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NO. 1
1917

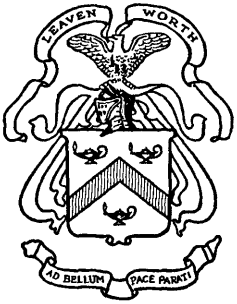
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MACHINE GUN NOTES

No. 1

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WAR DEPARTMENT,
WASHINGTON, *May 26, 1917.*

The following reprint of Machine Gun Notes No. 1 is published for the information of all concerned.

[2608038, A. G. O.]

BY ORDER OF THE SECRETARY OF WAR:

TASKER H. BLISS,
Major General, Acting Chief of Staff.

OFFICIAL:

H. P. McCAIN,
The Adjutant General.

WAR DEPARTMENT,
THE ADJUTANT GENERAL'S OFFICE,
Washington, June 19, 1917.

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By order of the Secretary of War:

H. P. MCCAIN,
The Adjutant General.

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NOTES ON THE EMPLOYMENT

OF

LEWIS GUNS

IN

DESERT WARFARE IN EGYPT

ISSUED BY THE BRITISH GENERAL STAFF

DECEMBER, 1916

NOTES ON THE EMPLOYMENT OF LEWIS GUNS IN DESERT WARFARE.

1. The general experience seems to be that it is never possible to control more than two guns in action, and that it is usually necessary to control each gun separately. This bears out the general experience of Lewis gun officers during the war.

2. Very little trouble seems to have been experienced from stoppages except from the action of sand. This result appears to be due to the realization by commanders of Lewis gun detachments of the necessity of "Care and cleaning," and also to the simplicity and speed with which the guns can be stripped for this purpose. It is necessary to note that parts such as the gas chamber and barrel mouthpiece should be very rarely stripped, as the fine threads by which these parts are connected together easily becoming damaged. On the other hand, the gas cylinder and gas regulator must be frequently stripped, as otherwise it is impossible to clean them properly. The latest pattern of both gas cylinder and gas regulator have much stouter threads than earlier patterns.

As regards prolonged stoppages, the breakage of the cartridge guide spring appears to have been the most common, but to have been very quickly remedied. Plenty of "spares" for the purpose are kept with the gun. Instances are mentioned of guns firing as many as 3,000 rounds without a stoppage. An instance occurred of a bullet carrying away the gas regulator key and at the same time turning the gas regulator. This was not noticed by the gun numbers, and the gun was in consequence out of action for about 15 minutes. This accident would usually have the effect of turning the gun into a hand-operated magazine firer, since the action of the gases is destroyed. This fact should be a useful guide to Lewis gun detachments under similar circumstances. Several separated cases are reported. The fact that no clearing plug has till recently been carried made this stoppage very difficult to deal with, if, as sometimes happened, the separated portion was not extracted from the chamber by the next round. A clearing plug is now being supplied for each gun.

Difficulties from the action of sand were experienced in a greater or less degree by most detachments. The general experience

appears to have been that the amount of trouble met with was proportionate to the amount of care taken. For example, one detachment commander gives his experience as follows: "On August 5 the gun was in action for a short time only, as difficulties were experienced with sand in magazines and in the gun, making it impossible to fire bursts of more than three or four shots. On August 9 we were in action most of the day, as *great care was taken* to keep the gun and magazine free from sand."

The following points were found of assistance by various detachment commanders and should be noted:

(1) Guns when not in use should be kept in the covers which are now being issued. Magazines, too, should be kept in the carriers till the last moment.

(2) Too much oil should not be used to keep the gun clean. Only a slightly oiled rag should be used when the gun is not actually firing.

(3) Suction of sand into the mechanism was prevented by laying a coat or ground sheet under the gun and occasionally by wetting the ground under the forward part.

(4) A magazine which has been dropped in the sand should not be used until it has been unloaded and thoroughly cleaned.

(5) Special precautions must be taken should any wind be blowing.

3. Pack transport appears to have been general and to have been most satisfactory.

4. Combined sights were only used on one or two occasions, owing to the fact that guns were generally used singly. It should be remembered that combined sights are useless for ranging purposes, that they are only needed at long ranges, and that the Lewis gun is primarily a short-range weapon. Still, occasions may arise when combined sights can be employed usefully.

5. Indirect fire was not used and appears not to have been suited to the particular actions described. It is on very rare occasions that Lewis guns can be used for indirect fire because:

(I) Indirect fire can not be directed from a bipod, and

(II) Indirect fire is usually sustained fire for searching woods, approaches, and reverse slopes, and the Lewis gun is unsuited for sustained fire.

6. Cooperation between the machine-gun companies and the Lewis gun detachments was sometimes maintained, but was not sufficiently general. One excellent example is given of the Lewis gun detachment commander not only cooperating with the M. G. section in his vicinity, but also obtaining ranges for the artillery forward

observing officer by means of bursts of fire from his guns.[1] It can not be too strongly impressed on all concerned that cooperation between the Lewis gun detachments and the machine-gun companies both before and during action is essential if the best results are to be obtained.

7. The establishment of one N. C. O. and six men was found adequate for infantry units. In the case of mounted units, an increase of two men, to act as leaders of pack animals and horse holders, appears necessary.

8. The usual methods of "Indication and recognition of targets" appear to have worked satisfactorily.

9. The following points seem worthy of consideration:

(*a*) A pair of field glasses would be of the greatest assistance to each N. C. O. in charge of a detachment.

(*b*) Regimental arrangements should be made to insure that an adequate supply of oil is always available with the guns. The provision of ammunition and oil in action is one of the special duties of the battalion Lewis gun officer.

(*c*) Company commanders should be taught to appreciate the value of their Lewis gun detachments. They can only do this if they have some knowledge of their tactical employment. The fire power of a well-handled Lewis gun is certainly not less than that of 30 rifles.

(*d*) Numbers 5 and 6 should be trained regimentally in their duties of scouts and range takers.

(*e*) To aid invisibility and facilitate transport, it has been found useful to cover the radiator casing of the earlier pattern guns with puttees, etc. The more recent pattern guns have, however, been painted service color before issue.

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[1] The use of Lewis guns for finding ranges for the artillery must be considered very exceptional, e. g., for ranges of not more than 1,500 yards when artillery range finders are not available.

NOTES ON THE EMPLOYMENT

OF

MACHINE GUNS

IN

DESERT WARFARE IN EGYPT

ISSUED BY THE BRITISH GENERAL STAFF

DECEMBER, 1916

101862°—17——2

NOTES ON THE EMPLOYMENT OF MACHINE GUNS IN DESERT WARFARE.

1. *Control.*—The general experience has been that the control of more than two guns in action is almost always impossible. This bears out the general experience of machine gunners throughout the war.

2. *Stoppages and action of sand—Vickers.*—With the Vickers guns the only trouble experienced was that when the guns were mounted in the "Low position," sand was sucked up into the mechanism through the ejection opening on the underside of the breech casing. This was remedied in some cases by putting a coat under the gun.

Maxim.—A careful consideration of all the reports received from the different units shows that the amount of trouble experienced from stoppages was by no means excessive. In many cases no trouble whatever occurred, and where difficulties did occur they could almost always be traced to two causes:

(1) The action of sand, and

(2) The condition of the locks and the lack of spare parts.

As regards the action of sand—as in the case of the Lewis guns—it was obvious that where the trouble from this cause had been foreseen and special precautions had been taken, its ill effects were largely minimized. The following quotation is of interest as bearing out this statement: "No special difficulties were encountered owing to the action of sand in the mechanism, as we were able to keep the guns practically clear of sand by exercising a reasonable amount of care. The guns were examined and cleaned on every possible occasion."

Except when actually in action guns should invariably be kept covered whether on the move or in camp. Bags made from light canvas or any other suitable material can be improvised for this purpose. It should be remembered, however, that guns kept in this way for any length of time need frequent attention; otherwise they very quickly rust. In emplacements, blinds, where provided, should be kept down whenever possible. Special precautions should be taken whenever the wind is blowing.

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The trouble caused by sand can be considered under three headings, viz:

(1) Its action in the lock; (2) its action in the feed block; and (3) its action in the belt.

(1) *The lock.*—Locks should not be kept dry but covered with a thin film of oil. A wipe over with an oily rag is all that is necessary. The spare lock should be kept in its wallet until actually required. Any loss of time in changing locks is amply repaid by the fresh lock being fit for use.

(2) *The feed block.*—The above remarks are equally applicable to feed blocks, special attention being paid, as far as oil is concerned, to the action of the slide.

(3) *The belts.*—The greatest care should be taken to keep the boxes and belts free from sand. This precaution is specially necessary just after a belt has been fired. What usually happens is that the used portion of the belt is allowed to fall into the sand on one side of the gun, while the box when empty is thrown aside on the other, getting half filled with sand in the process. The belt is then at once refilled and put back into the sandy box. More sand is worked into the belt in the process of refilling. It is from this source that sand finds its way into the feed blocks causing sluggish feed and trouble with the upper pawls, and hence stoppage in the fourth position.

Too much care can not be taken in the correct filling and overhauling of belts. The latter duty should be carried out by Nos. 3 and 4 during action. It must be remembered that, however accurately a belt may have been filled before moving off, it is quite possible for a few hours on a pack saddle to render it quite incapable of being fired without stoppages.

Prolonged stoppages.—These were generally caused by broken cotter pins. This stoppage seems to have occurred to an absolutely inexplicable extent, supposing that the right sized cotter pin was used. It must be remembered that when washers are taken into use the correct size cotter pin must be used with them; this precaution is most essential, otherwise breakages are sure to occur. The length of the connecting rod should be continually tested by the artificers.

In the event of a No. 3 stoppage occurring and of the cover being opened to investigate the cause, the horns of the extractor should always be forced down to remedy this defect. Any attempt to pull them up may lead to an explosion of the cartridge and a resulting accident.

Every effort should be made by company commanders to insure that the sections are as complete as possible in spare parts and particularly in spare locks. In the event of failure to obtain the necessary articles, the company commanders should report the fact to superior authority.

3. *Transport.*—Pack transport was generally used and appears to have been satisfactory. The weight a horse or mule can carry in heavy sand and the best method of packing to avoid any danger of chafing are matters to which company commanders should pay the closest attention.

4. *Ammunition supply.*—Pack animals supplemented when necessary by camels and limbered wagons appear to have been generally used. Careful arrangements seem to have been made by all company commanders to insure the continuity of their supply, and the results appear to have been successful in all cases. Too much emphasis can not be laid on the necessity for these arrangements by all M.G. officers.

5. *Combined sights.*—Combined sights with two guns were used with good results on several occasions. Two instances occur illustrating a right and a wrong method of using this form of fire.

(*a*) Indirect fire with combined sights was used by one section to search the reverse slope of a hill. This proceeding is very sound, and the officer notes in his report that though observation could not be obtained "the Turks came out."

(*b*) Another officer reports that he used combined sights "to obtain the range." Combined sights are useless for this purpose.

6. *Indirect fire.*—Indirect fire was seldom employed, but opportunities for the use of this method of fire will occur in future. All sections should be instructed in the "Graticule" and "Spirit level" methods which are very simply and quickly employed in action.

7. *Cooperation between M.G. companies and Lewis gun detachments.*—Cooperation appears to have been attained in several cases, but is not yet sufficiently general. M.G. company and section officers should give the most careful study to this question both in attack and defense, for it is only by the complete cooperation of all arms that success can be attained. This cooperation should nowhere be closer than between the machine gunners and Lewis gunners, whose methods, up to a certain point, are similar, and therefore make mutual understanding easy.

8. *Overhead covering fire.*—Overhead covering fire was used on many occasions, the "Tangent sight method" being that most commonly employed. All ranks should be instructed in the use of

this method, which is of the greatest assistance whenever the control passes from the officer to the No. 1 at the gun. It should be remembered that the "card and string" method, used in conjunction with it, enables the section officer to insure that his No. 1's are preserving the correct "angle of safety."

9. *Emplacements.*—Great care must be taken in deciding whether overhead cover should be provided or not. It must always be remembered that although such cover is of the greatest value against shrapnel and bullets, it is useless against a direct hit from a heavy shell, and that an emplacement which has been detected, either from the enemy's position or from aircraft reconnaissance, will most certainly be subjected to bombardment and probably destroyed. Several instances of this actually occurred during the operations of last August. Many officers mention in their reports that the scrubby "tumps," which are common in some localities, can easily and quickly be converted into emplacements in which guns are quite indistinguishable, and they say that guns which have been brought forward to a "position of readiness" are far safer when kept in these than when on the reverse slopes of hills or in valleys, both of which were always heavily shelled. Light overhead cover on which pieces of scrub were planted would in these cases be of great protection against hostile aircraft reconnaissance. Great care must be taken in cases where emplacements are furnished with overhead cover that the latter is high enough for the cover to be lifted and the lock and feed block removed if necessary. This should always be tested *at once* on taking over emplacements from other troops.

Loopholes should be blinded when the gun is not actually in use. Care must be taken that they are of sufficient size not to restrict the field of fire of the guns.

10. *Horsemanship.*—Since rapid reconnaissance is essential in all machine-gun tactics, officers commanding companies should insure that all their section officers are sufficiently expert horsemen to enable them to make full use of the chargers at their disposal.

11. *Spare barrels.*—Several extemporized methods of carrying the spare barrel were observed. It is absolutely necessary that some dust-proof covering or box should be provided for this article when pack transport is employed.

12. *Sledges.*—Frequent attention is drawn in officers' reports to the long distances which guns had to be carried owing to the lack of cover for transport animals. It is thought that some light form of

sledge might be of use in desert warfare, and experiments in this direction might well be worth undertaking.

13. *Fire.*—An idea appears to have arisen in some quarters that the machine gun is best adapted for enfilade fire, the Lewis gun for direct fire. The second part of the theory is entirely false. Machine guns of whatever description should always attempt to obtain oblique or when possible enfilade fire for which they are peculiarly adapted. The mistake may perhaps have arisen from the fact that the arrangement of guns advocated for the defense of a position is that the machine guns should form the "Belt of fire" while the Lewis guns cover avenues of approach which are, from the conformation of the ground, protected from the fire of the former. This often leads to the Lewis guns having to be employed to bring a direct fire to bear down such approaches, but this is always a matter of necessity and not of choice.

14. *Command.*—As some doubts seem still to exist on the matter the following decision as regards the command of machine-gun sections may be of help to M.G. officers and others: "M.G. sections detached from their company and ordered to cooperate with any body of troops are under the orders of the officer commanding those troops, and the company commander can not move or take away any such sections without the permission of that officer or a direct order from the brigadier. The M.G. company commander may give his advice as to the use or disposition of such sections, but the responsibility as to whether or not he takes that advice rests with the commander of the troops. Sections held in reserve or detailed for special duties are under the orders of the M.G. company commander."

HOTCHKISS AND LEWIS GUN COURSES.

PART I.—*Instructional.*

[To be fired at a range of 25 yards. Target, Instructional Machine Gun Target, plate 35, Musketry Instructions, Part II.]

No.	Nature of practice.	Rounds.	Method of conducting and object of practice.
1	Holding.....	12	Single shots. To accustom the firer to the gun, and assist in obtaining the correct setting of the Hotchkiss gas regulator.
2	.....do.....	12	Rapid, in two groups of 6 rounds each on different figures. To accustom the firer to the gun, grouping, and correct tension of the return spring. (Hotchkiss gas regulator.)
3	Grouping.....	6	Single shots. To teach importance of consistency of aim and holding.
4	.....do.....	18	Rapid, fired in three spaced groups of 6 rounds each. Each group to be fired at a separate figure. To teach the firer, who in the previous practices has learned the holding and peculiarities of the gun, how to group his shots consistently; and to test his accuracy of holding. A group should not exceed 3-inch ring.
5	Application.....	12	Rapid, in two groups of 6 rounds each; the first group to be fired at the figure named, with regulation aim; the second group at another figure, correcting point of aim, if necessary, in order to bring the group within the band directly over the figure aimed at. To teach the firer how to apply correctly his group to a given target, and to change his point of aim quickly.
6	Distribution by groups (along a line).	30	Rapid, to be fired in groups of 3 to 4 rounds (not spaced), and in two parts of 15 rounds each; left to right 15 rounds, and right to left 15 rounds; each part as it is fired will be criticized separately. To teach the firer to engage a linear target, and to ensure that no spaces of the line are missed. The bipod or barrel rest will be used.
7	Distribution by swinging.	30	Position lying. Two-thirds of the target to be crossed in one continuous burst, evenly and smoothly. The radiator casing or barrel will be rested on a sandbag or parapet.
8	Rectification of stoppages.	50	Position lying. Accuracy of shooting, after rectification, to be criticized.

Total rounds per man: Hotchkiss, 170; Lewis, 152.
Practices 1 and 3 will not be fired by Lewis gunners.

PART II.—*Classification practices 10, 11, and 13 only.*

No.	Nature of practice.	Target.	Range.	Rounds.	Time.	Method of conducting.
			Yds.		*Secs.*	
9	Ranging.....	Plates, iron falling, placed so that they cannot be knocked over.[1]	400	25	.....	The firer will observe his own fire, without outside assistance. Bursts of from 5 to 10 rounds (unspaced) will be fired. When ranging, the sights should be altered between each burst, if necessary. The firer should say "Range" when found, and cease fire.
10	Application.....	Screen 3′ × 10′.	400	20	20	The time allowed includes loading. Bursts of about 5 rounds should be fired.
11	Distribution of groups along a line.	Screen 3′ × 20′.	300	60	40	*10 rounds will be utilized for ranging purposes as in practice 6.* Two magazines or stripe of 25 rounds each. This time includes reloading. The first 25 rounds will be fired from left to right, the second 25 rounds from right to left. (Fired in bursts of about 5 rounds.)
12	Distribution by swinging.	Screen 3′ × 30′. 18 spaces.	200	50	30	Two magazines or strips. The first of 20 rounds, the second of 30 rounds. The time includes reloading, the firing of each swing must be continuous.
13	Snap-shooting..	Figure 3.....	100	[2] 15 [3] 6	3 3	The figure will be exposed for 3 seconds at a time. At each exposure 3 to 5 rounds will be fired in the case of the Lewis gun and in the case of the Hotchkiss gun, 2 rounds (single shots). Hits will be signaled as in rifle practices.

[1] See Musketry Regulations, Part II, par. 201.
[2] Lewis gun.
[3] Hotchkiss gun.

Total rounds per man: Hotchkiss gun, 169 rounds; Lewis gun, 170 rounds.

CLASSIFICATION.

The firer will be classified on the results of practices 10, 11, and 13.
Points will be allotted as follows:
Practice 10 (application), 20 rounds, 2 points per hit.

Practice 11 (distribution), 50 rounds, 12 spaces, 4 points per space hit.
Practice 13 (snap-shooting), 3 exposures, 4 points per figure hit.
For "first-class" gunner, 70 points.
For "qualified" gunner, 45 points.

NOTE.—Practice 12 may be omitted if time is insufficient for the complete course. The "swinging traverse" should only be taught for use in emergency, e. g., for the repulse of a frontal attack at short range.

PART III.—*Field practices.*

Practice.	Nature.	Target.	Range.	Rounds.	Objects.
			Yards.		
14	Attack	15 falling iron plates on a 15-yard frontage.	600 to 400	Sufficient to show effect.	i. Quick change of position and rapid opening of fire. ii. Concealment by the use of existing cover. iii. Method of carrying the gun. iv. Ammunition supply by No. 2. v. Replacement of casualties.
15	.....	5 iron falling plates per gun on a 5-yard frontage.	About 600	.....do.....	i. Rapidity in engaging a target when on the march. ii. Use of hand-cart. iii. Use of existing cover. iv. Quick and correct application of fire. v. Ammunition supply by carts and dumps. vi. Speed in getting out of action.

NOTES ON METHOD OF CONDUCTING THE PRACTICES.

PART I.—*Instructional.*

1. *General.*—Since Part I is probably the first time a new Lewis or Hotchkiss gunner fires with service ammunition, careful and thorough instruction is necessary throughout these practices. The best results will be obtained by criticizing each portion of a practice after its completion.

In these practices the firer should learn, as he gains experience, the peculiarities of his gun and its mounting, and after full explanations and criticism, should be able to compensate for them by suitable holding. These points should receive careful attention and explanation by the instructor, and each group fired must be a separate lesson in view of the small number of rounds available for instructional purposes.

2. *Holding practices, 1 and 2.—(1) Object.*—These practices teach and demonstrate the following:

(i) The peculiarities of the bipod;
(ii) Any peculiarities of the mechanism;
(iii) The sighting of the gun;
(iv) Correct tension of the return spring, and setting of gas regulator, which should give a rate of fire of 10 rounds per second;
(v) Correct holding and position of the firer.

(2) Points for criticism.—The instructor watches the firer to see that he holds and fires the gun correctly. Criticisms should take place, both at the gun position and at the target on the completion of each group.

3. *Grouping practices, 3 and 4.—(1) Object.*—Having acquired a knowledge of the peculiarities of his gun, the firer in these practices learns how to group shots consistently, and obtains further experience of correct holding, sighting, and adjustment of mechanism and mounting.

(2) Points for criticism.—Each group should be fully criticized as it is fired, both at the gun position and at the target. In practice 4 the result of each of the first two groups should be criticized with the aid of field glasses from the gun position. The firer should be taught how to correct his errors.

4. *Application, practice 5.—(1) Object.*—Having been taught how to group correctly, the firer now learns how to apply a group accurately to a given target, to change the point of aim quickly, and to correct any errors of elevation and direction. The interval between the first and second group will be only sufficient for a fresh target to be indicated.

(2) Points for criticism.—The instructor should take note of the rate of loading, laying, and firing. The previous practice gives the firer a guide as to the elevation. At the target errors due to inaccuracies in laying and elevation should be criticized.

5. *Distribution, practice 6.—Points for criticism.*—At the target the following points should be discussed after each part:

(i) Application;
(ii) Length traversed;
(iii) Density of each group;
(iv) Elevation; and
(v) Spaces missed.

6. *Swinging, practice 7.—Points for criticism.*—At the target the evenness of the distribution of the fire, and its effectiveness, will

be discussed. Attention will be directed to elevation, and spaces missed.

PART II.—*Classification practices.*

7. The practices of Part II will not be fired until the man has fired Part I satisfactorily. In the classification practices 10, 11, and 13, the firer will receive no assistance, and the time limit and methods of loading must be strictly observed. An officer will always be present at the butts, and the usual rules for marking, signaling, etc., will be followed. Failure to fire from whatever cause, other than defective mechanism, will count against the firer. In the case of a breakage of mechanism, the practice will be repeated.

8. Battle sights will not be used, except in practice 12, when their employment is left to the discretion of the conducting officer.

9. *Practice 9.*—A falling plate, or other aiming mark, should be placed well to a flank of each application target and in line with the bottom of the target. Only the actual number of rounds required to find the range should be fired. Rounds thus saved should be used for Part III.

10. *Practice 10.*—The target should be named, but the point of aim must be left to the firer and no assistance given to him; the previous practice should have guided him as to elevation, wind, etc.

11. *Practice 11.*—Only 50 rounds are to be fired at the target. Any surplus of the 10 rounds allowed for ranging will be allotted to Part III. In filling the strips for the Hotchkiss gun, the first five spaces will be missed in the first strip and the last five spaces in the second strip.

12. *Practice 12.*—This practice will be fired from a sandbag or parapet without using the barrel rest or bipod; any position suitable to the available cover will be adopted.

13. *Practice 13.*—The figure will be exposed for three seconds at a time, and from a different part of the trench at each exposure.

PART III.—*Field practices.*

14. *Practice 14—Lewis gun.*—The gunner lies down 50 yards in rear of the first position which should be about 600 yards from the target; No. 2 will lie down about 50 yards to his left rear. On the command "Action" No. 1 will pick up the gun and double forward to the position indicated and open fire. The gun will be carried in the most inconspicuous manner, and the magazine will not be on the gun. On fire being opened, No. 2 will double forward with two magazine carriers having full magazines and lie down under cover to the left rear

of No. 1. The practice will be continued as above, each advance being about 100 yards. Before the final position, No. 1 should be made a casualty, and on the command or signal to advance, No. 2 will pick up the gun as he doubles forward and fire it from the final position.

Points for criticism—

(i) The pace of the advance, which should be regulated by the distance, and physical condition of the firer;
(ii) The method of carrying the gun, which should combine freedom of movement and inconspicuousness;
(iii) The use of cover, and speed in opening fire; and
(iv) The method of supplying ammunition by No. 2, and his use of cover.

15. *Practice 14—Hotchkiss gun.*—The team (Nos. 1, 2, and 3) will be formed up, mounted, in order of march, 300 to 400 yards from the first firing position.

On the command or signal "Action" they will gallop to a convenient position, affording cover for horses, in rear or to the flank of the firing position. No. 1 will dismount and run to the firing position with the gun and open fire. No. 2 will dismount, take off the ammunition box, and run with it to No. 1, when he will assume his usual position on the right of the gun. The remainder of the practice will be carried out as with the Lewis gun, except that No. 2 should be on the right of the gun when in action. No. 2 will replace No. 1 at the last range.

When the ground is favorable, on the signal "Out of action," No. 3 will bring up the horses at the gallop to No. 2, who will repack the gun, mount, and gallop back to the position originally selected for the led horses.

Points for criticism.—

(i) Selection of position for dismounting;
(ii) Quickness in opening fire, and use of cover in fire position;
(iii) Method of advance and use of cover;
(iv) Ammunition supply and use of cover by No. 2; and
(v) Speed in getting out of action.

16. *Practice 15—Lewis gun.*—The detachment, with handcarts, will be moving in column of route when they receive word to engage the enemy on their flank. They will move as quickly as possible with the carts to a position which is under cover and is as close to the fire position as tactical conditions allow. A gun and magazine carrier will be taken out of the cart by each No. 1, and two magazine

carriers by each No. 2. The guns will be mounted in a position offering good cover to the firer. No. 2 will take cover to the rear and left flank of No. 1.

Nos. 3 and 4 will arrange for ammunition supply, forming "dumps" where necessary between carts and guns.

"Cease fire" will be given on obtaining effect, and ammunition supply will be practiced. No. 1 may be made a casualty to enable others to fire. On "Out of action" being given, carts will be repacked and march be resumed.

Points for criticism.—

(i) Time taken to come into action;
(ii) Undue exposure in coming into action;
(iii) Use of cover;
(iv) Method of ammunition supply; and
(v) Speed in coming out of action.

17. *Practice 15—Hotchkiss gun.*—A similar practice to that of the Lewis gun may be fired, substituting ammunition supply from pack horses, instead of from "dumps." Alternatively, if the ground is favorable, a practice may be framed for a retirement from position to position, two guns working in mutual support. In both cases, the main object is to give practice in bringing the gun into action from the horse, opening fire, and remounting the gun again.

PART IV.—*Advanced field practices.*

The more advanced field practices will take place in close cooperation with a troop or a platoon.

Total ammunition allowed per man.

	Hotchkiss gun.	Lewis gun.
Part I	170	152
Part II	169	170
Repetitions, Parts I and II	31	48
Part III	80	80
Part IV	50	50
Total	500	500

INFANTRY MACHINE-GUN COMPANY TRAINING

(PROVISIONAL)

1917

TO BE READ IN CONJUNCTION WITH INFANTRY TRAINING AND MUSKETRY REGULATIONS

ISSUED BY THE BRITISH GENERAL STAFF

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CHAPTER I.

ORGANIZATION AND DEFINITIONS.

1. *Organization.*

1. A machine-gun company consists of—

Headquarters.
Sections, each of 4 guns.

The guns may be either Vickers or Maxims, but all the guns of the same company will be of the same pattern.

2. A machine-gun company is commanded by a major or captain with a captain or lieutenant as second in command.

Each section is divided into two subsections, each commanded by a subaltern with a sergeant as second in command. The senior of the two subalterns also commands the section.

3. The machine guns of a section are carried in two limbered G.S. wagons. Each section has also one limbered G.S. wagon for ammunition.

4. Further details as to personnel and vehicles are given in War Establishments.

2. *Definitions.*

The following definitions are added to those given in Infantry Training:

Band of fire.—When a machine gun is fired so that the cone of fire is directed on a fixed aiming mark, while the gun is so sighted that the first catch is at the muzzle and the cone never rises above the height of a man, a *band of fire* is formed in the space between the first catch and the first graze. (See Pl. XVII.)

For practical purposes on flat ground, the trajectory limits the length of the band to 600 yards.

Detachment (in a machine-gun company).—The number of men detailed for the service of one gun. Each detachment is numbered from 1 to 6, permanent duties being allotted to each number. (See secs. 16 and 17.)

Fighting limbers.—Those limbers detailed to carry the guns, tripods, and first supply of ammunition.

In action.—A machine gun is said to be "in action" when it is mounted, loaded, and laid, but is not necessarily firing.

Indirect fire.—Fire directed at an object or area of ground which is invisible from the gun position.

Laying.—The process of elevating and traversing a gun until its axis is made to point in any given direction. On completion of this process the gun is said to be *laid.*

Machine gun.—A gun of the Vickers or Maxim type. Lewis guns are not included in the term *machine gun.*

Position of readiness.—A position in which guns and personnel are assembled preparatory to coming into action.

Ranges, terms applied to.—These are the same for machine guns as for the rifle.

Screen of fire.—If machine guns are sited on any given defensive line so that no portion of the gound in front of that line is unswept by at least one band of fire, that front is said to be protected by a *screen of fire.* (See Pl. XVIII.)

CHAPTER II.

PRINCIPLES AND SYSTEM OF TRAINING.

3. *General instructions.*

The principles and system of training laid down in Infantry Training, Chapter I, apply to the training of the personnel of machine-gun companies.

4. *Annual training.*

1. The details given in Infantry Training, section 8, require modification to suit the new organization of machine-gun companies.

2. (*a*) The establishment given in paragraph 1 of the above-quoted section has been superseded.

(*b*) Paragraph 2. There will be no brigade machine-gun officer, but when necessary the commander of the machine-gun company attached to the brigade will act as such.

3. Machine-gun companies will, if available, be practiced in field operations with infantry battalions, sections being also occasionally detailed to cooperate with companies of infantry during their training.

5. *Elementary training.*

The personnel of machine-gun companies are trained as Infantry soldiers in squad drill, as laid down in Infantry Training, before being instructed in the special formations necessary for machine-gun companies which are given in Chapter III of this manual.

CHAPTER III.

SECTION AND COMPANY DRILL.

SECTION DRILL.

6. *General rules.*

1. A section will be exercised in all the movements of squad drill, the word section being substituted for squad.

2. The rules laid down in Infantry Training, Chapter III, for section and platoon drill will apply. It must be remembered that a machine-gun section corresponds to a platoon, and a subsection to an Infantry section.

3. The normal positions of the units of a machine-gun section formed up on parade for inspection are given in Plate I, but a section parading by itself for inspection will fall in with one pace interval between subsections.

COMPANY DRILL.

7. *General rules.*

1. The object of and rules for company drill of a machine-gun company are the same as laid down in Infantry Training, Chapter IV, for an Infantry company, with the provisos laid down in section 6 (2) of this manual.

2. The normal positions of the units of a machine-gun company in line and in column of route, are given in Plates I, II, and III.

3. The detail of some special movements is given in the following sections.

8. *A company in line moving to a flank in column of route, "Action expected."* [1]

Move to the right (or left) in column of route. No. — Section leading.

1. The company commander, company sergeant major, and signalers will take post on the flank nearest the direction of march.

2. The section commanders will give the command *No. — Section, Form-Fours, Right* (or *Left*), *Quick—March*, on which the gun limber

[1] In this and the following sections the title of the section or of the movement is shown in *italics*, and is followed in the next line by the caution or executive word of command in **boldface type.** The body of the section contains the detail. Cautions or words of command referred to in the detail are in *italics*.

nearest the flank of march will wheel into column of route, followed by its subsection and in succession by the remaining gun limbers and subsections in that order.

3. The ammunition limbers will follow the rear section in the same order as their sections. They will be followed by the headquarters' limber, water cart, cook's cart, and train transport in rear in that order.

9. *A company in line moving to a flank in column of route, "Action not expected."*

Move to the Right (or Left) in Column of Route, Detachments Leading; Sections, Form—Fours, Right (or Left).

1. The company sergeant major and signalers will take post at the head of the column.

Quick—March.

1. The men of the detachments will act as in squad drill.

2. When the rear of the detachments are clear the subsection officer of the leading section will place himself at the head of the gun limber nearest the direction of march and give the command, *No. — Section, Walk—March.* This limber will be followed by the other gun limber, while the No. 3 limber waits until the gun limbers of the remaining sections have passed. The remaining subsection commanders will act in a like manner in succession.

3. The ammunition limbers, headquarters' limber, water cart, cook's cart, and train transport will follow in that order in rear, supervised by the second in command and the transport sergeant, who will ride in rear of the column.

4. The corporals and other details, as shown in Plate II, will act as brakesmen to the fighting limbers and other vehicles, respectively.

10. *A company in line advancing in column of sections.*

Advance in Column of Sections from the Right (or Left).

1. The company sergeant major and signalers will take post in front of the section commander on the right (or left) of the line, distances as in Plate I.

2. No. 1 section commander will give the command *No. 1 Section, by the Right, Quick—March.* The remaining section commanders in succession will give the command *No. — Section, Quick—March,* on which they will lead their sections into their places in column in rear of the preceding section.

3. The ammunition limbers will take post in rear of the last section, the limber nearest the flank of direction leading followed by the headquarters' limber, water cart, cook's cart, and train transport.

11. *A company in column of sections forming line in the same direction.*

At the Halt, on the Left (or Right), Form Line, Remainder Left (or Right)—Incline.

1. The leading section commander will give the command *No. — Section, Halt.* The remaining sections will incline as ordered, when each section is immediately in rear of its position in line it will receive from its commander, *Left* (or *Right*) *Incline*, and, when on alignment, *Halt.* The section commander will, if necessary, give the command *Right* (or *Left*) *Dress*, on which the whole will take up their dressing by the flank of direction.

2. The company sergeant major, signalers, ammunition limbers, water cart, etc., will move to their places in line during the movement.

3. This movement will always be done at the halt.

12. *A company in column of route, "Action not expected," forming line facing a flank.*

At the halt, line to the left (or right), company halt, left (or right) turn.

1. The men of the detachments will act as in squad drill.

2. The subsection officers and the transport sergeant will lead their wagons to their places in line during the movement, and when the movement is completed will take up their places in line.

3. The company sergeant major, signalers, servants, cooks, etc., will take up their places in line during the movement.

13. *A company in column of route, "Action expected," forming line facing a flank.*

At the halt, facing left (or right), form line.

The leading gun limber will wheel in the named direction and halt, followed by the remaining gun limbers, which will wheel and halt in succession as they arrive at the correct interval. They will be followed by their respective subsections, which will be led to their places in line by their subsection sergeants, who will give the command *Halt, left* (or *right*) *turn.*

2. The company sergeant major, signalers, ammunition limbers, headquarters' limber, water cart, cook's cart, and train transport will move to their places in line during the movement.

14. *A company in column of route, "Action expected," forming line in the same direction.*

At the halt, on the left (or right), form line.

The leading gun limber will halt, the remainder disengaging to the left (or right) and taking up their places in line. As the gun limbers arrive at their places, their respective subsections will disengage by the right. On reaching the correct distance in front of the gun limbers, each subsection sergeant will give the command *At the halt, on the left* (or *right*), *form subsection.*

2. The company sergeant major, signalers, ammunition limbers, headquarters' limber, water cart, etc., will move to their places in line during the movement.

15. *A company in column of route, "Action not expected," forming line in the same direction.*

At the halt, on the left (or right), form—Company.

1. The men of the detachments will act as in squad drill.

2. The gun limbers will be led to their places in line by their respective subsection officers.

3. The company sergeant major, signalers, cooks, servants, etc., ammunition limbers, headquarters' limber, water cart, cook's cart, and train transport will move to their places in line during the movement.

CHAPTER IV.

MACHINE GUN DRILL.

NOTE.—The following sections 16 and 17 are substituted for sections 102 and 103, respectively, in Infantry Training, Chapter VII. Additional sections, 18 to 22, are added for more advanced training. In order that training may be progressive, the sequence of these sections should be adhered to.

16. *Allocation of duties.*

1. The duties of the section commander are to command the section in accordance with his orders and the tactical situation, to select gun positions, to observe and to control fire generally, to regu-

late the ammunition supply, and to give instructions regarding the movements of limbered wagons.

2. The duties of the subsection officer are to assist the section commander and to act as second in command of the section. He should be ready to replace the section commander should the latter become a casualty. Normally he will command one subsection in action and supervise the transport of his section in quarters and on the line of march.

3. The duty of the sergeant is to supervise guns coming into action as the section officer may direct. He must be prepared to take command of the section in the event of both the officers becoming casualties. He is responsible for replacing casualties among the gun numbers when they occur.

4. The corporal is responsible generally for the packing and contents of the gun limber. On the line of march he marches behind it and works the brake as required. On the order to unpack he will superintend the unpacking, and take command in the absence of the section officer or sergeant. He will have the spare parts box handy, supervise the ammunition supply and filling of belts, direct the gun limber as required, superintend the filling of sandbags, and watch for signals from the section officer. He will be prepared to take the place of the sergeant should he become a casualty.

5. The following are the duties of the various numbers:

No. 1 is the firer. He will personally clean and look after his gun and insure that the mechanism is working smoothly. On going into action he will carry the Mark IV tripod and place it in a suitable position and assist No. 2 in mounting the gun. He repeats all orders received, observes his own fire when possible, and makes the necessary alterations of elevation and direction.

No. 2 assists No. 1 at the gun, carries the gun into action when No. 1 is carrying the tripod, and mounts it with the assistance of No. 1.

On going into action he will secure the tube of the condenser to the gun and take the first-aid case. In action he will attend to the feeding of the gun, watch for signals from the section or company officer, and generally assist No. 1.

No. 3 is responsible for keeping the gun supplied with ammunition, seeing that the condenser (half filled with water) reaches the gun position before there is any chance of the water in barrel casing boiling, and carrying out minor repairs while the gun is in action.

No. 4 assists No. 3 in his duties. He is responsible for keeping No. 3 supplied with ammunition, water, and spare parts from the spare-parts box as required.

Nos. 5 and 6 are spare men. These numbers and the scout and range taker, if detailed to the section, act according to the orders of the section or subsection officer.

6. Section officers will insure that each man of the section is thoroughly trained in the duties of each "number." A system of "changing round" will be arranged, so that every man will perform the several duties of the section in turn.

17. *Elementary drill.*

NOTE.—Elementary drill consists of the following:

(*a*) Mounting the gun.
(*b*) Loading.
(*c*) Sight setting and laying.
(*d*) Unloading.
(*e*) Dismounting the gun.
(*f*) Coming into action.
(*g*) Coming out of action.
(*h*) Tap traversing and vertical searching.
(*i*) Use of condenser tube and bag with water.
(*j*) Elementary drill with gun mounted in lowest position.

1. The guns of a subsection, with tripods and ammunition boxes, will be placed on the ground, muzzles to the front and in line, legs to the rear, and clamps sufficiently tight to prevent the legs from hanging loose when the tripod is lifted off the ground. The traversing clamp should be sufficiently loose to enable the gun to be deflected by a sharp tap with the hand on the rear crosspiece; guns on the right, ammunition boxes 3 paces in rear of the guns. The guns should be a convenient distance apart, but not closer than 8 paces.

2. On the command *Fall in*, the subsection will fall in in two ranks, 5 paces in front of the interval between the two guns, the sergeant on the left of the front rank, covered by the corporal in the rear rank. The front rank will provide the right gun detachment, the rear rank the left gun detachment.

On the command *Number*, the subsection will number from right to left.

On the command *Take post*, detachments turn outward and double to their respective guns (the sergeant and the corporal on the outer flank, where they can superintend). Nos. 1 and 2 fall in on the left of the tripod and right of the gun, respectively, No. 3 on the left of the ammunition box. If the ground is suitable, these numbers should lie down.

Nos. 4, 5, and 6 should take up positions as directed by the instructor.

3. Before commencing drill, each "number" will examine the gun and equipment as follows:

No. 1 will examine the tripod and see that—

(*a*) The legs are closely folded and clamped.
(*b*) The traversing clamp is *sticky*.
(*c*) The pins are in and turned down.
(*d*) The elevating screws are exposed the same amount.

No. 2 will examine the gun and see that—

(*a*) The lock is in and the lock spring is released.
(*b*) The sliding shutter is closed (in the Vickers gun).
(*c*) The feed block is in and the front cover catch of the Vickers gun turned down.
(*d*) The T fixing pin is screwed up and vertical (Vickers gun).
(*e*) The cork plug is in.
(*f*) The slide of the tangent sight is adjusted to 600 yards.
(*g*) The auxiliary mounting is correctly fixed and in working order.

No. 3 will examine the belt and see that—

(*a*) The cartridges are correctly placed.
(*b*) The belt is packed correctly in the box and the lid fastened.

Nos. 2 and 3 will report to No. 1 when they are satisfied that all is correct.

4. In each stage of the drill the correct method will first be demonstrated by the instructor, and will then be practiced by each member of the team before proceeding to the next stage. During drill, the spare numbers will be brought up near the gun to watch and listen to the criticism. No. 1 will always repeat the words of command loudly and clearly.

5. *Mounting the gun.*—A machine-gun instructional target or landscape target will be placed about 25 yards from the guns. The instructor will point out a place for the guns to be mounted, not more than 5 yards from where they are lying. He will then give the command *Mount gun.*

No. 1 picks up the tripod, carries it to the spot ordered, and places it in position. In adjusting the tripod he must insure that the socket is upright and that the legs are clamped tight. He must learn by experience *the adjustment that suits him best for the position ordered and for the nature of the ground, so that he will not be cramped when firing and will not have to alter the tripod after the gun has been mounted.*

As soon as the tripod is nearly in position, No. 2 picks up the gun (with Vickers gun pushes the sliding shutter to the rear), and carries it to the right side of the tripod holding the rear crosspiece with the left hand with the gun muzzle to the rear under the right arm. He then kneels on the left knee, facing the tripod, and supporting the gun on the right knee places it on the tripod, drives in and turns down the crosshead joint pin, and removes the cork plug from the steam escape hole. No. 1 fixes the elevating joint pin, and directs the gun toward the mark. Meanwhile No. 2 lies down and places the ammunition box in position.

No. 2 should time his advance so as to reach the tripod at the moment its adjustment is completed.

When No. 3 sees that the gun is nearly mounted, he carries the ammunition box forward and places it within reach of No. 2. The ammunition must be at hand directly No. 2 is ready for it. No. 3 then retires to a position not immediately in rear of the gun. (Standard time, 20 seconds.)

6. *Loading.*—On the command *Load*, No. 1 pulls the crank handle on to the roller. (Maxim: Turns the crank handle on to the buffer spring.) No. 2 passes the tag of the belt through the feed block. No. 1 with his left hand pulls the belt straight through to the left front as far as it will go and releases the crank handle. Relaxing the strain on the belt, No. 1 pulls the crank handle on to the roller (Maxim: Turns the crank handle on to the buffer spring), pulls the belt to the left front and releases the crank handle. Each motion should be clean and distinct. (Standard time, 5 seconds.)

The gun is now loaded and ready to fire.

7. *Sight setting.*—For ranges not exceeding 500 yards the fixed sight will be ordered, except when firing at a very small target, when orders will be given as in the case of ranges over 500 yards.

For ranges over 500 yards, on the command (*Range*), e. g. "*900.*" No. 1 raises the tangent sight, repeats the order for his own gun, and adjusts the slide to the elevation required for the distance ordered.

8. *Laying.*—On the command *At* —— (naming the aiming mark), No. 2 adjusts the traversing clamp if told to do so by No. 1, and No. 1 lays the gun, maintaining the same pressure on the handles while laying as he would when firing.

When the gun is laid, No. 1 raises the automatic safety catch with the forefinger, and prepares to fire. When No. 1 is ready, No. 2 holds out his left hand and arm horizontally.

9. As proficiency increases, the pause between naming the range and the aiming mark should be slight. (Standard time for sight

setting and laying, 12 seconds; taken from the time the range is ordered until No. 2 holds out his hand.)

10. On the command or signal *Fire*, No. 1 presses the thumbpiece or double button.

11. On the command or signal *Cease fire*, No. 1 releases the pressure on the thumbpiece or double button, and remains steady.

12. The points for criticism when the gun is mounted should follow a definite sequence.

(*a*) *Tripod:*

i. Position of legs with reference to the ground.
ii. Clamps of leg tight.
iii. Socket upright.
iv. Traversing clamp *sticky*.
v. All pins in and turned down.
vi. Elevating screws equidistant.
vii. Rear leg in prolongation of line of sight to the target.

(*b*) *Gun:*

i. Muzzle toward the target.
ii. Cork plug out.
iii. Shutter back.
iv. Belt box in line with the feed block.
v. No. 1 with holding taken and elbows supported on thighs.
vi. No. 2 in position.
vii. Gun fairly level.
viii. Tangent sight set to 600 yards.

(*c*) The following points should also be noted:

i. Loading; the cleanness of loading must be insisted on.
ii. Accuracy of sight testing.
iii. Absolute accuracy of aim.
iv. Firing; that on the order or signal being given, to open fire, the double button or thumbpiece is immediately pressed, without disturbing the laying.

13. *Unloading.*—On the command *Unload*, No. 1 lowers the tangent sight, if it has been raised, and leaves the sight as last adjusted; he pulls the crank handle twice in succession on to the roller, letting it fly back each time on to the check lever, and finally depresses the lower pawls (Maxim: He turns the crank handle twice in succession on to the buffer spring, letting it fly back each time on to the check lever) while No. 2 withdraws the belt and packs it in the box; this must be done correctly, and the lid closed and fastened; No. 1 releases the lock spring by pressing the double button or thumbpiece. (Standard time, 5 seconds.)

14. *Dismounting the gun.*—On the command *Dismount gun*, No. 1 removes the elevating and crosshead joint pins.

No. 2 passes the ammunition box to No. 3, replaces the cork plug when the condenser is not in use, removes the gun as in mounting, and replaces it in its original position in rear. On reaching this position, he closes the sliding shutter (Vickers), and readjusts the tangent sight to 600 if previously altered.

No. 1 carries back the tripod, replaces the cross-head and elevating joint pins, taking care that they are turned down, and then folds and clamps the legs. (Standard time, 15 seconds.)

15. *Coming into action.*—As proficiency increases, the gunners should be exercised in performing all the movements required to bring the gun into action.

On the command or signal *Action* (followed by range and aiming mark) the gunners will, from the positions described in paragraph 2, combine all the foregoing details of mounting, loading, and laying the gun, No. 2 signifying when No. 1 is "ready" to fire. (Standard time, 35 seconds.)

16. *Coming out of action.*—On the command or signal *Out of Action*, the gun will be unloaded without withdrawing the belt from the feed block. No. 1 will seize the rear leg and rapidly withdraw the gun and tripod under cover or to the original position, with the least possible exposure. No. 2 similarly will withdraw the ammunition box. The gun will then be dismounted in the usual manner. If the cover is some distance away, Nos. 1 and 2 will carry the gun, tripod, and belt box in the most convenient manner to cover.

17. *Tap traversing.*—Frequent instruction will be given in traversing fire. The firer must first insure that the traversing clamp is just sufficiently loose to enable the gun to be deflected by means of a sharp tap with the hand on the rear crosspiece. Each man must learn by experience the exact degree of clamping he requires, and before firing he should *insure that the clamp is correctly adjusted* to suit himself.

Traversing fire is applied by means of a series of groups fired at intervals within certain limits indicated by such figures on the machine gun instructional target as may be ordered by the instructor.

The procedure for horizontal traversing is as follows: The instructor having described the figures between which fire is to be directed, will give the command *Traversing* followed by the signal to fire. The firer will lay the gun on the flank figure named and press the button, then tap the gun approximately to the center of the interval to the next figure, again press the button, then tap, and so on, until

the limit ordered has been reached. The firer should be taught to fire groups of about eight rounds by maintaining pressure on the button for about one second at each group. By this method he will learn to tap the gun with the necessary force in order to avoid firing more than one group at the same place, and also to avoid leaving gaps in the line he is traversing. (Standard time, 2 seconds for each completed series, i. e., a group and completed traverse.)

As proficiency increases, instruction should be given in diagonal traversing. In this case the target will be three bands each with three figures as for horizontal traversing. The bands will be joined so that each of the outer bands is in the same vertical plane as the center band and forms an angle of 120° with it.

In this case the firer is taught to combine the use of the elevating wheel with tapping for deflection, the same principles being applied as in horizontal traversing. Instruction should be afforded in traversing from right to left as well as from left to right.

During instruction, fire should be stopped at least twice in order to check the laying and also to measure the distance traversed. By comparing the distance traversed with the groups fired, an estimate can be made as to the value of the traversing fired. For example: Traversing fire is ordered from the first to the sixth figure; fire is stopped after the fourth group. If the traverse had been correctly carried out, the gun should be laid on the interval between the second and third figures. (Standard time, 3 seconds for each completed group and traverse.)

18. *Swinging traverse.*—Against dense targets at close range, the normal method of traversing is too slow, and fire is unnecessarily concentrated. The "swinging traverse" will therefore be employed for this purpose. This consists of rapidly traversing a given line with the traversing clamp loose, the limit and speed of traverse being controlled by the action of the gunner.

Elementary instruction in "swinging traverse" will be given on the machine gun instructional target. The gunner will be trained to traverse evenly and smoothly the breadth of the target from outside figure to outside figure in about 5 seconds.

As proficiency is attained, practice will be afforded in traversing various types of targets which are suitable for this method of fire.

18. *Combined drill.*

Instruction in machine-gun signals (see Infantry Training, sec. 164) must be given before combined drill is commenced, and these signals should henceforth be used whenever possible.

Combined drill is best carried out with four or more guns. Condensers will always be attached and bags filled. Barrel casings will also be filled. Competition between detachments should be encouraged with a view to increasing proficiency in elementary drill. The following subjects are taught during combined drill:

(a) The execution and delivery of fire orders.
(b) The use of combined sights.
(c) Indication and recognition of targets.
(d) Immediate action.
(e) The replacement of breakages.
(f) Casualties.

The instructor should take times, correct mistakes, and carefully note the performance of each detail. When combined drill is carried on out of doors in fine weather, all numbers should lie down, 3 and 4 forming a short chain, and the remainder representing reserves in the rear.

19. *Auxiliary mounting drill.*

1. The auxiliary (light) mounting is not intended to replace the Mark IV tripod. The gun can be placed on the Mark IV tripod without removing the light mounting.

It is intended for use in—

(a) The firing line.
(b) Rapid advances.
(c) Trench to trench rushes.
(d) Fighting in captured trenches when hurried changes of position are essential, etc.
(e) Trench fighting, when the gun has to be fired hurriedly from a position other than the battle emplacement, or when the Mark IV tripod has been destroyed.

The gun can be carried by either one or two men, as desired. The leather straps, one on the rear crosspiece and one on the front clip band, enable Nos. 1 and 2 to carry the gun between them. They should move in single file, thus concealing the gun from the front. In this way the fact that a machine gun is being brought up will be more easily concealed from the enemy.

When in action in the open with the light mounting, No. 1 should lie on his back, with his legs to the left of the tripod, No. 2 being on his right-hand side, supporting the firer's back and neck with his legs. (See Pl. VII.)

2. When it is desired to have the gun carried by one man, Nos. 1 and 2 should move extended to two or three paces, but conform-

ing as far as possible to neighboring infantry extensions, No. 1 carrying the gun and No. 2 two or more boxes of ammunition and first aid case.

3. The following method will be taught in addition to other methods which may be suitable on special occasions. The gun will be carried vertically on the right-hand side, muzzle upward, the right hand grasping the rear leather band, back of the hand to the front, and taking all the weight; the left hand steadying the muzzle end by means of the light mounting clip.

The method of carrying the gun on the shoulder leads to exposure, and is unsuitable in trenches or when in close contact with the enemy.

The condenser tube will be attached throughout.

4. (*a*) For drill purposes about 3 seconds after No. 1 has opened fire he should pull the crank handle on to the roller, thus allowing the short length of belt to be pulled through the feed block and the web belt inserted.

(*b*) The fixed sight is invariably used in light mounting work; consequently the tangent sight will not be raised.

(*c*) Stoppages should be practiced.

(*d*) When this drill is carried out on rough ground the necessary precautions for concealment will be observed when bringing the gun into and out of action.

5. *Drill with "two-man load."*—The gun, with light mounting attached, legs closed and engaged in the clip, will be placed on the ground 20 yards in the rear of the selected position upon which the gun is to be brought into action.

The muzzle of the gun will be placed to the front.

Nos. 1 and 2, each with an ammunition belt box containing a few dummy cartridges at the end of the belt, will assume the prone position, No. 1 behind the rear crosspiece, No. 2 on the right of the gun. No. 2 will have also a short length of belt with two dummy cartridges in its leading end, and the first aid case.

The condenser bag will not be carried.

6. On the caution *Prepare to advance.*—No. 1 will—

(*a*) Pull back the sliding shutter.

(*b*) Perform the first half of the loading motion.

(*c*) Throw the short length of belt over the feed block to the left.

(*d*) Release the lock spring.

(*e*) Turn the gun on its left-hand side.

No. 2 will—

(*a*) Insert the short length of belt in the feed block.

(*b*) See that the front leather strap is to the top.

(*c*) Open the tripod legs after (*e*).

7. On the command *Action*, the numbers spring to their feet seizing the appropriate straps, and, each carrying a belt box in the disengaged hand, will move rapidly to the position selected. No. 1 has the strap in his right hand; No. 2 in his left hand.

8. On arrival at the position, No. 1 will call out *Action* and—

(*a*) Steady the tripod and lie down, placing the belt box in a convenient position for No. 2.

(*b*) Throw the short length of belt over to the right and complete the loading motions.

(*c*) Adjust the rear leather strap if necessary.

(*d*) Open fire.

No. 2 will—

(*a*) Turn down the front leather strap.

(*b*) Lie down and support No. 1.

(*c*) Open the belt box and hold a new belt ready.

9. On the caution *Prepare to advance*, preceded by the command *Cease fire*, No. 1 will unload; No. 2 removes the web belt and inserts the short length of belt, if there has been time to replace it.

10. On the command *Out of action*, the gun will be unloaded without removing the belt from the feed block and will be withdrawn until cover is reached, when No. 1 will—

(*a*) Depress the pawls and release the lockspring.

(*b*) Close the sliding shutter.

No. 2 will—

(*a*) Pack away the belts.

(*b*) Adjust the front strap.

Both will then jump up and retire, carrying the boxes and gun.

11. *Drill with "single load."*—As for drill with the two-man load, except that No. 2 will carry both belt boxes.

12. On the caution *Prepare to advance*, the same procedure will be followed as for the two-man load, except that No. 2 should see that the front strap is at the *bottom*.

13. On the command *Action*, as for the two-man load, except that No. 1 carries the gun alone; No. 2 the belt boxes. In moving forward, No. 2 should extend to the right, and close in again on No. 1 on nearing the position.

The remainder of the drill follows the same lines as for the two-man load.

20. *Rough ground drill.*

1. The gun will be mounted throughout on a steep slope, for firing in each of the following directions in turn:

(*a*) Down.
(*b*) Up.
(*c*) Horizontally to the right.
(*d*) Horizontally to the left.

Nos. 1, 2, and 3 with the gun, tripod, and ammunition box, and 4 with water bag (full) and another box of ammunition, will be in a position of readiness not more than 10 yards from the selected position. The instructor having marked the position and pointed it out, the gun numbers, on receipt of a target and range, will, on the order *Action*, mount, load, and lay the gun on the target indicated. The same procedure will be followed for each of the four positions.

2. The following points are important:

(*a*) Correct setting up of the tripod, the rear leg always downhill.
(*b*) The positions adopted by Nos. 1 and 2 (as regards fire effect, exposure, and comfort).
(*c*) The position of the ammunition box to insure correct feed.
(*d*) The position of No. 3 (minimum exposure with facility for supply).
(*e*) The position of No. 4.
(*f*) The gun must be properly in action, and all details of elementary training must be observed.

21. *Trench drill.*

1. The object of trench drill is to practice:

(*a*) Posting and relieving sentries and No. 1.
(*b*) Relieving detachments.
(*c*) Action in trenches.
(*d*) Preparing to advance and coming into action.
(*e*) Quick change to an alternative position.

All the above should be practiced on the barrack square before drill takes place in the trenches.

2. *Posting and relief of sentries and No. 1.*—The principles involved are identical with those of posting and relief of an infantry sentry on guard or outpost duty.

3. At a gun position in trenches:

(*a*) *By day* only one number need be on duty at the gun position, and he will be the sentry.

(*b*) *By night* two men will always be on duty; one being the sentry, who is keeping a lookout, and the second being the No. 1 for the term of duty. The latter is actually at the gun, and may sit down, but must be awake.

4. A gun number (if by night, usually the last number on gun duty) will be posted as a sentry—by day with a periscope or at a loophole if no periscope is available; by night, looking over the parapet. He will be acquainted with the position of all emplacements allotted to his gun, and will have a thorough knowledge of the following:

(*a*) The section of the ground covered by the gun which it is his duty to watch.

(*b*) Points shown on the range card.

(*c*) Special orders for his gun position during his relief. These may include action as regards patrols, wiring parties, etc.

(*d*) Standing orders for the sentry on machine-gun emplacements.

He will be informed of any unusual circumstances noticed by his predecessor.

The relieving No. 1 will inspect the gun and insure that the gun is in firing order, also that all necessary equipment is in place. He will be informed of any special fire orders which may have been issued for that gun.

All the foregoing is applicable to internal relief within a gun detachment. For relief of sentries when sections or companies are concerned see paragraphs 5 and 6.

5. *Relief of detachments.*—The guide with the relieving detachment will lead them to the dugout of the detachment to be relieved, and report to the gun commander of that detachment that the relieving detachment has arrived.

The relieving N. C. O. or man in charge will—

(*a*) Ascertain the positions of the gun, the sentry, alternative emplacements, his officer's headquarters, the nearest telephone, and the latrine.

(*b*) Take over and give a receipt for trench stores.

(*c*) Receive a report from his No. 1 when his gun, etc., is present and correct.

(*d*) Ensure that his No. 1 understands his orders, range card, etc., for his gun, and show him the alternative emplacements.

(*e*) Order his No. 1 to mount his tripod (and gun, if relief is by night), and see that this is done correctly.

(*f*) Detail his first sentry, and instruct him to take over.

(*g*) Report to his officer, "Relief complete."

(*h*) Draw out a duty roster.

6. The relieving sentry will ascertain the orders for the sentry as detailed in paragraph 4, and, in addition, will find out—

(*a*) Whether the gun has been fired during the previous relief.

(*b*) If so, at what target, and from what emplacement.

7. The officer in charge of the relieving detachment will—

(*a*) On arrival in the trench sector to be defended by his guns, report to the officer of the guns to be relieved.

(*b*) Remain with him and receive reports from his gun commanders.

(*c*) Receive any instructions or information with regard to the situation, other than those he has learned during his previous reconnaissance.

(*d*) As soon as the relieved detachment has moved off he will go round all his guns and make sure that his gun commanders have carried out their work correctly. At the same time he will see that any special orders he may have issued with regard to work to be done, standing fire orders, etc., are being complied with.

(*e*) Report "Relief complete" to his machine-gun company commander and to the company commander of the trench sector in which he finds himself.

(*f*) See that his arrangements for communication are on a satisfactory basis.

8. Officers in charge of detachments relieved will not move off until their detachments are reported closed up and complete.

ACTION IN TRENCHES.

9. (*a*) *By day.*—On the command *Action*, the sentry runs to the dugout, wakes the other members, takes the gun to the emplacement, mounts, loads and lays; No. 2 follows immediately with the ammunition and first-aid case, and the remaining members stand by in the dugout. When the occupants of the trench are ordered to *Stand-to*, the above procedure is carried out by the machine-gun detachments, except that the gun is only half loaded.

The loophole (if blinded) would have to be cleared before fire could be opened; the actual moment when this should be done depends on the nature of the situation.

(*b*) *By night.*—On the command *Action*, No. 1 will complete the loading motions. The sentry will waken the men in the dugout and return to his post.

(*c*) Practice should be given in mounting the gun on the auxiliary mounting in alternative positions during drill by day to represent the Mark IV mounting having been destroyed.

Practice will also be given with the pivot and ammunition box mountings.

PREPARE TO ADVANCE.

10. (*a*) *By day.*—The sentry will run to the dugout and warn the other numbers. Nos. 1 and 2 will carry out their duties as laid down for the caution *Prepare to advance* in "Auxiliary Mounting Drill." (Sec. 19 (6).) After this is completed they will carry the gun from the dugout to the correct place in the trench. No. 3 will come up and dismount the tripod.

(*b*) *By night.*—Nos. 1 and 2 will be in their proper positions (see par. 3), spare parts, short length of belt, and two belt boxes in the emplacement, spare numbers in the dugout. On the command *Prepare to advance*, No. 1 will unload, withdraw the web belt, insert the short length, perform half the loading motions, throw the short length over the feed block and release the lock spring; while No. 2 warns the spare numbers in the dugout. The latter then returns to the gun, helps No. 1 to dismount, opens the auxiliary legs, and both adjust the leather straps. The gun is then brought to the easiest place from which to climb over the parapet, two belt boxes, spare parts, etc., being brought with it. No. 3 dismounts the tripod when the emplacement is clear, and awaits further orders.

(*c*) On the command *One-man load*, *Action*, or *Two-man load*, *Action*, either by day or night, Nos. 1 and 2 will act as laid down in section 19, (7) and (8). No. 3 will assist Nos. 1 and 2 with their equipment over the parapet.

(*d*) At this stage the instructor may either—

(i) Give the command *Out of action*, on which the gun numbers will retire with the gun to their original position, or

(ii) Order No. 3 to advance with Mark IV tripod and mount it near Nos. 1 and 2, taking care that there is no crowding of men.

22. *Section tactical exercises.*

1. Section tactical exercises will include all details of training that a section of machine guns should receive from the section officer. If these exercises are carefully prepared and executed, the section officer on service will be relieved from the necessity of supervising the detailed execution of his orders, and will be left free to devote his attention to the general situation, while maintaining control of the movements and actions of his guns.

2. *Exercises with one gun.*—The position of readiness will be not closer to the gun position than about 50 yards. Instead of indicating the exact position on which the tripod will be set up the instructor will mark two points about 30 yards apart, between which the gun will come into action. The ground selected should afford practice in firing in the positions described in rough ground drill (sec. 20). Whenever possible there should be only one small portion of the prescribed frontage from which the objective can be seen when the gun is in action. By this means the detachment will be practiced in selecting suitable gun positions to meet the particular requirements of the situation, and thus develop an eye for ground.

In these exercises attention will be paid to the following points:

(*a*) The use of ground to obtain the greatest possible concealment in approaching the gun position from the position of readiness. This should be kept in mind by the instructor in selecting positions.

(*b*) The method of approach to the gun position as regards carrying the gun, tripod, and ammunition box. Concealment is of greater importance than rapidity within reasonable limits.

(*c*) Proficiency in the lessons taught in rough ground drill. Observers will be sent out to note visibility in the approach, in mounting, and when the gun and detachment are in action.

3. *Exercises with two guns.*—The entire subsection will be exercised with two guns on the same progressive lines as those laid down in paragraph 2. The actual position of each gun will be marked by the instructor in order to bring out the handling of the section with reference to the ground and the requirements of the situation. The tactical situation should be described in greater detail than is necessary for elementary drill purposes in order to employ scouts and range takers in a realistic manner. A simple tactical situation should be given and ranges actually taken. The position of the gun limber, of which the corporal will be in charge, will be represented by a handcart or indicated by a flag. The supply of ammunition will be actually carried out, empty boxes being returned. The men will be changed around at intervals so that each may be exercised in the duties of the various numbers.

4. The points to be attended to in rough ground drill (sec. 20) and in tactical exercises with one gun (par. 2) should be carefully observed and the performance criticized.

5. Further instruction should be given by carrying out a certain number of elementary tactical exercises, involving all duties of machine-gun section or subsection establishments, with a view to

developing cooperation between the gun numbers and initiative. These exercises should comprise movements of various kinds over a wider stretch of country than hitherto attempted. Complete exercises should be prepared in detail, with maps, instructions, and points for criticism.

When possible, trained men should be used to demonstrate the methods employed.

6. Schemes should also be framed for the purpose of training machine-gun officers in the tactical principles laid down in Infantry Training and Field Service Regulations, as well as those given in this manual, and in Notes for Infantry Officers on Trench Warfare. These exercises should involve the rapid appreciation of a situation, the issue of orders to meet the situation, and the control of machine guns.

The actual presence of guns on such tactical schemes is of value, in order to test to some extent the feasibility of the execution of the orders given. The presence, however, is not essential for the conduct of the exercise.

Chapter V.

FIRE DIRECTION.

23. *General remarks.*

1. The theory of rifle fire and its practical application discussed in Chapter III of the Musketry Regulations is equally applicable to the fire of machine guns, due regard being had to the greater concentration or closer grouping of shots produced by the fire of a machine gun than by the fire of an equivalent number of rifles.

2. The principal methods of machine-gun fire are dealt with in Infantry Training, section 163. Some further methods are given in this chapter.

3. It must be remembered that these methods are not suitable for Lewis guns, but only for machine guns fired from a fixed platform, such as the Mark IV tripod.

4. Various tables for use in these methods of fire are given in Appendix A.

24. *Traversing fire.*

1. The principles of traversing are taught during elementary gun drill and during the annual and general machine-gun courses. (See also Infantry Training, sec. 163 (1) (iii).)

2. This method of engaging a linear target possesses certain disadvantages. It is a slow method and requires careful training, and the regularity of the groups may possibly detract from the effect produced on the target. The former can be remedied to a great extent by seeking opportunities for oblique fire, thus reducing traversing to a minimum. Fire effect from this very systematic form of traversing may be lost owing to the enemy anticipating where the next series of groups will fall. This can be overcome if the gunner is trained to apply series of groups at different parts of the linear target in turn.

3. An alternative method is the "swinging traverse," the traversing clamp being kept fairly loose, and the gun swung evenly and smoothly from side to side. This method may sometimes be found necessary against dense targets at close range, when the normal method would be too slow.

Using this method, a gun can distribute fire over approximately 30 yards of front in five seconds at close ranges.

25. *Searching fire.*

1. The principles of searching are demonstrated in Part I of the Annual and General Course for Vickers, Maxim and Colt Guns. It is used when only one or two guns are available or combined sights will not overcome ranging errors. It requires much skill on the part of the firer to avoid gaps. The size of the groups fired will depend on the nature of the target engaged.

2. When one gun is being employed in "searching" the sights are adjusted so that the first group will include the lowest limit of range to be searched, which is dependent on the probable error to be expected in estimating the range. The gun is then laid on the aiming mark, and the sights adjusted without relaying, so that the last group will include the highest limit of range. The line of sight will now strike the ground short of the aiming mark. (See Pl. XXII.) A group will now be fired, after which the elevating wheel will be so turned as to cause the next group to strike sufficiently far beyond the first to insure an overlap. This is continued until the line of sight is again brought on to the aiming mark.

3. When using two guns the left gun will act as described above; the sights of the right gun will be adjusted in the first instance to the highest limit, and will work down to the lowest limit. (See Pl. XXIII.)

4. Searching will be discontinued if observation of results is obtained.

5. The effect of ground rising with respect to the line of sight must be considered when combined sights or searching is employed. (See Musketry Regulations, sec. 187.)

6. Combined sights, searching, or a combination of both can also be used for engaging targets of great depth, such as roads, bridges, etc.

26. *Combined sights.*

Combined sights is a method of increasing the beaten zone by ordering two or more guns to engage the same target with different elevations. It can be used to engage targets of great depth, or it may be employed to insure that the target shall fall within the beaten zone, when the range to the target is uncertain. (See Pl. XXI.)

The table below shows the number of guns required, and the differences for 5 per cent, 10 per cent, and 15 per cent errors in ranging. The table is not extended to include a larger number of guns than four, as on service a section would most probably be the largest unit under the control of a single fire commander.

Combined sights table.

75 per cent effective beaten zone.				90 per cent effective beaten zone.			
Estimated range.	Error in ranging.	Least number of guns.	Differences between guns.	Estimated range.	Error in ranging.	Least number of guns.	Differences between guns.
	Per ct.				*Per ct.*		
700 and 800.....	15	2	100	1,000 and 1,100..	15	2	100
900 and 1,000...	10	2	100	1,200 and 1,300..	10	2	100
	15	3	100		15	3	100
1,100.....	10	3	100	1,400.....	10	3	100
	15	4	100		15	4	100
1,200.....	5	2	50	1,500.....	5	2	100
	10	4	50		10	3	100
1,300.....	5	2	50	1,600.....	5	2	100
			50		10	3	100
1,400, 1,500, and 1,600.....	5	3	50	1,700 to 2,000, inclusive.....	5	2	100
			50		10	4	100
1,700 to 2,100....	5	4	50	2,100 and above.	5	2	100

The number of variables in the table above makes it difficult to lay down any accurate rule for the employment of combined sights. For average service conditions the following will be found to give good results.

RULE.—Always use as many guns as possible: With 100 yards differences, if error in ranging is probably considerable; 50 yards differences if error in ranging is probably small.

27. *Overhead fire.*

1. Overhead fire with machine guns may be employed under certain conditions. The following factors, all of which tend to increase the difficulty and risk, necessitate the working out of a reasonable margin of safety:

(*a*) The state of the barrel.

(*b*) The condition of the tripod and the nature of the ground on which mounted.

(*c*) The degree of visibility of the target.

(*d*) Errors due to ranging and climatic conditions.

(*e*) Accuracy of laying and holding by the firer.

2. The flat trajectory of modern ammunition necessarily restricts overhead fire at the closer ranges, if the gun position, friendly troops, and the enemy are approximately in the same horizontal plane; while at long ranges the dispersion of the cone of fire and difficulty in ranging make it necessary to insist on ample precautions being taken to insure safety.

3. Overhead fire, therefore, may normally only be employed under the following conditions:

(*a*) When the distance to the target has been obtained accurately; that is, by a highly trained range taker, who is able to guarantee the distance within 5 per cent of error.

(*b*) When the No. 1 at the gun is an expert firer.

(*c*) When an angle of not less than 30 minutes is formed by the intersection of imaginary lines drawn from the target and friendly troops to the gun, the distance to the target being 1,000 yards or under. If the distance to the target is over 1,000 yards, the angle thus formed should be not less than 60 minutes, if over 1,500 yards not less than 100 minutes, provided always that fire must cease whenever the friendly troops reach a distance of 2,000 yards from the gun, since the position of the lowest shot over this range is uncertain.

The above angles give a sufficient margin of safety at 1,000, 1,500, and 2,000 yards, respectively. At distances within 1,000 yards, between 1,000 and 1,500 yards, and between 1,500 and 2,000 yards, the margin of safety continually increases. In order to obtain these safety angles, it will often be necessary to seek commanding positions for the guns, i. e., rising ground, upper stories of houses, etc.

4. The foregoing instructions may be modified provided accurate and reliable observation is insured. This, however, is a matter for the exercise of judgment and common sense on the part of the machine-gun commander. Too much reliance must not be placed

on the ability of an observer to pick up the cone of fire during an attack. The fire of the attacking troops, the supporting troops and the artillery will probably be such that the machine-gun cone of fire can not be observed correctly.

5. The safety angles may be obtained as follows:

(*a*) From prismatic field glasses, graticuled for Mark VII ammunition. In this case the distance between the zero line and the 600 yards graticule gives the required angle for 1,000 yards and under; the distance between the zero line and the 1,000 yards graticule will give the angle for distances between 1,000 and 1,500 yards, and the distance between the zero line and the 1,300 yards graticule will give the angle for distances between 1,500 and 2,000 yards.

(*b*) With the aid of the graticule card as follows:

Hold the card vertically and at the full length of the cord from the eye; the space between the safety lines marked will then give the required angles. (See Pl. XXIV.)

(*c*) By means of the tangent sight:

Lay the gun on the target with the correct elevation; then move the slide up 300 yards for all ranges up to 2,000 yards without altering the elevation of the gun; and adopt the auxiliary aiming mark thus found. (See Pl. XXV.)

With the tangent sight method, the firer must note carefully the auxiliary aiming mark obtained after raising the slide, and re-lay on this mark. If he is traversing, he must find a second auxiliary aiming mark at the other end of the line to be traversed, and must traverse along an imaginary line joining the two auxiliary aiming marks and parallel to the enemy's position.

The tangent sight method and either graticuled glasses or a graticule card should be used simultaneously, in conjunction with and as a check on each other.

When the heads of the friendly troops become visible to the firer over the sights, he should not cease fire, but should elevate his gun, taking the *enemy position* as his auxiliary aiming mark. This will cause the cone of fire to search ground in rear of the enemy's position, which may be occupied by his supports and reserves.

28.[1] *Indirect fire.*

1. On occasions indirect fire may be used. This form of fire is rendered possible by the Mark IV tripod of the machine gun. Guns not fired from a fixed platform must *never* be used for indirect fire.

[1] NOTE.—This section does not deal with *overhead* indirect fire or with searching reverse slopes, for which see pars. 30 and 31, respectively.

2. Indirect fire may be of great value in annoying the enemy and affecting his morale, but, except under unusually favorable conditions, can not be expected to inflict serious loss.

The main disadvantages of indirect fire are that it requires, in most cases, a great deal of preparation and accuracy in calculation. Unless officers possess experience, it may sometimes be employed under conditions where direct fire is not only possible but necessary. Under certain conditions it may be positively dangerous to our own troops.

3. As the target is invisible, the problems to be solved are—

How to lay the gun, both to obtain and to put on elevation and direction; and

How to maintain the laying.

The methods of solving these problems are given in skeleton form in the following table. The actual details of each of the methods are given in the subsequent paragraphs.

Indirect fire table.

Direction.	See par.	Elevation.	See par.
Obtained by—			
Posts, direct	8	Graticules	4
Map and compass	9		
Map, protractor, and reference object	10	Contoured map	5
Put on gun by—			
Posts and compass	11	Elevation dial	6
Reference object and direction dial	12	Tangent sight	7
Maintained by—			
Auxiliary aiming mark	15	Auxiliary aiming mark	13
Direction dial	16	Elevation dial	14

4. *To obtain elevation by means of graticules.*

By means of graticules cut across the focal plane of a pair of prismatic field glasses, or by graticules printed on a card with a string for a base, indirect fire can be as quickly applied as ordinary direct fire. These graticules are similar to an inverted backsight and represent the angles of elevation for the gun. The topmost graticule represents zero, and the lines below represent every 100 yards upwards, from 200 yards.

The procedure is as follows:

(i) Obtain the range to the target.

(ii) Select an auxiliary aiming mark visible to the firer and directly above the target.

(iii) Move to a position whence the target and the auxiliary aiming mark already chosen can be observed; look at the target in such a way that the graticule, representing the range to the target, falls

across the target; then see which graticule falls across this aiming mark. (See Pl. XXVI.)

The range corresponding to this graticule is the tangent elevation at which to open fire, using the aiming mark already chosen to lay on. By this means accuracy may be obtained from a gun which is invisible to the enemy. It is important to get an aiming mark vertically above the target, making any necessary allowance for wind. This method becomes inaccurate when the eye of the observer using the graticuled glasses is much below or above the gun.

If it is found necessary to increase or decrease the elevation after fire has been opened, the following method must be employed since the position of the slide does not indicate the range to the target. The range on the sights is the range for the aiming mark and not the actual range to the target, e. g., the sights may show 500 yards when the target is 1,200 yards away. If in this case the cone of fire is observed to fall 100 yards short of the target, the necessary correction will not be obtained by moving the slide of the tangent sight up to 600 yards. It will be necessary to move the slide up for the same distance as from 1,200 yards to 1,300 yards. In moving the slide up for all ranges below 1,500 yards, as many clicks can be heard on the ratchet of the tangent sight as there are hundreds of yards in the range, e. g., between 1,000 and 1,100 yards there are 10 clicks, between 1,100 and 1,200 yards 11 clicks, and so on. In the present example, therefore, it will be necessary to move the slide up for 12 clicks. If the cone of fire were falling 50 yards short, it would be necessary to move the slide up for 6 clicks.

This method of indirect fire must not be employed when firing over the heads of our own troops.

5. *To obtain elevation by means of a contoured map.*

Having noted on the map the exact positions of gun and target, measure the distance between them. From Table I, Appendix A, obtain the corresponding angle of tangent elevation.

From the map note the contours on which the gun and target lie and by subtraction obtain the difference in height between them. By means of the angle of sight formula,[1] knowing the range and the

[1] NOTE.—The "angle of sight" can be calculated by means of the following approximate formula:

$$\frac{VI}{HE} \times 3400 = \text{angle of sight in minutes.}$$

Where VI and HE are in the same denomination.

To convert yards to meters deduct one-tenth.

To convert meters to yards add one-tenth.

From tables in Appendix A the quadrant angle can be obtained directly without working out the angle of sight.

difference in height between gun and target, work out the angle of sight. If the angle of sight is found to be positive, add it to the angle of tangent elevation to obtain the angle of quadrant elevation necessary to put on the gun; if, on the other hand, the angle of sight is found to be negative, subtract it.

6. *To put on elevation by means of the elevation dial.*

To place the required quadrant elevation on the gun—

(*a*) Level the gun by the spirit level No. 1 taking the holding pressure.

(*b*) Slip the dial round till zero is under the pointer without disturbing the bubble.

(*c*) Clamp the dial to, but without disturbing the elevating wheel.

(*d*) Turn the elevating wheel till the required angle is obtained. One revolution of the elevating wheel produces 4° of elevation or depression on the gun. To obtain an angle of elevation of 8° the elevating wheel would have to be revolved twice. The elevation dial is accordingly graduated to 4°, showing subdivisions of five minutes, which are easily capable of subdivision by eye.

(*e*) If an obstruction exists between gun and target, make sure before firing that the shots will clear it. (See par. 17.)

7. *To put on elevation by means of the tangent sight.*

This method entails the use of an auxiliary aiming mark which must be at least 100 yards distant from the gun.

To put elevation on the gun by means of the tangent sight, convert the angle of quadrant elevation (see par. 5 above) into a range by reference to Table I, Appendix A. Then level the gun by the spirit level, No. 1 taking the holding pressure.

Any of the four following cases may occur:

(*a*) Quadrant elevation is positive and a suitable natural auxiliary aiming mark can be seen or an artificial one put out.

(*b*) Quadrant elevation is negative and a suitable natural auxiliary aiming mark can be seen or an artificial one put out.

(*c*) Quadrant elevation is positive, but there is no suitable natural auxiliary aiming mark, nor can an artificial one be placed in position.

(*d*) Quadrant elevation is negative, but there is no suitable natural auxiliary aiming mark, nor can an artificial one be placed in position.

Cases (*c*) and (*d*) may occur when the ground slopes down steeply in front of the gun.

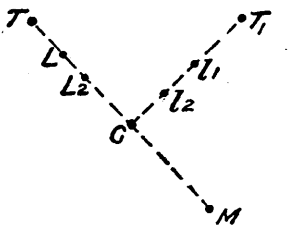
Case (*a*).—With sights at zero, look along the sights and select a natural aiming mark or place one out and lay on it. Run the tangent sight up to the range found above and relay on the auxiliary aiming mark.

Case (*b*).—Run the tangent sight up to the range found above (disregarding the sign), maintaining the holding. Select a suitable natural aiming mark or place one out and lay on it. Run the sights down to zero and relay on the auxiliary aiming mark.

Case (*c*).—Run the tangent sight up till some suitable natural or artificial auxiliary aiming mark is visible and lay on it. Note the range on the tangent sight and convert into an angle by means of the table given in Appendix A. Add to this angle the angle of quadrant elevation found as in (par. 5). Convert the answer into a range by means of the table given in Appendix A. Run the sights up to this range and relay.

Case (*d*).—Run the tangent sight up till some suitable natural or artificial auxiliary aiming mark is visible and lay on it. Note the range on the tangent sight and convert into an angle by means of the table given in Appendix A. Subtract from this angle the angle of quadrant elevation found as in par. 5. Convert the answer into

Fig. 1.



a range by means of the table given in Appendix A. Run the sights down to this range and relay.

8. *To obtain direction by posts, direct.*

By day, an observer selects the gun position and also the target he wishes to engage. He places a stick (L) (see fig. 1) in the ground in rough alignment between the target and gun position. He then crawls back and, if necessary, places a second stick (L_2) in exact alignment with his first stick (L) and the target, continuing the process until his last stick is visible from the gun position (G). If it is probable that more than one target is to be engaged, other sticks (l^1, l^2) can be placed between the stick (G) and the different targets (T, T^1). To do this an assistant is required to place the sticks in position while the observer dresses them from G. It is necessary to place the sticks vertically in the ground, and the stick (G) should not be more than 6 inches above the ground to avoid being knocked over by the crosshead of the tripod when it is placed over it.

Should it be found impossible to place the stick (L) in position owing to the proximity of the enemy, the stick (G) should first be placed in position, and a second stick (M) placed in rear of it and in alignment with (G) and the target.

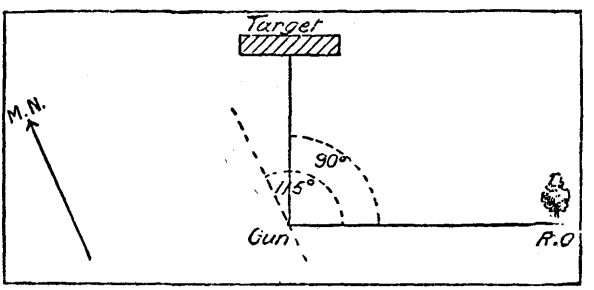
Under cover of darkness the position of (L) can be easily ascertained by an observer at (M) directing an assistant to place a stick in alignment with (M) and (G).

9. *To obtain direction by map and compass.*

To direct fire onto a target invisible to the guns, a map having a scale of not less than 1/20,000 must be used. The *exact* position of the guns nust be marked also. This can be done by resection. (See Chapter XIV, Manual of Map Reading and Field Sketching.)

The magnetic bearing of the target from the gun position must be worked out on the map. If the target to be engaged is a linear one,

Fig. 2.



the magnetic bearings of its limits must be worked out in the same way.

10. *To obtain direction by map, protractor and reference object.*

The exact position of the gun must be marked on the map as directed in paragraph 9 above. If possible, a reference object should be selected, which is marked on the map and visible from the gun position. If the only suitable reference object visible from the gun position is *not* marked on the map, its magnetic bearing should be taken from the gun position, and a line showing its direction drawn through the gun position on the map.

On the map by means of a protractor measure the angle included between lines joining the target and the gun, and the reference object and the gun. (See fig. 2.) If the target to be engaged is a linear one, measure the angles included between lines joining its limits to the gun and the target to the gun,

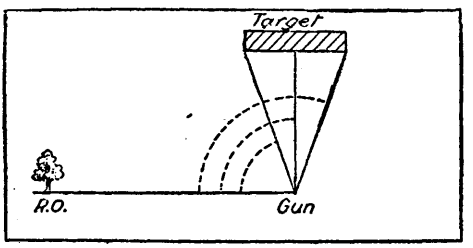
11. *To lay for direction by means of a post and compass.*

To lay out an aiming post, drive in a stick (not more than 6 inches high) at the gun position, and place a compass on top. Rotate the compass till the dial indicates the required magnetic bearing found as directed in paragraph 9. Dress a post on this bearing, using the hair line on the compass glass. Replace the gun and tripod on the first stick and lay on the post put out.

12. *To lay for direction by means of reference object and direction dial.*

The gun is laid on any convenient part of the reference object with the sights set for any convenient range; it need not be leveled. The elevation required to hit the target should not be placed on the gun till the latter is directed on the target. The direction dial should now be set to read zero (or the reading noted if the dial can not be rotated). The gun is then swung right or left through the angle found as directed in paragraph 10, according as the reference

Fig. 3.



object is to the left or right of the target. The gun can be directed to either end of a linear target simply by swinging through the angles found as directed in paragraph 10. (See fig. 3.)

13. *To maintain elevation by means of an auxiliary aiming mark and the tangent sight.*

Once the gun has been laid the sights only may be adjusted so as to bring a line of sight onto any suitable natural or artificial auxiliary aiming mark, e. g., a night firing-box, white or luminous stone, chimney, post, etc. The range shown on the tangent sight after such adjustment will have no connection with the quadrant elevation on the gun, unless the elevation has been put on by the method given in paragraph 7, and the same auxiliary aiming mark is used to maintain it.

The distance between the gun and the auxiliary aiming mark is immaterial when *maintaining* elevation, and in this respect differs from the minimum distance laid down in paragraph 7 when *putting on* elevation.

14. *To maintain elevation by the elevation dial.*

Between bursts of fire the firer should make sure that the pointer continues to show the same quadrant elevation on the dial as was originally put on the gun. If this method is to be reliable, it is essential that the legs of the tripod should not sink unevenly into the ground; the tripod must, therefore, be placed on a firm foundation.

It is desirable, where possible, to use an auxiliary aiming mark in addition, but if this is not possible the spirit level should be placed on the gun at frequent intervals, and the procedure laid down in paragraph 6 for putting on elevation repeated. It should be noted that unless the socket is absolutely upright the quadrant elevation may vary considerably if the gun is traversed through a wide arc, though the reading of the elevation dial will not alter.

15. *To maintain direction by means of an auxiliary aiming mark.* (See par. 13 above.)

16. *To maintain direction by means of the direction dial.*

The gun having been laid for direction, the reading of the direction dial is noted. Direction can be maintained during firing by insuring that the pointer is set accurately to this reading.

17. In all cases where the target is invisible, owing to the presence of an obstacle, steps must be taken before firing to insure that the shots will clear the obstacle. The procedure is as follows:

(*a*) After the gun has been given the quadrant elevation necessary to hit the target, the tangent sight will be adjusted for the range to the top of the obstacle. If on looking along the sights the obstacle is not visible, the shots will clear. If, however, the obstacle *is* visible, the shots will not clear, and the gun must be moved farther back.

(*b*) If the range to the obstacle is under 100 yards, the method given above will not apply, and the No. 1 must look through the barrel, either directly or by using the mirror reflector.

(*c*) Should the obstacle be invisible from the gun position, recourse must be had to the formula given in section **30**, paragraph 4 (*l*). The clearance required will be one-half of the height of the 90 per cent cone at the range of the obstacle. In using the formula given in section **30**, paragraph 4 (*l*), for "our own troops" read "the obstacle" throughout.

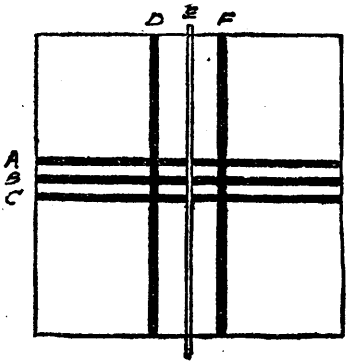
29. *Night firing.*

1. If the gun position is not exposed to the enemy's fire or to direct observation, the gun can be mounted and laid by day and left until night.

Some kind of auxiliary aiming mark must be in position in front of the gun for the purpose of maintaining elevation and direction after nightfall. (See sec. 28.)

This auxiliary aiming mark can be a transparent screen secured to the open side of a box containing some form of illuminant. (See fig. 1.) The screen is marked with lines to permit of searching and traversing within definite limits. The horizontal lines are 1 inch apart, which will give a difference in angle of 10 minutes from the center line if the screen is placed 10 yards from the gun. The amount that 10 minutes represents in range can be readily ascertained from the tables showing the angles of elevation for the gun. (Appendix A, Table 1.) The vertical lines are 2½ inches apart, which will give a deflection of about 2 feet per 100 yards of range when the screen is placed 10 yards from the gun.

Fig. 1.



Bands A, B, C, D, F are ½ inch wide.

2. When the gun position is exposed, or the gun is required elsewhere during the day, it will sometimes be possible for arrangements to be made by day so that the gun and tripod can be brought up under cover of darkness and placed in position to open fire when required. (See sec. 28.)

The direction and elevation dials should be employed; and a luminous reference object should be laid out in any convenient position, where it is invisible to the enemy, for obtaining the direction to any target, correct elevation being put on by the elevation dial.

As the rear leg of the tripod may sink during firing, elevation can not be maintained by means of the elevation dial, which is a component part of the mounting. One or more luminous auxiliary

aiming marks should therefore be laid out by the method given in section 28, paragraph 8.

30. *Indirect overhead fire.*

1. In trench warfare, where the positions of our own and the enemy's units are clearly marked, indirect fire over the heads of our own troops may often be safely employed.

2. The best results will be secured when observation of the strike of the bullets can be obtained. The element of chance, due to errors in ranging, climatic conditions, errors as to the exact position of the gun, etc., will thus be removed.

3. Fire may be directed on the hostile support or reserve lines, communication trenches, cooking places, ration parties, reverse slopes of hills, roads, etc. When observation is not possible, the most that can be done is to sweep an area of ground, in which is included the target it is desired to engage. (See sec. 31.)

4. To insure the safety of our own troops the following rules must at all times be strictly adhered to:

(*a*) The guns must never be more than 2,000 yards distant from bodies of our own troops, over whom they are firing.

(*b*) When the guns are 1,000 yards or under from our own troops, the range at which they are fired must be such as to insure the center of the cone of fire passing at least 20 yards over their heads. (See trajectory table, Appendix A.) When the guns are between 1,000 yards and 1,500 yards from our own troops this height must be at least 40 yards; between 1,500 and 2,000 yards it must be at least 80 yards.

(*c*) When, the gun, friendly troops, and target are all on the same plane (not necessarily the same *horizontal* plane), rules (*a*) and (*b*) give the following results:

(i) No target may be engaged at a range of less than 1,500 yards.

(ii) Range to target (in yards):	Limits of safety zone for friendly troops (in yards).
1,500	700 to 1,000 from gun.
1,600	500 to 1,000 from gun.
1,700	500 to 1,000 from gun.
1,800	400 to 1,200 from gun.
1,900	400 to 1,500 from gun.
2,000	300 to 1,500 from gun.
2,100	300 to 1,500 from gun.
2,200	300 to 1,500 from gun.
2,300	200 to 1,800 from gun.
2,400 and over	200 to 2,000 from gun.

(*d*) Climatic conditions must be carefully studied (see Musketry Regulations, sec. 29).

(*e*) The laying must be checked frequently, both for direction and elevation, upon the auxiliary aiming mark.

(*f*) The necessity for good holding must be impressed on the firer.

(*g*) As a slight sinking of the tripod during firing may seriously affect the safety of our own troops, owing to the altered angle of elevation, every precaution must be taken to prevent this happening. The legs of the tripod should be firmly imbedded in the ground, and provision made to prevent them moving from their original position, but the use of an auxiliary aiming mark largely minimizes the effect of slight movements of the tripod.

(*h*) When "traversing" or "searching" is used, provision must be made by means of wooden battens, etc., to fix safe limits beyond which the gun can not be moved.

(*i*) A worn barrel should not be used, and the barrel should be cleaned after every 1,000 rounds continuous fire.

(*j*) All calculations must be carefully checked by an officer before fire is opened.

(*k*) Troops over whom fire is to be opened must be cautioned, and a certificate to this effect signed by the machine gun company commander.

(*l*) In order to find the clearance, i. e., the height from the ground to the center of the cone at any point in the line of fire, the following is the simplest and most accurate method, which should be used:

(i) Let gun contour..... =A yards.
Let own troops contour..... =B yards.
Let center of cone above or below horizontal plane through gun position when passing over own troops' heads ..... =C yards.

Then clearance (yards) $=A-B\overset{+}{\underset{-}{\text{ or }}}C$.

C must be added or subtracted according as the trajectory to our own troops position is above or below the horizontal plane through the gun position.

(ii) From the sketch the clearance is XZ.

Then A−B=ZY and XY is the height of trajectory either above or below the horizontal plane through the gun position.

Obviously clearance $=XZ=ZY\overset{+}{\underset{-}{\text{ or }}}XY=A-B\overset{+}{\underset{-}{\text{ or }}}C$.

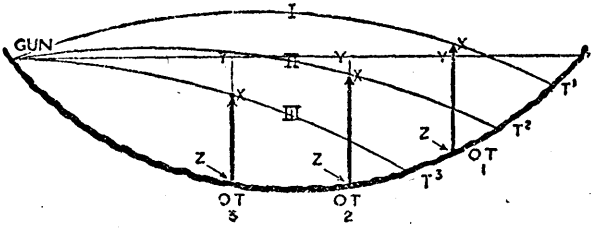
(iii) In order to find C, either Table 2A or Table 2B must be used according as to whether the quadrant angle on the gun is positive

or negative. On these tables, the words "positive" and "negative" are printed. If the trajectory height found is positive, C must be added to A−B; if negative, it must be subtracted from A−B.

(iv) If the quadrant angle on the gun is positive, the range corresponding must be found from Table 1 in order to use Table 2(A). If the quadrant angle is negative it will be used directly in Table 2(B) without conversion.

(v) The following three examples illustrate the method and deal with three typical cases. (See sketch above.)

CASE I.—Quadrant angle is positive and sufficiently large to throw the center of cone above the horizontal plane when passing over own troops' heads.



Example. Gun contour (A)=70 yards.
Own troops contour (B)=20 yards.
Q.E.=+86 minutes. Range corresponding=1,200 yards.
Assumed range to own troops 900 yards.

From Table 2(A) trajectory height for 1,200 yards at 900 yards =9 yards (positive)=C.

Clearance=A−B+C.
=70−20+9=59 yards.

Clearance required=20 yards. It is safe to fire.

CASE II.—Quadrant angle is positive but small so that the center of cone is below the horizontal plane when passing over own troops' heads.

Example. A and B as above.
Q.E. =+35 minutes. Range corresponding=700 yards.
Assumed range to own troops 900 yards.
From Table 2 (A) trajetory height for 700 yards at 900 yards=4.5 yards (negative)=C.
Clearance=A−B−C.
=70−20−5 (say)=45 yards.
Clearance required=20 yards. It is safe to fire.

CASE III.—Quadrant angle is negative.

Example. A and B as above.

Q. E.= −75 minutes.

Assumed range to own troops 900 yards.

From Table 2B trajectory height for −75 minutes at 900 yards=33.2 yards (negative)=C.

Clearance=A−B−C.

=70−20−33 (say)=17 yards.

Clearance required=20 yards. It is not safe to fire.

(vi) In Appendix B is given a copy of the "indirect overhead fire" sheet which should be used on service. Certain specimen examples have been filled in on it, for the purpose of bringing out various points.

5. Elevation and direction may be obtained, put on the gun, and maintained by any of the methods described in section 28. The dials are particularly suitable for this type of fire.

31. *Searching reverse slopes.*

1. It may sometimes be desired to search the reverse slope of a hill occupied by the enemy, where he is under shelter from short-range fire.

2. Reverse slopes are often chosen by the enemy as suitable areas where troops may be disposed preparatory to attack, or may maneuver free from observation. It is therefore necessary to know how such ground may be brought, most effectively, under machine-gun fire. Table 7 enables the machine-gun officer to search the reverse slope of a hill, and is constructed on the following basis:

3. If a gun is placed at such a distance from the crest that the cone, just passing over it, will fall at a steeper angle than the slope of the ground on the other side of the hill, then fire effect will be brought to bear on the reverse slope. No endeavor has been made to fit the trajectory exactly to the reverse slope, as the difficulties and variables in the problem are so many, that small errors would upset the results. Traversing and searching should be employed, for the same reasons as govern all forms of indirect fire.

4. *Table 7.*—This table is so constructed that when the gun is placed as required by its use, and fire suitably directed at the reverse slope, the bullets will fall on it at an angle of somewhere between 100 and 200 minutes to the slope itself.

The table is divided into two parts, "Gun above crest" and "Gun below crest."

The table is used as follows:

(*a*) On the map, draw a line from the crest, which will be the probable line of fire.

(*b*) From the map, determine the drop *in yards* in 100 yards, measured from the crest down the slope.

(*c*) Making use of the two top horizontal columns, note the distance to measure back, which will vary according as the spot thus found is above or below the crest. (See center column.)

(*d*) From map note the difference in height between this spot and the crest, above or below as the case may be. Run down the center column till this height is found.

(*e*) Then look along horizontally, when the final range from the crest will be found in the vertical column under the drop in yards found in (*b*).

(*f*) Place the gun at this point, and lay on the crest by any suitable means.

NOTE.—If it is found that the gun position is on the same level as the crest, two answers will be given, i. e., one in portion of "Gun above crest," one in portion "Gun below crest," both opposite the zero mark. Select the most suitable.

CHAPTER VI.

MACHINE GUNS IN BATTLE.

32. *Introductory.*

1. The general principles laid down in Infantry Training, Chapter XV, for the employment of machine guns in battle remain unaltered by the introduction of the machine-gun company organization and the substitution of Lewis gun detachments for machine-gun sections in battalions. But the new organization and the increase in the number of machine guns with infantry units have rendered necessary certain modifications in detail which are discussed in the present chapter. A certain amount of repetition and rearrangement of matter that is already dealt with in Infantry Training has been found necessary in order to avoid too frequent reference to paragraphs or sentences in that manual.

2. The special characteristics of Lewis guns and the manner in which these characteristics affect their employment must be studied by machine-gun officers, as they have to cooperate closely with Lewis guns. These characteristics, therefore, are discussed in

sections 33 and 34.[1] Detailed instructions for Lewis guns are given in Lewis Gun Training.[2]

3. The special principles which govern the employment of machine guns in the phase of operations known as trench warfare are dealt with in Notes for Infantry Officers on Trench Warfare.

4. It must be remembered that in Infantry Training a machine-gun section means two guns, whereas under the present organization it means two subsections each of two guns, or four in all.

33. *Characteristics of machine guns and Lewis guns compared.*

1. The principal characteristic of the machine gun is its ability to produce *rapid and sustained fire.* Provided water and ammunition are available, a machine gun is capable of keeping up a rapid fire for a very considerable period.

On the other hand, the Lewis gun, though capable of extremely rapid fire, is incapable of sustaining this fire for long. This necessitates, therefore, the use of short bursts of fire as the normal practice.

Its inability to sustain fire is primarily due to the fact that a water jacket is not provided (in order to economize weight) and the gun consequently becomes hot very quickly. Further, owing to their lightness, the working parts will not stand constant vibration to the same extent as those of the machine gun.

2. A further difference between the two weapons is in the type of mounting used. The machine gun is provided with a heavy tripod which enables the gun to be used for overhead and indirect fire. This mounting also allows of the gun being laid on a fixed point, and fired at any time, by day or night, without further preparation. By this means it is possible to form "bands of fire" through which any enemy attempting to pass must suffer heavy loss.

The Lewis gun is fired from the shoulder, a light bipod providing a support for the barrel; there is no traversing or elevating gear; and aim is taken and altered as when using a rifle, the conditions are, therefore, not suitable for overhead or indirect fire, nor for creating "bands of fire."

3. The machine gun, owing to its weight, and that of its mounting, is less mobile than the Lewis gun. The latter being specially provided with a light bipod to increase its mobility, can be carried like a rifle, and fired with very little preliminary preparation, so that

[1] Infantry battalions are provided with Lewis guns organized in Lewis gun detachments of 1 noncommissioned officer and 12 men each, with 2 Lewis guns.

[2] To be issued shortly.

after movement its fire can be brought to bear on any object much more rapidly than that of a machine gun.

34. *The employment of Lewis guns.*

1. Owing to its greater mobility a much greater liberty of action can be allowed to this weapon than to the machine gun. It must, however, be clearly understood that the Lewis gun can not take the place of the machine gun. It is a supplement to and not a substitute for the latter type of weapon.

2. It is adapted for even closer cooperation with infantry than the machine gun, as the Lewis gunner can move and appear to the enemy as an ordinary rifleman. Its distribution as a battalion and company weapon provides a mobile reserve of fire available for the smallest unit commander wherever an infantry soldier can go.

3. It is specially adapted for a concentrated enfilade fire on a definite line such as a hedge or wall, or to cover a road or defile where it is not possible to deploy a number of rifles, and for places where it is difficult or impossible to bring up a machine gun unobserved. When wider fronts have to be swept with fire or heavier fire is required at longer ranges machine guns can be more usefully employed.

4. Although the expenditure of ammunition is not so great as with machine guns, the difficulty of getting ammunition up to the more exposed positions to which Lewis guns can go will be much greater. It is important, therefore, to withhold fire as long as possible and to use the power of the gun to develop unexpected bursts of fire against favorable targets.

35. *The tactical handling of infantry machine guns.*

1. The tactical principles laid down in Infantry Training, sections 160, 161, and 162, apply generally, but the organization and distribution of the machine guns with a brigade there discussed need modification to suit the new organization and distribution of machine guns.

2. The introduction of the machine-gun company organization, while facilitating the collective employment of machine guns, does not mean that they should always be so employed. It may sometimes be advisable to detach machine guns under the orders of battalion commanders and this should be done if the tactical situation requires it. (See sec. 36 (2) (3).). In this case the battalion commander concerned should clearly understand the reasons why the guns are attached to him. Definite instructions should be given

by the battalion commander to the machine-gun officer as to what is required of him, but the latter should be allowed as much freedom as possible in the execution of his task.

3. *Command and control.*—The various tasks which the machine-gun company has to carry out demand the most careful preparation and organization on the part of the company commander.

He must insure that all section commanders fully understand the part they have to play, and he must be always on the watch to regain control, at the earliest possible moment, of any guns temporarily detached, in order to provide a reserve for his brigade commander.

During action the machine-gun company commander will keep in the closest possible touch with the brigade commander, and it is important that section officers should keep in close touch with the commanders of units to which they may be attached and under whose command they come. Machine-gun officers must carefully observe this principle in order to avoid dual control and consequent misunderstanding.

It is unsafe to rely on telephones, especially in open fighting. Steps must, therefore, be taken to maintain communication by visual signaling and by orderlies.

4. *Cooperation.*—Cooperation is an essential feature in machine-gun tactics, both between the machine guns and other arms and between the guns themselves.

Grouping machine guns into companies by centralizing control facilitates the execution of a comprehensive scheme of machine-gun cooperation in accordance with the needs of the tactical situation. When this is to be effected the machine-gun company commander must be thoroughly conversant with the situation. He should take every step to insure cooperation, not only between the guns of his company, but between his company and machine guns on the flanks.

5. *Concealment.*—

(*a*) *During movement.*—To insure concealment when on the move machine gunners should try to disguise their identity as such by adopting the formation of the neighboring troops. This, and any other means of escaping detection, should be constantly practised.

When machine guns are moving, they should watch and avoid areas that are being swept by shell fire.

(*b*) *When in position:*

(i) As few men as possible should be near the gun. It will usually be found that two men are quite sufficient.

(ii) When time, implements, etc., are available, guns should be dug in, but, unless it is possible to construct a really satisfactory em-

placement, it is better to seek cover from view. A hastily made emplacement will merely serve to draw the attention of the enemy.

(iii) Masks and gloves will often facilitate concealment, especially when facing strong sunlight.

Every effort must be made to prevent machine guns being located by artillery. If, however, machine guns are shelled, their action will largely depend on the tactical situation. They may make a change in position of about 50 yards or they may temporarily cease fire, the guns and detachment getting under cover; the latter will often deceive the enemy into thinking that they have been destroyed and enable the guns to obtain a good target later. A careful distribution of the gun numbers will minimize casualties.

36. *Machine guns in the attack.*

1. In order to obtain the best results, the machine-gun company commander must be thoroughly acquainted with the plan of operations and must make a careful reconnaissance of the ground.

By use of maps and study of the ground through a telescope from positions in rear or on the flanks, he should endeavor to make himself familiar with the nature of the ground, the correct use of which may prove of decisive value. (See Infantry Training, sec. 161.)

Having made his reconnaissance, and having received instructions from the brigade commander (Infantry Training, sec. 160 (13)), the machine-gun company commander will give definite orders to his section officers.

2. *Distribution of machine guns in the attack.*—The machine-gun company commander may divide the guns under his command into groups, some to go forward with the Infantry, some to cover their advance, others as a reserve.

3. The machine guns that go forward with the attacking Infantry will be placed under the control of the Infantry commander to whom they are attached. (See Infantry Training, sec. 160 (13).)

The rôle of these guns will be to—

(*a*) Assist the Infantry in obtaining superiority of fire.
(*b*) Make good the positions won.
(*c*) Pursue the enemy with fire.
(*d*) Cover reorganization of the Infantry.
(*e*) Repel counterattack.
(*f*) Cover retirement in the event of the attack proving unsuccessful.

The number of guns to be sent with the Infantry will be governed by two factors, viz, the length of front and the nature of the ground.

The *time* of their advance will be determined by the nature of the ground and progress of the Infantry. The progress of the Infantry must be carefully watched so that the guns may be brought forward at the earliest possible moment. They should very rarely advance with the leading line of Infantry. This is the duty of the Lewis guns, the fire of which should suffice to hold the position won until it can finally be consolidated by the machine guns.

4. The guns detailed to cover the advance of the Infantry will normally be under the control of the machine-gun company commander, who acts under the instructions of the brigade commander. The rôle of these guns will be to provide covering fire for the Infantry up to the last possible moment in the following ways:

(*a*) By fire from the flanks or through gaps in the line.

(*b*) By overhead fire.

(*c*) By indirect fire.

Great care must be exercised in (*b*) and (*c*) in order to avoid endangering our own troops.

Orders to the machine guns detailed for this task may, if necessary, include general instructions to govern their action, after the task has been completed, pending receipt of further orders from the machine-gun company commander. It must, however, be remembered that it is usually dangerous to prescribe to a subordinate at a distance anything that he should be better able to decide on the spot, with a fuller knowledge of local conditions, for any attempt to do so may cramp his initiative in dealing with unforeseen developments. (See F.R.S., Part I, sec. 12, par. 2.)

5. Guns kept as a reserve will be under the control of the machine-gun company commander, acting under the instructions of the brigade commander. Owing to their characteristics, machine guns are valuable as a reserve of fire power, and when kept in reserve in the hands of the brigade commander may prove of the utmost value at the critical moment. It must be remembered, however, that a great development of fire power is most useful in the opening stages of an attack, to cover the advance of the infantry, and it is a mistake to keep guns in reserve if they can be usefully employed in supporting the advance. These guns may be used for long range searching fire on ground behind the enemy's line, which is likely to hold supports or reserves, but must be available to move forward at once, when required.

6. The great fire power of machine guns relative to the space they occupy, the rapidity with which they may be brought into or out of action and the ease with which they can change the direction

of their fire render them especially suitable for the protection of threatened flanks and for filling gaps which may appear laterally or in depth. Any of the guns mentioned in the previous paragraphs may at times be employed in this manner.

7. During an attack it may be advisable to continue to hold certain tactical points, which have been captured, until the attacking troops have made good their next objective. The characteristics of machine guns fit them for this duty; their use will avoid diminishing the strength and dash of the attacking infantry.

8. *Limbers and ammunition reserve.*—Gun limbers will generally remain under the orders of section or subsection officers, but ammunition limbers would, as a rule, be placed under the officer in charge of the brigade ammunition reserve (Infantry Training, sec. 166 (2)), or under a machine-gun officer, who should keep thoroughly in touch with the progress of the machine guns so that he may be able to keep the wagons as close up as possible.

When machine guns are attached to battalions, a proportion of ammunition limbers will accompany them if required.

It must be remembered that ammunition limbers are far less mobile than gun limbers.

37. *Machine guns in the defense.*

1. When it has been decided to consolidate a position for defense a reconnaissance should be carried out, the machine guns being generally allotted on the following principles.

2. Some guns should be posted as soon as possible in accordance with the nature of the ground to form a complete belt of flanking machine-gun fire along the front of the position. Important concealed approaches and folds in the ground should also be covered by machine guns.

Cooperation must be arranged with the Lewis guns of battalions, which can cover the less important approaches or small depressions or hollows which the machine guns can not sweep.

3. A proportion of machine guns should be kept in reserve. When the ground is suitable, these may be used for indirect overhead fire if the results are likely to justify the expenditure of ammunition, and the readiness of the guns to take up other tasks is not impaired. It will often be found advisable to prepare machine-gun emplacements at important tactical points in rear of the front line and to detail guns for their occupation, if necessary. Preparation in this respect will facilitate a rapid readjustment of the line at any point.

4. Secondary positions and lines of retirement must be reconnoitered, and steps must be taken to insure that the detachments are familiar with them. In case of a withdrawal becoming necessary, machine guns in supporting positions will cover the retirement of the Infantry and guns in the front line. When the latter have occupied their secondary positions, they, in their turn, will cover the movement of the guns originally in support.

5. Arrangements for firing at night should be made. The day and night gun positions will probably be different; the change from the one to the other should be made just after dark and just before dawn.

6. Communication must carefully be arranged throughout machine-gun sections. Machine-gun officers must keep in touch with battalion commanders and the machine-gun company commander. (See sec. 35, par. 3.)

7. The following points should also be noted:

(*a*) The position of the ammunition limber should be determined and the arrangements for ammunition supply made known to all concerned.

(*b*) Range cards should be made for each gun.

8. The variations that arise during the protracted defense of a position are dealt with in Notes for Infantry Officers on Trench Warfare.

38. *Machine guns with an advanced guard.*

1. The functions of an advanced guard make it necessary that great fire power should be available when required. A large proportion of machine guns should therefore be allotted to advanced guards.

These machine guns should move well forward in the column, so that they may be able to get quickly into action.

2. The principal duties of machine guns with the advanced guard are to—

(*a*) Assist in driving back enemy forces by rapid production of great fire power at any required point;

(*b*) Assist in holding any position gained until the arrival of the Infantry;

(*c*) Cover the deployment of the main body by holding the enemy on a wide front.

3. The characteristics of machine guns render them as a rule more suitable for employment with the main guard than with the van-

guard, but the size of the vanguard may necessitate machine guns being attached to it.

39. *Machine guns with a rear guard.*

1. As rear guards will usually be required to hold positions with the minimum of men, a large proportion of machine guns should be allotted to them.

2. Experience has shown that well-placed machine guns, supported by a few Infantry only, will frequently hold up an advance for long periods.

3. In occupying a rear guard position with machine guns the ordinary principles of defense apply, but the following points should be specially noted:

(*a*) As wide a field of fire as possible should be selected.

(*b*) Guns must be concealed in the least obvious places.

(*c*) Covered lines of retirement must be reconnoitered.

(*d*) Gun limbers should be close up to facilitate a hasty retirement.

(*e*) Positions in rear must be chosen before the machine guns retire from their forward positions.

(*f*) A proportion of the machine guns should occupy the positions in rear before all the machine guns retire from the forward position. Thus the retirement of the last gun can be covered.

(*g*) Pack transport is very useful.

40. *Village fighting.*

1. As soon as the infantry have made good one edge of a village, machine guns should be brought up in close support. They should then search windows, doorways, roofs, etc., likely to be held by the enemy.

2. Machine guns should be used to command cross streets, etc., so as to guard against attack on the flanks or rear of the infantry. They should also be posted on the edges of the villages to prevent flank attacks, and when possible should be pushed forward well on the flanks, so as to command the exits from the village.

3. During village fighting use may be made of windows, doors, etc., as machine-gun positions. If a good field of fire can not be obtained from existing doors and windows, and time is available, small holes can be made in the outside walls of the upper stories of buildings, enabling a good field of fire to be obtained.

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41. *Occupation of various positions.*

1. Machine guns may be hidden in almost any position, but it is advisable to avoid places which are either obvious or easy to recognize, such as cross roads or single objects, or places which can easily be located on the map. It is important that guns should merge into the surroundings, and straight edges or distinct shadows should not be made.

2. Banks of rivers, canals, and railways, ditches, folds in the ground, hedges, palings or walls, also mounds of earth, may be used either to afford a covered line of approach and supply to a gun position or else a gun position itself. When firing over the top of the cover, greater protection is given if hollows are scooped out for the front tripod legs. (Pls. XII to XIV.)

3. Houses may be employed in the following ways:

The gun may be placed in rear, firing through windows or doors in line or past the sides of the house. When firing from a window, door, or hole in the roof, the gun should be placed well back for concealment. (Pl. XVI.) A damp piece of cloth hung in front of the gun helps to conceal the flash. When firing from a cellar, care should be taken not to cause a cloud of dust to rise and give away the position. A means of retirement and alternative emplacements should be arranged. Overhead fire and observation may often be obtained from high buildings.

4. Woods and crops provide cover from view, facilities for communication, and good lines of approach or supply. In neither case should guns be placed too near to the front edge. In woods it will often be possible to construct hasty overhead cover.

5. If a barricade has been constructed across a road, machine guns should not be put on the barricade itself but, if possible, in a concealed position to a flank from which they can sweep the road.

6. Haystacks do not as a rule afford a very satisfactory position, but guns may be placed in a hollow in front, or behind, firing past the side, or else in a hollow on top, firing through the front face of the stack. A machine gun concealed in a field which is covered with cornstalks, manure heaps, or mounds of roots is very hard to locate. (Pl. XV.)

7. Wood stacks, planks, logs of trees, and farm implements may be used to conceal guns; cover from fire can often be obtained by the addition of bricks or sandbags. (Pl. XV.)

8. Trees generally provide better observation posts than machine-gun positions.

42. *Signals.*

In many cases observation will be impossible from the gun position, and it will be necessary for observers to signal results from a flank. The following semaphore code is used in signaling the results of observation of fire:

O =Fire observed *over.*
S =Fire observed *short.*
R =Fire observed to *right* of target.
L =Fire observed to *left* of target.
K=Fire observed *correct* (target or range).
W=Fire unobserved or "Washout."

APPENDIX A.

TABLE I.—*Tangent elevation, angles of descent, dimensions of cones and zones, etc., .303 Vickers gun, Mark VII ammunition.*

1	2	3		4	5				6	
Range, yards.	Angle of tangent elevation, minutes.	Slope of descent.		Height in yards of lowest shot below crest of cone.	Dimensions in yards of horizontal beaten zones.				Dimensions of cones in yards.	
					Width.		Length.		Width.	Height.
		In minutes.	As a gradient.		75 p.c.	90 p.c.	75 p.c.	90 p.c.	75 p.c.	75 p.c.
100	3									
200	7			.1	.3				.3	
300	11			1.0	.5				.5	
400	16	15	One in 230	1.3	.7				.7	
500	22	23	One in 149	1.7	.8	2.3	220	700	.8	1.5
600	28	32	One in 107	2.0	1.0	2.8	204	600	1.0	1.9
700	35	42	One in 82	2.3	1.2	3.3	188	525	1.2	2.3
800	43	54	One in 64	2.7	1.3	3.8	172	450	1.3	2.7
900	52	69	One in 50	3.0	1.5	4.3	156	375	1.5	3.1
1,000	62	88	One in 39	3.3	1.7	5.0	140	300	1.7	3.6
1,100	73	111	One in 31	4.0	2.0	6.0	126	270	2.0	4.1
1,200	86	139	One in 25	4.7	2.3	7.0	112	240	2.3	4.5
1,300	101	172	One in 20	5.3	2.7	8.0	98	210	2.7	4.9
1,400	117	209	One in 16	6.0	3.0	9.0	84	180	3.0	5.2
1,500	135	251	One in 14	6.7	3.3	10.0	75	160	3.3	5.4
1,600	155	298	One in 12	7.3	4.0	11.3	70	150	4.0	5.8
1,700	177	350	One in 9.8	8.0	4.7	12.7	70	145	4.7	7.2
1,800	201	407	One in 8.5	8.7	5.3	14.0	70	140	5.3	8.3
1,900	227	469	One in 7.3	9.3	6.0	15.3	70	135	6.0	9.6

TABLE 2 (A).—*Trajectory table, .303 Vickers gun, Mark VII ammunition.*

Range yards.	Point distant from gun in yards.																											
	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,700	2,800
0	0.4	1.0	1.9	3.2	4.9	7.1	10.0	13.6	18.0	23.4	30.0	38.2	47.6	58.9	72.1	87.5	105	125	149	.....	.....	.....	.....	.....	.....	.....	.....
100	.2	.7	1.5	2.8	4.4	6.5	9.3	12.8	17.2	22.4	28.9	37.0	46.4	57.0	70.7	86.0	104	124	147	.....	.....	.....	.....	.....	.....	.....	.....
200	0	.4	1.1	2.2	3.7	5.7	8.4	11.8	16.0	21.1	27.6	35.5	44.8	55.9	68.9	84.0	102	121	145	.....	.....	.....	.....	.....	.....	.....	.....
300	.3	0	.6	1.6	3.0	4.9	7.5	10.7	14.8	19.8	26.2	34.0	43.1	54.5	67.0	81.6	99.5	119	142	.....	.....	.....	.....	.....	.....	.....	.....
400	.5	.5	0	.9	2.1	3.9	6.3	9.5	13.3	18.3	24.1	31.1	41.4	52.0	64.4	79.6	96.8	117	140	.....	.....	.....	.....	.....	.....	.....	.....
500	.9	.9	.6	0	1.1	2.6	4.9	7.9	11.6	16.3	22.1	29.9	38.5	49.2	61.4	76.6	93.6	113	136	.....	.....	.....	.....	.....	.....	.....	.....
600	1.2	1.4	1.3	.9	0	1.4	3.5	6.3	9.8	14.4	20.2	27.6	36.1	46.6	59.0	73.6	90.6	110	133	.....	.....	.....	.....	.....	.....	.....	.....
700	1.6	2.0	2.1	1.9	1.2	0	1.9	4.5	7.9	12.2	17.8	25.0	33.3	43.6	55.8	70.1	87.0	106	128	.....	.....	.....	.....	.....	.....	.....	.....
800	2.1	2.7	3.1	3.1	2.6	1.6	0	2.4	5.5	9.6	15.0	21.9	30.0	40.1	52.0	66.1	82.7	102	124	.....	.....	.....	.....	.....	.....	.....	.....
900	2.6	3.5	4.1	4.4	4.2	3.5	2.0	0	2.9	6.7	11.9	18.5	26.4	36.2	48.0	61.7	78.0	96.6	119	.....	.....	.....	.....	.....	.....	.....	.....
1,000	3.2	4.3	5.3	5.8	5.9	5.5	4.4	2.6	0	3.5	8.7	14.7	22.4	31.8	43.2	56.9	72.8	91.1	113	.....	.....	.....	.....	.....	.....	.....	.....
1,100	3.9	5.4	6.6	7.5	7.9	7.8	7.1	5.6	3.3	0	4.5	10.6	17.9	27.0	38.2	51.4	67.0	85.0	106	.....	.....	.....	.....	.....	.....	.....	.....
1,200	4.6	6.5	8.1	9.3	10.2	10.3	10.1	9.0	7.1	4.2	0	5.7	12.6	21.4	32.1	45.0	60.1	78.0	98.9	.....	.....	.....	.....	.....	.....	.....	.....
1,300	5.5	7.8	9.5	11.5	12.7	13.4	13.5	12.8	11.3	8.6	5.1	0	6.5	14.8	25.1	37.5	52.3	69.5	90.0	.....	.....	.....	.....	.....	.....	.....	.....
1,400	6.4	9.2	11.7	13.8	15.5	16.7	17.2	17.0	16.0	13.9	10.6	6.0	0	7.9	17.7	29.6	43.9	60.7	80.8	.....	.....	.....	.....	.....	.....	.....	.....
1,500	7.3	10.7	13.7	16.3	18.7	20.3	21.3	21.7	21.9	19.7	17.0	12.7	7.3	0	9.3	20.7	34.6	50.8	70.4	.....	.....	.....	.....	.....	.....	.....	.....
1,600	8.7	12.7	16.0	19.3	22.0	24.3	26.0	27.0	27.0	26.0	24.0	20.4	15.3	8.7	0	10.9	24.1	39.7	58.6	.....	.....	.....	.....	.....	.....	.....	.....
1,700	10.0	14.3	18.7	22.7	26.0	29.0	31.3	32.7	33.3	33.0	31.7	28.7	24.3	18.3	10.0	0	12.6	27.6	45.9	.....	.....	.....	.....	.....	.....	.....	.....
1,800	11.3	16.7	21.3	26.0	30.3	33.8	36.7	39.0	40.3	40.7	40.0	37.7	34.3	28.7	21.3	12.0	0	14.3	32.0	.....	.....	.....	.....	.....	.....	.....	.....
1,900	13.0	19.0	24.7	30.0	35.0	39.1	43.0	46.0	48.3	49.3	49.3	48.0	45.0	40.3	33.7	25.0	14.0	0	16.8	.....	.....	.....	.....	.....	.....	.....	.....
2,000	14.3	21.3	27.7	34.0	39.7	45.0	49.7	53.3	56.7	58.3	59.3	58.7	56.7	53.0	47.3	39.3	29.0	16.0	0	.....	.....	.....	.....	.....	.....	.....	.....
2,100	16.3	24.3	31.7	38.7	45.3	51.7	57.0	62.0	65.7	68.7	70.7	70.7	69.8	66.7	62.0	54.7	45.7	33.7	18.7	0	.....	.....	.....	.....	.....	.....	.....
2,200	18.3	27.3	35.7	43.7	51.3	58.7	65.0	70.7	75.7	80.0	82.7	83.7	83.7	81.7	77.7	71.7	63.3	52.3	38.3	20.7	0	.....	.....	.....	.....	.....	.....
2,300	20.7	30.7	40.0	49.3	58.3	66.7	74.0	80.7	86.3	92.0	96.0	98.0	99.0	98.3	95.7	90.7	83.3	73.7	60.7	44.0	24.0	0	.....	.....	.....	.....	.....
2,400	23.0	34.0	45.0	55.3	65.3	74.7	83.3	91.7	99.0	105	110	114	116	116	115	111	105	96.0	84.3	69.0	50.7	27.3	0	.....	.....	.....	.....
2,500	25.7	38.0	50.0	62.0	73.3	84.0	94.3	104	112	120	126	131	135	136	136	134	129	121	111	97.0	79.7	58.0	31.7	0	.....	.....	.....
2,600	28.7	42.7	56.3	69.3	82.3	94.3	106	117	127	136	144	150	155	158	159	158	155	149	140	127	111	91.0	66.3	35.3	0	.....	.....
2,700	32.3	47.7	62.7	77.7	92.0	106	119	132	143	153	163	171	178	182	185	186	184	180	172	161	147	128	105	75.7	41.7	0	.....
2,800	35.3	52.7	69.7	86.3	102	118	133	147	161	173	184	194	202	209	213	215	215	212	207	197	185	168	146	119	86.0	46.3	0
L. S	.7	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.7	9.3	10.0	13.3	16.7	20.0	25.0	30.0	35.0	41.7	.....

NEGATIVE
POSITIVE

NOTES.

The table is divided into two parts, one below the zero line and the other above. That part below the zero line is the ordinary trajectory table; that part above and the words "positive" and "negative" are for use when determining clearance in indirect overhead fire. (See sec. 30, par. 4 (*l*).)

PART BELOW ZERO LINE.

1. This table gives at any distance from the gun the height *in yards* of the center of the cone *above* the line of sight.

Example.—At a range of 1,900 yards and at a distance of 1,000 yards from the gun the center of the cone is 48.3 yards above the line of sight.

2. To find the height of the lowest shot above the line of sight *subtract* the figure in the line marked L.S. from the height of the trajectory.

Example.—At a range of 1,800 yards the lowest shot at 900 yards from the gun is 39 − 3 = 36 yards above the line of sight.

PART ABOVE ZERO LINE.

1. This table gives at any distance from the gun the height *in yards* of the center of the cone *below* a horizontal plane passing through the gun position. When using this table the range is not the range to the target, but is the quadrant angle on the gun converted to a range by Table 1, column 2.

Example.—At a range of 800 yards, and at a distance of 1,200 yards from the gun the center of the cone is 15 yards below the horizontal plane through the gun position.

2. To find the height of the lowest shot below the horizontal plane passing through the gun position *add* the figure in the line L.S. to the height of the trajectory.

Example.—At a range of 800 yards, the lowest shot at 1,400 yards from the gun is 30 plus 6 = 36 yards below the horizontal plane through the gun position.

2,000	256	541	One in 6.4	10.0	6.7	16.7	70	130	6.7	10.9
2,100	288	623	One in 5.5	13.3	8.0	18.0	74	140	8.0	13.4
2,200	322	715	One in 4.8	16.7	9.3	19.3	78	150	9.3	16.2
2,300	360	817	One in 4.2	20.0	10.7	20.7	82	160	10.7	19.5
2,400	401	929	One in 3.7	25.0	12.0	22.0	86	170	12.0	23.2
2,500	447	1,052	One in 3.3	30.0	13.3	23.3	90	180	13.3	27.2
2,600	496	1,186	One in 2.9	35.0	16.7	25.0	100	190	16.7	34.5
2,700	551	1,332	One in 2.6	41.7	20.0	26.7	110	200	20.0	42.3
2,800	610	1,491	One in 2.3	48.3	23.3	28.3	120	210	23.3	52.1

TABLE 2 (B).—*Trajectory table for negative quadrant angles, .303 Vickers gun, Mark VII ammunition.*

Q. E. mins.	Distance of point from gun, in yards.															
	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000
— 5	0.7	0.9	1.0	1.2	1.3	1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.5	2.6	2.7	2.9
— 0	3.2	4.8	7.1	10.0	13.6	18.0	23.7	30.4	38.2	47.5	58.7	72.1	87.5	105	125	149
— 25	6.8	9.2	12.2	15.8	20.2	25.3	31.7	39.1	47.6	57.6	69.7	83.7	99.6	118	139	163
— 50	10.4	13.6	17.3	21.6	26.7	32.6	39.7	47.8	57.1	67.8	80.6	95.5	112	131	153	178
— 75	14.1	17.9	22.4	27.4	33.2	39.8	47.8	56.5	66.6	78.0	91.6	107	124	144	167	192
—100	17.7	22.3	27.6	33.2	39.8	47.2	55.6	65.4	76.0	88.4	102	119	137	158	180	207
—125	21.3	26.8	32.7	38.0	46.4	54.5	63.6	74.0	85.5	98.5	113	130	149	171	194	221
—150	24.9	31.1	37.8	44.7	52.9	61.6	71.6	82.8	95.0	109	124	142	162	184	208	236
—175	28.5	35.4	42.9	50.5	59.5	68.9	79.6	91.5	104	119	135	154	174	197	222	250
—200	32.2	39.7	47.8	56.4	66.1	76.1	87.6	100	114	129	146	164	186	210	236	265
—225	35.6	44.1	52.9	62.2	72.7	83.4	95.6	109	123	139	157	177	199	223	250	279
—250	39.5	48.4	58.2	68.0	79.0	90.7	104	118	133	149	168	188	211	236	264	294
—275	42.8	52.8	63.3	73.8	85.6	98.1	112	126	142	159	179	200	224	249	287	308
—300	46.8	57.1	68.4	79.6	92.1	105	120	135	152	169	190	211	236	262	301	323
—325	50.0	61.5	73.2	85.4	98.6	113	128	144	161	180	201	223	248	275	325	.....
—350	54.1	65.8	78.3	91.2	105	120	136	152	171	190	212	235	261	288	.....	.....
—375	57.2	70.2	83.4	97.0	112	127	144	161	180	200	223	246	.....	.....	.....	.....
—400	61.3	74.5	88.5	103	118	134	152	170	189	210	234	.....	.....	.....	.....	.....
—425	65.0	78.9	93.6	109	125	142	160	179	199	220	244	.....	.....	.....	.....	.....
—450	68.6	83.2	98.7	115	131	149	168	189	208	230	255	.....	.....	.....	.....	.....
—475	72.2	87.6	104	120	138	156	176	196	218	240	.....	.....	.....	.....	.....	.....
—500	75.9	92.1	109	126	145	163	184	205	227	.....	.....	.....	.....	.....	.....	.....
—525	79.5	96.5	114	132	151	170	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
—550	83.1	101	119	138	158	178	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

NEGATIVE

NOTES.

1. This table gives at any distance from the gun the height, *in yards*, of the center shot of the cone below a horizontal plane passing through the gun position.

2. It is for use when determining clearance over our own troops' heads in direct overhead fire. (See sec. 30, par. 4 (*l*).)

3. The line Q. E.= −5 means that at 1,000 yards, for instance, each addition of 5 minutes to the Q. E. adds 1.4 yards to the height of the trajectory.

Example.—Q. E. = −265 minutes; range =1,400 yards. Trajectory height=149 plus 2 yards for each 5 minutes added above 250.
=149+($\frac{4}{5}$×2)=155.

TABLE 3 (A).—*The quadrant angle in minutes, knowing range and V. I., .303 Vickers gun, Mark VII ammunition.*

V. I. in yards.	Range to target in yards.																							
	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,700	2,800
1	7	6	5	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
5	56	57	60	65	71	79	89	100	114	129	147	166	187	211	236	265	296	330	368	408	454	503	557	616
10	91	85	84	86	90	96	104	115	127	142	158	177	197	220	245	273	304	338	375	415	461	509	564	622
15	125	114	109	108	109	114	120	129	141	154	169	187	207	230	254	282	313	345	382	423	468	516	570	628
20	160	143	133	129	129	131	136	143	154	166	181	198	218	239	263	290	321	353	390	430	475	522	577	635
25	194	171	158	151	148	148	151	158	167	178	192	209	228	249	272	299	329	361	397	437	481	529	583	641
30	228	200	183	172	167	165	167	172	181	191	204	220	238	258	281	308	337	369	405	444	488	536	589	647
35	263	229	207	194	186	183	183	186	194	203	215	230	248	268	291	317	345	377	412	451	495	542	596	653
40	297	258	232	215	205	200	198	201	207	215	227	241	258	278	300	325	354	385	420	458	502	549	602	659
45	332	286	256	237	224	217	214	215	220	228	238	252	268	287	309	334	362	392	427	465	509	556	608	665
50	366	315	281	258	243	234	229	229	233	240	250	263	278	297	318	342	370	400	435	473	516	562	615	672
55	400	344	305	279	262	251	245	244	247	252	261	273	288	306	327	351	378	408	442	480	523	569	621	678
60	435	372	330	301	281	268	261	258	260	265	273	284	299	316	336	359	386	416	450	487	530	576	628	684
65	469	400	354	323	300	285	276	272	273	277	284	295	309	325	345	368	394	424	457	494	537	582	634	690
70	503	429	379	344	319	303	292	287	286	289	296	306	319	335	353	376	402	432	465	501	544	589	640	696
75	538	458	403	366	338	320	307	302	300	302	307	316	329	344	362	385	411	440	472	509	550	596	646	703
80	572	486	428	387	358	337	323	317	313	314	319	327	339	354	372	394	419	448	480	516	557	603	652	709
85	606	515	452	408	377	354	339	331	327	327	330	338	349	363	381	403	427	456	487	523	564	609	659	715
90	641	544	477	429	396	371	354	346	340	339	342	348	359	373	390	411	436	464	495	530	571	616	665	721
95	675	572	502	451	415	389	370	360	353	351	353	359	369	383	399	420	444	471	502	538	577	622	671	727
100	688	602	526	472	434	406	386	375	366	363	364	370	379	392	408	429	452	479	510	545	584	629	678	733

TARGET ACME

NOTES.

1. This table combines the angle of sight with the angle of tangent elevation, thereby producing the quadrant angle directly.
2. It is used as follows: Range=1,900 yards. Target 55 yards above gun. Quadrant elevation=327 minutes.
3. The top line where V. I. =1 yard is used as follows: Example I. Range=1,900, V. I. = 57 yards. The quadrant elevation for range=1,900 and V. I.=55 is 327 minutes. For each extra yard of V. I. the top line shows that 2 minutes must be *added*. Therefore necessary quadrant angle is 327 plus (2×2)=331 minutes.

TABLE 3 (B).—*The quadrant angle in minutes, knowing range and V. I., .303 Vickers gun, Mark VII ammunition.*

V. I. in yards.	Range to target in yards.																						
	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,700	2,800
1	7	6	5	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
5	-12	-1	10	21	33	45	57	72	88	105	123	144	167	191	218	248	280	314	352	394	440	489	545	604
10	-47	-29	-14	0	14	28	42	57	75	92	112	133	157	182	209	239	272	306	345	387	433	483	538	598
15	-81	-58	-39	-22	-5	10	26	43	61	80	101	123	147	172	200	230	263	299	338	379	426	476	532	592
20	-116	-87	-64	-43	-25	-7	10	29	48	68	89	112	136	163	191	222	245	291	330	372	420	470	525	585
25	-150	-115	-88	-65	-44	-24	-4	14	35	56	78	101	126	153	182	213	141	283	323	365	413	463	519	579
30	-184	-144	-113	-86	-63	-41	-21	0	21	43	66	90	116	144	173	204	239	275	315	358	406	456	513	573
35	-219	-173	-137	-108	-82	-59	-37	-14	8	31	55	80	106	134	164	196	231	267	308	351	399	450	506	567
40	-253	-202	-162	-129	-101	-76	-52	-29	-5	19	43	69	96	124	155	187	222	259	300	344	392	443	500	561
45	-288	-230	-186	-151	-120	-93	-68	-43	-18	6	32	58	86	115	146	178	214	252	293	336	385	436	494	555
50	-322	-259	-211	-172	-139	-110	-83	-57	-31	-6	20	47	76	105	137	170	206	244	285	329	378	430	487	548
55	-357	-288	-235	-193	-158	-127	-99	-72	-45	-18	9	37	66	96	128	161	198	236	278	322	371	423	481	542
60	-391	-316	-260	-215	-177	-144	-115	-86	-58	-31	-3	26	55	86	119	153	189	228	260	315	364	416	474	536
65	-425	-344	-284	-237	-197	-161	-130	-100	-71	-43	-14	15	45	77	110	144	181	220	263	308	358	410	468	530
70	-460	-372	-309	-258	-216	-179	-146	-115	-84	-55	-26	5	35	67	101	136	173	212	255	301	351	403	462	524
75	-495	-401	-333	-280	-235	-196	-161	-129	-97	-67	-37	-6	25	57	92	128	166	206	248	294	344	397	456	518
80	-529	-430	-358	-301	-254	-214	-177	-144	-111	-79	-48	-17	15	48	82	119	158	199	240	287	337	391	449	512
85	-563	-459	-382	-323	-273	-231	-192	-158	-124	-92	-60	-28	5	38	73	111	149	191	233	280	330	384	443	506
90	-598	-488	-407	-344	-292	-243	-208	-172	-137	-104	-71	-39	-5	29	64	102	141	183	225	273	323	378	436	500
95	-632	-517	-431	-366	-311	-265	-223	-186	-150	-117	-83	-50	-15	19	55	93	132	175	218	266	316	371	430	494
100	-666	-545	-456	-387	-330	-282	-239	-200	-163	-129	-94	-60	-25	10	46	85	124	167	210	259	310	365	424	488

Target BELOW Gun

NOTES.

1. This table combines the angle of sight with the angle of tangent elevation, thereby producing the quadrant angle directly.
2. It is used as follows: Range=1,900 yards. Target 55 yards below gun. Quadrant elevation=128 minutes.
3. The top line where V. I.=1 yard is used as follows: Example I—Range=1,900 yards. Target 57 yards below gun. The quadrant angle for range=1,900 and V. I.=55 is 128 minutes. For each extra yard of V. I. the top line shows that 2 minutes must be *subtracted*. Therefore necessary quadrant angle is 128−(2×2)=124 minutes. Example II—Range=1,300 yards, V. I.=38 yards, Q. E.=8−(3×3)= −1 minute. Example III—Range=1,100 yards, V. I.=47 yards, Q. E.= −68−(2×3)= −74 minutes.

TABLE 4.—*Wind allowances.*

The following is the usual table for rough guidance:

Yards.	Lateral allowances.					
	Mild.		Fresh.		Strong.	
	Yards.	*Minutes.*	*Yards.*	*Minutes.*	*Yards.*	*Minutes.*
500	1	5	1½	10	2	15
1,000	3	10	6	20	9	20
1,500	6	15	12	30	18	45
2,000	12	20	24	40	36	60

NOTES.

(i) The table is for right-angle winds; halve the allowances for oblique winds.
(ii) The minutes of angle should be used in conjunction with a card and string in order to obtain an auxiliary aiming mark on which to order the gunner to lay.
(iii) When no clearly defined auxiliary mark is obtainable the lateral angular allowance may be put on by the direction dial, if the angle is reasonably large. If not, the following rough rule may prove of value.
(iv) Assume the following factors: Mild, 2; fresh, 3; strong, 4; then multiply the range by the appropriate factor, and the first figure of the answer gives the taps required. Thus fresh wind at 1,500 yards; 1,500×3=4,500; 4 taps are necessary.
(v) The deflection due to drift is negligible below 1,000 yards. At 1,500 yards it is about 2 yards. Above 1,500 yards it is unknown but is certainly several yards at extreme ranges.
N. B.—Drift is to the left.

TABLE 5.—*Allowances for atmospheric influences.*

More elevation.	Less elevation.
Cold (40° F. or less). Strong head wind. Extreme dryness.	Heat (80° F. or more). Strong rear wind. Rain. Over 3,000 feet above sea.

ALLOWANCES IN YARDS OF RANGE.		
Range.	1 factor.	2 factors.
1,000 yards		50
1,500 yards	50	100
2,000 yards	100	150

TABLE 6.—*Time of flight.*

Total time of flight (in seconds).	Distance covered (in yards).	Total time of flight (in seconds).	Distance covered (in yards).
1.....	600	9.....	2,350
2.....	1,000	10.....	2,450
3.....	1,300	11.....	2,550
4.....	1,550	12.....	2,625
5.....	1,775	13.....	2,700
6.....	1,950	14.....	2,775
7.....	2,100	15.....	2,840
8.....	2,225		

NOTES.

(i) Due to the effect of light on the human eye, *more* elevation must be given in a very bright light and *less* elevation in a very poor light.

(ii) Factors affecting elevation in opposite directions will naturally cancel out; the result of combined factors only must be used in the allowance table.

(iii) Less elevation is required when firing up or down hill. This may be neglected when the angle of sight to the target does not exceed 10°.

TABLE 7.—*Searching reverse slopes. .303 Vickers gun, Mark VII ammunition.*

[All figures represent yards.]

1	2	3	4	5	6	7	8	9	10	11	12	Gun above or below crest.	12	11	10	9	8	7	6	5	4	3	2	1
1500	1600	1650	1700	1850	1850	1900	1950	2000	2000	2050	2100		1900	1800	1700	1600	1500	1400	1400	1350	1300	1300	1300	1200
1350	1400	1500	1600	1650	1700	1800	1850	1900	1950	2000	2050	0	2050	2000	1950	1900	1850	1800	1700	1650	1600	1500	1400	1350
1400	1450	1550	1600	1700	1750	1800	1850	1900	1950	2000	2050	10	2000	1950	1900	1850	1800	1750	1650	1600	1550	1450	1300	1150
1450	1500	1550	1650	1700	1750	1850	1900	1950	2000	2050	2100	20	2000	1950	1850	1800	1700	1650	1600	1550	1450	1350	1200	.....
1500	1500	1600	1650	1750	1800	1850	1900	1950	2000	2050	2100	30	1950	1900	1850	1750	1650	1600	1550	1500	1400	1250	1100	.....
1500	1550	1650	1700	1750	1800	1900	1950	1950	2000	2050	2100	40	1900	1850	1800	1700	1600	1500	1450	1450	1300	1150	.....	.....
1550	1600	1700	1700	1800	1850	1900	1950	2000	2050	2100	2100	50	1900	1850	1750	1650	1550	1450	1400	1350	1200	.....	.....	.....
1600	1650	1700	1750	1800	1850	1950	2000	2000	2050	2100	2150	60	1850	1800	1700	1600	1450	1400	1350	1300	.....	.....	.....	.....
1650	1650	1750	1750	1850	1900	1950	2000	2050	2100	2150	2150	70	1800	1750	1650	1550	1500	1500	1300	1200	.....	.....	.....	.....
1650	1700	1800	1800	1850	1900	1950	2000	2050	2100	2150	2150	80	1750	1700	1650	1550	1450	1350	1250	1250	.....	.....	.....	.....
1700	1700	1800	1800	1900	1950	2000	2050	2050	2100	2150	2200	90	1750	1700	1650	1550	1450	1250	1150	.....	.....	.....	.....	.....
1750	1800	1850	1850	1950	1950	2000	2050	2100	2150	2200	2200	100	1700	1650	1550	1400	1200	1100	.....	.....	.....	.....	.....	.....
1800	1850	1900	1900	1950	2000	2050	2100	2100	2150	2200	2200	110	1650	1600	1500	1350	1150	.....	.....	.....	.....	.....	.....	.....
1850	1850	1900	1950	2000	2000	2050	2100	2100	2150	2200	2200	120	1600	1550	1450	1300	1100	.....	.....	.....	.....	.....	.....	.....
1850	1900	1950	1950	2000	2050	2050	2100	2150	2200	2250	2250	130	1600	1550	1450	1250	.....	.....	.....	.....	.....	.....	.....	.....
1900	1950	2000	1950	2050	2050	2100	2150	2150	2200	2250	2250	140	1550	1500	1400	1200	.....	.....	.....	.....	.....	.....	.....	.....
1900	2000	2050	2000	2050	2100	2100	2150	2150	2200	2250	2250	150	1500	1450	1350	1150	.....	.....	.....	.....	.....	.....	.....	.....
.....	2000	2050	2050	2100	2100	2150	2200	2200	2250	2300	2250	160	1450	1400	1300	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	2100	2050	2150	2150	2150	2200	2200	2250	2300	2300	170	1400	1350	1250	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	2100	2150	2150	2200	2250	2200	2250	2300	2300	180	1400	1350	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	2200	2200	2250	2250	2300	2350	2300	190	1350	1300	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	2250	2250	2300	2350	2350	200	1300	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

GUN ABOVE Crest

APPENDIX B.

Indirect overhead fire sheet.

[No. 515 M. G. Coy. No. 3 Section. Date, 11.2.19. Map used, 36c N. W. 3. 1/10,000. Officer i/c firing, 2/Lt. D. Hay.]

Gun No.	Target.	Elevation.						Clearance over own troops.					Direction.	Remarks.			
		Range to target (in yards).	Contours in yards.		V. I. (in yards).	Q. E. minutes. Table 3 (A) or 3 (B).	Range for Q. E. (in yards). Table 1, col. 2.	Contour of own troops (in yards). B.	Range to own troops (in yards).	Trajectory height (in yards). Table 2 (A) or 2 (B). C.	Clearance obtained by note (1) below (in yards).	Clearance required (in yards).	Compass bearing or D. D. reading.	Time of firing.	Number of rounds fired.	Checked by—	General.
			Gun. A.	Target.													
1	Dump, U.28.b.5.4	2,000	118	93	25	213	1,850	104	400	[1] 23	37	20	80° magnetic	19.56	500	D. H.	Traversed and searched slightly. Enemy retaliated on front line with 77 mm. shells.
2	Brickworks, U.29.c.0.9	1,900	100	140	40	300	2,150						D. D. 62° (left of R. O.).	10.00, 12.24	750	D. H.	Own troops not between gun and target. Artillery F. O. O. reports enemy casualties on both occasions.
3	Crossroads, B.17.d.5.1	1,500	111	63	47	28	600	88	700	[2] 1	22	20	D. D. 72°–74° (right of R. O.).	21.15	355	D. H.	Firing line reports noises of stampeding transport. Enemy retaliated on dummy emplacement.
4	Battalion headquarters, B.18.a.8.4.	1,700	132	29	103	−31		114	550	[2] 9	9	20	71° magnetic			D. H.	Insufficient clearance over own troops. Did not fire.
5–16	Barrage on near edge of Crow Wood.	2,300	[3] 111	138	27	399	2,400	95	1,100	[1] 105	121	40	Parallel lines of fire 101° magnetic.	On call from infantry.	41,500	D. H. L. T. N. R. O. A.	S. O. S. signal at 18.20, 19.30–19.56, and 21.10. No enemy attacks developed.
3	Shafskopf redoubt	2,200	119	71	48	258	2,000	99,97	900, 1,500	[4] 53, 53	73, 75	20, 40	Gun laid by day.	19.08	710	D. H.	Traversed slightly. No information as to results.

[1] Positive. [2] Negative. [3] Lowest. [4] Both positive.

NOTES.

1. Clearance in yards=A−B plus or minus C according as trajectory tables give positive or negative values of C.
2. Immediately before firing Q. E. must be corrected, if necessary, for atmospheric influences, see Table 5.
3. For lateral wind allowance see Table 4.
4. If obstruction exists between gun and target and its highest point can not be seen, ascertain if shots will clear by substituting "Obstruction" for "Own troops" in clearance columns above and find clearance by rule.

Note.—Minimum clearance required is one-half height of cone at range to obstruction.

101862°—17. (To face page 94.)

NOTES.

1. The top horizontal line is the drop *in yards* in the first 100 yards beyond the crest. The horizontal line directly below it is the distance to measure back from the crest to find gun position.

2. For full explanation of use of table, see section 31.

Example.—The ground drops 7 yards in 100, and assume also that the gun is below the crest. The left-hand side of table must therefore be used. The table shows that for a drop of 7 yards we must go back 1,900 yards from the crest. At this point, say, the gun position is found to be 90 yards below the crest. Final range, therefore, equals 2,000 yards. Place the gun at this point.

3. When the gun is in position, fire should be directed on the crest, elevation and direction being put on by any of the usual methods for indirect fire. In the example given above, the quadrant angle is that for a V.I. of 90 yards and a range of 2,000 yards—i. e., 411 minutes. (See Table 3 (A).)

4. Searching should be employed away from the crest, but it must be remembered that as the cone is beating falling ground the length of the zone will be very much increased; therefore the turns of the wheel should be few in number.

5. If the final position is not suitable the gun should be moved farther away from—not nearer to—the crest, and the elevation increased by the distance moved.

6. If it be desired to engage an area of ground which lies some distance back from the crest, without searching back from the crest itself, the position of the gun must be determined with reference to the crest as detailed above. Then the quadrant elevation necessary to hit the near limit of the ground to be searched must be put on in the usual way for indirect fire.

KEY TO PLATES.

 .....Company commander.

 .....Second in command.

 .....Section officer.

 .....Subsection officer.

 .....Company sergeant major.

 .....Company quartermaster sergeant.

 .....Sergeant.

 .....Corporal.

 .....Range taker.

 .....Scout.

 .....Gun number, lance corporal, or private.

 .....Artificer.

 .....Batman.

 .....Saddler.

 .....Shoeingsmith.

 .....Cook

 .....Storeman.

 .....Driver.

 .....Signaler.

 .....Filterer.

 .....Horse or mule.

PLATE I.

MACHINE-GUN COMPANY DRAWN UP IN LINE.

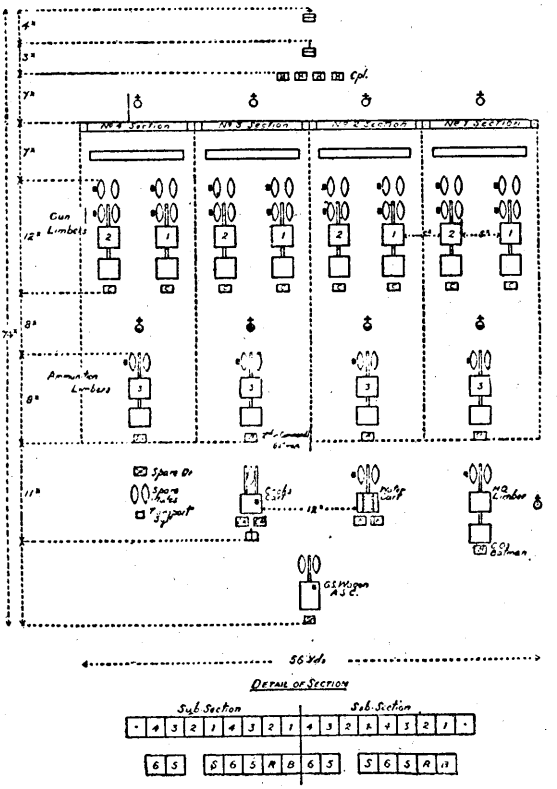
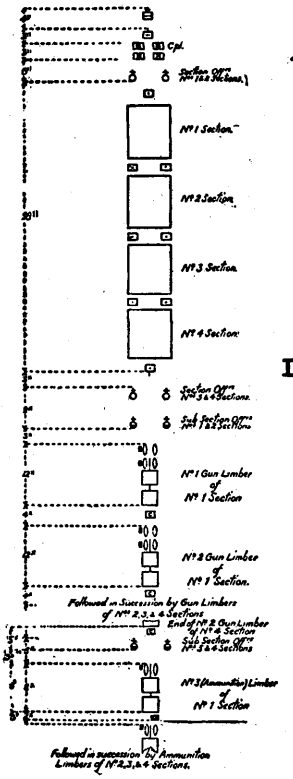
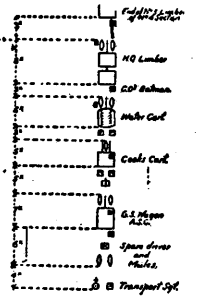


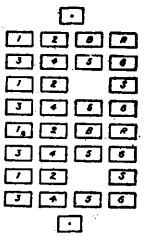
PLATE II.

MACHINE-GUN COMPANY IN COLUMN OF ROUTE. ACTION NOT EXPECTED.





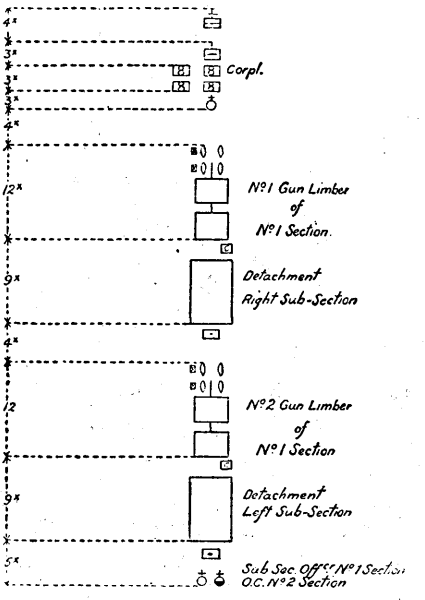
Detail of section in fours.



Total length of column = 311 yds.

PLATE III.

MACHINE-GUN COMPANY IN COLUMN OF ROUTE. ACTION EXPECTED.



Followed in succession by 2, 3 and 4 sections in above order. The subsection officer of No. 4 section followed by No. 3 (ammunition) limbers and remainder of transport in same order as shown when action is not expected.

Length of column=326 yards.

PLATE IV.



MOUNTING GUN AT ELEMENTARY DRILL.

Points to note:

1. Method of supporting gun on the right thigh by No. 2.
2. Forcing crosshead joint pin home with handle upward.
3. Firm grip with left hand on rear crosspiece.
4. No. 1 assisting with left hand.
5. No. 1 ready to connect elevating screw to the bracket with right hand.

PLATE V.



GUN INCORRECTLY MOUNTED.

Points to note:

Tripod—1. Feet not firmly planted in ground.
2. Rear leg at an angle to the line of fire.
3. Socket inclined.
4. Joint pin not turned down.
5. Upper elevating screw too short.

Gun—1. Inclined to one side.
2. Muzzle pointing upward.
3. Condenser tube outside front carrying handle.

PLATE VI.



NORMAL FIRING POSITION (SITTING).

Points to note:

1. Gun and tripod mounted correctly at suitable height, with belt box in position.
2. Condenser tube passed through the loop of front carrying handle.
3. Condenser bag screened as far as possible.
4. No. 1. Feet closed in and firmly planted in ground.
5. Correct method of taking "holding" pressure with both hands.
6. Elbows supported inside the thighs.
7. Eyes directed toward the target.
8. No. 2. Lowest possible position.
9. Right hand assisting feed belt.
10. Observing controlling officer from position below the gun.
11. Left hand out horizontally indicating "Ready to fire."

PLATE VII.

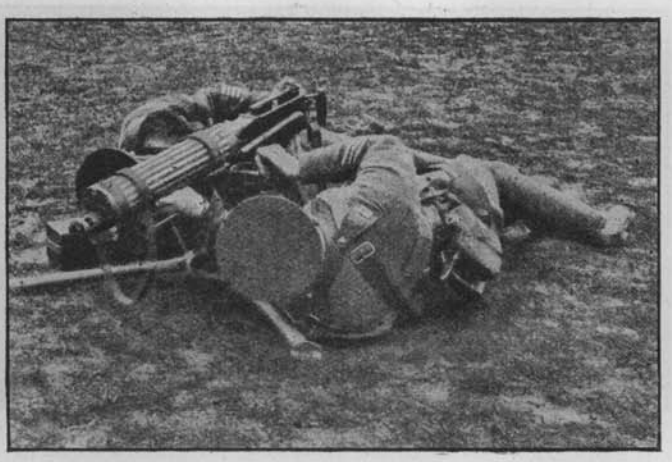


NORMAL FIRING POSITION (LYING).

Points to note:

1. Gun and tripod mounted in lowest position with socket clear of the ground.
2. No. 1. Heels firm on ground and legs close in to gun.
3. "Holding" pressure taken with both hands, arms close to body.
4. Back supported by No. 2.
5. No. 2. Lowest possible position consistent with performance of duties.
6. Right hand keeping ammunition box in position.
7. Watching for signals from a position below the gun.
8. Left hand out indicating "Gun ready to fire."
9. Knees drawn up behind No. 1 for support.

PLATE VIII.



MOUNTING GUN (VICKERS) IN PRONE POSITION.

Points to note:

1. Minimum exposure.
2. Tripod mounted in lowest position—socket just clear of ground.
3. No. 1. Position taken up on left of gun.
4. Left hand supporting barrel casing.
5. Right hand forcing home the crosshead joint pin.
6. No. 2. Left hand gripping rear crosspiece.
7. Ready to connect elevating screw to the bracket with right hand.

PLATE IX.

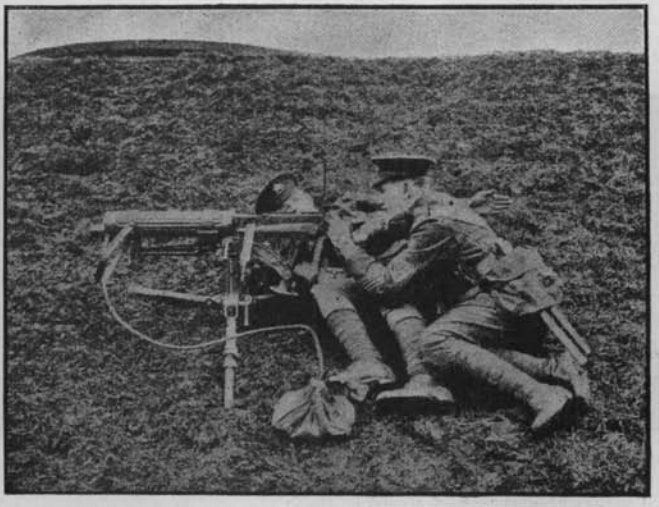


FIRING WITH AUXILIARY TRIPOD.

Points to note:

1. Feet of tripod forced in ground by No. 2.
2. Sights upright.
3. No. 1. Correct "holding" with both hands.
4. Elbows splayed out to support gun and body.
5. No. 2. Assisting feed belt with right hand.
6. Left hand out indicating "Gun ready to fire."
7. Watching controlling officer.

PLATE X.



POSITIONS WHEN FIRING ALONG A STEEP SLOPE.

Points to note:

Tripod.—1. Feet firmly planted. Legs adjusted to suit ground. Rear leg down the slope.
2. Socket upright.
Gun.—3. Loaded and laid correctly.
4. Condenser tube inside carrying handle.
No. 1.—5. Position suitable to ground.
6. Holding pressure, supported by No. 2.
No. 2.—7. Supporting ammunition box with right hand.
8. Watching controlling officer.
9. Hand out indicating "Gun ready to fire."

PLATE XI.



POSITIONS WHEN FIRING DOWN A STEEP SLOPE.

Points to note:

Tripod.—1. Legs adjusted to suit ground. Rear leg down slope.
2. Socket upright.

Gun.—3. Loaded and laid.
4. Condenser tube inside carrying handle.

No. 1.—5. Position adapted to suit ground.
6. "Holding" with arms close to body.

No. 2.—7. Supporting ammunition box.
8. Position adapted to ground.

PLATE XII.

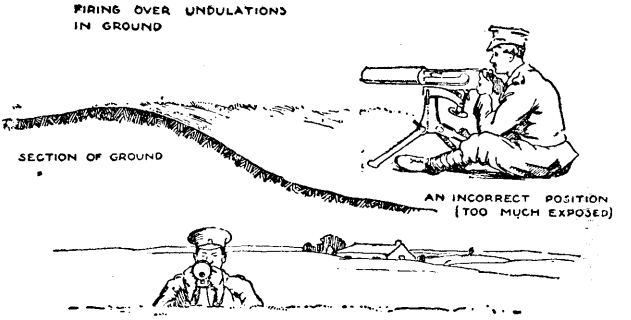


PLATE XIII.

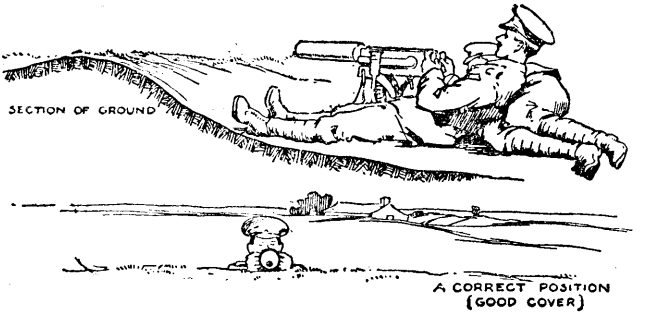
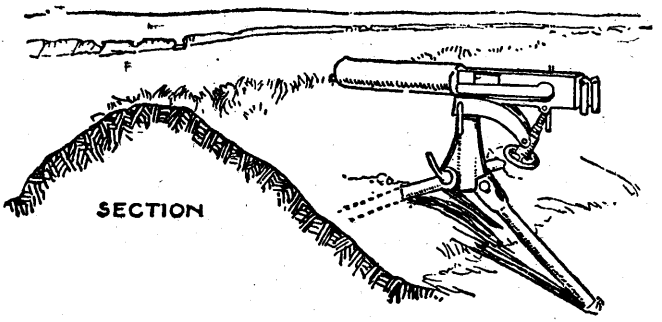
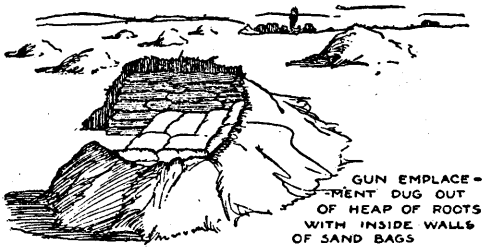


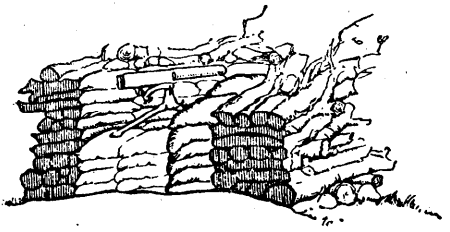
PLATE XIV.



VICKERS OR MAXIM GUN MOUNTED BEHIND BANK.

PLATE XV.





STACK OF WOOD USED AS
GUN EMPLACEMENT

PLATE XVI.

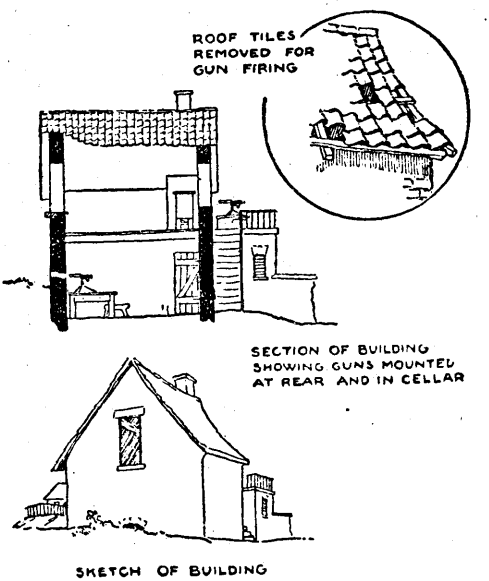


PLATE XVII.

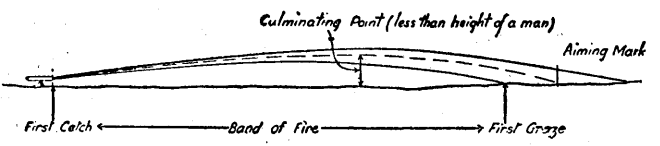


PLATE XVIII.

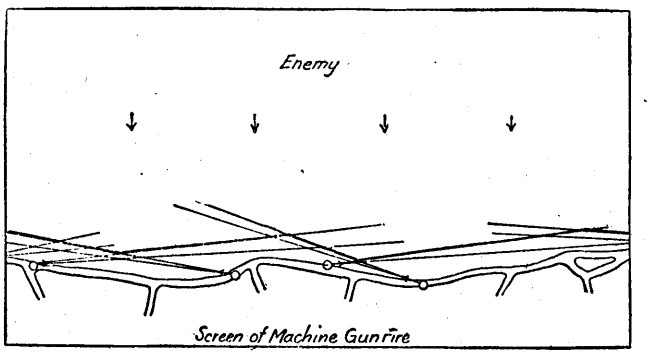


PLATE XIX.

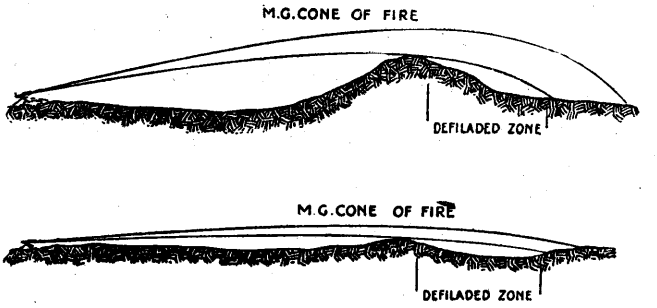


PLATE XX.

SEARCHING REVERSE SLOPES.

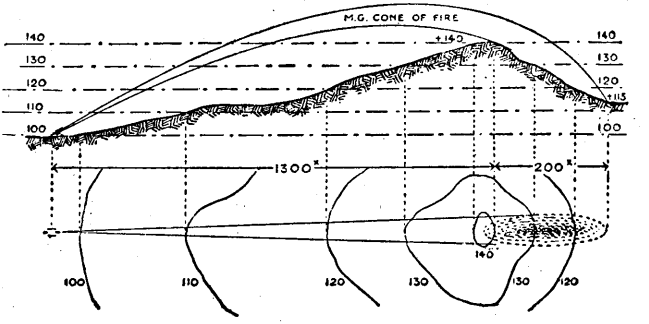


PLATE XXI.

USE OF COMBINED SIGHTS.

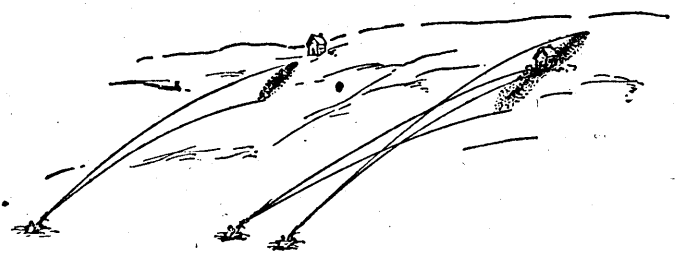


PLATE XXII.

SEARCHING FIRE.



PLATE XXIII.

SEARCHING FIRE, USING TWO GUNS.

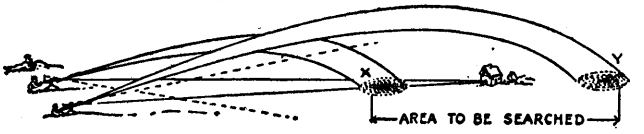
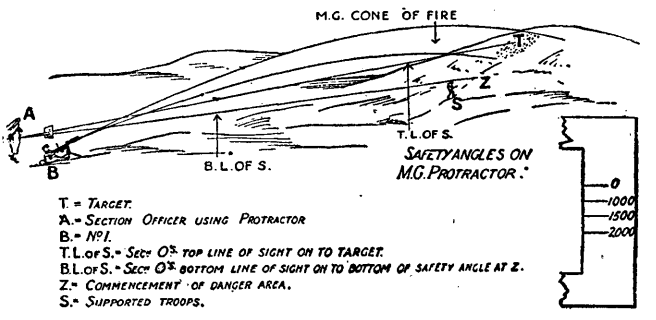


PLATE XXIV.

OVERHEAD FIRE—PROTRACTOR METHOD.

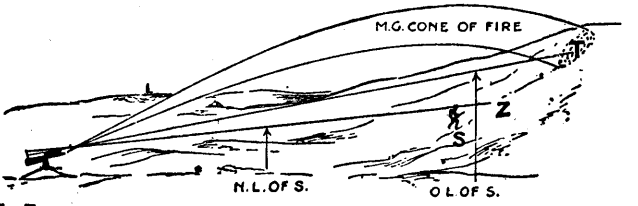


T. = TARGET.
A. = SECTION OFFICER USING PROTRACTOR
B. = No. 1.
T.L. OF S. = SEC. OF TOP LINE OF SIGHT ON TO TARGET.
B.L. OF S. = SEC. OF BOTTOM LINE OF SIGHT ON TO BOTTOM OF SAFETY ANGLE AT Z.
Z. = COMMENCEMENT OF DANGER AREA.
S. = SUPPORTED TROOPS.

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PLATE XXV.

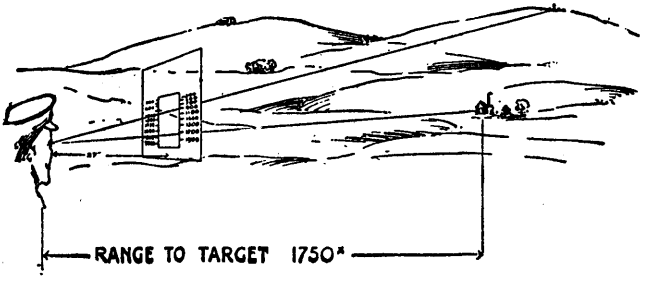
OVERHEAD FIRE—TANGENT SIGHT METHOD.



T. = *Target*
O.L.of S. = *Original Line of Sight on target with correct elevation on gun*
N.L.of S. = *New Line of Sight on to bottom of safety angle at Z*
S. = *Supported Troops.*

PLATE XXVI.

INDIRECT FIRE—GRATICULE METHOD.



CONTENTS.

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Employment of machine guns and light automatic weapons by cavalry	117
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Tactical use of auto-mounted machine guns and 37-mm. guns	135

THE EMPLOYMENT OF MACHINE GUNS AND LIGHT AUTOMATIC WEAPONS BY CAVALRY.

Types of Automatic Machine Rifles.

The term "machine gun" is popularly applied to all rifles of this character. Some foreign authorities, however, are careful to apply the name "machine gun" to automatic machine rifles of the Maxim, Vickers, heavy Hotchkiss, St. Etienne, and Colt types only, calling those of the Lewis, light Hotchkiss, Benet-Mercie, and Madsen types "light automatic weapons," for the reason that the latter are a cross between the machine gun proper and the automatic rifle. The automatic rifle implies a weapon which can replace the ordinary magazine rifle in the hands of the individual soldier.

The powers and limitations of these two classes of automatic machine rifles have been carefully studied, and each is used for the work to which it is best suited. The machine gun, or heavier type, is used where long-sustained fire of any kind is necessary, as for—

(*a*) Creating bands or belts of fire across the front of a defensive position.

(*b*) Guarding the flanks of an attack by covering areas of ground with fire.

(*c*) Long-range covering fire.

(*d*) Indirect fire, etc.

The lighter or Lewis gun type has generally been assigned to infantry companies and cavalry troops and is considered ideal for supplementing the fire power of riflemen, assisting them to gain fire superiority and closely supporting them on all occasions in either attack or defense.

The Lewis gun type is the first to go forward in an attack and the last to be brought away in a retirement. The use of this type makes it possible to place fewer of the Vickers gun type in the front line of an entrenched position, reduces the

number of riflemen in the front-line trenches, and enables positions won in an attack to be more quickly organized.

In the British service at present there is one light automatic weapon to each troop of cavalry (i. e., 12 per regiment), and in addition there are six Vickers machine guns assigned to each cavalry brigade.

In this paper the term "machine gun" will always refer to the heavy or Vickers type, and the term "automatic weapon" will refer to the light type (Lewis, Hotchkiss, Benet-Mercie, or Madsen). When both classes are referred to, the term "automatic machine rifle" will be used.

Notes on Employment.

The following are some notes on the employment of machine guns and light automatic weapons compiled by a prominent cavalry general serving in France. He offers them, not as a final pronouncement, but only as a foundation upon which to build a doctrine.

GENERAL REMARKS.

A. The characteristics of a weapon will usually determine its tactical use.

A clear difference must be drawn between the machine gun and the automatic weapon.

The Vickers gun type is capable, owing to its water jacket, of a rapid and sustained fire for a very considerable period. It is capable also, owing to the stable platform its tripod and clamps afford, of indirect and overhead fire, both by day and night.

On the other hand, the Lewis gun type, the automatic weapon, has no water jacket, and its working parts are too light to stand constant vibration, consequently, though capable of extremely rapid fire, it can not sustain it for long, and must be used for short bursts of rapid fire.

B. It must be understood that an automatic weapon can not take the place of a machine gun. It is a supplement to and not a substitute for the machine gun.

It must be regarded, especially by the cavalry, as a single-shot rifle and used as such, but as one capable on emergency, and when the circumstances and target are suitable, of a very high rate of fire for a short period.

It should therefore be a maxim that an automatic weapon should not be employed for rapid automatic fire unless the tactical result desired, whether it be defensive or offensive, can not be obtained without it.

It follows that it should never be used for long-range shooting at insignificant targets, or for "on the chance" shooting, except for definite purposes, such as deception, or on occasion covering fire, but must be primarily regarded as a close-range weapon for decisive use.

If this is not insisted on, especially in open warfare, the ammunition supply with the cavalry will become an acute difficulty, and the automatic weapon will fail us just when it is likely to be of most use.

C. We must not have detachments permanently told off to the automatic weapon, but at least 50 per cent as soon as possible, and eventually every cavalry soldier must be trained to its use. The only specialists should be a certain number of gunners—six or eight per weapon—who should be specially trained in its mechanism, and have a higher knowledge of its tactical use, but primarily it should be regarded as every man's weapon.

D. Machine guns and automatic weapons, acting solely by fire, can prepare an offensive movement or repulse an attack, but can not themselves gain ground. This rôle must always be left to the infantry, or with cavalry, to the man and horse combined.

It can therefore be said that, whenever action by fire alone is sufficient for the desired tactical result, it may be advantageous to use machine guns and automatic weapons rather than men, reserving the latter for combined operation by movement and fire. They may, and in fact often do, economize men.

E. Machine guns and automatic weapons produce a dense, deep, but narrow cone of fire. Traversing widens the zone, but the consequent loss of density weakens the effect very considerably.

Their fire has therefore the maximum power on narrow-fronted, deep objectives. Flanking fire must therefore always be sought for, and frontal fire will only have its full effect against troops who are compelled by the accidents of ground or obstacles to narrow their front.

All automatic machine rifles, by reason of their small detachments and ease of concealment, possess the power of surprise action with all the effect this produces. Opening fire by

surprise should therefore always be sought for, and automatic machine rifles should never give away their positions by opening fire without full justification and a certainty of producing the desired effect.

F. If the above general principles are departed from, as they may be in exceptional cases, the sole justification must be an affirmative answer to the question, Does the result hoped for justify the expenditure of ammunition?

G. The light automatic weapon is part of the ordinary fire power of a troop, and there should therefore be very strong reasons of tactical expediency for withdrawing all or any of them for use elsewhere.

They have been referred to as a reserve of fire power in the hands of the squadron leader, as have the Vickers guns as a reserve in the hands of the brigadier.

They will both, of course, occasionally be used as such, but, speaking generally, it is, I think, a mistake so to regard them. Opportunities for taking full advantage of their powers are more often than not very fleeting with cavalry, and it should be the aim of squadron and brigade commanders to distribute them in such proportion as they think fit as early as possible.

H. The following are put forward as suggestions for the employment of automatic machine rifles in specific cases.

(1) *Duties when acting purely as infantry.*

Trench warfare.—Machine guns are the framework on which a defensive line is built, and their number will not be affected by the presence of automatic weapons, though their distribution may be. The value of automatic weapons is to economize men, not to reduce the number of machine guns.

Machine guns are posted to create belts of cross fire along the front of a position. The sustained rate of fire of automatic weapons is not sufficient for this purpose, nor are they suitable for indirect or overhead fire.

It is rarely possible for machine guns to cover all the ground, and what they can not cover must be searched by automatic weapons firing over the parapet; owing to their mobility and absence of a fixed platform considerable liberty of action can be allowed them. They must be kept under cover during bombardment, but as they require no definite emplacements greater choice is possible in the selection of spots for their shelter, provided they can come into action without delay. Definite

fronts must be allotted to them and the detachments be thoroughly familiar with all possible firing places covering such fronts.

Provided all are familiar with their use, great economy of men and consequent lessening of casualties may be brought about by their use in the front line.

In the event of a portion of the line being broken, automatic weapons can, owing to their mobility and invisibility, be brought into action, covering the captured portion of the trenches from positions impossible for machine guns, even from shell holes and accidents of ground out in the open. Their use for firing "inward" from communication trenches to confine a hostile success in a water-tight compartment is also indicated.

In an attack out of trenches covering fire on the flanks is the province of the machine guns. Automatic weapons can do great service in providing covering fire from the front. They can be pushed out under cover of darkness, smoke, or bombardment and establish themselves in shell holes, ditches, long grass, etc., and by concentrating on hostile machine-gun emplacements or sweeping the parapet greatly aid the advance.

They should not accompany the first line of attack, but as soon as the first line of trenches is taken should be rapidly pushed up to cover reorganization and pursue the enemy with fire and ward off counter attack until the line is established.

(2) *Open warfare—acting as infantry.*

If cavalry have to undertake an infantry attack on a locality where the enemy is only hastily entrenched, it may be possible to push forward automatic weapons with the leading line, as they will appear to the enemy as ordinary riflemen. If used in this way they can provide covering fire for the front line when advancing in rushes over short distances. They may even be able to work forward in front of the line with the same object.

Machine guns will always be used for long-range covering fire and if "preparation" is necessary, both in the case of advances mounted and dismounted.

It should be a maxim that no attempt is made to gain ground against known opposition without the provision of such covering fire to assist forward progress, provide against forced retirement if the advance fails, and to cover the flanks.

The weight of the machine guns should in all such operations gravitate naturally toward the flanks, from where they can combine cross fire to the front and protection of the flanks. They follow the attack by advancing en échelon on the wings.

In wood fighting automatic weapons should not accompany the front line, as they can not fire suddenly from the shoulder. They should be distributed some 50 or 100 yards in rear of the front line, at the heads of the supporting line (which should always be in columns of sections or files) and some toward the flanks of the supporting line, but inside the flank columns.

Machine guns should normally accompany the reserve with their weight toward the most dangerous flanks. Every effort must be made to keep a close control over fire in wood fighting, a most difficult thing to do. Sudden, extremely intense bursts of fire will assist forward movement to a greater degree than uncontrolled tree to tree fighting.

(3) *Open cavalry fighting.*

The distribution of the machine-gun squadron in a column on the march would seem to be dictated by the proximity of the enemy. If contact is expected early, there should be at least a section with the advance-guard squadron, and one or perhaps two sections in rear of the leading squadron of the leading regiment. Such distribution would tend to insure that minor opposition is disposed of quickly, and would prevent the head of the column being driven in by unexpectedly strong hostile offensive action.

Normally the position of the remainder of the machine guns would seem to be following the horse artillery, i. e., in rear of the leading regiment, from which position they could be quickly distributed, either forward or to regiments following in rear which are ordered to deploy or to move to either flank.

Advance guards.—It is the business of a cavalry advance guard to take very bold and aggressive action, to grip, hold, and outflank the enemy as rapidly as possible to compel him to disclose his disposition. It is a reflection on any mounted advance guard if it permits the march of the main column to be delayed by what afterwards turns out to be only minor opposition.

On being held up, the enemy must be "held" in front by fire, and immediate offensive flank reconnaissance undertaken, to both flanks if possible, and at least to one.

Machine guns should be used for the direct holding fire, and to cover the advance of flanking detachments, and their retirement if they are driven back.

Automatic weapons should be used for the flanking movements, and may be able to progress—owing to their mobility and the small target they offer—by making use of the accidents of terrain, where a large body, such as a troop, would be stopped by fire. At the same time, if they reach their objective, the volume of fire they produce will be equal to and more concentrated than that of a troop. When a direct advance appears possible again at least a section of machine guns should remain in action until the situation is quite clear again.

Rear guards should always be strong in automatic machine rifles, which enable them to hold on longer, use fewer men, and cover a wider front.

It may therefore be advisable to increase the proportion of automatic weapons with a rear guard, especially with flank detachments. The question of ammunition supply is made easier as a rear guard is always retiring on its supply. Automatic weapons are quicker in and out of action, so their use is indicated with the rearmost parties for close work, while the Vickers guns should retire first and assist with long-range covering fire the retirement of the remainder.

All automatic machine rifles in such work should endeavor to come into action just where the enemy does not expect them, and avoid conspicuous points—villages, houses, small woods, etc.—which attract artillery fire. Opportunity should always be sought to make an over-bold enemy pay dearly for a premature advance by feigning a retreat of mounted men and drawing them into a storm of lead.

When a prolonged defense is contemplated automatic machine rifles will be used on the same general principles as in trench warfare. If we have to "seize and hold" ground until the arrival of the infantry, the Vickers guns will be posted to create a belt of cross-fire in front of the position; for long-range fire against distant approaches; for overhead and indirect fire, especially by night; for strengthening weak flanks and holding strong points for determined defense.

Automatic weapons will be best employed to command and cross-fire the final approaches and to cover ground which the Vickers guns can not. Their use is also indicated in "advance posts" commanding covered approaches invisible from the main

defensive line and compelling premature deployment. Very careful instructions as to how long such posts are to remain in action and their lines of retirement are necessary.

When cavalry is making successive mounted advances against opposition, or seizing a particular line, the preliminary occupation of tactical points covering the subsequent advance of the bulk of the force is very important, especially toward the flanks, whether the force engaged is a large one or only an advance-guard squadron. It is as if we throw out "kedge" anchors with which to warp ourselves forward.

Attempts to gain such points should always be the first step in mounted forward movement.

Covering fire is essential—by horse artillery if present, and always by Vickers guns, the procedure of advance being scouts, sections with automatic weapons, troops complete, and finally squadrons, followed by other Vickers guns, gradually increasing our hold, making good and extending outward till all join up.

A proportion of horse artillery and Vickers guns must always be left in their covering positions until the success of the operation is assured and the need no longer exists of a rallying point in case of retirement.

Retirements on a broad front follow the same procedure as regards automatic machine rifles as rear guards.

In all open operations the presence of automatic weapons with flank protective patrols and detachments will much assist them in their duties, which are, first, to give ample warning of a flank offensive, and, secondly, to put up such delaying action as they can to give time to the reserve to be moved to a suitable position to deal with the situation.

When cavalry is "bluffing" and holding a long line thinly, automatic weapons might be of great value for deception, and in this case their use at long ranges is permissible. Thus, by firing a few rapid rounds simulating a machine gun, which is usually associated with the presence of considerable formed bodies.

Automatic weapons and machine guns add greatly to the strength of an outpost line and enable us to economize men in this fatiguing duty.

All defiles, bridges, roads, and approaches will be covered by them, the general distribution being the same as outlined above for a prolonged defensive.

They are especially valuable if the ground held is that on which the main body intends to fight if attacked.

The mobility of the automatic weapon will enable it to be used by day with great boldness in positions well in front of the general line.

If mounted offensive is attempted against us by large bodies of cavalry, the skillful posting of automatic machine rifles in hedges, buildings, copses, groups of trees, sunken roads, etc., anywhere, in fact, where the horsemen can not get at us to use his weapon, should prevent his ever getting home with the sabre. We must, however, remember that we can not always foretell beforehand the exact line of advance that will be taken by the enemy's mass, and we must not be premature in dispersing our weapons. A few Vickers guns will probably be sufficient to turn back a hostile mounted mass or compel them to adopt dismounted tactics, but if we want decisive results we must hold our automatic machine rifles in hand until the last possible moment, possibly endeavoring to draw the enemy in a desired direction by a portion of our force mounted.

Concealment and surprise are essential to complete success. Scouts and patrols must be acted against with great boldness.

At the last possible moment an avalanche of fire must be brought to bear on the enemy by every machine rifle in the force, each portion of it moving to its allotted position and coming into action with extreme rapidity.

For such action automatic weapons would appear to be best used with the more dispersed action of the individual squadron, while a considerable proportion of the Vickers guns would probably have most effect if handled as a battery.

The retention of a mounted reserve should also be considered.

Such an action to be really successful demands a good eye for country and rapid judgment to decide when to assume the fire offensive and is a most interesting tactical study.

In mounted encounters between small bodies of cavalry, the quick combination of fire and shock will mean the difference between partial and complete success. The use of automatic weapons in such affairs is worth close study and practice.

NOTES ON THE USE OF AUTOMATIC WEAPONS WITH CAVALRY.

(Arranged in condensed form to assist regimental officers.)

Characteristics of automatic weapons.—Capable of very rapid fire, but can not sustain it for long. Best target deep and narrow. Can be used as a single loader, by repetition or auto-

matically. Three drawbacks—heating, limited traverse, awkward to get on and off horse; these will be lessened with experience and improved equipment.

From a consideration of the above, the following general principles emerge:

An automatic weapon is a supplement to, and not a substitute for, a machine gun.

Conditions to be looked for are concealment, surprise, and flanking fire.

Automatic weapons should be used to economize men and as a reserve of fire power of the squadron commander or of the troop commander of a detached troop.

Automatic weapons must generally be used as single-shot rifles, occasionally by repetition, seldom automatically.

Positions must never be given away prematurely, so that full effect may be obtained at decisive ranges.

Regimental officers must practice themselves in tactical schemes, constantly considering when, where, and how to use their automatic weapons.

Automatic-weapon men must be constantly selecting positions in tactical schemes.

The difficulty of ammunition supply must always be remembered.

(1) *In open warfare—With advance guards.*—During an approach march the automatic weapon should be used to strengthen our hold on tactical positions at the end of various rushes, the moment the position has been scouted, especially toward the flanks.

It should also be useful with a troop to cover the advance or retirement of patrols reconnoitering suspected places.

When held up by enemy we must at once develop his fire so as to ascertain whether we have encountered a post or a line.

Open holding fire in front and start offensive flank reconnaissance on both flanks.

For holding frontal fire employ machine guns if available.

Use automatic weapons for flank movements, as owing to their mobility and small target offered it may progress where a troop could not and be more concentrated.

If a post, combined frontal and flanking fire will probably cause it to move.

If part of a line not to be turned, we must break through.

Establish automatic weapons at tactical points which will secure our deployment.

The commander having reconnoitered and made his plan, a dismounted attack must be pushed home. (Par. 5 below.)

(2) *With a rear guard.*—Automatic weapons will be especially useful. The question of ammunition supply is facilitated, as a rear guard is always retiring on its supply. Concealment and flanking fire should be sought for and the automatic weapons placed in the most unlikely places and not in the most obvious. Machine guns should retire before automatic weapons and assist the retirement of the latter with covering fire. Alternative positions should always be selected for each automatic weapon so that if one position is located another can be occupied.

Practice getting out of action unseen, quickly, and quietly.

(3) *With flank guards.*—The automatic weapons should be pushed well out until they can get a series of mutually cross-firing positions to cover the approaches from the flank.

During the march between rushes officers must always ask themselves the question, If the enemy is reported now, where do I send my automatic weapons? If they can not answer it correctly, they are leaving things to chance. To be able always to answer this question means foresight, good map reading, and reconnaissance. For this purpose the second in command of the squadron and troop leaders must be freely used to supplement the information obtained from the map.

Delay in coming into action is always owing to lack of foresight and reconnaissance on the part of the commander rather than to slowness of the troops concerned.

(4) *For protection of troops halted.*—Automatic weapons should be used to strengthen pickets holding likely approaches.

(5) *In a dismounted attack.*—(*a*) To provide covering fire from the front during an attack wherever concealment or cover exist, the automatic-weapon men should creep forward and get into action, so as to provide covering fire from the front for the advance. If cover is scarce, advantage should be taken of our artillery fire for automatic weapons to push forward. Machine guns should provide covering fire from rear or flanks whenever possible.

(*b*) In the struggle for superiority of fire more automatic weapons should be sent up to reinforce the firing line, rather than more men if the latter would suffer heavy loss.

(*c*) To provide a mobile reserve of fire power under the squadron commander likely to be useful in repelling counter attacks, especially on the flanks.

(6) *In defense* automatic weapons should be used to cross-fire the front and sweep any approaches not covered by machine-gun fire.

(7) *In a mounted attack.*—The automatic weapons should either (*a*) be concealed so as to engage the enemy frontally whilst the cavalry attack in flank, or (*b*) should gallop out to a flank so as to enfilade the enemy while the cavalry attack in front.

(8) *In a pursuit.*—Full use must be made of our horses. Squadrons must gallop and seize tactical points on the flanks of the enemy's lines of retreat where, owing to obstacles, the enemy will bunch and offer good targets to the automatic weapons.

(9) *In wood fighting.*—So soon as the scouts have located the enemy some automatic weapons should go forward and get into position so as to smother the enemy with fire the moment he opens and cover our forward movement. Other automatic weapons should move forward at the heads of the supporting line, which will generally be in line of troop columns.

The machine guns should be toward the flanks and with the reserve.

In trench warfare—

1. To supplement the fire of infantry and machine guns.
2. To economize infantry.
3. Firing from the parapet to command ground which can not be swept by machine-gun fire.
4. To provide covering fire from the front during an attack automatic-weapon men creep forward under cover of night, smoke, or artillery bombardment and hide in shell holes, ditches, crops, etc.
5. To help consolidate positions won and cover the reorganization of the attacking troops.
6. For small enterprises where the weight and visibility of machine guns are unsuitable.
7. To reinforce infantry when sending forward more men would entail heavy losses.
8. As a mobile reserve of fire power.

TACTICAL USE OF MACHINE GUNS BY CAVALRY WHEN ACTING AS INFANTRY AND IN TRENCH WARFARE.

NOTE.—In this paper the term "machine gun" is used indiscriminately for the machine gun proper (the Vickers type) and the automatic weapon (the Lewis gun type). Their uses must not be confounded. The Lewis type is in the hands of the infantry companies and the cavalry troops, while the machine gun proper, or Vickers type, is organized into machine-gun companies and troops and they are used for long-range covering fire, for flank protection, for delivering indirect fire, etc., for which the lighter type should never be used.

This memorandum has been drawn up from various notes on the tactical handling of machine-gun detachments based on experience gained in the present war and lays down the principles governing their use.

I. CHARACTERISTICS OF MACHINE GUNS.

The increase in the number of machine guns tends to make this weapon the chief arm of the infantry.

The principal characteristics of the machine gun are as follows.: Its power is limited to fire action; the nature of the fire; its comparative invisibility.

Fire action.—Machine guns by fire action alone can pave the way for an attack or drive back a hostile assault, but they can not gain ground. The latter is almost exclusively the rôle of the infantry which is capable of crossing all obstacles.

Wherever, therefore, fire action alone is needed, machine guns can be used with advantage in preference to infantry, the latter being reserved for fire action combined with movement.

The use of machine guns, therefore, allows economy in the use of infantry and frees a greater proportion for maneuvering.

Fire effect.—Machine guns produce a dense, deep, but narrow cone of fire. Sweeping gives the cone greater width, but then the density becoming insufficient, the effect is weak. Machine-gun fire will therefore be most effective against narrow targets of considerable depth. As infantry normally fights in extended

order, the above conditions can generally be realized only by taking the lines in flank. Machine-gun fire parallel to the probable front of the enemy—that is, flanking fire—will therefore be the rule.

Frontal fire should be used as a matter of principle only upon points where the enemy is compelled to pass, such as bridges, roads, defiles, communicating trenches, etc.; that is, against places where the enemy is obliged to take up dense formations on a narrow front or where his troops are in mass.

Visibility.—By reason of its small personnel, the machine-gun section can use the slightest cover and, therefore, escape being seen by the enemy. Hence the possibilities for surprise effect are far greater for a machine gun than for infantry. The opening of fire by surprise must be the rule; machine guns must not disclose their locations by firing on targets of minor importance.

Flanking fire and surprise attack are two conditions that must invariably be sought for.

II. Use of Machine Guns.

The grouping of machine guns into companies assures the instruction of the crew and the upkeep of the material; it also favors cohesion and "esprit de corps." These companies are tactical as well as administrative units. Although in trench warfare they are generally used by sections, in open warfare frequent occasions will arise for them to operate by company under their commander.

At the beginning of an action, in order to save the infantry as much as possible, machine guns must be pushed forward with advance guards and placed from the start at the disposal of the subordinate commanders.

For the same reason the brigade machine-gun companies must not be considered as a reserve ("reserve de feux"). The brigade commander should assign them without delay to his two regiments, such proportion as he deems necessary. When the brigade commander or the regimental commander does not give directly to the machine-gun companies a special or somewhat independent mission, these companies should be placed during combat under the orders of the battalion commander. The latter can then place one or more sections under the orders of their captains.

Use on the offensive.—The principal situations in which machine guns are called upon to engage are as follows:

(*a*) *Reinforcing a front temporarily stationary.*

At the beginning of an action machine guns supported by small parties of infantry will cover very effectively the main infantry advance and offer at the same time an indifferent target to the enemy.

During the course of the action they assist in holding on to the ground won and give time to make preparations for resuming the advance.

(*b*) *Preparation for an attack.*

The power of machine-gun fire allows them to be used in completing the artillery preparation, firing either against the personnel or making breaches in the auxiliary defenses. Sometimes machine guns may be given the duties of preparing for an infantry attack when it is necessary to act very quickly (as in pursuit following up a success).

Whatever the situation, the intense concentrated fire on one or more points will alone attain certain results.

(*c*) *Covering the flanks of an attack.*

Placed from the start on the flanks of attacking troops, machine guns will assist their start. They will then follow the advance of these troops, keeping on the flanks, in position to be used instantly on all points from which hostile counter attacks might be delivered.

(*d*) *Occupation of an interval.*

Machine guns are also used to sweep an interval or gap made intentionally or by accident between two units. In the latter case they constitute a powerful weapon which may be quickly put into action by the commander.

Flank action and surprise effect are sought in every case. The men and guns must be protected against fire as much as possible.

Use on the defensive.—In the defense the use of flanking fire is more necessary than ever.

A defensive organization is complete only when machine guns have been distributed in such a way as to form successive cur-

tains of fire along the front. The machine guns are therefore constantly on the lookout, especially at night, ready to block with instantaneous fire any hostile attempt.

In order that the curtains of fire thus organized play their part at the moment of an attack, it is indispensable that the machine gun shall not have been destroyed by the bombardment. Their protection is consequently a matter of particular care. The three following precautions should be observed: Place the machine guns in bombproofs. Make their emplacements invisible. Echelon them from front to rear.

Shelters: A machine-gun casemate that is really bombproof requires considerable overhead thickness and relief. In open ground this would necessarily be noted by the enemy who may destroy it if it is worth the ammunition. The casemate form of emplacement must, therefore, be reserved for those cases where it will escape the enemy's observation, such as reverse slopes, or where it is possible to merge the relief with a well-marked slope of the ground, in woods, shelters, etc.

The greater part of the work such as the preparation of timber, etc., should be done at the rear. By this condition alone can the work be done solidly and rapidly.

While the gunners and their assistants are digging the excavation, the special troops prepare at the rear the wooden frames. The latter are then brought to the location and the casemate is completed in one or two nights at most, the greatest care being taken to hide the work from the enemy's observation.

Invisibility: To render machine guns invisible it is necessary to build emplacements outside the dugouts, but near enough to insure the guns being brought up without delay. The dugout being only to protect the personnel may be dug as deep as required and have only an insignificant relief.

The firing position should be in the immediate vicinity of the dugout. The former may be protected against splinters by a light roof with little relief or be entirely open.

The firing emplacement may be a simple pit dug in the open, in front or behind the parapet. This well-like pit should be connected with the dugout by an underground passage. The machine gun is brought into action at the last minute, flush with the edge of the pit, either without protection or, preferably, behind a shield or small embankment connected with the natural ground by the gentle slope. This pit and its approaches if carefully disguised will certainly escape the enemy's observa-

tion. Emplacements of this type are frequently used in rear of the front-line trenches.

When trenches lie on the reverse slope it is advantageous to place machine guns in this way in front of the crest and to connect them with the trenches by an underground passage.

Trees may also be used as gun positions.

To insure invisibility, it is necessary on the one hand to disguise all approaches leading to the emplacements by means of underground passages and on the other to increase the number of emplacements so as to avoid firing daily from those specially reserved for use in case of attack.

Positions in echelon: The natural tendency is to place all the machine guns in the front line in order to form an impenetrable curtain of fire in front of the trenches. But during a violent bombardment the first-line trenches and most of the machine guns, at any rate those that have been located, will be destroyed. It is therefore dangerous to place too many machine guns in the front line.

The object in view is to place the guns and men under such conditions that, should the effects of the bombardment and the asphyxiating gases enable the enemy to penetrate our lines, the hostile infantry as it advances will come under the fire of our machine guns, previously echeloned from front to rear, which will bring it to a standstill.

What is required is not to sweep an extensive sector but to bring flanking fire to bear over certain definite zones or strips of ground, which will surely mow down the advancing waves of hostile infantry.

Orders will, therefore, be given to distribute the available machine guns between the front-line trenches and the ground in rear, organizing in each particular case an emplacement suitable to the surrounding ground and having the above object in view.

III. General Rules of Location.

Under no circumstances must the machine gunners abandon their posts. If surrounded they will fight to the last.

On several occasions the tenacity and devotion of a few machine gunners have enabled a lost position to be regained rapidly.

To allow of this utmost resistance, gun emplacements should fulfill the following conditions:

(*a*) They should be surrounded by barbed wire of irregular trace, concealed as much as possible.

(*b*) Inside this should be several alternative emplacements in case one of them should be rendered untenable.

(*c*) The men should be provided with means of protection against gas, and have besides plenty of food, water, and ammunition.

IV. Use of Fire Action and Instruction.

Machine-gun fire is the more effective as it is the more grazing. This leads to the use of machine guns principally at ranges of 800 to 1,000 meters in order to benefit by the flat trajectory.

However, the effort to secure grazing fire does not preclude firing at longer ranges. This is always justified on important objectives and at points where the enemy must pass. For this fire to be effective the range must be determined with the greatest accuracy.

In the defense indirect fire will sometimes be used to hinder bringing up supplies, reliefs, etc. To obtain results a considerable expenditure of ammunition will generally be necessary.

All officers, noncommissioned officers, and the greater percentage of the men should know how to fire the gun, so that in case of attack no weapon will remain unused for lack of men.

It is also indispensable to keep up the training of the crew by making them fire at least twice a month, and, if possible, once a week.

To Sum Up.

Machine guns should be utilized to as large an extent as possible, in order to economize infantry.

Flanking fire should always be used.

Guns should be concealed to obtain surprise effect.

Guns should be well sheltered and placed in echelon from front to rear to avoid being destroyed prematurely.

REGULATIONS FOR THE TACTICAL USE OF AUTO-MOUNTED MACHINE GUNS AND AUTO-MOUNTED 37-MM. GUNS, OPERATING WITH CAVALRY.

(Dated September 4, 1916.)

[Translated from the French. Army War College, May, 1917.]

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1. Characteristics.

In addition to the special properties of machine guns, these appliances are characterized by:

(*a*) Their mobility, by which surprise action can be used to the utmost.

(*b*) Practically complete protection from infantry fire and shrapnel.

(*c*) The accuracy of fire and the relatively greater power of the auto-mounted 37-mm. guns supplements the action of the auto-mounted machine guns.

The cast-iron shell, with a percussion fuze, easily starts fires when it passes through the roofs of houses, light shelters, etc.; it also bursts into numerous and deadly fragments.

(*d*) The steel shell, with a base fuze, causes considerable damage to armored caissons, slightly protected observation posts, light masonry, etc.

(*e*) The auto-mounted 37-mm. guns are especially adapted for the destruction of the enemy machine guns by direct fire (they are called machine-gun destroyers).

On the other hand, the auto-mounted machine guns and auto-mounted 37-mm. guns have the following disadvantages:

(*a*) Their general inability to leave the roads.

(*b*) Their great visibility due to their size and the dust raised in dry weather.

(*c*) The difficulty of protecting them without either infantry or cavalry support.

(*d*) The difficulty of marching in column.

2. General Rules for the Use of Auto-Mounted Machine Guns and Auto-Mounted 37-mm. Guns.

The group constitutes an administrative and tactical unit.

In a war of movement it does not always operate as a unit at one point, but is divided into detachments of one or two sections; one section should be assigned to every large unit (brigade or regiment), not, however, displacing any artillery.

The auto-mounted machine gun and the auto-mounted 37-mm. gun should not be considered as a reserve-fire unit. Every gun section attached to an element of combat for a certain operation must develop instantly all its destructive capacity.

The principal conditions producing success are audacity in occupying positions, even exposed positions, which permit effective action against the enemy; suddenness in opening fire; and promptness in transferring to another position on the front.

It is essential that the chief of the auto-mounted machine guns and auto-mounted 37-mm. guns should have a thorough knowledge of the commanding officer's intentions, a trained eye for estimation of the terrain after rapid reconnaissance, and prompt and bold decision. Great activity and energy on the part of the personnel is also essential, as well as complete understanding of the combat methods of the cavalry with which it is operating.

The auto-mounted machine guns and auto-mounted 37-mm. guns should not be incorporated in columns, as they hinder movement, without mentioning the disadvantages to the matériel resulting from moving in the column at such low speed. In a column of division the groups on detached motor carriages should march between the troops and the automobile combat trains.

The commander of troops designates the position of the attached fractions of the group, the position they are to occupy during the march, taking into consideration the tactical situation, the condition and number of roads, and the clearance necessary for the vehicles.

The rapid movement of heavy convoys on narrow roads must be under strict marching discipline; all countermarching on the route taken by troops going to the front, halting of vehicles apt to retard movement, or passing a column unless authorized by its commander is forbidden.

USE IN THE OFFENSIVE.

(*a*) *Advance guard.*—As long as the advance guard does not come into contact with the enemy, the auto-mounted machine guns and auto-mounted 37-mm. guns, by daring and vigorous action, may cut short the reconnaissance of localities and woods, and be able to insure possession in a few minutes.

They conceal themselves, if in proximity of the enemy, taking advantages of the terrain, and try to gain the enemy's flanks, to realize the effect of surprise.

When the advance guard halts momentarily, the auto-mounted machine guns and auto-mounted 37-mm. guns occupy the most favorable points of the terrain, so as to cover the position while halted, especially to the flanks.

(*b*) *Flank guard.*—One or more sections may be called upon to hold a point of the terrain, to cover the flanks of a marching column.

(*c*) *Reconnaissance detachment.*—The addition of auto-mounted machine guns and auto-mounted 37-mm. guns to a reconnaissance detachment is often advantageous. Without encumbering the detachment it adds a force with which it is possible to overcome the resistances opposed to carrying out the detachment's mission.

The auto-mounted machine gun alone should rarely be used as a means of reconnaissance, as it is blind, unable to leave the road, and at the mercy of slight obstacles or obstructions.

(*d*) *Combat.*—The auto-mounted machine guns and auto-mounted 37-mm. guns cover the flanks of an attack by barrages, on terrain favorable to enemy counter attacks, and also seek to surprise the enemy on his flank with sudden salvos, intense and intermittent, and to disorganize him by the rapid progression of fire, which ceases at one point only to be resumed from a new position as soon as the motor cars have been able to advance. They have the greatest chance to escape the enemy artillery fire because of their rapidity in changing position.

(*e*) *Pursuit.*—Thrown forward with the light elements, the sections seek to reach the retreating enemy on his flanks, and to outstrip him to those command points he is obliged to pass. The commander of a detachment in pursuit should not hesitate, if necessary, to risk the loss of the auto-mounted machine guns and auto-mounted 37-mm. guns by failure to give them immediate support, if sending a support would interfere with a successful action.

(*f*) *Night combat.*—For lack of other matériel the auto-mounted machine guns may be employed in the same manner as ordinary machine guns, but the auto-mounted 37-mm. guns are not used at night, except in exceptional circumstances. Impossibility of using searchlights makes the movement of the motor carriages absolutely uncertain, the recoil from each shot necessitates a correction in aim that can not be made as the line of sight can not be taken. In addition, the flash of firing renders the gun's position too easily located.

USE IN THE DEFENSIVE.

It has been noted that the section is the unit normally used in the offensive, but the group may also find occasion to operate in the defensive, directly under the orders of its chief.

In all cases the auto-mounted machine gun and auto-mounted 37-mm guns are used for flanking fire, as are all machine guns.

These auto-mounted guns constitute mobile blockhouses, which, distributed over the whole of a position, command the roads, bridges and defiles which may be used by the enemy.

Except in prolonged inaction, or if it is impossible to push the carriages into the firing line, there is no advantage in dismounting the auto-mounted machine guns for use on the ground. The extra machine gun with tripod, with which each carriage should be furnished, fills this purpose.

In rear-guard action the use of the auto-mounted 37-mm. guns and auto-mounted machine guns is particularly marked because of their mobility by which they can avoid combat until the last moment.

In exceptional circumstances the group commander can be withdrawn to form temporary groups of several auto-mounted 37-mm. guns.

3. General Rules of Emplacement.

As noted in section 2, rapid but complete reconnaissance must precede all placing of batteries. It is most important that each fraction of the auto-mounted machine guns and the auto-mounted 37-mm. guns called into action does not proceed toward the position to be occupied until the object and plan of engagement are thoroughly determined and the zone of operations reconnoitered. The operation of the auto-mounted machine guns and auto-mounted 37-mm. guns on unknown

terrain is forbidden because of the grave miscalculations possible under such circumstances. Knowledge of all information relating to the operation is one of the essential conditions of its success. The group and section commanders must be sufficiently versed in equitation to be able to proceed mounted with the commander of the troops.

The commander of the support will receive exact reports on the direction of fire and the successive objects from the chief of the group section. He must take care to have reconnaissances made of the roads practicable for vehicles.

The most favorable firing distances are for the auto-mounted 37-mm. guns from 1,500 to 2,000 meters (1640.44 to 2187.26 yards); for the auto-mounted machine guns from 500 to 1,500 (547 to 1640.44 yards). In general, the firing position of the auto-mounted machine gun is on the firing line to the front and, if possible, on the flanks of the auto-mounted 37-mm. guns.

4. Tactics Under Fire.

The greatest factor for the safety of the carriages is their mobility; they escape destruction by rapid movement.

Under infantry fire.—Frequently change position of battery; use every screen to advance, to withdraw, to disappear, in order to reappear suddenly a few minutes later as far as possible to the right or left of the first position.

Under artillery fire.—To move by rushes in advance, or to the rear, and as far as possible in oblique directions relative to the enemy line of fire.

If the enemy fire follows, it is essential to avoid direct disabling fire and to disappear until the enemy fire has ceased or is lifted, then to return rapidly, fire a salvo, and disappear again.

If the enemy artillery creates a barrage, it must be crossed at high speed and by several roads.

In case of surprise by cavalry or infantry, to use the case shot and grenades which each carriage should have in a small quantity. In addition, each carriage must be supplied with several smoke bombs, to be used to blind the enemy and facilitate the retreat.

5. Liaisons.

1. Between commander of group of auto-mounted 37-mm. guns (when near to the commander of troops) and the group.

(*a*) By means of the reel cart or telephone wagon of the

group, which moves as close as possible to the group commander.

(*b*) By the motorcyclists of the group.

(*c*) By the liaison troopers (one corporal and three men) detailed with the group commander.

2. In the sections and between sections and commander of the group:

(*a*) By the reel cart or telephone wagon of the section.

(*b*) By the motorcyclists of the section.

SIGNALS.

The auto-mounted machine gun and auto-mounted 37-mm. gun units will conform in the matter of signaling to the principles established by "the instructions of December 4, 1915, on Liaison."

6. ORGANIZATION AND MANEUVERING OF THE GROUP.

(*a*) *Organization.*—This group contains:

A certain number of sections (generally three).

One armored liaison carriage (reel cart or telephone wagon) for the group commander.

One motorcycle.

One work truck.

Four heavy trucks (3 tons).

One light truck (1½ tons).

As a rule, two groups are attached to each cavalry division.

The section is composed of:

2 auto-mounted machine guns.

1 auto-mounted light gun (37 mm.).

1 liaison carriage (reel cart or telephone wagon).

1 motorcycle.

A captain commands the group; a lieutenant or sergeant each section.

(*b*) *Maneuvering.*—Road marching: The group, when assembled for the march, is normally by sections, with the liaison carriage and the detachment commander's motorcycle at the head, if these have not been pushed in advance of the column.

Each section, whether isolated or in a group, has a liaison carriage and the section motorcycle at its head. The two auto-mounted machine guns precede the auto-mounted light guns.

Group combat train: Four heavy trucks; follows the last section.

The reserve combat train: Work car and light truck; bring up the rear.

Assignment of the group for combat: When the group commander is notified that all, or part of his group, is going on to the line, he divides the trucks, places the carriages in combat order, and increases their ammunition supply to double the normal load of machine-gun cartridges and triple the number of shells for light guns. He also completes the gasoline and oil supplies for the auto-mounted machine gun and auto-mounted 37-mm. gun carriages.

In addition to these measures, he makes such arrangements as will assure the refilling of his ammunition trucks from the section of the ammunition train which has been assigned for his supply.

The commander of the group, having made his reconnaissance and given the section commanders their tasks, designates the position of the combat train and the eventual group-rallying point.

The commander of an isolated section operates on the same principles.

J. JOFFRE.

COMPOSITION IN DETAIL.

Group.		Sections.			
		I.	II.	III.
Liaison wagon of group commander.	Group commander. Quartermaster sergeant. Driver. Noncommissioned liaison agent.	Carriage of chief of section.	Lieutenant. Driver. Noncommissioned communication agent.	Lieutenant. Driver. Noncommissioned communication agent.	Lieutenant. Driver. Noncommissioned communication agent.
Work car	Sergeant mechanic. Driver. Assistant driver (repairs). Blacksmith. Wheelwright.	Auto-mounted machine gun No. 1.	Sergeant (gun commander). Driver. Pointer. Loader.	Sergeant (gun commander). Driver. Pointer. Loader.	Sergeant (gun commander). Driver. Pointer. Loader.
4 trucks, heavy	Driver (*a*). Assistant driver (*a*). Hospital attendant.	Auto-mounted machine gun No. 2.	Sergeant (gun commander). Driver. Pointer. Loader.	Sergeant (gun commander). Driver. Pointer. Loader.	Sergeant (gun commander). Driver. Pointer. Loader.
Light truck	Driver. Assistant driver (cook).	Auto-mounted light gun.	Sergeant (gun commander). Driver. Pointer. Gunner.	Sergeant (gun commander). Driver. Pointer. Gunner.	Sergeant (gun commander). Driver. Pointer. Gunner.
Motorcycle	Motorcyclist.	Motorcycle.	Motorcyclist.	Motorcyclist.	Motorcyclist.

(*a*) To each truck.

TABLE FOR LOADING THE TRUCKS OF A GROUP OF AUTO-MOUNTED MACHINE GUNS AND AUTO-MOUNTED 37 MM. GUNS.

	Total quantity.		Unit quantity by case or crate.	Unit.
	Combat cars.	Ammunition trucks.		
Ammunition.				*Kilos.*
Cartridges in belts for St. Etienne machine gun.	23,400	48,900	Box of 300	13
			Case of 1,050	40
Shell for 37 mm. guns:				
Cast iron	900	1,584	In cases of 33 rounds.	25.3
Steel	300	264		27
Shrapnel	60	132		20
Explosives.				
Melinite or cheddite detonating caps,	.....	.....	1 case	45
Bickford fuze and primers	.....	.....	.....do	10
Gasoline and lubricating oil.[1]	*Liters.*	*Liters.*		
In the reservoirs	1,190	.....	.....	.....
In reserve on the cars	240	.....	5 or 10 liter drum.	5 or 10
In reserve on the trucks	.....	900	50-liter drum	60
			Cases of 10, drum of 5 liters.	70
Miscellaneous material.				
Angle-iron beams for crossing obstacles	.....	(2)	1 iron	90

[1] Gasoline for 400 kilograms at rate of 30 liters for 100 kilograms for each of 19 cars and 5 trucks. Lubricating oil all vehicles for 400 kilograms and for operation and care of all machine guns and 37 mm. guns.

[2] Eight pieces, 3½ meters.

TABLE FOR LOADING THE TRUCKS OF A GROUP OF AUTO-MOUNTED MACHINE GUNS AND AUTO-MOUNTED 37 MM. GUNS—Continued.

	On each of the 6 auto-mounted machine gun cars.		On each of the 3 auto-mounted 37 mm. guns.		On each of the 3 combat trucks.	
	Quantity.	Weight.	Quantity.	Weight	Quantity.	Weight.
Ammunition.		*Kilos.*		*Kilos.*		*Kilos.*
Cartridges in belts for St. Etienne machine gun.	7,800	338	.....	.....	10 by 300...	130
	.....	.....	.....	.....	15 by 1,050.	480
Shell for 37 mm. guns:						
Cast iron.....	.....	.....	300	210	14 by 33....	353
Steel.....	.....	.....	100	75	5 by 33.....	135
Shrapnel.....	.....	.....	20	12	1 by 33.....	20
Explosives.						
Melinite or cheddite detonating caps, Bickford fuze and primers.	.....	.....	.....	.....	2 by 45.....	90
	.....	.....	.....	.....	1 case.....	10
Gasoline and lubricating oil.[1]	*Liters.*		*Liters.*		*Liters.*	
In the reservoirs.....	60	60	60	60	60	60
In reserve on the cars...	10	10	10	10	10	10
In reserve on the trucks.	.....	.....	.....	.....	200	240
	.....	.....	.....	.....	50	70
Miscellaneous material.						
Angle-iron beams for crossing obstacles.....	.....	.....	.....	.....	2	180
Ropes, tackle, tow lines.	.....	.....	.....	.....	.....	60
Reserve tools:						
Spades.....	.....	.....	.....	.....	2	50
Pickaxes.....	.....	.....	.....	.....	2	
Axes.....	.....	.....	.....	.....	2	
Saw (two-hand)....	.....	.....	.....	.....	1	
Pedestal, tripod, and spare gun.....	1	57	.....	.....	.....	.....
Men and equipment....	4	400	4	400	3	300

[1] Gasoline for 400 kilograms at rate of 30 liters for 100 kilograms for each of 19 cars and 5 trucks. Lubricating oil all vehicles for 400 kilograms and for operation and are of all machine guns and 37 mm. guns.

TABLE FOR LOADING THE TRUCKS OF A GROUP OF AUTO-MOUNTED MACHINE GUNS AND AUTO-MOUNTED 37 MM. GUNS—Continued.

	On the reserve truck.		Work truck.	Light truck.	Liaison wagon.	Motor-cycle.
	Quantity.	Weight.				
Ammunition.						
Cartridges in belts for St. Etienne machine gun	2 by 1,050	*Kilos.* 80				
Gasoline and lubricating oil.[1]	*Liters.*		*Liters.*	*Liters.*	*Liters.*	*Liters.*
In the reservoirs	60	60	60	60	60	10
In reserve on the cars	10	10	10	20	20	
In reserve on the trucks	100	120				
	50	70				
Miscellaneous material.						
Angle-iron beams for crossing obstacles	2	180				
Ropes, tackle, tow lines		50				
Reserve tools:						
Spades	2					
Pickaxes	2	50				
Axes	2					
Saw (two-hand)	1					
Baggage		1,500				
Men and equipment	3	300				

[1] Gasoline for 400 kilograms at rate of 30 liters for 100 kilograms for each of 19 cars and 5 trucks. Lubricating oil all vehicles for 400 kilograms and for operation and care of all machine guns and 37 mm. guns.

METHOD OF INSTRUCTION

IN THE

LEWIS GUN

Issued by the British General Staff, May, 1917

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During hours of instruction, except at the actual firing point on the range, live ammunition must never be brought near the Lewis gun. Thus, in time allotted to filling magazines, the guns must be removed from the squads.

Two kinds of dummy cartridges are issued by ordnance for instructional purposes:

(1) Wooden dummies to show the movement of the ammunition inside the gun, action of feed mechanism, stoppages, etc.

(2) Metal dummies, for use as tools in stripping.

The authority for the issue of these dummies is G. R. O. 2065, dated July 1, 1917.

METHOD OF INSTRUCTION IN THE LEWIS GUN.

SECTION 1.

GENERAL DESCRIPTION.

Name: Lewis gun; .303 inch; gas operated and air cooled.

Weight: Gun, 26 pounds. Magazine, empty, 1½ pounds; full, 4⅓ pounds. Bipod mounting, 2 pounds.

The gun is worked by two forces: (*a*) The force of the gas; (*b*) the return spring.

Explain briefly: (*a*) How gun is loaded and fed; (*b*) how gun is fired; (*c*) how gas operates piston and moving portions; (*d*) how return spring operates piston and bolt; (*e*) how gun is cooled.

NOTE.—Do not talk too much about things that can not be seen. Wait for these until gun is stripped.

The gun is divided into two portions: (1) The stationary portions; (2) the moving portions.

The stationary portions consist of (*a*) the barrel group, (*b*) the body group.

(*a*) The barrel group consists of—

(1) *The barrel.*—Caliber, .303 inch; number of grooves, 4; twist of rifling, right handed.

NOTE.—For purpose of demonstration the spare barrel should be shown.

It is threaded at the muzzle to take the barrel mouthpiece, which has a left-handed thread to prevent it from working loose or being detached from the barrel during the firing.

A gas vent is bored in it 4 inches from the muzzle to allow the gas to pass into the gas cylinder. A square thread is cut at the rear end for attachment to the body.

A stud in front of the square thread fits in a slot in the radiator, insuring the gas vent being in position to receive the gas chamber.

At the rear end of the barrel is a projection which coincides with the cut-away portion of the bolt face when the bolt is

closed; the rim of a cartridge bears against it in order to give room for the extractor to clip over the rim.

The upper part of the entrance to the chamber is grooved to direct the nose of the bullet downward.

(2) The radiator is of aluminum, is split longitudinally, and sprung onto the barrel.

It assists in dissipating the heat of the barrel. A recess for the gas chamber is provided at the forward end, and a flat which corresponds with one on the radiator casing is made at the rear end to assist in alignment.

(3) The radiator casing consists of front and rear portions which are connected by a clamp ring. The rear portion has a hole cut in it to allow the entrance of the gas regulator.

A flat is provided at the rear end to correspond with the flat on the radiator, and the rear face is drilled to admit the barrel and gas cylinder, and also the body locking pin.

The front portion is tapered and extends beyond the barrel mouthpiece.

On both portions are slots to take the stud on the clamp ring. The clamp ring is turned up at both ends to form a foresight protector, and the inner portion on right side forms the foresight block, and is dovetailed to receive the foresight. It is held in position by the clamp-ring screw.

(4) The Mark I gas chamber screws into the barrel band which fits around the barrel, and fits into a recess in the barrel, which is cut around the gas vent.

The rear face of the gas chamber is threaded to receive the gas cyclinder and tapped for the gas regulator, and has wings which the spanner grips when screwing up.

(5) The gas regulator has a large and a small hole marked "L" and "S," either of which can be placed opposite the hole in the rear face of the gas chamber.

It is operated and held in position by means of the gas regulator key, for which a recess is cut in the gas regulator.

The key is held in position by a stud on the rear end, which enters a recess in the rear radiating casing. A loop is provided at the rear end of the key, which enables the point of a bullet to be used to spring the key out of the recess.

(6) The gas cylinder is shaped at the rear end to admit the rack on the piston rod. Its forward end screws on to the gas chamber.

NOTE.—Great care should be taken to guard the threads from injury, and to prevent the flattened portion from being damaged by the rack in stripping.

When guns are fitted with the Mark II gas chamber and gas cylinder, substitute the following for paragraphs (4) and (6) above:

The Mark II gas chamber embodies a ring which fits round the barrel and takes the place of the barrel band in the Mark I pattern. Its rear end is threaded to take the gas cylinder. It is threaded internally to take the screwed plug. The latter has a left-hand thread, is arranged to take the barrel mouthpiece spanner and has eight holes drilled through the cylindrical portion. It is threaded internally to take the gas regulator. On its upper surface is a nipple which passes up through the ring and seats in the vent hole in the barrel. The plug is kept in position by a keeper screw and the holes in it and the recesses for the barrel mouthpiece spanner are so arranged that when the keeper screw is in one of the recesses one of the holes is opposite the gas cylinder.

(*b*) The body group consists of:

(1) The body, which is threaded to screw on to the barrel, is drilled to take the body-locking pin, and a groove is cut through which the pin is operated when stripping.

Bottom.—Underneath the body is a pin, on to which the pinion casing hooks, and openings are cut to allow the pinion, plunger, and sear to enter.

Grooves are also made to take the pistol grip, and the lower projection of the butt cap.

Sides.—On either side of the gun is an opening in which the shank of the cocking handle can travel. Over each opening is a sliding plate with two recesses and thumbpiece, as safety catch and dust protector. On the right side is the ejector opening.

Top.—The body carries on top the magazine post, which is hollowed and countersunk to actuate the magazine catch when placed in position with a key on the exterior, to prevent the center block of the magazine from rotating.

The top of the body is slotted throughout the greater part of its length, the front part of the slot taking the shape of a cartridge, while the rear portion fits the boss on the feed arm actuating stud.

Near the front end of the cartridge-shaped slot, on its left, is a small groove which coincides with a depression in front

portion of the feed arm. Near the rear end of the cartridge-shaped slot are two projections which keep the cartridge in position until the bullet enters the chamber. At the rear end, on the right side, is a groove into which fits the rim of the cartridge.

The ejector seating lies on the left side of the slot, and is closed by a spring cover, and a hole is drilled in the body, into which the stud on the ejector fits, and on which it pivots.

A groove is cut at the rear end of the body, into which the stud on the tail end of the feed arm moves.

Projections are provided to lock the body cover.

Interior.—Inside the body are drilled the bolt way and the piston way.

The bolt way has four grooves in the form of a cross which admit the lugs on the bolt and the feed arm actuating stud.

Recesses are provided at the forward end of the bolt way in which the locking lugs on the rear end of the bolt lie when the bolt is closed. Near the rear end of the bolt way are recesses in which the interrupted flanges of the butt cap engages.

On the left of the bolt way slots are cut to allow the ends of the ejector to project alternately into the bolt way.

The piston way is flat-bottomed to take the rack.

(2) The body cover fits on top of the body.

The projecting tongue at the front end has underneath it a seating for the cartridge guide spring. Underneath are the axis studs for the stop pawls.

Projections to engage under the projections on the body are provided at the sides. Fixed to the top by a screw is the tangent-sight bed.

The tangent-sight leaf is hinged to it and held in position by the tangent-sight spring.

The tangent-sight slide is of the aperture pattern, and is actuated by the elevating screw, which is operated by a milled head with a nib and spring.

The cartridge-guide spring (or cartridge guide) is held in position by an undercut recess and has a stud which fits in a hole in the tongue. The left leaf is turned over; in the case of the cartridge guide the right leaf is hinged and operated by a flat spring.

The stop pawls pivot on studs, the pawl on the left fitting underneath that on the right. Its head is enlarged to bring it on a level with the underside of the cover.

The stop-pawl spring lies behind the pawls, and a stud on its back fits in the rib behind it. Part of the left of the spring is turned over to embrace the stop pawl.

(3) The pinion casing is shaped to contain the pinion and spring. At the front end is the hook, which connects it to the body, and at the rear end is the pinion pawl; a rib on one arm of the pawl engages in the pinion and is kept in action by a spring bearing against the back of the arm. The other arm of the pawl projects from the casing and is lifted by the pistol grip as the latter is slid into position, thus disengaging the rib from the pinion.

The casing is drilled to take the tension screw.

(4) The pistol grip consists of a frame which is channeled to contain the plunger, trigger, sear, and butt catch.

It extends to form the trigger guard and pistol grip. Guide grooves to connect it with the body are cut on the sides of the former. At the forward end is a recess for the pinion pawl. The plunger is a cover for the trigger spring and is slotted to take the front end of the trigger.

The sear and trigger are both pivoted on axis pins; the jaw on the rear end of the trigger controls the sear.

At the rear end is the butt catch, with a spiral spring and fixing pin.

(5) The butt has on the front face the butt cap. Projections are provided for attaching it to the body, also a recess into which the tooth on the butt catch fits.

The moving portions consist of—

(1) The piston rod, which is in two parts and is joined by a loosely fitting thread, secured by a pin, to compensate for any slight want of alignment between cylinder and body.

The head is cupped and ringed, the rings tend to make a gas-tight joint.

Under the rear portion of the piston is a rack; behind the rack is a bent which engages with the nose of the sear.

On top is the striker post, which is drilled for the striker, which is secured by a fixing pin.

A slot for the shank of the cocking handle is cut in the rear end.

(2) The bolt has on the face a rim to support the base of the cartridge.

Gaps for the extractor seatings are cut in the surface of the bolt.

The extractors are flat springs with a hook on the head to engage the rim of the cartridge. They are fitted with a stud and shoulders, which spring into a recess and a groove on the bolt.

A slot is cut in the rim for the head of the ejector.

A cammed slot is cut into the bolt in which the striker post travels.

There are four lugs at the rear end to take the shock of discharge, and the rear face is tapped to take the feed-arm actuating stud.

The ejector is housed in a seating on the left side of the bolt way. It is pivoted on a stud which fits in a hole cut in the body to receive it. Slots cut in the bolt way allow the head and tail alternately to project into the bolt way, the ejector being operated by the bolt as it travels to and fro. The front end is the head and the rear the tail. The rear end is bent in order to allow the left lug of the feed-arm actuating stud to strike it as the bolt comes to the rear. It is retained in its seating by a spring cover.

(3) The feed-arm actuating stud screws into the rear of the bolt, has lugs which work in the guideways and prevent it from turning, and a boss which travels in the long slot in the bolt way and actuates the feed arm.

(4) The feed arm has an axis hole which passes over the magazine post, and a recess to clear the key on the post when stripping. A hinged latch secures the feed arm to the magazine post by engaging in a cut on the front face of it.

An opening is cut to allow the cartridges to pass from the magazine to the body; a small depression on its left acts as a bullet stop and keeps the cartridge in position during the movement of the feed arm to the left.

A tongue slightly farther in rear prevents the cartridge from jumping up after leaving the cartridge-guide spring.

Behind this are the axis, stop and spring-retaining studs for the feed arm pawl. The pawl has a slot in which the spring lies, and underneath is a recess for the stop stud and a stud for the loop on the spring.

The tail of the feed arm is curved and grooved underneath to receive the boss on the feed-arm actuating stud.

At the end of the tail is a stud which engages with the top lug of the bolt when the latter reaches its limit of movement to the rear, thus holding the feed arm in position until the boss

on the feed-arm actuating stud again enters the groove in the tail of the feed arm.

(5) The pinion is bored to admit the tension screw, and has an internal recess to correspond with a projection on the spring casing, to lock the two parts.

The hub is threaded for the tension screw, and is slotted to take one end of the return spring, which is coiled inside the spring casing and attached to it by two studs.

THE MAGAZINE.

The magazine, which holds 47 rounds, is a circular pan with rectangular indentations on the rim, inside which are riveted plates to hold the bases of the cartridges. A ring carrying 25 separating pegs is riveted over a hole which is cut out of the center of the pan. The pegs and indentations hold the cartridges in position and force them around when the pan is rotated.

Twenty-five recesses for the nib on the magazine catch are provided inside the ring and pan. A steel disk covers the central hole and has a channel cut in it for the magazine catch, which has a hook with sloping head and a projection to engage below the cone on the magazine post.

A spring (magazine catch spring) lies in the channel and keeps the nib pressed into one of the recesses in the ring and pan.

A center block with a spiral channel in which the bullet ends of the cartridges lie, is riveted to the center disk and keeps the magazine catch in position in the channel.

In the center is the hole for the magazine post, and a keyway is cut to fit the key on the magazine post. The magazine catch locks the center block to the pan and prevents it from rotating when not in position.

To fill by hand:

1. Place the magazine bottom upward on a flat surface.

2. Insert the loading handle and rotate the center block or pan, placing the cartridges horizontally in succession between the separating pegs in such a way that the lip of the bullet groove engages them and leads them to place.

3. Care should be taken not to leave an empty space.

NOTE.—When no loading handle is available, the nose of a bullet, or a charger, may be used as a substitute; it is a help to place a cartridge vertically in one of the holes of the center block of the magazine.

SECTION 2.

STRIPPING.

Special dummy cartridges with steel bullets are issued for use in stripping. Live rounds must never be used for instructional purposes. Many accidents have been caused by this practice.

With the exception of the gas chamber and the barrel mouthpiece, for which a spanner has to be used, and the clamp ring, which is taken off with the gas regulator key, the whole of the gun can be stripped by means of the nose of a bullet.

To strip the gun—

1. With cocking handle in the forward position, lift the butt catch and remove the butt stock by turning it one-eighth turn to the left.
2. Press the trigger and withdraw the pistol grip to the rear.
3. Pull back the cocking handle to its fullest extent and withdraw it.
4. Remove bolt and piston rod.
5. With the feed arm over to the right, pull back the body cover and lift it off.
6. Unhook the pinion casing.
7. Open the latch, turn the keyway until opposite the key on the magazine post and lift off the feed arm, taking care not to strain it in doing so.
8. Take out the body locking pin and unscrew the body from the barrel.

CARE MUST NOW BE TAKEN TO PREVENT DAMAGE TO THE PROJECTIONS ON BARREL.

9. Lift key out of hole in radiator and unscrew the gas regulator.
10. Unscrew the clamp ring and remove the front radiator casing, sliding the rear part of the casing off to the rear.
11. Insert the piston to form a wrench, and unscrew the gas cylinder. Care should be taken to insert the piston rod sufficiently far to prevent damage to the rear end of the cylinder.
12. With the spanner unscrew the barrel mouthpiece to the right.

THE FOLLOWING PARTS SHOULD BE STRIPPED AS SELDOM AS POSSIBLE.

13. With the spanner unscrew the gas chamber (or screwed plug).

14. Heat the radiator with hot water, drift out the barrel to the rear with a piece of wood, and remove the band or gas chamber.

REASSEMBLE IN THE REVERSE ORDER.

NOTE.—(1) See that the feed arm is over to the right before replacing the body cover, and to the left when replacing the bolt. (2) See that feed-arm actuating stud is screwed up. (3) See that cocking handle is right home and forward before replacing pistol grip. (4) See that barrel band is right way on before replacing barrel. A letter "F" indicates the front of the band.

STRIPPING VARIOUS COMPONENTS.

1. To remove an extractor, raise the hook until the stud is clear of the recess in the bolt and push the extractor out, care being taken not to strain it by lifting it more than is necessary.

2. To remove the stop pawls, force the stud on the pawls spring out of its seating and lift the pawls off their studs. Note that the studs and pawls are marked 1 and 2, so as to insure their being reassembled in the right order.

3. To remove the cartridge guide spring, press the stud down and slide the spring out.

4. Raise the rear end of the ejector cover and slide it to the rear to remove the ejector.

5. To remove return spring, press up the arm of the pinion pawl to release the spring. Unscrew the tension screw.[1] Allow the pinion to drop out of its casing. With the point of a bullet press on the hub and push the spring casing out of the pinion.

THE FOLLOWING SHOULD ONLY BE CARRIED OUT WHEN NECESSARY.

6. To remove the sear, press out axis pin, and to remove trigger, plunger, or spring, press out trigger axis pin.

---

[1] If the spring is broken, in order to remove the tension screw it may be nesessary to release the pinion pawl and unwind the return spring, at the same time tapping the tail of the tension screw.

7. To remove pinion pawl, push out the axis pin.

8. The foresight can be driven out of its bed with a punch through the holes in the foresight protector.

9. To remove the tangent sight bed and tangent sight, unscrew the fixing screw.

NOTE.—(1) After the first few times, stripping should be practiced in a sitting or lying position; (2) when replacing damaged parts, the gun should be stripped as little as possible; (3) it may be necessary to move the cocking handle slightly when raising the pinion casing into position before the rack will engage with the pinion.

SECTION 3.

MECHANISM.

To demonstrate the working of the mechanism, dummy rounds with wooden bullets should be used. To prevent accidents, live ammunition must never be brought near the gun during instruction.

Sequence of instruction:

1. Show how to load.
2. Show how to fire.
3. Action of the gas on the moving portions.
4. Action of the return spring.
5. Single shots and continuous fire.
6. How to unload.

(1) Show how to put on the magazine and load.

NOTE.—Show each action as it takes place. Dummies should always be used. The magazine may be removed after the first cartridge has dropped to show the action more clearly.

(2) Show that—

(*a*) On pressing the trigger the gun fires and continues to fire until the pressure is released.

(*b*) On releasing the trigger the gun stops in a fully cocked position, with a live round under the cartridge guide spring.

(3) Show that—

When the powder gases expand through the gas vent into the gas chamber and pass through the hole in the gas regulator:

(*a*) The piston is forced back, and the rack on its underside, rotating the pinion, winds up the return spring and the bent passes over the nose of the sear.

(*b*) The striker post bearing against the cammed slot in the bolt (after the first 1½ inches of travel) rotates the bolt and frees the locking lugs from the recesses in the body, and the rear part of it bears against the cammed slot, forcing the bolt back till the piston and bolt are back to their full extent.

(*c*) The bolt, by means of the extractors, withdraws an empty case from the chamber, and in its backward travel pushes the tail of the ejector out of the bolt way, and the head, swinging into the bolt way, ejects the empty case.

(*d*) The boss on the feed-arm actuating stud carries the feed arm over to the left, and the feed-arm pawl, which is bearing against a projection on the magazine, carries the pan around with it.

(*e*) A cartridge is forced down the slope of the center block. When the bullet end is clear of the lip it is forced through the cartridge opening in the feed arm onto the top of the body, the tongue on the body cover insuring this action.

It is carried to the left by the indentations and separating pegs of the magazine, and forced under the cartridge guide spring (or cartridge guide), aided by the right side of the cartridge opening in the feed arm.

(*f*) The spring retaining stud of the feed-arm pawl, moving to the left, releases the right pawl, allowing the latter to engage in front of the projections on the magazine and preventing it rotating too far; the left pawl is pressed back by one of the projections on the magazine as it moves to the left, and then comes forward again to prevent any rotation in the opposite direction.

4. Show that—

(*a*) Pressing the trigger disengages the sear from the bent, and the unwinding of the return spring rotates the pinion, forcing the piston rod forward by means of the rack.

(*b*) The striker post, unable to rotate the bolt owing to the lugs being in the guide grooves, carries the bolt forward.

(*c*) The feed-arm actuating stud is carried forward with the bolt, and the boss carries the feed arm over to the right; the feed-arm pawl passes over a projection on the magazine and engages behind it; the spring retaining stud presses the right pawl out of the path of the magazine, the left pawl prevents the magazine from slipping back.

(*d*) The top extractor during the forward movement of the bolt meets the cartridge and pushes it into the chamber, the

cartridge stop and the small depression stop on the feed arm controlling it during the movement. The front of the bolt pushes the head of the ejector out of the bolt way and the tail swings in.

The extractors spring over the rim of the cartridge as it goes home into the chamber, and the bolt, which is now fully forward, is able to turn, the lugs being clear of the grooves.

(*e*) The striker post now rotates the bolt and turns the locking lugs into the recesses in the bolt way; the striker, passing through the face of the bolt, hits the cap and explodes the charge.

(5) Show that—

(*a*) If the trigger is instantaneously released after pressing it, single, or at times two, shots will be fired according to the rapidity with which the sear rises and engages with the bent.

(*b*) If pressure is maintained the gun will fire until the magazine is empty.

NOTE.—The action of the feed can be more clearly shown as follows:

Hold the loading handle vertically in the hand and place over it the spare feed arm. This will represent the magazine post of the gun with its feed arm. Then place on the handle a magazine, in which is a dummy cartridge, and show action.

SECTION 4.

POINTS BEFORE, DURING, AND AFTER FIRING.

Points before firing:

(1) Remove oil from the bore.

(2) Oil all frictional parts behind the body locking pin.

(3) Weigh return spring (13 to 14 lbs.) with cocking handle in the forward position at the moment when the cocking handle begins to move.

(4) Test the feed mechanism.

(5) Examine magazines and ammunition while filling.

(6) Examine spare parts.

(7) See that the barrel mouthpiece is tightly screwed up.

To increase the tension of the return spring (after withdrawing the pistol grip sufficiently to allow the pinion pawl to engage in the pinion), press up the pinion casing with the left hand, in order to keep the pinion engaged with the rack, and draw back the cocking handle. Allow the pinion casing to drop so that the

pinion is not engaged with the rack, and push the cocking handle forward.

To decrease the tension of the return spring, allow the pinion casing to drop so as to disengage the pinion from the rack, draw back the cocking handle, press the pinion casing up to engage the pinion with the rack, and disengage the pinion pawl from the pinion to allow the piston rod to fly forward.

Reassemble and weigh as before.

Points during firing:

(1) Replace empty magazines in cases.

(2) Oil bolt and striker post, and also magazine post.

(3) Weigh return spring.

(4) Turn gas regulator slightly to prevent seizing of the threads in the gas chamber.

(5) Replace partially used magazines.

(6) Send empty magazines back for refilling.

(7) See that clamp ring is screwed tight.

Points after firing:

(1) Unload and press trigger, to ease the return spring.

(2) Oil the bore.

On return to billets:

(1) Strip gun and clean thoroughly.

(2) Carry out any necessary repairs.

(3) Wash, dry, and oil dirty magazines.

(4) Examine barrel for metallic fouling and remove as in section 5.

(5) Lower the tension of the return spring to zero.

SECTION 5.

INSTRUCTIONS FOR CLEANING.

When ball ammunition has been fired, daily cleaning of the barrel is necessary for at least 10 days afterwards. Subsequent cleaning must depend on the discretion of the officer in charge of the gun; but in situations where the barrel is exposed to a moist atmosphere it must be carried out daily.

The gas chamber, cylinder, regulator, and piston rod must be cleaned with the same frequency as the barrel. In order to avoid loosening of the joint between the gas chamber and the barrel by constant stripping, it must not be removed, but will be cleaned while in position on the barrel.

After cleaning, all parts must be left lightly coated with oil.

To clean the barrel.—Pull the cocking handle back till the sear engages. Place a piece of flannelette about 4 inches by 1½ inches in eye of the cleaning rod, taking care to surround the metal of the cleaning rod with the flannelette, which must be well oiled. Insert the rod into the muzzle and pass it up and down the bore till all fouling has been removed. Replace the oily flannelette with dry pieces, and finally pass freshly oiled pieces through, leaving the barrel well oiled. If the flannelette is tight and is pushed through the breech, it is necessary to reverse it before pulling it back, otherwise it will jamb.

If the chamber has not been properly cleaned by the above process, remove the butt, body cover, pistol grip, piston rod, and bolt. Place a larger piece of flannelette in the front eye of the cleaning rod, insert the rod from the breech end and clean the chamber first with oiled and then with dry flannelette.

To use the double pull-through.—If rust or metallic fouling is present in the barrel, remove the parts of the gun described in the preceding paragraph. Thoroughly oil the gauze on the pull-through and drop the weight through the bore from the breech. Care should be taken to pull the pull-through through the bore in line with its axis. Continue the motion until the rust or fouling is loosened. The barrel can now be cleaned with the cleaning rod and flannelette as already described. When the gauze fits too loosely to clean the grooves of the rifling its diameter can be increased by inserting under each side narrow strips of flannelette or paper. When the gauze is worn out, it should be replaced by one of the spare pieces which are issued with each double pull-through.

To clean the gas cylinder.—Joint up the cylinder cleaning rod and screw on the wire brush. Insert the rod into the gas cylinder and work it backwards and forwards a few times. Then remove the wire brush, replace it with the mop and clean the cylinder. When there is not time to remove the cylinder for cleaning, the foregoing operations can be carried out by removing the bolt and piston rod and inserting the cylinder cleaning rod through the piston rod hole.

To clean the mechanism.—A mixture of equal parts of Russian petroleum and paraffin should be used. If any parts are clogged with dried oil, spirits of turpentine should be used to remove it. After cleaning each part it should be thoroughly dried and

slightly oiled with Russian petroleum. Very little oil should be used for this purpose, as it is apt to catch the dust and clog. A little oil should be applied to the magazine catch and around the exterior of the center disk.

The exterior of the gun and the exterior and interior of the magazine should be rubbed over with a slightly oiled rag. Any excess of oil in the interior of the magazine is likely to be carried into the chamber.

Protection during gas attack.—The gun must be kept carefully cleaned and well oiled with mineral oil. The effects of corrosion of ammunition are even more serious than the direct effects of gas upon the gun. Magazines should be kept in some form of box, the joints of which can be made gas tight by inserting strips of flannelette.

Occasional short bursts of fire will lessen the chance of guns jamming from the action of gas during a gas attack.

After a gas attack, the gun must be cleaned and reoiled at once; and at the first available opportunity it should be stripped and all working parts cleaned in boiling water containing a little soda.

SECTION 6.

EXAMINATION OF GUN.

It is most important that any signs of wear, friction, or play should be at once reported to armourers for adjustment and repair.

Examine.

Barrel.—Condition of bore, rifling and lead, for metallic fouling or erosion. Projections on rear face and thread on muzzle for damage.

Pinion and casing.—Teeth for breakage, pawl and spring for dirt, thick oil, or weakness.

Return spring for breakage.

Ejector for roughness.

Feed arm.—Latch for weakness, axis hole for play on magazine post, thin portion of arm for bending or strain, stud and groove for wear, top of feed arm for friction against ribs on body cover. Pawl for wear and spring for weakness.

Body cover pawls and spring for damage, and cartridge guide spring for correct assembling.

Piston rod.—Joint for excessive play, rack and striker post for damage or wear, piston head for erosion or carbon deposit.

Bolt.—Cammed slot for wear or roughness, studs on extractors and face of bolt for corrosion or rust. Lug on left of feed-arm actuating stud for wear or roughness.

Trigger guard for lateral play in grooves, sear for wear, and plunger for thick oil and dirt.

Gas regulator for erosion and carbon deposit.

Gas cylinder for erosion and carbon deposit.

Gas chamber for erosion and carbon deposit.

Clamp ring.—Screw for wear and ring for tightness on radiator casing.

Tangent sight leaf.—Elevating screw and slide for damage and spring for weakness.

Body for play at each end and wear.

Pinion hinge and see pin is straight.

Butt-cap for marking by piston during recoil and for play.

Magazines.—Rims for damage and pan for distortion, by rotating on loading handle.

SECTION 7.

STOPPAGES.

Position of cocking handle.	Immediate action.	Secondary action.	If—	Cause.
I. In forward position.	Rotate magazine, pull back cocking handle, and carry on.	.....	.....	Misfire due to defective round.
		If the gun still will not fire, remove the magazine, pull back the cocking handle, and examine the ejected round.	Ejected round is untouched.	Broken striker.
			Ejected round is marked by striker.	Bad ammunition.
			Empty case is ejected.	No gas.
			No round ejected.	Broken feed pawl or spring or damaged magazine.

STOPPAGES—continued.

Position of cocking handle.	Immediate action.	Secondary action.	If—	Cause.
II. Over thumbpiece.	Pull back cocking handle, using lanyard if necessary, and carry on.	.....	.....	Hard extraction. Lack of oil or gas. Dirt. Carbon in gas vent, regulator, cylinder, or piston.
		Remove magazine—oil gun—turn gas regulator and examine moving parts for brightness.	.....	Defective part in gun. Return spring the wrong weight.
III. Behind the thumbpiece on safety catch.	Pull back cocking handle and carry on.	Pull back cocking handle, raise safety catch, and remove magazine. Examine cartridge slot, ejection opening, and for broken cartridge guide spring.	One cartridge is half under cartridge guide spring, pull it back and carry on. It occurs again. One cartridge is in cartridge slot and one in ejection opening. One cartridge in chamber and one in ejection opening.	 Weak cartridge guide spring. Broken ejector. Broken extractor.

SECTION 8.

ADDITIONAL NOTES ON STOPPAGES.

1. *Return spring.*—A very weak or broken return spring may give a stoppage in any position. It is easily recognized by the lack of weight on the cocking handle when performing immediate action. When the spring is weak, the gun may stop in No. 1 position; when it is broken, the gun will probably stop in No. 3 position.

2. A method of removing a round, which has passed under the tongue when there is an empty case in the chamber, if the clearing plug is not available.

(*a*) Draw back the cocking handle and raise the safety catch.

(*b*) Take a live round in the right hand, with the point of its bullet draw back and depress the base of the round under the tongue.

(*c*) Seize the bullet of the latter round in the left hand, draw it forward, and place the round held in the right hand, bullet downward, behind its base.

(*d*) Lower the safety catch, hold the cocking handle in the right hand, press the trigger with the left hand, and allow the cocking handle to move slightly forward in order to bring the feed arm over to the right.

(*e*) It will now be possible to pull forward to the right front the round which was caught under the tongue.

3. *Friction, fouling, etc.*—In very bad cases the gun may stop in No. 1 position, owing to friction in the gas cylinder or other working parts of the gun, also owing to the gas regulator or gas chamber being fouled.

Prevention of recurrence.—Clean the breech, cylinder, and piston head, also remove gas regulator and fire one shot to clean out gas vent.

4. *Gas regulator key missing.*—This may give either No. 1 or No. 2 position, according to the amount the gas regulator has turned. As a remedy, a piece of wood may be inserted and tied to the radiator casing.

5. *Hard extraction.*—

(*a*) If, in addition to hard extraction, there is friction in the working parts, or the gas regulator and gas chamber are fouled, the cocking handle may remain in No. 1 position. The gun will then have to be stripped and cleaned.

(*b*) If it stops in No. 2 position with an empty case in the chamber, the extractor having jumped or the rim being torn, the usual remedy will fail and a No. 3 stoppage will result.

(*c*) It is possible that, owing to hard extraction, an empty case may be left in the chamber or bolt way and the bolt may pass behind the base of the next round, causing the gun to stop in No. 3 position.

Prevention of recurrence: Clean the chamber.

6. *Magazines, damaged or broken*—

(*a*) If the magazine rim is bent, or the projections are worn, the feed arm pawl will not rotate the magazine.

(*b*) If the magazine is bent the stop pawl will not engage in front of a projection, a No. 3 stoppage will result, owing to too many cartridges having fallen down.

(*c*) If the rim is broken so that the cartridge is not able to leave the magazine, a No. 3 stoppage will probably result.

7. *Piston rod, broken.*—The gun may fire for a considerable time with this breakage. Eventually it will fire erratically, and finally stop, owing to the burring up of the broken ends.

8. *Rebound pawl, worn or broken.*— Gun will probably fire single shots, stopping in No. 1 position.

9. *Striker or striker post, broken.*—The mechanism may jamb in any position.

10. *Stop pawl and spring.*—If the stop pawl or its spring are worn, a No. 3 position may occur. If it is broken, gun will probably stop in No. 1 position, and cocking handle can not be drawn back more than 2 or 3 inches.

11. *Bulged rounds and separated cases.*—These occur so rarely that it is only necessary to set them up once for instructional purposes. They usually give a position "in front of trigger," but a badly bulged round may cause a fault in feed (No. 3 position). Bulged rounds are cleared by means of a lanyard placed on the cocking handle. Separated cases cleared by means of a clearing plug. If no clearing plug is available, reload and press trigger—the obstruction will probably adhere to the next cartridge. If it does not, increase tension of return spring and repeat.

12 *Long ammunition.*—If the third position occurs frequently, and it can not be traced to any of the "probable causes," remove the magazine and examine the position of the cartridge. If bullet is bearing against front of cartridge slot in the body—ammunition is too long. If the front of the cartridge slot is sloped off downward this stoppage will not occur.

13. *To avoid alteration of weight of return spring.*—When stripping to clear a stoppage, the pistol grip should be replaced with the cocking handle in the same position as when commencing to strip.

The best rule to follow is that whenever possible the cocking handle must be forward before the pistol grip is withdrawn or replaced.

14. When the gun stops with the cocking handle in the forward position and the magazine rotates freely, the magazine is empty.

SETTING UP STOPPAGES.

When practicing stoppages firers should be in the prone position, butt in the shoulder. They should try magazine and pull back cocking handle without removing the butt from the shoulder, and recognize the position of the cocking handle without looking at it.

Cause.	In barracks.	On range.
Misfire	Load and press the trigger.	Place dummy round in magazine.
Worn or broken striker	Load and press trigger but gun still won't fire.	Place two dummy rounds in magazine.
Worn or broken feed pawl or feed pawl spring.	Remove feed pawl spring.	Remove feed pawl spring.
Damaged magazine	Use damaged magazine	Use damaged magazine.
Hard extraction	Replace an empty case partly in chamber.	
Friction in gas cylinder	Withdraw cocking handle far enough to eject an empty case, but not far enough for bolt to engage behind a fresh round.	Remove gas regulator key and turn regulator slightly.
Weak cartridge guide spring.	Press down nose of cartridge and allow bolt to go forward. Replace magazine.	
Broken cartridge guide spring.	Remove, or use a broken, cartridge guide spring.	Remove, or use a broken, cartridge guide spring.
Broken extractors	Load and place an empty case in the chamber.	Load and place an empty case in chamber.
Broken ejector	Remove ejector	Remove ejector.

SECTION 9.

ELEMENTARY DRILL.

During drill dummies will be used, but great care must be taken that only those with wooden bullets are used.

Carrier containing four magazines placed on left of gun at 2 paces interval.

Command.—"Fall in," squad falls in in single rank, 5 paces in front of gun.

Command.—"Number," as usual.

Command.—"Take post," squad turns to right and doubles around behind gun.

No. 1. (*a*) Takes up position on left of gun.

(*b*) Takes off cover and examines gun.

(*c*) Takes magazine from No. 2 and places it on gun.

(*d*) Reports "Ready."

No. 2. (*a*) Takes up position on left of carrier.

(*b*) Examines the magazines.

(*c*) Hands one magazine to No. 1 and closes carrier. After this No. 1 repeats all words of command.

On the command.—"Action, range, object"—

No. 1. (*a*) Adjusts the sights to the range ordered, then lowers leaf.

(*b*) Runs forward and gets into a firing position on the position indicated.

(*c*) Raises leaf, rotates magazine, and pulls back cocking handle.

No. 2. Runs forward, and when No. 1 is in position, lies down on left of gun and takes one magazine out of carrier.

When No. 1 is ready to fire, No. 2 holds out his hand and watches commander.

Signal.—"Fire"—

No. 2 touches No. 1.

No. 1 presses trigger and fires in bursts of about one second, relaying after each burst, but allowing cocking handle to remain forward.

NOTE.—If fire is not opened within three seconds of the signal, instructors must take steps to ascertain the reason of the delay.

Command.—"Change."

No. 1 grips magazine with right hand, releasing catch with thumb.

No. 2 helps to lift off empty magazine by pressing up center block with left hand, and puts full magazine on gun with right, pressing it down. No. 1 passes empty magazine upside down under gun to No. 2, pulls full magazine in the feeding direction, and pulls back cocking handle. He then relays and continues firing.

Signal.—"Cease fire"—

No. 1 (*a*) raises safety catch. (In drill, cocking handle must first be pulled back.)

(*b*) If magazine is nearly empty, replaces with full one.

NOTE.—Before dropping safety catch again, pull back cocking handle.

Signal.—"Out of action"—

No. 1 (*a*) unloads, i. e., removes magazine in the usual manner, pulls back cocking handle, takes aim, and presses the trigger. Then lowers leaf of back sight.

(*b*) Retires with gun to cover (at drill, to original position).

No. 2 (*a*) helps No. 1 to unload and replaces magazine in carrier.

(*b*) Retires to cover with No. 1.

NOTE.—To save time in drill the command "Unload" may sometimes be given instead of signal "Out of action." Nos. 1 and 2 then perform actions (*a*) only.

SECTION 10.

TESTS OF ELEMENTARY TRAINING.

(1) "Action," time 10 seconds. Points to be observed, sights upright and approximately aligned. Length of run, 5 yards.

(2) "Change magazine," time 3 seconds. Each motion done distinctly. New magazine rotated.

(3) "Magazine filling by hand," time 1 minute 15 seconds.

SECTION 11.

NOTES ON RANGE WORK.

1. In cases where circumstances make it impossible to carry out the full practices laid down in Addendum No. 2 to Musketry Regulations, the following short practices are suggested:

	Rounds.
(1) Grouping	6
(2) Repetition	6
(3) Application	12
(4) Swing traverse	20
(5) Practical rectification of stoppages	30

2. Strict drill discipline will always be maintained on the range.

3. Points before, during, and after firing will always be carried out by members of the squads, supervised by instructors.

4. The first firer of each practice will be instructed by the instructor in the presence of the whole squad. That firer afterwards instructs the next firer, supervised by the instructor.

5. Groups must be separate and distinct on the target; they should be within the horizontal bands.

6. No groups, or shots from the swing traverse, should be low enough on the target to go through the figures.

7. Conduct of practices:

(1) *Grouping.*—Criticize from gun position by means of field glasses after each group. Before the target is patched out each group should be further criticised in the presence of the firer at the target by the officer or N. C. O. who conducted the practice.

(2) *Repetition.*—All who fail to make a reasonable group at the first attempt will repeat, if time permits, after the whole squad has completed that practice. The practice will be conducted as for practice (1), supervised by the staff sergeant.

(3) *Application.*—The fire orders for both groups will be given before fire is opened. Particular attention should be paid to the time elapsing between the groups and the position of the second group chiefly criticized. If observation of the group is difficult, an observer with field glasses may be allowed. Criticism at gun position and target will be carried out as for practice (1).

(4) *Swing traverse.*—Before commencing to fire each firer will be given two timed practice swings. Time allowed to swing across target, from left figure to right figure, six seconds. The ammunition allotted will sweep about two-thirds of the target, but the swing should be continued to the right figure. Criticism as above.

(5) *Stoppages.*—Note 5 will be adhered to also in stoppages. The No. 2 on the gun will always be in possession of the necessary spare parts, etc.

APPENDIX I.

LIST OF EQUIPMENT, WITH SPARE PARTS, TOOLS, AND APPURTENANCES, FOR THE LEWIS GUN. (WAR OFFICE LETTER 79/7881 (A. 3) OF AUG. 5, 1916.)

WOOLWICH SECTION 16–B.

Components.

Gun, Lewis, .303 inch:	
Barrel	1
Blades, foresight, high	1
Blades, foresight, low	1
Bolt (assembled, with two extractors and one feed-arm actuating stud)	1
Casting, pinion (assembled complete)	1
Cylinder, gas	1
Ejector	1
Extractors	4
Handle, cocking	2
Head, screw, tangent sight	1
Key, gas, regulator	1
Magazines	[1] 64
Pawl, feed arm	1
Pawl, pinion	1
Pawl, stop, magazine, left	1
Pawl, stop, magazine, right	1
Pin, axis, pawl, pinion	1
Pin, axis, sear	1
Pin, axis, trigger	1
Pin, fixing, head, screw, tangent sight	2
Pin, fixing, striker	2
Pin, locking, body	1
Regulator, gas	1
Rod, piston, complete	1

[1] Number of magazines per gun now reduced to 44.

Gun, Lewis, .303 inch—Continued.	
Screw, clamp ring	1
Sear	1
Spring, guide, cartridge	[2]12
Spring, head, screw, tangent sight	2
Spring, pawl, feed arm	3
Spring, pawl, pinion	2
Spring, pawls, stop, magazine	3
Spring, return, with retaining collar	2
Spring, trigger	1
Striker	2

Tools and appurtenances.

Gun, Lewis, .303 inch:	
Brush, wire, rod, cleaning, cylinder	2
Handle, loading, magazines	10
Handle, wood	1
Mop, rod, cleaning cylinder	2
Plug, clearing	1
Rod, cleaning, cylinder	1
Spanner, mouthpiece, barrel	2
Guns, Maxim and Lewis, .303-inch:	
Balance, spring, M. G	1
Box, tin, small parts, M. G	1
Hammer, M. G	1
Pliers, cutting, M. G	1
Punch, No. 4, M. G	1
Reflector, mirror, M. G	1
Rod, cleaning, M. G	1
Screw driver, large, M. G	1
Screw driver, small, M. G	1
Wallet, case, spare parts box (Mark I)	1
Guns, Vickers and Lewis, .303-inch:	
Can, oil	1

WEEDON SECTIONS.

Gauze, wire, pieces	2
Pull-through, double	1

[1] In the case of the stronger new pattern cartridge guide springs (now in general use), the number is reduced to 6.

COMPLETE LIST OF COMPONENT PARTS OF THE LEWIS .303-INCH GUN.

Arm, feed (with latch).
Band, barrel.
Barrel.
Bed, tangent sight.
Body.
Bolt.
Butt.
Cap, butt.
Casing pinion.
Casing radiator, front.
Casing radiator, rear.
Casing return spring.
Catch, butt.
Chamber, gas.
Cover body.
Cover ejector.
Cylinder, gas.
Ejector.
Extractors (2).
Fore sight.
Guard, trigger (and pistol grip).
Handle, cocking.
Head, screw, elevating tangent sight.
Hub, return spring.
Key, gas regulator.
Latch, feed arm.
Leaf, tangent sight.
Magazine.
Mouthpiece, barrel.
Pawl, feed arm.
Pawl, pinion.
Pawl, stop, magazine, right.
Pawl, stop, magazine, left.
Pin, axis, leaf, tangent sight.
Pin, axis, pawl, pinion.
Pin, axis, sear.
Pin, axis, trigger.
Pin, fixing, rack, piston rod.
Pin, fixing, striker.
Pin, hinge, pinion casing.
Pin, keeper, butt catch.
Pin, fixing, head, screw.
Pin, tangent sight.
Pin, locking body.
Pin, split, keeper, axis pin, tangent sight.
Pinion.
Plate, butt.
Plate, safety catch, right.
Plate, safety catch, left.
Plunger, spring, trigger.
Radiator.
Regulator, gas.
Ring, clamp.
Rod, piston.
Screw, bed and spring, tangent sight.
Screw, butt plate (2).
Screw, butt cap.
Screw, clamp ring.
Screw, elevating, tangent sight.
Screw, tension, return spring.
Sear.
Sidepiece, pistol grip, right.
Sidepiece, pistol grip, left.
Slide, tangent sight.
Spring, butt catch.
Spring, cartridge guide.
Spring, head, screw, tangent sight.
Spring, pawl, feed arm.
Spring, pawl pinion.
Spring, pawls, stop, magazine.
Spring, return.
Spring, tangent sight.
Spring, trigger.
Striker.
Stud, axis, latch, feed arm.
Stud, actuating, feed arm.
Stud, positioning, clamp ring.
Trigger.
Washer, pin, axis, tangent sight.

ADDITIONAL EQUIPMENT FOR LEWIS GUNS, AUTHORIZED BY G. R. O.'S FOR ISSUE IN FRANCE.

	G. R. O.	Date.
Rimers for use with Lewis guns; issue of 1 per unit	1210	13. 10. 15
Pistols, Very, 1-inch	1263	17. 11. 15
Handles loading magazine; additional issue to complete scale of 10 per gun	1328	20. 12. 15
Paint for casings, Lewis guns; issue on scale of 1 pint per battalion	1339	27. 12. 15
Hyposcopes for Lewis guns; issue on scale of 1 per 2 guns	1442	3. 3. 16
Cover for protection of working parts	1608	30. 5. 16
Canvas carriers for holding magazines; 11 per gun	1695	18. 7. 16
Stick carborundum, triangular, ⅜-inch, fine, for removal of sharp edges or burrs in working parts	1747	18. 8. 16
Slings, Lewis guns; issue of 1 per gun for carrying when hot	1967	25. 11. 16
Cartridges, dummy, wooden; cartridges, dummy, steel, 2 per gun (for instructional purposes)	2065	7. 1. 17

EQUIPMENT AUTHORIZED BY G. H. Q. LETTERS.

	Letter.	Date.
Revolvers for Nos. 1 and 2 of Lewis gun detachments	O.B./407	7. 7. 16
Number of handcarts reduced to 1 per gun [1]	O.B./896	15. 10. 16

[1] As soon as limbered wagons are available for Lewis guns (1 wagon per 4 guns), the handcarts will be withdrawn.

ARTICLES USEFUL TO LEWIS GUNNERS ISSUED TO BATTALIONS.

	Authority.	Date.
Binoculars, issued on scale of 2 prismatic and 38 ordinary per battalion	A. F. G. 1098/110	.....
Range finders, Barr and Stroud or Marindin, issued on scale of 5 per battalion	A. F. G. 1098/110	.....
Phosphorescent night-sights, issue on scale of 64 per battalion, together with 1 yard of magnesium wire (spare), per sight	G. R. O. 831	6. 5.
Lamps, brazing, 1 pint, scale of issue one per battalion, for use of armorer sergeant in carrying out repairs	G. R. O. 1081	13. 6. 15

LEWIS GUN EQUIPMENT NOTED IN "LISTS OF CHANGES IN WAR MATÉRIEL."

[Approved but not authorized for general issue on regular scale.]

	Number.	Date.
Gun, Lewis, washer, packing barrel, steel .005-inch, for taking up play between rear radiator casing and body in old guns	17674	1. 4. 16
Gun, Lewis, butt, short (approved for Bantam battalions)	17713	1. 5. 16
Box, magazines for two carriers and one handle, loading	17739	1. 6. 16
Spring, guide cartridge, new pattern with spring [1]	17769	1. 7. 16

[1] This stronger pattern is now practically universal.

Appendix II.

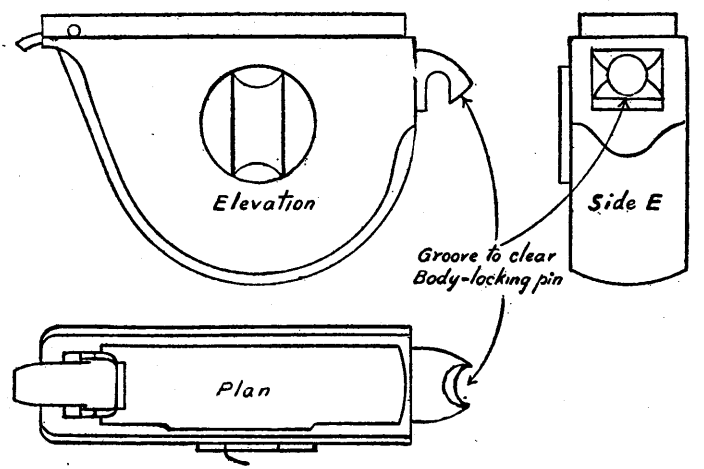
Instructions to Armorers for the Modification of Pinion Casings to Facilitate Removal.

The following alteration, which can be carried out by any armorer, enables the old pattern pinion casing to be removed without touching the body-locking pin, and so greatly reduces the time needed for changing a broken return spring:

Authority $\frac{\text{O.S.M./274}}{\text{Q/1538/4/S.P.}}$ of 16/8/16.

On the projection of casing forming the hinge, a small semi-circular groove will be made by filing away the metal at the position shown in sketch. Only sufficient to clear the body-locking pin should be removed.

To test if correctly modified.—When changing the casing it should only be necessary (1) to remove butt-stock; (2) to draw back the trigger guard slightly.



Lewis gun pinion casing.

APPENDIX III.

TRANSPORT OF LEWIS GUNS AND AMMUNITION.

As soon as four limbered G. S. wagons for transport of Lewis guns are available for each infantry battalion, one will be allotted to each company for its four guns. The company wagon will be loaded as follows:

	Pounds.
4 Lewis guns, at 27 pounds	108
4 gun chests, at 33 pounds	132
4 sets spare parts, complete, at 15 pounds	60
176 magazines, filled, at 4½ pounds	792
22 tin magazine boxes, at 8¼ pounds (each holding 8 magazines in 2 carriers)	182
9,000 rounds, S. A. A. (in boxes of 1,900 rounds, at 75 pounds)	675
Total	1,949

This load represents, per gun, 2,068 rounds in magazines and 2,250 rounds packed in chargers.

In addition, 2,000 rounds per gun are carried by the divisional ammunition column.

[S. S. 432.]

METHODS OF LAYING MACHINE GUNS IN THE DIRECTION OF INVISIBLE TARGETS BY MEANS OF MAPS, COMPASS, AND TRAVERSING DIAL.

Procedure is as follows:

(1) Reconnoiter and select a gun position. This position must be identifiable on the map.

(2) From gun position select some conspicuous landmark which is also shown on the map.

Call this landmark Reference Object (R. O.).

IN BILLETS.

(3) Draw a line on the map—

(*a*) From the gun position to R. O.

(*b*) From the gun position to target.

(4) Measure the angle contained by these lines by means of an ordinary protractor.

Note.—If it is desired to search an area draw lines from the gun position on the map to the boundaries of the area, and measure the angles these lines each make with the line to the Reference Object.

ON THE GROUND.

(5) Set up machine gun on selected position.

(6) Aim gun at R. O. Clamp.

(7) Align auxiliary aiming mark, such as night firing box, on R. O.

(8) Then, without disturbing gun, note what degree on the traversing dial is opposite the pointer on the bracket.

(9) Then, if the target is to the right of the Reference Object, *add* the angle contained by the lines from the gun position to the R. O. and target to the degree on the dial opposite the pointer; if the target is to the left, *subtract.*

(10) If the gun then be traversed until the pointer is opposite to the degree on the dial, the number of which is the result of the above addition or subtraction, it will be laid in the exact direction of the target.

Example:

(*a*) Without compass, when R. O. is point whose position you know.

IN BILLET.

On map mark gun position G (see diagram 1) and R. O. (church steeple) O. Area to be searched is shown shaded in squares B 12 C and 18 A. Draw a line G-O, and line G-L, G-R, to boundaries of area to be searched (and others, if required, to any points within it likely to be of interest). Measure angles O-G-L (65°), O-G-R (75°), etc. Also measure ranges to area and to points within it.

Note.—In order to have room to make notes on angles of elevation, bearing, etc., it is convenient to enlarge the area to be searched. For this purpose an enlarging block is provided (see *diagram 2*). *The enlargement should be made by the usual method of squares, as shown in inset to diagram 1. Divide area to be enlarged into squares (the example shows 100 yard squares), number the lines, and number those on the enlarging block similarly. Then, by careful drawing and measuring, enlarge the area on the enlarging block. If the position of the rays 177° and 187° is carefully measured off on the enlargement, then. by dividing up the distance between them on the E. and W. margins, you can set off the intervening rays accurately. On these rays enter angles of elevation for various ranges, having allowed for angle of sight.*

ON GROUND.

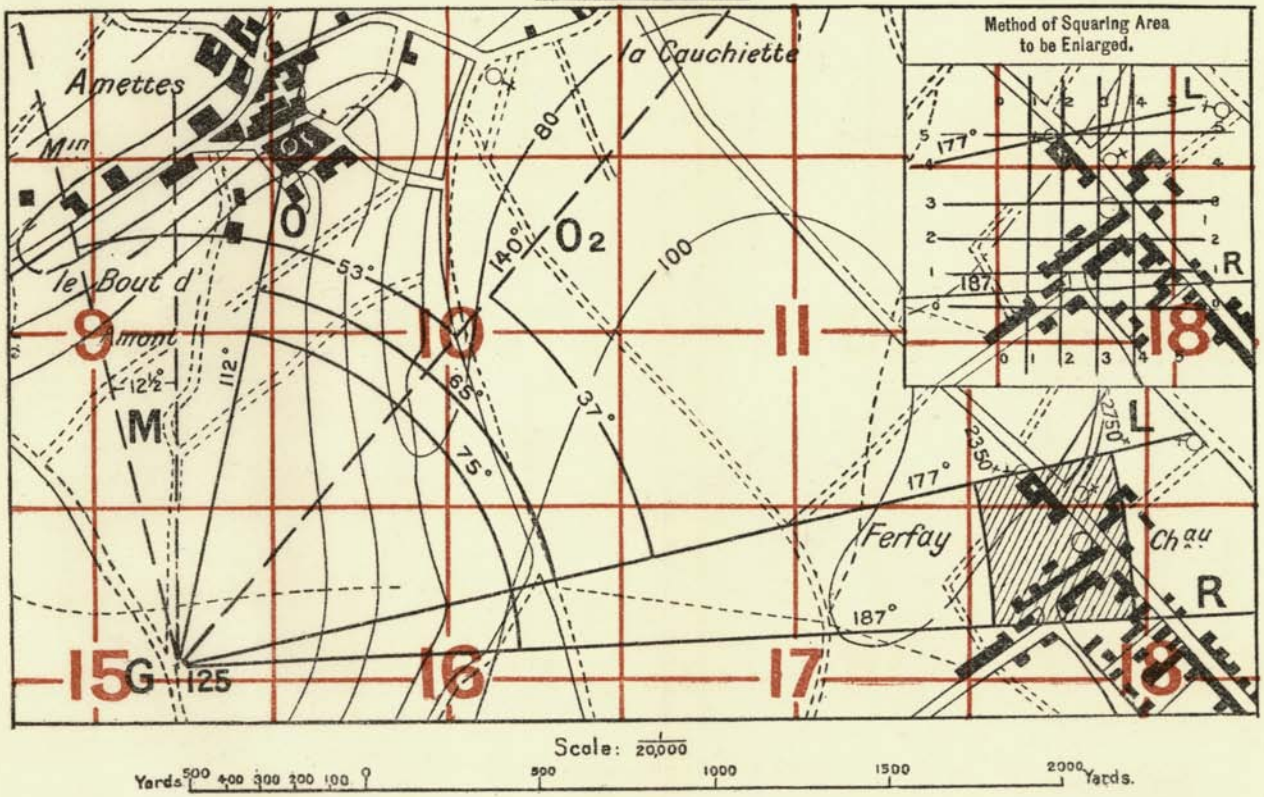
Set up gun conveniently for firing at target. Aim at R. O. and note reading on dial, say 112°. Add to this reading the angles 65°, 75°, etc., already measured to G-L, G-R. (Result, 177°, 187°.) Write these readings down on the lines on your enlargement. Then if you set gun on any of these readings it will be directed on to L, R, etc.

(*b*) With compass:

If there is no point available as R. O. which you can identify on map, you must fix direction of one on the ground by compass. Take any convenient mark (a house, tree, etc.), or put one up. Take its bearing (53°) carefully with your prismatic compass, doing this from gun position before gun is there, and taking care that there is no iron near you or on your body.

On map draw a line G-M, making angle $12\frac{1}{2}°$ to the W. of red grid lines. This shows magnetic north. Then from G-M measure off the compass bearing (53°) of the R. O., and mark this line G-O. (On map it is shown O_2 to distinguish from the other O.) After that proceed exactly as before, *i. e.*, measure angles O_2-G-L, O_2-G-R, etc.

DIAGRAM I.

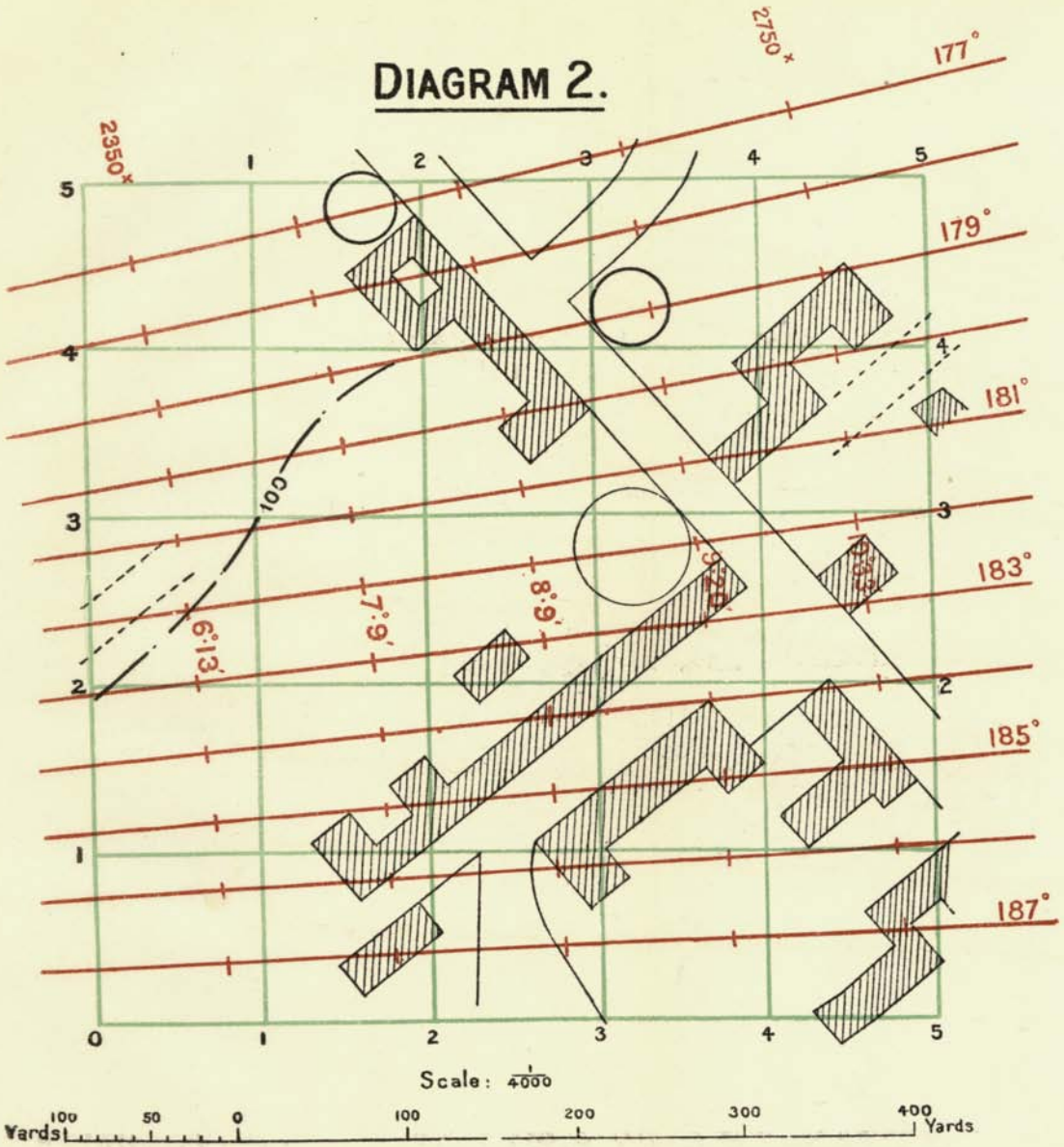


NOTE.

Height of "G" is taken as 125m.
Angles of Elevation noted on enlargement (Diagram 2) are obtained by taking angle of Elevation for Range and adding or subtracting angle of sight for difference in height between gun and target

101862—17. (To follow p. 181.) No. 1.

DIAGRAM 2.



101862°—17. (To follow p. 181.) No. 2.

SOME NOTES

ON

LEWIS GUNS AND MACHINE GUNS

Issued by the British General Staff, September, 1916

SOME NOTES ON LEWIS GUNS AND MACHINE GUNS.

I. PRINCIPLES OF EMPLOYMENT.

1. Now that two Lewis guns are added to the equipment of each company, any officer may find himself in command of this new weapon, and he should therefore have some notion of the best use to which it can be put.

These notes are designed to help officers in this. A good many of the remarks may be platitudes to the more experienced officers, but I know that many have had little opportunity of studying any form of machine gun.

2. The principles of machine guns in their simplest form necessarily come into such a subject, and I have dealt with them at some length for three reasons:

(1) A Lewis gun is a form of machine gun and takes over some of the work previously done by Maxim and Vickers guns. Some of this work they do as well as a Vickers, some better, some worse. An officer commanding a Lewis gun ought to know what work is best left to a machine gun and what he can take on better himself.

(2) Machine guns work so closely with infantry that much misunderstanding can be removed if the infantry officers know something of the principles on which they are used.

(3) One of the main jobs of Lewis guns is knocking out enemy machine guns. And to hunt anything successfully you must know its habits.

II. CHARACTERISTICS OF LEWIS GUNS AND MACHINE GUNS.

1. *Lewis guns share with machine guns* the following characteristics:

(i) They can at any moment open a heavy concentrated fire, and the volume of fire is not decreased till more than 66 per cent of the team become casualties.

(In a company every casualty sustained lessens the volume of fire.)

(ii) They can give a maximum volume of fire from a minimum of front.

(For a short burst the fire of a Lewis gun equals that of about 20–30 rifles, and it can be fired from a single loop-hole or, in the open, from a frontage of two men.)

(iii) Fire control is easy, since all the firing is done by one man.

2. *Lewis guns differ from machine guns* as follows:

(i) They are cooled by air and not by water. They therefore get hot much sooner and will be red hot if 700 or 800 rounds are fired rapidly. If more are fired, they may burst. Company officers, therefore, if requiring only one gun, should use both alternately. Again, if one company has a hot time while another has nothing to do, the latter should be prepared temporarily to exchange guns with the former.

(ii) They are more open, and therefore more exposed to dust, wet, and mud than machine guns. They also contain a greater number of easily broken parts.

(iii) The magazines are more easily damaged than the belts of machine guns. If a full one is dropped on hard ground, it will probably be so dented that it will not fit the gun. The bulk of the magazines therefore must be carried in boxes sufficiently strong to protect them, and these are very heavy.

(845 rounds in the boxes issued to us weigh 102 pounds, while a box of 1,000 rounds of S. A. ammunition in bandoliers only weighs 75 pounds more. Boxes carrying 1,000 rounds of machine-gun ammunition in belts weigh 78 pounds.)

(iv) The main advantage claimed for Lewis guns over machine guns is that, needing no water, they are lighter and so more mobile.

But company officers must remember that the mobility of a gun depends largely upon the mobility of its ammunition. They must therefore be prepared to provide men to lend a hand with the heavy magazine boxes in case of a long, rapid advance or of casualties among the section carriers.

3. To sum up, a Lewis gun is rather like that inevitable starter in the Grand National about which all the prophets say that "it

will win if it stands up." That generally means that it hasn't a chance unless it has a first-rate training with a real good jockey. In the same way stoppages and breakages in a Lewis gun can only be prevented and minimized by having real good men, who will keep their guns in order and use them properly. Company officers, in selecting men, should imagine that they have a new motor car and wish to choose one of their men to be trained as chauffeur. A Lewis gun is a more delicate piece of mechanism than a motor car and needs more constant attention. A rough, stupid man can put it out of action for a long time in cleaning it, and a careless, irresponsible man will waste endless ammunition if he fires it, and will have his gun red hot at the critical moment.

III. TACTICAL HANDLING.

The simplest way to arrive at the purposes to which Lewis guns may be put is to consider first the work machine guns have done in the past, and then see what part of this work Lewis guns should take over, and also if there is any further work for which they are specially adapted.

(I) TRENCH DEFENSE.

1. In normal times in the trenches the first duty of machine guns is defense. For this purpose brigade machine-gun officers make arrangements for their machine guns in the front trenches to join in forming what is called a "belt of fire" across the entire front. Every machine-gun officer, on taking over a sector of the line, is shown or provided with a map something like figure 1.

If this belt is properly constructed, it is clear that no considerable body of the enemy can cross "No-man's land" without terrific losses, so long as the machine guns remain in action. The emplacements from which machine guns fire to form this belt of fire are called "battle emplacements"; they must be well concealed and strong enough to resist anything but a direct hit from a large shell. Each gun should have an alternative battle emplacement covering the same allotted field of fire, in case one should be knocked in. "Defense" emplacement would probably be a better name than "battle" emplacement, for these emplacements are designed for defense, and for an attack different positions would often be selected.

2. Two points should first be noted about the siting of these emplacements:

(i) The guns all fire diagonally.

This is for three reasons. (*a*) They cover more ground. A greater space of "N.-man's land" can be swept without altering the aim, and together they form a belt of fire through which the enemy attack must pass. Fewer men will thus be needed to hold the trench. (*b*) They are less likely to be seen, because they are defiladed from the nearest part of the enemy's trenches. (*c*) They enfilade an enemy attack, and shots which miss or pass through a near party may hit the next.

Hence it follows that a gun sited in one company is probably looking after the front of another company or even another battalion. The men on duty with machine guns must not, therefore, be looked on by company officers as sentries in the ordinary way. Their only concern is to keep their guns tuned up to prevent anyone from tampering with them, and to look out *along their line of fire.* We had one emplacement for instance, in the middle sector at Ypres, where the sentry could only watch his line of fire at night through the loophole in his emplacement.

(ii) Each gun has its own particular ground to cover, which may be large or small, and so long as it covers that satisfactorily it fulfils its main purpose.

Company officers sometimes look through an emplacement and criticize it adversely on the ground that it has a small field of fire. Such criticisms can not be intelligently made unless the critic knows the purpose for which the gun has been so placed.

3. The formation of such a belt of fire looks very easy on a map, but in practice many points have to be considered. In the first place all the guns, so far as possible, must be sited for grazing fire and not for plunging fire. In other words, the trajectory of the bullet should coincide with the slope of the ground for as long a distance as possible. One of the great advantages of the Maxim or Vickers gun is its fixed platform. The gun can be laid along its line at dusk and fired with effect at any hour of the night, but this advantage is lost if the aim of the gun has to be continually changed. (The German front-line machine guns rarely traverse at all. The traversing fire that sometimes comes over our lines is generally from a reserve

trench.) It follows, therefore, that a high commanding position is a disadvantage for a front-line gun, especially at night. (See fig. 2.)

4. When your trench line runs up a slope, it is generally better to cover the front by siting your gun at the bottom and firing up the slope for the following reasons: (i) You are more likely to get an attacking party at night on the sky line. (ii) The emplacement at the top of the slope would be more easily spotted, and when spotted will be more easily shelled. (iii) When firing down a slope the bullets that miss their immediate object generally bury themselves in the ground. When firing up over a ridge the outside bullets of the cone may do damage on the other side. In fact one can generally site a gun with this secondary object in mind, and work out the aim with a map, clinometer, and compass so that such bullets are likely to fall somewhere useful either to enfilade an enemy trench farther up the line or hit a village, headquarters, dump, or crossroads behind.

"Mad Alick," of ——, the generic name of a family of machine guns in that neighborhood, is a good instance of this practice. He fires at the top of our parapet where he can partially enfilade it, but is so placed that shots which pass over it will fall in the neighborhood of ——. Luckily he has mistaken the contours and can not get observation of his fire, with the result that the center of his effective beaten zone is generally halfway up the tower of —— Church. If he retired two or three hundred yards and fired at the same mark and elevation, he would make —— Street a much more unpopular promenade.

5. This is an important point for Lewis guns as well as machine guns. The main criticism that can be brought against both is that they fire so rapidly that every shot can not hit and therefore they are wasteful of ammunition. This charge can largely be answered by so firing that the outside shots of the cone have a reasonable chance of hitting a secondary target. To accomplish this successfully the directing gunner must have a good bump of locality and a thorough knowledge of the map.

(II) STRAFING IN TRENCHES.

1. While the formation of a belt of fire, to economize infantry in defense, is the first duty of machine guns posted in front-line trenches, a certain amount of useful strafing can also be done on occasions. But only in exceptional circumstances should this

be indulged in from the battle emplacements or they will soon be discovered. This work can generally be best done by reserve guns from rising ground behind the trenches. Dumps, approaches, crossroads, etc., can often be fired on. But if an attack is contemplated, any approaches or communication trenches that can be reached should be left alone till the day of attack, or the enemy will defilade them with traverses or choose a safer line.

2. Patrols, working parties, or gaps in the enemy's parapet can be strafed from the front line, and for this purpose less elaborate emplacements may be made, often in commanding positions.

(III) LEWIS GUNS IN TRENCHES.

1. Now arises the question, what part of the machine-gun work in the trenches can Lewis guns usefully take over?

The "belt of fire" business is, in the main, best left to machine guns when these are available, because owing to their fixed platforms they can better cover their lines by night; but there are occasions when Lewis guns can usefully supplement them. For instance, your trench line may run over a flat-topped ridge. Both slopes may be swept by machine guns shooting upward, but neither may sweep the flat top. The top would be an unsuitable place for a permanent emplacement, and in any case it would be wasteful to retain a machine gun for so small a space. A Lewis gun placed near would make this secure. (See fig. 3*a*.) Again, in the middle sector at Ypres there was a hollow with a hedge in it running at right angles to our trenches, and we had to keep one machine gun solely to watch it. (See fig. 3*b*.) Here a Lewis gun would do the work perfectly well.

2. But it is in the strafing that Lewis guns will be most useful. There is practically no front-line strafing that can not be better done by Lewis guns. The work does not need long-continued fire, and two or three Lewis guns could quickly be concentrated to join in such work without leaving any gaps in the belt of fire, as would occur if front-line machine guns were moved for this purpose.[1]

3. Again, any work in front of our own lines is more suited to Lewis guns. At Fleurbaix last June the Germans used often to work in the daytime on a new trench 40 yards in front of

[1] *Note by General Staff.*—Lewis guns are not, however, suitable for "strafing" by indirect fire and should not be used for this purpose (see S.S. 106, Appendix A, 3 (*a*)).

their line—dead ground from our parapet. I asked permission to take out a Maxim through the long grass to stalk them, but the colonel refused because if we were surprised by an enemy patrol we would have difficulty in getting so heavy a gun away. Here was an ideal opening for a Lewis gun. Similarly in an enterprise on the German trenches two Lewis guns pushed out into "No-man's land" on either side of the point of attack would keep clear the raiding party's line of retreat.

(IV) THE ATTACK FROM TRENCHES.

1. In any attack the duties of all forms of machine guns are (i) to cover the advance of the infantry by keeping down or unsteadying the enemy's fire; (ii) to prevent or delay the enemy from bringing reinforcements to the threatened points; (iii) to help in the fight for superiority of fire before the assault.

In a trench attack (iii) will not occur. The necessary superiority must be obtained beforehand by greater weight of artillery and by holding the supremacy of "No-man's land."

Let us picture a typical trench attack and see how machine guns and Lewis guns can attain the first two objects.

FIRST PHASE.

2. In the preliminary bombardment, Lewis guns can do nothing and machine guns very little. I have seen it suggested that machine guns should enfilade any communication trenches that they can in order to catch Germans retiring to the shelter of the second line. I do not agree with this. Impatience is a very general fault on our side. When we see a chance of inflicting some small damage on the enemy we are far too apt to do it at once instead of saving up the blow for some time when it will have a real importance. As an example of this when officers in the front line spot an enemy machine gun, even if it is doing no damage, they often call on the artillery to shell it. Even if our guns knock it out, another will quickly be brought up to sweep the same ground from a safer position and nothing material has been gained. On the other hand, if the gun were left in fancied security till the morning of an attack, and then knocked out, the Germans probably could not replace it in time

to be of any service. In just the same way, by enfilading communication trenches early in a bombardment you may catch a few men. But the trench can be easily cleared and will be marked as dangerous. If you leave it alone and strafe it when the enemy are returning to the front line to meet our attack, the effect wil be far greater. You may block the trench and upset the German organization.

3. When the bombardment ceases, our infantry goes "over the top." As soon as the enemy sees them, every loophole will be opened and parapets manned. An intense fire will be poured upon our men, both from the enemy's front line and from any positions behind commanding "No-man's land." However severe our bombardment, some machine-gun emplacements are sure to be left, and it is from these that the greatest losses will be dealt.

4. The Vickers in rear can deal with the enemy's second-line positions; they can also delay reinforcements; they can do this by enfilading communication trenches; by shooting over others which can not be directly enfiladed they will make the enemy stick to the trench instead of coming up more quickly over the top. They can also often search ground which the artillery can not effectively shell, as it is here that reinforcements will probably be collecting.

5. But before the arrival of Lewis guns it was always very difficult to silence the enemy's front line. It is clear that this can not be properly done from our own trenches, because our fire would at once be masked by our own attacking troops. As a suggestion, gaps might be left in our attacking line, especially in a salient opposite well-shelled trenches, for machine guns to fire through. (See fig. 4.) But this covering fire must chiefly be done by guns placed well in front of our own trenches, which can continue firing till the infantry is past them. For this purpose the light and easily concealed Lewis gun is particularly well adapted, and Vickers guns can also be used in the most favorable positions for cover. How these guns get there is immaterial provided that they reach their places unseen before the attack. They may go out the night before, dig themselves in, and stop there; or they may prepare their shelter at night and crawl out to it in the later stages of the bombardment or under cover of a smoke cloud. They should get as far forward as possible so long as they are out of bombing distance of enemy saps and not in the line of fire of our own wire-cutting

guns. Since they will fire diagonally, a position behind a hillock where they are covered from the trenches opposite might be a good one. But each position must be chosen on its merits.

6. If Vickers guns and Lewis guns were used together, the Vickers guns should sweep the enemy's parapets and their breastworks at loophole height, since they are more suited to sustained traversing fire.

7. The special job of Lewis guns is knocking out machine guns. But to do this one must study their habits. If a Lewis gunner hears a machine gun firing straight opposite him it is a great temptation to fire at the sound; but this would almost always be useless because German guns, like our own, fire diagonally and are defiladed from the front.

German front-line machine guns have narrow loopholes because they traverse very little. They all have strong head cover, coming low down in front so that they can only be hit by short range fire. They fire diagonally so that they can only be hit from the direction in which they are firing. Lewis gunners, therefore, have the best chance of putting out the gun whose bullets are coming nearest themselves; and the strike of machine gun bullets on the ground is the best guide to the place from which you can put that machine gun out. German machine gun loopholes are generally near the ground level.

8. Every gun, Vickers or Lewis, must have assigned to it its own particular length of enemy trench before it is sent out. The Vickers guns will cover, between them, the whole parapet; while Lewis guns would be given a particular length of parapet to watch for machine guns. All these lines should be diagonal. (See Fig. 5.)

9. Only two men should go out with the gun, the rest waiting in the trench behind ready to bring on ammunition when the gun advances. With the gun must be sufficient ammunition for its immediate purpose as well as a load for No. 2 to take forward.

SECOND PHASE.

10. The Lewis guns, having ceased fire as the infantry passed, would remain in position until they were assured that the trenches had been carried. In case of failure they would cover the retreat. As soon as the infantry were well into the front trench the guns would move forward and join their companies.

11. If the attack was proceeding further they would endeavor to cover the next advance precisely as they covered the first. If, however, they have to meet a counter-attack at once, they must be arranged to form a belt of fire across the front precisely as machine guns do in the trenches, and they will continue to do this until a further advance is to be made, or the machine guns come up to consolidate the positions won. Occasionally a Lewis gun may be used to defend a straight communication trench; but these are rarely found near the front line; generally these trenches twist too much and are better defended by bombers, while the Lewis guns prevent a direct rush over the top. If the counter-attack comes before you have time to organize a belt of fire across the whole battalion, companies should separate their Lewis guns to fire inward across each other's front.

12. It may happen that X Battalion captures its trench, but Z Battalion on its left fails to do so. One or two guns of X Battalion may then be usefully employed with the bombers working their way along the trench to the left. A good position for such a gun is shown in figure 6. In any case where one battalion finds itself in front of the general alignment, the Lewis guns of the middle companies must be prepared to form the belt of fire by themselves across the entire front, because the guns of the flank companies may have to be drawn back to protect the flanks of the battalion.

13. The best positions for the Lewis guns should always be chosen before the guns themselves follow up the attack. It is very dangerous to move guns laterally across the firing line. The guns, following up from the rear, should always be directed straight to their positions. Company commanders should arrange with their Lewis gun officers as to who is to carry out this important duty. In the authorized personnel of a Lewis gun team, no provision is made for scouts, range takers, or observers. I suggest that Lewis gun officers should have a liberal allowance of runners trained in this work.

14. Provided the gun is not overheated, ammunition may be used freely from the first position the guns occupy. But the moment guns go forward they must fire more sparingly. Once you are in the enemy's trenches every round of ammunition increases 10 times in value, and must be economized accordingly. All further supplies will have to pass through the enemy's curtain fire.

(V) LEWIS GUNS IN OPEN FIGHTING.

1. The main principles that govern the use of Lewis guns are the same in open fighting as under the circumstances already described.

2. The guns will sometimes have to be used for covering fire. If, for instance, the company is surprised by rifle or machine-gun fire while in artillery formation, all Lewis guns will at once get into action to cover the deployment.

3. Similarly in an attack, where the infantry has to advance over an exposed piece of ground, Lewis guns will be pushed ahead secretly to cover the movement. In former times companies would pass such ground by advancing by alternate platoons or sections, one platoon firing while the next advanced. Now Lewis guns can provide the necessary fire and the whole company can pass quickly over without halting. But where there is a long stretch of open ground, the covering can better be done by the overhead fire of machine guns. Machine guns can fire far more continuously and can put in accurate shooting at ranges up to a mile and a half. At this distance their bullets have a steep angle of descent and are therefore better calculated to demoralize troops in trenches. Still, for short distances of exposed ground Lewis guns are better, because, by the use of prearranged signals, they can open fire at the exact moment that the infantry advances.

4. Lewis guns are also useful for shifting hostile advanced pickets or unexpected machine guns.

5. Such covering fire often has to be used when no clear target presents itself, but even so it may be of real value. In South Africa the men of the squadrons used to jibe at our machine guns and say they never hit anything, but they added "We like to hear them popping because they make the Boers shoot so badly."

6. Though in a war like this covering fire often has to be used, gunners must never lose sight of the real object of all kinds of machine guns, which is the annihilation of a body of the enemy. They are weapons of opportunity, and in general must lie low till they can get the greatest effect. They must get as near as they safely can to the enemy when our side is advancing, and conversely they must allow an attacking enemy to come as near as they can without undue risk. This margin of safety varies according to circumstances. An enemy patrol

of 50 men might be allowed to approach within 50 yards. If there are several patrols converging on the gun, this distance must be increased. The distance would be lessened if there were concealed barbed wire in front of the gun, and so on.

7. If one gun is firing at a party of the enemy, it should open fire at that part of the enemy nearest to likely cover and traverse inward. The enemy will probably run into the line of fire in trying to reach cover.

8. If two or more guns are used for the same purpose, each must have a separate point of aim. With two guns, each would start at an extreme flank of the party and traverse inward. If there were four guns, the other two would lay on the center and traverse outward to left and right. All these points of aim must be settled beforehand.

9. It is impossible to go over all the situations that may occur in open fighting, but the following remarks may cover some of them.

The best mark a Lewis gun can have is cavalry. Cavalry has no terrors for any machine guns if the latter are ready for action.

Except in the case of covering fire, it is a general rule for Lewis guns that they should not open fire unless they have a reasonable chance of inflicting very severe losses. There are times, however, when this rule will not hold good, viz: (1) In a rearguard delaying action, guns would open at extreme range to delay the enemy by making him deploy early. (2) If an enemy is retreating, a lucky burst of fire at long range may turn the retreat into a panic. In such a case there is no object in waiting, because your target will get no nearer. (3) It is worth having a long shot at particularly tempting marks. A battery limbering up, a machine-gun section on the move, a general and his staff, should, like a woodcock, be strafed by everybody.

If there is a gap in our line, a Lewis gun on either side of it, shooting diagonally across each other's front, will prevent an enemy getting through till it is filled up.

In any organized scheme of attack or defense (as opposed to patrol work or small enterprise) each Lewis gun must be given its own particular line to deal with, and from this line of fire it must only move in exceptional circumstances. Such a case might be a local raid by the enemy. If the raiding party seemed likely to gain a footing in A sector, and B sector was not attacked, the gun defending B sector might be swung round to

help the defense of A. But in all such cases one man of the gun team must be ordered to keep watch along the original line, so that he can switch the gun back the moment a target presents itself on that line.

In defense Lewis guns should not be ordered to cover too wide a stretch of front. This would only lead to an inefficient watch, while if several targets presented themselves the gun would be constantly changing from one to the other and do little real damage to any. It is much better to give a gun a smaller line—say, one field and a hedge—even if the whole line is not covered. For if you prevent the enemy from crossing two fields here and two fields there, you will break up and disorganize his line, and he will attack your infantry with little chance of success.

Finally, Lewis guns should be handled as a sailor handles a submarine. In a square, straight fight with a Vickers a Lewis gun stands no more chance than a submarine in a similar encounter with a battleship. Both only succeed by popping up unexpectedly, delivering a rapid crushing blow, and then, when they are discovered, trusting to escape by their mobility and invisibility to some other unexpected place from which they can repeat the dose.

IV. GENERAL REMARKS.

1. The question may be asked, Is it worth while to try to work this somewhat elaborate organization? Why not use the Lewis guns as a kind of superior rifle, just like any other rifle is used now?

To this there are two answers.

(i) At the present moment rifles are not, in practice, used to the best advantage. The most important principles summed up in the expression "Fire control" are, owing to the extreme difficulty of applying them in action, in grave danger of being disregarded. Even in trenches one sees sentries at night firing off rounds haphazard in the direction of the opposite trench, instead of each bay being given some definite aiming mark along which its occupants can fire with greater chance of success. But with Lewis guns fire control is greatly simplified, since only one man is firing the equivalent of 20 rifles, and therefore the fullest attention devoted to this subject is never wasted.

(ii) All automatic rifles and machine guns are extremely wasteful of ammunition unless used on the principles already

described. It is only by such methods that they get their full effect. Hitherto we have been far behind the Germans in material of this kind; now we may be about equal to them. But even if we get a preponderance the advantage will largely be lost unless we get out of every weapon the full work of which it is capable.

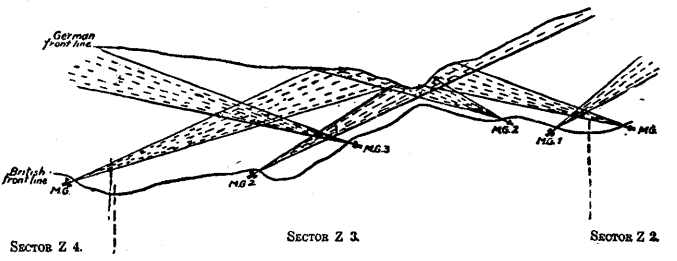
2. And from this another point arises. It has been said that Lewis guns and machine guns get their best effects by diagonal fire. Why not carry this to its logical conclusion?

Many of us saw something of the fiasco of the 9th of May, 1915. I got full accounts from men who went through and came back. All of them told the same story—that, once they were through the German front line, they were swept by machine guns from both flanks, but not a man could tell me even roughly where those machine guns were situated.

3. And if you think of our own practice attacks, it is easy to see how such a thing happened. We are given a compass bearing on which to march. The officers find some object at which the flanks of their command are to aim, and their best N. C. O.'s are wholly occupied in keeping this direction. The officers divide their attention between seeing that the direction is kept, studying the dangers and difficulties of the ground to be traversed, and looking for signs of the enemy in their objective. The remainder are watching for the officer's signals. But nobody is looking to the place from which casualties will come—the flanks, half right and half left, where machine guns may be lying safely defiladed from their own front.

Now, this sidelong glance might well be the special duty of Lewis gun teams. In their position in the fourth line they have few anxieties about direction. If a few guns with a small supply of ammunition were sent forward to assist the advance, the remainder of the teams carrying heavy ammunition would suffice to mark the line which the guns could rejoin as the battalion passed. Similarly no injury would be done to the direction of the line if spare men of Lewis gun teams were sent forward to points of vantage from which they could watch our flanks and signal the guns forward if they saw signs of any danger from those directions. I feel confident that if some such arrangement were made, our losses in an attack would be very greatly lessened, and no German machine guns would inflict heavy casualties upon us, as they did on May 9, without being in any danger themselves.

FIGURE 1.

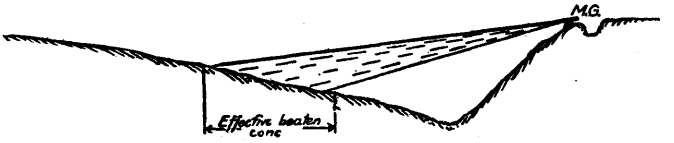


Example of chart given to machine gun officer on taking over a sector of trenches (Z 3), showing lines of fire which his four guns must cover from their battle (i. e., defense) emplacements.

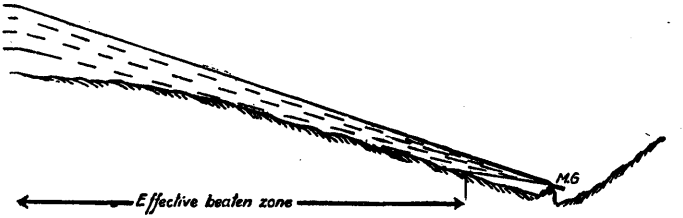
FIGURE 2.

MACHINE GUN DEFENDING A LINE.

(A) Machine gun in a commanding position.



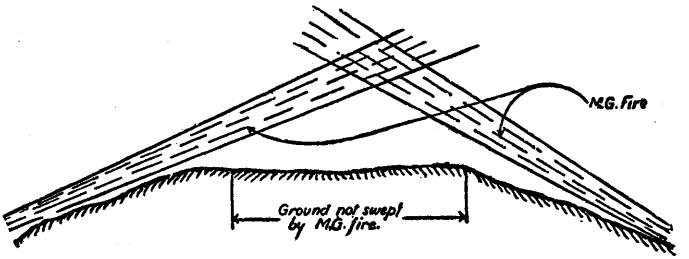
(B) Machine gun in low position.



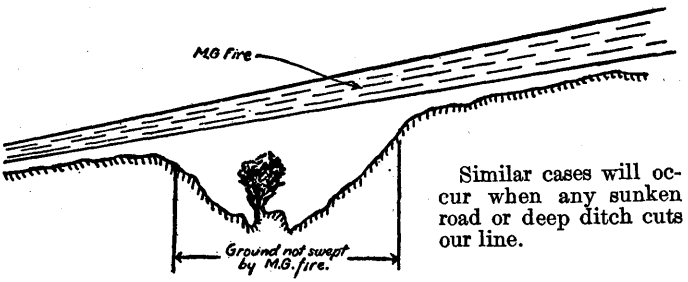
(Remember that both guns are shooting diagonally, so that (A) position would leave many gaps through which an enemy might pass. In (B) position there are no gaps.)

FIGURE 3.

(A)



(B)

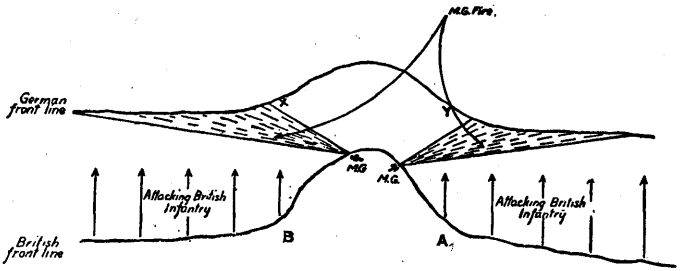


Similar cases will occur when any sunken road or deep ditch cuts our line.

Examples of ground in front of trenches better defended by Lewis guns than by machine guns.

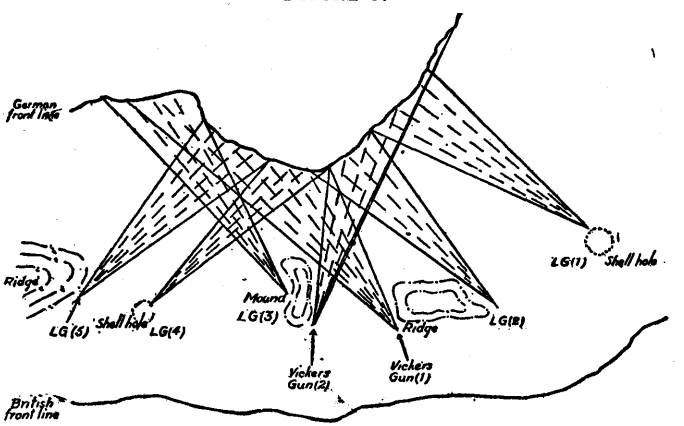
(In both cases you are supposed to be looking straight to your front out of your own trench. The machine guns are firing away from you diagonally.)

FIGURE 4.



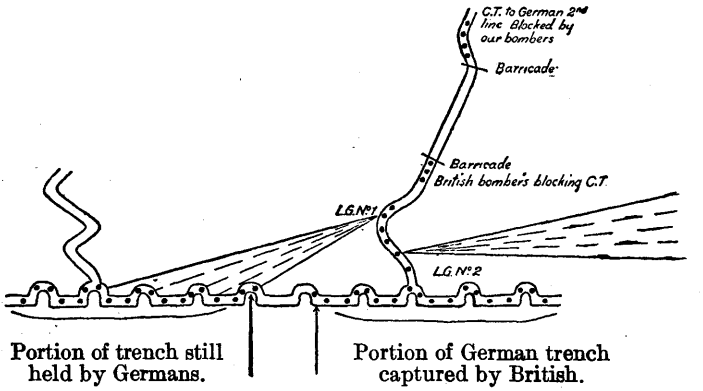
Example of machine guns covering a trench attack, when a gap is left in the line of attack A—B—a British salient. The infantry can get more than half-way across before masking the M.G. fire. The enemy's line must be well bombarded between X—Y, to prevent them from making this a rallying point for reserves, and must be watched by Lewis guns from M.G. emplacements. (Conventional drawing to show arrangement.)

FIGURE 5.



Example of arrangement of Lewis (5) and Vickers (2) guns to cover attack on German salient. The Vickers sweep the whole length of the parapet in their zones. The Lewis guns are allotted sections which they must watch for M.G. emplacements. These are always likely to be found in the sides of a salient.

FIGURE 6.



NO MAN'S LAND.

German bombers. British bombers working along trench.

Here the German trench has been captured on our right, but the attack on the left has failed. Our bombers are working to the left along the front trench.

Lewis gun No. 1 is pushed forward up a communication trench to assist these bombers; it will make the Germans keep their heads down, so that they can get no observation, it may hit some where the parados is low or broken, and will generally make things uncomfortable for them. It will also prevent our bombers being rushed by a counter-attack " over the top " from the second line.

Lewis gun No. 2 protects the trench already captured by enfilading any counter-attack.

GENERAL HEADQUARTERS OF THE ARMIES
OF THE NORTH AND NORTHEAST,
April 26, 1917.

NOTE FOR THE ARMIES.

SECRET.

The English Army utilizes machine guns to a great extent in firing at long distance (2,500 to 3,000 meters) to prevent an enemy movement, to produce a barrage, and even during the course of an attack to form a rolling barrage ahead of the attacking troops.

This fire of prevention in normal periods allows a very considerable economy of artillery ammunition, and its effect is at least as certain and more demoralizing by its continuity than that of the cannon.

Isolated trials of indirect fire at long distance have also been made by us; we should generalize the practice of using it.[1] It is not, however, with an improvisation nor with the isolated initiative of a single commander that serious effects may be obtained. The high command must take the question into its hands, orient the ideas, and develop the education of the machine-gun officers in the practice of this kind of fire.

The augmentation of the number of automatic machine rifles in the hands of the troops permits of withdrawing machine guns from the front in order to make a more perfected use of them than to immobilize them entirely for the defense of the first lines.

In withdrawing them slightly to the rear they are protected from a premature demolition and their field of action is increased.

At distances greater than 2,500 meters the fire of the machine guns becomes very plunging; this permits of reaching objectives quite strongly defiladed and produces a moral effect all the more accentuated as it reaches an enemy who considers himself securely sheltered from musketry fire.

In this line of ideas, the machine guns may be employed to keep up a fire upon battery emplacements to prevent all supply

[1] Machine-gun fire at long range was treated in the Instruction of Feb. 19, 1917, on indirect machine-gun fire (forwarded to War College division).

to them, upon posts of command, upon places where numerous shelters are located, or on crossways in the boyaux.[1]

Finally, the guns must have a permanent mission of barrage organized like that of the artillery and which can operate immediately in case of attack.

We give below, as an indication, some information on the employment of machine guns in an English army corps during the recent attacks.

The quota of about 70 per division was distributed in the following manner:

With the assaulting troops	26
Grouped for barrage fire	30
In reserve for reinforcement	14
	70

The machine guns designated for the barrage and supporting fire were assembled in batteries of eight guns, and the batteries themselves in groups of two or more.

Each brigade of assault employed one group and the front of the barrage was calculated at 50 meters (54.682 yards) per gun. The distance of the initial fire was between 2,000 and 2,500 meters (1,187.260 and 1,733.875 yards) and the barrage adjusted at 400 meters (437.452 yards) in front of the parallel of departure.

The barrage was carried forward at the moment of assault in the same manner as the artillery barrage which it preceded, and at 400 meters beyond the first objective its movement was arrested and it became a fixed barrage along that belt of ground. At this moment the machine guns were moved forward by echelons, one battery at a time, to occupy new positions picked out beforehand on the plan director (map 1–10,000) and permitting the execution of barrage fire between the first and second objective, and so on.

In order to assure the liaisons between the troops and the machine guns, the commander of each group remains at the post of command of the brigade of attack, connected with his batteries by telephone during the first phase and by optical signals and runners during the following phases.

It may be imagined that such an operation by machine guns requires a very careful instruction of the personnel, troops

[1] The machine guns which are going to be distributed to batteries might very usefully be employed for this purpose.

accustomed to the whistling of bullets over their heads and a most minute preparation of the operations. It could therefore be attempted only when our troops have been well broken to this kind of fire, but the foregoing general ideas, which result from experience already quite prolonged, may be taken advantage of to utilize machine guns during stationary periods for fire of prevention and of barrage.

With an effect often more certain, we will economize artillery ammunition which can be better used elsewhere.

THE MAJOR GENERAL,
PONT.

ORDER OF THE SIXTH BAVARIAN DIVISION REGARDING MACHINE GUNS.

DIVISIONAL HEADQUARTERS,
September 3, 1916.

MACHINE GUNS.

The battle of the Somme has again shown the decisive value of machine guns in defense. If they can be kept in a serviceable condition until the enemy's infantry attacks and are then brought up into the firing position in time, every attack must fail. The greater the efforts the enemy makes in the future to destroy our trenches before his assault by an increased expenditure of ammunition, the greater the extent to which we must rely on the employment of machine guns for repulsing attacks. These should be brought into action unexpectedly and continue the fight when the greater part of the garrison of the front-line trenches is out of action and the enemy's barrage fire renders it difficult to bring up reinforcements. In view of the above, all improvements to existing works and all new construction must be carried out on the following principles:

1. In regular trench systems, the accurate trace of which is known to the enemy by aeroplane photographs and which he is therefore able to destroy, as regards the greater part at least of the foremost trenches, the employment of machine guns is only permissible when they can be kept in a serviceable condition in deep dugouts with several exits, and when it is possible to bring them into position *in time*, owing to the existence of strong obstacles which can not be completely destroyed by bombardment, or to the possibility of close observation of the enemy's movements.

The first trench and the ground between it and the second trench are therefore quite out of the question, for even if they contain excellent dugouts there is no certainty that the enemy's assault can be seen in time. Machine guns should therefore be placed, as a rule, behind the second, or, better still, behind the third trench. The methodical fire by which the enemy seeks to destroy our trenches is considerably less effective here, and, further, the obstacles erected in front of the second and third trenches and around the machine-gun emplacements themselves make it possible to see the enemy's assault in time. Command-

ing positions with a very wide field of fire, or positions which can at least flank the trench system, should be selected. About half the machine guns should be allotted to such positions.

2. The remainder should be sited behind the trench system and on ground further in rear, in deep pits which are usually covered over and also on platforms concealed in trees, in such a manner that the enemy is caught in an unexpected cross-fire if he breaks through. The important point is that the machine guns should not, in any circumstances, be detected beforehand. They must not, therefore, be too close to trenches which can be photographed or to well-defined woods which the enemy will suspect in any case. The best sites are in the open, in or under clumps of trees and bushes, or in hedges. All the earth excavated must be removed or concealed under hedges, etc. A low network of trip-wires has proved to be the best form of obstacle. To each machine gun there should be allotted a certain number of infantrymen armed with hand grenades, who can also work the gun if necessary.

3. The construction of special machine-gun emplacements is not advisable. If sited in the position itself, they are destroyed, and if further in rear they disclose their positions. The guns should either be fired from improvised mountings or from sandbags.

4. In cases where the ground which the enemy's attack has to cross is not covered by machine guns sited in retired positions, it is necessary to hold machine guns in readiness even in the first trench, particularly by night or during misty weather, as a means of defense against surprise attacks made without artillery preparation, though these can only be of local and minor importance. The machine guns mentioned in paragraph 2 should be employed for this purpose. By day, however, or at the very latest as soon as intense artillery fire begins, they should be taken back to their proper positions.

5. Machine guns may always be sited in the front trench in thick woods or under other exceptional conditions. The decision in such cases will rest with me; suggestions should be submitted.

(Signed) v. HOEHN.

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