

OFFICIAL

A. E. F. No. 1475-3
G-5

GAS MANUAL

Part III

Use of Gas by Gas Troops

General Headquarters
American Expeditionary Forces, France
March, 1919

GENERAL HEADQUARTERS
AMERICAN EXPEDITIONARY FORCES

March, 1919.

The "Gas Manual," in six parts, is approved and published for the information and guidance of the American Expeditionary Forces. Although this manual presents the practice in the American Expeditionary Forces, its publication is not intended to convey approval for adoption in the future military service of the United States of any details of organization contained herein.

BY COMMAND OF GENERAL PERSHING:

JAMES W. McANDREW,
Chief of Staff.

OFFICIAL:
ROBERT C. DAVIS,
Adjutant General.

Contents

Part I—Tactical Employment of Gases..A. E. F. No. 1475-1	G-5
Part II—Use of Gas by the Artillery..A. E. F. No. 1475-2	G-5
Part III—Use of Gas by Gas Troops....A. E. F. No. 1475-3	G-5
Part IV—Use of Gas by Infantry.....A. E. F. No. 1475-4	G-5
Part V—Use of Gas by Air Service....A. E. F. No. 1475-5	G-5
Part VI—Defense Against Gas.....A. E. F. No. 1433	G-5

TABLE OF CONTENTS.

Introduction	Par. 1-4
Organization of Gas Regiment.....	5
Regimental Headquarters	6
Duties of Regimental Officers.....	7
Adjutant and Personnel Officer.....	7
Chemical Advisor and Intelligence Officer.....	8
Supply Officer	9
Master Engineers	10
Battalion Headquarters	11
Duties of Battalion Officers.....	12
Adjutant	13
Chemical Adviser and Intelligence Officer.....	14
Supply Officer	15
Master Engineers	16
Company Organization	17
Duties of Company Officers.....	18
Company Commander	18
Second in Command.....	19
Supply Officer.....	20
Platoon Leader	21
4-Inch Stokes Material.....	22
Barrel	22
Stand	22
Base	22
Bombs	23
British	24
American	25
Light Smoke	26
Heavy Smoke	27
Termite	28
Gas	29
Ranging	30

TABLE OF CONTENTS (*Continued.*)

	Par.
Propellants	32-35
Fuses	36
British { Mills	36
{ 146 Allways	37
{ 31-D	38
{ Sutton 79	39
American { Mark V	40
{ Mark XI	41
Stokes Range Tables	42-45
Livens Material	46
Projectors { British	47
{ American	48
Base	49
Drums	50
Gas	50
Incendiary	50
H. E.	50
Gaines	51
Priming System	52
Propellants	53
Electric Fuses	54
Exploders	55
Fuses	56
Mills	56
Livens	56
Livens Range Table	57
Painting and Marking of Drums	58-62
Cloud Gas Apparatus	64
Transportation Table	65
General Procedure in Gas Operations	66-79
Notes on Operation	80-80-A
Grad Circle	81
Material for Stokes Operations	82-83
Material for Livens Operations	84
Table of Allowances— <i>Technical Equipment</i>	85-86
Projects	88
Stokes Mortars	85
Cylinders	85
General Supplies	85
Table of Allowances— <i>Unit Equipment</i>	87
Organization Allowances	87
Drafting Equipment	87
Signal Equipment	87
Meteorological Equipment	87
Photographic Equipment	87
Carpenter Equipment	87
Reconnaissance Equipment	87
Office Equipment	87
Workshop Equipment	87

TABLE OF CONTENTS (Continued.)

	Par.
Projects	88
Wind Limits	88-A
Safety Limits	88-B
Reconnaissance Reports	89
Operation Orders	90
Operation Reports	91
Tactics of Gas Troops.....	92-95
Choice of Weapons.....	96
Selection of Weapons.....	97
Training of Gas Troops.....	98-99
Principles Covering Training.....	100
School Phase	101
General Training	102
Equipment and Supplies.....	103
Detailed Instruction	104
Infantry Training	105
Target Practice Instruction.....	105
Technical Training	106
4" Trench Mortar.....	107
Projector	108
Cylinders	109
Special Instruction for Officers.....	110
Special Lecture	111
Organization of Army.....	112
Liaison	113
Service of Security and Information.....	114
Secrecy	114
Camouflage	114
Meteorology	114
Service of Supply.....	114
Map Reading and Making.....	114
Organization of an Attack.....	114
Writing of Orders.....	114
Meteorological Section.....	115
Runner Service	115
Exhibit A—Fighting Order.....	116
Exhibit B—Report of Reconnaissance.....	117
Exhibit C—Operation Order.....	118
Exhibit D—Operation Report.....	119
Functions of Corps and Division Gas Officers.....	120
Administration	121
Relations within Corps.....	121
Operations	121
Supplies	121
Subordinate Units	121
Corps Troops	121
Casualties	121
Enemy Material	121
Training of Divisions.....	121-122

TABLE OF CONTENTS (Continued.)

	Par.
Duties of Gas N. C. O.'s.....	123
Questionnaire for Inspection.....	126
Questionnaire for Gas Patients.....	128
Offense Duties of a Staff Gas Officer.....	129
Use of Gas on Stable Front.....	130
Use of Gas on Advance Front.....	130
Use of Gas on Withdrawal.....	130

GAS MANUAL

PART III

USE OF GAS BY GAS TROOPS

INTRODUCTION.

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

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

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

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

ORGANIZATION OF GAS REGIMENT.

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

Gas regiments as now authorized consist of six battalions of three companies each, with a total of 210 officers and 4,873 enlisted men, as shown in the organization table opposite.

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

REGIMENTAL HEADQUARTERS.

6. The organization of the Regimental Headquarters follows that of the Special Engineer Regiments, organized for the emergency, except that a lieutenant colonel is provided for each two battalions and an additional first lieutenant is authorized as assistant adjutant. Fig. 1 (see Appendix) shows the normal organization of a regiment.

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

DUTIES OF REGIMENTAL OFFICERS.

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

8. *Chemical Adviser and Intelligence Officer* should have:

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

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

The duties of this officer are, to obtain, properly file, and transmit information, particularly with a view of keeping the Gas Troops informed of the results obtained in Gas Warfare, and of keeping the technical and supply divisions informed of

the needs of the Gas Troops. Since all intelligence matters concerning operations pass through the hands of the Chemical Advisor and Intelligence Officer, certain other duties concerning the conduct of operations and reports thereon, have been added to the foregoing.

The Chemical Advisor and Intelligence Officer should, therefore:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(b) To control all motor and animal transportation.

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

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

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

(c) All miscellaneous duties.

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

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

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

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

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

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

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

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

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

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

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

BATTALION HEADQUARTERS.

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

DUTIES OF BATTALION OFFICERS.

12. The duties of the Battalion Staff Officers, while following generally those of similar positions in the normal battalion, also parallel to a great extent the duties of the corresponding regimental positions outlined above. The duties of Battalion Staff Officers are, furthermore, made difficult by the necessity

of controlling and supplying units operating over an extended front and in small detachments.

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

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

15. *Supply Officer.*

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

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

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

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

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

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

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

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

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

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

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

COMPANY ORGANIZATION.

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

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

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

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

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

Fig. 2 (see Appendix) shows the normal organization of the company.

DUTIES OF COMPANY OFFICERS.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

20. Duties of Company Supply Officer.

(1) Supplies.

(a) Source:

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

(b) Kinds of Supplies:

- (1) Quartermaster.
- (2) Ordnance.
- (3) Signal.
- (4) Engineer.
- (5) Technical Supplies.
- (6) Rations.

(c) Quartermaster Supplies:

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

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

(d) Ordnance Equipment:

Same as Quartermaster.

(e) Signal Equipment:

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

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

(f) Engineer Equipment:

Same as Signal Equipment.

(g) Technical Equipment and Supplies:

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

(h) Rations:

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

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

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

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

(2) Transportation.

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

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

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

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

(3) Records.

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

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

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

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

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

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

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

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

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

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

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

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

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

FOUR-INCH STOKES MATERIAL.

The Mortar.

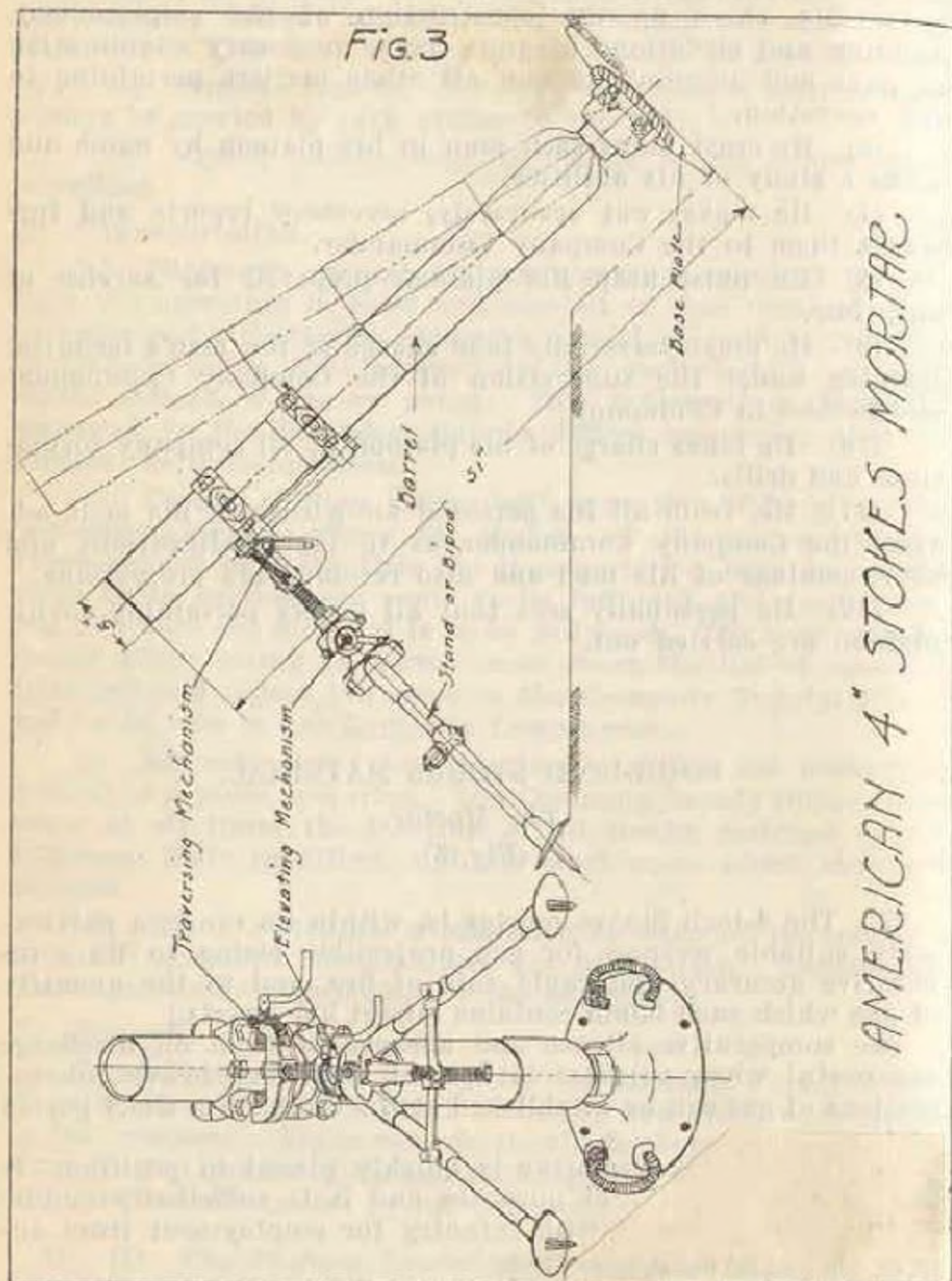
(Fig. 3)

22. The 4-inch Stokes mortar is, within its range, a particularly suitable weapon for gas projectiles owing to its comparative accuracy and rapid rate of fire, and to the quantity of gas which each bomb contains (about $2\frac{1}{2}$ quarts.)

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

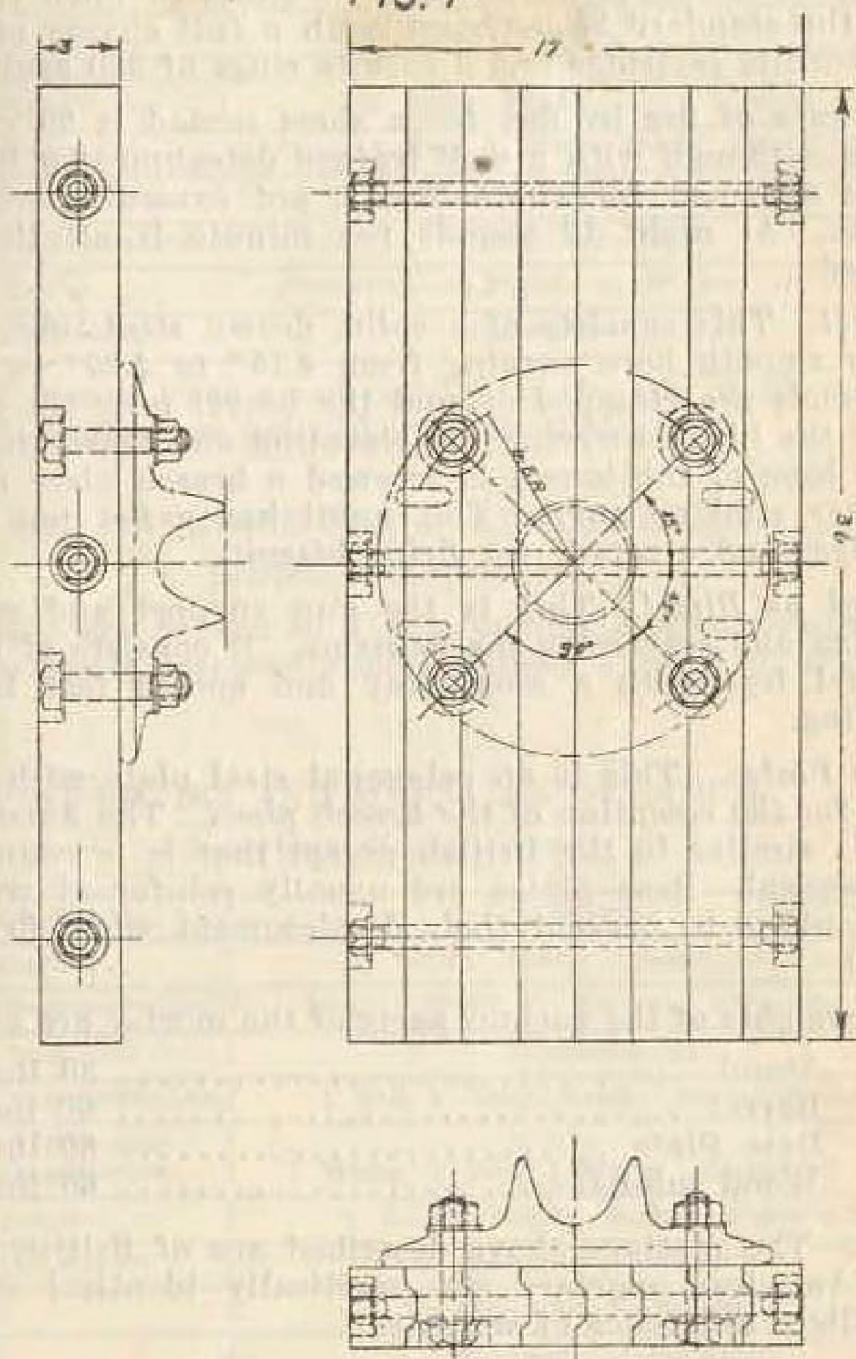
The 4-inch Stokes mortar is quickly placed in position. It can be used for several purposes and it is sufficiently mobile to be carried forward with infantry for employment from advanced positions.

It consists of a steel barrel connected by a double collar to a tubular steel stand which is fitted with elevating and traversing gears. The breech piece of the mortar rests on a base plate with socket. The mounting admits of the mortar being traversed $2\frac{1}{2}^{\circ}$, traversing to the right or left of the central line without moving the legs of the stand or the base plate.



AMERICAN 4" STOKES MORTAR

FIG. 4



AMERICAN 4^{inch} STOKES MORTAR - MARK I - SUB BASE
DEB OFFENSE DIVISION ENG SEC C.W.S. 5580

The maximum range is 840 yards when firing the standard 25-lb. bomb with full charge of 1,200 grains E. C. 3 powder, and 465 yards with the 13-lb. light smoke bomb and the 350-grain ballistite cartridge.

The cordite ring propellant gives a range of 1,090 yards when firing the standard 25-lb. bomb with a full charge of one 150-grain cordite cartridge and 4 cordite rings of 350 grains each.

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

Barrel. This consists of a solid, drawn steel tube, 48" long, with a smooth bore varying from 4.15" to 4.20" in diameter. Two bands are clamped around the barrel near the muzzle to engage the bipod carrying the elevating and traversing devices. In the base of the barrel is screwed a breech piece containing a striker stud or anvil. This anvil has a flat top for firing cartridges and a nipple for firing biscuits.

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

Base Plates. This is an octagonal steel plate with a flanged socket for the reception of the breech piece. The American base plate is similar to the British except that it is round instead of octagonal. Base plates are usually reinforced with heavy oak planking to prevent their displacement when firing. (See Fig. 4.)

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

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

NOTE—The mortars above described are of British manufacture. American mortars are practically identical except for some slight difference of weights.

AMMUNITION.

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

24. **PROPERTIES AND MARKINGS OF BOMBS**
British Manufacture.

Filling	Properties	Marking
C.G.	Lethal	1 Red, 1 White, 1 Red Band. Bands $\frac{1}{2}$ " Wide
A.K.	Lethal	3 White Bands. Bands $\frac{1}{6}$ " Wide
P.G.	Lethal and Penetrative	2 White Bands. Bands $\frac{1}{6}$ " Wide
N.C.	Penetrative	1 White, 1 Red, 1 White Band. Bands $\frac{1}{6}$ " Wide
P.S.	Penetrative	1 White Band. Band $\frac{1}{6}$ " Wide
K.S.K.	Lachrymatory	Stencilled—HVY.
W.P.	Smoke	Stencilled—W.PHOS or W and R PHOS.
Thermit	Incendiary	Stencilled—INCDY.

All filled bombs have a red band near the top of the body
All bomb bodies are painted—"Dirty White."

BOX MARKINGS FOR 4" STOKES BOMBS.

British Manufacture.

Two bombs are packed in a box, complete with charges and fuses. The boxes measure approximately 2 ft. 2 in. x $7\frac{1}{2}$ in. x $11\frac{1}{2}$ in.

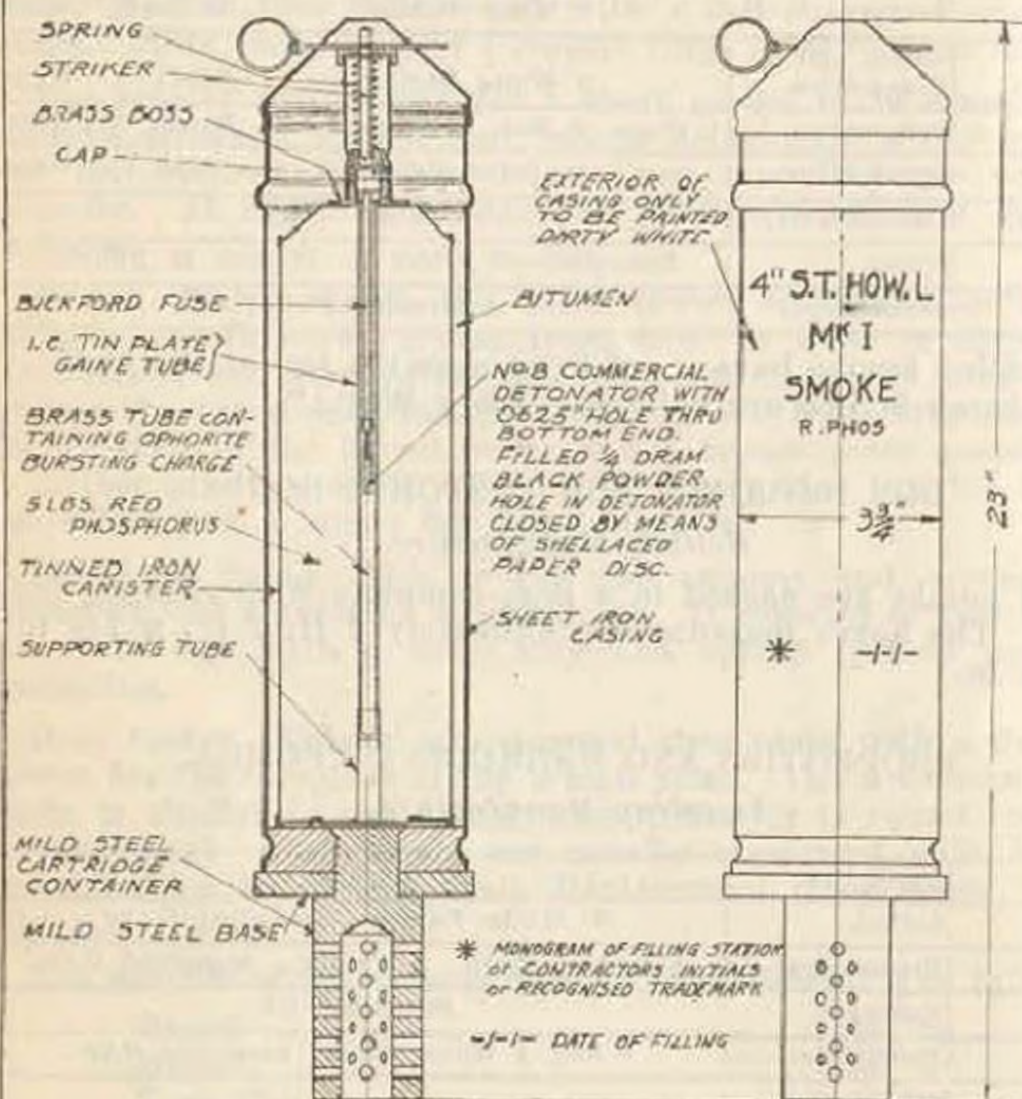
25. **PROPERTIES AND MARKINGS OF BOMBS.**
American Manufacture.

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

BRITISH BOMBS.

26. *Light Smoke Bomb* (Fig. 5). This is a 16-pound bomb consisting essentially of a steel cartridge container, sheet metal body, and a canister containing red phosphorus. The canister is kept in position and the whole bomb cemented together by a layer of pitch. The gain consists of a .410 cap, a length of Bickford fuse, and a primer which explodes an ophorite charge

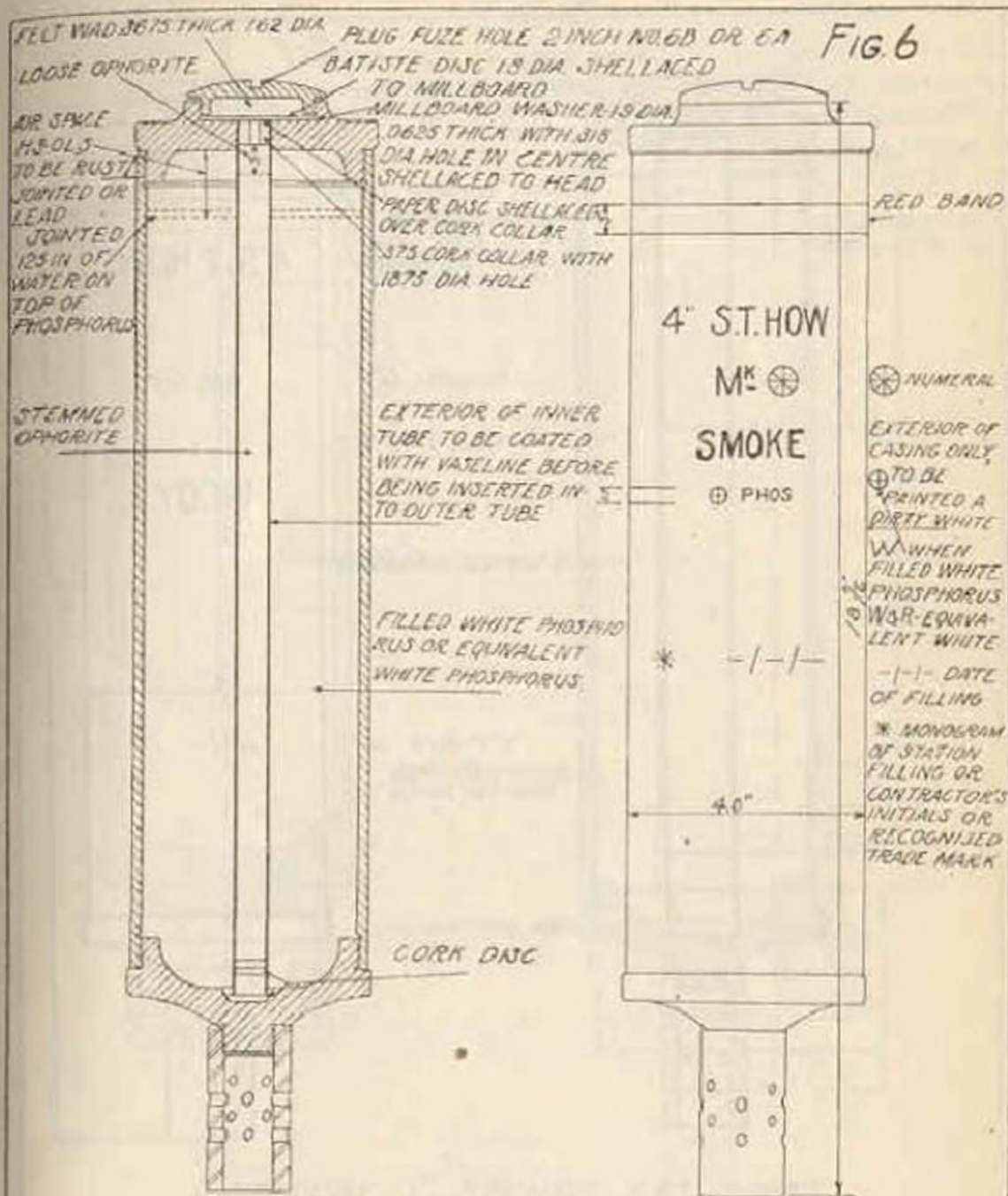
FIG 5



BRITISH 4" STOKES LIGHT SMOKE BOMB

D.E.B.

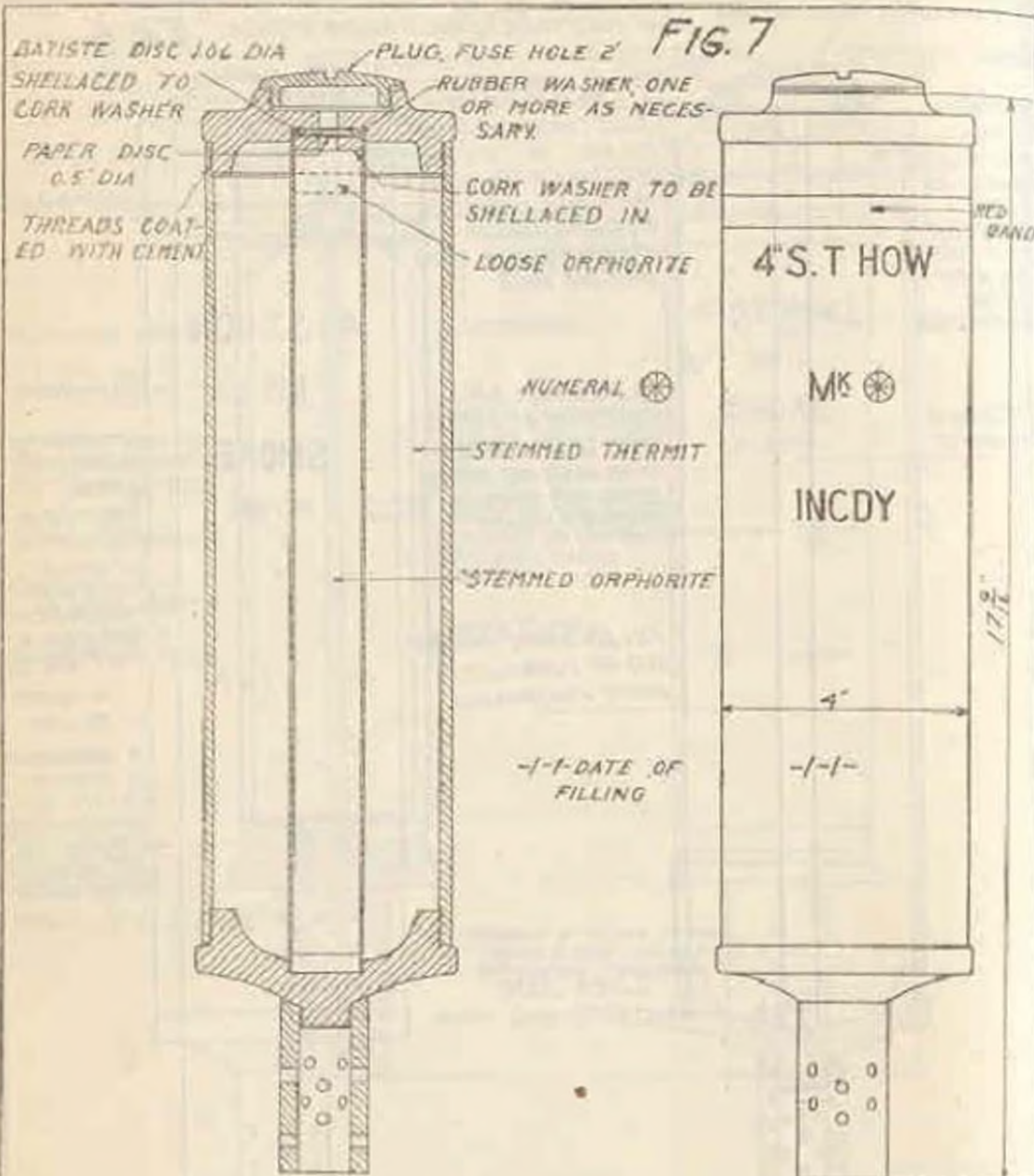
OFFENSE DIVISION, ENG. SEC. C.W.S. 5542

BRITISH 4" STOKES MORTAR SMOKE BOMB-MK^s I, C, IMC & II

STEEL OR W.I.

D.E.B.

OFFENSE DIVISION, ENG. SEC. C. W.S. 5553

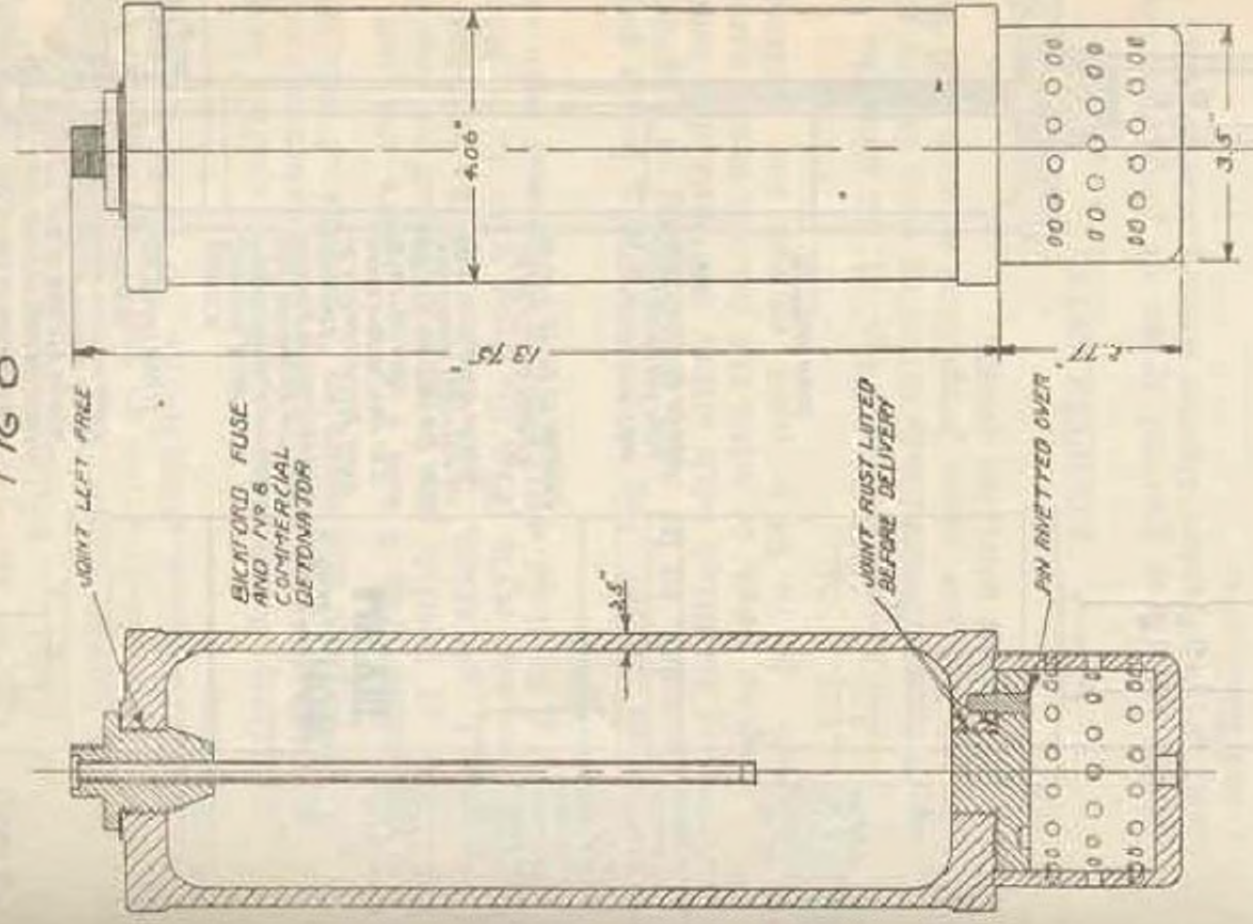


BRITISH 4" STOKES MORTAR-INCENDIARY BOMB MK¹ IC, I.M.C. & II
STEEL OR W.I.

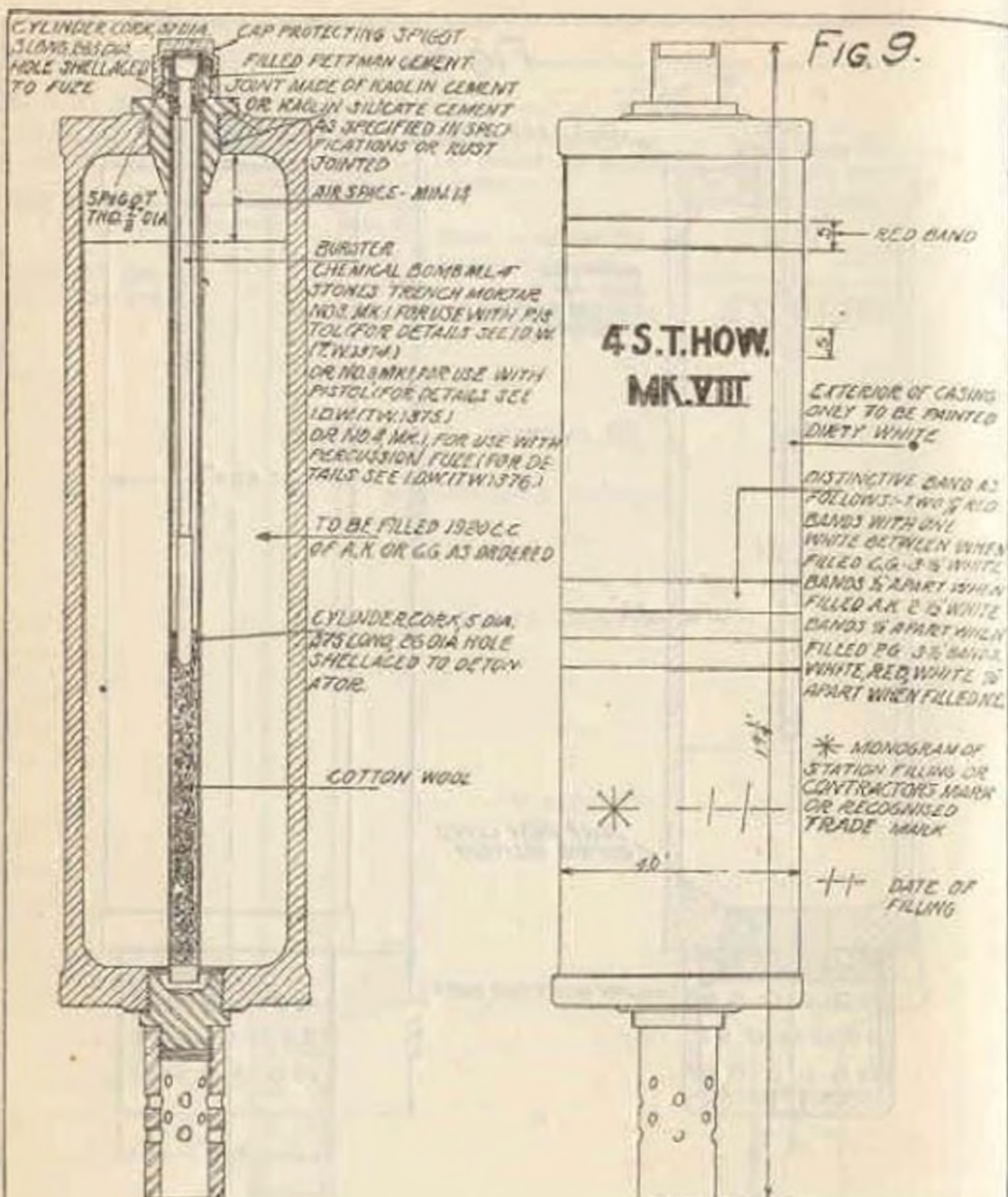
DEB

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

FIG 8



BRITISH 4" STOKES GAS BOMB
(OLD STYLE)



BRITISH 4 STOKES MORTAR GAS BOMB MK VIII
(NEW STYLE)

DEB

OFFENSE DIVISION, ENG SEC. CWS 5557

in the bottom part of the gaine. The cap is fired by a spring striker head, so adjusted that the inertia of the striker is sufficient to compress the spring and fire the cap on discharge. This bomb is fired with a ballistite cartridge which gives a maximum range of 460 yards. For this reason the bomb is seldom used except for training purposes.

27. *Heavy Smoke Bomb* (Fig. 6). This is a 25-pound steel bomb, of general construction as shown on Fig. 6, and contains 7 1/4 pounds of white phosphorus. It is fired by the British 31-D of 79 fuse.

28. *Incendiary Bomb* (Fig. 7). This is similar to the heavy smoke bomb in general construction and takes the same fuses. It weighs 22 pounds and contains 7 pounds of thermit.

29. *Gas Bomb* (Fig. 8 and Fig. 9). There are over fifty different marks of British gas bombs, different in details of construction and operation. But they may be divided into two general types—old style (Fig. 8), fired with E. C. biscuits; and new style (Fig. 9) fired with cordite rings and with either pink or blue cartridges.

30. *Ranging Bombs* (Fig. 10). This is a bomb partly filled with black powder, to be used for ranging or registering purposes. It may be fitted with either the cartridge container for firing by cordite rings, or with the biscuit container for firing with biscuits. It is little used except for instruction and practice.

31. *American Stokes Bombs* (Figs. 11, 12 and 13). American bombs have been standardized, differing only in the gaine tube. They will all use the same propelling charge and fuse. This will give all bombs uniform range.

PROPELLANTS.

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

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

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

34. *British Cordite Charges* (Fig. 14). This ammunition is used with all thermit and heavy smoke bombs. It consists of a 12-gauge cartridge containing 150 grains of cordite, or ballistite and from one to four rings of 350 grains each. In firing the cordite cartridge is placed in a cartridge container screwed on the base of the bomb, and 1 to 4 rings placed around the cartridge container, depending upon the range desired. The cartridges bear their own strikers, which are protected by a ring. Blunt strikes or anvils turned down to a smaller diameter than the protective ring, are used for firing. The objection to this charge is that it makes a very strong flash and soon dirties the mortar.

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

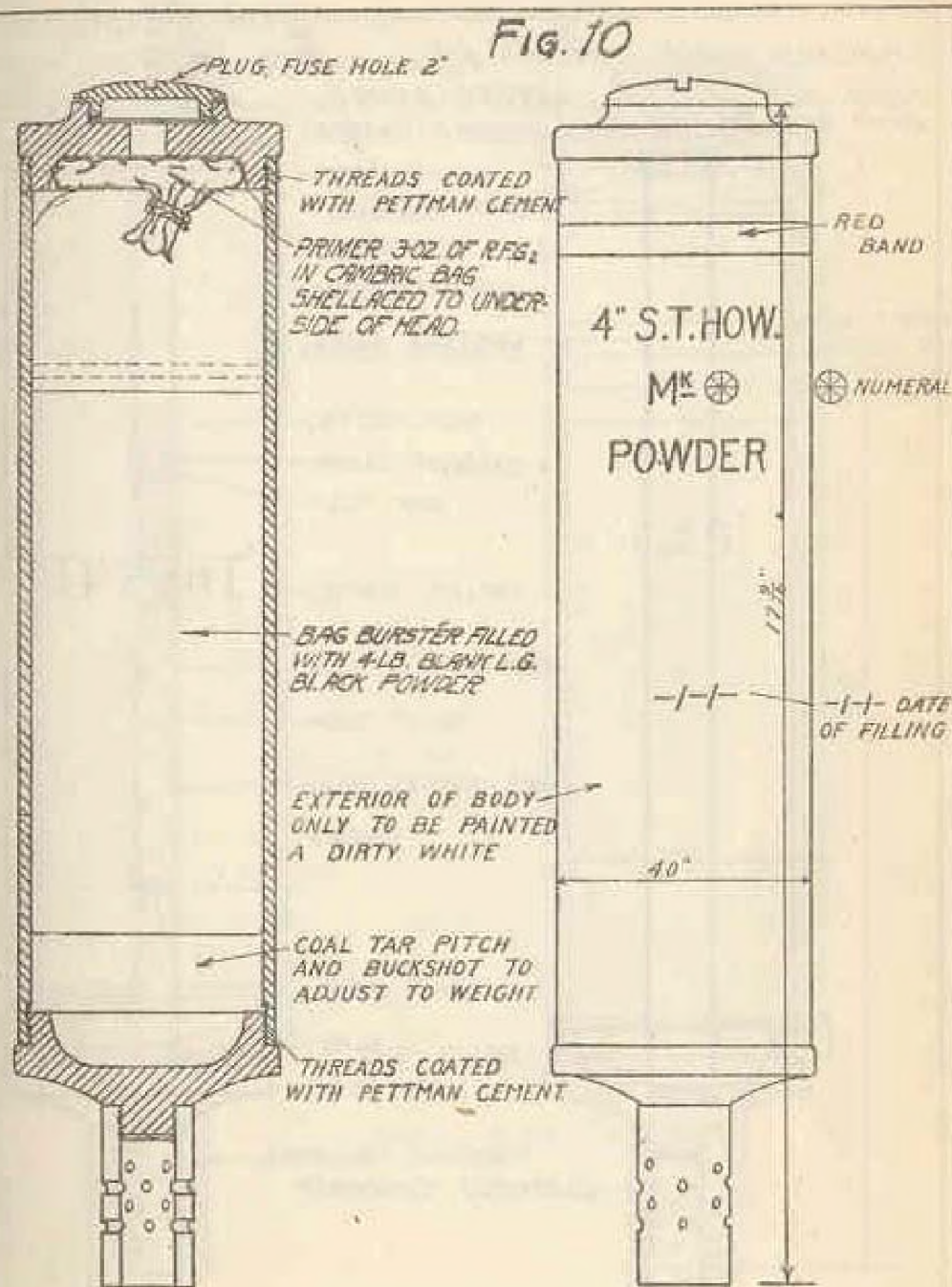
35. *British Balistite Charge* (Fig. 15). The balistite charge consists of a cartridge containing 350 grs. of balistite primed with gun cotton. It is used only with a light smoke bomb. It is fired by means of a striker clip and a flat anvil similar to that used for the cordite cartridge.

FUSES.

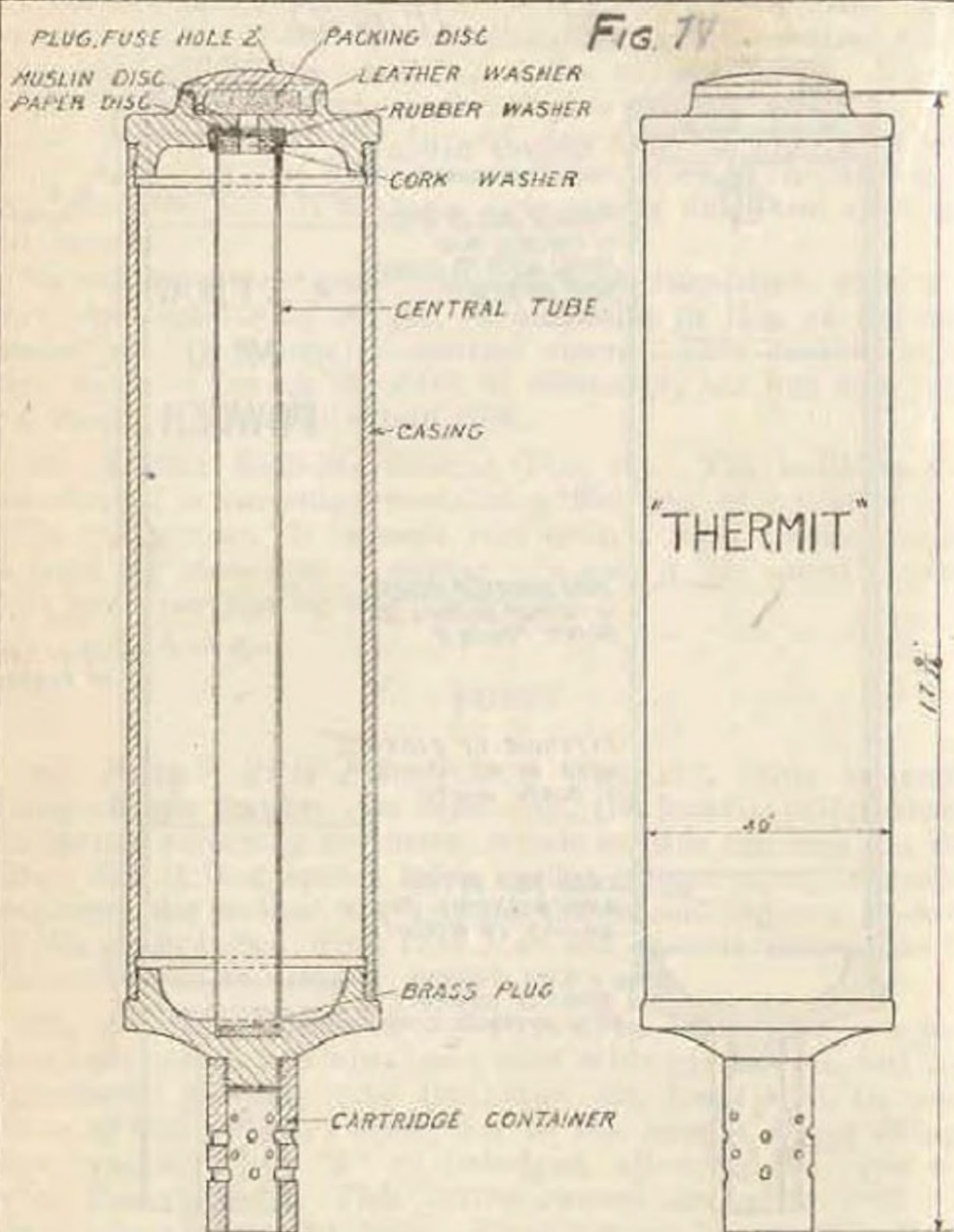
36. *British Mills Pistol Head* (Fig. 31). This is used for firing all gas bombs. On discharge, the inertia pellet depresses its spring, releasing the lever, which in turn releases the striker pin. The striker spring being under compression expands and impinges the striker pin against the detonating cap in the end of the gaine tube. This fuse does not operate unless the bomb has sufficient velocity to travel 100 yards.

37. *British Always or 146 Fuse* (Fig. 16). This is a percussion fuse which has also been used with gas bombs, but is now practically obsolete. An instantaneous fuse must be used in place of the ordinary time fuse in the bomb. Upon firing, the tape retaining pin "E" is dislodged, allowing the tape to unwind during flight. This action causes the safety bolt "H" to drop out, arming the fuse. Upon impact the steel ball forces down the striker holder, forcing the detonator and igniting the instantaneous fuse. Immediately before firing, the safety pin arm must be withdrawn. On no account should the tape be disturbed. If on withdrawing the safety pin, the tape retaining pin is released, it must be replaced before firing.

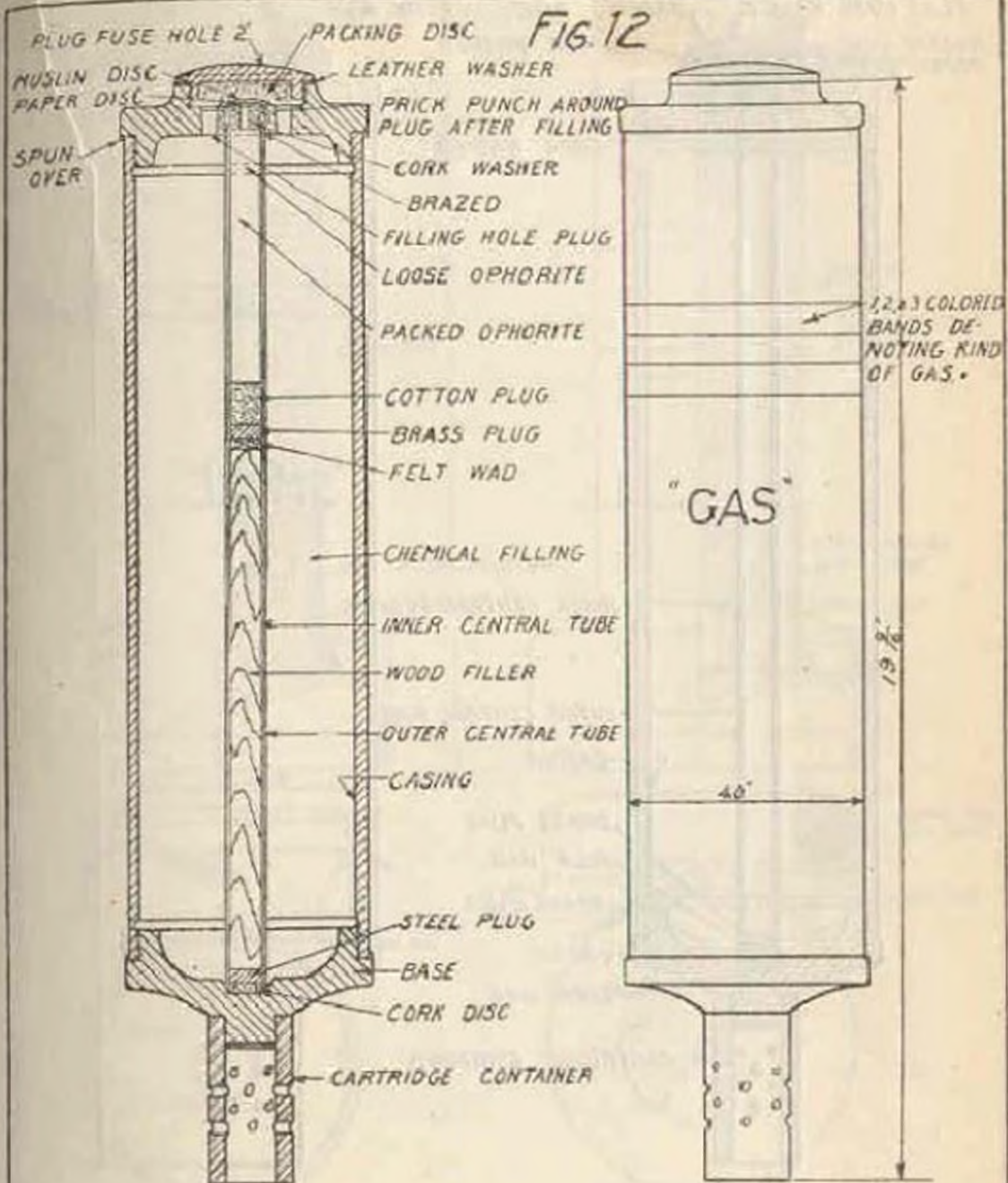
38. *31-D Fuse* (Fig. 17). This fuse was formerly used on all thermit heavy smoke and ranging bombs. It was only an improvised fuse, made by modifying the obsolete No. 31 British artillery fuse, and it is now being supplanted by the No. 79 (Sutton) Mark II fuse. The 30-D fuse consists of two powder



BRITISH 4" STOKES RANGING BOMB
STEEL OR W.I.



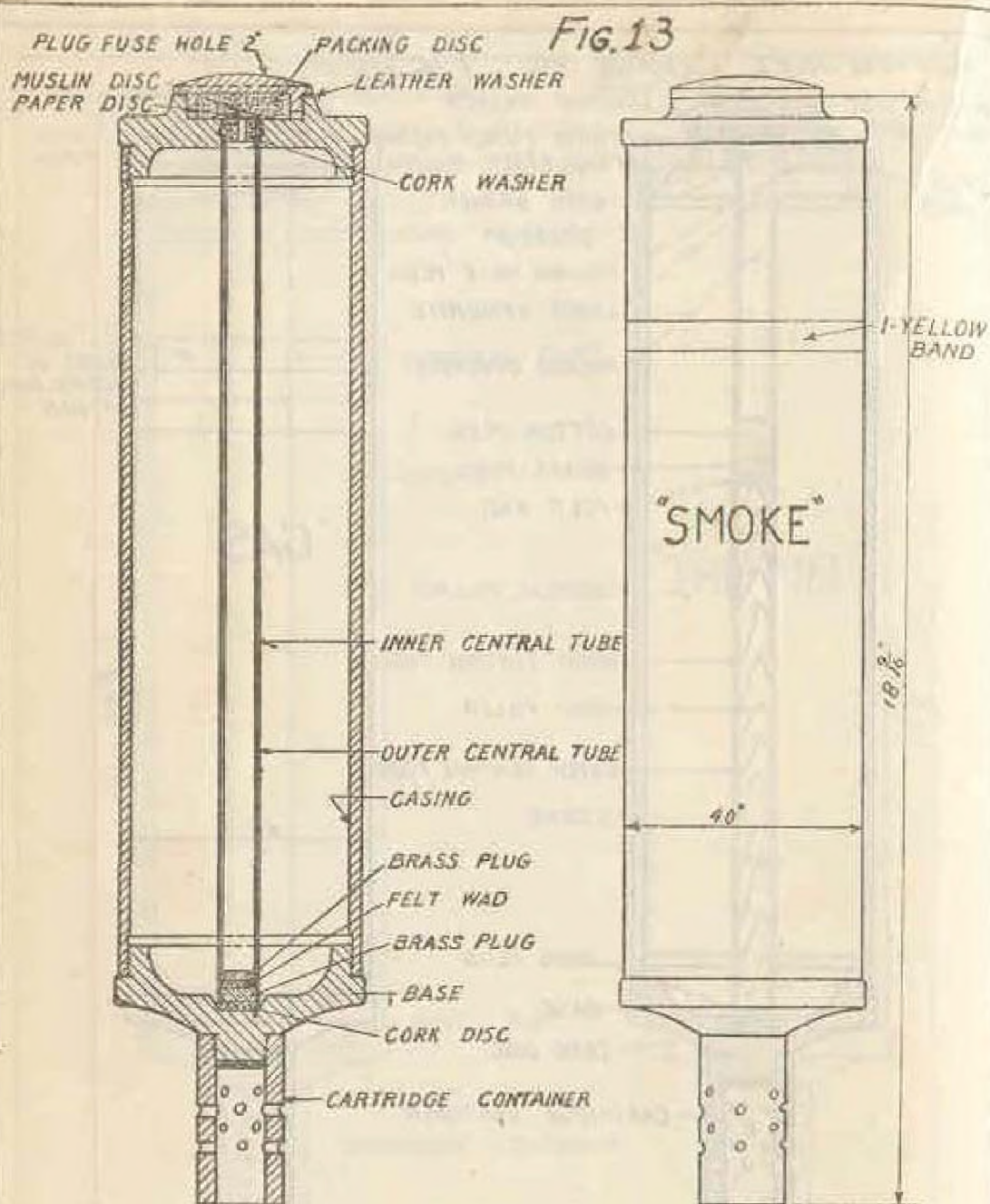
AMERICAN 4 STOKES MORTAR INCENDIARY BOMB
STEEL OR W.I.



AMERICAN 4 STOKES MORTAR GAS BOMB
STEEL OR W.I.

D.E.B.

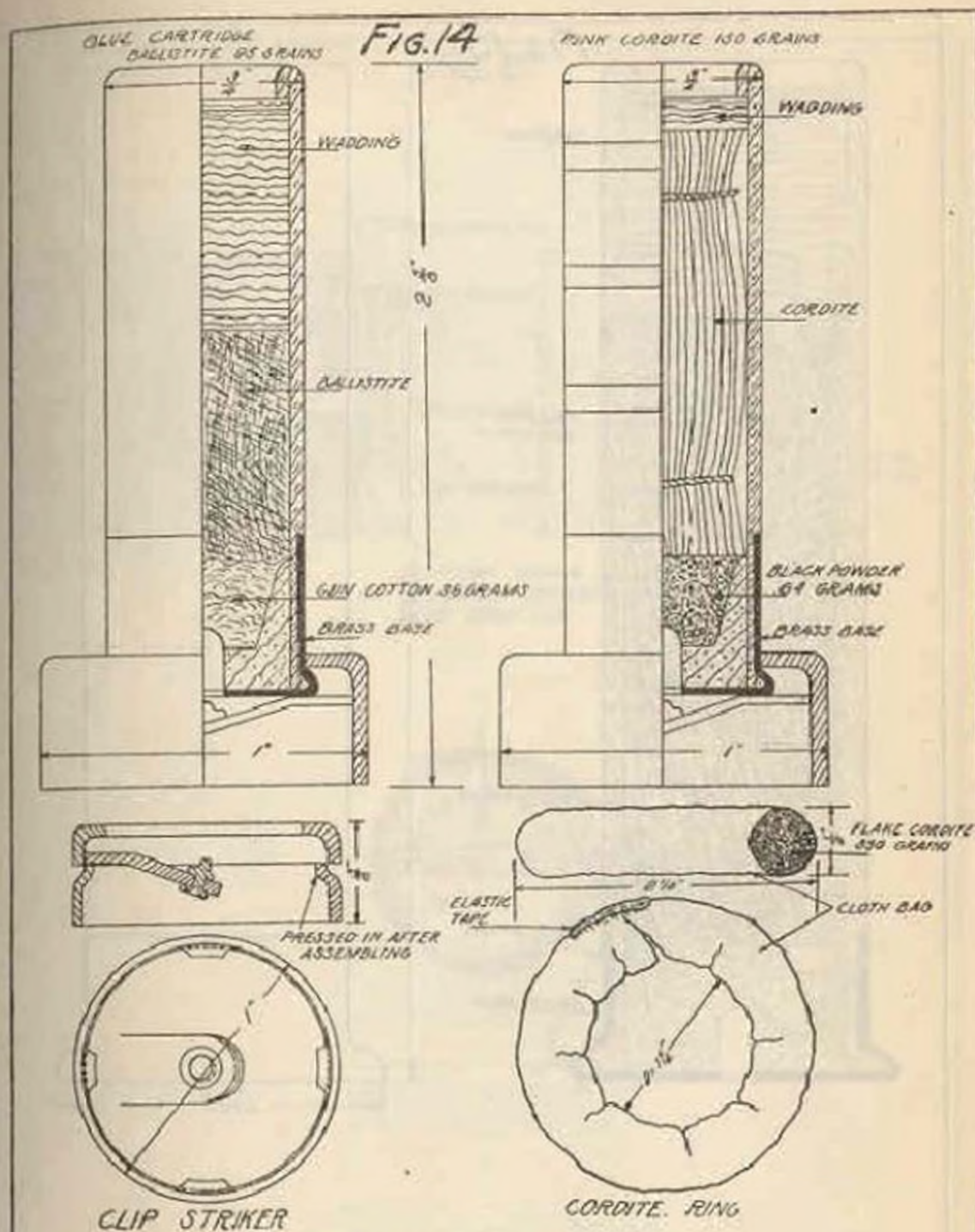
OFFENSE DIVISION, ENG. SEC. C.W.S. 5,570



AMERICAN 4 STOKES MORTAR SMOKE BOMB
STEEL OR W.I.

D.E.B.

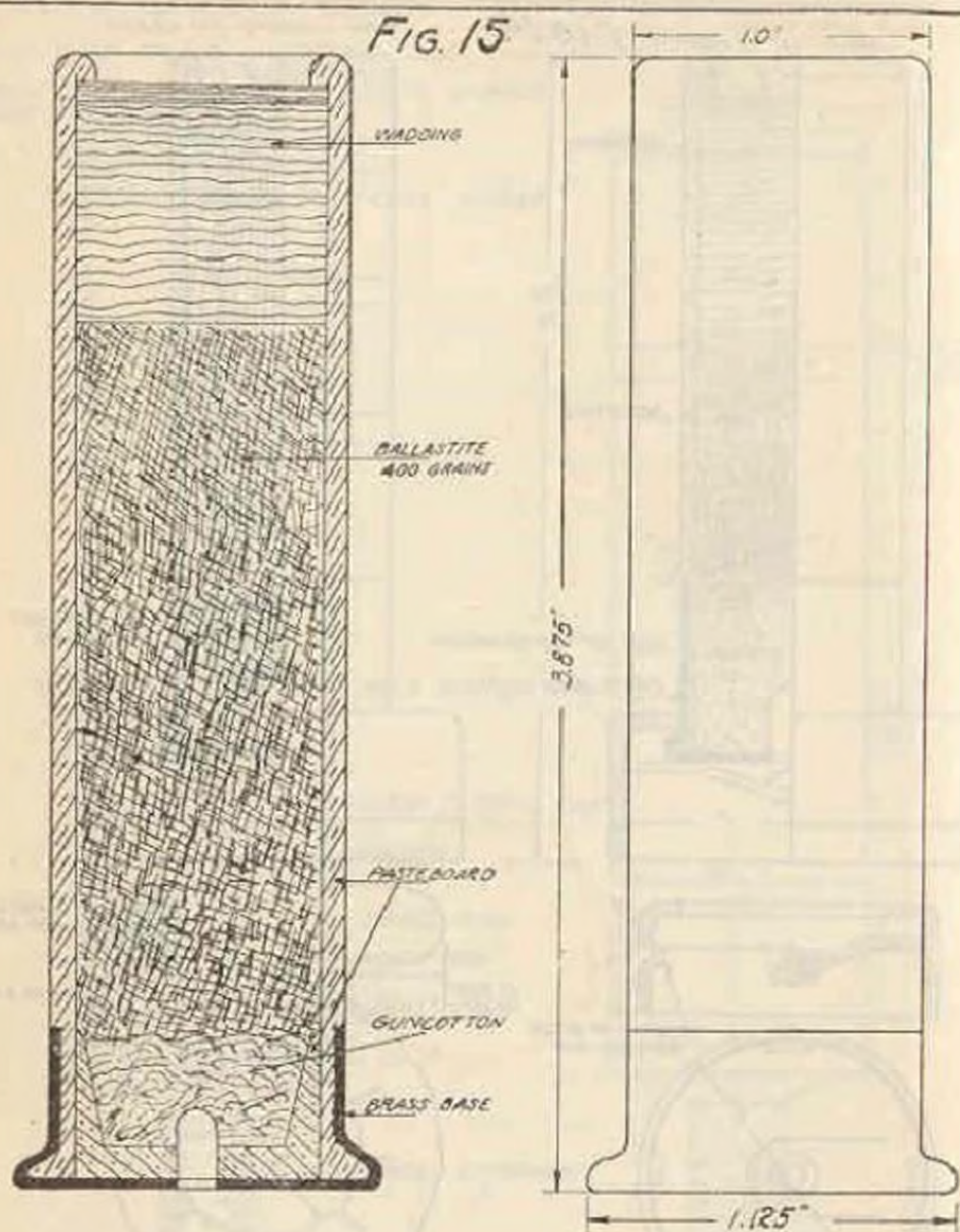
OFFENSE DIVISION, ENG. SEC. G.W.S. 5572



STOKES MORTAR PROPELLANTS

D.E.B.

OFFENSE DIVISION, ENG. SEC. C.W.S. 5546



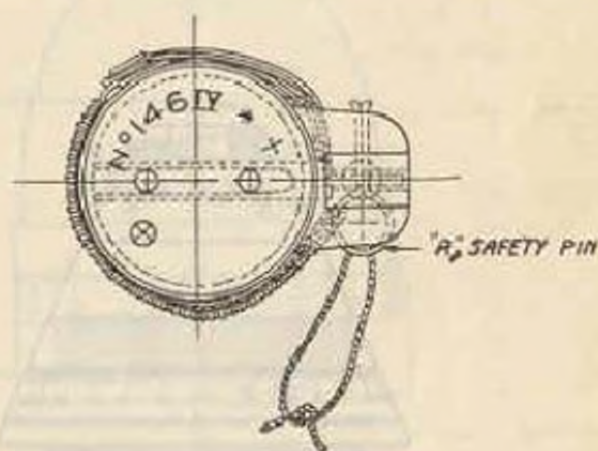
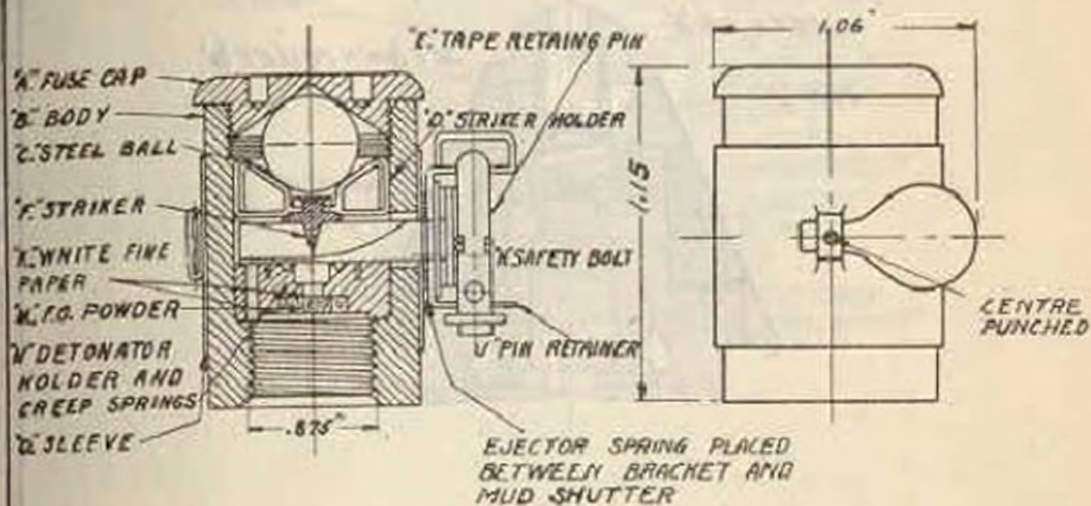
STOKES MORTAR PROPELLANT

(USED ONLY IN LIGHT SMOKE BOMB)

DEB.

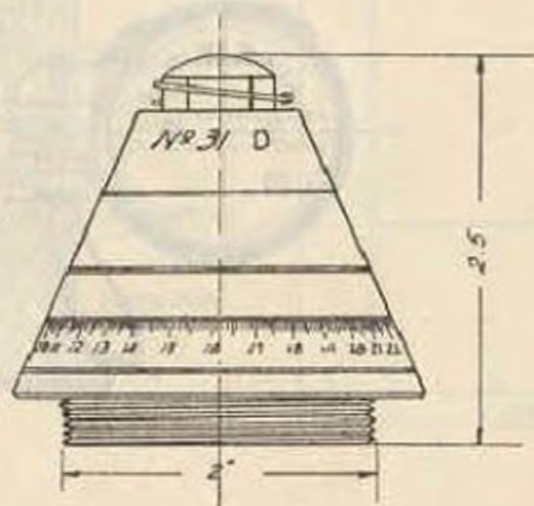
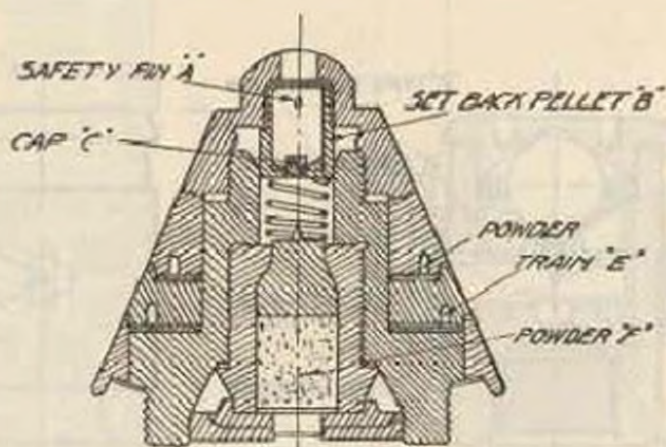
OFFENSE DIVISION ERG. SEC. C.W.S. 554B

FIG. 16



BRITISH 146 (ALLWAYS) FUSE

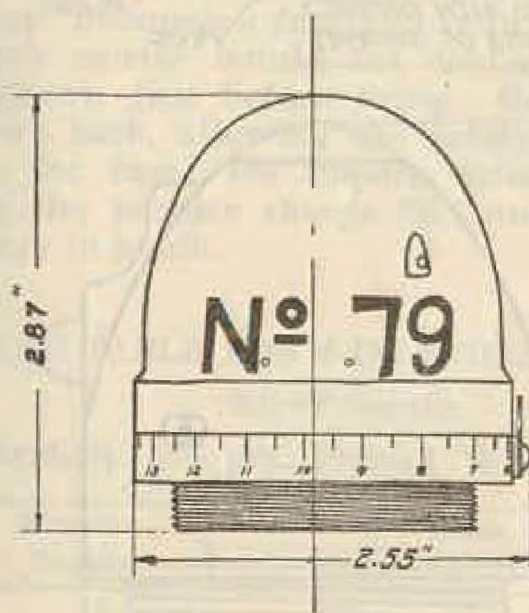
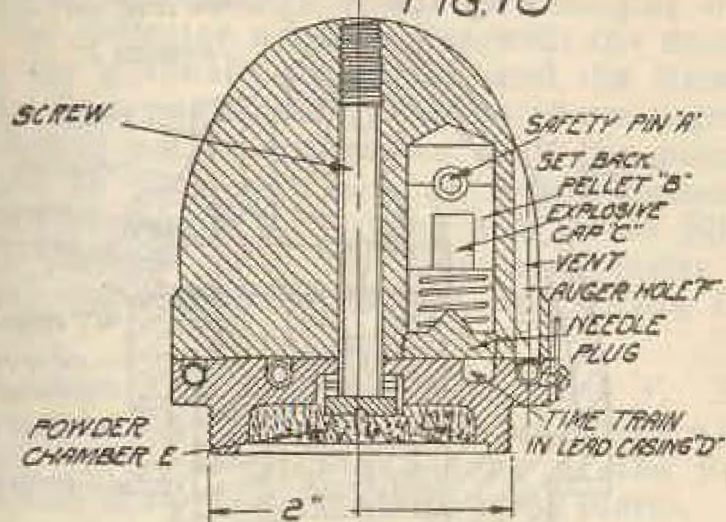
FIG. 17



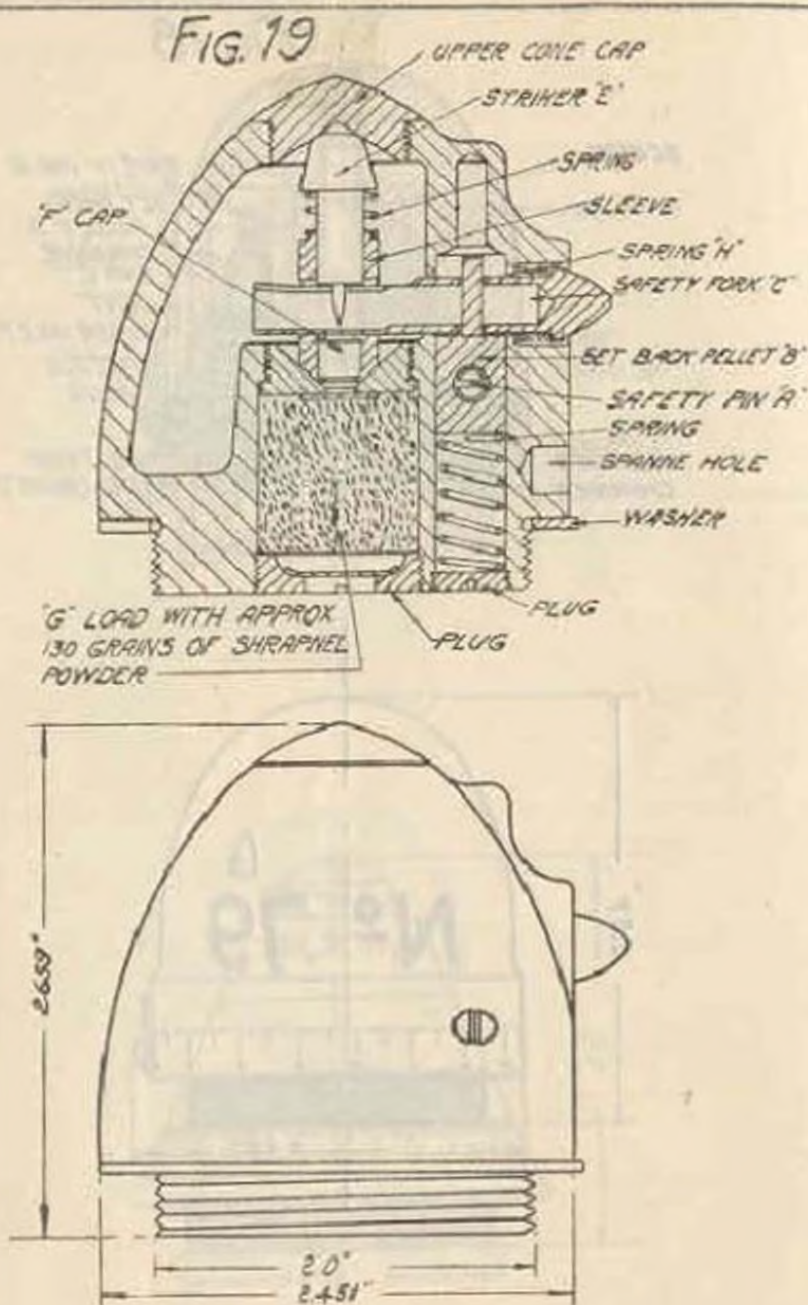
FUSE 31-D FOR
STOKES MORTAR BOMB

OFFENSE DIVISION, ENG. SEC. (W.S. 5566)

FIG. 18



BRITISH TYPE
TIME FUSE Nº 79 MARK II/L



AMERICAN
TRENCH MORTAR FUSE MARK XI

trains, set by means of a time scale. On discharge, the set-back pellet "B" fires the cap "C" which ignites the powder train. This in turn ignites the powder charge "E" which explodes the bursting charge in the bomb.

39. *British Sutton or 79 Fuse* (Fig. 18). This fuse is now used on all thermit, heavy smoke and ranging bombs. To set the fuse, the indicator mark in line with the auger hole "F" is turned to the graduation required, and the time train in the base of the fuse punctured by means of an auger. The safety pin "A" should not be withdrawn until the moment of firing. This should be done with care as a fuse cannot be clamped, and any alteration in the setting will cause blinks. On discharge, the set-back pellet "B" fires an explosive cap, which in turn ignites the powder train "D", and thence the powder in chamber "E".

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

41. *American Trench Mortar Fuse, Mark XI* (Fig. 19). This is an "Allways" percussion fuse and is to be used on all American 4" trench mortar bombs for contact bursts. Safety pin "A" is withdrawn just before firing. On shock of discharge, pellet "B" sets back, allowing the safety fork "C" to fly out, thus arming the fuse. On impact, striker "E" fires the cap "F", igniting the powder charge "G" and thus exploding the bursting charge in bomb.

42. RANGE TABLE FOR 4-IN. STOKES MORTAR.

Light Smoke.

Cartridges, 350 grs. Primed With Guncotton.

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

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

43. STOKES RANGE TABLE FOR GAS

E. C. 3 and E. C. 5 Biscuit.

(Fig. 20, see Appendix.)

Range		1 Biscuit		2 Biscuits		3 Biscuits	
Yds.	Mtrs.	Time of Flight	Elev.	Time of Flight	Elev.	Time of Flight	Elev.
200	183	12.1	74				
240	220	11.8	70½				
280	256	11.5	68¼				
320	293	11.1	61½	16.8	75½		
380	329	10.4	55½	16.6	73½		
380	348	8.9	45				
400	366			16.4	71½		
440	403			16.2	69¼	19.6	74¼
480	439			15.9	67	19.5	72¾
520	476			15.6	64¼	19.3	71
560	512			15.2	62½	19.1	69¼
600	549			14.7	58	18.9	67½
640	585			13.8	53	18.6	65½
660	604			12.2	45	18.5	64½
680	622					18.2	63¼
720	659					17.8	60¾
760	695					17.3	58
800	732					16.6	54½
840	768					14.5	45

DEFLECTION TABLE.

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

*Deflection same unit as Range*44. STOKES RANGE TABLE FOR HEAVY SMOKE
AND THERMIT.*Pink Cartridge.*

(Fig. 21, see Appendix.)

Charge: 150 Grains Cordite M. D., size 2 1/4. (Primed 10-12 P.),
rings, 350.

Grains: 4 mm. Flake Cordite.

Projectile: Black Bomb, weight 24 3/4 lb.

Range.	Range.	Elevation.	Time of flight.	Elevation.	Time of flight.	Elevation.	Time of flight.	Time of flight.	Elevation.
Yards.	Meters.	Degs.	Secs.	Degs.	Secs.	Degs.	Secs.	Degs.	Secs.
		1 Ring		2 Rings		3 Rings		4 Rings	
200	183	75	13.1						
220	201	73 1/2	13.0						
240	220	72	12.9						
260	238	70 1/2	12.8						
280	256	68 3/4	12.7						
300	280	67	12.6						
320	293	65 1/4	12.4						
340	311	63 1/4	12.2	75 1/4	17.4				
360	329	61	12.0	74 1/4	17.4				
380	348	58 3/4	11.8	73 1/4	17.3				
400	366	56	11.4	72 1/2	17.3				
420	385	52 1/4	10.9	71 1/2	17.2				
440	403	45	9.8	70 1/2	17.1				
460	421			69 3/4	17.0				
480	439			68 3/4	16.9	75	20.5		
500	458			67 3/4	16.8	74 1/4	20.5		
520	476			66 3/4	16.7	73 3/4	20.4		
540	494			65 3/4	16.5	73	20.3		
560	512			64 1/2	16.4	72 1/4	20.3		
580	531			63 1/4	16.2	71 1/2	20.2	75	22.7
600	549			62	16.1	71	20.1	74 1/2	22.6
620	567			60 3/4	15.9	70 1/4	20.0	73 3/4	22.6
640	585			59 1/4	15.6	69 1/2	19.9	73 1/4	22.5
660	601			57 3/4	15.4	68 3/4	19.8	72 3/4	22.4
680	622			56	15.2	67 3/4	19.7	72	22.3
700	641			54 1/2	14.8	67	19.6	71 1/2	22.3
720	659			52	14.4	66 1/4	19.5	70 3/4	22.2
740	677			48 1/2	13.7	65 1/2	19.4	70 1/2	22.1
760	695					64 1/2	19.2	69 1/2	22.0
780	714					63 1/2	19.1	69	21.9
800	732					62 1/2	18.9	68 1/4	21.8
820	750					61 1/2	18.7	67 1/4	21.7
840	768					60 1/2	18.6	66 3/4	21.6
860	787					59 1/2	18.4	66	21.5
880	805					58 1/4	18.1	65 1/2	21.4
900	824					57	17.9	64 1/2	21.2
920	842					55 1/2	17.6	63 3/4	21.1
940	860					53 3/4	17.2	63	20.9
960	877					51 3/4	16.8	62	20.7
980	896					48 3/4	16.1	61	20.5
1000	915					45	15.0	60 1/4	20.4
1020	933							59 1/4	20.2
1040	951							58 1/4	20.0
1060	969							57	19.7
1080	988							55 3/4	19.4
1100	1006							54 1/4	19.0
1120	1025							52 1/2	18.6
1140	1044							50 1/4	18.0
1160	1061							45	16.6

NOTE—The gas bomb wgt. 25 lb. ranges short of the above by approximately 6 per cent. of the range.

45. STOKES RANGE TABLE FOR HEAVY SMOKE AND THERMIT.

Blue Cartridge.

(Fig. 22, see Appendix.)

Charge: 95 grs. Ballistite, reinforced with 5 grs. G.C. Yarn.

Rings: 350 grs. 4 mm. Flake Cordite.

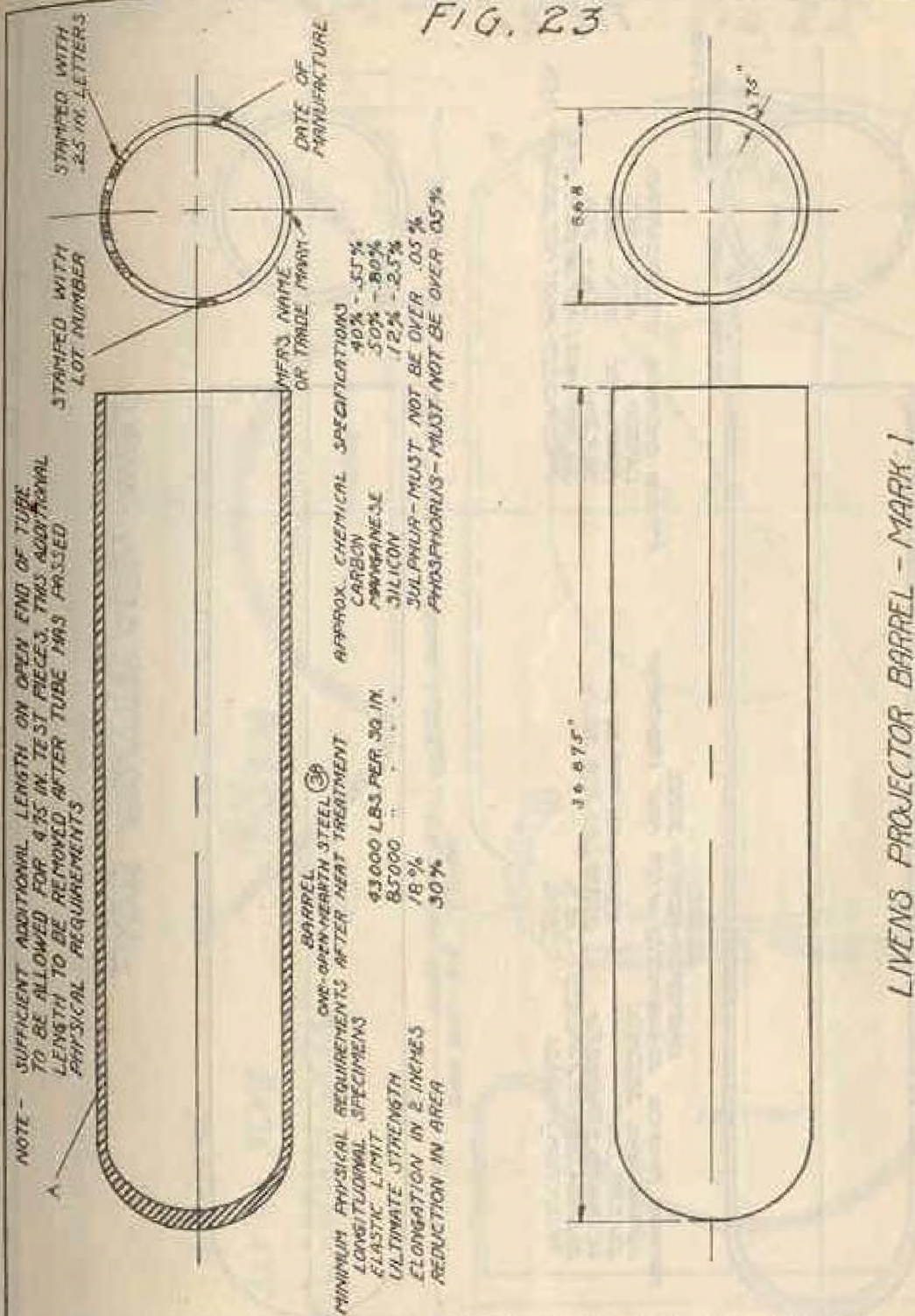
Projectile: Bomb, weight 25 lbs.

Range.		Cartridge + 1 Ring.		Cartridge + 2 Rings.		Cartridge + 3 Rings.		Cartridge + 4 Rings.	
Yards	Meters.	Elevation.	Time of Flight.	Elevation.	Time of Flight.	Elevation.	Time of Flight.	Elevation.	Time of Flight.
		Degs.	Secs.	Degs.	Secs.	Degs.	Secs.	Degs.	Secs.
100	92	81½	11.2						
150	139	77	11.0						
200	183	72	10.7						
250	229	66¼	10.3	78½	15.4				
300	275	59	9.7	76	15.2				
350	320	45	8.0						
350	329			73½	15.0	77¾	18.3		
400	366			70½	14.8	76	18.2		
450	412			67¾	14.5	74	18.1	77	20.0
500	458			64¼	14.2	72	17.9	75¼	19.9
550	504			60¼	13.6	69¾	17.7	73¾	19.8
600	549			55¼	12.9	67½	17.4	72	19.6
640	585			45	11.1				
650	594					65	17.0	70¼	19.4
700	640					62¼	16.6	63¼	19.2
750	686					59	16.1	61¼	18.9
800	732					55	15.4	64¼	18.6
850	777					45	13.3	61¾	18.2
900	824							59	17.7
950	868							55¾	17.1
1000	915							50¾	15.9
1020	933							45	14.6

50 PER CENT. PROBABILITY ZONES.

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

FIG. 23



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

D.E.B.

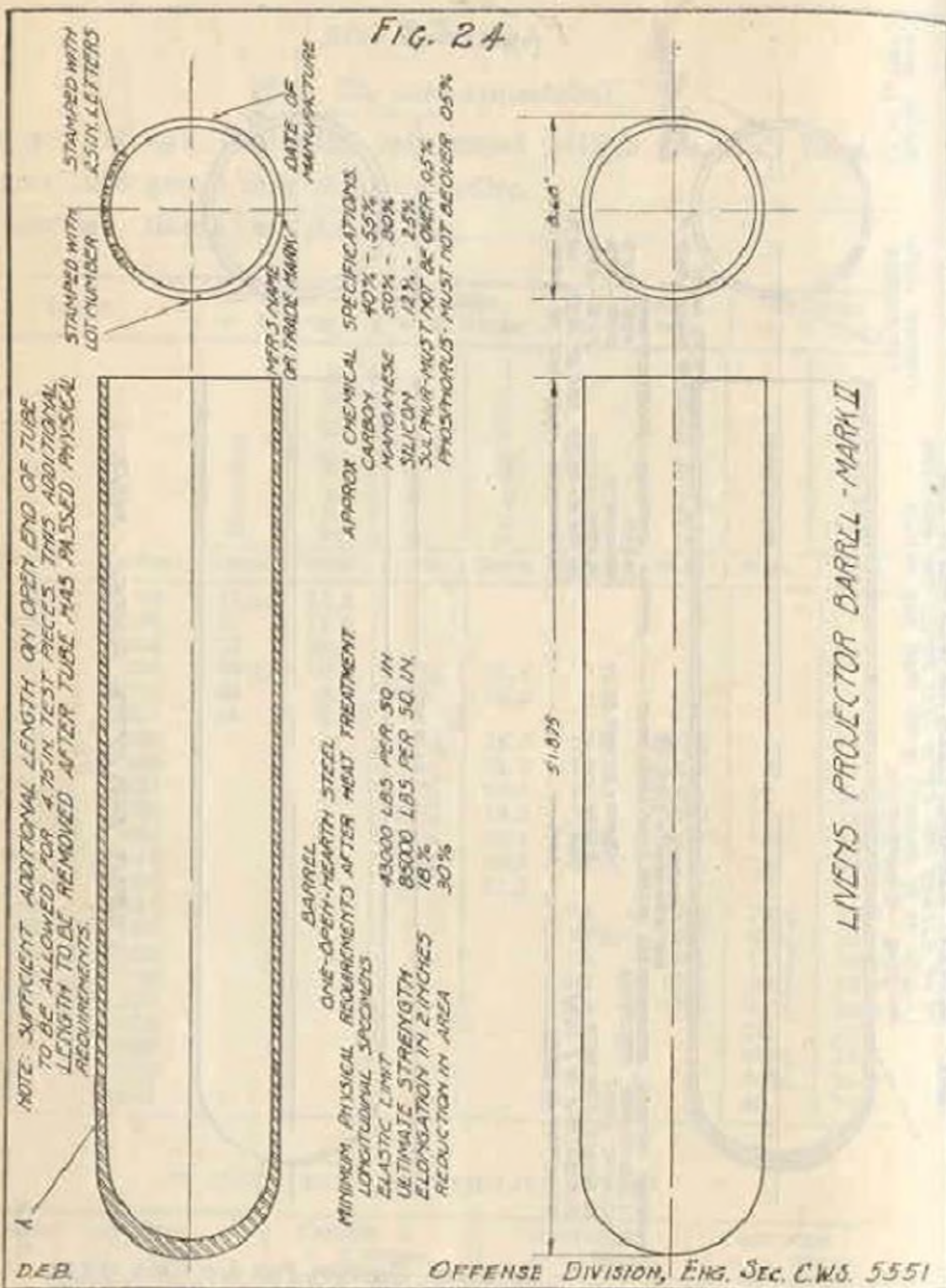


FIG. 23-

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

D.E.B.

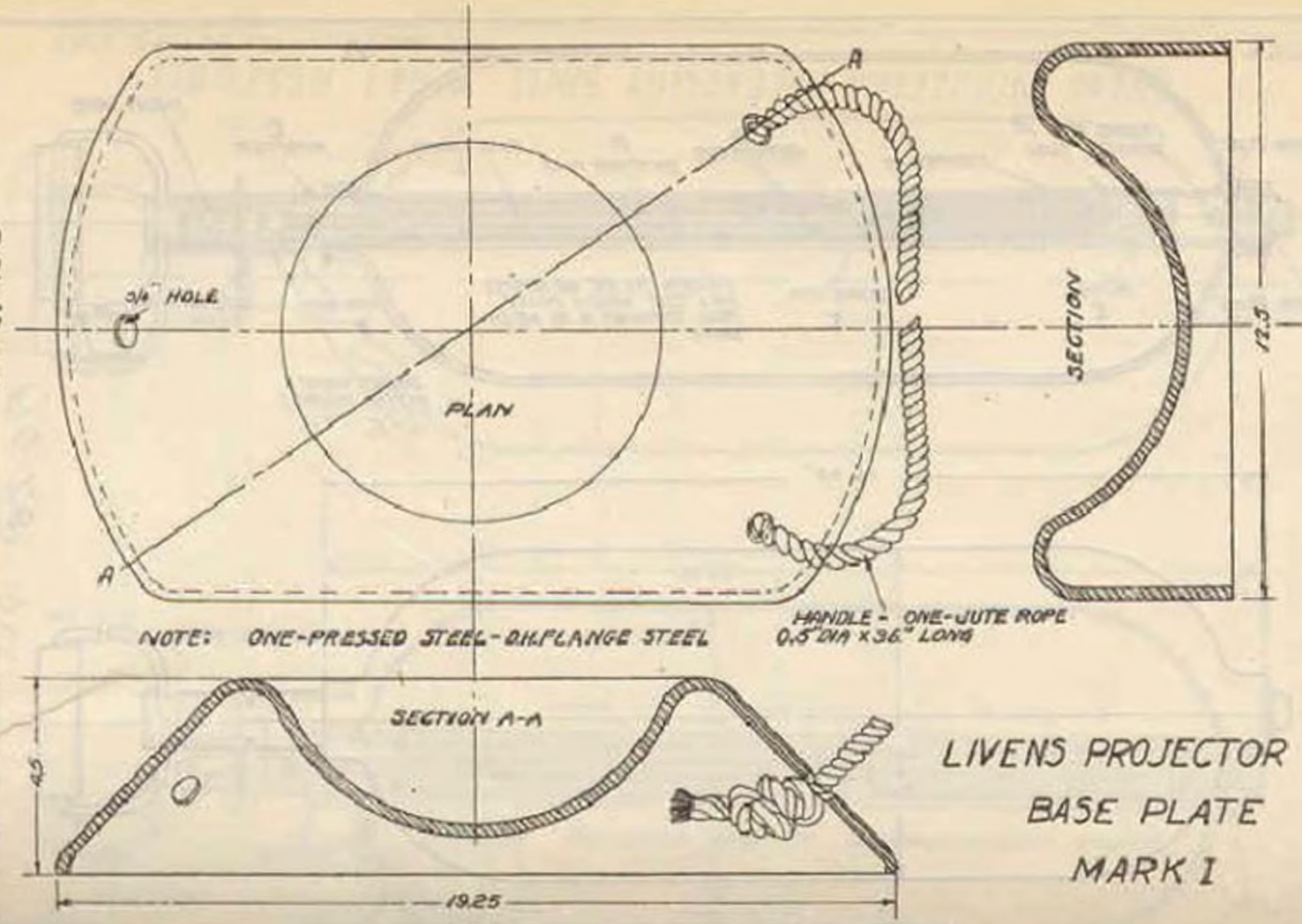
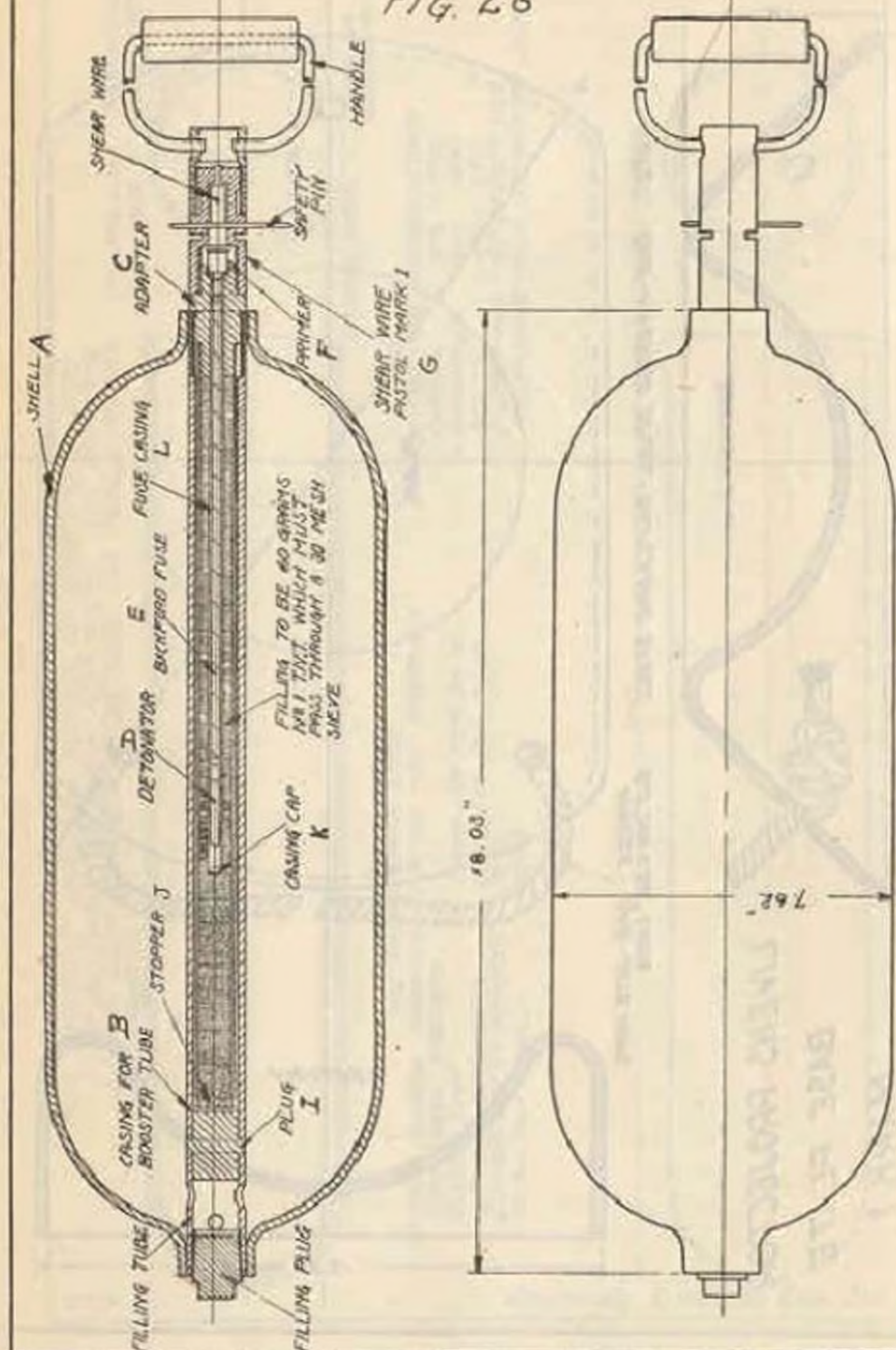


FIG. 26

LIVENS PROJECTOR GAS SHELL
MARK-I

OFFENSE DIVISION, ENG. SEC. C. W. S. 5502

DER

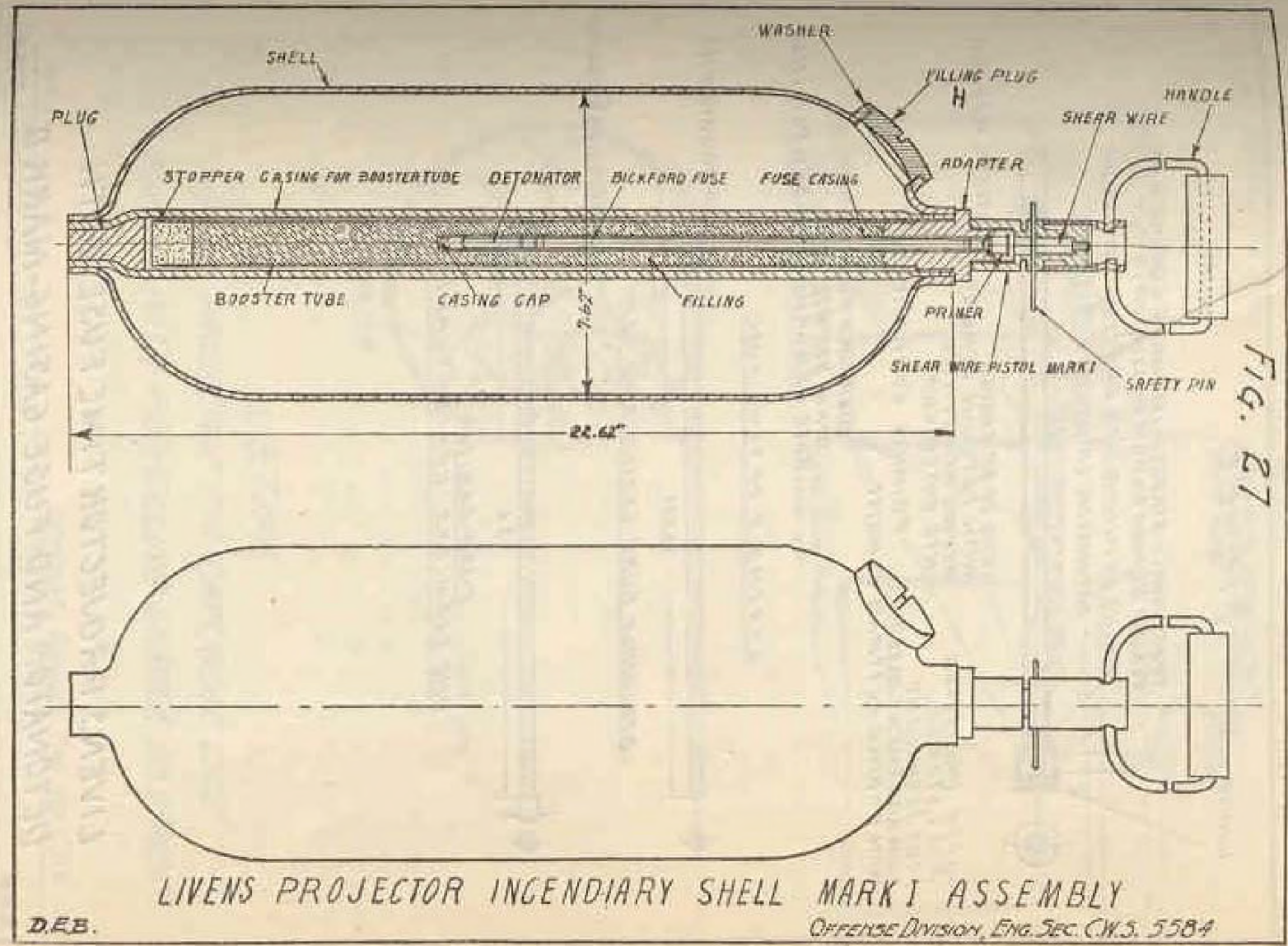
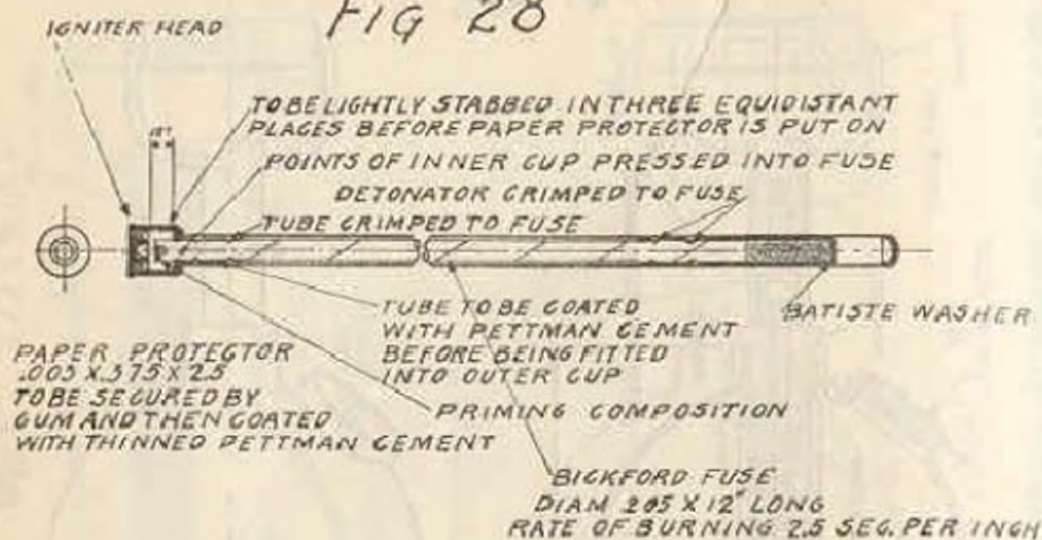
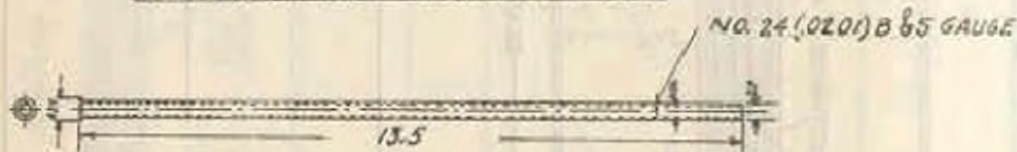
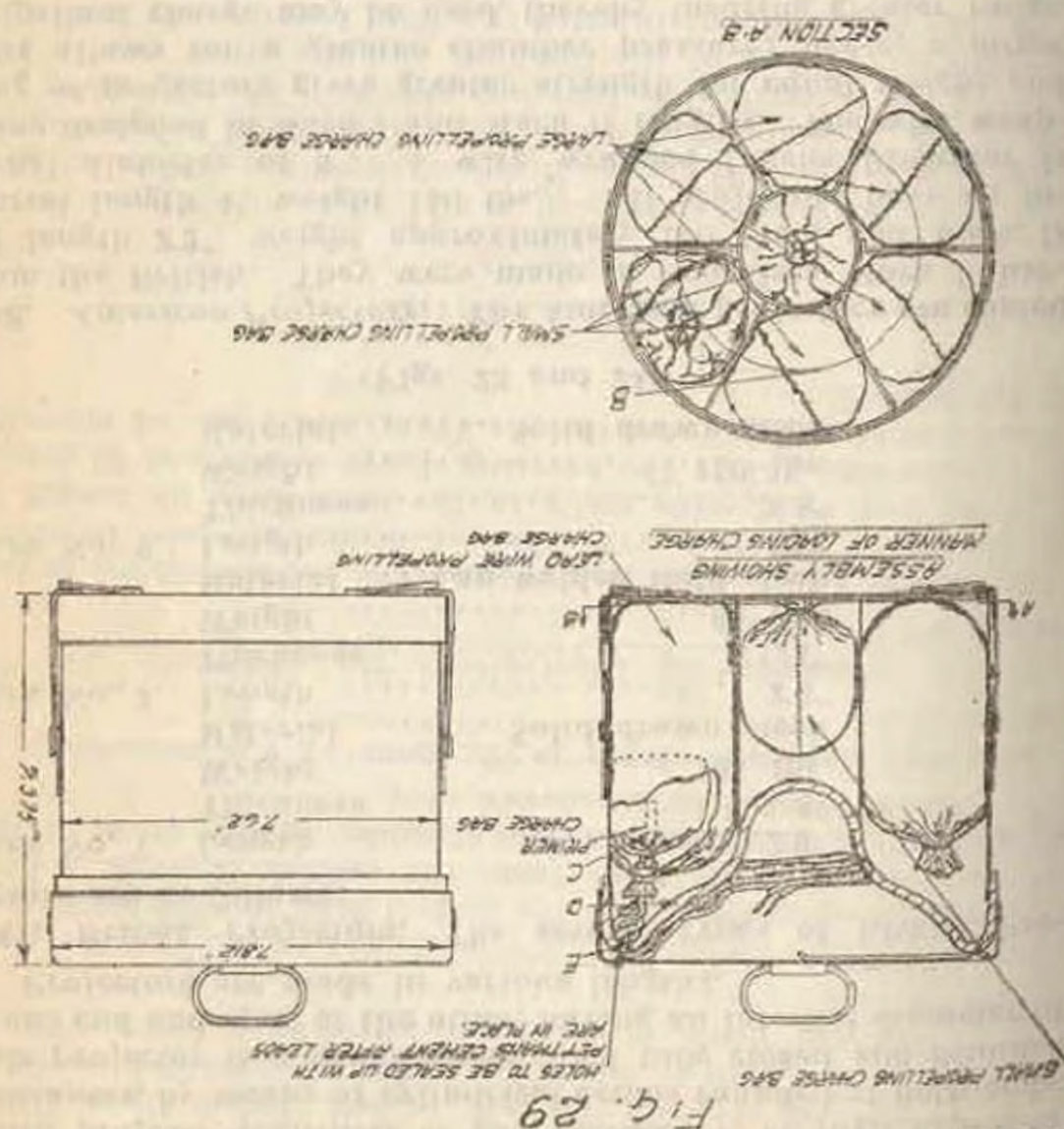


Fig 28

ASSEMBLY OF TIME FUSEASSEMBLY FUSE CASING AND CAPFUSE CASINGONE SEAMLESS COPPER TUBING

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

U.S. TYPE LIVENS PROJECTOR TIN CARTRIDGE CASE MARK I. WITH PROPELLING CHARGE ASSEMBLY



LIVENS MATERIAL.

The Projector.

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

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

Mark No. 1.	Length	2'9"
	Thickness	3/8"
	Weight	105 lbs.
	Material	Solid drawn steel.
Mark No. 3.	Length	2'6"
	Thickness	1/4"
	Weight	65 lbs.
	Material	Lap welded mild steel.
Mark No. 9.	Length	4'6"
	Thickness	3/8"
	Weight	150 lbs.
	Material	Solid drawn steel.

(Figs. 23 and 24)

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

49. *Base Plates.* (Fig. 25.) The Livens Projector Base Plate is of pressed steel about 1/4" thick and 18" in diameter. It weighs about 30 pounds. It is used as a backing to prevent the projector from burying itself in the ground on recoil. There is also a 12" base plate, the only difference being that the crimped edges are flattened instead of slanting as in the 18".

DRUMS.

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

In the latest American drawings of the Gas Drum (Fig. 26) the internal diameter of this tube is slightly more than 1". These drums are filled through holes bored in this tube about 2" from the end opposite the fuse socket. Below these filling holes the central tube is sealed by a steel plug welded in place. After filling, the drum is sealed by screwing a taper plug in the filling end.

The Incendiary Drum (Fig. 27) is similar to the gas, the only difference being in the size of the central tube and the method of filling. This drum is filled from the outside through a hole about 2" in diameter, cut in the shoulder of the drum at the fuse end, and closed by a screwed plug.

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

In the accompanying illustrations the difference may be readily distinguished.

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

PRIMING SYSTEM.

(Fig. 28)

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

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

PROPELLANTS.

(Fig. 29)

53. Propelling charges are contained in a cylindrical tin box divided into one central compartment and six radial com-

partments. One compartment contains 12 ozs. of cordite, inserted into which is an electric fuse and 4 ozs. of black powder as a priming charge.

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

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

54. *Electric Fuses.* The British electric fuse used to ignite the cordite propelling charges is known as the Mark III, No. 14. In this fuse a fine platinum iridium wire extends between two copper terminals, projecting from a hard rubber casing. Around this wire is wound a small piece of guncotton, and a charge of 2.25 grammes of black powder which is set off by the guncotton, and in turn explodes the black powder in the bag surrounding the fuse and hence the cordite propelling charge. The wire has a resistance when cold of 1.06 ohms, and 2.6 ohms on fusion. A current of 0.9 amperes is required to fuse the wire and this amount must be supplied in order to be certain of setting off the guncotton.

The American electric primer is a copy of the British No. 14 fuse. A sketch of the fuse complete is shown in Fig. 30.

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

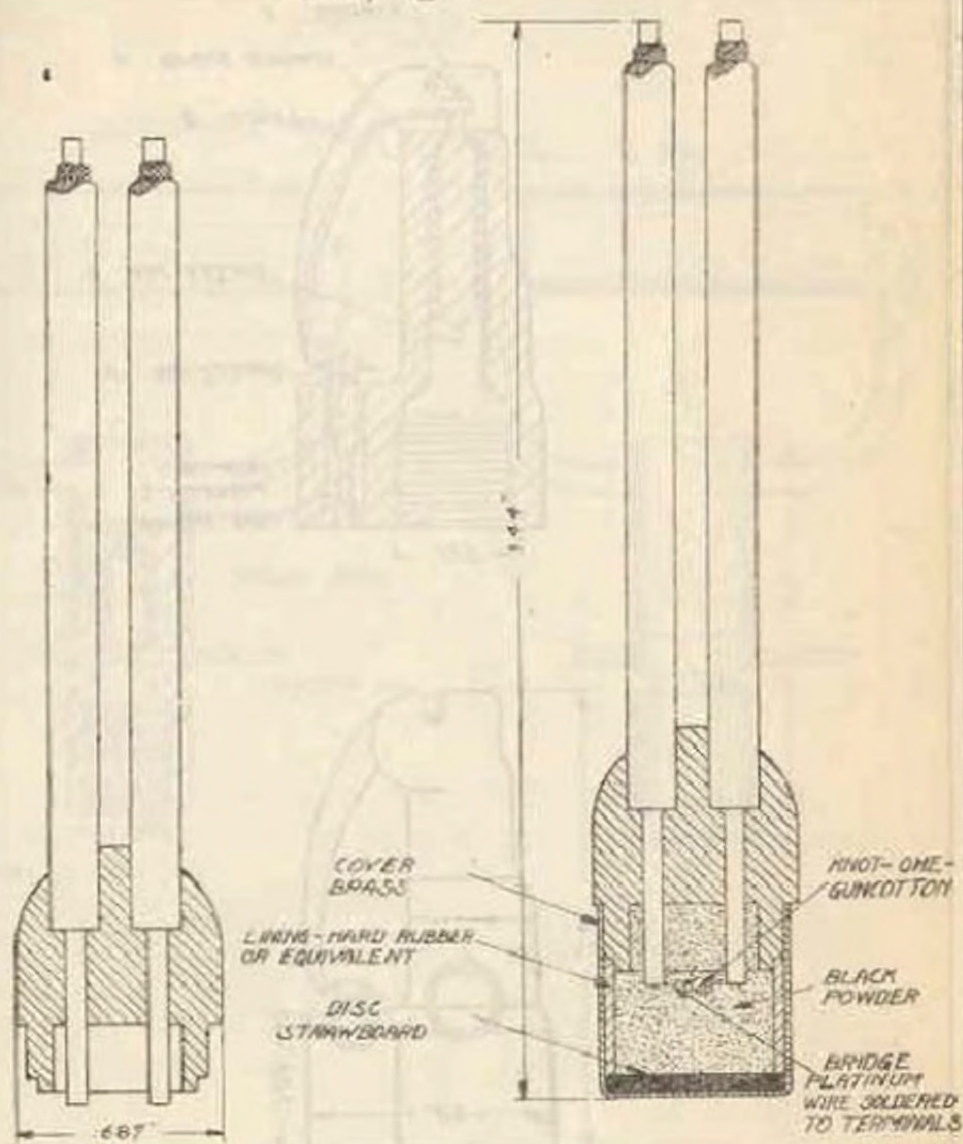
The wire used in connection exploders to electric fuses consists of six strands of copper wire and one strand of iron and has a resistance of 1.46 ohms per 100 yds. It is known as "E.I. 6".

FUSES.

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

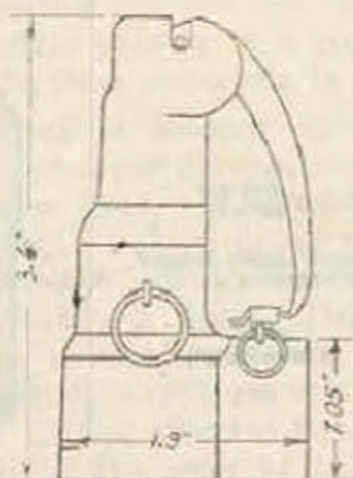
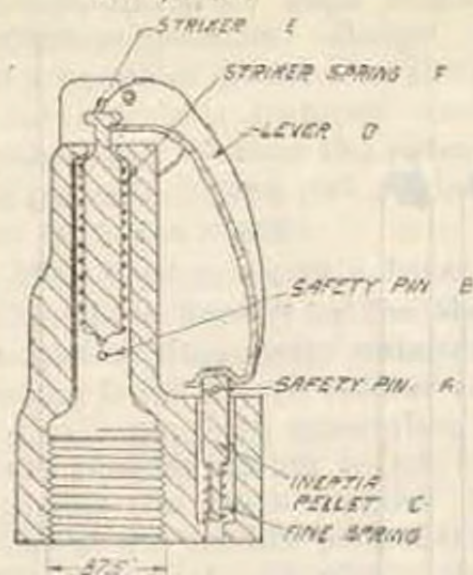
The Mills pistol head (Fig. 31) is the same as that used on the Stokes gas bomb. On discharge the inertia pellet is forced back, releasing the lever, which in turn releases the striker, and detonates the cap in the gaine.

FIG. 30



LIVENS PROJECTOR ELECTRIC PRIMER
MARK I

FIG. 31

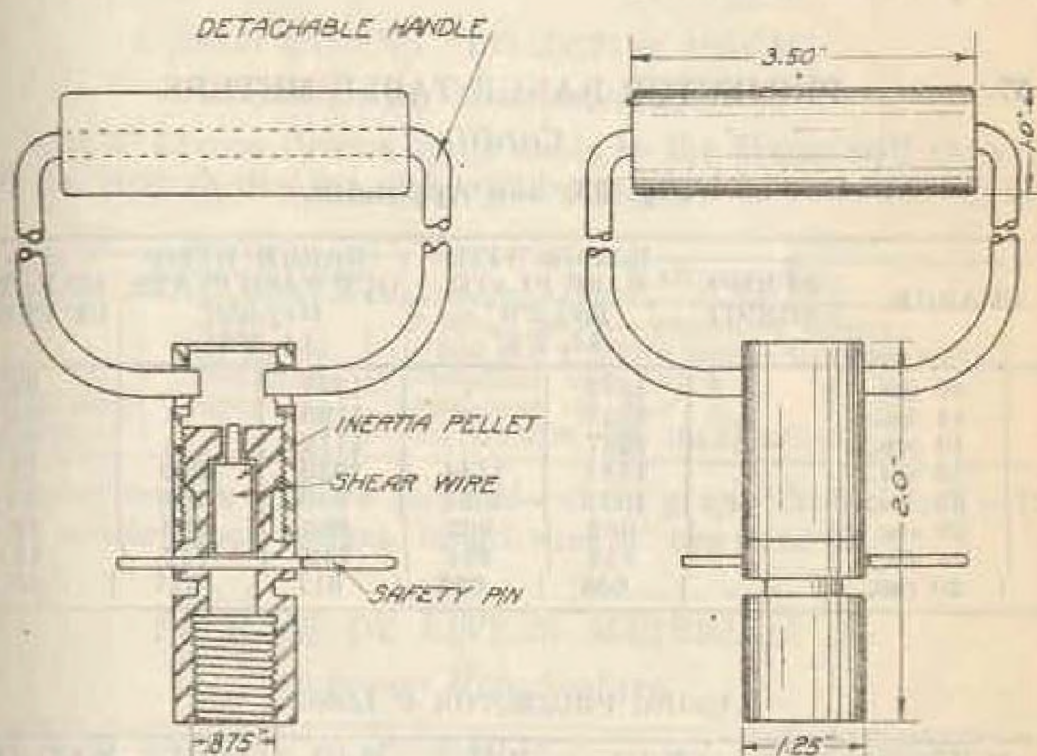


MILLS PISTOL HEAD

DEB

OFFENSE DIVISION, ENG SEC CWS 5547

FIG. 32



U.S. TYPE LIVENS HEAD

OFFENSE DIVISION - ENG SEC CWS 5590

The Livens head (Fig. 32) is the fuse now commonly used. It consists of a small inertia pellet, held in place by a thin wire. On discharge the inertia pellet is forced back, shearing the wire and detonating the cap. The object of the shear wire is to prevent accidents from shorts. If the velocity of discharge is below a certain value, the wire does not shear and the cap is not detonated.

57. PROJECTOR RANGE TABLE METERS

Cordite

(Fig. 33, See Appendix.)

CHARGE	SYMM'L ARR'GT	RANGE WITH BASE PLATE		RANGE WITH- OUT BASE PLATE		MAX. TIME OF FLIGHT
		Hvy. 2'9"	Lt. 2'6"	Hvy. 2'9"	Lt. 2'6"	
1.	46 ozs.	..	1372	..	1235	22 secs.
2.	44 ozs.	..	1327	..	1193	22 secs.
3.	40 ozs.	..	1237	..	1112	21 secs.
4.	36 ozs.	..	1144	1144	1030	21 secs.
5.	32 ozs.	..	1051	1051	946	20 secs.
6.	28 ozs.	..	962	962	866	18 secs.
7.	24 ozs.	..	824	824	742	16 secs.
8.	20 ozs.	..	686	686	617	15 secs.

USING PROJECTOR 4' LONG.

	M-III	M-II	M-III	M-II	M-III	M-II	MAX. TIME OF FLIGHT
1.	54 and	..	1693 and	..	1524 and	..	25 secs.
	52	..	1647	..	1480	..	
2.	50	..	1600	..	1440	..	24 secs.
3.	46	46	1510	1554	1359	1400	24 secs.
4.	42	42	1462	1462	1315	1315	23 secs.
5.	38	38	1372	1372	1234	1234	22 secs.
6.	..	34	..	1280	..	1152	22 secs.
7.	..	30	..	1190	..	1071	21 secs.

Mark III=7 1/4" Charge box.

Mark II=5 3/4" Charge box.

NOTE.—The accuracy of the projectors is about as follows:

Direction—7% of Range.

Deflection—5% of Range.

8 INCHES LIVENS PROJECTOR DRUMS

British Manufacture

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

59.

BRITISH MARKINGS.

FILLED	1/2" BAND AS BELOW—1/2" BETWEEN BANDS
C.G.	TWO RED BANDS
N.C.	1 WHITE—1 RED—1 WHITE

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

8 INCH LIVENS PROJECTOR DRUMS

American Manufacture.

60. The 8" Livens Drums being made in the States will closely follow the British designs and will be marked as follows: (Fig. 34.)

FILLING	PROPERTIES	MARKINGS
C.G.	Lethal	2 White Bands—Stencilled «Gas.»
N.C.	Penetrative	1 Red and 1 White Band—Stencilled «Gas.»
Oil	Incendiary	Stencilled «Oil.»
High Explosive	Explosive	Stencilled «H. E.»
Practice		NO BANDS OR MARKINGS.

All drum bodies will be painted—slate gray. Stencilled will be in 1" white block letters, lengthwise of the drums.

61.

PACKING OF LIVENS MATERIAL.

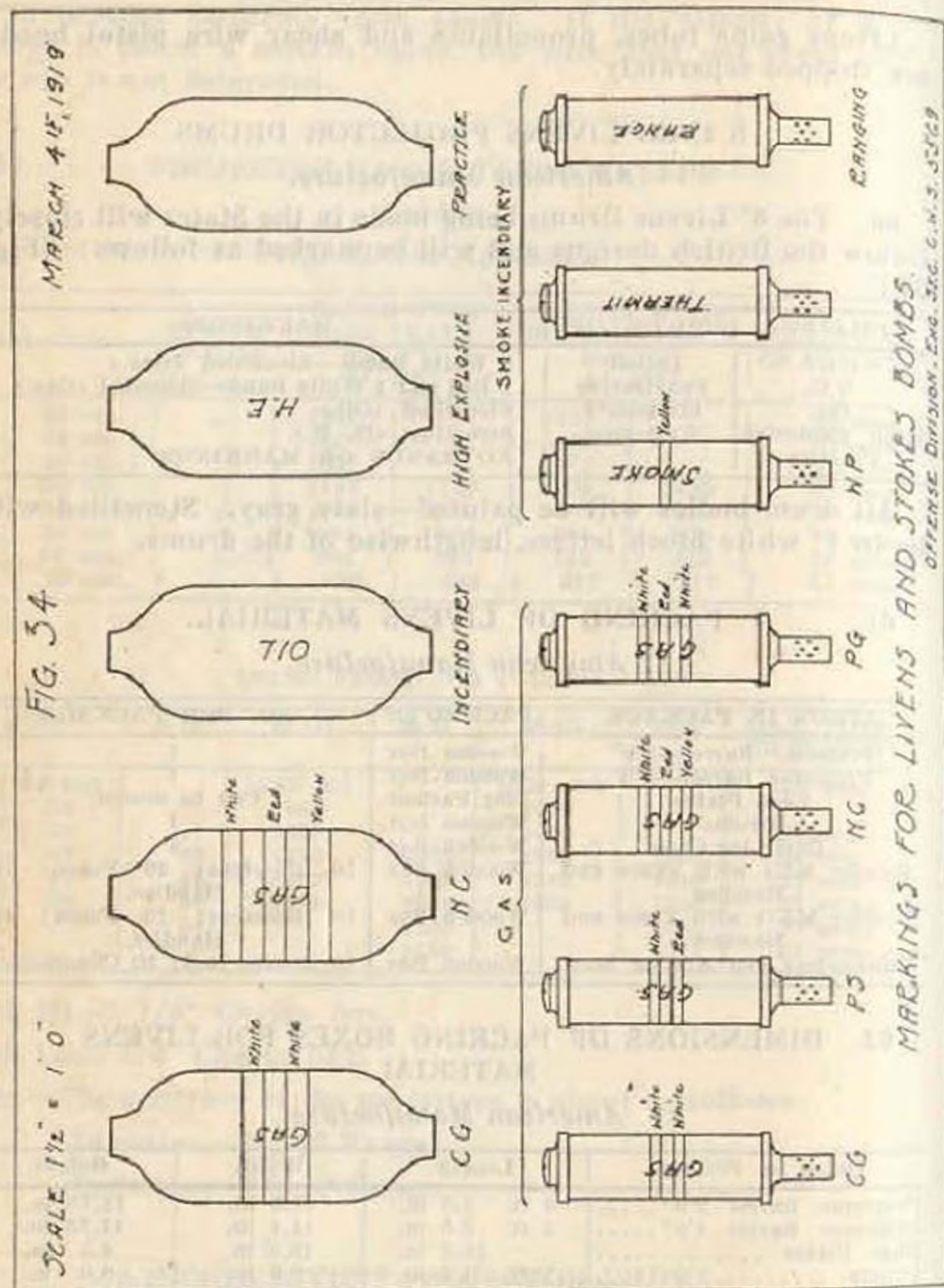
American Manufacture.

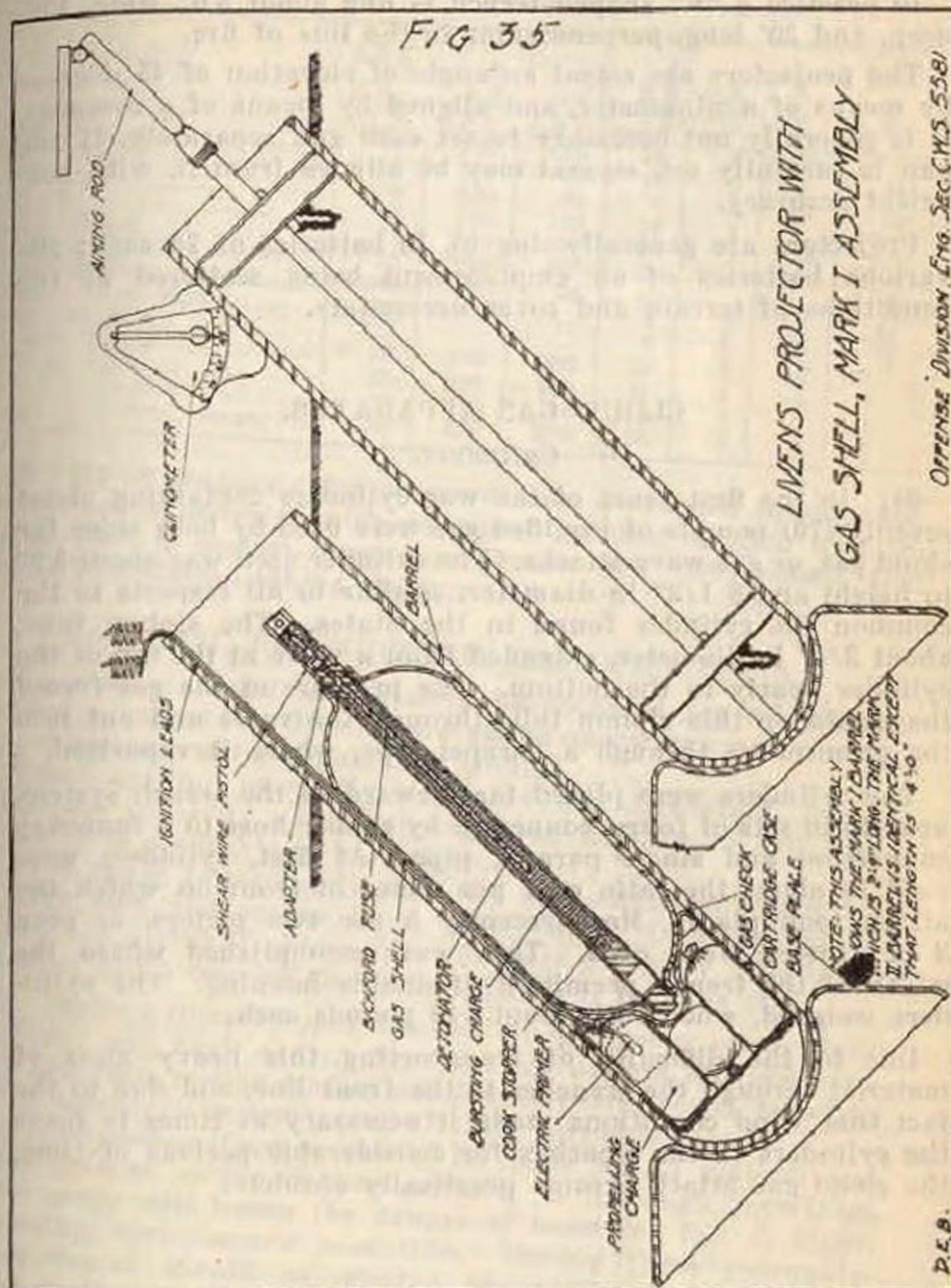
ITEMS IN PACKAGE	PACKED IN	NO. PER PACKAGE
Projector Barrel—2'9"	Wooden Box	1
Projector Barrel—4'0"	Wooden Box	1
Base Plates	Not Packed	Can be nested.
Drums	Wooden Box	1
Cartridge Case	Wooden Box	4
Booster MKI with Fuses and Handles	Wooden Box	10 Boosters; 10 Fuses; 10 Handles.
Booster MKII with Fuses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

62. DIMENSIONS OF PACKING BOXES FOR LIVENS MATERIAL.

American Manufacture.

Items in Package	Length	Width	Height
Projector Barrel 2'9".....	3 ft. 5.5 in.	11.5 in.	11.75 in.
Projector Barrel 4'0".....	4 ft. 8.5 in.	11.4 in.	11.75 in.
Base Plates	19.5 in.	13.0 in.	4.5 in.
Drums	1 ft. 1.5 in.	9.0 in.	9.0 in.
Cartridge Case	2 ft. 10.5 in.	10.5 in.	10.5 in.
Booster MKI with Fuses and Handles	2 ft. 6.0 in.	10.5 in.	8.0 in.
Booster MKII with Fuses and Handles	2 ft. 8.0 in.	12.0 in.	8.0 in.
Clinometers and Aiming Rods	4 ft. 2.0 in.	9.5 in.	12.5 in.





THE STANDARD SET UP.

63. Fig. 35 shows the projector installed, ready for firing.

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

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

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

CLOUD GAS APPARATUS.

Cylinders.

64. In the first years of the war cylinders containing about seventy (70) pounds of liquified gas were used by both sides for cloud gas, or gas wave attacks. The cylinder used was about 3'9" in height and 8 1/2" in diameter, similar in all respects to the common CO_2 cylinder found in the States. The siphon tube, about 3/4" in diameter, extended from a valve at the top of the cylinder nearly to the bottom. The pressure of the gas forced the liquid up this siphon tube through the valve and out into the atmosphere through a parapet pipe, where it vaporized.

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

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

65.

TRANSPORTATION TABLE.

Units of Capacity.

Stores	Approx. Weight in Lbs.	5 Ton Truck	3 Ton Truck	2 Mule Wagon	Pack Mule	Barro	Man
2½" Gun	63	135	100	14	2	2	1
2"9" Gun	103	150	60	10	2	..	¾
4"0" Gun	150	100	40	6	2	1	¾
Drums	60	165	100	16	4	..	1
Base Plates	28	350	200	48	8	4	1
Charges, Boxed	55	640	400	20	4	..	..
Gun Complete, Boxed.....	280	40	24	..	..	..	¼
Heavy Base Plates.....	120	..	..	8	2	1	½
Gun and Stand Loose.....	125	..	..	8	2	1	½
T.M.E. Boxed	68	350	200	30	8	4	1
T.M.E. Loose	25	450	250	40	8	4	3
Light Cylinders, Full.....	65	160	96	15	4	2	1
Light Cylinders, Empty...	20	850	200	30	8	4	2

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

GENERAL PROCEDURE IN GAS OPERATIONS.

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

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

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

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

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

68. After a close study of the tactical situation, enemy concentrations, the terrain, and time allowed, the company commander decides upon his plan of operations. He then prepares a project (see form following) which he submits to the Chief.

of Staff of the division. On approval of his project the company commander gives detailed instructions to his platoon commanders, assigning them definite duties. These instructions should be given in conference, and confirmed in writing.

All gas officers commanding units assigned to support infantry units will immediately report to the commanding officer of such infantry unit, prepared to submit recommendations regarding the employment of his gas troops. After reporting to the infantry commander he comes directly under his orders and is directly responsible to him for the proper conduct of his command, in accordance with the orders issued by such infantry commander. Until he is relieved by the latter he is subject only to his orders, superior commanding officers of gas troops having no authority to issue orders to him affecting the employment of his troops.

Commanding officers of all gas troops in assigning units under competent orders, to operate with infantry units will carefully instruct the commanders of such units, in order that they shall fully understand from whom they receive and obey orders and that they are not sent into combat to conduct independent operations.

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

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

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

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

73. Work done by Gas Troops in forward areas must be directed and controlled with the greatest care and caution. The enemy must not be forewarned by sound or sign. The success

of the entire operation depends primarily upon surprise. Warning to the enemy will result in a heavy shelling of the area, and probably in a withdrawal of the target.

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

- (1) Aerial photography.
- (2) Air observation—Airplane or balloon.
- (3) Direct observation.

It is necessary to consider and provide against:

- (a) New tracks.
- (b) Regularity of lines.
- (c) Production of shadows.
- (d) Leaving any work uncovered.

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

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

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

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

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

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

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

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

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

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

Leave Company

8:00 A. M.

5:00 P. M.

Leave Battalion

11:00 A. M.

6:00 P. M.

During normal operations such reports should be sent as follows:

Leave Company

8:00 A. M.

Leave Battalion

11:00 A. M.

NOTES ON OPERATION.

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

Reconnaissances.

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

Emplacements.

- (1) Avoid shelled areas, exposed positions, or trench intersections.
- (2) Do not have more than 50% of range in own lines for projectors.
- (3) Select good cover if possible.
- (4) Consider routes to emplacement.
- (5) Consider soil, and ease of camouflage.

Assistance.

- (1) Determine assistance in men or transport needed.

Digging Emplacements.

- (1) Look over lines of fire.
- (2) Check up accessories; compasses; tapes; triangles; clinometers, etc.
- (3) See that camouflage is available.

Carrying.

- (1) Arrange method carefully, and have material arrive in the order needed.
- (2) Work to time schedule.
- (3) Have good N. C. O. in charge at forward dump.

Firing Party.

- (1) Before leaving billets.
 - (a) Inspect accessories; tools; exploders; galvanometers, etc.
 - (b) Tell senior sergeant the zero hour. Give him sufficient data to go ahead in case you become a casualty.
- (2) On arrival in line—
 - (a) Don't waste time.
 - (b) See that runners are ready.
 - (c) See that Infantry is informed.
 - (d) See that everyone is ready and knows what to do.
- (3) After firing.
 - (a) Withdraw all possible material, such as mortars, exploders, galvanometers, etc.
 - (b) Camouflage.
 - (c) Submit an immediate report.

DATA ON OPERATIONS.

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

4" Stokes Mortars:

Gas: Allow 1 mortar to 100 yards of lateral target.

Bombardments are made:

(1) *On Days or Nights Preceding Zero.* Rapid bursts of fire for one or two minutes, once or twice on each of the nights preceding zero. Expenditure of ammunition is calculated at the rate of 1 round per 5 yards of lateral target per minute.

(2) *During the Assault.* Smoke and lachrymatory agents are used on the flank of the attack.

Smoke: One Gas Company (16 mortars) is usually sufficient for a smoke barrage on the flank of an attack. One Section (4 mortars) has frequently been used. Average rate of expenditure of ammunition is 1 round per mortar per minute.

Miscellaneous:

Mortars are sited in the front line, or in saps just behind it, and are carried up by the special personnel. The latter also construct emplacements if time permits. The actual preparations can be completed in 12 hours, but a longer time is desirable. Infantrymen are required to carry bombs (2 bombs to 1 man).

8" Projectors:

(1) Train all guns on one target, *e. g.*, woods, village, or area of dugouts.

(2) Only one shot can be fired, as the gun then requires digging out.

(3) Not more than 250 guns can be installed by one company in one night.

(4) If several working nights are allowed the gas company can carry up and dig-in all its own guns if normal trench tramway facilities are available.

(5) Infantrymen are usually required for assistance in carrying drums (1 drum per man).

(6) Guns are sited in the front line or preferably just behind it in the open; with breastworks the guns are better placed behind the traffic trench than in the front line.

(7) Surface emplacements should be used wherever concealment is possible.

Cylinders:

(1) Recesses in front walls of trenches should be completely prepared before carrying into trenches is commenced.

(2) Each cylinder requires 2 men with 2 wooden poles to carry it.

(3) Wrap each cylinder in burlap or sand bags to prevent noise from clanking together.

(4) All valves and fittings should be tested for gas-tightness and easy operation before leaving dump.

(5) Cover cylinders in position by sand bags, boards or earth for protection against shell fragments or shrapnel.

(6) At zero minus 10 minutes, station one man at each two cylinders to turn on valves. Stand by during discharge to prevent accidents and gassing own men. All men should wear masks.

GRAD CIRCLE WITH CODE.

Fig. 36.

81. It has been decided to adopt the Grad or 40 point system in noting wind direction, and miles per hour in noting velocity.

In transmitting wind observations a known number is added to each reading; other pertinent information; signature.

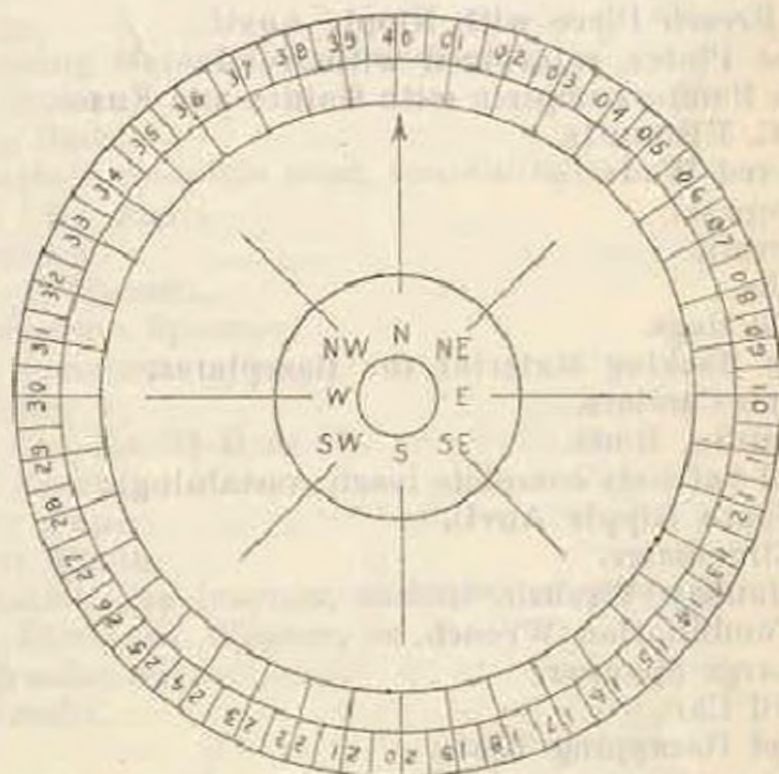
Example: At a station known as Pierre, at 16 hours the wind blows from the north, or point 40 with a velocity of 8 miles per hour, and is steady.

The key number, which is frequently changed, is assumed as 15. The message will then read:

Pierre, 1600, 5523, steady. Smith.

*40 + 15 = 55 8 + 15 = 23.

FIG 36
NUMERICAL POINTS OF COMPASS



GRAD SYSTEM

MATERIAL REQUIRED FOR 4-INCH STOKES MORTAR OPERATION.

4 Guns—40 Rounds Ammunition Each Gun.

Gas Ammunition.

- 4 4" Stokes Mortars complete in good order.
 - Gun Barrel.
 - Barrel Cover.
 - Gun Legs.
 - Legs Cover.
 - Traversing Handle.
 - Muzzle Cover.
 - Breech Piece with Nipple Anvil.
- 4 Base Plates, reinforced with wood.
- 160 Gas Bombs complete with Gages and Fuses.
- 320 E. C. 3 Biscuits.
- 160 Waxed Wads.
 - 1 Compass.
 - 8 Shovels.
 - 8 Picks.
- 300 Sand Bags.
 - 4 Sets Backing Material for Baseplates.
- 54 Bomb Carriers.
- 4 Cleaning Rods.
- 4 Tool Satchels complete (each containing):
 - 1 Spare Nipple Anvil.
 - 1 Clinometer.
 - 1 Monkey Wrench.
 - 1 Combination Wrench.
 - 1 Large Spanner.
 - 1 Oil Can.
 - 1 Set Recapping Tools.
 - Spare Caps.
 - Emery Paper.
 - Cotton Waste.
- Transportation one journey, exclusive of personnel:
 - 2 Double Limbered Wagons, or
 - 2 5-ton Trucks, or
 - 2 3-ton Trucks.

MATERIAL REQUIRED FOR 4-INCH STOKES MORTAR OPERATION.

4 Guns—40 Rounds Ammunition Each Gun.

Smoke or Thermit Ammunition.

- 4 4" Stokes Mortars complete in good order.
 - Gun Barrel.
 - Barrel Cover.
 - Gun Legs.
 - Legs Cover.

- Traversing Handle.
- Muzzle Cover.
- Breech Piece with Flat Anvil.
- 4 Base Plates, reinforced with wood.
- 160 Smoke or Thermit Bombs (with Detonator Smoke).
- 160 31 D or Sutton 79 Fuses.
- 640 Cordite Rings (32) Extra.
- 160 Cartridges Pink or Blue.
- 1 Compass.
- 8 Shovels.
- 8 Picks.
- 300 Sandbags.
- 4 Sets Backing Material for Baseplates.
- 54 Bomb Carriers.
- 4 Cleaning Rods.
- 4 Tool Satchels complete (each containing):
 - 1 Spare Flat Anvil.
 - 1 Clinometer.
 - 1 Monkey Wrench.
 - 1 Combination Spanner.
 - 1 Large Spanner.
 - 1 Oil Can.
 - 1 Fuse Key No. 31-D or 79.
 - 1 Fuse Punch.
 - Emery Paper.
 - Cotton Waste.
- Transportation one journey, exclusive of personnel.
- 2 Double Limbered Wagons, or
- 2 5-ton Trucks, or
- 2 3-ton Trucks.

MATERIAL REQUIRED FOR 250 LIVENS PROJECTOR OPERATION.

- 250 Projector Guns.
- 250 Base Plates.
- 250 Bombs
- 250 Gaines with Fuses and Detonators.
- 250 Charges (Prepared).
- 250 Muzzle Covers.
- 250 Sandbags.
- 12 Sets Marking Tape.
- 12 Pieces Camouflage.
- 360 Camouflage Pins.
- 24 Picks.
- 24 Shovels.
- 15 Exploders.
- 15 Reels Lead Wire (100 yds. double).
- 5 Triangles.
- 5 Clinometers.

- 5 Circuit Detectors.
- 220 yds. Insulating Tape.
- 15 Spanners, D. E.
- 3 Watches.
- 1 Resistance Box.
- Transportation, one journey, exclusive of personnel.
- 16 Double Limbered Wagons, or
- 8 3-ton Trucks, or
- 5 5-ton Trucks, for 2'6" Projectors.

85. TABLE OF ALLOWANCES FOR GAS TROOPS *Technical Equipment.*

	I. <i>Projectors.</i>	
	Monthly Consumption, per Company.	
	100% Operations.	60% Operations.
Projectors 2'9" complete with muzzle cap.....	563	338
Projectors 4'0" complete with muzzle cap.....	187	112
Base Plates	937	562
Drums, C. G., complete with propellant and component parts	1200	720
Drums, N. C., complete with propellant and component parts	400	240
Drums, H. E., complete with propellant and component parts	300	180
Drums, incendiary, complete with propellant and component parts.....	100	60
Spherical Bombs, H. S., with propellant and component parts	250	150
10% Extra component parts for drums and bombs.....	...	...
Propellant charges 10% extra on bombs and drums	...	...
Muzzle caps, 10% extra on Projectors.....	300	180
Projector Pullers	20	12
Wire, 7 strand, rubber insulated, for firing, miles	1.7	1
Tape, racing, 1½" wide, yds.....	500	300
Tape, insulating, 50 ft. rolls.....	30	18
Clinometers	5	3
Sets of accessories, U. S. Ordnance Dept., class 54, Division 8, Drawing 7.....	1/3	1/5
Exploders, Magneto Type.....	1	2/3
Circuit Detectors, Galvanometers.....	1	2/3
Batteries, extra (1/3 of Galvanometers).....	1	2/3
Platinum iridium wire or substitute.....	4'	2.5'
Resistance Boxes	1/3	2/5

NOTE—For every company to be trained, 150 empty drums will be required (discarded gas).

II.

Stokes Mortars.

	Monthly Consumption, per Company.	
	100% Operations.	20% Operations.
4" Stokes Mortars, complete with technical equipment and wooden base-plates.....		2*
S. M. Bombs, complete, C. G.....	4000	800
S. M. Bombs, complete, N. C.....	2000	400
S. M. Bombs, Lachrymator	500	100
S. M. Bombs, Thermit	1600	300
S. M. Bombs, Smoke	2000	400
4" T. M. E. Bomb Carrier	10	2
Breech pieces, extra.....	$\frac{1}{2}$	0.1
Traversing Screws, extra.....	$\frac{1}{2}$	0.1
Lubricating Oil for Barrels, Gals.....	1	0.2

*NOTE—16 Stokes mortars to be issued per company as initial equipment. One set of technical equipment to be furnished with every four (4) Stokes Mortars.

III.

Cylinders.

	Monthly Consumption, per Company.	
	100% Operations.	20% Operations.
Cylinders filled, C. G.....	3000	500
Smoke Candles, Type S or Type F., complete..	200	40

IV.

General Supplies.

	Initial Equipment.	Monthly Consumption per Company
Ammunition Hand Car.....	22	1
Salvus Sets	4	1/5
Oxygen Cylinder		1
Potash Cartridges		1
Haldane Apparatus	1	1/5
Oxygen cylinder for Haldane.....		1
Axes, pick, complete.....	150	10
Handles, pick-axe	100	10
Pliers, side cutting, 8".....	250	20
Pliers, Websheath	250	10
Monkey wrenches, 12".....	10	1
Canvas, waterproof, 10 oz., yds.....	100	10
Batteries for Flashlights.....		25
Bulbs for Flashlights.....		25
Sandbags		1500

Luminous Paint, lbs.....	...	1
Paint Base Zinc, lbs.....	...	1
Rope, $\frac{1}{2}$ ", yds.....	...	100
Large Paulins, 20'x30', Approx.....	...	10
Verrey Gun, 35 mm.....	1/3	...
Verrey Lights, 35 mm. Red one Star.....	...	8
Verrey Lights, 35 mm. Green one Star.....	...	8
Verrey Lights, 35 mm. White one Star.....	...	8
Compasses, prismatic	20	2
Shovels, 9" Blade, round point.....	150	10

86. The foregoing Table of Allowances is based upon the following assumption:

The proportions of the personnel engaged, on the average, in each form of attack is as follows:

Cylinders	20%
Projectors	60%
Stokes Mortars	20%

This assumption is largely influenced by the fact that it is considered that there would always be a large percentage of the troops engaged operating on stabilized fronts. In preparation for any future conflict, there will be an increase in the use of cylinders and Stokes mortars, certainly if the cylinder is satisfactorily developed.

It is estimated that 25 % of 4' and 75 % of 2'9" projectors working entirely on cylinders, projectors, or Stokes mortars, could discharge during one month the following:

Cylinders	3000
Projectors	3000
Stokes Mortars	10000 bombs.

It is estimated that 25% of 4' and 75% of 2'9" projectors would be used.

Average life of a projector would be four shots, or 25% loss in each shot.

Two base-plates will be necessary for each 4' projector; average loss on base-plates will be 25% of the total in each shoot.

The total number of Stokes Mortars would be sufficient to replace the guns destroyed by shell fire, accident, or capture.

87. TABLE OF ALLOWANCES FOR GAS TROOPS.

Unit Equipment.

I.

Table Number	NAME OF EQUIPMENT ALLOWANCES	One Company	One Battalion Headquarters	One Regiment Headquarters	Total for Regiment, 18 Companies, 6 Battalions.
2	Drafting	1	2	2	32
2	Signal	1	1	1	25
4-a	Meteorological	1	.	.	18
4-b	Meteorological	.	1	1	7
5	Photographic	.	1	1	7
6	Carpenter	1	2	2	32
7	Reconnaissance	1	2	2	32
8	Office	1	1	1	25
9	Workshop	.	1	1	7

II.

Drafting Equipment.

Article.	Amt.
Camel hair brushes, medium	1
Camel hair brushes, fine	1
Cloth, tracing, 30", roll	1
Dividers, 4"	12
Dividers, proportional	1
Drawing instruments	1
Drawing tables, 36"x60", with trestles	1
Erasers, steel	1
Erasers, shield	1
Erasers, rubber, pencil	6
Erasers, rubber, ink	6
Frames, blueprint, 24"x30", with celluloid face	1
Ink, drawing, black, bottles	6
Ink, drawing, blue, bottles	3
Ink, drawing, carmine, bottles	3
Ink, drawing, yellow, bottles	3
Ink, drawing, green, bottles	3
Ink, drawing, white, bottles	1
Map measures	1
Note book, 4"x3", approx	3
Paper, blueprint, 30", roll	1
Paper, detail, white, 30", roll	1
Paper, blotting, large sheets	6
Paste, library, jars	3
Pencils, drawing, H	12
Pencils, drawing, 4H	6
Pencils, drawing, 6H	6

Pencils, drawing, Graphite.....	1
Pens, crowquill, doz.....	1
Pens, mapping, doz.....	1
Pens, contour.....	1
Pads, pencil pointing.....	3
Pens, scratch.....	6
Powder, pounce, for tracing, cans 2 1-2 oz.....	1
Paper, tracing, 30", roll.....	1
Pins, boxes.....	3
Protractors, semi-circular, 6".....	1
Protractors, map, celluloid.....	2
Protractor Rectangular, map (T. S. 1077).....	12
Reading Glasses, 5", 3-power.....	1
Rule, parallel, steel, 18".....	1
Rubber bands, boxes.....	1
Scales, Engineer, triangular.....	1
Scales, Engineer, triangular, metric.....	1
Scales, Architects.....	1
Scales, Triangular, metric.....	1
Straight Edge, steel, 30".....	1
"T" Squares, 36".....	1
Trays, washing, blueprint, 24 x 30".....	1
Triangular 30°-60°, 12".....	2
Triangular 45°- , 10".....	2
Triangle, 30°-60°, 5".....	2
Triangle, 45°, 4".....	2
Tubes, tin, for maps and tracing cloth.....	4
Tape, adhesive, rolls.....	3
Thumbtacks, doz.....	10
Water colors, assorted, sets.....	1

III.

Signal Equipment.

Bags, dispatch.....	2
Batteries, for Flashlights.....	25
Bulbs for Flashlights.....	25
Cases, Brief.....	2
Flashlights with Batteries.....	20
Glasses, field, type E. E.....	5
Kits, flag, combination, standard.....	2
Knives, Jack, heavy, with loops.....	250
Telephone sets, complete.....	1
Telephone wire, insulated, feet, (twisted pair).....	300
Watches, luminous dial.....	20

IV.

Meteorological Equipment.

Anemometer, Stanley, hand, portable, (or equivalent).....	1
Wind Vanes, hand.....	10

IV-A.

Meteorological Equipment.

Anemometer, Stanley, (or equivalent).....	1
Hand, portable.....	1
Aneroid Barographs.....	1
Wet and Dry Thermometer.....	1
Sling Psychrometer.....	1
Aneroid Barometer, large.....	1
Stereoscope Panteroscope Schweissgith.....	1
Stop Watches	1

V.

Photographic Equipment.

Camera, Graphlex 3-A.....	1
Developing, equipment, complete.....	1
Films, doz.....	5

VI.

Carpenter Equipment.

Augers, ship handled, sets of 5.....	1
Awls, scratch.....	2
Axes, handled, 32".....	4
Bit, auger, sets of 7.....	1
Bit, expansion, 2 cutters.....	2
Bit, Screwdrivers, 3/8".....	6
Bit, Screwdrivers, 1/2".....	6
Brace, ratchet.....	1
Calipers, 8" set of inside and outside.....	2
Chalk, carpenter's, lbs.....	6
Chalk lines, 40'.....	3
Chisels, cold, 3/8 x 1".....	6
Chisels, framing, 1" handled.....	1
Chisels, framing, 1/2" handled.....	1
Chisels, framing, 2" handled.....	1
Dividers, wind.....	1
Drawknife	1
Files, taper, saw, 6".....	6
Hammer, claw, handled.....	2
Handles, axe, 32".....	6
Handles, Chisels, framing 6".....	6
Handles, Hammer, claw.....	4
Hatchets, handled.....	8
Level, carpenter's 24".....	1
Mallet, carpenter's handled.....	1
Oiler, 1-2 pint.....	1
Pencil, carpenter's, doz.....	1/2
Plane, Jack.....	2

Pliers, side-cutting.....	2
Plumb bombs, 9 1/2 oz.....	1
Rules, 2 ft. 4 fold.....	3
Saw, compass, 12" key hole blade, handled.....	1
Saw, compass, 14" blade, handled.....	1
Saw, compass, 18" nail cutting blade.....	1
Saw, cross cut, hand, 26".....	4
Saw, rip, hand, 26".....	2
Screwdriver, 5" blade.....	2
Square, steel carpenter's.....	2
Tape, metallic, 50 ft.....	1
Square, try.....	1
T-bevels.....	1
Wrenches, monkey, 12".....	2

VII.

Reconnaissance Equipment.

Alidades.....	2
Boards, sketching.....	2
Chests, sketching outfit.....	2
Clinometers, service, with cases.....	2
Compasses, Box.....	2
Compasses, Prismatic, with cases.....	2
Celluloid sheets.....	36
Erasers, rubber, pencil.....	14
Holders, timing pad.....	2
Hand levels.....	2
Metallic tapes, in tenths, 150 ft.....	2
Note books, field.....	6
Page tallies.....	2
Pockets, pencil.....	2
Pads, timing.....	2
Paper, sketching, sheets, gross.....	1
Pencil, blue.....	4
Pencil, drawing H.....	4
Pencil, drawing, green.....	4
Pencil, drawing, red.....	4
Protractors, pencil point.....	4
Tape, adhesive, rolls.....	4
Tripods, wood, folding.....	2

VIII

Office Equipment.

Army Regulations.....	1
Defensive Measures against Gas.....	32
Desk, field (Unit A).....	1
Desk, field, (Unit B).....	1
Engineers' Field Manual.....	5

Engineers' Training Manual.....	5
Field Service Regulations.....	3
Infantry Drill Regulations.....	5
Manual of Courts-martial.....	1
Dictionary, French-English, large.....	1
Manual Interior Guard Duty.....	5
Mimeograph, small type, portable.....	1
Non-commissioned Officer's Manual.....	32
Small Arms Firing Manual.....	3
Typewriters, Underwood, 10" Carriage.....	2

IX

Workshop Equipment.

Anvils, 150 lbs.....	2
Aprons, leather.....	2
Bolt cutters, 1/2".....	2
Bolt cutters, 5/8".....	2
Brace, carpenter's.....	1
Chain Block, 3-ton.....	1
Chisels, cold, 1/2".....	12
Chisels, cold, 1".....	12
Calipers, outside, 6" pairs.....	1
Calipers, inside, 6" pairs.....	1
Chisels, square, hot, 1".....	2
Drills, post, 15".....	1
Drills, Yankee Breast, double speed, three jaw chuck No. 44..	2
Drills, Yankee Breast, small for drills ranging 1 to 60.....	2
Drills, Morris, straight shank, twist size from 1 to 60.....	1
Drills, 1/4" straight shank.....	6
Drills, 5/16" straight shank.....	6
Drills, 3/8" straight shank.....	6
Drills, 7/16" straight shank.....	4
Drills, 1/2" straight shank.....	4
Drills, 5/8" Square shank twist drills.....	2
Drills, 3/4" square shank twist drills.....	1
Drills, 7/8" square shank twist drills.....	1
Drills, 1" square shank twist drills.....	1
Drills to fit post drill chuck, 3/16".....	6
Drills to fit post drill chuck 1/8".....	6
Drills to fit post drill chuck 1/4".....	6
Drills to fit post drill chuck 5/16".....	6
Drills to fit post drill chuck 3/8".....	6
Drills to fit post drill chuck 7/16".....	2
Drills to fit post drill chuck 1/2".....	2
Drills to fit post drill chuck 5/8".....	1
Drills to fit post drill chuck 3/4".....	1
Drills to fit post drill chuck 7/8".....	1
Drills to fit post drill chuck 1".....	1
Dies and Taps, sizes from 1/8" to 2" pipe set.....	1

Dies and Taps, U. S. Standard machine screw, set, sizes 5/15", 3/8", 7/16", 1/2", 5/8", 3/4", 7/8", 1".....	1
Dividers, pairs	2
Dies and Taps, U. S. set of Standard thread 1/4", 5/16", 3/8", 7/16", 1/2", 5/8", 3/4", 7/8", 1".....	1
Forge, medium size.....	1
Flatters	2
Files, flat bastard, 16".....	3
Files, smooth, 16".....	2
Files, half-round, bastard, 16".....	2
Files, flat bastard, 14".....	3
Files, round bastard, 12".....	2
Files, round bastard, 8".....	2
Files, square bastard, 16".....	6
Files, square bastard, 12".....	6
Files, knife, 6".....	6
Files, warding, 4".....	6
Files, Mill, 12".....	12
Files, Mill, 8".....	12
Files, Mill, 6".....	12
Files, half round bastard, 8".....	12
Files, half round bastard, 6".....	12
Files, Mill flat, 4".....	6
Fuller set up to 2 3/8" size.....	1
Grease gun, Townsend.....	12
Handles, assorted, file.....	24
Handles, hammer, assorted.....	12
Handles, file, assorted.....	6
Handles	2
Hammers, sledge, 12-lbs.....	3
Hammers, ball pien, 2-lb.....	12
Hammers, ball pien, 1-lb.....	12
Hammers, cross pien, 2-lb.....	2
Hammers, cross pien, 3-lb.....	2
Hammers, cross pien, 4-lb.....	2
Hammer, set	2
Hammers, ball pien, 3-lb.....	6
Hammers, flat pien, 2-lb.....	6
Hack saw frame, 12".....	3
Hack saw blades, medium tooth, 12", doz.....	6
Hammer, sledge, with flat pien, 12-lb.....	1
Heading tools, set of six, set.....	1
Oil can, 1 pint.....	1
Oil stones, carborundum.....	4
Punches, 1/8".....	12
Punches, belt, 3/8".....	2
Pliers, combination, 6".....	12
Pliers, cline, 8".....	12
Pliers, cline, 6".....	12
Pliers, gas, 10".....	12

Pliers, gas, 12"	6
Rule, 2 ft. 4 fold	1
Rules, Stanley, joined, 6 ft.	2
Solder irons, 2-lbs.	2
Solder irons, 1-lb.	2
Scale, combination steel, Starret, 12"	1
Scale, steel Starret, 6"	1
Snips, tin, 14", pairs	2
Scrapers, bearing set	1
Scrapers, carbon, sets	2
Swedges, size 3/8" to 1 1/4", set	1
Square, carpenters	1
Screwdrivers, 3"	6
Screwdrivers, 6"	12
Screwdrivers, 8"	12
Screwdrivers, 12"	6
Screwdrivers, 16"	6
Tongs, blacksmith, straight	2
Tongs, gad, 3/4" to 1"	2
Torches, blow, gasoline	4
Vise, blacksmith, 70-lb.	1
Valve setting tools, 1 set of gas engine	1
Vise, machinist's, 4"	1
Vise, machinist's, 6"	6
Wrench, monkey, 18"	2
Wrench, monkey, 12"	6
Wrench, Stillson, 8"	12
Wrench, monkey, 8"	6
Wrench, Stillson, 10"	12
Wrench, Stillson, 14"	12
Wrench, Stillson, 18"	6
Wrench, Stillson, 24"	2
Wrench, monkey, 10"	12
Wrench, monkey, 16"	4
Wrench, monkey, 24"	2
Wrench, Westcott or adjustable, 6"	12
Wrench, Westcott or adjustable, 8"	12
Wrench, End to No. 27	12
Wrench, End to No. 25	12
Wrench, End capscrew and nut, A. L. A. M. set, size 1/4"-1"	12
Wrench, End U. S. Standard, capscrew and nut size 1/4" to 1 1/2", sets	6
Welding outfit, portable, oxyacetylene	1

88.

PROJECTS.

After receiving the reconnaissance report the unit commander prepares a project. This is submitted to Division Headquarters for approval. (See Paragraph 68).

The project generally covers the following points:

- (1) Map Reference.
- (2) Object of Proposed Operation.
- (3) Emplacements and Target.
- (4) Location of Billets Desired.
- (5) Assistance or material needed from Division, (Transport, carrying parties, etc.).
- (6) Safety precautions to be taken by Units holding Line.
- (7) Wind Limits, with Map.
- (8) Estimate of Time Required for Installation.

Signature.

WIND LIMITS.

88-A. Since the successful use of gas is largely dependent upon wind conditions, it is essential to establish rules governing the relation of the wind direction and velocity to the use of gas. The question as to whether gas can be used under the wind conditions of the day is determined for projectors and Stokes mortars as follows:

(See Fig. 37.)

- (a) The target area is plotted.
- (b) From the intersection (O) of the near edge of the target with the line of fire (x-x), lines (O-1) are drawn clearing all the salients of our trenches, for a distance of 5 kilometers on both sides of the target.
- (c) Lines (O-2) are then drawn making angles of 20° with lines (O-1). These angles (A) are the angles of safety.
- (d) Lines (O-3) are next drawn making angles of 15° with lines (O-2). These angles (B) are the angles of spread, over which the gas may be expected to diffuse.
- (e) The angle (C) remaining between lines (O-3) gives the wind limits for the operation.

If the direction of the wind is within these limits and its velocity is between 3 and 12 miles per hour the operation may take place; if otherwise, it should be postponed.

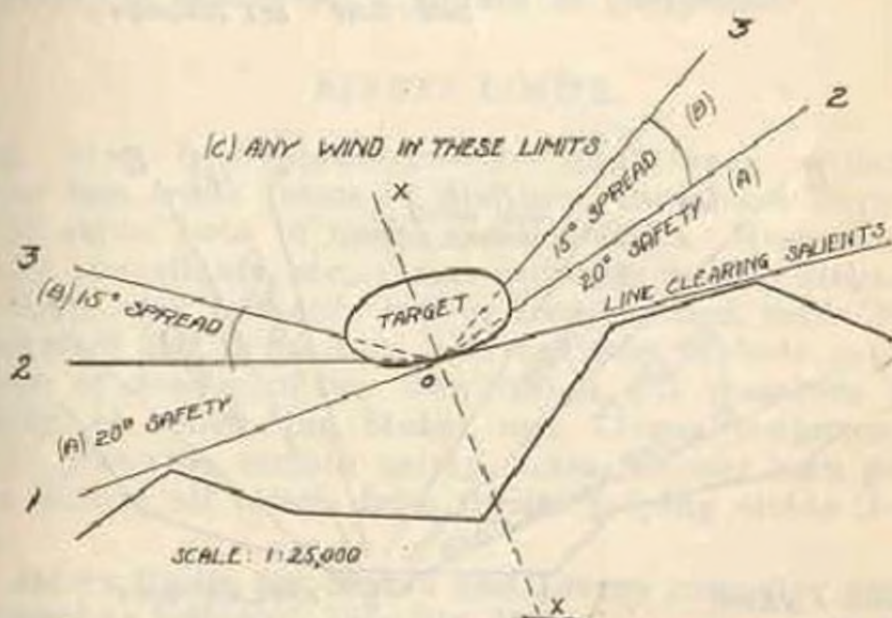
If the gas is to be discharged from cylinders, the wind limits are determined as follows: (See Fig. 38.)

- (a) The cylinder emplacement is plotted.
- (b) From the center of the emplacement (O), lines (O-1) are drawn to clear all salients in our own lines, for a distance of 10 kilometers on each side of the target.

FIG 37

PROJECTOR'S STOKES MORTARS

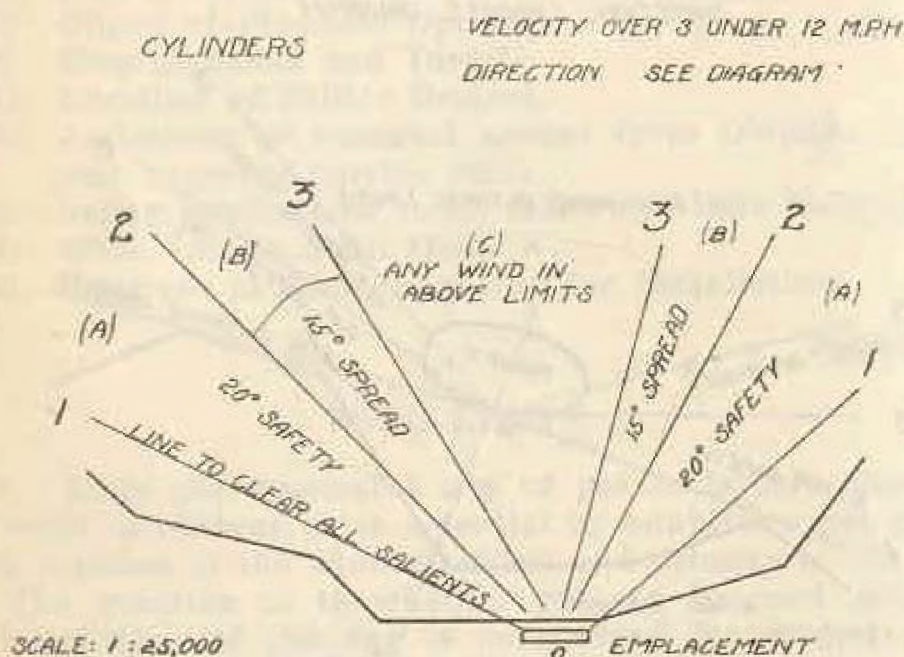
VELOCITY OVER 3 AND UNDER 12 MPH
DIRECTION, EXAMPLE DIAGRAM



- (A) 20° IS THE ANGLE OF SAFETY—MEASURED FROM A LINE FROM THE TARGET CLEARING ALL THE SALIENTS WITHIN FIVE KILOMETERS ON BOTH SIDES.
- (B) 15° IS THE ANGLE OF SPREAD MEASURED FROM THE INTERIOR SIDES OF THE SAFETY ANGLES.
- (C) THE REMAINING ANGLE GIVES THE WIND LIMITS FOR THE OPERATION.

SAFETY WIND LIMITS

FIG. 38



- (A) 20° IS THE SAFETY LIMIT—MEASURED FROM A LINE FROM EMPLACEMENT PRODUCED TO CLEAR ALL SALIENTS IN OUR OWN LINES WITHIN 10 KILOMETERS—ON EACH SIDE
- (B) 15° IS THE SPREAD OF THE CLOUD MEASURED WITHIN THE ANGLE ENCLOSED BY THE INTERIOR SIDES OF THE SAFETY ANGLES
- (C) THE REMAINING ANGLE GIVES THE WIND LIMITS FOR THE OPERATION

SAFETY WIND LIMITS

(c) Lines (O-2) are then drawn making angles of 20° with lines (O-1). These angles (A) are the angles of safety.

(d) Lines (O-3) are next drawn making angles of 15° with lines (O-2). These angles (B) are the angles of spread.

(e) The angle (C) remaining between lines (O-3) gives the wind limits for the operation.

If the direction of the wind is between these limits and its velocity is between 3 and 12 miles per hour the operation may take place; if otherwise, it should be postponed.

SAFETY LIMITS.

88-B. Since both Stokes mortars and Livens projectors are more or less crude forms of artillery, they have large dispersions of shots, both in range and deflection. Moreover, due to defective propellants, etc., shorts quite frequently occur. These short shots may fall only one or two hundred yards from the emplacement and if the fuse is armed they explode and become a source of danger to our own troops. It therefore becomes necessary in conducting Stokes and Livens projector operations to prescribe certain safety zones for our own personnel and to remove all troops from territory lying outside the safety limits.

The safety limits for Stokes and Livens projector shoots are determined as follows: (See Fig. 39.)

(a) The emplacement and target are plotted and lines are drawn between the lateral limits of each.

(b) Lines are next drawn making angles of 10° with the lines joining the emplacement and target.

(c) A second pair of lines is next drawn from the emplacement making angles of $(10^\circ + 30^\circ)$ with the lines from the emplacement to target.

(d) With the center of the target as a center, and with a radius equal to one-half the range, a semi-circle is described.

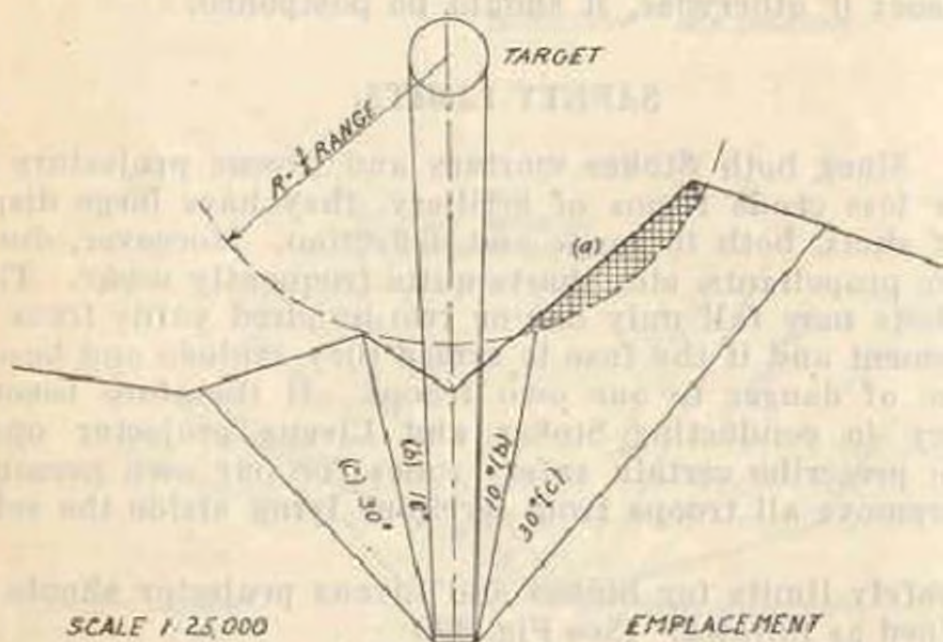
(e) Remove the infantry from all areas included between the line of trenches and the arc of the circle. See areas (a) on Plate.

(f) Remove all men from the area between the lines making angles of 10° with the lines from the emplacement to the target. See areas "b".

(g) All men should wear box respirators in the area between the lines making angles of $(10^\circ + 30^\circ)$ with the lines from the emplacement to the target. See areas "c."

(h) In order to avoid moving men, it is often advisable to place the guns nearer the trenches than the target is; that is, to choose a range that is less than twice the distance from the target to our own trenches.

FIG 39

PROJECTORSTOKES MORTAR

- (A) REMOVE INFANTRY FROM THE AREA INCLOSED BY AN ARC HAVING FOR A CENTER, THE CENTER OF THE TARGET AND A RADIUS EQUAL TO ONE HALF THE RANGE.
- (B) REMOVE ALL MEN FROM THE AREA BETWEEN THE LINES MAKING AN ANGLE AT THE EMPLACEMENT OF 10° WITH THE LINES FROM EITHER END OF THE EMPLACEMENT TANGENT TO THE TARGET
- (C) ALL MEN TO WEAR BOX RESPIRATORS IN THE AREA INCLOSED BY THE LINES MAKING AN ANGLE OF $10^\circ+30^\circ$ WITH THE ABOVE LINES
- TO AVOID MOVING MEN TAKE RANGE THAT IS LESS THAN TWICE THE DISTANCE OF THE TARGET FROM OUR FRONT LINE TRENCHES

SAFETY LIMITS

OFFENSE DIVISION, ENG. SEC. C.W.S. 5597

RECONNAISSANCE REPORTS.

89. After reconnoitering a position, a reconnaissance report is made out, giving the following data:

- (1) Reference map.
- (2) Division holding line.
- (3) Targets with map reference, and occupation.
- (4) Emplacement positions with map reference.
- (5) Recommend: No. of Projectors. Stokes Mortars. Bombs. Cylinders 2'6" - 2'9" - 4'0" No. and kind of each.
- (6) Number and kind of batteries and angle of fire of each battery.
- (7) Wind limits.
- (8) Billets for men; map reference.
- (9) Company dump with map reference. Method of getting material from battalion dump to company dump.
- (10) Detailed description of method to be used in taking material forward from company dump to battery position. Give route to be followed, number of trucks (3-Ton), light railway trucks, number of push trucks, etc., necessary; number of infantry carrying party necessary and length of time that the party will be used; map reference of all advance dumps; time necessary to take material forward; work that is to be done during the night, and that during daylight. Number of company men to be used in taking the material forward.
- (11) Battery positions, number of men necessary to install; work done at night or during daylight. Time necessary.
- (12) Total number of lorries necessary and length of time they will be used.
- (13) Total time necessary to complete the job.
- (14) Total number of men and officers necessary to complete the job.
- (15) Camouflage necessary; kind, color, etc.
- (16) Position of Company Commanders, Section Commanders, giving map reference, telephone number or name.
- (17) Communications from battery position to Company Commanders and to Battalion Commander if necessary.
- (18) Infantry Brigade, Regimental, Battalion, and Company Headquarters, with map reference and telephone number.

Signature.

OPERATION ORDERS.

90. These orders are issued by the officer in charge of an operation, after approval of his project, and generally so as to reach all organizations concerned about six hours before zero.

Operation orders cover the following points:

- (1) Map references.
- (2) Company operations, and purpose of operation (target).

(3) Installation, giving map reference of emplacement; number of guns; ammunition, etc.

(4) "D" Day and "H" hour if decided. It is usual to state "at a day and hour to be given later".

(5) Discharge orders.

(6) Wind limits—direction and velocity.

(7) Safety precautions; cleared areas, and box respirator areas.

(8) Synchronization of watches. Place and hour.

(9) Liaison and code words. This includes location of various P. C.'s and routine messages, such as wind, readiness, etc.

(10) Action after zero hour. Camouflaging.

(11) Copies to.....

OPERATION REPORT.

91. Immediately after an operation, reports are rendered to units concerned, usually Corps and Divisions.

The type of report rendered is shown on the following form.

OPERATION REPORT TO C. O. FIRST GAS REGIMENT.

Serial No.....
.....1919.

Reference Maps.

1. Headquarters
2. Gas units operating.....
3. Corps, Division and Brigade to which attached.....
4. Purpose of operation.....
5. Wind limits
6. Map reference of emplacements.....
7. Map reference of targets.....
8. Enemy regiments affected.....
9. "D" Day..... "H" Hour.....
10. Wind direction and velocity: weather conditions.....
11. Number installed. Cylinders. Projectors. Stokes Mortars. (And type of gas used.)
.....
12. Number fired
- Percentage fired
13. Reason for discrepancies (in any)
14. Enemy action before, during and after attack.....
15. Casualties. (Names of officers, regimental numbers of other ranks, since reconnaissance.)
.....
16. Time taken and men employed on operation.....
17. Infantry assistance obtained for operation.....
18. Remarks.....
19. Operation order and map attached.
(Should be sent previously when possible.)

Copies forwarded to:

.....
.....
.....

Signed:

C. O.....

TACTICAL USE OF GAS, THERMIT AND SMOKE BY
GAS TROOPS.*Gas.*

92. The amount any kind of gas used by gas troops should conform to tactical conditions, having due regard for wind and terrain conditions.

93. Gas may be correctly used as follows:

I. In an active offensive:

(a) Preceding an attack, all enemy targets should be kept under a gas atmosphere, allowing only a reasonable time for clearance before the arrival of our troops. Only by so doing can the full benefit be derived in producing casualties, demoralization, reduction in fighting efficiency, and morale.

(b) During a temporary check of an advance, extending from a few hours to several days, gas should be used on enemy concentrations, villages, strong points, woods, reverse slopes and machine-gun nests.

(c) During organization and consolidation of the line, gas should be used as for a temporary check, with special attention to sectors from which counterattacks may be launched.

(d) During nights of an advance gas should be used on enemy supports and reserves, and on machine-gun nests and strong points.

(e) Against machine-guns just before an attack, a judicious use of gas by Stokes Mortars is an effective means of handling this form of defense. Placing from two to ten bombs of phosgene, depending on wind and terrain conditions, in a machine-gun nest establishes a local concentration sufficient to kill and force enemy to wear masks or abandon guns. The gas will have dissipated sufficiently by the time of arrival of our own troops to be safe. Close co-operation between the advanced infantry units and gas troops will allow this result. Troops must become accustomed to the smell of slight concentrations of phosgene, and should be taught to advance through or around it, just as they are trained to follow a barrage.

II. In stabilized warfare:

(a) Surprise shoots of high concentration may be used on enemy concentrations, machine-gun and minenwerfer emplacements, strong points, trench intersections, and from one end of the line to the other, when conditions are favorable.

Thermit.

94. Thermit may be used under conditions similar to I (e) or II, above, when conditions of wind or terrain prevent the use of gas.

Smoke.

95. The intelligent use of smoke in modern infantry tactics offers many advantages arising from concealment and deception.

Smoke may be correctly used by gas troops as follows:

(a) To mask enemy observation posts and blind hostile machine-guns.

(b) To cover front and flanks of attacking troops. In frontal screens care must be exercised to place the smoke screen, preferably on the enemy trench system, so that an enemy barrage laid on the screen will not catch our own advancing troops.

(c) As a feint to draw the enemy's attention to a front which it is not expected to attack, causing him needlessly to retain troops and expend ammunition.

(d) Deceptive screens to simulate general or local attacks. Gas should generally be used with smoke in these cases. A proper use of gas in connection with smoke screen work will cause the enemy to expect gas whenever smoke is used. This offers a tremendous advantage to our own troops.

(e) To conceal concentrations of our guns and troops, and to screen roads and movements.

(f) To cover construction of bridges and trenches in the face of the enemy.

The use of smoke should be such as to lead the enemy to expect some object other than the real one.

CHOICE OF WEAPONS.

The Stokes Mortar.

96. The mortar gas bomb is adapted to any of the cases set forth in Par. 93 above. The mortar is especially useful in an active offensive where its mobility permits it to be pushed far forward and brought into operation on short notice. With efficient transport, gun teams can readily follow the reserve battalions of attacking regiments and be brought into action when required on enemy machine-gun nests or concentrations within two hours. This weapon is particularly adapted to the formation of local high concentrations, and is one of the best means of silencing hostile machine guns or minenwerfers within range.

The mortar smoke bomb is used effectively under all conditions given in Par. 95, above. The mortar thermit bomb is used primarily for its demoralizing effect, against enemy machine-guns, or concentrations within range. It is not as effective as gas, but can be used irrespective of wind directions. It may at times be used where conditions are unfavorable for smoke, or in addition to smoke, on strong points, trench intersections, and machine-guns. It has a considerable terrorizing effect.

The Projector.

The projector gas drum, with its thirty pounds of gas, is an excellent weapon for producing high concentrations in surprise shoots. It is especially effective against enemy concentrations, in villages and woods.

Due to its longer range, it can be used when Stokes mortars cannot. On the other hand, the weight and bulk of the equipment hinder its use on a rapidly moving front. With a length of carry not to exceed 500 meters from the limit of mortar traffic to the emplacements, from 100 to 150 projectors can be installed and discharged in one night by one company. This makes the projectors an efficient weapon during temporary checks, or during organizations and consolidation of the line.

Projector drums filled with high explosive may be used whenever wind conditions prevent the use of gas. They contain large charges in a case which is much lighter than an artillery shell, and are very deadly against troops in the open. They may also be used to demolish wire.

Projector drums may be also filled with oil, but as such have not yet been used by our troops. They would be useful in burning woods, or as a demoralizing agent when gas could not be used.

Cylinders.

A cylinder gas attack against suitable targets is undoubtedly the most effective means of using gas. High concentrations may be established over wide areas, and to depths of 10 or 15 kilometers. Even when the enemy has been aware that an attack was probable, there have been casualties amounting to nearly 10% of the enemy forces in the area affected. In addition, the gases, being highly corrosive in high concentrations, attack the metal parts of all guns and rifles.

A cylinder attack, with a suitable wind, may be made immediately preceding an attack along the entire front. It can be closely followed by the infantry and will succeed in thoroughly breaking the defense.

97.

SELECTION OF WEAPONS.

The determination of the kind of gas attack to execute depends primarily upon the time available, nature of terrain, and target, range, and wind. The selection of weapons should, therefore, not be made until after a thorough tactical study of the situation.

TRAINING OF GAS TROOPS.

98. In the training of gas troops it must be kept constantly in mind that they are strictly fighting troops who will be required to carry on their operations in the foremost areas.

They must be trained to insure correct technical execution with their special equipment, as well as to know to handle themselves in action as Infantry, and take care of themselves in all emergencies of front line work.

The course as outlined herein is of the most intensive character, but must be considered of an emergency nature made necessary in order to place troops in action at the earliest practicable moment.

In addition, the assumption is made that the troops are organized and equipped, have a full complement of officers and at least half of their non-commissioned officers, and that they have received preliminary instructions, including the simpler close order movements up to and including the Battalion Parade.

99. The course is divided into two phases, the first consisting of eight weeks and the second four weeks. The first phase consists of the school proper and is divided roughly as follows:

(a) Four weeks or forty-four drill periods devoted to special training in the use and operation of the special equipment.

(b) Two weeks or twenty-two periods to Infantry training.

(c) Two weeks or twenty-two periods devoted to target practice, instruction and firing.

The second phase covers four weeks, during which platoons or sections will be attached to units of experienced troops actually operating at the front. During this phase troops under instruction will assist the experienced troops by providing additional labor and gradually working into the operations, fixing the work of the first phase definitely in all details, under the conditions met with in actual operations at the front. Where it is impossible to do this, an additional four weeks should be allowed and the entire phase used in improving discipline, technical execution, and the carrying out of operations under all simulated conditions, of front line work.

PRINCIPLES TO GOVERN THE TRAINING.

100. Underlying all instruction must be a keen fighting spirit. Both officers and men must be made to appreciate from the very start that the ultimate and sole object of the work of this organization is to produce enemy casualties and assist other organizations to produce enemy casualties. Its success and value to the Army and our country can be measured directly in enemy casualties. Gas troops will be carefully instructed in their part in the team work necessary to the success of tactical operations in which they may be engaged, especially in the necessity of giving loyal and faithful service to the commanding officer of the Infantry unit under whose orders they may be directed to operate.

Officers and men must appreciate that absolute discipline, and compliance with orders and instructions are not only essential to greater direct success but also afford the only real means of protection against large casualties in our own personnel.

Officers and men must not be allowed to drill in an indifferent or aimless manner. The picture of actual combat must be kept in the mind of the instructor and transmitted to those undergoing instruction.

Lectures will be reduced to a minimum, made brief and whenever possible given in connection with explanations and demonstration of equipment in the field.

Gas defense training will be continued during the entire course of training, using any available time and under conditions which will leave every man capable of protecting himself in extreme emergency.

SCHOOL PHASE.

101. It is essential that the officers who are to actually lead the troops be trained with them, and know their men. This necessitates dividing the personnel into six classes, dividing along tactical lines of the units where possible. These classes are as follows:

Class A—One-half of commissioned personnel.

Class B—One-half of commissioned personnel.

Class C—One-half of non-commissioned personnel.

Class D—One-half of non-commissioned personnel.

Class E—One-half of remainder of units.

Class F—One-half of remainder of units.

Classes A, B, C and D will be given sufficient actual field training with the special equipment to insure not only a thorough understanding, but also correct mechanical execution. Officers will be trained separately from the other ranks, and will be required to actually handle and carry loads, use the pick and shovel, and do all the practical work. They will also carry out operations, including transportation of material, both before and after the operation.

GENERAL TRAINING.

102. Throughout the course of instruction the strictest attention will be paid to discipline, the routine administration of the units, and in as far as possible, the routine functioning of officers and men.

Strict attention will be paid to the performance of guard duty. Messing arrangements will be carefully supervised and additional training given in the handling of rations. Billeting of the men will be given careful consideration. Sanitation and proper policing will be carefully watched. Bathing of the men will be done by schedule and supervised.

In the general training stress must be laid on the absolute necessity of learning routine administration, the proper handling and care of men under the better conditions of the rear areas, or training camps, so thoroughly that both officers and men will be able to take care of themselves under the adverse conditions of the front line work. Discipline and insistence on the performance of every detail of this work is essential.

EQUIPMENT AND SUPPLIES.

103. Chiefs of parties will anticipate their needs and place requisitions well in advance of time required, to insure delivery at advanced dumps. The minimum allowance of ammunition is as follows:

	Stokes Mortars.		
	Live.	Dummy.	Projectors.
Officers	20	20	5
N. C. Officers.....	10	10	2
Men	5	5	1

The Stokes Mortar ammunition will be furnished in the following proportions:

Phosphorus	2
Ranging	1
P. S.	1
Thermit	1

Instructors will insure accuracy of operations before expenditure of live material. In the use of live material every effort will be made to approximate actual conditions at the front, giving due consideration to tactical use.

DETAILED INSTRUCTION.

104. Instructors will be required to prepare and carry out the actual instruction in accordance with their experience and all information available, with due regard to prescribed standard practices. Instructors will not introduce personal specialties until approved, or endeavor to cover little used schemes. Instruction must be clean cut and definite, covering fundamentals and leaving variations and changes to be worked out in the field.

The working out of definite schedules covering the training should be made by the officer in charge of the instruction in advance, for the entire period of the school phase. With definite information as to the length of time available and with all other conditions known, it will be possible, using the outlines which will follow, to cover the entire course. It can be covered in the outlined time, if the work is organized and every officer and man is required to give his entire time and thought to it.

By dividing the two classes of personnel into two sections it is possible to have one-half the officers and non-commissioned officers with the men during all periods of their training, and, by making the instruction progressive, that is, training the officers and non-commissioned officers first, they can be used to supervise the work of the men; for instance, in Stokes mortar work, one-half of the officers and non-commissioned officers can be given training in Stokes mortar bombs, their construction and weights, and the same instruction to the men in the afternoon with these officers and non-commissioned officers present actually supervising the work of the men.

Evening conferences followed by written quizzes should be held for officers five nights a week during the entire period of training.

Classes along similar lines should be held for non-commissioned officers, except when night marches and operations prevent.

Attention is again brought to the importance of absolutely correct execution of every detail of training, whether it is insistence on the observance of military courtesy, proper feeding of the men, sanitation, guard duty, march discipline, preparation of ammunition, care of equipment, and the work in the field actually simulating front line conditions. In operations in the field men will be required to wear shrapnel helmets and carry gas masks properly adjusted.

First aid stations will be established in their proper relative positions in accordance with the assumed tactical disposition, and the Medical Department will be required to function as it would under actual front line conditions.

In the preparation of problems ingenuity will be utilized so as to make no two problems the same, and every effort will be made to develop resourcefulness and ability to carry on under all conditions.

Officers must be made to realize that the only too limited training and experience, which they will be able to get in the short time available, will not only tax their abilities to the utmost when they take their units into action, but also that once in action mistakes are inexcusable and are measured in the lives of their men.

In night work both the officers and men must be trained to carry out the operations on the darkest nights over unfamiliar ground, carrying parties must actually carry their loads properly to a definite destination, having the same checked carefully before starting, during the march and at the destination.

In the outline to follow short synopses will be given covering points which must be included in the instruction and which are pertinent to this special service.

105.

INFANTRY TRAINING.

- (1) Physical Training.
- (2) School of the Squad.
- (3) School of the Platoon.

In the work of the gas troops the platoon is the working unit and it should be an entirety in itself. It should be trained as a unit and should work together. It should be so organized that it can undertake independent operations.

- (4) School of the Company and the Battalion.

Ceremonies should be given a prominent place in the schedule. As the training progresses and the units are split up undergoing technical training, the parade and review offer the best means of keeping the men set up and snappy.

- (5) Guard Duty.

Formal guard mounts should be held, especial care must be taken in the instruction of sentinels; they must be made to realize the serious nature of their charge when posted as sentinels, in time of war. Any laxity in the training area may result in the gravest offense in the forward area.

- (6) Extended Order.

In the close order work correct execution should be the keynote. This should be obtained at once, and the extended order taken up at the earliest opportunity, maintaining just sufficient close order work to keep the men set up and in hand. Extended order instruction should progress as rapidly as is consistent with correct execution to field maneuvers with especial reference to service of security, patrolling, inter-communication and thorough control.

- (7) Full marching order.

In forward areas the men will be required to make many marches under full pack, frequently bivouacking in the open. They will be trained how to carry the essentials, and only the essentials, as well as how to go into bivouac and take care of themselves. Only by doing this frequently, and under the closest supervision, will it be possible to carry on efficiently forward where every ounce of energy of both officers and men must be conserved.

- (8) Fighting Order.

Men should be required in all field operations to go equipped as they would actually go into action, with the exception of rifle ammunition, which should be used during the last week of their training but after they have had range practice. An itemized statement showing fighting order is attached as Exhibit A.

- (9) Gas Defense Training.

In the first drill periods careful instruction must be given in the correct mechanical adjustment of the respirators. This in-

struction must be followed up during the entire period of training by frequent drills so as to insure prompt and correct adjustment under all conditions. This is of special importance in night work, and night marches should be made with the respirators adjusted. Men should be trained to fire Stokes Mortars with respirators adjusted. Instructors will pay special attention to requiring men to adjust the mask at odd times when engaged on other work, such as digging-in projectors, carrying material forward, and the like.

The use of a mild lachrymator will materially assist in showing the importance of this work and assist in checking up delinquencies.

(10) Lectures.

(a) Military Courtesy.

(b) Organization of the Regiment, Battalion, Company and Platoon. Spirit of the organization.

(c) Sanitation.

(d) First aid in case of battle wounds.

(e) Care of Gassed cases.

(f) Articles of War.

TARGET PRACTICE INSTRUCTION.

(1) The rifle and its care.

(2) Position, aiming and trigger squeezing drills.

(3) Range practice.

The importance of target practice cannot be over-emphasized.

At least a fourth of the command should be kept at this work during the entire time of the training.

(4) Estimating of distances.

This should not be perfunctory, but the men should be actually trained to estimate distances correctly and the work should be included during the entire period devoted to target practice, utilizing the time when the men are not actually firing or taking care of their rifles. Officers will be required to estimate distances in connection with Stokes mortar operations in war of movement. This training should be supplemented by work in the trench mortar training.

TECHNICAL TRAINING.

106. This work is outlined in periods covering the work which should be presented to the officers and followed by an outline covering the sequence to be taken up in the training of the units.

107. 4-INCH TRENCH MORTAR.

- (1) (a) The mortar, its construction, weight of the various parts, method of setting up, and explanation of its operation.
- (b) Mortar Drill.
- (c) Dummy loading.
- (d) Explanation of range tables.
- (2) (a) Bombs, their construction, contents and weights.
- (b) Propellants and ranges obtained.
- (c) Fuses and fuse setting.

In this work equipment should be used supplemented by drawing and cross-sections of the actual material.

- (3) (a) Construction of emplacements, and the importance of good solid foundation for base-plates.
- (b) Setting up mortars and firing same.
- (4) Map reading, laying out lines of fire with map, protractor and compass.

All officers and the senior non-commissioned officers must be thoroughly trained in map reading.

- (5) Characteristics of the active materials used in the bombs.

- (6) Tactical use of Trench mortars.
 - (a) Smoke and Thermit.
 - (b) Gases.
 - (c) Precautions to be taken in the use of the materials.
- (7) Drawing, cleaning and testing mortars and ammunition and their preparation for action.
 - (a) Gun inspection and checking up of guns and tools.

Inspection must not be slighted. Tools should be definitely assigned to the different members of the gun teams and they must be required to accept the responsibility for them. Any laxity in this feature is sure to result in the handicapping of operations sooner or later at the front.

- (8) Methods of making reconnaissances and points to be observed.

- (9) Preparation of personnel, guns and ammunition for action.

- (a) Duties of all ranks in action.
- (10) Operation orders and operation reports.

- (11) Actual firing by day and night simulating actual front line conditions in accordance with assumed tactical situations.

Officers should be given a written examination at the completion of the training with each weapon.

- (12) Training of the men should be taken up in the following sequences.

- (a) Explanation of setting up mortars.

(b) Trench mortar drill, practice in loading with dummy mortars.

(c) Lectures on propellants, bombs and ranges. Recapping and cleaning of shells and fuses.

(d) Digging-in base-plates, setting up guns, camouflage.

(e) Firing with reduced charges.

(f) Firing full charges.

(g) Complete installation and laying down a smoke barrage.

(h) Firing at night.

(i) Actual carrying out operations, both day and night, up to and including the use of live materials.

PROJECTORS.

108. History of the projector, its development, construction and effectiveness.

Explanation of the material used in the construction of gun, base-plate, propellant, charge box, lead wire and exploder.

Explanation of construction of drums, fuse head, gaine, detonator and contents of bombs.

Weight and dimension of the gun and accessories. Range with various charges.

Methods of installation, connecting up and firing.

Lines of fire, by map, protractor and compass. Laying out of battery base lines. Digging of battery trenches.

Careful account must be taken of the nature of the ground and the time required to make a normal installation. By choosing different sites it will be possible during the course of training to obtain a definite idea as to the time required to make installations in the forward area. This will be of the greatest assistance in planning operations and estimating correctly the time required to carry them out.

Installing guns and checking lines of fire with a compass, and elevation with clinometer.

Handling of drums, fuses, detonators, charge boxes and exploders.

Assembly of drums, of gaine tubes and detonators.

Cutting of fuses. Loading guns.

Wiring of batteries, including drill with exploders.

The greatest care must be exercised in this training, and a thorough system worked out. One of the greatest sources of trouble in actual operations is in not having the wiring correctly done, or in getting the wiring of several batteries mixed up. Careful training must be given in the use of the exploder and special men trained in its use.

Testing of circuits and drawing safety pins.

Disconnecting batteries, unloading and storage of drums and charge boxes.

In the handling of live materials in the forward area special precautions must be taken to prevent the accumulation of large quantities of drums in a exposed position. Dugouts or protected locations must be found.

Testing exploders, charge boxes before placing in tube, battery connections, battery connected to lead wire, with explanation covering galvanometer, resistance box, and resistance of the different elements.

Instruction in the complete installation of batteries ready to fire under different conditions of terrain and weather, including work at night.

Characteristics of the active materials used in the drum.

Tactical use of projector.

Location of emplacements, wind limits and safety zones.

Methods of making reconnaissances and points to be observed.

Preparation of personnel, guns and ammunition for action.

(a) Duties of all ranks in action.

Operation Orders and Operation Reports.

Organization of a complete projector attack.

This will include the initial reconnaissance with a decision as to emplacement positions; number of batteries; method of transporting material, by trucks, rail, animal or personnel; routes to be used; location of nearest Headquarters with telephone; location of our own front line or outposts; arrangements for withdrawal of infantry; estimates of time required; making out list of material and drawing same; organization of materials, installation; carrying on of liaison; meteorological work, camouflage; testing; firing; inspection for duds, firing same; leaving position; preparation of necessary reports, and salvage of material.

Training of the men should be taken up in the following sequence:

- (1) Parts of the projector, drums and all accessories.
- (2) Digging of projector trenches, placing and sighting of projectors.
- (3) Preparation of charges and fuses.
- (4) Wiring and firing.
- (5) Organization of carrying parties and their training.
- (6) Training in the use of the testing apparatus and exploders.
- (7) Complete installation of single battery including camouflage.
- (8) Carrying out complete projector operations under different conditions of terrain and lengths of carry.
- (9) Carrying out of complete projector operations in keeping with assumed tactical situations at night.

109.

CYLINDERS.

The cylinder, its construction, weights of the various parts, and explanation of its operation.

Instruction in handling installation, connecting up and firing.

Characteristics of the active materials used.

Tactical use of cylinders.

Reconnaissance and arrangements for a cylinder attack.

Preparation of personnel and all materials for carrying out of cylinder attacks.

Field work in actually carrying out cylinder attack.

Operation Orders and Operation Reports.

Organization of a complete cylinder attack, with its execution in every detail.

Training of the men should be taken up in the following sequence:

(1) The cylinder, its construction, and explanation of its various parts.

(2) Wiring and connecting.

(3) Installation of batteries and firing.

(4) Preparation and carrying out small operations.

(5) Carrying out larger operations, with special attention to the handling of material over considerable distance and an extended front.

(6) Operation in keeping with an assumed tactical situation at night.

110.

SPECIAL INSTRUCTION FOR OFFICERS.

In the conference and by special lectures, special training can be given to the officers covering the detail of their work which applies to efficient fighting of the organization. Such subjects as meteorology and liaison, making of reconnaissances, preparation of orders, and the writing of reports are common, in general principles, to all operations.

The training should be sufficiently thorough as to make an officer ready to go into a Division Headquarters, state his business, and from there on down through Brigade, Regiment and Battalion, making all necessary arrangements, carrying out the necessary reconnaissances, organization of the complete operation and carrying it through to a satisfactory completion which in all cases must be in full accord with the plans and existing situation confronting the unit with which he is working.

In addition to supplementing the work as outlined above, special subjects with notes are given below.

111.

A SPECIAL LECTURE.

(a) Importance of supporting senior officers at all times.

(b) Necessity of cheerfulness, especially in action, and in the presence of enlisted men when under severe conditions.

(c) Speed in all preparatory work as far as is consistent with thoroughness. This can be done by making careful plans beforehand for any work in course of operation.

(d) Knowing where all enlisted men are and being able to have a platoon turned out quickly for duty and in proper fighting order.

(e) Personal knowledge of the sector on which the company is operating especially the motor truck roads, horse-drawn wagon roads, railheads and termini of trench tramways, distances of mule tracks or trails, distance of hand carrying for personnel.

(f) Ability to look ahead and provide for unforeseen contingencies. Give instances of guides going astray; traffic choked on roads; loss of time in getting command ready; not making proper rendezvous for infantry carrying party; not making proper reconnaissances in daylight and losing time in finding way at night; not drawing supplies complete, and having to go back for same; leaving the carrying till the last night before the attack, and then having all "up" trenches blocked by infantry when same could be avoided; leaving work until last night, and then being rushed; overloading of motor trucks in bad weather; failing of material to arrive in time; not selecting good men for guides and runners; bad liaison; despatching supplies without proper guides and with insufficient instructions.

(g) Personal interest in all matters affecting billets for men, their health, food, clothing, and sanitation.

(h) Giving good men every encouragement for advancement and "scrapping" unreliable non-commissioned officers.

(i) Careful supervision of work and realizing that the officer is personally responsible for his subordinates. Responsibility cannot be delegated to non-commissioned officers unless officer becomes a casualty.

(j) Officers must not discuss their business in the presence and hearing of clerks or enlisted men. Orders can be issued to non-commissioned officers and men when the final course of action is decided upon.

112. ORGANIZATION OF THE DIFFERENT ELEMENTS OF AN ARMY.

The officers should be given a complete explanation of the functioning of the elements of an army, such as Corps and Division Headquarters. This should be covered in detail, as to when to take up questions of operations, intelligence and supplies. They must be made to realize that in the conduct of active operations every man in the unit has definite duties to perform, that it is necessary to see the right man, state the

business explicitly, and generally work into the organization so as always to be of assistance and never a hindrance. Only in exceptional cases is it warranted to request special consideration or break into the regularly established functioning of the larger organization.

113.

LIAISON.

It is important to select smart intelligent men as runners. They will be men who are above the average in soldierly qualities, but not mature enough for non-commissioned rank.

They will receive the same training as other enlisted men, but when they have learned the technical work and drill, they will be given special instructions in map reading, use of the compass, finding their direction at night, and carrying verbal messages from Battalion or Company Commanders to Company Officers without any alteration.

During practice operations on the training ground they will be used by the officers in conveying code messages relating to the operation and they will be practiced at night, getting across country after dark.

Each officer will select and train two runners for his own use. He will be responsible that these men are fit for the job, and that they realize the importance of the duties in hand.

When companies move up to battle positions, these men will be required to accompany officers on reconnaissances of the advanced line, to act as guides for carrying parties, as runners attached to an assaulting battalion, or left as runners to wait important messages at a Divisional, Brigade, Regimental or Battalion Headquarters. When on the last mentioned duty, they must not leave the message center or headquarters day or night until relieved.

They must have a good sense of direction and be able to find their way over desolate country at night with few visible landmarks.

When moving about in the advance zone an officer will be accompanied by at least one runner, so that the latter will have a thorough knowledge of the country and be in a position to convey messages from his officer at any later time to the company headquarters, or to any infantry headquarters. This is especially necessary during an operation where the officer is busily engaged in his work of preparation, and has to send back reports of progress of same.

Operation reports from platoon commanders. Importance of furnishing same without delay.

Use of telephone lines from battalion and advanced regimental headquarters; use of telegrams from divisional message centers.

Use of "Courier" dispatch services from Division M. C. to Corps M. C. and Corps M. C. to Army M. C.

Importance of complete chain of liaison from battalion to company and company to platoon or detachment for operation.

Importance of complete chain of liaison from platoon to advanced battalion when in action.

114. SERVICE OF SECURITY AND INFORMATION.

This should follow the principles laid down in the Field Service Regulations with special attention to the following:

Secrecy.

The success of these operations depends largely upon the attack being a complete surprise to the enemy. Codes must be used. Care should be exercised in the use of telephones. Telephones should not be used for conversation in "clear" or at regular intervals, as in the transmission of meteorological data. When operating with other units in the line greatest care must be exercised so as not to indicate increased activity. The regulations in force in the particular sector must be strictly complied with.

Camouflage.

The simpler principles should be covered which will allow an officer to decide as to color and texture of material quantity and dimensions of artificial material, as well as to make the best out of natural concealment in woods and accidents of the terrain. Track discipline is of especial importance. The position should never be left either before or after firing before it is thoroughly camouflaged.

Frequent aerial photographs should be obtained as work progresses on the larger operations.

Meteorology.

There are certain fundamental principles in meteorology which every officer should understand. All gas operations are dependant in more or less degree upon wind and weather conditions, but with an understanding of the simpler principles and complete data, not only from the Meteorological Service itself, but from that obtained by the Meteorological Sections of the units themselves, it is possible to predict and make a much larger use of gas than would otherwise be possible.

This is so important and will be of such greater importance in future operations that this knowledge must be obtained. The safety limits must be thoroughly understood.

Service of Supply.

Under this should be covered all the details of supply, whether automatic or otherwise, and a definite understanding had as to the procedure in each case.

Map Reading and Making.

It is not only disgraceful but criminal for an officer to take his men into action over unfamiliar ground without the ability to keep himself properly located at all times.

Organization of an Attack.

Operations such as the gas troops must carry out frequently necessitate the movement of large amounts of material and use of a considerable number of men. As in any other operation it requires careful planning and organization. Time is an essential element and must always be taken into consideration.

If normal contingencies are allowed for, the adverse conditions of front line work will usually add sufficient difficulties to tax the energy and ability of all concerned without allowing for mistakes and lack of supplies.

Writing of Orders.

All officers must be trained to write clear, complete and correct orders covering units which they will be expected to lead. After a thorough explanation of the necessity and the details to be covered in an order, practical instruction in connection with actual operations undertaken in the general training will usually suffice if these orders are carefully checked and mistakes corrected.

115. TRAINING OF SPECIAL DETACHMENTS.

Meteorological Section

Eight men in each Battalion should be thoroughly trained to take and properly record meteorological data. They should know how to interpret data received from the Meteorological Service and apply it to local conditions.

A regular system should be instituted in each Battalion and Company so as to keep all officers thoroughly informed as to wind and weather conditions.

Runner Service.

Each battalion and company should have four trained runners and each platoon leader two trained runners. These men should be carefully selected, intelligent and resourceful. They must be instructed in the operations of the units and their relation to the other troops with which the unit is operating. They should be trained to carry messages correctly under the most adverse conditions, and must be made to realize that upon their work the failure or success of an operation may depend.

While they must be given special training throughout the entire period of instruction they must also function with the units themselves in carrying out the field operations. Officers cannot devote too much time to the selection and training of these men.

116.

EXHIBIT A.

Fighting Order.

- (1) Clothing worn on the men as issued.
- (2) Rifle, bayonet, and ammunition. (100 rounds.)
- (3) Accoutrements as issued, with the exception of the pack. In going into action the pack is dropped and left under guard.
- (4) Small box respirator.
- (5) Shrapnel helmet.
- (6) In haversack—reserve rations, toilet articles, mess kit.
- (7) Canteen filled with water.

Men must be trained to drink sparingly and a most careful supervision given to a renewal of the supply.

Men are forbidden to carry any letters, papers, orders or sketches which may convey information to the enemy. Men will be warned not to give any information, but name and rank in event of capture. These points should be checked up at frequent intervals during the course of training.

EXHIBIT B.

AMERICAN EXPEDITIONARY FORCES,
HEADQUARTERS FIRST GAS REGIMENT.

SECRET

August 15, 1918.

From: Chemical Adviser and Intelligence Officer, 1st Gas Regiment, A. E. F.
To: Commanding Officer, 1st Gas Regiment, A. E. F.
Subject: Report of Reconnaissance.

1. Map reference.
Emplacement Presnos-on Woevre Vigneulles 3:1-10,000.
Target: St. Mihiel, 3:1-10,000.
2. Second Division of Second Corps of Second French Army holds this sector.
3. Target is a Battalion Headquarters, Depot of Stores, Ravin de Conouseveaux 42.15 (42.40) 52.12.
4. The emplacement position is in Ravin de Souvaud 42.30—53.24.
5. Installation recommended:
200—2'6" projectors. Ammunition C. G.
100—2'6" projectors. Ammunition N. C:
6. Install as fifteen batteries. Angle of fire true South.
7. Target distance is 1130 meters. Charge recommend is thirty-six ounces of cordite in 5¾ inch charge box.
8. Wind limits are 5 through North to 25.
9. Billets at Rupt on Woevre or nearer the line.
10. Railroad transportation to Rupt on Woevre- advanced dump in woods near P. C. Liege, 41.80—53.57. Material can be brought to this point at night by trucks carefully managed and separated.
11. Light wagon transportation to 42.42-53.44 (700 metres), then through Boyou 7 by Observatoire Bruery, through Boyau Guillaume and into Ravin de Sonvaux. (At night better transportation, and much shorter, could almost certainly be obtained directly over the top from wagon to Ravin, making a carry of two hundred or three hundred meters).
12. Estimate that one company should be able to transport material from Rupt on Woevre and install guns in two days. Position can be visited in daylight but work cannot be done owing to aeroplane observation. Transportation to advanced dump only at night.

13. The haul from Rupt on Woevre to advanced dump is about eight kilometers. The total weight to haul, about 25 tons. Four 3-ton trucks should handle the transportation in one night to advanced dump (not including men, water and provision). Light transportation of some kind for 700 meters should be provided.

14. Two days for one company will be required for installation.

15. Green serum to cover 300 projectors is necessary.

16. Company Commander should be in P. C. Liege, 41.80-53.57.

17. Communication from battery position to commanding officer by runner.

18. Base-plates should be used.

19. Ravin des Fouilles can be gassed from the same position, using four foot guns and same line of fire. This is well worth attempting with four hundred guns, if carry can be arranged.

20. Stokes mortars can be used from the front line near the above emplacement to advantage. Exact best location not determined.

J. E. Mills,
Captain, 1st Gas Regiment.

118.

EXHIBIT C.

HEADQUARTERS
2ND BATTALION, 1ST GAS REGIMENT
AMERICAN E. F.

COPY NO. 1.

September 1, 1918.

SECRET

Operation Order No. 41.

Map reference, Vigneulles "A", 1-20,000.

1. The following targets will be engaged by projectors at a time to be specified later ("D" Day—"H" Hour).

PROJECTOR.

Target.	Emplacement Site.	No. of Projectors.	
42.90-52.50			
43.29-52.72	42.11-53.52	340	C.G.
43.35-53.64	to		and
43.01-52.41	42.22-53.53		N.C.

2. Our line at emplacement sites held by 26th Division, 5th U. S. Army Corps.

3. Projectors will be installed by Company D, 1st Gas Regiment, assisted by platoons from Companies E and F.

4. Watches will be synchronized with 5th U. S. Army Corps time.

5. Discharge of projectors will be at "H" minus four hours, Batteries will be inspected and unfired guns will be discharged twenty minutes after original discharge.

6. Projector attack will not take place unless the wind is from 27 through WEST AND NORTH to 03, and from two to fifteen miles per hour.

7. A decision in regard to this discharge will be made by the Commanding Officer, 2nd Battalion, 1st Gas Regiment at "H" minus eight hours and communicated to Division and Corps Headquarters by wire and written confirmation.

Code. OPERATION WILL TAKE PLACE—MAINE.
OPERATION CANCELLED—CALIFORNIA.

8. If weather conditions are unfavorable at "H" minus six hours the operation will be cancelled by Commanding Officer, 2nd Battalion, 1st Gas Regiment, Messages being sent in Code of Paragraph No. 7 to Division and Corps Headquarters. The officer in charge of emplacements can cancel at Zero if local conditions are outside of limits specified in paragraph No. 6.

9. The Commanding Officer, Company D, 1st Gas Regiment, will be at P. C. Marengo 41.04-54.16, from "H" minus six hour until "H" minus four hours. He will maintain communication with his emplacement officers by runners.

10. Messages from the position officers to the Company Commander will be sent as follows:

- (a) Wind Messages—each half-hour from "H" minus six hours to "H" minus four and one-half hours.
- (b) All ready—when all preparations are completed.
- (c) Number of drums discharged after final discharge.

11. The area enclosed by 43.10-53.09; 42.00-53.54; 41.90-53.46 and 42.27-52.92 should be cleared of all troops as far as the tactical situation will permit from "H" minus four hours and ten minutes until "H" minus three hours and thirty-five minutes. Any troops left in the above area and in areas enclosed by 43.46-53.45; 42.00-53.54 and 43.10-53.09; and 42.27-52.92; 41.90-58.46 and 42.04-52.92 must wear box respirators from "H" minus four hours and five minutes until the "All Clear" signal is given by their Gas Officer.

12. It will not be necessary to camouflage this position after the discharge. All personnel, with the exception of those needed for the later attacks, will retire to the advanced billets.

13. Please acknowledge.

J. B. Carlock,
Major, 1st Gas Regiment.

Copies:

1. C. G. 5th U. S. Corps.
2. C. G. 26th U. S. Division.
3. C. O. 1st Gas Regiment.
4. C. G. Company D.
5. War Diary.

119.

EXHIBIT D.

OPERATION REPORT

To

C. O. First Gas Regiment.

SERIAL NO.

August 5, 1918.

Reference Maps.

Violu (Nord) 1/5000.

1. Headquarters—Company A, 1st Gas Regiment, A. E. F.
2. Engineer Companies Operating, Company A, 1st Gas Regiment.
3. Corps or Division to which attached, 21. D. I. 33 C. A. (French).
4. Purpose of operation, harrassing enemy in new positions. Prevention of further work in organizing new trenches as jumping off place for seizing TETE du VIOLU.
5. Wind limits—N. thru W. to S.
6. Map reference of emplacements—(S) 54.5-59.6, (S-1) 54.7-58.7, (S-2) 54.7-58.6.
7. Map reference of targets—55.3-60.0, 55.2-59.0, 55.05-58.65.
8. Enemy Regiments affected—80 Landwehr, others not identified.
9. Zero Hour—23.00 Aug. 5-6, 1918.
10. Wind direction and velocity and weather conditions—West, 7 m. p. h. Misty overcast sky. Started to rain at 1.00 a. m. Aug. 6.
11. Number installed,
and type of gas used. Cylinders. Projectors. Stokes Mortars.
C.G. 495 300
12. Number fired. 495 294
Percentage fired. 100 98
13. Reason for discrepancies (if any) 3 bombs stuck in guns and could not be removed, early in the shoot, putting them out of action. Enemy action made it inadvisable to hold a gun in position while biscuit, container and ammunition were being changed.
14. Enemy action before, during and after attack—No rockets. Green and red flares at 0 plus 3 min. Heavy artillery retaliation at 0 plus 7 mins. on positions (S-1)-(S-2), on trench system, lines of communication, billets and artillery. Enemy apparently very much annoyed.

15. Casualties (Name of officers; regimental numbers of other ranks (since reconnaissance). No. 915384 slightly gassed in clearing a trench of a short T. M. E.

16. Time taken and men employed on operation—7 days and nights—90 men for eight days, 46 more for four days

17. Infantry assistance obtained for operation 6—4 ox teams for 5 nights. Trench mortar and artillery fire 0 plus 5 min. to 0 plus 10 min.

18. Remarks—Information from photographs and deserter showed Germans creeping in to capture TETE du VIOLU. Intense fire for destruction two days previous by artillery and trench mortars. 3000 shells, 2000 T. M. E. Quiet for two days to encourage enemy to return to work. Guns will be left in on position S for future use if need develops.

W. F. Pond,
Captain, Co. A,
1st Gas Regiment.

Copies to:

C. O. 1st Gas Regiment.

C. O. Prov. Btn., 1st Gas Regt.,

21st D. I. (French).

33rd C. A. (French) Secret File.

FUNCTIONS OF GAS OFFICERS.

(See paragraphs 100-148—Defense Against Gas.)

120. The essential qualities of a gas officer are technical knowledge, tact, courtesy, initiative, ingenuity, and energetic perseverance. He must bear in mind that his supply and administrative duties are not the most important, and that one of his most important duties is to advise with respect to gas offense operations. These duties cannot be properly performed from an office in the rear.

121. The following enumeration of functions of corps and division gas officers is suggestive and not all inclusive.

I. Administration.

(a) Secure and employ as near full allowance of officers and enlisted men as practicable in corps (or division) office.

(b) Keep lists up to date of regimental and battalion gas officers and N.C. O's.

(c) Study personality of subordinate gas officers. Attempt to make best use of them by suitable assignments, and to correct faults and weaknesses when possible.

(d) Departmentalize, as far as practicable, the work of the corps (or division) gas personnel

(e) Place all enlisted personnel immediately under responsible non-commissioned officer in charge of office.

(f) Secure, if practicable, separate quarters for enlisted personnel.

(g) Know by name and rank each officer on the staff and the nature of his duties.

(h) Insure that required number of regimental and battalion gas officers and N. C. O's are trained at proper schools. Maintain written record of training of gas personnel, commissioned and non-commissioned, and their ability, recommending

advance of those who discharge their duties satisfactorily whenever a vacancy exists.

(i) Secure as near full allowances of transportation as practicable.

(j) Maintain filing system, emphasize care of and making of maps, form and substance of reports and correspondence, appearance of office.

(k) Keep a war diary.

II. *Relations within corps (or division).*

(a) Maintain intimate liaison with all staff departments.

(b) Cultivate interest in gas among all officers by congenial, unobtrusive methods.

(c) Request action of G-3 on reports and recommendations relating to gas discipline, training and supplies.

(d) Secure official publications of necessary orders, such as zone regulations.

(e) Secure co-operation of Military Police in enforcement of orders relating to gas defense.

(f) Secure all necessary information, such as maps, reports and circulars concerning enemy operations from G-2 (Intelligence), concerning our own movements from G-3 (Operations), concerning casualties from the Corps (or Division) Surgeon's office, concerning casualties and our own posts of command from the Statistical Office.

(g) Co-operate with representative of Inspector General and Medical Gas Officer.

III. *Operations.*

(a) Furnish counsel in gas matters as requested by Commanding General, Chief of Staff, G-3, or (Corps) Artillery Officer.

(b) Act as liaison between gas troops operating in corps (or division) area and (corps and) division staffs, establishing understanding on the part of the staff and an appreciation of their potential value. (Division Gas Officer will aid in establishing similar relations between gas troops and units with which they are to act in the line.)

(c) Furnish gas troops with all available information concerning suitable targets and movements involving the possibility of activity on their part.

(d) Devise plans for use of gas, submitting them to G-3 or to Commanding Officer of Gas Troops concerned where his organization is affected.

(e) Establish relations with artillery brigades (or brigade) cultivating interest in gas.

(f) Maintain liaison with Munitions Officer and Artillery Operations Officer, also Salvage Officer. and be cautious in recommendations of artillery gas programme, leaving all matters of recommendation which are exclusively in the field of artillerists.

(g) Report without delay direct to Army Chief of Chemical Warfare Service all gas offensive operations executed by troops of the division (or corps), submitting copy of such report to G-3.

IV. Supplies.

(a) Study carefully means of supply and probable future needs of division (or corps).

(b) Insure adequate supply of timely requisition on the nearest advance army depot, but keep stock in corps park or division dump as small as compatible with local needs.

(c) If not near an advance depot see that requisitions on the base or intermediate depots are placed with G-4 of the army in ample time to secure supplies.

V. Subordinate Units.

(a) Under such instructions as may be issued from headquarters, make periodic inspections with view toward determining state of gas discipline, training and supplies, reporting defects to Division (Regimental) Gas Officer and Commanding Officer of unit concerned. When corrective measures are not applied, submit special report to G-3 for information of Commanding General.

(b) Keep Commanding General advised of state of gas training, discipline and supplies in divisions assigned to corps (or units within the division).

(c) Advise next senior Gas Officer on same subject, sending copy of such report to Chief C. W. S.

(d) Assist Division (Regimental and Battalion) Gas Officers by counsel and suggestion.

(e) Study conditions within divisions (regiments, etc.) through routine report and personal interview.

(f) Encourage criticism and suggestion from Division (Regimental and Battalion) Gas Officers.

(g) Be watchful at all times of gas personnel who, through temperamental or other unfitness, tend to bring the Chemical Warfare Service into discredit and recommend to Chief of C. W. S. transfer of such officers and men to other work.

(h) Insist upon the use of proper channels of communication.

(i) Accustom troops to the use of smoke, H.E., and thermit by gas troops through demonstration and brief lectures.

VI. Corps Troops.

(a) Maintain gas discipline, training and supplies.

(b) Undertake training of gas N. C. O's. in the units not as a whole indentified with front line activity (such as remount squadrons, etc.).

(c) Check closely situation concerning replacement battalion and the sending of replacements to the line without proper anti-gas equipment.

(d) Interview gas officers and non-commissioned officers of corps troops frequently for purpose of securing from them helpful suggestions and criticism.

VII. *Casualties.*

(a) Keep accurate account of casualties noting particularly causes, avoidability, fatigue and malingering cases, the nature of gas responsible for casualty, tactical use of that gas, ratio of shell to casualties.

(b) Analyze periodically the proportion of casualties attributable to the several gases as indicated by symptoms and recollection of patients respecting smell and appearance of gas.

(c) Submit report to Commanding General through G-3 when facts and findings justify.

(d) Co-operate with Medical Gas Officer in securing data concerning methods of relief of gas affections and in giving them publicity within the corps (or division). Notify Chief of C. W. S. of all such methods in use in the unit.

(e) Take steps to prevent needless salvage by hospitals of gas equipment of patients.

VIII. *Enemy Material and Intelligence.*

(a) Secure all material, documentary and otherwise, of gas interest through divisional (regimental) gas personnel, salvage officers, G-2, and miscellaneous sources, and, if practicable, by examination of enemy dugouts, dumps and positions in immediate wake of infantry advance.

(b) Utilize all available means of transportation for removal of non-mailable material to nearest Advance Army Gas Depot, notifying next senior Gas Officer or find and where it is deposited, sending copy of report to Chief of C. W. S.

(c) Deliver all non-gas intelligence thus secured to G-2.

(d) Secure, if practicable, translation of gas documents before forwarding them when data is likely to be of immediate importance to Corps (division).

(e) A set of enemy fuses and typical gas shell, sectioned, should be kept at gas office for information of all concerned.

IX. *Training of Divisions.*

(a) When Division is in training recommend to G-3 to establish conferences of regimental and battalion gas officers and schools for gas N. C. O's.

(b) Recommend to G-3 to establish a series of lectures, demonstrations, inspections and drills for the enlisted personnel of the division.

122. The following is a suggestive digest of the functions of a Regimental and Battalion Gas Officer. It should be noted that responsibility for all measures taken in chemical warfare, whether in offense or defense, rests ultimately upon the commanding officer concerned, and the gas officers concerned are

under their command. Usually, either the commanding officer of the regiment will order his gas officer to follow the technical advice of the Division Gas Officer, or this may be ordered by higher authority. (The suggestions are supplementary to Par. 391, Defense Against Gas.)

(a) Keep accurate record of training and ability of subordinate personnel, recommending such advancement as may be merited and practicable.

(b) Keep gas personnel advised of the latest available data, holding frequent conferences and inviting suggestion and criticism.

(c) Exact strict compliance with orders relating to inspection by subordinate personnel, condition of material, gas discipline and reserve supplies by means of personal supervision and frequent inspections.

(d) Insure the immediate availability of authorized reserve anti-gas supplies, their suitable transportation and proper issue.

(e) Advise commanding officers of the proper precautions to be taken in anticipation of gas attacks, and in the event of such attacks keep informed concerning all action taken.

(f) Minimize false alarms and supervise instruction to sentries, insuring active liaison with gas personnel of subordinate and superior commands.

(g) Secure sufficient first aid relief in exposed areas.

(h) Furnish counsel to Commanding Officer in gas matters and stimulate interest in and understanding of the use of gas on the part of all officers.

(i) Furnish liaison between command and gas unit operating therewith, insuring sufficient understanding by troops of nature of proposed activity of gas unit operating therewith, in order to enable them to take full advantage thereof.

(j) Report accurately and promptly concerning the enemy use of gas and its effect. In case of artillery gas officers, report in addition concerning delivery of gas upon enemy objectives.

(k) Secure strict compliance with zone regulations and punishment of offenders.

(l) Minimize waste of anti-gas material, applying disciplinary measures to offenders and insuring the full and proper use of all anti-gas supplies.

(m) Advise next senior Gas Officer of the location of finds of enemy gas material or cause prompt delivery thereof to his office.

123.

DUTIES OF GAS N. C. O.'s.

(See Pars. 135-148, Defense Against Gas.)

124. Inspections of division by corps gas officers and of regiments by division gas officers should be frequent and thorough thereby stimulating initiative and interest of subordinate gas

personnel, furnishing basis for the removal of the unfit, advancement of the meritorious, and securing helpful suggestions for the improvement of the Service.

125. In general, the basis of inspection will be the determination by interview, of the activities of Gas Officer of the unit inspected and the instructions issued by him, followed by investigation of conditions in subordinate units, and the manner in which existing instructions are complied with by gas personnel of these subordinate units.

126. The following questionnaire outlines the inspection of a division by a corps gas officer and may be adapted by the division gas officer to his inspection of regiments.

QUESTIONNAIRE—BASIS FOR INSPECTION OF GAS TRAINING, DISCIPLINE AND SUPPLIES OF DIVISIONS.

I. *Personnel.*

(a) How many gas officers are there in the Division and how distributed?

(b) How many have trained in A. E. F. Gas Defense School?

(c) How many have conflicting non-gas duties?

(d) How many gas N. C. O.'s are there in the Division, and what is their distribution?

(e) How many have been trained in the Army Gas School?

(f) What measures have been adopted to secure co-operation and to create an esprit de corps in the gas personnel within the Division?

II. *Training.*

(a) What training had Division received in the United States?

(b) In the rest area?

(c) What training does it receive in reserve?

(d) In line?

III. *Inspection.*

(a) How often are inspections made of gas equipment and discipline?

IV. *Experience.*

(a) What experience has Division had in actual attacks?

V. *Casualties.*

(a) How are report of casualties obtained?

(b) What has been the proportion of gas casualties to casualties from other sources?

(c) What percentage of gas casualties has been returned to duty from Field Hospital?

(d) What are the principal causes of such casualties?

VI. *First Aid.*

- (a) What first aid methods are employed within the Division?
- (b) What measures are taken to give troops exposed to gas access to first aid and protective supplies?
- (c) How is sag paste distributed?
- (d) How is it used?
- (e) What results are obtained from its use?

VIII. *Gas Attacks.*

- (a) What orders govern the selection of alternative positions?
- (b) What is the number and location of gas-proof dugouts?
- (c) What instructions govern sentries in event of gas attack?
- (d) What instructions govern N. C. O.'s, Battalion Gas Officer, Regimental and Division Gas Officer?

VIII. *Division Gas Officer.*

- (a) What reports are received from Regimental Gas Officers concerning supplies, gas intelligence, discipline and training?
- (b) What reports are made to corps?
- (c) What channels of communication are employed?
- (d) What system is used in the care, use and record of gas literature and intelligence?
- (e) Of what does the Division Gas Officer personnel consist, and what is the distribution of duties?
- (f) What gas memoranda and orders are in force in the Division?
- (g) What reports are made to the Commanding General of the Division?

IX. *Relations.*

- (a) What are the relations with the Commanding General and the Chief of Staff?
- (b) Is technical knowledge of Division Gas Officer employed with respect to offense use of gas?
- (c) What are the relations between Gas Officer and Division G-2, G-3 and G-1?

X. *Transportation.*

- (a) What personal transportation is furnished D. G. O.?
- (b) What transportation is available for Divisional reserve and distribution of supplies?
- (c) What transportation is available for the gas needs of units within the Divisions?

XI. *Supplies.*

- (a) Are all men and animals supplied with respirators?
- (b) What reserve is maintained in Division Dump?
- (c) What reserve is maintained by units within the Division with respect to M-2, Tissot, S. B. R., horse respirators, lime,

gloves, suits, alarms, canisters, suit bags, blankets and sag paste?

(d) What is the policy with respect to salvage?

(e) What is average length of time between the sending of requisition and receipt of supplies?

(f) Where is the nearest Advance Army Gas depot?

XII. *Captured Enemy Material and Duds.*

(a) What is the policy with respect to captured enemy material and duds?

XIII. *Recommendations.*

(a) Are there any recommendations, suggestions or criticisms?

XIV. *Observations.*

(a) Note improper carriage and improper condition of respirator, securing the name, rank, number and organization of cases requiring disciplinary or corrective measures.

(b) Note the observation of "Alert" and "Danger" zone regulations and the manner in which these zones are defined for the command.

(c) General impressions of conditions in Division.

(d) Recommendations.

127. Valuable information revealing weakness in gas discipline or training, inadequacy of anti-gas protective or precautionary measures by commanding officers or the use of new tactics by the enemy and the value of such tactics may be gained by the careful questioning of gas casualties.

128. The following questions are outlined for the purpose of gaining the foregoing information from casualties the type of casualty determining which group of questions are put in a given case. The inquiries concerning training are common to all cases.

QUESTIONNAIRE FOR GAS PATIENTS.

I. *General.*

(a) Name, rank, number, organization.

(b) Did the gas burn your skin or eyes, or affect your lungs?

II. *Skin Cases.*

(a) Where were you burned?

(b) Just how did you get burned? Give details and circumstances.

(c) Did you have an opportunity to use sag paste?

(d) Did you use sag paste?

(e) If so, how did you use it?

(f) Did you use anything else before you were burned?

- (g) Did you use anything after you were burned?
- (h) Did you know there was gas about when you were burned?
- (i) Did you have your mask on when you were burned?
- (j) What will you do next time to avoid being gassed under similar circumstances?
- (k) How close to you did gas shell burst?
- (l) Did it splash you?
- (m) Was chloride of lime available?

III. *Eye Cases.*

- (a) Just how were you burned? Give details and circumstances.
- (b) What will you do next time to avoid being gassed under similar circumstances?
- (c) Did you wear a mask? If so, how did you wear it?
- (d) How long after alarm did you put mask on?
- (e) Did you take your mask off before being ordered to do so?
- (f) By whose orders did you take it off?
- (g) Did you use sag paste?

IV. *Lung Cases.*

- (a) Just how were you gassed? Give details and circumstances.
- (b) How far did you walk after you were gassed?
- (c) What did the gas smell like?
- (d) What did it look like?
- (e) How did it act?
- (f) Did you know what kind of gas it was?
- (g) How long after alarm did you put mask on?
- (h) Did you take mask off without orders to do so?
- (i) What will you do next time to avoid being gassed under similar circumstances?
- (j) How near did gas shell burst?
- (k) How long was it after you were gassed before you felt the effects?
- (l) When were you gassed?
- (m) Just how do you feel now?

V. *Training.*

- (a) Did you have gas training in the States?
- (b) How often?
- (c) How long have you been over here?
- (d) What kind of gas drills have you had here?
- (e) How often?
- (f) How often in the training area?
- (g) How long since then?
- (h) Have you practiced fighting with mask on?
- (i) What is the longest time you have worn mask?

- (j) How many false gas alarms did you have within two weeks before you were gassed?
- (k) When was your mask last inspected by gas N. C. O.?
- (l) Did he look at the canister?

DUTIES OF A STAFF OFFICER WITH RESPECT TO OFFENSE OPERATIONS.

Preliminary.

129. From G-2 the Gas Officer should obtain maps and information regarding enemy dispositions. He will study these dispositions and the character of the enemy terrain with the view of selecting favorable targets for gas. He will study friendly terrain in order to select favorable positions for emplacements. Information should be obtained from the Chief of Artillery regarding the availability of guns of various types and calibers. He should also obtain from the munitions officer information regarding the material available for use. The Commanding Officer of gas troops will be consulted regarding the use of cylinders, projectors and trench mortars, their availability and the feasibility of any project which might be contemplated.

130. A hypothetical map (Fig. 40) showing enemy terrain and dispositions is shown opposite. In the following paragraphs it is intended to indicate the possible uses of gas in this terrain under various tactical situations. It is hoped that this will help division gas officers to solve their own problems in the use of gas. In each case the D. G. O. memorandum to G-3 is given.

(1) *Use of Gas on a Stable Front.*

(a) Cloud Gas.

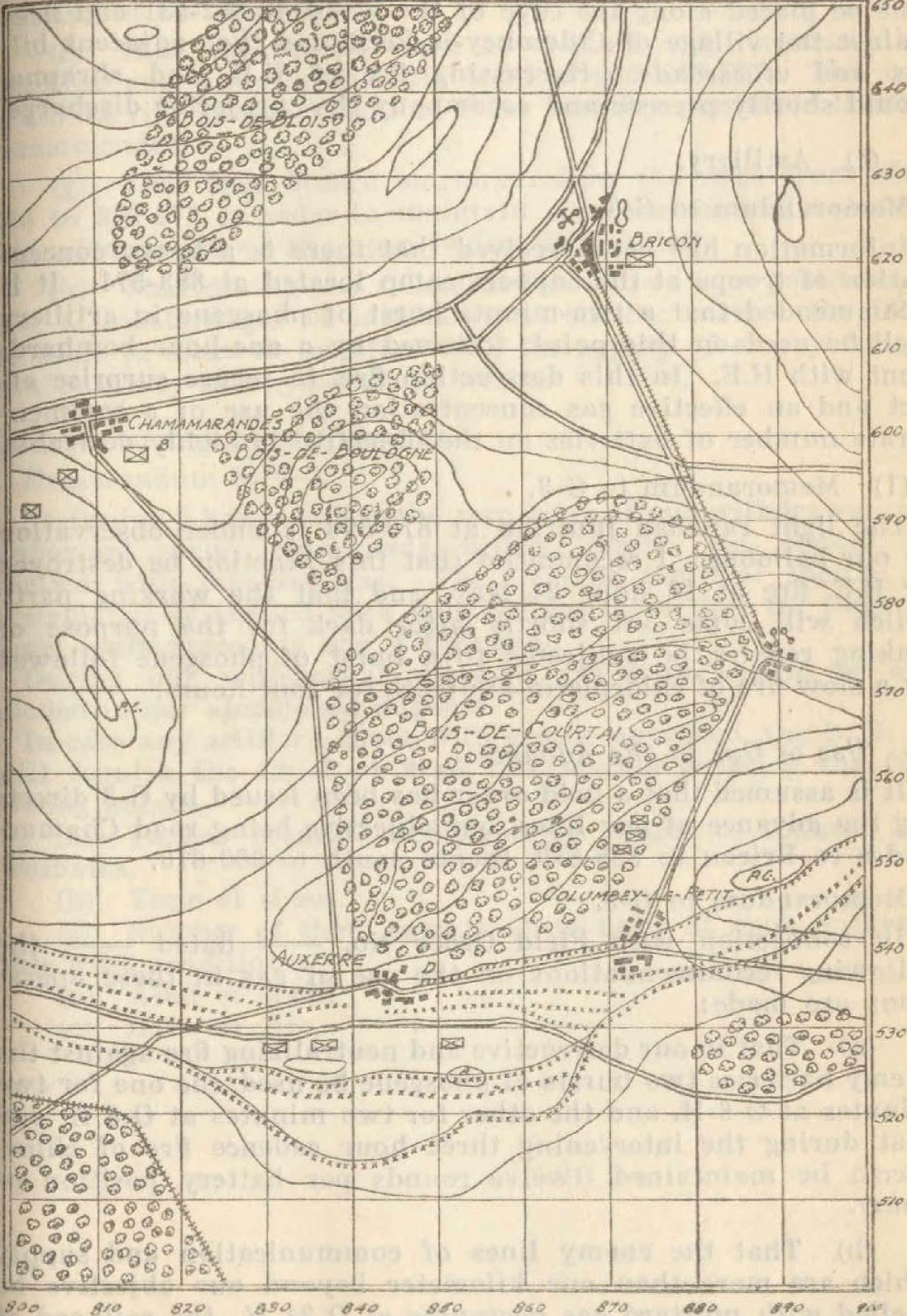
Memorandum to G-3.

Our front offers possibilities of a cylinder gas attack against the enemy. Such an attack would have the following purposes.

- (1) To cause casualties among the enemy ranks.
- (2) To lower the enemy morale.
- (3) To damage enemy material.

The gas should be liberated between 830-528 and 825-520 where a favorable wind will carry the gas forward across the open country. The light railroad running along our front at this point can be used, the cylinders being brought up on trucks and discharged from them. The front line should be temporarily evacuated by our troops. A suitable accompanying artillery program should be arranged. The more minute details of the attack can be prepared with the officer commanding our company gas troops.

FIG. 40



(b) Projector Attack.

Memorandum to G-3.

It is recommended that about 500 projectors filled with phosgene be placed along the edge of the wood at 882-531 and fired against the village of Colombey-le-Petit and the adjacent billets and crossroads. Harrassing fire of H.E. and shrapnel should shortly precede and accompany the projector discharge.

(c) Artillery.

Memorandum to G-3.

Information has been received that there is a heavy concentration of troops at the support camp located at 883-574. It is recommended that a two-minute burst of phosgene in artillery shell be used on this point, followed by a one-hour bombardment with H.E. In this destruction fire, to secure surprise effect and an effective gas concentration the use of a commensurate number of batteries on the objective is highly desirable.

(1) Memorandum to G-3.

The light railroad junction at 879-596 is under observation by our balloons. I recommend that this junction be destroyed by H.E. fire at 16 hour 24 May, and that the working party which will come out shortly after dark for the purpose of making repairs, be subjected to a burst of phosgene followed by a slow fire of chlorpicrin and H.E. for four hours.

(2) *Use of Gas in the Advance.*

It is assumed that a field order has been issued by G-3 directing the advance of our lines, our objective being road Chamarandes to Bricon to 855-610, thence south to 900-610.

Memorandum to G-3.

In connection with Field Order No. — dated —, the following recommendations on the use of gas in these operations are made:

(a) That in our destructive and neutralizing fire against the enemy batteries two bursts of phosgene be used, the one for two minutes at O-6 H. and the other for two minutes at O-3 H, and that during the intervening three hour cadence fire of chlorpicrin be maintained (twelve rounds per battery position per hour).

(b) That the enemy lines of communication and supply which are more than one kilometer beyond our objective be shelled with mustard gas beginning at O-24 H., the railhead at Bricon to receive special attention.

(c) That in the accompanying barrage 5% of phosgene shell be used and that if the wind is favorable this be increased to 10%.

(d) That 100 projectors be placed at 882-531, and that from these projectors H.E. bombs be fired at O-H.—5 min. against machine gun nests and the pill-box at 886-543.

(e) That trench mortars firing smoke bombs be used along the entire front from 800-828 to 870-525 in order to cover our crossing of the stream.

(f) That thermit be used at O-H.—5 min. against the machine gun nests at 810-530, 832-523 and 848-527. The use of smoke rifle grenades against these machine gun nests is also recommended.

(g) That four Stokes mortars follow the road from 838-536 to 835-571 in order to maintain a smoke screen to protect our advance across the open region on our left.

(h) That during the consolidation of our new positions a belt of mustard gas be laid down across the rear of the Bois de Blois in order to interfere with the supply of enemy troops and batteries occupying those woods.

(3) *Use of Gas in Withdrawal.*

Memorandum to G-3.

Beginning 8 hours before the zero hour of our withdrawal, all important enemy cross-roads, billets, camps, etc., should be shelled with mustard gas. The Bois de Courtrai should be systematically shelled with mustard gas (zone fire) for twenty-four hours preceding our withdrawal.

During our withdrawal mustard gas shell should be exploded in our abandoned dugouts.

In case any artillery shoot with gas be approved, the D. G. O. will furnish the Chief of Staff information covering the following points

(a) Target—accurate definition by means of reduced co-ordinates.

(b) Time of shoot.

(c) Number of shell, calculated on basis of most unfavorable wind conditions.

(d) Kind of shell.

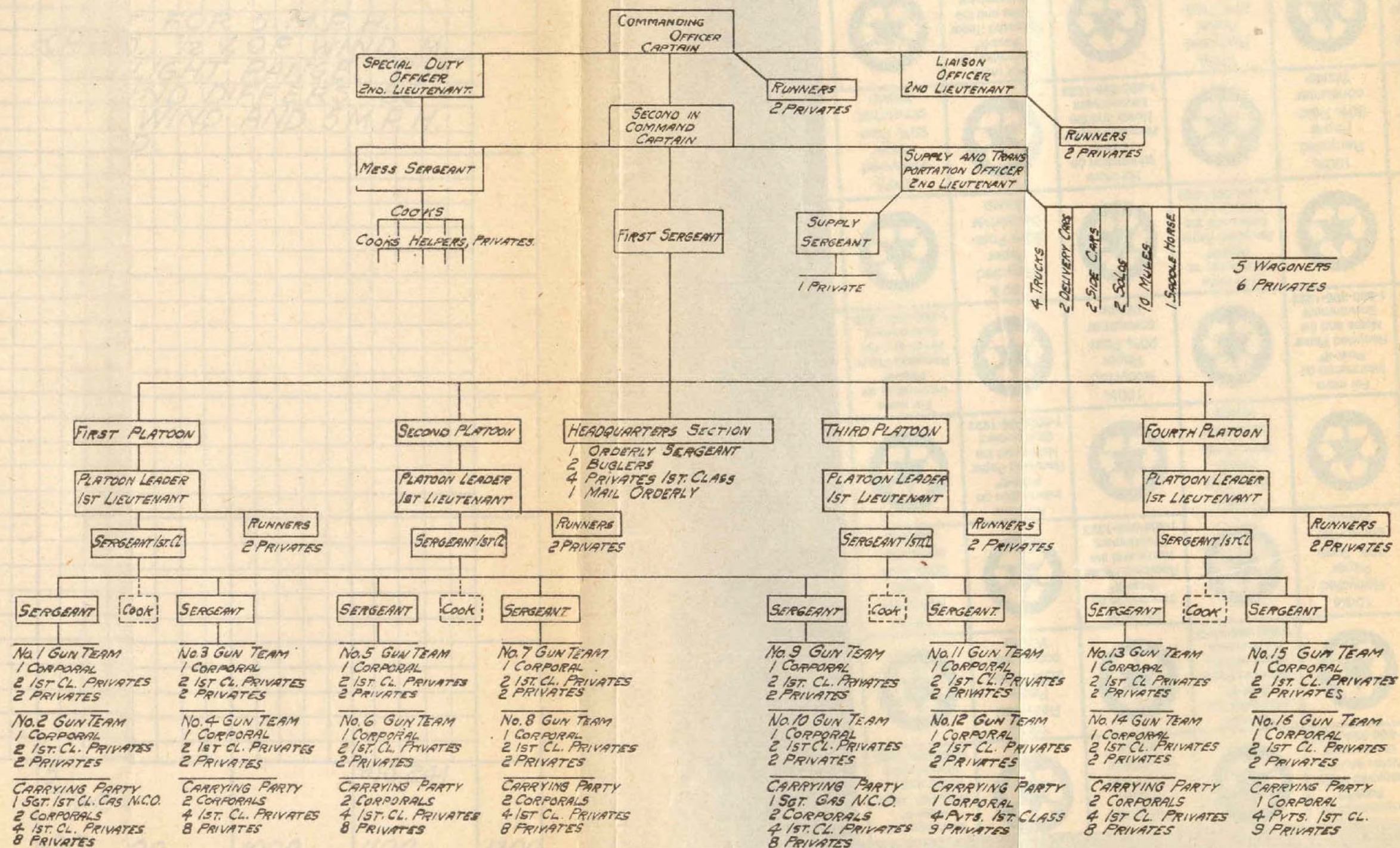
(e) Rate of fire.

FIG. 1
ORGANIZATION OF FIRST GAS REGIMENT
PART I
SECTION 4

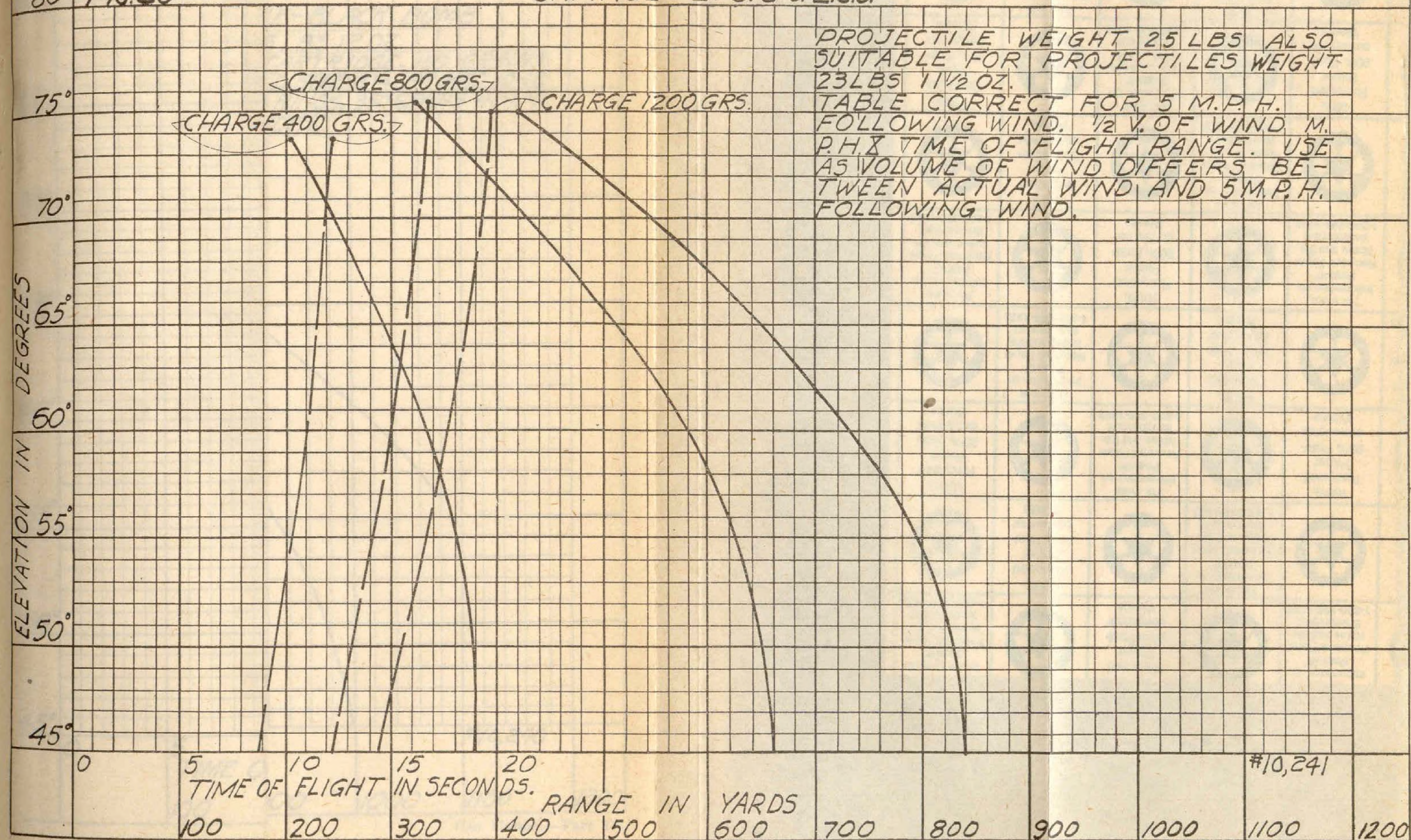
TABLE 233—GAS REGIMENT, CHEMICAL WARFARE SERVICE

UNIT	One Company (a)	BATTALION				REGIMENT			Medical Department and Dental Corps	Ordnance Dept. Attached	Aggregate
		Headquarters	Supply and Work Shop Section	Companies	Total	Headquarters	6 Battalions (b)	Total			
Colonel						1		1			1
Lieutenant Colonel						3		3			3
Majors		1			1		6	6	1		7
Captains	2	2 ^c		6	8	2 4 ^d	48	52	6		137
First Lieutenants	4		1	12	13	1	78	79			
Second Lieutenants	3		1	9	10		60	60			60
Chaplains, 1 st Lieutenants									2 ^g		2
Total Commissioned	9	3	2	27	32	9	192	201	9		210
Master Engineers, Sr. Grade		1 ^p	1 ^p		2	4 ^p	12	16			16
Master Engineers, Jr. Grade		2 ^p	2 ^p		4	4 ^p	24	28			28
Battalion Sergeant Majors		1 ^p			1						
Battalion Supply Sergeants			1 ^p		1		6	6			6
1 st Sergeants	1 ^p			3	3		18	18			18
Sergeants, 1 st Class	5 ^p			15	15		90	90	1		91
Mess Sergeants	1 ^p			3	3		18	18			18
Supply Sergeants	1 ^p			3	3		18	18			18
Sergeants	10 ^p	1 ^p	1 ^p	30	32	2 4 ^p	192	196	6		202
Corporals	30 ^a	2 ^a		90	92		552	552		6 ^p	558
Cook	3 ^p	1 ^p	1 ^p	15	17	2 ^p	102	104			104
Mechanics			4 4 ^a		4		24	24			24
Wagoners	5 ^p	1 ^a	1 ^a	15	17	3 ^a	102	105			105
Buglers	6 2 ^p			6	6		36	36			36
Privates, 1 st Class	62 ^a	2 ^a	5 ^a	186	193	6 ^p	1158	1164	56	6	3638
Privates	128 ^a	4 ^a	11 ^a	384	399	12 ^p	2394	2406	6	6	
Total Enlisted	250	15	27	750	792	39	4752	4791	63	19	4873
Aggregate	259	18	29	777	824	48	4944	4992	72	19	5083
Motor, Closed, Type D. Car						1		1			1
Motor, Type F. Car		1			1	3	6	9			9
Cart, Water, Trailmobile	1			3	3		18	18			18
Kitchen, Rolling, Trailmobile	1			3	3		18	18			18
Motor Cycles, with side cars	2	2	1	6	9	4	54	58	6 ^a		64
Motor Cycles, solo	2	2	1	6	9	4	54	58			58
Bicycles	4	1	1	12	14		84	84			84
Trucks, Type B	6		2	18	20	1	120	121			121
Trucks, Type AH	2			6	6	1	36	37			37
Rifles	225	9	21	675	705	3	4230	4233			4233
Pistols	34	9	8	102	119	45	714	759		19	778
Machine Guns	2		1	6	7		42	42			42

FIG. 2 GAS REGIMENT COMPANY ORGANIZATION CHART.



80° RANGE TABLE FOR 4 INCH STOKES HOWITZER USING BISCUIT CONTAINERS ONLY.
FIG. 20 CHARGE E. C. 3 & E. C. 5



80° FIG. 21

RANGE TABLE FOR 4 INCH STOKES MORTAR. (T.W.C. MINUTE 553)

PINK CARTRIDGE

PROJECTILE-BLACK BOMB
WEIGHT 25 LBS 12 OZ.
CHARGE-CARTRIDGE, 150 GRAINS
CORDITE M.D. SIZE 2 1/4, PRIMED 10-12
GRAINS P.P. RINGS, 350 GRAINS 4 M.M.
FLAKE CORDITE.

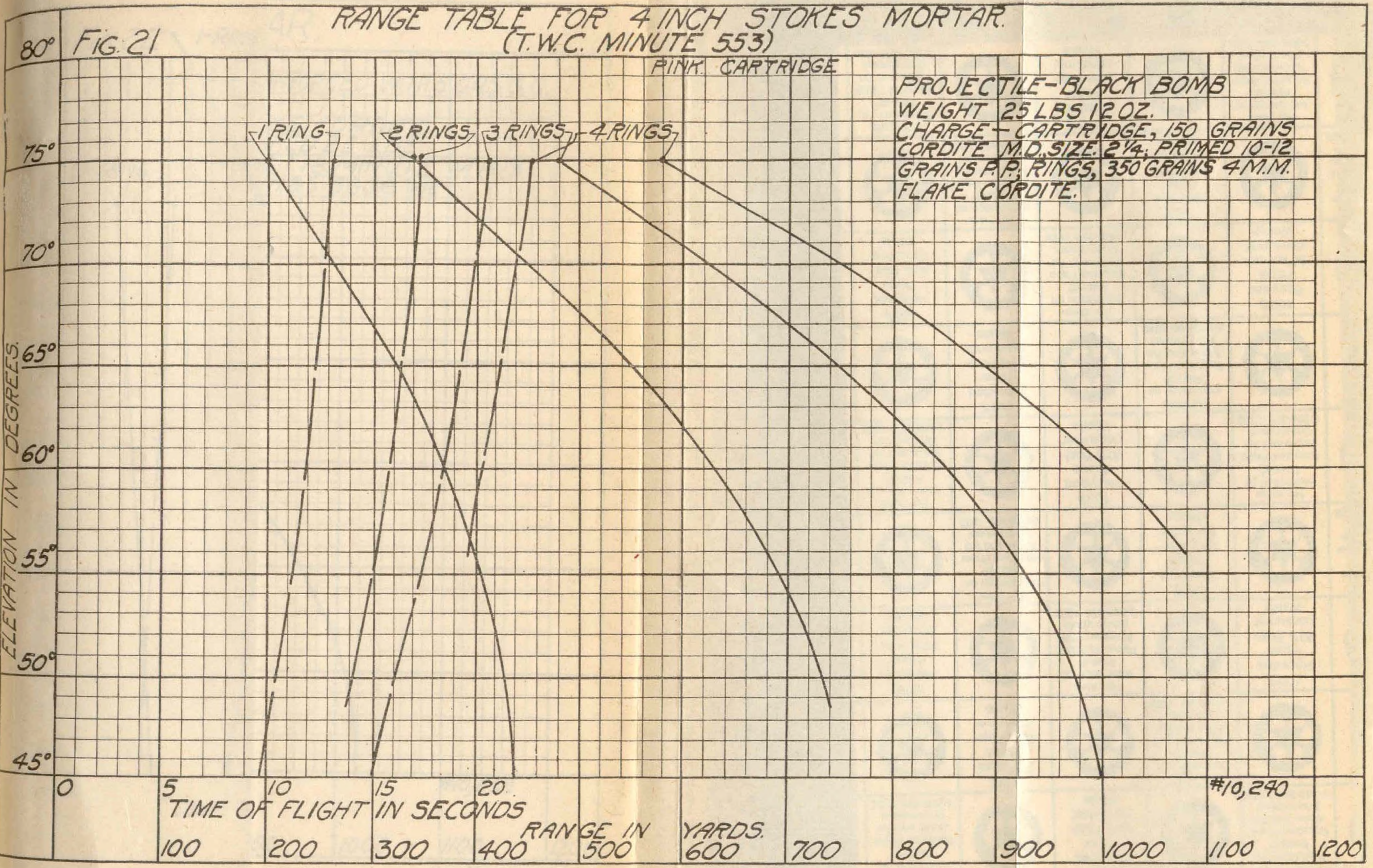
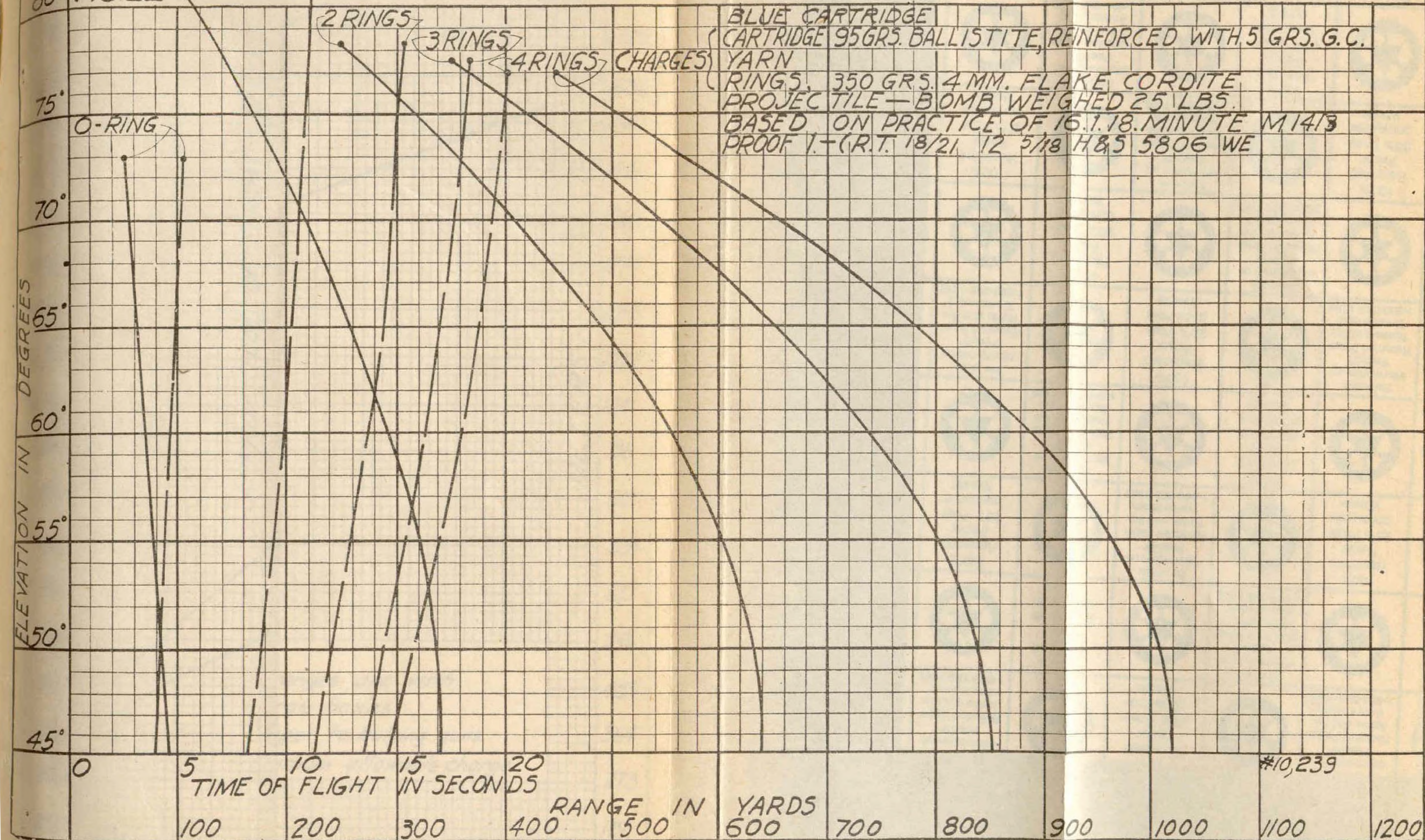


FIG. 22 1-RING RANGE TABLE FOR 4 INCH STOKES MORTAR.

BLUE CARTRIDGE
 CARTRIDGE 95GRS. BALLISTITE, REINFORCED WITH 5 GRs. G.C.
 YARN
 RINGS, 350 GRs. 4 MM. FLAKE CORDITE
 PROJECTILE—BOMB WEIGHED 25 LBS.
 BASED ON PRACTICE OF 16.1.18. MINUTE M 1413
 PROOF 1—(R.T. 18/21 12 5/18 H&S 5806 WE



#10,239

FIG. 33

