of the percussion plunger *q* and an ordinary percussion primer *r*.

To cause the centrifugal percussion plunger to take up immediately the rotation of the projectile due to the rifling, the rotating device *x*, which consists of a pair of jaws fitting over corresponding flat surfaces on the plunger, is fastened to the fuze body, as shown on the drawing.

The system of vents through the walls of the fuze shown in fig. 3 conduct the flame from the percussion primer to the magazine *p*.

In the fuzes provided with centrifugal plungers, the brass cup *t* closes the end of the percussion-plunger recess and prevents powder from entering. The bottom closing screw bears upon it when screwed down and keeps it firmly in place. The linen gauze cover *v* is coated with shellac and held in place by the brass washer *w*, over the outer edge of which a projecting lip is crimped.

About 4,000 fuzes have been manufactured in accordance with the form shown in figs. 1 and 2, Plate IX. Except the above, all Frankford Arsenal 21-second combination fuzes issued prior to January 1, 1908, have been of the form shown in figs. 3 and 4, Plate IX. Centrifugal percussion plungers arming at 2,500 revolutions per minute were used in the first 15,000 of these fuzes manufactured. The remainder are provided with ring resistance plungers; 21-second combination fuzes issued subsequent to January 1, 1908, will be of the form shown in figs. 1 and 2, Plate X.

The Frankford Arsenal 21-second Combination Fuze, Model of 1907 (Plate X, figs. 1 and 2).

This fuze differs essentially from the one just described only in the method of providing for the escape of the gases from the burning time trains.

In the model of 1907 fuze the vents open into annular grooves in the interior of the fuze. These grooves are connected with the outer air by means of channels, the external ends of which are protected by a hood, as shown in the illustration. The object of this system of ventage is to prevent the air from impinging directly upon the vents, and consequently to cause the fuze to burn in flight under conditions approximating as nearly as possible those at rest.

The 31-second Combination Fuze (Plate X, fig. 3).

This fuze does not differ in principle from the 21-second fuze shown in figs. 3 and 4, Plate IX. The 31-second fuze is made larger, so as to provide a time train of greater length, and, owing to its use in field and siege howitzers and mortars, it is provided with a centrifugal percussion plunger and a low resistance concussion plunger. The latter is rendered safe in transportation by means of a retaining wire.

Experiments are in progress which look to the modification of this fuze to incorporate the hooded vent principle.

Ehrhardt Combination Fuze (Plate XI).

This fuze consists of the following parts:

a, body, bronze.

b, front closing cap, bronze.

c, front ring, bronze.
d, upper time-train ring, bronze.
d', cloth washer.
e, lower time-train ring, bronze.
e', cloth washer.
f, time or concussion plunger.
f', arming resistance spring, brass.
g, arming resistance pin, brass.
h, fulminate primer.
i, concussion firing pin, German silver.
i', firing-pin diaphragm, brass.
j, channel leading to upper time train.
j', vent leading to expansion chamber j^2.
j^2, expansion chamber.
k, compressed powder pellet in chamber leading to upper time train.
k', vent for upper time train.
l, upper time train, compressed powder.
m, powder pellet in hole leading to lower time train.
m', vent for lower time train.
m^2, fuze setter stud, brass.
n, lower time train, compressed powder.
o, pellet compressed powder in channel leading to powder magazine.
p, channel to powder magazine.
q, powder magazine.
r, percussion plunger.
s, percussion primer.
t, percussion firing pin, German silver.
t', restraining pin, brass.
t^2, restraining pellet, compressed powder.
u, lead washer.
v, linen gauze.
w, linen disk.
x, linen disk.
y, brass disk.

This fuze was manufactured in Germany by the Rheinische Metallwaaren und Maschinenfabrik.

The body, front closing cap, front ring, upper and lower time-train rings are of bronze. All of the other metal parts are of brass or German silver.

An examination of the drawing will show that the time element consists of the time plunger and a system of channels similar to those used in the Frankford Arsenal 21-second fuze.

The arming of the time plunger *f* is resisted by the U-shaped spring *f'*, the upper ends of which are sprung out into the counterbored recess in the closing cap, and by the brass pin *g*, which passes through the plunger and both sides of the closing cap.

The concussion primer *h* is a fulminate of mercury mixture inclosed in a copper case, which is dropped into the concussion plunger from the rear, and held in place by the closing screw shown on the drawing.

The firing pin *i* is of German silver in one piece with the percussion firing pin; it is made fast in the diaphragm *i'* by means of a shoulder bearing below and a plate screwed to the diaphragm above.

The time-train grooves in the upper and lower rings *d* and *e* are milled out in the form of a horseshoe, as in the case of the Frankford Arsenal 21-second fuze.

The channel *j*, from the time plunger recess to upper time train, leads in this fuze to that end of the train from which the direction of burning is clockwise; and the channel from the upper to the lower time train leads to that end of the latter from which the direction of burning is anticlockwise. It will thus be seen that the direction of burning in the Ehrhardt fuze is the reverse of that in the Frankford Arsenal fuze.

The lower time-train ring is graduated in an anticlockwise direction from 0 to 22 seconds. The setting is made to a datum line cut in the lower flange of the fuze.

The safety point is marked by an arrow and is located about halfway between the 0 and 22-second graduations on the outer edge of the lower time-train ring.

The upper and lower time-train vents *k'* and *m'*, covered by thin brass disks crimped in place, are for the purpose of relieving the pressure of the gases due to the burning of the powder trains.

The inside of the front ring *c* is bored out to form an expansion chamber, *j'*, into which the gases may expand through the vent j^2.

The percussion element consists of the percussion plunger *r*, the percussion primer *s*, the firing pin *t*, the restraining pin *t'*, the restraining pellet of black powder t^2, and the magazine charge *q*.

The restraining pin *t'* is of brass, and has a head at the upper end. It is let into a hole in the diaphragm *i'*, the head abutting against a shoulder near the bottom of the hole. The restraining pellet of powder t^2 is pressed in to fill the recess above the restraining pin. A brass disk prevents the pellet from jarring out of place.

The restraining pin holds the percussion plunger back and prevents premature firing of the percussion primer *s* in handling or transportation. The percussion primer is a mercuric fulminate mixture and is inclosed in a copper case which is let into the front end of the percussion plunger and retained there by crimping over a portion

of the metal of the plunger. The plunger is drilled centrally, the hole coming opposite a vent through the bottom of the percussion plunger cavity leading to the magazine *q*. This hole is closed by a disk of gauze heavily coated with shellac.

The action of the percussion element is as follows: The firing of the time or concussion primer by shock of discharge ignites the restraining pellet t^2 at the front end, quickly burning it out, after which the restraining pin is free to move to the front. On impact, the firing pin *t* fires the percussion primer which ignites the magazine charge *q*.

The rear end of the fuze is closed by means of the linen washers *w* and *x* and the brass disk *y*, held in place by a crimping wall, as shown.

Krupp Combination Fuze (Plate XI).

This fuze consists of the following parts:

a, fuze body, brass.
b, front closing cap, brass.
c, upper time-train ring, brass.
c', cloth washer.
d, lower time-train ring, brass.
d', cloth washer.
e, time plunger.
e', arming resistance spring, brass.
f, concussion primer.
g, firing pin, German silver.
h, channel leading to upper time train.
i, compressed powder pellet.
j, upper time train, compressed powder.
k, pellet in vent to lower time train.
k^2, fuze setter stud, brass.
l, lower time train, compressed powder.
m, pellet in hole to magazine *o*.
o, powder magazine, 125 grains powder.
p, percussion plunger.
p', percussion-plunger sleeve, brass.
q, arming resistance spring, brass.
r, percussion primer.
s, restraining spring.
t, percussion firing pin, German silver.
u, lead washer.
v, bottom closing screw.
w, linen gauze.
x, brass washer.

An inspection of the drawing will show that this fuze does not differ essentially from the Ehrhardt so far as the time element is concerned. In this case the arming resistance spring e' is made strong enough not to require a shear pin, as in the case of the Ehrhardt fuze.

The channels leading to the time trains are arranged, as in the case of Frankford Arsenal 21-second combination fuze, so that the direction of burning in the upper time train is anticlockwise and that in the lower time train clockwise.

The graduations on the outer edge of the lower time train are in a clockwise direction from 0 to 22, decreasing in length. They represent time of burning in flight. The safety point is located in the same manner as for the Ehrhardt and Frankford Arsenal fuzes. The settings are made to an arrow on the lower flange of the fuze body. A pin is fitted in the outer edge of the lower time-train ring to serve as a means for setting the fuze.

The percussion element of this fuze consists of the following parts: The percussion plunger p with closing screw, the U-shaped arming resistance spring q, the percussion primer r, the restraining spring s, the percussion-plunger sleeve p', and the firing pin t. It will be seen that this plunger resembles in principle the ring-resistance plunger of Frankford Arsenal design. On discharge the percussion-plunger sleeve moves to the rear, coming to a bearing on the flange at the rear of the plunger, arming the plunger and exposing the primer r to the blow of the firing pin on impact.

The plunger is drilled centrally, as shown, to allow the flame to pass through and ignite the magazine charge o.

The restraining spring s is to keep the plunger from creeping forward as the projectile meets with atmospheric retardation in flight.

DETONATING FUZES (PLATES XII, XIII, XIV, AND XV).

The detonating fuzes used in service are enumerated in Table IV. This table gives all the information to be published in connection with fuzes of this class.

Plates XII, XIII, XIV, and XV show the outlines of these fuzes.

TABLE I.—*Ring-resistance fuzes.*

Designation.	Diameter of thread.	Threads per inch.	Weight of sleeve.	Resistance to arming.	Value of ratio $\frac{W}{R}$.	Weight of—		Height of drop to arm.	Projectiles in which used and remarks.
						Plunger.	Assembled fuze.		
POINT INSERTION.									
			Grains.	*Pounds.*		*Grains.*	*Ounces.*	*Feet.*	
Minor-caliber point percussion fuze, standard type.	0.722	18	147	147	1.0	206	2.3	17.5 in 1-lb. shell	1-pdr. and 2-pdr. point-fuzed shell of future manufacture.
Point percussion fuze for 1.65-in. shell of Hotchkiss manufacture.	.838	14	147	114	1.3	208	3.0	12 in 1.65-in. shell	1.65-in. point-fuzed shell on hand of Hotchkiss manufacture. About 3,800 of these fuzes have been manufactured.
Point percussion fuze for 1.65-in. shell of Winchester Repeating Arms Co. manufacture.	.722	18	147	114	1.3	208	1.9	12 in 1.65-in. shell	1.65-in. point-fuzed shell on hand of Winchester Repeating Arms Co. manufacture. About 4,600 of these fuzes have been manufactured.
Point percussion fuze for 1.65-in. shell, former standard type.	.779	16	165	126	1.21	234	2.125	15 in 1.65-in. shell	1.65-in. point-fuzed shell to the number of about 5,000. The manufacture of this type is discontinued.
BASE INSERTION.									
Minor-caliber base percussion fuze, standard type.	.722	18	165	165	1.0	234	2.6	17 in 1-pdr. shell	2.38-in. and 6-pdr. shell of future manufacture tapped for base fuze.
Base percussion fuze for 1.65-in. shell, standard type.	.722	18	155	119	1.3	227	2.25	12 in 1.65-in. shell	1.65-in. base-fuzed shell. About 25,000 have been manufactured for that number of 1.65-in. shell.
Base percussion fuze for 1-lb. shell, former type.	.722	18	104	80	1.3	165	1.9	14 in 1-lb. shell	1-pdr. base-fuzed shell. None on hand.
Base percussion fuze, "High C"	.875	14	266	138	1.92	357	3.9	17 in 15-pdr. shell	3, 3.2, and 3.6 in. rifle shell and 3.6-in. mortar powder-charged shell. It may also be used in siege detonating fuze and Peirce stock.
Base percussion fuze, "High A"	1.125	12	715	222	3.22	850	8.2	5 in 45-lb. shell	An obsolete type. A few in service in 7-in. howitzer powder-charged shell.
Base percussion fuze medium and major caliber.	1.5	12	464	220	2.11	549	15.6	13 in 15-lb. shell	Powder-charged shell from 2.95 to 7 in., inclusive, when used in guns giving high accelerations.

NOTE.—65.96 "S" fuzes have been provided with ring-resistance plungers with ratio $\frac{W}{R}$ of 3.22. These fuzes are for use in A. P. detonating fuzes, modified Peirce stocks. O. O. 30024 BBB—928.

TABLE II.—*Centrifugal fuzes.*

Designation.	Diameter of thread.	Threads per inch.	Revolutions per minute to arm.	Weight of plunger.	Weight of fuze assembled.	Projectiles and detonating fuzes in which used.
LINK LIFT.				*Grains.*	*Lbs. Oz.*	
"F" fuze	0.875	14	3,500	292	0 4.0	Siege detonating (S. D.) Peirce fuze stocks for 5 and 7 in. common steel shell tapped for this fuze stock, charged with high explosive to the number of 9,500.
Base percussion fuze, medium and major caliber.	1.5	12	2,000	513	0 15.6	Powder-charged shell from 2.95 to 12 in., inclusive, when used in guns giving low accelerations.
12-M fuze, "link lift" design	1.5	12	1,300	1,500	1 1.125	Torpedo detonating (T. D.) Peirce fuze stocks for 12-in. torpedo shell tapped for this fuze to the number of about 2,200.[a]

[a] 3,404 12-M fuzes have been manufactured for use in a like number of A. P. detonating fuzes, Peirce stocks, which have been altered therefor. These A. P. detonating fuzes were used in a corresponding number of 1046-lb. D. P. shell. O. O. 30024 BBB—725.

TABLE III.—*Combination fuzes.*

Designation.	Diameter of thread.	Threads per inch.	Weight of assembled fuze.	Weight of time plunger.	Resistance to arming time plunger.	Value of ratio $\frac{W}{R}$ time plunger.	Weight of percussion-plunger sleeve.	Resistance to arming percussion plunger.	Value of ratio $\frac{W}{R}$ percussion plunger.	Projectiles in which used, and remarks.
			Lbs. Oz.	*Grains.*	*Pounds.*		*Grains.*	*Pounds.*		
15-second combination fuze	1.18	0.8	1 1.5	200	35	5.71	235	111	2.11	75-mm. V. M. mountain gun, 3.2 and 3.6 in. field-gun shrapnel on hand.
28-second combination fuze, "high resistance."	1.18	8	1 2	200	15	13.33	248	75	3.30	3.6-in. mortar and 7-in. howitzer shrapnel on hand.
28-second combination fuze, "low resistance."	1.18	8	1 2	200	15	13.33	248	32	7.75	7-in. mortar shrapnel on hand.
Frankford Arsenal 21-second combination fuze.	1.70	14	1 4	128	75	1.7	308	210	1.4	75-mm. mountain, 3-in. field and 15-pdr. R. F. gun shrapnel. About 15,000 of these fuzes carry a centrifugal percussion plunger arming at 2,500 r. p. m.
Ehrhardt combination fuze	1.70	14	1 2⅛	110	90	1.22	215	----------	----------	3-in. field shrapnel. About 10,000 of these fuzes were purchased from the Ehrhardt Company.
Krupp combination fuze	1.70	14	1 2⅛	142	190	.70	124	177	.70	3-in. field shrapnel. About 10,000 of these fuzes were purchased from the Krupp Company.
Frankford Arsenal 31-second combination fuze.	1.70	14	2 2	150	35	4.3	Centrifugal plunger.			Shrapnel for siege guns and howitzers.

NOTE.—The 15 and 28 second fuzes are obsolete types.

TABLE IV.—*Detonating fuzes for use in steel projectiles containing a bursting charge of high explosive.*

No.	Designation of fuze.	Diameter of thread of fuze.	Number of threads per inch.	Weight of fuze.	Projectiles in which used.
		Inches.		*Pounds.*	
1	Minor-caliber base detonating fuze.	0.875	14	0.195	For use in 6-pdr. and 2.38-in. steel shell containing a bursting charge of picric acid.
2	Field-point detonating fuze (F. D.).	1.3	12	1.00	For use in steel shell for 3-in. field gun tapped in the point for this fuze. 1,000 of them have been manufactured and 722 are still on hand. No more of these fuzes will be manufactured.
3	Point detonating fuze for mobile artillery.	1.5	12	1.13	For use in steel shell for 3-in. field gun tapped in the point for this fuze. 8,000 of them have been manufactured for that number of steel shell now on hand. No more of these fuzes will be manufactured.
4	Special "S" base fuze with 100-grain detonator.	1.123	12	.65	For use in steel shell for 3-in. R. F. gun tapped in the base for this fuze. 14,000 of them have been manufactured for that number of steel shell on hand. No more of these fuzes will be manufactured. Superseded by the medium-caliber detonating fuze.
5	Base detonating fuze for minor-caliber projectiles.	1.5	12	1.22	For use in steel shell for 3-in. field gun and 3-in. R. F. gun tapped in the base for this fuze. 2,100 have been made for that number of 3-in. steel shell. No more of these fuzes will be manufactured. Superseded by the medium-caliber detonating fuze.
6	Medium-caliber base detonating fuze.	1.5	12	1.5	For use in all steel projectiles from 2.95 to 7 in. in caliber, inclusive. Superseding other fuzes for use in these projectiles when the present stock has been exhausted.
7	Base detonating fuze for medium-caliber projectiles.	1.5	12	2.18	292 of these fuzes only have been manufactured for use in that number of 4-in. Driggs-Schroeder common steel shell. No more of these fuzes will be manufactured. Superseded by medium-caliber detonating fuze. These fuzes were provided with split-ring plungers.
8	Siege base detonating fuze (modified Peirce stock).	1.5	12	1.96	For use in 5 and 7 in. siege projectiles adapted to this fuze until the stock of fuzes on hand (about 9,500) has been exhausted. No more of these fuzes will be manufactured. Superseded by medium-caliber detonating fuze.
9	Armor-piercing base detonating fuze (modified Peirce stock).[a]	2.4	8	7.09	For use in 8, 10, and 12 in. rifle A. P. shot and shell adapted to this fuze until the stock of fuzes on hand (about 10,000) has been exhausted. No more of these fuzes will be manufactured. Superseded by major-caliber detonating fuze. 30024 BBB–928.
10	Major-caliber base detonating fuze.	2.0	10	2.908	For use in 8, 10, and 12 in. rifle and mortar steel projectiles, superseding all other types of fuzes in these projectiles when the stock on hand has been exhausted.
11	Torpedo base detonating fuze (modified Peirce stock).	2.4	8	7.8	For use in 12-in. mortar steel shell on hand until the stock on hand (about 2,200) has been exhausted. No more will be manufactured. Superseded by major-caliber detonating fuze.

[a] 3,404 of these fuzes were altered for use in a corresponding number of 1,046 pounds D. P. Shell. See note, Table II.

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O

PLATE-I.

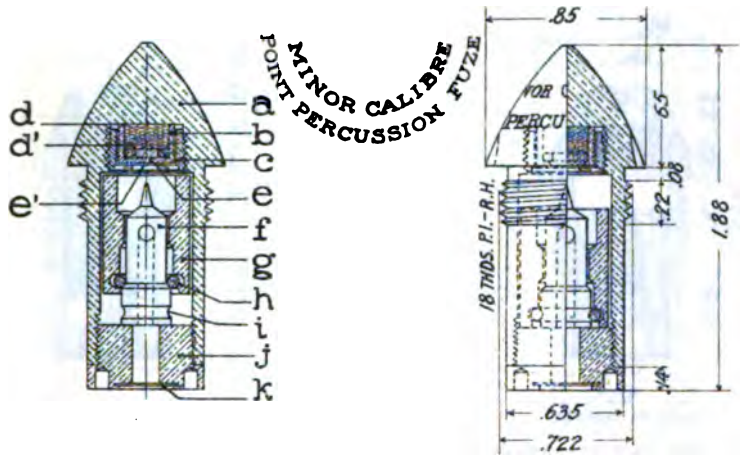
FRANKFORD ARSENAL RING RESISTANCE FUZES.

MINOR CALIBRE POINT PERCUSSION FUZE.
FOR 1PDR. AND 2 PDR. SHELL

STANDARD TYPE.

FIG. 1
BEFORE ARMING.

FIG. 2.
AFTER ARMING.



POINT PERCUSSION FUZE FOR 1.65IN. SHELL.

FORMER TYPE

FIG. 3.
BEFORE ARMING.

F.A. 1.65.

FIG. 4.
AFTER ARMING.

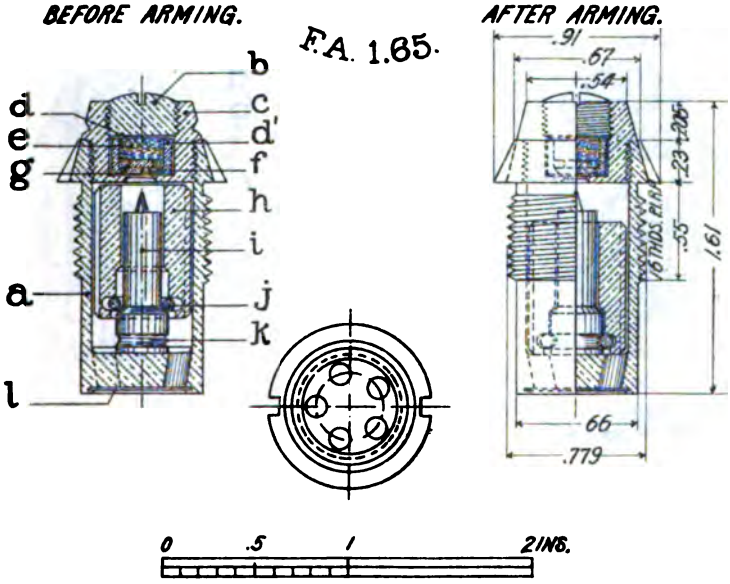


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PLATE II.

FRANKFORD ARSENAL RING RESISTANCE FUZES

POINT PERCUSSION FUZE FOR 1.65 INCH SHELL OF WINCHESTER REPEATING ARMS CO. MANUFACTURE.

FIG. 1.
BEFORE ARMING.

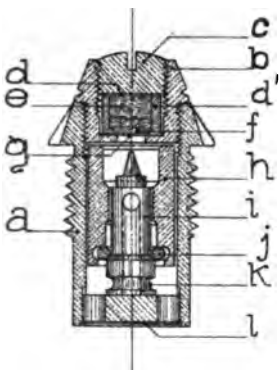
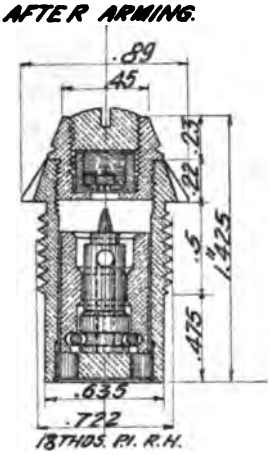


FIG. 2.
AFTER ARMING.



POINT PERCUSSION FUZE FOR 1.65 INCH SHELL OF HOTCHKISS MANUFACTURE

FIG. 3.
BEFORE ARMING.

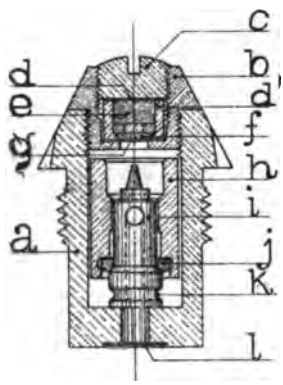
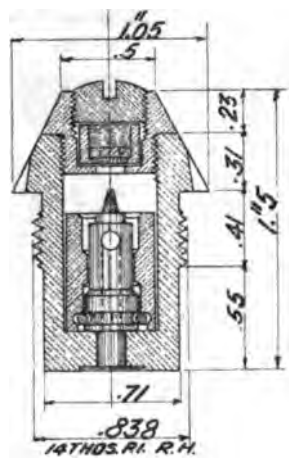
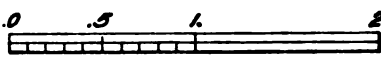


FIG. 4.
AFTER ARMING.





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FRANKFORD ARSENAL RING RESISTANCE FUZES.

BASE PERCUSSION FUZE FOR 1.65 INCH SHELL.
FORMER TYPE

FIG. 1.
BEFORE ARMING.

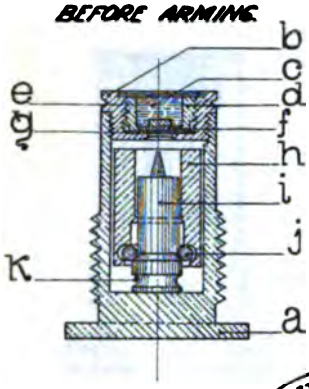
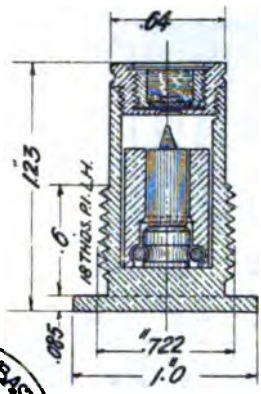


FIG. 2.
AFTER ARMING.



BASE PERCUSSION FUZE FOR 1 POUNDER SHELL.
FORMER TYPE

FIG. 3.
BEFORE ARMING

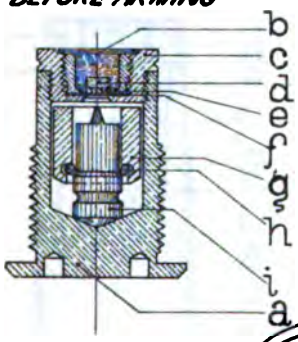
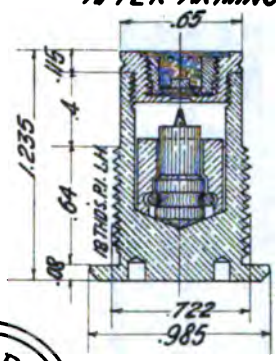


FIG. 4.
AFTER ARMING.



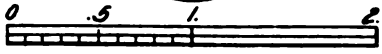


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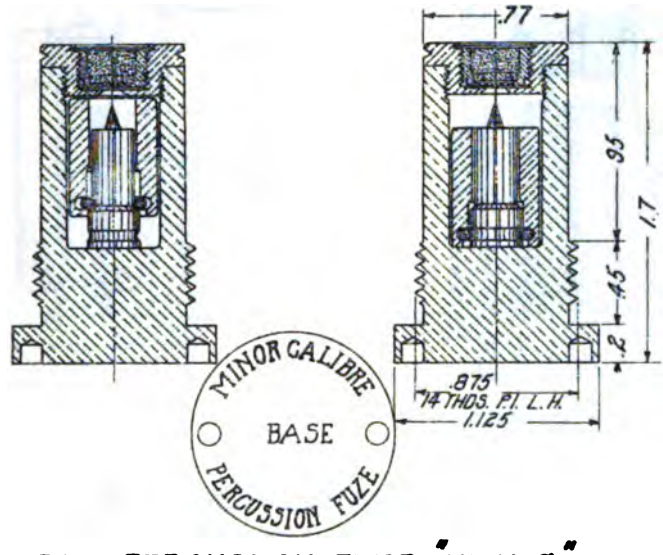
PLATE. IV.

FRANKFORD ARSENAL RING RESISTANCE FUZES.
MINOR CALIBRE BASE PERCUSSION FUZE FOR 2.38 INCH AND 6 PDR. SHELLS

FIG. 1.
BEFORE ARMING.

FIG. 2.
AFTER ARMING.



BASE PERCUSSION FUZE "HIGH C."

FIG. 3.
BEFORE ARMING.

FIG. 4.
AFTER ARMING.

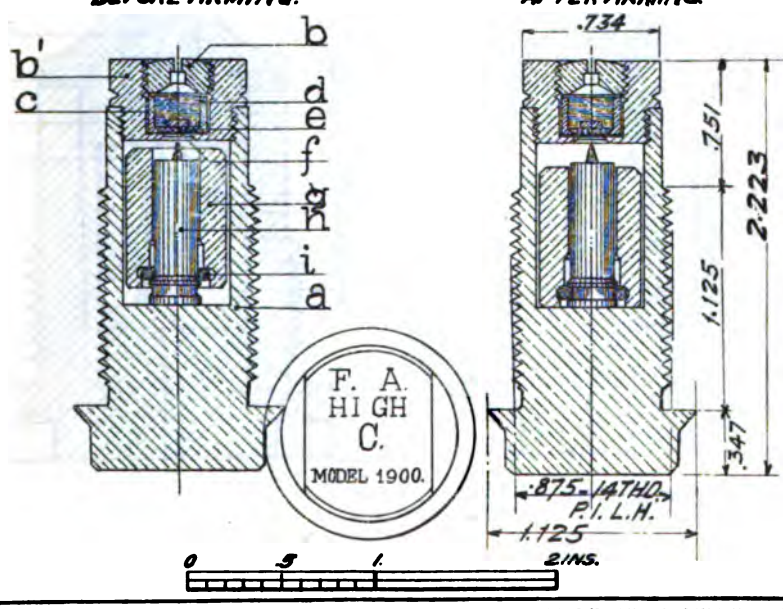


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PLATE V.

FRANKFORD ARSENAL RING RESISTANCE FUZES

BASE PERCUSSION FUZE "HIGH A" (OBSOLETE)

FIG. 1. BEFORE ARMING

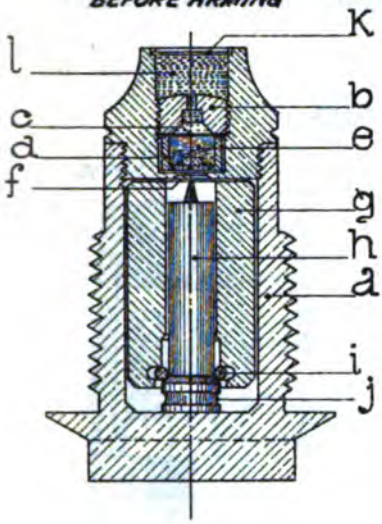
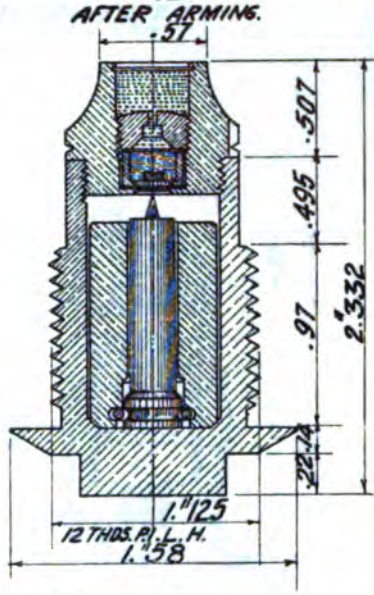


FIG. 2. AFTER ARMING.



BASE PERCUSSION FUZE MEDIUM AND MAJOR CALIBER.

FIG. 3 BEFORE ARMING.

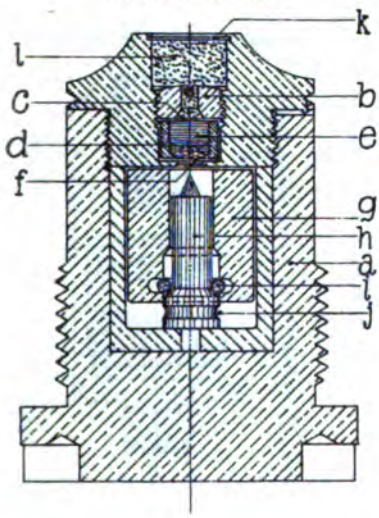
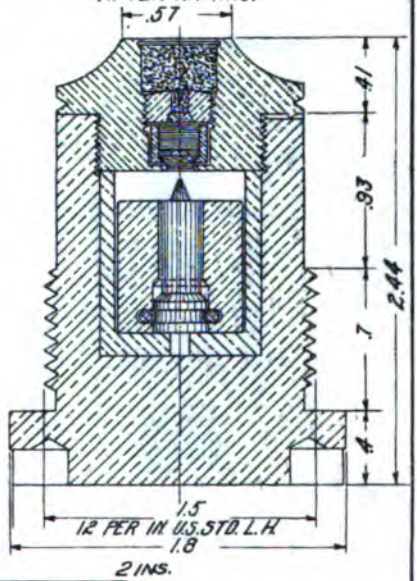


FIG. 4 AFTER ARMING.



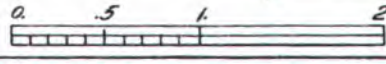


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PLATE. VI.

FRANKFORD ARSENAL CENTRIFUGAL FUZES.

BASE FUZE "F"

FIG. 1.
BEFORE ARMING.

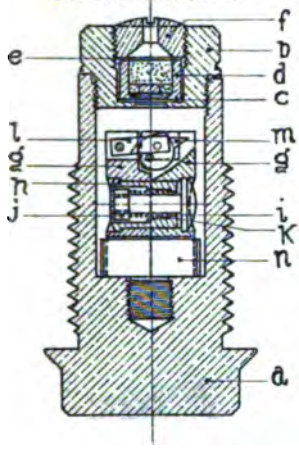
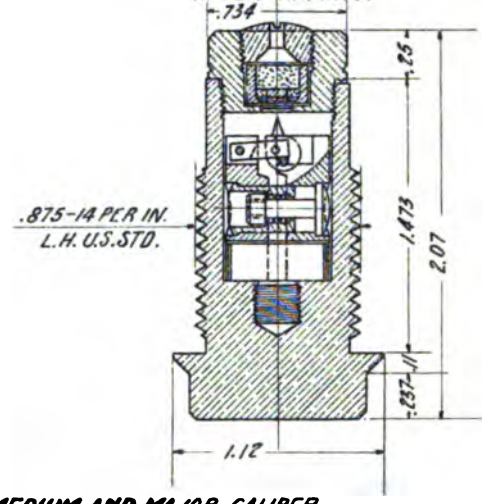


FIG. 2.
AFTER ARMING.



BASE PERCUSSION FUZE MEDIUM AND MAJOR CALIBER.

FIG3 BEFORE ARMING.

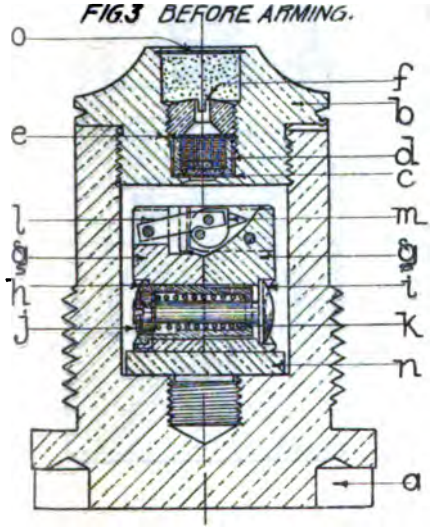


FIG 4. AFTER ARMING.

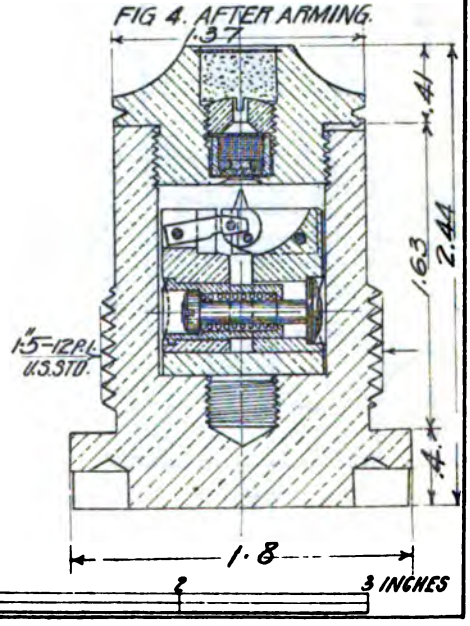


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PLATE VIII.

FRANKFORD ARSENAL CENTRIFUGAL FUZES.

BASE FUZE "12 M."

FIG 1. BEFORE ARMING.

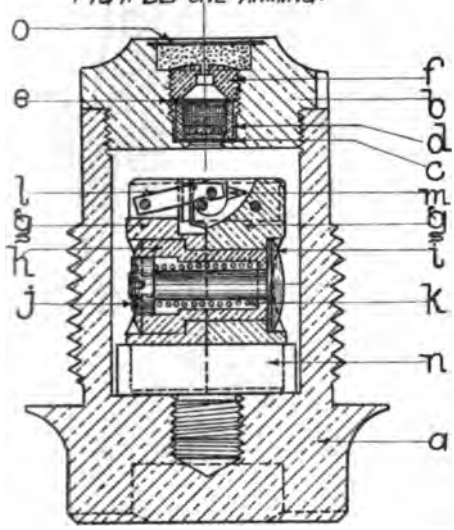
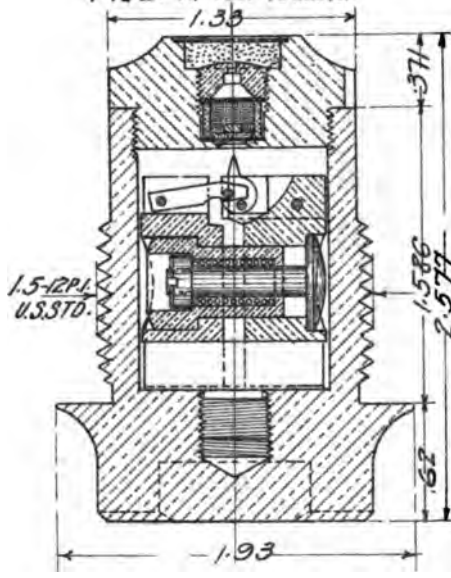


FIG 2. AFTER ARMING.



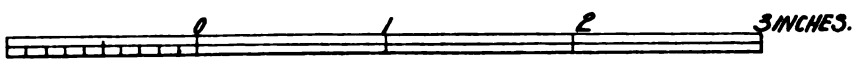


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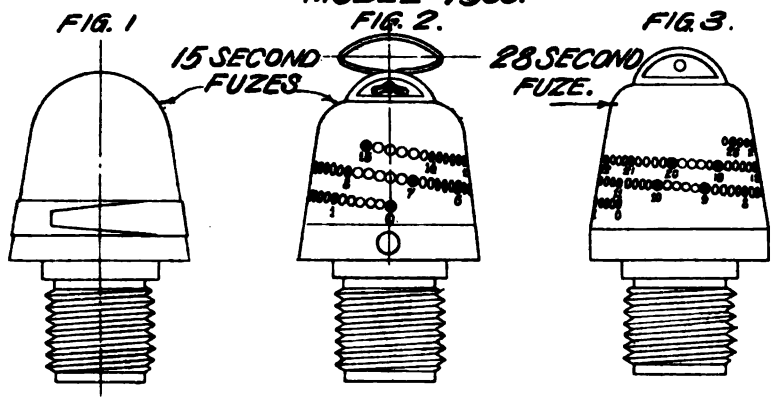
PLATE VIII.

FRANKFORD ARSENAL COMBINATION FUZES.
MODEL 1900.



FRANKFORD ARSENAL 15 SEC. COMBINATION FUZE

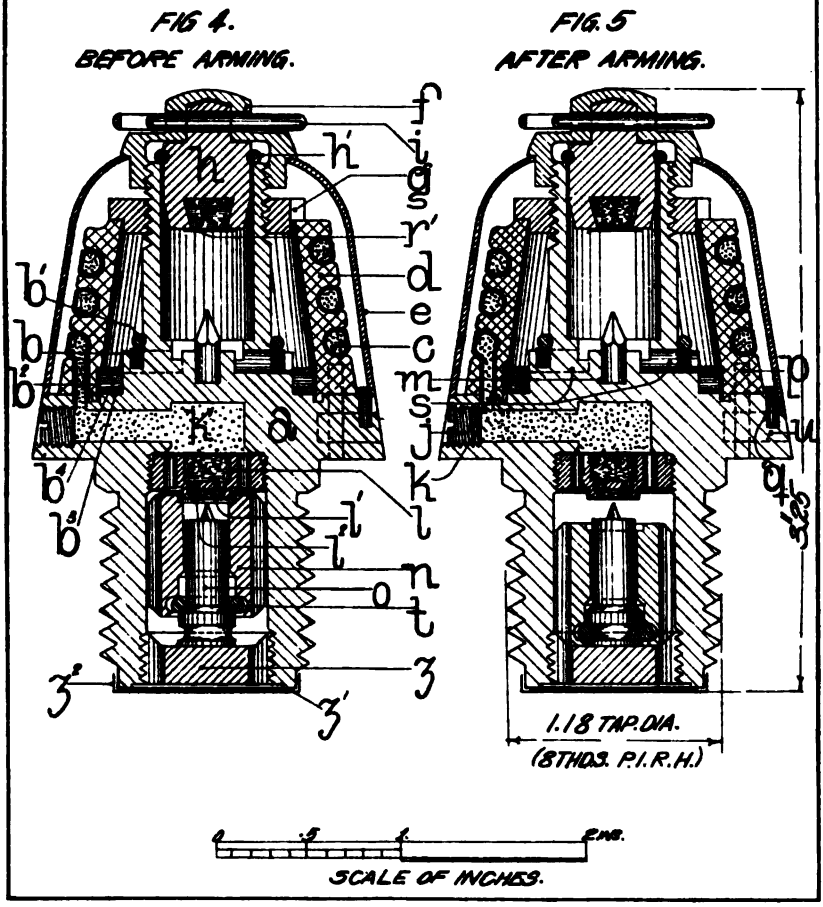


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PLATE IX.

FRANKFORD ARSENAL 21 SECOND COMBINATION FUZES.

FIG. 1. EXTERIOR.

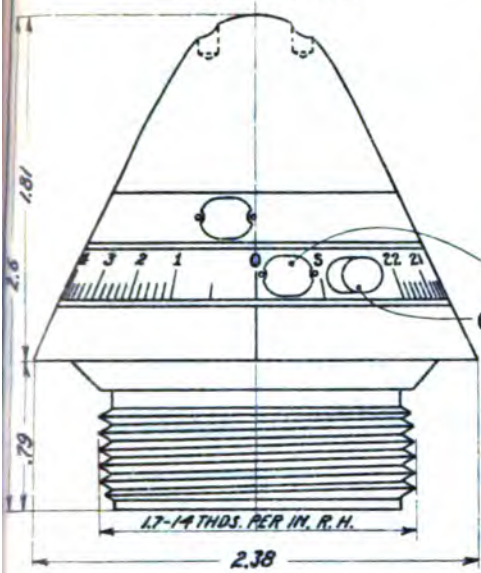


FIG. 2. BEFORE ARMING.

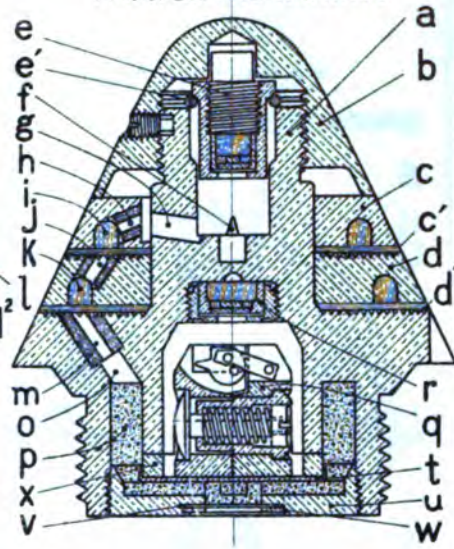


FIG. 3. EXTERIOR.

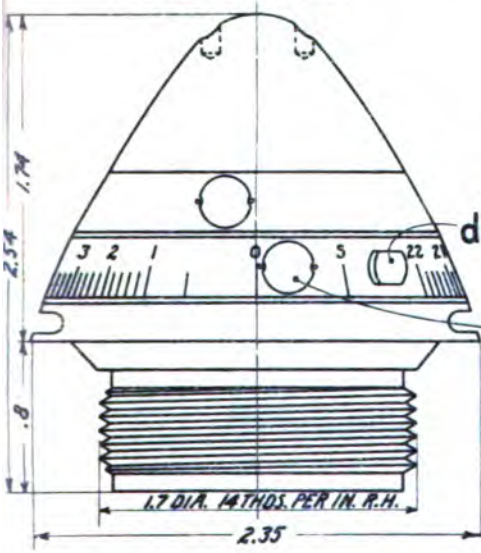
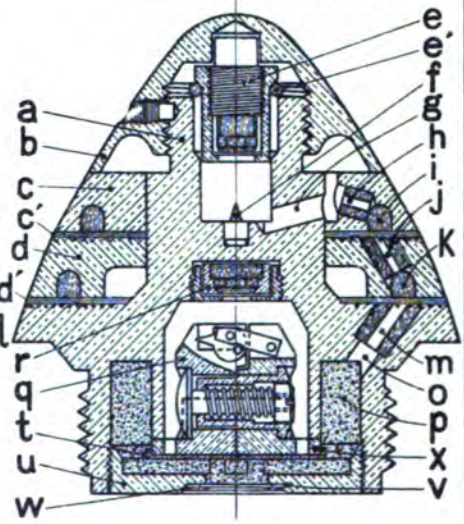


FIG. 4. BEFORE ARMING.



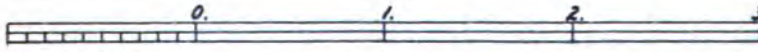


PLATE X.

21 SECOND COMBINATION FUZE MODEL OF 1907.

FIG. 1. EXTERIOR.

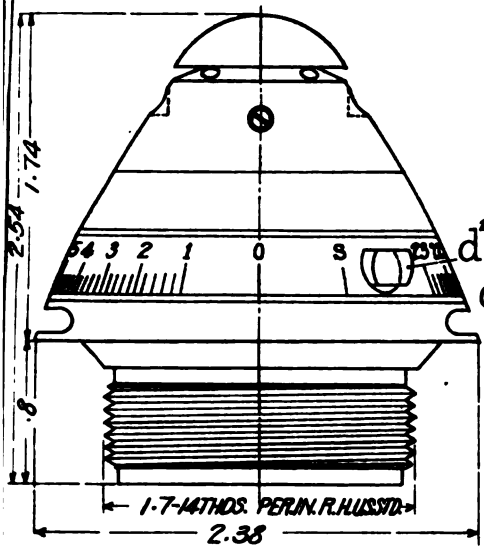
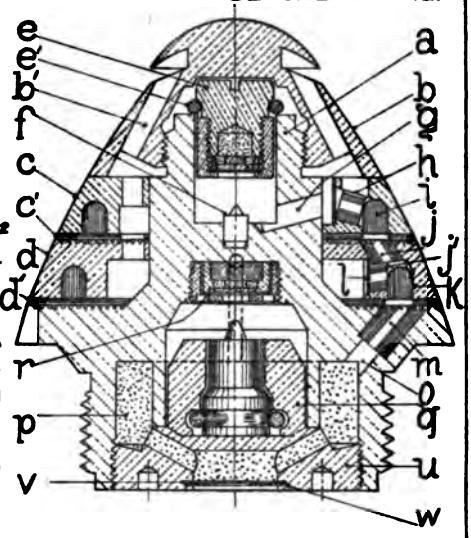


FIG. 2. BEFORE ARMING.



31 SECOND COMBINATION FUZE.

FIG. 3. EXTERIOR.

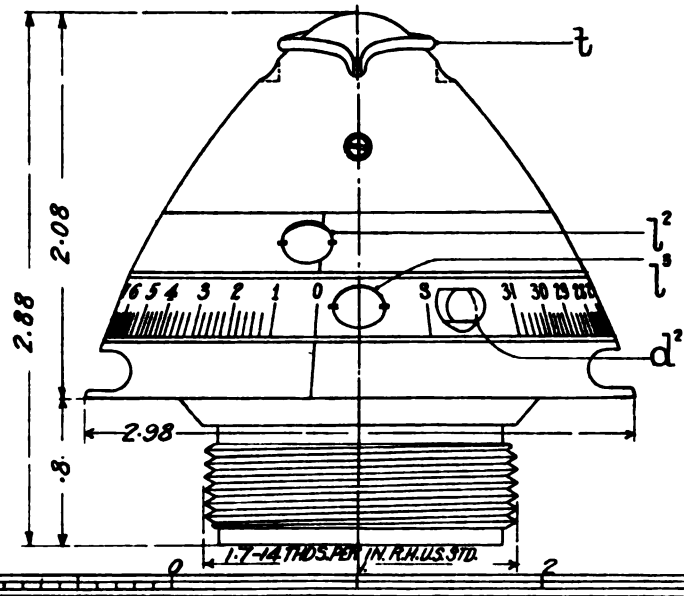


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PLATE XI.

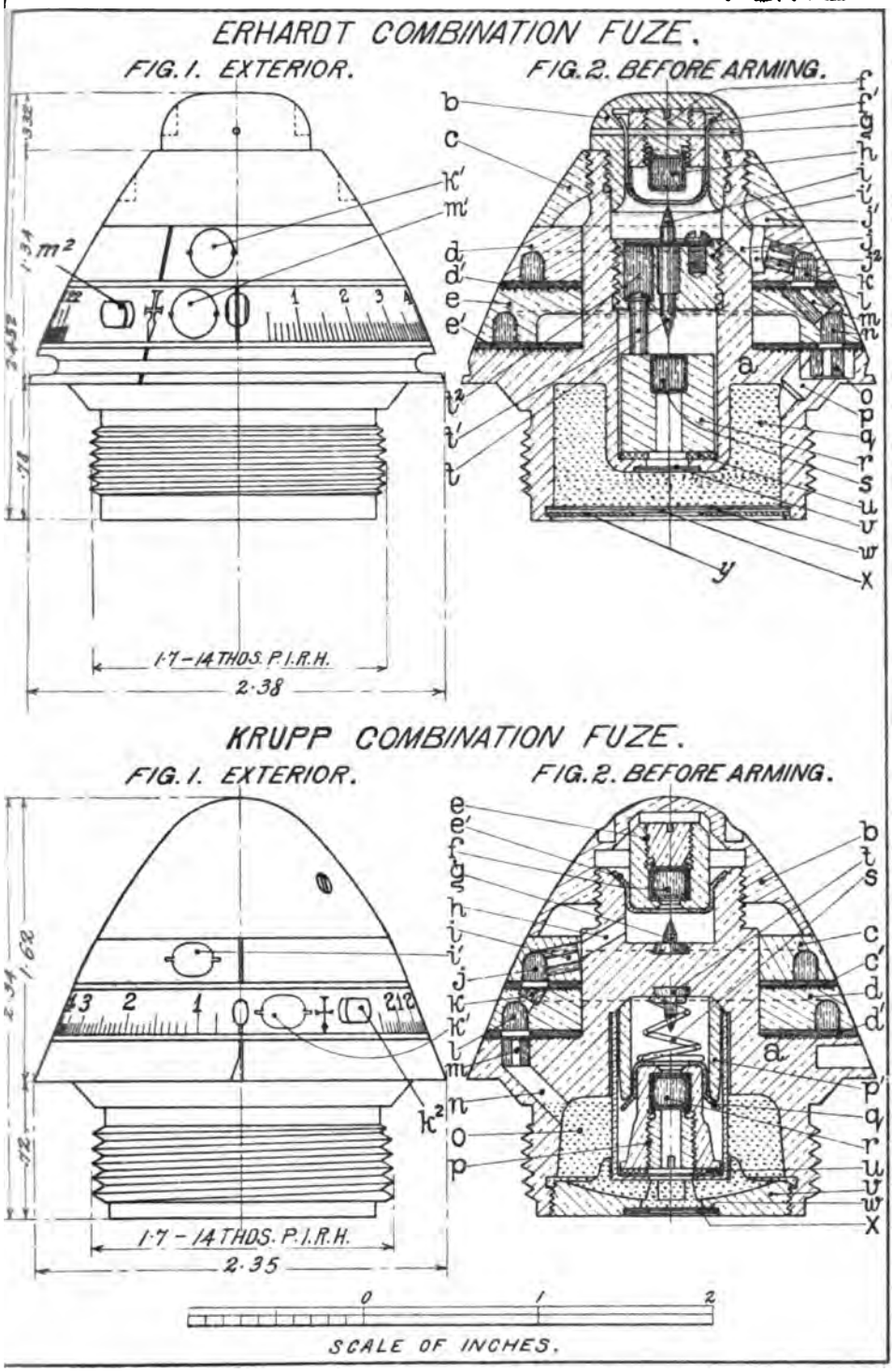

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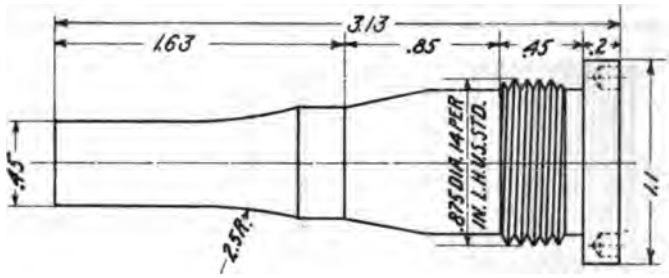
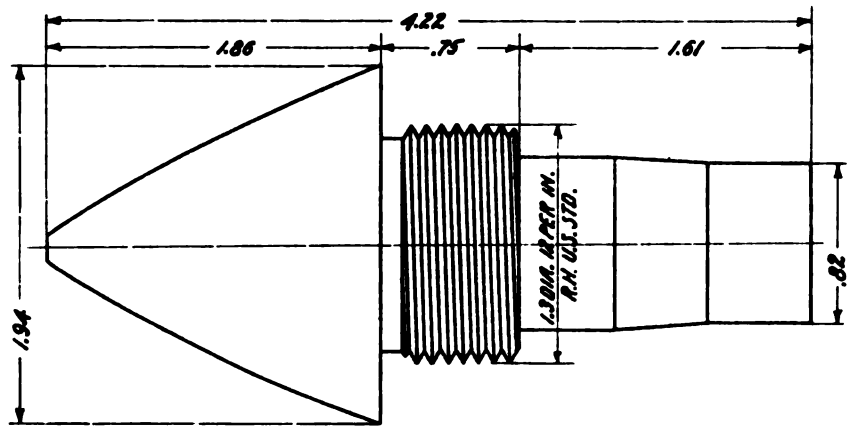
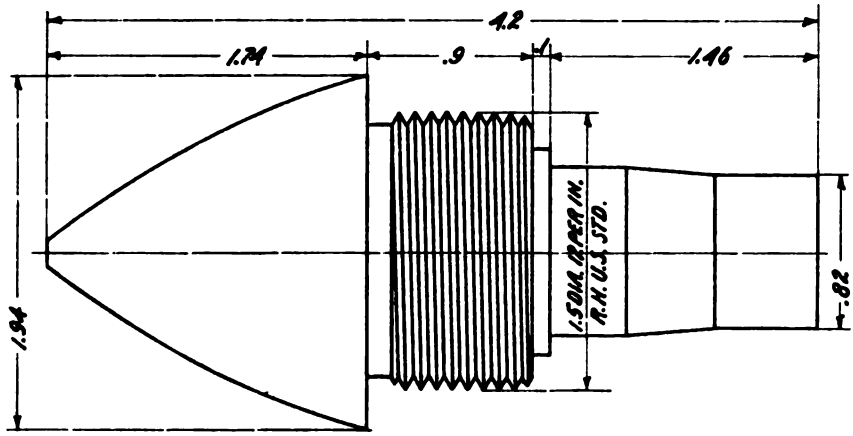
PLATE XII



NO. 1. BASE DETONATING FUZE MINOR CALIBER.



NO. 2. POINT DETONATING FUZE FOR MOBILE ARTILLERY. WITH "S" FUZE PLUNGER AND 1.3 DIAM. OF THREAD.



NO. 3. POINT DETONATING FUZE FOR MOBILE ARTILLERY.

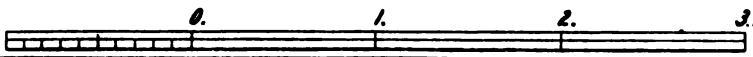


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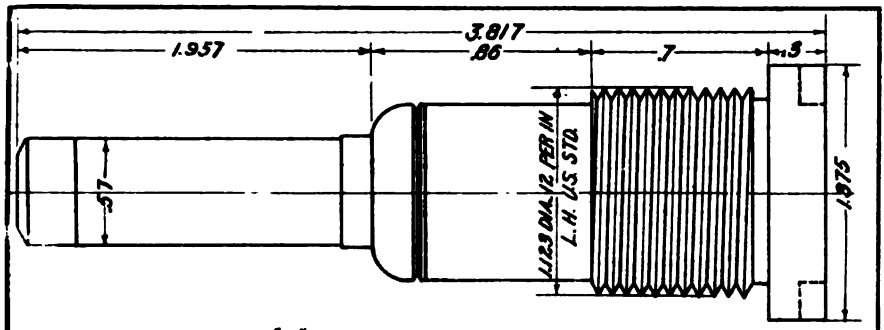
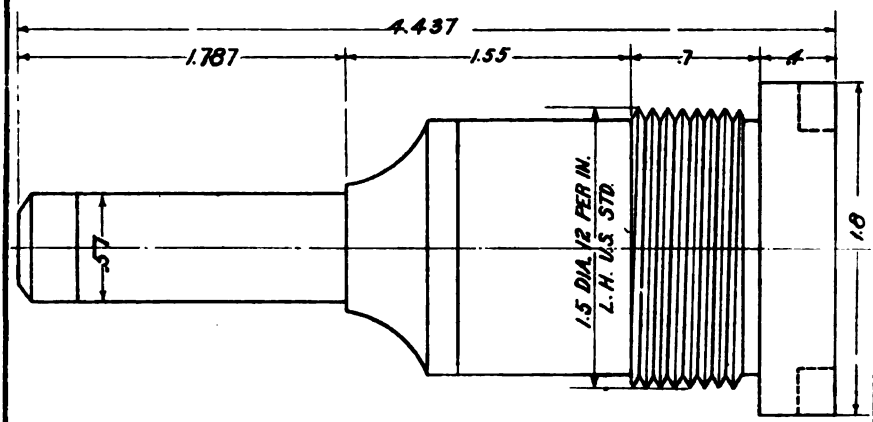
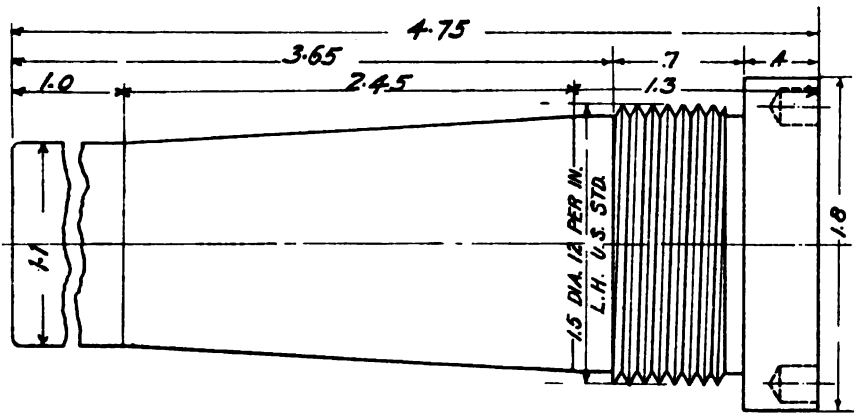
PLATE XIII



NO.4. SPECIAL "S" FUZE WITH 100 GRAIN DETONATOR.



NO.5. BASE DETONATING FUZE FOR MINOR CALIBER PROJECTILES.



NO.6. BASE DETONATING FUZE MEDIUM CALIBER.

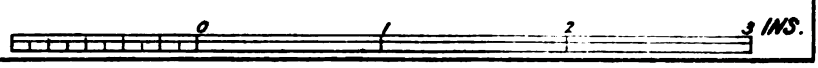


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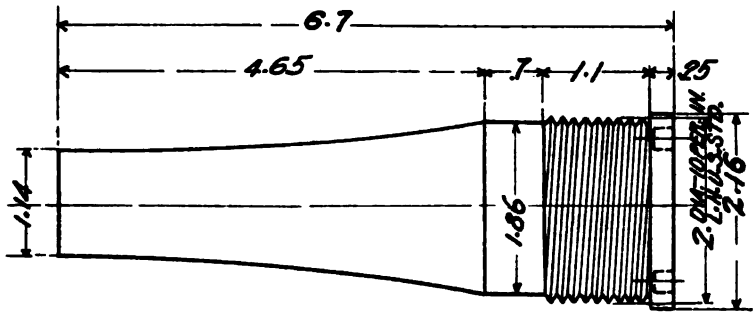
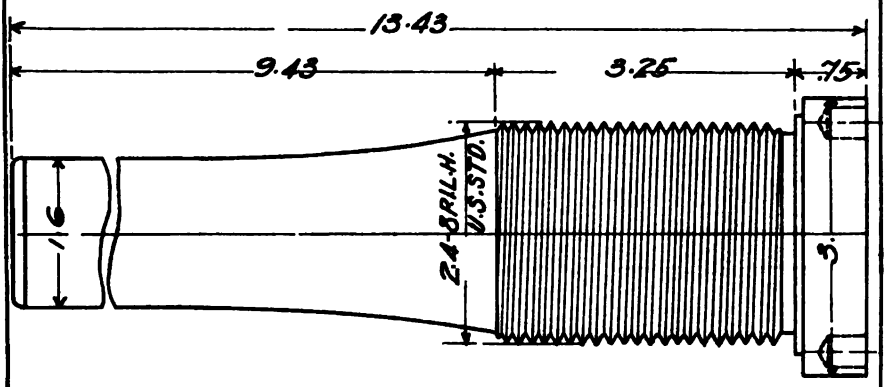
PLATE XIV.



NO.10. BASE DETONATING FUZE MAJOR CALIBER.



NO.11. TORPEDO DETONATING FUZE (MODIFIED PIERCE STOCKS.)

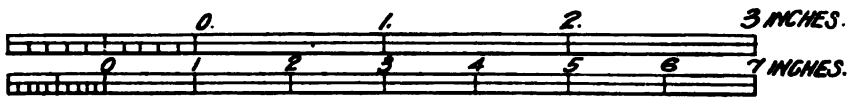
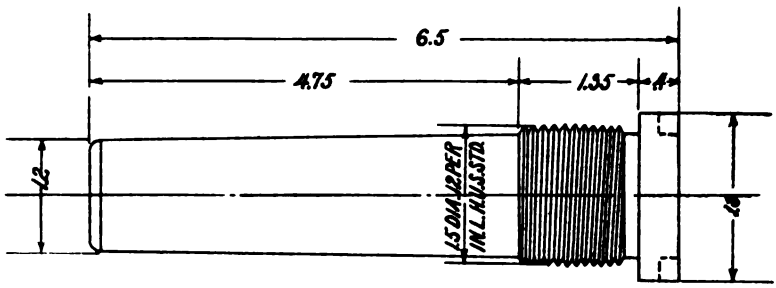
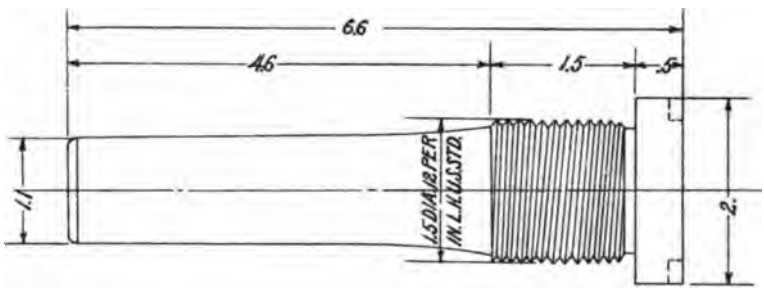


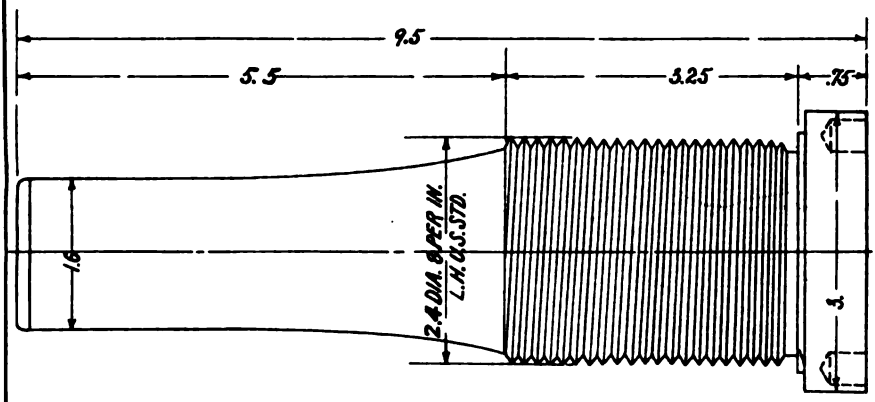
PLATE XV.



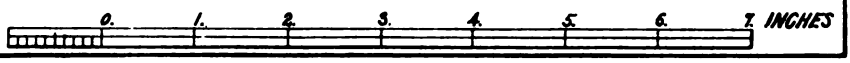
NO.7. BASE DETONATING FUZE FOR MEDIUM CALIBER PROJECTILES.



NO.8. SIEGE DETONATING FUZE MODIFIED PIERCE STOCKS.



NO.9. A.P. DETONATING FUZE MODIFIED PIERCE STOCKS.



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