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[MISC. PUBS. I I]

INSTRUCTIONAL NOTES

ON THE

LEWIS GUN.

PREPARED BY THE GENERAL STAFF.

APRIL, 1918.

N.B.—Heavy Type applies to GROUND GUN
only.

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ROYAL AIR FORCE.

INSTRUCTIONAL NOTES ON THE LEWIS GUN.

SUB-HEADS OF TRAINING.

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11. Examination of Gun.
12. Minor Repairs and Adjustments.
13. Spare Parts.
14. Testing of Ammunition.
15. Aiming Instruction (Deflection Practice).

I.—HINTS FOR SQUAD INSTRUCTORS.

- (1) Always inform squad what is the subject of instruction, and the object of the lesson.
- (2) Make sure that every member of the squad fully understands each item or part of the subject, before proceeding to the next.
- (3) Talk to the squad, not to the gun.
- (4) Do not shout; talk just loud enough for all the squad to hear.
- (5) Illustrate each point as you explain it; do not try to explain without the use of a diagram anything that cannot be seen.
- (6) Be brief; do not dwell on non-essentials.
- (7) Always have kit ready to commence each lesson at the hour appointed.
- (8) Keep a record of the progress made by every member of the squad.
- (9) Make yourself acquainted each evening with the next day's work, and prepare your instruction carefully.
- (10) The success of a squad depends largely on the zeal and ability of the instructor.

(11) The method of instruction should, wherever possible, be based on the following sequence :—

- (a) Demonstration.
- (b) Explanation.
- (c) Imitation.
- (d) Interrogation.

NOTE .—

(a) During the hours of instruction, except at the actual firing-point on the range, live ammunition must never be brought near the Lewis Gun. It follows, therefore, that when magazines are being filled with live rounds, the work should be done at some distance from the gun.

(b) Two kinds of dummy cartridges are issued by Ordnance for instructional purposes :—

i. Wooden dummies to shew the movement of the ammunition inside the gun, action of the feed, mechanism, stoppages, etc.

ii. Metal dummies which should only be used as tools for stripping.

(c) Neither instructors nor pupils should ever stand opposite to the muzzle of the gun, nor should they pass in front of it.

II.—GENERAL DESCRIPTION.

The teaching of this branch of the work calls for a considerable effort of memory. It should, therefore, be taken in short sections, each of which should be thoroughly understood before passing on.

The general description should be brief, the main idea being to call the attention of the pupils to the peculiarities of the various parts, with a view to their subsequent understanding of the mechanism of the gun.

It has been necessary to introduce in a few places parts not yet taught, for the clearer explanation of the particular portion under consideration. On the rare occasions when this is necessary, the instructor should refer to the unknown part without giving its name. The stage at which each new name should be introduced is indicated by *italics*.

The instruction in general description should proceed as follows :—

(a) *Demonstration.*

The instructor strips the gun as far as necessary and shews in turn the parts under consideration.

(b) *Explanation.*

The instructor

(i) Gives the official name in each case (taking care that the pupils acquire it correctly).

(ii) Explains the purpose of this part (without encroaching upon the teaching of mechanism).

(iii) Shews its relation to the rest of the gun.

(c) *Squad Practice.*

The pupils give short description of the parts, using correct names.

(d) *Interrogation.*

By a few rapid questions covering the whole of the section that is being dealt with, the instructor tests the pupils' knowledge of the names and parts.

A.—GENERAL DESCRIPTION OF GUN.

A short general account of the gun should first be given, so that the pupils may get an elementary idea of what the gun is and what it can do, and that their interest may be aroused. This description should not take more than a few minutes, and should touch on the following points :—

Name : .303 in. Lewis Machine Gun, and why so called.

Weight : Ground Gun (Mark I) 26 lbs.

Aerial Gun (Mark II) 17 lbs.

How operated : The force of the gas.
The return spring.

Explain briefly :

- (a) How the gun is loaded and fed.
- (b) How gun is fired.
- (c) How gas operates piston and other moving portions.
- (d) How return spring operates piston and bolt.
- (e) How gun is cooled.

NOTE.—This should be general, without the mention of names. Avoid talking of things that cannot be seen. Detailed explanations will come later when the gun is stripped.

Advantages :

- (a) Lightness.
- (b) Compactness.
- (c) Reliability.
- (d) Rapid rate of fire.

Disadvantages :

- (a) Smallness of magazine supply.

Suitability for Aerial Work :

- (a) Well adapted for use as a mobile gun in an aeroplane.
- (b) Allows large field of fire.
- (c) Can be mounted on the top planes as well as in the fuselage.

B.—GENERAL DESCRIPTION OF PARTS.

The gun is divided into two portions :—

- (1) Stationary portions.
- (2) Moving portions.

STATIONARY PORTIONS.

These consist of :—

- (a) The Barrel Group.
- (b) The Body Group.

(a) *Barrel Group :*

1. *Barrel.* Calibre .303 in., number of grooves, 4 ; twist of rifling, right-handed.

NOTE.—For the purpose of demonstration, the spare barrel should be shewn.

It is threaded at the muzzle to take the *Barrel Mouthpiece*, which has a left-handed thread to prevent it from working loose, or becoming detached from the barrel during firing. In the Mark II gun this thread is utilized to take the nut which secures the *Norman Vane Foresight*.

A *Gas Vent* is bored in the barrel 4" from the muzzle to allow the gas to pass into the gas chamber. Around this vent, in the thickness of the barrel, is a conical recess with a flat base.

On the top of the barrel, near the rear end, is a Stud which fits in a slot in the radiator, ensuring that the gas vent is in position to receive the gas chamber. In the Mark II gun, this stud lies between two positioning studs on the under side of the flat surface at the rear end of the barrel casing.

Behind this stud is a *Collar* which determines the position of the barrel in the casing.

Behind the collar a *Square Thread* is cut for attachment to the body.

On the rear face of the barrel is a projection which coincides with the cut-away portion of the bolt face when the breech is closed. By this means the rim of the cartridge is held away from the barrel, so that the extractors are able to grip it, while at the same time the base of the cartridge is efficiently supported. The upper part of the entrance to the chamber is slightly sloped, to direct the nose of the bullet downwards.

Surrounding the barrel is the Radiator, which is of aluminium, has projecting flanges, and is split longitudinally. It assists in dissipating the heat of the barrel. At the forward end, on the under side, is a recess for the gas chamber. At the rear end, on the upper side, is a flat which corresponds with another flat on the radiator casing to ensure an alignment.

2. *Radiator Casing.* Around the barrel and radiator is the *Radiator Casing*, which consists of front and rear portions, connected by a *Clamp Ring*. The rear portion has a hole cut in it to allow for the entrance of the gas regulator, and a small hole to take the stud of the gas regulator key. The rear face is drilled to admit and hold in position the barrel and gas cylinder. There is also a small hole drilled for the body locking pin. The front portion is tapered, and extends beyond the barrel mouthpiece. On both portions are collars which take the clamp ring, slots being cut to accommodate the stud on it. The clamp ring is turned up at both ends to form a foresight protector, and the inner portion on the right side forms the foresight block, and is dovetailed to receive the foresight. The clamp ring is held in position by the *Clamp Ring Screw*. On the upper side of the radiator casing and at the rear, is a flat surface, the casing being cut away immediately in front for cooling purposes.

In the aerial gun the casing is in one piece, known as the *Barrel Casing*. There is no radiator, and the casing is of smaller diameter, except at the rear end, where it is of the same size as the ground gun. At the front end are two holes, one to take the gas regulator and one to take the stud on the gas regulator key. A small hole is drilled in the rear face to take the body locking pin. At the rear end are two bands, one of which takes the *Mounting Yoke*, and the other the *Ring Sight*.

3. *Barrel Sleeve.* In the aerial gun the barrel is supported at the front end by a *Barrel Sleeve*. This fits the casing exactly, but is fretted for cooling purposes. Its body is cut away to allow the barrel band to be inserted.

4. *Barrel Band.* Fitting closely round the barrel, and over the gas vent, is the *Barrel Band*. Being tapered, its correct placing is ensured by keeping to the front the small letter "F" stamped upon it. The band is bored and threaded to receive the gas chamber.

5. *Gas Chamber.* This may be one of two patterns:—

(a) Mark I type screws into the barrel band by means of a *Nipple* chamfered away at the end to fit tightly into the conical recess in the barrel. Its rear face is threaded to receive the gas cylinder. The chamber is hollowed out to take the gas regulator. On its circumference there are two wings which provide a grip for the spanner.

(b) Mark II type embodies:—

(i) A ring which fits round the barrel and takes the place of the barrel band in the Mark I pattern.

(ii) A vertical seating threaded internally to take a screwed plug.

(iii) A horizontal seating into which the gas cylinder screws.

The *Screwed Plug* has a left-handed thread, and is recessed at the top to take the barrel mouthpiece spanner. It has eight holes drilled through the cylindrical portion, and is threaded internally to take the gas regulator. The plug is kept in position by a *Keeper Screw*. The holes and recesses are so arranged that when the keeper screw is in one of the recesses, one of the holes is opposite to the gas cylinder.

6. *Gas Regulator.* Screwed into the gas chamber is the *Gas Regulator*, the object of which is to regulate the amount of gas admitted to the gas cylinder. For this purpose it has two holes of different size, either of which can be placed opposite the hole in the rear face of the gas chamber.

The position of these holes is indicated by the letters L and S (meaning large or small) stamped on the exposed end of the regulator.

7. It is held in position by means of the *Gas Regulator Key*, for which a square hole is cut through it. The key is held in place by a stud at its rear end, which enters a hole in the casing, a loop being provided immediately above to enable the point of a bullet to be used for springing the key out of the hole.

8. *Gas Cylinder*. This is a tube shaped at the rear end to admit the rack on the piston rod. Its forward end screws on to the gas chamber.

Mark I and Mark II cylinders differ in their manner of attachment to the gas chamber, and can only be used with Mark I and Mark II gas chambers respectively.

NOTE.—Great care should be taken to preserve the threads and to prevent the flattened portion from being damaged by the rack in stripping.

(b) *Body Group* :—

1. *Body*. This has a square thread for attachment to the barrel.

Bottom. Underneath the body is the Housing for the *Body Locking Pin*, in which lies the dumb-bell shaped *Body Locking Pin* that ensures and maintains the correct relative placing of body and barrel. At the side is a groove for the insertion of the nose of a bullet to withdraw the pin when stripping.

Immediately to the rear is the *Pinion Hinge Pin*, on which the pinion casing is hooked. Openings are cut to allow the pinion, plunger and sear to enter the interior of the body. There are also grooves in which the trigger group slides. Behind the grooves is a slot into which fit the lower projections of the butt cap.

Sides. On either side of the body is a slot in which the shank of the cocking-handle can travel. Each slot can be covered by a plate sprung into position and moved vertically by a thumb-piece. This plate serves as a *Safety Catch or Dust Protector*, the recesses in it holding the cocking-handle, whether in the forward or backward position. On the right hand side of the body is the *Ejection Opening*.

Top. Near to the front end is the *Magazine Post*, which is hollowed and countersunk to take the magazine catch. On the exterior of the post is a key which fits into a groove in the centre block of the magazine, and near the base at the front is a saw-cut. The magazine post can be lengthened to take Mark II magazines by the addition of an auxiliary *Magazine Post*. The top of the body is slotted throughout the greater part of its length, the front of the slot taking the shape of a cartridge, while the rear portion acts as a guide to the boss on the feed arm actuating stud. Near the front end of the cartridge-shaped slot, on the left, is a small groove, which coincides with a depression in the 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 which guides the rim of the cartridge. On the left side of the slot lies the *Ejector Seating*, which is closed by an *Ejector Spring Cover* sprung into position, and held at its forward end by grooves cut in the body. At the bottom of the seating is a hole into which fits the stud on the under side of the ejector.

The *Ejector* is hook-shaped and is pivoted on a stud on its under side. It is slightly cranked, in order that, while keeping its head in line with the slot in the face of the bolt, its tail may be in position to be actuated by the lug on the bolt.

At the rear of the body is a shallow channel in which moves the stud on the tail of the feed arm.

The rear part of the top of the body has running round it a raised portion which is flanged and under cut in places, to retain the body cover in position. The curved portion of this, at the front on its left side, acts as a stop to the forward movement of the body cover. At the front end, on its right side, is a small flat portion, which acts as a guide for the cartridges. The extreme rear part of the top of the body forms a bridge, above which is a raised platform, which gives strength and helps to position the body cover.

Interior. Inside the body are drilled the *Bolt-way* and the *Piston-way*. The bolt-way has four *Cruciform Guide-ways*, or grooves in the form of a cross, which admit the lugs on the bolt and on the feed arm actuating stud. At the forward end of the bolt-way are the *Locking Recesses*, in which the resistance lugs on the bolt lie when the breech is closed. Near the rear end of the bolt-way are recesses in which the interrupted flanges of the butt cap engage. On the left of the bolt-way, slots are cut to allow the head and tail of the ejector to project alternately into it. The piston way is flat-bottomed to take the rack.

2. *Body Cover.* This is shaped to fit on the top of the rear portion of the body. At its front end is a projecting *Tongue*, on the under side of which is the seating for the cartridge guide spring.

The *Cartridge Guide Spring* is held in position by an under-cut recess, and has a stud which fits in a hole in the tongue. The left leaf is turned over; the right leaf is in the form of a flat spring turned in and positioned at its free end by the left leaf.

The *Cartridge Guide*, which is superseding the cartridge guide spring, fits in exactly the same way. Its right leaf is similar in shape, but it is hinged and operated by a flat spring.

Behind the tongue is the *Housing for the Stop Pawls*, of which there are two, pivoted on studs. The *Left Stop Pawl* (marked 1) is the nearer to the top of the housing. The *Right Stop Pawl* (marked 2) has an enlarged head which brings it on a level with the under side of the body cover, and also prevents undue friction between the pawls themselves. Each stop pawl has a short tail which bears against the sides of the body cover and limits its movement. When Double magazines are used, the pawls need to be bevelled to avoid the lowest rivets on the magazine. Behind the pawls is the *Stop Pawls Spring*, a flat spring which tends to push their free ends forward. On its rear face is a stud by which it is positioned. At its left end a small portion is turned over to grip the right stop pawl, so holding both stop pawls down on their studs. At the back of the housing is a hole which accommodates the stud on the stop pawls spring. Behind this hole is a groove for the insertion of the nose of a cartridge. For lightness and the reduction of friction, the body cover is milled out, with the exception of two *Ribs*, which strengthen the cover and also act as a bearing surface for the feed arm. The body cover has round it a raised portion which corresponds with that on the body. At the rear end this raised portion fits over the raised platform on the body.

3. *Pinion Casing.* This is hollowed out to contain the pinion and return spring. At the front end is a hook which connects it to the body; this is cut away to accommodate the body locking pin, and slotted to allow the casing to be removed when the pistol grip is drawn back. At the rear end is the *Pinion Pawl*, which has two arms set at right angles, and is pivoted. One arm is actuated by a U spring bearing against it from behind; the other arm projects from the casing. When the trigger group is not in position, the former engages in the pinion to prevent the spring from unwinding. When the trigger group is in place, the projecting arm of the pawl is lifted so that the other arm is withdrawn from the pinion, leaving the pinion free to revolve. The casing is drilled to take the *Tension Screw*, and has shoulders which prevent that screw and the hub

from turning when the pinion and return spring revolve. Internally it has on one side a shallow recess which accommodates a circular projection on the pinion.

The *Pinion* is a hollow casing which forms one half of a drum, and is bored centrally to take the tension screw. On its outer circumference are 52 teeth, while its inner circumference has a recess into which a corresponding projection on the spring casing enters, causing the two parts to move as one.

The *Spring Casing* contains the *Return Spring*, which is flat and coiled and has its outer end anchored by two studs which fit into two slots in the rim of the casing. The inner end of the spring is turned over to fit into a slot in the *Hub*. The latter is bored and threaded to take the tension screw.

4. *Trigger Group*. This is held in the grooves on the under side of the body. It is a frame which is channelled at the top to contain the plunger, the trigger, the sear, and the butt catch. The lower part of the frame forms the *Trigger-Guard* and *Pistol Grip*. Externally it has grooves cut along the top edge, while at its front end is a recess for the projecting arm of the pinion pawl. The *Plunger* is a hollow cylinder with a slot to take the front end of the trigger. It contains the spring by which the trigger is actuated, and serves to position the pistol grip frame when the spade grip is removed. The *Trigger*, which is pivoted on an axis pin, has two arms, the forward one of which engages with the plunger, while the other has at its rear end a claw.

The *Sear* is also pivoted on an axis pin and has two arms, the front one engaging with the claw on the trigger, while the rear end of the other forms the sear *Nose*.

At the rear end of the pistol grip frame is the *Butt Catch*, which is operated by a spiral spring and is secured by a fixing-pin.

5. *Spade Grip*. This is fitted to the rear end of the body and comprises the *Butt Cap* and a *Handle*. On the cap is a stud with four cruciform lugs by which the spade grip is attached to the body. Below this stud is a projection with a recess into which the butt catch fits. The handle is covered with leather and hollowed out to form a reservoir for oil, this reservoir being closed by a milled-head screw to which is attached a camel hair brush.

MOVING PORTIONS.

1. *Piston Rod*. This is in two parts, joined by a loosely fitting thread secured by a pin, an arrangement designed to compensate for any want of alignment between the cylinder and the body. The piston *Head* is cupped, and has four *Rings* with the same number of *Grooves*: these tend to hinder the escape of gas, to clear away fouling, and to reduce friction. Under the rear portion of the piston rod is a *Rack* having 60 teeth. Behind the rack is a *Bent* which engages with the nose of the sear. On the top of the piston rod is the *Striker Post*, which is drilled for the *Striker*, the latter being secured by a fixing pin; the striker post is cammed at the front left and right rear side, so as to work in conjunction with similar cam surfaces on the slot in the bolt.

The rear end of the piston rod is cut away at the sides for lightness and the reduction of friction. Behind this cut-away portion is a slot which takes the shank of the cocking-handle.

The *Cocking-handle* has a flat *Shank* which fits into the slot in the piston rod. On this shank are two shoulders which secure the cocking-handle in the slots in the side of the body. The *Head* of the cocking-handle is cupped for the sake of lightness.

2. *Bolt*. This is a hollow cylinder. Its face is pierced by the *Striker Hole*, and has a rim which supports the base of the cartridge, gaps being cut to accommodate the extractors, the cartridge rim stop, and the head of the ejector.

The two *Extractors* are flat springs, each of which fits into a recess or *Extractor Seating* cut in the outer surface of the bolt. At the front there is a claw which grips the rim of the cartridge, and a stud which sinks into a hole in the seating. The rear end is shaped to fit into a groove which positions it securely. Lengthwise in the bolt is cut a *Cam Slot* in which the striker post travels. At the rear end of the bolt are four *Cruciform Resistance Lugs* which fit the *Cruciform Guide-ways* in the body. These are all rounded off at the right rear corner to facilitate their rotation into the locking-recesses. The top lug is flattened to allow free movement of the feed arm, while the left one is slightly cut away to admit of free movement of the tail of the ejector. The bolt is threaded internally at the rear end, and its rear face has two shoulders which act as stops for the feed arm actuating stud.

3. *Feed Arm Actuating Stud*. This is threaded externally to screw into the rear of the bolt, and has two square stops to correspond with the two on the bolt. It has four *Cruciform Guide Lugs* which also fit the cruciform guide-ways. On the topmost lug is the *Boss of the Feed Arm Actuating Stud*, a heart-shaped stud which works in the rear part of the slot in the top of the body and operates the feed arm.

4. *Feed Arm*: This has at its front end a hole which passes over the magazine post on which it pivots. A hinged *Latch* secures the feed arm to the magazine post by engaging in the saw-cut on its base. A slot called the *Feedway* is cut in the feed arm to allow the cartridges to pass from the magazine to the body. A small depression and turned-up portion on the left acts as a *Bullet Stop*; this keeps the cartridge in position during the movement of the feed arm to the left. Slightly further back is the *Cartridge Stop*, which prevents the cartridge from jumping up after leaving the cartridge guide spring. The raised portion forming the cartridge and bullet stops is interrupted by a small cut-away part which allows clearance for the separating pegs of the magazine. Further to the rear are three studs. The largest is the *Feed Pawl Spring Stud*, which positions one end of the *Feed Pawl Spring*. The next in size is the *Feed Pawl Stud*, which serves as a pivot for the *Feed Pawl*. The smallest is the *Feed Pawl Stop Stud*, the function of which is to stop the forward movement of the feed pawl. The *Feed Pawl* has a slot in which its spring lies, and its under side is recessed to accommodate the other end of the spring, which is positioned by the *Feed Pawl Spring Retaining Stud*. The *Tail* of the feed arm is curved and grooved on its under side to receive the boss on the actuating stud. At the end of the tail is a positioning 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 actuating stud again enters the groove in the tail of the feed arm.

THE MAGAZINE.

This is a circular pan with 25 rectangular *Indentations* or *Corrugations* on the rim. Inside these, plates are riveted to hold the bases of the cartridges. A circular hole is cut in the centre of the pan, 25 *Recesses* being cut round the edge of this hole. The hole is covered by a *Disc* which has a circular channel on its under side for the *Magazine Catch*. The catch is shaped to fit this channel, and has a projecting *Tongue* with a *Nib* at the end, the nib being intended for engagement with the recesses mentioned above. Opposite to this tongue is placed the *Magazine Catch Spring*, which tends to keep the nib pressed into one of the recesses. A ring carrying 25 *Separating Pegs* is riveted round the central hole. These

pegs and the indentations on the rim hold the cartridges in position, and carry them round when the magazine is rotated. Projecting from the magazine catch into the hollow magazine post is a sloping thumb-piece terminating in a hooked portion which engages in a recess below the counter-sunk portion of the post and so holds the magazine on to the gun. To the under side of the centre disc is riveted an aluminium *Centre Block* which has a spiral channel connected by a ramp to accommodate the noses of the bullets. In the centre is the hole for the magazine post, and a *Key-way* is cut to fit the key on the magazine post. The magazine catch locks the centre block to the pan and prevents the latter from rotating when the magazine is not in position on the gun.

Magazines are of two types:—

- (a) *Single Magazines*. These hold 47 cartridges and weigh when empty $1\frac{1}{2}$ lbs.; when full $4\frac{1}{4}$ lbs.
- (b) *Double Magazines*. These hold 97 cartridges and weigh when empty $3\frac{1}{2}$ lbs.; when full 8 lbs., 14 ozs.

“SPEEDED-UP LEWIS GUNS.”

In order to make Lewis Guns more certain of functioning at high altitudes with the double magazine, and also to increase the rate of fire, Conversion Sets are being fitted, consisting of the following components:—

- (1) Mark 1* Barrel.
- (2) Mark 1* Gas Regulator.
- (3) Plug and Volute Spring.

Mark 1 Barrels* are special to the speeded-up Guns and have a flat near the muzzle on which they are marked 1* A.S. They have a larger gas hole but are otherwise the same as a Mark 1 Barrel.

Mark 1 Gas Regulators* are also special to the Speeded-up Gun and are reduced in internal capacity by the insertion of a plug, shaped to guide the gases straight into the gas cylinder. A slot is cut in the underneath surface for easy identification, and the Regulator is marked 1* A.S.

The Mark 1 Barrel and the Mark 1* Gas Regulator*, when fitted to the gun in place of the standard barrel and gas regulator, increase the blow of the gases on the piston rod, thereby increasing the velocity of the backward movement of the recoiling parts.

The Plug is fitted into the rear end of the piston rod, with its flat end to the rear.

The Volute Spring is then inserted so that its smaller end protrudes to the rear and provides a buffer between the piston rod and the spade grip. This spring serves to absorb some of the extra energy, due to the greater velocity of the backward movement of the recoiling parts and gives some of this energy back for the purpose of increasing the velocity of their forward movement. The velocity of the backward movement is therefore increased by the larger gas hole and special gas regulator, and the velocity of the forward movement is increased by the Volute Spring which, in addition, serves to minimise the blow on the spade grip and to prevent fractures.

HAZLETON MUZZLE ATTACHMENT.

This is still being used as a temporary means of speeding up the gun until the adequate supplies of the Conversion Sets mentioned above are available.

It is screwed on to the muzzle and speeds up the gun by allowing more of the gases to be trapped.

IMPORTANT.—H.M.A.'s and the Conversion Sets must never be used together, as otherwise excessive breakages would result.

III.—DRILL.

1.—GENERAL REMARKS.

- (1) The objects of the drill are :—
 - (a) To accustom the gunner to handle the gun and to change magazines cleanly and correctly.
 - (b) To train the gunner in certain movements till they become automatic, so that no time may be lost in opening and maintaining the fire of the gun during action.
- (2) Double magazines should always be used.
- (3) The gunner will repeat all orders.
- (4) In the early stages no time limit should be set. This may be introduced later and gradually reduced as proficiency is attained.
- (5) Streamlining to meet various directions of slipstream should be practised.
- (6) When the pupils are proficient, drill should be carried out with the gun in various positions, e.g., the gunner may sit with his legs between the short legs of the tripod, the long leg of which then points towards the target.
- (7) Further practice should be given in a fuselage, or with a Scarff—or other mounting fixed on a stand

2.—KIT REQUIRED.

- (1) Gun with ring sight and mounting.
- (2) Six magazines, with one dummy in each.
- (3) Model aeroplane, for use as a target.
- (4) Tripod.
- (5) Ground sheet, when working in the open.

POSITION OF GUN.

- (1) Mounted on the tripod.
- (2) Muzzle pointed to the ground.
- (3) Target at 10 yards distance.
- (4) Six magazines, placed on the right of the tripod.

3.—PRELIMINARY.

On the command "Fall in!" the squad takes up position in line, 5 yards in rear of the tripod.

The squad then numbers.

Each detail should see that the magazines are placed on his right, with the luminous paint to the rear and the lip of the centre-block in the correct position.

4.—METHOD OF TEACHING.

(a) *Demonstration* :

Instructor demonstrates :—

- (i) Complete drill, taking care to set an example of clean and correct action.

- (ii) The section about to be taught.

(b) *Explanation* :

Instructor explains in detail the section to be practised, shewing clearly the various points to be observed.

(c) *Squad Practice* :

Each member of the squad carries out the section just demonstrated and explained.

The Instructor criticises after each attempt.

(d) *Interrogation* :

Instructor tests Pupils' knowledge of the sequence of the actions and of the points to be observed.

Command.	Detail of Gunner's Action.
I.—“ No Detail, take post ! ”	(1) Double to tripod. (2) Take up position on seat. (3) Place gun in position for loading :— (a) Place right hand on spade grip. (b) Lower gun.
II.—“ Load ! ”	(1) Place magazine on post :— (a) Grip magazine firmly with both hands, putting thumbs across the upper surface and fingers under the centre-block. (b) Streamline magazine on to post. (c) Test magazine catch by a sharp upward pull on magazine before releasing grip. (2) Put gun in firing-position :— (a) Grasp spade grip firmly with right hand. (b) Raise gun to horizontal position, at the same time pulling back cocking-handle smartly with left hand. (c) Grasp pistol grip with left hand.
III.—“ At aeroplane ! ”	(1) Take aim :— (a) Plant feet firmly on ground. (b) Place elbows firmly on the inside of the thighs, keeping the knees apart. (c) Grip gun firmly, pressing inwards with both hands, and placing thumb on the top of the spade grip. (d) Rest chin on thumb. (e) Align sights on mark.
IV.—“ Fire ! ”	(1) Press trigger. (2) Release trigger. (3) Keeping the eye on the mark, strike magazine a glancing blow towards left front, using palm of left hand. NOTE.—This movement should be made from the elbow, and the hand at the moment of striking the magazine as near vertical as possible. (4) Lower gun till pistol grip rests on tripod. (5) Change magazine :— (a) Grip magazine as before. (b) Release catch with left thumb. (c) Stream-line magazine to left side of tripod. (d) Place on next magazine in same manner as before.

NOTE.—Repeat II, III and IV until all magazines have been used.

Command.	Detail of Gunner's Action.
V.—“Unload !” and “Clear gun !”	(1) Remove magazine. (2) Raise gun to firing-position, and keeping the eye on mark, pull back cocking-handle 3 times, keeping trigger pressed (3) Raise gun and place it so that the muzzle points to the ground, taking care that the gun does not strike the tripod with any force. (4) Report “Gun clear !”
VI.—“Stand Clear !”	Rise from seat and retire to position in squad.

NOTE 1.—In actual practice on the range, there may be a round in the feed arm. This round is thus fired.

NOTE 2.—To remove round from the feed arm when it is not safe to fire :—
Hold back the cocking-handle with the left hand and press the trigger with the right hand.

Allow the cocking-handle to go slightly forward. Insert screw-driver through the ejection opening (after opening deflector bag) and press on the under side of the shoulder of the cartridge.

Allow the cocking-handle to go forward slowly ; the cartridge will roll out to the right on the top of the feed arm.

TEST :—

- (1) 6 Magazines to be used with a dummy cartridge in each.
 - (2) Gun to be loaded, aimed and fired ; magazine to be rotated and changed.
 - (3) Repeat until the 6 magazines have been used.
 - (4) Gun to be un-loaded and cleared.
- Time allowed—1 minute.

IV.—STRIPPING.

1.—GENERAL REMARKS.

(1) Stripping guns should be used for instructional purposes.

(2) No time limit will be imposed ; ability to strip a part correctly, (or in the case of instructors to teach how it should be stripped correctly) will form the basis of all stripping examinations. (When pupils are proficient, time tests are permissible).

(3) For stripping the Mark II gun, the only tools necessary are :—a dummy cartridge with a metal-pointed bullet and a barrel mouth-piece spanner.

(4) When stripping, all parts are to be laid out in order and so placed that they will be kept clean and undamaged.

(5) With reasonable care, defects and breakages should be of extremely rare occurrence. They are simply due to the neglect of ordinary precautions.

2.—SEQUENCE OF STRIPPING MARK II GUN.

- | | |
|--------------------------|--|
| (1) Spade Grip. | (9) Body. |
| (2) Trigger Group. | (10) Gas Regulator Key. |
| (3) Pinion Casing. | (11) Gas Regulator. |
| (4) Body Cover. | (12) Barrel and Attachments from Casing. |
| (5) Feed Arm. | (13) Gas Cylinder. |
| (6) Cocking-handle. | (14) Gas Chamber. |
| (7) Piston Rod and Bolt. | (15) Barrel Sleeve and Band. |
| (8) Body Locking Pin. | |

Pinion Casings should have a small recess cut in the front part of the hook which attaches them to the pinion hinge pin. This recess, as it clears the body locking pin, enables the pinion casing to be removed without any further steps than the release of the projecting end of the pinion pawl.

3.—DETAILS OF STRIPPING GUNS.

NOTE.—Before commencing to strip see that the cocking-handle is in the forward position.

- (1) Insert bullet in the recess behind the butt catch and force it forward. Turn spade grip $\frac{1}{4}$ of a turn to the left and draw out.
- (2) Keeping the trigger pressed, slide off the pistol grip.
- (3) Unhook the pinion casing.
- (4) Pull back body cover to fullest extent and lift it off.
- (5) Open feed arm latch, turn the feed arm till the key-way coincides with the key on the magazine post and lift it off.

NOTE.—As the feed arm is easily damaged, care must be taken to keep bullet vertical when opening feed arm latch, and to avoid strain on the feed arm when handling it.

- (6) Draw the cocking-handle to the rear and pull it out.
- (7) Slide out piston rod and bolt, separating the two after removal.
- (8) Turn the gun over to the left; push back the body locking pin with the nose of a bullet and take it out.
- (9) Unscrew the body from the barrel (giving $2\frac{1}{2}$ turns).
- (10) Remove the gas regulator key, placing nose of bullet in loop provided.
- (11) Unscrew the gas regulator.
- (12) Draw out the barrel and attachments from the front end of the barrel casing.

NOTE.—In the case of the Mark I gun, unscrew the clamp ring screw, remove the clamp ring and front radiator casing: slide the rear part of the casing off to the rear.

- (13) Unscrew the gas cylinder.
- (14) Unscrew the gas chamber.
- (15) Tap off the barrel sleeve and barrel band and separate them when removed.

4.—RE-ASSEMBLING.

To re-assemble the gun, reverse the order and processes given above. The following points are important :—

- (1) See that the barrel band is placed correctly on the barrel. (The letter "F" indicates the front).
- (2) When screwing on the gas cylinder, see that it is quite square with the gas chamber ; otherwise the fine threads of the screw may be injured. If the piston rod is used for this purpose, it must enter so that the rack has a good bearing on the flattened portion of the cylinder.
- (3) See that the feed arm actuating stud is screwed up as far as the stops allow.
- (4) See that the cocking-handle is placed securely in the slot, and right forward, before replacing the feed arm.
- (5) See that the feed arm is over to the right before replacing the body cover.

5.—DETAIL OF STRIPPING COMPONENT PARTS.

Trigger Group :

Using a No. 4 punch—

- Drive out the sear axis pin.
- Remove the sear.
- Drive out the trigger axis pin.
- Remove the trigger.
- Take out the plunger and spring.
- Drive out the butt catch fixing pin.
- Remove the butt catch and spring.

To assemble :

Reverse the order and processes given above, taking care that the pins do not protrude into the grooves.

NOTE.—The trigger group should be stripped only by students in training as Instructors or Armourers.

Pinion Casing :

Raise the pinion pawl and ease down tension of the return spring.

This will cause the tension screw to come away from the shoulders on the pinion casing.

Remove the tension screw.

Remove the pinion from the casing.

Separate the return spring casing from the pinion (pressing out the opposite side of the hub with the point of a bullet, if necessary).

Remove the hub.

To assemble :

Replace the hub, making sure that the turned-in edge of the return spring is over the rounded edge of the slot.

Replace the spring casing in the pinion, taking care that the projection on the rim of the former is in the recess provided for it in the latter.

Replace the pinion in the pinion casing, taking care that the circular projection round its hub is in the shallow depression made for it in the pinion casing.

Screw in the tension screw until it is nearly home, then, holding the screw in line with the shoulders, rotate the pinion until the tension screw is drawn into its seating.

NOTE.—If the spring is broken, in order to remove the tension screw, it may be necessary to release the pinion pawl and unwind the return spring, at the same time tapping the tail of the tension screw

Body Cover :

- (a) To remove the cartridge guide spring.
Press down stud with the point of a bullet.
Slide the spring out.
- (b) To remove the stop pawls :
Force the stud of the stop pawls spring out of its seating (using the point of a bullet and keeping the fingers over the pawls to prevent spring from flying out).
Lift the pawls off the studs.

To assemble :

Reverse the above order. (The studs and pawls are marked 1 and 2 to ensure their correct arrangement).

Feed Arm :

Lift the pawl and spring off their studs.
Unhook the spring from the pawl.

To assemble :

Reverse the above order.

Extractor :**To remove :**

Insert the point of a bullet under the claw. Force back until the stud is just clear of the recess. Lever the extractor out of its seating, using no more force than is necessary.

To replace :

Place the extractor in the seating so that its rear end is at the commencement of the grooves. Grasp the bolt in the hand with the thumb pressed on the extractor and bear downwards and slightly outwards on to a solid surface till the extractor springs into position.

Body :**(a) Ejector :**

Raise the rear end of the ejector cover with a bullet and withdraw it. Remove the ejector from its seating, rear end first, by pushing it up from underneath with a bullet.

To assemble :

Replace the ejector, front end first.
Slide the spring cover into grooves, convex surface uppermost.

(b) Safety Catch :

Raise the safety catch.
Insert a screw-driver under it near the middle.
Spring it out, keeping the other hand over it to prevent it from flying up.

To assemble :

Spring the safety catch into position.

METHOD OF INSTRUCTION.

The instruction in stripping should proceed on the following lines :—

(a) Demonstration :

The instructor strips the gun or the part under consideration, and then re-assembles, proceeding slowly enough for each step to be followed and understood.

(b) Explanation :

The instructor explains each step, and emphasises any precautions that are to be taken.

(c) Squad Practice :

Each member of the squad in turn carries out the practice, the instructor insisting on clean and correct handling (which, in the instructional stage, is much more important than speed).

(d) Interrogation :

The instructor tests the students' knowledge of the order of stripping and of precautions to be taken

V.—THE TEACHING OF MECHANISM.

GENERAL REMARKS.

1. 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.

2. As the mechanical processes of the Lewis Gun are difficult (or, in some cases, impossible) to see from the outside, the gun should at every stage be stripped down sufficiently to make clear all that is happening.

3. Diagrams and Pascoe models should be used.

4. The following is the correct sequence in which instruction should always be given. Each stage must be thoroughly understood before the next stage is attempted :—

A.—Backward Movement :

1. Action of gases.
2. Backward movement of Piston Rod.
3. Backward action of Bolt ; Extraction and Ejection.
4. First action of Feed Arm and Pawls.
5. Action of Magazine.
6. Engagement of Sear.

B.—Forward Movement :

1. Release of Sear.
2. Forward Movement of Piston Rod and Bolt.
3. Locking of Bolt.
4. Ignition of the Cartridge.
5. Second action of Feed Arm and Pawls.

NOTE.—During the forward movement, the magazine does not rotate.

KIT REQUIRED.

1. Gun mounted on some form of mounting.
2. Skeleton magazine (if available).
3. Dummy cartridges.
4. Empty case (dummy without bullet).
5. Metal pointed dummy (for stripping).
6. Instructional diagrams and models.

METHOD OF TEACHING.

A.—Backward Movement :

1.—ACTION OF GASES.

(a) Preparation of Gun :

Remove :—

- Spade Grip.
- Trigger Group.
- Pinion Casing.
- Body Cover.
- Feed Arm.
- Gas Regulator.

(b) Demonstration :

Shew on gun and by sectional diagrams and model, the path followed by the gas, inserting gas regulator at the proper moment.

(c) Explanation :

When the explosion takes place, cordite turned to gas which rushes along barrel behind bullet.

Part of the gas enters through the gas vent into gas chamber (which has the gas regulator for lining).

Hole in gas regulator and gas chamber admit gas to gas cylinder.

Here it strikes the head of the piston rod.

Piston rod driven to the rear.

(d) *Squad Practice :*

Individual members of the squad give an account as outlined above.

(e) *Interrogation :*

- Instructor tests pupils' understanding of this part of the mechanism.

2.—BACKWARD MOVEMENT OF PISTON ROD.

(a) *Preparation of Gun :*

Remove :—

Spade Grip.
Trigger Group.
Pinion Casing.
Body Cover.
Feed Arm.
Gas Regulator.
Piston Rod and Bolt.

(b) *Demonstration :*

- (a) With parts removed from gun.
Shew movement of piston rod ; bolt stationary.
(b) With parts in gun.
Repeat with parts assembled.

(c) *Explanation :*

Movement of piston rod to rear.
Revolves pinion on hub.
Return spring is, therefore, wound up.
Striker post moves with piston rod.
First $1\frac{1}{8}$ of movement is along straight part of camway groove.
Reason for this :—Safety device to allow pressure of gas in barrel to drop before breech is opened. Also to allow moving parts to gain sufficient momentum to unlock bolt.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

3.—BACKWARD ACTION OF BOLT.

EXTRACTION AND EJECTION.

(a) *Preparation of Gun :*

Remove :—

Spade Grip.
Trigger Group.
Pinion Casing.
Body Cover.
Feed Arm.
Piston Rod and Bolt.

(b) *Demonstration :*(i) *Rotation of Bolt :*

With parts out of gun :—
Shew movement of piston rod : bolt rotates.

With parts in gun :—

Draw back cocking-handle slowly to shew rotation of resistance lugs.

(ii) *Extraction :*

Place empty case into chamber through the ejection opening and push bolt forward so that the extractors grip the rim of the case. Pull cocking-handle back, to shew empty case through the ejection opening (avoid ejecting case at this stage).

(iii) *Ejection :*

Pull back cocking-handle smartly.

Insert case again and repeat slowly.

Shew, through the slot in the top of the body, the action of the bolt on the tail of the ejector.

Shew movement of the head of the ejector.

(c) *Explanation :*(i) *Rotation of Bolt :*

The right side of the striker post bears against the right side of the curved part of the camway groove.

Bolt rotates $\frac{1}{8}$ of a turn to the left.

Resistance lugs withdrawn from the locking recesses and placed opposite the cruciform guide-ways.

(ii) *Extraction :*

Rear of the striker post presses on rear end of the slot in the camway groove.

Bolt is carried backwards.

Extractors pull the empty case out of the chamber and carry it to the rear.

(iii) *Ejection :*

Left lug on the feed arm actuating stud strikes against the tail of the ejector.

Head of the ejector is therefore pushed across the face of the bolt (through the recess provided for it).

Cartridge receives a smart tap near its base and is ejected through the ejection opening.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

4.—FIRST ACTION OF FEED ARM AND PAWLS.

(a) *Preparation of Gun :*

Remove :—

Spade Grip.

Trigger Group.

Pinion Casing.

Body Cover.

(b) *Demonstration :*

(i) Pull back cocking-handle slowly, shewing movement of feed arm from right to left.

(ii) Place on magazine.

Pull back the cocking-handle, shewing the rotation of the magazine by the feed pawl.

(iii) Place on body cover and shew movement of right stop pawl—using Pascoe model first, as this is very difficult to shew on the gun.

(iv) Shew action of the left stop pawl, using Pascoe model first.

(c) *Explanation :*

- (i) As the bolt comes back, the boss on the feed arm actuating stud moves down the channel on the under side of the feed arm.

Feed arm is moved from right to left.

- (ii) Feed pawl moves with the feed arm.

- (iii) Feed pawl spring stud bears away from the head of the right stop pawl, so allowing it to move forward.

Head of the right stop pawl engages in front of a corrugation and prevents further rotation of the magazine.

- (iv) Left stop pawl is meanwhile moved backwards by the corrugation acted on by the feed pawl, but engages behind it.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

5.—ACTION OF MAGAZINE.

(a) *Preparation of Gun :*

Remove :—

Spade Grip.

Trigger Group.

Pinion Casing.

(b) *Demonstration :*

Hold loading handle, with magazine (containing dummies), above the eye level of the squad and rotate, to shew action of the slope of the centre block.

Place skeleton magazine (containing dummies) on gun and rotate to shew action of the cartridge guide spring.

Shew, through the ejection opening, the position of the cartridge at the end of the movement.

(c) *Explanation :*

As the magazine rotates, the cartridge nearest the lip of the centre block is forced down by the slope into the slot on the feed arm.

Corrugations in magazine pan, combined with separating pegs and feed arm, carry it under the cartridge guide spring, which forces it completely out of the magazine into the slot on the body.

Cartridge assumes a slanting position with the nose of the bullet pointing downwards towards the chamber.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

6.—ENGAGEMENT OF SEAR.

(a) *Preparation of Gun :*

Remove :—

Spade Grip.

Trigger Group.

Pinion Casing.

(b) *Demonstration :*

Hold up trigger group to shew nose of sear. Turn the gun over to shew, through the aperture in the under side of the body, the bent on the piston rod.

Place the trigger group in position on the gun and pull back the cocking-handle till the nose of the sear is engaged in the bent on the piston rod.

(c) *Explanation :*

As the piston rod comes back, the bent passes over the sear (owing to the bevel).

As long as the nose of the sear is not held down by pressing the trigger, it will rise immediately under the influence of the spring and engage in the bent on the piston rod.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

B.—Forward Movement :**1.—RELEASE OF SEAR.**(a) *Preparation of Gun :*

Remove :—

Spade Grip.

Pinion Casing.

(b) *Demonstration :*

(i) Press the trigger and shew that the cocking-handle can be moved forward.

(ii) Put on pinion casing and pull back cocking-handle ; press the trigger and shew that the cocking-handle and piston rod are carried forward by the return spring.

NOTE.—The movement of the piston rod can be seen through the cocking handle slot on the right of the body.

(c) *Explanation :*

(i) When the trigger is pressed, the nose of the sear is disengaged from the bent on the piston rod.

(ii) Return spring is allowed to carry the piston rod and bolt forward, the pinion acting on the rack.

(d) *Squad Practice.*

As before.

(e) *Interrogation :*

As before.

2.—FORWARD MOVEMENT OF PISTON ROD AND BOLT.(a) *Preparation of Gun :*

Remove :—

Spade Grip.

Trigger Group.

Pinion Casing.

Body Cover.

Feed Arm.

Piston Rod and Bolt.

(b) *Demonstration :*

(i) Holding up piston rod and bolt, shew how striker post bears on the side of the camway groove.

(ii) Replace piston rod and bolt in gun and shew forward movement of bolt, demonstrating the position of the lugs in the cruciform guide-ways.

- (iii) Demonstrate the action of the bolt on the ejector.
- (iv) Place on feed arm and body cover ; lay cartridge in feed arm ; pull back cocking-handle and repeat forward movement, shewing how cartridge is forced into the chamber.

(c) *Explanation :*

- (i) As the piston rod goes forward the left side of the striker post bears on the left side of the curved part of the camway groove.
- (ii) Bolt tends to rotate but is prevented by resistance lugs being in the cruciform guide-ways ; so the bolt is carried forward.
- (iii) As the bolt goes forward, it pushes back the head of the ejector, the tail being thereby forced into the bolt-way behind the bolt.
- (iv) Top extractor strikes the lower edge of the cartridge and pushes it forward into the chamber, where the extractor claws spring over the rim and grips it.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

3.—LOCKING OF BOLT.

(a) *Preparation of Gun :*

Remove :—

Spade Grip.
Trigger Group.
Pinion Casing.
Body Cover.
Feed Arm.
Piston Rod and Bolt.

(b) *Demonstration :*

- 1. Holding up piston rod and bolt, show the rotation of the bolt.
- 2. Move cocking-handle forward, stopping when the resistance lugs are opposite the locking recesses.
- 3. Continue forward movement of cocking-handle and show rotation of bolt.

(c) *Explanation :*

- 1. Left side of the striker post continues pressure on the left side of the curved part of the camway groove.
- 2. Bolt has now reached the limit of its forward movement. Resistance lugs are out of the cruciform guide-ways.
- 3. Resistance lugs turn into the locking recesses. Bolt is now locked and the breech closed. Resistance lugs are in a position to take the shock of discharge.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

4.—IGNITION OF CARTRIDGE.

(a) *Preparation of Gun :*

Remove :—

Spade Grip.
Trigger Group.
Pinion Casing.
Body Cover.
Feed Arm.
Piston Rod and Bolt.

(b) *Demonstration :*

1. Holding up piston rod and bolt, show the striker post moving along the straight part of the camway groove.
2. Replace piston rod and bolt in gun and show that when the bolt has ceased to move, the piston rod continues forward movement.

(c) *Explanation :*

When the bolt is home, the piston rod continues forward movement ; the striker post moves along the straight part of the camway groove, the striker passing through the striker hole till it ignites the cartridge.

Reason for this :—A safety device to ensure that the breech is closed before the shock of the explosion takes place. Also free movement of the striker is required to allow it sufficient momentum to ignite the cap.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

5.—SECOND ACTION OF FEED ARM AND PAWLS.

(a) *Preparation of Gun .*

Remove :—

Spade Grip.
Trigger Group.
Pinion Casing.
Body Cover.

(b) *Demonstration :*

1. Push forward the cocking-handle, showing the movement of the feed arm from left to right.
2. Put on the magazine and push forward the cocking-handle to show movement of the feed pawl : holding magazine with the right hand.
3. Put on the body cover and show movement of the right stop pawl, using Pascoe model first.
4. Show that the left stop pawl remains stationary, using Pascoe model first.

(c) *Explanation :*

1. As the bolt goes forward, the boss on the feed arm actuating stud moves along the channel on the underside of the feed arm.
Feed arm is moved from left to right.
2. Feed pawl moves with the feed arm, rides over the corrugation of the magazine and engages behind it.
3. Feed pawl spring stud moves towards the head of the right stop pawl and presses it back out of action.
4. Left stop pawl remains stationary, preventing any movement of the magazine.

(d) *Squad Practice :*

As before.

(e) *Interrogation :*

As before.

VI.--CARE AND CLEANING.

- (1) Importance of subject.
- (2) Instructional kit required for teaching.
- (3) General points.
- (4) Wear in bore.
- (5) High polish of interior of new barrel.
- (6) Kinds of fouling :
 - (a) Internal.
 - (b) Superficial
 - (c) Metallic.
- (7) Removal of fouling.
- (8) Care of Gas Cylinder.
- (9) Care of Gas Chamber.
- (10) Lubrication of Gun.
- (11) Daily Cleaning.
- (12) Weekly Cleaning.
- (13) How to use the steel cleaning-rod.
- (14) How to put on a gauze.
- (15) How to use the double pull-through.
- (16) Cleaning with boiling water.
- (17) Barrels : packing for store.
- (18) Care of Magazines..

I.—IMPORTANCE OF SUBJECT.

Careful attention should be given to this branch of the instruction, in order that the gun may fulfil to the utmost of its power any task demanded of it from a mechanical point of view, and in order to obtain the maximum results when fire is applied.

2.—INSTRUCTIONAL KIT REQUIRED FOR TRAINING.

Gun.
 Spare parts.
 Magazines.
 Loading-handle.
 Dummy cartridges.
 Steel cleaning rod for barrel.
 Wooden cleaning-rod for gas cylinder.
 Wire brush.
 Woollen mop.
 Double pull-through.
 Gauze.
 Flannelette and oil linen.
 Lubricating oil, turpentine and paraffin.
 Mirror reflector.
 Spring balance.
 Boiling water.

3.—GENERAL POINTS.

The Instructor should explain the necessity for observing the following points :—

- (a) Guns should be examined daily after cleaning.
- (b) Avoid damage to the gun through careless handling.
- (c) Never play with the cocking-handle (the reason for this being that unnecessary action of the cocking-handle produces wear on the striker post and the return spring).
- (d) Never keep the return spring compressed unnecessarily.

- (e) See that the milled head brush is kept secure.
- (f) See that all the points taught in Stripping and Examination of Gun are observed.
- (g) The browning on the gun and barrel must be preserved, as it is a protection against rust.
- (h) Carbon deposit occurs in Gas Chamber, Gas Regulator, Gas Cylinder and on Piston Head. This should be removed by the Armourer Sergeant.

4.—WEAR IN THE BORE.

Wear in the bore of machine guns is due to three causes :

- (a) The friction of the bullet.
- (b) The heat generated by the firing of the ammunition.
- (c) The friction of the pull-through gauze when the bore is being cleaned.

Undue wear is caused by improper and unnecessary use of the pull-through gauze, to prevent which it is most important that instructions for cleaning be adhered to:

5.—HIGH POLISH OF INTERIOR OF NEW BARREL.

The interior of a new barrel carries a high polish, and this is a safeguard against rust and metallic fouling, but it must be recognised that as the bore becomes worn this polish will diminish. Efforts to restore it with wire gauze on the pull-through result in unnecessary wear. But though the polish may diminish, it must be understood that the lands should be bright and free from stain or rust or fouling.

6.—KINDS OF FOULING.

In order that the instructions for cleaning the barrel may be understood, it is essential that the causes of fouling in barrels should be briefly explained. Fouling may be of three kinds :—

- (a) *Internal*, caused by the forcing of the products of combustion into the pores of the metal.
- (b) *Superficial*, caused by the deposit in the bore, of the solid products of the charge and of the cap composition.
- (c) *Metallic*, which is also known as Nickelling, and is caused by a portion of the cupro-nickel envelope of the bullet being left on the bore. It appears as a whitish streak on the lands, or as a roughness on the edge of the grooves. If deposited near the muzzle or the breech, it is visible to the eye when the bore is clean, but can only be detected in the centre of the bore by the use of the gauge plug. It is a cause of inaccuracy, and, if the gun shoots badly for no apparent reason, its presence should be looked for as a possible explanation.

7.—REMOVAL OF FOULING.

- (a) *Internal Fouling*. This may be removed satisfactorily by the use of boiling water. If, for any reason, this method cannot be used, the barrel will sweat, and a hard black crust of fouling will appear in the bore. This will turn to red rust if not removed, and the barrel will then require repeated cleanings with flannel-ette and with gauze for a length of time which will vary according to climatic conditions and the state of the bore.
- (b) *Superficial Fouling*. This is readily removed when warm, by the use of the cleaning-rod and flannel-ette, but if it is allowed to remain long in the barrel it will become hard and will have a corrosive effect equal to that produced by internal fouling.
- (c) *Metallic Fouling*. This is removed by the use of the double pull-through, or by Kings' Norton Nickel Solvent.

8.—CARE OF GAS CYLINDER.

The gas cylinder should not be removed from the gun more often than is absolutely necessary, as the threads on its front end are very fine, and constant stripping tends to cause wear and consequent loss of gas. The only reason for removing the gas cylinder is to cleanse the barrel of internal or metallic fouling or to clear away from the holes in the barrel and the gas chamber the carbonisation which would otherwise block them up and hinder the working of the gun. If any difficulty is found in unscrewing the cylinder from the gas chamber the joint should be well soaked in paraffin to loosen it.

The cylinder should be cleaned out daily with the wire brush and the mop provided, but it does not require oiling. If there is oil in the cylinder when the gun is in action, the heat of the gases will carbonise the oil and form a hard deposit. If any time then elapses between combats in the air, this deposit is liable to impede the free movement of the piston and cause the gun to stop.

To clean the Gas Cylinder :—Join up the wooden cleaning-rod and screw on the wire brush. Insert the rod into the cylinder and work it backwards and forwards a few times. Then remove the wire brush, replace it with the woollen mop, and clean the cylinder. The foregoing operations can be carried out by removing the bolt and piston rod and inserting the cleaning-rod through the piston-way.

NOTE.—To avoid dirtying the woollen mop unnecessarily a piece of 4 by 2 flannelette may be tied over it for the preliminary cleaning.

METHOD OF TEACHING.

(a) *Demonstration* :

Instructor cleans gas cylinder in manner laid down.

(b) *Explanation* :

Why gas cylinder should be kept clean.

Why wire brush is used first.

Why woollen mop is used.

Why cylinder should be unscrewed as seldom as possible

Why cylinder should not be oiled.

(c) *Squad Practice*.(d) *Interrogation*.

9.—CARE OF GAS CHAMBER.

In order that the joint between the gas chamber and the barrel should not be loosened by constant stripping, the gas chamber should not be removed except when absolutely necessary. When possible, it should be cleaned while in position on the barrel. If any difficulty is found in unscrewing the gas chamber the joint should be well soaked in paraffin to loosen it.

Cleaning of Gas Regulator.

10.—LUBRICATION OF GUN.

Owing to the low temperature experienced at high altitudes (especially during the winter months), there is a constant risk of the working parts becoming clogged by the congealing of oil. The gun should, therefore, only be sparingly oiled. P. 924 alone should be used in winter, and an equal mixture of P. 924 and oil, lubricating, G.S. in summer. The oil should be put on with a camel hair brush.

The parts that demand special attention are :—

Threads on Gas Regulator.

Side of piston head and Rings on piston rod.

Teeth on rack.

Striker post.

Edges of Camway groove.
 Resistance lugs.
 Worm of feed arm actuating stud.
 Locking-recesses.
 Base of magazine post.
 Curved channel of feed arm.
 Under side of feed arm.
 Feed pawl stud.
 Stop pawl studs.
 Body cover ribs.
 Teeth and sides of pinion.
 Trigger mechanism.

11.—DAILY CLEANING.

For daily cleaning, the gun should be stripped as follows :—

Spade grip.
 Trigger group.
 Pinion casing.
 Body cover.
 Feed arm.
 Cocking-handle.
 Piston.
 Bolt.
 Gas Regulator.

These parts, together with the exterior now exposed, should be cleaned with a mixture of equal parts of oil, lubricating, G.S., and paraffin. If any parts are clogged with dried oil, turpentine should be used to remove it. After each part is cleaned, it should be thoroughly dried and slightly oiled. When paraffin has been used, all traces of it should be carefully removed, for paraffin—though an efficient agent for the removal of rust—does not prevent the formation of rust.

METHOD OF TEACHING.

- (a) *Demonstration* :
 Instructor strips gun as shown above.
 Instructor cleans parts, examines and re-oils.
- (b) *Explanation* :
 Removal of clogged or dried oil.
 Parts dried after cleaning.
 Amount of lubricating oil used after cleaning.
- (c) *Squad Practice*.
- (d) *Interrogation*.

12.—WEEKLY CLEANING.

The gun should be completely stripped and cleaned each week. The oil should be removed from the bore, and replaced by fresh oil. In cases where the bore has once become rusty at any previous time, it should be wiped out with flannelette, and then, if rust is visible, cleaned with the gauze on the pull-through.

13.—HOW TO USE THE STEEL CLEANING-ROD.

- (a) *Demonstration* :
 Instructor strips the gun as shown in Section 8, and uses the cleaning-rod, carefully observing points laid down in the following paragraph.

(b) *Explanation :*

Insert a piece of oily flannelette about 4 ins. by 2 ins. in the eyelet of the cleaning rod. (Demonstrate how oil is worked into flannelette with fingers).

See that flannelette surrounds the cleaning-rod.

Insert cleaning-rod from muzzle, and fix the movable brush.

Work rod forwards and backwards centrally with axis of bore.

If rod is difficult to withdraw, no cross strain must be applied, otherwise rod will snap.

Remove oily flannelette, and replace it by dry flannelette.

Finally leave bore slightly oiled, using a slightly smaller piece of flannelette.

N.B.—Flannelette used for cleaning purposes need not be thrown away; if washed, it is again quite serviceable.

(c) *Squad Practice.*(d) *Interrogation.*

14.—HOW TO PUT ON A GAUZE.

As the instructor has already explained that it is necessary, in the case of a rusty barrel, to use the gauze in weekly cleanings, he must now proceed to teach how the gauze is put on the pull-through.

Wire gauze in pieces $2\frac{1}{2}$ inches by $1\frac{1}{2}$ inches is supplied, and should be used for the removal of hard fouling or of rust. In attaching it to the pull-through, the following principles should be applied.

(a) *Demonstration.*(b) *Explanation :*

In attaching the gauze to the pull-through, turn the shorter sides towards the upper, so that the longer sides take the form "S." Open the loop of the pull-through, and put one side of it in each loop of the "S." Then coil each half of the gauze tightly round the portion of the cord over which it is placed, till the two rolls thus formed, meet.

The object of the gauze is mainly to scour out the grooves, and it should, therefore, fit the bore tightly. When it fails to do this, it should be partially unrolled and packed with paper or flannelette, to increase its bulk.

Grit must be removed from the gauze and pull-through before use, and the gauze should be thoroughly oiled.

Cleaning with gauze entails wear of the bore. Gauze should, therefore, not be pulled through the barrel more often than is laid down here, without sufficient cause. The surest way of preventing the necessity of the continued use of gauze is to keep the bore well oiled so as to prevent rust.

A barrel which has once become rusty will always be more liable to rust than one which has been kept in good condition. It will, therefore, require more attention, and more frequent cleaning with gauze. Similarly, a barrel in which corrosion has commenced will require more care than one of which the surface has not been attacked, for, the corroded portion being rough, moisture is more likely to collect on it and form rust. It is also more difficult to remove rust thoroughly from a rough surface than from a smooth one.

(c) *Squad Practice.*(d) *Interrogation.*

15.—HOW TO USE THE DOUBLE PULL-THROUGH.

Place the gun-metal protector on the muzzle so as to keep the cord central. Fix the barrel in a vice, or have it held firmly by one man, while two others, helping with their free hands to keep the barrel steady, pull the cord backwards and forwards, taking care to prevent it rubbing against the breech end of the barrel, until the fouling or rust is loosened. When the gauze is worn out, it should be replaced by one of the spare pieces which are issued with each double pull-through.

NOTE.—With the “Perivale” Barrel Holder, only two men are needed for using the double pull-through and holding the barrel steady.

When signs of wear appear on the double pull-through, a new cord should be taken into use, to avoid the risk of the pull-through breaking in the bore. If a breakage does occur, the barrel must be taken at once to the armourer. No attempt should be made by the gunner to remove the obstruction.

(a) *Demonstration* (with the assistance of the squad).

(b) *Explanation* :

Removal of the barrel necessary.

Fixing on of muzzle protector.

How pull-through is inserted.

How barrel is held steady.

Necessity of pulling cord centrally with axis of bore, and the result of the neglect of this.

Subsequent cleaning, with rod and flannelette.

Use of muzzle protector.

(c) *Squad Practice*.

(d) *Interrogation*.

16.—CLEANING WITH BOILING WATER.

An effective means of cleaning the bore, whether firing has taken place or not, is found in the use of boiling water. Before this is used, superficial fouling and grease should be removed. About 5 or 6 pints of water should be poured through the bore from the breech, a funnel being used for the purpose. Before this is done, the barrel should be removed from the gun. The bore should be thoroughly dried and, when it has cooled, oiled. Not only does the boiling water remove the fouling, but the expansion of the metal, due to the heat of the water, loosens any rust there may be, and makes it easily removable.

METHOD OF TEACHING.

(a) *Demonstration* :

Barrel removed from gun.

Grease and fouling cleaned away.

Boiling water poured through barrel by means of funnel.

Barrel dried and re-oiled.

(b) *Explanation* :

Necessity for first cleaning barrel.

Effect of boiling water on metal.

Amount of water used.

Necessity for drying and re-oiling.

Effect of the process on rust.

(c) *Squad Practice*.

(d) *Interrogation*.

17.—CARE OF MAGAZINES.

Magazines must be handled with great care and kept clean, or gun stoppages will result. They must be examined daily and always after a flight (whether used or not). When stored in the armoury they should be placed on shelves, open side downwards, and never piled more than two deep.

Cleaning.—Remove all superficial dirt and clogged oil. Place the magazine on a loading handle, and revolve the outer pan. If there is any sluggishness, or friction caused by grit, clean out with turpentine the junction between the outer and inner portions. Dry and slightly oil the frictional parts. Any excess of oil in the magazine is likely to be carried into the chamber and cause abnormal pressure when the gun is fired.

Examination.—When clean, the magazine should always be examined as follows :—

- (1) Inspect the outer pan, to see that it is not bent or broken.
- (2) Examine the separating pegs, to see that they are not loose, bent, or broken.
- (3) Examine the lip of the centre block, to see that it is not burred.
- (4) See that the magazine catch is working properly.
- (5) Place the magazine on the gun, to see that no part of the lower circumference touches the barrel casing or the body cover.

18.—OILS.

The oil used in the R.F.C. for Aerial Guns is known as P.924, and is an anti-freezing oil. The test for this oil is that it should remain fluid at a temperature of 40 degrees centigrade.

With the Lewis Aerial Gun, P. 924 should be used for lubricating purposes at all times—except on rare occasions in extremely hot weather, when a mixture of equal parts of G.S. oil and P. 924 may be used.

WITH THE GROUND GUN G.S. OIL ONLY SHOULD BE USED.

CARE AND CLEANING OF SPEEDED-UP LEWIS GUNS.

All the instructions on the care and cleaning of the gun become even more important when the gun is fitted with the Conversion Set, and the very greatest care should be taken to see that no fouling is allowed to accumulate in the gas regulator or on the piston.

It will be noticed that there will be more tendency to fouling than with the standard gun.

The length of the Volute Spring should be carefully checked after each flight and it should be replaced when its length has decreased to $1\frac{1}{8}$ ". This indicates that the spring is weakening and is taking a "permanent set" and is therefore not so efficient in absorbing the blow at the end of the recoil stroke, and breakages may result.

Care should also be taken that the Volute Spring is a reasonably tight fit in the rear end of the piston rod, and that it has no tendency to shake out.

VII.—IMMEDIATE ACTION.

DEFINITION.

Immediate Action is the immediate execution of certain automatic movements by which the gunner attempts to remedy a stoppage in order to re-open fire with the minimum of delay.

GENERAL REMARKS.

(1) During the teaching, guns must be set up to simulate the conditions resulting from the particular stoppage under consideration. This should be done by the Instructor without detail.

(2) The Instructor must not deal with the causes of stoppages until every member of the squad can carry out Immediate Action cleanly and correctly.

(3) The remedy of a stoppage must in no case be considered complete until the gun has been relayed and fired.

(4) The Instructor should lay stress on the importance of sighting the gun on the target. For this purpose, a model aeroplane is found suitable.

(5) It is essential that all kit necessary for the instruction should be prepared before the commencement of the lesson.

KIT REQUIRED FOR INSTRUCTION.

Gun on mounting.
Magazines.
Dummy cartridges.
Loading-handle.
Toggle.
Covering for Magazine.

METHOD OF INSTRUCTION.

- (1) Give the definition of Immediate Action, and teach thoroughly the processes involved, setting up stoppages but not entering into the causes.
- (2) Show that the stoppage is never remedied until the gun is firing again.
- (3) When Immediate Action is understood and can be properly carried out, proceed to Secondary Action as given below.
- (4) When both Immediate and Secondary Actions are thoroughly known, the Instructor may proceed to deal with the causes of stoppages.

SPECIMEN LESSON.

Object of Lesson :—To teach Immediate Action (part a).

(a) *Demonstration* :

Instructor demonstrates Immediate Action.

(b) *Explanation* :

Glancing blow on magazine towards left front, using palm of left hand.

Magazine rotates.

Change magazine.

Relay.

Fire.

Eye to be kept on target throughout the I. A.

(c) *Squad Practice* :

Each member of the squad performs the I. A.

Instructor criticises.

(d) *Interrogation* :

Instructor tests pupils' knowledge of the actions carried out and the order in which they are performed.

NOTE.—In training pupils in Immediate Action, a cloth should be used to cover the magazine, and should be removed only when the gunner is in the firing-position. It is unnecessary to say "Gun stops." The removal of the cloth by the Instructor indicates to the firer that his gun has ceased action.

EXPLANATIONS OF TABLES OF STOPPAGES.

The following Table, set out in four columns, gives a clear indication of the method to be employed in teaching.

Column 1 gives a detailed description of the Immediate Action to be performed by the gunner.

Column 2 deals with the causes of stoppages, but (as has already been laid down) it is of the first importance in the teaching of Immediate Action that the Instructor does not proceed to this stage until the steps necessary to remedy stoppages can be carried out correctly and without the slightest hesitation.

Column 3 gives the method of preventing the occurrence of stoppages. They can generally be overcome by a careful examination of gun, magazines and ammunition before flight.

Column 4 shows how the stoppages can be simulated for instructional purposes. It is unnecessary to teach these methods of preparation to every pupil, but Instructors (and pupils being trained as Instructors) must have a thorough knowledge of this column in order to be able to teach the subject properly.

IMMEDIATE ACTION.

Immediate Action.	Cause.	Prevention of Occurrence.	Method of Preparation for Instructional Purposes.
(1) Strike magazine a glancing blow towards left front, using palm of left hand.			
(a) If magazine rotates, Change magazine, Relay, Fire.	(a) Empty magazines.	(a) Nil.	<i>Off Range :—</i> (a) Place on empty magazine. Cocking-handle forward.
(b) If magazine does not rotate, Pull back cocking-handle, Relay, Fire.	(b) Misfire. Space in magazine. Weak charge. Weak cartridge guide spring.	(b) Nil. Care in filling magazine. Examination of gun before flight.	(b) Place on magazine containing several dummy cartridges. For weak cartridge guide spring, place on magazine containing dummy cartridges. Pull back cocking-handle. Ease cocking - handle slightly forward.
(c) Should it be difficult to draw back cocking-handle, Use toggle, Relay, Fire.	(c) Hard extraction. Bulged round. Separated case telescoped on next round.	(c) High standard of training in examination of ammunition. Nil.	(c) Place prepared dummy cartridge in chamber. Place on magazine containing dummies. Let go cocking-handle. <i>NOTE.</i> —The only certain way to set up this stoppage is to use a dummy with the front portion of a separated case soldered on to it.
			<i>On Range :</i> (a) Place on magazine containing one live round. (b) Insert dummy among live rounds in magazine. For cartridge guide spring use one that is weak. (c) To be dealt with only when actually occurring.

Stoppages may arise from the following causes, but they rarely occur and stress should not be laid on them in the course of instruction. It is sufficient to point out that they are possible, but largely avoidable by means of careful examination of the gun before flight. In the event of their occurrence, the gunner would be compelled to break off the action.

(a) Broken striker or striker post.

(b) Split in gas cylinder.

(c) Broken parts falling into the moving parts of the gun.

If the gun should stop several times running, and the Secondary Action reveals no faulty part, the conclusion will be that the front half of a separate case is fixed in the chamber. This conclusion may be easily corroborated by allowing the cartridge then in the feed-way to be forced into the chamber, the deflector bag being meanwhile kept open for the purpose of inspection. The cartridge will only go part way in. The gunner's action will then be to extract the cartridge in the bolt-way and to get rid of the separated case by means of the clearing-plug. This stoppage is, however, rare, as the front half of a separate case is nearly always telescoped on to the next round and removed by Immediate Action.

If, when applying Immediate Action, no force is required to draw back the cocking-handle, the stoppage is due to a broken return spring, and the gunner's action will be to change the pinion casing, reload, relay and fire.

VIII.—SECONDARY ACTION.

DEFINITION.

Secondary Action is the immediate execution of certain automatic movements (over and above those required for Immediate Action) by which the gunner proceeds to discover and remedy a stoppage when Immediate Action fails.

GENERAL REMARKS.

(1) Only when the class is proficient in Immediate Action should the Instructor proceed to the next phase of the teaching, *i.e.*, Secondary Action. Exactly the same method and sequence as is shown above must be adhered to throughout this branch of the subject also.

(2) By carrying out the various processes of Secondary Action, the gunner is trained to recognise the fault quickly by a rapid examination of certain easily accessible parts of the gun, one of which is probably causing the stoppage.

(3) As the gunner becomes more adept, he will learn to locate the fault without going through every stage of the examination, but such skill comes only as the result of much practice and an exhaustive knowledge of the mechanism of the gun. For the purpose of *teaching* stoppages, and enabling beginners to locate and remedy them quickly and easily, the method of examining the parts concerned will be found the most simple and effective. It is not, however, implied that an expert gunner will need to use this method in all its details in order to remedy a stoppage in action.

Nos. 1, 3, 4 and 5 of the General Remarks given under "Immediate Action" are equally applicable to Secondary Action.

KIT REQUIRED FOR INSTRUCTION.

As for Immediate Action.

Spare parts.

METHOD OF INSTRUCTION.

(1) Give the definition of Secondary Action, and teach thoroughly the processes involved, setting up stoppages but not entering into the causes.

(2) Set up in turn the stoppages needing Secondary Action, calling on pupils in turn to apply the measures required for the discovery of the cause and for remedy.

(3) Set up miscellaneous stoppages, calling on pupils to deal with them in the same way.

TABLE OF SECONDARY ACTION.

The stoppages dealt with in this section will cause the gun to be out of action for a somewhat longer period than is the case with stoppages remedied by Immediate Action. The measures necessary for their remedy comprise the following:—

(a) A Secondary Action, by which the fault is located. This consists of a rapid examination of certain parts liable to breakage, and involves as many of the following steps as are necessary to discover the reason of the stoppage.

(1) Pull back cocking-handle.

*(2) Raise safety catch.

(3) Lower gun.

(4) Remove magazine.

(5) Examine cartridge guide spring.

(6) Examine feed and pawls.

(7) Open deflector bag.

*(8) Examine ejector.

(9) Examine bolt (clearing bolt-way, lowering safety catch, pressing trigger and easing cocking-handle forward, if necessary).

(b) Partial stripping of the gun, in order to remove the faulty part and replace it with a spare one.

NOTE.—Instructors should demonstrate and practise pupils in (b) prior to setting up any particular stoppage for which Secondary Action is necessary.

Action.	Cause.	Prevention of Occurrence.	Method of Preparation for Instructional Purposes.
(1) Apply Immediate Action. Apply Secondary Action, 1 to 5. Having located fault:— Remove cartridge from feed arm. Change cartridge guide spring. Reload. Relay. Fire.	(1) Broken cartridge. Guide Spring.	(1) Cannot be provided for: Examination of parts may limit its occur- rence.	(1) <i>Off Range and On Range:</i> Insert broken cartridge guide spring.

* Home Training only.

Action.	Cause.	Prevention of Occurrence.	Method of Prevention for Instructional Purposes.
(2) Apply Immediate Action. Apply Secondary Action, 1 to 6. Having located fault :— Change feed arm. Re-assemble parts. Reload. Relay. Fire.	(2) Broken feed pawl or spring.	(2) Cannot be prevented. Examination of parts may limit its occurrence.	(2) Remove feed pawl and spring.
(3) Apply Immediate Action. Apply Secondary Action, 1 to 6. Having located fault :— Change pawls (if possible). Re-assemble parts. Reload. Relay. Fire.	(3) Broken stop pawls or spring.	(3) Cannot be prevented. Examination of parts may limit its occurrence.	(3) Remove stop pawl or spring.
(4) Apply Immediate Action. Apply Secondary Action, 1 to 7. Having located fault :— Tighten up or empty deflector bag. Clear bolt-way. Remove cartridge from feed arm. Close deflector bag. Reload. Relay. Fire.	(4) Loose deflector bag. Full deflector bag.	(4) Careful adjustment before flight. Periodical emptying of bag.	(4) Loosen fitting. Place a cloth in the mouth of the bag.

Action of Gunner.	Cause.	Prevention of Occurrence.	Method of Preparation for Instructional Purposes.
(5) Apply Immediate Action. Apply Secondary Action, 1 to 8. Having located fault :— Clear bolt-way. Remove cartridge from feed arm. Close deflector bag. Change ejector. Re-assemble parts. Reload. Relay. Fire.	(5) Broken ejector.	(5) Cannot be prevented. Examination of parts may limit its occurrence.	(5) Remove ejector.
(6) Apply Immediate Action. Apply Secondary Action, 1 to 9. Having located fault :— Clear feed arm. Change bolt. Re-assemble parts. Reload. Relay. Fire.	(6) Broken extractors.	(6) Cannot be prevented. Examination of parts may limit its occurrence.	(6) Remove extractor.

NOTE.—To remove cartridge from the feed arm.

(a) Lower the safety catch.

(b) Holding back the cocking-handle with the left hand, press the trigger with the right hand.

(c) Allow the cocking-handle to go slightly forward.

(d) Insert screwdriver through the ejection opening, and press on the under side of the shoulder of the cartridge.

(e) Allow the cocking-handle to go forward slowly, the cartridge will roll out to the right on the top of the feed arm.

IX.—INSTRUCTION IN CAUSES OF STOPPAGES AND SETTING UP GUN.

Before this subject is attempted, the pupils must have a thorough knowledge of mechanism, and must know how to apply the correct Immediate or Secondary Action in the event of a stoppage. The instruction should then proceed on the following lines :—

(a) *Demonstration :*

Instructor sets up gun to represent a particular stoppage. (For example, Immediate Action-a).

(b) *Explanation :*

Magazine empty.

No explosion.

No feed.

NOTE.—The remedy to be applied in the event of this stoppage has already been taught, and only needs to be applied without detail.

(c) *Squad Practice :*

Each member of the class sets up the stoppage, and explains what his actions represent.

(d) *Interrogation :*

The squad is then questioned with regard to the nature of the stoppage, and the mechanical cause which brought it about, as well as the mechanical effects produced thereby.

X.—POINTS TO BE OBSERVED BEFORE, DURING, AND AFTER A FLIGHT OR RANGE PRACTICES.

Points marked *S* are applicable only to Flight.

Before Flight or Range Practices (Under the supervision of the Gunnery Officer):—

1. See that the large hole of the gas regulator is to the rear, and that the gas regulator key is properly fixed.

2. See that the mounting yoke is securely fixed, with the screw on the right side. If a pin is used, this should be inserted from the rear and turned down.

3. See that the deflector and bag are securely clamped to the gun, with the mouth opposite to the ejection opening, and the bottom properly fastened.

4. See that the cocking-handle is securely fixed.

5. See that the return spring is at the correct tension, i.e., 11 to 12 lbs.

6. See that the cartridge guide spring is working properly.

7. See that the sights are correctly adjusted and harmonised on the checking mark at the required range. Examine Norman Foresight for rigidity and smoothness of working.

S 8. Fire a burst of 20 rounds into the ground. If the gun does not give rapid fire, investigate the cause.

S 9. See that the gun mounting is working freely.

NOTE.—The check lever is liable to go out of order if neglected, or if dirt is allowed to accumulate. These causes prevent it from revolving freely.

10. See that the gun is fitted securely on its mounting.

S 11. See that the revolving seat is working properly, and that the elevating catch grips securely.

12. See that all tools and spares are correctly in place.

S 13. Examine all magazines. See that loaded magazines are in place and can be conveniently removed from the fixing-bands.

During Flight :

- S** 1. Work the moving portions frequently to prevent them from becoming clogged with congealed oil.
- S** 2. At high altitude, or in very cold weather, fire short bursts occasionally—keeping one magazine (specially marked) for this purpose. Clear gun immediately after firing each burst.
- S** 3. Rotate the gun mounting, and elevate the gun at intervals to keep the parts from becoming clogged with congealed oil.
- S** 4. Practise frequently throwing the gun round against the ship-stream. This serves as a test of what pressure will be needed in action, and also helps to keep the gunner warm.
- S** 5. Load with a full magazine as soon as the Aerodrome is cleared.
- S** 6. Clear the gun immediately after action, and reload again with a fresh magazine, in order to have fullest fire-power whenever required.

After Flight or Range Practices (Under the supervision of the Gunnery Officer):—

1. See that the gun is correctly unloaded.
2. Empty the deflector bag and separate live rounds from empty cases.
3. Release the tension of the return spring.
4. Take the gun to the armoury: clean it thoroughly, and examine the working parts for wear and burrs. Oil according to instructions given in section on "Care and Cleaning."
5. Examine all springs.
6. Examine sights.
7. (IMPORTANT).—Check the length of the volute spring.

NOTE.—Sights are liable to become damaged by being struck against the planes or the mounting.

- S** 8. Examine the gun mounting for firmness of seating. Clean and oil it.
9. Fill up the history sheet.
10. Empty all magazines; clean, test, and refill them.

NOTE.—It is important that these measures should be taken with unused magazines as well as empty ones.

FORCED LANDINGS IN ENEMY TERRITORY.

The gun should be placed out of action as far as is possible before landing. With this object, the following parts should be removed and thrown from the machine:—

1. Spade Grip.
2. Cocking-handle.
3. Bolt.
4. Body Cover.
5. Feed Arm (before throwing this away bend or break it as far as possible).
6. Piston Rod.

Magazines should be emptied, if possible, in order that no special aircraft ammunition shall fall into the hands of the enemy.

XI.—EXAMINATION OF GUN.

- (1) Kit required for teaching.
- (2) General remarks.
- (3) Barrel.
- (4) Gas Chamber.
- (5) Gas Cylinder.
- (6) Gas Regulator.
- (7) Body.
- (8) Ejector.
- (9) Feed Arm.
- (10) Body Cover.
- (11) Piston Rod.
- (12) Bolt.
- (13) Cocking-handle.
- (14) Pinion and Casing.
- (15) Trigger Guard.
- (16) Spade Grip.
- (17) Moving Portions.

1. KIT REQUIRED FOR TEACHING.

Gun and Mounting.
Spare Parts complete.
Spare Barrel.
Magazine.

2. GENERAL REMARKS.

It is important that not only should machine guns be examined when first taken over, but that they should also be frequently examined afterwards, together with the mountings. The gun should be examined daily, as stated in the section on "Care and Cleaning," and a more detailed examination should be made occasionally, as required.

The method and sequence of instruction will be the same as for all other subjects, whenever the sub-head being dealt with permits. The work will, therefore, take the usual form of:—

- (a) Demonstration.
- (b) Explanation.
- (c) Squad Practice.
- (d) Interrogation.

3. BARREL.

- (a) Examine bore, rifling, and lead for fouling.
- (b) See that neither thread at muzzle end nor cartridge rim stop is damaged.

4. GAS CHAMBER.

- (a) See that threads are not burred.
- (b) Examine for erosion.

5. GAS CYLINDER.

- (a) See that it is not split where flattened out for rack.
- (b) Examine for erosion or carbonised oil.

6. GAS REGULATOR.

- (a) See that this is not fixed tight through fouling or rust. If it is, apply paraffin at the joints, and allow it to soak in. The fouling or rust is thereby loosened.
- (b) Examine for erosion or hard fouling.

7. BODY.

- (a) Examine for play and wear, especially in interior.
- (b) Examine pinion hinge to see that pin is straight.

8. EJECTOR.

- (a) See that it is not broken, burred, or otherwise damaged.

9. FEED ARM.

- (a) Examine latch to see that it is not weakened. See that it engages magazine post properly.
- (b) Examine axis-hole to see that there is not too much play on the magazine post.
- (c) Examine thin part of feed arm to see that it is not bent nor strained.
- (d) Examine the curved channel and the positioning stud to see that there is not undue wear.
- (e) Examine feed-pawl and feed pawl spring to see that they are not worn. Test for proper working condition.

10.—BODY COVER.

- (a) Examine stop pawls and spring for damage and undue wear. See that they are correctly assembled.
- (b) See that the cartridge guide spring is neither damaged, nor weak. Make sure that the right leaf is properly positioned by the left.

11.—PISTON ROD.

- (a) Examine piston head for erosion.
- (b) Examine the joints for excessive play.
- (c) See that the striker is not damaged nor loose.
- (d) See that the striker post and teeth of the rack are not damaged nor worn.
- (e) See that the bent is not worn nor broken.

12.—BOLT.

- (a) Test extractors to see that they are not weak. See that the studs are not damaged.
- (b) Examine the face of bolt for erosion.
- (c) See that the edges of the groove are not worn nor rough.
- (d) See that left resistance lug is not burred nor worn.

13.—COCKING-HANDLE.

- (a) See that the cocking-handle is securely held in its slot in the body.
- (b) See that it is properly held back when the safety catch is raised and the trigger pressed.

14.—PINION AND CASING.

- (a) See that teeth of pinion are not damaged nor worn.
- (b) See that the pawl is working correctly and the axis-pin secure.
- (c) See that the return spring is not broken.

15.—TRIGGER GUARD.

- (a) See that the sear is not worn nor broken.
- (b) See that the plunger is not clogged.
- (c) See that the sear and trigger are working freely.
- (d) See that the catch is acting properly.

16.—SPADE GRIP.

- (a) See that the handle is undamaged.
- (b) See that the locking-lugs are not broken nor burred.
- (c) See that the milled-head brush is in the reservoir and the screwed head tight.

17.—MOVING PORTIONS.

- (a) See that these move freely.
- (b) See that the feed arm is properly moved by feed arm actuating stud.
- (c) Test ejection with dummy cartridge.
- (d) Place empty magazine firmly on magazine post. Work cocking-handle backwards and forwards to see that the feed works correctly.

XII.—MINOR REPAIRS AND ADJUSTMENTS.

- (1) Kit required.
- (2) General Remarks.
- (3) Instructions for weighing the return spring.
- (4) Instructions for increasing the tension of return spring.
- (5) Instructions for decreasing the tension of return spring.
- (6) Instructions for fitting new return spring in casing.
- (7) Repairs and Adjustments in action.

1.—KIT REQUIRED.

- (a) Lewis Gun and tripod.
- (b) Spare parts box and case complete.

2.—GENERAL REMARKS.

- (a) It is necessary that all machine gunners should be able to carry out any of the minor repairs enumerated here.
- (b) Whenever possible, the subject must be taught in the same method and sequence as laid down for the teaching of other subjects.

3.—INSTRUCTIONS FOR WEIGHING THE RETURN SPRING.

- (1) See that the moving portions are working freely.
- (2) Cocking-handle to be in the forward position.
- (3) Place loop of spring balance over cocking-handle.
- (4) Holding balance perfectly horizontal, commence to draw the cocking-handle to the rear.
- (5) Read off weight of balance when centre of cocking-handle is over pinion pawl axis pin.
- (6) Take three readings, and the average.
- (7) The weight should be between 11 and 12 lbs., according to the particular gun.

4.—INSTRUCTIONS FOR INCREASING THE TENSION OF RETURN SPRING.

- (1) Withdraw the pistol grip sufficiently to allow the pinion pawl to engage in the pinion.
- (2) Press up the pinion casing with the right hand in order to keep the pinion engaged with the rack.
- (3) Draw back the cocking-handle.
- (4) Allow the pinion casing to drop so that the pinion is not engaged with the rack.
- (5) Push the cocking-handle forward.

5.—INSTRUCTIONS FOR DECREASING THE TENSION OF RETURN SPRING.

- (1) Withdraw the pistol grip sufficiently to allow the pinion pawl to engage in the pinion.
- (2) Allow the pinion casing to drop so as to disengage the pinion from the rack.
- (3) Draw back the cocking-handle.
- (4) Press the pinion casing up to engage the pinion with the rack.
- (5) Disengage the pinion pawl from the pinion to allow the piston rod to fly forward.

NOTE.—To avoid alteration of the tension of the 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.

6.—INSTRUCTIONS FOR FITTING A NEW RETURN SPRING IN CASING.

- (1) Drive out fixing studs from slots in spring casing; withdraw the spring, holding the broken end with pliers.
- (2) Partially insert new spring into spring casing, making sure that the studs on the new spring are in line with the slots in the spring casing, and that the retaining collar is resting on the rim of the casing.
- (3) Using a block of wood and a hammer, tap round the edge of the new spring until it is correctly in place in the spring casing.

7.—REPAIRS AND ADJUSTMENTS IN ACTION.

The most urgent need for carrying minor repairs and adjustments is when the gun stops firing while in action. In almost all cases these repairs take the form of replacement of damaged or broken parts by spare parts carried for that purpose. In order that this may be done as quickly as possible, pupils should be practised in stripping the gun so as to reach the defective part most easily.

Spare Parts and Tools taken up into the air should be as follows :—

- Cartridge guide spring.
- Bolt complete.
- Feed arm complete with feed pawl and spring.
- Stop pawls and spring.
- Pinion group.
- Spring balance.
- Screw-driver.
- Clearing plug.
- Loading-handle.
- Metal-pointed dummy.
- Toggle.

In the above is a complete list of parts which a skilled gunner could reasonably expect to be able to change under favourable conditions. In view, however, of the fact that skill and circumstances vary considerably, it is impossible to lay down that all the parts named should be changed.

The idea underlying this instruction is that the pupils should be made as adept as possible in carrying out repairs and adjustments which may be necessary while in action.

XIII.—SPARE PARTS.

GENERAL REMARKS.

- (1) It is essential to know where to find any spare part that may be required.
- (2) All spare parts must be called by their proper names, and the use of fancy names is forbidden.
- (3) A list of deficiencies should be kept inside each box.
- (4) Spare parts must be kept slightly oiled.
- (5) Spare parts should be inspected weekly by Gunnery Officers.
- (6) All deficiencies should be reported at once.

METHOD OF INSTRUCTION.

FIRST LESSON:

Object of Lesson :—To teach the correct names of spare parts.

The instructor, having laid out on a table or waterproof sheet, the whole of the contents of the spare parts box, spare parts case and wallet, will teach his squad as follows :—

(a) *Demonstration* :

Instructor holds up each article in turn (in accordance with the official list of spare parts), and tells squad the correct name given to it.

(b) *Explanation :*

The use of the part under consideration is taught.

(c) *Squad Practice :*

When all spare parts have been named and explained by the instructor, the members of the class teach the names and uses in similar manner.

(d) *Interrogation :*

SECOND LESSON.

*Object of Lesson :—*To teach the proper method of packing spare parts.

(a) *Demonstration :*

Instructor exhibits to the squad the spare parts box, and spare parts case and wallet, properly packed. He then lays out the spare parts on table or waterproof sheet, as before.

(b) *Explanation :*

Instructor teaches the number of each particular spare part, issued per 2 guns, and explains where they are kept, and the method of packing them into the spare parts box, spare parts case or wallet.

(c) *Squad Practice :*

All the spare parts are again laid out as before, and members of the squad teach in a similar manner.

(d) *Interrogation :*

Instructor questions squad as to where spare parts are packed ; number issued ; how packed, etc.

SPARE PARTS.

LEWIS GUNS, MARK II, SPARE PARTS PER 2 GUNS.

IN LARGE BAG.

- 1 Bolt (complete with 2 extractors and feed arm actuating stud).
- 1 Casing, pinion (assembled complete).
- 2 Handles, Loading, Magazine.
- 1 Spanner, Mouthpiece, barrel.
- 1 Screwdriver, large, M.G.
- 1 Screwdriver, small, M.G.
- 1 Can, Oil, Vickers, Lewis or Hotchkiss M.G.
- 1 Hammer M.G.
- 1 Pliers, cutting M.G.
- 1 Box, tin, small parts (with list of spares in centre pocket).

IN WALLET.

- 6 Guides, cartridge.
- 2 Springs, return (with retaining collars).
- 1 Key, gas regulator.
- 1 Ejector.
- 2 Handles, cocking.
- 1 Balance, spring combination.
- 3 Mops, rod, cleaning cylinder.
- 2 Brushes, wire rod, cleaning cylinder.

IN SMALL TIN BOX.

- 1 List of spare parts.
- 1 Pull-through, double.
- 4 Gauze, wire, pieces.
- 1 Punch, No. 4.M.G.
- 4 Extractors.
- 1 Sear
- 1 Spring, trigger.
- 1 Pawl, stop, magazine, No. 1, left.
- 1 Pawl, stop, magazine, No. 2, right.
- 3 Springs, pawl, stop, magazines.
- 1 Pawl, feed arm.
- 3 Springs, pawl, feed arm.
- 2 Springs, pawl, pinion.
- 1 Pin, axis, pawl, pinion.
- 1 Pawl, pinion.
- 1 Pin, axis, trigger.
- 1 Pin, axis, sear.
- 2 Strikers.
- 1 Pin, fixing, striker.
- 1 Pin, locking, body.
- 6 Washers, packing, barrel.

IN GUN CHEST.

- 1 Barrel.
- 1 Rod, piston (complete).
- 1 Rod, cleaning, cylinder.
- 1 Rod, cleaning, M.G. Mark II.

THE FOLLOWING ITEMS WILL BE ISSUED AS STATED BELOW:—

Regulator, gas.
Cylinder, gas.
Cover, ejector.
Feed arm, with latch.
Reflector, mirror, M.G.
Hammer, hide.
Posts, extension.
Magazine.
1 Jack, removing collar.

For Service and Mob. sqdn.
1 per 6 guns for training sqdns.
1 each per Sqdn. on demand.

XIV.—TESTING OF AMMUNITION.

IMPORTANCE OF SUBJECT.

When the vital importance was realised of employing the best possible type of ammunition in the R.F.C., on account of the seriousness of stoppages in the air, it was decided to manufacture special ammunition. This is now done, but for further security every round should be most carefully tested before use.

DEFECTS LOOKED FOR IN AMMUNITION.

- (1) Cracks round the indents which join the case to the cannellure of the bullet.
- (2) Faulty diameter (bulged round).
- (3) Length of cartridge over or under gauge.
- (4) Thick rim.
- (5) High set cap.
- (6) Loose bullet.
- (7) Any unusual feature.
- (8) Deep Set Cap.

METHOD OF TESTING.

For testing purposes, the following plan will be found useful. A new barrel should be sunk into the bench. Near to it should be screwed the extractor of a Vickers gun lock, face upwards and having the gib and gib-spring removed. Above the extractor should be placed an arch gauged to the standard length of a cartridge. (For teaching purposes, this apparatus may be arranged on a small block of wood). After the cartridge has been inspected with the eye, it should be dropped into the barrel, to test its diameter. It should then be removed, and slipped along the grooves of the extractor to test the rim. This process tests the length of the cartridge at the same time as the rim, and also probably reveals any case of high set cap that may have escaped notice. While the cartridge is being passed through the cartridge grooves, it should be turned round, so that every part of the rim is tested.

If these tests are properly carried out, the only gun stoppages likely to occur through ammunition are those due to a badly-drawn case or a weak charge, both of which only become apparent when the cartridge is fired.

HOW TAUGHT.

- (a) *Demonstration* :
Instructor exhibits testing apparatus, and shows how to inspect and test a round.
- (b) *Explanation* :
The necessity for the careful testing of ammunition.
The various defects looked for, and the manner of testing for them.
How a simple testing apparatus may be made.
- (c) *Squad Practice* :
Each member of the squad tests rounds of ammunition, explaining meanwhile the purpose of his actions.
- (d) *Interrogation*.

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