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AMERICAN EXPEDITIONARY FORCES

CHEMICAL WARFARE SERVICE

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MANUAL OF GAS WARFARE

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1. Importance of Gas Warfare.

2. When to Use Gases.

INTRODUCTION

IMPORTANCE OF CHEMICAL WARFARE

1. The importance of gases in warfare is very great. To protect ourselves efficiently against enemy gases and to use our own gases with the greatest effect upon the enemy requires a good knowledge of the properties of the various gases as well as initiative and ingenuity. Starting in April, 1915, with the use of cylinders to produce a gas cloud, Gas Warfare has developed until it is now a powerful instrument in offensive warfare. It now embraces all poisonous gases used in war, whether in cylinders, shells, or otherwise, and in addition smoke, incendiary and irritating substances. The chemical substances designated as "gases" have a great variety of properties and effects. To think of all "gases" as having substantially the same properties and tactical uses is a serious mistake. The "gases" used in warfare include not only true gases, but solids and liquids of widely varying properties, that are converted in their actual use into "particulate" gases and vapors. This makes possible a great variety of tactical uses in combination with other means of warfare. The effect of gas persists after the explosion, imposing upon the enemy the necessity of wearing masks. This is a source of discomfort, and impairment of vision and efficiency. Gas is, moreover, capable of penetrating certain means of defense, such as trenches and dugouts, often more effectively than other forms of ammunition.

2. <u>When gas may be employed</u>:

Gas may be employed both day and night:-

(a) in preparation for attack;

(b) in trench warfare;

(c) in advance in open warfare;

(d) in raids;

(e) during a retirement, and;

(f) on stabilized fronts.

PART I.

GASES

and

THEIR CHARACTERISTICS

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PART I.

GASES AND THEIR CHARACTERISTICS.

CLASSIFICATION OF SUBSTANCES USED IN CHEMICAL WARFARE SERVICE.

3. The tactical uses of the various substances employed in Chemical Warfare depend upon their psychological and physical properties. A moderate knowledge of these properties is, accordingly, necessary to enable such substances to be intelligently used.

4. Physical Properties. The most important physical property is that which determines the "persistency" of the substance when used in the field. This property depends chiefly upon the rapidity of evaporation, which may be roughtly estimate from the boiling point of the liquid. According to this criterion, we may name the following classes, giving the most prominent example of each:

(A) Substances which are gases at ordinary temperatures (of low persistency),- Phosgene.

(B) Moderately volatile liquids, (of moderate persistency),- Chlorpicrin.

(C) Slightly volatile liquids, (of high persistency),- Mustard "Gas".

(D) Toxic smoke producers, - Diphenylchlorarsine.

(A) Gases at ordinary temperatures (like phosgene) when released from containers will be blown about by the air currents. Hence, if the air is relatively still, as when the wind is low, or in a dense wood, such a gas may persist for some time. On the other hand, in the open, and when the wind is blowing, it will be quickly dissipated. Such a gas can be used advantageously against positions to be attack shortly afterwards.

(B) Moderately volatile liquids, (like chlorpicrin), when splashed upon the ground will vaporize rather slowly, and will continue to contaminate the air in the neighborhood.. In the woods or in dugouts, or when the air is still, this contamination may persist for considerable lengths of time. However, that portion of the liquid which has vaporized is no more persistent than the gases in class (A).

(C) Slightly volatile liquids (like mustard gas) will give off their vapors still more slowly, so that an infected area will remain dangerously infected for a greater length of time. However, it is difficult to get their vapors into the air in high concentrations. Only by breaking them up to form a mist can high concentrations and rapid deadly effects be realized. Substances of this class are accordingly especially useful in harassing an enemy and in preventing him from attacking over areas drenched with them. It has, in fact, been possible to ascertain positions which the enemy expected to attack by noting gaps left in territory otherwise heavily shelled with mustard "gas".

(D) Toxic smoke producers (as diphenylchlorarsine) are substances which can be made to give a suspension of extremely fine particles of poisonous dust, or mists in the air. Such clouds are no more persistent than those caused by gases in class (A). Their chief value lies in their ability to penetrate, more or less, the enemy masks. Usually when the cloud has settled upon the ground the amount of vapor given off is too small to have any toxic effect. Such effect is only produced by the inhalation of the particles themselves while suspended in the air.

5. Physiological Effects. The toxic substances may be classified according to the predominant effects which they exert, with the understanding, however, that the action of any substance is not limited to a single tissue or group of tissues. Thus, a substance, the vapor of which causes injury to the respiratory passages, may, when applied to the skin, cause blistering. If the sole or chief usefulness of a substance in warfare depends upon its effect on the respiratory tract, it is classed as a respiratory irritant. If its power to produce casualties is due to its action on the skin, it is classed as a skin irritant. If both actions are useful, it is placed in both groups.

6. Respiratory Irritants. By far the greatest number of substances thus far used injure the respiratory apparatus. Three groups may be differentiated:

(a) Those which exert their chief effects upon the delicate membranes in the lungs through which oxygen passes from the air into the blood. The main result of this injury is to cause fluid to pass from the blood into the minute air sacs and thus to obstruct the oxygen supply to the blood. Death from one of these substances may be compared to death by drowning; the water in which the victim drowns being drawn into his lungs from his own blood vessels. Examples: phosgene, chlorine, chlorpicrin, diphosgene.

(b) Substances which injure the membranes which line the air passages. During normal life these membranes insure protection to the lungs against mechanical injury by particles which may be taken in with the air and against bacterial infection. As a result of the action of substances of this group their protective power is lost. Portions of the membrane may become swollen and detached and may plug up the smaller passages leading to the lung tissue, or the damaged tissue may become the seat of bacterial infection, thus setting up bronchitis and pneumonia. Examples: mustard gas, ethyldichlorarsine.

(c) Substances which affect chiefly the upper air passages, i.e., the nose and throat. These substances cause intense pain and discomfort but are not dangerous to life. They cause sneezing, painful smarting of the nose and throat, intense headache, a feeling of severe constriction of the chest, and vomiting. For varying periods after exposure they may cause general muscular weakness and dizziness, loss of sensation in parts of the body or even transitory unconsciousness. Examples: diphenylchlorarsine, diphenylcyanarsine.

7. Tear Producers. (lachrymators) Certain substances have a powerful effect upon the eyes, causing copious flowing of tears, followed by reddening and swelling of the eyes, producing thereby effective temporary blindness. These effects are often produced by extremely minute quantities of tear producing substances. Larger quantities of the same substances usually act as lung irritants as well. Examples: brombenzylcyanide, bromacetone, ethyl idioacetate, chlorpicrin.

8. Skin blisterers. (vesicants). Certain substances have a powerful irritating effect upon the skin, very much like that produced by poison ivy. The same effect is produced upon all the surfaces of the body with which the substance may come in contact, such as the eyes and the breathing passages. Accordingly, a substance producing skin blistering will, if inhaled, also act as a powerful irritant of the air passages. Example: mustard gas.

9. The following table includes the most important substances now in use in Chemical Warfare, grouped according to persistency, with brief indications of their physiological effects. Little attempt is made to describe the odors, as this is very difficult. However, all who have any responsibility in connection with Chemical Warfare, should become familiar with the various odors by actual experience:

PROPERTIES OF SUBSTANCES USED IN CHEMICAL WARFARE.

NAME	PROPERTIES	
	Physical	Physiological
(A) Gases at ordinary temperatures. (Non-persistent).		Readily dissipated by wind.
Chlorine (Berthollite)	Greenish Yellow Gas.	Lung irritant, death rapid or delayed. Less toxic than phosgene. Odor like that of bleaching lime.
Phosgene (C.G.) (Collongite)	Colorless gas, easily liquified.	Lung irritant, death rapid or delayed. Mouldy odor.
Hydrocyanic Acid (V.N.) (Vincennite)	Colorless gas, easily liquified.	Nerve poison. Immediate death if concentrated; very little effect if dilute. Rapid recovery with no after effects.

- - - - - -

(B) Moderately volatile liquids (moderately persistent).

Chlorpicrin (P.S.)	Liquid less volatile than water.	Lung irritant, slightly less toxic than phosgene. Tear producer.
Diphosgene (S.P.) (Superpalite) (Green Cross).	Liquid less volatile than water.	Lung irritant.
Dichlorethylarsine (Yellow Cross I) (New Green Cross 3)	Moderately volatile liquid	Nerve poison and respiratory irritant. Produces pain in throat, chest and head.

- - - - - -

(C) Slightly volatile liquids (highly persistent).

Brombenzylcyanide (C.A.) (Other tear producers similar in properties and effects.)		Powerful tear producer.
Mustard gas (H.S.) (Yperite) Dichlorethylsulphide. Yellow Cross.	Liquid, boiling at 217° C. (423°F). Faint pungent odor when pure. Garlic odor from shell bursts.	Air passage irritant, producing death, and skin blistering agent. Eyes and genitals very sensitive. Effects often delayed 3 hours to 2 days.

- - - - - -

(D) Toxic Smoke Producers.

Diphenylchlorarsine (D.A.) Sternite, (Blue Cross).	Solid, melting at 39° C.(102°F.), boiling at 333°C, (632°F) vapor condensing to smoke.	Produces violent pain in head, throat and chest, with sneezing and coughing.
Diphenylcyanarsine.	Similar to diphenylchlorarsine.	Same effects as D.A. but more powerful.
Stannic chloride (K.J.)	Volatile liquid forming solid smoke with moisture of the air.	Little toxic. Gives opaque cloud and penetrates German mask, producing coughing.

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10. RELATION OF TOXICITY TO TIME OF EXPOSURE.

It is evident that the more dilute the gas, the greater is the time of exposure necessary to produce an equally toxic effect. We may say roughly that doubling the concentration of a given gas reduces the time

of exposure necessary to kill by at least half, and usually by more than half. This is very important in connection with tactical considerations, because of chief effectiveness of the gases of the non-persistent type, like phosgene, is attained through surprise-poisoning the enemy before he is able to put on his mask. It is exceedingly important, from this standpoint, to surround him suddenly with gas of sufficient concentration before his mask is in place.

11. The effectiveness of mustard gas is partly due to the fact that it retains its proportionate effectiveness at very low concentrations. The low concentration of one part in 100,000 acting for 20 minutes produces as much effect as the high concentration of one part in 10,000 acting for 2 minutes. This is also true to a large extent with chlorpicrin. On the other hand, the toxicity of hydrocyanic acid, (the toxic constituent of Vincennite), falls off much more abruptly as the concentration diminishes, so that a dilution is very soon reached at which it can be breathed almost indefinitely with no bad results.

12. The following table gives the concentrations necessary to produce death, or other characteristic effects, upon exposure for different lengths of time:

CONCENTRATION NECESSARY TO PRODUCE DEATH

Gases	Exposure for 5 minutes		Exposure for 30 minutes		Exposure for 2 hours.	
	Conc. by Vol.	Gms. per M 3.	Conc. by Vol.	Gms. per M 3.	Conc. by Vol.	Gms. per M 3.
Phosgene....	1 per 5,000	0.82	1 per 25,000	0.16	1 per 100,000	0.04
Chlorpicrin/	1 " 2,500	2.7	1 " 20,000	0.34	1 " 50,000	0.14
Mustard Gas	1 " 13,000	0.5	1 " 100,000	0.07	1 " 300,000	0.02
Hydro-cyanic acid.....	1 " 2,000	0.06	1 " 8,000	0.14	1 " 10,000	0.1

INTOLERABLE CONCENTRATIONS

Diphenyl-chlorarsine	1 per 10,000,000	0.0001	1 per 100,000,000	0.00001
Brombenzyl-cyanide.....	1 per 20,000,000	0.0004		

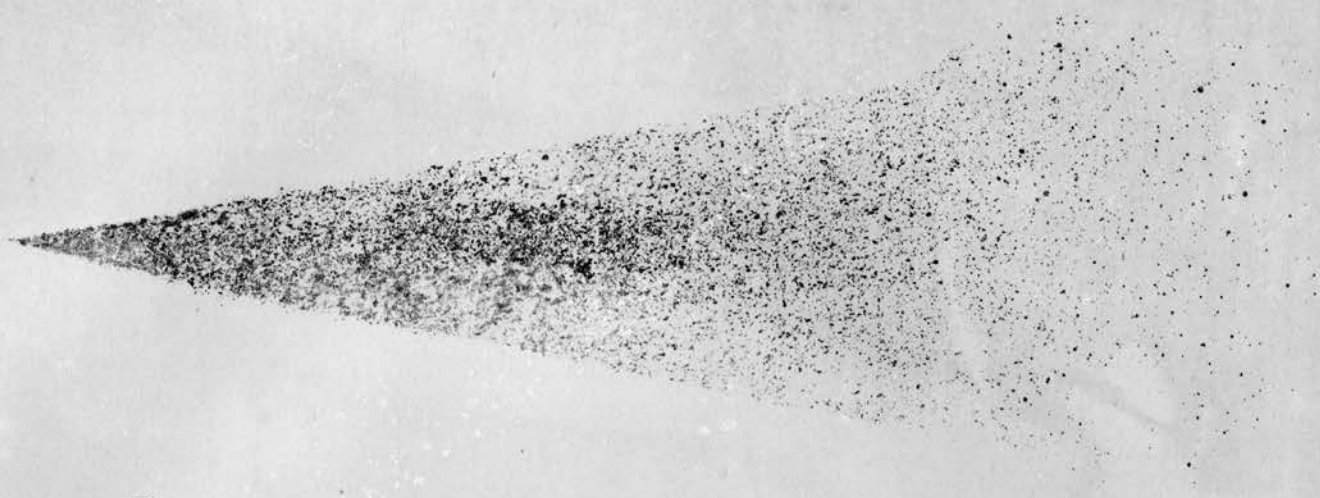


Fig. 1.

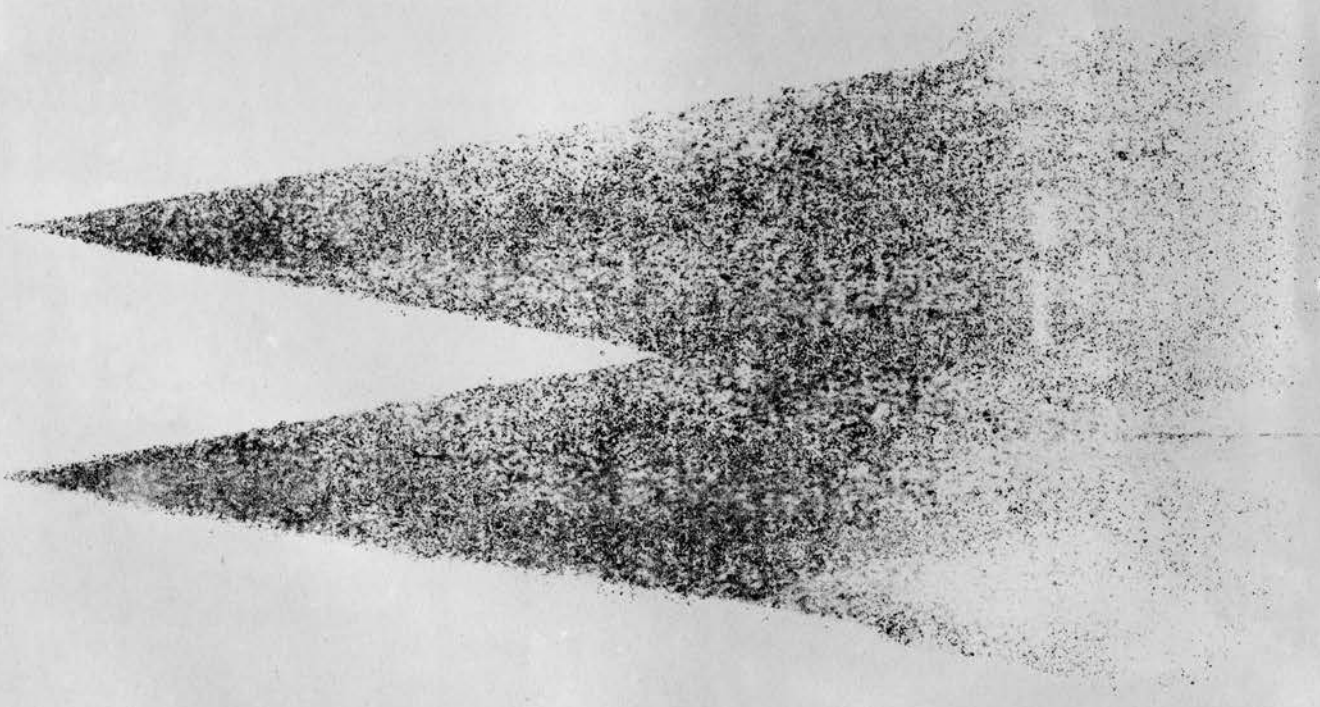
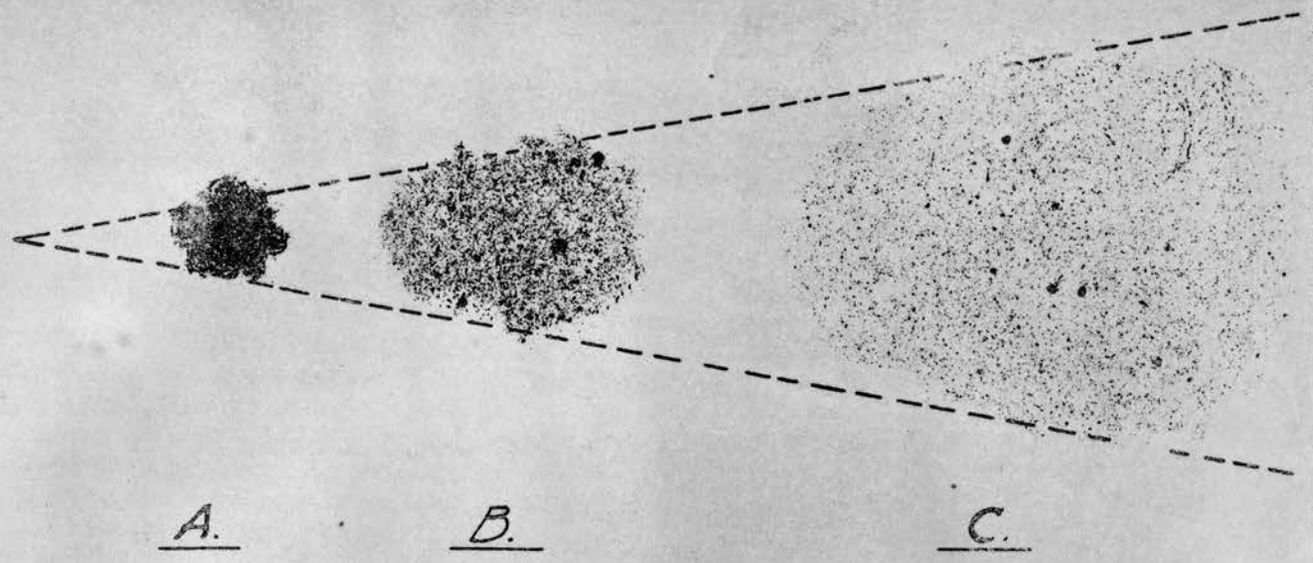
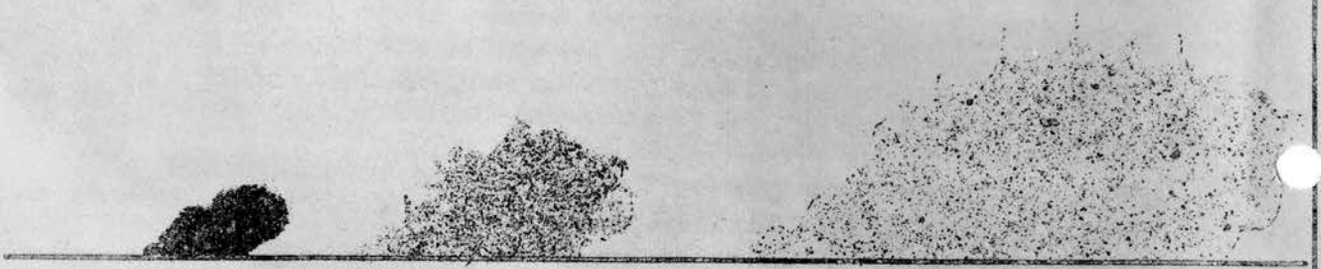


Fig. 2.



A. B. C.

Fig. 3.



A. B. C.

Fig. 4.

BEHAVIOR OF GAS IN THE OPEN.

A. RATE OF DILUTION OF GAS CLOUDS.

(1) Gas from Cylinders.

13. When gas is liberated from a cylinder it is blown along the wind and as a result of the eddies set up by its passage over the surface of the ground, it is mixed with air. The height of the cloud, when the ground is cool and the wind is not too high, is not very great, being limited largely by the height to which the eddies extend. Over smooth ground this amounts roughly to 30 feet at a distance of 100 yards from the point of emission, increasing only slowly at greater distances.

14. The cloud spreads laterally in the form of a fan, as illustrated in figure 1. The angle of this spread may vary from 15 to 25 degrees. It is safe to take 20 degrees as an average. This means that the width of the cloud at any distance from the cylinder will be about 0.4 of the distance. An increase in this angle seems to be favored by decreases in wind velocity and by increase in the rate of emission of the gas. It is possible, for practical purposes, to calculate the concentration of gas in the cloud at varying distances from the cylinder provided the velocity of the wind and the rate of emission of gas are known. The concentration will be greatest in the middle, decreasing towards the edges, as indicated by the shading in fig.1. Increased wind velocity produces a proportionate decrease in the concentration of the cloud. The average concentration at any cross section of the cloud falls off somewhat more rapidly than the increase of the distance from the cylinder. Thus, if the concentration were one per cent at 50 yards, it would be somewhat less than 0.5 per cent at 100 yards, and considerably less than 0.05 per cent at a thousand yards.

15. If gas is emitted from the cylinders or groups of cylinders at a distance from each other, each cloud will behave as above, but at the point where they begin to intersect dilution will become very slow, as illustrated by the intersecting lines in Fig.2.

(2) Gas from Shells.

16. As the clouds formed from bursting gas shells proceed down the wind, the rate of speed is roughly the same as for the fan shaped cylinder discharge, as shown in Fig.3, in which A, B, and C represent horizontal cross sections of the cloud at the point of burst and at two later intervals, respectively. Viewed from the side in elevation, these clouds are seen to spread out to a very great extent in the direction of travel. This is due to the friction offered by the ground to the passage of the wind, that portion of the gas cloud closer to the ground being retarded the most. Fig.4 illustrates the appearance of the cloud in elevation at the three points of its path shown above in Fig.3.

17. This longitudinal spreading of the cloud from a single shell burst causes it to dilute much more rapidly, as it proceeds from the point of emission, than does the cloud from a cylinder discharge. Of course, the retarding influence of the ground operates in both cases, but the continuous supply of gas from the cylinder tends to keep up the concentration. The result of artillery fire is usually a succession of distinct clouds, due to limitations in the rapidity of fire and to the dispersion of the shots.

18. It is very important, therefore, that bursts should be as close as possible to windward of the target, in order to surround the target with clouds of the maximum concentration.

19. Just as the behavior of the cloud from a single cylinder discharge enables one to predict the general behavior of the cloud formed by the simultaneous discharge of a number of cylinders, so the behavior of the cloud from a single shell burst, as outlined above, allows the prediction of the effect of gas shell fire in relation to wind, rates of fire and zones of dispersion.

20. Artillery "Gas Zones of Dispersion". When gas shell are fired at a position the shell do not burst simultaneously. The zone of dispersion of a gun is the pattern produced upon the ground by the impact of a large number of shell from a single piece. This pattern is independent of the rate of fire. The individual gas clouds move at once with the wind from the points of burst, each growing and diluting as indicated by the above paragraphs. If, as is usually the case, the shell do not fall simultaneously the effective zone of dispersion becomes not a pattern on the ground but a pattern in the air elongated in the direction of the wind. This elongation has the effect of an increased dispersion, the increase being greater the greater the velocity of the wind and the less the rate of fire. Fig. 6 represents, in idealized fashion, the points of impact and the sizes, position and concentrations of the clouds produced in a wind blowing across the line of fire. It is readily seen that doubling the rate of fire will distribute the gas in roughly half the area, producing thereby at least twice the concentration and having far more than twice the effect in producing casualties. It is evident, also, that an increase in the wind velocity will distribute the gas over a larger area, decreasing the concentration of the cloud. (As shown in Fig.7 as compared with Fig. 6).

21. One of the chief reasons for the effectiveness of gas is the fact that the cloud of gas is present for an appreciable length of time after its emission from cylinder or shell and is capable of producing casualties until the division becomes too great, or until it is blown away.

22. Increased wind velocity reduces rapidly the length of time that gas remains in the neighborhood. Gas is used most effectively in winds under 3 meters per second. However, too low a velocity is objectionable in the case of gas emitted near our own lines because of the possibility of a variation in wind direction bringing the gas back. Gas may be used in artillery shell fired at longer ranges even when the enemy is to windward by so adjusting the amount of gas used that the concentration will be harmless when it reaches our own lines.

23. In order to kill a man with gas by surprise, it is necessary to surround him with gas so concentrated that the small amount he must breathe before getting his mask on is effective. After his mask is put on, the gas cloud is of relatively small effectiveness. Even when the enemy is wearing his mask, however, it is desirable to subject him to gas of high enough concentration to penetrate the mask, especially the nearly exhausted ones likely to be in possession of many of the enemy's troops.

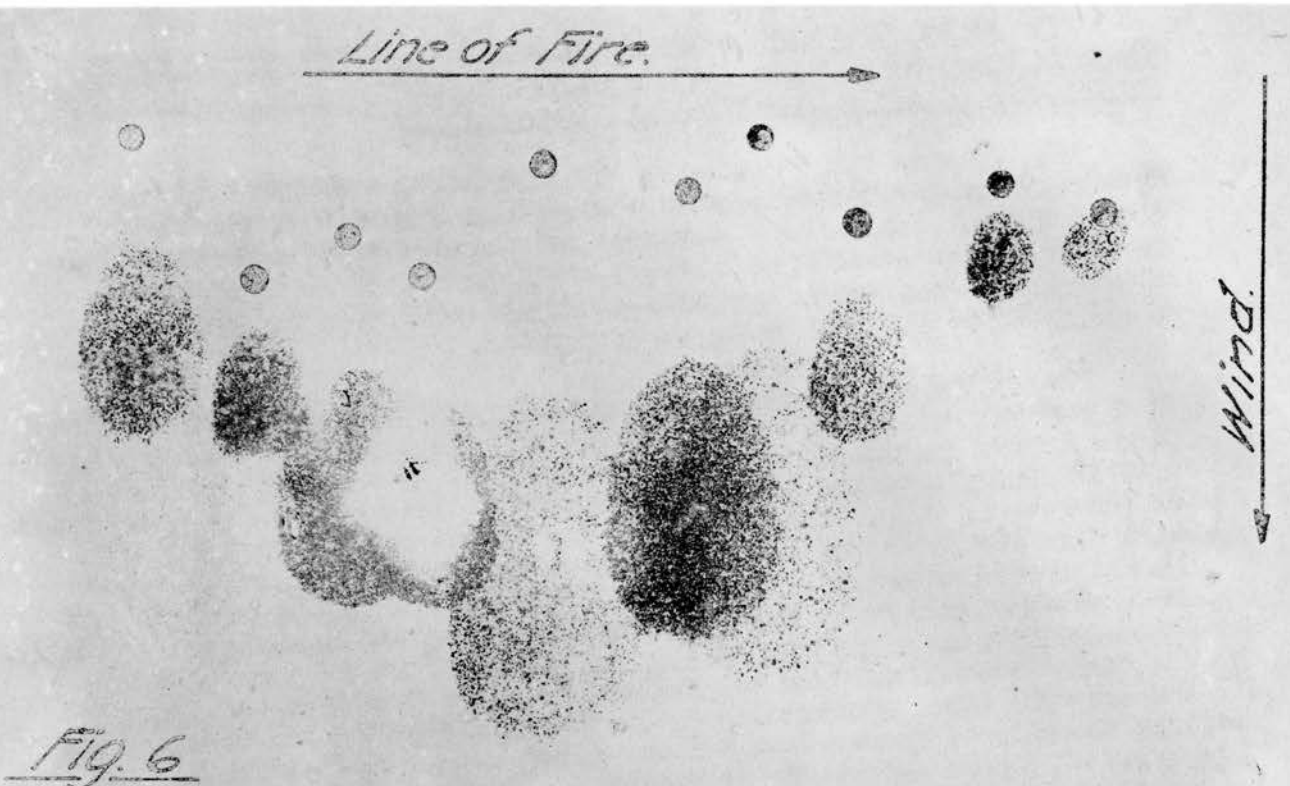


Fig. 6

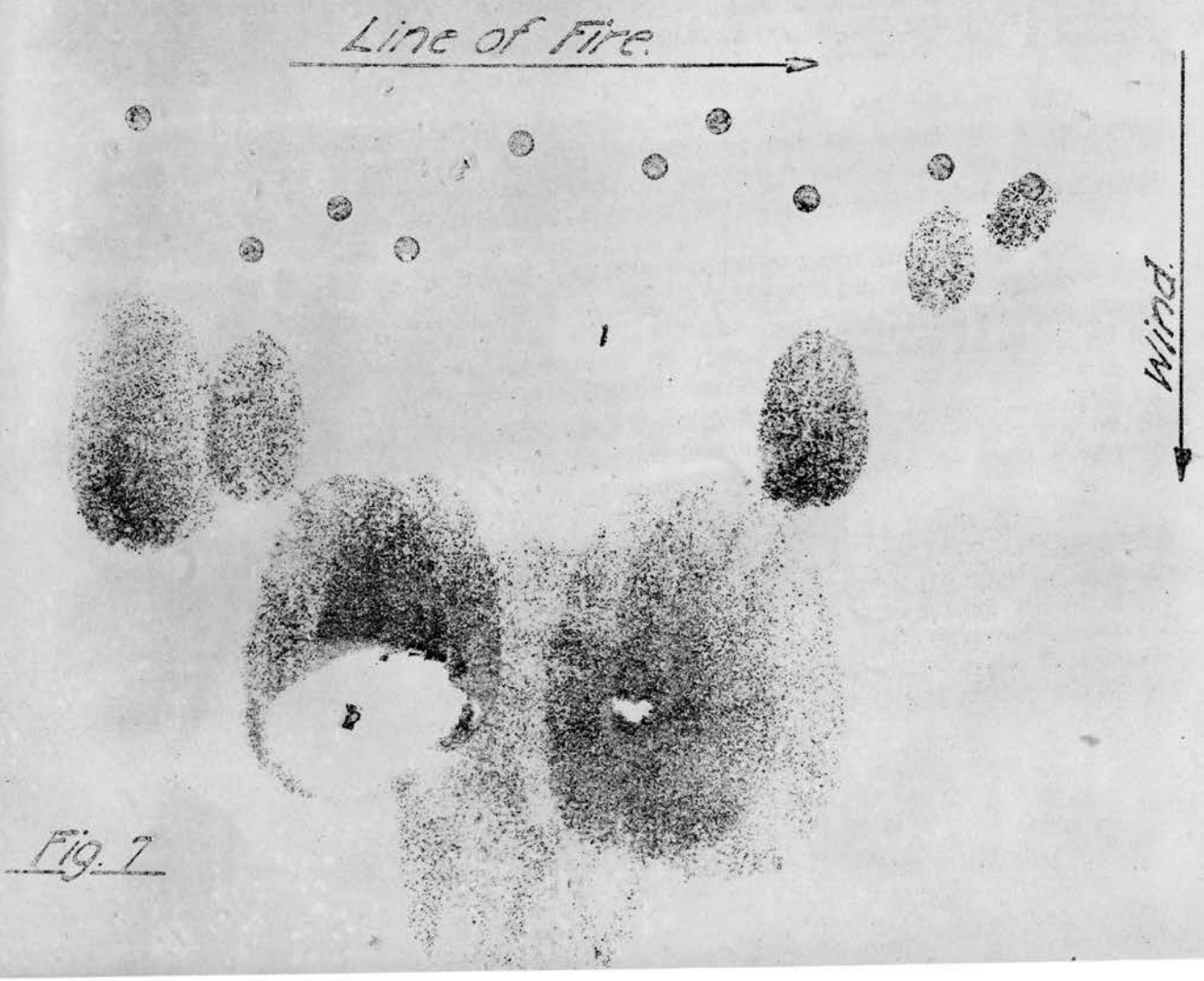


Fig. 7

24. Effect of Temperature. When the ground is considerably warmer than the air, as when the sun is shining brightly, vertical currents of air rising from the surface of the ground are generally produced, which have a great tendency to dissipate gas clouds. For this reason, gas is used far more effectively at night, or when the sky is overcast.

25. Effect of Terrain. It is very difficult to obtain a gas cloud, containing more than 0.1% of gas, for more than a very short time after its release, and even this concentration rapidly diminishes. Therefore, there is but little difference in physical behavior between a so-called gas cloud and so much air. Its density is but infinitesimally greater, and it is subject to the same movements as the surrounding air. If it stays longer in a valley than on higher ground it is chiefly because the winds blowing at higher elevations are not so strong in the valley.

26. Features of terrain which affect the movements of the air affect the movements of gas clouds in almost the same way. Tall grass, bushes, trees, buildings, etc., retard the movement of air, and in an increasing degree they retard the movement of and retain gas clouds. In an attack following a gas bombardment, more time must be allowed if a field of grain is in the path than if short grass or ploughed fields intervene. Still more time is, of course, necessary where bushes or trees are present.

27. Persistency of liquids upon the ground. To know how long the persistent substances will infect an area is very important. When ground has been evacuated in consequence of a mustard gas bombardment the length of time which must elapse before it can be occupied should be foretold as accurately as possible. Tremendous advantage may be gained by being able to estimate this period more accurately than can the enemy.

28. The rate of evaporation of a liquid from the ground is increased by increased wind velocity and especially by increased temperature. Mustard gas in the woods, or in calm weather, will persist much longer than in the open or in windy weather. It will last longer on cold ground than on hot ground. However, during a cold night, an infested area may perhaps be traversed with little danger provided the feet are properly protected, whereas the following morning, after the sun has warmed the ground, enough vapor may be given off into the air as a result of the increased evaporation to gas severely anyone traversing the area.

29. Moisture produces (though very slowly) the chemical decomposition of mustard gas so that it will persist for a shorter time in moist soil than in dry soil of equal temperature.

30. If the mustard gas liquid is dispersed in very fine droplets, it will disappear much more rapidly than when splashed in large drops upon the ground.

31. The following table will serve to give a rough idea of the persistency which may be expected from gases as spread by shell of the usual type:

-THE PERSISTENCY OF GASES-

GAS NAME	CLASS	SYMBOL	PERSISTENCE IN OPEN	PERSISTENCE IN WOODS	REMARKS
Vincennite Vitrite Collongite (Phosgene)	NON PERSISTENT	V.N. C.C. C.G.	10 minutes	3 hours	These gases are very volatile, they are vaporized entirely at the moment of explosion, forming a cloud, capable of giving deadly effects, but which loses, more or less rapidly its effectiveness by dilution and dispersion into the atmosphere.
Aquinite (Chlorpicrin) & (Operite) (Stannic Chloride).	MODERATELY PERSISTENT	N.C.	3 hours	12 hours	These gases, having moderately high boiling points, are only partially vaporized at the moment of explosion. The cloud formed upon explosion is generally not deadly, but it immediately gives penetrative lachrymatory, or irritant effects. The majority of the "Gas" contents of the shell is pulverized and projected in the form of a spray or fog which slowly settles on the ground and continues to give off vapors which prolong the action of the initial cloud.
Aquinite Chlorpicrin Martonite (Bromacetone)		P.S. B.A.			
Yporite (Mustard Gas) Camite (Brom Benzyl Cyanide)	HIGHLY PERSISTENT	H.S. C.A.	3 days	7 days	These gases, having a very high boiling point, are but little vaporized at the moment of explosion. A small portion of the contents of the shell is atomized and gives immediate effect, but by far the greater part is projected on the ground in the form of droplets which slowly vaporize and continue the action of the initial cloud.

NOTE:- The above figures on time of persistency are approximate only and for calm weather. Persistency is dependent to a large extent on temperature, wind velocity, and amount of gas liberated, especially in woods or other more or less closed places. High temperatures and wind velocities decrease persistency and low temperatures and wind velocities increase it.

32. The persistency of mustard gas on the ground is diminished by heavy rain, which washes it away, or by sunshine or strong wind which hastens its evaporation. Sunshine, on the morning after a bombardment, may produce a dangerous concentration of gas, where no marked effect had been noticed during the night. The wind limits for mustard gas are from calm to 12 m.p.h.; the lower the velocity of wind, the greater the local concentration of gas. Variations may be expected according to the principles above discussed. In the case especially of chlorpicrin, the air may have become safely free from the gas while the ground still contains enough to make it dangerous to entrench in it.

33. Infected areas may be crossed at night when the ground is cold at shorter intervals than those indicated by the above tables. It is always legitimate to take some risk of injury when important military advantages may be gained thereby. It is no more necessary to seek absolute safety from gas than from other forms of ammunition.

P A R T II.

TACTICAL USE OF GASES

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PART II.

TACTICAL CLASSIFICATION OF GASES.

1. The tactical values of gases are dependent - first, upon their persistency; and second, upon the character of their effects upon the enemy.

2. So far as persistency is concerned, we may distinguish three groups as outlined in Part I, namely:

(a) non-persistent,
(b) moderately persistent,
(c) highly persistent.

3. The characteristics of the effects of the different gases are important chiefly insofar as the casualties produced are:

(a) temporary,
(b) permanent,
(c) delayed.

(It is safe to assume that a substance which would produce only a temporary casualty would not be used if its effect were delayed, so that this possible class need not be considered). It is relatively unimportant to distinguish between the various physiological effects which may be included under the above headings. For example, it is not of great consequence in planning an operation to distinguish between temporary casualties produced by coughing, by vomiting, or by lachrymation. It is important to know only whether the effects will be produced rapidly and whether they will persist for a long time. Moreover, it is unimportant to distinguish between substances on the one hand which produce bad burns, and those on the other hand which produce lung lesions. Both can be used to decrease the fighting strength of the enemy.

4. The following table illustrates the tactical possibilities of the substances described in Part I:

TACTICAL USES OF GASES.
EFFECT - NATURE OF CASUALTY.

PERSISTENCE		TEMPORARY	PERMANENT	DELAYED
Group I	Low	Diphenyl-Chlor-arsine	Phosgene Chlorine	------
Group II	Moderate	------	Chlorpicrin	------
Group III	High	Brombenzyl cyanide and other lachrymators (tear producers)	------	Mustard Gas.

5. Smoke, although used for screening purposes rather than for toxic effect, falls within the scope of Chemical Warfare, and may be considered as a separate group - Group IV. This group includes Tin Tetrachloride,

Silicon Tetrachloride, Titanium Tetrachloride, and White Phosphorous. The Tetrachlorides are liquids, non-poisonous, but producing a dense smoke, principally useful in ranging. Being liquids, shell filled with them have the same ballistic characteristics as gas. White Phosphorous is a solid which, upon bursting in air, burns with a dense white smoke. It is useful for smoke screens. Phosphorous burns make ugly wounds.

6. Gases can be used to produce casualties or to neutralize enemy activity, as follows:

(a) In preparation for an attack.
(b) During an attack.
(c) In defense against attacks.
(d) On stabilized fronts.

The kind of gas to use and the time to use it depends upon the tactical situation and upon the poisonous and persistent qualities of the gases available.

7. General Tactics in Gas Warfare. In broad terms, gas can be used as follows:

(a) To neutralize and produce casualties in the front line and closely supporting trenches just prior to an attack. In this case, use a gas which quickly dissipates if the attacking troops are not to wear masks.

(b) To neutralize and produce casualties in front line trenches, among supports and reserves and at all points where it is not expected to attack within a few hours. In this case there is more latitude in the choice of gases, as there will be a longer time for the gas to dissipate before the attack is made.

TACTICAL GROUPS OF DIFFERENT TYPES OF GASES.

GROUP I.

8. Phosgene. During the entire period of preparation for an attack, as well as in the earlier stages of preparation, when mustard gas is being used, put over phosgene in sudden two-minute bursts of artillery fire, at repeated intervals of from 3 to 12 hours, upon strong points, concentration areas, woods and ravines, and upon groups of trenches and dugouts, to kill those whose masks are worn out or those who, through recklessness or carelessness, have removed their masks.

On targets, distant 1900 meters or more, use artillery to carry out the tactics outlined in paragraph above. Whenever possible, the area within 1900 meters of our line should be taken care of by Gas Troops, using cylinders for cloud gas, when the wind is favorable, and projectors and 4" Stokes mortars, all of which can produce much higher gas concentration than artillery.

When the wind is favorable (blowing toward enemy) launch against the entire front to be attacked, and for miles along the front not to be attacked, heavy phosgene gas attacks by all methods, including cloud gas from cylinders.

If the wind is unfavorable, phosgene may still be used with artillery, projectors and Stokes Mortars by simply reducing the amounts put over in accordance with the tables of safe distances given in Part III.

When immediate neutralization is required, phosgene is generally preferable on account of its immediate effect.

Gas troops with Stokes mortars, projectors and cylinders can keep up with Infantry reserves; and when needed they can attack strong points, machine gun nests and enemy troops concentrating for counter attacks, with phosgene, or with phosphorous for smoke screens. They can also drive out troops with thermite, phosphorous and incendiary bombs and drums thrown from mortars and projectors.

With unfavorable winds phosgene and chlorpicrin may be used by artillery, and by Gas Troops, employing projectors and 4" Stokes mortars, who should direct their fire just beyond the nearest enemy masses so as to let the gas drift back over them. The amount of gas must be reduced, but not necessarily to the amounts given as safe under rules for firing of gas by artillery. Some chances must be taken with our own gas even to the extent of an occasional casualty as with H.E. and shrapnel. With the new comfortable mask, giving perfect vision, accidental casualties should be rare.

GROUP II.

9. Chlorpicrin is stopped by the mask much less readily than phosgene, and in the high concentrations attainable in projector attacks heavy casualties may be expected. It is moderately persistent, and its value in artillery shell is due to this fact and to its lachrymatory power. From 3 to 12 hours should be allowed where troops are to cross the infected area, depending upon whether the area is open or wooded.

GROUP III.

The characteristics which make mustard gas so valuable are:

(a) It has very little odor.
(b) The absence of immediate effect.
(c) Its effectiveness in low concentrations.
(d) Its persistence.

10. Mustard Gas. (a) Use for harassing fire against batteries, strong points, woods, cross roads and enemy concentrations everywhere at all times prior to attacking.

(b) As it affects eyes, lungs, body, and food, and persists for days, it wears down the enemy morale and vigor by forcing constant wearing of the mask and the necessity of always taking other extensive precautions.

(c) In the open, it may be used when the weather is clear and warm up to 3 days before an attack.

(d) When weather is cloudy and warm, add 1 day to (c).

(e) When weather is cold and especially cloudy, allow 4 to 7 days.

(f) In thick woods or brush heavily bombarded with mustard gas, allow 5 days in warm weather and 7 days in cold weather before attacking through them, except under special conditions.

(g) An infected area may be crossed more safely when the ground is cold, as during the night. The above intervals may be reduced if this precaution is taken.

(h) Continue neutralizing and harassing fire against strong points, battery positions, cross roads and any possible concentration points during the entire battle, in accordance with the schedules given in (c), (d), (e), and (f). The flanks, where no attack is to be made by our troops, should be kept smothered with mustard gas to prevent the possibility of a flank counter-attack.

(i) It may prove possible in the future to change the burst of mustard gas shell so as to diminish the persistency, allowing earlier attack following its use, and producing greater concentrations.

(j) When the enemy succeeds in halting our attack at any point, use mustard gas in accordance with the schedules given under (e) and (f), and in the intervening period up to the moment of the attack, pour in phosgene with both artillery and Gas Troops. When the wind is unfavorable, i.e., blowing toward our troops, merely reduce the amounts sent over.

(k) Gas used as explained under (j) is a valuable weapon to break up resistance in general, and is especially valuable for use against enemy troops concentrated for counter-attacks.

(l) The use of mustard gas must be continuous on woods, ravines, roads, villages, railroads, and any other places where enemy troops can concentrate or where they must move. Fields that the enemy may cross should be thoroughly gassed.

(m) Used in this way, it should be very effective in inflicting serious losses from burns, even if the mask fully protects.

(n) Mustard gas can be used in the offensive, without endangering our troops, beyond or to the flanks of an objective. When the objective is a limited one, always allow clearance of one mile as a safety factor in case the wind should prove adverse.

(o) Bombardments with mustard gas are best carried out at night, when the atmospheric conditions are most likely to be favorable, and, when, owing to the difficulty of seeing while wearing a respirator the maximum amount of interference with movement is caused. In addition, the evacuation of shelled areas is most difficult at night.

11. Bombenzylcyanide (lachrymator)

(a) Use anywhere to force immediate wearing of the mask. It is a powerful lachrymator, and very persistent, but not poisonous unless one is very close to a bursting shell. It is two to three times as persistent as chlorpicrin.

(b) It is useful to save mustard gas, phosgene and chlorpicrin, and still harass the enemy by forcing him to wear masks. For this purpose it is many times more effective than phosgene and chlorpicrin.

(c) It is especially useful against active combatants, as few guns are necessary to produce the desired effect.

GROUP IV.

12. Smoke. The following substances are used in our service for producing smoke:-

(a) Phosphorous
(b) Tin)
Titanium) Tetrachloride
Silicon)
(c) Special Smoke Mixtures.

Phosphorous, when exposed to air quickly produces great volumes of dense white smoke, the particles burning on the ground persisting for several minutes. Phosphorous gives smoke of the highest obscuring power and greatest persistency of any of the smoke producing substances. Moreover, the burning particles of phosphorous make deep and serious burns in flesh and hence it has a decided value against troops exposed to it. Phosphorous is, therefore, used for smoke barrages and screens, in artillery shell, trench mortar bombs, and hand grenades.

Tin, Silicon, and Titanium Tetrachlorides are liquids which give smoke when liberated in the air. They are not as effective as phosphorous for smoke barrages and screens because their smokes have a smaller obscuring

power and less persistency. They are, however, more abundant than phosphorous and are in the nature of substitutes where phosphorous cannot be obtained. These materials are, therefore, loaded as phosphorous substitutes into artillery shell, trench mortar bombs, and hand grenades. Due to the fact that these substances are liquids, they are peculiarly suited for smoke ranging shell, as they exhibit the same ballistic characteristics as liquid "gases". The relative merits of these three substances are as in the order named above; and, as compared with white phosphorous, may be taken as follows:

White Phosphorous		100%
Tin Silicon Titanium	Tetrachloride	40%

Other Smoke Mixtures include:-

The British "S" Mixture, consisting essentially of the following:-

Saltpetre
Sulphur
Pitch
Borax
Glue

This mixture has been used in smoke candles effectively and as compared with phosphorous has the following relative screening value:-

White Phosphorous - - - - 100%
"S" Mixture - - - - - - - - 20%

The B.M. Mixture, consisting essentially of:-

Powdered Zinc
Carbon Tetrachloride
Sodium Chlorate
Magnesium Carbonate

This has recently been used as a substitute for phosphorous in hand grenades and also in smoke candles. It is claimed that this mixture has an obscuring value equal to phosphorous and a relative persistency of about one-half that of phosphorous.

WHO USES SMOKE

13. Smoke is used by:-

Artillery, with smoke shell for distant smoke barrages and for ranging gas shell.

Infantry, with 3" Stokes smoke bombs for smoke screens up to a range of 740 yards; with hand and rifle smoke grenades to protect advancing troops against machine gun nests, etc.; with smoke candles to conceal troop movements, etc.

Gas Troops, with 4" Stokes smoke bombs for conducting special tactical operations, often combined with use of gas; for establishing smoke screens of large dimensions up to a range of 1000 yards.

Air Service, with small smoke drop bombs used for training observers in bomb dropping, etc.

14. The description of the materiel above mentioned will be found elsewhere in this book.

15. The following table gives a rough idea of the comparative weight of phosphorous and the approximate efficiencies of the several British smoke producing devices now in use.

DEVICE	WEIGHT OF PHOSPHOROUS	EFFICIENCY
No. 27 Smoke Grenade	14 oz. White	3
P. Bomb 18 lb. Artillery Shell	10½ oz. White	1
45 lb. Artillery Shell - Howitzer	4 lb. White	10
4" Stokes Mortar Bomb - Light Smoke	4½ lb. Red	10
4" Stokes Mortar Bomb - Heavy Smoke	7½ lb. White	15

Smoke Tactics.

16. Smoke, if its use is carefully studied, will be found of great value in modern infantry tactics, as it confers many of the advantages which are to be gained by conducting operations at night, while few of the disadvantages are present.

Smoke screens may be employed with one or more of the following objects in view:-

(a) To mask known enemy observation posts; to conceal and protect the front and flanks of attacking troops from enemy observation; and to blind hostile machine guns.

(b) As a feint to draw enemy's attention to a front on which no attack is being made, so as to hold his troops to their trenches and prevent them from rendering assistance to the sector attacked; in inducing him to expend ammunition needlessly and to put down a barrage in the wrong place.

(c) In the case of a smoke cloud used offensively, to simulate gas, with a view of lowering the enemy's morale and forcing him to use his gas masks. It may also be used to extend the front of a gas attack.

To make this effective, gas should occasionally be mixed with smoke in order to impress upon the enemy the belief that it is never safe to remain in a smoke cloud without wearing his mask.

(d) In flat or open country to conceal concentrations of guns and troops, and to screen roads, forming-up places and lines of advance. To blind the flashes of a battery in action in view of the enemy's observation posts and to hamper observation from the air.

(e) To cover the construction of bridges, trenches, etc. in the face of the enemy.

Ground and troops behind smoke screens can seldom be concealed from hostile airplanes or kite balloon observation.

If troops are hidden in smoke clouds such clouds attract the enemy's fire and are, therefore, dangerous; for this reason, smoke screens intended to conceal concentrations should normally be formed at some distance - about 400 yards - from the object to be concealed.

In frontal screens, care must be exercised to place the screen so that an enemy barrage laid on it will not catch advancing troops. Such a screen should preferably be placed on the enemy trench system.

The necessity for anticipating the effect which a smoke cloud will have in impeding our own observation and artillery fire should be considered, as well as the possibility of troops being hidden from our contact patrol airplanes.

When smoke is liberated on the flank of an assault, care should be taken, by defining permissible wind limits beforehand, that the cloud does not pass across the front of the assaulting troops, as the latter attacking through smoke are very liable to lose direction.

When the use of a smoke screen in operation is contemplated, the enemy should be educated to associate such a screen with some object other than the real one, e.g., he may, by means of a practice smoke screen, followed by no action, be led to suppose that the object of the demonstration is to compel him to expend ammunition uselessly.

It is obvious from the foregoing that it is of the utmost importance that the use of smoke should be systematic but varied instead of casual and haphazard.

Initiative at the critical moment means the saving of valuable lives and the avoidance of delay in the progress of the attack. If this is to be cultivated, and if misuse and waste are to be prevented, the most careful training is required, not only of the individual, but also of companies, battalions, and even brigades

Smoke Screens.

17. The amount of smoke producing material required to form a screen depends on a number of considerations, the most important of which are as follows:

(a) The extent of the screen. As a rough guide it may be assumed that the width of the screen should be from two to three times the width of the object to be concealed, (as seen by observers from the points from which it is intended to prevent observation).

(b) The duration of the screen.

(c) The direction of the wind. A cross wind requires, as a rule, less expenditure of smoke than one at right angles to the front; and the difficulty of concealment increases if the direction of the wind is variable.

(d) The velocity of the wind. The density of the smoke cloud diminishes considerably in proportion as the velocity of the wind increases. In a wind of over 20 miles per hour it is very difficult to form an opaque screen without excessive expenditure of material.

(e) The number of directions from which the enemy can observe the object or area to be concealed. The greater the number of points from which an object can be observed by the enemy, the greater will be the extent of the screen required and, therefore, of the amount of smoke producing substances necessary to form it.

(f) The distance of the object from the enemy's observation posts. The greater this distance the more effective the smoke cloud will be.

In forming a screen with any form of smoke producer, it is necessary for the formation of the smoke screen to be very carefully organized, so that the best results may be obtained with the greatest economy of material. All personnel required for providing smoke screens should be trained beforehand in the use of the actual material which is to be employed and a simple rehearsal is most valuable. The program which is to be followed should state in detail the rate of expenditure of the smoke producing substances and should be given in writing to the personnel at each smoke source.

Protection of Tanks.

18. Since the enemy artillery is the most dangerous adversary of the tanks, one of the vital conditions for the successful operation of tanks is blinding the ground observation posts which look out on the field of attack by means of a very dense, well regulated smoke screen. In front of artillery in position, a natural or artificial fog is a necessity

to the tanks. Our artillery, therefore, must thoroughly understand this need, and should supply themselves in advance with plenty of smoke shell, and should insure the supply of projectiles of this type during the action. The formation of an artificial cloud by the use of smoke shell has always proved efficacious whenever it has been employed. Thus, on August 10, 1918, the infantry, supported by 1 battalion of light tanks attacking from the Ressons Wood reached Neuville-sur-Ressons, thus making a rapid advance of 6 kilometers. Out of 30 tanks engaged only one was put out of action by hostile artillery fire.

Smoke shell should not be employed in the rolling barrage alone. In different actions, notably that just cited, the method of forming a "smoke cage", or box barrage, gave excellent results. This method consists in establishing a smoke barrage on all points from which the objective to be taken could be seen at a distance of 500 to 600 meters. An enclosed area is thus formed in which the infantry and tanks may operate, screened from the view of the enemy observers, without themselves being bothered by lack of visibility within combat distance.

19. Gas and Smoke during a Withdrawal or on Stabilized Fronts.

Gas and smoke on these fronts will be used according to the directions heretofore given. On a retirement maximum amounts of mustard gas should be used from close up to our retiring troops to as far back as the longest range guns will reach.

PART III.

USE OF GAS BY THE ARTILLERY

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INTRODUCTION

1. The information in this Part of the Manual of Gas Warfare, on the use of gas in Artillery shell, is compiled with the certain definite purpose of furnishing the artilleryman and the gas officer concise information on the use of chemical ammunition. All subject matter which is covered in other chapters of this pamphlet and any documents or pamphlets compiled by the American Expeditionary Forces dealing with the subject of artillery firing, has been omitted. Information contained in other chapters treating in detail on the characteristics of gases, their tactical use, gas defense and gas training, will, however, be useful.

2. Information. In accordance with paragraph 1, G.O. 107, G.H.Q., A.E.F., 1918, Gas Officers will be consulted preparatory to the offense use of gas on a large scale. In order that the Gas Officer may give intelligent advice, information must be furnished him on the following points:

Information of the Enemy:

1. Points of concentration.
2. Strong Points.
3. Battery Positions.
4. Reserves.
5. Dumps.
6. Lines of Communication.

Information of Our Own Troops:

1. Positions.
2. Plan of Action.
3. Location of Batteries.
4. Number of Guns.
5. Caliber of Guns.
6. Quantity of Ammunition Available.
7. Kind of Ammunition.

3. The Gas Officer must make a careful study of the topographical features of the terrain, and the meteorological conditions applying. After a solution has been arrived at, the Gas Officer must be able to advise definitely the Chief of Staff or Artillery Commander as to the following:

1. Location of Target.
2. Time of Shoot.
3. Rate of Fire.
4. Kind of Gas Shell.
5. Number of Gas Shell Required.
6. Object to be Accomplished.

4. The effective range of a gun must be considered, and, therefore, its position as regards distance from available targets must be known.

5. The volume of fire which can be placed on a position is limited by the quantity of gas shell on hand, and by the percentage of all gas shell fired which will fall within an effective distance of the same. This last crosses the line of demarcation of the duties of a Gas Officer and of

an Artillery Commander, and the latter must be consulted by the former, so that impossible solutions are not arrived at.

6. Shrapnel, H.E., and gas shell each has its distinctive uses and in many cases efficient results cannot be obtained by substitution. If the artilleryman understands the simple rules governing the use of gas shell, he has an excellent weapon at his command, and its proper use incurs no danger to his men or to others of our own forces.

7. Safe does of Mustard Gas. The following table gives the maximum number of rounds of H.S. which may be fired without endangering our own troops. The greater the range the more you can safely use.

Rounds per 100 meters front.
Not to be repeated oftener than every six hours.

Size of Shell.	Lbs. of Gas	500 Meters	1000 Meters	2000 Meters	3000 Meters and beyond
75 mm.	1.35	6	15	50	100 or more
4.7" G.	4.2	3	9	30	60 or more
5" S.C.	5.16	2	6	20	40 or more
6" S.C.	10.1	1	3	10	20 or more
155 mm.	10.35	1	3	10	20 or more
8" How.	21.6			4	8 or more
9.2" How.	28.3			3	6 or more
9.5" How.	36.1			2	3 or more

8. In shelling an area with mustard gas you need not use more than one 75 mm. shell for each 25 square meters (5 meters square), and for larger shell you can use proportionately less.

9. At ranges less than 2,500 meters, the firing should not be repeated with mustard gas oftener than once every six hours. Indeed, it is hardly ever necessary to repeat mustard gas firing at more frequent intervals. Chlorpicrin, and similar moderately persistent gases, may be fired in double the above quantities and at intervals of half the time shown above. With phosgene and similar lethal low-persistent gases, 2½ times as much may be fired and repeated at intervals of one hour or even less, though not oftener than every 30 minutes. For Group IV, fire ½ as much as for mustard gas and repeat not oftener than every 4 hours.

10. Miscellaneous hints.

(a) Use instantaneous fuse; either French I/L or American Mark III.

(b) The largest angle of fall possible is desired.

(c) Secure enfilade fire whenever possible so gas cloud will reach as many of enemy as possible.

(d) H.E. or shrapnel should accompany gas shell whenever possible. They add to the confusion of the enemy and camouflage the use of gas. They do not appreciably dissipate the gas clouds.

11. Zones in front of our own lines within which it is dangerous to place shell.

	Wind blowing toward enemy.	Wind blowing toward our lines.
NonPersistents		
Small Quantity	300 meters	1000 meters
Large Quantity	300 meters	2000 meters
Persistents		
Small Quantity	1000 meters	1000 meters
Large Quantity	2000 meters	2000 meters

If you do place shell within these zones, study the matter carefully and be sure to warn our own troops so that masks may be worn and other precautions taken, including temporary evacuation if advisable.

12. Fire for Adjustment.

(a) For ranging use special liquid smoke shell (Marked with 2 yellow bands). When special smoke shell are not available, H.E. shell may be employed for ranging, in which case correction must be made for the difference in ballistic coefficient between the solid filled H.E. shell and the liquid filled gas shell. For 75 mm. caliber the difference in range between H.E. and gas shell is negligible at 2000 meters, but at 7000 meters gas shell range short of H.E. by 200 meters. At ranges between 2000 and 7000, the difference may be taken as proportional. Range differences for other calibers of shell will be published as soon as available.

(b) Range firing for gas shelling should be done on a datum point in the same general direction and at approximately the same range as the target but sufficiently distant therefrom so as not to attract attention, as effective gas bombardment must set in suddenly. If the cessation of the bombardment is covered by a repetition of shelling of individual objectives (possibly with a lesser number of shots), the timely reinforcement of the enemy is then hindered. The enemy will also be obliged to wear his gas mask longer.

(c) Use range tables for Semi-Steel Shell (Fonte aciree) - with fuse wherever special tables for Gas Shell are not provided.

(d) Accuracy of fire is essential.

A. Correct for differences in weight when substituting gas shell for H.E. or Smoke Shell.

B. With Non-Persistent Gases: seek narrow bracket; if there is no

wind adopt mean angle of elevation of bracket in fire for effect. If there is a wind, modify the mean angle of elevation by 1/6 fork to the windward.

C. With Persistent Gases: seek narrow bracket and adopt mean angle of elevation regardless of wind direction.

13. Fire for Effect.

(a) With Non-Persistent Gases. Execute Precision Fire. On targets of depth repeat fire every 100 meters in depth.

(b) With Persistent Gases. Execute Zone Fire.

EXPENDITURE OF AMMUNITION.

14. To ascertain number of guns and rounds required to gas an enemy position, see C.G. chart opposite. The following notes show how to use the chart.

15. For Non-Persistent gases-(Phosgene). Since intense rate of fire is necessary to obtain effective concentration of gas, it is as important to know the number of guns required as well as the number of rounds necessary.

(a) Determine range and front of objective.

(b) Locate intersection of the range ordinate, and the curve for the calibre of gun chosen.

(c) Project to the right and read number of guns required for each fifty meters front, firing at "R" rate of fire.

(d) Multiply this number of guns by the number of times 50 is contained in the objective front measured perpendicular to the direction of the wind, to get the total number of guns.

(e) Number of guns x R x 2 equals expenditure of ammunition.

(f) Carry fractions through to end of computations but take result in round numbers.

(g) If mixed calibers are to be used because of being available determine effective kilograms of gas to be had from one gun as read at left and combine guns to give the total lethal dose.

(h) If P.S. is used for lethal effect, expenditure of ammunition should be at least that for C.G.

16. For Persistent gases - (Mustard Gas). Since intensity of fire is not necessary for these gases, the number of guns used is unimportant - the total rounds fired being the only figure necessary to obtain. Hence the above calculation simplifies as follows:

(a) Determine range and area to be covered and read direct from chart number of rounds required for each area 100 meters square.

25 ROUNDS

H.5.

10,239

NUMBER OF ROUNDS PER UNIT AREA (100 METERS X 100 METERS)
ASSUMING THAT 100 KG. ARE NECESSARY PER UNIT AREA

375
360
345
330
315
300
285
270
255
240
225
210
195
180
165
150
135
120
105
90
75
60
45
30
15

75 mm. Gun
4.7" Gun
155 m.m. Gun
9.2" How.
155 m.m. How.
8" How.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

RANGE IN KILOMETERS

KILOGRAMS OF C.G. EFFECTIVE PER 50 METER FRONT WHEN FIRED
FROM ONE GUN IN TWO MINUTES AT "R" RATE OF FIRE-LETHAL DOSE 50 KGS. R-ROUNDS PER MINUTE

KG.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

RANGE IN KILOMETERS.

75mm Gun R=12

155mm Gun R=3

4.7" Gun R=7

155mm How. R=3

8" How. R=2

82 m/m R=1

Change 2

Change 1

Change 0

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

NUMBER OF GUNS REQUIRED TO PRODUCE A LETHAL DOSE PER 50 METER FRONT.

(b) If P.S. is used in place of H.S., expenditure of ammunition should be the same.

17. For Lachrymatory Gases:

(a) With Brombenzylcyanide (C.A.) use 1/20 as many rounds as given by the chart for H.S.

(b) When firing chlorpicrin (P.S.) for lachrymatory effect, use 1/4 as many rounds as given by the chart for H.S.

(c) To maintain the lachrymatory atmosphere with brombenzylcyanide continue to fire every 4 hours the same amount as fired at first. That is, give the same dose every 4 hours.

(d) If chlorpicrin is used, repeat the original dose every hour.

Whenever enough ammunition is available use a "factor of safety", by doubling the amounts obtained from the chart. This will make up for unknown factors such as local wind currents at enemy position, etc.

METEOROLOGICAL AND TOPOGRAPHIC CONDITIONS.

18. Meteorological.

1. Stability of Air. In dry, sunny weather, upward air currents are usually present. They rapidly dissipate gases. Therefore, a warm, sunny day is not a particularly good time in which to conduct a gas shoot. The best time for a gas shoot is usually at night, because the atmosphere then is relatively stable. In the case of a persistent gas, as soon as the sun comes up the heat causes the liquid on the ground and foliage to vaporize, thereby increasing the concentration.

2. Fog. Foggy days are usually excellent for firing gas, for the atmosphere at such times is fairly stable.

3. Rain. Very heavy rain washes down all gases and is a considerable disadvantage. Very light rains or drizzles are often beneficial.

4. Barometer. With a low barometer, the air near the surface is full of "pockets" and upward currents which may dissipate the gas.

5. Temperature. A low temperature lessens the concentration of persistent gases since the liquid evaporates more slowly. The highly lethal, non-persistent gases are not much affected by a low temperature.

6. Time. For persistent gases, any hours are good, though the hours after midnight are best. Their best effects are obtained during the weather familiarly termed "warm and muggy", which is warm enough to cause the gas to rise freely, when the heavy air assists their penetrative action by causing the gas clouds to spread.

7. Winds. Winds have a considerable influence. Generally, toxic gases of low persistency should be limited to velocity not exceeding ten miles per hour ($4\frac{1}{2}$ meters per second). Limit persistent and tear gases to wind velocity not exceeding 20 miles per hour (9 meters per second).

The ideal weather conditions are usually found on summer nights as well as the late evening and early morning hours of spring and autumn.

19. Topography.

The use of gas is greatly influenced by earth forms. The effect of topography is closely connected with atmospheric conditions, which it influences by altering the direction and force of air currents. Wooded and very undulating ground has a very great influence on the result of a gas shell bombardment.

Gases, being slightly heavier than air, tend to flow into gullies, draws and valleys, leaving the tops of hills free. In deep, narrow and long valleys, currents of air are usually found which carry the gas long distances.

In hilly country special attention must be paid to deviations of the lethal wind from the general air current and to the mountain winds which in clear weather set in at certain periods of the day. A drifting of the gases from higher to lower places, such as obtains with attacks with gas projectors, cannot be reckoned with, for the gas density in the air is less in bombardments than in the spraying method.

Gas may be used under intelligent direction in nearly every character of terrain. It may be most satisfactorily used in almost level, slightly undulating districts.

Targets, such as woods, may be shelled with good results when the wind has too high velocity for targets situated in open ground. When undulations in the ground are very marked, the fact that the wind is stronger on high ground than on low must be taken into account. High ground and open places must, therefore, receive a more intense concentration than those localities which are wooded or enclosed.

The effects of gas shell will be diminished in marshy ground or in an intensely shelled area, if the craters are full of water.

During gas shell bombardments in open country, particular attention must be paid to the deviation of the local wind from the general wind direction and to air currents peculiar to the combined action of mountains and valleys, which occur on certain days in bright weater. That is, you must, if possible, consider what the wind conditions are <u>at the enemy position</u>.

With the long range of artillery, gas may be safely sent over to the enmy no matter what the direction of the wind. It is merely necessary to establish safety zones, (see paragraph 11), and knowing the characteristics of the gases available, deliver the gas where it may be needed in an effective dose, which at the same time cannot be blown back in dangerous quantities to our own line. To do this requires the ability to make use of topographic maps and judge the effect of topography on prevailing winds.

20. <u>The Wind Circle</u>. The Gas Officer cannot do good work without good topographic maps. On each map which exhibits the trench systems, he should mark the Gas Safety Zones and draw a wind circle six inches in diameter. This wind circle is divided into forty parts, called "Grads", numbered clockwise.

The daily meteorological report gives the direction of the wind by numbers. The wind blows from the circumference to the center of the circle, which represents the gun position. The 0 of the circle is north, 10 is east, 20 is south and 30 is west. In transmitting wind data, 50 is added to wind speeds to prevent confusion with the numbers which indicate wind direction. The speed is in meters per second.

The artilleryman uses the wind circle to make meteorological corrections to his firing data. The Gas Officer uses the wind circle to study the probable effect of topography on the travel of a gas cloud impelled by the prevailing wind. The wind direction should be plotted on the maps.

The Gas Officer should lay over his map each day a piece of transparent paper. On this he should trace the boundaries of the safety zones, a few of the heavier contours showing marked earth forms and also the bottom of all large depressions and the crests of all hills, indicating heights by figures. Across the hills and valleys he should draw in yellow pencil parallel lines indicating the wind direction. Mark in figures on these lines the speed in meters per second. Date each sheet and sign it.

With the data thus ready, the Gas Officer can quickly decide just what gas to use on a certain target and the quantity. These sheets should be filed for record and the one used on the day of a gas shoot should accompany the report on the shoot, a copy being retained at Headquarters.

In order to be able to allow for unexpected atmospheric changes, the firing order should, if necessary, be given by pre-arranged signal visible at great distance; for instance, from a captive balloon. A similar signal is also to be decided upon in case a break or cessation of the bombardment is necessary. The lighter the bombardments are, the more can these measures be modified.

TACTICAL USE OF ARTILLERY CHEMICAL SHELL.

21. Two general types of bombardment with gas shell may be carried out. Variations, and combinations, of these two types should be often employed. The two general types are:-

1st. Destruction Fire. This type of bombardment is to be carried out with lethal shell, and is intended to produce casualties. Ordinarily, a shoot of more than two minutes at one time is not profitable, though in dead calm or thick woods and similar places, especially at night, the time may be extended to 5 minutes. Too much emphasis cannot be laid upon the fact that a gas attack must be executed with the greatest rapidity of fire and that the hits be close together, so as to create a solid gas cloud. Only in complete absence of wind may the rapidity of fire be decreased. In case of air currents, allowance must be made accordingly in the range finding. Gas effects at the objective point must be obtained quickly. The necessary number of rounds is therefore to be distributed to as many batteries as possible.

2nd. Neutralization Fire. This fire is intended to lower the physical resistance, morale of the enemy, and to interfere with his activities, by causing him to wear his mask continuously, for a considerable time. This result can be obtained most economically with persistent gases, - H.S.

and lachrymatory, - but in case an infantry attack is to follow soon after, a large number of lethal, non-persistent gas shell must be used.

22. A heavy fire, or a very rapid rate of fire, with a persistent gas is not necessary. Since instantaneous lethal effects are not obtainable, a heavy burst of fire at the commencement of a bombardment is not required. After the desired concentration has been reached, it is only necessary to fire a small number of shell occasionally in order that this concentration will be maintained. A sudden burst of fire with H.S. amounting to 1/10 that for phosgene may be used to begin a bombardment.

23. Counter-Battery. This, as a rule, should consist of a burst of destruction fire, followed by a slow, neutralizing fire with a persistent gas. The final burst of concentrated fire with a lethal gas is often useful, if the neutralizing fire has been maintained for four or more hours. This final burst of fire should last for ten or fifteen minutes. Its purpose is to penetrate the enemy masks that have been exhausted by long continued wearing.

24. Harassing. This is solely a neutralizing fire, for the purpose of hampering enemy movements of material, and troops, and to cause exhaustion of personnel through wearing the mask.

Lachrymatory gases are used primarily for harassing effect. Any lethal effect obtained from these gases will be purely incidental, and they should not be used for this purpose, as the amount required would be abnormal. Where lethal effect is desired after a lachrymatory shoot, a bombardment with lethal shell may follow immediately.

25. Blanketing. This is a type of neutralizing fire which may be employed under especially favorable weather conditions. During a dead calm (at night) it is possible, with a comparatively small number of shell, to form clouds of gas which will lie in pools of fog, in hollows and valleys, for a considerable time after the shelling has ceased. If no wind arises, the enemy will have to wear his mask all night, or vacate the low ground. Non-persistent, lethal gases are useful in such cases. Caution: The objective must be far enough away from the friendly line to avoid danger from a slight drift of the clouds or from an adverse wind springing up.

26. Denying Ground. This is a type of neutralizing fire for the purpose of rendering important positions untenable. This is best carried out by the use of Mustard Gas, unless our troops expect to occupy or pass over the area soon after the bombardment.

27. Bombardment of Area. In the bombardment of an area, which is essentially a question of neutralizing fire, it should be noted that it is often advisable to open the fire with a burst of lethal shell, on certain important targets in the area, and then to carry out the slow neutralizing fire.

28. While attacking one front, a harassing and neutralizing mustard gas bombardment can be effectively made on fronts, flanks, rear areas, and strong points not thus attacked. Troop concentrations, reserves, artillery groups, lines of communication, villages, and extended areas which it is contemplated the advancing troops will not reach, may be attacked with mustard gas.

When more than one objective is to be attacked for surprise effect with a lethal gas, the objective to the leeward of the wind is to be bombarded first. In this way the surprise effect on the second objective is not

last. However, if fire on other targets are made soon enough so the wind will not carry gas to later targets before fire is opened on them this rule need not be applied.

29. When harassing fire with a tear gas is to be used upon more than one objective, the objective to the windward should be first bombarded.

When it is not considered practicable to attack a strong position by frontal assault the position may be rendered untenable for the enemy by shelling heavily with mustard gas, which will not interfere with surrounding or passing around position.

30. Barrages. Gas shell may be employed in a barrage, in the following ways:

(a) Accompanied by H.E., when used under favorable weather conditions, gas tends to cause confusion among the enemy. About 25% of gas shell (1 gun per battery) should be used. While no danger to our own troops will occur from the use of this small percentage of gas shell, it will serve to deceive the enemy, causing him to wear his mask, and in this way hinder his activity. With a four m.p.h. wind, men can follow within 1 minute.

(b) May be used in "back" barrages, during an attack, to place enemy reserves and reinforcing troops at a disadvantage, by compelling them to wear masks. This is highly destructive to morale.

31. Formations for counter-attack. After an infantry objective has been reached, a gas attack will cause casualties, confusion and delay, among enemy troops intended for use in counter-attacks.

Smoke.

32. Screens. Smoke screens have many times greatly aided in the execution of all sorts of operations, large and small, and it would seem that their use should be greatly extended. Smoke candles or grenades will always be used for the production of smoke, when their use is possible. Within 1,000 meters of the front, trench mortars should be used. At greater distances artillery shell are a necessity. For all uses of smoke clouds, wind conditions must be carefully studied.

33. Kinds of Smoke Shell. There are two varieties of smoke shell in our service: White Phosphorous (W.P.) shell, used only for screening purposes, and titanium tetrachloride (F.M.) shell, used only for ranging purposes. The W.P. shell are not intended for ranging, but they can be used for this purpose when the F.M. shell is not available, provided certain corrections are made. (See paragraph 12). Vice versa, the F.M. shell are not intended for screening purposes, although they may be used as such, if W.P. shell are not available. The F.M. shell will not give as dense and durable a cloud of smoke or as great a screening effect as the same size W.P. shell, hence it will be necessary to increase the number of F.M. shell used and the rate of fire over the figures prescribed for establishing smoke screens with W.P. shell.

34. Smoke May be Used by the Artillery:

(1) To blind enemy observation posts, machine gun emplacements, infantry or artillery, thereby screening-in infantry raids or other operations.

(2) In order to draw gunfire and distract attention from another operation.
(3) To define visibly the limits of an attack or raid.
(4) As a fake gas attack, or to make the enemy think a real gas attack is more extended.
(5) In back areas to screen gun positions, etc.
(6) Occasionally for burning effect against enemy troops.

35. Considerations Affecting the Quantities of Smoke Shell Required to Form a Screen. The number of smoke shell required to form an effective screen depends upon the considerations enumerated under the general discussion on "Smoke Screens" (See paragraph 32). In winds much over 20 miles per hour it is practically impossible to form an opaque screen. The stronger the wind the further must be the source of the screen from the objective. Experiments have shown, however, that a screen can be formed even in a strong wind. The best wind for the use of artillery shell appears to be one having a velocity of about 14 m.p.h. (6 meters per second), and blowing across the object to be concealed.

100 yards per 10 feet per second of wind may be taken as a general guide as to the distance from the object at which artillery smoke shell should be placed. In hot weather particularly the smoke tends to rise from the ground, and there is, therefore, a greater tendency for gaps to form in the screen.

The effect of phosphorous shell of all kinds is cumulative, as the globules of phosphorous continue to burn on the ground for 15 to 20 minutes. As the cloud in the case of phosphorous projectiles is at its thickest soon after the bursts, it will be maintained more evenly by adding small quantities at frequent intervals of time rather than by adding large quantities at greater intervals.

36. Number of Shell Required. No definite rules can be laid down as to the exact quantities of smoke shell required to form a screen, as the conditions will vary to a very large extent. However, as a general guide it may be taken that the following number of shell are required to form an adequate smoke screen under normal conditions:

75 mm. shell,	2 rounds	per 10 Yds.	per Minute.
4.7" "	2 "	" 15 "	" "
155 mm. "	2 "	" 25 "	" "

37. The above figures apply to the establishment of the smoke screen which may thereafter be maintained by a reduced rate of fire, which should be controlled primarily by observing the behavior of the smoke screen. In general, it may be stated that one half the above rate of fire will effectively maintain a smoke screen after it is once established and under normal conditions. The following example is given for guidance:

4.7" Smoke Screen. The four guns of the battery were concentrated on a point 400 yards to the windward of the place where the commencement of the screen was required. The wind at the time was 40 ft. per second. The relation of the distance - 400 yds. to the wind - 40 f.p.s. is worth noting. Battery fire, 10 second intervals was used and the result was effective.

HANDLING AND STORAGE OF GAS SHELL

General

38. The chief source of danger in handling gas shell is leakage, which can always be detected by the smell, or by the effect produced upon the eyes. All personnel handling these shell should carry gas masks.

The handling of shell under suspicion, and the rescue of any man affected by the fumes will be the duty of special detachments which should be detailed and trained for this purpose. If a leak is suspected, it should be reported immediately and all men working in the vicinity should bring the respirator to the "alert" position.

39. Leaking gas shell may be disposed of in two ways:

(a) By burying them. Shell should be buried six feet deep and covered with a layer of chloride of lime before filling in the earth. They should not be fired from the gun. Spots where defective shell are buried should be indicated by sign posts driven into the ground and marked in an appropriate manner. Leaky shell can generally be detected by the smell of the gas.

(b) By exploding them.

40. If there are large numbers of leaking shell, it is more satisfactory to explode them than to bury them, thus preventing the contamination of the area from a large number of buried shell. When gas projectiles are to be blown up, they should be collected in lots so as not to exceed 100 lbs. of gas. Each lot should be exploded singly and another lot should not be exploded until the first gas cloud formed has disappeared. The gas cloud from one lot of this size is dangerous up to 500 yards' distance, and personnel within that distance to leeward should be warned. The procedure for exploding the gas projectiles is almost the same as that followed for exploding H.E. and shrapnel. The projectiles are piled in a narrow ditch about 6 feet deep, and an explosive or blasting charge is placed in the center of the lot and connected up to the blasting leads or time fuse. The lot is then covered with sand bags or other material to keep the metal pieces from scattering. The lot is then exploded. Then when the gas cloud has fairly well cleared, men wearing the respirators will fill in the holes, first covering with a layer of chloride of lime. Men working at destroying the blind gas projectiles should always wear the respirator from the moment they start to blast. Under no conditions should leaking shell be thrown into water. The necessity of careful handling of this sort of ammunition cannot be impressed too strongly. These instructions, however, are purely precautionary and are not intended to give the impression that the handling of these shell is unduly dangerous.

TRANSPORT OF GAS SHELL

41. Wagons containing gas shell, on arrival at depots, will be opened by a gas N.C.O. who will supervise the unloading and storage of shell. If the presence of a leaking shell is suspected in any wagon, the matter must be reported at once to the officer in charge. Such a wagon will then be unloaded by a special detachment wearing the respirator in the alert position.

If possible, gas ammunition should be carried in trucks provided with shutters which should be left open. If closed trucks only are available, on arrival at the ammunition depot, or dump, the doors of both sides should be opened by a competent person and no one should be allowed to enter the truck until it is ascertained whether or not any gas has leaked. If, of necessity, open trucks have to be used, no tarpaulins should be put on.

STORAGE OF GAS SHELL

42. This ammunition should be stored in separate bays and should be ventilated as well as possible, compatible with the exclusion of rain. If stored under tarpaulins, arrangements should be made to give access of air to the stack. Gas shell should be left in a cool place, as heat increases the internal pressure and the possibility of leaks.

Buildings on or about the line between the gas area of the ammunition depot and the direction of the wind, must not be occupied during a raid. A messenger wearing a box respirator should be sent off to rouse sleeping men in such buildings and to see that the buildings are clear. If gas ammunition has been destroyed, it is forbidden to enter these buildings until they have been ventilated thoroughly, by men wearing respirators. All windows and doors of the building may be opened and wood fires burned in the center of the cellars. The building will be occupied only when declared safe by a gas officer or gas N.C.O.

Inasmuch as the proportion of leaks tends to increase with storage, ammunition parks should supply batteries from the oldest lots on hand.

GAS SHELL DUMPS AT BATTERIES

43. At battery positions, gas shell should be piled in small dumps, the number in each being generally limited as follows:

The 75 mm. - - - - - - 100.
The 4,7" - - - - - - - 50.
The 155 mm. - - - - - 25.

Dumps should preferably be located to the leeward of battery positions, according to the prevailing wind.

If a direct hit occurs on a dump of gas shell, respirators will be put on immediately and without waiting for orders, and if possible a move will be made to the windward. All personnel of a battery will be kept constantly informed of the direction of the wind. (flags, wind-vanes, etc.).

"Dud" gas shell, or gas shell debris, must not be touched until examined by a gas N.C.O. who will attend to the proper disposal of the same.

Special Precautions Relative to Mustard Gas Shell.

44. Mustard gas shell which show traces of leakage should be handled only by men who are protected with respirators and special gloves. Men detailed for such work should likewise be equipped with protective clothing (if obtainable), whenever there is a possibility of the projectiles coming in contact with the clothes.

As soon as the shell are received, they should be examined. Any indication of leakage at the gaine joint is a danger sign. (Masks and gloves should be worn).

Whenever possible, cases containing the shell should be stored in small piles in the open air.

Near all such piles, a heap of earth and a supply of chloride of lime should be provided for covering any shell that may be burst by enemy fire. All storage depots should be supplied with shovels, and with chloride of lime in air-tight containers.

If an ammunition dump is reached by enemy fire, all personnel should move off to the windward and all men within 200 meters to the leeward should be warned. Broken shell should be covered with a layer of chloride of lime on top of which 6 inches of earth should be spread. During this work, masks and protective gloves should be worn.

Undamaged shell of a small dump struck by a direct hit will not be setapart for future use, but will be buried with the fragments of the damaged shell in a hole six feet deep and covered with a layer of chloride of lime before filling in.

45. CHEMICAL ARTILLERY AMMUNITION

The following is a brief description of the chemical ammunition which may be used by our troops. It includes not only chemical shell of the American manufacture but also French shell which may be used by our troops. It does not include a discussion of artillery ammunition in general which has been fully covered in "Notes on Artillery Ammunition", issued by the Office of the Chief Ordnance Officer, A.E.F.

In our service, chemical shell include the following classes:

G.S.
SMOKE
INCENDIARY

G.S SHELL

46. A description of the gases which have been approved for use in our artillery shell is given hereinafter. A thorough knowledge of the gases, their properties and effects, is necessary. Gases may be divided into three classes, as follows:

Non-Persistent.
Semi-Persistent.
Persistent.

47. The following table shows our gases, divided according to this classification, and their principal characteristics:

Class	Name of Gas in order of persistency	Boiling Point	Physiological Action.
1 Non-Persistent.	D.A.)	--	Lethal and
	C.G.)	+ 8° C.	Sternutatory
2 Semi-Persistent.	P.G.) xx	--	Penetrative and
	N.C.) x	--	
	P.S.)	+ 112° C.	Suffocant.
3 Persistent.	C.A.)	--	Lachrymatory and
	H.S.)	+ 217° C.	Vesicant.

x. N.C. is a mixture of 80% P.S. and 20% K.J. The active principle of this mixture is P.S.; the K.J. acting merely to stabilize the P.S. and help penetrate the mask.

xx. P.G. is a mixture of 75% P.S. and 25% C.G. As with N.C. the active ingredient is P.S. - the purpose of the C.G. being to stabilize the P.S. and to add to its toxicity.

Non-Persistent Gases.

48. It will be noted that the only non-persistent gas which we are using, (C.G.)* is lethal and boils at + 8°C. (46°F.). In general, the non-persistent gases all have these same characteristics. They are all lethal and boil below + 20°C. (68°F.), i.e., below normal atmospheric summer temperature. For this reason these gases change from liquids to gases without the aid of any artificial agency. When the shell is burst the liquid at once gasifies. Hence, the smallest bursting charge that will effectively open the shell is used. However, the bursting charge must be of sufficient strength not only to burst the shell, but also to check, to a large extent, the forward velocity of the base portion of the shell. Otherwise, a considerable portion of the liquid will be cupped in the base portion of the shell and buried in the ground or carried by richochet beyond the point of burst.

In the employment of lethal gases, the main object is to produce a cloud of the highest possible initial concentration which will drift down wind and completely envelop the object attacked. Such a cloud should consist of a highly concentrated nucleus when liberated from the shell. This will drift down wind and expand by lateral rather than upward enlargement. The formation of such a cloud requires; First, complete vaporization at the moment of liberation; and Second, a bursting charge which will completely shatter the shell, but which is not so strong as to give undue dissipation of the liquid contents, particularly in an upward direction.

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*(D.A. is not a true gas. It is a solid substance and its action is very different from that of the liquids. Upon the bursting of the shell the D.A. is expelled in the form of a highly pulverized cloud of dust. These fine particles remain in suspension in the air and the particles pass through the mask.)

It is essential that the bursting charge should break the shell completely into small fragments. The more rapid and complete the break-up, the more concentrated is the cloud. Moreover, the loss of heat due to the sudden vaporization adds density to the cloud nucleus formed.

Semi-Persistent Gases.

49. The semi-persistent gases boil between - 20°C. and - 200°C., i.e., above normal atmospheric temperature. With these gases to obtain a cloud nucleus of greatest possible concentration it is necessary to expel the liquid contents in a high state of atomization. This results in the most rapid vaporization with the least possible disturbance of the cloud. To secure this effect, the bursting charge should be of high power to insure maximum atomization, and yet not so high as to destroy the gas by dissociation. The object is to ensure that the liquid is converted into a cloud with least possible disturbance. This requires a more powerful bursting charge than the non-persistent gases and a shell of greater resistance, so that the liquid may be released under maximum pressure.

Persistent Gases.

50. In the case of persistent gases, boiling above - 200°C. the object sought is quite different. Here, the cloud should be reduced to the minimum, and the area sprayed by the liquid contents of the shell increased to a maximum. This requires a large bursting charge of relatively high capacity but of slower action than the charge for the semi-persistent gases, and at the same time, a shell of relatively loss strength than that required for complete atomization, but of sufficient resistance to give the maximum amount of coarse spray that will reach the ground as such. The charge which sprays the greatest area of ground and gives the minimum cloud is the one of maximum effectiveness. Due to their high boiling points, the persistent gases are relatively slow in their action, and hence prompt effects cannot be obtained unless the vaporization of the gas is secured by some artificial means. Such a means is a bursting charge developing high temperature and pressure, both of these conditions accelerating vaporization, the temperature acting directly and the pressure through increased pulverization. Consequently, if it is desired to obtain quick effect from persistent gases such as H.S., the shell should be loaded with a super-charge of high explosive, but it must be remembered that by so doing the gain in activity of the gas is obtained at the expense of greatly reducing its persistency. Another advantage in providing H.S. shell with a super-charge of high explosive is that they detonate with the noise and the shock of a true H.E. shell and thus disguise the fact that they are gas shell. Recent developments in the use of H.S. have indicated that a portion at least, of these shell should be provided with a super-charge of high explosive to accelerate their action. If H.S. shell have a super-charge of high explosive are used they will be stencilled with some distinguishing mark to indicate the fact that the bursting charge is above normal.

Construction of Gas Shell.

51. In general gas shell are similar to high explosive shell. In fact, the majority of gas shell in use at the present time are converted H.E. shell. While the principles involved in the design of gas shell are radically different from those affecting H.E. shell, it has been considered desirable to simplify the manufacturing program by converting H.E. shell into gas shell. As the proportion of gas shell to H.E. shell increases, it becomes more and more important for gas shell to be specially designed.

52. Gas shell consist of the shell body, which contains the gas, the gaine tube (adapter and booster casing), which screws into the nose of the shell and contains the bursting charge; and the bursting charge which consists of a small quantity of high explosive sufficient to open the shell, and, in some cases, to atomize the liquid contents. Since most of the gases used enter the shell, as liquids, they expand as liquids when heated, and it is, therefore, necessary to leave a space for this expansion and only partially fill the shell. The void amounts to from 6% to 11% of the total capacity of the shell; depending upon the coefficient of expansion and the vapor pressure of the gas, and the pressure which the joint between the shell and gaine tube will withstand.

53. There are various methods of making these joints gas tight.

(a) The general method employed by the British to prevent leakage of gas into the gaine tube, is to make the adapter and gaine tube of one piece, so that there is no joint through which gas may leak into the gaine tube. To prevent the gas from leaking through the joint between the adapter and the shell body, the British paint the threads with cement, screw the adapter in, and then "spin" over the exterior of the joint between the adapter and shell. This joint is made <u>before</u> the shell is filled and a test pressure of 100 lbs. per square inch is applied to the shell, through the filling hole in the side of the shell to test the integrity of the joint. The shell is then filled and the filling hole plugged up with a small tapered iron plug.

(b) The French use, in some cases, a one-piece adapter and gaine tube. In other cases, however, the gaine tube is threaded into the adapter. The following is quoted from a French document and shows the method of closing joint between the adapter and shell body:

"To close this, we put in the first place between the bottom part of the head of the gaine and the machined shell, around the eye of the projectile, a pliable ring of lead tubing with a core of asbestos; in seating the gaine into the eye of the projectile, this ring is compressed and forms a dam between the head of the gaine and the throat of the eye of the shell. Furthermore, the threads are painted with a cement which is not attacked by the charging liquid and which in addition to stopping leakage adds to the solidity of the union of the two parts..."

(c) In our present American models of gas shell the gaine tube is welded to the adapter, though it is probable that, for certain gases at least, this method will be abandoned for a one-piece adapter and gaine tube. The joint between the adapter and the shell body is made gas tight by means of a tapered or pipe thread. The adapter and gaine tube are screwed into the shell until the tapered threads bind tightly and produce a gas tight joint. To facilitate assembling, the threads on the adapter are lubricated with oil, but no cement is used; dependence for gas tightness is placed entirely upon the metal to metal contact between the threads.

54. Of the three methods mentioned above, that employed by the British is probably the most satisfactory, and the method of side filling has the additional advantage of permitting the testing of the joint before filling.

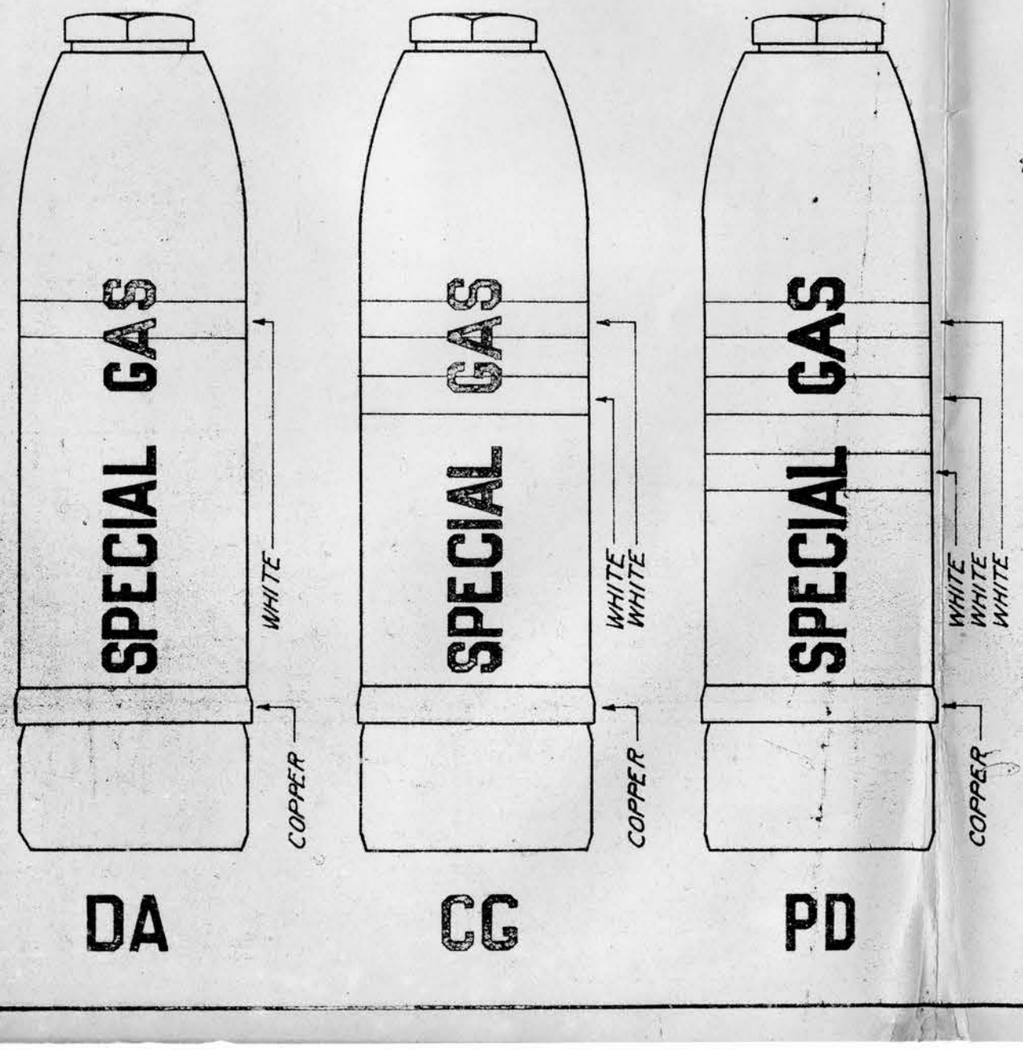
55. For certain gases, notably those containing bromine compounds, which have a corrosive action upon steel, it is necessary that the shell have a lining of glass or lead; and the gaine tube, a coating of enamel; in order to protect the metal from the action of the gas.

AMERICAN CHEMICAL

GAS

NON-PERSISTANT
TOXIC & LETHAL

SEMI-PERSISTANT
PENETRATIVE & SUFFOCANT



MICAL SHELL MARKINGS

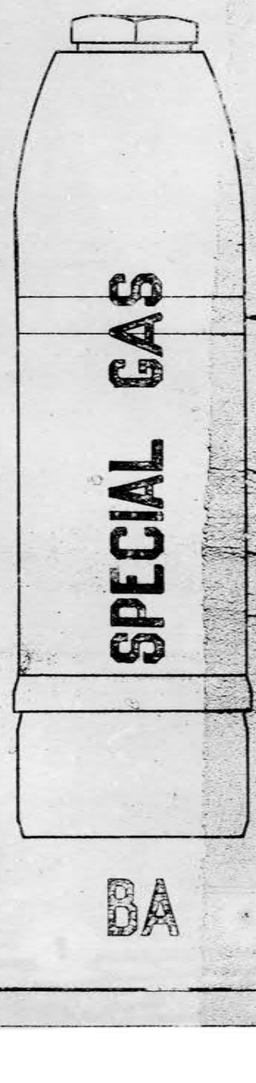
SMOKE INCENDIARY

PERSISTANT
LACHRYMATORY & VESICANT

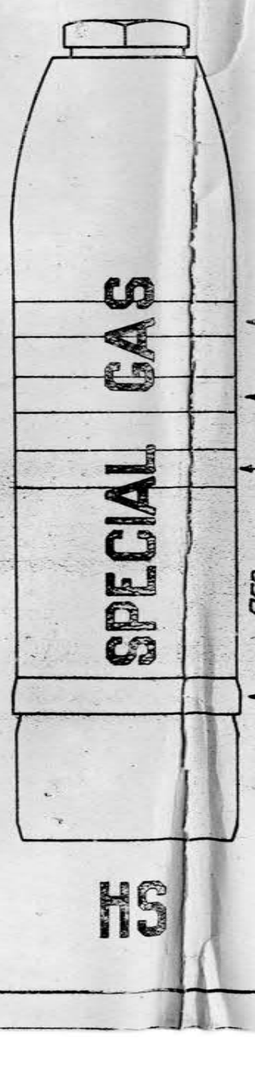
SOLID

LIQUID

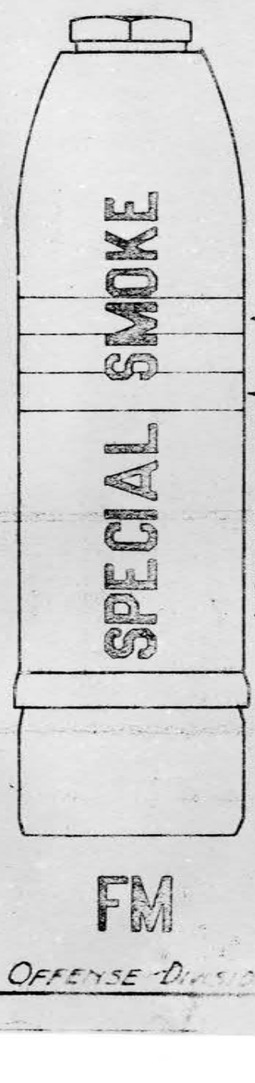














OFFENSE DIVISION, ENG. SEC. C.W.S. 10

TYPES OF AMERICAN SHELL

56. It is intended to provide American chemical artillery shell in the following calibers:

75 mm.	Gun.
4.7"	Gun.
155 mm.	Gun
155 mm.	How.
5" S.C.	Gun.
6" S.C.	Gun.
8" S.C.	Gun.
8"	How.
9.2"	How.
240 mm.	How.

MARKINGS FOR AMERICAN SHELL.

57. American chemical artillery shell will be marked with colored bands to denote the different types of gases, as follows:

Red Bands denote persistency.
White Bands denote non-persistency and lethal action.
Yellow Bands denote smoke.

The number of bands indicates the raltive strength of the property indicated. Thus, three red bands denote a gas more persistent than one red band, and three white bands indicate a gas where lethal action is greater than one marked with only one white band.

U. S. Symbol	U.S. Markings 1/2" Bands around Shell as Follows:	U. S. Symbol	U.S. Markings 1/2" Bands around Shell as Follows:
D.A.	1 White	B.A.	1 Red
C.G.	2 White	C.A.	2 Red
P.G.	1 White, 1 Red, 1 White	H.S.	3 Red
P.S.	1 White, 1 Red	W.P.	1 Yellow
N.C.	1 White, 1 Red, 1 Yellow	F.M.	2 Yellow

The body of the shell is painted gray. The words "SPECIAL GAS" or "SPECIAL SMOKE", as the case may be, is stencilled lengthwise of the shell in black block letters 5/8" high.

Incendiary shell are painted gray, with the word "SPECIAL INCENDIARY" stencilled lengthwise in black block letters 5/8" high, but with no distinguishing bands.

AMERICAN SHELL FILLING.

The following are the amount of each kind of chemical filling contained in the different calibers.

TYPE	CALIBERS	MARK	APPROXIMATE WEIGHT OF PROJECTILE, - LESS FUSE AND THE FILLING, IN POUNDS	THE APPROXIMATE WEIGHT OF SHELL FILLING. GAS H.S. Lbs.	C.G. Lbs.	N.C. Lbs.	P.S. Lbs.	C.A. Lbs.	B.A. Lbs.	SMOKE F.M. Lbs.	W.P. Lbs.
Field Gun.	75 mm.	II	10.27	1.35	1.32	1.74	-	1.45	1.97	1.71	1.90
Gun	4.7".	II	37.40	4.38	4.27	5.62	5.30	4.44	6.36	5.53	6.14
How.	155 mm.	II	80.80	11.30	11.00	14.50	13.66	12.18	16.41	14.30	15.85
Gun.	155 mm.	VII	79.45	11.30	11.00	14.50	13.66	12.18	16.41	14.30	15.85
Gun	5".	VI	42.84	5.38	-	-	-	-	-	6.70	-
Gun.	6".	III	74.98	10.50	-	-	-	-	-	13.28	-
How.	8".	III	169.75	22.45	22.01	28.90	27.20	24.20	32.67	28.40	31.50
Gun.	8".	III	169.75	22.45	-	-	-	-	-	28.40	-
How.	9.2"	*	252.65	29.45	28.69	37.80	35.62	31.70	42.78	37.20	41.30
How.	240 mm.	*	303.50	37.50	36.54	48.20	45.37	40.40	54.48	47.40	52.6

* These volumes are based on the H.E. shell.

Note:- Of the fillings given in the above table it should be noted: N.C. is the same as P.S. except that it contains a stabilizer (K.J.), B.A. and C.A. shell are both lachrymatory and can be used interchangeably, except that C.A. is several times more effective than B.A.

F.M. and W.P. shell are both smoke shell. F.M. is a liquid, and F.M. shell are therefore primarily intended for ranging gas shell. W.P. is a solid and produces a dense and more persistent smoke than F.M., hence W.P. shell should be used primarily for smoke barrages and screens.

With fixed ammunition, (75 mm. and 4.7") chemical shell are also marked on the base of the cartridge case by a black band 3/8" wide and the words "SPECIAL GAS", "SPECIAL SMOKE", or "INCENDIARY", in 1/4" letters.

The boxes in which chemical shell are packed are marked on each end with distinguishing bands and words used on the shell, in addition to the markings common to all artillery shell.

WEIGHTS OF AMERICAN CHEMICAL SHELL.

58. For the present, the system of weighing and marking of chemical shell will follow the general scheme employed with H.E. artillery shell, i.e., each caliber of shell will be divided into a number of different weight lots and marked on the 75 mm. by crosses just above the rotating band, on the 4.7" by squares just below the bourelet, and for calibers larger than 4.7", by squares on the ogive. In addition, for calibers greater than 4.7" the mean weight of the lot will be stencilled on the shell; on 6" shell just above the driving band and on other calibers on the ogive.

This system will probably be changed so that chemical shell will be of one weight only for each caliber.

59. The method of indicating the weight lots under the present system is shown in the following table:

CALIBER	FROM Lbs.	FROM Oz.	TO Lbs.	TO Oz.	Weight Marks	Weight Stencil
75 mm.	10	11	11	0	L	
	11	0	11	5	+	
	11	5	11	11	+ +	
	11	11	12	0	+ + +	
	12	0	12	5	+ + + +	
4.7" Shell	43	0	43	11	□	
	43	11	44	6	□ □	
	44	5	45	1	□ □ □	
5 inch.	49	11	50	8	□	50.10
	50	8	51	5	□ □	50.90
	51	5	52	2	□ □ □	51.70
6 inch.	86	14	88	4	□	87.56
	88	4	89	10	□ □	88.94
	89	10	91	1	□ □ □	90.34
155 mm.	91	3	92	5	□ □	41 K 700
	92	5	93	6	□ □ □	42 K 200
	93	6	94	8	□ □ □ □	42 K 700
	94	8	95	10	□ □ □ □ □	43 K 200
	95	10	96	12	□ □ □ □ □ □	43 K 700
8 inch.	192	1	195	6	□	194.58
	195	6	198	11	□ □	197.88
	198	11	202	0	□ □ □	201.20

FRENCH CHEMICAL SHELL

60. The only French chemical shell to be used by our service are the 75 mm. gun, the 155 mm. gun and howitzer, and the 240 mm. howitzer. The 240 mm. howitzer gas shell is still in process of development.

WEIGHTS OF FRENCH CHEMICAL SHELL.

61. The general weight classification of the 75 mm. and 155 mm. shell is the same as the U.S. classification.

MARKING OF FREN CH CHEMICAL SHELL.

62. The system of marking and the weight, nature, and action of the filling of the French chemical shell which may come into the hands of our troops are shown under description of shell. Mixtures No. 4 and 4B are not authorized for use in our service.

SMOKE SHELL.

63. In addition to the use of smoke shell for smoke barrages, these shell will be used in our service for ranging gas shell.

Gas shell of the French, British, and Germans all have visible bursts, due to the presence of a smoke producing mixture in the shell. The French mix a "fumigen", or smoke producing compound, with the chemical filling. The British incorporate the smoke producing material with the bursting charge. The Germans produce a visible burst by use of a very large bursting charge. All of these methods reduce the efficiency of the shell and also have the disadvantage of producing a visible gas cloud whose limits are readily discernible by the enemy.

All smoke producing compounds will be omitted from American gas shell and the bursts will, therefore, be practically invisible. For ranging therefore, it is necessary to have smoke shell of the same weight and ballistic characteristics as the gas shell. Smoke shell will first be fired until the correct range has been ascertained, and then the fire for effect will be continued with gas shell having invisible bursts.

64. By far the best smoke producing material for smoke barrages and curtains is white phosphorous, and this is used in all smoke shell intended for barrage purposes. These shell are known as W.P. shell and are marked with one yellow band. However, since phosphorous is a solid material, the W.P. shell is not accurate for ranging purposes, since shell filled with liquids (as all our gas shell are) have different ballistic characteristics, and therefore different ranges from solid filled shell. For this reason it is necessary that smoke shell for ranging purposes be liquid filled. The best liquid smoke producing material is F.M. which has been adopted for our smoke ranging shell.

65. While the W.P. shell is not intended for ranging, it can be used for this purpose when the F.M. shell are unavailable, provided certain range corrections are made. The F.M. shell is not intended for barrage purposes, although it may be so used, if W.P. shell are not available. The F.M. shell will not give as dense and durable a cloud of smoke or as great a screening effect as the same size W.P. shell, hence it is necessary to increase the number of shell used and the rate of fire, over the figures prescribed for smoke screens with W.P. shell. The exact amount of shell and rate of fire can best be determined by observation of the smoke screen during its establishment and maintenance.

TABLE OF FRENCH SPECIAL PROJECTILES

SHELL	PROPERTIES	CHARGE	FILLING	PRIMER	MARKINGS	NOTES	EFFICIENCY
75mm.No.2	Incendiary	Carbon disulphide White Phosphorous Cyl. of incendiary in celluloid	320 cc.	Gaine Model 1897-1914. Soldered joint Percussion fuse 24/31-'14	Green Ogive. Red body.No.2 on top of ogive and also on bottom.	Body of shell explosive	
75mm.No.3	Incendiary	White Phosphorous Neutral Liquid.	485 grs. 240 cc.	" "	Green Ogive. Red body.No.3 on top & bottom.	" "	
75mm.No.4	Toxic	Vincennite Quaternaire (V4)	478 grs.	" "	Green,2 white rings. No.4 on top and bottom.	Explosive fuse hole fitted with washer of plastic metal.	Immediately after formation explosion cloud is fatal but dilution quickly decreases its efficiency.
75mm. No.4B.	Violent Poison	Vitrite Manganite Marsite	1 7 645 3 grs.	1897-1914 Mdl. Relay gaine 24/31 percussion '14 Mdl.	2 White Bands. "4B" on ogive, base and shell case.		Immediately after formation explosion cloud is fatal; under certain conditions it may have a latent action.
75mm.No.5	Toxic	Collongite 2/3 Opacite - 1/3	714 grs.	Gaine Model 1907-1914.Soldered joints. Percussion fuse 24/31,'14 Mdl.	Green, 1 White Ring,No.5 on top & bottom.	Explosive fuse hole fitted with washer of plastic metal.	Immediate or delayed fatal according to concentration.
75mm.No.7	Lachrymatory, Toxic.	Aquinite - 3/4 Opacite - 1/4	792 grs.	" "	Green,1 Orange-yellow ring. No.7 on top and bottom	In preparation	6 hours.
75mm.No.9	" "	Martonite Opacite	507 grs. 99 grs.	" "	Green,2 Orange Yellow Ring. No.9 on top and bottom.	" "	2 days

SHELL	PROPERTIES	CHARGE	FILLING	PRIMER	MARKINGS	NOTES	EFFICIENCY
75mm. No. 20.	Vesicant Toxic	Yperite with T. Solvent. C.Solvent.	590 grams or 558 grams	1897-'14 Mdl. Relay Gaine-24/31. Per. Fuse.'14 Mdl.	2 Orange Yellow Bands, "20"		15 days
75mm. No. 21.	Very violent lachrymator,-irritates upper respiratory tracts.	Camite -- 13 Aquinite-100	685 grs.	'97-'14 Model. Enameled Gaine without extension '14 Model 24/31.I. Percussion Fuse.	1 Orange Yellow Band. "21".		15 days.
155 mm. F.A. No.4.	Toxic	Vincennite Quaternaire	2 Kgs. 850	Gaine 40,Cartridge 147 mm. Wedging ring 24/30 Percussion fuse. 24/31 IA.	Green Body. 2 White Rings. No.4 on top of ogive.	Cast steel shell,model '14 fuse hole 40, modified for plastic metal ring.	Immediately after formation,explosion is fatal but dilution quickly decreases its efficiency.
155 mm. F.A.No.5.	",	Collongite 2/3 Opacite 1/3	4 Kgs. 300	" "	Green body, 1 white ring.No. 5 on top ogive		Same as 75 mm.above.
155 mm. F.A.No.7.	Lachrymatory Toxic	Aquinite 3/4 Opacite 1/4		Gaine 40,cartridge.147 mm. Wedge Ring 24/31, Per. fuse 24/31 IA.	Green body, 1 white ring, No.7 on top of the ogive.	Same as 4 & 5	6 hours.
155 mm. F.A.No.20.	Vesicant Toxic	Yperite with T. or (solvent C.	3420 grs. 3420 grs.	1897-1914 Mdl. Relay gaine 24/31 percussion fuse. 1914 Model.	2 Orange Yellow bands."20" on top of ogive.		15 days

Sheet 2.

SHELL	PROPERITES	CHARGE	FILLING	PRIMER	MARKINGS	NOTES	EFFICIENCY
155 mm. F.A.No.21.	Lachrymatory. Irritates upper respiratory tracts.	Camite 13 Aquinite 100	3975 grs.	1895 Mdl.Cyl. head. 40-gaine but without extension for smoke producer. Primed as the No. 4.	1 Orange Yellow Band, "21" on top of the ogive.		15 days.
155 mm. F.A.Type Naud.	Incendiary	Carbon disulphide and Tar. Phosphorous 1 Kg. Cyl of incendiary matter.	660 cc. 670 cc. 67 cc.	Gaine system; fuse, 22/31 I.	Green body, Red Head, and black ring.	Provisional Charge.	
155 mm. (Steel) Type Naud	" "	Carbon disulphide and Tar. White Phosphorous.Cyl. of Incendiary.	1520 cc. 3 Kgs.800 3 Kgs.160	Gaine 40, Wedge Ring and fuse 24/31 I. or I.A.			

Sheet 3.

66. While the above remarks concerning the presence of smoke producing substances in our own and French and British gas shell are generally true, there are exceptions as follows:

(1) The French gas shell #20, (Yperite or H.S.) marked with two orange-yellow bands and #21 (Camite or C.A.) marked with one orange-yellow band, contain no fumigen, and hence some smoke producing shell must be used for ranging.

(2) In American shell N.C. (1 white, 1 red, and 1 yellow band) has 20% K.J. in it to stabilize the P.S. K.J. is a smoke producer. Therefore, N.C. shell give a visible cloud on burst and require no ranging shell. <u>In fact N.C. shell can themselves be used as ranging shell.</u>

67. In the case of the French 75 mm. No. 20 and No. 21 shell, their practice is to pack one #5 shell (C.G. + K.J.) with 8 No. 20 or No. 21 shell, in a box which holds 9 shell. The #5 shell, so used, is marked on the body of the shell with a red star and on the shell case with a green star and is employed as a ranging shell for the No. 20 and No. 21 shell.

In the larger caliber French shell, the box containing only one or two shell, no attempt is made to pack smoke containing shell with the gas shell, but efforts are made to forward with every nine boxes of gas shell a box of smoke shell, so that constant ratio of the two will be maintained in supply.

At the present time our 75 mm. gas shell are being assembled in France, and since no smoke shell have arrived from the States, and our boxes also hold 9 shell, we have followed French practice; and our gas shell will be packed 8 in a box with one N.C. shell to be used for ranging the other gas shell. The box will be marked around its middle with the characteristic color stripes of the gas shell contained therein. The N.C. shell to be used for ranging, can be distinguished by its characteristic bands (1 white, 1 red, 1 yellow). In this connection, it should be pointed out that the ratio of 1 smoke-containing shell to 8 gas shell is much higher than necessary for purely ranging purposes. It is probable that 5% smoke shell will prove sufficient for registration and to maintain fire direction and control, so that there will, sooner or later, be an accumulation of N.C. shell at each battery firing gas shell. N.C. shell so accumulated should be fired by themselves for effect under circumstances and conditions prescribed for this gas.

68. When used for ranging other gas shell, no more N.C. shell should be fired than is absolutely necessary to effect registration and to maintain fire direction and control, for the reason that continued firing of smoke-containing shell results in the building up of a <u>visible toxic cloud</u> which the enemy may avoid by withdrawal beyond its limits. Furthermore, the surprise element is largely lost by the visible bursts of smoke-containing gas shell. The use of large quantities of ranging shell (either F.M., W.P., or N.C.) during a gas shoot will largely neutralize the advantages of our gas shell.

69. American 4.7" gas shell are packed two in a box. No smoke shell will be packed with the gas shell of this caliber. Instead, a box of 2 smoke shell will be forwarded with every 9 boxes of gas shell. This box will be marked with characteristic color stripes of the smoke-producing shell.

Our larger caliber gas shell come packed one in a box and the same scheme as for the 4.7" will apply to these calibers.

Battery commanders should, from time to time, verify the fact that there are always on hand sufficient smoke-containing shell to amount to at least 5% of the gas shell on hand.

INCENDIARY SHELL

70. No satisfactory American incendiary shell has been developed as yet. The French have two calibers of incendiary shell - 75 mm. and 155 mm. These are made from common H.E. shell by replacing a part of the explosive charge by a number of special incendiary cylinders, known as Incendiary Cylinder Model 1878. The incendiary cylinder model 1878 consists primarily of a bundle of slow action quick match, tied with nitrated string, and internally and externally primed with a small quantity of ordinary quick match. This bundle is enclosed in a rectangle of cretonne cloth coated with an incendiary composition, and securely fastened with a heat-treated brass wire. The weight of the cylinder proper is 30 gr. and reaches 45 gr. when enclosed in a tar paper covering. On explosion of the projectile, the cylinder is ignited at both ends and projects 10 to 15 cm. fire jets for a period of 10 to 20 seconds, at the expiration of which time it burns, torch-like, for 70 to 80 seconds. Total combustion of the cylinder is, therefore, completed in approximately one and a half minutes.

FUSES.

71. The action of all percussion fuses is started by the flash produced by the contact of a firing pin with a special detonator called a primer. This primer is filled with a very sensitive mixture of fulminate of mercury and other ingredients. The construction of all percussion fuses is such that the primer and the firing pin cannot come in contact until the shell is fired, and they are then kept a small distance apart until the shell or fuse touches the ground. Then the firing pin and the primer are brought in contact in one of the following ways:

(a) The firing pin may be attached to a movable plunger at the front end of thefuse and be forced back into the fuse the instant the plunger comes in contact with the ground. This will cause the firing pin to hit the primer which is attached to the fuse body.

(b) The primer may be carried in a movable part inside the fuse. When the shell is checked by striking the ground the inertia of this movable part carries it forward causing the primer to hit the firing pin.

It is evident that the action described in (a) will bring the needle in contact with the primer as soon as the resistance of the ground is sufficient to overcome the inertia of the plunger and force it into the fuse. It is, therefore, a quicker action than that described in (b) which will take place only when the inertia of the shell itself has been overcome by the resistance of the ground.

72. Fuses having the action described in (a) are called "super-quick", Only such fuses are suitable for chemical shell.

It is essential that a chemical shell should burst above ground. A fuse whose action is not super-quick allows the shell either to bury itself, at least partially, or to ricochet before bursting. If the shell is even partially buried before bursting the effectiveness of a part of the contents of the shell is lost due to its soaking into the ground. If the shell ricochets before bursting, the gas may be carried beyond the target.

73. Even with super-quick fuses, a certain amount of the effectiveness of the chemical shell is lost owing to the fact that the shell bursts at the ogive which leaves the base and part of the body more or less unbroken, and acts as a carrier for a certain portion of the liquid gases. If the angle of fall is low, the unbroken portion of the shell may ricochet and carry a portion of the gas past the target. If the angle of fall is great the unbroken portion will penetrate into the ground, thereby sealing its open end and preventing the liquid therein from being liberated.

74. In order that a super-quick fuse may function, it must land on its point. If the angle of fall is small the ogive of the shell will hit the ground first, the shell may then ricochet before the point of the fuse can come in contact with the ground, and the fuse will not function. For this reason, and for the reasons given in the preceding paragraph, chemical shell should be fired with reduced charges whenever possible. This should not, however, be carried to the extreme of using vertical fire, as by so doing the dispersion is greatly increased and the unbroken base and body of the shell will bury part of the contents as explained in the preceding paragraph.

75. Owing to the failure of super-quick fuses to function at low angles, and the increase in dispersion and decrease in range (caused by the great length of such fuses) when used with small calibers of shell, the French use short fuses, which are not super-quick, in the 75 mm. It is a question whether the increase in dispersion is more desirable than the loss of effectiveness due to the comparatively slow action of the short fuses.

76. For smoke shell, when used for smoke barrages, and for gases such as H.S., it is sometimes highly desirable to have <u>time</u> fuses, allowing air bursts. With smoke shell air bursts permit the adjustment of the dimensions of the smoke cloud and thus greatly facilitate the establishment and control of effective smoke curtains. With vesicant gases, air bursts allow a greater and more efficient dispersion of the liquid contents. A combination fuse, combining a time element and a super-quick percussion element is now being developed, so as to enable batteries to conduct gas or smoke shoots with both ground and air burst. An effective combination fuse will also greatly reduce the number of duds, since its double action will cause the shell to explode on contact if it falls on time and vice versa.

<u>TYPES OF FUSES TO USE WITH CHEMICAL SHELL.</u>

77. Drawings and descriptions of fuses which may be used with gas shell together with remarks as to their advantages and disadvantages follows.

FRENCH I.A. MODEL 1915. I.A.L. MODEL 1916. AND U.S. MARK III FUSES.

78. The general functioning and construction of these three fuses are similar, the I.A.L. and the Mark III being successive modifications of the I.A. All are super-quick fuses, functioning by means of a plunger in the front of the fuse being driven into contact with a fulminate of mercury primer.

ARMING: The firing plunger is prevented from coming on contact with the primer during transportation, and while the shell is in the bore of the gun, by means of two steel half collars which engage with a shoulder on the firing plunger and prevent its movement to the rear. Two half collars are held in place by being wrapped with a brass ribbon on the end of which is a third half collar. The ribbon being wound in a direction opposite to the rotation of the gun, tends to tighten as long as there is rotational acceleration. When rotational acceleration is over, centrifugal force throws the third half collar out, and unwinds the ribbon, releasing the inner half collars and freeing the firing plunger. The firing plunger is prevented from being forced to the rear during flight by a shear wire.

FIRING: On impact the end of the plunger hits first and is driven into the body, shearing the shear pin, and impinging on the primer before the shell itself has touched the ground.

79. I.A. (instantaneous elongated). MODEL 1915.

In this fuse the lower detonator is made of compressed melinite and is connected to the upper detonator by a length of detonating fuse.

80. I.A.L. (instantaneous elongated Lefevre). MODEL 1916.

This fuse is the same as the I.A. with the exception that the lower detonator is of fulminate and there is an empty flash tube between it and the upper detonator. To readily distinguish it from the I.A., the I.A.L. is painted blue around the body just below the tinfoil cover.

81. U.S. MARK III.

This fuse is identical with the I.A.L.

A number, however, as shown in the illustration, will have a safety device added. This consists of a centrifugal bolt which blocks the passage connecting the upper and lower detonators until after "set back" is over and the projectile is out of the gun. If, for any reason, the upper detonator fires prematurely, the flash will be prevented from reaching the lower detonator by means of this safety bolt. In a number of these fuses, as shown in the drawing, the firing plunger impinges directly on the upper detonator, thus doing away with the intermediate primer.

SAFETY: The arming mechanism of these fuses is held in place by means of a gummed tape of oil cloth and a tinfoil cover.

The tinfoil cover and tape are easily removed before firing, but care must be taken that in so doing, the brass ribbon and weights are not also removed. The cover should not be removed until after the fuse has been screwed into the shell.

Never use a fuse which has no brass ribbon. Destroy it or send it to the rear. If the brass ribbon becomes unwound do not attempt to rewind it. Destroy the fuse or send it to the rear.

A fuse which is painted red on the end of the plunger and on the top of the tinfoil cover is wound for left hand rifling and should not be used in any of our guns.

82. USE: These fuses are the most satisfactory now in use for gas shell. They can be used with all calibers.

At angles of fall of less than 10^{o}, approximately, the ogive of the shell will hit before the point of the fuse can touch the ground, and the shell will probably ricochet before the fuse can function.

With 75 mm. shell the dispersion when using fuses is considerably greater than with short fuses.

FRENCH R.Y. MODEL 1917 FUSES.

83. This is a super-quick fuse and the following advantages are claimed for it over the I.A.L.: (1) It is safer, and (2) its shape is such as to produce better ballistic effects, and, therefore, less dispersion.

ACTION: The firing pin and primer cannot come in contact until both have moved. On "set back", the plunger moves to the rear until the head engages with the body of the fuse. It is then as far to the rear as possible, and it becomes necessary for the primer to move forward to come in contact with the firing pin. The primer cannot move forward because the sleeve around the firing pin, at the bottom of which the primer is fastened, is engaged with the prongs of the upper half of the safety piece, which, in turn, is prevented from moving forward by engaging with the body of the fuse. On "set back", the lower half of the safety piece moves to the rear, freeing the upper half and allowing the upper half to move to the rear, the prongs being forced out of the groove in the primer sleeve. The upper half of the safety piece continues to "set back" until the prongs catch in the lower groove. The upper half of the safety piece is thus farther down on the primer sleeve than before the gun was fired.

After "set back" is over, and the velocity of the projectile begins to diminish, the inertia of the parts free to move causes them to "creep" forward. The upper half of the safety piece returns to its original position, carrying the primer sleeve and primer with it. The primer has thus moved forward in the fuse. At the same time the firing plunger "creeps" forward to its original position.

On impact, the firing plunger is driven back to the position it had during the "set back". The primer, however, has moved forward, so that the firing pin now comes in contact with it.

SAFETY: The cover over the head of the firing plunger is painted red, and should not be removed.

FRENCH I MODEL 1914 FUSE

84. This is a fuse used extensively by the French for 75 mm. gas shell. The head of this fuse is usually painted red, though on certain models it is painted yellow.

It has not been adopted by our service as it is considered unsafe. THE I MODEL 1914 FUSE IS NOT TO BE USED.

FRENCH SCHNIEDER MODEL 1916 FUSE

85. This is a non-superquick fuse used by the French for 75 mm. gas shell. It causes considerably less dispersion than the I.A.L., but it is not considered quick enough for gas shell.

It should not be used with gas shell of caliber greater than 75 mm. and should not be used when any of the super-quick fuses are available.

The head of this fuse is painted white to indicate non-delay action.

ACTION: For this fuse to function it is necessary for the primer pellet to move forward so that the primer comes in contact with the firing pin.

On "set back" the ring A moves to the rear, bending up the flangs on the ring B so that both A and B are free to move back inside of the cylinder C. This movement compresses the spring D until the flange of B catches on the prongs E of the cylinder C. When "set back" is over, the spring D forces A, B, and C forward. The segments F. are then free to move outwards by centrifugal force. When they have moved sufficiently the spring G pushes forward the guard H until the shoulder I of the guard H is in such position as to prevent any return of the segments F into their original position. The primer pellet J is now free to move forward on impact.

MODIFIED BRITISH NO. 106 FUSE

86. This is a fuse of the super-quick type and has only recently been adopted by us. It is suitable for all calibers and ranks next to the Mark III and I.A.L. fuses for chemical shell.

AMERICAN 75 MM. COMMON STEEL SHELL MARK II.

MARKING

GASES USED	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING 1/2" BANDS AROUND THE BODY.	THE FOLLOWING WORDS LENGTHWISE ON THE BODY.	APPROXIMATE WEIGHT OF GASES POUNDS.
H.S.	3 RED	SPECIAL GAS	1.36
C.A.	2 RED	" "	1.46
B.A.	1 RED	" "	1.97
N.C.	1 WHITE, 1 RED, 1 YELLOW	" "	1.74
C.G.	2 WHITE	" "	1.32
F.M.	2 YELLOW	SPECIAL SMOKE	1.71
W.P.	1 YELLOW	" "	1.90

The bottom of the cartridge case is marked with a black band 3/8" wide and the words "SPECIAL GAS", or "SPECIAL SMOKE".

The weights of the shell are the same as for H.E. shell and are marked as follows:

FROM Lbs.	FROM Oz.	TO Lbs.	TO Oz.	WEIGHT MARK JUST ABOVE DRIVING BAND.
10	11	11	0	L
11	0	11	5	+
11	5	11	11	+ +
11	11	12	0	+ + +
12	0	12	5	+ + + +

Immediately above the weight marks, and on the side of the shell opposite the words "SPECIAL GAS" are the letters 75-G.

The following fuses are authorized for use with these shell:

U.S. Mark III.
French I.A.L., Model 1916.
French I.A., Model 1915.

These three fuses are similar in general construction and action, and are here listed in order of preference.

Modified British No. 106 (when issued).
French R.Y.
French Schneider, Model 1916.

These last two fuses have not been adopted by our Service, but may be encountered by troops who are supplied from French Dumps. The Schneider Model 1916 is to be used only when other fuses are not available.

The French Model 1914 (red head) is <u>not</u> to be used. It is unsafe.

FRENCH 75 MM. STEEL SHELL MODEL 1915.

88. The following are the 75 mm. French chemical shell in common use.

FILLING			MARKING	APPROXIMATE WEIGHT OF GAS IN POUNDS.
No.		U.S. SYMBOL	The shell is painted green with the following distinguishing marks:	
2	Incendiary	Incendiary	Red ogive, No. 2 on Ogive	----
3	Smoke	W.P.	Red ogive, No. 3 on ogive.	1.06
5	Collongite	C.G.	1 White band around body No. 5 on Ogive.	1.55
7	Aquinite	N.C.	1 Orange Yellow band around body. No. 7 on Ogive.	1.76
9	Martonite	B.A.	1 Orange Yellow band around body. No. 9 on Ogive.	1.34
20	Yperite	H.S.	2 Orange Yellow Bands. No. 20 on Ogive.	1.31
21	Camite	C.A.	1 Orange Yellow Band. No. 21 on Ogive.	1.52

On the ogive, immediately below the number of the mixture, are letters indicating its nature. With No. 20, "Yt" indicates Yperite dissolved in carbontetrachloride, and "Yc" indicates Yperite dissolved in monochlorbenzene.

Immediately below these letters, the date and place of fillings are placed. "Aub" for Aubervilliers, "Vis" for Vincennes, "P.Cx" for Pont-de-Claix.

With the exception of No. 20 and No. 21, the above mixtures contain a percentage of opacite (stannic chloride) added to produce smoke.

The numbers of the mixtures are also placed on the base of the cartridge case.

No. 4 mixture (Vincennite) and No. 4B, are <u>not</u> authorized for use.

The weight classification and weight marking of this shell are the same as the U.S. 75 mm.

The same fuses are to be used with this shell as with the U.S. 75 mm.

89. AMERICAN 4.7" COMMON STEEL SHELL, MARK II.

MARKING

Gases Used	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING ½" BANDS AROUND THE BODY.	AND THE FOLLOWING WORDS LENGTHWISE ON THE BODY.	APPROXIMATE WEIGHT OF GASES LBS.
H.S.	3 Red	Special Gas	4.38
C.A.	2 Red	" "	4.44
B.A.	1 Red	" "	6.36
P.S.	1 Red - 1 White	" "	5.3
N.C.	1 Red-1 White - 1 Yellow	" "	5.62
C.G.	2 White	" "	4.27
F.M.	2 Yellow	Special Smoke	5.53
W.P.	1 Yellow	" "	6.14

The bottom of the cartridge case is marked with a black band 3/8" wide and the words "SPECIAL GAS", "SPECIAL SMOKE" or "INCENDIARY".

The weights of the shell are the same as for H.E. and are marked as follows:

FROM	TO	WEIGHT MARK JUST BELOW BOURRELET.
43 Lbs. 0 Ozs.	43 Lbs. 11 Ozs.	□
43 " 11 "	44 " 6 "	□ □
44 " 6 "	45 " 1 "	□ □ □

The weight marks are 1/2" squares with a center-punch mark in the center of each square.

Immediately above the driving band are stencilled the letters 4.7 G.

The following fuses are authorized for use with this shell:

U.S. Mark III.
French I.A.L. Model 1916.
French I.A. Model 1915.

These three fuses are similar in general construction and action, and are here listed in order of preference.

Modified British No. 106 (when issued.

French R.Y. (This fuse is only to be used in case others are not available.)

A. 4.7" semi-steel shell Mark V has also been developed which differs from the steel shell only in that the net capacity is reduced from 92.4 cu. in. to 90.9 cu. in.

90. AMERICAN 5-INCH COMMON STEEL SHELL MARK VI.

GASES USED.	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING 1/2" BANDS AROUND BODY.	AND THE FOLLOWING WORDS LONGITUDINAL ON THE SHELL.	APPROXIMATE WEIGHT OF GASES LBS.
H.S.	3 RED	SPECIAL GAS	5.58
F.M.	2 YELLOW	SPECIAL SMOKE	6.79

The weights of the shell are the same as for H.E. and the shells are marked as follows:

FROM Lbs.	FROM Oz.	TO Lbs.	TO Oz.	WEIGHT MARKS ON OGIVE	WEIGHTS STENCILLED JUST ABOVE DRIVING BAND
49	11	50	8	■	50.10
50	8	51	5	■ ■	50.90
51	5	52	2	■ ■ ■	51.70

The weight marks on the ogive are 1/2" squares with a center-punch mark in the center of each square.

Just below the weight marks the ammunition lot number is stencilled in letters 1" high.

The weight stencils just above the driving band are 1" letters, and just above them are the letters 5-G.

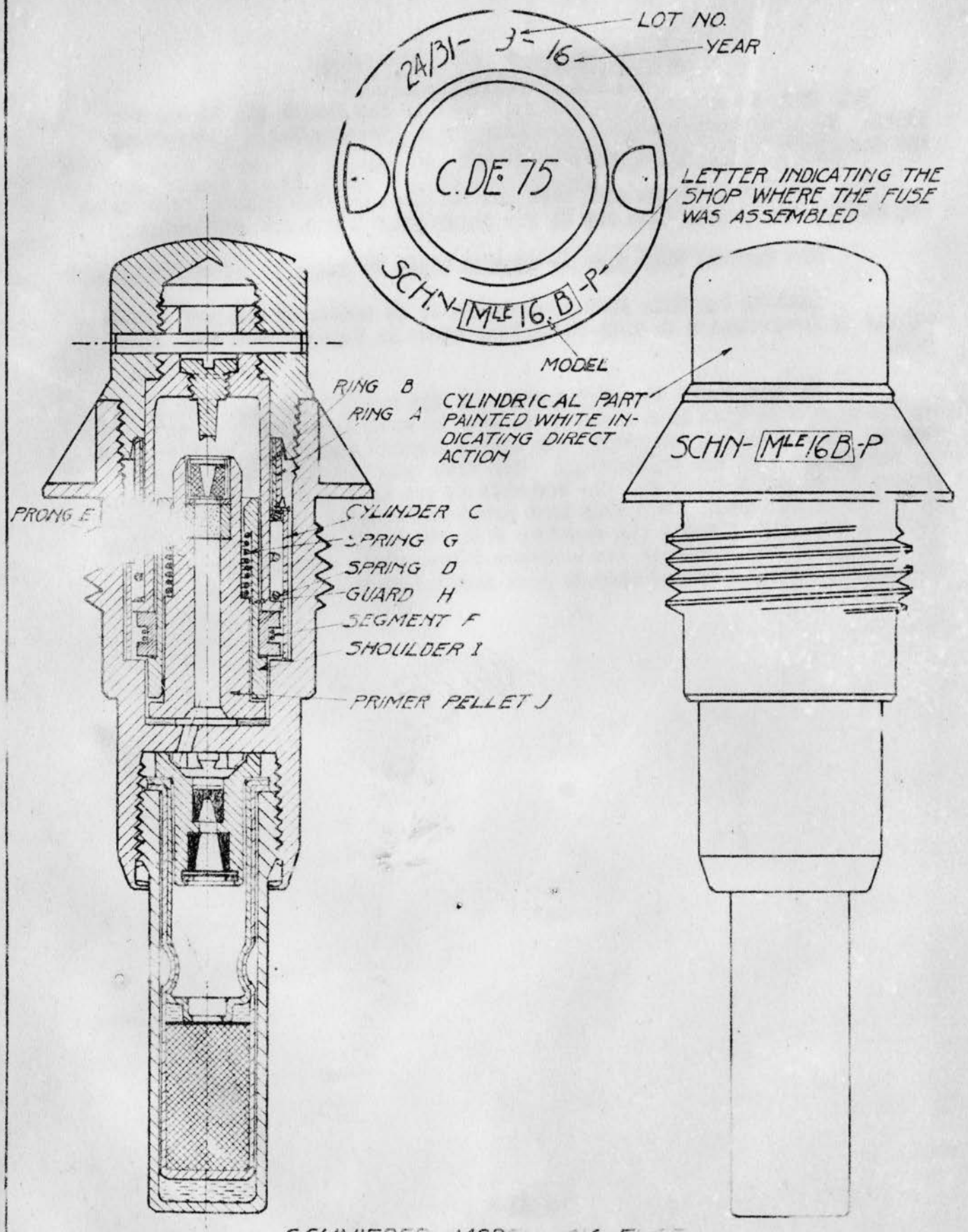
The following fuses are authorized for use with this shell:

H.S. Mark III.
French I.A.L. Model 1916.
French I.A. Model 1915.

These three fuses are similar in general construction and action, and are here listed in order of preference.

Modified British No. 106 (when issued).
French R.Y. (This fuse is to be used only in case others are not available).

A 5-inch semi-steel shell has also been developed which differs from the steel shell only in reduced capacity.



SCHNIEDER MODEL 1916 FUSE

OFFENSE DIVISION, ENG. SEC. C.W.S. 33.

91. AMERICAN 6-IN. COMMON STEEL SHELL MARK III FOR GUN.

GASES USED.	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING ½" BANDS AROUND THE BODY	AND THE FOLLOWING WORDS LENGTHWISE ON BODY	APPROXIMATE WEIGHT OF GASES LBS.
H.E.	3 - Red	Special Gases	10.50
F.M.	2 - Yellow	Special Smoke	13.28

The weights of the shell are the same as for H.E. and are marked as follows:

LBS.	OZS.	LBS.	OZS.	WEIGHT MARKS ON OGIVE	WEIGHT STENCIL JUST ABOVE DRIVING BAND.
86	14	88	4	□	87.56
88	4	89	10	□ □	88.94
89	10	91	1	□ □ □	90.34

The weight marks on the ogive are 1/2" squares with a prick punch mark in the center of each square.

Just below the weight marks the ammunition lot number is stencilled in letters 1" high.

The weight stencils just above the driving band are 1" letters, and just above them are the letters 6-G.

The following fuses are authorized for use with these shell:

U.S. Mark III.
French I.A.L. Model 1916.
French I.A. Model 1915.

These three fuses are similar in general construction and action, and are here listed in order of preference.

Modified British No. 106 (when issued).

French R.Y. (This fuse is to be used only in case others are not available.)

A six-inch semi-steel shell has also been developed whichdiffers from the steel shell in reduced capacity only.

92. AMERICAN 155 MM COMMON STEEL SHELL MARK II FOR HOWITZER.

GASES	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING ½" BANDS AROUND THE BODY.	AND THE FOLLOWING WORDS LENGTHWISE ON THE BODY.	APPROXIMATE WEIGHT OF GASES POUNDS.
H.S.	3 RED	SPECIAL GAS	11.3
C.A.	2 RED	" "	12.18
B.A.	1 RED	" "	16.41
P.S.	1 RED 1 WHITE	" "	13.66
N.C.	1 RED 1 WHITE 1 YELLOW	" "	14.5
C.G.	2 WHITE	" [illegible]	11.0
F.M.	2 YELLOW	" Smoke	14.30
W.P.	1 YELLOW	" "	15.85

The weights of the shell are the same as for H.E. and are marked as follows:

FROM LBS.	FROM OZ.	TO LBS.	TO Oz.	WEIGHT MARKS ON OGIVE	WEIGHT STENCILLED JUST ABOVE THE DRIVING BAND
91	3	92	5	□□	41 K 700
92	5	93	6	□□□	42 K 200
93	6	94	8	□□□□	42 K 700
94	8	95	10	□□□□□	43 K 200
95	10	96	12	□□□□□□	43 K 700

The weight marks on the ogive are 1/2" square with a center-punch mark in the center of each square.

Just below the weight marks the ammunition lot number is stencilled in letters 1" high.

The weight stencils, just above the driving band, are in 1" letters, and just above them are the letters 155 H.

The following fuses are authorized for use with this shell.

U.S. Mark III.
French I.A.L. Model 1916.
French I.A. Model 1915.

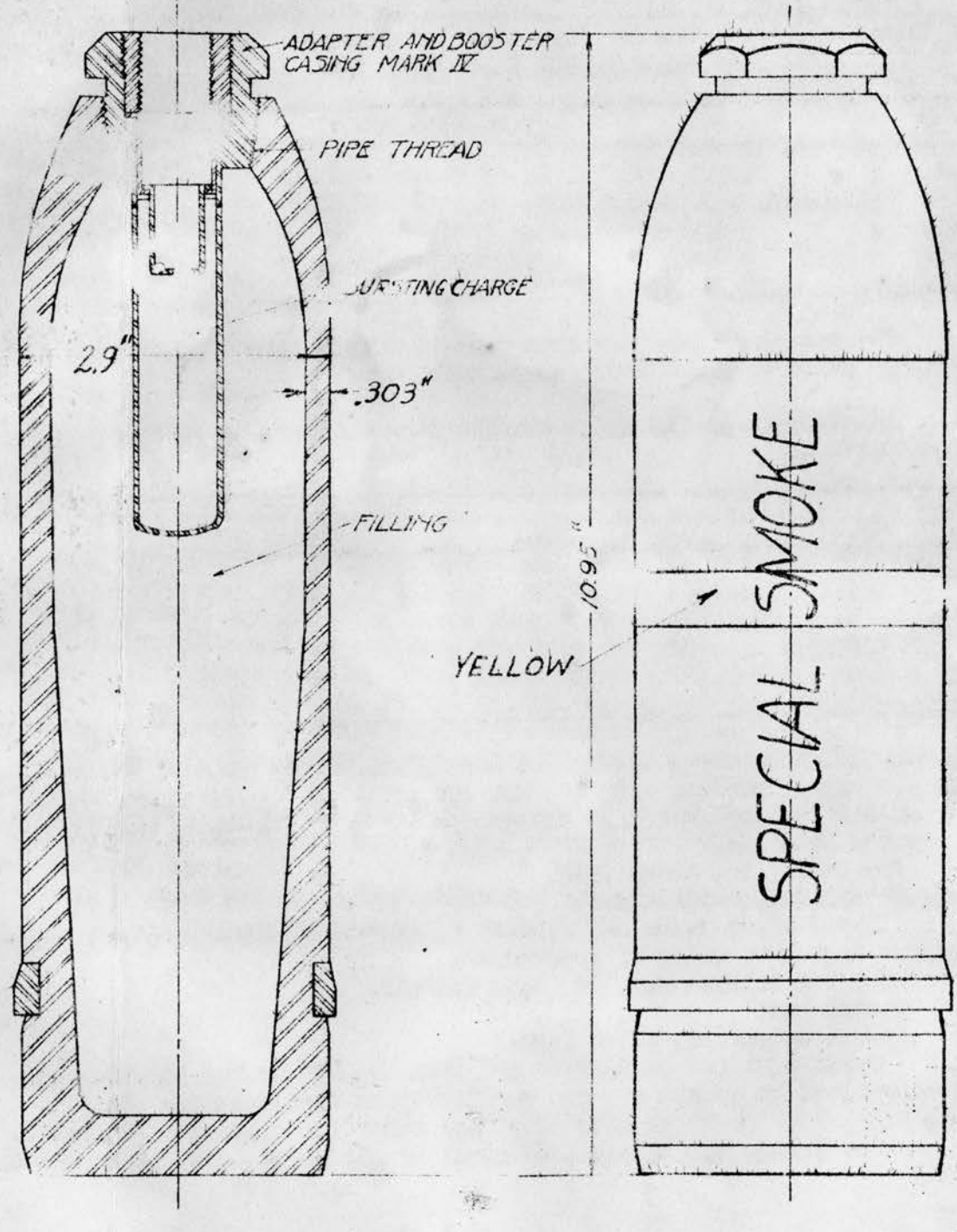
These three fuses are similar in general construction and action, and are here listed in order of preference.

Modified British No. 106, (when issued).

French R.Y. (This fuse is to be used only in case others are not available).

A 155 mm. semi-steel shell has also been developed which differs from the steel shell in reduced capacity only.

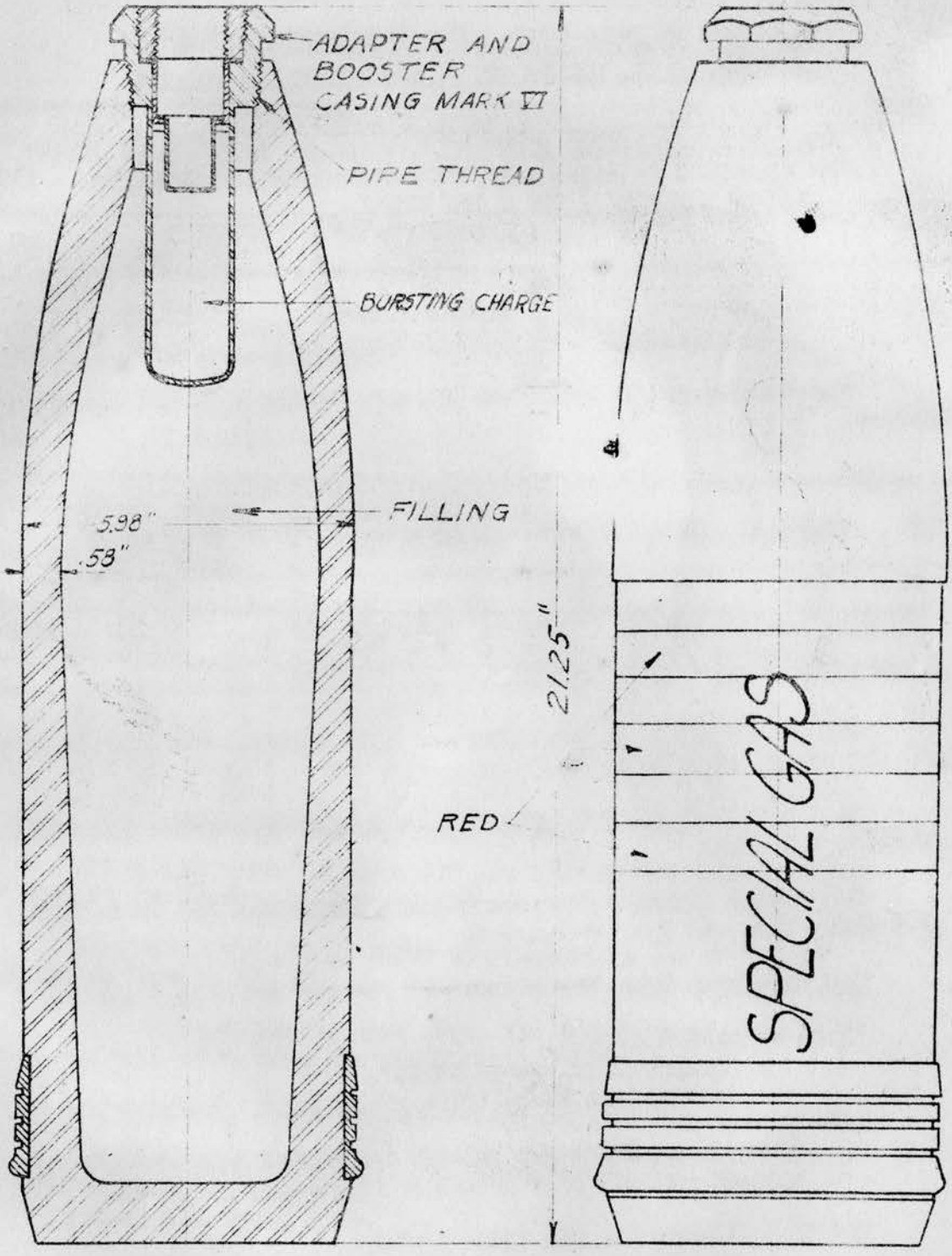
NET CAPACITY 28.6 CU. IN.



75 M/M COMMON STEEL SHELL MARK II

MARKING TYPICAL FOR W.P.

OFFENSE DIVISION, [illegible] SEC. G.W.S. 5526

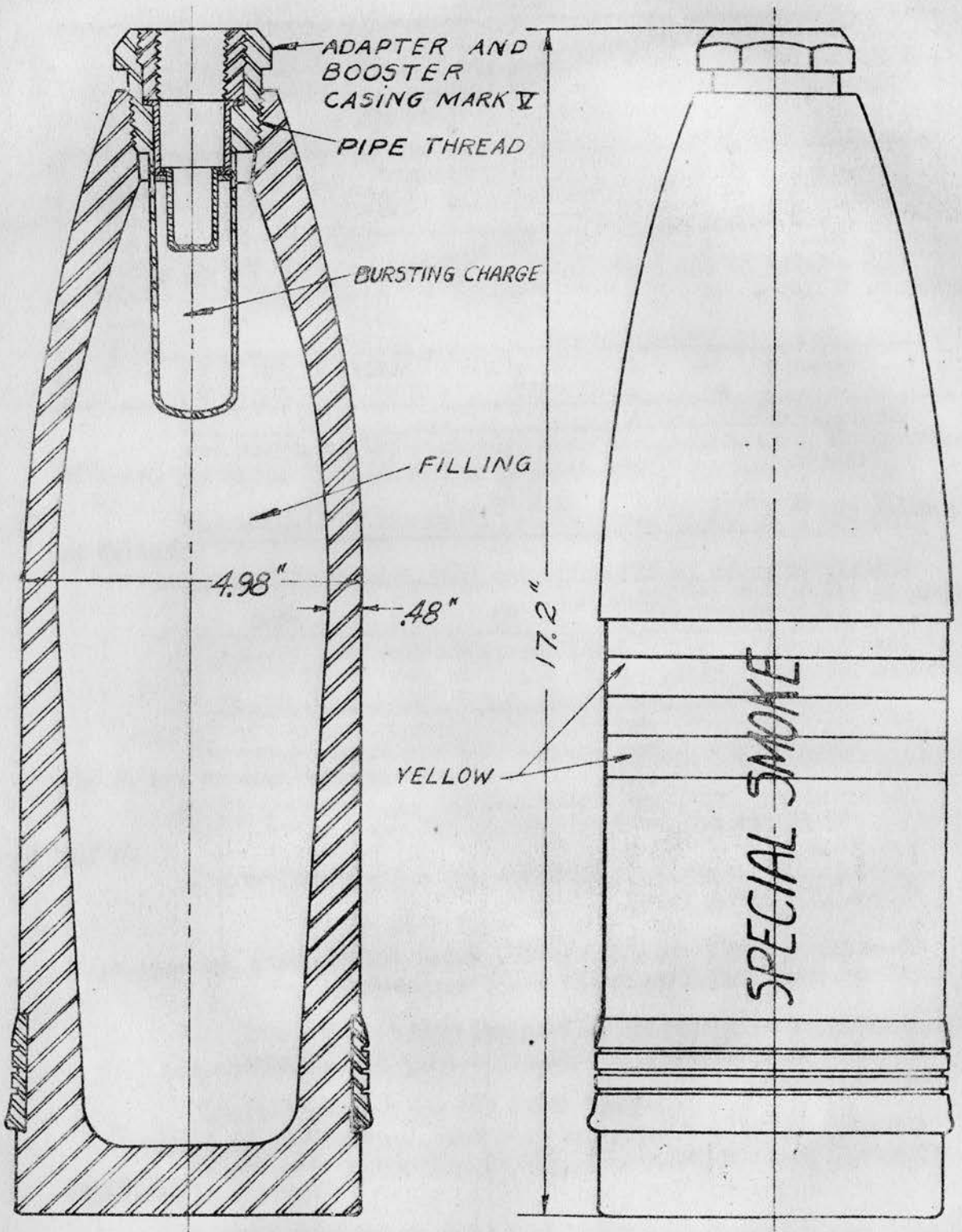


6 IN. COMMON STEEL SHELL MARK III

MARKING TYPICAL FOR H.S.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5531

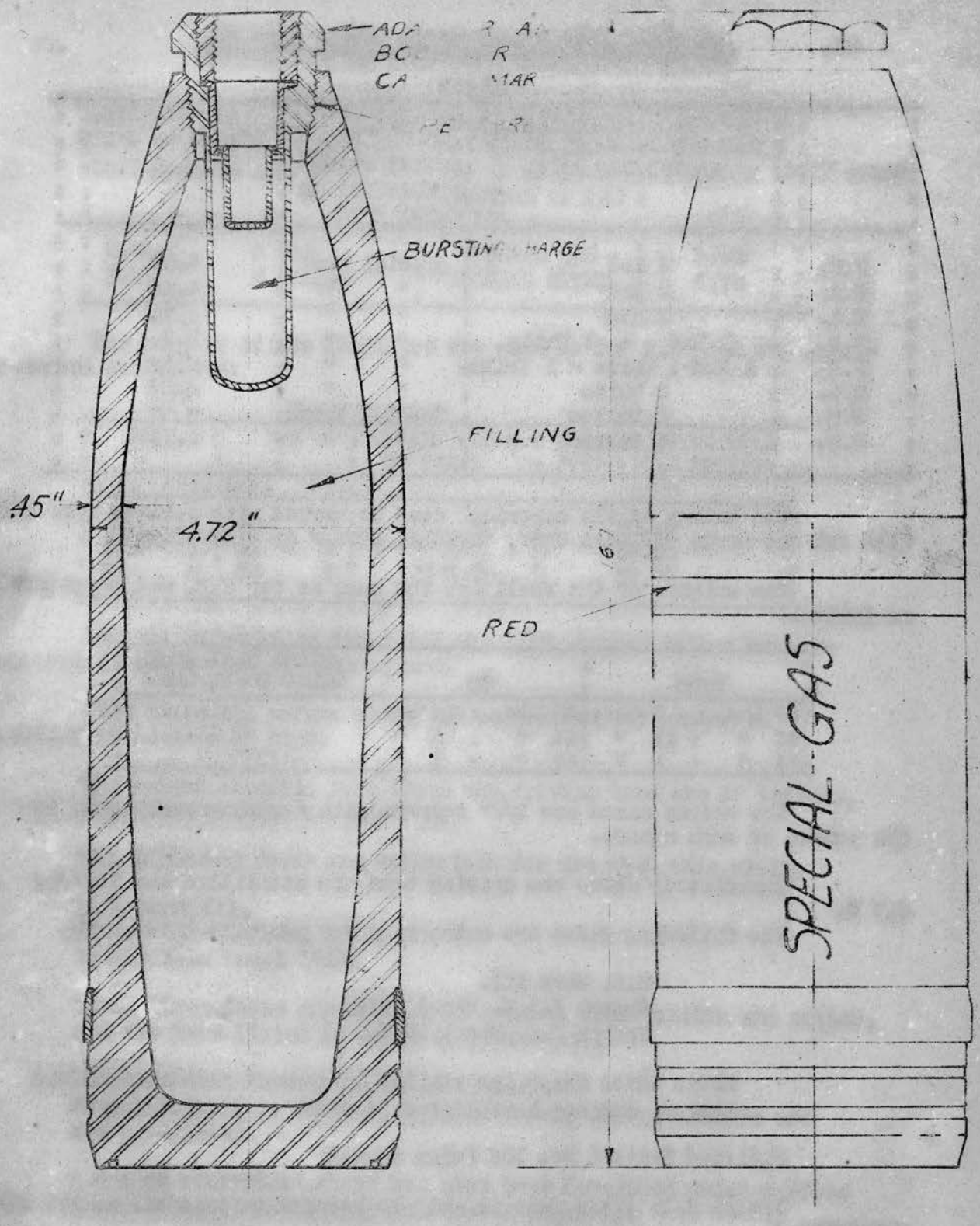
.E" CAPACITY 113 CU. IN.



5" N. COMMON STEEL SHELL POINT FUSE MARK VI

MARKING TYPICAL FOR F.M.

OFFENSE DIV[illegible], ENG. SEC. C.W.S. 5525

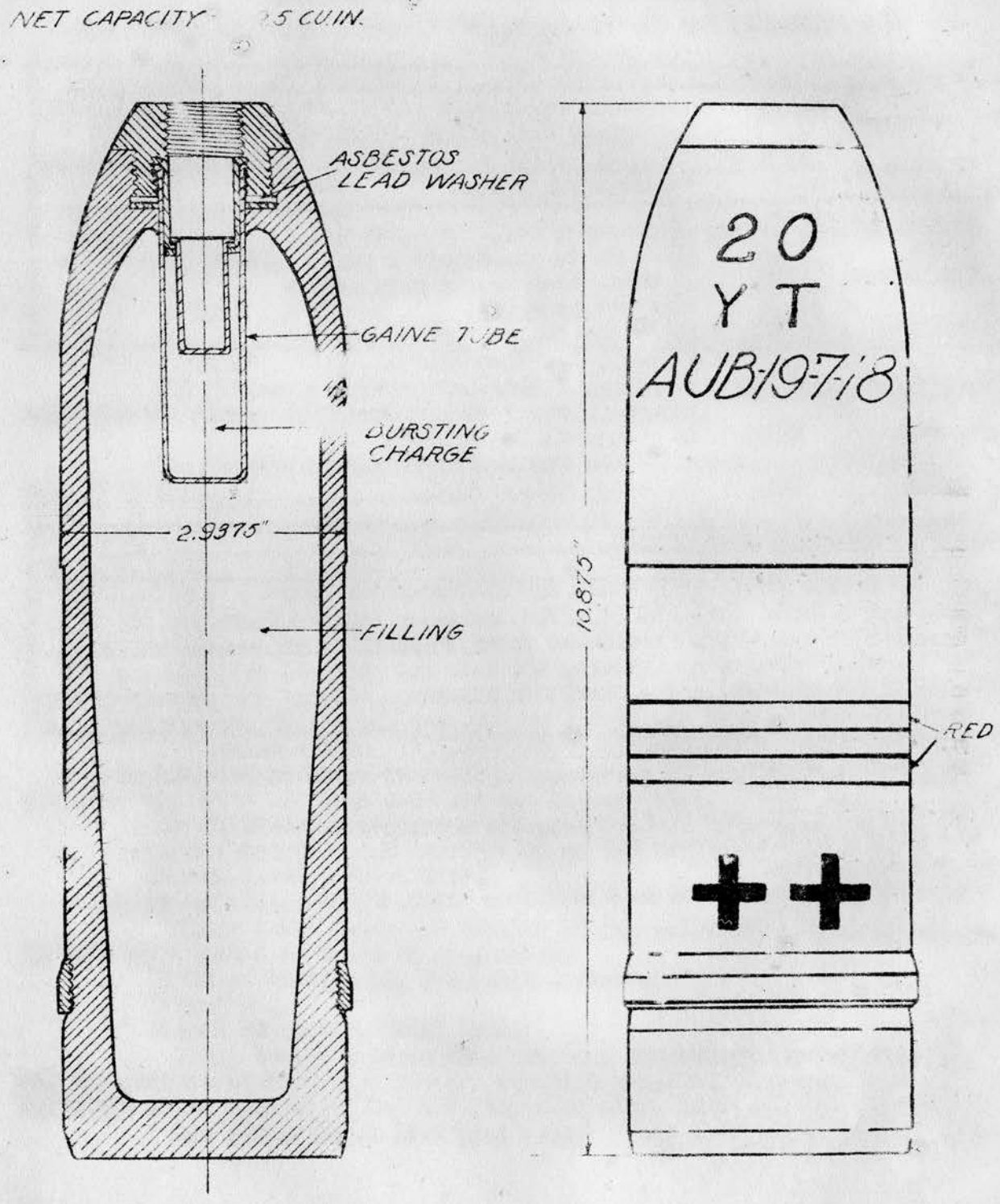


4.7 IN. COMMON STEEL SHELL MARK II

MARKING

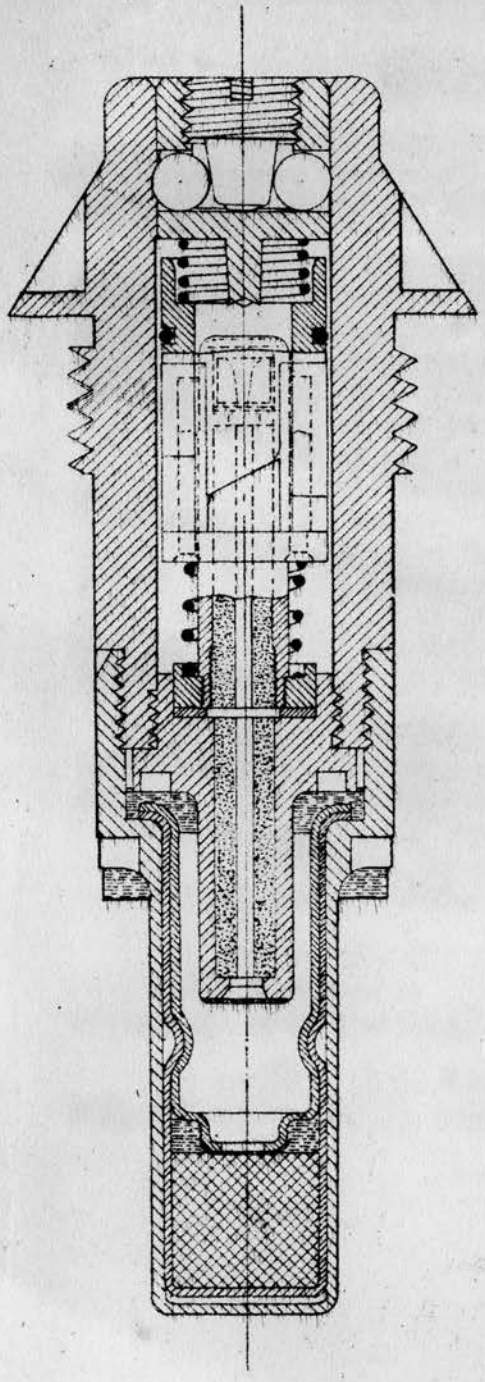
B.A.

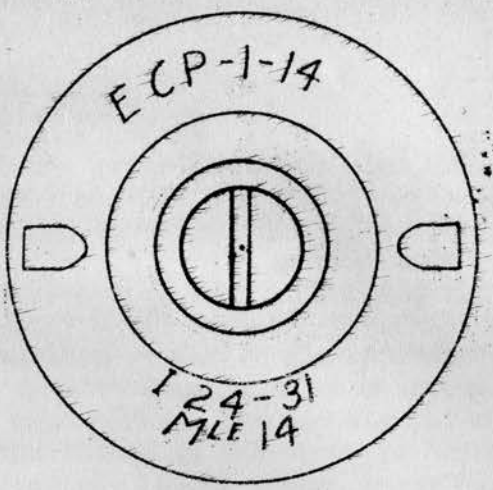
ORDNANCE DIVISION, ENG. SEC. C.W.S 5532

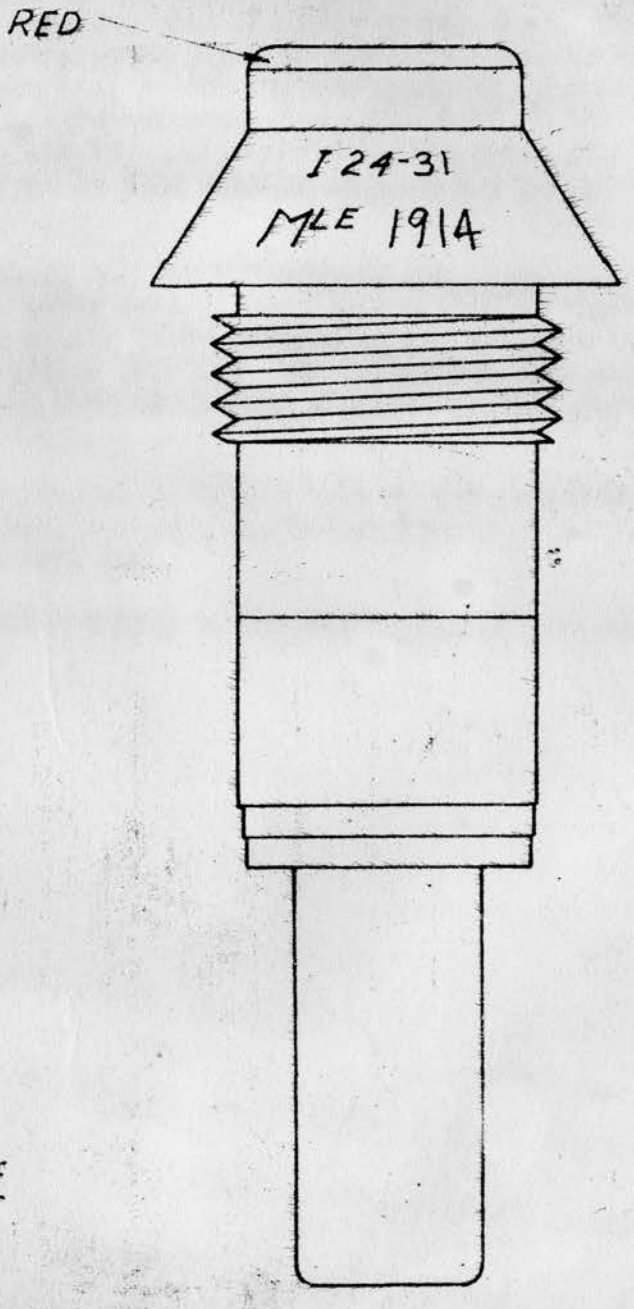


FRENCH 75m/m STEEL SHELL MODEL 1915
MARKING TYPICAL FOR №20 MIXTURE (H.S)

REVISED DIVISION-ENG. SEC-C.W.S. 5528

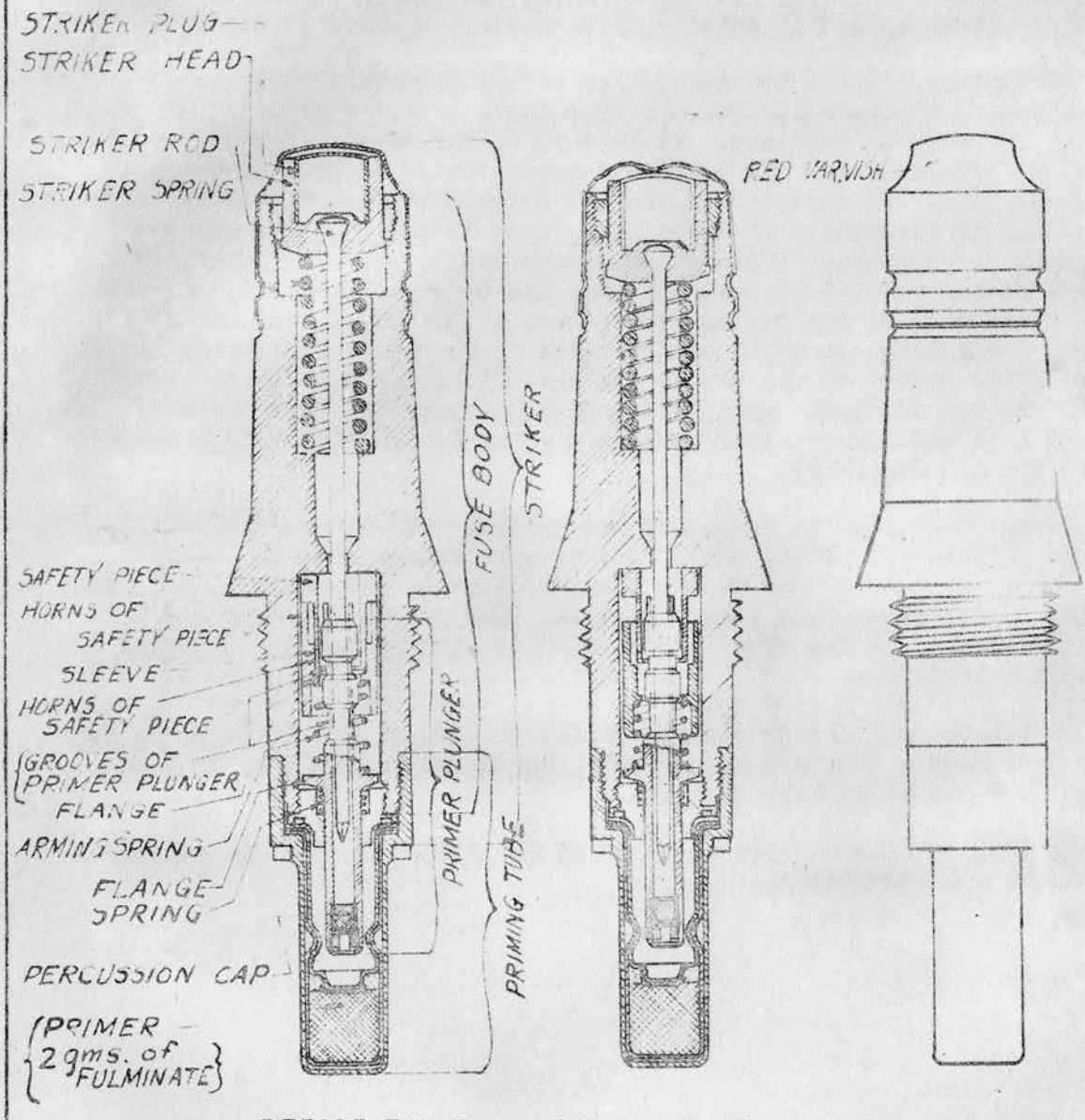






INSTANTANEOUS FUSE
MODEL 1914

OFFENSE DIVISION, ENG. SEC. C.W.S. 5535



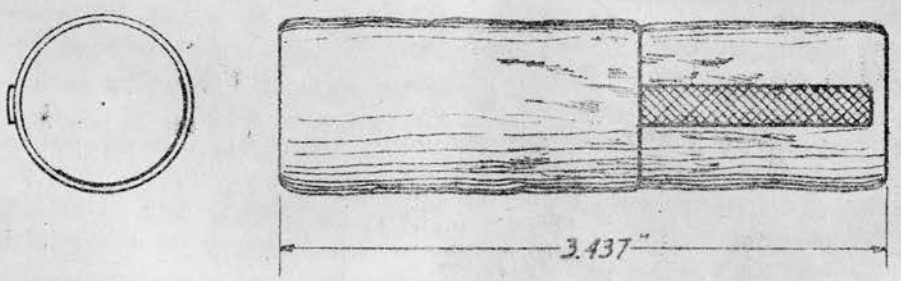
INSTANTANEOUS PERCUSSION DETONATING FUSE

24/31 R Y 1917 MODEL

OFFENSE DIVISION, ENG. SEC C.W.S. 536



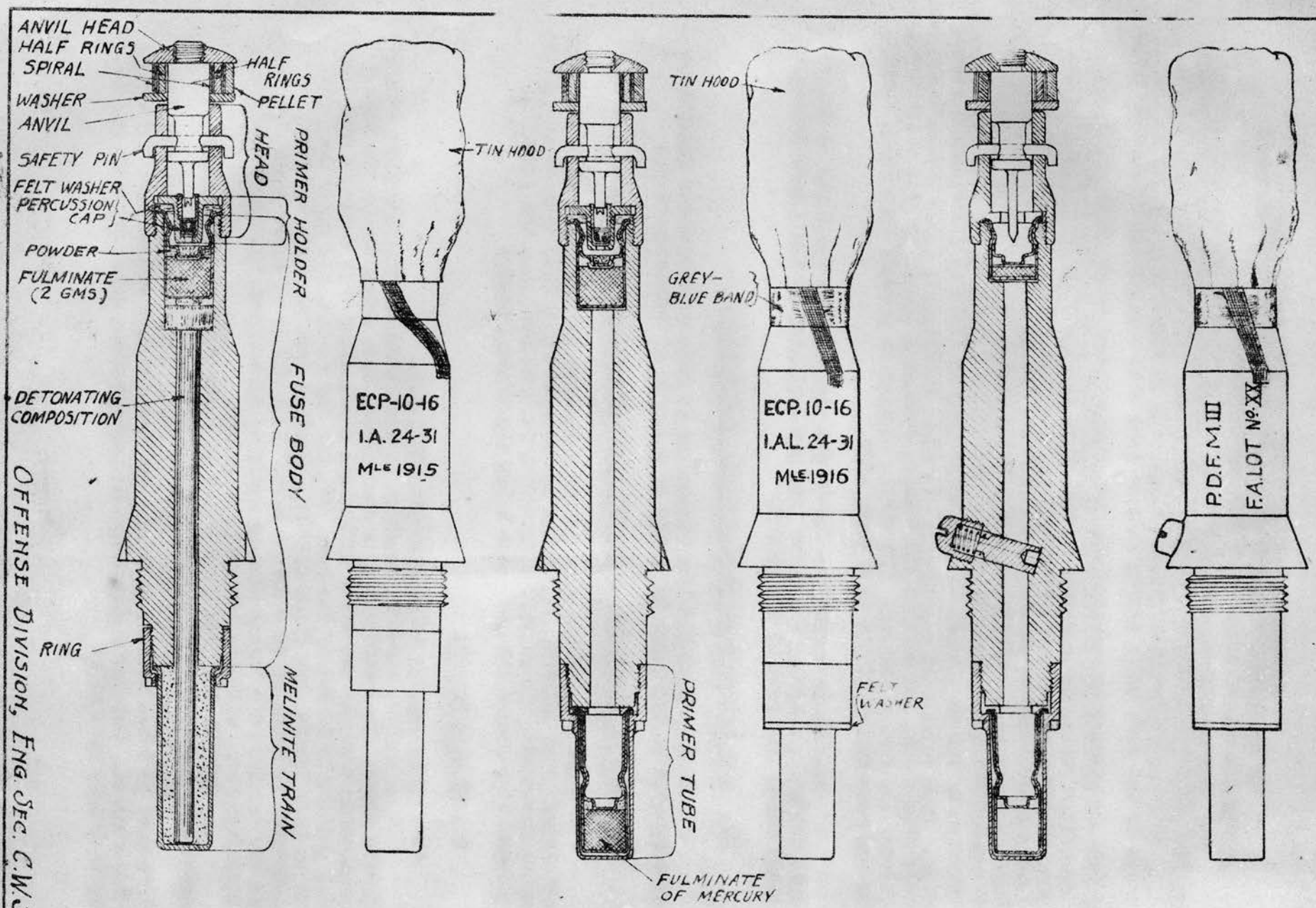
CYLINDER [illegible]OPER



CYLINDER ENCASED IN TAR PAPER

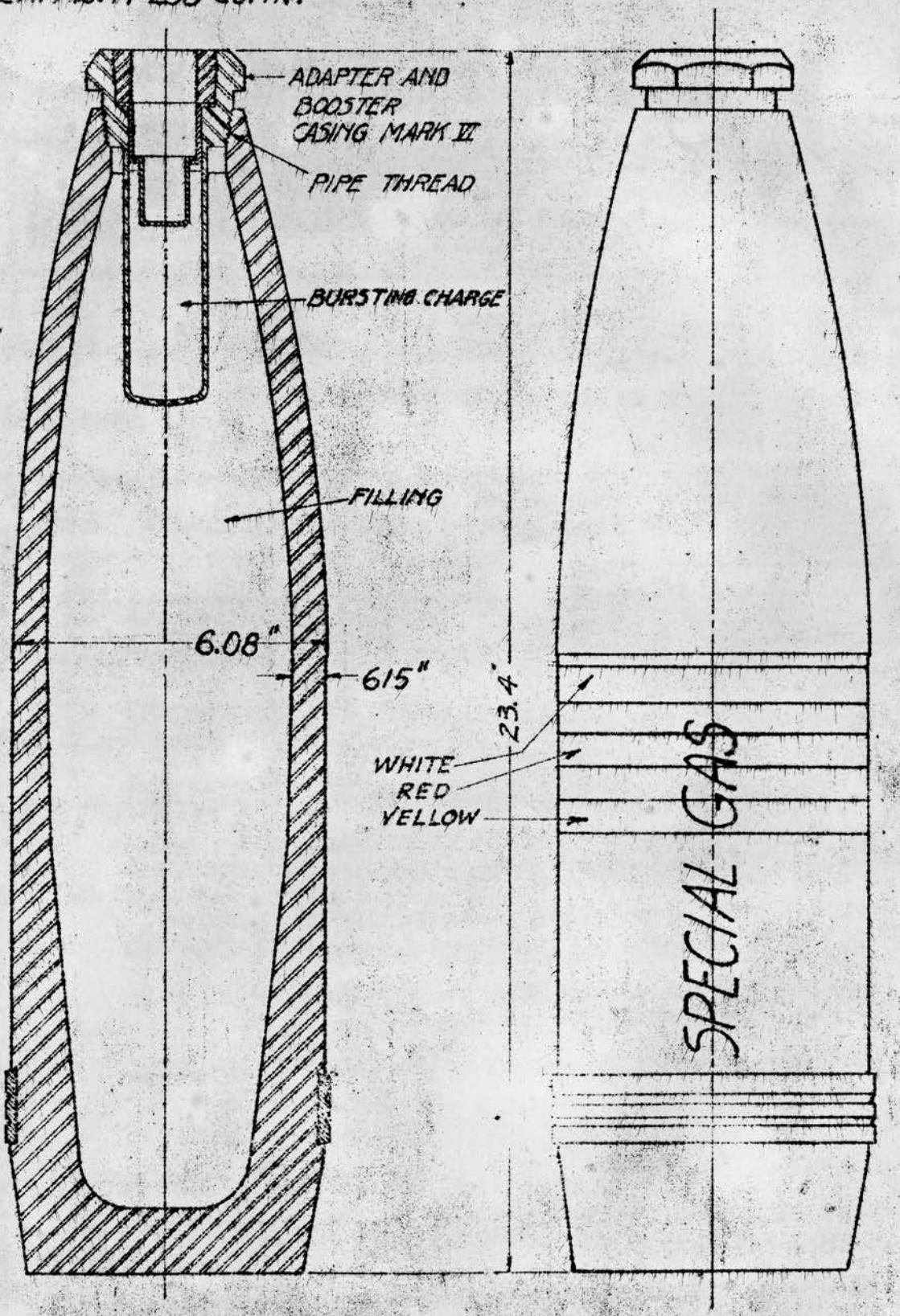
FRENCH INCENDIARY CYLINDER MODEL 1878

OFFENSE DIVISION, ENG. SEC. C.W.S. 5540



OFFENSE DIVISION, ENG. SEC. C.W.S. 5538

NET CAPACITY 238 CU. IN.

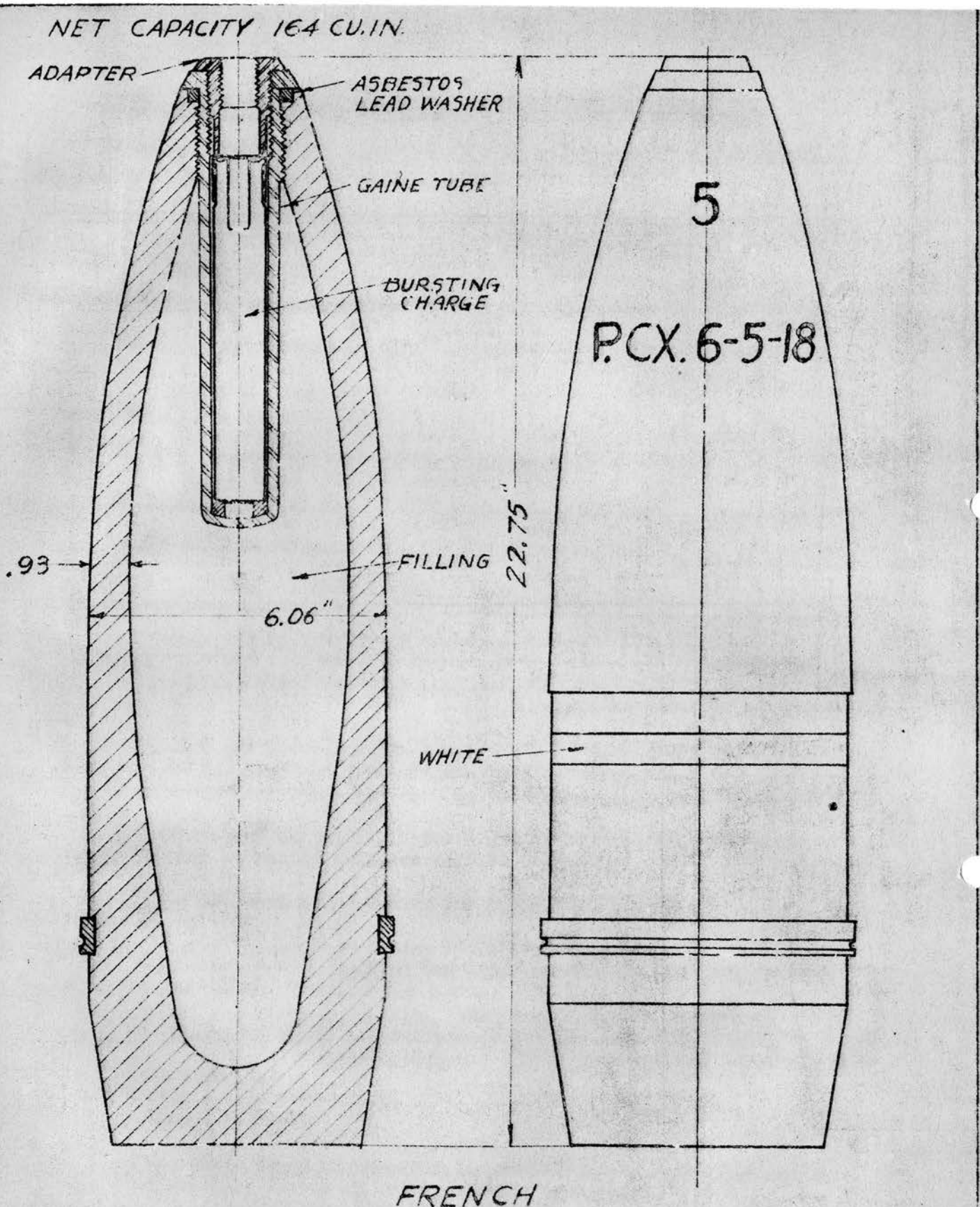


155 m/m COMMON STEEL SHELL MARK II FOR HOWITZER

MARKING TYPICAL FOR N.C.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5533

PJJ.



FRENCH

155 M/M SEMI STEEL SHELL MODEL 1915 FOR HOWITZER.

MARKING TYPICAL FOR Nº 5 MIXTURE (C.G)

OFFENSE DIVISION, ENG. SEC. C.W.S. 5530

23. FRENCH 155 mm. SEMI-STEEL SHELL. MODEL 1915 FOR HOWITZER.

The following are the 155 mm. howitzer French chemical shell in common use:

Filling		U.S.Symbol	Marking.	Approximate Wt. of Gas. Lbs.
No.	Name		The shell is painted green with the following distinguishing marks.	
Type Naud	Incendiary	Incendiary	Red ogive. 1 black ring	---
5	Collongite	C.G.	1 White band around body. No. 5 on Ogive.....	9.0
7	Aquinite	N.C.	1 Orange Yellow band around body. No.7 on ogive.	10.7
9	Martonite	B.A.	1 Orange Yellow band around body. No.9 on ogive.	7.46
20	Yperite	H.S.	2 Orange Yellow bands. No. 20 on ogive.....	7.6
21	Camito	C.A.	1 Orange Yellow band. No. 21 on ogive.....	8.83

On the ogive, immediately below the number of the mixture are letters indicating the nature of the mixture. With No. 20, "Yt" indicates Yperite dissolved in carbontetrachloride, and "Yc" indicates Yperite dissolved in monochlorbenzene.

Immediately below these letters are indicated the date and place of filling: "Aub" for Aubervilliers, "Vis" for Vincennes, and "P.Cx" for Pont-de-Claix.

With the exception of No. 20 and No. 21, the above mixtures contain a percentage of Opacite (stannic chloride) added to produce smoke.

The No. 4 (Vicennite) and No. 4B are not authorized for use.

The weight classification and weight markings of this shell are the same as for the U.S. 155 mm. howitzer shell.

A limited number of the Model 1914 steel shell are filled with No. 4 and No. 5 mixtures. The steel shell has a greater capacity than the semi-steel and the markings of the two are similar.

94. AMERICAN 155 MM. COMMON STEEL SHELL MARK VII. FOR GUN.

This shell is the Mark II howitzer shell, modified for use in the 155 mm. gun. It has two driving bands.

GASES USED	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING ½" BANDS AROUND THE BODY.	AND THE FOLLOWING WORDS LENGTHWISE ON BODY.	APPROXIMATE WEIGHT OF GASES. POUNDS
H.S.	3 RED	SPECIAL GAS	11.30
C.A.	2 RED	" "	12.18
B.A.	1 RED	" "	16.41
P.S.	1 RED & 1 WHITE	" "	13.66
N.C.	1 RED & 1 WHITE & 1 YELLOW	" "	14.50
C.G.	2 WHITE	" "	11.00
F.M.	2 YELLOW	SPECIAL SMOKE	14.30
W.P.	1 YELLOW	" "	15.85

The weights of the shell are the same as for H.E. and are marked as follows:

FROM Lbs.	FROM Oz.	TO Lbs.	TO Oz.	WEIGHT MARKS ON OGIVE	WEIGHTS STENCILLED JUST ABOVE DRIVING BAND.
91	3	92	5	▨ ▨	41 K 700
92	5	93	6	▨ ▨ ▨	42 K 200
93	6	94	8	▨ ▨ ▨ ▨	42 K 700
94	8	95	10	▨ ▨ ▨ ▨ ▨	43 K 200
95	10	96	12	▨ ▨ ▨ ▨ ▨ ▨	43 K 700

The weight marks on the ogive are 1/2" squares with a center-punch mark in the center of each square.

Just below the weight marks the ammunition lot number is stencilled in letters 1" high.

The weight stencils, just above the driving band, are in 1" letters, and just above them are the letters 155 G.

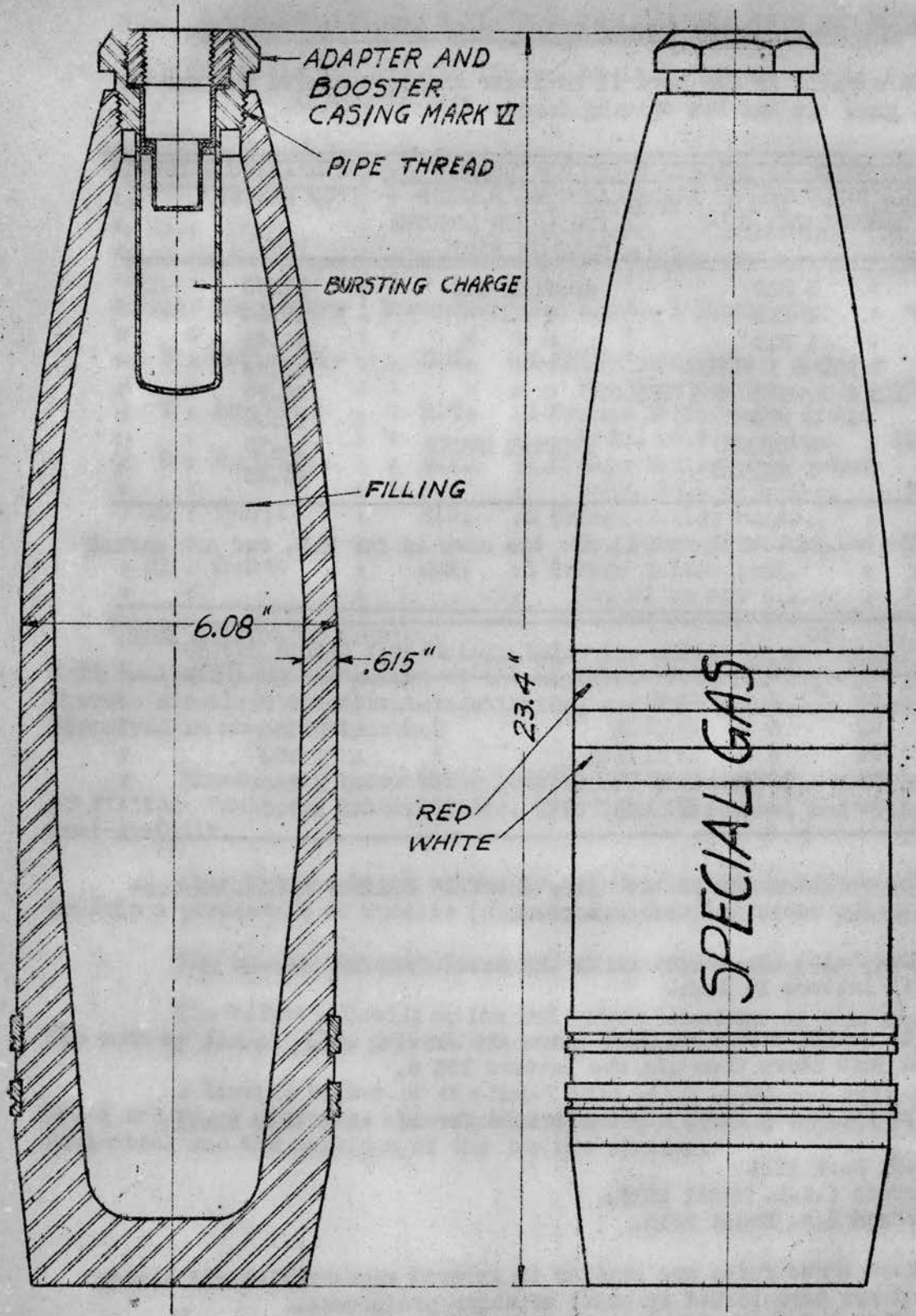
The following fuses are authorized for use with this shell:

U.S. Mark III.
French I.A.L. Model 1916.
French I.A. Model 1915.

These three fuses are similar in general construction and action and are here listed in order of their preference.
Modified British No. 106, (when issued).
French Y.R. (This fuse is to be used only in case others are not available).

A 155 mm. semi-steel shell has also been developed which differs from the steel shell in reduced capacity only.

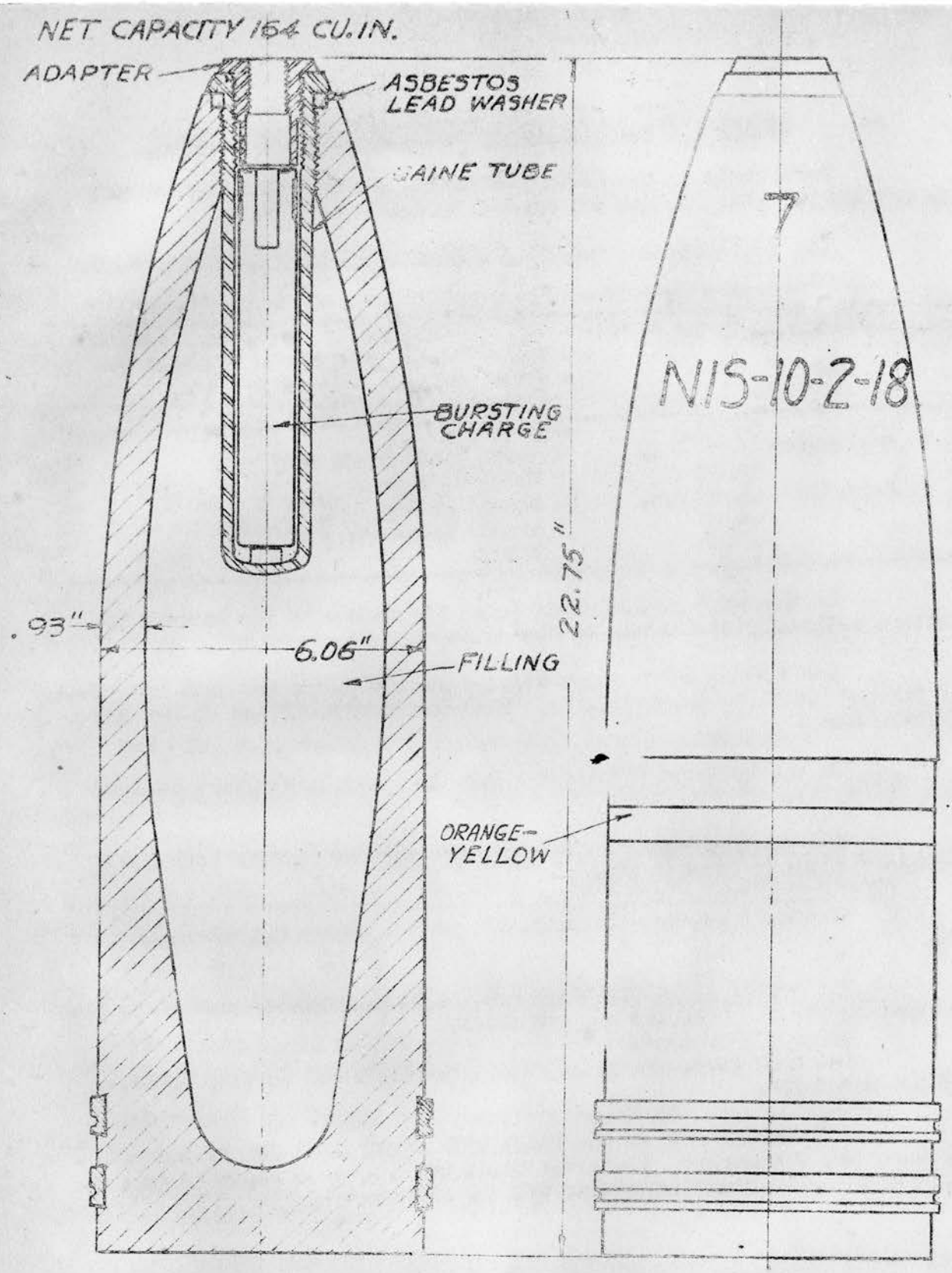
NET CAPACITY 238 CU. IN.



155 M/M COMMON STEEL SHELL MARK VII FOR GUN.

MARKING TYPICAL FOR P.S.

OFFENSE DIVISION, ENG. SEC. C.W.S. 552



155 M/M SEMI ST[illegible] [illegible]HELL MODEL 1917 FOR GUN.

MARKIN[illegible] L FOR Nº 7 MIXTURE (N.C.)

OFFENSE DIVISION, ENG. SEC. C W.S. 5534

95. FRENCH 155 mm. SEMI-STEEL SHELL MODEL 1917. FOR GUN.

This shell is the model 1915 howitzer shell modified for use in the 155 mm. gun. It has two driving bands.

The following are the 155 mm. French chemical shell in common use.

Filling No.	Filling Name	U.S. Symbol	Marking. The shell is painted green with the following distinguishing marks.	Approximate Weight of Gas. Lbs.
5	Collongite	C.G.	1 white band around body No. 5 on ogive.	9.0
7	Aquinite	N.C.	1 orange yellow band around body. No. 7 on ogive.	10.7

On the ogive, immediately below the number of the mixture are letters indicating the nature of the mixture.

Immediately below these letters are indicated the date and place of filling "Aub" for Aubervilliers, "Vis" for Vincennes, and "P.Cx" for Pont-de-Claix.

On the body are the letters G.P. in white, indicating that it is a gun shell.

The above mixtures contain a percentage of Opacite (stannic chloride) added to produce smoke.

The No. 4 mixture (Vincennite) and No. 4B are not authorized for use.

The weight classifications and weight markings of this shell are the same as for the U.S. 155 mm. gun shell.

The same fuses are to be used with this shell as with the U.S. 155 mm. gun shell.

A limited number of the Model 1915 steel shell are filled with No. 4 and No. 5 mixtures. The steel shell has a greater capacity than the semi-steel shell. The markings of the two are similar.

96. AMERICAN 8-INCH COMMON STEEL SHELL MARK III.

The same shell is used for both howitzer and gun.

FILLINGS FOR HOWITZER SHELL.

GASES USED.	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING ½" BANDS AROUND THE BODY	AND THE FOLLOWING WORDS LENGTHWISE ON THE BODY:	APPROXIMATE WEIGHT OF GASES. LBS.
H.S.	3 Red	Special Gas	22.45
C.A.	2 Red	" "	24.20
B.A.	1 Red	" "	32.67
P.S.	1 Red - 1 White	" "	27.20
N.C.	1 Red-1 White-1 Yellow	" "	28.90
C.G.	2 White	" "	22.05
F.M.	2 Yellow	Special Smoke	28.4
W.P.	1 Yellow	" "	31.5

FILLINGS FOR GUN SHELL.

Only the H.S. and F.M. fillings will be used in the gun.

The weights of the shell are the same as for H.E. and are marked as follows:

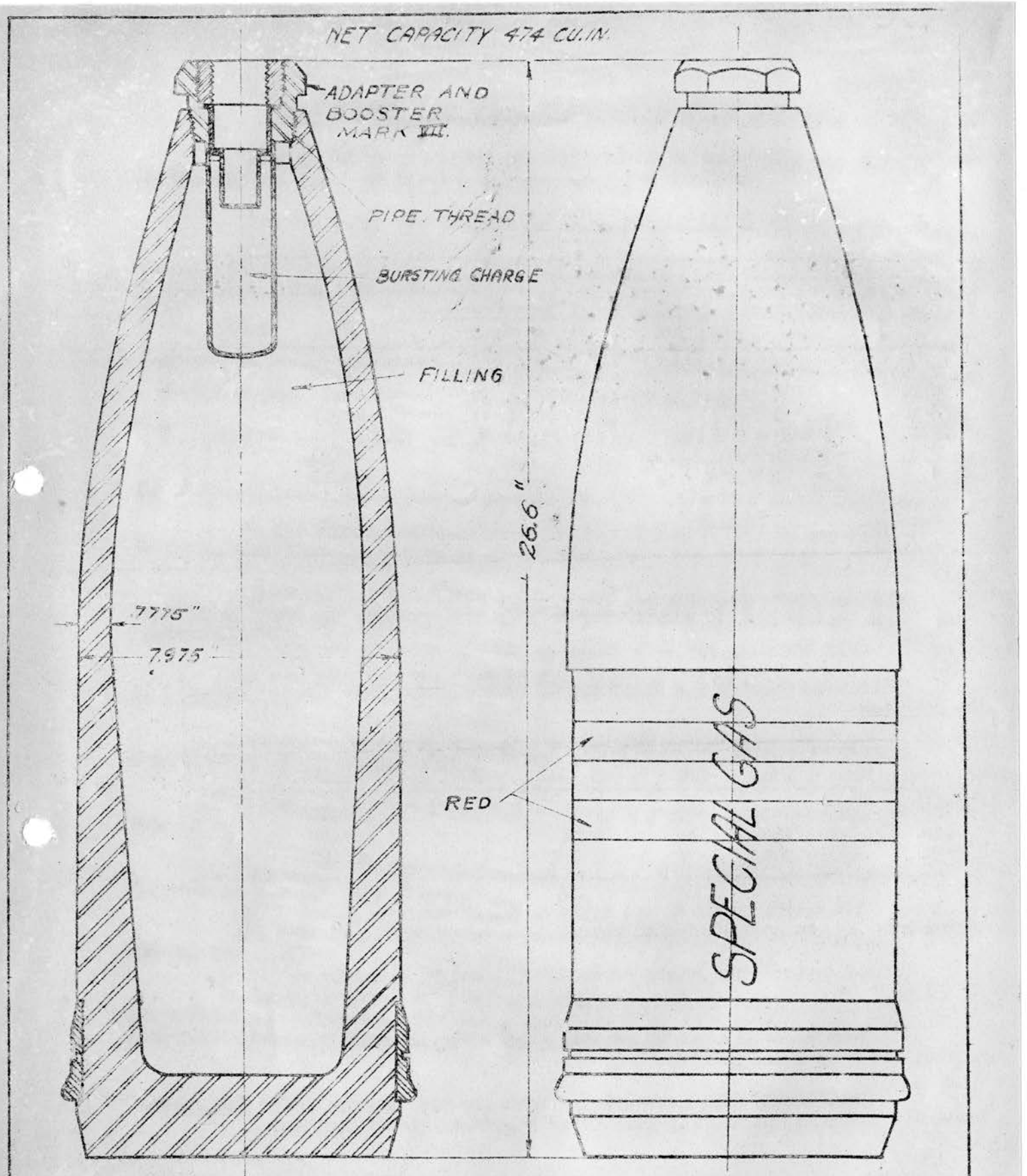
FROM Lbs.	FROM Ozs.	TO Lbs.	TO Ozs.	WEIGHT MARKS ON OGIVE	WEIGHT STENCILLED ON OGIVE JUST BELOW WEIGHT MARKS.
192	11	195	6	▨	194.58
195	6	198	11	▨ ▨	197.88
198	11	202	0	▨ ▨ ▨	201.20

The weight marks on the ogive are 1/2" squares with a prick punch mark in the center of each square.

Just below the weight marks are the weight stencils in letters 1" high.

Just below the weight stencils the ammunition lot number is stencilled in letters 1" high.

Immediately above the driving band are the letters "8-GH" indicating that the shell may be used in either the 8" gun or the 8" howitzer.



8 IN. COMMON STEEL SHELL MARK III

MARKING TYPICAL FOR D.A.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5529

The following fuses are authorized for use with this shell:

U.S. Mark III.
French I.A.L. Model 1916.
French I.A. Model 1915.

These three fuses are similar in general construction and action, and are here listed in order of preference.

Modified British No. 106, (when issued).

French R. Y. (This fuse is to be used only in case others are not available).

An 8" semi-steel shell has also been developed which differs from the steel shell in reduced capacity only.

9.2 INCH CHEMICAL SHELL.

Full data concerning the 9.2 inch chemical shell are not yet available. It is probable that there will be both steel and semi-steel shell.

The following fillings will be used with this caliber.

GASES USED.	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING 1/2" BANDS AROUND THE BODY.	AND THE FOLLOWING WORDS LENGTHWISE ON THE BODY.
H.S.	3 RED	Special Gas.
C.A.	2 RED	" "
B.A.	1 RED	" "
P.S.	1 RED 1 WHITE	" "
N.C.	1 RED 1 WHITE 1 YELLOW	" "
C.G.	2 WHITE	" "
F.M.	2 YELLOW	Special Smoke
W.P.	1 YELLOW	" "

The same fuses will be used as with other calibers.

The British are also developing 9.2 inch chemical shell.

98. 240 MM. CHEMICAL SHELL.

Full data concerning the 240 mm. chemical shell are not yet available. It is probable that there will be both steel and semi-steel shell.

The following fillings will be used with this caliber:

GASES USED.	THE SHELL IS PAINTED SLATE GRAY WITH THE FOLLOWING ½" BANDS AROUND THE BODY.	AND THE FOLLOWING WORDS LENGTHWISE ON THE BODY.
H.S.	3 RED	Special Gas.
C.A.	2 RED	" "
B.A.	1 RED	" "
P.S.	1 RED 1 WHITE	" "
N.C.	1 RED 1 WHITE 1 YELLOW	" "
C.G.	2 WHITE	" "
F.M.	2 YELLOW	Special Smoke
W.P.	1 YELLOW	" "

The same fuses will be used as with other calibers.

The British are also developing 9.2 inch chemical shell.

PART IV.

USE OF GAS BY GAS TROOPS

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INTRODUCTION

1. The development of the use of chemicals in modern warfare has resulted not only in the introduction of new weapons and methods, but also in the employment of gas troops. The experience already gained is sufficient to fix the field in which such troops can operate most effectively and point out the general principles underlying the most advantageous use of the weapons with which they are armed. Because of the highly technical nature of this service, troops engaged in it should be specially trained and equipped. Because of the hard physical labor required, the personnel should be of specially good physique.

2. Without attempting any refined analysis, the chemicals now used in warfare may be divided into four general classes. One class comprises chemicals which, when breathed or brought into contact with the human body, produce fatal or incapacitating results. Another comprises those used for purposes of deception or concealment. The third comprises incendiary agents. The fourth comprises high explosives.

3. The use of these materials has brought about the perfecting of three new weapons, the Stokes trench mortar, the Livens projector and the gas cylinder. The two former are used for the projection of bombs or drums containing chemicals. The projectile for Stokes trench mortars is usually called a bomb, while that of the Livens projector is usually called a drum. The cylinder is used exclusively for the projection of gas clouds. Stokes mortar bombs may contain any of the four classes of chemical agents, but in general the Livens projector is limited to agents of the first and fourth classes only.

4. It is the purpose of this hand book to present in concise form the principles underlying the proper organization and equipment of troops for this service, the nature of the weapons and chemical agents which they employ, and what experience has shown to be the most satisfactory use of such troops and weapons.

ORGANIZATION OF GAS REGIMENT

5. Gas troops are Army troops, one regiment per Army having been authorized. Their battalions and companies are attached to Corps and Divisions as required by the nature of the operations contemplated. As a rule, a unit smaller than a company should never be attached to a Division, nor a unit smaller than a battalion to any Army Corps.

Gas regiments as now authorized consist of six battalions of three companies each, with a total of 210 officers and 4873 enlisted men, as shown in the organization table opposite.

Of the six battalions five are combat battalions and one a replacement battalion. This is made necessary by the technical nature of the work, and the necessity of replacing casualties with trained personnel.

REGIMENTAL HEADQUARTERS

6. The organization of the Regimental Headquarters follows that of the

APPENDIX I

ORGANIZATION OF FIRST GAS REGIMENT

PART I

SECTION 4

TABLE 233—GAS REGIMENT, CHEMICAL WARFARE SERVICE

UNIT	One Company (a)	BATTALION				REGIMENT			Medical Department and Dental Corps	Ordnance Dept. Attached	Aggregate
		Headquarters	Supply and Work Shop Section	3 Companies	Total	Headquarters	6 Battalions (a)	Total			
Colonel						1		1			1
Lieutenant Colonel						3		3			3
Majors		1			1		6	6	1		7
Captains	2	2[c]		6	8	[z] 4[d]	48	52	6		137
First Lieutenants	4		1	12	13	1	78	79			
Second Lieutenants	3		1	9	10		60	60			60
Chaplains, 1st Lieutenants									2[g]		2
Total Commissioned	9	3	2	27	32	9	192	201	9		210
Master Engineers, Sr. Grade		1[p]	1[p]		2	4[p]	12	16			16
Master Engineers, Jr. Grade		2[p]	2[p]		4	4[p]	24	28			28
Regimental Sergeant Major						[z] 2[p]		2			2
Ordnance Sergeant										1[p]	1
Regimental Supply Sergeant						2[p]		2			2
Battalion Sergeant Majors		1[p]			1		6	6			6
Battalion Supply Sergeants			1[p]		1		6	6			6
1st Sergeants	1[p]			3	3		18	18			18
Sergeants, 1st Class	5[p]			15	15		90	90			
Mess Sergeants	1[p]			3	3		18				18
Supply Sergeants	1[p]			3	3		18	18			18
Sergeants	10[p]	1[p]	1[p]	30	32	[z] 4[p]	192	196	6		202
Corporals	30[q]	[f] 2[q]		90	92		552	552		6[p]	5[illegible]8
Cook	5[p]	1[p]	1[p]	15	17	2[p]	102	104			104
Mechanics			[i] 4[r]		4		24	24			24
Wagoners	5[r]	1[r]	1[r]	15	17	3[r]	102	105			105
Buglers	[e] 2[p]			6	6		36	36			36
Privates, 1st Class	62[r]	2[r]	5[r]	186	193	6[p]	1158	1164	56	6	3638
Privates	128[r]	4[r]	11[r]	384	399	12[p]	2394	2406		6	
Total Enlisted	250	15	27	750	792	39	4752	4791	63	19	4873
Aggregate	259	18	29	777	824	48	4944	4902	72	19	5083
Motor, Closed, Type D. Car						1		1			1
Motor, Type F. Car		1			1	3	6	9			9
Cart, Water, Trailmobile	1			3	3		18	18			18
Kitchen, Rolling, Trailmobile	1			3	3		18	18			18
Motor Cycles, with side cars	2	2	1	6	9	4	54	58	6[k]		64
Motor Cycles, Solo	2	2	1	6	9	4	54	58			58
Bicycles	4	1	1	12	14		84	84			84
Trucks, Type B	6		2	18	20	1	120	121			121
Trucks, Type AA	2			6	6	1	36	37			37
Rifles	225	9	21	675	705	3	4230	4233			4233
Pistols	34	9	8	102	119	45	714	759		19	778
Machine Guns	2		1	6	7		42	42			42

Special Engineer Regiments, organized for the emergency, except that a Lieutenant Colonel is provided for each two battalions and an additional first Lieutenant is authorized as assistant adjutant. The accompanying chart shows the normal organization of a regiment.

The enlisted personnel of 39 is sufficient to handle only the routine administration work. In order to maintain the necessary transportation to take care of the regiment's service of supply, it is necessary to call upon the battalions and companies for assistance. In normal operations, from 200 to 250 men are required for transportation and service of supply. It was found that by far the best results were obtained by directing the use of transportation from regimental headquarters.

DUTIES OF REGIMENTAL OFFICERS

7. Adjutant and Personnel Officer. - These duties follow closely those of similar positions in a normal regiment.

8. Chemical Advisor and Intelligence Officer should have:

First: An exact knowledge of the characteristics and proper use of gases in gas warfare; and such knowledge as will enable him to forecast with fair accuracy the probable importance of suggested developments.

Second. An accurate knowledge of the varying front line conditions; of the past and present operations of Gas Troops; and of the plans and possibilities for future operations.

The duties of this officer are, to obtain, properly file, and transmit information, particularly with a view of keeping the Gas Troops informed of the results obtained in Gas Warfare, and of keeping the technical and supply divisions informed of the needs of the Gas Troops. Since all intelligence matters concerning operations pass through the hands of the Chemical Advisor and Intelligence Officer, certain other duties concerning the conduct of operations and reports thereon, have been added to the foregoing.

The Chemical Advisor and Intelligence Officer should, therefore:

1. Procure, digest and file such scientific and technical papers and publications as are of possible practical value to the regiment.

2. Keep in touch with new developments in Offense Gas Warfare, with changes in offense gas weapons or material, and pass on useful information regarding the same.

3. Forecast all the necessary ordnance supplies for the regiment.

4. Investigate complaints regarding the technical supplies received and suggest any necessary improvements.

5. Transfer all suggestions of value regarding possible improvement of weapons or methods in Gas Warfare to the Commanding Officer concerned or to the Offense Division, Headquarters, Chemical Warfare Service, for investigation.

6. Render all possible assistance (consistent with other duties) to the Offense Division in its investigations.

7. Obtain information from army regarding positional of our advance line and keep regimental headquarters map up to date.

8. Obtain daily summaries of intelligence published by the army and the various corps and divisions with whom the regiment is operating. Study any intelligence regarding the enemy positions or activity that may prove useful in pending operations, and furnish same to all commanding officers concerned.

9. Have the location of all gas battalion or company headquarters and dumps indicated on the regimental headquarters map. Be conversant with the various means available for inter-communication between all regimental units.

10. Have on hand a list showing the location of all corps and division headquarters on the front where the regiment is operating and have same plotted on the regimental headquarters map.

11. Have suitable road maps of the advance zone, showing first class "up" and "down" traffic routes; also have traffic maps of lines of communication.

12. Procure and keep on hand a sufficient supply of suitable maps for all present and pending operations, and be prepared to make at short notice maps concerning any projects on hand.

13. Have on hand a relief map of the front on which the regiment is operating.

14. Obtain information as to present plans of battalion and company commanders and be prepared to suggest new operations on which these units can be profitably employed.

15. Take charged of all secret correspondence "inward" and "outward", regarding the employment of the regiment and its movements or future operations.

16. Received all daily progress and operation reports from battalions and companies, check same, and be conversant at all times with their contents.

17. Collect and pass on to officers concerned intelligence on results of operations by the regiment and the gas troops.

18. Compile and distribute a regimental daily bulletin containing information of importance or interest.

19. Be thoroughly conversant with all Gas Defense measures, and be able to advise concerning any special precautions necessary to be taken by Gas Troops for protecting them against their own gas.

20. Advise the Regimental Supply Officer as to the location of important forward Gas Dumps and the storage of material in them.

21. Obtain and supply to all officers concerned such meteorological data as may be of service.

9. Regimental Supply Officer. The duties of this officer are as follows:

(a) Anticipate the supplies required by the Regiment and deliver them to mobile dumps easily accessible to the companies and battalions. These mobile points should move as the units move so that the amount of truck transportation is minimized.

(b) To control all motor and animal transportation.

1. In connection with motor transportation, the Regimental Supply Officer is to maintain a suitable and sufficient personnel to operate and maintain all trucks, touring cars and side-cars assigned to the organizations.

2. The Regimental Supply Officer is to care for the replacement of all animals injured or taken sick, recommend personnel to handle them and to arrange for periodic inspection as a check on their care, use and proper shoeing.

3. Assist the companies and battalions in arranging for any rail shipment they may be required to make.

(c) All miscellaneous duties.

Billeting: take care of any construction work and any other miscellaneous work which obviously is not a part of the duties of the other staff officers.

(d) Work with the Battalion Supply Officers, and through them with the Company Supply Officers, and see that each is acquainted with and performs his full duty.

10. Master Engineers. The duties of the Master Engineers are as follows:

(1) Chemical Assistant. This assistant will operate directly under the orders of the Regimental Chemical Advisor and Intelligence Officer and assist him in every way in chemical matters.

(2) Map and Intelligence Assistant. This assistant will be charged, under the Regimental Chemical Advisor and Intelligence Officer, with maintaining complete map files and all intelligence covering operations.

(3) Training Assistant. This assistant will be charged, under the Regimental Chemical Advisor and Intelligence Officer, with the co-ordinating and assisting in the training and instruction.

(4) Transportation Assistant. This assistant will be charged, under the Regimental Supply Officer, with looking after the work in the transportation division and will include operation and maintenance of all motor vehicles.

(5) Supply Assistant. This assistant will function directly under the Regimental Supply Officer.

(6) Special Equipment Assistant. This assistant will be charged, under the Regimental Supply Officer, with keeping fully informed on Special Equipment situation as regards manufacture, supply in all depots, and supply of troops operating on the lines.

(7) Construction Assistant. This assistant functions directly under the Regimental Supply Officer and will be available for all construction work. He must be a man capable of handling men on general construction work.

(8) Military Assistant. This assistant functions under the Regimental Adjutant. He will be available for the training of replacements, for taking charge of or assisting in special technical training.

BATTALION HEADQUARTERS

11. In the Battalion organization, additional strength over that of the special Engineer organizations was provided to care for the battalion dumps and workshops. This has proven to be a necessity.

DUTIES OF BATTALION OFFICERS

12. The duties of the Battalion Staff Officers, while following generally those of similar positions in the normal battalion, also parallel to a great extent the duties of the corresponding regimental positions outlined above. The duties of Battalion Staff Officers are, furthermore, made difficult by the necessity of controlling and supplying units operating over an extended front and in small detachments.

13. The Adjutant's duties are those normally pertaining to this position.

14. The Chemical Advisor and Intelligence Officer's duties parallel those outlined for the Regimental Chemical Advisor and Intelligence Officer.

15. Supply Officer.

(a) The Battalion Supply Officer is the personal representative of the Regimental Supply Officer and should act as an intermediary between the Regimental Supply Officer and the Company Supply Officer. He should observe closely the needs of each company in his battalion, the work of each Company Supply Officer, and anticipate any extraordinary request for supplies. All this information should be communicated to the Regimental Supply Officer,

together with any other information which might assist the Regimental Supply Officer in performing his duties.

(b) Battalion Supply Officer is absolutely responsible for keeping his particular Battalion properly equipped and supplied.

(c) Battalion Supply Officer should keep in close touch with each of the Company Supply Officers and see that all records and reports required from Company Supply Officers are rigidly adhered to.

(d) Battalion Supply Officer must consolidate the requests for supplies from the various companies of his battalion and obtain the material from the Regimental Supply Officer. He must also keep the Regimental Supply Officer informed of his immediate needs, the condition of all equipment in his battalion, and its disposition.

16. Master Engineers. The duties of the Master Engineers are as follows:

(1) Map and Intelligence Assistant. This assistant will be in charge of the drafting room, will maintain map files, co-ordinate information, and prepare project maps.

(2) Meteorologist. This assistant functions under the Battalion Chemical Advisor and Intelligence Officer and is charged with securing and maintaining necessary weather records, preparation of stations, and otherwise advising as to the meteorological situation insofar as it concerns offensive operations.

(3) Transportation Assistant. This assistant is charged, under the Battalion Supply Officer, with the upkeep and operation of transportation assigned to the battalion.

(4) Special Equipment Assistant. This assistant functions under officer in charge of the battalion dump, and will be charged with receipt, storage, care in storage, and issue of special equipment.

(5) Construction and Workshop Assistant. This man will be charged, under the Dump Officer, with control of shops and any special construction work.

(6) Training Assistant. This man, under the Battalion Chemical Advisor and Intelligence Officer, will assist in co-ordinating instruction in the battalion.

COMPANY ORGANIZATION

17. The company is organized into a headquarters section and four platoons. The headquarters section takes care of the normal administration of the company, thus leaving the platoons free for actual fighting. Each platoon is organized into two sections and each section consists of two Stokes Mortar gun teams with a carrying party. This gives sixteen mortars per company. All platoons are trained in projector and cylinder work.

The platoon is the working unit of the regiment. This is specially

true in a war of movement. It is rarely necessary to install more than four guns in conjunction with the advances or attacks of an infantry regiment, and when it is necessary for one company to operate on a divisional front, such an arrangement permits covering the front not only at the start of the operation but also enables the platoons to follow the infantry regiments to which they are attached and give assistance as the attack develops.

Each platoon is organized as an independent unit insofar as concerns its independent functioning in action. This calls for the assignment of a cook and the supply of the necessary cooking equipment. Each company should be supplied with four small field ranges in addition to the regular rolling kitchen.

The commissioned personnel of the company consists of nine officers, two of whom are captains. The additional commissioned personnel is made necessary by the character of the work and the entire number is necessary to insure proper functioning.

It is impossible for one officer to properly command the company, care for his men and at the same time carry on the extensive liaison that is necessary in the functioning of a gas company. The addition of the second captain (the Second in Command), fills a need and has actually proved to be a necessity in action.

The accompanying chart shows the normal organization of the company.

DUTIES OF COMPANY OFFICERS

18.

(1) The Company Commander actually commands the company and carries the full responsibility of the position.

(2) He directs and supervises the training of his company.

(3) He personally directs disciplinary actions and is responsible for the discipline of the company.

(4) It is his duty to see that all officers under his command have the requisite technical knowledge and training.

(5) It is his duty to see that all officers perform their full duty and actually accept the full responsibilities of their respective duties.

(6) He personally examines, verifies and signs all reports and letters connected with the company work.

(7) He makes inspections from time to time to ascertain whether the company is properly clothed and equipped and whether the equipment is up to the standard set.

(8) He designates the approximate location of advanced company and platoon headquarters and dumps.

GAS REGIMENT

COMPANY ORGANIZATION CHART.

- **COMMANDING OFFICER CAPTAIN**
  - **SPECIAL DUTY OFFICER 2ND. LIEUTENANT.**
    - **MESS SERGEANT**
      - COOKS
      - COOKS HELPERS, PRIVATES.
  - **RUNNERS** — 2 PRIVATES
  - **SECOND IN COMMAND CAPTAIN**
    - **FIRST SERGEANT**
  - **LIAISON OFFICER 2ND LIEUTENANT**
    - **RUNNERS** — 2 PRIVATES
  - **SUPPLY AND TRANSPORTATION OFFICER 2ND LIEUTENANT**
    - **SUPPLY SERGEANT**
      - 1 PRIVATE
    - 4 TRUCKS
    - 2 DELIVERY CARS
    - 2 SIDE CARS
    - 2 SOLOS
    - 10 MULES
    - 1 SADDLE HORSE
    - 5 WAGONERS, 6 PRIVATES

- **FIRST PLATOON**
  - **PLATOON LEADER 1ST LIEUTENANT**
    - **SERGEANT 1ST CL.**
      - **SERGEANT**
        - No. 1 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 2 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 1 SGT 1ST CL. CAS N.C.O., 2 CORPORALS, 4 1ST CL. PRIVATES, 8 PRIVATES
      - **COOK**
      - **SERGEANT**
        - No. 3 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 4 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 2 CORPORALS, 4 1ST CL. PRIVATES, 8 PRIVATES
    - **RUNNERS** — 2 PRIVATES
- **SECOND PLATOON**
  - **PLATOON LEADER 1ST LIEUTENANT**
    - **SERGEANT 1ST CL.**
      - **SERGEANT**
        - No. 5 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 6 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 2 CORPORALS, 4 1ST CL. PRIVATES, 8 PRIVATES
      - **COOK**
      - **SERGEANT**
        - No. 7 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 8 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 2 CORPORALS, 4 1ST CL. PRIVATES, 8 PRIVATES
    - **RUNNERS** — 2 PRIVATES
- **HEADQUARTERS SECTION**
  - 1 ORDERLY SERGEANT
  - 2 BUGLERS
  - 4 PRIVATES 1ST CLASS
  - 1 MAIL ORDERLY
- **THIRD PLATOON**
  - **PLATOON LEADER 1ST LIEUTENANT**
    - **SERGEANT 1ST CL.**
      - **SERGEANT**
        - No. 9 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 10 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 1 SGT GAS N.C.O., 2 CORPORALS, 4 1ST CL. PRIVATES, 8 PRIVATES
      - **COOK**
      - **SERGEANT**
        - No. 11 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 12 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 1 CORPORAL, 4 PVTS. 1ST CLASS, 9 PRIVATES
    - **RUNNERS** — 2 PRIVATES
- **FOURTH PLATOON**
  - **PLATOON LEADER 1ST LIEUTENANT**
    - **SERGEANT 1ST CL.**
      - **SERGEANT**
        - No. 13 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 14 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 2 CORPORALS, 4 1ST CL. PRIVATES, 8 PRIVATES
      - **COOK**
      - **SERGEANT**
        - No. 15 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - No. 16 GUN TEAM: 1 CORPORAL, 2 1ST CL. PRIVATES, 2 PRIVATES
        - CARRYING PARTY: 1 CORPORAL, 4 PVTS. 1ST CL., 9 PRIVATES
    - **RUNNERS** — 2 PRIVATES

5304

(9) He makes the necessary forecasts covering amounts and kinds of ammunition and supplies needed.

(10) He issues the necessary orders to cover reconnaissances and operations.

(11) He carries on and maintains liaison with Division and Brigade Headquarters.

(12) He keeps fully informed of the tactical situation, the plans of the various Commanders and makes the necessary recommendations covering the correct and best tactical use of the company.

(13) He assists the Platoon and Section Leaders in perfecting and maintaining liaison with Regimental and Battalion Headquarters.

(14) He obtains information as to enemy troop concentrations and sends data to Platoon Leaders as to possible targets.

(15) He arranges necessary system of runners and necessary passage of messages between the units of his command and units with which he may be operating.

19.

(1) The Second in Command keeps himself prepared to take up the duties and responsibilities of the Company Commander at any time.

(2) He sees that all orders and instructions are complied with and routine matters carried out.

(3) He supervises the care of the men, their training and equipment, and is responsible for the company being at all times ready for immediate service.

(4) He carries on the interior administration of the company.

(5) He establishes and arranges forward company billets and dumps and sees that necessary and proper guards are established.

(6) He must see that proper messing arrangements are made and that at all times the men are supplied with proper food.

(7) He personally checks up the ration issue and sees that rations are properly used.

(8) He supervises the supply of munitions as given by forecasts of the Company Commander.

(9) He keeps himself fully informed of the existing tactical situation of all company units.

(10) He is the Company Gas Officer and is responsible for the gas discipline of the company.

20. Duties of Company Supply Officer.

(1) Supplies -

(a) Source:

All supplies must be requisitioned through the Battalion Supply Officer. When the Company is operating independently, rations will be drawn from the units to which the company is attached.

(b) Kinds of Supplies:

(1) Quartermaster.

(2) Ordnance.

(3) Signal.

(4) Engineer.

(5) Technical Supplies.

(6) Rations.

(c) Quartermaster Supplies:

(1) Each Corporal must be held personally responsible for the condition of his men's equipment. He must report once each week to his platoon commander who will report to the Company Supply Officer.

(2) Company Supply Officers must make a weekly report to the Battalion Supply Officer, showing their exact present needs and their immediate future needs.

(d) Ordnance Equipment:

Same as Quartermaster.

(e) Signal Equipment:

(1) Signal Equipment is company property and must be checked once each week to determine its conditions and any loss.

(2) Results should be reported immediately to the Company Commander and the Battalion Supply Officer.

(f) Engineer Equipment:

Same as Signal Equipment.

(g) Technical Equipment and Supplies:

Same as quartermaster supplies but in addition the location of all company dumps, and supplies in each dump must be reported to the Company Commander and Battalion Supply Officer.

(h) Rations:

(1) Garrison rations are always to be used when available.

(2) Field rations are to be used when directed by the Commanding Officer; usually when it is impracticable to use fresh meat. Five days' rations should always be kept on hand.

(3) Reserve rations. Two-day tins reserve rations must always be carried by each soldier in the field.

(4) Travel rations must be issued to all troops when travelling.

2. Transportation -

(1) Minimum amount of transportation required to perform the operation in hand and amount of time required must be estimated. Particular attention should be paid to the type of transportation best adapted to the operation; e.g., rail, truck, animal or narrow gauge. This information should be conveyed to the Battalion Supply Officer requesting that he furnish the transportation.

(2) Careful written orders with map should be given the non-commissioned officer in charge of the transportation. These should state the time the transportation is to leave, the cargo to be carried, the route to be followed, the destination, and to whom the material is to be delivered. The non-commissioned officer acting as convoy must check the list of material delivered and report the same to the Company Supply Officer, and he in turn to the Company Commander.

(3) All company transportation is under his immediate control as regards operation. The Company Supply Officer must know at all times the location of all trucks assigned to his company, their condition, and the work upon which they are engaged.

(4) All unserviceable trucks must be reported immediately to the Regimental Headquarters for disposition. Transportation is not to be overhauled by the companies.

3. Records -

Careful records must be kept by the Company Supply Officer showing the disposition of all material and equipment issued to his company. These records should be kept so that at any time he can render a report showing the amount of loss of any particular supplies by his company.

21.

(1) The Platoon Leader must fight his platoon along correct tactical lines.

(2) He must personally see that his platoon is properly clothed, equipped, fed and housed.

(3) He must carry on and maintain proper liaison with company and units to which attached.

(4) He must make necessary local reconnaissances and select suitable emplacements with maximum possible protection.

(5) He must actually direct the work of his platoon and personally check up the construction of the emplacement, sighting and elevations of guns, make nocessary examination of guns and ammunition and all other matters pertaining to the operation.

(6) He must know each man in his platoon by name and make a study of his abilities.

(7) He makes out accurately, necessary reports and forwards them to the Company Commander.

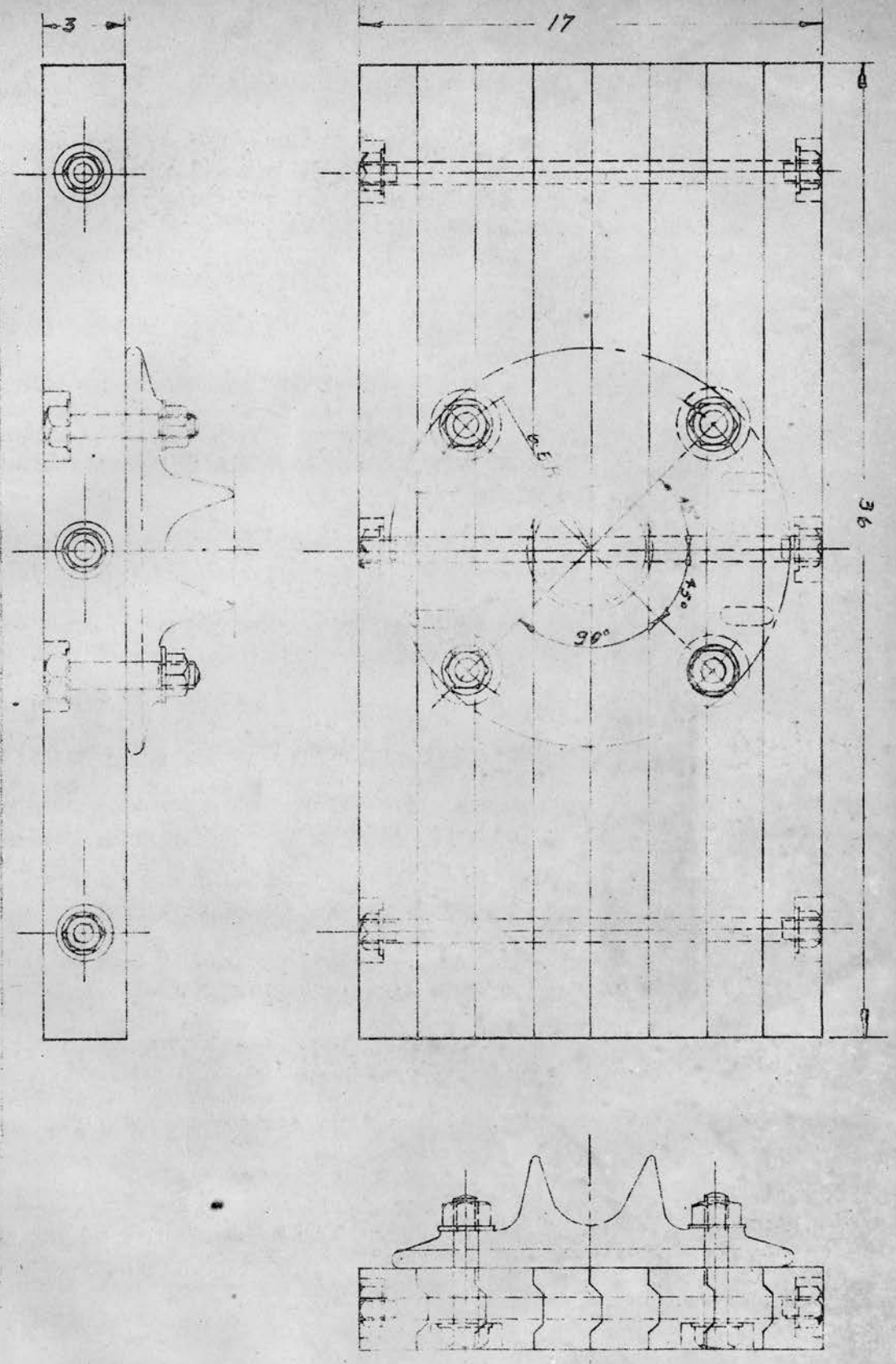
(8) He must keep his platoon prepared for service at any time.

(9) He must personally take charge of the men's technical training under the supervision of the Company Commander and Second in Command.

(10) He takes charge of his platoon at all company formations and drills.

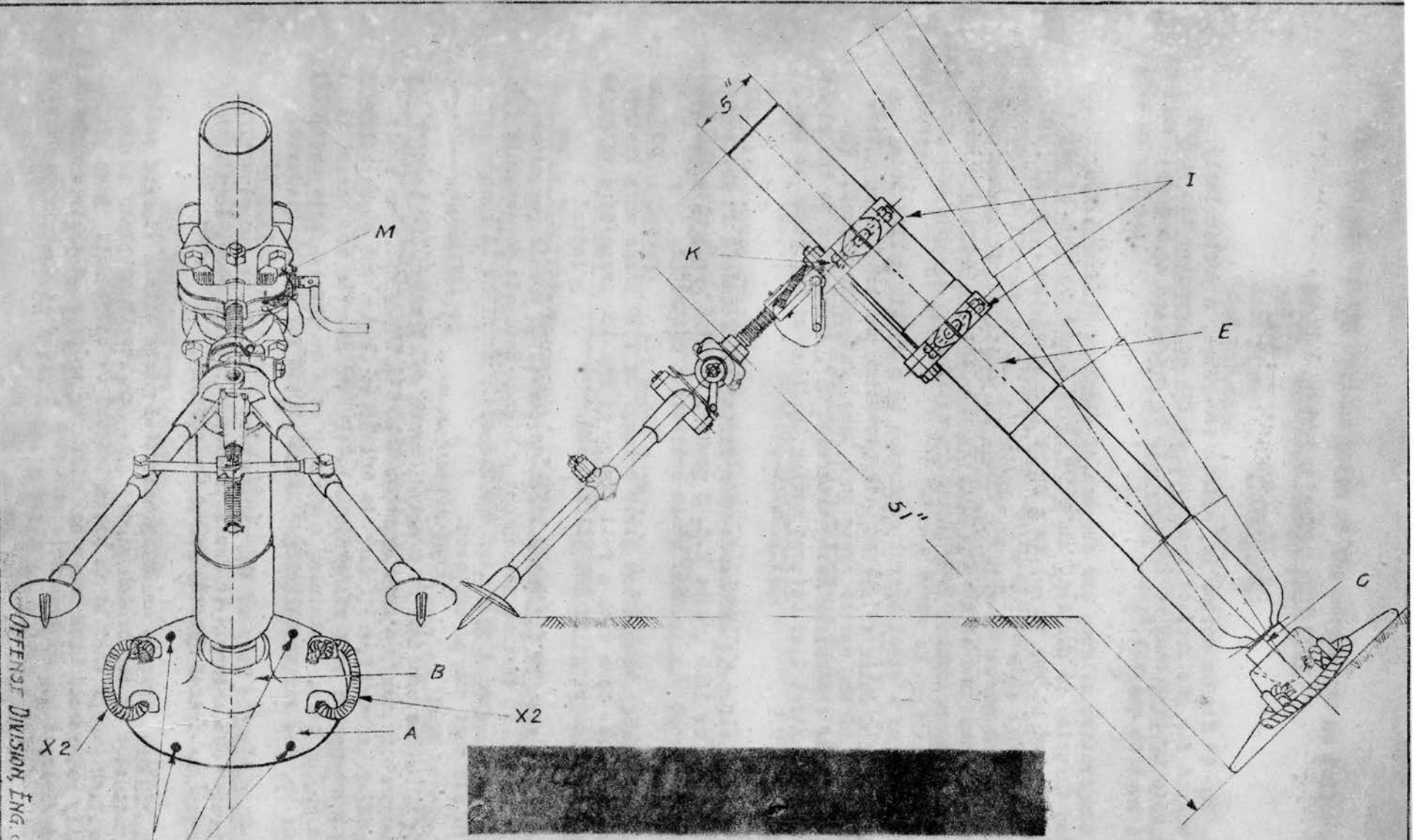
(11) He, from all his personal knowledge of his men, advises the Company Commander as to the qualifications and short-comings of his men and also recommends promotions.

(12) He personally sees that all orders pertaining to his platoon are carried out.



DIE B.

DIVISION ENG SEC S. 5580



TRENCH MORTAR MARK I

GENERAL ASSEMBLY

OFFENSE DIVISION, ENG. SEC. C.W.S. 5558

D.E.B.

FOUR INCH STOKES MATERIAL

THE MORTAR

22. The 4" Stokes mortar is, within its range, a particularly suitable weapon for gas projectiles owing to its comparative accuracy and rapid rate of fire, and to the quantity of gas which each bomb contains (about 2½ quarts).

The comparative silence and absence of flash on discharge are useful when surprise is desired, and very heavy concentrations of gas can be established at the target in a short period of time.

The 4" Stokes mortar is quickly placed in position. It can be used for several purposes and it is sufficiently mobile to be carried forward with infantry for employment from advanced positions.

It consists of a steel barrel connected by a double collar to a tubular steel stand which is fitted with elevating and traversing gears. The breech piece of the mortar rests on a base plate with socket. The mounting admits of the mortar being traversed 2½°, traversing to the right or left of the central line without moving the legs of the stand or the base plate.

The maximum range is 840 yards when firing the standard 25 lb. bomb with full charge of 1200 grains E.C. 3 powder, and 465 yards with the 13 lb. light smoke bomb and the 350 grain ballistite cartridge.

The cordite ring propellant gives a range of 1090 yards when firing the standard 25 lb. bomb with a full charge of one 150 grain cordite cartridge and 4 cordite rings of 350 grains each.

The rate of fire by day for a short period is 20 rounds per minute, although with a well trained detachment a higher rate can be obtained for short bursts, not exceeding one or two minutes. At night 12 rounds per minutes is all that can be expected.

Barrel. This consists of a solid, drawn steel tube, 40" long, with a smooth bore varying from 4.15" to 4.20" in diameter. Two bands are clamped around the barrel near the muzzle to engage the bipod carrying the elevating and traversing devices. In the base of the barrel is screwed a breech piece containing a striker stud or anvil. This anvil has a flat top for firing cartridges and a nipple for firing biscuits.

Stand or Bipod. This is the gun support and carries the elevating and traversing mechanisms. It consists of two tubular steel legs with a cross stay and spiked feet to prevent spreading.

Base Plates. This is an octagonal steel plate with a flanged socket for the reception of the breech piece. The American base plate is similar to the British except that it is round instead of octagonal. Base plates are usually reinforced with heavy oak planking to prevent their displacement when firing.

The weights of the various parts of the mortar are as follows:

Stand	30 lbs.
Barrel	90 "
Base Plate	60 "
Wood sub-base	60 "

Note: The mortars above described are of British manufacture. American mortars are practically identical except for some slight differences of weights.

AMMUNITION

23. Bombs. At the present time there are roughly four (4) types of Stokes Mortar bombs in use by the Gas troops, as follows: Gas, Thermit, Smoke, Ranging. All American bombs are made of wrought iron or steel. The following tables give the principal dimensions, weights, markings, and characteristics of the various bombs of British and American manufacture.

24.

PROPERTIES AND MARKINGS OF BOMBS

BRITISH MANUFACTURE.

Filling	Properties	Marking.
CG	Lethal	1 Red - 1 White - 1 Red Band. Bands ½" Wide.
AK	Lethal	3 White Bands. Bands ½" Wide.
PG	Lethal & Penetrative.	2 White Bands. Bands ½" Wide.
MC	Penetrative.	1 White - 1 Red - 1 White Band. Bands ½" Wide.
PS	Penetrative.	1 White Band. Band 1" Wide.
KSK	Lachrymatory.	Stencilled - "HVY"
WP	Smoke	Stencilled - "W.PHOS" or "W & R PHOS"
THERMIT	Incendiary.	Stencilled - "INCDY"

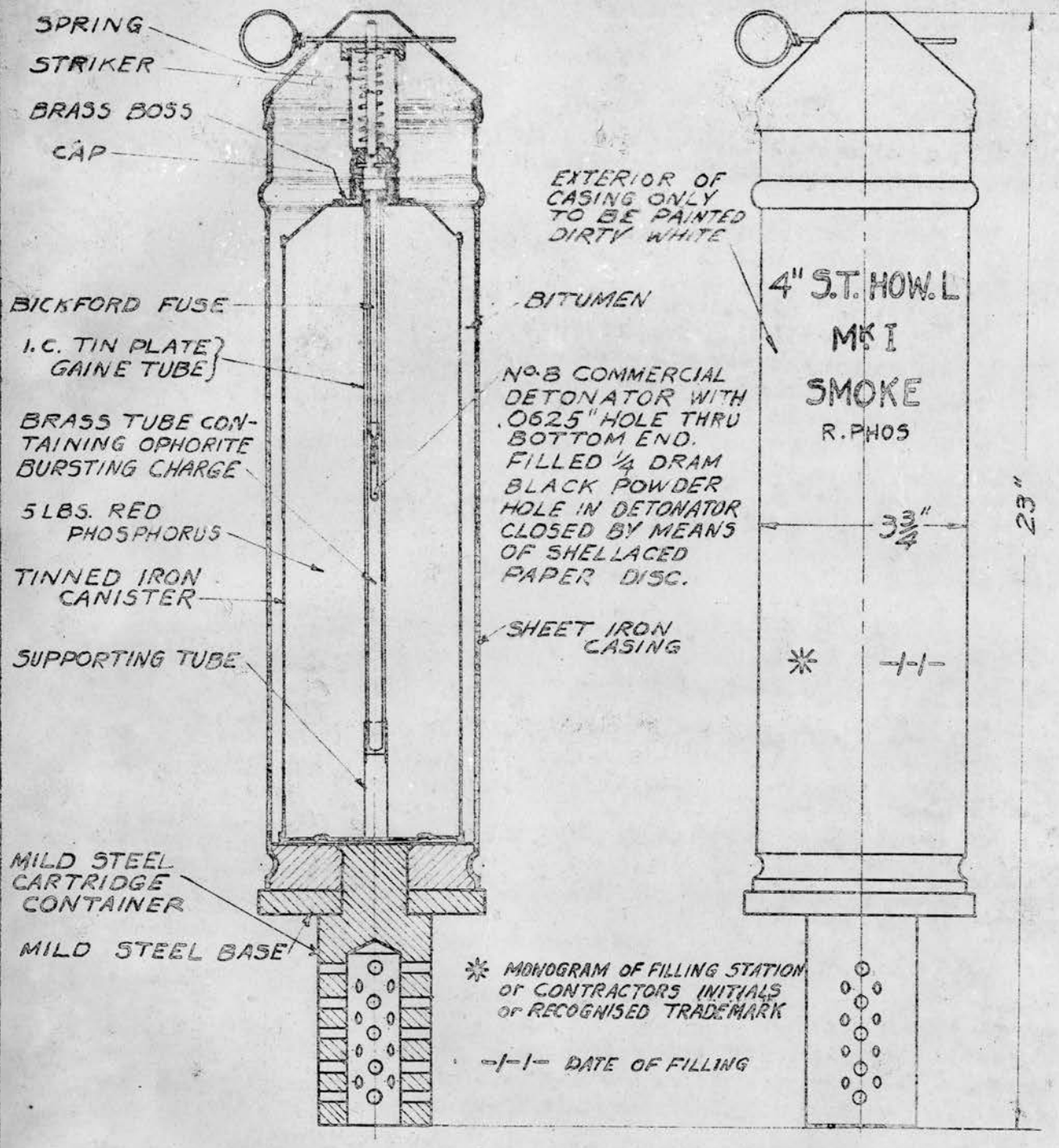
All filled bombs have a red band near the top of the body.

All bomb bodies are painted - "Dirty White".

BOX MARKINGS FOR 4" STOKES BOMBS

BRITISH MANUFACTURE

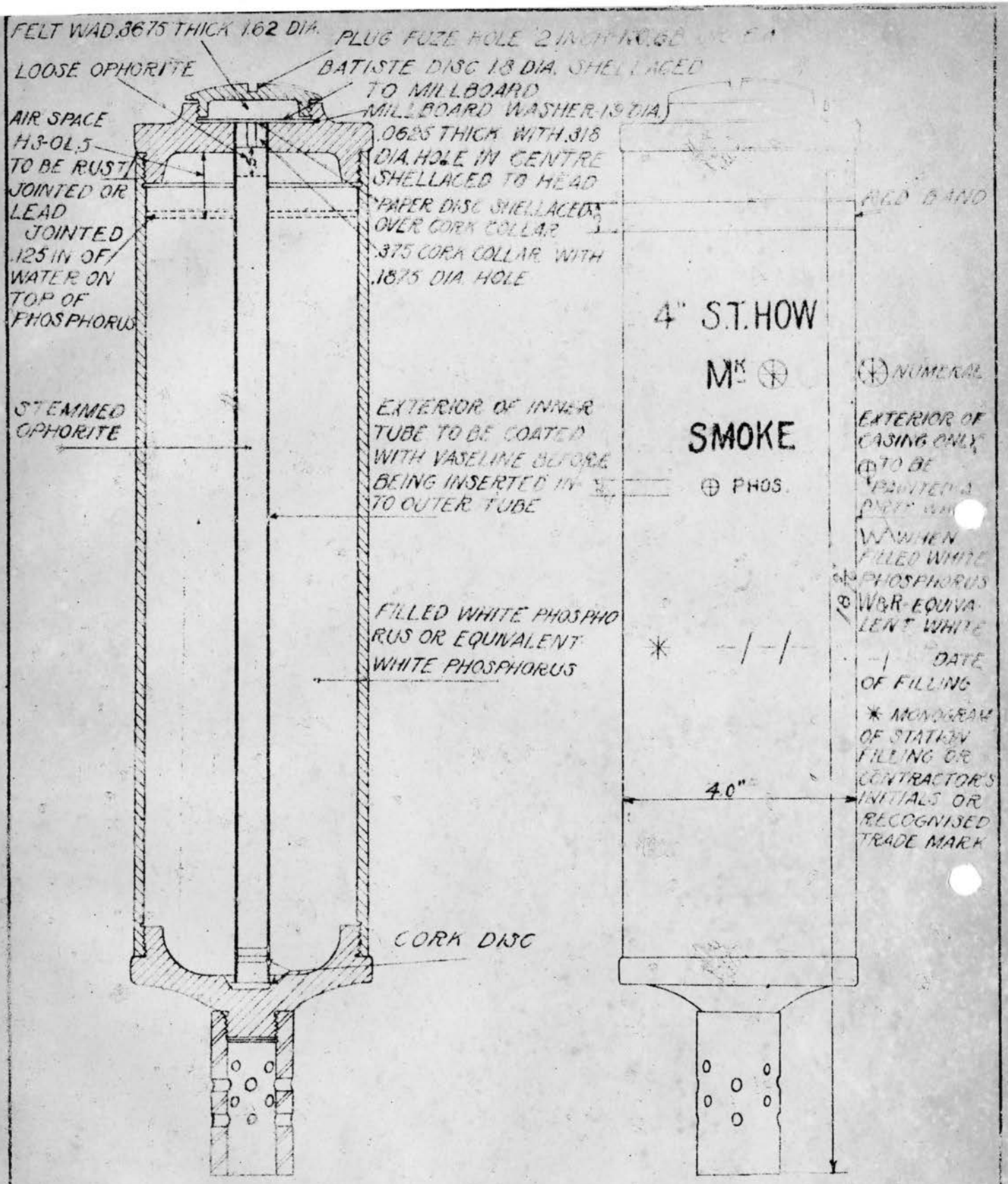
Two bombs are packed in a box, complete with charges and fuses. The boxes measure approximately 2 ft. 2 in. x 7-1/2 in. x 11-1/2 in.



BRITISH 4" STOKES LIGHT SMOKE BOMB

D.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5542

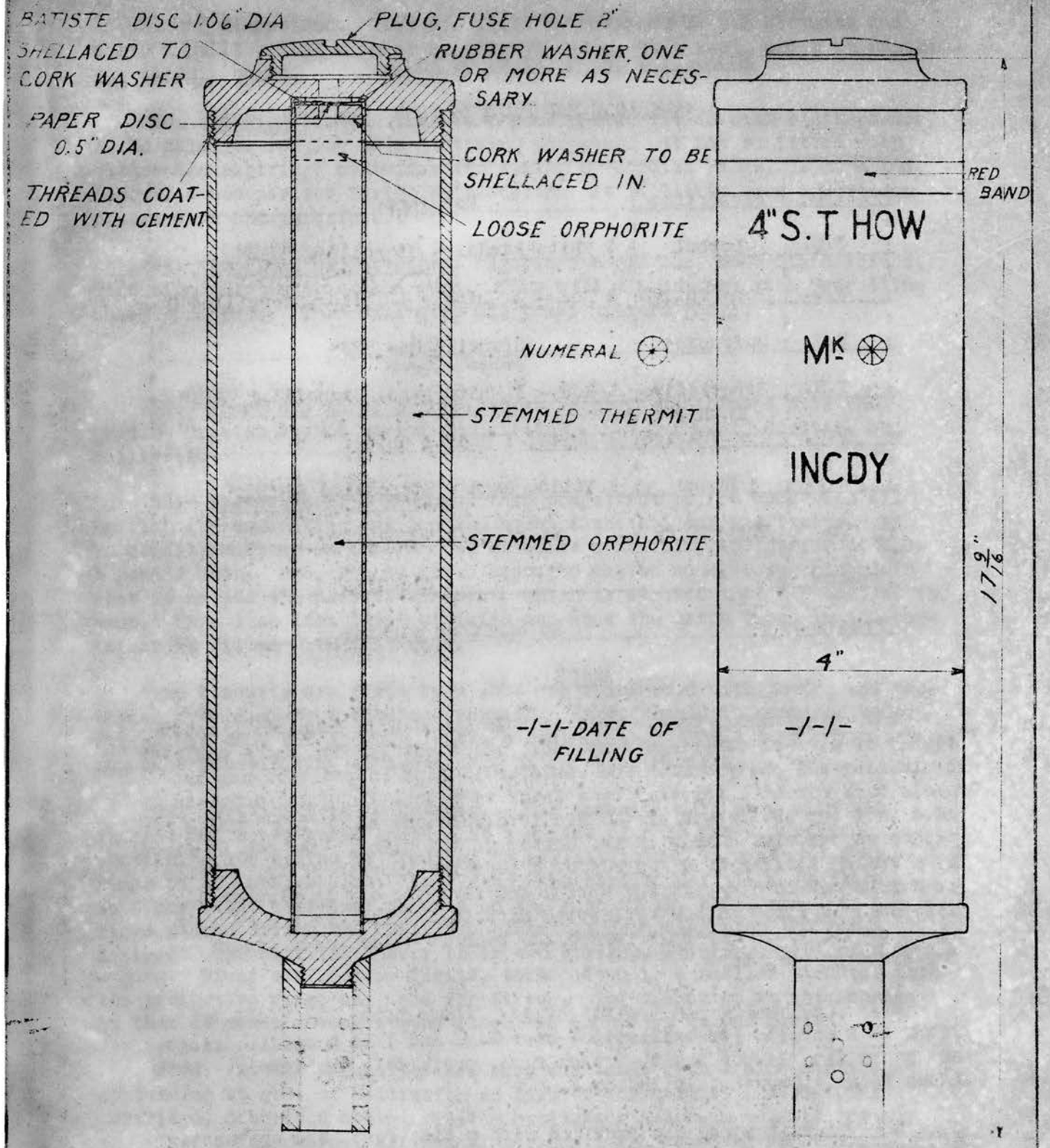


BRITISH 4" STOKES MORTAR SMOKE BOMB-MK's I.C. I.M.C. & II

STEEL OR W.I

D.E.B

OFFENSE DIVISION, ENG. SEC. C



BRITISH 4 STOKES MK I INCENDIARY BOMB MKS I.C., I.M.C. & II.

STEEL OR W.I.

DCB

OFFENSE DIVISION, ENG. SEC. C.W.S. 5554

25. PROPERTIES AND MARKINGS OF BOMBS

AMERICAN MANUFACTURE

Filling	Properties	Markings.
C.G.	Lethal	2 White Bands. - Stencilled "GAS"
N.C.	Penetrative	1 Red - 1 White - 1 Yellow. Stencilled "GAS".
K.J.	Suffocant	Stencilled - "KJ"
P.S.	Penetrative	1 Red - 1 White Band. Stencilled "GAS"
P.G.	Lethal & Penetrative	1 White, 1 Red, 1 White. " "
W.P.	Smoke	1 Yellow Band - Stencilled "SMOKE"
Th.	Incendiary	Stencilled "THERMIT"
Ranging		" "RANGING"
Practice		No bands or marking.

BOMBS.

26. Light Smoke Bomb. This is a 16 pound bomb consisting essentially of a steel cartridge container, sheet metal body, and a canister containing red phosphorus. The canister is kept in position and the whole bomb cemented together by a layer of pitch. The gaine consists of a .401 cap the length of the Bickford fuse and the primer, which explodes an ophorite charge in the bottom of the gaine. The cap is fired by a spring striker head, so adjusted that the inertia of the striker is sufficient to compress the spring and fire the cap on discharge. This bomb is fired with a ballistite cartridge which gives a maximum range of 460 yds. For this reason the bomb is seldom used except for training purposes.

27. Heavy Smoke and Thermit Bombs. These bombs are fired by means of a cordite (or ballistite) cartridge and 1 to 4 cordite rings, and carry the 31-D or the 79 Sutton fuse, preferably the former. Both bombs range approximately the same.

28. Thermit Bombs are provided with a time fuse, and on bursting scatter a shower of molten metal over an area about fifty yards in diameter. They can be used for incendiary purposes and they are also very effective when burst in the air or on the ground, against troops in shell holes and wide, shallow trenches, or against machine gun nests. In addition to the casualties which they cause by severe burns, Thermit bombs can be relied on to produce a very decided moral effect on the enemy, resulting in temporary neutralization. They should not be used against targets within a distance of about 200 yards from our own troops but they can be fired over the heads of the latter as they advance to the assualt.

29. Gas Bombs. These bombs are all very similar, differing however in

weight and dimensions. They are fired by means of E. C.3 biscuits and carry a Mills pistol head or an Allways fuse. They range under the smoke and thermit bombs.

30. Ranging Bombs. This is a bomb partly filled with black powder, to be used for ranging or registering purposes. It may be fitted with either the cartridge container for firing by cordite rings, or with the biscuit container for firing by biscuits. It is little used except for instruction and practice.

31. American Stokes Bombs. American bombs have been standardized, differing only in the gaine tube. They will all use the same propelling charge and fuse. This will give all bombs uniform range.

PROPELLANTS

32. There are three general types of propellants used with the present British Stokes Mortar Ammunition, - E.C.3 Powder, Cordite, and Ballistite.

33. British E.C. 3 Powder. This propellant is now used with all British gas ammunition and ranging bombs furnished our gas troops. It is usually made up in the form of biscuits containing 400 grains of E.C. 3 powder each. One, two or three biscuits may be used, being placed in what is called the biscuit container which is screwed onto the base of the bomb. When less than three biscuits are used the extra space in the container is filled with felt wads.

The biscuits are fired by a .303 cap reinforced with powder and protected from damp by a disc and varnish. Caps should be examined before firing. If they fit loosely in the container they should be removed and new ones substituted, as loose caps often cause misfire.

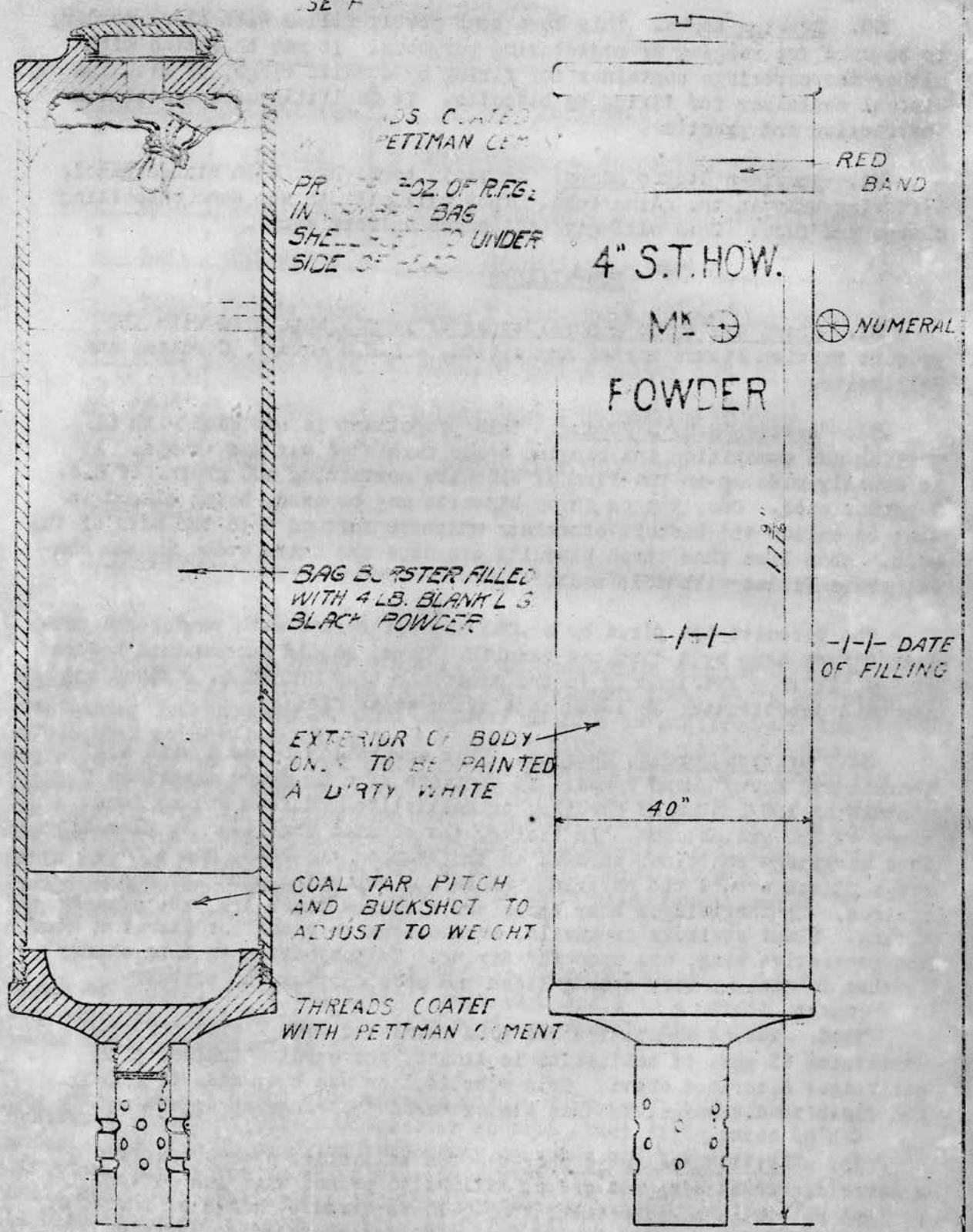
34. British Cordite Charges. This ammunition is used with all thermit and heavy smoke bombs. It consists of a 12 gauge cartridge containing 150 grains of cordite, or ballistite and from one to four rings of 350 grains each. In firing, the cordite cartridge is placed in a cartridge container screwed on the base of the bomb, and 1 to 4 rings placed around the cartridge container depending upon the range desired. The cartridges bear their own strikers which are protected by a ring. Blunt strikers or anvils, turned down to a smaller diameter than the protective ring, are used for firing. The objection to this charge is that it makes a very strong flash and soon dirties the mortar.

Note: Recent ammunition has been furnished with a blue cartridge containing 95 grs. of ballistite is lieu of the cordite (called pink cartridge) described above. This substitution has been made to reduce the flash of discharge, but has also reduced the range by approximately 10%.

35. British Ballistic Charge. The ballistite charge consists of a cartridge containing 350 grs. of Ballistite primed with gun cotton. It is used only with a light smoke bomb. It is fired by means of a striker clip and a flat anvil similar to that used for the cordite cartridge.

FUSES.

36. British Mills Pistol Head. This is used for firing all gas

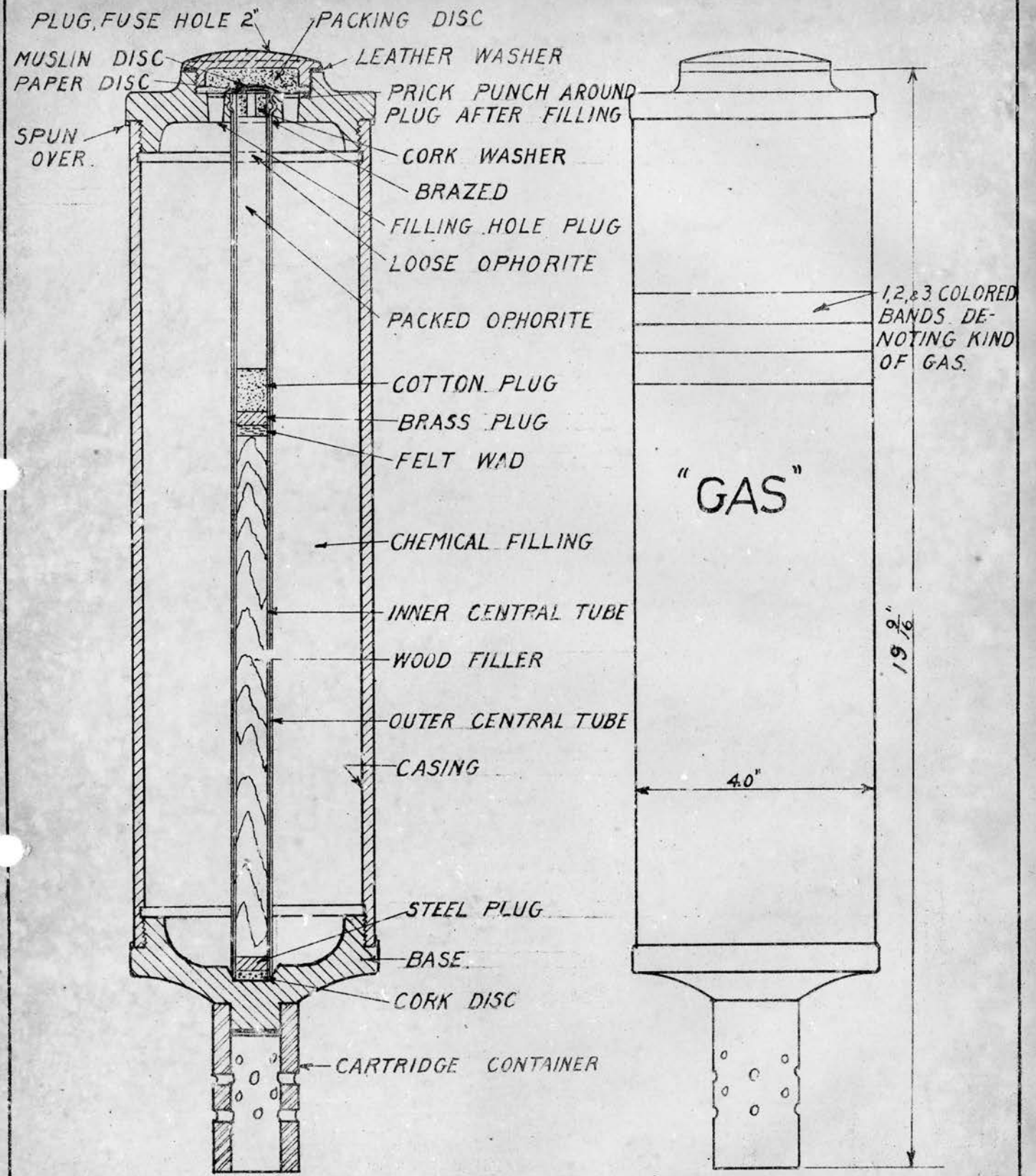


BRITISH 4" STOKES RANGING BOMB

STEEL OR WI

D.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5571

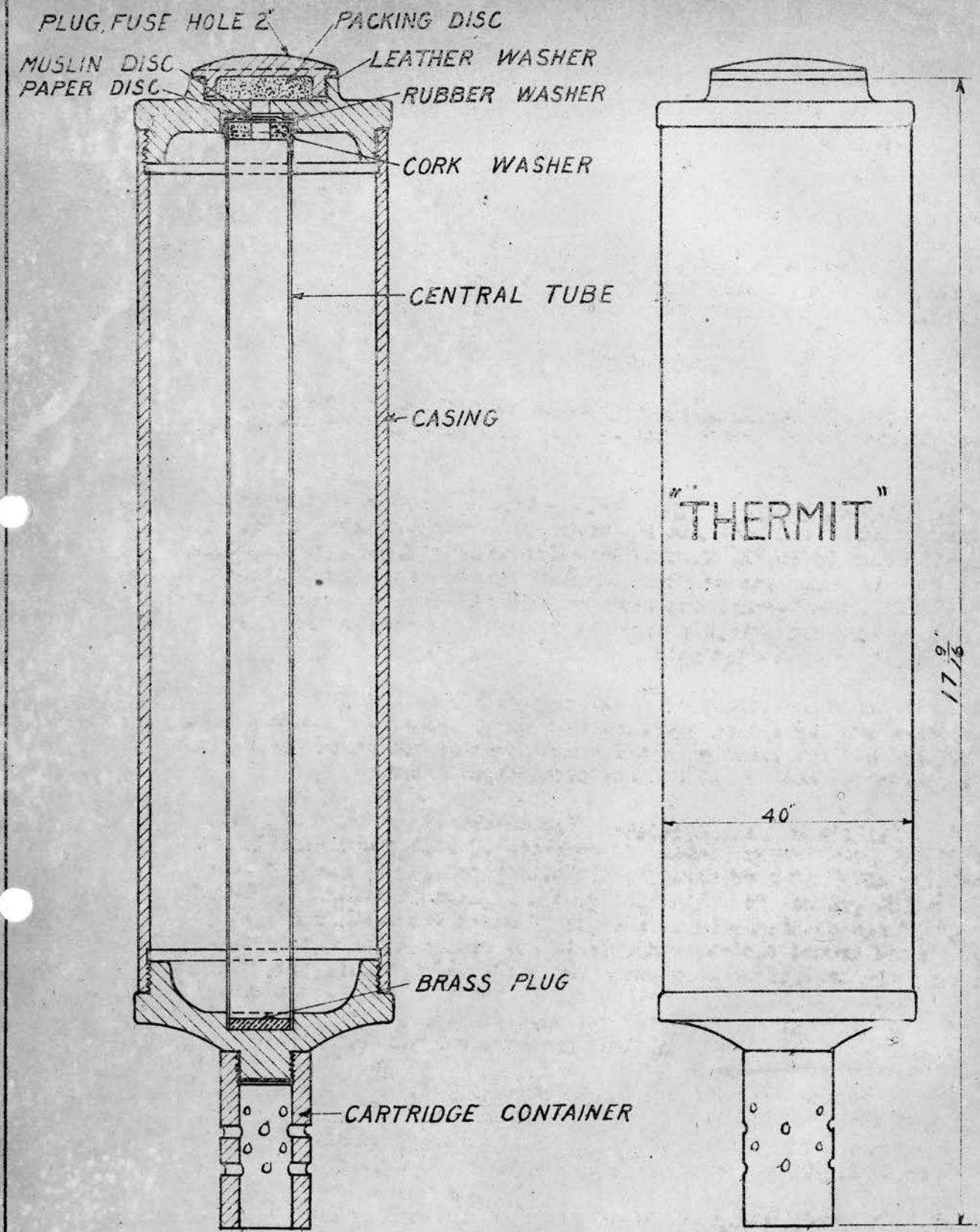


AMERICAN 4" STOKES MORTAR GAS BOMB

STEEL OR W.I.

D.E.B

OFFENSE DIVISION, ENG. SEC. C.W.S. 5570

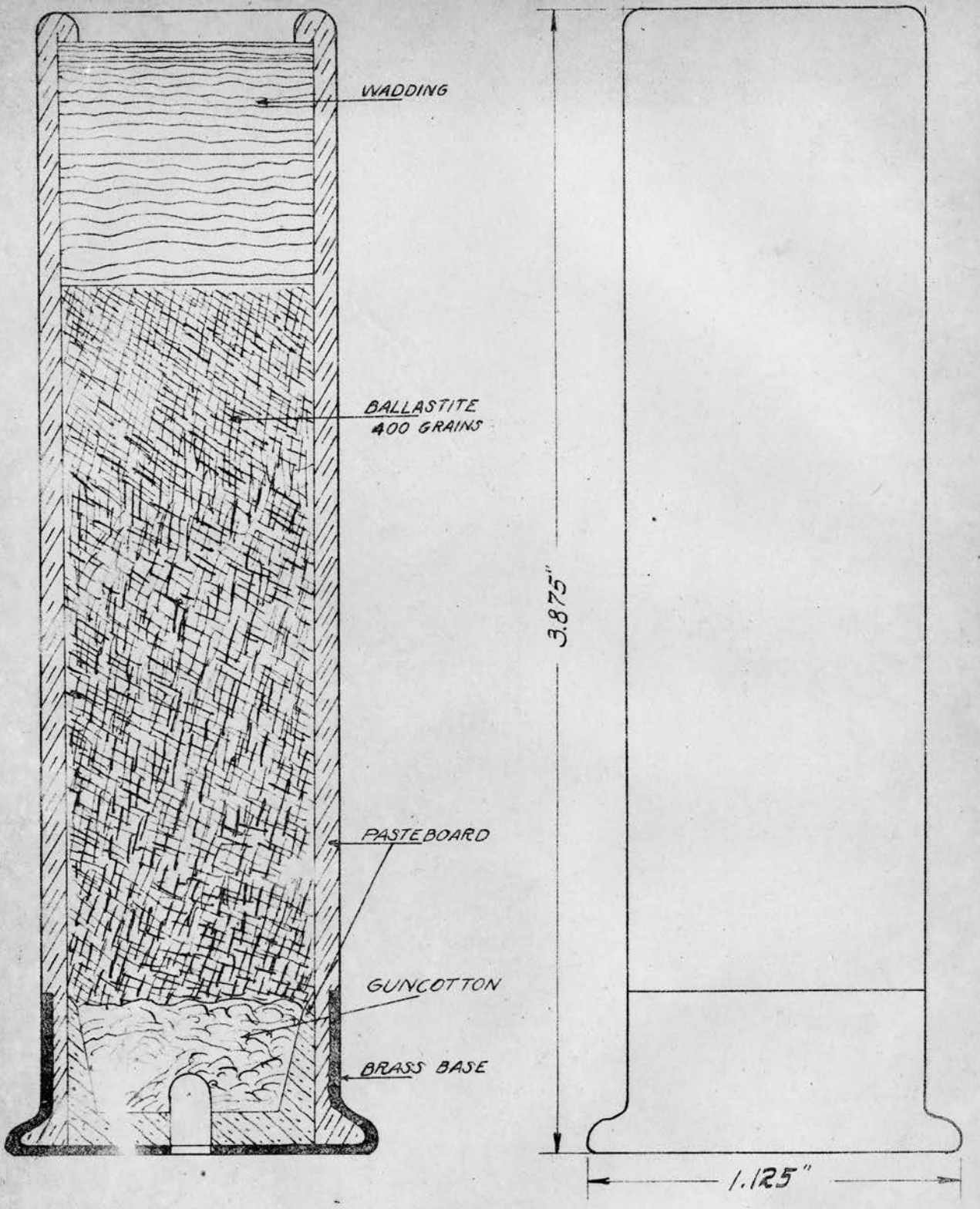


AMERICAN 4" STOKES MORTAR INCENDIARY · BOMB

STEEL OR W.I.

D.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5573



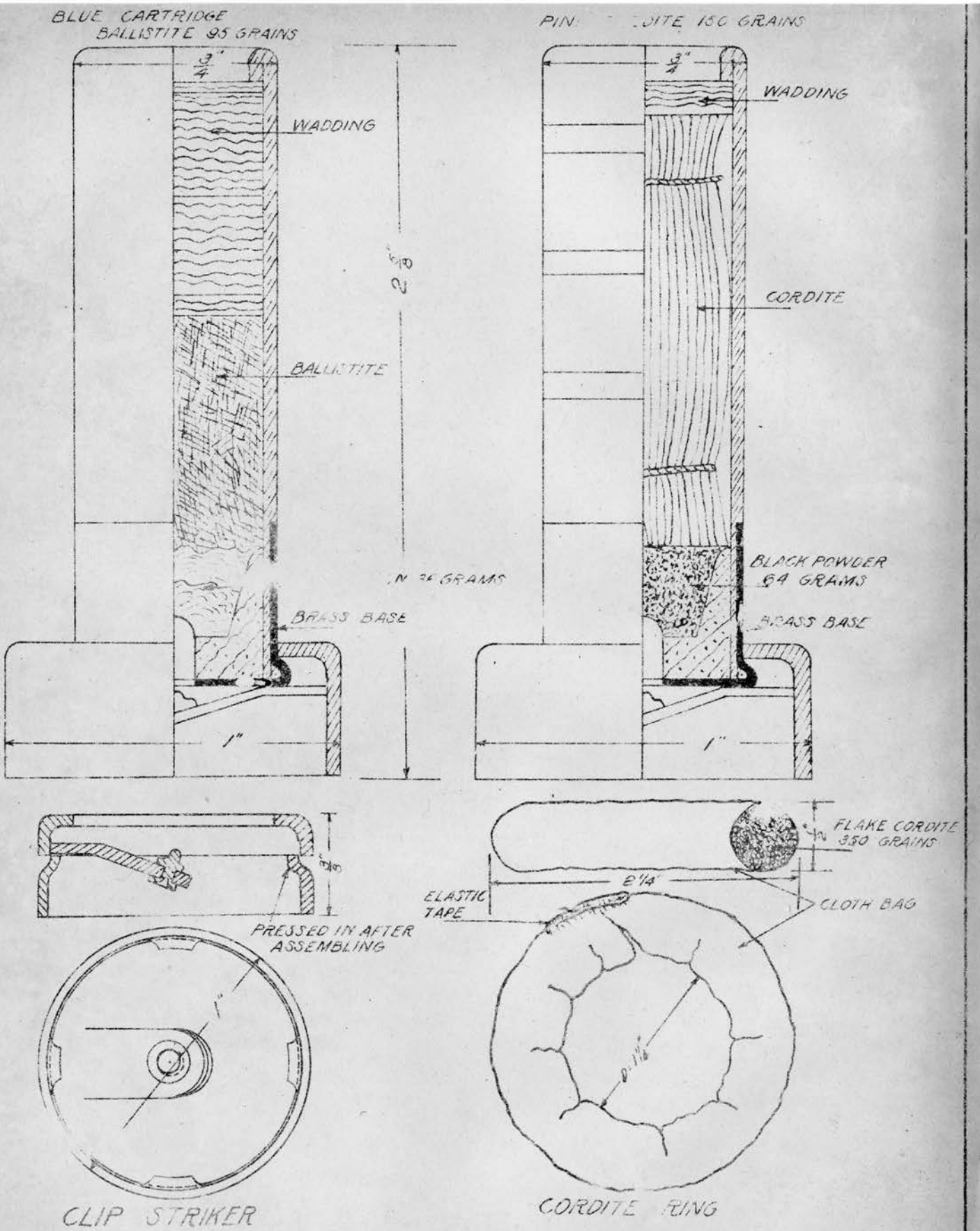
STOKES MORTAR PROPELL

(USED ONLY IN LIGHT SMOKE BOMB)

D.E.B.

OFFENSE DIVISION, E

C. C.W.S. 5548

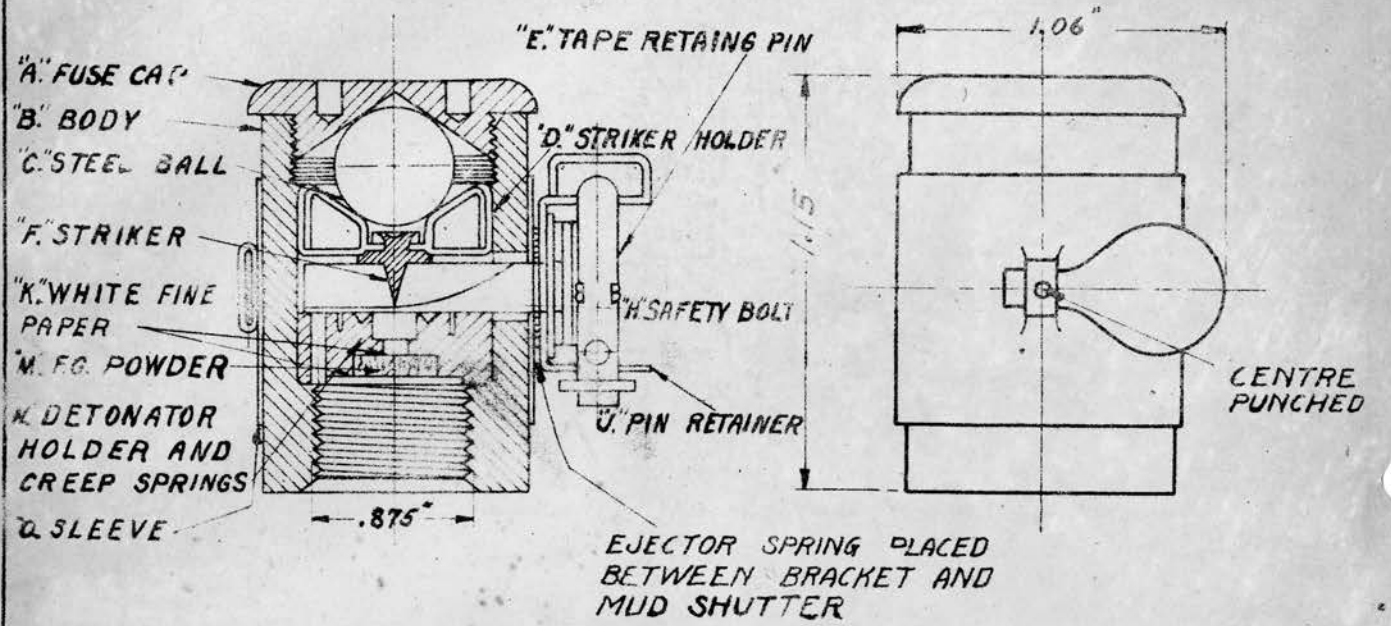


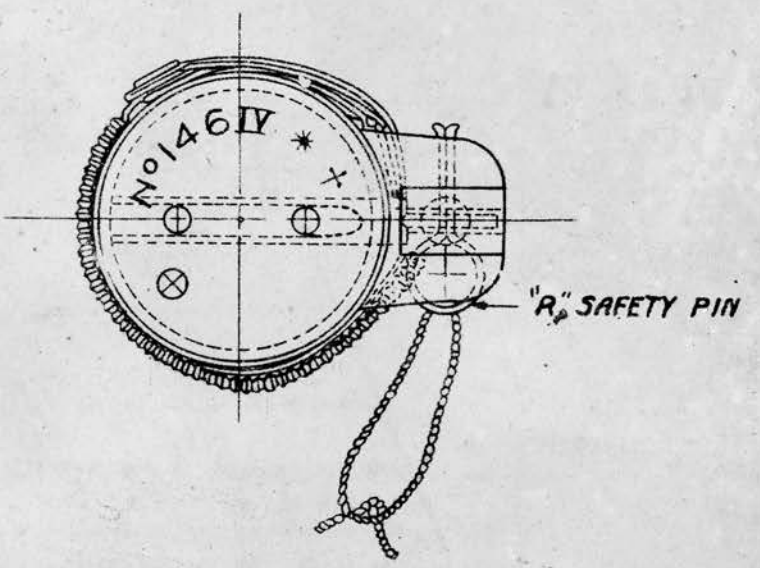
STOKES MORTAR PROPELLANTS

D.E.B.

OFFENSE DIVISION

SEC. C.W.S. 5546

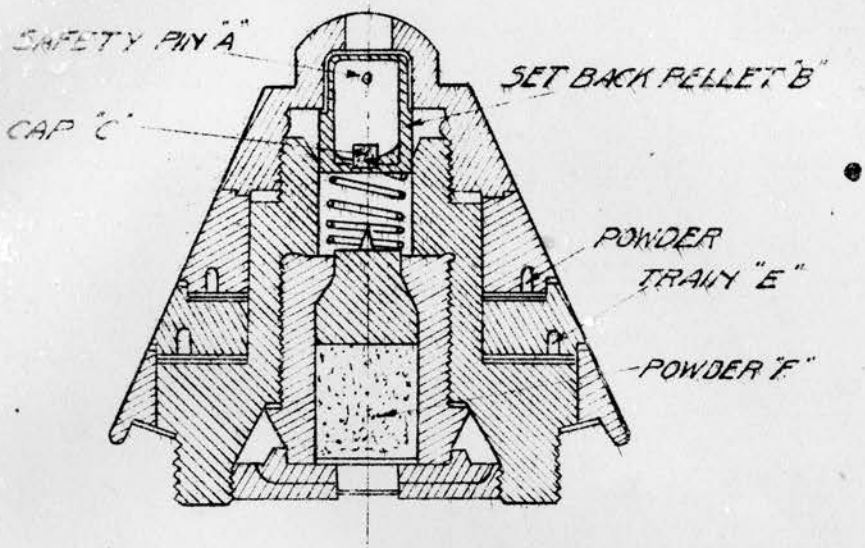


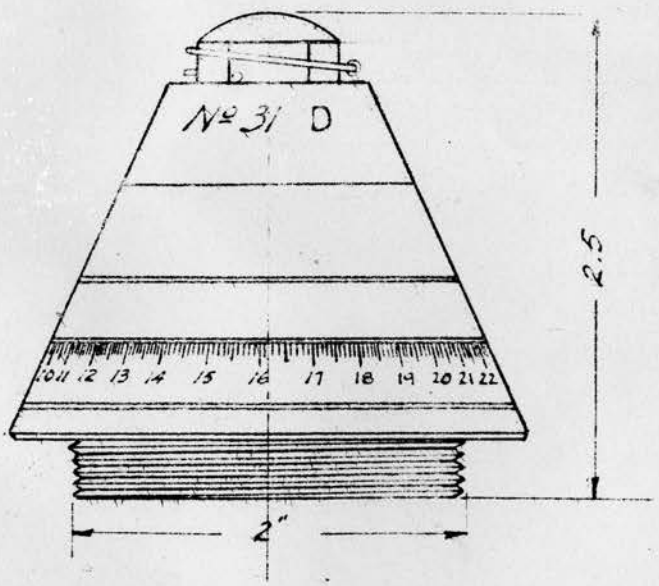


BRITISH 146 ALWAYS FUSE

D.E.B.

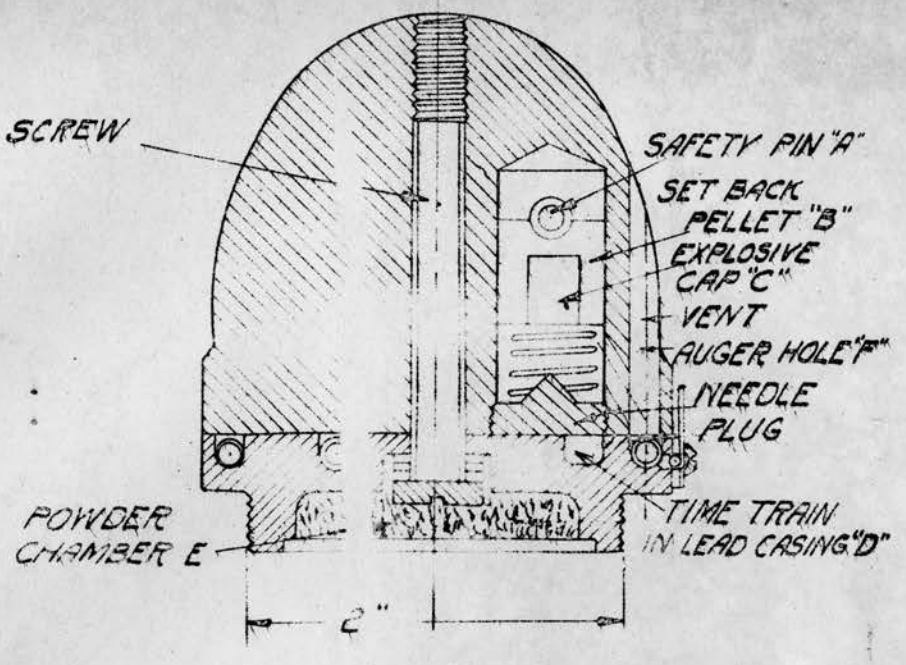
OFFENSE DIVISION, ENG. SEC. C.W.S. 5543

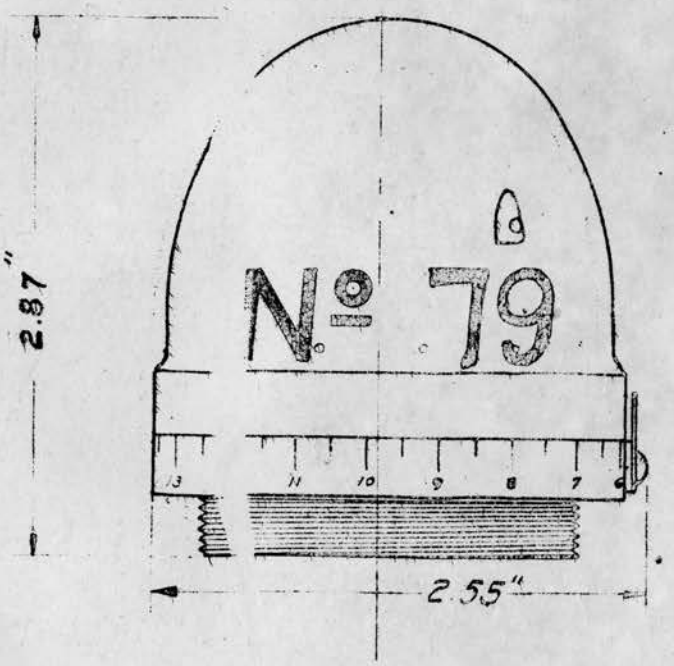




FUSE 31-D FOR STOKES MORTAR BOMB

OFFENSE DIVISION, ENG. SEC. CWS

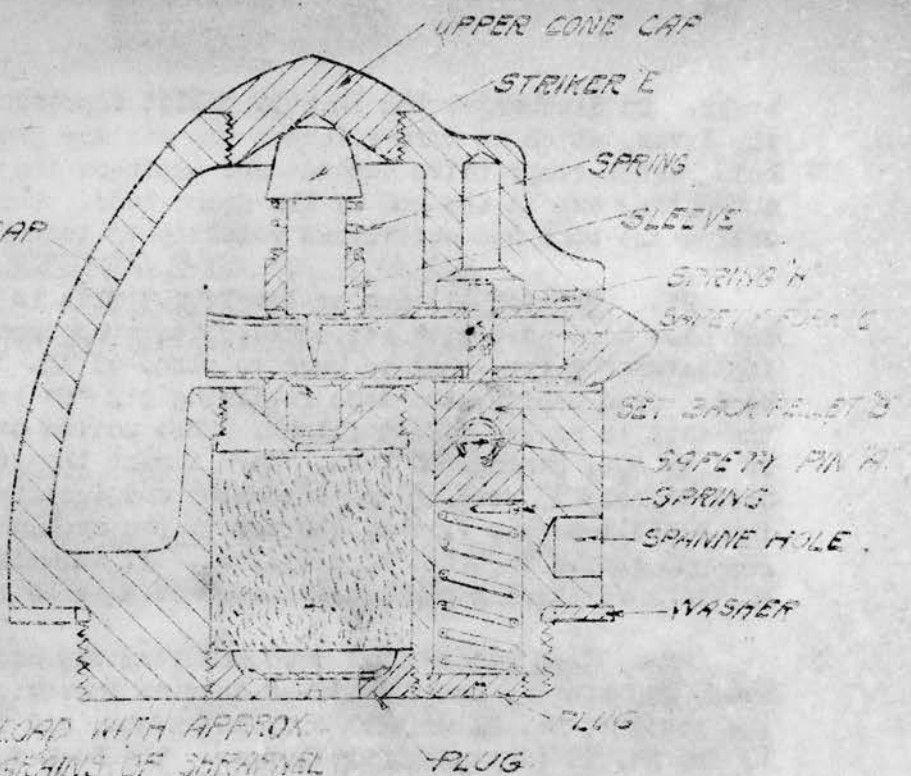




BRITISH TYPE
TIME FUSE No. 79 MARK II/L

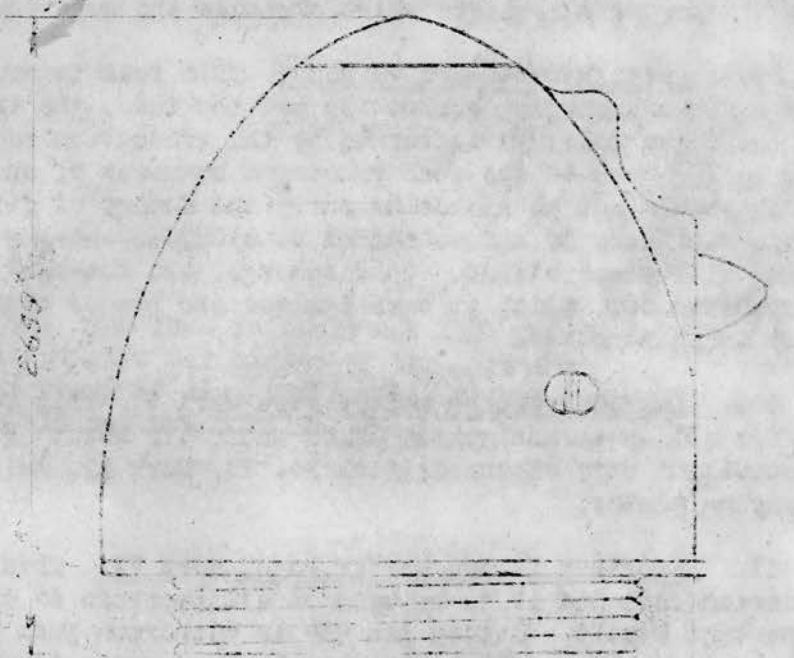
D.F.B

OFFENSE DIVISION, ENG. SEC. CWS 5545



'G' LOAD WITH APPROX
130 GRAINS OF SHRAPNEL
POWDER

PLUG



U.S. Type
Trench Mortar Fuse Mark XI

bombs. On discharge, the inertia pellet depresses its spring, releasing the lever, which in turn releases the striker pin. The striker spring being under compression expands and impinges the striker pin against the detonating cap in the end of the gaine tube. This fuse does not operate unless the bomb has sufficient velocity to travel 100 yards.

37. British Allways or 146 Fuse. This is a percussion fuse which has also been used with gas bombs, but is now practically obsolete. An instantaneous fuse must be used in place of the ordinary time fuse in the bomb. Upon firing, the tape retaining pin "E" is dislodged, allowing the tape to unwind during flight. This action causes the safety bolt "B" to drop out, arming the fuse. Upon impact the steel ball forces down the striker holder, forcing the detonator and igniting the instantaneous fuse. Immediately before firing, the safety pin arm must be withdrawn. On no account should the tape be disturbed. If on withdrawing the safety pin, the tape retaining pin is released, it must be replaced before firing.

38. 31-D Fuse. This fuse was formerly used on all thermit heavy smoke and ranging bombs. It was only an improvised fuse, made by modifying the obsolete No. 31 British artillery fuse, and it is now being supplanted by the No. 79 (Sutton) Mark II fuse. The 30-D fuse consists of two powder trains, set by means of a time scale. On discharge, the set-back pellet "B" fires the cap "C" which ignites the powder train. This in turn ignites the powder charge "E" which explodes the bursting charge in the bomb.

39. British Sutton or 79 Fuse. This fuse is now used on all thermit, heavy smoke and ranging bombs. To set the fuse, the indicator mark in line with the auger hole "F" is turned to the graduation required, and the time train in the base of the fuse punctured by means of an auger. The safety pin "A" should not be withdrawn until the moment of firing. This should be done with care as a fuse cannot be clamped, and any alteration in the setting will cause blinds. On discharge, the set-back pellet "B" fires an explosive cap, which in turn ignites the powder train "D", and thence the powder in chamber "E".

40. American Trench Mortar Fuse Mark V. This fuse is a simple time fuse for all 4" trench mortar bombs where air burst are desired. It is essentially a copy of the British No. 79, Mark II, which is shown in accompanying plates.

41. American Trench Mortar Fuse, Mark XI. This is an "Allways" percussion fuse and is to be used on all American 4" trench mortar bombs for contact bursts. Safety pin "A" is withdrawn just before firing. On shock of discharge, pellet "B" sets back allowing the safety fork "G" to fly out, thus arming the fuse. On impact, striker "E" fires the cap "F", igniting the powder charge "G" and thus exploding the bursting charge in bomb.

42.

RANGE TABLE FOR 4-IN. STOKES MORTAR

-LIGHT SMOKE-

Cartridges, 350 grs. primed with guncotton

Elevation Degrees	Range Yards	Range Metres
45	465	425
50	450	412
55	420	384
60	395	362
65	375	344
70	300	275
75	240	220

NOTE: The fuse is short and will nearly always give air bursts if the mortar is set above 60 deg. Preferably the elevation should not be above 55 degs.

RANGE TABLE FOR 4 INCH STOKES HOWITZER USING BISCUIT CONTAINERS ONLY.
CHARGE E.C.3 & E.C.5.

PROJECTILE WEIGHT 25 LBS ALSO SUITABLE FOR PROJECTILES WEIGHT 25 LBS 11½ OZ.
TABLE CORRECT FOR 5 M.P.H. FOLLOWING WIND. ½ V. OF WIND M.P.H. TIME OF FLIGHT RANGE. USE AS WORKING OF WIND DIFFERS BETWEEN ACTUAL WIND AND 5 M.P.H. FOLLOWING WIND.

CHARGE 800 GRS.
CHARGE 1200 GRS.
CHARGE 400 GRS.

80°
75°
70°
65°
60°
55°
50°
45°

DEGREES IN ELEVATION

0 5 10 15 20

TIME OF FLIGHT IN SECONDS.

100 200 300 400 500 600 700 800 900 1000 1100 1200

RANGE IN YARDS

#10,241

STOKES RANGE TABLE FOR GAS
E. C. 3 and E. C. 5. BISCUIT

Range		1 Biscuit.		2 Biscuits.		3 Biscuits.	
Yds.	Mtrs.	Time of flight.	Elev.	Time of Flight.	Elev.	Time of Flight.	Elev.
200	183	12.1	74				
240	220	11.8	70½				
280	256	11.5	66¼				
320	293	11.1	61½	16.8	75½		
360	329	10.4	55½	16.6	73½		
380	348	8.9	45				
400	366			16.4	71½		
440	403			16.2	69¼	19.6	74¼
480	439			15.9	67	19.5	72¾
520	476			15.6	64¼	19.3	71
560	512			15.2	62½	19.1	69¼
600	549			14.7	58	18.9	67½
640	585			13.8	53	18.6	65½
660	604			12.2	45	18.5	64½
680	622					18.2	63¼
720	659					17.8	60¾
760	695					17.3	58
800	732					16.6	54½
840	768					14.5	45

Deflection Table

TURNS	1	2	3	4	5	6	7	8	9	10
(500	3	6	9	12	14	17	20	23	26	29
(750	4	9	13	17	22	26	30	35	39	44
(1000	6	12	17	23	29	35	41	47	52	58

Deflection same unit as Range.

RANGE TABLE FOR 4 INCH STOKES MORTAR

1-RING
2 RINGS
3 RINGS
4 RINGS
(CHARGES)
0-RING

CARTRIDGE 95 GRS. BALLISTITE, REINFORCED WITH 5 GRS. G.C. YARN
RINGS, 350 GRS. 4 MM. FLAKE CORDITE
PROJECTILE — BOMB WEIGHED 25 LBS.
BASED ON PRACTICE OF 16.1.18. MINUTE M1413
PROOF 1 — G.R.T. 18/21 12 5/18 H.&S. 5806 WE

ELEVATION IN DEGREES

80
75°
70°
65°
60°
55°
50°
45°

0
5
10
15
20

TIME OF FLIGHT IN SECONDS

100 200 300 400 500 600 700 800 900 1000 1100 1200

RANGE IN YARDS

#10,239

STOKES RANGE TABLE
for
HEAVY SMOKE & THERMIT
PINK CARTRIDGE

Charge-150 Grains Cordite M.D., size 2 1/4. (Primed 10-12 P.)., Rings, 350 Grains 4 m.m. Flake Cordite.
Projectile: - Black Bomb, Weight 24 3/4 lb.

Range Yards	Range Meter	Elevation Degs.	Time of flight Secs.	Elevation Degs.	Time of flight Secs.	Elevation Degs.	Time of flight Secs.	Elevation Degs.	Time of flight Secs.
		1 Ring		2 Rings		3 Rings		4 Rings	
200	183	75	13.1						
220	201	73½	13.0						
240	220	72	12.9						
260	238	70½	12.8						
280	256	69¾	12.7						
300	280	67	12.6						
320	293	65½	12.4						
340	311	63¼	12.2	75½	17.4				
360	329	61	12.0	74¼	17.4				
380	348	58¾	11.8	73¼	17.3				
400	366	56	11.4	72½	17.3				
420	385	52¼	10.9	71½	17.2				
440	403	45	9.8	70½	17.1				
460	421			69¾	17.0				
480	439			68¾	16.9	75	20.5		
500	458			67¾	16.8	74¼	20.5		
520	476			66¾	16.7	73¾	20.4		
540	494			65¾	16.5	73	20.3		
560	512			64½	16.4	72¼	20.3		
580	531			63¼	16.2	71½	20.2	75	22.7
600	549			62	16.1	71	20.1	74½	22.6
620	567			60¾	15.9	70¼	20.0	73¾	22.6
640	585			59½	15.6	69½	19.9	73½	22.5
6060	604			57¾	15.4	68¾	19.8	72¾	22.4
680	622			56	15.2	67¾	19.7	72	22.3
700	641			54½	14.8	67	19.6	71½	22.3
720	659			52	14.4	66¼	19.5	70¾	22.2
740	677			48½	13.7	65½	19.4	70¼	22.1
760	695					64½	19.2	69½	22.0
780	714					63½	19.1	69	21.9
800	732					62½	18.9	68¼	21.8
820	750					61½	18.7	67½	21.7
840	768					60½	18.6	66¾	21.6
860	787					59½	18.4	66	21.5
880	805					58¼	18.1	65½	21.4
900	824					57	17.9	64½	21.2
920	842					55½	17.6	63¾	21.1
940	860					53¾	17.2	63	20.9
960	877					51¾	16.8	62	20.7
980	896					48¾	16.1	61	20.5
1000	915					45	15.0	60¼	20.4
1020	933							59¼	20.2
1040	951							58¼	20.0
1060	969							57	19.7
1080	988							55¾	19.4
1100	1006							54¼	19.0
1120	1025							52½	18.6
1140	1044							50½	18.0
1160	1061							45	16.6

Note: - The gas bomb wgt. 25 lb. ranges short of the above by approximately 6 per cent of the range.

STOKES RANGE TABLE
for
HEAVY SMOKE AND THERMIT
BLUE CARTRIDGE

Charge:- 95 grs. Ballistite, reinforced with 5 grs. C.C. Yarn.
Rings:- 350 grs. 4 mm. Flake Cordite.
Projectile:- Bomb, weight 25 lbs.

RANGE		Cartridge + 1 Ring.		Cartridge + 2 Rings		Cartridge + 3 Rings		Cartridge + 4 Rings	
		Elevation.	Time of Flight	Elevation.	Time of Flight	Elevation.	Time of Flight	Elevation.	Time of Flight
Yards.	Meters.	Degs.	Secs.	Degs.	Secs.	Degs.	Secs.	Degs.	Secs.
100	92	81½	11.2						
150	139	77	11.0						
200	183	72	10.7						
250	229	66¼	10.3	78½	15.4				
300	275	59	9.7	76	15.2				
350	320	45	8.0	....	....				
350	329			73½	15.0	77¾	18.3		
400	366			70½	14.8	76	18.2		
450	412			67¾	14.5	74	18.1	77.	20.0
500	458			64½	14.2	72	17.9	75¼	19.9
550	504			60¼	13.6	69¾	17.7	73¾	19.8
600	549			55¼	12.9	67½	17.4	72	19.6
640	585			45	11.1	---	....	...	....
650	594					65	17.0	70¼	19.4
700	640			?		62¼	16.6	63¼	19.2
750	686					59	16.1	66¼	18.9
800	732					55	15.4	64¼	18.6
850	777					45	13.3	61¾	18.2
900	824							59	17.7
950	868							55¾	17.1
1000	915							50¾	15.9
1020	933							45	14.6

50 per cent. Probability Zones.

Elevation.	Cartridge + 1 Ring.		Cartridge + 2 Rings.		Cartridge + 3 Rings		Cartridge + 4 Rings.	
	Length	Broadth	Length	Broadth	Length	Broadth	Length	Broadth
Degrees	Yds.	Yds.	Yds.	Yds.	Yds.	Yds.	Yds.	Yds.
45	34	5	20	8	49	20	49	22
60	24	5	51	29	66	17	24	30
75	5	2	30	17	17	10	44	42

LIVENS MATERIAL

THE PROJECTOR

46. The Livens Proejctor is a very simple form of mortar which projects quantities of gas, incendiary, or high explosive substances, by means of cylindrical drums rounded at both ends. This projector is a smooth-bore steel tube closed and rounded at one end and open at the other, having an internal diameter of 8". Projectors are made in various lengths.

47. British Projectors. The several types of Livens Projectors are as follows:

Mark #1.	Length	2'9"
	Thickness	11/32"
	Weight	105#
	Material	Solid drawn steel.
Mark #3.	Length	2'6"
	Thickness	1/4"
	Weight	65#
	Material	Lap welded mild steel.
Mark #9.	Length	4'6"
	Thickness	3/8"
	Weight	150#
	Material	Solid drawn steel.

48. American Projectors. - The American projectors are copied from the British. They were made in two sizes, Mark I (barrel length 2'9", weight approximately 100 lbs.), and Mark II (barrel length 4', weight 150 lbs.). All projectors have an internal diameter of 8". A wire wrapped Livens Projector is being designed in Mark I and Mark II lengths. The wire wrapping of projectors gives greater strength for equal weight and thus allows for a greater chamber pressure; hence, a larger propellant charge may be used, thereby insuring greater range. Increased portability can also be obtained without decrease of range.

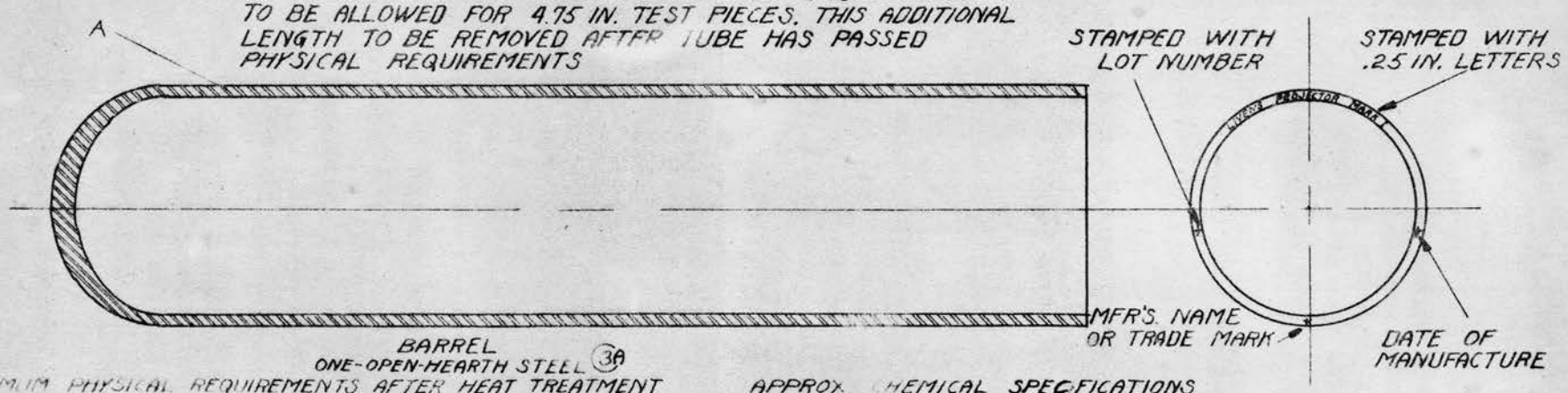
49. Base Plates. The Livens Projector Base Plate is of pressed steel about 1/4" thick and 18" in diameter. It weighs about 30 pounds. It is used as a backing to prevent the projector from burying itself in the ground on recoil. There is also a 12" base plate, the only difference being that the crimped edges are flattened instead of slanting as in the 18". Sketches of both types are shown on page .

DRUMS

50. The Livens Drums are of three classes, GAS, INCENDIARY, and HIGH EXPLOSIVE. All drums are made of mild steel pipe with ends nosed or spun in. They are 21" in length and have an outside diameter of 7-11/16". There is a central tube running the length of the drum welded in to the drum at both ends.

In the latest American drawings of the Gas Drum the internal diameter of this tube is slightly more than 1". These drums are filled through holes bored in this tube about 2" from the end opposite the fuse socket. Below these filling holes the central tube is sealed by a steel plug welded in place. After filling, the drum is sealed by screwing a taper plug in

NOTE - SUFFICIENT ADDITIONAL LENGTH ON OPEN END OF TUBE TO BE ALLOWED FOR 4.75 IN. TEST PIECES. THIS ADDITIONAL LENGTH TO BE REMOVED AFTER TUBE HAS PASSED PHYSICAL REQUIREMENTS



BARREL
ONE-OPEN-HEARTH STEEL (3A)

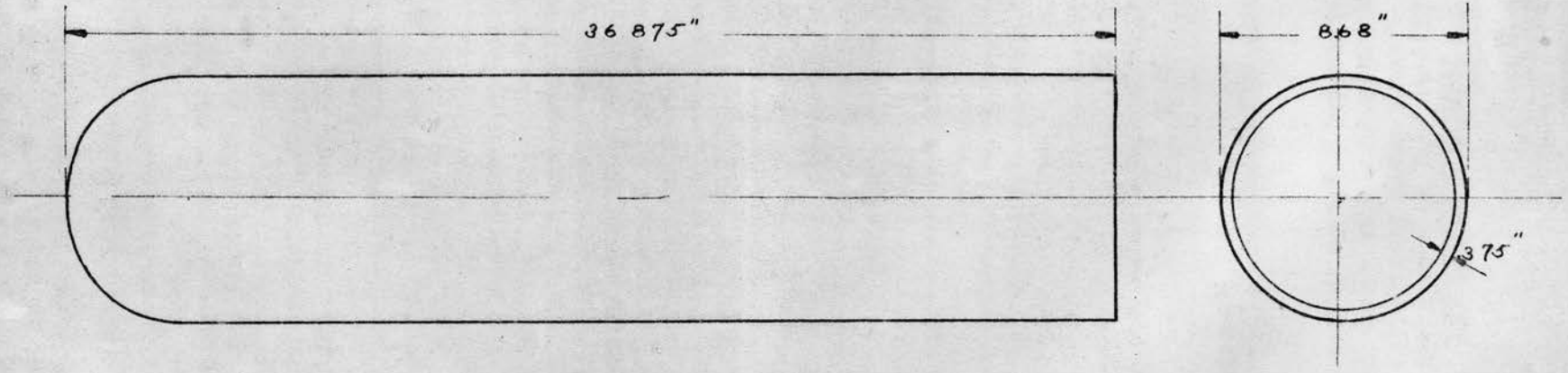
MINIMUM PHYSICAL REQUIREMENTS AFTER HEAT TREATMENT
LONGITUDINAL SPECIMENS

ELASTIC LIMIT	43000 LBS. PER SQ. IN.
ULTIMATE STRENGTH	85000 " " " "
ELONGATION IN 2 INCHES	18%
REDUCTION IN AREA	30%

APPROX. CHEMICAL SPECIFICATIONS

CARBON	.40% - .55%
MANGANESE	.50% - .80%
SILICON	.12% - .25%

SULPHUR - MUST NOT BE OVER .05%
PHOSPHORUS - MUST NOT BE OVER .05%

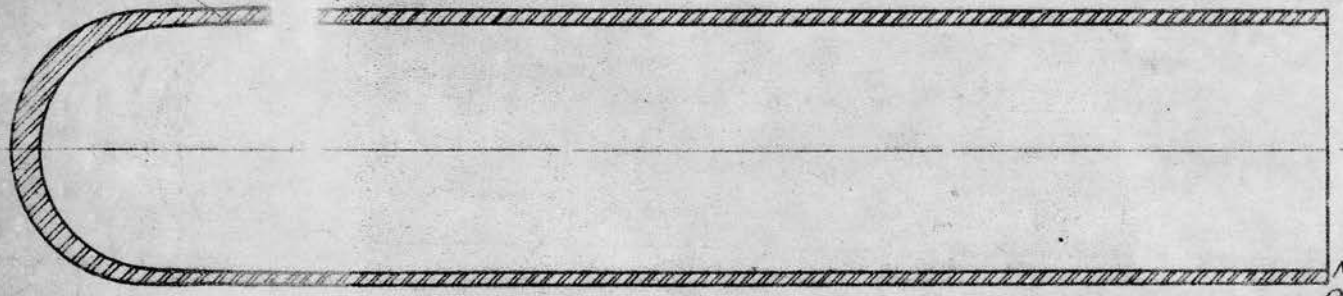


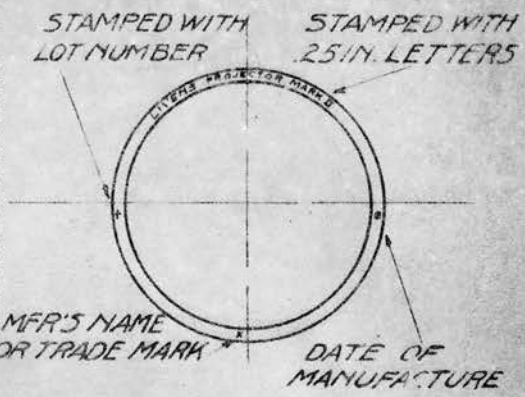
LIVENS PROJECTOR BARREL - MARK I

OFFENSE DIVISION, ENG. SEC. C.W.S. 5550

DEP

A ... SUFFICIENT ADDITIONAL LENGTH ON OPEN END OF TUBE ... BE ALLOWED FOR 4.75 IN. TEST PIECES. THIS ADDITIONAL ... NGTH TO BE REMOVED AFTER TUBE HAS PASSED PHYSICAL ... QUIREMENTS.





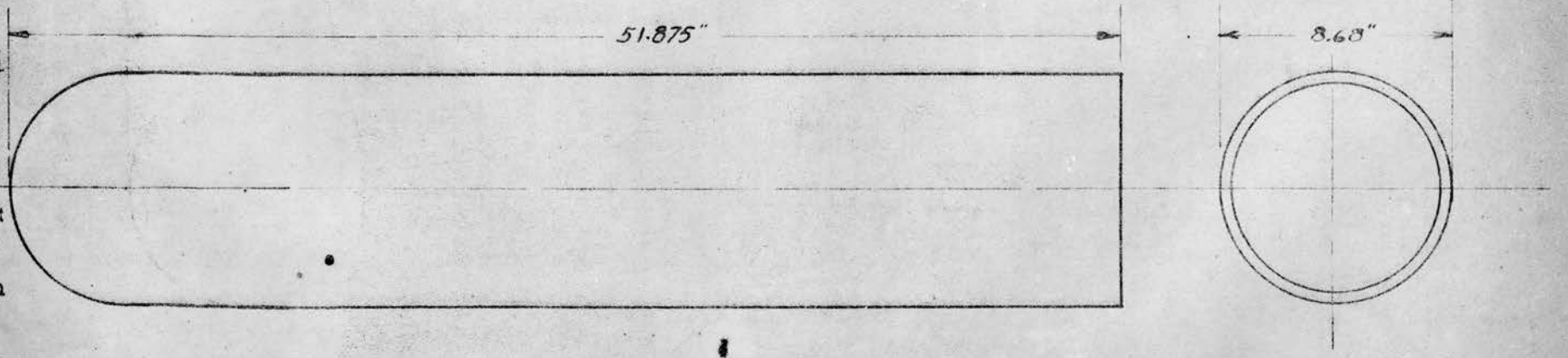
BARREL
ONE-OPEN-HEARTH STEEL

MINIMUM PHYSICAL REQUIREMENTS AFTER HEAT TREATMENT.

LONGITUDINAL SPECIMENS	
ELASTIC LIMIT	43000 LBS. PER. SQ. IN.
ULTIMATE STRENGTH	85000 LBS. PER. SQ. IN.
ELONGATION IN 2 INCHES	18 %
REDUCTION IN AREA	30%

APPROX. CHEMICAL SPECIFICATIONS.

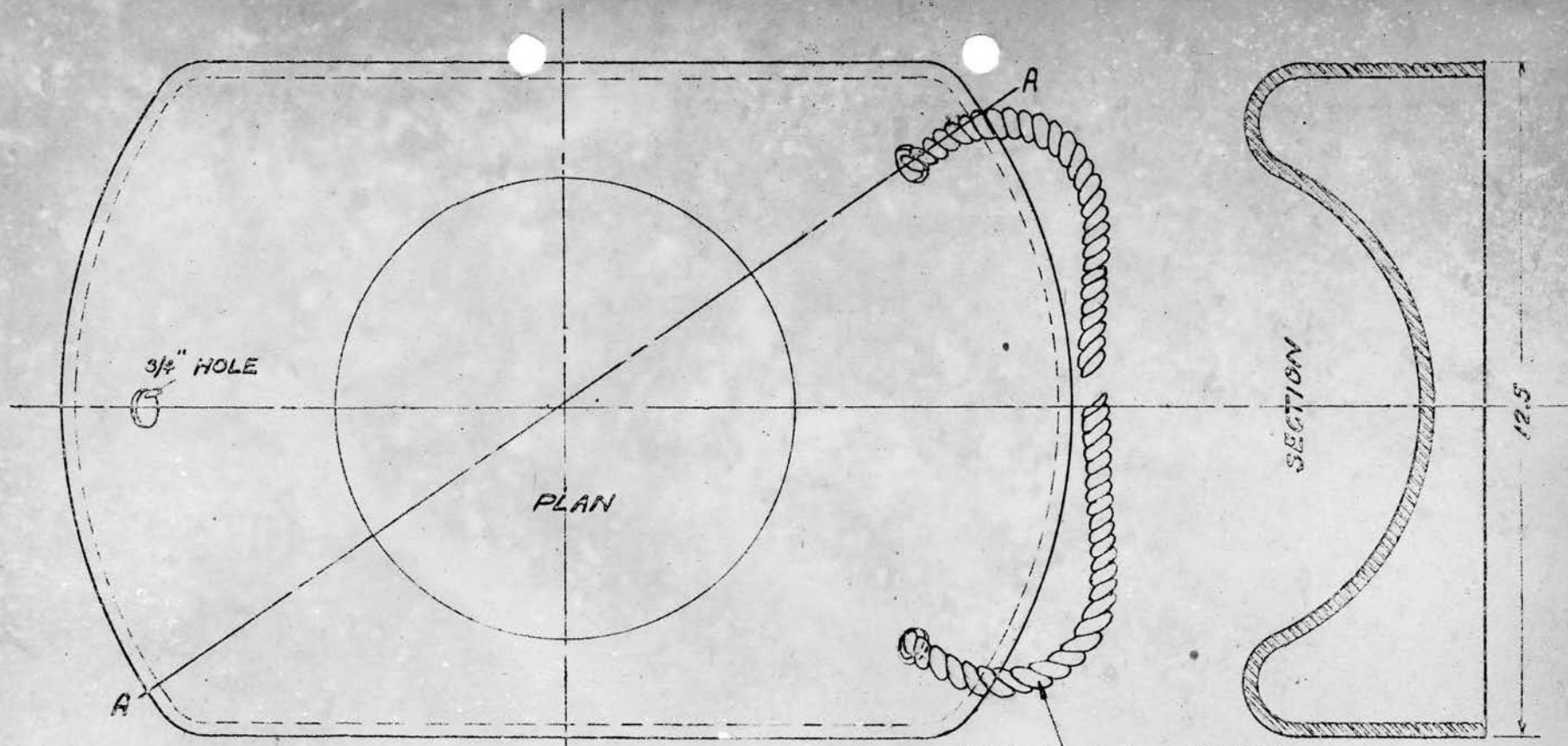
CARBON	.40% – .55%
MANGANESE	.50% – .80%
SILICON	.12% – .25%
SULPHUR – MUST NOT BE OVER .05%	
PHOSPHORUS – MUST NOT BE OVER .05%	



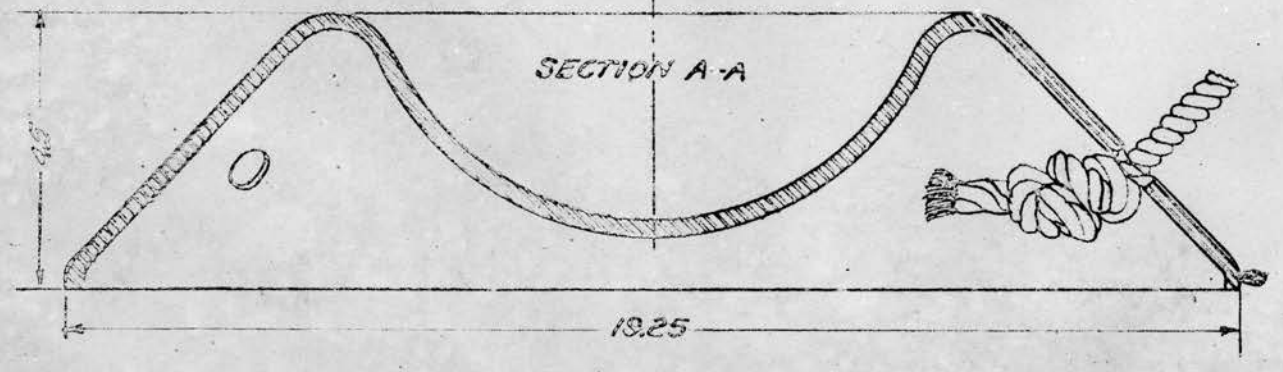
LIVENS PROJECTOR BARREL – MARK II

O.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5551



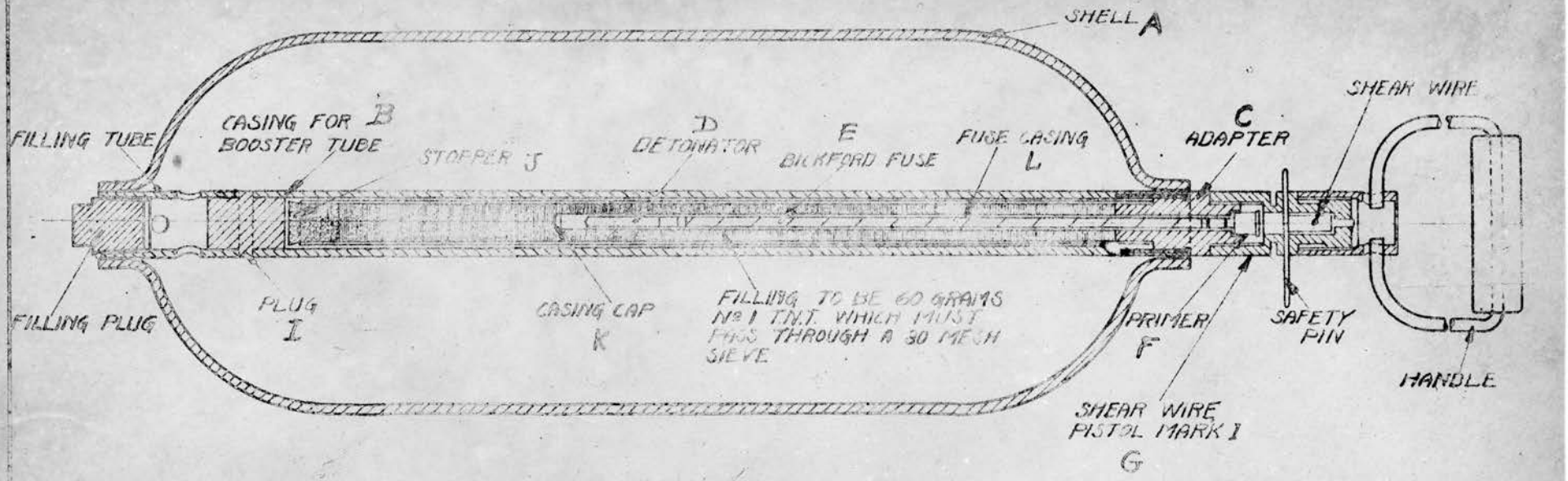
NOTE: ONE-PRESSED STEEL-O.H.FLANGE STEEL

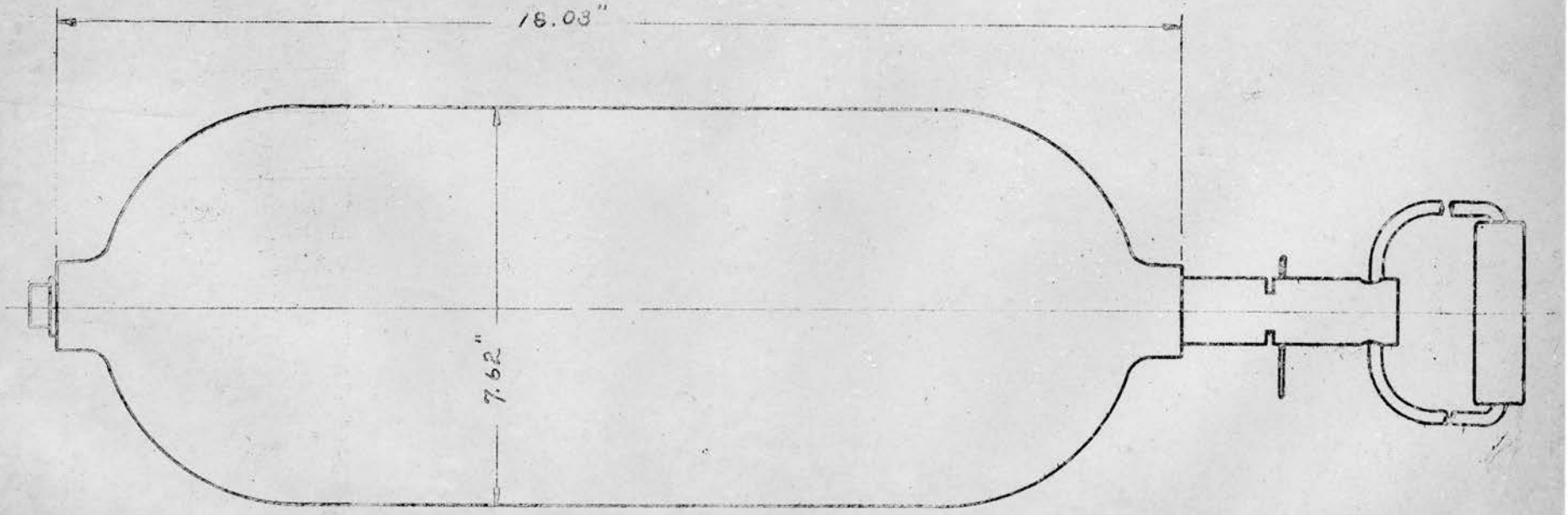


LIVENS PROJECTOR BASE PLATE MARK I

OFFENSE DIVISION, ENG. SEC. C.W.S. 3562

D.E.B.

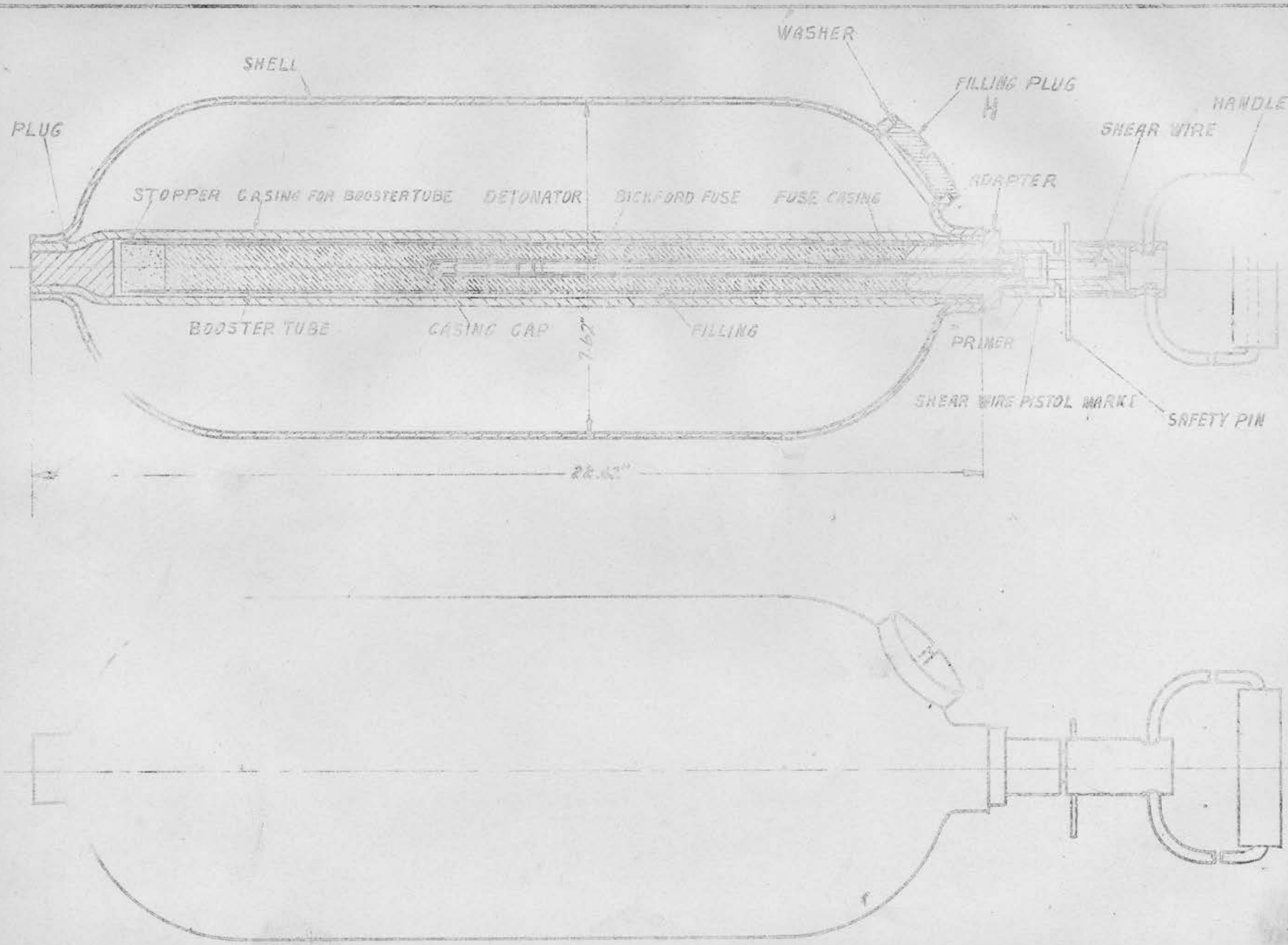




LIVENS PROJECTOR GAS SHELL MARK-I

D.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S 550

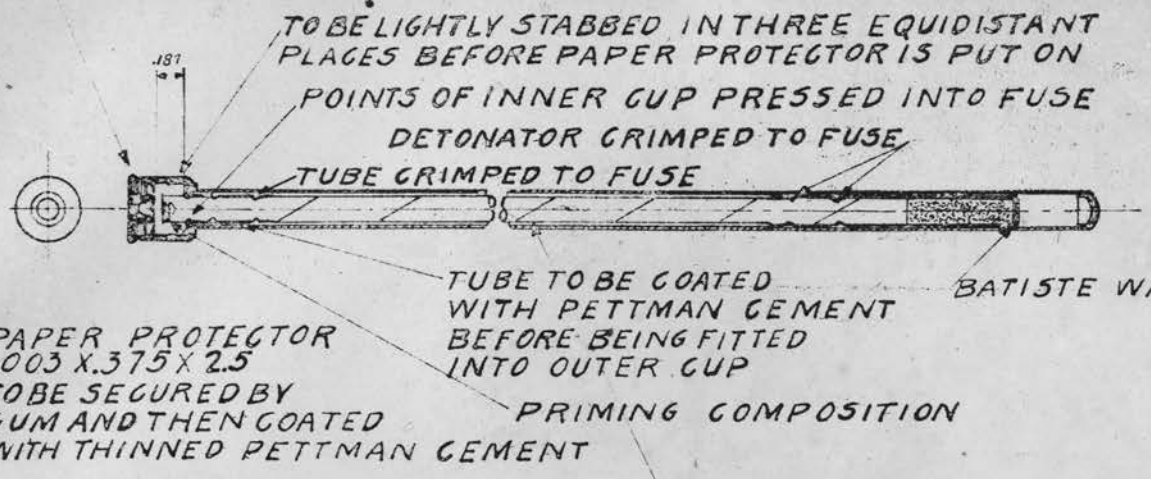


LIVENS PROJECTOR INCENDIARY SHELL MARK I ASSEMBLY

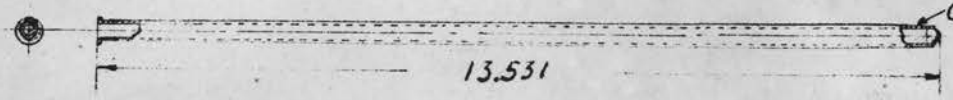
D.E.B.

DEFENSE DIVISION, ENG. SEC C.W.S. 5584

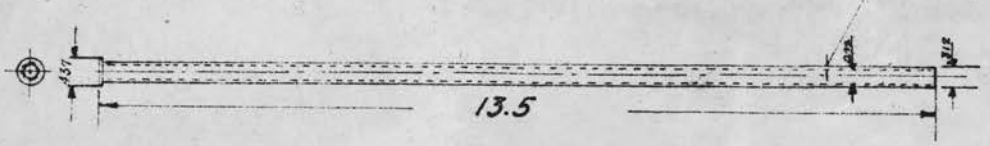
IGNITER HEAD



ASSEMBLY OF TIME FUSE



ASSEMBLY FUSE CASING AND CAP

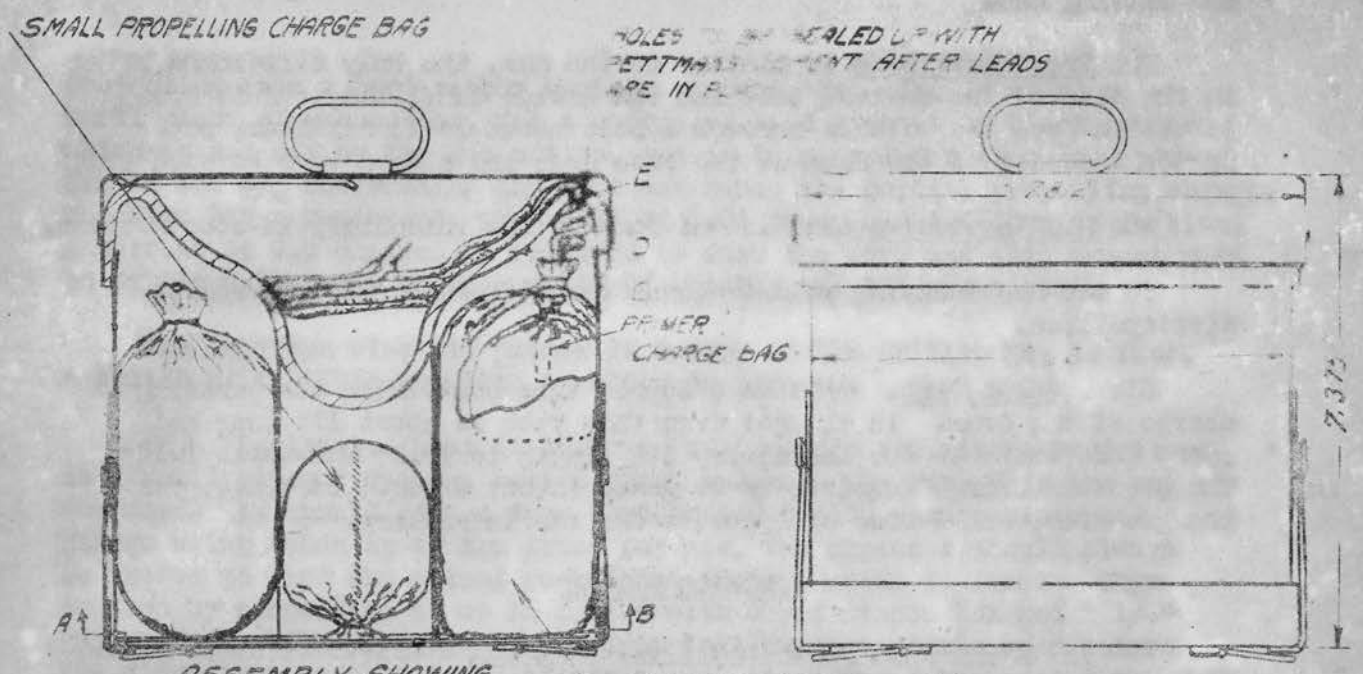


FUSE CASING
ONE SEAMLESS COPPER TUBING

LIVENS PROJECTOR TIME FUSE WITH DETONATOR AND FUSE CASING-MARK II

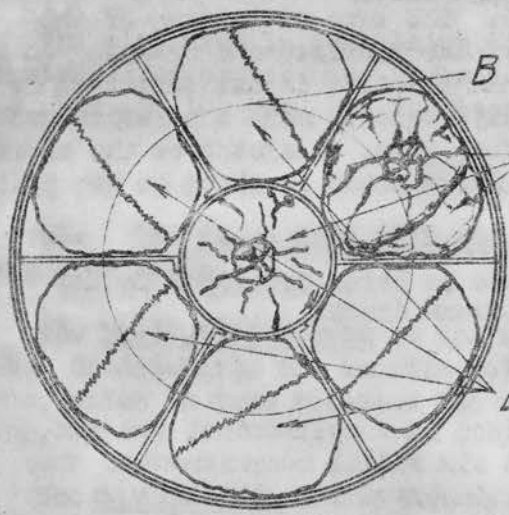
D.E.B.

5736



ASSEMBLY SHOWING MANNER OF LOADING CHARGE

LEAD WIRE PROPELLING CHARGE BAG



SECTION A-B.

U.S. TYPE

LIVENS PROJECTOR TIN CARTRIDGE CASE

MARK I. WITH PROPELLING CHARGE. ASSEMBLY.

D.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5574

the filling end.

The Incendiary Drum is similar to the gas, the only difference being in the size of the central tube and the method of filling. This drum is filled from the outside through a hole about 2" in diameter, cut in the shoulder of the drum at the fuse end, and closed by a screwed plug.

The High Explosive drum is the same as the incendiary in construction.

In the accompanying illustrations the difference may be readily distinguished.

51. Gaine Tube. This is a copper tube containing the bursting charge of the drum. In the gas drum this tube is about 17" long and .875" wide while in the incendiary its length is 19.3" and width 1.12". The bursting charge consists of 60 grams (about 2 ozs.) of T.N.T. for the gas drum, and 2 ozs. of ophorite for the incendiary.

52. PRIMING SYSTEM

The priming system used in all Livens drums consists of a .410 pistol cap; a 22 second Bickford time fuse, 10" in length; and a No. 8 commercial detonator loaded with fulminate of mercury to detonate the bursting charge. The detonator is attached to one end of the Bickford and the pistol cap to the other; the whole is then inserted in a thin brass casing which in turn is placed in the gaine tube. The pistol cap is fired by means of a device known as a Livens or Mills fuse. The time of burning of this fuse may be varied by cutting off part of the Bickford and crimping on a new detonator at the desired length. This practice is not satisfactory for the reason that in the field it is difficult to make a moisture-proof joint between the detonator and the Bickford fuse. A sketch of the several parts of the fuse and of the Mills and Livens heads is shown on the plate opposite.

An "Allways" time and percussion fuse is being developed in the United States for the several types of Livens drums.

PROPELLANTS.

53. Propelling charges are contained in a cylindrical tin box divided into one central compartment and six radial compartments. One compartment contains 12 ozs. of cordite, inserted into which is an electric fuse and 4 ozs. of black powder as a priming charge.

The charge is made up of small bags containing various amounts of U.S. smokeless powder. Range variations are obtained by varying the amount of powder in the charge box.

The top of the tin container is a stamped steel plate 11/64" thick. The flanges of this plate overlap the sides of the charge box. On discharge this plate is forced out against the sides of the projector and serves as a gas check.

54. Electric Fuses. The British electric fuse used to ignite the cordite propelling charges is known as the Mark III, No. 14. In this fuse a fine platinum iridium wire extends between two copper terminals,

projecting from a hard rubber casing. Around this wire is wound a small piece of gun cotton, and a charge of 2.25 grammes of black powder which is set off by the gun cotton, and in turn explodes the black powder in the bag surrounding the fuse and hence the cordite propelling charge. The wire has a resistance when cold of 1.06 ohms, and 2.6 ohms on fusion. A current of 0.9 amperes is required to fuse the wire and this amount must be supplied in order to be certain of setting off the gun cotton.

The American electric primer is a copy of the British No. 14 fuse. A sketch of the fuse complete is shown on page .

55. Exploder. What is known as an exploder for Livens Projectors is a small plunger driven, series wound dynamo. The Mark V is the one now used. It should fire a fuse through 100 to 130 ohms resistance. Before being taken up to the front for use, the exploder should always be tested to find the actual resistance through which it fires. This is done by connecting it up in series with a resistance box and a 1/4" gap, across which a bridge of platinum iridium wire of the same nature and dimensions as that in an electric fuse is placed. The tested resistance should equal the sum of the resistance of the main leads, the leads between the guns, and the fuses, plus an allowance for resistance of joints, inequality of fuses and safety. This "factor of safety" is taken 25-33%. Mark V should never be used to fire more than 20 guns.

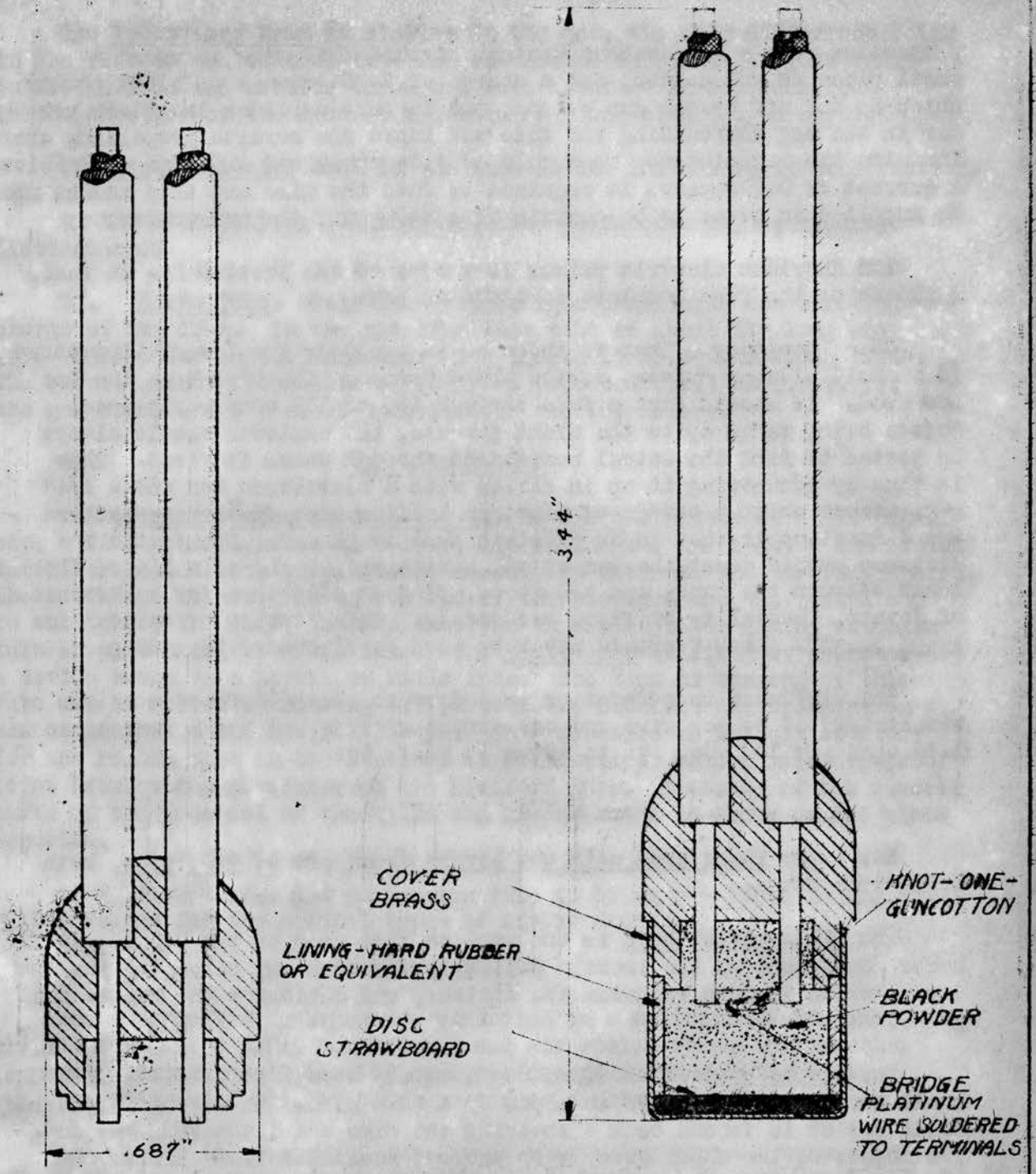
The wire used in connection exploders to electric fuses consists of six strands of copper wire and one strand of iron and has a resistance of 1.46 ohms per 100 yds. It is known as "E.I. 6".

FUSES

56. The fuses used with the Livens drums are of two types, both being time fuses.

The Mills pistol head is the same as that used on the Stokes gas bomb. On discharge the inertia pellet is forced back, releasing the lever, which in turn releases the striker, and detonates the cap in the gaine.

The Livens head is the fuse now commonly used. It consists of a small inertia pellet, held in place by a thin wire. On discharge the inertia pellet is forced back - shearing the wire and detonating the cap. The object of the shear wire is to prevent accidents from shorts. If the velocity of discharge is below a certain value, the wire does not shear and the cap is not detonated.

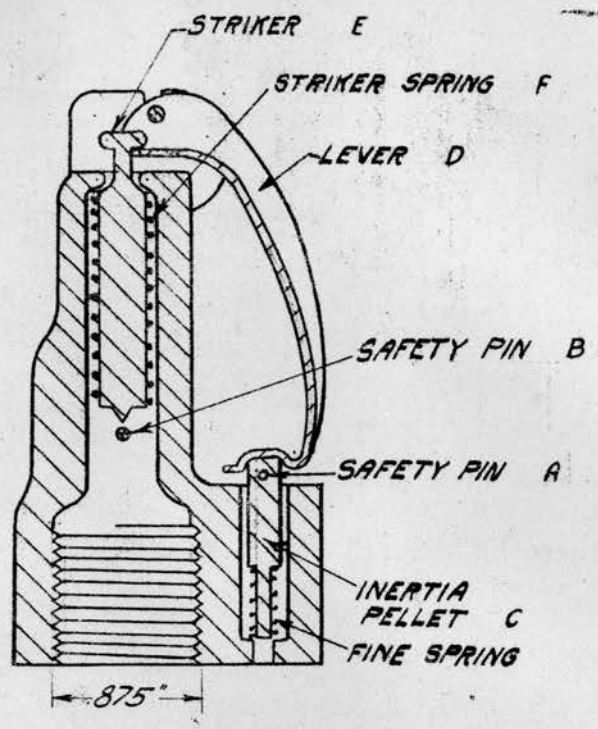


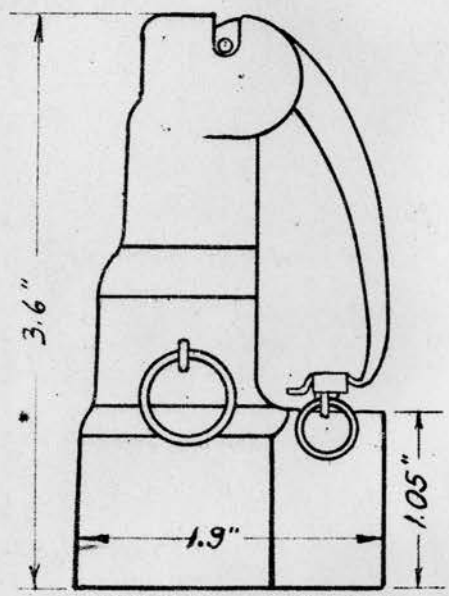
LIVENS PROJECTOR ELECTRIC PRIMER

MARK I

D.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5560



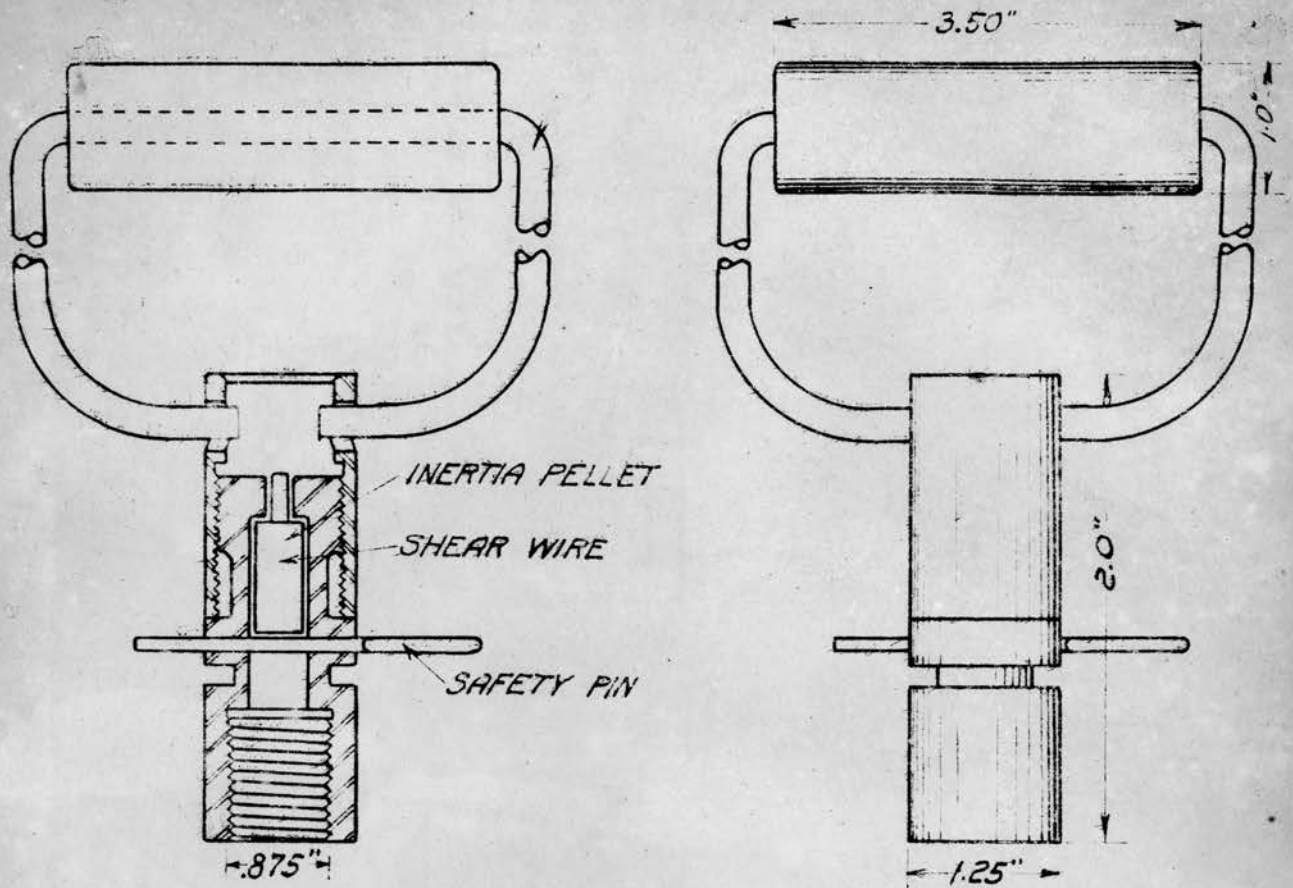


PISTOL HEAD

DEB.

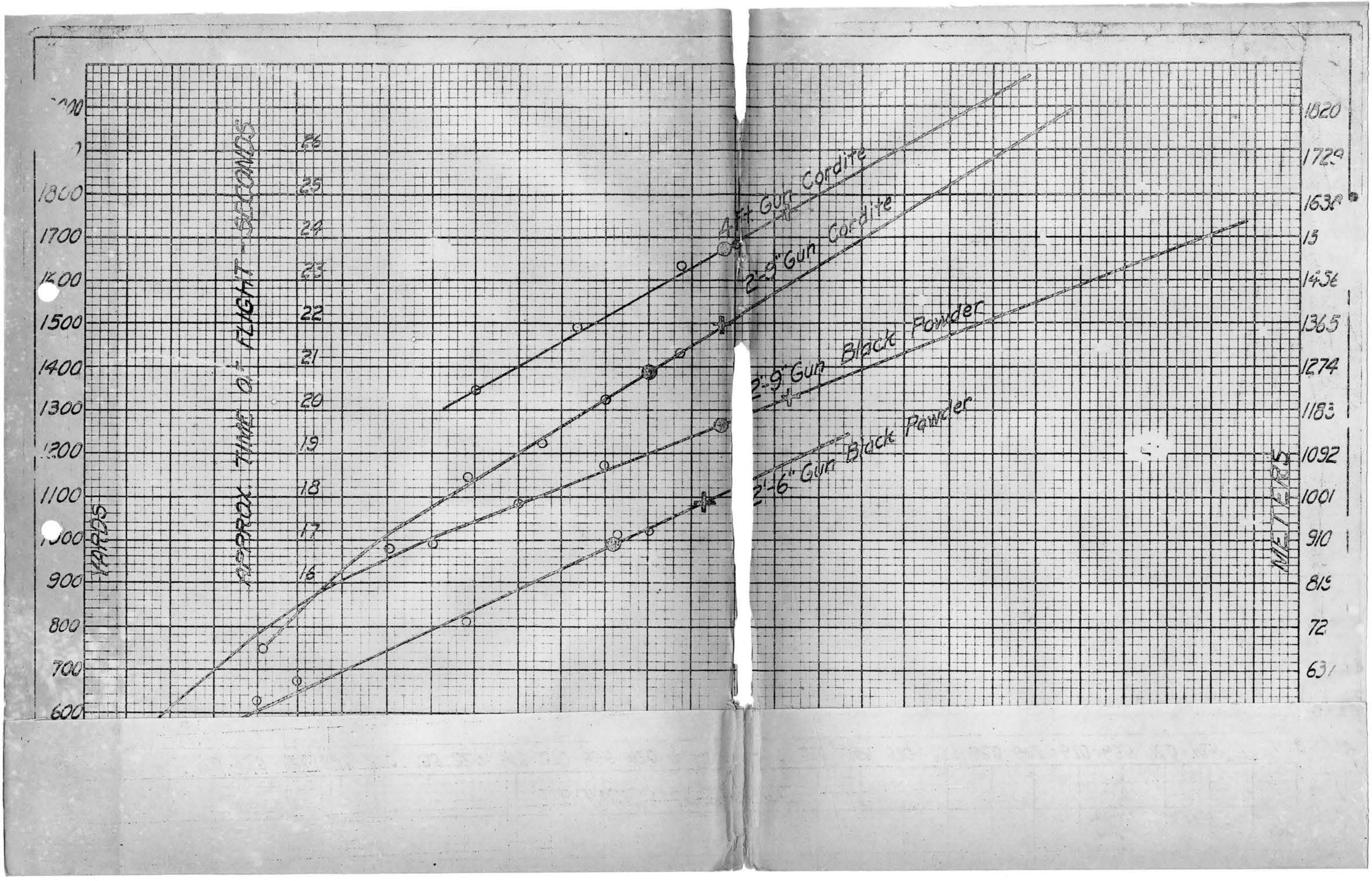
OFFENSE DIVISION, ENG. SEC. C.W.S. 5547

DETACHABLE HANDLE



U.S. TYPE
LIVENS HEAD

OFFENSE DIVISION - ENG. SEC. C.W.S. 5590


YARDS
METERS
TIME OF FLIGHT - SECONDS
4"-4 Gun Cordite
2'-9" Gun Cordite
2'-9" Gun Black Powder
2'-6" Gun Black Powder
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
1820
1729
1638
1547
1456
1365
1274
1183
1092
1001
910
819
728
637
26
25
24
23
22
21
20
19
18
17
16

after we get the diagram

PROJECTOR RANGE TABLE METERS
- CORDITE -

	Charge	Symm'l Arr'gt	Range with Base Plate Hvy 2'9" Lt. 2'6"		Range without Base Plate Hvy 2'9". Lt. 2'6"		Max. time of flight
1.	46 ozs.		1372		1235		22 sec.
2.	44 "		1327		1193		22
3.	40 "		1237		1112		21
4.	36 "		1144	1144	1030	1030	21
5.	32 "		1051	1051	946	946	20
6.	28 "		962	962	866	866	18
7.	24 "		824	824	742	742	16
8.	20 "		686	686	617	617	15

USING PROJECTOR 4' LONG

	M-III	M-II	M-III	M-II	M-III	M-II	Max. Time of Flight.
1.	54 & 52		1693 & 1647		1524 & 1480		25 Secs.
2.	50		1600		1440		24
3.	46	46	1510	1554	1359	1400	24
4.	42	42	1462	1442	1315	1315	23
5.	38	38	1372	1372	1234	1234	22
6.		34		1280		1152	22
7.		30		1190		1071	21

Mark III = $7\frac{1}{4}$ " Charge box.
Mark II = $5\frac{3}{4}$" Charge box.

Note: The accuracy of the projectors is about as follows:

Direction - 7% of Range
Deflection - 5% of Range.

8" LIVENS PROJECTOR DRUMS
BRITISH MANUFACTURE

58. Livens Drums are shipped without packing of any sort. The weight of the filled drum is approximately 61 pounds and each drum contains approximately 30 pounds of gas.

59. BRITISH MARKINGS.

FILLED	½" BAND AS BELOW - ½" BETWEEN BANDS:
CG	TWO RED BANDS
NC	1 WHITE - 1 RED - 1 WHITE

Livens gaine tubes, propellants and shear wire pistol heads are shipped separately.

8" LIVENS PROJECTOR DRUMS
AMERICAN MANUFACTURE

60. The 8" Livens Drums being made in the States will closely follow the British designs and will be marked as follows:

FILLING	PROPERTIES	MARKINGS
C.G.	LETHAL	2 WHITE BANDS - STENCILLED - "GAS"
N.C.	PENETRATIVE	1 RED AND 1 WHITE BAND-STENCILLED "GAS"
Oil	INCENDIARY	STENCILLED - "OIL"
HIGH EXPLOSIVE	EXPLOSIVE	STENCILLED - "H.E."
PRACTICE		NO BANDS OR MARKINGS.

ALL DRUM BODIES WILL BE PAINTED - SLATE GRAY. STENCILLED WILL BE IN 1" WHITE BLOCK LETTERS, LENGTHWISE OF THE DRUMS.

61. PACKING OF LIVENS MATERIAL
AMERICAN MANUFACTURE

ITEMS IN PACKAGE	PACKED IN	NO. PER PACKAGE.
Projector Barrel-2'9"	Wooden Box	1
Projector Barrel-4'0"	Wooden Box	1
Base Plates	Not packed	Can be nested.
Drums.	Wooden Box	1
Cartridge Case	Wooden Box	4
Booster MKI with Fuses and Handles	Wooden Box	10 Boosters; 10 Fuses; 10 Handles.
Booster MKII with Fuses and Handles	Wooden Box	10 Boosters; 10 Fuses; 10 Handles.
Clinometers and Aiming Rods	Wooden Box	10 Aiming Rod; 10 Clinometers;

DIMENSIONS OF PACKING BOXES
FOR LIVENS MATERIAL
AMERICAN MANUFACTURE

ITEMS IN PACKAGE	LENGTH	WIDTH	HEIGHT
Projector Barrel 2'9"	3 ft. 5.5 in.	11.5 in.	11.75 in.
Projector Barrel 4'0"	4 ft. 8.5 in.	11.4 in.	11.75 in.
Base Plates	19.5 in.	13.0 in.	4.5 in.
Drums	1 ft. 1.5 in.	9.0 in.	9.0 in.
Cartridge Case	2 ft. 10.5 in.	10.5 in.	10.5 in.
Booster MKI with Fuses and Handles	2 ft. 6.0 in.	10.5 in.	8.0 in.
Booster MKII with Fuses and Handles	2 ft. 8. in.	12.0 in.	8.0 in.
Clinometers and Aiming Rods.	4 Ft. 2. in.	9.5 in.	12.5 in.

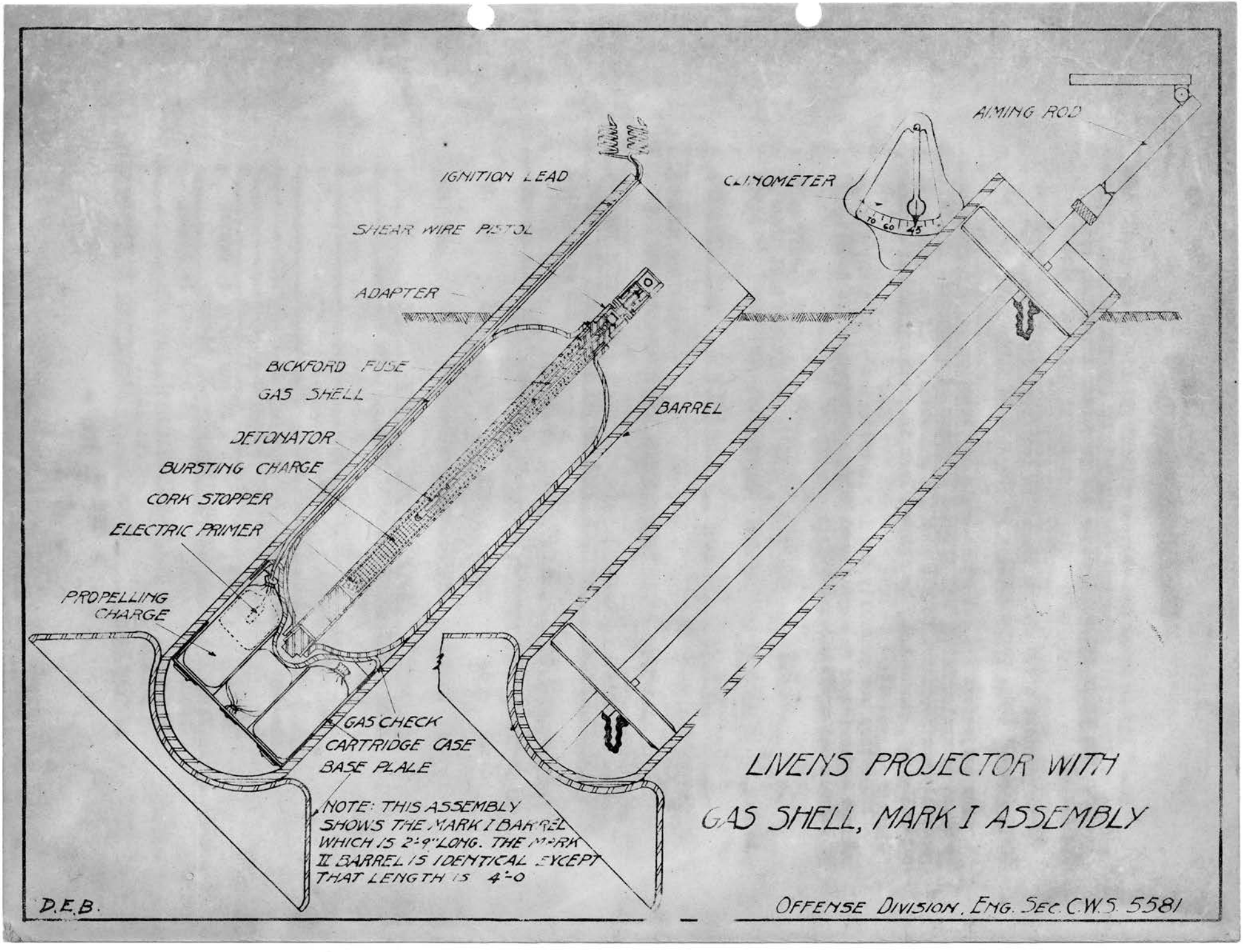
THE STANDARD SET UP

63. The plate following shows the projector installed, ready for firing.

In practice a "V" shaped trench is dug about 3'6" wide, 1'9" deep, and 30' long, perpendicular to the line of fire.

The projectors are set at an angle of elevation of 45 degrees by means of a clinometer, and aligned by means of a compass. It is generally not necessary to set each gun separately. If one gun is carefully set, several may be aligned from it, with sufficient accuracy.

Projectors are generally dug in, in batteries of 20 each; the various batteries of an emplacement being scattered as the conditions of terrain and cover necessitate.


IGNITION LEAD
SHEAR WIRE PISTOL
ADAPTER
BICKFORD FUSE
GAS SHELL
DETONATOR
BURSTING CHARGE
CORK STOPPER
ELECTRIC PRIMER
PROPELLING CHARGE
GAS CHECK
CARTRIDGE CASE
BASE PLATE
BARREL
CLINOMETER
70
60
45
AIMING ROD
NOTE: THIS ASSEMBLY SHOWS THE MARK I BARREL WHICH IS 2'-9" LONG. THE MARK II BARREL IS IDENTICAL EXCEPT THAT LENGTH IS 4'-0
D.E.B.
LIVENS PROJECTOR WITH
GAS SHELL, MARK I ASSEMBLY
OFFENSE DIVISION, ENG. SEC. C.W.S. 5581

CLOUD GAS APPARATUS

CYLINDERS.

64. In the first years of the war cylinders containing about seventy (70) pounds of liquified gas were used by both sides for cloud gas, or gas wave attacks. The cylinder used was about 3'9" in height and 8-1/2" in diameter, similar in all respects to the common Co_2 cylinder found in the States. The siphon tube, about 3/4" in diameter, extended from a valve at the top of the cylinder nearly to the bottom. The pressure of the gas forced the liquid up this siphon tube through the valve and out into the atmosphere through a parapet pipe, where it vaporized.

The cylinders were placed far forward in the trench system, usually in sets of fours, connected by rubber hose to a four-way connection and single parapet pipe. At first, cylinders were used in about the ratio of 1 per meter of front on which the attack took place. More recently 3 per two meters, or even 2 per meter were used. This was accomplished where the width of the trench permitted of double banking. The cylinders weighed, when full, about 140 pounds each.

Due to the difficulty of transporting this heavy mass of material through the trenches to the front line, and due to the fact that wind conditions made it necessary at times to leave the cylinders in the trenches for considerable periods of time, the cloud gas attack became practically obsolete.

TRANSPORTATION TABLE

STORES	Approx. weight in Lbs.	UNITS OF CAPACITY 5 Ton Truck	3 Ton Truck	2 Mule Wagon	Pack Mule	Burro	Man
2'6" Gun.	63	165	100	14	2	2	1
2'9" Gun.	105	150	60	10	2		½
4'0" Gun.	150	100	40	6	2	1	½
Drums	60	165	100	16	4		1
Base Plates	28	350	200	48	8	4	1
Charges Boxed	55	640	400	20	4		
Gun Complete Boxed	280	40	24				¼
Heavy Base-Plate	120			8	2	1	½
Gun and Stand Loose	125			8	2	1	½
T.M.E. Boxed	66	350	200	30	8	4	1
T.M.E. Loose	25	450	250	40	8	4	3
Light Cylinders Full	65	160	96	15	4	2	1
Light Cylinders Empty	20	350	200	30	8	4	2

Trucks or wagons going forward must be loaded in the case of projector material with an equal number of each unit in order that a broken down conveyance will not prevent the entire installation taking place.

GENERAL PROCEDURE IN GAS OPERATIONS

66. Passes should immediately be obtained for all Officers, upon assignment to a division for active operations, and circulation maps and sector regulations studied.

Passes are not generally necessary for circulation, but to avoid the necessity of explaining your mission to too many people, it is advisable to have them.

Get in touch immediately with G-2 and obtain complete data of your own and enemy lines, with maps. Aeroplane photographs are useful if obtainable. Arrange for daily intelligence bulletins and a copy of the sector history if there is one.

67. Make a complete and detailed study of your sector: both the front and back areas. See that all officers of your company and your section leaders are familiar with roads, trenches, P.C.'s telephone systems, etc., of their particular areas.

Detailed reconnaissances should be made by all platoon and section leaders, as far as time permits. A thorough knowledge of the sector will lessen the danger of becoming lost at night, or causing unnecessary casualties. During these reconnaissances, dumps should be selected tentatively, P.C.'s chosen, routes decided, and emplacements selected. Each officer making a reconnaissance should submit a reconnaissance report of the form shown hereafter.

68. After a close study of the tactical situation, enemy concentrations, the terrain, and time allowed, the company commander decides upon his plan of operations. He then prepares a project, (see form following) which he submits to the Chief of Staff of the Division. On approval of his project the Company Commander gives detailed instructions to his platoon commanders, assigning them definite duties. These instructions should be given in conference, and confirmed in writing.

69. One officer of the company is charged with getting up supplies. A table showing the amount of material necessary in various cases is appended.

70. Platoon leaders make their own detailed arrangements, and assign the tasks in their own platoons. They must organize their platoons as required for carrying, digging in, and camouflaging. Their orders will specify the approximate emplacements and target. They must in general determine range, changes, and angle of fire. Their plan of operations, with detailed instructions, should be written and submitted to the Company Commander for check and approval.

71. At this time, officers and N.C.O.'s in charge of details must make another and detailed reconnaissance. Runners, who are assigned to keep liaison with company or other P.C.'s, must familiarize themselves with routes. Every man must know the terrain over which he is to function, so that he can find his way, day or night.

72. As soon as material arrives, the installation is commenced. As a rule all work must be done at night, in absolute darkness, and silently. This means that each man must know his task, and carry it out promptly and carefully. All material sent forward must be complete and ready for use. No necessary item must be omitted.

73. Work done by Gas Troops in forward areas must be directed and controlled with the greatest care and caution. The enemy must not be forewarned by sound or sign. The success of the entire operation depends primarily upon surprise. Warning to the enemy will result in a heavy shelling of the area, and probably in a withdrawal of the target.

74. Camouflage is the concealing of all work done in such a manner as to give no sign of activity or change. It must, therefore, conform to the surroundings. It must protect against:

(1) Aerial photography.

(2) Air observation - Airplane or balloon.

(3) Direct observation.

It is necessary to consider and provide against:

(a) New tracks.

(b) Regularity of lines.

(c) Production of shadows.

(d) Leaving any work uncovered.

Preliminary reconnaissance must include a special study of camouflage requirements, and the report cover the exact kind and amount needed. Natural camouflage is superior if it can be obtained without being itself noticed.

The concealment of emplacements must be carefully supervised each morning before leaving. In difficult cases the division camouflage expert may be called on for assistance.

75. When the installation is nearly completed, the Company Commander issues his operation order. A typical form follows. In addition, a company operation order is issued giving the duties of all platoon or section leaders in the operation.

76. The zero hour is usually set in conference with the Chief of Staff of the Division, as it may be dependent on other operations. If not, the best time to shoot is at night, when the target is most heavily held, or in general when the chances of surprise are greatest.

77. On the completion of the operation, an operation report on the form shown hereafter is immediately rendered to the proper officials. This report must be rendered promptly and be complete.

78. Liaison. Experience has demonstrated the great importance of good liaison. It must always be maintained with all units whose operations are in any way dependent upon or influenced by the operations of the gas troops.

In normal operations telephones, runners or dispatch riders may be utilized. Use of telephones is not advisable since unusal activity is apt to arouse suspicion. Dispatch riders are not reliable. A good runner system is therefore essential. In planning operations, runners must be provided for, and trained. They are always sent in pairs, and should be sent frequently over their routes, both b y day and night, to insure proper liaison in action.

From company headquarters to the rear the Army dispatch service should normally be used. All messages should be properly addressed and marked "to be called for". Messages for Regimental Headquarters of Gas Troops will normally be sent "in care of Army Message Center", for Battalion Headquarters "in care of Corps Message Center".

In active operations where platoons may be detached from company headquarters, it may be inadvisable to utilize company runners, in which case messages may be sent to company "in care of Division Message Center". In such cases the company should maintain a good N.C.O. and two runners permanently at the Advance Division Message Center. This N.C.O. must always be kept informed of the location, of the Company P.C.

79. In active operations Progress, Oporations and Dump reports must be forwarded daily to Battalion and Regimental Headquarters at the following hours:

Leave Company	Leave Battalion
8:00 A.M.	11.00 A.M.
5:00 P.M.	6.00 P.M.

During normal operations such reports should be sent as follows:

Leave Company	Leave Battalion
8:00 A.M.	11.00 A.M.

NOTES ON OPERATION

80. The following notes concerning operations will furnish a general guide for all cases.

RECONNAISSANCES.

1. Secure good maps.
2. Secure passes.
3. Go over ground with N.C.O.'s and runners.
4. Plan out and ascertain everything asked for on reconnaissance report.

EMPLACEMENTS.

1. Avoid shelled areas; exposed positions, or trench intersections.

2. Do not have more than 50% of range in own lines for projectors.

3. Select good cover if possible.

4. Consider routes to emplacement.

5. Consider soil, and ease of camouflage.

ASSISTANCE.

1. Determine assistance in men or transport needed.

DIGGING EMPLACEMENTS.

1. Look over lines of fire.

2. Check up accessories; compasses; tapes, triangles; clinometers, etc.

3. See that camouflage is available.

CARRYING.

1. Arrange method carefully, and have material arrive in the order needed.

2. Work to time schedule.

3. Have good N.C.O. in charge at forward dump.

FIRING PARTY.

1. Before leaving billets.

   (a) Inspect accessories; tools; exploders; galvanometers, etc.

   (b) Tell senior sergeant the zero hour. Give him sufficient data to go ahead in case you become a casualty.

2. On arrival in line-

   (a) Don't waste time.

   (b) See that runner are ready.

   (c) See that Infantry is informed.

   (d) See that everyone is ready and knows what to do.

3. After Firing.

(a) Withdraw all possible material, such as mortars, exploders, galvanometers, etc.

(b) Camouflage.

(c) Submit an immediate report.

DATA ON OPERATIONS

80-A. In planning operations of Gas Troops, the following data is useful. They refer to conditions of Trench Warfare and as based on British experience.

4" Stokes Mortars:

Gas: Allow 1 mortar to 100 yards of lateral target. Bombardments are made:-

(1) On days or nights preceding zero. Rapid bursts of fire for one or two minutes, once or twice on each of the nights preceding zero. Expenditure of ammunition is calculated at the rate of 1 round per 5 yards of lateral target per minute.

(2) During the assault. Smoke and lachrymatory agents are used on the flank of the attack.

Smoke: One Gas Company (16 mortars) is usually sufficient for a smoke barrage on the flank of an attack. 1 section (4 mortars) has frequently been used. Average rate of expenditure of ammunition is 1 round per mortar per minute.

Miscellaneous:

Mortars are sited in the front line, or in saps just behind it, and are carried up by the special personnel. The latter also construct emplacements if time permits. The actual preparations can be completed in 12 hours but a longer time is desirable. Infantrymen are required to carry bombs (2 bombs to 1 man).

8" Projectors

(1) Train all guns on one target, e.g., woods, village, or area of dugouts.

(2) Only one shot can be fired, as the gun then requires digging out.

(3) Not more than 250 guns can be installed by one company in one night.

(4) If several working nights are allowed the gas company can carry up and dig-in all its own guns if normal trench tramway facilities are available.

(5) Infantrymen are usually required for assistance in carrying drums (1 drum per man).

(6) Guns are sited in the front line or preferably just behind it in the open; with breastworks the guns are better placed behind the traffic trench than in the front line.

(7) Surface emplacements should be used wherever concealment is possible.

Cylinders

(1) Recesses in front walls of trenches should be completely prepared before carrying into trenches is commenced.
(2) Each cylinder requires 2 men with 2 wooden poles to carry it.
(3) Wrap each cylinder in burlap or sand bags to prevent noise from clanking together.
(4) All valves and fittings should be tested for gas-tightness and easy operation before leaving dump.
(5) Cover cylinders in position by sand bags, boards, or earth for protection against shell fragments or shrapnel.
(6) At zero minus 10 minutes, station one man at each two cylinders to turn on valves. Stand by during discharge to prevent accidents and gassing own men. All men should wear masks.

GRAD CIRCLE WITH CODE

81. It has been decided to adopt the Grad or 40 point system in noting wind direction, and miles per hour in noting velocity.

In transmitting wind observations a known number is added to each reading, and messages are arranged as follows:

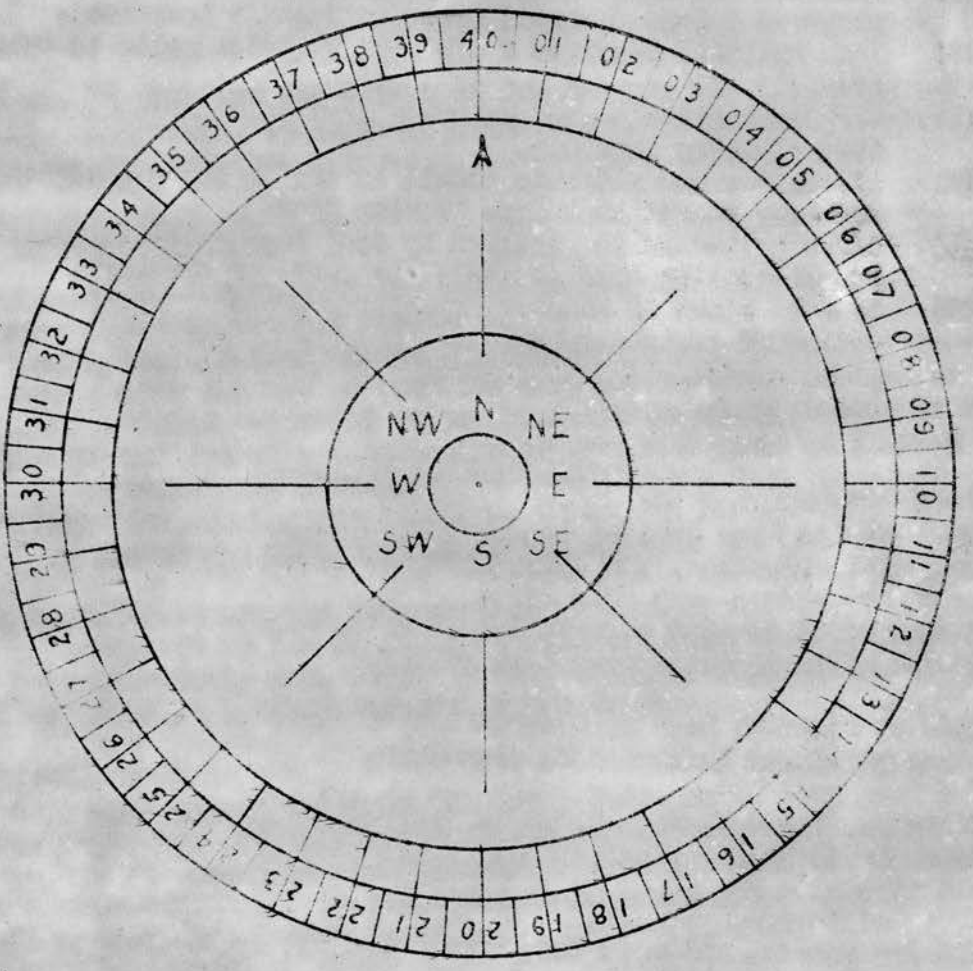
Name of station; hour of observation; direction and velocity of wind; other pertinent information; signature.

Example: At a station known as Pierre, at 16 hours the wind blows from the north, or point 40 with a velocity of 8 miles per hour, and is steady.

The key number, which is frequently changed, is assumed as 15. The message will then read:
Pierre, 1600, 5523, steady. Smith.

* 40 + 15 = 55 8 + 15 = 23.

NUMERICAL POINTS OF COMPASS



GRAD SYSTEM

OFFENSIVE DIVISION, ENG. SEC. C.W.S. 5591

82.

MATERIAL REQUIRED

for

4" STOKES MORTAR OPERATION

4 Guns - 40 Rounds.
Ammunition each gun.

GAS AMMUNITION

4 - 4" Stokes Mortars complete in good order.

Gun Barrel.
Barrel Cover.
Gun Legs.
Legs Cover.
Traversing Handle.
Muzzle Cover.
Breech Piece with Nipple Anvil.

4 - Base Plates - reinforced with wood.
160 - Gas Bombs complete with Gaines and Fuses.
320 - E.C. 3 Biscuits.
160 - Waxed Wads.
1 - Compass.
8.- Shovels.
8 - Picks.
300 - Sand Bags.
4 - Sets Backing Material for Baseplates.
54 - Bomb Carriers.
4 - Cleaning Rods.
4 - Tool Satchels complete (each containing)
1 - Spare Nipple Anvil.
1 - Clinometer.
1 - Monkey Wrench.
1 - Combination Wrench.
1 - Large Spanner.
1 - Oil Can.
1 - Set Recapping Tools.
Spare Caps.
Emery Paper.
Cotton Waste.

Transportation 1 journey, exclusive of personnel.

2 - Double Dimbered Wagons, or
2 - 5-ton Trucks, or
2 - 3-ton Trucks.

MATERIAL REQUIRED

for

4" STOKES MORTAR OPERATION

4 Guns - 40 Rounds
Ammunition each Gun.

SMOKE OR THERMIT AMMUNITION

4 - 4" Stokes Mortars complete in good order.
- Gun Barrel.
- Barrel Cover.
- Gun Legs.
- Legs Cover.
- Traversing Handle.
- Muzzle Cover.
- Breech Piece with Flat Anvil.

4 - Baseplates - reinforced with wood.
160 - Smoke or Thermit Bombs (with Detonator Smoke)
160 - 31 D or Sutton 79 Fuses.
640 - Cordite Rings (32) Extra.
160 - Cartridges Pink or Blue.
1 - Compass.
8 - Shovels.
8 - Picks.
300 - Sandbags.
4 - Sets Backing Material for Baseplates.
54 - Bomb Carriers.
4 - Cleaning Rods.
4 - Tool Satchels complete (each containing)
- 1 - Spare Flat Anvil.
- 1 - Clinometer.
- 1 - Monkey Wrench.
- 1 - Combination Spanner.
- 1 - Large Spanner.
- 1 - Oil Can.
- 1 - Fuse Key No. 31-D or 79.
- 1 - Fuse Punch.
- Emery Paper.
- Cotton Waste.

Transportation 1 journey, exclusive of personnel.

2 - Double Limbered Wagons or
2 - 5-ton Trucks, or
2 - 3-ton Trucks.

MATERIAL REQUIRED

for

250 LIVENS PROJECTOR OPERATION

250 - Projector Guns.
250 - Base-plates.
250 - Bombs.
250 - Gaines with Fuses and Detonators.
250 - Charges (Prepared).
250 - Muzzle Covers.
250 - Sandbags.
12 - Sets Marking Tape.
12 - Pieces Camouflage.
360 - Camouflage Pins.
24 - Picks.
24 - Shovels.
15 - Exploders.
15 - Reels Lead Wire (100 yds. double).
5 - Triangles.
5 - Clinometers.
5 - Circuit Detectors.
220 - Yds. Insulating Tape.
15 - Spanners, D.E.
3 - Watches.
1 - Resistance Box.

Transportation, 1 journey, exclusive of personnel.

16 - Double Limbered Wagons, or
8 - 3-ton Trucks, or
5 - 5-ton Trucks, for 2'6" Projectors.

TABLE OF ALLOWANCES FOR GAS TROOPS
TECHNICAL EQUIPMENT

1.

PROJECTORS

	Monthly Consumption per Company. 100% Operations.	60% Operations.
Projectors 2'9" complete with muzzle cap	563	338
Projectors 4'0" complete with muzzle cap	187	112
Base Plates	937	562
Drums, C.G., complete with propellant and component parts	1200	720
Drums, N.C., complete with propellant and component parts	400	240
Drums, H.E., complete with propellant and component parts	300	180
Drums, incendiary, complete with propellant and component parts	100	60
Spherical Bombs, H.S., with propellant and component parts	250	150
10% Extra component parts for drums and bombs .		
Propellant charges 10% extra on bombs & drums .		
Muzzle caps, 10% extra on Projectors	300	180
Projector Pullers	20	12
Wire, 7 stand, rubber insulated, for firing, miles	1.7	1
Tape, tracing, 1 1/2" wide, yds.	500	300
Tape, insulating, 50 ft. rolls, ...	30	18
Clinometers	5	3
Sets of accessories, U.S. Ordnance Dept., class 54, Division 8, Drawing 7, .	1/3	1/5
Exploders, Magneto Type	1	2/3
Circuit Detectors, Galvanometers	1	2/3
Batteries, extra (1/3 of Galvanometers)	1	2/3
Platinum iridium wire or substitute	4 ft.	2.5 ft.
Resistance Boxes	1/3	2/5

Note: For every company to be trained, 150 empty drums will be required, (discarded gas).

2.

STOKES MORTARS

	Monthly Consumption per Company. 100% Operation.	20% Operation.
4" Stokes Mortars, complete with technical equipment and wooden base-plates	- -	2*
S.M. Bombs, complete, C.G.	4000	800
" " " " N.C.	2000	400
" " " Lachrymator	500	100
" " " Thermit	1500	300
" " " Smoke	2000	400
4" T.M.E. Bomb Carrier	10	2
Breech pieces, extra	½	0.1
Traversing screws, extra	½	0.1
Lubricating Oil for Barrels, Gals.	1	0.2

* Note: - 16 Stokes mortars to be issued per company as initial equipment. One set of technical equipment to be furnished with every four (4) Stokes Mortars.

3.

CYLINDERS.

	Month Consumption per Company. 100% Operation.	20% Operation
Cylinders filled, C.G.	3000	500
Smoke Candles, Type S. or Type F., complete	200	40

4.

GENERAL SUPPLIES

	Initial Equipment.	Monthly Consumption per Company.
Ammunition Hand Car	22	1
Salvus Sets	4	1/5
Oxygen Cylinder		1
Potash Cartridge		1
Haldane Apparatus	1	1/5

	Initial EQUIPMENT	Monthly Consumption per Company.
Oxygen cylinder for Haldane		1
Axes, pick, complete	150	10
Handles, pick-axe	100	10
Pliers, side cutting, 8"	250	20
Pliers, Webbsheath	250	10
Monkey wrenches, 12"	10	1
Canvas, waterproof, 10 oz., yds.	100	10
Batteries for Flashlights		25
Bulbs for Flashlights		25
Sandbags, ...		1500
Luminous Paint, lbs.		1
Paint Base Zinc, lbs.		1
Rope, 1/2", yds.		100
Large Paulins, 20' x 30', Approx.		10
Verey Gun, 35 mm.	1/3	
" Lights, 35 mm. Red one Star ...		8
" " " " Green " "		8
" " " " White " "		8
Compasses, prismatic, ...	20	2
Shovels, 9" Blade, round point, ...	150	10

86. The foregoing Table of Allowances is based upon the following assumption:

The proportions of the personnel engaged, on the average, in each form of attack is as follows:

Cylinders	20%
Projectors	60%
Stokes Mortars ..	20%

This assumption is largely influenced by the fact that it is considered that there would always be a large percentage of the troops engaged operating on stabilized fronts. In preparation for any future conflict, there will be an increase in the use of cylinders and Stokes mortars, certainly if the cylinder is satisfactorily developed.

It is estimated that a company of two hundred and fifty men, working entirely on cylinders, projectors, or Stokes mortars, could discharge during one month the following:

Cylinders.....	3000
Projectors	3000
Stokes Mortars	10000 Bombs.

It is estimated that 25% of 4" and 75% of 2"9" projectors would be used.

Average life of a projector would be four shoots, or 25% loss in each shoot.

Two base-plates will be necessary for each 4" projector; average loss on base-plates will be 25% of the total in each shoot.

The total number of Stokes Mortars would be sufficient to replace the guns destroyed by shell fire, accident, or capture.

87. TABLE OF ALLOWANCES FOR GAS TROOPS

UNIT EQUIPMENT

1.

Table Number	NAME OF EQUIPMENT	ALLOWANCES			
		ONE COMPANY	ONE BATTALION Hqtrs	ONE REGIMENT Hqtrs	TOTAL FOR REGIMENT. 18 COMPANIES. 6 BATTALIONS.
2	Drafting	1	2	2	32
3	Signal	1	1	1	25
4-a	Meteorological	1			18
4-b	Meteorological		1	1	7
5	Photographic		1	1	7
6	Carpenter	1	2	2	32
7	Reconnaissance	1	2	2	32
8	Office	1	1	1	25
9	Workshop		1	1	7

2.

DRAFTING EQUIPMENT

Article.	Amount.
Camel hair brushes, medium	1
Camel hair brushes, fine	1
Cloth, tracing, 30", roll	1
Dividers, 4"	12
Dividers, proportional	1
Drawing instruments	1
Drawing tables, 36" x 60", with trestles	1
Erasers, steel, ...	1
Erasers shield, ...	1
Erasers, rubber, pencil, ...	6
Erasers, rubber, ink, ...	6
Frames, blueprint, 24 x 30" ..... with celluloid face	1
Ink, drawing, black, bottles, ...	6
" " Blue, " ...	3
" " Carmine, " ...	3
" " Yellow, " ...	3
" " Green, " ...	3
" " White, " ...	1
Map measures, ...	1
Note books, 4" x 3", approx.	3

DRAFTING EQUIPMENT (CONTINUED)

Article	Amount.
Paper, blueprint, 30", roll	1
Paper, detail, white, 30", roll,	1
Paper, blotting, large sheets ...	6
Paste, library, jars, ...	3
Pencils, drawing, H	12
" " 4H, ...	6
" " 6H, ...	6
" " Graphite, ...	1
Pens, crowquill, doz., ...	1
" mapping, doz., ...	1
" contour, ...	1
Pads, pencil pointing, ...	3
" scratch, ...	6
Powder, pounce, for tracing, cans 2 1/2 oz.	1
Paper, tracing, 30", roll, ...	1
Pins, boxes, ...	3
Protractors, semicircular, 6", ..	1
Protractors, map, celluloid, ...	2
Protractor Rectangular, map (T.S. 1077)	12
Reading Glasses, 5", 3-power, ...	1
Rule, parallel, steel, 18", ...	1
Rubber bands, boxes, ...	1
Scales, Engineer, triangular.....	1
" " " metric	1
" Architects, ...	1
" Triangular, metric, ...	1
Straight Edge, steel, 30"	1
"T" Squares, 36"	1
Trays, washing, blueprint, 24 x 30"	1
Triangular 30°-60°, 12"	2
" 45°- ,10".....	2
Triangle, 30°-60°, 5", ...	2
" 45°, 4"	2
Tubes, tin, for maps and tracing cloth, ...	4
Tape, adhesive, rolls, ...	3
Thumbtacks, doz., ...	10
Water colors, assorted, sets, ...	1

3.

SIGNAL EQUIPMENT

Bags, dispatch, ...	2
Batteries, for Flashlights, ...	25
Bulbs for Flashlights, ...	25
Cases, Brief, ...	2
Flashlights with Batteries, ...	20
Glasses, field, type E.E.	5
Kits, flag, combination, standard	2

SIGNAL EQUIPMENT (CONTINUED)

Knives, Jack, heavy, with loops, ... 250
Telephone sets, complete, ... 1
Telephone wire, insulated, feet,
(twisted pair)..... 300
Watches, luminous dial, ... 20

4-a

METEOROLOGICAL EQUIPMENT

Anemometer, Stanley, hand, portable,
(or equivalent)..... 1
Wind Vanes, hand, ... 10

4-b

METEOROLOGICAL EQUIPMENT

Anemometer, Stanley, (or equivalent), 1
hand, portable 1
Aneroid Baragraphs, ... 1
Wet and Dry Thermometer, ... 1
Sling Psychrometer, ... 1
Aneroid Barometer, large, ... 1
Stereoscope Panteroscope Schweissgith, 1
Stop Watches, ... 1

5.

PHOTOGRAPHIC EQUIPMENT

Camera, Graphlex 3-A, ... 1
Developing, equipment, complete, ... 1
Films, doz., ... 5

6.

CARPENTER EQUIPMENT

Augers, ship handled, sets of 5, ... 1
Awls, scratch, ... 2
Axes, handled, 32", ... 4
Bit, auger, sets of 7, ... 1
" expansion, 2 cutters, ... 2
" Screwdrivers, 3/8", ... 6
" " 1/2", ... 6
Brace, ratchet, ... 1
Calipers, 8" set of inside and outside 2
Chalk, carpenter's, lbs., ... 6
" lines, 40', ... 3
Chisels, cold, 3/8 x 1", ... 6
" framing, 1" handled, ... 1
" " 1/2" handled, ... 1
" " 2" handled..... 1

CARPENTER EQUIPMENT. (CONTINUED)

Dividers, wind.....	1
Drawknife, ...	1
Files, taper, saw, 6".....	6
Hammer, claw, handled, ...	2
Handles, axe, 32", ...	6
" Chisels, framing 6", ...	6
" Hammer, claw, ...	4
Hatchets, handled, ...	6
Level, carpenter's 24", ...	1
Mallet, carpenter's handled, ...	1
Oiler, 1/2 pint, ...	1
Pencil, carpenter's, doz., ...	1/2
Plane, Jack, ...	2
Pliers, side-cutting, ...	2
Plumb bombs, 9 1/2 oz., ...	1
Rules, 2 ft. 4 fold, ...	3
Saw, compass, 12" key hole blade handled, ...	1
Saw, compass, 14" blade, handled, ...	1
Saw, compass, 18" nail cutting blade, .	1
Saw, cross cut, hand, 26", ...	4
Saw, rip, hand, 26", ...	2
Screw driver. 5" blade, ...	2
Square, steel carpenter's, ...	2
Tape, metallic, 50 ft., ...	1
Square, try, ...	1
T-bevels, ...	1
Wrenches, monkey, 12", ...	2

7.

RECONNAISSANCE EQUIPMENT

Articles.	Amount.
Alidades, ...	2
Boards, sketching, ...	2
Chests, sketching outfit, ...	2
Clinometers, service, with cases, ...	2
Compasses, Box, ...	2
Compasses, Prismatic, with cases, ...	2
Celluloid sheets, ...	36
Erasers, rubber, pencil, ...	14
Holders, timing pad, ...	2
Hand levels, ...	2
Metallic tapes, in tenths, 150 ft., ...	2
Note books, field, ...	6
Page tallies, ...	2
Pockets, pencil, ...	2
Pads, timing, ...	2
Paper, sketching, sheets, gross, ...	1
Pencil, blue, ...	4
" drawing H., ...	4
" " green, ...	4
" " red, ...	4
Protractors, pencil point, ...	4
Tape, adhesive, rolls, ...	4
Tripods, wood, folding, ...	2

OFFICE EQUIPMENT

Army Regulations	1
Defensive Measures against Gas .	32
Desk, field (Unit A).....	1
Desk, field, (Unit B).....	1
Engineers, Field Manual, ...	5
Engineers Training Manual, ...	5
Field Service Regulations	3
Infantry Drill Regulations.....	5
Manual of Courts-martial, ...	1
Dictionary, French-English, large	1
Manual Interior Guard Duty, ...	5
Mimeograph, small type, portable	1
Non-commissioned Officer's Manual	32
Small Arms Firing Manual, ...	3
Typewriters, Underwood, 10"Carriage	2

WORKSHOP EQUIPMENT

Anvils, 150 lbs.	2
Aprons, leather, ...	2
Bolt cutters, 1/2", ...	2
Bolt cutters, 5/8",.....	2
Brace, carpenter's	1
Chain Block, 3 ton, ...	1
Chisels, cold, 1/2"	12
" " 1", ...	12
Calipers, outside, 6" pairs, ...	1
" inside, 6" "	1
Chisels, square, hot, 1", ...	2
Drills, post, 15", ...	1
" Yankee Breast, double speed, three jaw chuck No.44.	2
" " small for drills ranging 1 to 60	2
" Morris, straight shank, twist size from 1 to 60...	1
" 1/4" straight shank	6
" 5/16" " "	6
" 3/8" " "	6
" 7/16" " "	4
" 1/2" " "	4
" 5/8" Square shank twist drills,.....	2
" 3/4 " " "	1
" 7/8 " " "	1
" 1" " " "	1
" to fit Post Drill Chuck 3/16"	6
" " " " " 1/8"	6
" " " " " 1/4"	6
" " " " " 5/16"	6

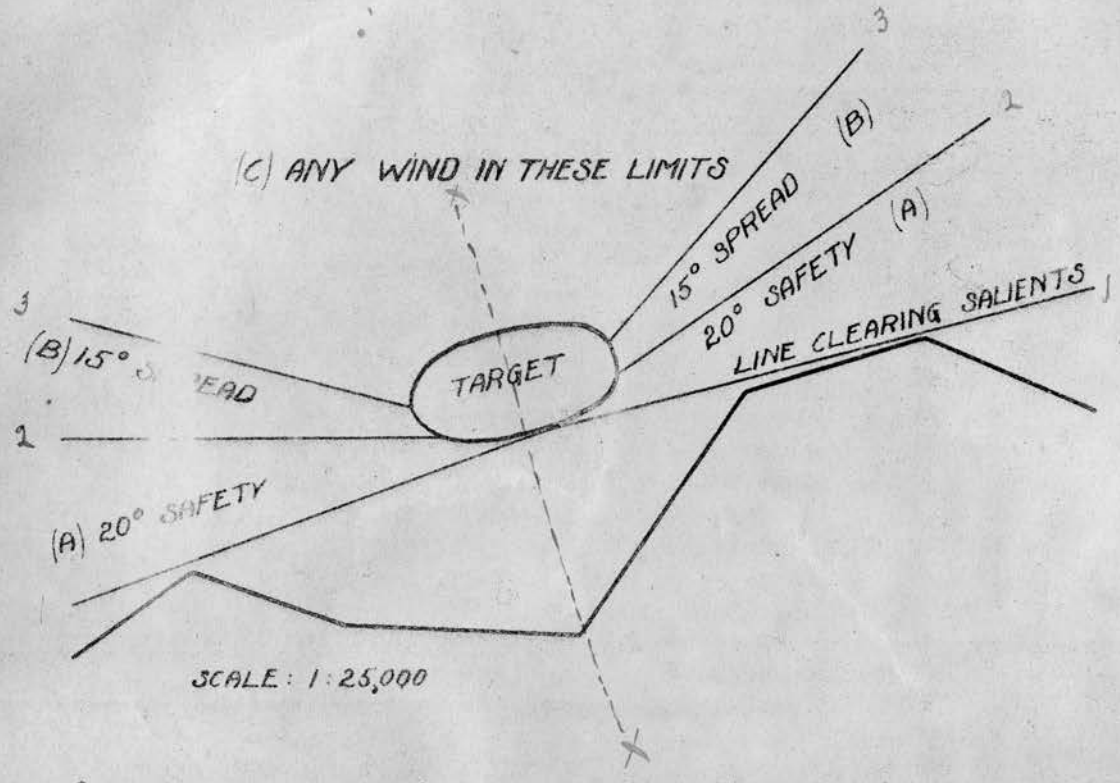
Article.	Amount.
Drills to fit Post drill chuck 3/8" ...	6
" " " " " " 7/16" ..	2
" " " " " " 1/2" ...	2
" " " " " " 5/8" ...	1
" " " " " " 3/4" ...	1
" " " " " " 7/8" ...	1
" " " " " " 1"	1
Dies and Taps, sizes from 1/8" to 2" .. pipe set	1
Dies and Taps, U.S. Standard machine screw, set, sizes, .. 5/15", 3/8", 7/16", 1/2", 5/8", 3/4" 7/8", 1", ...	1
Dividers, pairs, ...	2
Dies and Taps, U.S. set of Standard thread 1/4", 5/16", 3/8", 7/16", 1/2", 5/8", 3/4" 7/8", 1", ...	1
Forge, medium size, ...	1
Flatters, ...	2
Files, flat bastard, 16", ...	3
" smooth, 16", ...	2
" half-round bastard, 16", ...	2
" flat bastard, 14", ...	3
" round bastard, 12", ...	2
" " " 8", ...	2
" square bastard, 16", ...	6
" " " 12", ...	6
" knife, 6", ...	6
" warding, 4", ...	6
" Mill, 12", ...	12
" " 8", ...	12
" " 6", ...	12
" Half round bastard, 8", ...	12
" " " " 6"	12
" Mill Flat, 4", ...	6
Fuller set up to 2 3/8" size, ...	1
Grease gun, Towsend, ...	12
Handles, assorted, file, ...	24
" hammer, assorted, ...	12
" file, assorted, ...	6
Handles, ...	2
Hammers, sledge, 12-lbs.....	3
" ball pien, 2-lb.....	12
" ball pien, 1-lb.....	12
" cross pien, 2-lb.....	2
" " " 3-lb.....	2
" " " 4-lb.....	2
" set, ...	2
" ball pien, 3-lb.....	6
" flat pien, 2-lb.....	6
Hack saw frame, 12", ...	3
" " blades, medium tooth, 12",	Doz.6

WORKSHOP EQUIPMENT (CONTINUED)

Article.	Amount.
Hammer, sledge, with flat pien, 12-lb.	1
Heading tools, set of six, set	1
Oil can, 1 pint,	1
Oil stones, carborundum,	4
Punches, 1/8",	12
" bolt, 3/8",	2
Pliers, combination, 6",	12
" cline, 8",	12
" " 6",	12
" gas, 10",	12
" " 12",	6
Rule, 2 ft. 4 fold,	1
Rules, Stanley, joined, 6 ft.	2
Solder irons, 2-lbs	2
" " 1-lb	2
Scale, combination steel, Starret, 12"	1
Scale, steel Starret, 6",	1
Snips, tin, 14", pairs,	2
Scrapers, bearing set,	1
Scrapers, carbon, sets,	2
Swedges, size 3/8" to 1 1/4", set,	1
Square, carpenters,	1
Screwdrivers, 3",	6
" 6"	12
" 8"	12
" 12"	6
" 16"	6
Tongs, blacksmith, straight,	2
" gad, 3/4" to 1",	2
Torches, blow, gasoline,	4
Vise, blacksmith, 70-lb.	1
Valve setting tools, 1 set of gas engine	1
Vise, machinist's, 4",	1
" " 6",	6
Wrench, monkey, 18",	2
" " 12",	6
" Stillson, 8",	12
" monkey, 8",	6
" Stillson, 10",	12
" " 14",	12
" " 18",	6
" " 24",	2
" Monkey, 10",	12
" " 16",	4
" " 24",	2
" Westcott or adjustable, 6",	12
" " " 8"	12
" End to No. 27,	12
" " " " 25,	12
" " capscrew and nut, A.L.A.M. set, size, 1/4" - 1"	12
" End U.S. Standard, capscrew and nut size 1/4" to 1 1/2",	6 sets.
Welding outfit, portable, oxyacetylene,	1

PROJECTORS STOKES MORTARS

VELOCITY OVER 3 AND UNDER 12 M.P.H DIRECTION, EXAMPLE DIAGRAM



(A) 20° IS THE ANGLE OF SAFETY - MEASURED **FROM** A LINE FROM THE TARGET CLEARING ALL THE SALIENTS WITHIN FIVE KILOMETERS ON BOTH SIDES.

(B) 15° IS THE ANGLE OF SPREAD MEASURED **FROM** THE INTERIOR SIDES OF THE SAFETY ANGLES.

(C) THE REMAINING ANGLE GIVES THE WIND LIMITS FOR THE OPERATION.

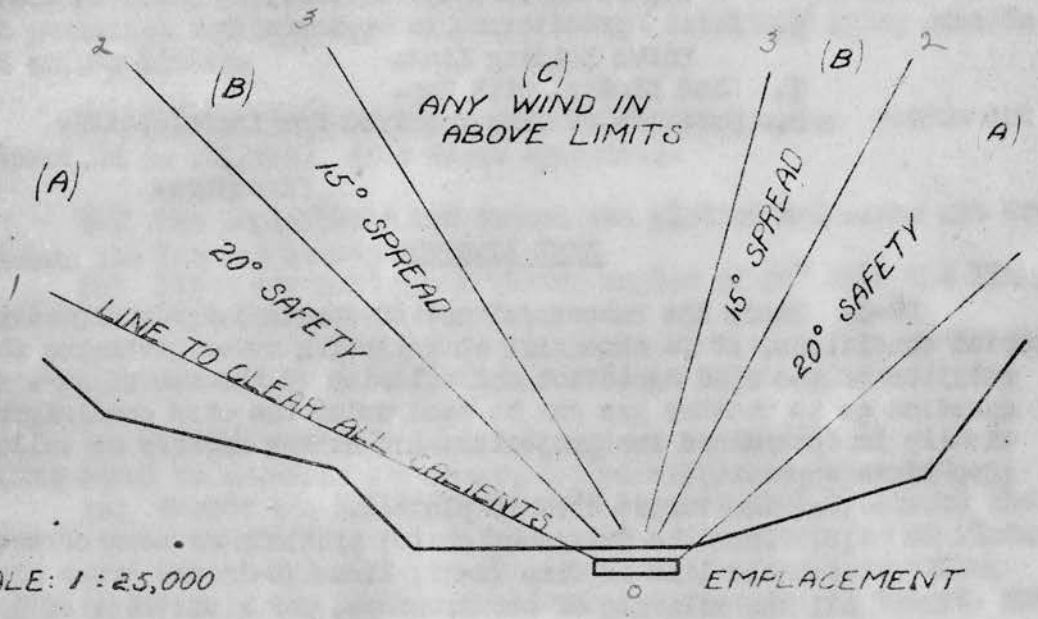
SAFETY WIND LIMITS

OFFENSE DIVISION, ENG SEC, C.W.S. Nº 5594

CYLINDERS

VELOCITY OVER 3 UNDER 12 M.P.H.

DIRECTION SEE DIAGRAM



SCALE: 1 : 25,000

(A) 20° IS THE SAFETY LIMIT - MEASURED FROM A LINE FROM EMPLACEMENT PRODUCED TO CLEAR ALL SALIENTS IN OUR OWN LINES WITHIN 10 KILOMETERS – ON EACH SIDE

(B) 15° IS THE SPREAD OF THE CLOUD MEASURED WITHIN THE ANGLE ENCLOSED BY THE INTERIOR SIDES OF THE SAFETY ANGLES

(C) THE REMAINING ANGLE GIVES THE WIND LIMITS FOR THE OPERATION

SAFETY WIND LIMITS

OFFENSE DIVISION, ENG. SEC, C.W.S. Nº 5536

PROJECTS

88. After receiving the reconnaissance report the unit commander prepares a project. This is submitted to Division Headquarters for approval. (see paragraph 68).

The project generally covers the following points:-

1. Map reference.
2. Object of Proposed Operation.
3. Emplacements and Target.
4. Location of Billets Desired.
5. Assistance or material needed from Division, (Transport, carrying parties, etc.)
6. Safety precautions to be taken by Units holding Line.
7. Wind Limits, with Map.
8. Estimate of Time Required for Installation.

Signature.

WIND LIMITS.

88-A. Since the successful use of gas is largely dependent upon wind conditions, it is essential to establish rules governing the relation of the wind direction and velocity to the use of gas. The question as to whether gas can be used under the wind conditions of the day is determined for projectors and Stokes mortars as follows: (See Plate opposite).

(a) The target area is plotted.
(b) From the intersection (O) of the near edge of the target with the line of fire (x-x), lines (O-1) are drawn clearing all the salients of our trenches, for a distance of 5 kilometers on both sides of the target.
(c) Lines (O-2) are then drawn making angles of 20° with lines (O-1). These angles (A) are the angles of safety.
(d) Lines (O-3) are next drawn making angles of 15° with lines (O-2). These angles (B) are the angles of spread, over which the gas may be expected to diffuse.
(e) The angle (C) remaining between lines (O-3) gives the wind limits for the operation.

If the direction of the wind is within these limits and its velocity is between 3 and 12 miles per hour the operation may take place; if otherwise, it should be postponed.

If the gas is to be discharged from cylinders, the wind limits are determined as follows: (See Plate opposite.)

(a) The cylinder emplacement is plotted.
(b) From the center of the emplacement (O), lines (O-1) are drawn to clear all salients in our own lines, for a distance of 10 kilometers on each side of the target.
(c) Lines (O-2) are then drawn making angles of 20° with lines (O-1). These angles (A) are the angles of safety.
(d) Lines (O-3) are next drawn making angles of 15° with lines (O-2). These angles (B) are the angles of spread.
(e) The angle (C) remaining between lines (O-3) gives the wind limits for the operation.

If the direction of the wind is between these limits and its velocity is between 3 and 12 miles per hour the operation may take place; if otherwise, it should be postponed.

SAFETY LIMITS

88-B. Since both Stokes mortars and Livens projectors are more or less crude forms of artillery, they have large dispersion of shots, both in range and deflection. Moreover, due to defective propellants, etc., shorts quite frequently occur. These short shots may fall only one or two hundred yards from the emplacement and if the fuse is armed they explode and become a source of danger to our own troops. It therefore becomes necessary in conducting Stokes and Livens projector operations to prescribe certain safety zones for our own personnel and to remove all troops from territory lying outside the safety limits.

The safety limits for Stokes and Livens projector shoots are determined as follows: (See Plate opposite).

(a) The emplacement and target are plotted and lines are drawn between the lateral limits of each.

(b) Lines are next drawn making angles of 10^{0} with the lines joining the emplacement and target.

(c) A second pair of lines is next drawn from the emplacement making angles of (10^{0} + 30^{0}) with the lines from emplacement to target.

(d) With the center of the target as a center, and with a radius equal to one-half the range, a semi-circle is described.

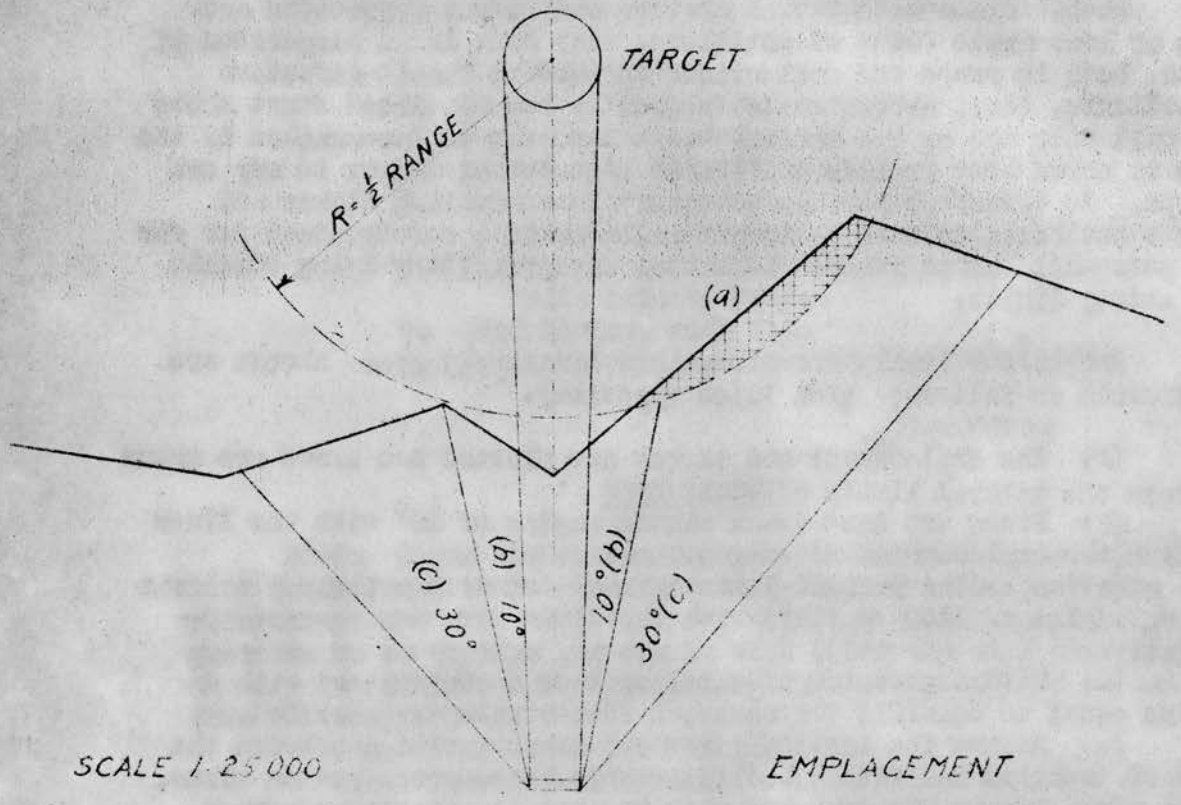
(e) Remove the Infantry from all areas included between the line of trenches and the arc of the circle. See areas "a" on Plate.

(f) Remove all men from the area between the lines making angles of 10^{0} with the lines from the emplacement to the target. See areas "b".

(g) All men should wear box respirators in the area between the lines making angles of (10^{0} + 30^{0}) with the lines from the emplacement to the target. See areas "c"

(h) In order to avoid moving men, it is often advisable to place the guns nearer the trenches than the target is; that is, to choose a range that is less than twice the distance from the target to our own trenches.

PROJECTOR STOKES MORTAR



SCALE 1-25 000 EMPLACEMENT

(A) REMOVE INFANTRY FROM THE AREA INCLOSED BY AN ARC HAVING FOR A CENTER, THE CENTER OF THE TARGET AND A RADIUS EQUAL TO ONE HALF THE RANGE.

(b) REMOVE ALL MEN FROM THE AREA BETWEEN THE LINES MAKING AN ANGLE AT THE EMPLACEMENT OF 10° WITH THE LINES FROM EITHER END OF THE EMPLACEMENT TANGENT TO THE TARGET.

(C) ALL MEN TO WEAR BOX RESPIRATORS IN THE AREA INCLOSED BY THE LINES MAKING AN ANGLE OF 10°+30° WITH THE ABOVE LINES.

TO AVOID MOVING MEN TAKE RANGE THAT IS LESS THAN TWICE THE DISTANCE OF THE TARGET FROM OUR FRONT LINE TRENCHES.

SAFETY LIMITS

OFFENSE DIVISION, ENG. SEC. C.W.S. 5597

RECONNAISSANCE REPORTS

89. After reconnoitering a position, a reconnaissance report is made out, giving the following data:-

1. Reference map.
2. Division holding line.
3. Targets with map reference, and occupation.
4. Emplacement positions with map reference.
5. Recommend:
   No. of Projectors. Stokes Mortars. Bombs. Cylinders
   2'6" - 2'9" - 4'0" No. and kind of each. No.
6. Number of batteries and angle of fire of each battery.
7. Wind limits.
8. Billets for men; map reference.
9. Company dump with map reference. Method of getting material from battalion dump to company dump.
10. Detailed description of method to be used in taking material forward from the company dump to the battery position. Give route to be followed, number of trucks (3-Ton), light railway trucks, number of push trucks, etc., necessary; number of infantry carrying party necessary and length of time that the party will be used; map reference of all advanced dumps; time necessary to take the material forward; work that is to be done during the night, and that during day-light. Number of company men to be used in taking the material forward.
11. Battery positions, number of men necessary to install; work done at night or during daylight. Time necessary.
12. Total number of lorries necessary and length of time they will be used.
13. Total time necessary to complete the job.
14. Total number of men and officers necessary to complete the job.
15. Camouflage necessary; kind, color, etc.
16. Position of Company Commanders, Section Commanders, giving map reference, telephone number or name.
17. Communications from battery position to Company Commanders and to Battalion Commander if necessary.
18. Infantry Brigade, Regimental, Battalion, and Company Headquarters, with map reference and telephone number.

Signature.

OPERATION ORDERS.

90. These orders are issued by the officer in charge of an operation, after approval of his project, and generally so as to reach all organizations concerned about six hours before zero.

Operation orders cover the following points:

1. Map references.
2. Company operations, and purpose of operation (target).
3. Installation, giving map reference of emplacement; number of guns; ammunition, etc.

4. "D" Day and "H" hour if decided. It is usual to state "at a day and hour to be given later".
5. Discharge orders.
6. Wind limits - direction and velocity.
7. Safety precautions; cleared areas, and box respirator areas.
8. Synchronization of watches. Place and hour.
9. Liaison and code words. This includes location of various P.C.'s and routine messages, such as wind, readiness, etc.
10. Action after zero hour. Camouflaging.
11. Copies to _____

OPERATION REPORT

91. Immediately after an operation, reports are rendered to units concerned, usually Corps and Divisions.

The type of report rendered is shown on the following form:

OPERATION REPORT Serial No.___
to
C. O. First Gas Regiment. _____ 1918.

Reference Maps.

1. Headquarters _____
2. Gas units operating _____
3. Corps, Division and Brigade to which attached _____
4. Purpose of operation _____
5. Wind limits _____
6. Map reference of emplacements _____
7. Map reference of targets _____
8. Enemy regiments affected _____
9. "D" Day _____ "H" Hour _____
10. Wind direction and velocity: weather conditions _____
11. Number installed. Cylinders. Projectors. Stokes Mortars. (and type of gas used)

_____
_____
12. Number fired _____
percentage fired _____
13. Reason for discrepancies (in any)
14. Enemy action before, during and after attack.
15. Casualties. (Names of Officers, regimental numbers of other ranks, (since reconnaissance)

_____
16. Time taken and men employed on operation _____
17. Infantry assistance obtained for operation _____
18. Remarks.
19. Operation order and map attached. (should be sent previously when possible).

Copies forwarded to:
_____
_____
_____

Signed.
C.O. _____

TACTICAL USE OF GAS, THERMIT & SMOKE BY GAS TROOPS

GAS

92. The amount and kind of gas used by gas troops should conform to tactical conditions, having due regard for wind and terrain conditions.

93. Gas may be correctly used as follows:

I. In an active offensive:

(a) Preceding an attack, all enemy targets should be kept under a gas atmosphere, allowing only a reasonable time for clearance before the arrival of our own troops. Only by so doing can the full benefit be derived in producing casualties, demoralization, reduction in fighting efficiency, and morale.

(b) During a temporary check of an advance, extending from a few hours to several days, gas should be used on enemy concentrations, villages, strong points, woods, reverse slopes and machine-gun nests.

(c) During organization and consolidation of the line, gas should be used as for a temporary check, with special attention to sectors from which counterattacks may be launched.

(d) During nights of an advance gas should be used on enemy supports and reserves, and on machine-gun nests and strong points.

(e) Against machine-guns just before an attack, A judicious use of gas by Stokes Mortars is the best means of handling this form of defense. Placing from two to ten bombs of phosgene, depending on wind and terrain conditions, in a machine-gun nest establishes a local concentration sufficient to kill and force enemy to wear masks or abandon guns. The gas will have dissipated sufficiently by the time of arrival of our own troops to be safe. Close co-operation between the advanced infantry units and gas troops will allow this result. Troops must become accustomed to the smell of slight concentrations of phosgene, and should be taught to advance through or around, it, just as they are trained to follow a barrage.

II. In stabilized warfare:

(a) Surprise shoots of high concentration should be used on every possible occasion, on enemy concentrations, machine-gun and minenwerfer emplacements, strong points, trench intersections, and from one end of the line to the other.

THERMIT

94. Thermit may be used under conditions similar to I (e) or II, above, when conditions of wind or terrain prevent the use of gas.

SMOKE

95. The intelligent use of smoke in modern infantry tactics offers many advantages arising from concealment and deception.

Smoke may be correctly used by gas troops as follows:

(a) To mask enemy observation posts and blind hostile machine-guns.

(b) To cover front and flanks of attacking troops. In frontal screens care must be exercised to place the smoke screen preferably on the enemy trench system, so that an enemy barrage laid on the screen will not catch our own advancing troops.

(c) As a feint to draw the enemy's attention to a front which it is not expected to attack, causing him needlessly to retain troops and expend ammunition.

(d) Deceptive screens to simulate general or local attacks. Gas should generally be used with smoke in these cases. A proper use of gas in connection with smoke screen work will cause the enemy to expect gas whenever smoke is used. This offers a tremendous advantage to our own troops.

(e) To conceal concentrations of our guns and troops, and to screen roads and movements.

(f) To cover construction of bridges and trenches in the face of the enemy.

The use of smoke should be such as to lead the enemy to expect some object other than the real one.

CHOICE OF WEAPONS

The Stokes Mortar

96. The gas bomb is adapted to any of the cases set forth ~~above~~ in par. 92 + 93. The mortar is especially useful in an active offensive where its mobility permits it to be pushed far forward and brought into operation on short notice. With efficient transport, gun teams can readily follow the reserve battalions of attacking regiments and be brought into action when required on enemy machine-gun nests or concentrations within two hours. This weapon is particularly adapted to the formation of local high concentrations, and is one of the best means of silencing hostile machine guns or minenwerfers within range.

The mortar ~~smoke~~ thermit bomb is used effectively under all conditions given in par. 95 above. The mortar smoke bomb is used primarily for its demoralizing effect, against enemy machine-guns, or concentrations within range. It is not as effective as gas, but can be used irrespective of wind directions. It may at times be used where conditions are unfavorable for smoke, or in addition to smoke, on strong points, trench intersections, and machine-guns. It has a considerable terrorizing effect.

THE PROJECTOR.

The projector gas drum, with its thirty pounds of gas, is an excellent weapon for producing high concentrations in surprise shoots. It is especially effective against enemy concentrations, in villages and woods.

Due to its longer range, it can be used when Stokes mortars cannot, On the other hand, the weight and bulk of the equipment hinder its use on a rapidly moving front. With a length of carry not to exceed 500 meters from the limit of motor traffic to the emplacements, from 100 to 150 projectors can be installed and discharged in one night by one company. This makes the projectors an efficient weapon during temporary checks, or during organizations and consolidation of the line.

Projector drums filled with high explosive may be used whenever wind conditions prevent the use of gas. They contain large charges in a case which is much lighter than an artillery shell, and are very deadly against troops in the open. They may also be used to demolish wire.

Projector drums may be also filled with oil, but as such, have not yet been used by our troops. They would be useful in burning woods, or as a demoralizing agent when gas could not be used.

CYLINDERS.

A cylinder gas attack against suitable targets is undoubtedly the most effective means of using gas. High concentrations may be established over wide areas, and to depths of 10 or 15 kilometers. Even when the enemy has been aware that an attack was probable, there have been casualties amounting to nearly 10% of the enemy forces in the area affected. In addition, the gases, being highly corrosive in high concentrations, attack the metal parts of all guns and rifles.

A cylinder attack, with a suitable wind, may be made immediately preceding an attack along the entire front. It can be closely followed by the infantry and will succeed in thoroughly breaking the defense.

97. SELECTION OF WEAPONS.

The determination of the kind of gas attack to execute depends premarily upon the time available, nature of terrain, and target, range, and wind. The selection of weapons should, therefore, not be made until after a thorough tactical study of the situation.

TRAINING OF GAS TROOPS

98. In the training of gas troops it must be kept constantly in mind that they are strictly fighting troops who will be required to carry on their operations in the foremost areas. They must be trained to insure correct technical execution with their special equipment, as well as to know how to handle themselves in action as Infantry, and take care of themselves in all emergencies of front line work.

The course as outlined herein is of the most intensive character, but must be considered of an emergency nature made necessary in order to place troops in action at the earliest practicable moment.

In addition, the assumption is made that the troops are organized and equipped, have a full complement of officers and at least half of their non-commissioned officers, and that they have received preliminary instruction, including the simpler close order movements up to and including the Battalion Parade.

99. The course is divided into two phases, the first consisting of eight weeks and the second, four weeks. The first phase consists of the school proper and is divided roughly as follows:

(a) Four weeks or forty-four drill periods devoted to special training in the use and operation of the special equipment.

(b) Two weeks or twenty-two periods devoted to Infantry training.

(c) Two weeks or twenty-two periods devoted to target practice, instruction and firing.

The second phase covers four weeks during which platoons or sections will be attached to units of experienced troops actually operating at the front. During this phase troops under instruction will assist the experienced troops by providing additional labor and gradually working into the operations, fixing the work of the first phase definitely in all details, under the conditions met with in actual operations at the front. Where it is impossible to do this, an additional four weeks should be allowed and the entire phase used in improving discipline, technical execution, and the carrying out of operations under all simulated conditions, of front line work.

PRINCIPLES TO GOVERN THE TRAINING

100. Underlying all instruction must be a keen fighting spirit. Both officers and men must be made to appreciate from the very start that the ultimate and sole object of the work of this organization is to produce enemy casualties and assist other organizations to produce enemy casualties. Its success and value to the Army and our country can be measured directly in enemy casualties.

Officers and men must appreciate that absolute discipline, and compliance with orders and instructions are not only essential to greater direct success but also afford the only real means of protection against large casualties in our own personnel.

Officers and men must not be allowed to drill in an indifferent or aimless manner. The picture of actual combat must be kept in the mind of the instructor and transmitted to those undergoing instruction.

Lectures will be reduced to a minimum, made brief and whenever possible given in connection with explanations and demonstration of equipment in the field.

Gas defense training will be continued during the entire course of training, using any available time and under conditions which will leave every man capable of protecting himself in extreme emergency.

SCHOOL PHASE.

101. It is essential that the officers who are to actually lead the troops be trained with them, and know their men. This necessitates dividing the personnel into six classes, dividing along tactical lines of the units where possible. These classes are as follows:

Class A. One-half of commissioned personnel.
Class B. One-half of commissioned personnel.
Class C. One-half of non-commissioned personnel.
Class D. One-half of non-commissioned personnel.
Class E. One-half of remainder of units.
Class F. One -half of remainder of units.

Classes, A, B, C, and D, will be given sufficient actual field training with the special equipment to insure not only a thorough understanding, but also correct mechanical execution. Officers will be trained separately from the other ranks, and will be required to actualy handle and carry loads, use the pick and shovel, and do all the practical work. They will also carry out operations including transportation of material, both before and after the operation.

GENERAL TRAINING.

102. Throughout the course of instruction the strictest attention will be paid to discipline, the routine administration of the units, and in as far as possible, the routine functioning of officers and men.

Strict attention will be paid to the performance of guard duty. Messing arrangements will be carefully supervised and additional training given in the handling of rations. Billeting of the men will be given careful consideration. Sanitation and proper policing will be carefully watched. Bathing of the men will be done by schedule and supervised.

In the general training, stress must be laid on the absolute necessity of learning routine administration, the proper handling and care of men under the better conditions of the rear areas, or training camps, so thoroughly that both officers and men will be able to take care of themselves under the adverse conditions of front line work. Discipline and insistence on the performance of every detail of this work is essential.

EQUIPMENT AND SUPPLIES

103. Chiefs of parties will anticipate their needs and place requisitions well in advance of time required, to insure delivery at advanced dumps. The minimum allowance of ammunition is as follows:

	Stokes Mortars. Live - Dummy		Projectors.
Officers -	20	20	5
N.C.O.'s -	10	10	2
Men -	5	5	1

The Stokes Mortar ammunition will be furnished in the following proportions:

Phosphorus	2.
Ranging	1.
P.S.	1.
Thermit	1.

Instructors will insure accuracy of operations before expenditure of live material. In the use of live material every effort will be made to approximate actual conditions at the front, giving due consideration to tactical use.

DETAILED INSTRUCTION

104. Instructors will be required to prepare and carry out the actual instruction in accordance with their experience and all information available, with due regard to prescribed standard practices. Instructors will not introduce personal specialties until approved, or endeavor to cover little used schemes. Instruction must be clean cut and definite, covering fundamentals and leaving variations and changes to be worked out in the field.

The working out of definite schedules covering the training should be made by the officer in charge of the instruction in advance, for the entire period of the school phase. With definite information as to the length of time available and with all other conditions known, it will be possible, using the outlines which will follow, to cover the entire course. It can be covered in the outlined time, if the work is organized and every officer and man is required to give his entire time and thought to it.

By dividing the two classes of personnel into two sections it is possible to have one-half the officers and non-commissioned officers with the men during all periods of their training, and, by making the instruction progressive, that is, training the officers and non-commissioned officers first, they can be used to supervise the work of the men; for instance, in Stokes mortar work, one-half of the officers and non-commissioned officers can be given training in Stokes mortar bombs, their construction and weights, and the same instruction to the men in the afternoon with these officers and non-commissioned officers present actually supervising the work of the men.

Evening conferences followed by written quizzes should be held for officers five nights a week during the entire period of training.

Classes along similar lines should be held for non-commissioned officers, except when night marches and operations prevent.

Attention is again brought to the importance of absolutely correct execution of every detail of training, whether it is insistence on the observance of military courtesy, proper feeding of the men, sanitation, guard duty, march discipline, preparation of ammunition, care of equipment, and the work in the field actually simulating front line conditions. In operations in the field men will be required to wear shrapnel helmets and carry gas masks properly adjusted.

First aid stations will be established in their proper relative positions in accordance with the assumed tactical disposition, and the Medical Department will be required to function as it would under actual front line conditions.

In the preparation of problems ingenuity will be utilized so as to make no two problems the same, and every effort will be made to develop resourcefulness and ability to carry on uder all conditions.

Officers must be made to realize that the only too limited training and experience, which they will be able to get in the short time available, will not only tax their abilities to the utmost when they take their units into action, but also that once in action mistakes are inexcusable and are measured in the lives of their men.

In night work both the officers and men must be trained to carry out the operations on the darkest nights over unfamiliar ground, carrying parties must actually carry their loads properly to a definite destination, having the same checked carefully before starting, during the march, and at the destination.

In the outline to follow short synopses will be given covering points which must be included in the instruction and which are pertinent to this special service.

105. INFANTRY TRAINING

1. Physical Training.
2. School of the Squad.
3. School of the Platoon.

In the work of the gas troops the platoonis the working unit and it should be an entirety in itself. It should be trained as a unit and should work together. It should be so organized that it can undertake independent operations.

4. School of the Company and the Battalion.

Ceremonies should be given a prominent place in the schedule. As the training progresses and the units are split up undergoing technical training, the parade and review offer the best means of keeping the men set up and snappy.

5. Guard Duty.

Formal guard mounts should be held, especial care must be taken in the instruction of sentinels; they must be made to realize the serious nature of their charge when posted as sentinels, in time of war. Any laxity in the training area may result in the gravest offense in the forward area.

6. Extended Order.

In the close order work correct execution should be the keynote, This should be obtained at once, and the extended order taken up at the earliest opportunity, maintaining just sufficient close order work to keep the men set up and in hand. Extended order instruction should progress as rapidly as is consistent with correct execution to field maneuvers with especial reference to service of security, patrolling, inter-communication and thorough control.

7. Full marching order.

In forward areas the men will be required to make many marches under full pack, frequently bivouacing in the open. They will be trained how to carry the essentials, and only the essentials, as well as how to go into bivouac and take care of themselves. Only by doing this frequently, and under the closest supervision, will it be possible to carry on efficiently forward where every ounce of energy of both officers and men must be conserved.

8. Fighting Order.

Men should be required in all field operations to go equipped as they would actually go into action with the exception of rifle ammunition, which should be used during the last week of their training but after they have had range practice. An itemized statement showing fighting order is attached as Exhibit A.

9. Gas Defense Training.

In the first drill periods careful instruction must be given in the correct mechanical adjustment of the respirators. This instruction must be followed up during the entire period of training by frequent drills so as to insure prompt and correct adjustment under all conditions. This is of special importance in night work, and night marches should be made with the respirators adjusted. Men should be trained to fire Stokes mortars with respirators adjusted. Instructors will pay special attention to requiring the men to adjust the mask at odd times when engaged on other work, such as digging-in projectors, carrying material forward, and the like.

The use of a mild lachrymator will materially assist in showing the importance of this work and assist in checking up delinquencies.

10. Lectures.
(a) Military Courtesy.
(b) Organization of the Regiment, Battalion, Company and Platoon, Spirit of the organization.

(c) Sanitation.
(d) First aid in case of battle wounds.
(e) Care of Gassed cases.
(f) Articles of War.

TARGET PRACTICE INSTRUCTION.

1. The rifle and its care.
2. Position, aiming and trigger squeezing drills.
3. Range practice.

The importance of target practice cannot be over-emphasized. At least a fourth of the command should be kept at this work during the entire time of the training.

4. Estimating of distances.

This should not be perfunctory, but the men should be actually trained to estimate distances correctly and the work should be included during the entire period devoted to target practice, utilizing the time when the men are not actually firing or taking care of their rifles. Officers will be required to estimate distances in connection with Stokes mortar operations in war of movement. This training should be supplemented by work in the trench mortar training.

TECHNICAL TRAINING

106. This work is outlined in periods covering the work which should be presented to the officers and followed by an outline covering the sequence to be taken up in the training of the units.

107. 4" TRENCH MORTAR.

1. (a) The mortar, its construction, weight of the various parts, method of setting up, and explanation of its operation.
(b) Mortar Drill.
(c) Dummy loading.
(d) Explanation of range tables.

2. (a) Bombs, their construction, contents, and weights.
(b) Propellants and ranges obtained.
(c) Fuses and fuse setting.

In this work equipment should be used supplement by drawings and cross-sections of the actual material.

3. (a) Construction of emplacements, and the importance of good solid foundation for base-plates.
(b) Setting up mortars and firing same.

4. Map reading, laying out lines of fire with map, protractor and compass.

All officers and the senior non-commissioned officers must be thoroughly trained in map reading.

5. Characteristics of the active materials used in the bombs.

6. Tactical use of Trench mortars.

(a) Smoke and Thermit.
(b) Gases.
(c) Precautions to be taken in the use of the materials.

7. Drawing, cleaning and testing mortars and ammunition and their preparation for action.

(a) Gun inspection and checking up of guns and tools.

Inspection must not be slighted. Tools should be definitely assigned to the different members of the gun teams and they must be required to accept the responsibility for them. Any laxity in this feature is sure to result in the handicapping of operations sooner or later at the front.

8. Methods of making reconnaissances and points to be observed.

9. Preparation of personnel, guns, and ammunition for action.

(a) Duties of all ranks in action.

10. Operation orders and operation reports.

11. Actual firing by day and night simulating actual front line conditions in accordance with assumed tactical situations.

Officers should be given a written examination at the completion of the training with each weapon.

12. Training of the men should be taken up in the following sequences,

1. Explanation of setting up mortars.
2. Trench mortar drill, practice in loading with dummy mortars.
3. Lectures on propellants, bombs and ranges, Recapping and cleaning of shells and fuses.
4. Digging-in base-plates, setting up guns, camouflage.
5. Firing with reduced charges.
6. Firing full charges.
7. Complete installation and laying down a smoke barrage.
8. Firing at night.
9. Actual carrying out operations, both day and night, up to and including the use of live materials.

PROJECTORS.

108. History of the projector, its development, construction, and effectiveness.

Explanation of the material used in the construction of gun;

base-plate, propellant, charge box, lead wire, and exploder.

Explanation of construction of drums, fuse head, gaine, detonator, and contents of bombs.

Weight and dimension of the gun and accessories. Range with various charges.

Methods of installation, connecting up, and firing.

Lines of fire, by map, protractor and compass. Laying out of battery base lines, Digging of battery trenches.

Careful account must be taken of the nature of the ground and the time required to make a normal installation. By choosing different sites it will be possible during the course of training to obtain a definite idea as to the time required to make installations in the forward area. This will be of the greatest assistance in planning operations and estimating correctly the time required to carry them out.

Installing guns and checking lines of fire with a compass, and elevation with clinometer.

Handling of drums, fuses, detonators, charge boxes, and exploders.

Assembly of drums, of gaine tubes and detonators.

Cutting of fuses, Loading Guns.

Wiring of batteries, including drill with exploders.

The greatest care must be exercises in this training, and a thorough system worked out. One of the greatest sources of trouble in actual operations is in not having the wiring correctly done, or in getting the wiring of several batteries mixed up. Careful training must be given in the use of the exploder and special men trained in its use.

Testing of circuits and drawing safety pins.

Disconnecting batteries, unloading, and storage of drums and charge boxes.

In the handling of live materials in the forward area special precautions must be taken to prevent the accumulation of large quantities of drums in an explosed position. Dugouts or protected locations must be found.

Testing exploders, charge boxes before placing in tube, battery connections, battery connected to lead wire, with explanation covering galvanometer, resistance box, and resistance of the different elements.

Instruction in the complete installation of batteries ready to fire under different conditions of terrain and weather, including work at

night.

Characteristics of the active materials used in the drum.

Tactical use of projector.

Location of emplacements, wind limits and safety zones.

Methods of making reconnaissances and points to be observed.

Preparation of personnel, guns and ammunition for action.

(a) Duties of all ranks in action.

Operation Orders and Operation Reports.

Organization of a complete projector attack.

This will include the initial reconnaissance with a decision as to emplacement positions; number of batteries; method of transporting material, by trucks, rail, animal, or personnel; routes to be used; location of nearest Headquarters with telephone; location of our own front line or outposts; arrangements for withdrawal of infantry; estimates of time required; making out list of material and drawing same; organization of materials, installation; carrying on of liaison; meteorological work, camouflage; testing; firing; inspection for duds, firing same; leaving position; preparation of necessary reports; and salvage of material.

Training of the men should be taken up in the following sequence:

1. Parts of the projector, drums, and all accessories.
2. Digging of projector trenches, placing and sighting of projectors.
3. Preparation of charges and fuses.
4. Wiring and firing.
5. Organization of carrying parties and their training.
6. Training in the use of the testing apparatus and exploders.
7. Complete installation of single battery including camouflage.
8. Carrying out complete projector operations under different conditions of terrain and lengths of carry.
9. Carrying out of complete projector operations in keeping with assumed tactical situations at night.

109. CYLINDERS.

The cylinder, its construction, weights of the various parts, and explanation of its operation.

Instruction in handling, installation, connecting up, and firing.
Characteristics of the active materials used.
Tactical use of cylinders.
Reconnaissance and arrangements for a cylinder attack.
Preparation of personnel and all materials for carrying out of cylinder attacks.

Field work in actually carrying out cylinder attack.
Operation Orders and Operation Reports.
Organization of a complete cylinder attack, with its execution in every detail.
Training of the men should be taken up in the following sequence.

1. The cylinder, its construction, and explanation of its various parts.
2. Wiring and connecting.
3. Installation of batteries and firing.
4. Preparation and carrying out small operations.
5. Carrying out larger operations, with special attention to the handling of material over considerable distance and an extended front.
6. Operation in keeping with an assumed tactical situation at night.

110. SPECIAL INSTRUCTION FOR OFFICERS.

In the conference and by special lectures, special training can be given to the officers covering the detail of their work which applies to efficient fighting of the organization. Such subjects as meteorology and liaison, making of reconnaissances, preparation of orders, and the writing of reports are common, in general principles, to all operations.

The training should be sufficiently thorough as to make an officer ready to go into a Division Headquarters, state his business, and from there on down through Brigade, Regiment, and Battalion, making all necessary arrangements, carrying out the necessary reconnaissances, organization of the complete operation and carrying it through to a satisfactory completion which in all cases must be in full accord with the plans and existing situation confronting the unit with which he is working.

In addition to supplementing the work as outlined above, special subjects with notes are given below.

111. A SPECIAL LECTURE.

(a) Importance of supporting senior officers at all times.

(b) Necessity of cheerfulness, especially in action, and in the presence of enlisted men when under severe conditions.

(c) Speed in all preparatory work as far as is consistent with thoroughness. This can be done by making careful plans beforehand for any work in course of operation.

(d) Knowing where all enlisted men are and being able to have a platoon turned out quickly for duty and in proper fighting order.

(e) Personal knowledge of the sector on which the company is operating especially the motor truck roads, horse-drawn wagon roads, railheads and termini of trench tramways, distances of mule tracks or trails, distance of hand carrying for personnel.

(f) Ability to look ahead and provide for unforeseen contingencies. Give instances of guides going astray; traffic choked on roads; loss of time in getting command ready; not making proper rendezvous for infantry carrying party; not making proper reconnaissances in daylight and losing time in finding way at night; not drawing supplies complete, and having to go back for same; leaving the carrying till the last night before the attack, and then having all "up" trenches blocked by infantry when same could be avoided; leaving work until last night, and then being rushed; overloading of motor trucks in bad weather; failing of material to arrive in time; not selecting good men for guides and runners; bad liaison; despatching supplies without proper guides and with insufficient instructions.

(g) Personal interest in all matters affecting billets for men, their health, food, clothing, and sanitation.

(h) Giving good men every encouragement for advancement, and "sorapping" unreliable non-commissioned officers.

(i) Careful supervision of work and realizing that the officer is personally responsible for his subordinates. Responsibility cannot be delegated to non-commissioned officers unless officer becomes a casualty.

(j) Officers must not discuss their business in the presence and hearing of clerks or enlisted men. Orders can be issued to non-commissioned officers and men when the final course of action is decided upon.

112. ORGANIZATION OF THE DIFFERENT ELEMENTS OF AN ARMY.

The officers should be given a complete explanation of the functioning of the elements of an Army, such as Corps and Division Headquarters. This should be covered in detail, as to when to take up questions of operations, intelligence and supplies. They must be made to realize that in the conduct of active operations every man in the unit has definite duties to perform, that it is necessary to see the right man, state the business explicitely, and generally work into the organization so as always to be of assistance and never a hindrance. Only in exceptional cases is it warranted to request special consideration or break into the regularly established functioning of the larger organization.

113. Liaision.

It is important to select smart intelligent men as runners. They will be men who are above the average in soldierly qualities, but not mature enough for non-commissioned rank.

They will receive the same training as other enlisted men, but when they have learned the technical work and drill, they will be given special instructions in map reading, use of the compass, finding their direction at night, and carrying verbal messages from Battalion or Company Commanders to Company Officers without any alteration.

During practice operations on the training ground they will be used by the officers in conveying code messages relating to the operation and they will be practiced at night, getting across country after dark.

Each officer will select and train two runners for his own use. He will be responsible that these men are fit for the job, and that they realize the importance of the duties in hand.

When companies move up to battle positions, these men will be required to accompany officers on reconnaissances of the advanced line, to act as guides for carrying parties, as runners attached to an assaulting battalion, or left as runners to await important messages at a Divisional, Brigade, regimental, or battalion headquarters. When on the last mentioned duty, they must not leave the message center or headquarters day or night until relieved.

They must have a good sense of direction and be able to find their way over desolate country at night with few visible landmarks.

When moving about in the advance zone an officer will be accompanied by at least one runner, so that the latter will have a thorough knowledge of the country and be in a position to convey messages from his officer at any later time to the company headquarters, or to any infantry headquarters. This is especially necessary during an operation where the officer is busily engaged in his work of preparation, and has to send back reports of progress of same.

Operation reports from platoon commanders. Importance of furnishing same without delay.

Use of telephone lines from battalion and advanced regimental headquarters; use of telegrams from divisional message centers.

Use of "Courier" dispatch services from Division M.C. to Corps M.C. and Corps M.C. to Army M.C.

Importance of complete chain of liaison from battalion to company and company to platoon or detachment for operation.

Importance of complete chain of liaison from platoon to advanced battalion when in action.

114. SERVICE OF SECURITY AND INFORMATION.

This should follow the principles laid down in the Field Service Regulations with special attention to the following:

SECRECY:

The success of these operations depends largely upon the attack being a complete surprise to the enemy. Codes must be used. Care should be exercised in the use of telephones. Telephones should not be used for conversation in "clear" or at regular intervals, as in the transmission of meteorological data. When operating with other units in the line greatest care must be exercised so as not to indicate increased activity. The regulations in force in the particular sector must be strictly complied with.

CAMOUFLAGE:

The simpler principles should be covered which will allow an officer to decide as to color and texture of material, quantity and dimensions of artificial material, as well as to make the best out of natural concealment in woods and accidents of the terrain. Track discipline is of especial importance. The position should never be left either before or after firing before it is thoroughly camouflaged.

Frequent aerial photographs should be obtained as work progresses on the larger operations.

METEOROLOGY:

There are certain fundamental principles in meteorology which every officer should understand. All gas operations are dependent in more or less degree upon wind and weather conditions, but with an understanding of the simpler principles and complete data, not only from the Meteorological Service itself, but from that obtained by the Meteorological Sections of the units themselves, it is possible to predict and make a much larger use of gas than would otherwise be possible.

This is so important and will be of such greater importance in future operations that this knowledge must be obtained. The safety limits must be thoroughly understood.

SERVICE OF SUPPLY:

Under this should be covered all the details of supply, whether automatic or otherwise, and a definite understanding had as to the procedure in each case.

MAP READING AND MAKING:

It is not only disgraceful but criminal for an officer to take his men into action over unfamiliar ground without the ability to keep himself properly located at all times.

ORGANIZATION OF AN ATTACK:

Operations such as the gas troops must carry out frequently necessitate the movement of large amounts of material and use of a considerable number of men. As in any other operation it requires careful planning and organization. Time is an essential element and must always be taken into consideration.

If normal contingencies are allowed for, the adverse conditions of front line work will usually add sufficient difficulties to tax the energy and ability of all concerned without allowing for mistakes and lack of supplies.

WRITING OF ORDERS:

All officers must be trained to write clear, complete, and correct orders covering units which they will be expected to lead. After a thorough explanation of the necessity and the details to be covered in an order, practical instruction in connection with actual operations undertaken in the general training will usually suffice if these orders are carefully checked and mistakes corrected.

115. TRAINING OF SPECIAL DETACHMENTS

METEOROLOGICAL SECTION.

Eight men in each Battalion should be thoroughly trained to take and properly record meteorological data. They should know how to interpret data received from the Meteorological Service and apply it to local conditions.

A regular system should be instituted in each Battalion and Company so as to keep all officers thoroughly informed as to wind and weather conditions.

RUNNER SERVICE.

Each battalion and company should have four trained runners and each platoon leader two trained runners. These men should be carefully selected, intelligent and resourceful. They must be instructed in the operations of the units and their relation to the other troops with thich the unit is operating. They should be trained to carry messages correctly under the most adverse conditions, and must be made to realize that upon their work the failure or success of an operation may depend.

While they must be given special training throughout the entire period of instruction they must also function with the units themselves in carrying out the field operations. Officers cannot devote too much time to the selection and training of these men.

116.

EXHIBIT - A.

FIGHTING ORDER

1. Clothing worn on the men as issued.

2. Rifle, bayonet, and ammunition. (100 rounds).

3. Accoutrements as issued, with the exception of the pack. In going into action the pack is dropped and left under guard.

4. Small box respirator.

5. Shrapnel helmet.

6. In haversack, - reserve rations, toilet articles, mess kit,

7. Canteen filled with water.

Men must be trained to drink sparingly and a most careful supervision given to a renewal of the supply.

Men are forbidden to carry any letters, papers, orders or sketches which may convey information to the enemy. Men will be warned not to give any information but name and rank in event of capture. These points should be checked up at frequent intervals during the course of training.

EXHIBIT - B.

AMERICAN EXPEDITIONARY FORCES
HEADQUARTERS FIRST GAS REGIMENT

SECRET

August 15th, 1918.

From: Chemical Advisor and Intelligence Officer, 1st Gas Regiment, A.E.F.

To: Commanding Officer, 1st Gas Regiment, A.E.F.

Subject: Report of Reconnaissance.

1. Map reference.

Emplacement: Presnos-on Woevre Vigneulles 3:1-10,000.
Target: St. Mihiel, 3;1-10,000.

2. Second Division of Second Corps of Second French Army holds this sector.

3. Target is a Battalion Headquarters, Depot of Stores, Ravin de Conouseveaux 42.15 (42.40) 52.12.

4. The emplacement position is th Ravin de Sourand 42.30-53.24.

5. Installation recommended:

200 - 2'6" projectors. Ammunition C.G.
100 - 2'6" projectors. Ammunition N.C.

6. Install as fifteen batteries. Angle of fire true South.

7. Target is distant 1130 meters. Charge recommend is thirty-six ounces of cordite in 5 3/4 inch charge box.

8. Wind limits are 5 through North to 25.

9. Billets at Rupt on Woevre or nearer the line.

10. Railroad transportation to Rupt on Woevre- advanced dump in woods near P.C. Liege, 41.80-53.57. Material can be brought to this point at night by trucks carefully managed and separated.

11. Light wagon transportation to 42.42-53.44 (700 metres) then through Boyau 7 by Observatoirs Bruery, through Boyau Guillaume and into Ravin de Sonvaux. (At night better transportation, and much shorter, could almost certainly be obtained directly over the top from wagon to th Ravin, making a carry of two hundred to three hundred meters).

12. Estimate that one company should be able to transport material from Rupt on Woevre and install guns in two days. Position can be visited in daylight but work cannot be done owing to aeroplane observation. Transportation to advanced dump only at night.

13. The haul from Rupt on Woevre to advanced dump is about eight kilometers. The total weight to haul, about 25 tons. Four 3-ton trucks should handle the transportation in one night to advanced dump, (not including men, water and provision.) Light transportation of some kind for 700 meters should be provided.

14. Two days for one company will be required for installation.

15. Green serim to cover 300 projectors is necessary.

16. Company Commander should be in P.C. Liege, 41.80-53.57.

17. Communication from battery position to commanding Officer by runner.

18. Base-plates should be used.

19. Ravin des Fouilles can be gassed from the same position, using four foot guns and same line of fire. This is well worth attempting with four hundred guns, if carry can be arranged.

20. Stokes mortars can be used from the front line near the above emplacement to advantage. Exact best location not determined.

J.E.Mills,
Captain, 1st Gas Regiment.

EXHIBIT C.

118.

HEADQUARTERS
2ND BATTALION, 1ST GAS REGIMENT
AMERICAN E.F.

COPY NO. 1.

SECRET

September 1st, 1918.

Operation Order No. 41.

Map reference, Vignelles "A", 1 - 20,000.

1. The following targets will be engaged by projectors at a time to be specified later ("D" Day - "H" Hour)

PROJECTOR.

Target.	Emplacement Site.	Number of Projectors.	Ammunition.
42.90-52.50 43.29-52.72 43.35-53.64 43.01-52.41	42.11-53.52 to 42.22-53.53	340	C.G. and N.C.

2. Our lines at emplacement sites held by 26th Division, 5th U.S.Army Corps.

3. Projectors will be installed by Company "D", 1st Gas Regiment assisted by Platoons from Companies "E" and "F".

4. Watches will be synchronized with 5th U.S.Army Corps time.

5. Discharge of projectors will be at "H" minus four hours, Batteries will be inspected and unfired guns will be discharged twenty minutes after original discharge.

6. Projector attack will not take place unless the wind is from 27 through WEST AND NORTH to 05, and from two to fifteen miles per hour.

7. A decision in regard to this discharge will be made by the Commanding Officer, 2nd Battalion, 1st Gas Regiment at "H" minus eight hours and communicated to Division and Corps Headquarters by wire and written confirmation.

Code. OPERATION WILL TAKE PLACE - MAINE.
OPERATION CANCELLED - CALIFORNIA.

8. If weather conditions are unfavorable at "H" minus six hours the operation will be cancelled by Commanding Officer, 2nd Battalion, 1st Gas Regiment, Messages being sent in Code of paragraph #7 to Division and Corps Headquarters. The officer in charge of emplacements can cancel at Zero if local conditions are outside of limits specified in paragraph #6.

9. The Commanding Officer, Company "D", 1st Gas Regiment, will be at P.C. Marengo 41.04-54.16, from "H" minus six hours until "H" minus four hours. He will maintain communication with his emplacement officrs by runners.

10. Messages from the position officers to the Company Commander will be sent as follows:

(a) Wind Messages - each half-hour from "H" minus six hours to "H" minus four and one-half hours.

(b) All ready - when all preparations are completed.

(c) Number of drums discharged after final discharge.

11. The area enclosed by 43.10-53.09; 42.00-53.54; 41.90-53.46 and 42.27-52.92 should be cleared of all troops as far as the tactical situation will permit from "H" minus four hours and ten minutes until "H" minus three hours and thirty five minutes. Any troops left in the above area and in areas enclosed by 43.46-53.45; 42.00-53.54 and 43.10-53.09; and 42.27-52.92; 41.90-53.46 and 42.04-52.92 must wear box respirators from "H" minus four hours and five minutes until the "All Clear" signal is given by their Gas Officer.

12. It will not be necessary to camouflage this position after the discharge. All personnel, with the exception of those needed for the later attacks, will retire to the advanced billets.

13. Please acknowledge.

J.B.Carlock,
Major, 1st Gas Regiment.

Copies:

1. C.G.5th U.S.Corps.
2. C.G.26th U.S.Division.
3. C.O.1st Gas Regiment.
4. C.G.Company "D"
5. War Diary.

EXHIBIT D.

OPERATION REPORT

To SERIAL NO.

C.O. First Gas Regiment.

August 5, 1918.

Reference Maps.
Violu (Nord) 1/5000

1. Headquarters- Company "A", 1st Gas Regiment, A.E.F.
2. Engineer Companies Operating, Company "A", 1st Gas Regiment.
3. Corps or Division to which attached, 21. D.I. 33 C.A.(French)
4. Purpose of operation, Harassing enemy in new positions. Prevention of further work in organizing new trenches as jumping off place for seizing TETE du VIOLU.
5. Wind limits-N. thru W. to S.
6. Map reference of emplacements -(S) 54.5-59.6,(S-1) 54.7-58.7, (S-2) 54.7-58.6.
7. Map reference of targets- 55.3-60.0, 55.2-59.0, 55.05 - 58.65.
8. Enemy Regiments affected -80 Landwehr, others not identified.
9. Zero Hour - 23.00 Aug. 5-6, 1918.
10. Wind direction and velocity and weather conditions - West, 7 m.p.h. Misty overcast sky. Started to rain at 1.00 a.m. Aug. 6.
11. Number installed,

	and type of gas used.	Cylinders.	Projectors.	Stokes Mortars.
	C.G.		495	300
12	Number fired.-		495	294
	Percentage fired.-		100	98.

13. Reason for discrepancies (if any) 3 bombs stuck in guns and could not be removed, early in the shoot, putting them out of action. Enemy action made it inadvisable to hold a gun in position while biscuit, container and ammunition were being changed.
14. Enemy action before, during and after attack - No rockets. Green and red flares at 0 plus 3 min. Heavy artillery retaliation at 0 plus 7 mins. on positions (S-1) - (S-2), on trench system, lines of communication, billets and artillery. Enemy apparently very much annoyed.
15. Casualties, (Name of officers; regimental numbers of other ranks, (since reconnaissance). #915384 slightly gassed in clearing a trench of a short T.M.E.
16. Time taken and men employed on operation - 7 days and nights - 90 men for eight days. 46 more for four days.
17. Infantry assistance obtained for operation 6 - 4 ox teams for 5 nights. Trench mortar and artillery fire 0 plus 5 min, to 0 plus 10 min.
18. Remarks - information from photographs and deserter showed Germans creeping in to capture TETE du VIOLU. Intense fire for destruction two days previous by artillery and trench mortars. 3000 shells, 2000 T.M.E. Quiet for two days to encourage enemy to return to work. Guns will be left in on position S for future use if need develops.

W.F.Pond,
Captain, CO. "A"
1st Gas Regiment.

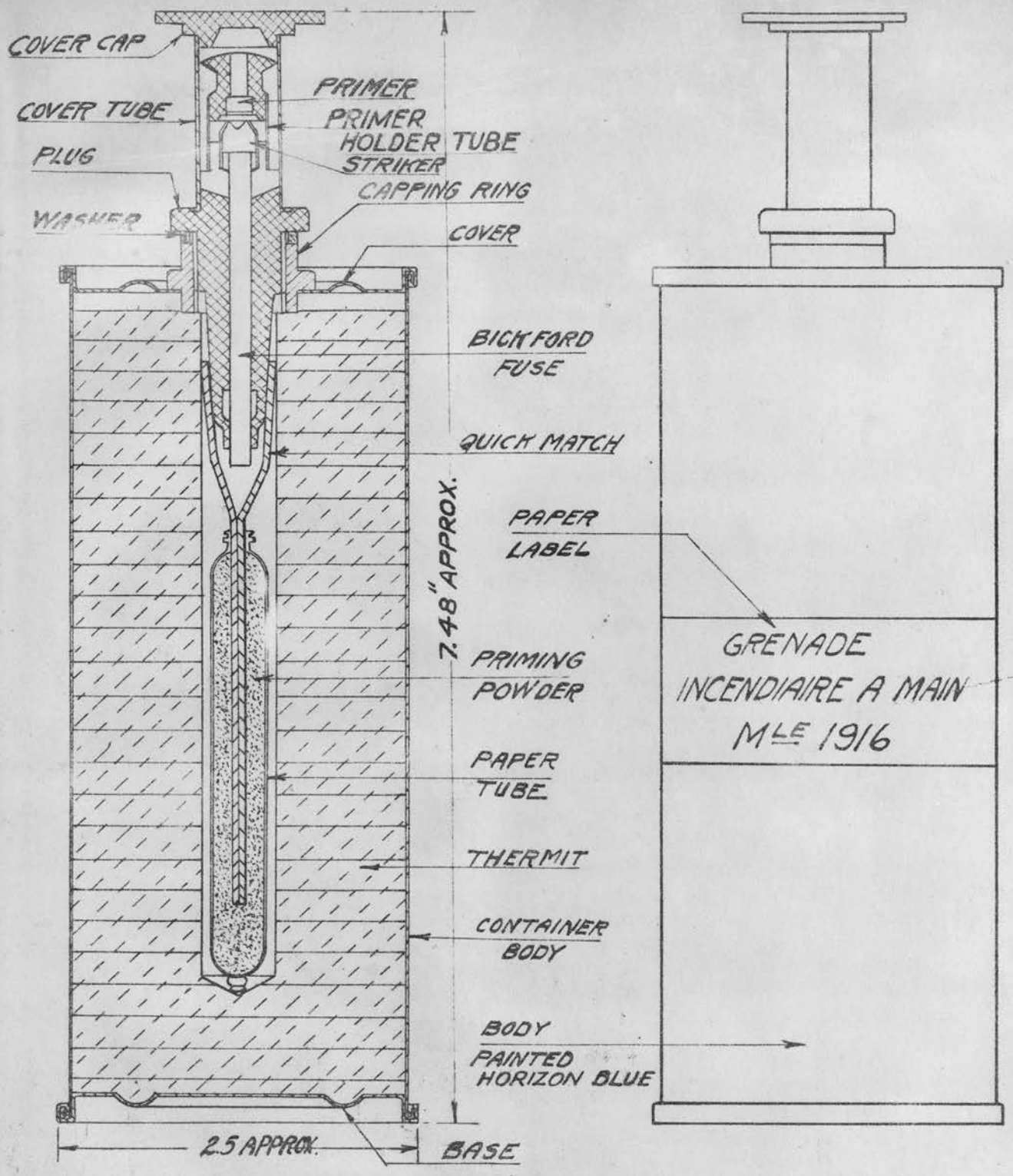
Copies to: C.O. 1st Gas Regiment,
C.O. Prov. Btn. 1st Gas Regt. 21st D.I. (French)
33rd C. A.(French) Secret File.

PART V.

USE OF CHEMICAL WEAPONS BY INFANTRY.

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FRENCH TYPE

GRENADE - INCENDIAIRE

M LE 1916 - CYLINDRIQUE

OFFENSE DIVISION, ENG. SEC. C.W.S. 5510

USE OF CHEMICAL WEAPONS BY THE INFANTRY.

1. Approved Types of Chemical Weapons. The following types of chemical weapons have been approved for use by the infantry in the A.E.F.

1. Incendiary Grenades.

A - French "Grenade-Incendiaire a Main".
B - U.S. - "Thermit Hand Grenade, Mark I".

2. Gas Grenades.

A - French "Suffocante et Lachrymogene", hand grenade.
B - British "No. 28, Chemical Hand Grenade, Mark II".
C - U.S. - "Gas Hand Grenade, Mark II".

3. Smoke Grenades.

A - French "Incendiaire et Fumigene," hand grenade.
B - British, "No. 27 Hand or Rifle Grenade, Mark I".
C - U.S. - "Phosphorous Hand Grenade, Mark II".

4. Smoke Candles.

A - British - "Smoke Candle, Mark I (L) Type S".
B - British - "Smoke Candle, Mark II, (L) Type S1".
C - U.S. - "Smoke Torch, Mark I".

5. 3" Stokes Mortar Smoke Bombs.

These bombs will be manufactured in the United States and will contain approximately three (3) pounds of W.P., or its equivalent.

INCENDIARY GRENADES.

2. French "Grenade - Incendiaire a Main".
This grenade consists of the following parts:

1. A cylindrical shell of tin plate to which the top and bottom are attached by crimping and soldering. In the cover is a hole into which is soldered a metallic ring, tapped to receive the firing mechanism.
2. A percussion cap provided with a Bickford fuse.
3. A charge of thermit.
4. A mixture of special ignition material.

The grenade body is approximately 5 7/8" long and 2½" in diameter. The total weight of the charged grenade is about 750 grammes or 1.65 pounds.

Method of Use. Hold the grenade in the hand, grasping the body firmly, and with the other hand remove the cover cap. Force the striker in sharply by striking it a keen blow against a hard body such as the heel, a rock, the butt of the gun, etc. The grenade takes fire in five (5) seconds after the percussion and burns without exploding.

Action. The percussion of the primer ignites the Bickford fuse. Its combustion requires five (5) seconds after which the quickmatch is lighted. This, in turn, ignites the special igniting mixture. By reason of the dealy and the absence of explosion the grenade can be placed by hand, or thrown to a distance.

3. U.S. Thermit Hand Grenade Mark I.

This grenade is an exact duplicate of the French "Grenade Incendiaire a Main".

4. Tactical Use of Incendiary Grenades.

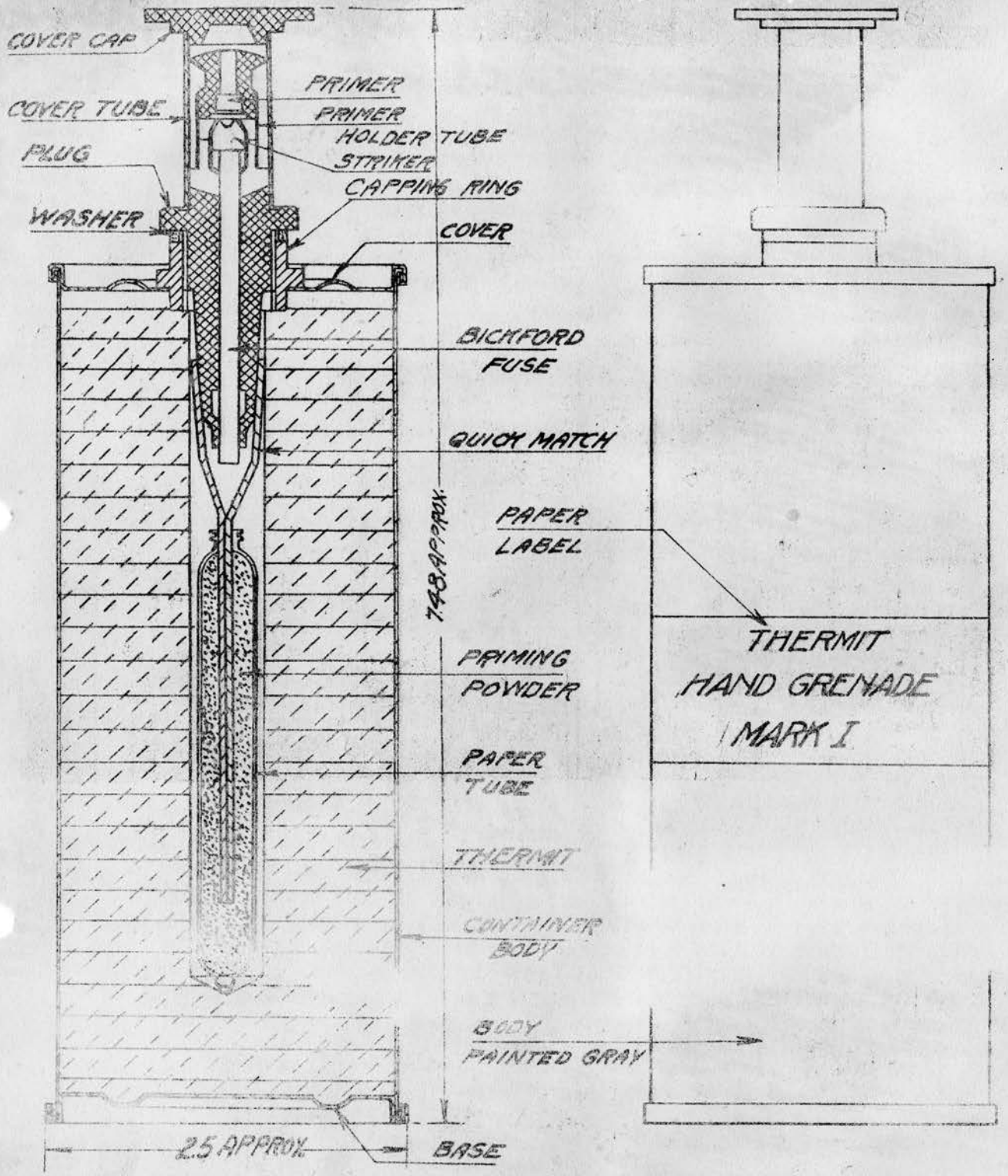
This grenade is effective because of the intense heat of the molten material. It should be placed above the object to be burned and not underneath it. It is placed by hand and used principally for the destruction of non-combustible material. It contains a thermit mixture which produces an exceedingly high temperature, the contents becoming a mass of white-hot molten metal. It is used by raiding parties, where a permanent advance is not contemplated, for the purpose of destroying enemy trench mortars, maching guns, etc., which cannot be brought back to our own lines. The incendiary grenade is ignited and dropped down the muzzle of a mortar or placed in contact with some vital part with the result that the gun is ruined. A few men in each raiding party should be taught how to use these grenades.

Special Uses. In destroying tanks of gas or oil, it is necessary to increase the time of burning of fuse. In such cases, to give the operators time to reach a place of safety, it is necessary to replace the cap by a piece of Bickford fuse of the desired length which can be fired with a match. For this substitution make a tube out of paper through the center of which the fuse is passed. Bind it with a thread to the collar of the grenade and then to the cord. Avoid getting the material wet during the operation.

Note. Grenades which have not taken fire can be picked up without danger and used again after having changed the fuse.

GAS GRENADES.

5. French -"Suffocante et Lachrymogene", hand grenade. This grenade consists of the following parts:- the body of the grenade, the collar, the gaine, and the automatic firing mechanism. The grenade is filled with "Papite" (acrolein), a liquified gas that is both lethal and lachrymatory.

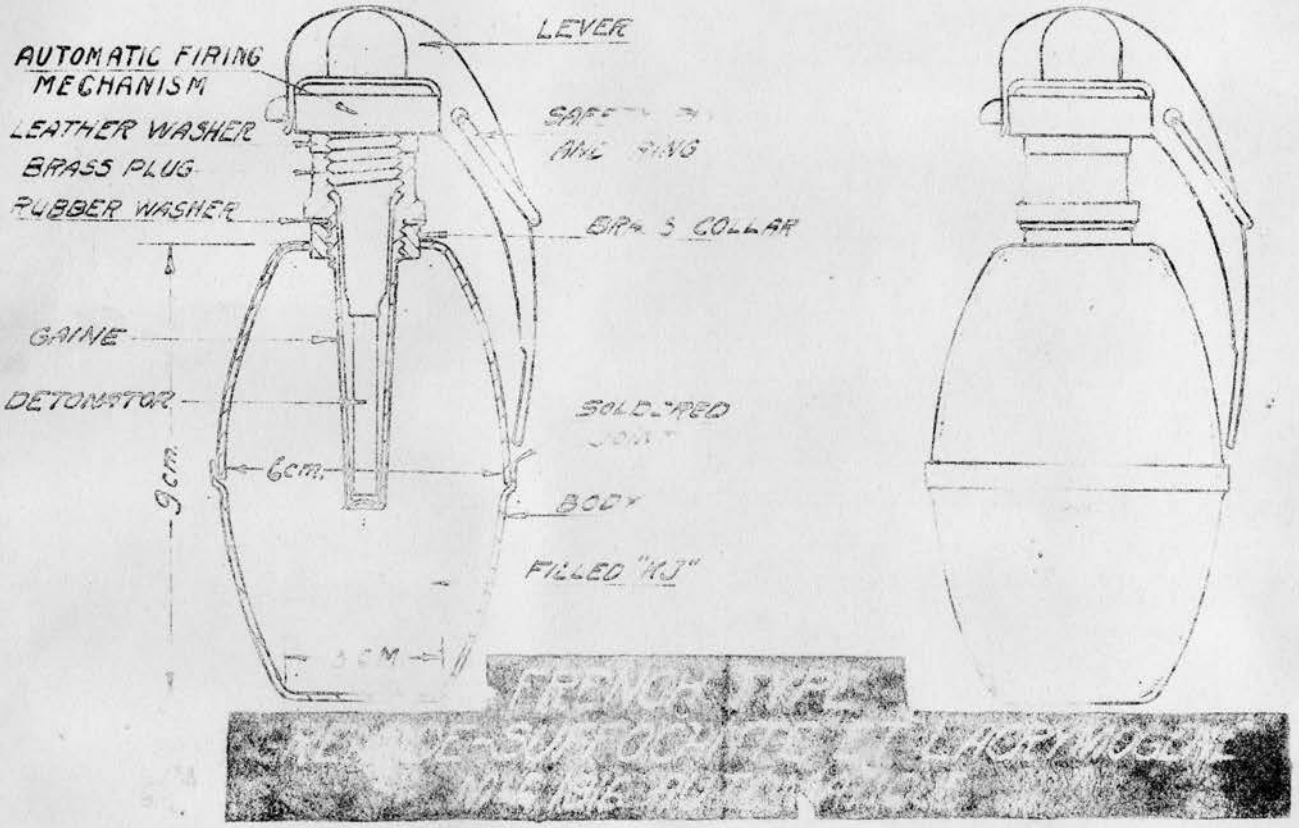


U.S. TYPE

THERMIT HAND GRENADE MARK I

JHeA

OFFENSE DIVISION, ENG. SEC. C.W.S. 5517



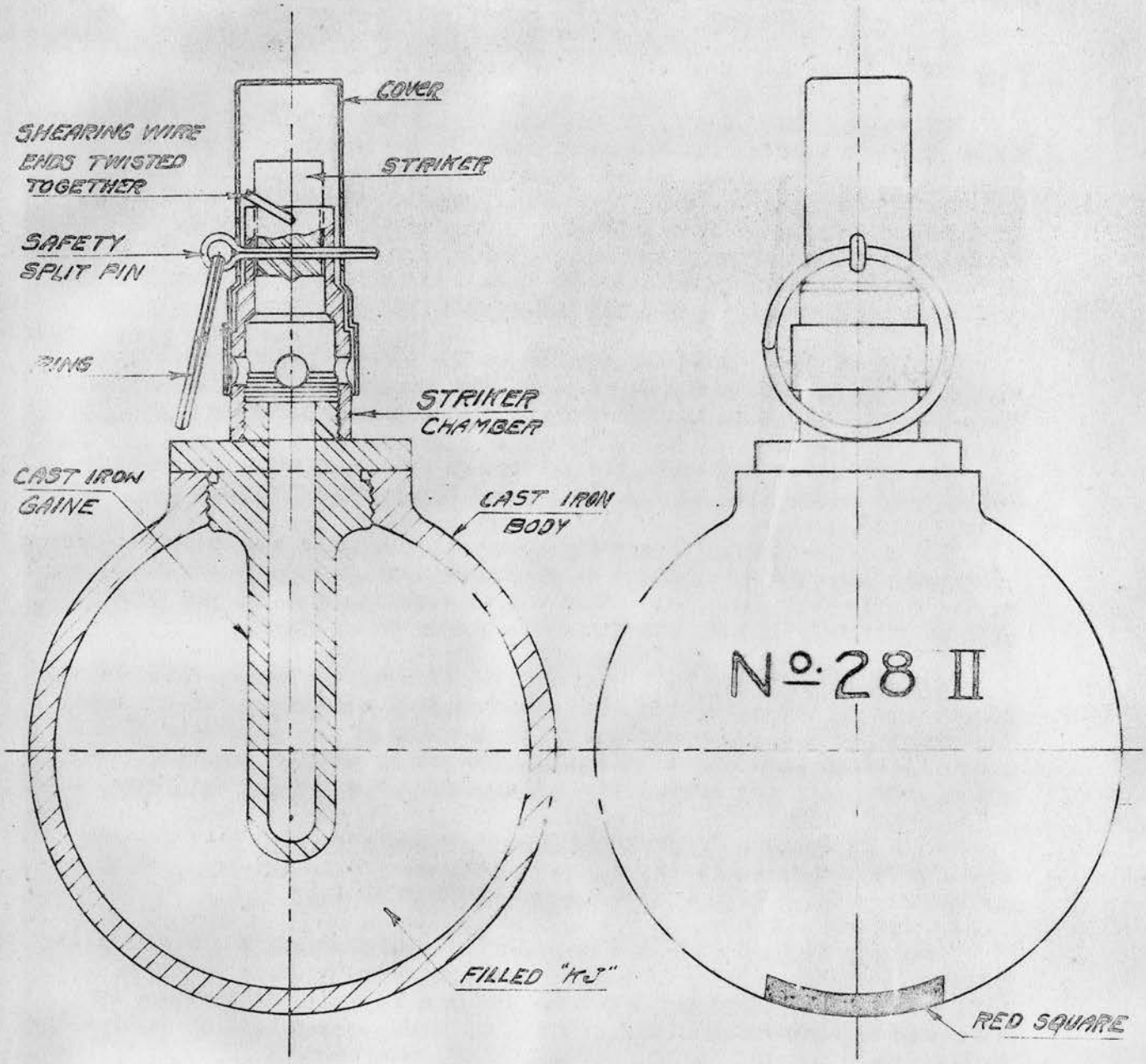
FRENCH TYPE

GRENADE-SUFFOCANTE ET LACRYMOGENE

MLE 1916 AUTOMATIQUE

JHS

OFFENSE DIVISION, ENG. SEC. C.W.S. 5513



BRITISH TYPE

GRENADE, HAND, No. 28, CHEMICAL, MARK II

OFFENSE DIVISION, ENG. SEC. C.W.S. 5511

The body of the grenade is the same as the French "Grenade- Incendiaire et Fumigene, Mle. 1916 Automatique" with the exception that there is an orifice in but one end. This orifice is for the reception of a brass collar which is inserted therein and soldered to the body of the grenade.

The collar is threaded internally for the reception of a hollow brass plug which is screwed into it and thus secured in the grenade.

The gaine, made of tin, is soldered to the lower part of the hollow brass plug and carries the detonator which is the bursting charge of the grenade. A rubber washer placed between the top of the collar and the shoulder of the plug forms a liquid tight joint. The hollow brass plug is threaded internally to receive the automatic firing mechanism. A leather washer is inserted between the top of the hollow brass plug and the shoulder of the automatic firing mechanism to form a tight joint. The total weight of the charged grenade is 400 grammes or 0.9 pounds.

Method of Use. Hold the grenade in the throwing hand, the firing mechanism up, in such a manner as to secure the lever. Pass the index finger of the free hand through the ring and withdraw the safety pin.

The grenade is now armed and the bomber must take every precaution not to release the grip on the lever until the grenade is thrown.

The grenade bursts (5) seconds after the action of the automatic firing mechanism, and produces a cloud of fine particles, intensely irritating to the respiratory passages. This causes violent coughing, and does not kill or seriously injure, but has considerable moral effect.

Action of the Grenade. After being thrown, the lever, which is no longer held by the safety pin, is projected from the grenade by the bolt. The removal of the lever permits the functioning of the automatic firing mechanism which sets off the primer. The primer ignites the slow fuse, which, after five (5) seconds fires the detonator exploding the grenade.

6. British No. 28, Chemical Hand Grenade, Mark II. This grenade consists of the following parts:- the body, the gaine, and the firing mechanism. It is filled with K.J. (stannic chloride).

The body is made of cast iron, spherical in form and 3 3/8 inches in outside diameter. A boss is cast on the body through which is tapped a hole for the reception of the gaine. The gaine or detonator sleeve is also made of cast iron, on the open end of which is provided an externally threaded boss for the assembly of the firing mechanism.

The firing mechanism is similar in construction to that used on the British"Grenade, Hand or Rifle, No. 27, Phosphorous, Mark I".

Method of Use. When used as a hand grenade its manipulation is the same as the British No. 27.

The effect of the grenade is essentially the same as the French "Grenade - Suffocante et Lachrymogene, Mle. 1916, Automatique".

7. U.S. - "Gas Hand Grenade, Mark II". This grenade is the same as the French "Suffocante et Lachrymogene" hand grenade.

Method of Use. The method of using the U.S. "Gas Grenade Mark II", is entirely similar to the French "Grenade - Suffocante et Lachrymogene, Mle. 1916, Automatique".

Action of the Grenade. The grenade and lever are firmly grasped in the throwing hand in such a manner as to secure the lever. The safety split pin is removed with the free hand and the grenade is ready to throw.

The thrower must take every precaution not to release the grip on the lever until he throws the grenade.

Upon release of the lever, the striker impelled by its stiff spring rotates around the hinge pin, forcing up the lever, and strikes the primer, first perforating the tinfoil disc which is sealed over the top of the cap to waterproof the primer. The end of the fuse is tipped with a priming powder composition, which ignited by the primer in turn ignites the fuse. In five (5) seconds the flame from the fuse spits into the fulminate composition of the detonator causing it to explode. The explosion of the detonator is sufficient to burst the body of the grenade and scatter the contents in all directions.

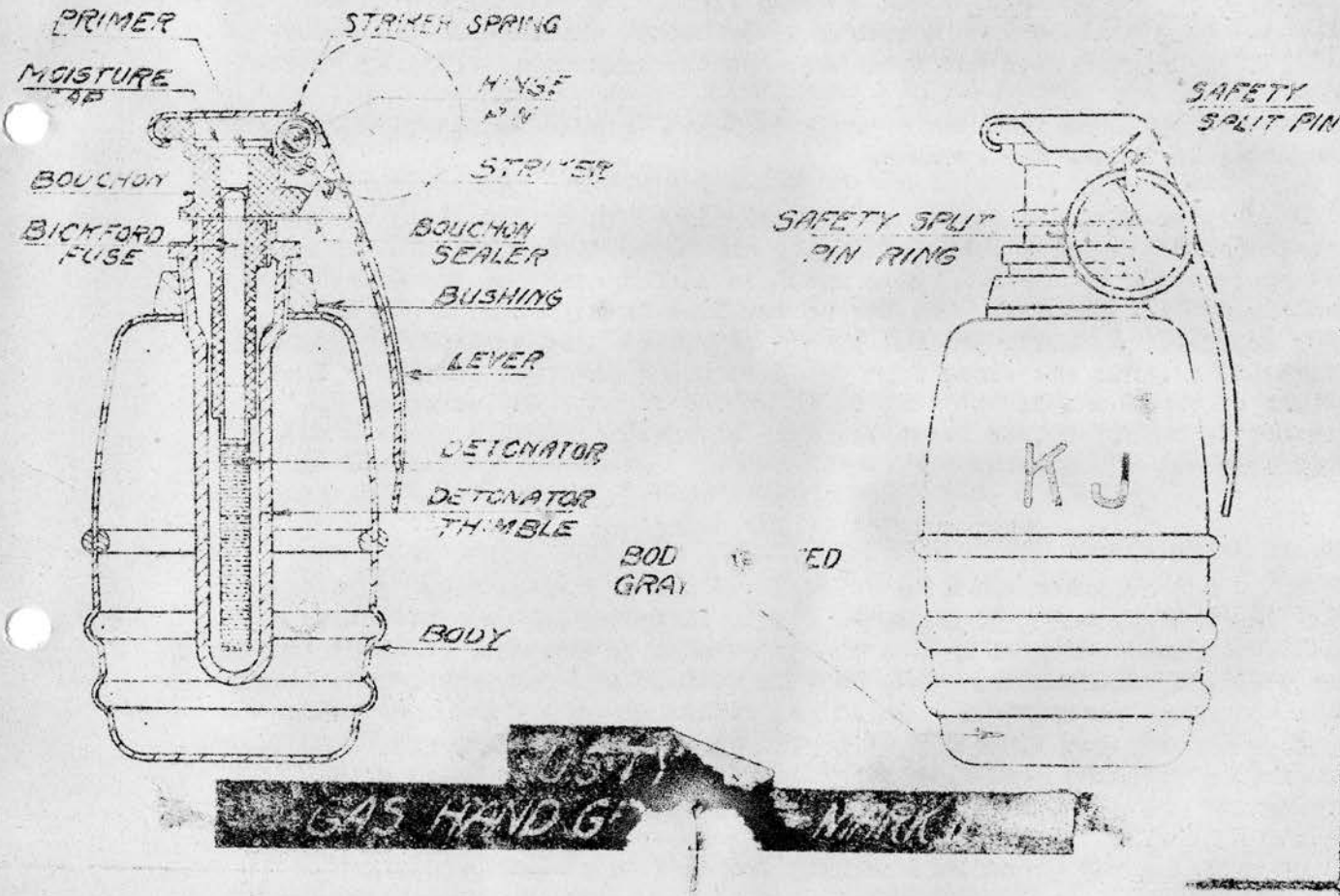
Tactical Use of Gas Grenades.

8. Gas grenades are intended for the use of "mopping up" parties in driving the enemy out of dugouts. This is generally more effective than blowing in the dugout with a charge of high explosive. A cloud is formed which violently attacks the eyes, nose and throat and penetrates to a large extent the enemy respirator. While not fatal, the fumes are unbearable in a close space, and the enemy is forced to come out choking and blinded. Four or five grenades should be carried by two men in each squad of a "mopping up" party. Upon coming to an enemy dugout, which is suspected of being inhabited, three or four grenades are tossed inside the entrance without exposing the grenadiers to fire from below.

Occasionally they may be found of value in driving the enemy from a machine gun nest or strong point, when such a position is located downwind.

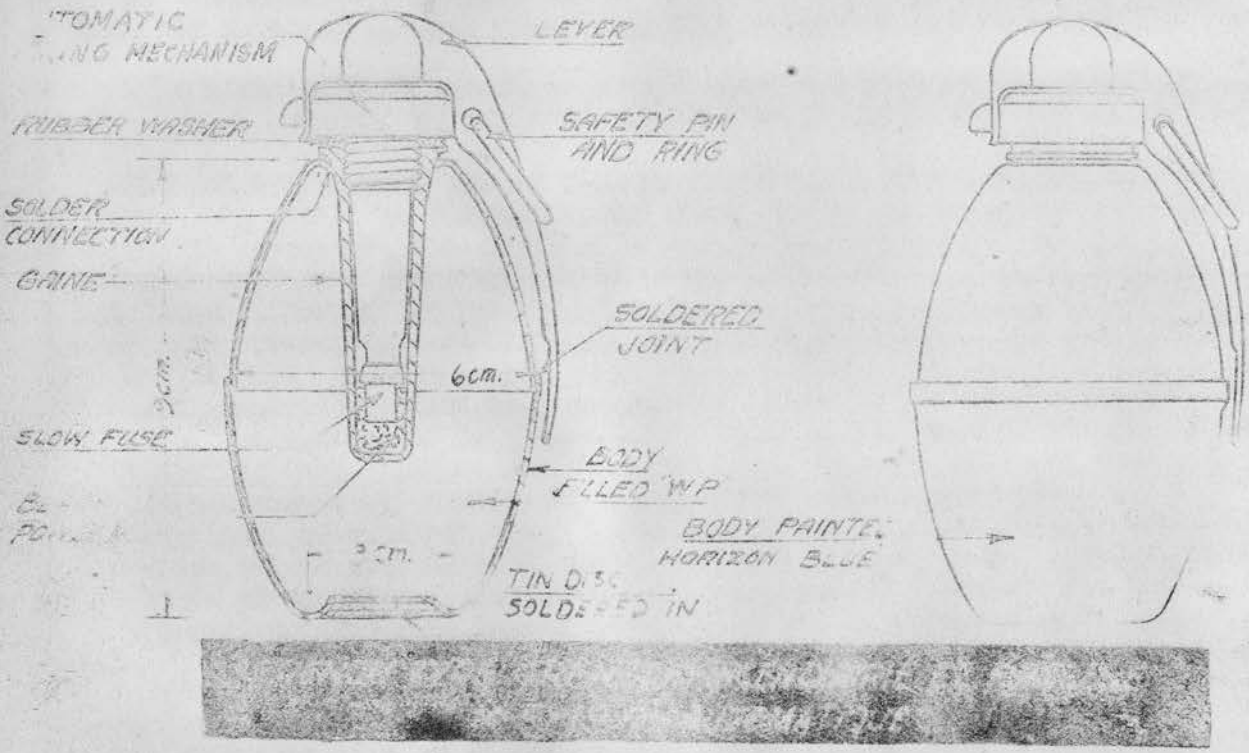
Smoke Grenades.

9. French "Incendiaire et Fumigene" hand grenade. This grenade consists of the following parts:- the body, the gaine, and the automatic



U.S. TYPE
GAS HAND GRENADE - MARK II.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5515



FRENCH TYPE

GRENADE-INCENDIAIRE ET FUMIGENE

MLE-1916-AUTOMATIQUE.

Plate

firing mechanism

The body, ovoid in form, is nine centimeters long, and six centimeters in diameter, at the center. It is made of two ogival caps of tin, set, clasped, and soldered to each other around the edges of their large bases. At each end of the body there is an orifice in a flattened surface, one for the reception of the gaine which is soldered in place and the other for the insertion of the filling charge. After filling, the hole is hermetically sealed by a disc of tin soldered to the body of the grenade.

The gaine, made of special metal, holds the charge of explosive powder. It is threaded on the interior to receive the fuse plug which forms the body of the firing mechanism.

The firing mechanism is automatic but is without a detonator. The fuse requires five (5) seconds for combustion.

A rubber washer placed between the upper flange of the gaine and the shoulder of the fuse plug, forms a tight joint for the grenade.

The total weight of the charged grenade is 560 grammes or 1.23 lbs., and the charge is 300 grammes of white phosphorous.

Method of Use. Hold the grenade in the throwing hand, the firing mechanism up, in such a manner as to secure the lever. Pass the index finger of the free hand through the ring and withdraw the safety pin.

The grenade is now armed and the bomber must take every precaution not to release the grip on the lever until the grenade is thrown.

The grenade when thrown, bursts into flames five (5) seconds after the lever is released, producing a cloud of dense white smoke and suffocating vapors. The range of the grenade is 25 to 30 meters. Its explosion does not produce any dangerous metallic pieces but throws in all directions within a radius of 15 to 20 meters pieces of burning material, (W.P.) capable of causing serious burns and which also constitute a possible source of fires. The burning of this material is prolonged for several minutes after the explosion, forming an abundance of white smoke. With a favorable wind, 20 grenades are sufficient to create an extended smoke cloud.

Action of the Grenade. Upon leaving the hand of the thrower, the lever, which is no longer held by the safety pin, is projected from the grenade by the bolt. The removal of the lever permits the functioning of the automatic firing mechanism which sets off the primer. The primer ignites the slow fuse which after five (5) seconds ignites the black powder charge in the gaine. This explodes the grenade with sufficient force to scatter the burning contents over a radius of 15 to 20 meters and at the same time produces an intense and suffocating vapor within a radius of 5 to 6 meters.

10. British "No. 27, Hand or Rifle Grenade, Mark I.". This grenade consists chiefly of the following parts: - the body, the gaine, and the firing mechanism.

The body of the grenade, cylindrical in form, is about 3 3/4 inches long and 2 1/4 inches in diameter. It is made of tinned plate and is capped on either end with dished tinned plate stampings somewhat heavier than the metal forming the body. To the lower cap, forming the base, is soldered a steel plate approximately 1/4 inch thick. This steel plate is tapped to receive a rod fifteen (15) inches long and of the proper diameter to fit the bore of the service rifle. The rod is used only when the grenade is projected with a rifle. The rods are issued detached from the grenades in the ratio of 60% of the grenades.

To the upper cap, forming the cover of the body, is soldered a spigot, externally threaded to hold the firing mechanism.

The gaine is inserted through the spigot and the cover, and is soldered to the spigot.

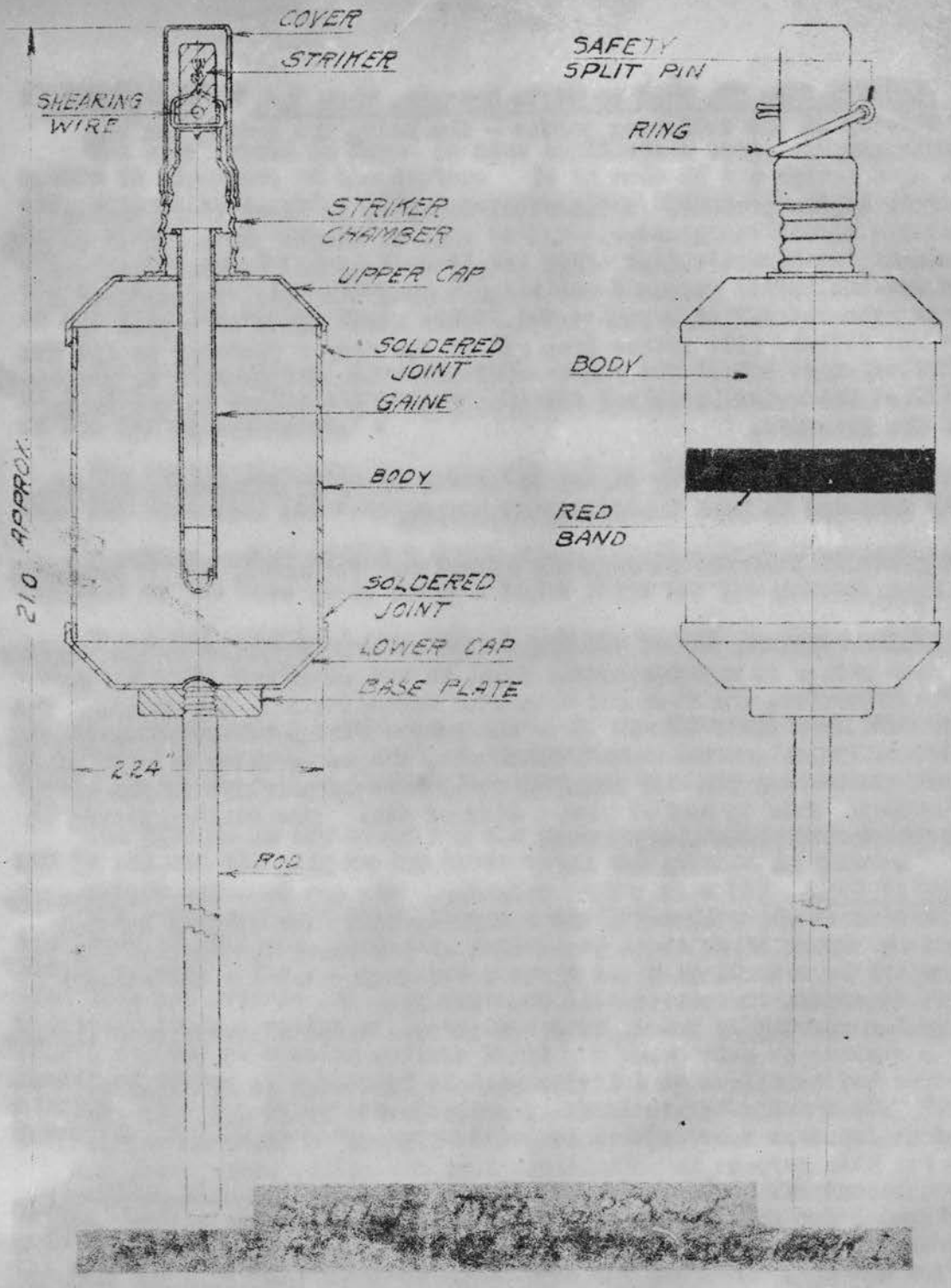
The primer rests on top of the spigot and is held in place by the striker chamber. The primer is crimped to the fuse, on the other end of which is crimped the detonator, the fuse and detonator extending into the gaine. The striker is held by a shear wire. Over the entire firing mechanism is placed a metal cover, to prevent accidental discharge, the cover being held in place by means of a retaining pin and ring. A small hole is provided in the cover cap for filling. This is sealed with a disc of tin. The filling charge is about 400 grammes of white phosphorous.

Method of Use. (A) - As a Hand Grenade. The cap over the firing mechanism is removed after withdrawing the retaining pin. The striker is then struck against any solid object, as the heel of the boot, the butt of the gun, a rock, etc. The shock shears the small restraining wire and the striker point fires the primer and starts the fuse burning.

The grenade is thrown immediately, and in five seconds bursts into flames.

(B) - As a Rifle Grenade. The stem is attached by screwing it into the base plate of the grenade as far as it will go. The protecting cap is then removed, exposing the striker. A blank cartridge furnished for this purpose is next loaded into the rifle, after which the grenade rod is inserted into the muzzle of the rifle and pushed down as far as it will go. The butt of the gun is set against some solid object, such as the bottom of the trench, a sandbag, etc., and the elevation adjusted according to the range desired. Upon the discharge of the rifle the set-back shears the small restraining wire, permitting the striker point to impinge upon the primer thus igniting the fuse which in five (5) seconds fires the detonator.

The maximum range is obtained with the rifle held at 45 degrees. Shorter ranges may be had by either raising or lowering this elevation. Under favorable conditions, ranges up to 230 yards are obtained.

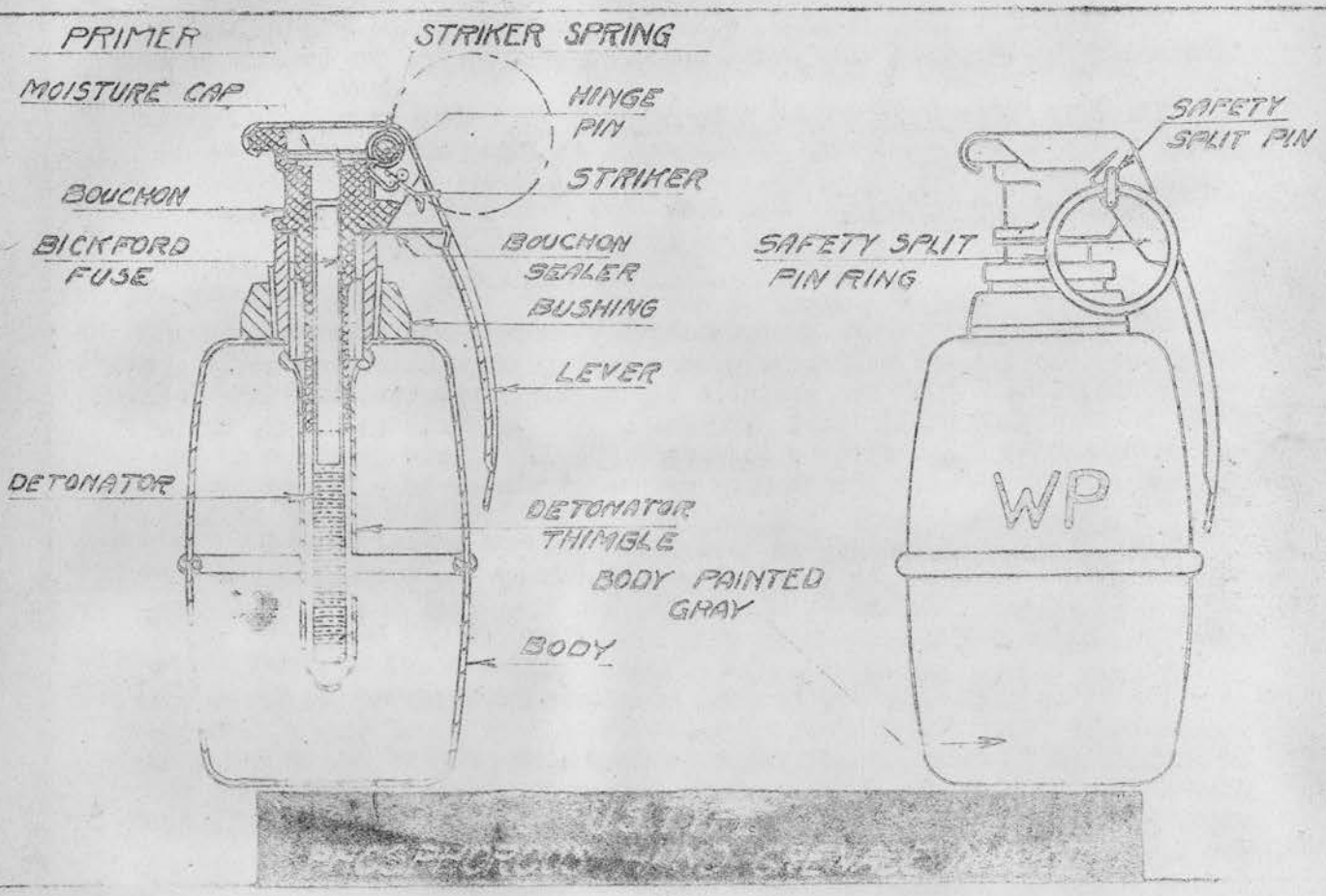


BRITISH TYPE

GRENADE, HAND OR RIFLE N° 27, PHOSPHOR, MARK I.

Sketch

OFFENSIVE DIVISION, ENG. SEC. C.W.S. 5512



U.S. TYPE

PHOSPHOROUS HAND GRENADE

Offense Div

These grenades are packed unassembled in three boxes, marked respectively W.P. 1, W.P. 2 and W.P. 3. W.P. 1 contains 12 grenades. W.P. 2 contains 12 tins, each tin containing 12 detonating sets. W.P. 3 contains 48 rods and 4 tins each containing 12 blank cartridges.

Directions for the use of the No.27 W.P. grenades as hand grenades are found in box W.P. 1, and for use as rifle grenades in box W.P. 3.

The effect of this grenade is similar to that of the French Grenade "Incendiare et Fumigene Mle. 1916, Automatique".

II. U.S. "Phosphorous Hand Grenade Mark II." This grenade is essentially the same as the French "Incendiaire et Fumigene", hand grenade.

Action of the Grenade. See U.S. "Gas Hand Grenade, Mark II".

Tactical Use of Smoke Grenades.

12. General. Smoke grenades have been primarily designed as infantry weapons for offensive operations both as incendiary and smoke producing articles. They are suitable for burning dug-outs, blinding machine guns, or screening small local attacks. Due to their scarcity, their use in producing smoke screens is uneconomical. These grenades on exploding scatter burning phosphorous over a circle of 15 - 20 meters radius.

Used as Rifle Grenades. The British Grenade - "No. 27, Hand and Rifle Mark I", is the only chemical grenade which has been designed for rifle projection. The other smoke grenades described are designed for hand projection only.

The rifle smoke grenade is most effective in brush or wooden country, particularly where the terrain is undulating, thus permitting a detachment of grenadiers to crawl within range of a machine gun without exposing themselves to severe fire. Unless there is natural cover at the firing point rifle pits should be scooped out so that the grenadiers will have protection from machine guns.

Two or three grenadiers should keep up a continuous fire upon the machine gun attacked. Others are designated to work their way into close striking distance from whence they can rush the gun from the flank, under cover of the smoke.

The rifle grenade is most effective when burst ten or fifteen feet above the ground.

The smoke generated by the burning phosphorous cuts off the machine gun from the possibility of direct fire. This effect may often be obtained, even though the strong point is out of range, if it is possible to work into a position to the windward so that the smoke will drift over the point to be screened.

If an attack is held up by hostile machine guns, their position might be indicated by firing single rifle grenades toward them, targets being thus provided on which fire from other weapons can be directed.

Two men in each squad may be trained to use these grenades and they should carry ten each in an advance.

Used as Hand Grenades. All of the smoke grenades previously described can be used as hand grenades.

The principal use of the phosphorous hand grenade is as a follow-up of a rifle grenade, for the maintenance at short range of the smoke cloud when taking a strong point. The smoke given off by the rifle grenades permits the grenadiers to advance to a point where the hand grenades may be used.

A minor use for the hand smoke grenade is in "mopping up" the enemy dugouts, although the gas grenade is more effective for this purpose.

Data on Smoke Screens or Barrages.

13. See data given under "Tactical Use of Smoke Candles". Inasmuch as the relative screening value of a phosphorous grenade is approximately twice that of a smoke candle, the number of phosphorous grenades may be proportionately decreased.

Smoke Candles.

14. British "Smoke Candle, Mark I. (L) Type S." This smoke candle consists of the following parts: case, lid, tin plate cover, striker, igniting device, charge, powder discs, cap, and band.

Case. The case is made of tinned iron plate of the form and dimensions shown on the drawing, having a welded side and bottom seam and four plugs to secure the lid.

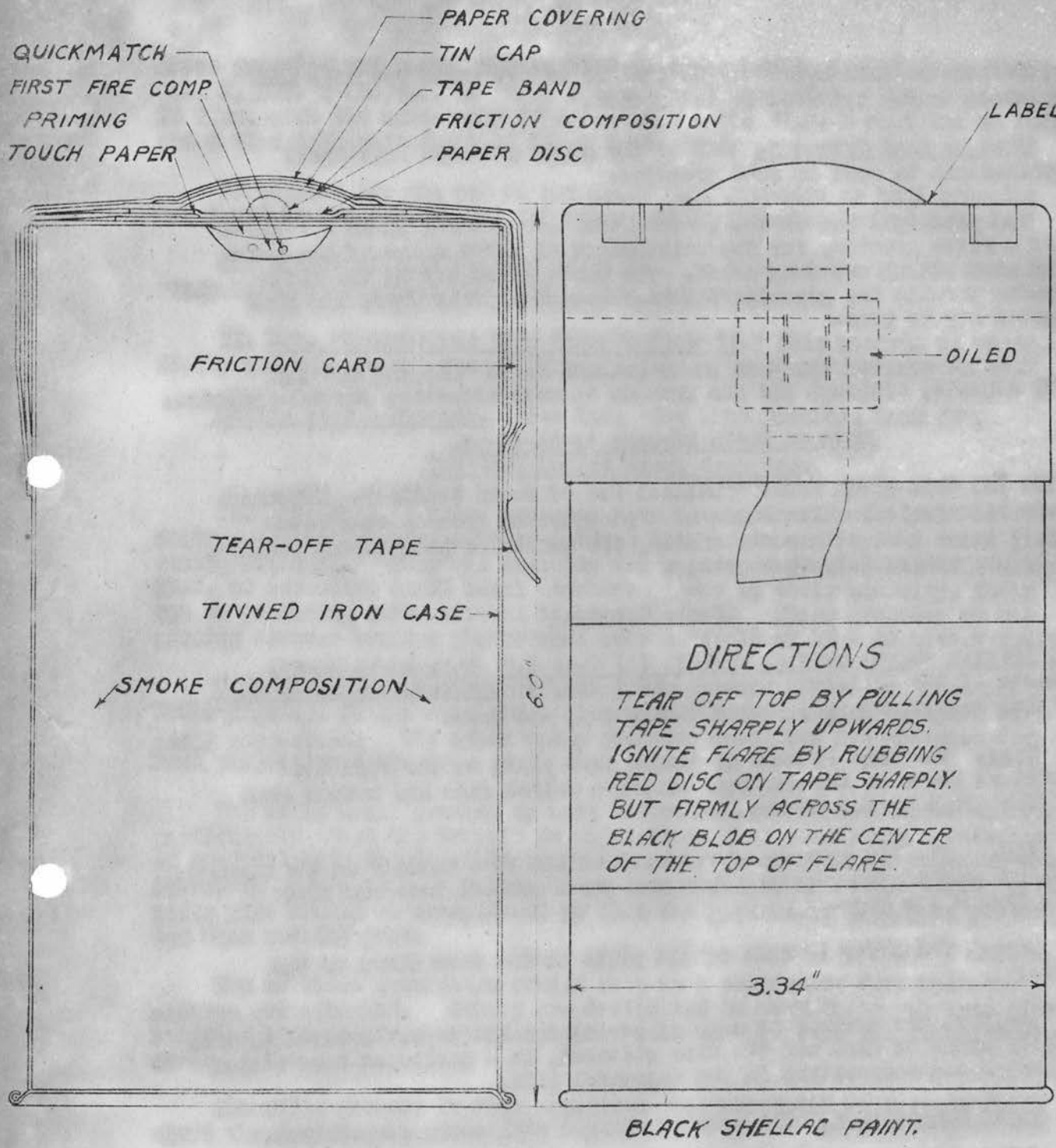
Lid. The lid is made of material of the same quality as the case. It is pressed to the required form and has a central hole and four slots around its edge.

Cover. The cover is made of tin plate in the form shown on the drawing.

Striker. The striker is made of strong durable tape. Secured to this tape, by means of glue and two wire stitches, is a cardboard disc coated with match box composition in the uncovered side.

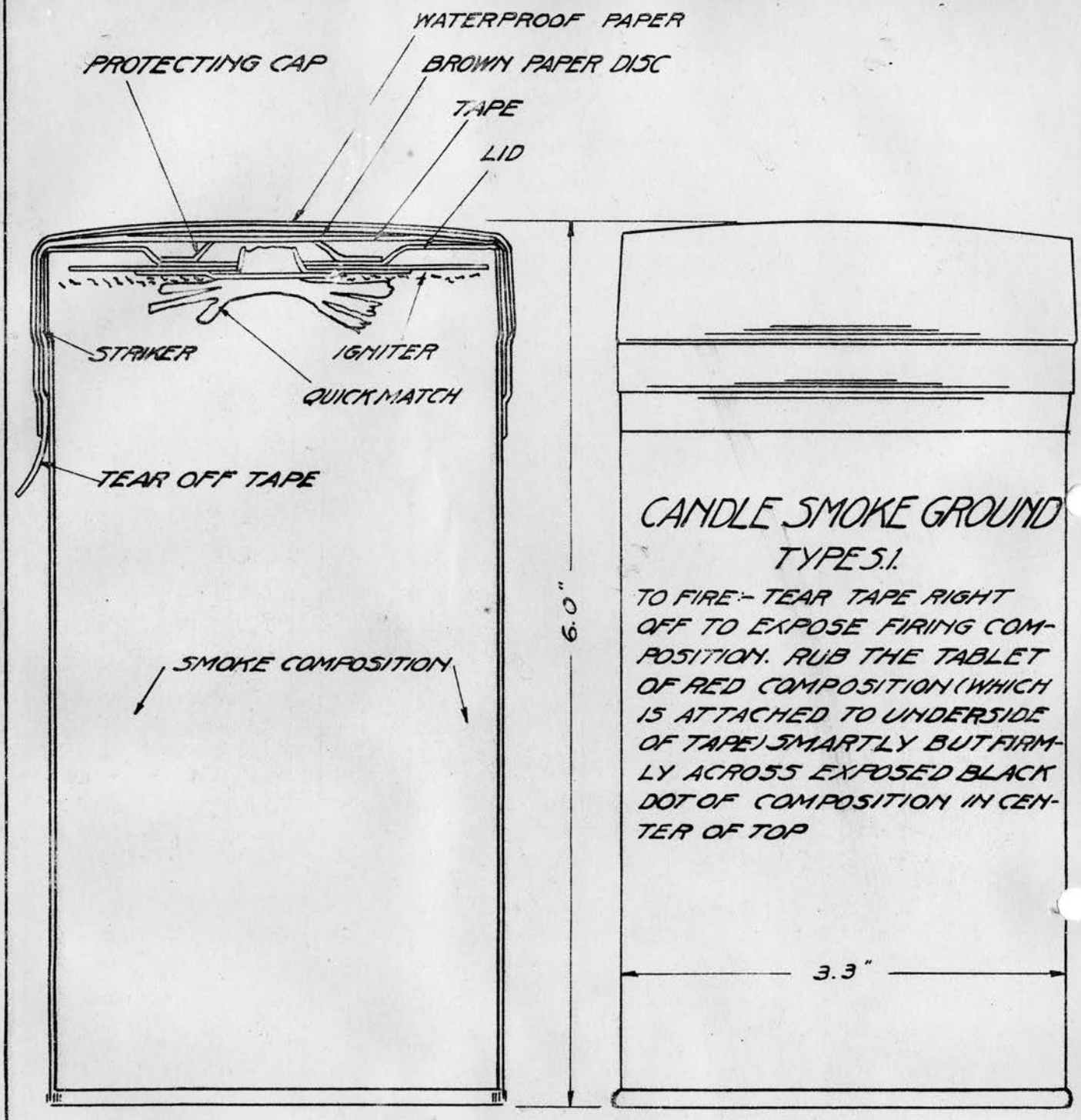
Smoke Composition. The case is charged with smoke composition.

Method of Operation. Tear off the top by pulling the tape quickly upwards. Ignite the flare by rubbing the red disc sharply and firmly across the black blob on its center. This operation ignites the match material which in turn ignites the quick match, which sets fire to the fire composition for lighting the smoke mixture. This burns and gives off a smoke for three minutes.



BRITISH
SMOKE CANDLE MARK I/L/ TYPE "S"

OFFENSE DIVISION, ENG. SEC. C.W.S. 5520



SECTION

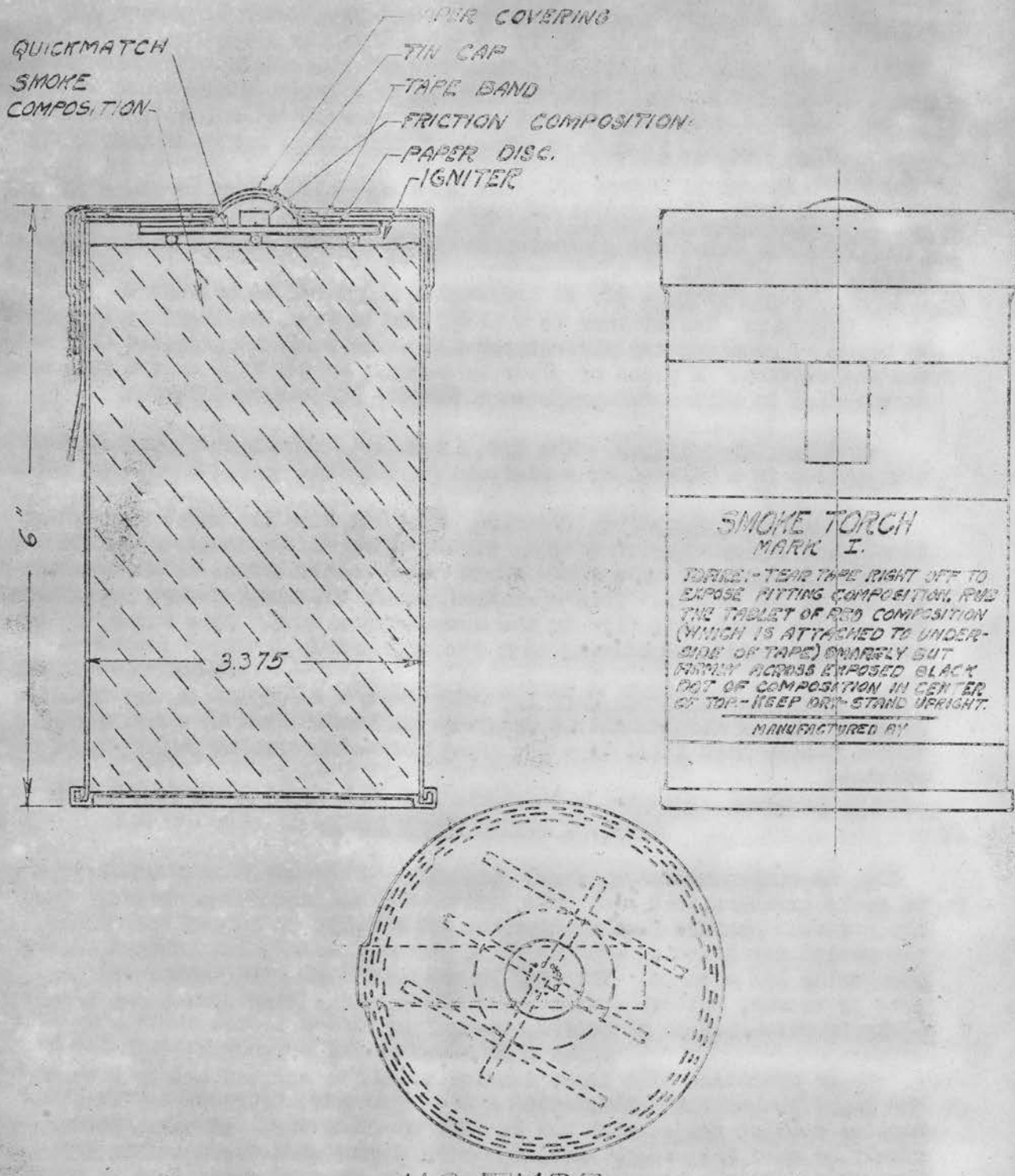
ELEVATION

CANDLE SMOKE GROUND TYPE S.I.

TO FIRE:- TEAR TAPE RIGHT OFF TO EXPOSE FIRING COMPOSITION. RUB THE TABLET OF RED COMPOSITION (WHICH IS ATTACHED TO UNDERSIDE OF TAPE) SMARTLY BUT FIRMLY ACROSS EXPOSED BLACK DOT OF COMPOSITION IN CENTER OF TOP

BRITISH
SMOKE CANDLE MARK II/L/ TYPE "S1"

OFFENSE DIVISION, ENG. SEC. C.W.S. 5563



U.S. TYPE
SMOKE TORCH - MARK I

O. S. S.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5519

15. British "Smoke Candle Mark II. (L) Type S-1." This candle consists of the following parts; case, lid, projector, friction thimble, striker, and igniting arrangement.

Case. The case is made of tinned iron plate of the form and dimensions shown on the drawing and has a welded side and bottom seam.

Lid. The lid is made of stamped tinned plate and fits tightly on the case.

Protection and Friction Thimble. These parts are stamped from tinned plate, the projector being slotted to allow for the passage of the tape and striker arrangement.

Striker. The striker is made of strong tape, to which is fastened by means of glue and two wire stitches, a cardboard disc, coated with match box composition. A piece of paper is secured to the tape on the same side as the disc in such a manner as to cover the striker.

Smoke Composition. The case is filled with about 3 pounds of smoke composition in a plastic or semi-fluid condition.

Method of Operation. To fire, tear off tape to expose firing composition. Rub the tablet of red composition, which is attached to the underside of the tape, smartly across the black blob of composition in the center of the top of the candle. This operation causes the match material to ignite the igniter which sets fire to the smoke composition. This burns and gives off smoke for five minutes.

16. U.S. "Smoke Torch, Mark I." The general construction and method of operation of this candle is entirely similar to that of the British "Smoke Candle Mark I (L) Type S", except that the time of burning is four minutes.

Tactical Use of Smoke Candles.

17. As smoke producers, smoke candles have about one-half the efficiency of smoke grenades, but they have practically no incendiary effect. They are portable and are designed for use by infantry in active operations. They are useful for blinding machine guns, for screening local attacks, and for simulating gas attacks. They may be used for concealing concentrations of guns or troops, battery positions or areas, or putting up a smoke barrage along the flank of an attack.

An operation with these candles should be carried out by a squad under the direction of a competent gas officer who makes wind observations and decides whether the candles may be used to advantage. At least 500 candles should be used for even a small operation. The number started at the beginning should make a dense cloud, and this can then be reinforced by fresh

generators as required.

The number of smoke grenades or smoke candles required to form an effective screen depends upon the considerations enumerated in Part II, Group IV, under Sub-heading "Smoke Screens". No definite rules can be laid down as to the exact quantities of smoke producing substances required to form a screen, as conditions vary greatly, but the following examples are given for guidance:-

18. Examples of Smoke Screens.

(1) Object to be concealed. - Concentration area on a front of 2,000 yards.

Direction of the wind. - Parallel to the enemy's front and steady.

Velocity of the wind. - Six to eight miles an hour.

Material available. - Smoke cases Type "S".

A smoke screen should be formed 4,500 yards long and 400 yards in front of the forward edge of the concentration area.

Groups of two men each should be placed 50 yards apart on the line of the intended screen. Each group should light four smoke cases every two minutes. Thus if the screen is to be maintained for a period of two hours, 21,600 smoke cases will be required.

Personnel required: 180 men, apart from those required for the transport of material.

The men should take advantage of any cover available and each group should be provided with a watch.

(2) Object to be concealed. - Concentration area on a front of 2,000 yards.

Direction of the wind. - Towards the enemy and steady.

Velocity of the wind. - Six to eight miles per hour.

Material available: Smoke Cases, Type "S"

A good smoke screen should be formed 4,500 yards long and 400 yards in front of the forward edge of the concentration area.

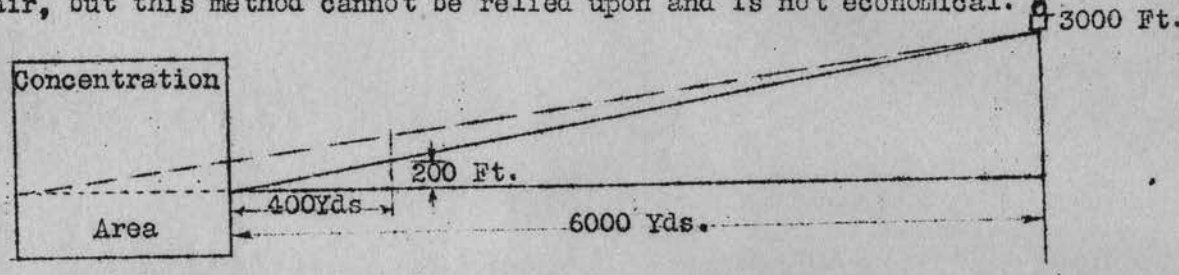
Men should be posted singly 25 yards apart along the line of the intended smoke screen. Each man should light two smoke cases every two minutes and should throw them in such a way that no gaps occur. Thus, if the screen is to be maintained for a period of two hours, 21,600 smoke cases will be required.

Personnel required: 180 men, apart from carrying parties for material.

Note:- This screen is more effective than the one described in example 1.

(3) Object to be concealed: Concentration area on a front of 2,000 yards, from a balloon at an altitude of 3,000 feet and 6,000 yards distant.

(a) With the wind blowing parallel to the front or towards the enemy, if the smoke screen is formed 400 yards in front of the forward edges of the concentration area, it would be necessary for it to be 200 feet high in order to conceal the forward edge of the concentration area from the balloon, and much more than that to conceal the rear edge. A certain amount of screening effect might be produced by bursting 4-in. Stokes bombs in the air, but this method cannot be relied upon and is not economical.



(b) With a wind blowing from the direction of the enemy, the cloud would drift over the area to be screened and the troops would therefore be concealed in the cloud. This might be objectionable owing to the possibility of confusion.

Consequently, it will seldom be possible to use smoke successfully to screen areas from hostile kite balloons unless there happens to be a considerable rise in the ground between the balloon and the object to be concealed.

3-Inch Stokes Mortar Smoke Bombs.

19. The 3" Stokes mortar smoke bomb has been approved for use but is not yet available.

The 3" and 4" Stokes mortar bombs will compare approximately as follows:

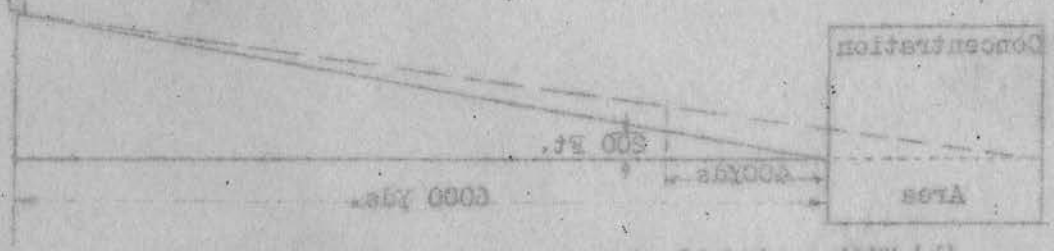
	Amount of W.P.	Maximum Range
3" Smoke Bomb	about 3.0 lbs.	740 yards
4" " "	" 7.0 lbs.	1160 yards

TACTICAL USE OF 3" STOKES MORTAR SMOKE BOMBS.

20. These 3" Stokes Mortar Smoke Bombs will be available for use by the infantry in the future. This will place in the hands of the infantry a means of forming smoke barrages at greater ranges than is possible with

the rifle grenade. The use of the 3" Stokes mortar smoke bomb will therefore economize on guns if they are used wherever possible, as they will be used from the front line trenches and will have a maximum range of approximately 740 yards. The fact that these smoke bombs will be entirely under the control of the infantry operates as an additional advantage in that smoke barrages will at all times be available to cover the retirement of daylight raiding parties.

It will also be possible to carry the mortars forward together with a supply of the smoke bombs to provide smoke screens in the large stages of an infantry advance.



PART VI.

USE OF CHEMICAL WEAPONS BY THE AIR SERVICE.

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USE OF CHEMICAL WEAPONS BY THE AIR SERVICE.

INCENDIARY BOMBS.

GENERAL.

1. Gas Warfare material, used by the Air Service, comprises incendiary and smoke bombs.

2. The only incendiary bomb available for use by the American Air Service at the present time is the French Chanard incendiary bomb. A description of the method of operation, action, marking, etc., of this bomb follows. The French Chanard bomb is of the intensive type and is for use against well defined targets. Other bombs of the same type under development are the American incendiary bombs, Mark II and Mark III.

Another type of incendiary bomb known as the scatter type is for use against more inflammable material such as wooden buildings, grain fields, etc. Of this type now under development or consideration are,- the American Incendiary Bomb Mark I, the American Incendiary Dart Mark I, and the British Baby Incendiary Bomb, known as the B.I.

FRENCH CHANARD INCENDIARY BOMB
(Bombs Incendiaire Chanard or C.D.)

3. DESCRIPTION. (See accompanying plates). The bomb consists of the following general parts: case or body, nose, stabilizer wings, H tube, quick match, tubes, vents, firing mechanism and safety propeller.

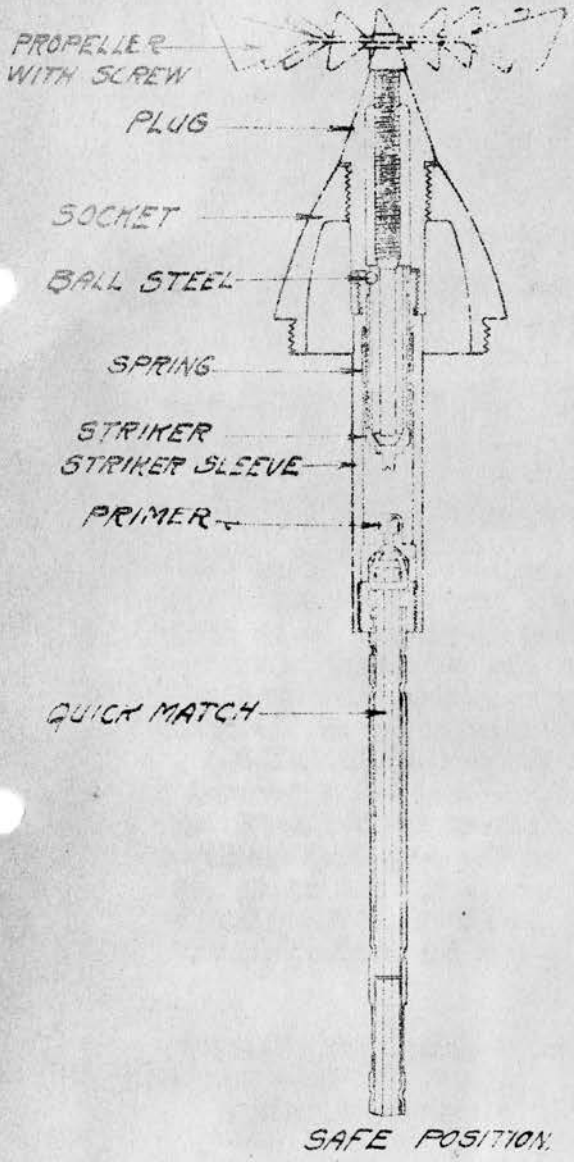
CONSTRUCTION. The bomb body or case is composed of two longitudinal halves of an ellipsoid of revolution. The edges of these are soldered to the annular core or H tube. Both the body and the H tube are made of tin plate. The H tube is filled with special Thermit mixture which is known as C.D. powder or Daisite No. 2. The charge is 275 grams. The main body is filled with Chanard incendiary material. This material consists of a plastic semi-fluid mass which on combustion flows freely. It consists principally of nitrocellulose and resin with a mixture of turpentines.

FIRING MECHANISM. (See plate showing firing mechanism details). This consists of a safety propeller with screw and plug into which screws a socket, striker, striker spring, three steel balls, striker sleeve, and quick match or fuse in the tube.

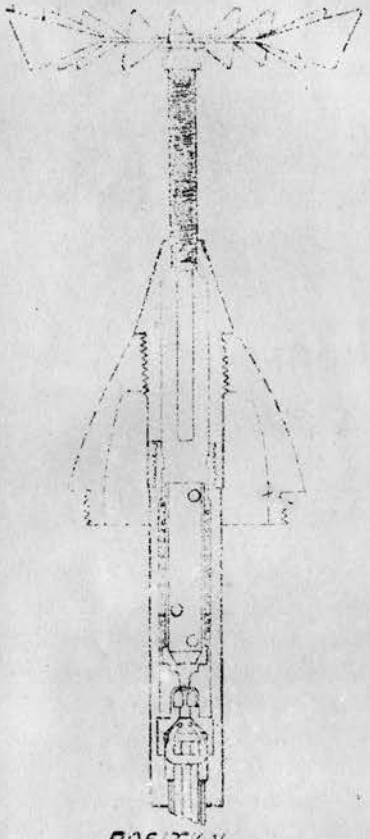
METHOD OF OPERATION. During shipment the propeller is held stationary by two strands of wire attached respectively to the propeller and the body of the bomb. The firing mechanism is permanently locked by means of a propeller screw which absolutely prevents accidental functioning.

Before the bomb is placed in the suspension on the plane, the wires which hold the propeller are removed and the propeller unscrewed by no more than four complete turns, according to the directions to be found in the packing case. The bomb is then placed in the suspension where the propeller is prevented from revolving by means of a spring wire which engages the blades. The firing mechanism consists principally of a striker driven forward by a spring. The tail of the striker, which is hollow, is held in place by three equi-distant balls separated by the thickness of the striker. These balls are held in placed between the vertical wall and the striker sleeve and the propeller stem. As the propeller unscrews, the stem moves with almost no frictional resistance, until the lower end passes the equator of the three balls. At that moment the striker spring comes into play. The balls drop into the striker and the striker is driven with considerable force against the detonator.

ACTION. As the bomb is released from the airplane, the current of air produced by the falling body, unscrews the propeller. Five seconds later, that is to say, at a distance of from 60 to 80 meters from the machine, the firing mechanism is automatically unlocked and immediately the 8-second fuse or quick match contained therein is ignited. When that time has elapsed and the bomb has descended some 500 meters or more, the firing mechanism is blown off by a slight explosion and the material in the H tube is ignited at four different points, A, B, C, and D. The bomb is split in two halves by melting the solder and the main incendiary mass is ignited.



SAFE POSITION.



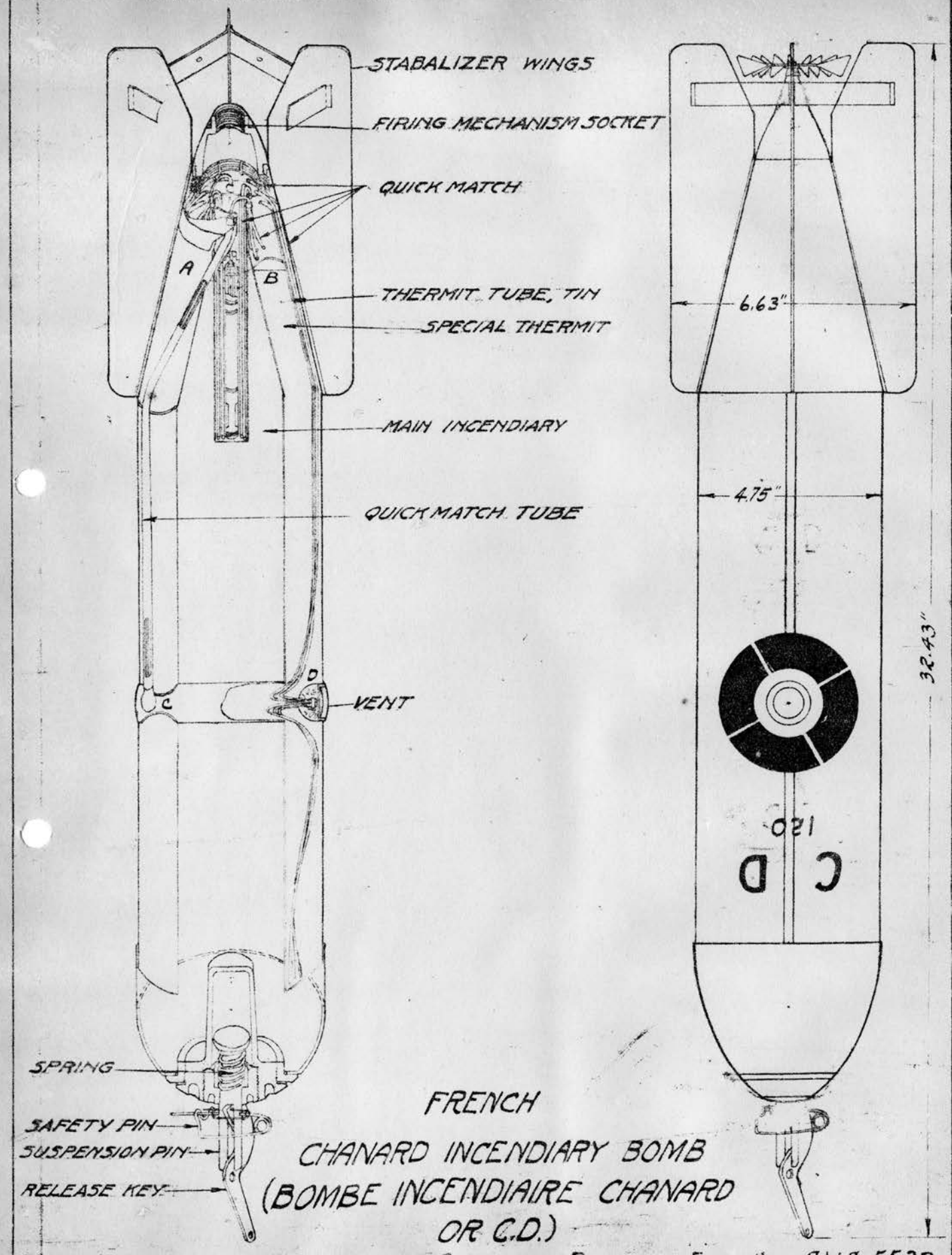
POSITION AT MOMENT OF PERCUSSION

CH

CHANARD [illegible] VARY BOMB

FIRING MECHANISM

O.C.D. OFFENSE DIVISION, ENG. SEC. C.W.S. 5518



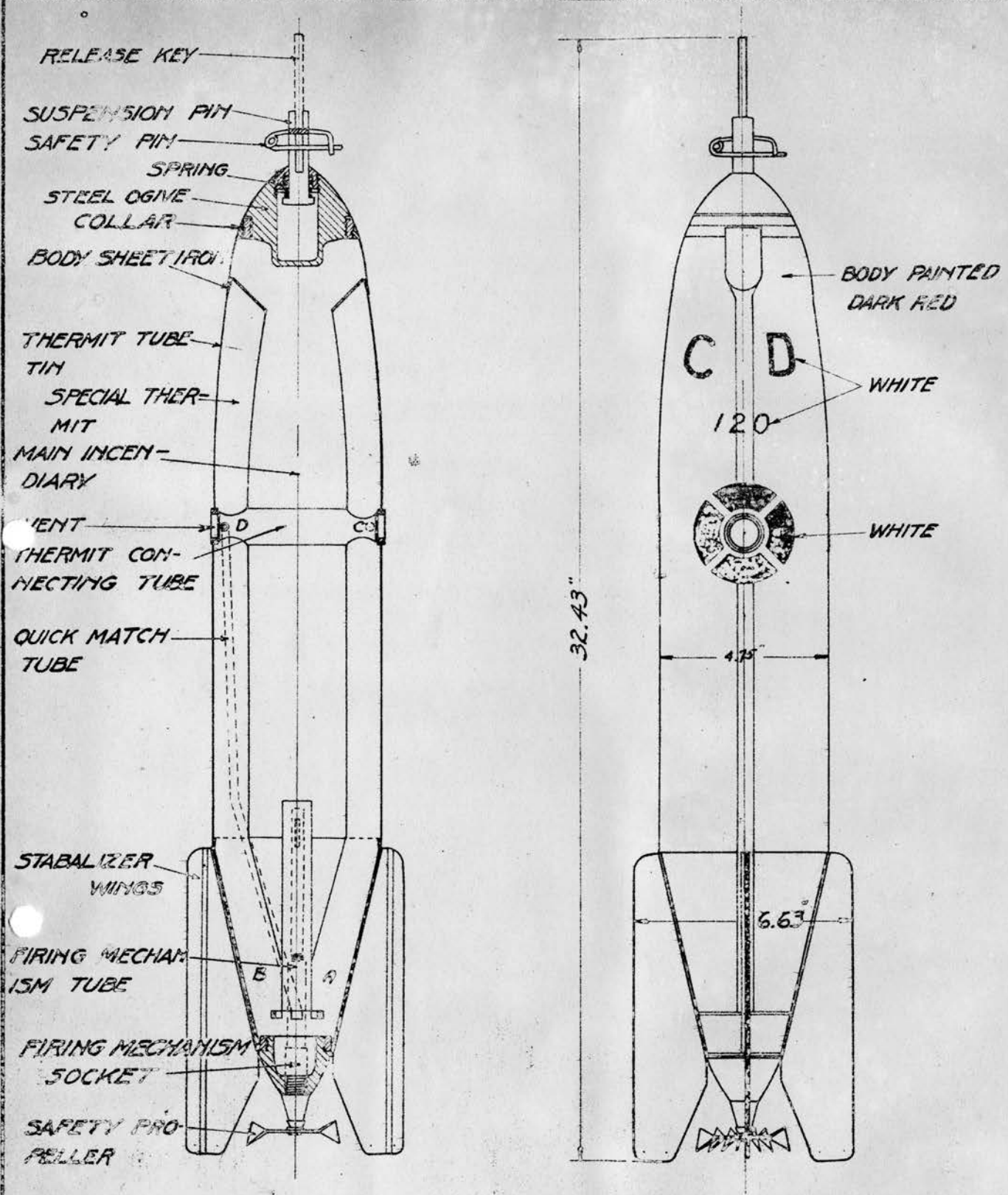
FRENCH

CHANARD INCENDIARY BOMB

(BOMBE INCENDIAIRE CHANARD OR C.D.)

S.O.S.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5522



FRENCH

CHANARD INCENDIARY BOMB

(BOMBE INCENDIARY CHANARD OR C.D.)

S.S.S.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5521

As this action takes place, the bomb is still dropping through the air and it reaches its target in flames. The blazing contents are deposited on the target without the necessity of an explosion. Here it continues to burn for some 18 minutes. A black smoke is given off which hinders fire fighting.

MARKING. The bomb is painted with light red oil paint. Around the vent holes are painted white circles and on the body of the bomb are the markings "C.D. 120", shown on the plate. The lot number and date of loading also are shown on the plate.

PACKING. The bombs fully assembled with the propeller tied as previously described, are packed two in a case. This case is painted red and bears the following inscription on the cover:

"AVIATION"
BOMBE INCENDIAIRE
C.D.
120
Lot No.

On the side - A RETOURNER
A LA 2eme RESERVE.

When these bombs are removed from the case, they should be lifted by their suspension keys. If replaced, they should be replaced in a horizontal position with the suspension keys crossed.

TACTICAL USE.

4. The Chanard Incendiary Bomb is designed for setting fire to buildings of either light or heavy construction. It is so designed that it will penetrate an ordinary roof and deposit its contents in the interior of the building. The incendiary material of the bomb being already ignited when it hits the target, it continues to melt, run, and burn as it runs communicating this fire to any inflammable material which it reaches. A bomb of this type should, of course, be used only against well defined targets where a direct hit is possible, for if it should miss the target and strike on the ground or other uninflammable material its effect would be nil.

5. Incendiary bombs of the scatter type are for use against light building construction, grain fields, etc. They possess the advantage of not requiring a direct hit, because the material scatters to a certain extent; but they possess a disadvantage in that the amount of incendiary material in any one place is small and unless the material is quite inflammable it will not be set on fire.

6. The number of bombs that can be carried by planes in use by the American Air Service are as follows:

Day Pursuit - The Spad XIII has cells for 2 Chanard bombs.

Day Observation - 6 American Mark I or Mark II.

Night Pursuit - same as Day Pursuit.

Night Observation - same as Day Observation.

Observation planes carry 6 bombs if equipped with the American Mark V release.

Day Bomber (DH-4) - 6 Mark I or Mark II.
Breguet - 8 Mark I or Mark II.

Night Bomber (Handley-Page) - 16 Mark II.

The American Mark V Release will carry 5 Chanard bombs per trap or 10 per plane.

FRENCH TRAINING NO. 2 SMOKE BOMB. STEEL.
(See accompanying plate).

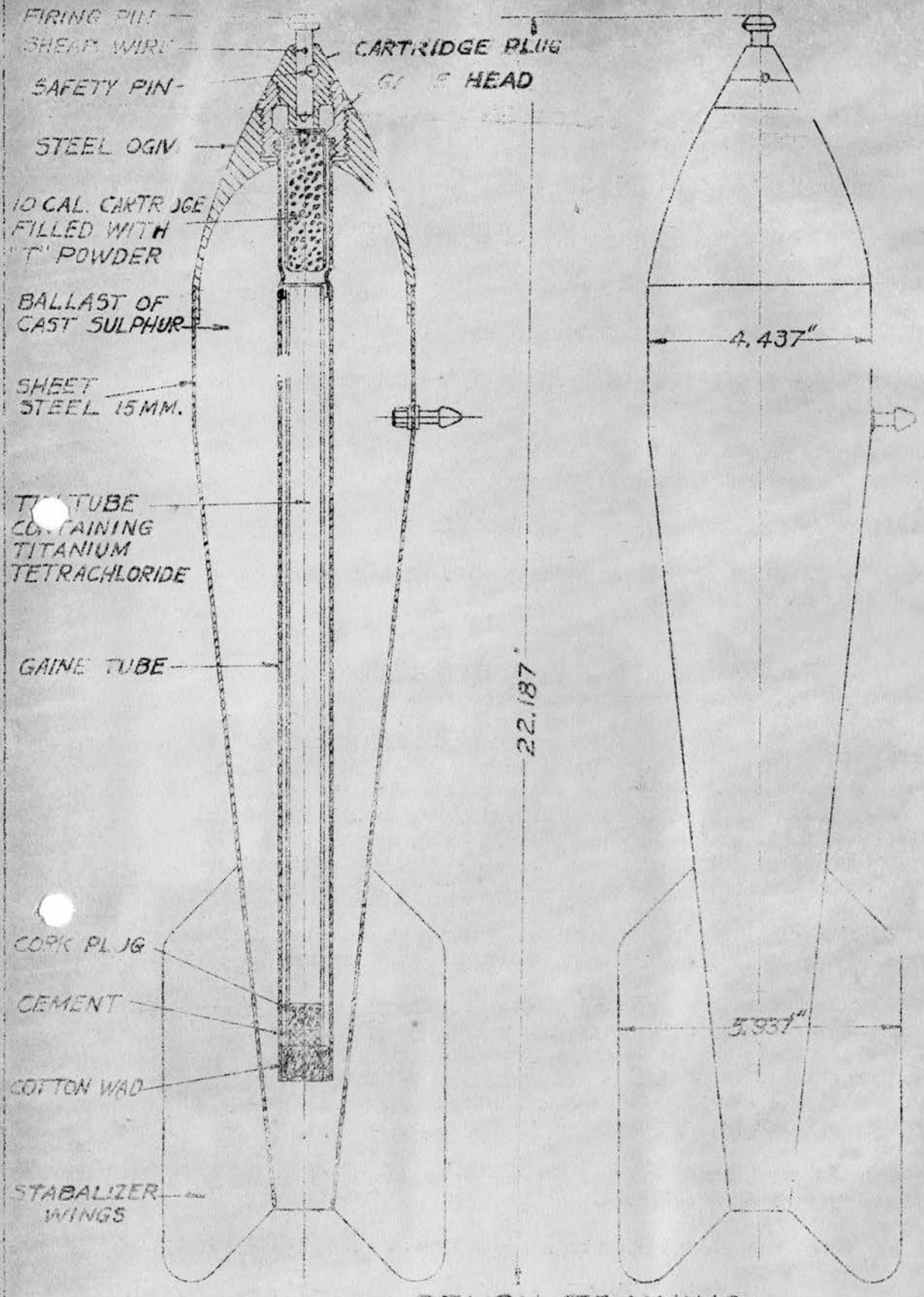
7. DESCRIPTION. The bomb consists of the parts designated on the drawing as follows: firing pin, shear wire, safety pin, cartridge plug, gaine head, steel ogive, 10 caliber cartridge, filled with "T" powder, sheet steel body, gaine tube, ballast of cast sulphur, stabilizer wings, tin tube containing titanium tetrachloride, cork plug, cement plug, and cotton wad. All the metal parts are made of steel or iron. "T" powder is a highly nitrated sporting powder containing less than 1.3% moisture.

METHOD OF OPERATION. The bomb is designed so that it has the same trajectory as regular bombs and is used to train aviators in bomb dropping.

When suspended in the dropping mechanisms the safety pin is removed. On striking the objective the shear wire is cut and the firing pin impinges on the detonator of the cartridge which is thereby fired. This expels the tin tube containing the fumigen and at the same time breaks it, causing a scattering of the liquid titanium tetrachloride which substance produces a white cloud of smoke visible from the airplane.

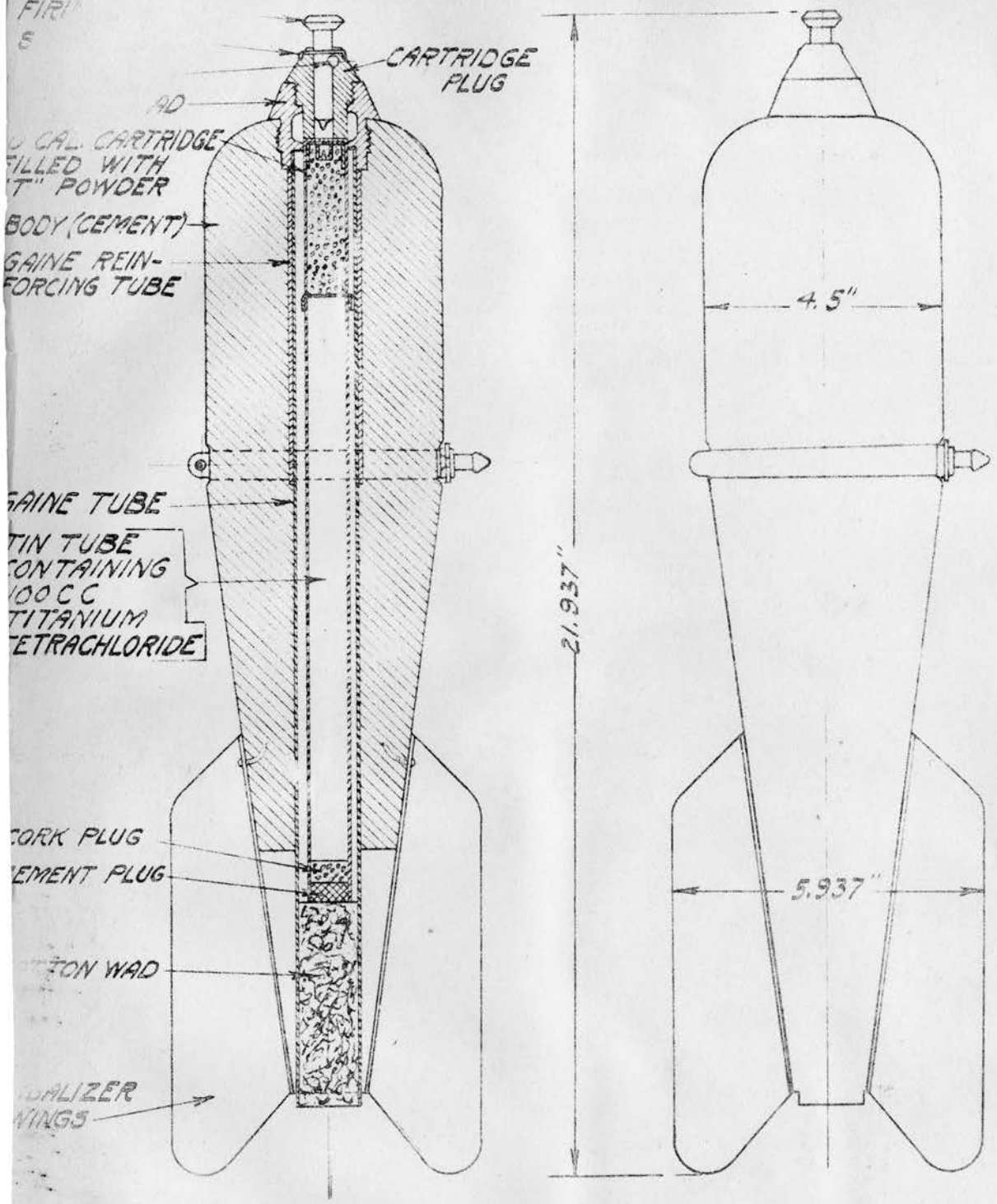
MARKING. The bomb is painted black, but has no special markings other than the Inspector of the Forges.

PACKING. The bombs are packed four in an open crate. The crates have the following stencilling:-



1 R"NCH TRAINING
No 2 SMOKE BO'B STEEL

...EMSE DIVISION, ENG. SEC. C.W.S. '38

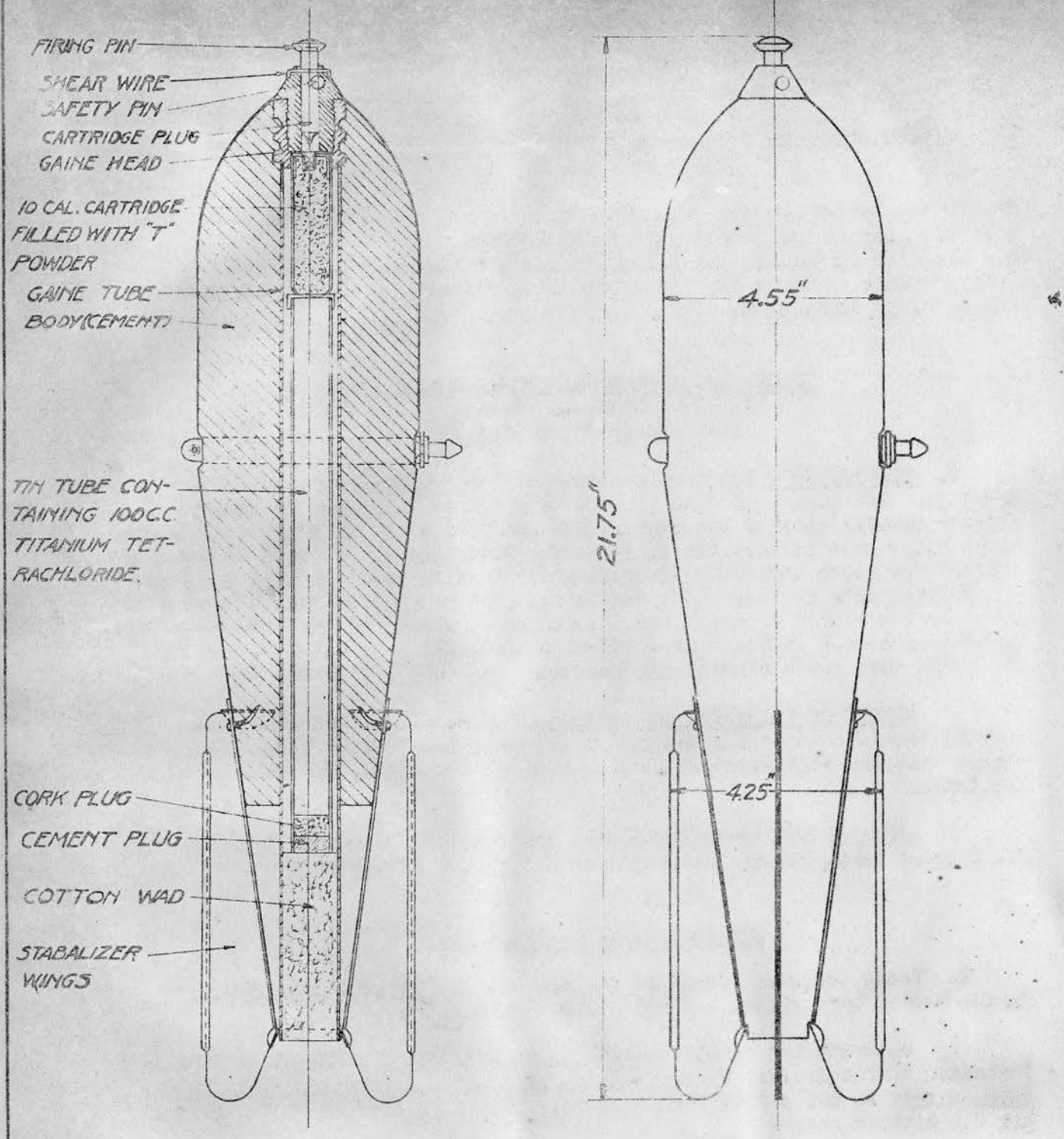


FRENCH TRAINING

SMOKE [illegible] 3-CEMENT

(BOMBE A' FUMEE' EN CIMENT)

OFFENSE DIVISION, ENG. SEC. C.W.S. 5565



FRENCH TRAINING
SMOKE BOMB —CEMENT

(BOMBE A' FUMEE EN CIMENT)

S.O.S

OFFENSE DIVISION, ENG. SEC. C.W.S. 5523

On two vertical sides -	(Smoke Bombs for (Adjustment of Fire (Michelin Type	(Crate to be returned to (2nd Aviation Reserve at (Mortimets.

The loaded cartridges are packed in tight boxes, the number of cartridges contained in the box, stencilled on the cover.
The tubes of fumigenite are packed in cases containing 100 tubes.
Each shipment of bombs has a corresponding shipment of filled cartridges and tubes of fumigenite.

FRENCH TRAINING SMOKE BOMB - CEMENT
(Bombe a Fumee en Cement)
(See accompanying plate)

8. DESCRIPTION. The bomb consists of the parts designated on the drawings. Two plates of this type of bomb are shown. One is simply a later modification of the other. The one having the narrower stabilizer wings and a more stream-like shape is the later model. It will be noted that in the later design a different gaine head is used and also the gaine reinforcing tube has been done away with. The main difference between this bomb and the French Training No. 2 smoke bomb, steel, is that the body is made of cement rather than of steel filled with cast sulphur, and that the gaine tube has a reinforcing tube near the nose end in the older model.

METHOD OF OPERATION AND MARKING. The method of operation and marking is the same as for the French Training No. 2 smoke bomb, steel, except that the stabilizer wings only are painted black, the body being unpainted.

PACKING. The bombs are packed the same as the French Training No. 2 smoke bomb, steel, the labels on the crates being the same.

USE OF TRAINING SMOKE BOMBS.

9. These bombs are designed for use only in training bomb droppers in the use of bomb sights and release mechanism.

On impinging on the ground the bomb expels its charge of fumigenite (titanium tetrachloride) which gives a smoke cloud which is visible to the bomb dropper in the plane, thus informing him as to whether or not he has hit the desired target.

PART VII

DEFENSE AGAINST GAS.

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8. Gas Defense Supply.

PART VII

DEFENSE AGAINST GAS.

1. GENERAL CONSIDERATIONS.

1. The following notes have been prepared for the guidance of officers when giving instruction on gas defense. Such information on the offense use of gas as can be published is issued by the Chemical Warfare Service in another pamphlet, in bulletins, and by the General Staff in books on artillery firing, etc.

2. Gas is one of the most important weapons of modern warfare. This is due to the insidious and poisonous effects of even extremely small quantities, and the fact that large areas can be made dangerous by its use. These characteristics of gas make necessary a system of defense against it at once wide in its scope and continuous in its action.

3. There is on the other hand no type of enemy warfare which can be as successfully resisted as gas. Against well-disciplined troops, some of the most violent gas bombardments have failed to secure a single casualty, though any laxity is sure to result in more or less serious losses.

4. It is the duty of commanding officers to familiarize themselves with the nature of gas, and the means of defense against it. Our protective appliances are constantly being improved as gas warfare develops, and when rightly used, they give complete protection against all forms of gas.

5. In warfare, any substance which is used for its poisonous or irritating effect may be called a gas, regardless of whether it is a "true gas", a mist of fine drops, a cloud of poisonous dust, an ordinary liquid, or a solid.

6. There are two groups of warfare gases. The first group, of which chlorine is an example, consists of substances that are true gases under ordinary conditions and form gas clouds immediately upon opening the container in which they are stored. Those of the second group, typified by mustard gas, form vapors only very slowly unless scattered by shell explosion or warmed by the heat of the sun. Even an extremely small amount of certain gases if breathed sufficiently long, will cause a casualty.

7. A man some distance from a shell hole containing poisonous liquid may become a casualty through inhaling the vapor or by its condensation on his body, even if no shell have fallen for several hours. It is important that this be explained so that the men may appreciate the danger of gas, and at the same time realize that there is nothing mysterious or supernatural about it.

8. In order to cut down gas casualties to the absolute minimum, the following measures must be taken:

(a) Thorough training and drilling of troops in the use of protective appliances so that they can adjust them accurately under all conditions and perform all duties while wearing them.

(b) Frequent and rigid inspection of all protective equipment.

(c) Absolute obedience to regulations in regard to carrying the respirator in danger and alert zones.

(d) Training all troops to recognize gas attacks.

(e) Installation of adequate gas alarms and instruction of sentries in their use.

(f) Teaching all officers and gas N.C.O's the properties of enemy gases, proper methods of defense against them, and action to be taken in situations likely to arise.

(g) Practice in wearing respirators for long periods.

(h) Wearing respirators as long as gas is present. Danger from gas can be greatly reduced by these means, and officers should impress this fact on their men. Excessive casualties from gas attacks indicate laxity or ignorance on the part of officers.

II. GAS ATTACKS.

GENERAL

9. The enemy employs gas for two purposes:

(a) To inflict casualties. For this purpose he relies upon surprise, and upon taking advantage of ignorance, bad discipline, faulty training and defective respirators.

(b) To reduce the fighting efficiency of our forces by compelling them to wear masks or to employ other protective appliances.

10. In making a gas attack the enemy seeks to generate a cloud of gas either directly within our own lines or in such a position that it will be carried by the wind into our lines. To accomplish this end he employs three distinct methods.

(a) Cylinder cloud attacks.

(b) Projector attacks.

(c) Bombardments with artillery or trench mortar gas shell.

In the case of cylinder attacks, a highly poisonous liquified gas of low boiling point is liberated from cylinders placed in or near the front line. In case of projector or trench mortar attacks, and of attacks by artillery shell, the gas is inclosed in a suitable projectile and is thrown into the adversary's territory. There, by means of a percussion or a time fuse and a bursting charge, the shell is broken open and the poisonous material is liberated. The bursting charge is varied, depending upon whether the "gas" is a liquid or a solid. The bursting charge is usually very small in the case of a liquified gas, but often sufficient to give practically a high explosive effect in the case of solids. A liquified gas vaporizes when the pressure is released by the breaking of the shell, while solids are either stomized or vaporized by the explosion of the bursting charge.

(a) Cloud gas is employed more frequently in trench warfare than in open warfare, as there is more time to place the cylinders in the trenches and the stability of movement allows the cloud to drift over the opponents trenches. However, the general tendency is to so develop it by the use of light cylinders and rapid transportation that it can be used in semi-stabilized warfare.

(b) The present tendency is to avoid the digging-in of the projections and to provide more efficient means of transporting them, so that they may be used on a semi-stable front.

(c) Gas shell attacks are used in all kinds of warfare.

11. Cylinder Cloud Attacks. Gas clouds are produced by the sudden liberation of a liquified gas from the cylinders in which it is stored under pressure. The gas used is generally chlorine, phosgene, or mixtures of chlorine with phosgene or chlorpicrin. Formerly cylinders were as a rule dug in at the bottom of the trench and connected with outlet pipes that lead from the bottom of the cylinder out over the trench parapet. Now they are often piled on trucks or flat cars and fired simultaneously by electricity. When the outlet valves are fully opened, whether by hand or electrically, the liquid is driven out as a gas in two or three minutes, which mixing with the aid forms a cloud. This cloud may vary in appearance due to weather conditions or to smoke mixed with it. It may be almost transparent and slightly green in color, or it may look like a thick mist.

12. The cloud is carried by the wind over the opposing line and oft-times the gas has been noticed in the rear areas as much as ten miles from the front line. Gas clouds are usually slightly denser than the surrounding air and therefore tend to fill up trenches and hollows and penetrate unprotected dugouts where the gas remains long after the main cloud has passed. Such clouds tend to follow the course of valleys. Lakes or streams do not affect the gas.

13. The chief dangers from such an attack are due to the high concentration of gas at the moment of its release and to the effect of the area which may be covered by the gas under favorable conditions. However, cloud gas attacks are very dependent on wind conditions and should not be made in heavy rains. They are best made only when upward-moving currents of air are not present, that is, when the sun is not shining. They offer little less chance for surprise than other forms of attack, and hitherto have often been detected by:

(a) Noise of hammering on metal in the trenches.

(b) Active wind observations by the enemy.

(c) Escape of gas from cylinders hit by shell.

(d) Raids.

(e) Prisoners' statements.

During the discharge the warning was often given by:

(a) The hissing sound of the escaping gas.

(b) The appearance of the cloud.

(c) The odor of the gas before the main cloud reached the trenches. Gas cloud attacks are still to be feared as a dangerous form of attack and when they are made, every form of gas defense equipment is given a most severe test. A new development is the use of portable gas cylinders fired by electricity while lying on the ground.

14. Projector Attacks. The enemy makes use of "gas projectors" having a range of about 1500 meters and in the case of the new rifled projectors of about 3000 meters. By this method a large number of projectiles, each containing about 16.5 pounds of liquified gas are simultaneously shot from smooth-bore or rifled iron tubes dug into the ground or set in wooden racks. The propelling charges are varied according to the range desired. The electric current for firing the charges is generated by hand-driven magnetos called "exploders", each of which fires about twenty-five projectors. On impact, or by means of a time fuse, the projectiles are exploded and the gas volatilized. By this method, the enemy is able to generate a cloud of gas within our lines. His tactics are not so dependent upon weather conditions as when cloud attacks are made. Projector attacks call for the highest degree of gas discipline among the troops affected because of the surprise which is often secured and the instantaneous formation of an extremely concentrated and deadly cloud of gas. (For new use of phosgene-pumice in projectors, see par. 29.) Warning of an impending projector attack may be given by:

(a) Noise of installation of the apparatus and material.
(b) Active wind observations on the part of the enemy.
(c) Airplane photographs of projector emplacements, new dumps and tracks.

In the future, not much reliance can be placed on these means of detection, as projectors will frequently be installed and fired during the same night.

15. When the shoot occurs a large flash or series of flashes may be seen in the enemy's lines, followed by a loud explosion, like that of an ammunition dump blowing up. The enemy often tries to conceal this shoot of flame by installing projectors behind hills so that the only warning given is the crash. Sentries should be warned to give the alarm when any sound is heard which might be interpreted as being caused by projectors. The course of the projectiles through the air is often seen by the trail of sparks emitted from the time fuses, and the bombs make a loud whirring noise described as being similar to the noise of partridge in flight. In the case of the rifled projector shell the noise is less distinctive and similar to that caused by ordinary artillery shell. Twelve to twenty-two seconds' warning is usually given by the flash and explosion. (New Z.M.u.s.W.M. 45 fuse graduated to 45 seconds, used on rifled projector.)

16. Gas Bombardment with Trench Mortars and Artillery. The enemy also employs toxic substances in the projectiles shot from trench mortars or minenwerfers. With sufficient rapidity and accuracy of fire, it is possible for him to generate a heavy cloud of gas within our line. A higher degree of accuracy is attained than with projectors and the bombardment can be continued indefinitely, whereas a projector can be fired only once during a considerable period of time. However, it is not possible by the use of minenwerfer to develop as high a concentration in as short a time and the likelihood of surprise is not so great.

17. The use of toxic substances in artillery shell is the most important weapon in gas warfare. Batteries firing rapidly and accurately against some objective, such as another battery, can develop a moderately high concentration at a long range. Owing to the greater range and accuracy of artillery fire, weather conditions affect this use of gas less than others, although a wind of high velocity or upward currents will disperse a cloud of non-persistent gas so rapidly that very little damage will be done. Gas shell are used in various ways, according to the tactical result desired. To produce casualties, sudden bursts of lethal shell are concentrated on small targets, and in preparation for an infantry advance enormous numbers of shell containing penetrating and surprise gases are often employed. Harassing fire with persistent gases like mustard, a few shell at a time, may be continued indefinitely against permanent positions.

18. Toxic substances find a use of minor importance in hand grenades. In this form, the enemy employs poisonous chemicals for the purpose of "mopping up" recently captured trenches and dugouts.

III WARFARE GASES.

MUSTARD GAS.

19. Physical and Chemical Properties. Dichlorethylsulphide, known as mustard gas is an oily liquid boiling at 423° F. On account of its high boiling point, it vaporizes very slowly, and is, therefore, extremely persistent. It has a slight and not unpleasant odor described as being like that of mustard or garlic. It is a stable compound, being but slowly destroyed by water at ordinary temperatures, more quickly by alkalis such as bicarbonate of soda. Chloride of lime will destroy any mustard gas, either liquid or gaseous, with which it comes in contact. The liquid will soak into soil on which it is thrown and remain there from a week to a month. Therefore, mustard gas shell holes should not be dug up for a considerable time after a bombardment. The liquid which remains in or above the surface layer of the soil will slowly vaporize under the heat of the sun. This vaporization will not as a rule be great enough at night or during cold weather to produce dangerous concentrations of gas, but as soon as the ground is warmed by the sun, troops passing near will be in almost as great danger from the gas as at the time of the bombardment. Mustard gas also has the property of remaining on and penetrating woolen and cotton fabrics. Rubber is penetrated fairly rapidly. Oiled fabrics delay penetration to a considerable extent. However, it is unwise to depend on this protection for more than a few hours.

20. Use in Enemy Projectiles. The enemy uses mustard gas in shell for 77 mm. gun, and for 105 mm., 150 and 210 mm. howitzers, more rarely in 100 mm. and 150 mm. guns. The distinguishing mark is a yellow cross on the side or base of the shell or both. The filling is dichlorethylsulphide, usually mixed with a solvent, -carbon tetrachloride, chlorbenzene, or nitrobenzene. These shell have been generally provided with a medium bursting charge, although the use of yellow cross shell with a high bursting charge, simulating H.E. shell, is increasing continually. These latter are marked with a yellow Lorraine cross. The charge in the Lorraine cross shell is of sufficient size to produce a spray of very finely divided particles of the liquid and in this form, though less persistent, the gas is more concentrated and dangerous.

21. Physiological Action. The following points should be carefully noted in regard to this gas, as they, in combination with its persistence, make it the most dangerous of all. Unlike others, it has very little immediate irritating action on the respiratory system or on the eyes, and, therefore, does not force a man to put on his respirator. Exposure to either liquid or vapor, even in low concentrations, will cause irritation of any tissue with which it comes in contact. This irritation is usually not noticed for from 3 to 12 hours after the exposure and may affect any part of the body. The worst mustard gas cases are due to irritation of the respiratory tract, which is often serious enough to cause death. A secondary effect is often pneumonia or in lighter cases bronchitis and an acute sore throat lasting for several weeks. Exposure of the eyes to the vapor will cause temporary blindness, which is very painful, and will last from a few days to several weeks, depending upon the length of the exposure.

The third effect, from which mustard gas derives its name of vesicent or blistering agent, is the production of painful burns on those portions of the skin which it comes in contact with, particularly the tender and moist parts under the arms and around the scrotum.

22. Tactical Uses. Mustard gas is used rather as a neutralizing than as a surprise gas, because its slow evaporation prevents the rapid formation of high concentrations. Its persistency is greater than that of any other gas, and hence by its use any position may be made untenable for days after it is shelled. It is particularly valuable for use against valleys and woods, because such terrain will remain infected longer than open country. It is used in general against artillery emplacements, support and reserve positions, command posts, billets, woods, communicating trenches and roads. The following translation of a captured German document is instructive.

23. "Bombardment with yellow cross shell will be executed preferably between one and four A.M. At first the bombardment will compel the enemy to wear his mask. A few hours later, when the presence of the gas is no longer revealed by the odor, the enemy will probably take off his mask, but will be overcome later, when the sun rises, by the action of the evaporation. Every attempt of the enemy to nullify the effects of our night gas bombardment in the morning should be neutralized by volleys of rifle, machine gun, minenwerfer and artillery fire.

24. Mustard gas is rarely used during the three or four days preceding a large scale "push", except against those points over which it is not intended to advance. Particular care must be taken in occupying terrain captured from the enemy because of the danger from gas traps left during his retreat. Gas shell and bombs may be left in dugouts or farmhouses and fuses to explode when the locality is filled with our troops. Mustard gas may be sprinkled on roads and all points over which troops must pass. All shelters will in general have been liberally soaked with mustard gas.

25. Individual Protection. (a) The respirators in use by the American forces give absolute protection against all but the blistering action of mustard gas. Certain special precautions in their use must be observed. Because of the slight odor and delayed action of mustard gas, troops must be trained to put on the respirators immediately after any odor is noticed which might be that of gas. They must not remove the respirator until all traces of the gas have disappeared. They must be trained to wear it for long periods of time and be able to work efficiently while wearing it. Men who have been exposed to mustard gas and have been testing for it for several hours, gradually lose their ability to detect it. On wearing the mask for a short time one recovers his keenness of smell for the gas.

(b) The issue of protective clothing such as suits and gloves, to special troops only, is authorized by the General Staff.

(c) Sag paste. This is a protective ointment which, if applied before exposure to the gas, will greatly diminish its effects upon the skin. The paste should be rubbed liberally in an even layer on the genital organs and region, the buttocks, the arm-pits, and other parts of the body which perspire freely. The length of time that such an application is effective depends entirely upon the strength of the gas. It should be carefully noted that sag paste must be applied before troops enter an area that is likely to be shelled. This will have to be done on the judgment of the unit gas officer.

(d) Any portion of the skin which has been splashed by the liquid from mustard gas shell or even moist parts that have been exposed to the vapor should be washed as quickly as possible with soap and water. Any kind of soap will answer and cold water is satisfactory. It is only necessary to work up a good lather and massage the place well with this lather. Very little water used in this way often suffices to prevent burns.

(e) If chloride of lime is available, as it should be, some of the dry powder sprinkled on the skin that is splashed with mustard gas liquid will prevent a bad burn. The powder is to be left on the skin about fifteen minutes and then washed off with water and soap if obtainable.

26. Collective protection. In general, the best protection against mustard gas is evacuation of all ground infected by it, if the tactical situation permits, in which case alternative positions should be prepared or selected in advance. If a zone has been evacuated after a mustard gas bombardment, sentries should be posted on all roads and paths entering this zone to warn troops away from it and to prevent their entering. Sentries should also be posted in front of contaminated dugouts in a zone otherwise free from mustard gas. If not possible to evacuate, frequent reliefs, or protection of troops as far as possible in gas-proof dugouts will alone prevent numerous casualties, as mustard gas will outlast the staying power of troops wearing the respirator. In connection with the use of gas-proof dugouts, it should be noted that men entering such dugouts have gassed the occupants by the gas which they have brought in on their clothes and, therefore, all outer clothing should be removed in the entrance to the dugout and soles of shoes treated with chloride of lime. A scraper, water, and box of chloride of lime should be kept near the entrance to each dugout. The shoes are first dipped into the water, then thoroughly rubbed in the lime, and finally washed off in the water. This precaution, if followed by thorough washing of the body, will be very effective in preventing burns. It should be noted that the enemy will probably not knowingly attack across an area recently shelled with mustard gas.

27. Disinfection of positions and clothing. After a mustard gas bombardment, the covering of the shell holes with chloride of lime will render such shell holes harmless. The chloride of lime should be spaded in well, then covered with another thinner layer of lime, which is in turn covered with fresh earth. This should be done by a special disinfecting squad provided with the proper protective clothing. It is manifestly impossible in the case of an extensive bombardment to disinfect all shell holes

in this way, but those near which troops pass or near dugouts should always be disinfected. Men after walking over an area infected with mustard gas will find it necessary to destroy the poison on their shoes before entering a dugout, as this liquid readily evaporates afterwards in the dugout, rendering the atmosphere extremely dangerous. Chloride of lime is placed on the ground outside of the dugouts, in order that men may usedthe lime to destroy the liquid that may be carried upon their shoes. There is an element of danger in the use of chloride of lime to destroy gas due to the fact that the odor of the former completely masks that of the latter. When chloride of lime is thrown on liquid mustard gas. some chlorine is given off. This will cause little annoyance. However, the heat of the reaction may vaporize some of the mustard gas which has not yet been destroyed. When large puddles of the liquid are encountered, they will first be sprinkled with sand, dry earth or ashes, to absorb the greater part of the poison before being treated with chloride of lime. Clothes which have been gassed can be disinfected by washing in running water for several days, by washing in nearly boiling water for 1 to 2 hours, by steaming for an hour, or by hanging them out in the rain. The extent of cleaning necessary and method employed will depend on the amount of contamination and the conditions of the field.

PHOSGENE.

28. Physical and Chemical Properties. Phosgene or carbonyl chloride is a liquid boiling at 47°F. with a marked odor, described as being like that of a mouldy hay. Because of its low boiling point, it will not remain on any terrain on which it is thrown for more than a few minutes. It will form clouds of varying concentration, depending on the manner in which it is thrown over, and a very heavy cloud may render positions dangerous 10 km. from the original point of attack.

29. Use by the Enemy. Phosgene is sent over by the enemy from cylinders, in projector bombs, trench mortar and artillery shells. In cylinders it is usually mixed with chlorine in order to form a mixed gas of high vapor pressure. It is generally used pure in the 75, 170 and 250 mm. trench mortar shell and in the 180 mm. smooth-bore projector bombs. In these it is rarely mixed with chlorpicrin. Recently the enemy has used phosgene in long range rifled projector shell mixed with pumice, absorption in which retards its evaporation, making it persist for several hours. Finally, it occurs generally in small proportion as a decomposition product of diphosgene in artillery shell for 77 and 100 mm. guns and the 105, 150, and 210 mm. howitzers.

30. Physiological Action. Phosgene is a lung irritant and is probably the most deadly gas used in warfare. Exposure to high concentration for even a short time will cause severe casualties, frequently and much lower concentrations will also have serious effects. Its full effect is usually delayed for several hours and exercise after exposure to this gas will render slight casualties much more serious or even fatal. Because of this effect, men who have been gassed even slightly and who have experienced no symptoms of gas poisoning must be prevented from taking any exercise whatever, if serious casualties are to be prevented.

31. Tactical Uses. Phosgene is used entirely as a surprise gas, as high concentrations can be developed with it very rapidly. Its persistency is low, and it is, therefore, possible to follow up a phosgene attack with an infantry advance after a very short time.

32. Defense Against Phosgene. The respirator gives absolute protection against this gas. Troops must be trained to put on the respirator quickly and well under any circumstances, and sentries must be thoroughly instructed so as to be able to recognize phosgene attacks and to give the alarm immediately. Trenches and dugouts can be quickly rid of phosgene by means of fanning and fires.

DIPHOSGENE

33. Diphosgene, superpalite or trichlormethyl chlorformate, is a liquid boiling at 261° F. Its other properties and action resemble those of phosgene very closely. It cannot be used in cloud or projector attacks because of its high boiling point. It is used by the Germans mixed with chlorpicrin in Green Cross 1 shell of different calibers and with diphenylchlorarsine in Green Cross 2. Phosgene usually accompanies diphosgene in the latter, due doubtless to the decomposition of the diphosgene.

CHLORPICRIN

34. Chlorpicrin is a colorless liquid boiling at 234° F, and hence is fairly persistent. It approaches phosgene in its poisonous effect. Even in very low concentrations it will cause lachrymation and in higher concentrations vomiting, which may necessitate the removal of the mask. The clothes of men who have been exposed to chlorpicrin are dangerous because of the gas which is carried on them and the same precautions against gassing men in dugouts must be taken as in the case of mustard gas. Chlorpicrin is used mixed with diphosgene in Green Cross 1 shell. The respirator gives full protection.

ARSINES

35. Diphenylchlorarsine is a solid of extremely low volatility and is practically odorless. It is used in Green Cross 2 and in the Blue Cross shell which contain in addition a large amount of high explosive. On the explosion a cloud of vapor is formed. The cloud will cause headache and intense pain in the throat and chest, accompanied by sneezing and coughing. Vomiting and even temporary paralysis of the nervous system may finally result. It is used mainly to unnerve a man and prevent him from adjusting his mask quickly or to prevent his keeping it on after it is adjusted. It is used also for direct neutralization through the production of the above painful symptoms. The effects of this gas when used alone disappear quickly. The respirator gives absolute protection, but must be put on immediately. Diphenylcyanarsine is similar in its action and rather more effective. It is used in Blue Cross shell.

20	Mustard Gas.(Dichlorethylsulphide).	H.S.	Ypérite	Yellow Cross.	Slight mustard garlic.	3 dgys	7dgys	Respiratory irritant. Eye and irritant. Blistering agent. Action delayed several hours.	

NOTE:- The above figures on time of persistency are approximate only and for calm weather. Persistency is dependent to a large extent on temperature, wind velocity, and the amount of gas liberated, especially in woods or other more or less closed places. High temperatures and wind velocities decrease persistency, and low temperatures and wind velocities increase it.

SUMMARY OF MARKINGS FOR CHEMICAL SHELL AND PROPERTIES OF COMMONEST GASES.

FRENCH NUMBER	SHELL FILLING	AMERICAN AND BRITISH CODE SYMBOLS	FRENCH DESIGNATION	GERMAN DESIGNATION AND SHELL MARKING	ODOR	PERSISTENCY		PHYSIOLOGICAL EFFECTS.	REMARKS
						In open	In Woods		
					NON - PERSISTENT GASES.				
	Chlorine (Used only in cloud gas	Red Star.	Bertholite		Chloride of Lime.	10 min.	3 hours	Lung irritant Deadly. Action immediate.	These gases are very volatile, they are vaporized entirely at the moment of explosion, forming a cloud capable of giving deadly effects, but which loses more or less rapidly its effectiveness by dilution and dispersion into the atmosphere.
4	Arsenic Trichloride-30%.Stannic Chloride-15% Hydrogen Cyanide-50% Chloroform-5%	Not used by the A.E.F. or the B.E.F.	Vincennite			10 min.	3 hours	Lachrymator and respiratory irritant. Considered quite toxic but in high concentrations only.	
4B	Cyanogen Chloride 70% Arsenic Trichloride - 30%		Vitrite			10 min.	3 hours	A lachrymator. Respiratory irritant and lethal agent.	
	Diphenylchlorarsine.	D.A.	Sternite	Blue Cross	Slight.	10 min.	3 hours	Sneezing Gas. Nerve depressant. Respiratory irritant.	These gases form non-persistant clouds of solid particles.

	Diphenlycyanarsine	D.C.	Sternite	Blue Cross	Interchang	eable with D.A.		Effects somewhat greater than D.A.	))
5	Phosgene	C.G.	Collongite	Three white bands white D.	Musty hay. Green corn	10 min	3 hours	Respiratory irritant. Very deadly. Action usually slightly delayed.	
					SEMI-PERSISTENT GASES.				
	Diphosgene	S.G.Not used by A.E.F.	Superpalite	Green Cross	Disagreeable, suffocating. Musty hay.	3 hours	12 hours	Same as phosgene	These gases, having moderately high boiling points, are only partially vaporized at the moment of explosion. The cloud is formed upon explosion and is generally not deadly, but it immediately gives penetrative lachrymatory or irritant effects. The majority of the "gas" contents of the shell is pulverized and projected in the form of a spray or fog which slowly settles on the ground and continues to give off vapors which prolong the action of the initial cloud.
	Phenylcarbylamine -chloride.			Green Cross		3 hours	12 hours	Eye, nose and throat irritant. Not very poisonous	
	Phosgene, Diphosgene and Diphenyl chlorarsine.			Green Cross 2.	Resembles diphosgene. A little pungent.	3 hours	12 hours	Respiratory irritant. Slightly delayed action. Very deadly. Causes vomiting and a little lachrymation	
	Chlorpicrin -75% Phosgene -25%	P.G.			Pungent	3 hours	12 hours	Respiratory irritant. Causes vomiting and little lachrymation.	)) Phosgene in those mixtures has the same effect as above if concentration is sufficiently high.
	Diphosgene and Chlorpicrin.			Green Cross 1.	Pungent	3 hours	12 hours	Slightly delayed action, very dead	

								-ly respiratory irritant. Causes vomiting and a lachrymation.	)))
7	Chlorpicrin	P.S.	Aquinite		Pungent	3 hours	12 hours	Causes vomiting. Respiratory irritant. Tear producer.	
	Chlorpicrin - 80%. Stannic Chloride 20%	N.C.			Pungent.	3 hours	12 hours	Respiratory irritant. Causes vomiting. Tear producer.	
	Ethyldichlorarsine and dichlormethylether.			Yellow Cross 1, or Green Cross 3.	Etheral. Pleasant	3 hours	12 hours	Nerve poison. Similar to diphenylchlorarsine, easily destroyed by water.	
9	Bromacetone	B.A.	Martonite	Green Cross	Pungent	3 hours	12 hours	Lachrymator. Tear producer. Slight respiratory irritant.	(Under unfavorable weather conditions bromacetone may persist for several days).
				PERSISTENT GASES.					
21	Brombenzylcyanide	C.A.	Camite		No odor	3 days	7 days	Not toxic but most powerful lachrymator known.	These gases, having very high boiling points are but little vaporized at the moment of explosion. A small portion of the contents of the shell is atomized and gives immediate effect, but by far the greater part is projected on the ground in the form of droplets which slowly vaporize and continue the action of the initial clouds.

36. Ethyldichlorarsine is a moderately volatile liquid, present in shells whose marking has recently been changed from yellow cross 1 to Green Cross 3. It is analogous to diphenylchlorarsine in physiological action, exerting a more destructive effect upon the respiratory tract along with the nerve poisoning. It is rapidly destroyed by moisture.

TEAR PRODUCING GASES

37. Various gases, such as brom-ketones, are used as tear-producing agents. They are heavy liquids with high boiling points and are used usually mixed with deadly gases, in all the various forms of projectiles. They are capable of producing blinding tears in very low concentrations and are particularly effective in forcing men to put on their masks. For this reason they are valuable as harassing gases. They have also a noticeable poisonous effect. They are fairly persistent. The respirator gives absolute protection against them. Chlorpicrin, in addition to its toxic properties, is of value as a tear producer.

SMOKE

38. The enemy may make use of smoke, either in the form of a cloud or emitted from shell and bombs. Smoke may be used with gas or between gas clouds; it may also be used alone to distract attention from a real discharge of gas, and in general for preventing observation, as for instance as a screening barrage, or for blotting out machine gun nests.

IV. PROTECTION AGAINST GAS

INDIVIDUAL

39. Every man whose duty carries him to the zone of the advance will be provided with an American Tissot respirator. No other respirator or mask may be carried or worn by any member of the American E F. except as noted in Part VII. For description, care, fitting, inspection of, and drill with the American Tissot respirator see paragraphs 65-90 inclusive.

COLLECTIVE

40. The following precautions are included under this head:

(a) Wind observations to ascertain when conditions are favorable for a hostile gas attack.
(b) Adequate systems of sentries and alarms.
(c) Gas proofing of dugouts and cellars.
(d) Clearing of gas from dugouts and trenches.
(e) Disinfection of ground and clothing.
(f) Precautions regarding food and water.
(g) Protection of weapons and equipment.

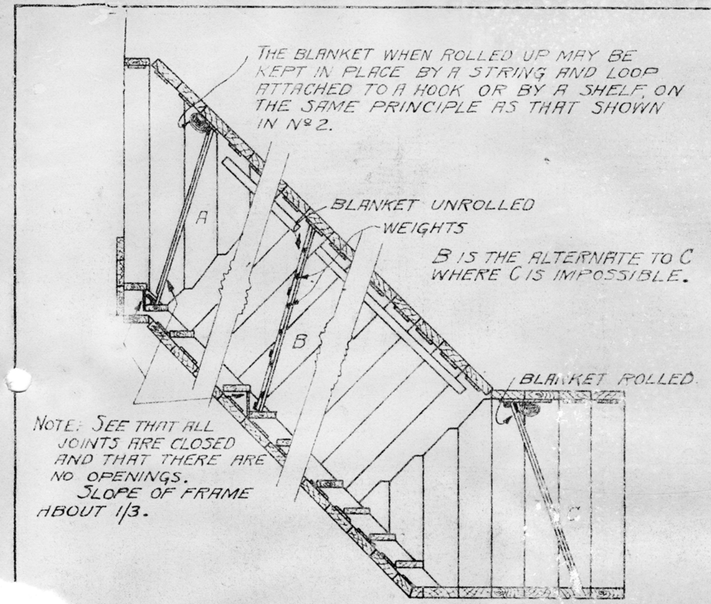
41. Wind observations. Such measures as the Division Commander on the recommendation of the Division Gas Officer, may decide to be necessary will be taken within the division for having wind observations made by the N.C.O's. The result of such observations should be reported to the Company Commander, who will in turn notify the D.G.O. when the wind is favorable for enemy gas attacks. (For further information on this subject see paragraphs 142-148 both inclusive).

42. Alarms. Experience has shown that numerous casualties occur through failure to warn men promptly when the enemy makes a gas attack. Officers are responsible that arrangements are made for the communication of the gas alarm to all ranks under their command in the shortest possible time. The need for dispatch in giving the gas alarm is imperative; a few second's delay, particularly in the case of projector attacks, makes a great difference in the number of casualties. Sentries must be posted over all men sleeping in dugouts. Whenever there is danger of projector attacks, men should be prevented from sleeping within 1500 yards of the enemy front line if tactical requirements permit. On detecting the presence of gas, sentries shout "Gas", put on their respirators and immediately spread the alarm in every possible way.

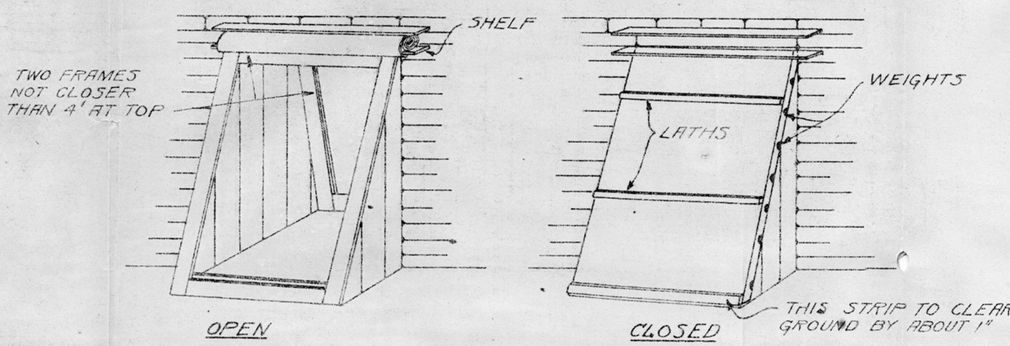
43. The method of giving the alarm varies with the nature of the attack. In cylinder and projector attacks it is necessary to warn troops over extensive areas, which may be traversed by a dangerous concentration of gas, while the effect of gas shell bombardments is much more local, and it is necessary to alarm only troops in the immediate neighborhood of the bombarded area. Any device may be used as an alarm for gas attacks which gives a loud and distinctive noise, and does not require the use of lungs. Improvised alarms, such as church bells and empty shell cases are in use as well as Klaxon horns, wooden rattles and steel triangles. Such light signals as may be approved by the Division Commander on recommendation of the Division Signal Officer and which do not conflict with those already in use, may be employed for gas alarms. Commanders of companies on the move should make sure that a sufficient stock of portable alarm devices is always on hand. Instructions with regard to the gas sentries and alarm systems are given in "Standing Orders", paragraphs 112-117.

44. Protection of Dugouts and Cellars. The protection of dugouts against gas has proven of great value especially in the case of gases of high persistency, which may necessitate the wearing of the respirain an area for long periods. The entrance to all dugouts and shelters of sufficiently good construction within the "Alert" zone should be provided with two gas tight doors, or with two curtains of gas proof material, with a space of several feet between them, thus forming a gas lock. Each curtain should be fitted so as to give a tight joint over the whole frame of the door stopping all draughts. The methods of proper dugout protection are shown in Figure 1. Not only should dugouts and cellars be provided with frames and blankets, but care must be taken that the cracks between the frames and the earth or rock walls are made gas tight. Curtainsshould always be kept moistened or oiled and rolled up when not in use. Unless this is done, the curtains are useless. All dugouts which have been made really gas proof, will be posted with a sign "Gas Proof". In P.C.'s, medical and signal dugouts, particular care should be taken to provide this protection so that

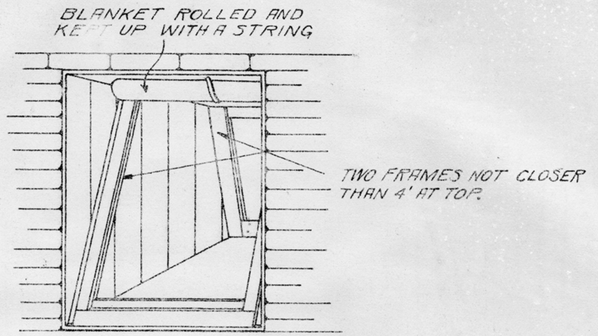
GAS BLANKET ARRANGEMENTS



Nº 1
ARRANGEMENT OF GAS BLANKETS

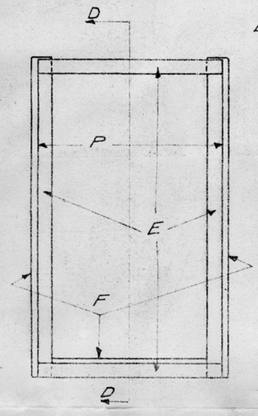


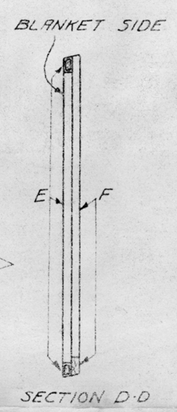
Nº 2
PROJECTING ENTRANCE
USED SOMETIMES IN DRESSING STATIONS TO AVOID NARROWING PASSAGE.



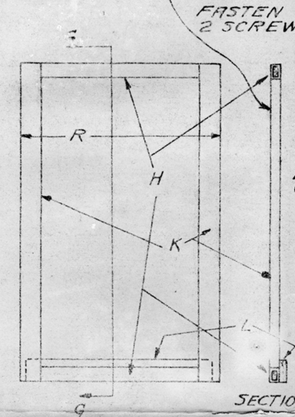
Nº 3
HORIZONTAL GALLERY

NOTE:- ANY WIRES SHOULD ENTER NEAR TOP OF FRAME.
BLANKET COVERED DOORS MAY ALSO BE USED TO SUPPLEMENT THE BLANKET CURTAINS.

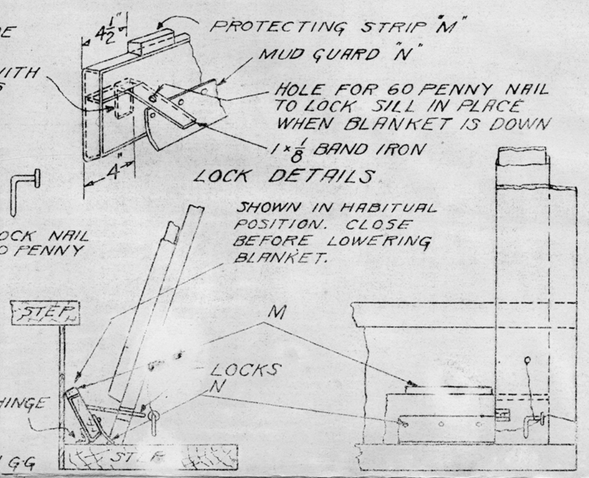




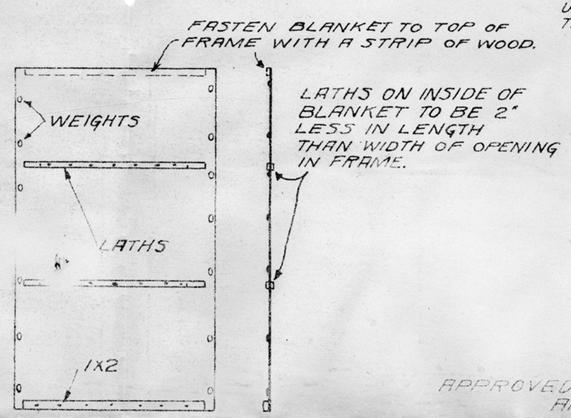
Nº 4
INTERIOR BLANKET FRAME
USED AS IN "C" OF Nº 1 AND IN Nº 3
E = 1×4 BLANKET COVERED.
F = 1×6 PLAIN.
P = 2'-8" TO 3'-8"



Nº 5
EXTERIOR BLANKET FRAME
USED AS IN Nº 2
H = 1×4 BLANKET COVERED.
K = 1×6 BLANKET COVERED
L = 1×6 PLAIN
R = 4' FOR DRESSING STATIONS.



Nº 6 (OPTIONAL)
DETAIL OF INTERIOR FRAME BOTTOM
WHEN FRAME IS USED AS IN "A+B" OF Nº 1.
M = 1×½ PLAIN, PROTECTING STRIP.
N = LEATHER OR RUBBER MUD GUARD.



Nº 7.
BLANKET.
WHEN USED ON INTERIOR FRAME BLANKET MUST BE 3" WIDER THAN DIMENSION "P" OF Nº 4. WHEN WITH EXTERIOR FRAME, 4" WIDER THAN DIMENSION "R" OF Nº 5

APPROVED:-
AMOS A. FRIES
COL. ENG'RS, N.A., C. OF E.S.
BY:-
E. D. Tinsley
LIEUT. COL., CORPS OF ENG'RS.

Fig. 1

R.E.M. 2-23-18

CONSTRUCTION SECTION GAS SERVICE 10061

officers and men can work during gas attacks without wearing respirators.

Precautions to be observed in dugouts in case of gas attacks:

(a) Lower curtains immediately.
(b) Wake all sleeping men.
(c) Put out all fires.
(d) Stop up any holes or flues.
(e) Prevent passing in and out as much as possible.
(f) In case of passage in or out, only one man must pass through at a time. Only one curtain must be raised at a time, and curtains must be lowered as quickly as possible.
(g) Men entering from gassed areas must remove outer clothing and leave it in the gas lock.

45. Clearing Gas from Dugouts, Trenches, etc. After a cloud attack some of the gas will remain in unprotected dugouts, trenches and hollows in the ground. A certain amount will also be absorbed in blankets and clothing. Any gas present in the air may be removed rapidly by ventilation. In shallow dugouts and trenches, fanning with coats or empty sand bags will produce a sufficient draught for this purpose, but all dugouts are cleared most rapidly and effectively by means of a fire. In dugouts provided with a single exit, the best results are obtained if the fire is placed in the center of the floor of the dugout. In those provided with two or more exits, the fire should be placed at the inner end of the exit passage farthest from the wind.

46. After a bombardment with mustard gas, in addition to gas remaining as described above, some of the liquid will remain on the ground near the shell craters, on the floor and walls of dugouts and emplacements that have received direct hits, in piles of straw and rubbish, in straw mattresses, clothing and equipment. This liquid may continue to give off gas for long periods and every possible means must be taken to destroy it immediately. Pumice soaked in phosgene should be covered deeply with earth (not chloride of lime,) or the position evacuated until it ceases to give off gas.

47. Precautions with Reference to Food and Water. Cases have been reported where food which has been exposed to gas caused ill effects. All food and water should be kept covered. No food that has an unusual taste or odor after a gas attack or bombardment should be eaten. Casualties have frequently been produced by the use of contaminated water from shell craters. All water from shell craters should be regarded as dangerous until proved to the contrary, and every effort should be made to use water from other sources. Blue Cross, containing arsenic, dissolves in water, making it highly poisonous, and this is not remedied by boiling.

48. Protection of Weapons and Equipment. Many gases, particularly phosgene and chlorine, have a corrosive action on metals. This action is greatly assisted by moisture which dissolves and retains the gas so that corrosion continues until the surface is cleaned. Mustard gas liquid will also corrode brass. Metal surfaces which are covered with mineral oil are not affected, provided they are cleaned and re-oiled after exposure. For details of protection see paragraphs 50-51.

SPECIAL ARMS

49. Artillery. Artillery is very liable to bombardment with gas shell. Owing to the suddenness of shell attacks and the long periods for which the neighborhood of a battery may be affected, it is essential that the following points be noted:

(a) All ranks must be thoroughly trained to stop breathing and adjust their respirators accurately before breathing, to wear their respirators for long periods, and to serve their guns while wearing them.

(b) Signalers must take all the precautions laid down in paragraphs 53-58.

(c) Special care must be taken to protect all dugouts near battery positions against gas.

(d) Alternative positions must be selected in advance, and mustard areas promptly evacuated when the tactical situation permits.

50. Artillery, Rifles and Machine Guns. All unpainted metal parts should be kept well oiled, and as soon as possible after exposure to corrosive gas should be washed in boiling water containing a little soda and re-oiled. Splashes of mustard should be brushed with dry chloride of lime.

51. Ammunition. When possible, ammunition should be stored in tight boxes or in recesses in the parapet, protected by a curtain moistened with water or oil. After an attack, corroded rounds should be cleaned, oiled and expended as soon as possible. Unboxed hand and rifle grenades should be kept covered. All safety pins and working parts, especially those made of brass, should be kept oiled to prevent their setting from corrosion by the gas.

52. Engineers. Tunneling companies are reminded that the respirator does not afford protection against mine or explosion gases and oxygen apparatus should therefore be used in sapping. The entrance to mine shafts must be protected from gas by blanket curtains in the manner already described for dugouts. Division Gas Officers are provided with detectors for poisonous mine gas.

53. Signal Corps. It is essential that telephone operators should be able to work as much as possible during a gas attack without wearing respirators or helmets. Signal dugouts must, therefore be particurly well protected against gas, so as to allow this to be done. Telephone operators must be especially practiced in using their instruments when wearing respirators. The headpiece of the receiver will be worn over the mask. Linemen must receive plenty of practice in carrying on their work, both at night and in the daytime, while wearing respirators.

54. Signal and Telephone Equipment. The only effective method of preventing corrosion of electrical apparatus during a gas attack is to prevent the gas reaching it, and the best way to do this is to have signal offices thoroughly protected against gas. As the corrosive effect on damp instruments is very much greater than on dry instruments, the shelters should be kept as dry as possible.

55. During a gas attack, telephones must be kept in their leather cases, and unless the buzzer key is being used the leather flap must be kept down, leaving only the cords with the receiver and hand-set out of the case. The backs of switchboards and buzzer exchanges must be kept closed. All apparatus, such as magnetos, telephones, test boards, spare instruments, etc., which are not essential to have uncovered should be well covered up with cloths, blankets or coats, etc.

56. After a cloud attack with chlorine or phosgene, telephone apparatus that has been exposed to gas should be treated as follows:

57. The ends of the wire should be removed from terminals and cleaned by being scraped with a knife. Terminals, exchange plugs and all exposed metal work should be cleaned first with a damp and then a dry cloth. This process should be repeated after 12 hours have elapsed. Instruments which have been splashed with mustard gas should be brushed with dry chloride of lime and later washed with soap and water. The internal portion of the instrument should not be interfered with. If an instrument has been kept closed or covered up, it is very unlikely that internal portions will have suffered; but if these portions show signs of corrosion, the instruments should be sent back to corps or division headquarters to be dealt with by an instrument repairer.

58. Protection of Carrier Pigeons. When the gas alarm is sounded pigeons should be placed in the special gas-proof boxes and bags provided for that purpose, or in gas-proof shelters. If for any reason the birds cannot be protected from the gas, they should be liberated at once. Where circumstances permit, gas-proof boxes or bags should always be kept near baskets containing birds, and should be regularly inspected. Pigeons can be utilized during a gas attack. Experience has proven that they will fly up through any gas cloud, as such clouds seldom rise above thirty feet from the ground, but it is imperative that the bird should be exposed to the gas for as short a time as possible. The message and carrier should therefore be prepared and, if possible, fastened to the pigeon's leg before the bird is exposed to the gas. Twenty seconds should suffice to fix a carrier and liberate a bird.

OUR OWN GAS

59. When the extensive use of gas in any form is contemplated, Corps and Division Gas Officers should always be consulted according to provisions of G.O. 107, paragraph 1, G.H.Q., A.E.F. 1918. The expert advice which these officers are able to furnish will not only be of value in helping to assure the success of an offensive, but may prevent injury to our own troops through the ill-timed use of gas or the use of a gas unsuited to the conditions. The tactical uses of the different gases very greatly and knowledge of their properties is essential to a realization of their full tactical values.

60. For cloud attacks it is advisable that before gas is discharged all troops except those whose presence is considered absolutely necessary, should be withdrawn from the line occupied by the cylinders. Any officer or man who has special orders to remain should put on his respirator. All troops will be cleared from any posts or saps in front of this line.

61. All troops in any part of the line within one-half mile of the nearest point where the gas is being discharged should put on their respirators.

62. In all attacks measures will be taken for the protection of the troops after consultation with the officer in charge of the operation.

63. If troops advance after one of our gas attacks, it must be remembered that the gas may hang about for some time in long grass, shell holes and hollows, and for several hours in the enemy's shelters. Dugouts should not be occupied until they have been thoroughly ventilated and the absence of gas established. This is equally necessary with regard to shelters which have been penetrated by gas from shell or bombs. For other precautions in connectionswith the seizure of enemy territory, see paragraph 24.

64. Gas Shell and Gas Bombs. These may, if necessary, be stored with other ammunition. In the event of leakage, all but mustard gas shell should be expended if possible, or buried in the ground five feet deep. Mustard gas shell should be buried. They should not be thrown into water, and care must be taken that they are not buried near the sources of water supply. All rescue work and disposal of leaky shells should be carried out by men wearing respirators.

V. RESPIRATOR

THE AMERICAN TISSOT RESPIRATOR - DRILLS.

65. The following drills are designed to teach officers and men to adjust their respirators accurately and quickly. The drill must be so thoroughly mastered that all will protect themselves instantly and almost automatically upon hearing the gas alarm. The strap of the steel helmet will be worn at the back of the head at all times when the helmet is worn. To the helmet will be attached a string or lanyard which will make a loop around the right shoulder.

66. Drill "A". To bring the respirator to the "Alert" position.

1. Slung position.

Respirator will sling over right shoulder, Satchel hanging on left side with press buttons closed and next to the body.

2. Gas "Alert" position.

Being at "slung" position, (1) GAS ALERT. Place the rifle between the knees. Slip the left arm back through the sling and bring the satchel around to the front of the body. Open the flap of the satchel. Take out the whipcord with the right hand and pass it through the metal loop on the right hand side of the satchell. Raise the satchel to the chest with the left hand so that the slack of the sling falls over the back, pulling it down with the right hand and holding it there. Then take the

sling in the left hand and with the right, pass the cord through the sling, then through the metal loop on the left side of the satchel and fasten it tightly with both hands after adjusting respirator to proper height on the chest. Fold flap over top to protect respirator from wet, but do not fasten.

(Alternative position, especially when pack is slung).

Being at "slung" position. (1) GAS ALERT. Place the rifle between the knees. Slip the left arm back through the sling and bring the satchel to the front of the body. With the right hand, grasp the metal hook at the left of the satchel and with the left hand reach behind the neck for the metal eyelet on the sling, pull down and fasten the two together. Open the flap and take out whipcord with right hand. pass it through the metal loop on the right of the satchel, then around the back and secure it to the metal loop on the left of the satchel.

57. Drill "B". Drill "by numbers" to obtain complete and accurate adjustment of the respirator from the "Alert" position.

This drill will be alternated with one without the numbers to insure as quick an adjustment as possible, in which practice in holding the breath will be included. The drill must be practiced until complete and accurate adjustment is obtained by all ranks in six seconds.

The respirator is in the "Alert" position. The helmet is worn with the strap adjusted at the back of the head. One end of a lanyard is attached to the left loop of the helmet and the other is passed around the left shoulder.

Being at "Alert" position with helmet adjusted: (1) By the numbers. (2) GAS. Stop breathing. Place the rifle, if unclung, between the knees. Insert the thumbs under flap and open satchel. Seize the facepiece with the right hand. TWO. Bring the facepiece smartly out of the satchel to the height of the chin, holding it firmly in both hands with the fingers extended outside, the thumbs inside at the binding midway between the two lever straps of the head harness. Stick out the chin. THREE. Bring the facepiece forward digging the chin into it. With the same motion, guide the straps of the harness over the head with the thumbs, knocking the helmet off backwards. FOUR. Grasp the outlet valve tightly between the fingers, to prevent the passage of air through it, and blow vigorously into the mask, completely emptying the lungs. FIVE. Feel around the edge to make sure the facepiece is well seated, correct adjustment of head harness. SIX. Replace helmet. Resume the attention.

68. Drill "C". To adjust respirator from slung position.

Being at slung position. (1) GAS. Stop breathing. Place the rifle, if unslung, between the knees. Pull the satchel around until it hangs in front of the body. Unfasten the flap and adjust the respirator as in practice "B", allowing the satchel to hang by the rubber tube. Replace helmet, and at once proceed to adjust the satchel in the "Alert" positinj as in practice "A".

69. Drill "D". Drill to teach method of testing for presence of gas.

Respirator being adjusted (1) Test for Gas. Take a deep breath. With the right hand pull the facepiece slightly away from the right cheek, hold the breath and sniff gently. If gas is smelled, readjust the facepiece, grip the outlet valve between the fingers and thumb, and breathe out hard.

70. Drill "E". To remove the facepiece.

Having tested and found no gas. (1) Remove. (2) FACEPIECE. Insert the first two fingers of the right hand under the facepiece of the chin, placing the thumb on the metal guard of the exit valve, bend the head forward at the same time removing the facepiece with an upward motion of the right hand.

Notes:

(a) Care must be taken to remove the respirator without undue stretching of the elastic.

(b) Folding facepieces. The facepiece should be folded flat (no part tucked inward) and the elastic bands should be folded against the outside of the facepiece on one side..

(c) After all drills the eyepieces should be rubbed with anti-dim, leaving a thin, transparent film of the composition on the glass, the facepiece should be wiped dry, folded correctly and put away in such a way that the rubber outlet valve is not bent.

71. Drill "F". Inspection.

The respirator being at slung position: (1) Prepare for Inspection of Respirators. Place the rifle between the knees. Slip the left arm back through the sling and bring the satchel around to the front of the body. Open the flap of the satchel. (2) Inspection. (3) Respirators. Examine the satchel and sling, make sure that metal hook and clasp and metal loops at each side are securely fastened. Remove canister and hold under left arm the tube and facepiece hanging over the army Examine the interior of the satchel to see that wire platform and anti-dim are present, and that whipcord is in good condition and free from knots. TWO. Examine inlet valve at bottom of canister. Examine the canister for rust spots and weak places by pressing lightly with the fingers beginning at bottom and working to the top. Watch carefully for holes in soldering at top of canister. See that flexible tube is properly fastened to the canister, and to the metal elbow tube and is free from obvious defects. THREE. See that the metal elbow tube is securely connected to facepiece and that outlet valve guard is not loose. Make sure that the outlet valve is in good condition, has no dirt or sand in it, has no tears, and is connected properly to elbow tube. FOUR. Examine the facepiece inside and out. See that chin rest is secure, and there are no pinholes or tears in fabric, that air passage to eyepieces is in proper condition and not torn away from the fabric, that the eyepieces are securely fastened in the facepiece.

Examine the head harness and make sure that it is firmly attached to binding. FIVE. Adjust mask to face to test valves. Hold canister in left hand. Grasp outlet valve between fingers to prevent passage of air through it, and breathe gently in and out a few times. The inlet valve, if working properly should vibrate back and forth. Test outlet valve by putting a kink in breathing tube to prevent the passage through it of air and attempt to draw air into the facepiece. If the outlet valve is in proper condition, it will not be possible to draw in any air. Remove respirators. SIX. All men with defective respirators step forward one pace. Others replace canister in satchel, taking care not to twist facepiece into wrong position; and return respirators to slung position. Note: After inspection men should be given drill "B" once, so that it can be seen whether all canisters have been correctly replaced in satchel.

72. Respirators will be inspected daily in the alert zone, and at least twice weekly in the danger zone. They must always be inspected before proceeding into the alert zone.

73. It is the duty of every officer and non-commissioned officer, and is especially the duty of the gas officers and their assistants, to make sure that these inspections are being carefully carried out. Only by constant supervision can officers be certain that respirators and other gas defense appliances are being properly and regularly inspected. The importance of this cannot be too greatly emphasized. A respirator must always give complete and absolute protection. Its condition can only be determined by constant and careful inspection.

74. General Points on Training with Respirator. When training men in the use of respirators the following points are of importance.

(a) Ordinary infantry drill should be combined with physical drill including arm and leg exercises, leap-frog, and double time. The time of practice need not exceed 15 minutes at first while wearing the respirator, but should be gradually extended. This drill will be in heavy marching order.

(b) Practice in bombing, rapid loading and aiming, judging distance and rifle firing, should be carried out while the men are wearing respirators.

(c) Officers and N.C.O.'s will receive the same training as the men and, in addition, will be practiced in giving orders while wearing their respirators.

(d) It must be realized that troops in the line always carry the respirator, and that practice in the rear should take this into account. Every effort must be made to approximate actual warfare conditions. Every opportunity will be taken to accustom men to carrying on their usual duties with the respirator adjusted. It is often necessary during and after a gas attack for men to wear their respirators for six or eight hours, or even longer when a highly persistent gas, such as mustard gas, is used.

(e) Practice and drill in the use of gas defense measures shou be carried out as continuously as tactical considerations will permi This applies especially to troops which return to the front line aft having been in rest areas and where the incorporation of drafts incon pletely trained in gas defense measures make such training very esse tial.

75. Description of the American Tissot Respirator. The respira consists of a metal canister filled with a mixture of chemical granul and connected by a rubber tube to an impervious facepiece. Air is dr in through the inlet valve which consists of a circular rubber disc fitted on a stud in the center of a perforated metal plate. Any pois ous gas is absorbed by the granules in the canister. The purified dr air passes into the facepiece, playing over the eyepieces, and keepin them clear. Air is expelled through the outlet valve, the inlet valv closing in order to prevent air passing through the canister. If the inlet valve does not close properly, expelled air passes into the can- ister causing deterioration of the chemicals and discomfort to the wearer.

76. The facepiece is held in position by a head harness of self- centering construction which keeps it firmly against the face without discomfort. The complete respirator is carried in a satchel which is divided into two compartments, one of which holds the canister and the other the mask. The canister rests on a wire platform which raises it from the bottom of the compartment and allows the free access of air.

77. Fitting. Respirators are made in five sizes. The various sizes will be needed in the following proportion:-

No. 1	Very Small . .	2%
No. 2	Small	12%
No. 3	Medium	60%
No. 4	Large	20%
No. 5	Very Large . .	6%

When respirators are issued they should be most carefully fitted. In some cases it will be necessary to change the length of the elastics b means of the buckles. When the fit of the mask appears satisfactory, it must be tested in tear gas and the test repeated at least every month. If possible, the test should be made in the gas chamber every time a battalion comes out of the line.

78. Men should remain in the tear gas for five minutes moving about and talking to make sure that the fit of the mask is good.

79. When the fit has been tested, each man should write his name, but not his organization, on the lower part of the front of the satche as worn in the "Alert" position to insure that he does not exchange hi respirator for another that may not fit him. Any man found without a respirator, or in possession of one not his own, will be strictly disc plined.

80. Care of Respirators. The most serious causes of damage to respirator are:-

(a) Water entering the canister and spoiling the chemicals
(b) Injury to the facepiece.
(c) Injury to the outlet valve.

81. Respirators must be protected from wet as far as possible, rough usage must be avoided. Nothing must be carried in the satchel, except the respirator and anti-dimming outfit; small articles of kit readily causes damage to the mask.

82. The inside of the facepiece should be wiped before it is put away, otherwise damage is caused by the rusting of metal parts, and by the rotting of the stitching.

83. To prevent freezing of the outlet valve during very severe frost, two or three drops of glycerine should be inserted through the slits at the bottom of the valve by means of a match or stick of wood. Supplies of glycerine are kept by Division Gas Officers for this purpose. Half a pint should be sufficient for 1,000 respirators. Inlet valve at bottom of canister are not affected if kept dry. If moisture has entered and frozen, the valve must be removed, thawed, wiped dry and replaced. The inlet valve must not be treated with glycerine.

84. Life of Canister. When canisters are issued, they will be painted with the number of the month of issue. They will be replaced after the lapse of a certain number of months. They will usually become ineffective through mechanical damage before they become useless chemically. The chemicals in the canister will slowly lose their efficiency, even when nothing but pure air is breathed through them. This is due to the fact that the moisture in the air gradually cakes the granules, increases their resistance, and lowers their absorptive power.

85. Replacement of Canister. When the canister of the respirator is defective owing to dampness, rust, or other damage, or has been breathed through 40 hours in gas, and the respirator is otherwise in good order, the canister should be replaced by a new one by the gas N.C.O. Tools for detaching canisters are provided and should be kept in charge of the gas N.C.O.

86. Removal of Old Canisters. In all operations great care must be taken to avoid damaging the rubber tube. Remove the tape on the wire. Turn up the twisted end of the wire at right angles to the tube. Press on point of the "tool for detaching canister" under a single strand of wire near the twisted end. On pressing over the tool the wire will be cut by the sharp edge inside the V. Remove the wire. Insert both points of the V under the rubber, then, with the handle of the tool at right angles to the tube, move the tool around the neck to loosen the rubber from the metal. On continuing with an upward movement the tube will be detached.

87. Fixing of new Canister. Remove the plug of cotton waste from the neck of the new box, lick the neck and slip the rubber tubing over it so that the neck is completely covered, taking care that the face-piece is in the correct position relative to the canister.

88. To bind the tubing with string, proceed as follows: (see Fig. 2). Rub the string with beeswax or cobbler's wax, if available. Make a loop at one end "A" of the string. Lay it along the tube and parallel to it. Wind the remainder of the string tightly around the tube at least four times. This holds the loop in position. Pass the end "B" through the loop, and then fix it by pulling the loop tight from "A". Tie "A" and "B" together with an ordinary knot. The string binding must see that it is secure and gas-tight.

89. Anti-Dimming Outfit. This is carried in the satchel, and contains a stack of composition and a piece of soft rag. Occasionally at inspection and always after each wearing of the respirator, the inner surfaces of the eyepieces should be cleaned and dried, a little of the composition rubbed on with the finger, and the surface rubbed with a soft rag until the film of composition is smooth and thin and nearly clear.

90. Minor Repairs. Small perforations in the facepiece can be repaired by applying pieces of adhesive plaster both inside and outside the mask. Respirators so repaired should be exchanged as soon as possible.

HORSE RESPIRATORS.

91. General. In choosing locations for stables and horse-lines if within shell range, high, sloping, treeless ground is preferable as less likely to hold gas. Horses should not be allowed to stand on or be ridden over areas that have been heavily shelled with mustard gas, as the skin of a horse is more sensitive than that of man to the effects of this gas. They should not be allowed to eat grass that has been contaminated with mustard gas, or drink from infected shell holes. Horses exposed to mustard gas should be washed all over as soon as possible with soap and warm water, especially around the mouth, anus, and sexual organs. Horses must be practiced in wearing the respirator, as they will otherwise resist protection, and cause delay and annoyance in emergencies.

92. Description. The respirator consists of a flannelette bag with a canvas mouthpiece which goes into the horse's mouth and saves the flannelette from being bitten through. The bag is provided with an elastic band which passes round the opening so as to draw the respirator close to the face when in use. The upper side of the mouth of the flannelette bag is furnished with a small unbleached calico patch by which the respirator is attached to the nose-band of the bridle or halter when in the "Alert" position, and while in use. Inside the bag and attached to the canvas mouthpiece there is a canvas frame which is attached on to the bag in such a way as to prevent the material drawing into the nostrils when the respirator is in use. The whole is folded and carried in a

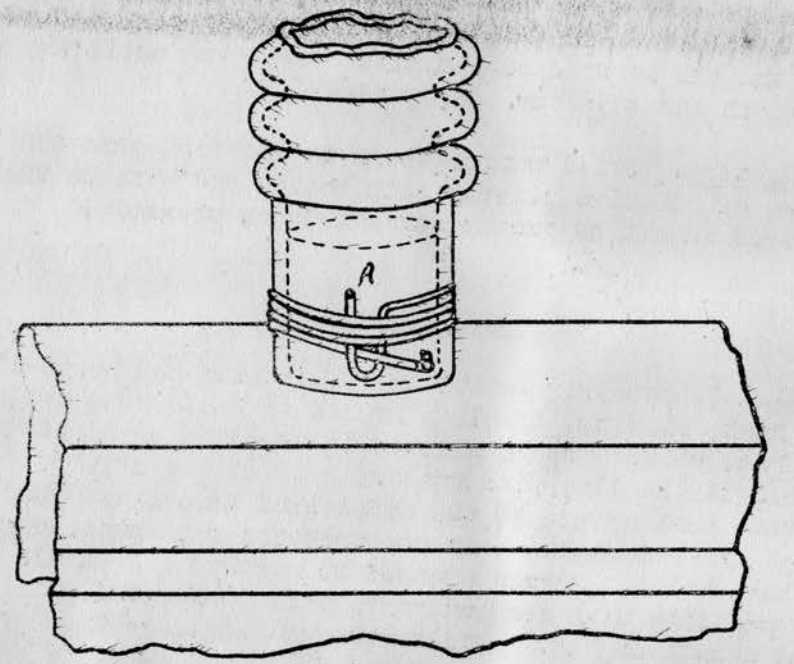


Fig. 2

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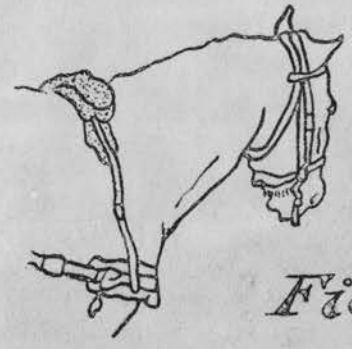


Fig. 3

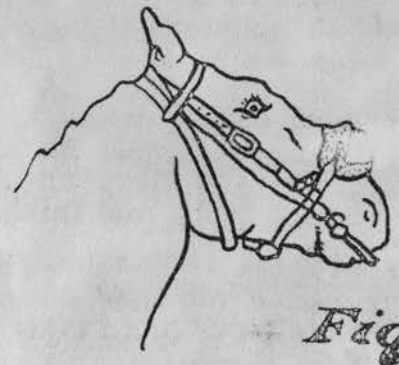


Fig. 4

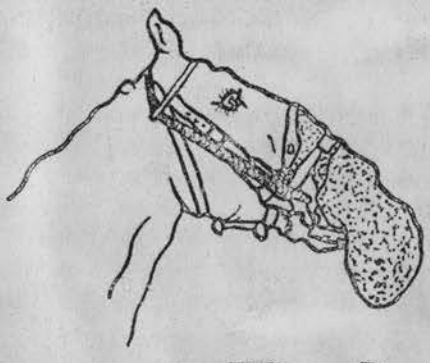


Fig. 5

canvas case provided with a flap, secured by three press buttons and having two straps at the back by means of which the case is attached to the bridle or halter.

93. Method of Use. Horses can stand a higher concentration of gas than human beings without serious injury, and it is not, therefore, necessary to protect them against cloud gas attacks when they are a considerable distance back from the trenches. Nor is it usually necessary to protect their eyes. The respirator is primarily intended for use on transport animals when they are sent to the vicinity of the trenches with supplies and ammunition. In the case of gas shell attacks, horse should be protected wherever the shelling is heavy.

94. Carrying When not Immediately Required. When not required for immediate use the respirator can be conveniently carried on the supporting strap of the breast harness as shown in Fig. 3, or if a zinc wither pad is worn, still more conveniently inside this pad. If a collar is used in place of the breast-strap, it can be carried in the channel of the collar where drivers often carry a sponge. However carried, the case is steadied by being strapped on either side to the metal ring on the supporting strap, and its flap should be passed under this strap, between it and the wither pad, and buttoned as in the "Alert" position.

95. "Alert" Position. When horses are being sent up to the trenches, the transport or other officer responsible should have the respirators adjusted in the "Alert" position before moving off, as follows:

(a) The flap of the respirator case is unbuttoned and slipped under the nose-band of the bridle or halter from below upwards.
(b) The two straps at the back are also passed under the nose-band and secured to the cheek pieces of the bridle, above the metal D on each side.
(c) The small unbleached calico patch on the upper side of the mouth of the respirator is buttoned on to the nose-band of the head collar, so that the respirator is ready to be slipped on immediately in the event of a gas attack.
(d) The cover of the case is then closed over the nose-band, and the respirator is thus protected from rain, and held in position on by the nose-band. Fig. 4 shows a respirator in its case carried in the "Alert" position.

96. Wearing in Gas. The respirator being carried in the "Alert" position is adjusted for use as follows:

(a) The flap of the case is unbuttoned and the respirator removed, leaving the case attached to the cheek pieces of the bridle and lying flat on the face.
(b) The mouth of the bag is drawn down over the upper lip and upper teeth with one hand on each side of the mouthpiece, slipped into the mouth, and drawn well up to the angle of the lips.
(c) The elastic band is seized on either side close to the mouthpiece, and pulled outwards so as to draw the mouth of the bag tight around the upper jaw, above the nostrils, and is then slipped over the poll.

97. The respirator is then in position and the animal may be worked in it without difficulty or undue distress. The bit and reins are not interfered with in any way. This is shown in Fig. 5.

98. Replacement in Case. In folding the respirator and replacing it in the case ready for use the following points should be observed.

(a) The canvas mouthpiece should be wiped as clean as possible.

(b) The flannelette bag should be held with the canvas mouthpiece underneath and the elastic band placed over the top of the bag in such a way that when the canvas patch is buttoned on to the nose band the elastic band has simply to be passed straight up over the face and over the poll. The bottom end of the respirator should then be tucked in and rolled up over the elastic band to make a neat roll for insertion in the canvas case.

99. A double feed bag filled with staw, moss or leaves saturated with sodium bicarbonate solution will make a fair emergency mask.

VI. STANDING ORDERS AND DUTIES OF GAS OFFICERS.

100. The division commander will be responsible for the proper training and instruction of his command in gas defensive measures. The presence or absence of gas casualties under a gas attack will form a basis for estimating the efficiency of his command.

The Chemical Warfare Service will provide the division and corps gas officers with suitable samples of the various kinds of gases, especially those of most frequent use, for instructing the personnel in the identification of the presence of gases. These samples will be prepared in such a form that they may be easily transported without the necessity of increasing the allowance of transportation now authorized for moving gas supplies. When in training areas, quantities of various gases will be supplied for the purpose of infecting areas and shell holes as they occur under actual conditions of warfare.

The following forms for orders and instructions for gas defense within a division are published as suggestions for the information of those concerned. They are generally applicable to a tactical situation in which the battle line has become stabilized and the troops are occupying an organized trench system. For the varying conditions of open warfare, the orders and instructions should be modified to meet the special situations.

TYPICAL DIVISIONAL STANDING ORDERS

FOR GAS DEFENSE

Headquarters,_____Division.

American E.F.

_____191____.

Bulletin
No._____.

Organization.

Commanding officers of all units are held responsible that all the anti-gas appliances for protecting their men are maintained in perfect condition, and that all ranks under their command are thoroughly trained in the use of these appliances, and in all measures which may affect their safety against gas, including identification of the presence of gases and the identification of gas attacks.

101 Battalion, regimental, division gas officers and assistants are appointed to aid in seeing that all anti-gas measures are efficiently carried out. It shall be their duty to bring any inefficiency in gas discipline or protection to the notice of the proper commanding officer when necessary.

102. All gas officers and gas non-commissioned officers will be relieved from all duties which might interfere with their duties as gas officers. Par. V. G. O. 79. c.s., G.H.Q.

103. Regimental and battalion gas officers will not be relieved from their duties as gas officers without the approval of the division commander. Regimental and other commanding officers should consult their gas officers before relieving the gas non-commissioned officers serving them in order that other non-commissioned officers, properly instructed, may be selected as replacements.

104. The commanding officers of units will be responsible, not only for the gas discipline of attached troops, such as machine gun companies, detachments of engineers and field signal men operating within their areas, but will also be responsible for the gas training of these troops, and will see that they receive training in gas defense equivalent to the training given their own units.

105. Gas non-commissioned officers in such attached troops will be reported to the gas officer of the unit to which they are attached (battalion or regimental). In case of detachments which are smaller than a platoon, and which have no gas non-commissioned officer of their own, one of the gas non-commissioned officers of the unit with which they are being rationed, will be assigned to them to act as gas non-commissioned officer, in addition to his duty with his own company.

106. Training and Inspection. In addition to training at the schools and in the training areas, all ranks whose duties require them to enter the "Danger" zone will continue respirator drill. As may be directed by the division commander, respirators must be worn at least four hours each week, but during this time usual drills and other duties should be performed. Once each month all combatant troops should wear the respirator for four consecutive hours. Respirator drill should include the adjustment of the respirator while the helmet is worn and also the adjustment and wearing of the respirator in the dark.

107. Respirators, alarm systems, protected dugouts, and such other gas defense measures as may exist under varying conditions within a divisional area will be inspected twice each week by the proper gas officers. In the "Alert" zone company commanders will provide for similar daily inspection by the gas N.C.O's. Any deficiencies will be called to the attention of the company commander concerned, and of the battalion commander. As many dugouts as possible will be made adequately gas proof. No dugout curtains or other devices apparently protecting against gas will be maintained in dugouts which are reported not to be adequately gas-proof.

108. Gas Zones. There will be defined in the area of the Armies, two zones to be known as the "Alert", and "Danger" zones.

109. The approximate extent of these zones will be as follows:

"Alert Zone". The area within three kilometers of the front line together with areas especially subject to shelling with gas, including all active battery positions and other points, such as villages, cross roads and convenient concentration points for troops, to be designated by the division gas officer.

"Danger Zone". The area between three and ten kilometers to the rear of the front line.

110. Within the alert zone all persons in or connected with the American Military Service will wear the respirator in the "Alert" position. Every man will be clean-shaven, except that a mustache may be worn, and the hair will be kept short in accordance with paragraph 285 of United States Army Regulations. Sleeping men must not remove the respirators from their bodies. A sufficient number of sentries must be posted to awaken all men quickly in case of a gas attack. Respirators and all gas defense appliances will be inspected daily in this zone under the supervision of gas N.C.O. Horse respirators will be worn in the "Alert" position.

111. Within the danger zone troops will carry their respirators at all times, except when asleep, in which case the respirator will be within immediate reach. Respirators and gas defense appliances will be inspected three times a week under direction of gas N.C.O. Horse respirators will be worn in the "carry" position over all equipment.

112. Sentinels and military police will be instructed to allow no person connected with the American Military Service to pass without complying with all the rules relating to the wearing of respirators. They will report all cases of infringement of the above orders, and copies of these reports will be furnished to the regimental or division gas officers.

113. The above named zones will be conspicuously marked by each regiment in such a manner as to attract the attention of persons entering them.

114. When not carried in the "Alert" position, the box respirator will be carried in the "Slung" position, that is, over the left hip, the sling passing over the right shoulder. Nothing will be worn so as to interfere with the immediate shifting of the respirator to the "Alert" position.

115. Gas Alarms. An efficient system of gas alarms will be provided throughout the "Danger" zone, and especially in the "Alert" zone. This will include Klaxon horns, rattles and triangles, together with other signals approved for this purpose by division commander on the recommendation of the division gas officer. These alarms will be used solely for the purpose of giving warning in case of a gas attack. When necessary, civil authorities within divisional areas will be warned by division headquarters.

116. Any person becoming aware of the presence of gas or of an impending gas attack will give alarm by means of the alarm signals or by calling "Gas". Anyone who knowingly gives a false gas alarm will be tried by court-martial.

117. Gas Sentries. All sentries will act as gas sentries, and if necessary, special gas sentries will be posted in order that the alarm may be promptly and properly given. Special gas sentries will have definite areas to alarm in the event of a gas attack. Two sentinels will be posted at night. When deemed necessary one of them will wear the respirator completely adjusted. They will relieve each other of wearing the respirator

every half hour. All working parties of ten or more men will have a gas sentry posted. All sentries, traffic control men, military police, etc., when on duty will act as gas sentries, and will be provided with suitable alarm devices when necessary. Sentries will be posted over all men sleeping and all men in dugouts or shelters, and each sentry will be definitely responsible for the group assigned to him. The loss of a few seconds in giving gas alarms may increase very greatly the number of casualties. In case of gas attack, sentries will shout "GAS", put on their respirators and then give the alarm. If possible sentries should be placed in positions overlooking the enemy lines to detect the characteristic flash which accompanies a projector attack. Sentries should be carefully instructed in methods of detecting the various forms of gas attacks, such as the hissing sound accompanying cloud attacks, and the flash, loud explosion and whirring of projectiles in a projector attack. In case of doubt, especially when a projector attack is suspected, alarm will be given. As frequent false gas alarms will eventually cause troops to disregard an alarm, gas sentries shall be carefully selected and thoroughly instructed so that false alarms will be reduced to a minimum.

118. Any concentration of troops within 1500 yards of the enemy lines should be avoided, unless the tactical situation so requires. Within this area troops should not be allowed to sleep except in dugouts fully gas-proofed, with a sentry posted at each dugout. Within this area every precaution must be taken to avoid giving information to the enemy of localities in which troops are concentrated, since such points of concentration are chosen as targets for projectors.

119. Intelligence. All intelligence indicating that an enemy gas attack is imminent should be communicated immediately to division or corps headquarters for the information of the division or corps gas officers, through G-2 of the division or corps, who should cause to be submitted to the division or corps gas officer, for report and recommendation, such copies of airplane photographs and intelligence reports bearing on the subject as may be available. Airplane photographs of enemy lines available at various headquarters should be examined for possible projector emplacements and copies of those not received from division or corps headquarters should be sent at once by courier to such headquarters. Gas officers and N.C.O's will make observations of wind and weather conditions with a view to ascertaining when conditions are favorable for enemy gas attacks, and from what direction danger may come from our own or enemy gas bombardments.

120. Liaison. Immediate reports of gas attacks and of heavy bombardments of any kind must be made to the unit gas officer and the division gas officer. In order that casualties may be reduced, it is necessary that there be no delay in notifying gas officers of such attacks. In order to guard against inflicting casualties on our own men, when the nature of the operations permit, it will be advisable to notify the division gas officers about any proposed extensive use of gas in operations by our own troops. See par. 410, General Orders 107, Par. 1, G.H.Q., A.E.F. 1918. In advances, the advance units must take steps to warn the

support and reserves of any dangerous areas containing gas. Battalion gas officers will indicate such areas on maps or by reference, and communicate with battalion gas officers to their rear.

121. Action During and After a Gas Attack. At the instant that any gas alarm is given, all ranks will immediately put on respirators and wear them until the order to remove masks is given by an officer acting upon the advice of a gas officer or gas N.C.O. In the case of isolated groups and in the absence of a gas officer, the order to remove masks will be given by the non-commissioned officer in charge, who will report this action promptly to the nearest officer. In case the gas attack is followed by an assault of enemy infantry not wearing masks, respirators may be removed without formal order. Any officer or man who fails to put on his respirator when warned of the presence of gas, by a gas officer or gas non-commissioned officer, or by a general gas alarm, or who removes his respirator without proper authority, will be court-martialed. If a person under such circumstances becomes a casualty, he will be considered as wounded "not in the line of duty".

122. The blanket curtains of protected dugouts and cellers will be properly adjusted, fires in such dugouts put out and flues closed. The organization attacked will at once notify battalion headquarters and troops on the flank of the attack. Battalion headquarters will in turn notify regimental headquarters and the regimental gas officer. Regimental headquarters will notify divisional headquarters of all gas attacks. Additional spreading of the alarm will take place when necessary.

123. No one will enter a gassed area into which he is not obliged to go in line of duty, and all who are within a gassed area will refrain from all movement and conversation not required by military necessity.

124. When the tactical situation permits, troops not on duty should be allowed to remain in gas-proof dugouts, and to remove their masks, if the dugout is entirely free from gas. An additional sentry must then be posted inside the dugout at each entrance until the area is free from gas. All unnecessary movement and talking must cease. In case of a cloud gas attack, all bodies of troops or transport on the move will halt, and working parties will cease work until the gas cloud has passed. If a relief is in progress, units should stand steady as far as possible until the gas cloud has passed. Supports and parties bringing up ammunition and grenades will only be moved up if the tactical situation demands.

125. As soon as possible after or during a gas attack, gas officers and gas N.C.O.'s will determine whether a "persistent" or a "non-persistent" gas is being employed. When the tactical situation permits a position extensively bombarded by the most persistent gas, namely mustard, must be temporarily evacuated.

126. If mustard gas is used, the area is dangerous for one or two days, and sometimes longer. (See Persistency Table). Unless the tactical situation forbids, a shelled area shall be promptly evacuated for a period of three days, or until pronounced safe by the division or regimental gas officer. If practicable, the division gas officer will be consulted.

The evacuation should be made up-wind from the shelled area when possible. For this reason alternative positions should be selected in advance and all the necessary preparatory steps should be taken to accomplish a rapid and orderly change to such positions in case of necessity. Special care will be taken that men sleeping in closed places will not be gassed by long exposure to small quantities of gas brought in on their clothing or equipment.

127. In case a position shelled with mustard gas must continue to be occupied, respirators will be worn continuously, men must not be permitted to sit or lie upon contaminated ground, and other precautions must be taken to avoid contamination of the body or clothing. In such a case, frequent reliefs should be established. After a gas attack, gas officers will take immediate steps to clear and disinfect gassed positions, (See par.27). They will report when the position is safe. As long as the slightest odor of mustard gas is detectable, the positions must be considered dangerous. It is especially to be noted that the odor of mustard gas in slight concentrations is not unpleasant, and that the gas produces no irritation for several hours. During a mustard gas attack, precautions must be taken to avoid contamination of dugouts from the clothing and especially from the shoes of men who enter..

128. Men who have been even slightly gassed will be treated as casualties, and withdrawn promptly from the gassed area with the least possible exertion on the part of the men gassed. Especially in the case of a mustard gas attack, it is important that fresh clothing be available and that fresh clothing be available and that the clothing should be changed and the men given a bath with soap and water as soon as practicable.

129. After a gas attack, food supplies which have been exposed should be thoroughly inspected, and any food suspected of contamination with gas should be condemned. Many casualties have been caused by the use of water from shell holes. Regardly of whether recent gas attacks have occurred, all water from shell holes must be regarded as contaminated, and must never be used for any purpose whatsoever.

130. It is customary for a gas attack to proceed in waves or salvos at variable intervals, <u>therefore, a sharp lookout will be maintained for a repetition of a gas attack.</u> When the tactical situation permits, troops which have been subjected to gas attacks will be withdrawn. Commanders of units relieving one another are responsible that all the anti-gas stores are handed over and receipted for by the respective gas N.C.O.'s of the units.

<u>TYPICAL DIVISION ORGANIZATION OF DISINFECTING SERVICE.</u>

(FOR OFFICIAL CIRCULATION ONLY) HQ.___DIV. AEF.____191__.

BULLETIN.

No.

131. In order to provide the most efficient means for the purificati of ground which has been shelled with mustard gas, special disinfection

squads shall be designated and trained by each regimental or battalion ga officer for this purpose. These squads shall be organized in the various units according to the tactical employment of these units as below; each squad to be under the immediate direction of the gas-non-commissioned offi cer of that unit. Except in case of mustard gas shelling, the men compos ing this squad shall be free to perform their regular duties. This does not apply to the gas non-commissioned officers who shall be assigned no other duties which might interfere with their duties as gas non-commissio officers. These men shall, however, spend such time as may be necessary order to make them proficient in their work, according to the discretion the regimental gas officer. The duties of these disinfecting squads will

(1) To disinfect mustard gas shell holes with chloride of lime and to cover this chloride of lime with earth.
(2) To bury leaking gas "duds".
(3) To mark the location of sound gas "duds", which location shall be given the regimental gas officer.
(4) To carry out infected equipment and clothing from mustard gas-infected barracks or dugouts, when an evacuation has been ordered.

132. The organization of these disinfecting squads shall be as follo

(1) Divisional Headquarters:
1 gas N.C.O. and 4 men.

(2) Infantry Regiment:
(a) Regimental headquarters: Regimental N.C.O. and 4 men.
(b) Each Battalion: Battalion N.C.O. and 6 men.

This squad can, if necessary, be split into two or more groups at times, to work under the direction of the company gas N.C.O. The Machine Gun Company attached to a regiment will be taken care of by the battalion disinfecting squad in whose area it is located.

(3) Artillery Regiment:
(a) Regimental headquarters: Regimental gas N.C.O. and 4 men.
(b) Each battalion headquarters: Battalion gas N.C.O. & 4 men.
(c) Each battery: Battery gas N.C.O. and 4 men.

(4) Engineer Regiment:
(a) Regimental headquarters: Regimental N.C.O. and 4 men.
(b) Each battalion headquarters: Battalion N.C.O. and 4 men.
(c) Each company: Company gas N.C.O. and 4 men.

(5) Machine Gun Battalion:
(a) Each battalion headquarters: 1 battalion gas N.C.O. and 4 men.
(b) Each machine gun company: 1 company gas N.C.O. and 4 men.

(6) Trench Mortar Battery:
(a) Battery gas N.C.O. and 4 men.

133. Field hospital, ambulance, and signal companies, and other units attached to the division will be looked after by the disinfecting party in whose area they are operating.

134. The equipment of each man in the disinfecting squad, in addition to small box respirator, will consist of a suit of special oiled clothing and two pairs of oiled gloves.

135. Casualties from mustard gas can be avoided if proper precautions are taken. As immediate disinfection is necessary to prevent casualties, every effort will be made to expedite the arrival of a disinfecting squad at a shelled area.

BY COMMAND OF GENERAL -

(Signed)

Chief of Staff.

OFFICIAL,
(Signed)
Acting Adjutant.

DUTIES OF REGIMENTAL AND BATTALION GAS OFFICERS

Typical Memorandum

136. 1. Report all gas shelling promptly, giving time, location, weather, wind, and number, size and kind of shell used, and any casualties reported.

2. Report immediately any mustard gas shelling in your area.

3. Report promptly all changes in gas personnel.

4. Report name, rank, and organization of all officers violating standing orders of gas defense.

5. Insist on daily inspections of respirators in "Alert" zone and twice weekly in "Danger" zone. Check up these inspections personally to be positive that they are being carried out.

6. Make sure by frequent inspections and tests that alarms in your area are adequate and in working order.

7. Frequent instructions of all sentries is mandatory. They must be thoroughly familiarized with all their duties. They must know all standing orders of gas defense. They must know how to detect a gas attack, how and when to give the alarm and when to awaken sleeping men ove whom they are posted.

8. Make sure that no men in your area are permitted to sleep without being near a sentry who knows where they are.

9. Question and instruct all gas N.C.O.'s frequently, reporting those (by name, rank and organization) you consider incapable, those who neglect their work, and those who have too many other duties to perform.

10. Make sure that when a man loses his respirator or when he turns one in for replacement that has been rendered unserviceable through carelessness or by intention, the new one issued is charged against his pay account, - $4.44 and see that further disciplinary action is taken.

11. Make sure that you know all units in your area.

12. Submit brief report each week covering work you have done during the week as gas officer, and, in addition, nature of other duties performed by you and the amount of time required for same.

(Signed)

Division Gas Officer.

DUTIES OF COMPANY G.S. N.C.O.'s.

137. They will assist officers at the inspection of respirators, taking particular care to see that each man's satchel is marked with his own name, and in making such local repairs as possible. They will assist in training men in the use of gas defense appliances.

Under the company commander they will have charge of all gas defense trench stores as follows:

(a) Alarm devices: Inspect daily and see that sentries posted at them know how they should be used.

(b) Gas-proof shelters: See that the blanket doorways fit and are kept in good condition.

On relief they will assist the company commander in taking over all gas defense trench stores. The company gas N.C.O.'s should accompany the advance party and take over trench stores (by daylight if possible).

They will make wind observations as directed by the division commander on the recommendation of the division gas officer, and will report any change of wind to the company commander, (See pars.141-146).

138. During or after the attack the N.C.O. must note down in writing as much information regarding the attack as possible. (See Par.147)

139. After a gas shell bombardment, if the use of a new gas is suspected, the gas N.C.O. should take samples of earth contaminated with the suspected gas. Such samples should be handed to the division gas officer through the company commander with notes as to the position from which sample was taken.

140. They will instruct gas sentries in their duties.

141. They will report breaches of gas discipline to their commanding officer.

Instructions to Gas N.C.O.'s for Making Wind Observations and Furnishing Reports.

142. The gas N.C.O.'s will make to company commander such wind observations and reports as may be directed by the division commander on the recommendation of the division gas officer. These reports will be verbal unless otherwise ordered. In order to make wind observations the following points must be attended to.

143. Wind vane. A simple wind vane should be set up. The vane must have as little friction as possible, so that a wind under 2 miles per hour will turn it. A little post at the top of the vane should carry a strip of linen 8 inches by 3/4 inch, by the movements of which the strength of the wind can be judged. The vane must be set up sufficiently high to get a true observation (e.g. 18 inches above the top of the dug-out, etc.) Correct orientation should be obtained by getting N by the N star and S by the sun at midday (Greenwich time).

144. Direction of wind. Before reading the direction of the wind the vane the observer should gauge the approximate direction by noting course taken by smoke, etc. Direction of wind must be stated in points

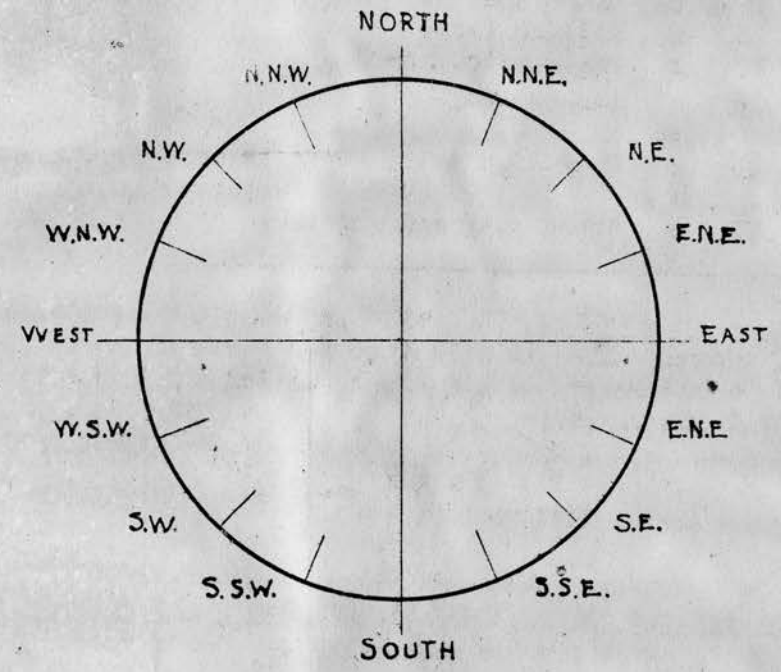

NORTH
N.N.W.
N.N.E.
N.W.
N.E.
W.N.W.
E.N.E.
WWEST
EAST
W.S.W.
E.N.E
S.W.
S.E.
S.S.W.
S.S.E.
SOUTH

FIG 6

No 5815

the compass. The points of the compass to be used are shown in Fig. 6.

145. Strength of Wind. This may be judged from Beaufort's scale:-

Beauforts Number.	Speed in m.p.h.	Observations of Natural Objects.	Behavior of Flag on Tops of Vanes
0	0	Smoke straight up.	No movement.
1	2	Smoke slants.	No movement.
2	5	Felt on face.	Slight.
3	10	Paper, etc. moved.	3/4 up.
4	15	Bushes sway.	Up and falling often.
5	20	Tree tops sway, wavelets on water.	Up. Falling less often.
6	30	Trees sway and whistle.	Up and flapping:

146. Warning Available. The following simple calculation determines the number of seconds which it will take for a gas cloud to move from the enemy's lines to our own:- Double trench distance (in yards) and divide by speed of wind (in m.p.h.)-

$$\text{Example:} - \frac{100 \times 2}{10} = 20 \text{ sec.}$$

Instructions to Gas N.C.O's. for Reporting on Hostile Gas Attacks.

147. During and after a gas attack the gas N.C.O. should note down in writing as much information as possible on the following points:

(a) Strength and direction of wind and general weather conditions.

(b) Times at which the gas wave or gas shell bombardment started and finished.

(c) Exact position and nature of place affected by gas or gas shell.

(d) To what extent telephone dugouts, covered gun and machine gun emplacements, etc., were affected.

(e) The approximate number of gas shell used and their caliber.

(f) The position of dud shell and fragments of shell, etc.

148. The following form will be used for making reports on gas attacks:-

\- - - - - - -

AMERICAN EXPEDITIONARY FORCES
DEFENSE DIVISION, CHEMICAL WARFARE SERVICE

Report on Gas Attack.

Serial No._____
Date of Report_____
Corps._____
Division_____

Unit._____Location_____

From____M____19___- to -_____M_____19___.

Method of attack (shells, cylinders, projectors.)_____

No. of projectiles_____Caliber_____Gas used_____

Wind direction_____Velocity_____M.P.S.#Temp___Humidity_

Character of terrain (woods, sloping ground, ravine, swamp, etc.)._____

_____

Area of terrain and length of front affected._____

No. of troops exposed_____

Duds found at (co-ordinates)_____No._____Caliber_____

Markings_____

Total casualties including deaths_____Total deaths_____

*Lung cases_____*Eye cases or burns_____

Causes of casualties (approx. no. from each cause; failure to put on mask, premature removal, etc.)._____

_____

Length of time respirators were worn._____

Was any part of gassed area evacuated?_____At what time?_____

Was attempt made to relieve units required to remain in sector._____

At what time (in the case of mustard gas was disinfection of ground begun?)_

Completed?_____

Remarks: (should include any new tactical use of gas, any suggestions, etc.).

_____

_____

_____

(Signed)_____

_____

x Shown on attached map.
Wind velocity should be given in meters per second.
* Information to be given when possible.

149. Forwarding of Samples, Specimens and Reports. After an attack gas shell bases and fragments, shell, gas samples, unexploded gas shell, and notes on the attack will be handed to the company commander for transmission to the division gas office, who will forward them to the corps gas officer. Corps gas officers are responsible for their examination, if possible, or for forwarding them to the proper place for such examination.

150. Earth samples should be taken when the use of a new gas is suspected. It must be remembered that earth samples containing shell-gas are extremely perishable. For instance, moist earth gradually destroys mustard gas, and unless such samples are forwarded to the laboratory at once they are valueless.

151. Earth samples must be sealed up in a proper container. Friction top tin cans or any tin can, the cover of which can be sealed on with surgeon's tape, are suitable to contain earth samples.

152. A letter of transmittal should accompany samples stating whether or not a report on the analysis is requested. If a report on the analysis is requested, the letter of transmittal should indicate whether the need of this report is urgent.

THREE IMPORTANT GENERAL ORDERS ON GAS.

G.H.Q.A.E.F.

GENERAL ORDERS)
)
No. 78.) France, May 25, 1918.

153. II. Paragraph 2, G.O. No. 53, H.A.E.F. November 3rd, 1917, is amended to read as follows:

"One respirator will be issued to each soldier and officer. A reserve of 10 per cent will be kept at the division in the division gas dump and 5 per cent with regiments and companies. Issues within the division will be made to authorized regimental officers by the division gas officer. In the case of detachments, they will be made to the senior officerppresent with the detachment. Issues will be made direct to detached officers. In the case of troops not attached to a division, but attached to an army corps, issues will be made in the same manner by the corps gas officer, and in the case of troops not attached to an army corps, but attached to an army, issues will be made in the same manner by the army gas officer. In all other cases issues will be made direct from the depots of this service. No person connected with the military service will proceed to the danger zone, as is now or may later be defined, without first being fitted with a respirator and drilled in its use, excepting those who will not have occasion to go within areas which will be designated as alert and ready zones and which usually will extend 5 miles back of the front line. Persons so excepted may be issued a French, type M-2 mask in place of the respirator, but shall not enter such alert or ready zones without a respirator. No mask or respirator will be worn by any person connected with the military service within the danger zone except as such mask or respirator is authorized and issued by the Gas Service."

G.H.Q.A.E.F.

GENERAL ORDERS)
)
No. 79.) France, May 27, 1918.

154. I. 1. The attention of all ranks is called to the increasing importance of gas warfare. Failure to understand the modes of employment of gas and the necessary measures for protection against it will have most serious consequences. While it is the duty of the Gas Corps to do all within its power to aid in effective preparation against gas, the ultimate responsibility devolves upon commanding officers. It will be their duty to make provision for the fullest protection against gas attacks, and to maintain the efficiency of gas discipline. To this end, they must provide for all officers and men under their command adequate instruction and drill in methods of protection against gas, arrange for the thorough training of officers and non-commissioned officer especially assigned to the work of gas defense, and at all times co-operate with authorized officers of the Gas Corps.

2. Chief gas officers of armies and of army corps, division gas officers and assistants to these officers, appointed by the Chief of Gas Service, will be attached to the staffs of the commanding officers of the units to which they are assigned, and will be under the command of such officers. In addition to reports through official channels, these gas officers will make direct to the Chief of the Gas Corps such reports as he may require. The Chief of the Gas Corps may, subject to authorization by G.H.Q., direct chief gas officers and division gas officers and their assistants to attend such conferences as may be needful for the co-ordination of gas defense.

3. Chief gas officers of armies and corps and division gas officers will, under the direction of their commanding officers, (1) instruct and supervise the work of all gas officers and gas non-commissioned officers within their units; (2) supervise anti-gas training and drill; (3) collect and transmit to the proper laboratories or proving grounds all material of enemy origin which may give information regarding new methods of gas warfare employed by the enemy; (4) inspect the measures taken for protection against gas attacks throughout their units, and (5) act as advisors to the commanders or staffs of the units to which they are attached on all matters pertaining to gas warfare.

4. The division gas officer will submit to the division commander a report of all gas casualties which occur in his division, together with reasons for such casualties, and the action taken, and the action recommended for their further prevention. A copy of every such report, together with action taken to correct deficiencies, will be forwarded by the division commander to the Chief of the Gas Corps through the proper channels.

5. A gas officer will be appointed by the unit commander for every regiment, for every battalion and for separate units, a gas non-commissioned officer will be assigned as assistant to each of these gas officers, and two gas-noncommissioned officers will be appointed for each company. All gas officers and gas non-commissioned officers will be relieved from all duties which might interfere with their duties as gas officers. These gas officers and gas non-commissioned officers, as well as other officers and non-commissioned officers chosen for their replacement, will be selected on account of their special qualifications. They will be required to take a course of training to fit them for their duties. This course will be taken at the A.E.F. Gas Defense School or at Corps Gas Schools. Division commanders will be notified from G.H.Q. when there will be vacancies in the A.E.F. Gas Defense School.

6. Regimental and battalion gas officers will, under the direction of their commanding officers, supervise the training of the troops of their organizations in the use of respirators, gas-proof shelters, alarm systems and other measures of protection against gas provided for in the manual on defense against gas, as authorized by G.H.Q. When a division is in the line, inspection of all gas defense equipment and of measures for protection against gas will be made by these officers at least twice a week. Any deficiency noted will be called to the attention of the company commander. These officers and gas-non-commissioned officers under their direction will assist division gas officers in obtaining information regarding new methods of gas warfare employed by the enemy and regarding material of enemy origin. They will also make systematic observation of and reports upon conditions of weather, terrain and any other conditions that might aid in predicting the time and the nature of the enemy gas attacks.

II. An A.E.F. Gas Defense School is established at the Experimental Field of the Gas Corps. It will be under the commandant of the Experimental Field as far as concerns supply, discipline, quarters for officers and men, and administration of grounds, buildings and equipment. A director and instructors will be appointed by G.H.Q. on advice of the Chief of the Gas Corps on all matters pertaining to personnel and instruction. The Commandant of the Experimental Field will render all practicable assistance to the Director of the Gas Defense School. At the A.E.F. Gas Defense School will be maintained a course of instruction in gas warfare, adequate for the training in gas defense of gas officers and gas non-commissioned officers. In order to bring this course to the highest possible efficiency, the Director of the School will co-operate to the fullest possible extent with officers engaged in offensive gas instructions as well as with those engaged in technical investigations at the Experimental Field. The Director shall keep full records of all persons attending the School, and will submit copies of these records to the commanding officers concerned, to the Chief of Gas Corps and to G.H.Q.

G.H.Q.A.E.F.

GENERAL ORDERS)
No. 107.) France, July 3, 1918.

155. 1. Gas officers acting as advisors to the commanders or staffs of the units to which they are attached, as provided in sub-paragraph 5, Par. 3, G.O. 79, G.H.Q.A.E.F., May 27, 1918, will be consulted and advantage taken of their technical knowledge and advice in the preparation of all plans involving the extensive use of gas, whether by artillery or by other means.

156. Extract from General Orders No. 144, G.H.Q.A.E.F.,c.s.,

VIII. 1. Because of the great importance which the use of poisonous gases has acquired in warfare, the following measures looking to a prompt and efficient treatment of gas casualties are ordered:

(a) Each division in the line of battle will have attached to it two mobile degassing units, Medical Department.

The organization and equipment of these units will be as follows:

UNITS	NOS.	REMARKS.
Captain or 1st Lieut. Sanitary Corps.	1	
Sergt. 1st Class.....	1	
Sergeants.....	2	1 Sergt. as chauffeur and automobile mechanic.
Privates 1st Class or Privates.....	7	1 Private 1st Class as chauffeur
Motorcycle with side car.....	1	
1,200 gallon tank car with pump and heating device.....	1	
Three-ton truck.....	1	

(b) A specially trained medical gas officer will be appointed in each division who will supervise the operation of these units and the instruction of the divisional medical personnel in the treatment of gas patients, and will see that proper provision of equipment is made at advance aid stations of everything necessary for the treatment of gas cases.

OTHER MASKS.

157. Until a sufficient number of American Tissot respirators are available to supply all the American forces, certain troops will continue to make use of the following masks:-

158. Small Box Respirator. This mask is similar to the American Tissot respirator in general form. It differs in the following respects, (see pars. 75-76). The incoming air is led to the lungs through a rubber mouthpiece held between the teeth, while the nostrils are closed by a rubber clip attached to the facepiece. The eyepieces show a tendency to dim, which must be corrected by especially careful and thorough use of anti-dim composition, and by occasional cleaning of the eyepieces.

(See drill below). Spent air from the lungs also reaches the outlet valve by way of the mouth-piece.

159. The following modifications in the drill are necessary for troops equipped with box respirators.

160. Drill "A", same as for American Tissot respirator.

161. Drill "B", Box respirator drill by the numbers.

The respirator is in the "Alert" position. The helmet is worn with the strap adjusted to the back of the head. A lanyard, either issue or made of shoestrings or similar material, is attached to the left loop of the helmet at one end and at the other is passed around the left shoulder.

Being at "Alert" position with helmet adjusted. (1) By the Numbers (2) GAS. Place the rifle, if unslung, between the knees. Insert the thumbs under the flap and open the satchel. Seize the facepiece with the right hand so that the metal elbow tube rests in the palm of the hand, the fingers grasping the wire frame of the nose clip. (Or thrust the right hand into the left hand compartment, grasping the facepiece in the palm of the hand, the fingers grasping the eyepieces). TWO Bring the facepiece smartly out of the satchel to the height of the chin, holding it tightly with the fingers extended outside, the thumbs inside at theebinding where the tapes are attached. Pull the hands apart until the tapes (harness) are taut. Throw chin well forward. Stick out the chin. THREE. Bring the facepiece forward, digging the chin into it. With the same motion, guide the tapes over the head, knocking off the helmet backwards. FOUR. Grasp the metal elbow tube outside the facepiece with the right hand. Insert the mouthpiece into the mouth, the teeth gripping the rubber lugs. FIVE. Grasp the circular spring (above metal elbow tube) with the right hand. By pressure open the rubber pads and adjust to the fleshy part of the nose. SIX. Complete adjustment by running the fingers around the facepiece at the binding, (to see that it is properly seated and no edges are turned in). SEVEN. Replace helmet. Resume the attention.

(a) After each drill, the facepiece should be cleaned of gas as in drill "C" below.

162. Drill "C". Same as with American Tissot respirators.

163. Drill "D". Drill to teach method of testing for presence of gas. See par. 68.

Take a deep breath. With the right hand pull the facepiece slightly away from the right cheek, hold the breath, loosen the nose-clip, and sniff gently. If gas is smelled, replace the nose-clip and facepiece. Then clear the facepiece of gas as in drill "E" below.

164. Drill "E". Same as with American Tissot respirator.

165. Drill "F". Inspection.

Up to and including command (Three) same as for American Tissot respirator. FOUR Examine the facepiece inside and out. See that mouthpiece is not split, loose or at wrong angle, and that metal lining is in position, 1/16" from opening. See that nose-clip is effective and firmly attached to mask fabric. Make sure that there are no pin holes or tears in fabric, and that eyepieces are securely fastened in the facepiece. Commands FIVE and SIX same as for American Tissot respirator.

166. ADDITIONAL DRILLS. Drill "G". To clear gas from the facepiece. The respirator being adjusted, (1) Clear. (2) Facepieces. Press the facepiece close to the face with the hands, forcing out the enclosed air at the sides. Refill the facepiece with air by blowing out around the mouthpiece, keeping the fingers on the nose clip to prevent its being displaced.

167. Drill "H" To clean eyepieces. The respirator being adjusted, (1) Clean. (2) Right Eye Piece. Grip the right eyepiece between the thumb and first finger of the left hand. Insert the first finger of the right hand into the fold of the facepiece behind the right eyepiece and clean it with a gentle, circular motion.

The left eyepiece, is cleaned in a similar way, with the forefinger of the left hand, the eyepiece being held with the right hand.

FRENCH TISSOT RESPIRATOR.

168. This respirator has been issued to certain special personnel, chiefly artillery, for use till the American Tissot respirator becomes available. These two respirators are similar, and both are based on the filter principle, the gas-laden air being drawn through a box of chemicals which filter out the poison and allow the pure air to pass through to the lungs.

169. The French and American Tissots differ principally in the method of carrying and the construction and material of the facepiece. The former has a larger canister which is carried on the back of the soldier, the flexible breathing tube passing over the left shoulder and then to the facepiece. The fabrics of the facepiece of the French apparatus is in some cases made of gum rubber or in many of the later issues is made of a rubberized fabric somewhat lighter than that of the American type. The French Tissot is too complicated and fragile to trust in the hnads of the average soldier and the canister is heavy and not easily carried. Directions for its use are in each box.

FRENCH M-2 MASK.

170. This mask is authorized to be worn by the following personnel only.

1. Labor and other troops whose duties do not require them to enter the gas danger zone.
2. Men so wounded as to be unable to wear the box respirators

For the latter use M-2 masks will be attached to stretchers and ambulances, and kept in field hospitals. They will not be worn except by the wounded.

171. The issue of M-2 masks for both these purposes will cease as soon as a sufficient supply of American Tissot respirators is available.

GAS DEFENSE SUPPLY SYSTEM.

172. Hitherto, no gas equipment has been issued to troops before their embarkation for overseas service. Although in the future respirators may be issued before sailing, the system described below has been developed to meet the needs of troops arriving unequipped.

Group A. Initial Equipment. (Training Sets, Respirators and Horse Respirators.)

173. The equipment in this group is issued to combat units while these units are in their training areas. Units except artillery, forming part of combat divisions will receive their equipment from the division gas officer, who will be stationed in the area with complete allowances of Group A on hand, in advance of the arrival of the division. He will then accompany his division to the line on completion of the period of training. Artillery units will receive Group A equipment from the C.W.S. officer permanently in charge of gas training at their camp or training center. Replacements will receive their equipment in depot divisions or the special replacement depots of the various arms.

174. Corps and army troops may be equipped.

(a) in base ports, in case they are to be sent direct to the Z. of A.

(b) in depot divisions to which they may be sent for the purpose.

(c) in special training areas, where officers of the C.W.S. will maintain supplies of Group A equipment.

175. Troops assigned to the S.O.S. will not ordinarily receive respirators. In case they are later ordered to the Z. of A., they will usually be routed through a depot division or special gas training station.

176. Small detachments and casuals should endeavor to secure Group A equipment at their stations before proceeding to the advance. If this is not practicable, they and any other troops not otherwise provided for, will receive respirators at regulating stations.

177. Finally, chief gas officers of armies, corps and divisions will maintain reserve stocks sufficient to equip any troops which reach their areas unequipped with respirators.

178. Group B. Reserve Respirators and Horse Respirators. Spare Canisters and Anti-dim Tubes. Protective Gloves, Suits, and Blankets, Alarm Sets. Chloride of Lime, Glycerine and Sag Paste.

These are issued to the gas officers of all units by the chief gas officers of the armies, army corps, and divisions, but only after the unit reaches the sector assigned to the group in question. The regimental, battalion, or other unit gas officer makes requisition of the division, corps or army gas officer, who fills the requisition from stocks on hand in the division or corps gas dump. Division gas officers replenish their stocks from the army gas parks, where credits for them will be maintained. These credits will be the supplies allotted to divisions by the Gas Defense Issue Schedule. When a division moves out of a sector, it will not carry supplies, but will get a credit for the supplies left. The latter will be turned in, either to the local army gas park or to the relieving division, if American. If division gas officers desire to draw more supplies than the total credits allowed them at the gas park in their sector, or when there is no gas park nearby, they will put requisitions through G-1 of the division and G-4 of the army in the regular way for Class 3 supplies. The division credit account will be kept in a balance book similar to those used in banks. These books will be sent to the army gas park with each requisition and "balanced" by the officer in charge of the gas park. Credits will not be carried over from one month to another, but a new credit will be established on the first of each month.

P A R T VIII.

ADMINISTRATIVE DUTIES OF GAS OFFICERS.

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PART VIII

ADMINISTRATIVE DUTIES OF GAS OFFICERS

(See paragraphs 100 - 148 Defense Against Gas).

1. The essential qualities of a gas officer are technical knowledge, tact, courtesy, initiative, ingenuity, and energetic perseverance. He must bear in mind that his supply and administrative duties are not the most important, and that one of his most important duties is to advise with respect to gas offense operations. These duties cannot be properly performed from an office in the rear.

2. The following enumeration of functions of corps and division gas officers is suggestive and not all inclusive.

I. Administration.

(a) Secure and employ as near full allowance of officers and enlisted men as practicable in corps (or division) office.

(b) Keep lists up to date of regimental and battalion gas officers and N.C.O.s.

(c) Study personality of subordinate gas officers. Attempt to make best use of them by suitable assignments, and to correct faults and weaknesses when possible.

(d) Departmentalize, as far as practicable, the work of the corps (or division) gas personnel.

(e) Place all enlisted personnel immediately under responsible non-commissioned officer in charge of office.

(f) Secure, if practicable, separate quarters for enlisted personnel.

(g) Know by name and rank each officer on the staff and the nature of his duties.

(h) Insure that required number of regimental and battalion gas officers and N.C.O.s are trained at proper schools. Maintain written record of training of gas personnel, commissioned and non-commissioned, and their ability, recommending advance of those who discharge their duties satisfactorily whenever a vacancy exists.

(i) Secure as near full allowances of transportation as practicable.

(j) Maintain filing system, emphasize care of and making of maps, form and substance of reports and correspondence, appearance of office.

(k) Keep a war diary.

II. Relations within corps (or division).

(a) Maintain intimate liaison with all staff departments.

(b) Cultivate interest in gas among all officers by congenial, unobtrusive methods.

(c) Secure action by Chief of Staff on reports and recommendations relating to gas discipline, training, and supplies.

(d) Secure official publications of necessary orders, such as zone regulations.

(e) Secure co-operation of Military Police in enforcement of orders relating to gas defense.

(f) Secure all necessary information, such as maps, reports and circulars concerning enemy operations from G-2 (Intelligence), concerning our own movements from G-3 (Operations), concerning casualties from the corps (or division) Surgeon's Office, concerning casualties and our own posts of command from the Statistical Office.

(g) Co-operate with representative of Inspector General and Medical Gas Officer.

III. Operations.

(a) Furnish counsel in gas matters as requested by Commanding General, Chief of Staff, or (Corps) Artillery Officer.

(b) Act as liaison between gas troops operating in corps (or division) area and (corps and) division staffs, establishing understanding on the part of the staff and an appreciation of their potential value. (Division Gas Officer will aid in establishing similar relations between gas troops and the units with which they are to act in the line).

(c) Furnish gas troops with all available information concerning suitable targets and movements involving the possibility of activity on their part.

(d) Devise plans for use of gas, submitting them to Chiefs of Staff Departments concerned, the Commanding General, Chief of Staff, or to Commanding Officer of Gas Troops concerned where his organization is affected.

(e) Establish relations with artillery brigades (or brigade) cultivating interest in gas.

(f) Maintain liaison with Munitions Officer and Artillery Operations Officer, also Salvage Officer, and be cautious in recommendations of artillery gas programme, leaving all matters of recommendation which are exclusively in the field of artillerists.

(g) Report without delay direct to Army Chief of Chemical Warfare Service all gas offensive operations executed by troops of the division (or corps).

IV. Supplies.

(a) Study carefully means of supply and probable future needs of division (or corps).

(b) Insure adequate supply by timely requisition on the nearest advance army depot, but keep stock in corps park or division dump as small as compatible with local needs.

(c) If not near an advance depot see that requisitions on the base or intermediate depots are placed with G-4 of the Army in ample time to secure supplies.

V. Subordinate Units.

(a) Make periodic inspections with view toward determing state of gas discipline, training, and supplies, correcting defects through Division (Regimental) Gas Officer when practicable, otherwise through Commanding General (or next senior Gas Officer), or Inspector General's representative, by report and recommendation.

(b) Keep Commanding General advised of state of gas training, discipline, and supplies in divisions assigned to corps (or units within the division).

(c) Advise next senior Gas Officer on same subject, sending copy of such report to Chief C.W.S.

(d) Assist Division (Regimental and Battalion) Gas Officers by counsel and suggestion.

(e) Study conditions within divisions (regiments, etc.) through routine report and personal interview.

(f) Encourage criticism and suggestion from Division (Regimental and Battalion) Gas Officers.

(g) Be watchful at all times of gas personnel who, through temperamental or other unfitness, tend to bring the Chemical Warfare Service into discredit and recommend to Chief of CWS transfer of such officers and men to other work.

(h) Insist upon the use of proper channels of communication.

(i) Accustom troops to the use of smoke, H.E., and thermit by gas troops through demonstration and brief lectures.

VI. Corps Troops.

(a) Maintain gas discipline, training and supplies.

(b) Undertake training of gas N.C.O.s in the units not as a whole identified with front line activity (such as remount squadrons, etc).

(c) Check closely situation concerning replacement battalion and the sending of replacements to the line without proper anti-gas equipment.

(d) Interview gas officers and non-commissioned officers of corps troops frequently for purpose of securing from them helpful suggestions and criticism.

VII. Casualties.

(a) Keep accurate account of casualties noting particularly causes, avoidability, fatigue and malingering cases, the nature of gas responsible for casualty, tactical use of that gas, ratio of shell to casualties.

(b) Analyze periodically the proportion of casualties attributable to the several gases as indicated by symptoms and recollection of patients respecting smell and appearance of gas.

(c) Submit report to Commanding [illegible] facts and findings justify.

(d) Co-operate with Medical Gas Officer in securing data concerning methods of relief of gas affections and in giving them publicity within the corps (or division). Notify Chief of C.W.S. of all such methods in use in the unit.

(e) Take steps to prevent needless salvage by hospitals of gas equipment of patients.

VIII. Enemy Material and Intelligence.

(a) Secure all material, documentary and otherwise, of gas interest through divisional (regimental) gas personnel, salvage officers, G-2, and miscellaneous sources, and, if practicable, by examination of enemy dugouts, dumps and positions in immediate wake of infantry advance.

(b) Utilize all available means of transportation for removal of non-mailable material to nearest Advance Army Gas Depot, notifying next senior Gas Officer of find and where it is deposited, sending copy of report to Chief of C.W.S.

(c) Deliver all non-gas intelligence thus secured to G-2.

(d) Secure, if practicable, translation of gas documents before forwarding them when data is likely to be of immediate importance to Corps (division).

(e) A set of enemy fuses and typical gas shell, sectioned, should be kept at gas office for information of all concerned.

IX. Training of Divisions.

(a) When Division is in training establish conferences of regimental and battalion gas officers and schools for gas N.C.O.s.

(b) Establish a series of lectures, demonstrations, inspections and drills for the enlisted personnel of the division.

X. The following is a suggestive digest of the functions of a Regimental and Battalion Gas Officer. It should be noted that responsibility for all measures taken in chemical warfare, whether in offense or defense, rests ultimately upon the commanding officer concerned; and the gas officers concerned are under their command. Usually, either the commanding officer of the regiment will order his gas officer to follow the technical advice of the Division Gas Officer, or this may be ordered by higher authority. (The suggestions are supplementary to Par. 391, Defense Against Gas.)

(a) Keep accurate record of training and ability of subordinate personnel, recommending such advancement as may be merited and practicable.

(b) Keep gas personnel advised of the latest available data, holding frequent conferences and inviting suggestion and criticism.

(c) Exact strict compliance with orders relating to inspection by subordinate personnel, condition of material, gas discipline and reserve supplies by means of personal supervision and frequent inspections.

(d) Insure the immediate availability of authorized reserve anti-gas supplies, their suitable transportation and proper issue.

(e) Advise commanding officers of the proper precautions to be taken in anticipation of gas attacks, and in the event of such attacks keep informed concerning all action taken.

(f) Minimize false alarms and supervise instruction to sentries, insuring active liaison with gas personnel of subordinate and superior commands.

(g) Secure sufficient first aid relief in exposed areas.

(h) Furnish counsel to Commanding Officer in gas matters and stimulate interest in and understanding of the use of gas on the part of all officers.

(i) Furnish liaison between command and gas unit operating therewith, insuring sufficient understanding by troops of nature of proposed activity of gas unit operating therewith, in order to enable them to take full advantage thereof.

(j) Report accurately and promptly concerning the enemy use of gas and its effect. In case of artillery gas officers, report in addition concerning delivery of gas upon enemy objectives.

(k) Secure strict compliance with zone regulations and punishment of offenders.

(l) Minimize waste of anti-gas material, applying disciplinary measures to offenders and insuring the full and proper use of all anti-gas supplies.

(m) Advise next senior Gas Officer of the location of finds of enemy gas material or cause prompt delivery thereof to his office.

4. Duties of Gas N.C.O.s.

(See paragraphs 135 - 148, Defense Against Gas).

5. Inspections of division by corps gas officers and of regiments by division gas officers should be frequent and thorough, thereby stimulating initiative and interest of subordinate gas personnel, furnishing basis for the removal of the unfit, advancement of the meritorious, and securing helpful suggestions for the improvement of the Service.

6. In general, the basis of inspection will be the determination by interview, of the activities of Gas Officer of the unit inspected and the instructions issued by him, followed by investigation of conditions in subordinate units, and the manner in which existing instructions are complied with by gas personnel of these subordinate units.

7. The following questionnaire outlines the inspection of a division by a corps gas officer and may be adapted by the division gas officer to his inspection of regiments.

Questionnaire: Basis for Inspection of Gas Training, Discipline and Supplies of Divisions.

I. Personnel.

(a) How many gas officers are there in the Division and how distributed?

(b) How many have trained in A.E.F. Gas Defense School?

(c) How many have conflicting non-gas duties?

(d) How many gas N.C.O.s are there in the Division, and what is their distribution?

(e) How many have been trained in the Army Gas School?

(f) What measures have been adopted to secure co-operation and create an esprit de corps in the gas personnel within the Division?

II. Training.

(a) What training had Division received in the United States?

(b) In the rest area?

(c) What training does it receive in reserve?

(d) In line?

III. Inspection.

(a) How often are inspections made of gas equipment and discipline?

IV. Experience.

(a) What experience has Division had in actual attacks?

V. Casualties.

(a) How are reports of casualties obtained?

(b) What has been the proportion of gas casualties to casualties from other sources?

(c) What percentage of gas casualties has been returned to duty from Field Hospital?

(d) What are the principal causes of such casualties?

VI. First Aid.

(a) What first aid methods are employed within the Division?

(b) What measures are taken to give troops exposed to gas access to first aid and protective supplies?

(c) How is Sag Paste distributed?

(d) How is it used?

(e) What results are obtained from its use?

VII. Gas Attacks.

(a) What orders govern the selection of alternative positions?

(b) What is the number and location of gas-proof dugouts?

(c) What instructions govern sentries in event of gas attack?

(d) What instructions govern N.C.O.s, Battalion Gas Officer, Regimental and Division Gas Officer?

VIII. Division Gas Officer.

(a) What reports are received from Regimental Gas Officers concerning supplies, gas intelligence, discipline and training?

(b) What reports are made to corps?

(c) What channels of communication are employed?

(d) What system is used in the care, use and record of gas literature and intelligence?

(e) Of what does the Division Gas Office personnel consist, and what is the distribution of duties?

(f) What gas memoranda and orders are in force in the Division?

(g) What reports are made to the Commanding General of the Division?

IX. Relations.

(a) What are the relations with the Commanding General and the Chief of Staff?

(b) Is technical knowledge of Division Gas Officer employed with respect to offense use of gas?

(c) What are the relations between Gas Officer and Division G-2, G-3, and G-1?

X. Transportation.

(a) What personal transportation is furnished D.G.O.?

(b) What transportation is available for Divisional reserve and distribution of supplies?

(c) What transportation is available for the gas needs of units within the Division?

XI. Supplies.

(a) Are all men and animals supplied with respirators?

(b) What reserve is maintained in Division Dump?

(c) What reserve is maintained by units within the Division with respect to M-2, Tissot, S.B.R., horse respirators, lime, gloves, suits, alarms, canisters, suit bags, blankets and sag paste?

(d) What is the policy with respect to salvage?

(e) What is average length of time between the sending of requisition and receipt of supplies?

(f) Where is the nearest Advance Army Gas depot?

XII. Captured Enemy Material and Duds.

(a) What is the policy with respect to captured enemy material and duds?

XIII. Recommendations.

(a) Are there any recommendations, suggestions or criticisms?

XIV. Observations.

(a) Note improper carriage and improper condition of respirator, securing the name, rank, number and organization of cases requiring disciplinary or corrective measures.

(b) Note the observation of "Alert" and "Danger" zone regulations and the manner in which these zones are defined for the command.

(c) General impressions of conditions in Division.

(d) Recommendations.

8. Valuable information revealing weakness in gas discipline or training, inadequacy of anti-gas protective or precautionary measures by commanding officers or the use of new tactics by the enemy and the value of such tactics may be gained by the careful questioning of gas casualties.

9. The following questions are outlined for the purpose of gaining the foregoing information from casualties the type of casualty determining which group of questions are put in a given case. The inquiries concerning training are common to all cases.

Questionnaire for Gas Patients.

I. General.

(a) Name, rank, number, organization.

(b) Did the gas burn your skin or eyes, or affect your lungs?

II. Skin Cases.

(a) Where were you burnt?

(b) Just how did you get burned? Give details and circumstances.

(c) Did you have an opportunity to use sag paste?

(d) Did you use sag paste?

(e) If so, how did you use it?

(f) Did you use anything else before you were burned?

(g) Did you use anything after you were burned?

(h) Did you know there was gas about when you were burned?

(i) Did you have your mask on when you were burned?

(j) What will you do next time to avoid being gassed under similar circumstances?

(k) How close to you did gas shell burst?

(l) Did it splash you?

(m) Was chloride of lime available?

III. Eye Cases.

(a) Just how were you burned? Give details and circumstances.

(b) What will you do next time to avoid being gassed under similar circumstances?

(c) Did you wear a mask? If so, how did you wear it?

(d) How long after alarm did you put mask on?

(e) Did you take your mask off before being ordered to do so?

(f) By whose orders did you take it off?

(g) Did you use sag paste?

IV. Lung Cases.

(a) Just how were you gassed? Give details and circumstances.

(b) How far did you walk after you were gassed?

(c) What did the gas smell like?

(d) What did it look like?

(e) How did it act?

(f) Did you know what kind of gas it was?

(g) How long after alarm did you put mask on?

(h) Did you take mask off without orders to do so?

(i) What will you do next time to avoid being gassed under similar circumstances?

(j) How near did gas shell burst?

(k) How long was it after you were gassed before you felt the effects?

(l) When were you gassed?

(m) Just how do you feel now?

V. Training.

(a) Did you have gas training in the States?

(b) How often?

(c) How long have you been over here?

(d) What kind of gas drills have you had here?

(e) How often?

(f) How often in the training area?

(g) How long since then?

(h) Have you practiced fighting with mask on?

(i) What is the longest time you have worn mask?

(j) How many false gas alarms did you have within two weeks before you were gassed.

(k) When was your mask last inspected by gas N.C.O.?

(l) Did he look at the canister?

DUTIES OF A STAFF OFFICER WITH RESPECT TO OFFENSE OPERATIONS.

Preliminary.

10. From G-2 the Gas Officer will obtain maps and information regarding enemy dispositions. He will study these dispositions and the character of the enemy terrain with the view of selecting favorable targets for gas. He will study friendly terrain in order to select favorable positions for emplacements. Information will be obtained from the Chief of Artillery regarding the availability of guns of various types and calibers. He will


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CHAMAMARANDES
B
BOIS-DE-BOULOGNE
P.C.
BOIS-DE-COURTAI
P.C.
COLUMBEY-LE-PETIT
AUXERRE
D
A
800
810
820
830
870
890

also obtain from the munitions officer information regarding the material available for use. The Commanding Officer of gas troops will be consulted regarding the use of cylinders, projectors. and trench mortars, their availability, and the feasibility of any project which might be contemplated.

11. A hypothetical map showing enemy terrain and dispositions is shown opposite. In the following paragraphs it is intended to indicate the possible uses of gas in this terrain under various tactical situations. It is hoped that this will help division gas officers to solve their own problems in the use of gas. In each case the D.G.O. memorandum to G-3 is given.

(1) Use of Gas on a Stable Front.

(a) Cloud Gas.

Memorandum to G-3.

Our front offers possibilities of a cylinder gas attack against the enemy. Such an attack would have the following purposes.

a) To cause casualties among the enemy ranks.
b) To lower the enemy morale.
c) To damage enemy material.

The gas should be liberated between 830-528 and 825-520 where a favorable wind will carry the gas forward across the open country. The light railroad running along our front at this point can be used, the cylinders being brought up on trucks and discharged from them. The front line should be temporarily evacuated by our troops. A suitable accompanying artillery program should be arranged. The more minute details of the attack can be arranged with the officer commanding our company gas troops.

(b) Projector Attack.

Memorandum to G-3.

It is recommended that about 500 projectors filled with phosgene be placed along the edge of the wood at 882-531 and fired against the village of Colombey-le-Petit and the adjacent billets and crossroads. Harassing fire of H.E. and shrapnel should shortly precede and accompany the projector discharge.

(c) Artillery.

Memorandum to G-3.

Information has been received that there is a heavy concentration of troops at the support camp located at 863-574. It is recommended that a two-minute burst of phosgene in artillery shell be used on this point, followed by a one-hour bombardment with H.E. In this destruction fire, to secure surprise effect and an effective gas concentration, the use of a commensurate number of batteries on the objective is highly desirable.

(d) Memorandum to G-3.

The light railroad junction at 879-596 is under observation by our balloons. I recommend that this junction be destroyed by H.E. fire at 16 hour 24 May, and that the working party which will come out shortly after dark for the purpose of making repairs, be subjected to a burst of phosgene followed by a slow fire of chlorpicrin and H.E. for four hours.

2. Use of Gas in the Advance.

It is assumed that a field order has been issued by G-3 directing the advance of our lines, our objective being road Chamarandes to Bricon to 855-610, thence south to 900-610.

Memorandum to G-3.

In connection with Field Order No. _____ dated _____, the following recommendations on the use of gas in these operations are made:

(a) That in our destructive and neutralizing fire against the enemy batteries two bursts of phosgene be used, the one for two minutes at O-6 H. and the other for two minutes at O-3 H, and that during the intervening three hour cadence fire of chlorpicrin be maintained (twelve rounds per battery position per hour).

(b) That the enemy lines of communication and supply which are more than one kilometer beyond our objective be shelled with mustard gas beginning at O-24 H., the railhead at Bricon to receive special attention.

(c) That in the accompanying barrage 5% of phosgene shell be used and that if the wind is favorable this be increased to 10%.

(d) That 100 projectors be placed at 882-531, and that from these projectors H.E. bombs be fired at O-H. - 5 min. against the machine gun nests and the pill-box at 886-543.

(e) That trench mortars firing smoke bombs be used along the entire front from 800-828 to 870-525 in order to cover our crossing of the stream.

(f) That thermit be used at O-H. - 5 min. against the machine gun nests at 810-530, 832-523 and 848-527. The use of smoke rifle grenades against these machine gun nests is also recommended.

(g) That four Stokes mortars follow the road from 838-536 to 835-571 in order to maintain a smoke screen to protect our advance across the open region on our left.

(h) That during the consolidation of our new positions a belt of mustard gas be laid down across the rear of the Bois de Blois in order to interfere with the supply of enemy troops and batteries occupying these woods.

(3) Use of Gas in Withdrawal.

Memorandum to G-3.

Beginning 8 hours before the zero hour of our withdrawal, all important enemy cross-roads, billets, camps, etc. should be shelled with mustard gas. The Bois de Courtrai should be systematically shelled with mustard gas (zone fire) for twenty-four hours preceding our withdrawal.

During our withdrawal mustard gas shell should be exploded in our abandoned dugouts.

In case any artillery shoot with gas be approved, the D.G.O. will furnish the Chief of Staff information covering the following points:

(a) Target - accurate definition by means of reduced co-ordinates.

(b) Time of shoot.

(c) Number of shell,- calculated on basis of most unfavorable wind conditions.

(d) Kind of shell.

(e) Rate of fire.