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DEFENSE AGAINST GAS

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The following "Defense Against Gas" is published for the information and guidance of the American Expeditionary Forces.

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DEFENSE AGAINST GAS

I. GENERAL CONSIDERATIONS.

1. The following notes have been prepared for the guidance of officers when giving instruction on Gas Defense. Such information on the offensive 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 very 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 gasses. 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 casaulty 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 drill 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—Such attacks are 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 opponent's trenches.

(b) Projector Attacks—Such attacks are limited to a stabilized front in which time and other circumstances permit the projectors to be brought up and placed in position for firing. Improvements to avoid digging trenches to emplace the

projectors and more rapid means of transportation will broaden the use of this form of attack.

(c) Bombardments With Artillery Or Trench Mortar Gas Shell—Such attacks are applicable in all modes of warfare.

In the case of cylinder attacks, a highly poisonous liquefied 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 liquefied gas, but often sufficient to give practically a high explosive effect, in the case of solids. A liquefied gas vaporizes when the pressure is released by the breaking of the shell, while solids are either atomized or vaporized by the explosion of the bursting charge.

Cylinder Cloud Attacks.

11. Gas clouds are produced by the sudden liberation of a liquefied gas from 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 led 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 air 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 at times the gas has been noticeable in the rear areas as much as 10 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 extent 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 a 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.

Projector Attacks.

14. 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 liquefied 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 sheet 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.)

Gas Bombardment With Trench Mortars Or Artillery.

16. 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 lines. A higher degree of accuracy is attained than with projectors and the bombardments 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 method of 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 shells are used in various ways, according to 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 shells at a time, may be continued indefinitely against permanent positions.

Gas Hand Grenades.

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.

Physical and Chemical Properties.

19. Dichlorethylsulphide, known as mustard gas, Yperite or Yellow Cross gas, is an oily liquid boiling at 423 degrees 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.

Use in Enemy Projectiles.

20. The enemy uses mustard gas in shell for 77mm. gun, and for 105mm., 150 and 210mm. howitzers, more rarely in 100mm. and 150mm. 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 nitro-benzene. These shells 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.

Physiological Action.

21. 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 concentration,

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 on the length of the exposure. The third effect, from which mustard gas derives its name of vesicant or blistering agent, is the production of painful burns on those portions of the skin with which it comes in contact, particularly the tender and moist parts under the arms and around the scrotum.

Tactical Uses.

22. 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 fused to explode when the locality is filled with our troops. Mustard gas may be sprinkled on roads and at all points over which troops must pass. All shelters will in general have been liberally soaked with mustard gas.

Individual Protection.

25. (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 respirator immediately when 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 to 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 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 di-

minish its effects upon the skin. The paste should be rubbed liberally in an even layer on the genital organs and region, the buttocks, the armpits, 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. Since there is no way of judging this easily in the field, care must be taken to use a sufficient quantity of the paste and to renew the application about once every 12 hours when continually exposed to 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 shells 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.

Collective Protection.

26. In general, the best protection against mustard gas is evacuation of all ground infected by it, IF THE TACTICAL SITUATION PERMITS, and *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 gasproof 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 gasproof 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.

Disinfection of Positions and Clothing.

27. After a mustard gas bombardment, the covering of 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 dugouts, in order that the men may use the 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 absord 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 in the field.

PHOSGENE.

Physical and Chemical Properties.

28. Phosgene or carbonyl chloride is a liquid boiling at 47 degrees F. with a marked odor, described as being like that of 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 10km. from the original point of attack.

Use by the Enemy.

29. Phosgene is sent over by the enemy in cylinders, projector bombs and trench mortar 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 250mm. trench mortar shells and in the 180mm. smooth-bore projector bombs. In these it is rarely mixed with chlorpicrin. Recently the enemy has used phosgene in long range rifled projector shells 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 100mm. guns and in the 105, 150 and 210mm. howitzers.

Physiological Action.

30. Phosgene is a lung irritant and is probably the most deadly gas used in warfare. Exposure to high concentrations for even a short time will cause severe casualties, or death, 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.

Tactical Uses.

31. 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.

Defense Against Phosgene.

32. 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 degrees 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 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 degrees 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 contains 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.

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 dipenylchlorarsine in physiological action, exerting a more destructive effect upon the respirator 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 7. For description, care, fitting, inspection, drill, etc., for 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) Cleaning of gas from dugouts and trenches.

(e) Disinfecting of ground and clothing.

(f) Precautions regarding food and water.

(g) Protection of weapons and equipment.

WIND OBSERVATIONS.

41. Such measures as the Division Commander on recommendation of Division Gas Officer may decide to be necessary will be taken within the Division for having wind observations made by the Gas N. C. O's. The

results 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 141-145.)

ALARMS.

42. 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 quickness in giving the gas alarm is imperative; a few seconds 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 bombardment 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 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 Gas Sentries and alarm systems are given in "Standing Orders, paragraphs 114-117."

Protection of Dugouts and Cellars.

44. The protection of dugouts against gas has proven of great value especially in the case of gas of high persistency, which may necessitate the wearing of the respirator in 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 door, stopping all draughts. The methods of proper dugout protection are shown in accompanying plate. 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. Curtains should 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 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.

Clearing Gas from Dugouts, Trenches, etc.

45. 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. (See par. 27.) 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.

Precautions with Reference to Food and Water.

47. "There have been cases reported of food which has been exposed to gas causing 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 more 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."

Protection of Weapons and Equipment.

48. 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.

SPECIAL ARMS.

Artillery.

49. 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) Signallers must take all the precautions laid down in paragraph 53.

(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 tactical situation permits.

Artillery, Rifles and Machine Guns.

50. 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.

Ammunition.

51. 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.

Engineers.

52. 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.

Signal Corps.

53. It is essential that telephone operators should be able to work as much as possible during a gas at-

tack without wearing respirators or helmets. Signal dugouts must, therefore, be particularly 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. Linesmen must receive plenty of practice in carrying on their work, both at night and in the daytime, while wearing respirators.

Signal and Telephone Equipment.

54. 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 magneto 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 with a dry cloth. This process should be repeated after twelve 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.

Protection of Carrier Pigeons.

58. 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 ill-timed use of gas or the use of a kind of gas unsuited to the conditions. The tactical uses of the different

gases vary 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 connection with the seizure of enemy territory, see paragraph 24.

Gas Shell and Gas Bombs.

64. 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.

RESPIRATORS.

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.

66. *Drill "A." To bring the Respirator to the "Alert" position.*

1. Slung Position.

Respirator with 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 satchel. 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.

67. *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 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 unslung, 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 thumb inside at the binding midway between the two lower 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 ad-

justment and 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" position, 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 arm. Examine the interior of 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, that there are no pinholes or tears in fabric, that air passage to eyepieces is in proper condition and not torn away from fabric, that 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 work-

ing 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. See pars. 108 and 109. 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.

General Points on Training with Respirator.

74. 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 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 respirator 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 appliances should be carried out as continuously as tactical conditions will permit. This applies especially to troops which return to the line after having been in rest areas and where the incorporation of drafts incompletely trained in gas defense measures make such training very essential.

Description of the American Tissot Respirator.

75. The respirator consists of a metal canister filled with a mixture of chemical granules and connected by a rubber tube to an impervious facepiece. Air is drawn 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 poisonous gas is absorbed by the granules in the canister. The purified dry air passes into the facepiece, playing over the eyepieces, and keeping them clear. Air is expired through the

outlet valve, the inlet valve closing in order to prevent air passing through the canister. If the inlet valve does not close properly, expired air passes into the canister 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.

Fitting.

77. Respirators are made in five sizes. The various sizes will be needed in the following proportion:

No. 1 Very small.
No. 2 Small.
No. 3 Medium.
No. 4 Large.
No. 5 Very large.

When respirators are issued they should be most carefully fitted. In some cases it will be necessary to change the length of the elastic by 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 satchel as worn in the "alert" position to insure that he does not exchange his 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 disciplined.

Care of Respirator.

80. The most serious causes of damage to the respirators 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, and rough usage must be avoided. Nothing must be carried in the satchel, except the respirator and anti-dimming outfit; small articles of kit readily cause 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 valves at bottom of canisters 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.

Life of Canister.

84. When canisters are issued, they will be painted with the number of the month of issue. They will then be replaced after the lapse of a certain number of months. They will usually become ineffective through mechanical damage before they become useless chemi-

cally. 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.

Replacement of Canister.

85. When the canister of the respirator is defective owing to wet, rust, or other damage, or has been breathed through for 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.

Removal of Old Canisters.

86. 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.

Fixing of New Canister.

87. 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 facepiece is in the correct position relative to the canister.

88. To bind the tubing with string, proceed as follows (see Fig. 1): 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 round the tube

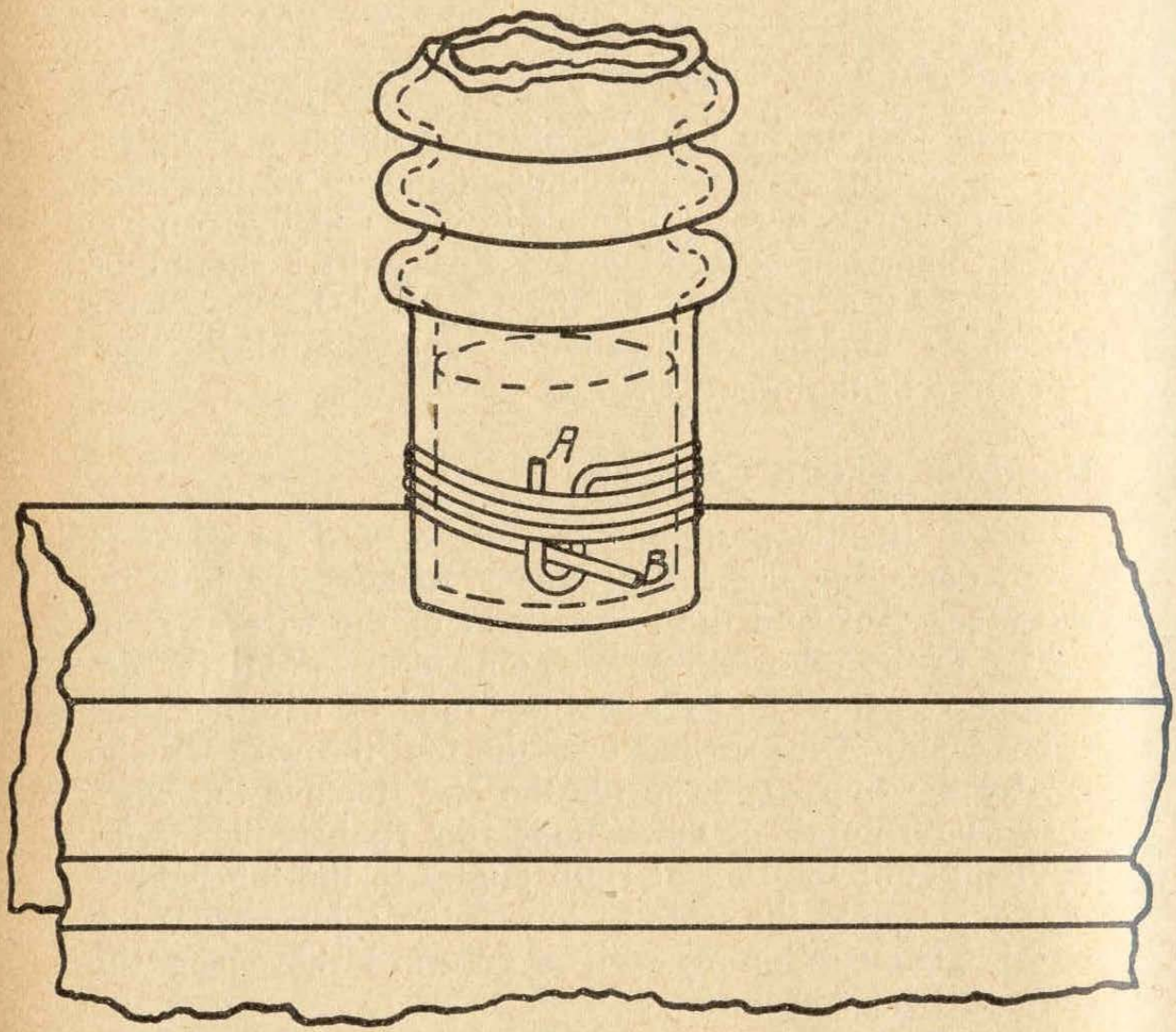


FIG. 1.

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 be below the ridge in the neck of the canister. Test the junction to see that it is secure and gas tight.

Anti-Dimming Outfit.

89. This is carried in the satchel, and contains a stick 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.

Minor Repairs.

90. 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 RESPIRATOR.

General.

91. In choosing locations for stables and horselines 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 by mustard gas as the skin of the 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 practised in wearing the respirator, as they will otherwise resist protection, and cause delay and annoyance in emergencies.

Description.

92. 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 stitched 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 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.

Method of Use.

93. 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, horses should be protected wherever the shelling is heavy.

Carrying When Not Immediately Required.

94. When not required for immediate use the respirator can be conveniently carried on the supporting strap of the breast harness as shown in Fig. 2, 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

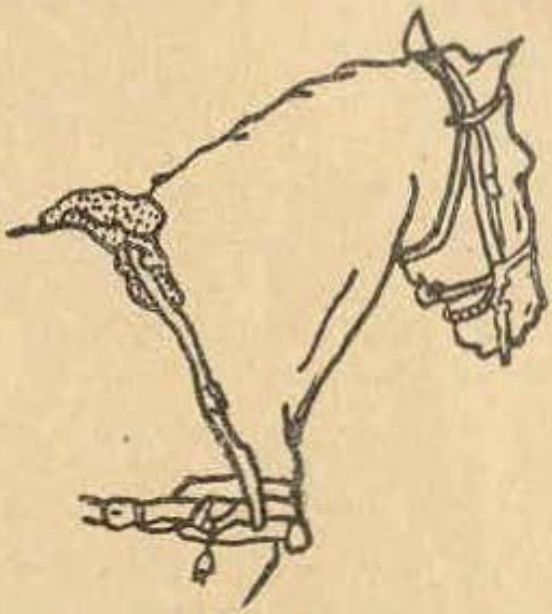


FIG. 2.

passed under this strap, between it and the wither pad, and buttoned as in the "Alert position."

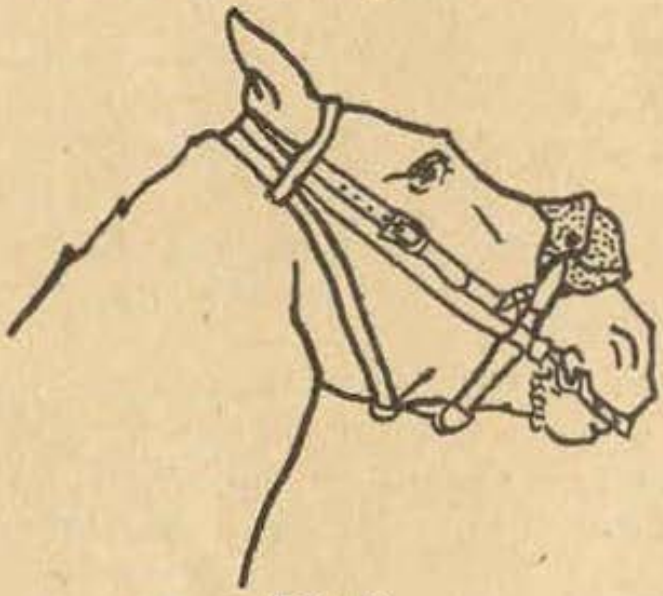


FIG. 3.

Alert Position.

95. 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 check 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 the nose-band. Fig. 3 shows a respirator in its case carried in the "Alert position."

Wearing In Gas.

96. 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.

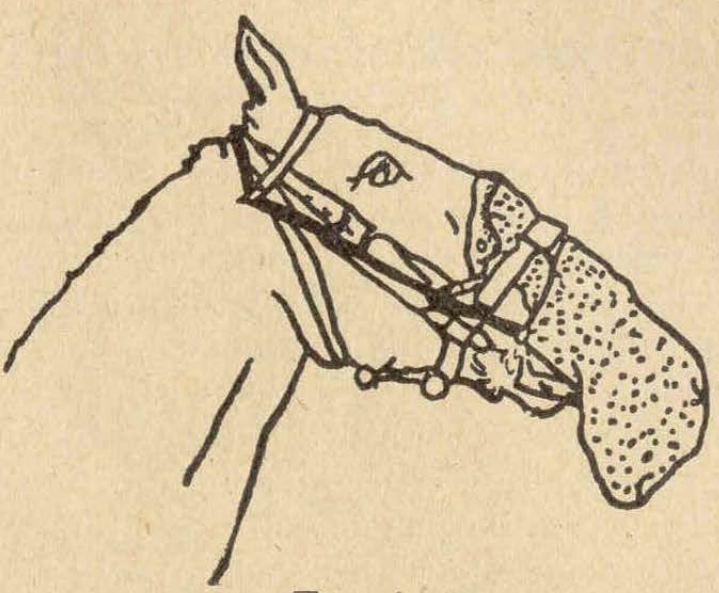


FIG. 4.

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. 4.

Replacement in Case.

98. 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 straw, moss or leaves saturated with sodium bicarbonate solution will make a fair emergency mask.

VI. STANDING ORDERS AND DUTIES OF GAS OFFICER.

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 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.

BULLETIN No.— ....., 1918.

Organization.

100. 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 indentification 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 efficiency in gas discipline or protection to the notice of the proper commanding officer when necessary.

102. 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 non-commissioned 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.

103. 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 replacement.

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.

Training and Inspection.

106. 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.*

Gas Zones.

108. 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 respirators 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 divisional 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, this 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.

Gas Alarms.

115. 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 the Division Commander on 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." Any one who knowingly gives a false gas alarm will be tried by court-martial.

Gas Sentries.

117. 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 very 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 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.

Intelligence.

119. All intelligence indicating that an enemy gas attack is imminent should be communicated immediately to the Division and Corps Gas Officers 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 Non-Commissioned Officers 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.

Liaison.

120. 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 permits, it will be advisable to notify the Division Gas Officers about any proposed extensive use of gas in operations by our own troops. 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.

Action During and After a Gas Attack.

121. 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 by a Gas Officer or gas N.C.O., or by a general gas alarm of the presence of gas, or who removes his respirator without proper authority, will be disciplined. 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 cellars 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 gasproof 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 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, Page 17), *unless the tactical situation forbids,* and an area subjected to such a gas attack should be promptly evacuated for a period of three days, or until pronounced safe by the Divisional or Regimental Gas Officer. If practicable, the Division Gas Officer will be consulted. The evacuation should be made upwind 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.

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 position 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 man gassed. Especially in the case of a mustard gas attack, it is important that fresh clothing be available and that the clothing should be changed and the man 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. Regardless 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, *therefore, a sharp lookout will be maintained for a repetition of a gas attack.* 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.

TYPICAL DIVISION ORGANIZATION OF DISINFECTING SERVICE.

(For Official Circulation Only)

Hq.——Div. A.E.F. . . . . , 1918.

BULLETIN: No. . . . .

131. In order to provide the most efficient means for the purification of ground which has been shelled

with "mustard gas" special disinfection squads shall be designated and trained by each Regimental or Battalion Gas 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 officer of that unit. Except in case of "mustard gas" shelling, the men composing 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 duties which might interfere with their duties as gas non-commissioned officers. These men shall, however, spend such time as may be necessary in order to make them proficient in their work, according to the discretion of the Regimental Gas Officer. The duties of these disinfecting squads will be:

(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 follows:

(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. and 4 men.

(c) Each Battery: Battery gas N.C.O. and 4 men.

(4) Engineer Regiment:

(a) Regimental Headquarters: Regimental gas N.C.O. and 4 men.

(b) Each battalion headquarters: Battalion gas 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 for 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 for 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 shells 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 organizations 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 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 instruction 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 over whom they may be 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 GAS 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 are 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) Gasproof Shelters.—See that the blanket doorways fit and are kept in good condition.

(c) Stores of Fuel for Clearing Shelters.—Insure sufficient supply for clearing all dugouts, to be maintained under company arrangements.

On relief they will assist the Company Commander in taking over all Gas Defense trench stores. The Com-

pany 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 recommendation of the Division Gas Officer, and will report any change of wind to the Company Commander. (See Pars. 142-145.)

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 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. Gas N.C.O.'s will make to Company Commander such wind observations and reports as may be directed by the Division Commander on 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:

Wind Vane.

143. 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 5 in. by ¾ in., 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 in. above the top of the dugout, etc.). Correct orientation should be

obtained by getting N by the N Star and S by the sun at midday (Greenwich time).

Direction of Wind.

144. Before reading the direction of the wind from the vane the observer should gauge the approximate direction by noting the course taken by smoke, etc. Direction of wind must be stated in points of the compass. The points of the compass to be used are shown in Fig. 5.

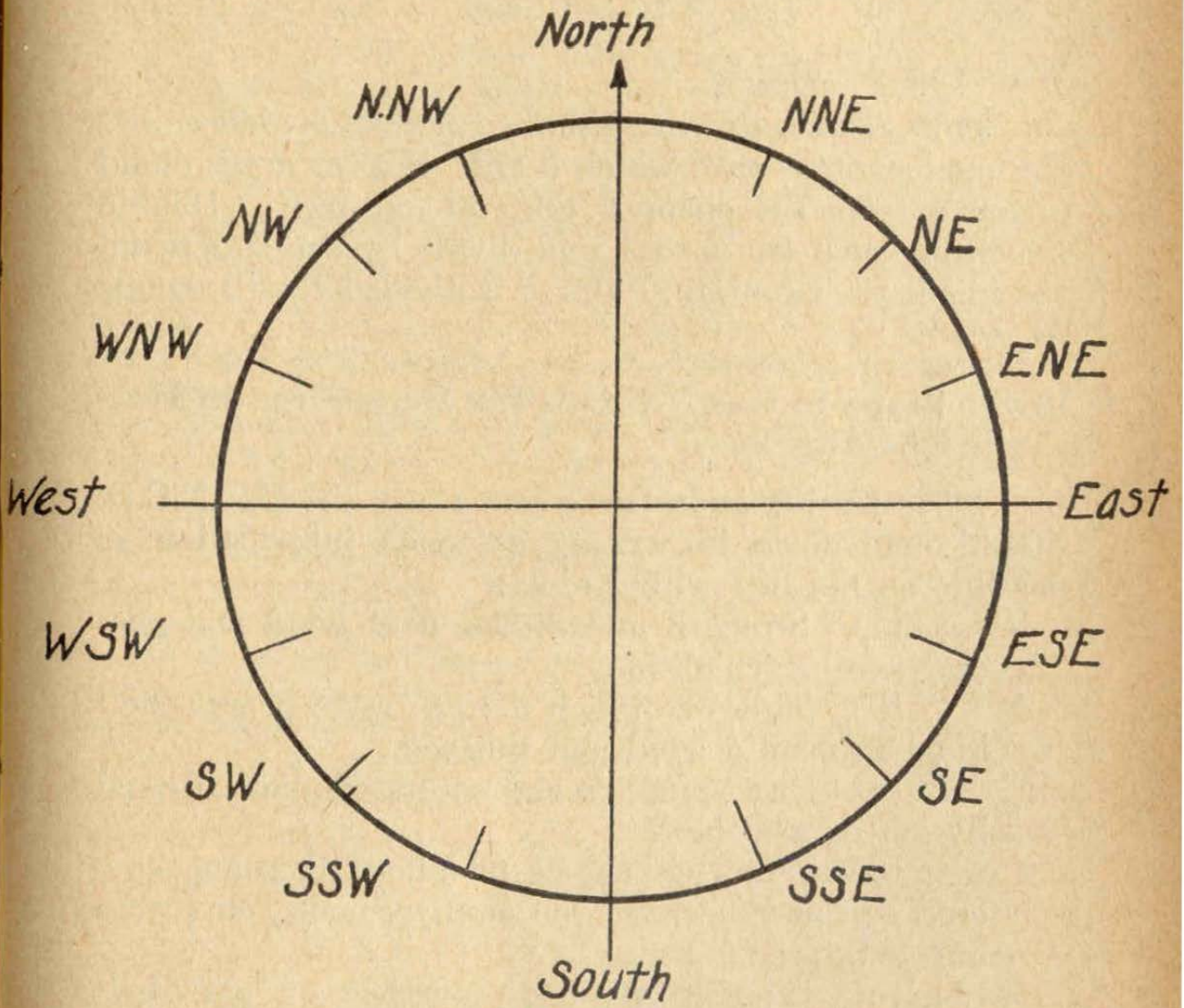


FIG. 5.

Strength of Wind.

145. This may be judged from Beaufort's scale.

Beaufort's No.	Speed in m.p.h.	Observations of Natural Objects	Behavior of Flag on Top of Vane
0	0	Smoke straight up	No movement
1	2	Smoke slants	No movement
2	5	Felt on face	Slight
3	10	Paper, etc., moved	Three-quarters 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

Warning Available.

146. 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.). Example: 100 x 2 divided by 10 equals 20 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 calibre.

(f) The position of dud shell and fragment of shell, etc.

148. *The following form will be used for making reports on gas attacks:*

Form No. 1. 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.....Calibre.....Gas used.....
Wind direction .....Velocity .....M.P.S. @Temperature.....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 (Coordinates).....No.....Calibre.....
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).....
.....

‡Shown on attached map.
@Wind velocity should be given in meters per second.
*Information to be given when possible.

Forwarding of Samples, Specimens and Reports.

149. After an attack gas shell bases and fragments, shell gas samples, unexploded gas shells, and notes on the attack will be handed to the Company Commander for transmission to the Division Gas Officer, 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 or companies. Issues within the division will be made to authorized regimental officers by the Division Gas Officer. In the case of detachments, issues will be made to the senior officer present 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 it 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 officers 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 the Gas Corps, 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 non-commissioned 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 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, gasproof shelters, alarm systems and other measures of protection against gas provided for in the manual on defense against gas, or 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 concerned, and in addition reported informally to the battalion commander. These officers and the gas non-commissioned officers under their direction will assist Division Gas Officers, in obtaining information regarding new methods of gas war-

fare 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 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. upon the advice of the Chief of the Gas Corps. The director will report to G.H.Q. through 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 2, 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. No. 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.

Extract from General Orders No. 144, G.H.Q., A.E.F., 1918.

156. 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 First Lieutenant, Sanitary Corps ..	1		
Sergeant First Class ...	1		
Sergeants	2	1	Sergeant as chauffeur and automobile mechanic.
Privates first class or privates	7	1	Private first class as chauffeur.
Motorcycle, with side car	1		
1200-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.

SMALL BOX RESPIRATORS.

158. This mask is similar to the American Tissot Respirator in general form. It differs in the following respects (see Paragraphs 75 and 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 face-piece. The eye-pieces 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 eye-pieces. 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 shoestring 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 face-piece 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 face-piece in the palm of the hand, the fingers grasping the eyepieces. *TWO.* Bring the face-piece smartly out of the satchel to the height of the chin, holding it tightly with the fingers extended outside, the thumbs inside at the binding 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 face-piece 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 face-piece with the right hand. Insert the mouth-piece 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 face-piece 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 face-piece should be cleaned of gas as in drill "G" below.

162. Drill "C." Same as with American Tissot Respirator.

163. Drill "D." *Drill to teach method of testing for presence of gas.*

Take a deep breath. With the right hand pull the face-piece 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 face-piece. Then clear the face-piece 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 face-piece inside and out. See that mouth-piece is not

split, loose or at wrong angle, and that metal lining is in position 1-16 in. 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 eye-pieces are securely fastened in the face-piece. Commands *FIVE* and *SIX* same as for American Tissot Respirator.

ADDITIONAL DRILLS.

166. Drill "G." *To clear gas from the face-piece.* Th Respirator being adjusted (1) *Clear* (2) *Face-pieces.* Press the face-piece close to the face with the hands, forcing out the enclosed air at the sides. Refill the face-piece with air by blowing out around the mouth-piece, keeping the fingers on the nose-clip to prevent its being displaced.

167. Drill "H." *To Clean Eye-Pieces.*

The Respirator being adjusted (1) *Clean* (2) *Right Eye-Piece.* Grip the right eye-piece between the thumb and first finger of the left hand. Insert the first finger of the right hand into the fold of the face-piece behind the right eye-piece and clean it with a gentle, circular motion.

The left eye-piece is cleaned in a similar way, with the forefinger of the left hand, the eye-piece being held with the right hand.

FRENCH TISSOT RESPIRATOR.

168. This respirator has been issued to certain special personnel, chiefly artillery, for use until 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 face-piece. 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 face-piece. The fabric of the face-piece 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 hands 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 respirator.

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 allowance 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. Atillery 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.

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.

178. These are issued to the Gas Officers of all units by the Chief Gas Officers of Armies, Army Corps, and Divisions, but only after the unit reaches the sector assigned

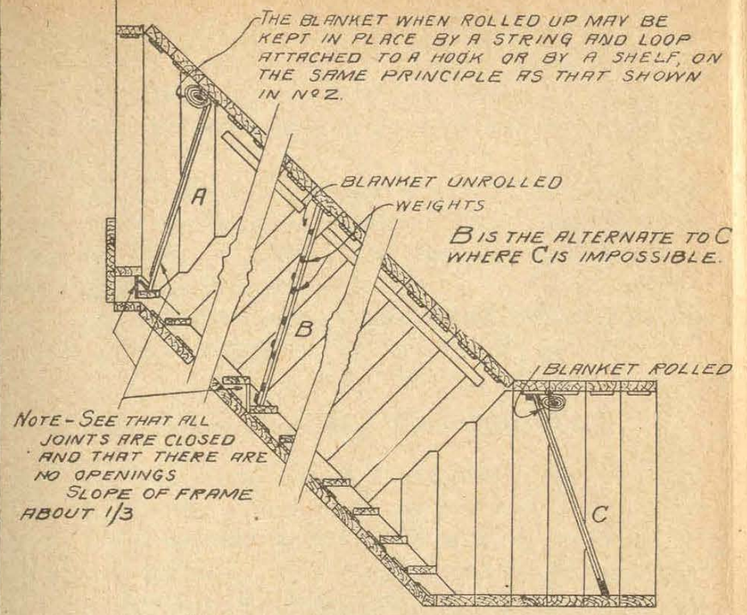
to the group in question. The regimental, battalion, or other unit gas officer makes requisition on the Division, Corps or Army Gas Officer, who fills the requisition from stocks on hand in the Division or Corps Gas Dump. Division Gas Officers replenish their stocks from the army gas parks, where credits 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.

SUMMARY OF MARKINGS FOR CHEMICAL SHELL AND PROPERTIES OF COMMONEST GASES

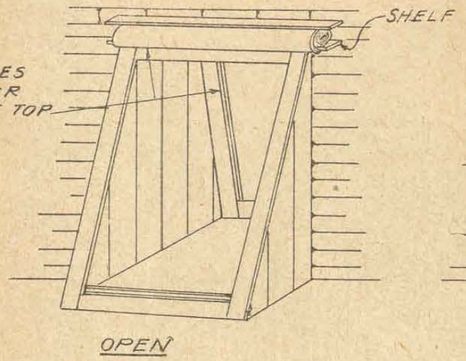
French Number	Shell Filling	American and British Code Symbols	French Designation	German Designation and Shell Marking	Odor	Persistency		Physiological Effect	Remarks
						In Open	In Woods		
						Non-Persistent Class.			
	Chlorine (Used only in cloud gas)	Red Star	Bertholite		Chloride of Lime	10 min.	3 hrs.	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 A.E.F. or B.E.F.	Vincennite			10 min.	3 hrs.	Lachrymator and Respiratory Irritant. Considered quite toxic, but in high concentrations only.	
4B	Cyanogen Chloride 70% Arsenic Trichloride 30%		Vitrite			10 min.	3 hrs.	A Lachrymator, Respiratory Irritant and Lethal Agent	
	Diphenyl Chlorarsine	D. A.	Sternite	Blue Cross	Slight	10 min.	3 hrs.	Sneezing Gas. Nerve Depressant. Respiratory Irritant.	These gases form non-persistant clouds of solid particles.
	Diphenyl Cyanarsine	D. C.	Sternite	Blue Cross	Is interchangeable with D.A.			Effects somewhat greater.	
5	Phosgene	C. G.	Collongite	Three White bands. White D.	Musty Hay, Green Corn	10 min.	3 hrs.	Respiratory Irritant. Very deadly. Action usually slightly delayed.	
						Semi-Persistent Class.			
	Diphosgene	Not used S. F.	Superpalite	Green Cross	Disagreeable, suffocating. Musty Hay.	3 hrs.	12 hrs.	Same as phosgene.	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 lacrymatory 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.
	Phenyl Carbylamine Chloride			Green Cross		3 hrs.	12 hrs.	Eye, Nose and Throat Irritant. Not very poisonous.	
	Phosgene, Diphosgene and Diphenyl Chlorarsine			Green Cross 2	Resembles Diphosgene a little pungent	3 hrs.	12 hrs.	Respiratory Irritant. Slightly delayed action. Very deadly. Causes vomiting and a little lachrymation.	
	Chlorpicrin 75% Phosgene 25%	P. G.			Pungent, Suffocating.	3 hrs.	12 hrs.	Causes vomiting, Respiratory Irritant, a little lachrymation.	
	Diphosgene and Chlorpicrin			Green Cross 1	Pungent, Suffocating.	3 hrs.	12 hrs.	Slightly delayed action, very deadly, respiratory irritant, causes vomiting and a little lachrymation.	Phosgene in these mixtures has same effect as used above, if concentration is sufficiently high.
7	Chlorpicrin	P. S.	Aquinite		Pungent	3 hrs.	12 hrs.	Causes vomiting, respiratory irritant, tear producer.	
	Chlorpicrin 80% Stannic Chloride 20%	N. C.			Pungent	3 hrs.	12 hrs.	Respiratory irritant, causes vomiting, tear producer.	
	Ethyl Dichlorarsine and Dichlormethylether			Yellow Cross 1 or Green Cross 3	Ethereal, Pleasant.	3 hrs.	12 hrs.	Nerve poison similar to diphenylchlorarsine, easily destroyed by water.	
						Persistent Class.			
9	Bromacetone	B. A.	Martonite			2 days	7 days	Lachrymator, Tear Producer.	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 cloud.
	Brom Ketones			Green Cross	Pungent	3 days	7 days	Tear Producers, Slight Respiratory Irritants. Action immediate.	
21	Brombenzylcyanide	C. A.	Camite		No Odor	3 days	7 days	Not toxic but most powerful lachrymator known.	
20	Mustard Gas (Dichlorethyl Sulphide)	H. S.	Yperite	Yellow Cross	Slight Mustard or Garlic	3 days	7 days	Respiratory Irritant. Eye and Skin Irritant. Blistering Agent. Action delayed several hours.	

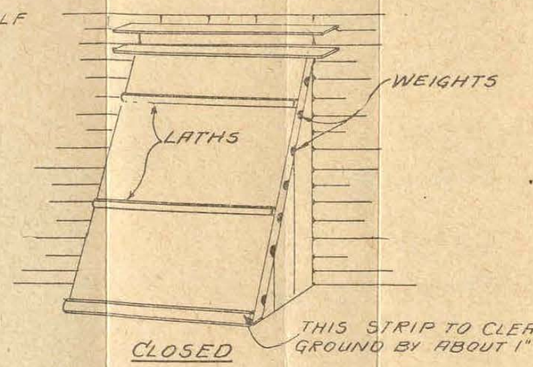
NOTE: The above figures on time of persistency are approximate only and for calm weather. Persistency is dependent to a large extent on temperature, wind velocity, and the amount of gas liberated, especially in woods or other more or less closed places. High temperatures and wind velocities decrease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

GAS BLANKET ARRANGEMENTS

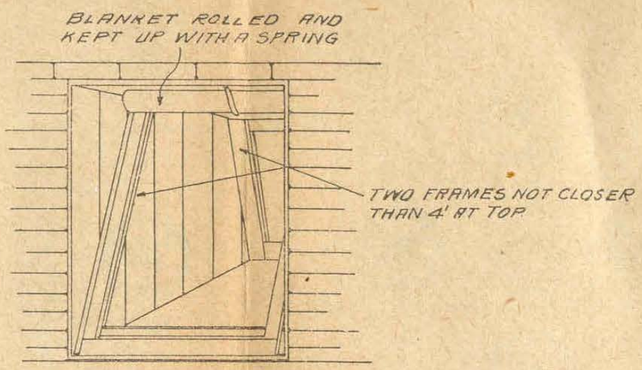


Nº 1
ARRANGEMENT OF GAS BLANKETS



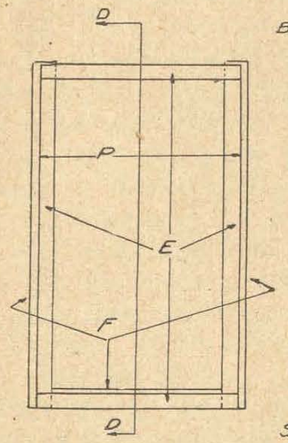


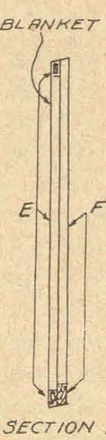
Nº 2
PROJECTING ENTRANCE
USED SOMETIMES IN DRESSING STATIONS TO AVOID NARROWING PASSAGE



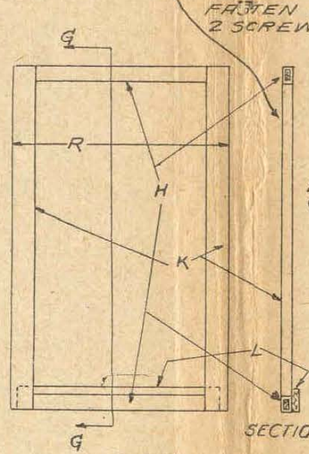
Nº 3
HORIZONTAL GALLERY

NOTE:- ANY WIRES SHOULD ENTER NEAR TOP OF FRAME
BLANKET COVERED DOORS MAY ALSO BE USED TO SUPPLEMENT THE BLANKET CURTAINS.

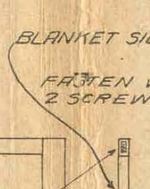


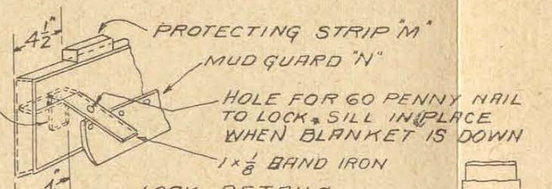


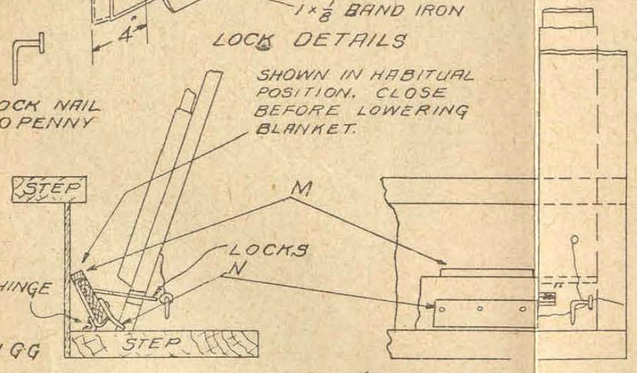
Nº 4
INTERIOR BLANKET FRAME
USED AS IN "C" OF Nº 1 AND IN Nº 3
E = 1×4 BLANKET COVERED.
F = 1×6 PLAIN.
P = 2'-8" TO 3'-8"



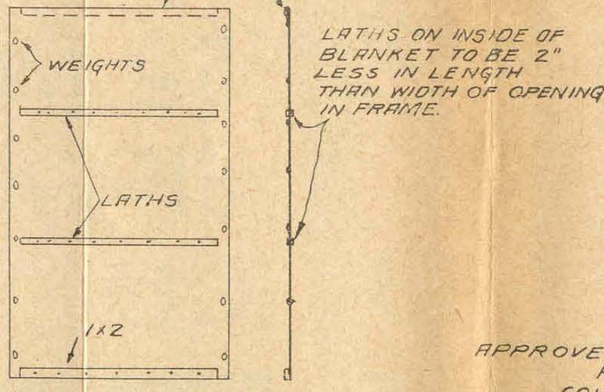
Nº 5
EXTERIOR BLANKET FRAME
USED AS IN Nº 2
H = 1×4 BLANKET COVERED.
K = 1×6 BLANKET COVERED
L = 1×6 PLAIN
R = 4' FOR DRESSING STATIONS







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 Q.S.
BY
(SIGNED) E.D. ARDERY
LIEUT. COL., CORPS OF ENG'RS

R.E.M. 2-23-18.