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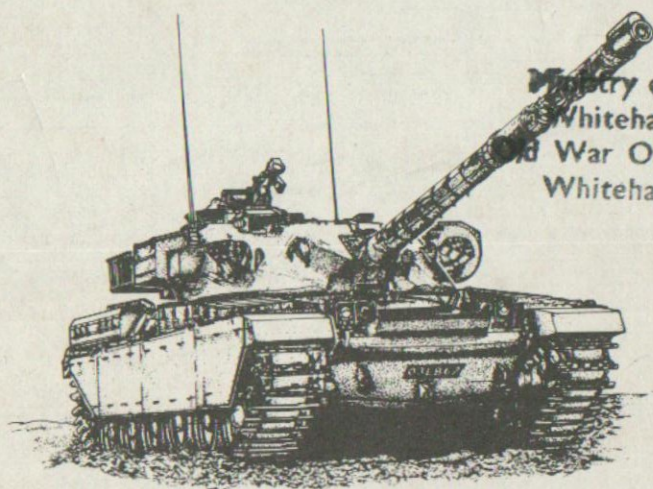
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Royal Armoured Corps Training Volume 3 – ARMAMENT



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MINISTRY OF DEFENCE
1980

Prepared under the direction of the Chief
of the General Staff

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AMENDMENTS

Amendment Number	By whom amended	Date amended

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PREFACE

Aim and Scope

Part ONE of this pamphlet provides the Chieftain crew with the necessary information to enable them to understand the operation of the armament and its associated equipment. It details the handling, tests, checks and servicing that is required.

Part TWO provides further information on certain aspects of the equipment which will be useful to the instructor and the gunner mechanic.

A supplement to this pamphlet will be issued which will include details of the IFCS equipment.

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PART ONE

GENERAL INFORMATION

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GENERAL
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CHAPTER 2 – ORDNANCE, BL, 120-MM, TK, L11

SECTION 1 – INTRODUCTION

General

1. The 120-mm gun with its mounting and sight is the main armament of the Chieftain tank. The gun which has an all round traverse, 356 mils elevation and 178 mils depression is designed to fire super velocity armour piercing shot, medium velocity high explosive and smoke shells.

Description2. *Particulars and performance*

a. *Name* – Ordnance, Breech Loading, 120-mm, Tank, L11 (A1 – A7).

b. *Calibre* – 120-mm.

c. *Muzzle velocities*

(1) Super	APDS	1370 ms
	Practice /DS	1460 ms
(2) Medium	HESH	670 ms
	Practice /SH	670 ms
	Smoke	670 ms

d. *Extreme ranges*

(1) Direct lay	APDS	3200 m /3000 m depending on mark of sight	
	HESH	3200 m	
	Smoke	3200 m	
	Practice /DS	2400 m	
(2) Semi-indirect / indirect	HESH	8000 m /10,600 m	
	Smoke	8000 m /10,600 m	
		(Depending on Mark of quadrant fire control fitted).	

e. *Operation*

- (1) *Loading* – The gun is loaded by hand with breech loading ammunition, ie, the round is in two parts, projectile and charge. The charge is contained in a combustible bag.
- (2) *Firing* – The charge is ignited by means of an electrically fired vent tube, 14 of which are held in a magazine in the vent tube loader on the breech ring. Gas sealing of the breech is effected by means of an obturator consisting of an insert in the face of the breech block and a sleeve fitted in the rear of the chamber.
- (3) *Recoil* – On firing, the gun recoils 35.5 cm under control of hydraulic buffers, and is returned to the runout position by a pneumatic (compressed air) recuperator.
- (4) *Unloading* – During runout the breech is opened automatically. Should the breech require to be opened by hand a breech mechanism lever (BML) or breech opening tool (BOT) are provided.

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3. The gun consists of the following main parts:-
 - a. *The barrel* – This is a single tube forging provided with external interrupted threads at the breech end for the attachment of the breech ring. The bore is prepared internally at the rear to form the chamber, the remainder of the bore being rifled. A recess at the rear of the chamber is for a spring loaded steel sleeve, (the obturator sleeve) which, in conjunction with a steel insert in the front face of the breech block (breech block insert) provides the means of obturation. There are two plain seatings for the fume extractor which is fitted roughly one third of the way down the barrel from the muzzle. Between the seatings there are eight ports, bored through the barrel at an angle towards the muzzle. A thermal sleeve, fitted round the barrel, protects it from adverse weather conditions when it becomes heated due to firing. Engravings on the breech face of the barrel show the Mark, registered number, part number, year of manufacture and manufacturer's initials. On L11A5 barrels, a forged platform is formed at the muzzle to allow the muzzle reference system of gun and sight alignment to be fitted.
 - b. *The fume extractor* is a cylindrical pressure vessel which encloses the eight ports in the barrel. Located underneath is a drain hole which is closed by a screwed plug. There are two types of fume extractors in use, which differ in weight to compensate for variation in gun balance.
 - c. *The breech ring* is rectangular in shape with vertical sliding breech block. The ring is secured to the barrel by interrupted threads and a locking plate. The breech ring houses the breech mechanism and has a clinometer plane on its upper left hand surface. A cut-a-way portion in the lower part of the rear of the breech ring houses the vent tube loader, and a recess in the right side of the breech ring houses the breech mechanism gearbox. A stop, running back, holds the breech ring to the gun cradle in the run out position, should the air pressure fail, when not in use.
 - d. *The breech mechanism* – This is mounted in the breech ring and is the means by which the breech is closed, the round fired, the breech opened and a fresh vent tube fed. The opening of the breech is done automatically during run out by a cam on the mounting and is held open by this cam until the closing lever is manually operated. The breech may also be opened by hand, when firing has not taken place, using a breech opening tool or the breech mechanism lever. A spring loaded interlock operates in the breech ring mortise; it protrudes and thus prevents the breech block from rising, should the obturator sleeve be missing from the chamber.
 - e. *The yoke* is secured to the front of the breech ring by four bolts and to the recoil system by two gun nuts. It is the means by which the gun and recoil system are secured.
4. When the gun is not in use, the barrel is clamped in a crutch /clamp, mounted on the rear of the vehicle.
5. *The mounting* – The gun is mounted in a steel cradle which is held in position by two trunnions, at the forward end, which are attached to the turret. Inside the cradle cylinder there is a front and rear bronze liner on which the gun slides on recoil and runout. Directly fitted to the cradle are the following:-
 - a. The recuperator.

- b. The gyro unit.
 - c. Anti-rotation bracket.
 - d. Mountings for co-axial MG and ranging gun.
 - e. The semi-automatic cam.
 - f. Depression stop.
 - g. Guards for the crew.
6. *The recoil system* – The main task of the recoil system is to dissipate recoil energy and return the gun to the firing position, and to hold it there through all angles of elevation. In order to do this it consists of two hydraulic cylinder buffers and a pneumatic recuperator. There is also a replenisher which accepts excess oil from the system as a result of thermal expansion.

SECTION 2 – HANDLING

To unclamp the gun (clamp) (See Fig 1)

1.
 - a. Ensure that the stop, running back, is fitted (see Fig 3).
 - b. Support the gun clamp with one hand; unwind the clamping screw on the right hand side of the clamp until the claws are well clear.
 - c. Elevate the gun until it is clear of the clamp; lower the clamp on to the bump pad on the hull; ensure that the locking catch has engaged and that the crutch is locked in the down position.
 - d. To clamp the gun, reverse the order.

To unclamp the gun (crutch) (See Fig 2)

2.
 - a. Ensure the stop, running back, is fitted (see Fig 3).
 - b. Withdraw the spring clip from the top of the gun crutch, raise the hand lever and swing the lever and fulcrum block clear of the clamp.
 - c. While supporting the crutch, raise the clamp and elevate the gun until it is clear of the crutch.
 - d. Re-engage the fulcrum block with the clamp, lower the hand lever and secure it with the spring clip.
 - e. Lower the crutch on to the bump pad on the hull; ensure that the locking catch is engaged and that the crutch is locked in the down position.
 - f. To clamp the gun, reverse the order.

To open the breech (using the breech mechanism lever (BML)) (See Fig 3)

3.
 - a. Check that the recuperator air pressure is not less than 500 psi. On earlier marks there may be a red line on the air pressure gauge and the needle should not be lower than this line.
 - b. Remove the stop, running back, by slackening the handwheel on top of it until the stop can be lifted clear of the cradle.
 - c. Check that the maintenance stop is protruding (see Fig 5).
 - d. Push forward on the hand lever on top of the BML to release the retaining catch and pull the BML to the rear to open the breech.

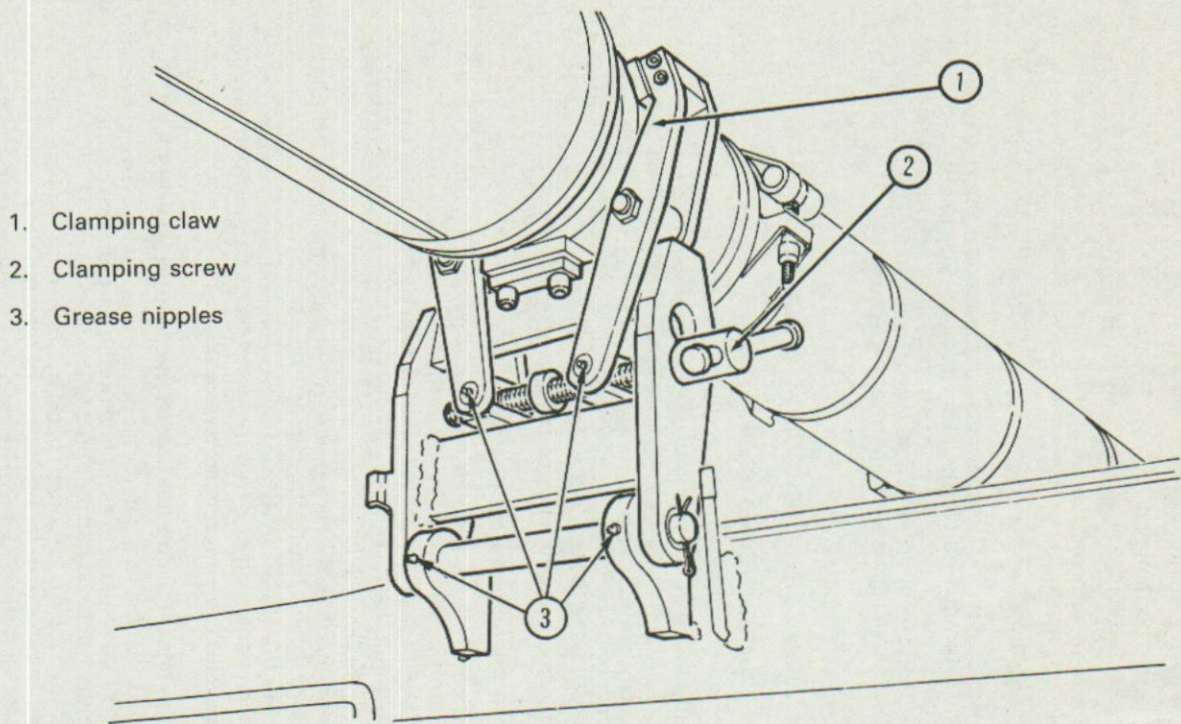


Fig 1 - 120mm Gun clamp

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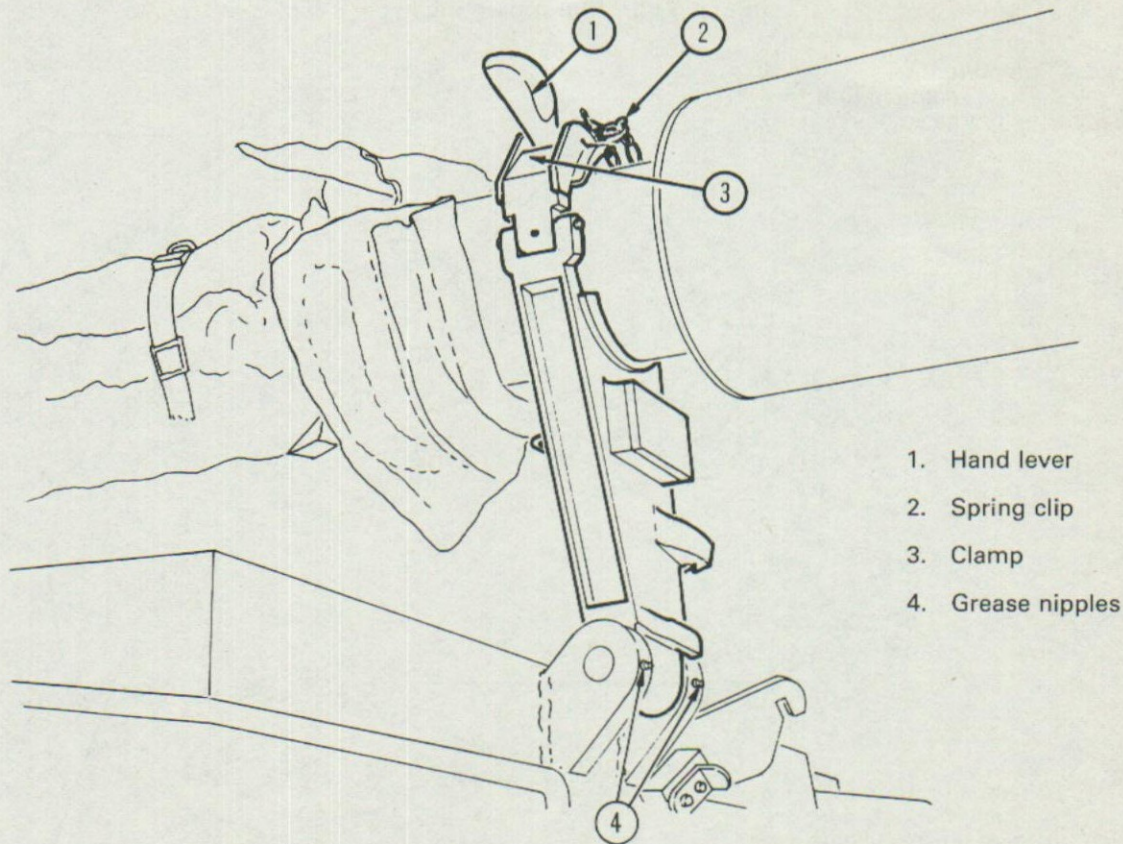


Fig 2 - 120mm Gun crutch

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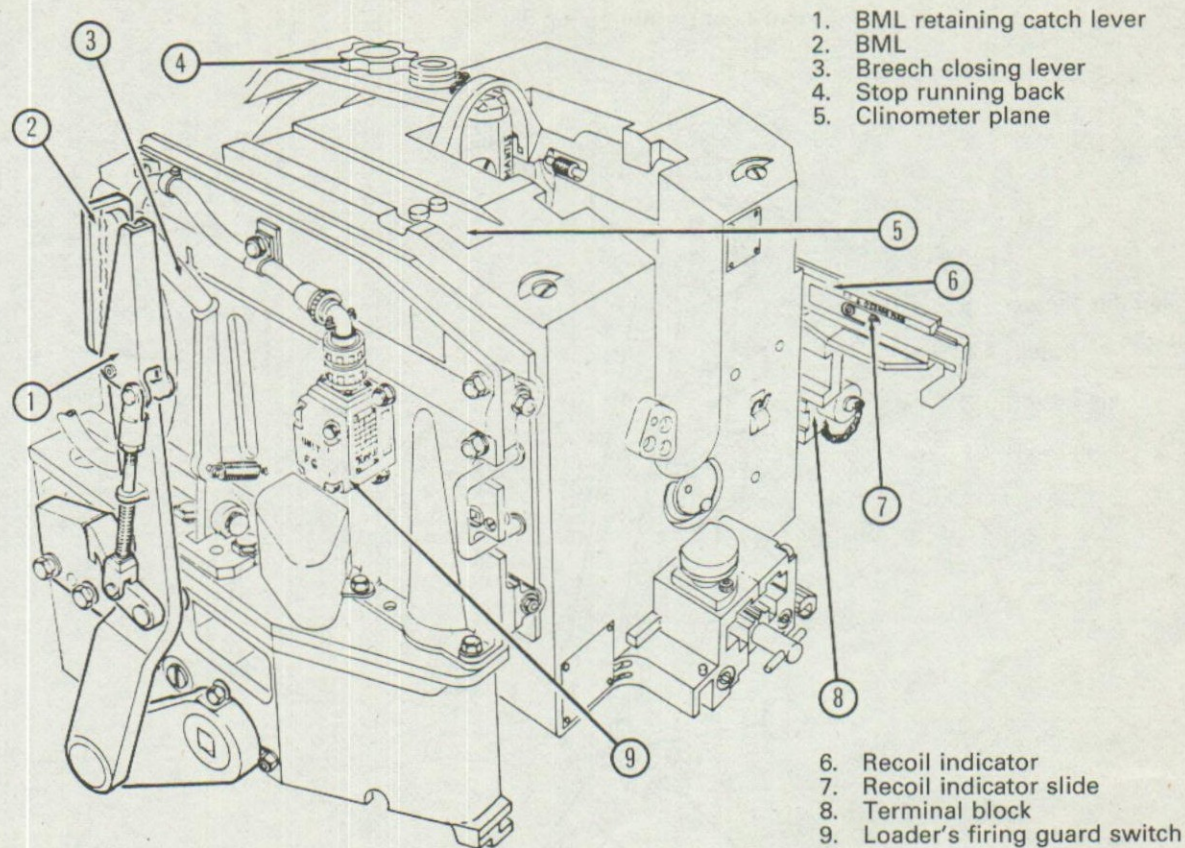


Fig 3 - 120mm Breech ring with BML fitted

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|---|--------------------------------|
| 1. Obturator sleeve protector retaining screw | 6. Gearbox |
| 2. Breech block | 7. Gearbox plunger |
| 3. Obturator sleeve protector | 8. Breech opening tool (BOT) |
| 4. Anti rotation key | 9. Vent tube loader |
| 5. Breech ring electrical contact | 10. Breech opening tool handle |
| | 11. Retaining plunger |

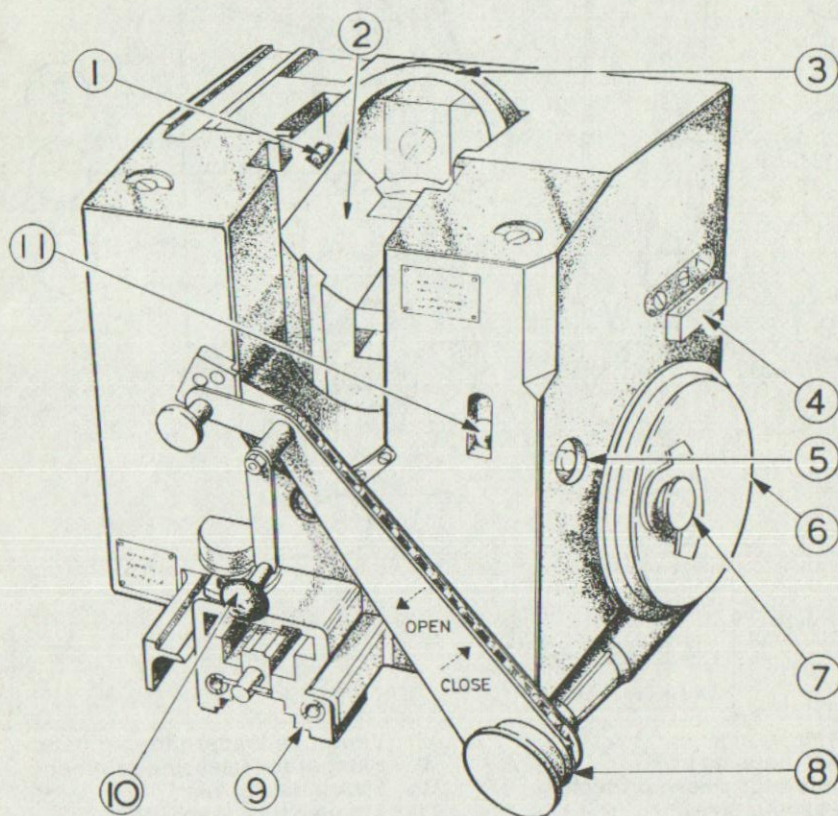
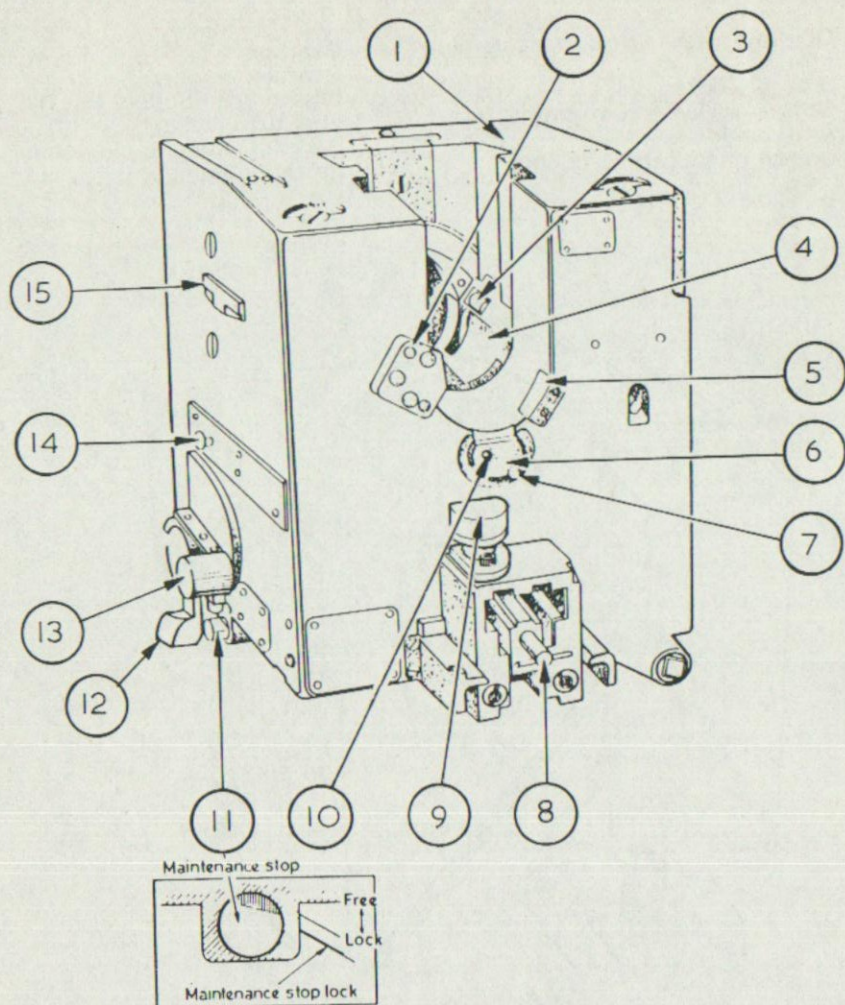


Fig 4 - 120mm Breech ring with breech opening tool fitted

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- | | |
|---|-----------------------------------|
| 1. Breech ring | 8. Vent tube loader rammer handle |
| 2. BOT housing | 9. Plunger for releasing rammer |
| 3. Obturator sleeve protector retaining screw | 10. FNA indicator pin |
| 4. Breech block | 11. Maintenance stop |
| 5. Projectile stop (LIIA2 gun) | 12. Cam control |
| 6. Firing needle assembly (FNA) | 13. Stud |
| 7. FNA Retaining plunger | 14. Firing needle actuating crank |
| | 15. Loader's firing guard cam |

Fig 5 - 120mm breech ring with breech open

- e. Return the BML to its forward position, so that the retaining catch is re-engaged.
- f. Strike the plunger on the top of the vent tube loader with the palm of the hand to release the rammer.

To open the breech (with the breech opening tool (BOT)) (See Fig 4)

4.
 - a. Check that the recuperator air pressure gauge reads not less than 500 psi. On earlier marks there may be a red line on the air pressure gauge and the needle should not be lower than this line.
 - b. Remove the stop, running back, by slackening the handwheel on top of it until the stop can be lifted clear of the cradle.
 - c. Check that the maintenance stop is protruding (see Fig 5).
 - d. Fit the breech opening tool in position. While turning the handle alternately clockwise and anti-clockwise, an assistant should ease out to its limit the gearbox plunger located in the gearbox coverplate, situated on the right side of the breech ring.
 - e. Rotate the BOT handle clockwise until the breech is fully open and resistance is met. The block is now on the maintenance stop.
 - f. Rotate the handle anti-clockwise; the breech will rise until the gearbox plunger re-engages in the worm wheel located under the coverplate. This re-location of the plunger should produce an audible click, but the assistant should feel the plunger re-engaging to confirm that it has done so.
 - g. Remove and restow the breech opening tool.
 - h. Strike the plunger on the top of the vent tube loader with the palm of the hand to release the rammer.

To close the breech

5. Operate the breech closing lever to the left of the breech ring, by pulling the handle to the left (see Fig 3).

To prove the gun

6. This action must be carried out before any work is completed on the gun.
 - a. Open the breech.
 - b. Looking from the top of the chamber to the bottom of the muzzle end, confirm that the chamber and bore are completely clear of any ammunition or fouling. (Rag, dirt, etc, ie, anything that can obstruct the passage of the round up the barrel constitutes fouling.)
 - c. If no further work is to be done on the gun, the breech will be closed. If, however, it is intended to strip the gun, carry out maintenance or load the gun, the block should be left in the open position.

120-mm handling

7. The full crew drill relating to the word of command "Action" is covered in Chapter 14, Section 1. The drills carried out by the loader when handling the 120-mm gun are given in the following paragraphs.

To load the gun (initially)

8.
 - a. Open the breech.
 - b. Inspect the vent tube magazine and ensure that the transparent end cap of the vent tubes is facing forward.
 - c. Insert a full vent tube magazine into the magazine guide in the bottom of the vent tube loader. Push the magazine upwards and ensure that the retaining catch on the vent tube loader engages correctly.
 - d. Pull the rammer handle, on the vent tube loader, fully to the rear. Strike the plunger with the palm of the hand to release the rammer. Check that the rammer handle is fully forward and only the white part is showing (if this does not happen, see Chapter 14, Section 3, vent tube stoppage drills).
 - e. Place the projectile on the loading platform and push it into the chamber so that it is clear of the charge retaining catch, taking care that the catch is not damaged by the projectile.
 - f. Open a charge bin, remove the correct charge for the selected projectile, close and secure the lid of the charge bin.
 - g. Insert the charge into the chamber with the carrying handle towards the projectile and the igniter pad towards the breech. Push the charge well into the chamber with the knuckles of the right hand, ensuring that it goes forward of the obturator sleeve; failure to do this will result in the charge bag being split, as the block rises on closing, and ignitor /propellant being spilt over the obturators and breech block. This could cause a flash back into the turret when firing takes place.
 - h. Close the breech.
 - j. Select the next projectile.
 - k. Pull the loader's firing guard to the rear.
 - l. Physically ensure that the turret safety switch is at LIVE. (Visual checking is not sufficient in poor light conditions when firing at night, closed down, or when using a respirator, etc.)
 - m. Report "Loaded".

To load the gun (subsequently)

9.
 - a. Place the projectile on the loading platform of the breech and push it into the chamber.
 - b. Strike the plunger on the vent tube loader with the palm of the hand to release the rammer. Check that the vent tube rammer handle is fully forward and only the white part of the rammer handle is showing. (If it is not fully forward, see Chapter 14, Section 3, vent tube stoppage drills.)
 - c. Open the charge bin, remove the correct charge, close and secure the lid of the charge bin.
 - d. Insert the charge into the chamber with the carrying handle towards the projectile and the ignitor pad towards the breech. Push the charge into the chamber with the knuckles of the right hand.
 - e. Close the breech.
 - f. Select the next projectile.
 - g. Pull the loader's firing guard to the rear.

- h. Physically check that the turret safety switch is at LIVE.
- j. Report "Loaded".

Safety arrangements

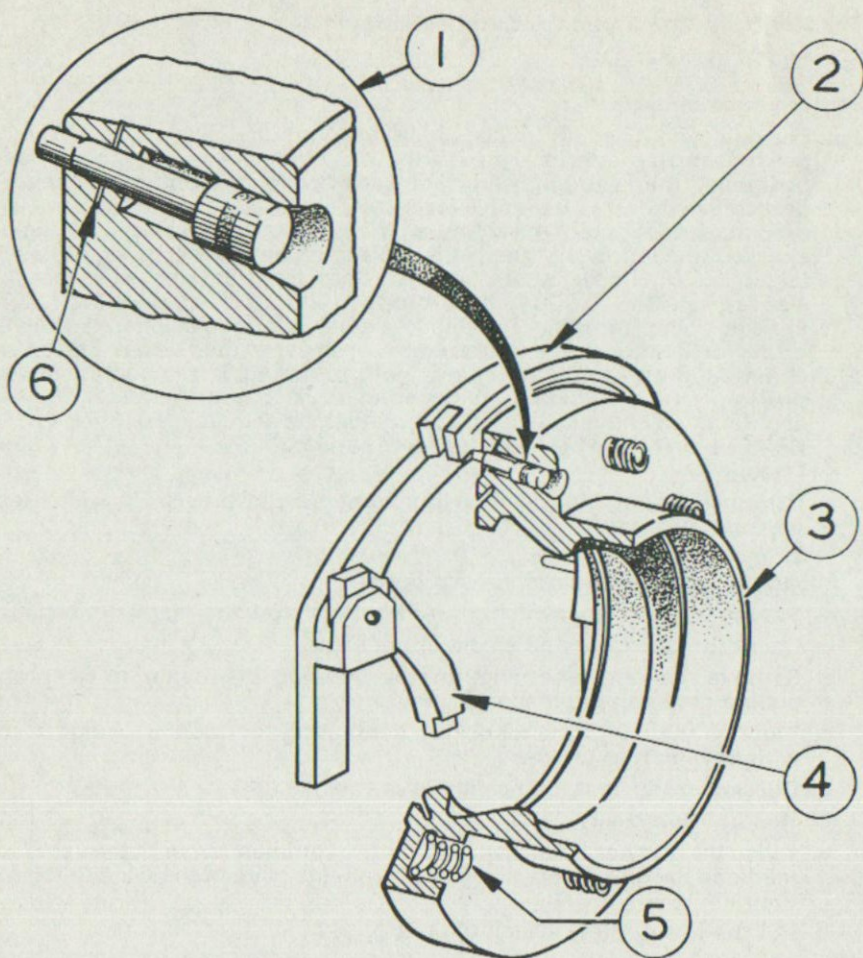
10. a. The gun cannot be fully loaded unless the obturator sleeve is fitted, due to the breech ring interlock preventing the block from rising to the load position. If the failure indicator pin (see Fig 6) on the obturator sleeve is protruding, the arm on the sleeve protector will have been broken and will drop across the rear of the chamber. If this happens, the sleeve should be checked to confirm that the pin is protruding and, if it is, firing must not take place until new obturators have been fitted. It is possible that the sleeve protector arm may have dropped, not as a result of the failure indicator pin protruding, but due to a weak retaining catch in the sleeve protector. If this is the case, the obturator sleeve should be checked by the commander to see that the pin is not protruding. If it is not, the sleeve protector arm should be re-engaged in its catch. If the commander is in any doubt as to the state of the obturators, he should cease firing until a REME examination has declared them serviceable or a new set have been fitted.
- b. If the insert is not fitted, loading is prevented by the breech block inter-lock indicator protruding.

To unload the gun (round fired, breech open)

11. a. Set the turret safety switch to SAFE and re-stow the ready projectile.
- b. Check that the bore and chamber are clear.
- c. Remove the vent tube magazine by pressing the magazine catch and pulling down on the magazine.
- d. Remove the vent tube loader by depressing the locking plungers and withdrawing it to the rear.
- e. Check that the vent tube chamber is clear.
- f. Report "Gun clear".
- g. When the gun has been inspected by the commander, re-fit the vent tube loader to the gun. Strike the plunger with the palm of the hand to release the rammer.
- h. Put the turret safety switch to LIVE.

To unload the gun (round not fired, breech closed)

12. a. Set the turret safety switch to SAFE and re-stow the ready projectile.
- b. Open the loader's firing guard by striking the roller from the inside of the guard with the palm of the hand.
- c. Remove the vent tube magazine.
- d. Remove the firing needle assembly by pushing in on the retaining plunger and rotating the assembly anti-clockwise as far as possible. Remove the unfired vent tube and replace the firing needle assembly. Place the vent tube in the magazine and restow the magazine.
- e. Open the breech.



1. Primary seal failure indicator pin
2. Obturator sleeve protector
3. Obturator sleeve
4. Obturator sleeve protector arm
5. Obturator sleeve springs
6. Shear wire

Fig 6 – 120mm Obturator protector and sleeve

- f. Withdraw the charge and restow it in the charge bin.
- g. Remove the projectile and restow.
- h. Remove the vent tube loader; check that the bore, chamber and vent tube chamber are clear; report "Gun clear".
- j. When the gun has been inspected by the commander, re-fit the vent tube loader to the gun. Strike the plunger with the palm of the hand to release the rammer.
- k. Set the turret safety switch to LIVE.

To ease springs

- 13. Close the breech and fit the stop, running back.

To make safe

- 14. a. Set the turret safety switch to SAFE.
- b. Open the loader's firing guard.
- c. Set the turret safety switch to LIVE.
- d. The gunner will set the gunner's selector switch to the OFF position. The commander will set the commander's selector switch to GUNNER.
- e. The loader will report "Main safe".

SECTION 3 - SERVICING

Introduction

- 1. The efficiency of the gun depends very largely on its mechanical condition, and to this end servicing plays a major part in that it allows the equipment to be checked and maintained to the highest standard.

STRIPPING AND ASSEMBLING

Equipment required

Breech block suspension tackle (including bracket, hawser, tommy bar)
Breech opening tool
Tool obturator assembly
Eyebolt for suspension tackle
Screwdriver, Cabinet
Transit box for obturators
Spanner OJ $\frac{1}{2}$ -in AF (for earlier type suspension bracket)

- 2. When servicing the 120-mm gun, stripping as detailed in this section will be carried out

The rules of stripping and assembling

- 3. a. Ensure that the gun is unloaded (prove the gun).
- b. Strip to the correct sequence.
- c. Use the correct tools correctly.
- d. DO NOT USE FORCE.
- e. Place the parts in a clean, dry, safe place.

To strip the 120-mm gun

4.
 - a. Prove the gun but do not close the breech.
 - b. Slacken the obturator sleeve protector retaining screws and remove the protector from the breech block (see Fig 5).
 - c. Remove the firing needle assembly.
 - d. Remove the vent tube loader.
 - e. Fit the breech opening tool and take the breech block down to the maintenance stop.
 - f. Fit the tool, obturator assembly, to the breech ring with the front plate against the obturator sleeve but clear of the failure indicator pin. The rear plate should be horizontal against the inside rear face of the breech ring (see Fig 7).
 - g. Tighten the handle of the tool until the obturator sleeve is compressed and clear of the retracting levers. Depress the axis pins (a fired vent tube can be used) and remove the retracting levers and axis pins.
 - h. Remove the tool, obturator assembly, being careful not to drop the front plate on to the obturator sleeve. Withdraw the sleeve from the chamber and check that the breech ring interlock protrudes; place the sleeve carefully in the transit box.
 - j. Remove the preserving screw from the top of the breech block and screw in the eye bolt.
 - k. Attach the breech block suspension bracket to the turret roof and tighten up the two bolts with the tommy bar provided. On earlier suspension brackets the spanner OJ $\frac{1}{2}$ -in AF must be used.
 - l. Fit the hawser to the bracket. Elevate or depress the gun, as necessary, to attach the hook to the eye bolt.
 - m. Elevate the gun until the tackle is taking the weight of the breech block. Rotate the BOT anti-clockwise until the block is clear of the maintenance stop. Lift the stop lock lever and, using a screwdriver, press the maintenance stop to the right as far as it will go. Pull down on the stop lock lever to hold the maintenance stop in the withdrawn position.
 - n. Rotate the BOT clockwise, while the gun is being depressed, until the breech block is clear of the breech ring and crank arms. The assistant must ensure that the steel hawser is taut at all times. As the breech block comes out of the guides it will tend to swing backwards and rotate, this should be prevented by steadying it as it clears the breech ring.

NOTE:- At this stage the gauging of the firing needle protrusion can be carried out. (See para 6 below.)

- o. Remove the sliding blocks from the crank arms after noting the position of them.
 - p. Rotate the breech block through 3200 mils. Take the tension off the breech block interlock by pressing the interlock indicator towards the side of the block. Remove the breech block insert from the recess in the breech block; place the insert in to the transit box.

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1. Primary seal failure indicator pin
2. Obturator sleeve
3. Tool Obturator assembly
4. Retracting lever axis pin
5. Retracting lever

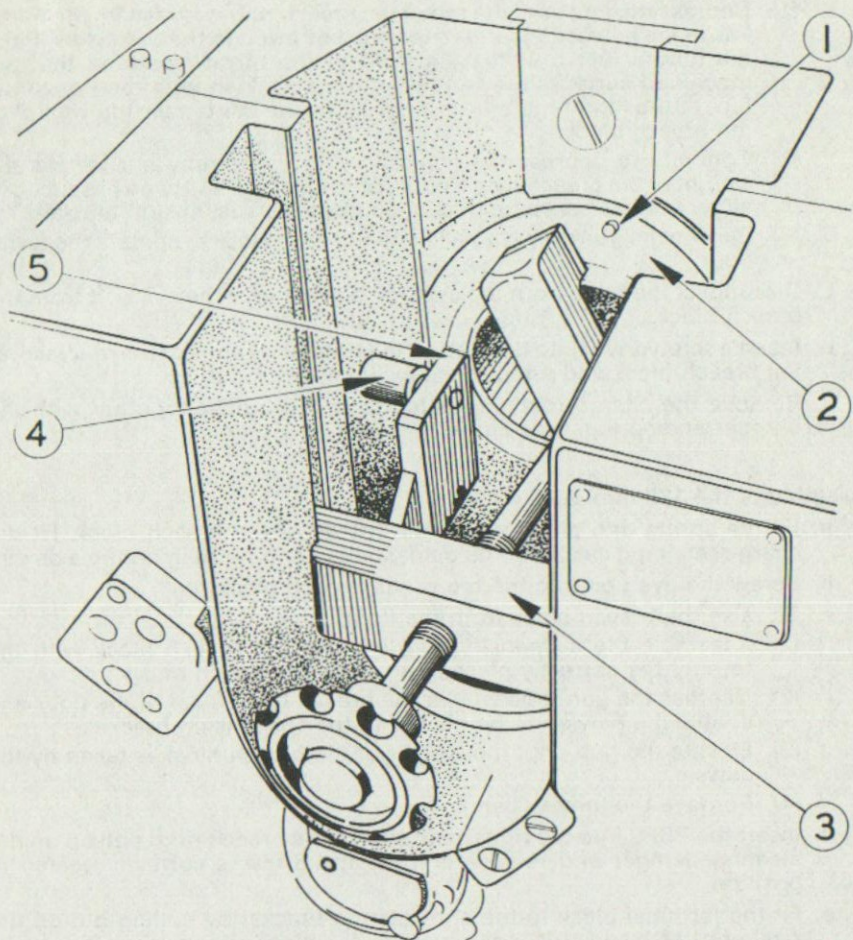


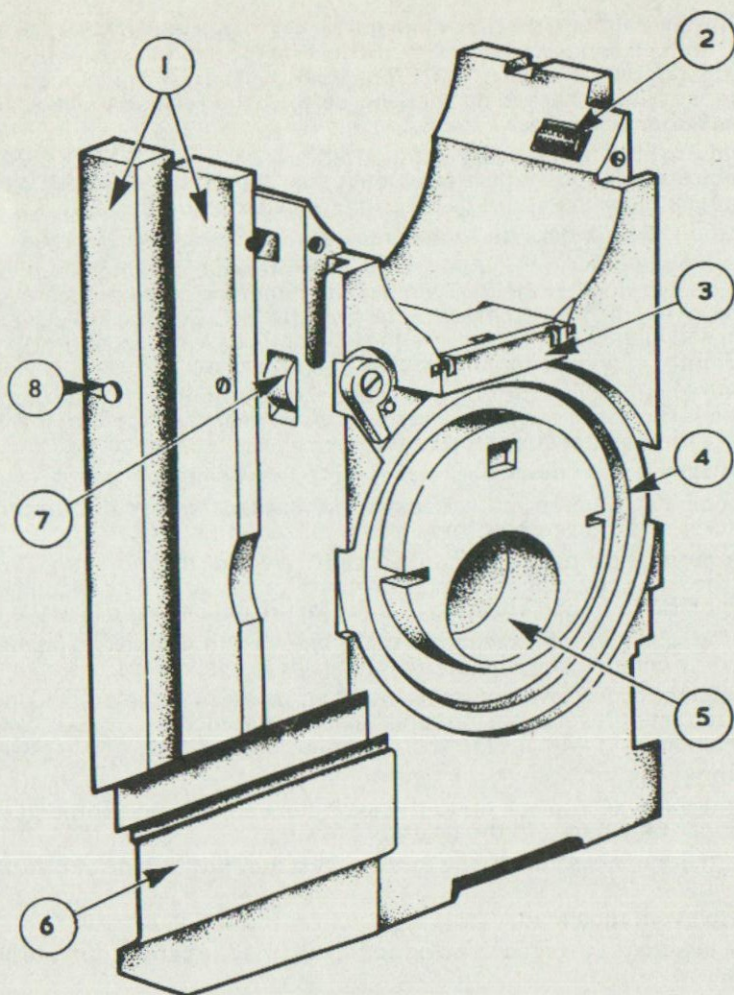
Fig 7 - 120mm Breech ring with obturator tool assembly fitted

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- q. Disconnect the electrical connector from the terminal block (See Fig 3). Pull out the retaining catch and pull the block to the rear, removing it from its guides.
- r. Pull out the breech ring electrical contact (BREC) retaining plunger situated in a recess in the rear face, right hand side, of the breech ring and withdraw the BREC to the right (see Fig 4).
- s. To lower the breech block to the turret floor:-
 - (1) Depress the gun until the top of the breech ring is level with the metal link in the hawser. Insert the tommy bar through the metal link. Push the tommy bar towards the front of the turret, ensuring that the machined surfaces are to the bottom and flush with the horizontal face at the top of the breech ring. Allow the bar to take the weight of the breech block.
 - (2) Continue to depress the gun, allowing the tommy bar to take the weight of the breech block, until sufficient slack has been produced to allow the hawser to be unclipped from the suspension bracket.
 - (3) Elevate the gun slowly to allow the breech block to contact the turret floor.
- t. Disconnect the hook from the eye bolt and remove the eye bolt from the breech block.
- u. Insert a screwdriver into the slot, on the right hand edge of the rear face, of the breech block and remove the axis pin (see Fig 8).
- v. Remove the charge retaining catch from the guides together with the plunger and spring. (See Fig 8).

Assembly of the 120-mm gun

- 5. a. Fit the spring and plunger into the recess of the breech block. Fit the charge retaining catch into its guides; align and press in on the axis pin.
- b. Screw the eye bolt into the top of the breech block.
- c. To raise the breech block from the floor:-
 - (1) Assemble the suspension tackle on to the breech block with the tommy bar correctly placed on top of the breech ring.
 - (2) Depress the gun; this will lift the breech block clear of the floor and enable the hawser to be pinned to the suspension bracket.
 - (3) Elevate the gun until the weight of the breech block is taken by the hawser.
 - (4) Remove the tommy bar.
- d. Insert the BREC into the right hand side of the breech ring; pull up on the locating plunger and release it when the BREC is correctly seated in position.
- e. Fit the terminal block to the anti-rotation bracket by pulling out on the retaining catch and pushing forward on the block, then release the retaining catch. Refit the electrical connector, ensuring that it is tight.
- f. Rotate the breech block so that the front face is towards the rear of the turret. After depressing the plunger situated to the side of the breech block interlock, press the breech block interlock indicator towards the side of the



1. Breech block guides
2. Obturator sleeve protector retaining screw
3. Charge retaining catch
4. Recess for breech block insert
5. Flame pocket
6. Inclined recesses
7. Breech block interlock
8. Charge retaining catch axis pin

Fig 8 - 120mm Breech block

breech block. Place the insert into the recess in the breech block, ensuring that, if the insert is marked 'Top' on the rear face, this is positioned at the highest point. (The word 'top' is only found on earlier mark breech block inserts. Where there is no marking of 'top', the relative position of the insert does not matter.)

NOTE:- Service obturator sets are stamped either with the prefix 'S' or 'D' to their registered numbers. It is imperative that the obturator sleeve and the breech block insert are of the same registered number.

- g. Fit the sliding blocks on to the crank arms.
- h. Elevate the gun slowly while guiding the breech block into the guides of the breech ring. Fit the BOT and rotate it until the crank arms are just in front of the inclined recesses in the breech block. Continue to elevate the gun and at the same time rotate the BOT anti-clockwise, ensuring that the sliding blocks enter the inclined recesses correctly.
- j. Continue to elevate the gun and rotate the BOT until the breech block has risen just clear of the maintenance stop. Release the stop lock lever and allow the maintenance stop to reassert.
- k. Wind the breech block back down on to the maintenance stop.
- l. Disconnect the breech block suspension tackle. Remove the suspension bracket and the eye bolt; replace the preserving screw.
- m. Compress the breech ring interlock until it is inside the mortise. Pull down on the small cover plate. Insert the obturator sleeve into its seating in the end of the chamber, ensuring that the failure indicator pin is at the top.
- n. Fit the tool, obturator assembly, to the breech ring. Tighten up on the tool thereby compressing the obturator sleeve into its recess.
- o. Fit the retracting lever axis pins into their recesses in the breech ring. Fit the retracting levers, making sure that the large smooth surface is towards the breech ring, with the lower projections pointing down and backwards.
- p. Remove the tool, obturator assembly.
- q. Wind the breech block up to the load position; check that the gearbox plunger re-engages in the gearbox housing.

NOTE:- At this stage the vent tube alignment test may be carried out (see para 7 below).

- r. Fit the vent tube loader.

NOTE:- At this stage the breach closing spring test may be carried out (see para 8 below).

- s. Close the breech.
- t. Fit the firing needle assembly.
- u. Fit the obturator sleeve protector in the recesses on the top of the breech block, with the pintle to the left and rear. Tighten the retaining screws.
- v. Fit the stop running back and secure it.

TESTS

Equipment required

Tools for stripping

Vent tube alignment gauge

Gauge, firing needle protrusion

To gauge the protrusion of the firing needle

6. This may be carried out at any stage where the firing needle actuating crank is either on the flat of the actuating cam, or completely clear of it, ie, the crank arms are either in the breech closed position or below the maintenance stop. The test is carried out as follows:-

- a. Fit the firing needle assembly into the breech ring.
- b. Place the gauge firmly, at right angles to the FNA, on the rear inside wall of the breech ring, below the FNA.
- c. Slide the gauge upwards with the needle in its path, checking that the gauge clears the FNA with the 0.11-in part but fouls the pin with the 0.09-in part.
- d. If the firing needle is too long or too short, report to REME.

To test the vent tube alignment

7. This test may only be carried out when the breech is in the load position, and is carried out as follows:-

- a. Remove the vent tube loader.
- b. Fit the plate of the alignment gauge in accordance with the engraved instructions, ie, rear and top.
- c. Insert the plug of the tool through the plate and into the vent tube chamber on the breech block until the red scribe mark on the plug is in line with the rear edge of the gauge plate.
- d. If the plug does not penetrate this far then the block is out of alignment; report to REME.

To test the breech closing springs

8. This test may only be done from the load position. The test is as follows:-

- a. Close the breech and watch for any sluggish movement of the breech block on its way up.
- b. Check that the roller on the firing needle actuating crank is on the flat portion of the actuating cam.
- c. If the movement of the breech block is sluggish or the FN actuating crank is not correctly positioned, report to REME.

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CLEANING

Equipment required

*Tools, accessories and spares as per CES
Clean cloth and oil as required*

9. The servicing of the 120-mm gun must be carried out in accordance with the Chieftain Servicing Schedule.

Routine cleaning

10. The term routine cleaning applies to the cleaning required during the two monthly and weekly servicing. The cleaning should be carried out as follows:-

- a. Traverse the gun to the 3, 9 or 12 o'clock position and depress below the horizontal.
- b. Lower the breech block to the maintenance stop.
- c. Assemble the staves, push them up the barrel, through the chamber on to the top of the breech block.
- d. Wrap one thickness of cloth around the brush (cleaner bore No. 4) and fit it to the end of the staves. Draw the rod, brush and cloth through the barrel. Repeat this process until such time as the cloth emerges clean and dry.
- e. Using clean cloth, or cloth and the brush cleaning artillery, clean the walls of the chamber thoroughly.
- f. Inspect the bore and chamber as carefully as possible to confirm that they are clean and dry, and that there is no damage.
- g. Saturate a cloth with oil and push it up the length of the barrel from the muzzle end in order to oil the bore.
- h. Wipe the chamber with the cloth and ensure as far as possible that there is a film of oil over the whole chamber and bore.
- j. Fit the muzzle cover.
- k. Ensure the breech block is on the maintenance stop.
- l. Wipe the breech block and the inside of the breech ring with a clean cloth and inspect.
- m. Wipe clean the obturators and inspect, then re-oil the insert and sleeve, and the area of the breech block surrounded by the insert, with oil OMD 75.
- n. Using OMD 75 (or other oil if climate, etc, demands) oil the rear and sides of the breech block, the escapement mechanism, the inclined recess, the breech block guides and the outside of the breech ring.
- o. Remove, clean and inspect for damage, the vent tube loader. If there is none, re-oil with OMD 75 (liberally) and replace on the rear of the breech ring.
- p. Close the breech and refit the breech cover.

Preparation for firing

11. a. Strip the 120-mm gun, including the fume extractor. Clean, inspect lubricate, leaving the following parts dry clean:-

- (1) Bore and chamber.
- (2) Vent tube chamber and flash channel.
- (3) Obturator sleeve and breech block insert mating surfaces.
- b. Assemble the gun and the fume extractor. Complete the tests.
- c. Check the fitting of the thermal sleeve.

During firing

12. a. Every opportunity should be taken to clean, examine and lubricate the gun during lulls in firing. Dusty conditions will demand extra attention.
- b. Obturators will be cleaned on the following occasions:-
 - (1) When ONLY the rigid combustible cases are fired, AFTER EVERY 30 ROUNDS.
 - (2) When mixed rigid combustible cases and cloth charge bags are fired, AFTER EVERY 30 ROUNDS.
 - (3) When ONLY cloth charge bags are fired, AFTER EVERY 60 ROUNDS.
- c. The crank retaining screw must be checked for security.
- d. Check security of the thermal sleeve.

After firing

13. a. The gun is easier to clean immediately after firing whilst it is still warm but, if this is not possible, a thorough oiling of the gas affected parts will greatly assist later cleaning.
- b. The gun will be stripped and the cleaning should be carried out as follows:-
 - (1) *Barrel* – Pour oil on to the brush; scour the bore and chamber throughout its length. Dry clean; examine to see that all fouling has been removed. Re-oil the bore and chamber.
 - (2) *Obturators* – Clean with OMD 75, wipe dry and examine for signs of gas erosion, which is indicated by light pitting on the sealing faces. Report any faults to REME.
 - (3) *Breech block* – Clean, inspect, re-oil.
 - (4) *Fume extractor* – Remove, clean and relubricate. Remove the drain plug and allow any fluid to drain.
 - (5) *Thermal sleeve* – Check condition and security.

Care after firing

14. The bore, chamber, obturators and breech block must be thoroughly cleaned, inspected and re-oiled daily for at least five days after firing. Inspection must be more frequent during humid conditions, keeping a careful watch for rust. In desert conditions of extreme dust and sand, the gun should be wiped dry.

SECTION 4 – THERMAL SLEEVE AND FUME EXTRACTOR

Introduction

1. The task of the thermal sleeve is to maintain the barrel at a constant temperature in all weather conditions. This is achieved by the sleeve keeping a pocket of

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air around the barrel. If the thermal sleeve is not fitted or fitted incorrectly, this pocket of air is not maintained and hence uneven cooling may occur on one part of the barrel which may cause it to distort about an axis, the result of which will be a loss of accuracy.

General

2. There are two thermal sleeves in service, one for use with L11A5 barrels and one for earlier marks of barrels.

a. Thermal sleeves L6A4 are made up as follows:-

- (1) Covers, thermal, No. 8 and 9 (see Fig 9).
- (2) Clamps, loop, No. 1, 2 and 3.
- (3) Clips, hose, worm drive type, 11-in in dia.

b. Thermal sleeves L6A3 are made up as follows:-

- (1) Covers, thermal, No. 6 and 7 (see Fig 10).
- (2) Clamps, loop, No. 1, 2 and 3.
- (3) Clips, hose, worm drive type, 11-in in dia.

3. The differences between the two thermal sleeves are that the L6A4 is a light weight sleeve compatible with the L11A5 barrel and gun clamp. The L6A3 sleeve is used with barrels of earlier marks and on tanks fitted with a gun crutch. (See Figs 9 and 10).

4. The thermal covers are made up of a canvas outer, lined with gauze wire and asbestos. They are retained in position by loop clamps located around the outside of the cover which, when tightened up, compress a series of pads (Mintex) and prevent the sleeve from moving in relation to the barrel. In between the clamp, the cover is retained by quick release straps. Hose clips retain the front thermal cover on the fume extractor retaining nut /locking ring.

FITTING

Equipment required

Spanner, box, No. 7, Mk 1 (or ¾-in AF)

Screwdriver, Cabinet

Hammer and block of wood

5. On certain barrels there is a small ridge on the outer surface a few inches forward of the gun bellows, when fitting either cover thermal No. 8 or 7, the rear set of Mintex pads must be placed on the turret side of the ridge.

Fitting the L6A4 thermal sleeve

6. a. Level the gun.

b. Drape the No. 8 cover over the barrel behind the fume extractor, with the yellow arrow on the outside of the cover pointing towards the muzzle. If the barrel has a ridge, the rear set of anti-friction pads should be behind it.

c. Wrap the lower portion of the cover around the bottom of the barrel, folding the top over and attaching the buckles on to the hooks. Tighten the

- straps. The overlap should be at the 4 o'clock position when viewed from the rear and the yellow indicating arrow at the bottom of the barrel.
- d. Pull the bellows over the thermal cover until it is in line with the rear set of anti-friction pads. Fit clamp No. 3 over the front of the bellows. Ensure that the stud is vertical with the nut at the top and is positioned on the left side of the barrel. Tighten the nuts evenly after ensuring that the washers are between the nuts and the clamp.
 - e. Fit clamp No. 2 over the front set of anti-friction pads. Ensure that the stud is vertical with the nut at the top and is positioned on the left side of the barrel. Tighten the nuts.
 - f. Using the block of wood as an intermediary, tap clamp No. 2 towards the muzzle of the gun. The thermal cover will stretch; continue to tap the clamp forward until the cover contacts the rear of the fume extractor. Ensure that the clamp does not slip off the anti-friction pads. Tighten the clamp nuts evenly and re-tighten the straps, tucking the loose ends into the loops.
 - g. Drape the No. 9 thermal cover over the barrel, with the yellow arrow on the outside pointing towards the muzzle.
 - h. Wrap the cover around the barrel and secure the buckles.
 - j. Position the rear set of pads in the groove of the fume extractor retaining nut /locking ring. Secure them in position with the two worm drive hose clips.
 - k. Fit clamp No. 1 over the larger set of anti-friction pads, to the rear of the cover. Ensure that the stud is vertical with the nut at the bottom and is positioned on the right side of the barrel. Tighten the nuts.
 - l. Fit the second clamp No. 1 over the front set of anti-friction pads. Ensure that the stud is vertical with the nut at the bottom and is positioned on the right side of the barrel. Tighten the nuts. Using the block of wood and hammer, tap the clamp towards the muzzle, stretching the cover until it reaches the barrel swell.
 - m. When the thermal cover has made contact with the swell, re-tighten clamp No. 1 and the buckle straps, tucking the loose ends into the loops. Re-tighten the worm drive hose clips on the fume extractor retaining nut /locking ring.

Fitting the L6A3 (modified) thermal sleeve

7. This is fitted in a similar manner to the L6A4, allowing for the minor differences in the thermal covers.

Tightening of clamps

8. During initial firings, some bedding of the Mintex pads under the clamps will occur. All nuts on the clamps and webbing straps should, therefore, be checked for tightness during firing and re-tightened as necessary.

Fitting the barrel in to the gun clamp /crutch

9. When the L6A4 thermal sleeve is fitted, the clamp fits directly on to the pads of the thermal cover No. 8.

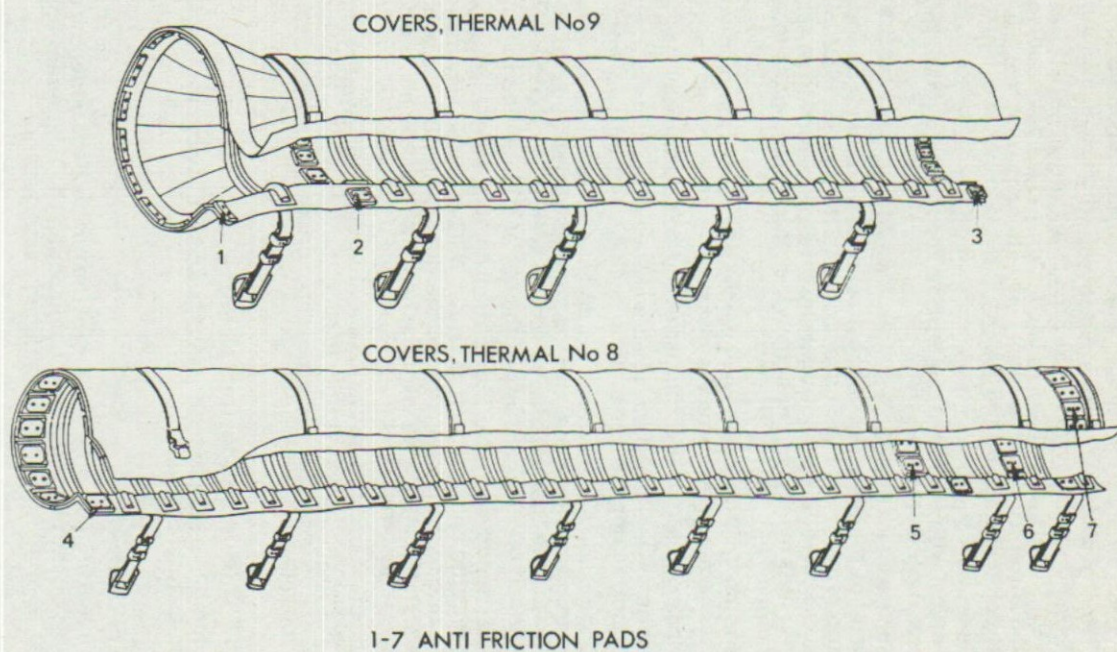


Fig 9 - Thermal sleeve L6A4

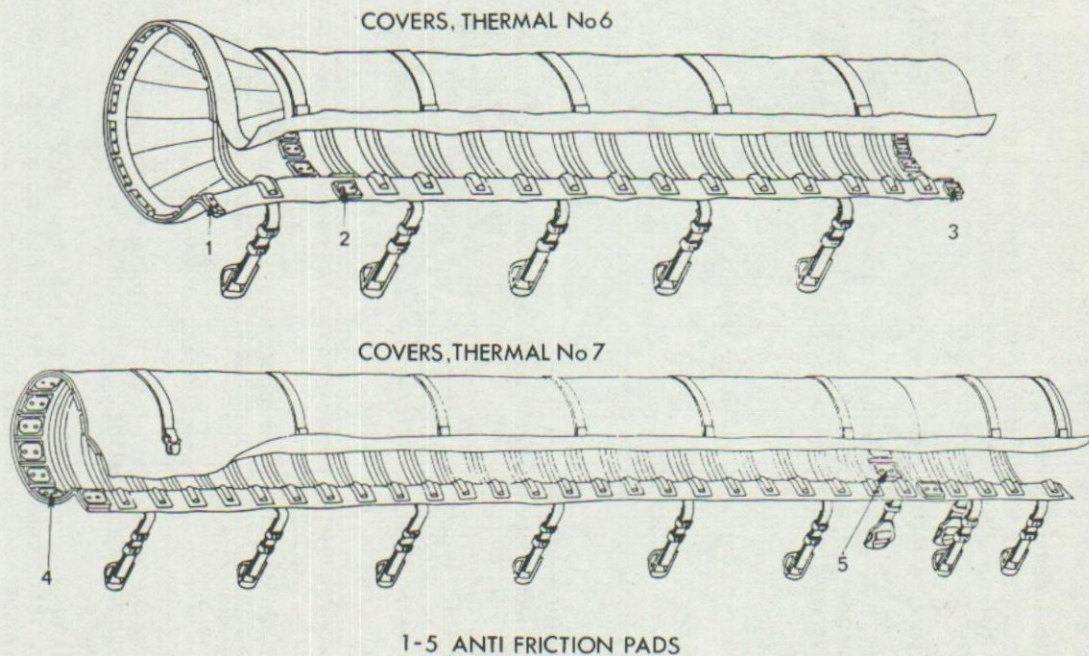


Fig 10 – Thermal sleeve L6A3

10. If thermal sleeve L6A3 (Mod) is used, irrespective of the type of gun crutch /clamp fitted, the front part of cover No. 7 **MUST** be unbuckled and folded back prior to placing the gun in the crutch.

Removing the thermal sleeve

11. The procedure for removing the covers is generally the reverse of that for their fitting. It should be noted, however, that there will be a tendency for the clamps to have become bonded to the fabric of the covers and for the latter to have become bonded to the barrel, particularly at the points where they were clamped. Great care must, therefore, be taken in removal to avoid undue bending of the clamps or tearing of the fabric or friction pads. If the pads are stuck to the barrel they must be eased off using a screwdriver. Great care must be taken to ensure that neither the pads nor the barrel are damaged. If the cover is torn off by jerking the overlap, the fabric will certainly tear, thus making the cover unserviceable.

FUME EXTRACTOR

Introduction

12. The task of the fume extractor is to prevent the passage of fumes into the fighting compartment, when the breech opens after the firing of the main armament.

Action of the fume extractor

13. As the projectile travels up the bore of the gun, some of the propellant gas enters the fume extractor through the ports in the barrel and builds up a pressure in the extractor cylinder. The gas, under pressure, is stored in the fume extractor until the projectile leaves the muzzle. The gas pressure in the bore then falls below that in the extractor, and the trapped gas re-enters the bore to cause a flow of air from breech to muzzle to force any residual gases out at the muzzle.

Description

14. The fume extractor L1A1 fitted to L11A2 /A3 barrels consists of the following components:-

- a. *The cylinder* which has rubber sealing washers fitted at each end that make a gas tight seal. It is threaded at the muzzle end and has a drain plug on the lower bevel.
- b. *The key anti-rotation* which consists of a split metal ring; the upper half is tabbed so that it fits into a recess in the barrel and cylinder. Its task is to prevent the cylinder from rotating in relation to the barrel and to keep the cylinder seated against the lip at the breech end of the cut-away section of the barrel.
- c. *The retaining nut and washer* which fit over the threads of the cylinder. The retaining nut screws on to the threads to hold the cylinder in position. The washer can be tapped into a recess in the cylinder to lock it.

15. The fume extractor L3A1, fitted to L11A5 barrels, consists of the following components:-

- a. The cylinder is similar to that used with the L1A1. It is, however, lighter

and its reduced diameter enables the barrel to be removed with the fume extractor in position.

- b. The key anti-rotation is housed in the upper half of a split locking ring which fits into a recess in the barrel. The split locking ring is secured to the cylinder by bolts.

To strip, service and assemble the fume extractor

Equipment required

Spanner, wrench, 9-in (L1A1)

Screwdriver, Cabinet

Spanner $\frac{1}{2}$ -in (L3A1)

16. a. Undo and either remove or fold back the No. 9 or No. 6 thermal cover and expose sufficient of the barrel to allow the cylinder to be moved forward off its seating.
- b. (1) *L1A1 fume extractor*. Unscrew the retaining nut; remove the anti-rotation key and washer.
- (2) *L3A1 fume extractor*. Remove the securing bolts from both halves of the split locking ring; remove the ring.
- c. Slide the fume extractor forward, clear of its seating on the barrel.
- d. Clean the barrel gas ports and cylinder seating. Remove the drain plug and allow any fluid to drain; replace the plug.
- e. Lightly grease the area of the barrel covered by the fume extractor.
- f. Slide the cylinder over the seating of the barrel, ensuring that the drain plug is in the 6 o'clock position.
- (1) *L1A1 fume extractor*. Align the recess in the cylinder with the one in the barrel. Fit the anti-rotation key and washer; tighten the retaining nut.
- (2) *L3A1 fume extractor*. Fit the split locking ring, ensuring that the anti-rotation key on the upper half fits into the recess of the barrel. Replace and fully tighten the securing bolts.
- g. Refit the thermal cover.

SECTION 5 – RECOIL SYSTEM

Introduction

1. The recoil system consists of two hydraulic buffer cylinders, a replenisher and a hydro-pneumatic recuperator contained in cylinders about the cradle. The function of these components is as follows:-

- a. To hold the gun at the firing position at all angles of elevation.
- b. To absorb the recoil energy.
- c. To achieve a fixed length of recoil at all angles of elevation.
- d. To return the gun to the firing position.

Description

2. a. *The buffers* consists of two cylinders located at the 2 and 8 o'clock positions on the gun cradle. There are filler and drain plugs, fitted with washers, at the rear end of each cylinder. Internally, each cylinder has a piston with a rod which protrudes through the rear end cap. These rods are attached to the breech ring yoke by gun nuts. Each cylinder holds up to eight pints of oil OM 13 (see Fig 11).
- b. *The replenisher* – This is located at the 12 o'clock position on the gun cradle. Its task is to accept excess oil from the buffer cylinders. On the top front there is a filler plug fitted with a washer (see Fig 12).
- c. *The recuperator* – This is located on the underside of the gun cradle. It consists of two cylinders, the left hand is the high pressure cylinder, the right hand is an oil cylinder. A pipe connects the high pressure cylinder to the air pressure gauge which indicates the air pressure in that cylinder. Protruding from the rear of the high pressure cylinder is a tell-tale rod. Surrounding the tell-tale rod is a sleeve on which there are two scribe marks, the front mark NORMAL, the rear mark CEASE FIRE (see Fig 13).
- d. *The recoil indicator* – This is located on the right hand gun shield to the rear of the breech ring. It consists of a bracket and slide. The bracket is marked with a series of white arrows and a rear red arrow marked CEASE FIRE. The slide has an indicating pointer which, when struck as the gun recoils, indicates the length of recoil.

Brief description of the operation

3. When the gun recoils, the buffer pistons, attached to the gun yoke, are pulled to the rear. The movement of the pistons is controlled by the oil in the cylinders and the recoil energy is absorbed. During recoil, the anti-rotation key on the breech ring strikes the indicator slide and the amount of recoil is recorded on the indicator. The runout of the gun is caused by the compressed air in the recuperator asserting itself. The final movement of runout is controlled by the action of the oil in the buffers. The gun will remain in the runout position providing that there is an air pressure of 500 psi registering on the air pressure gauge. The replenisher accepts oil from the buffers which expands due to heat; it also acts as a reservoir for oil.

SERVICING

Equipment required

*Oil OM 13
Injector, oil and petrol
Allen key $\frac{3}{8}$ -in
Spanner OJ $\frac{1}{2}$ -in x $\frac{7}{8}$ -in
Screwdriver, Cabinet
Oil OMD 75
Cloth
6-in adjustable spanner
 $\frac{3}{4}$ -in AF spanner
Replenisher jacking tool*

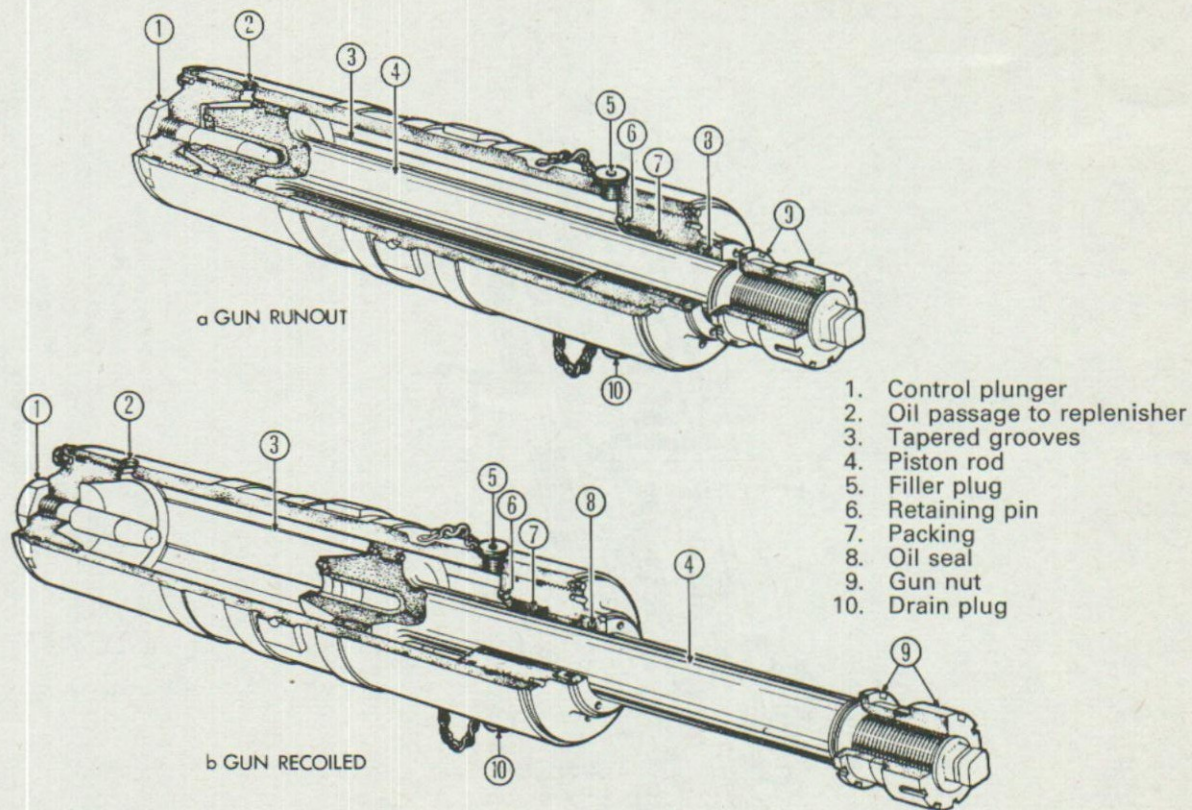
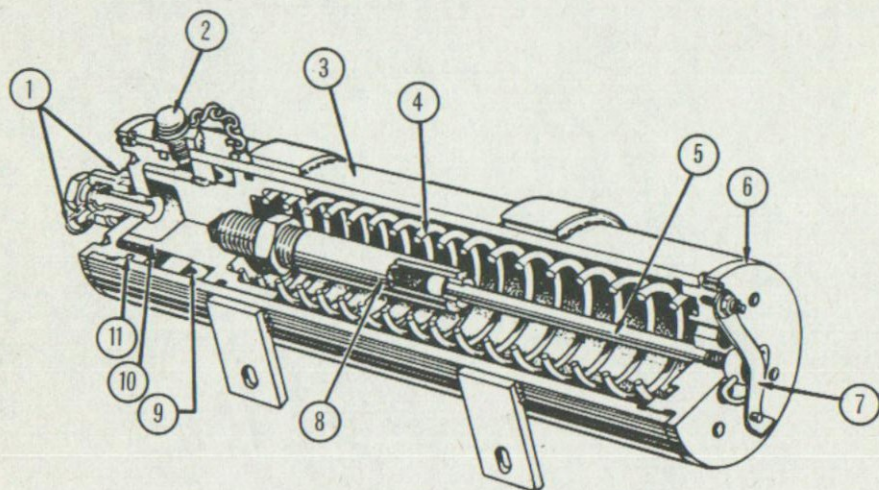
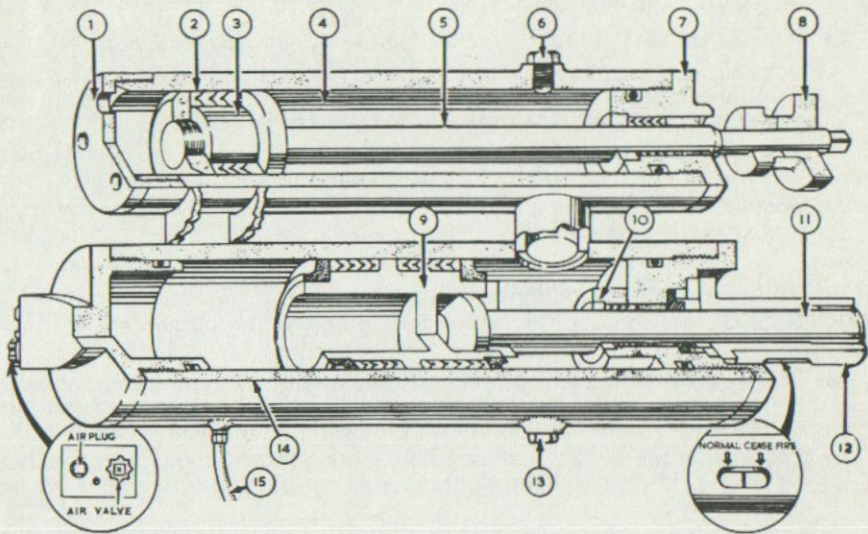


Fig 11 - Buffer cylinder No. 6



- | | |
|----------------------|-----------------|
| 1. Pipes to buffer | 6. Rear end cap |
| 2. Filler plug | 7. Leaf spring |
| 3. Cylinder | 8. Guide |
| 4. Spring | 9. 'U' seal |
| 5. Indicator rod | 10. Piston |
| 11. End cap oil seal | |

Fig 12 - Replenisher



- | | |
|-------------------|-----------------------|
| 1. Filter cap | 9. Floating piston |
| 2. Packing | 10. Rear end cap |
| 3. Piston head | 11. Tell tale rod |
| 4. Plane cylinder | 12. Rod cover |
| 5. Piston rod | 13. Drain plug |
| 6. Filler plug | 14. Cylinder air/oil |
| 7. Rear end cap | 15. Connection to air |
| 8. Gun nut | pressure gauge |

Fig 13 - Recuperator No. 8

- NOTES:-**
1. During the servicing of the recoil system and at all times, except when firing, the stop, running back must be fitted.
 2. Before removing any filler plug, ensure that the area surrounding it is free from dirt by wiping it with a clean cloth.
 3. Oil OM 13 is the correct oil to use in the recoil system. The oil should be strained before use to remove any foreign matter.

To test the replenisher for oil content (See Fig 12)

4.
 - a. Release the leaf spring clip retaining the replenisher indicator rod.
 - b. Pull the replenisher indicator rod to the rear manually and measure the amount of protrusion from the face of the rear end cap of the replenisher cylinder to the front face of the round nut on the indicator rod.
 - c. The protrusion should be in excess of 1.5-in (37-mm). If the protrusion is less than 1.5-in the buffers and replenisher require topping up.
 - d. Secure the leaf spring clip retaining the replenisher indicator rod if the protrusion is correct.

To top up the buffers and replenisher

WARNING:- Do not remove the buffer filler plugs as the oil content is under pressure.

5.
 - a. Fit the replenisher jacking tool on to the rear of the replenisher cylinder, engaging the sliding claw in front of the indicator rod round nut. For convenience, have the open end of the sliding claw facing left.
 - b. Ensure that the washer is fitted to the jacking tool bolt and rotate the bolt clockwise, until it is hand-tight, to take up all free movement on the indicator rod.
 - c. In cases where the deficiency of oil in the system is such that no free movement exists, it will be necessary to dismantle the tool and engage the sliding claw in front of the indicator rod by using the chamfered dogs to lever the indicator rod to the rear.
 - d. Level the gun, using the quadrant fire control (QFC), and remove the replenisher filler plug.
 - e. Using a 3/4-in AF spanner, rotate the jacking bolt clockwise to withdraw the indicator rod; simultaneously pour clean oil OM 13 into the replenisher, using an oil injector. Continue until the sliding claw fouls the tool body, preventing any further rotation of the jacking bolt.
 - f. Check that the sealing washer is serviceable and replace the replenisher filler plug.
 - g. Remove the jacking tool from the replenisher by rotating the jacking bolt anti-clockwise and disengaging the sliding claw from the indicator rod.
 - h. Fully elevate and depress the gun several times. Level the gun using the QFC.
 - j. Pull the replenisher indicator rod to the rear manually and measure the amount of protrusion. The protrusion should be in excess of 1.5-in. If it is less, the topping up procedure should be repeated until the correct protrusion is obtained.

- k. Slacken the replenisher filler plug and allow oil to bleed off until the indicator rod protrusion is reduced to 1/5-in.
- l. Tighten the replenisher filler plug and secure the leaf spring clip retaining the replenisher indicator rod.

To check the recuperator

- 6.
 - a. Check that the air pressure gauge reads not less than 500 psi. If it is less, report to REME.
 - b. Check the tell-tale rod at the rear of the high pressure cylinder. If it has reached the CEASE FIRE position, report to REME.
 - c. Check for oil leaks and security.

To set the recoil indicator.

- 7.
 - a. Clean and lubricate the indicator.
 - b. Push the slide fully forward; check that the pointer is in line with the front mark. If it is not, slacken the two screws on the pointer slide and move the plate until the marks coincide. Tighten the screws.
 - c. Set the pointer to the first mark forward of CEASE FIRE.
 - d. After firing the first round, check the position of the pointer. If the pointer is on or past the CEASE FIRE mark, the gun must not be fired until the recoil system has been checked.

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CHAPTER 3 – THE .50-IN RANGING GUN

SECTION 1 – INTRODUCTION

General

1. The .50-in ranging gun is fitted to the left of the main armament in a mounting attached to the gun cradle. Its task is that of a ranging device. In earlier marks and in vehicles where laser is not fitted, it is the only deliberate ranging means the commander has at his disposal.

Description2. *Particulars and performances*

- | | |
|----------------------|---|
| a. Name | Ranging gun, Browning, calibre, .50-in, L21A1. |
| b. Weight | 70 lb (barrel 23 lb approx). |
| c. Calibre | .50-in (12.7-mm). |
| d. Muzzle velocities | L11 ammunition 945 ms
L13 ammunition 777 ms |
| e. Extreme range | L11 ammunition Dot 4
L13 ammunition Dot 9 |
| f. Rate of fire | 240 rpm fired in bursts of 3. |
| g. Ammunition | Each round has a tracer and a flashing tip for observation purposes. 98 rounds are loaded into a metal disintegrating link type belt. |
| h. Operation | Recoil and driving spring. |

The gun

3. a. *The gun body* – This is known as the receiver; on the right of it is mounted a maxifort solenoid, the plunger of which protrudes through the receiver. Inside there are three main components, the bolt, the oil buffer and the barrel extension. The bolt rides on top of the oil buffer and barrel extension, the latter being screwed to the barrel; at the back of the receiver is the backplate and buffer assembly, and in the upper right side of the receiver is a driving spring and rod which passes through the bolt. On the left of the gun is the retracting slide handle which is used to draw the bolt to the rear.
- b. *The barrel* – This is rifled throughout its length. The back portion has been further drilled out to form the chamber and the outside is threaded, this being passed through a hole in the receiver and screwed into the barrel extension.
- c. *The firing arrangements* – When MAIN is selected on the gunner's selector switch box and the right hand foot pedal is pressed and held, the rate of fire controller mounted behind the selector box passes three impulses to the maxifort solenoid of the gun body. The plunger in the solenoid protrudes and pushes the sear slide to the left thus releasing the firing pin; this is repeated twice more each time the bolt comes to rest, ie, it is a repeater action not an automatic action. Exactly the same happens if the commander selects MAIN on his firing control box and presses and holds the ranging gun firing button.

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SECTION 2 - HANDLING

To prove the gun

1.
 - a. Disengage the buffer sleeve by pressing down on the fingerpiece and rotating the sleeve fully clockwise.
 - b. Pull the retracting slide handle fully to the rear and then push the handle to the fully forward position.
 - c. Open the cover of the receiver by rotating the cover latch forward.
 - d. Examine the face of the bolt, the chamber and receiver; check that they are free from rounds.
 - e. Pull the retracting slide handle fully to the rear, press the fingerpiece on the backplate and ease the working parts forward under control.
 - f. Close the cover.
 - g. Press the trigger, situated on the backplate.
 - h. Lock the fingerpiece on the backplate by pressing down and rotating the buffer sleeve anti-clockwise as far as it will go.

To half load

2.
 - a. Open the cover on the receiver and lift the extractor, on the left forward side of the bolt, clear of the trunnion block.
 - b. Place the belt into the feedway with the double link leading. Ensure that the first round is against the cartridge and bullet stops.
 - c. Press the extractor down so that it is engaged in the cannellure of the round.
 - d. Close the cover.

To load from the half load

3.
 - a. Pull the retracting slide handle fully to the rear and release it so that the working parts travel forward freely.
 - b. Report "Loaded".

To make safe

4.
 - a. Unlock the fingerpiece.
 - b. Pull the retracting slide handle fully to the rear so that the working parts are held.
 - c. Push the retracting handle fully forward.
 - d. Report "Ranging safe".

To load from the "Make safe"

5.
 - a. Press down on the fingerpiece and lock it in position with the buffer sleeve.
 - b. Report "Loaded".

To unload (clear guns)

6.
 - a. Unlock the fingerpiece.

- b. Pull the retracting slide handle to the rear and then push it forward.
- c. Open the cover and remove the belt and rounds.
- d. Clear the round from the face of the bolt by pulling the bolt fully to the rear and flicking up on the extractor until that round comes free.
- e. Check that the chamber is clear and report "Gun clear".

To ease springs

7. a. Pull back on the retracting slide handle, press the fingerpiece and allow the bolt to go forward under control.
- b. Close the cover.
- c. Press the trigger.
- d. Lock the fingerpiece with the buffer sleeve.

SECTION 3 – SERVICING

STRIPPING, ASSEMBLING, CHECKS AND CLEANING

Equipment required

*Screwdriver, MG
Pliers 6-in
Punch, pin, parallel, $\frac{1}{8}$ -in dia.*

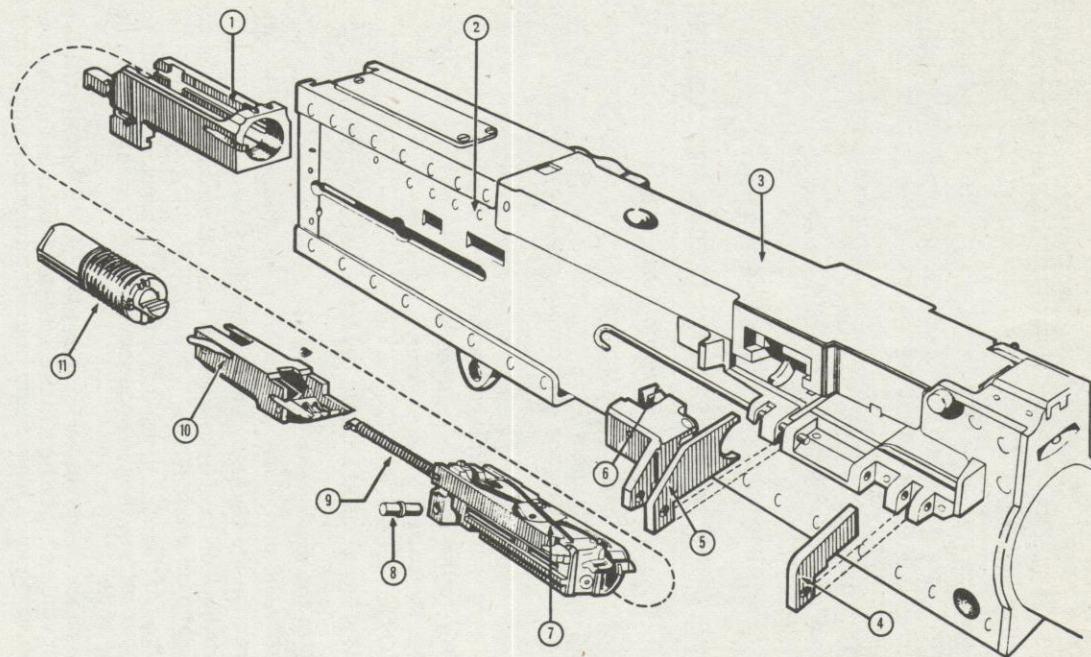
Rules

1. a. Ensure that the gun is unloaded (prove the gun).
- b. Strip to the correct sequence.
- c. Use the correct tools correctly.
- d. DO NOT USE FORCE.
- e. Place the parts in a clean, dry, safe place.

Stripping of the main parts (See Fig 14)

2. a. Prove the gun; leave the cover open; do not lock the buffer sleeve.
- b. Remove the barrel by unscrewing it.
- c. Pull back on the backplate latch lock, lift the latch and slide the backplate up and off the receiver.
- d. Remove the driving springs and rod by pressing slightly forward on the rod to release the pin engaged in the right side of the receiver. Withdraw the rod.
- e. Pull back on the retracting slide handle until the stud in the bolt is aligned with the enlarged hole in the left side of the receiver. Push forward on the retracting slide handle and pull out on the bolt stud.
- f. Push back on the face of the bolt and slide it out of the back of the receiver.
- g. Using the punch, pin, press the buffer spring lock in the rear right of the receiver. The oil buffer body and barrel extension can now be drawn rearwards out of the receiver.

- | | | |
|---------------------|-------------------------------------|----------------------------|
| 1. Barrel extension | 5. Cartridge stop and link stripper | 8. Bolt stud |
| 2. Receiver | 6. Cartridge aligning pawl | 9. Driving springs and rod |
| 3. Cover | 7. Bolt | 10. Oil buffer body |
| 4. Bullet stop | | 11. Oil buffer |



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Fig 14 - .50 in ranging gun part names

- h. Press forward on the tips of the accelerators, on the oil buffer body, to separate the oil buffer body and barrel extension.
- j. Remove the oil buffer from the body by pushing the piston to the rear.
- k. Push out the accelerator pin in the oil buffer body and remove the accelerators.
- l. Push out on the breech lock pin and lift out the breech lock.

Stripping the bolt (See Fig 15)

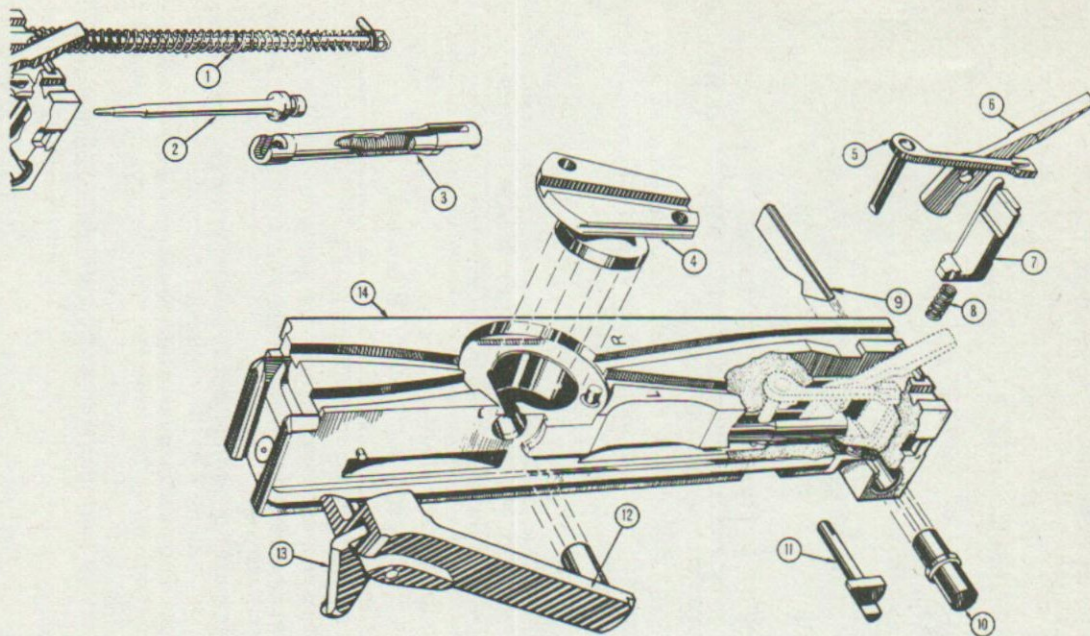
- 3. a. Raise the extractor arm vertically and withdraw it from the bolt by pulling to the left.
- b. Lift the bolt switch, on the top of the bolt, clear of its recess.
- c. Pivot the cocking lever to the rear and withdraw the pin. Lift out the cocking lever.
- d. Release the firing pin by pressing down on the sear.
- e. Pivot the sear stop sideways into the centre of the bolt and remove it by pushing up on the sear stop pin with the punch, pin.
- f. Depress the sear and pull out the sear slide, lift out the sear and spring.
- g. Tilt the bolt to the rear, pull out on the firing pin and the extension and separate them.

Stripping the feed mechanism

- 4. a. With the cover open, remove the split pin in the feed lever pivot.
- b. Hold the lower point of the feed lever in line with the cut-aways in the cover and pull the feed lever out, being careful not to lose the plunger and spring located in the upper hole of the feed arm.
- c. Remove the feed slide by pushing it out of its guides.
- d. Push out on the feed pawl axis pin with a punch, pin, after taking the pressure off the spring by pressing with the thumb.
- e. Remove the feed pawl and spring; remove the arm from the feed pawl.
- f. Press down on the cover latch and remove the spring by pushing it from beneath with a screwdriver.
- g. Remove the cover extractor spring from its seating in the cover extractor cam by pressing and sliding it to the right with a screwdriver.
- h. Remove the belt holding pawl by pulling out the split pin which retains the axis pin. Press on the pawl; withdraw the axis pin; remove the pawl and springs.
- j. Remove the bullet stop /cartridge stop and link stripper by pulling out the split pin which retains the axis pin, withdraw the axis pin, remove the bullet stop /cartridge stop and link stripper.

Assembling the feed mechanism

- 5. a. Fit the bullet stop /cartridge stop and link stripper on the right side of the feedway, slide in the axis pin and secure it with the split pin.



- | | | | | |
|----------------------------|------------------|----------------|-----------------------|-------------|
| 1. Driving springs and rod | 4. Bolt switch | 7. Sear | 10. Bolt stud | 13. Ejector |
| 2. Firing pin | 5. Sear stop | 8. Sear spring | 11. Cocking lever pin | 14. Bolt |
| 3. Firing pin extension | 6. Cocking lever | 9. Sear slide | 12. Extractor | |

Fig 15 - .50-in ranging gun part names of bolt

- b. Place the two small springs and the belt holding pawl on the left of the feedway, depress the springs, slide in the axis pin and secure it with the split pin.
- c. Rotate the cover latch and push up on the spring so that it rides over the latch; the pintle engages and the rear of the spring slides into its recess.
- d. Fit the cover extractor spring into the recess in the extractor cam and slide it to the left until it is retained by its seating.
- e. Fit the feed pawl arm to the feed pawl.
- f. Replace the spring, fit the feed pawl and push in the axis pin.
- g. Place the feed slide in the cover so that the feed pawl arm is to the rear with the cover closed.
- h. Position the feed slide so that its cut-away is in line with the cut-away in the cover. Fit the feed lever. This may require the spring and plunger, fitted to the feed lever, to be depressed in order to get over the projection in the cover. Fit the split pin to the feed lever pivot.

Assembling the bolt (See Fig 15)

6.
 - a. Assemble the firing pin and extension, and fit them in to the bolt. Ensure that the pin protrudes through the firing pin hole and that the shoulder is downwards.
 - b. Place the sear spring in to the recess at the rear of the bolt; slide the sear into the bolt.
 - c. Depress the sear and fit the sear slide from the RIGHT.
 - d. Fit the sear stop into the centre of the bolt and press it fully in. This may require turning the bolt over and easing forward, with the punch, on the firing pin spring. Press the arm of the sear stop to the left so that it fits into the recess.
 - e. Place the cocking lever, rounded toe to the rear, into the rear of the firing pin extension; replace the cocking lever pin.
 - f. Fit the bolt switch into its recess so that the cam groove marked 'L' (left) is lined up.
 - g. Replace the extractor; ensure that it is seated correctly.

Assembling the main parts (See Fig 14)

7.
 - a. Fit the breech lock into its recess with the double bevelled edge uppermost and to the front; fit the breech lock pin.
 - b. Fit the accelerators to the oil buffer body with the tips uppermost; fit the accelerator pin.
 - c. Place the piston and spring into the oil buffer body; ensure that the retaining lug is in line with the guideway. The small embossed arrow **MUST** be pointing to the right.
 - d. Fit the breech lock depressors on the oil buffer body into the grooves in the barrel extension and support the accelerators. While pressing the two parts together rotate the accelerators upwards and backwards so that the tips fit round the shank on the barrel extension. Check that the shank on the barrel extension has engaged on the front of the piston.

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- e. Slide the bolt on to the barrel extension. Place the three components into the receiver; lift up on the bolt latch in the top of the receiver so that it clears the shoulder of the bolt. Ensure that the studs on the buffer body align in the grooves and that the spring lock engages. Do not push the bolt too far forward or the accelerator face, on the lower rear of the bolt, will trip the accelerators, and break the lock between the barrel extension and the oil buffer body.
- f. Align the bolt with the enlarged hole in the side of the receiver and fit the bolt stud.
- g. Push the bolt forward with the driving springs and rod. Fit the driving springs and rod into the bolt and engage the pin in the recess on the right of the receiver.
- h. Ensure that the fingerpiece is unlocked. Replace the backplate by withdrawing the latch lock, lift the latch and press down on the backplate. Release the latch lock. Ensure that the lock is engaged by pulling up on the backplate.
- j. Pass the barrel through the front of the receiver and screw it into the barrel extension. The cartridge headspace **MUST** be adjusted once the barrel has been fitted.

The adjustment of cartridge headspace

Equipment required

.50-in gauge, headspace and timing

8. a. (1) Tighten up the barrel.
- (2) Draw the working parts to the rear until a gap of about $\frac{1}{16}$ -in appears between the trunnion block and the barrel extension.
- (3) Attempt to insert the end of the gauge marked GO between the face of the bolt and the barrel; at this stage it will almost certainly not fit.
- (4) Unscrew the barrel by one click at a time, trying to fit the gauge after each adjustment until it does go in.
- (5) Fit the other end of the gauge labelled NO GO between the bolt face and barrel extension, it should not pass. The cartridge headspace is now correct.

NOTE: If the cartridge headspace is not adjusted correctly, then there is every chance that a breech explosion will take place; this will cause damage to the gun and may injure the crew. The adjustment can be disturbed very easily and hence the headspace must be checked immediately before firing takes place, and after any adjustment which could possibly have disturbed the headspace setting.

CHECKS

The six point check

Equipment required

Screwdriver, MG

.50-in gauge, headspace and timing

9. a. (1) *Oil buffer assembly* – The erratic performance of a number of .50-in guns has been found to be due to the short overall length of the oil

- buffer assembly. A short buffer may cause the gun, when elevated, to fire spasmodically or prevent it from firing at all.
- (a) Remove the backplate, driving springs and rod, then replace the backplate and open the cover.
 - (b) Pull the bolt slightly to the rear and insert a thin piece of paper between the barrel extension and the trunnion block.
 - (c) Release the bolt and allow it to go forward and grip the piece of paper.
 - (d) Place the gun vertical, or if it is mounted in the tank, fully elevate the gun. Confirm that the paper is still held firmly.
 - (e) If the paper is not held, report to an armourer; if it is held, remove the paper and replace the driving springs and rod.
- (2) *Backplate and buffer assembly* – The task of the backplate and buffer assembly is to absorb shock and not to act only as a rebound pad; if it does, undue vibration will occur which could result in damage.
- (a) Screw fully in on the adjusting screw of the backplate. Check that part of the last thread is showing, if not, report to the armourer.
 - (b) Unscrew the adjusting screw half a turn, ensuring that it is retained in a locked position.
- (3) *Timing* – If the timing of the gun is incorrect, ie, the firing pin is released before the working parts are fully forward, the extractor will probably fail to grip the round in the belt.
- (a) Cock the gun and ease the working parts forward on to the .116-in timing gauge held between the barrel extension and the trunnion block.
 - (b) Attempt to fire the gun by pressing the trigger, it should not fire.
 - (c) Now insert the .020-in timing gauge in the same manner and attempt to fire, this time the firing pin should be released.
 - (d) If the gun fails either of these tests, report to an armourer.
- (4) *Firing pin protrusion*
- (a) Cock the gun.
 - (b) Lift the extractor arm and look down the face of the bolt; the firing pin should not be protruding.
 - (c) Now fire, and the pin should be seen protruding from the firing pin hole.
- (5) *Feed mechanism*
- (a) Lift the cover and examine the cover extractor spring, feed slide and belt holding pawl.
 - (b) Check the cam grooves for burrs.
 - (c) Check the extractor and ejector, and check that they are spring loaded.
- (6) *Feed slide test*
- (a) With the cover closed and the feed slide to the far left, check that the distance between the right of the feed slide and the right edge of the cover is not more than $\frac{3}{8}$ -in. (This is most easily done with a $\frac{3}{8}$ -in T piece where the crossbar is $\frac{3}{8}$ -in wide.)

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CLEANING

Equipment required

*Tools, accessories and spares as per CES
Clean cloth, flannelette and oil, as required*

10. The servicing of the .50-in ranging gun must be carried out in accordance with the Chieftain Servicing Schedule.

Routine cleaning

11. The term routine cleaning applies to the cleaning required during the two monthly and weekly servicing. The cleaning should be carried out as follows:-

- a. Unlock the fingerpiece, pull the working parts to the rear.
- b. Insert a clean piece of flannelette (8-in x 4-in) into the loop of the cleaning rod and fold it back over the end of the rod.
- c. Place the rod into the bore from the muzzle end and push in until it enters the receiver of the gun, taking care not to damage the bolt.
- d. When it is withdrawn examine for rust or fouling. If it is clean, re-oil the bore with a piece of flannelette (8-in x 1-in), paying particular attention to the chamber. If there is rust or fouling on the flannelette, the gun must be removed from the mounting in order to complete a full examination and thorough service.
- e. Strip the working parts from the receiver; do not dismount the receiver unless absolutely necessary.
- f. Strip and wipe clean all parts.
- g. Inspect for damage, especially parts in direct contact with the receiver and the feed mechanism.
- h. Oil all moving parts with an oil soaked cloth and reassemble; do not cover the face of the bolt with oil.
- j. The adjustment of the cartridge headspace and the six point check should be carried out.

Preparation for firing

12. a. Strip the gun. Clean, inspect and lubricate the gun, leaving the following parts dry clean:-
- (1) Bore and chamber.
 - (2) Face of the bolt.
 - (3) Exterior of the weapon.
- b. Assemble the gun, adjust the cartridge headspace and complete the six point check.

During firing

13. Every opportunity should be taken to clean, examine and lubricate the gun during lulls in firing. Dusty conditions will demand extra attention. The cover should be opened periodically to remove any fouling and lubricate the working parts.

After firing

14. a. The gun is easier to clean immediately after firing whilst it is still warm, but if this is not possible, a thorough oiling of the working parts will greatly assist later cleaning.
- b. The gun will be stripped and the cleaning should be carried out as follows:-
 - (1) *Barrel* – Clean the bore and chamber using the cleaning rod and oiled flannelette (8-in x 4-in). Dry clean and inspect. If there is any fouling present, report to an armourer. If the bore is satisfactory, re-oil using a well oiled piece of flannelette (8-in x 1-in).
 - (2) *Receiver* – Strip the working parts, wipe clean, inspect for damage, re-oil and assemble.
 - (3) The adjustment of the cartridge headspace and the six point check should be carried out.

Care after firing

15. The bore, chamber and receiver must be thoroughly cleaned and re-oiled daily for at least five days after firing. Inspection must be more frequent during humid conditions, keeping a careful watch for rust. In desert conditions of extreme dust and sand, the gun should be wiped dry. The gun should be dried out by sweating in the sun and constantly wiping off any oil that remains. As the gun is dry, frequent inspection for rust is essential. If oil has to be used to remove rust, use it sparingly and remove all traces of oil when clean. Cleaning brushes should be washed in gasoline or kerosene and dried before use.

SECTION 4 – THE RANGING GUN MOUNTING**Description** (See Figs 16 and 17)

1. The ranging gun mounting consists of a welded steel cradle which is bolted on to the left hand side of the main armament cradle. A gimbal bearing in the turret supports the ranging gun barrel. Adjustment for line is controlled by a central mounting ring which is moved by means of a hand adjusting ring under the mounting, through an eccentric cam secured by a locking nut ($1\frac{1}{8}$ -in AF).
2. Adjustment for elevation is made by slackening the four bracket locking nuts and turning the elevation adjuster with a $\frac{3}{4}$ -in AF spanner in the required direction, according to the arrows engraved on the mounting adjacent to the elevation adjuster. The bracket locking nuts must be fully tightened after the adjustment has been made. In NO circumstances will the shoulder bolts be slackened. The rear mounting pin of the gun is held in a clamp which can be moved by an adjuster which has a locknut ($1\frac{1}{8}$ -in AF). Certain mountings may be found unmodified, ie, having locking bolts instead of locking studs. The front bracket locking nuts will be positioned on the left side of the ranging gun cradle.

To mount the ranging gun*Equipment required*

Spanner, ring, $1\frac{1}{8}$ -in AF
Spanner, OJ, $\frac{1}{2}$ -in x $\frac{7}{16}$ -in AF
Spanner, wrench, MG

3.
 - a. When mounting the gun initially, check that the red part of the central mounting hand adjusting ring is in line with the scribe mark on the cradle. This indicates the centre position of the mounting ring. When dismounting or re-mounting the gun on subsequent occasions, the adjustment of the mounting ring should not be altered once zeroing has been carried out.
 - b. Pull the main armament BML to the rear.
 - c. Place the barrel through the central mounting ring; fit the locking ring on to the barrel.
 - d. Taking care not to foul the external canvas protector, push the gun fully into the mounting and screw the locking ring on to the receiver. Tighten the locking ring fully and secure it with the locking plate.
 - e. Fit the electrical lead to the solenoid.
 - f. Ensure that the rear trunnion pin is located centrally for line in the trunnion slots.
 - g. Rotate the adjuster clockwise until it is finger tight against the cradle. Tighten the rear lock nut.
 - h. Cock the gun, check the firing circuits and that the working parts move backwards and forwards freely. If they do not move freely, then the gun has 'cross bind' which is almost certainly due to the rear adjuster being overtight and thus distorting the gun body. To cure this, slacken off completely on the rear lock nut and adjuster, and retighten again correctly.
 - j. Return the BML to its correct position and close the breech.
 - k. The cartridge headspace must now be checked.

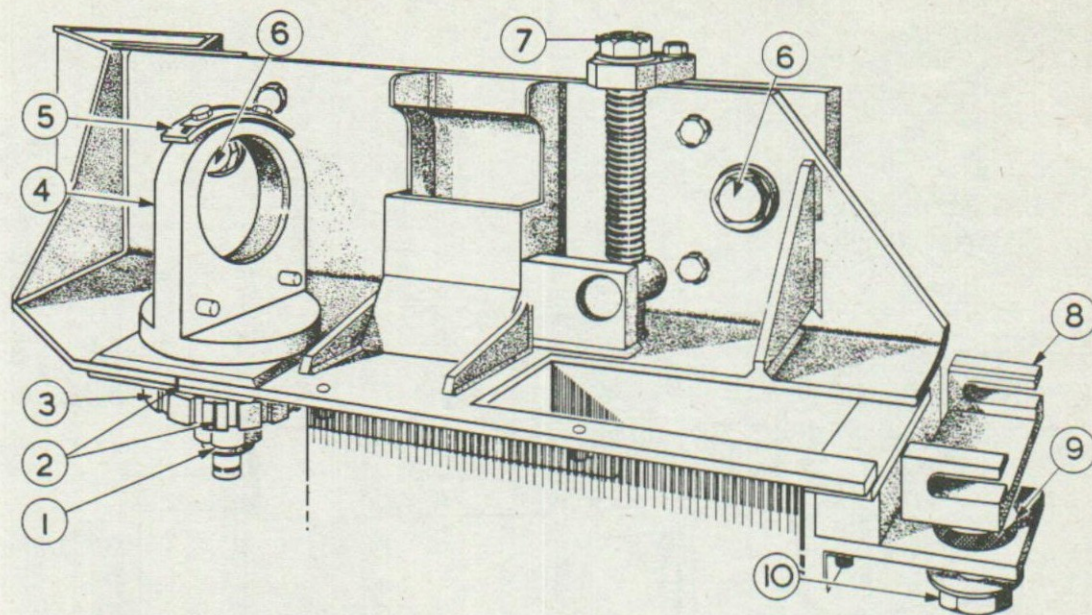
To dismount the ranging gun

4.
 - a. Pull the BML to the rear.
 - b. Remove the electrical lead from the solenoid.
 - c. Loosen the rear clamp.
 - d. Slacken off the bolts in the locking plate and unscrew the locking ring.
 - e. Remove the ranging gun from the mounting. Screw the locking ring on to the gun body.
 - f. Leave the adjustment on the central mounting undisturbed.
 - g. Return the BML to its correct position and close the breech.

Servicing the 50-in ranging gun mounting

5.
 - a. Thoroughly clean the mounting.
 - b. Inspect and check the security of all components.
 - c. Lubricate the centre and rear mounting points.
 - d. Lubricate the elevation adjuster.

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|--|--------------------------|----------------------------|
| 1. Lock nut $1\frac{1}{8}$ - in AF | 4. Central mounting ring | 8. Rear mounting clamp |
| 2. Scribe marks | 5. Locking plate | 9. Rear adjuster |
| 3. Central mounting hand
adjusting ring | 6. Shoulder bolts | 10. Rear adjuster lock nut |
| | 7. Elevation adjuster | |

Fig 16 - .50-in ranging gun mounting (side view)

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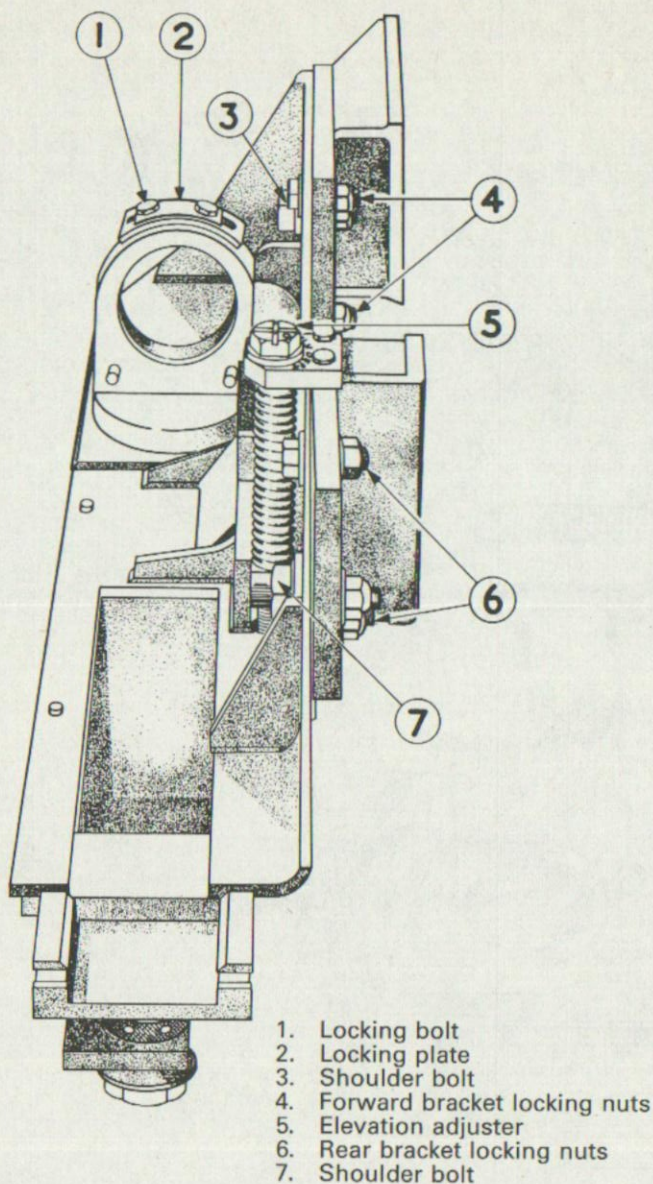


Fig 17 - .50-in ranging gun mounting (rear view)

- c. Use the correct tools correctly.
- d. DO NOT USE FORCE.
- e. Place the parts in a clean, dry, safe place.

STRIPPING

Barrel assembly

- 2. a. Prove the gun.
- b. Disengage the barrel locking nut catch by pressing on the thumb-piece.
- c. Rotate the barrel locking nut to the left, slide the barrel forward and lift it clear of the gun.

Gas regulator (See Fig 18)

- 3. a. *L3A2 barrel* – Unscrew the regulator spindle nut and remove it. Push the plug rearwards and remove it.
- b. *L1A2 barrel* – Unscrew the regulator nut and remove the two collets. Push the plug rearwards and remove it.

Flash suppressor tube (L3A2 barrel) (See Fig 19)

- 4. a. Tap out the locking washer from the recesses in the flash suppressor and excess gas duct.
- b. Unscrew the flash suppressor.
- c. Remove the locking washer and excess gas duct.

Trigger mechanism assembly

- 5. a. Remove the mounting pin from the front of the assembly by pressing the spring on the left and pushing the pin to the right (if fitted).
- b. Push out the retaining pin located through the centre of the joint pin.
- c. Remove the joint pin and remove the assembly from the gun body.

Recoil buffer

- 6. Raise the securing latch and lift the recoil buffer upwards until it is clear of the gun.

Return spring assembly

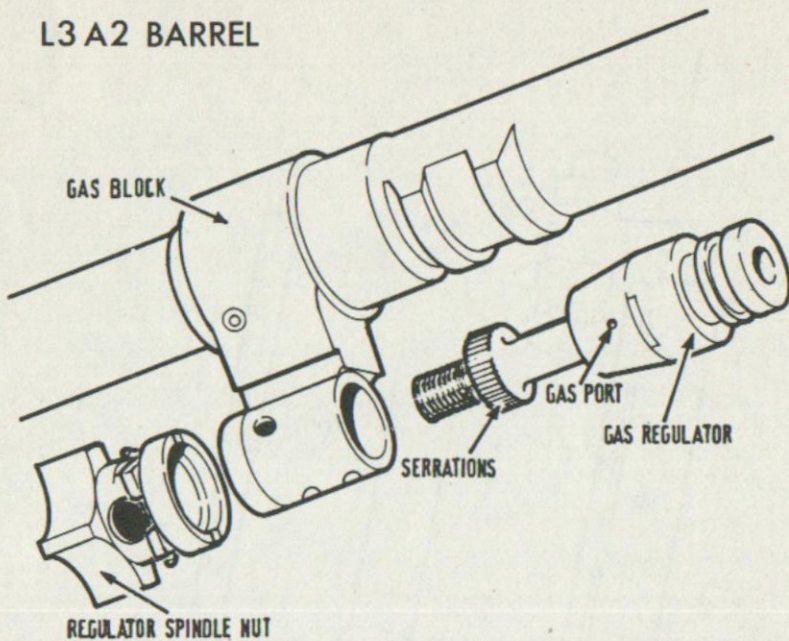
- 7. a. With the thumb, push the rear end of the return spring rod forward and upward to disengage the locating pin from the recess in the gun body.
- b. Withdraw the return spring assembly.

Piston assembly (See Figs 20 and 21)

- 8. a. Open the cover and pull the cocking handle gently to the rear; the piston assembly will now protrude from the rear of the gun.
- b. Remove the piston assembly.
- c. Push the cocking handle forward.

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L3A2 BARREL



L1A2 BARREL

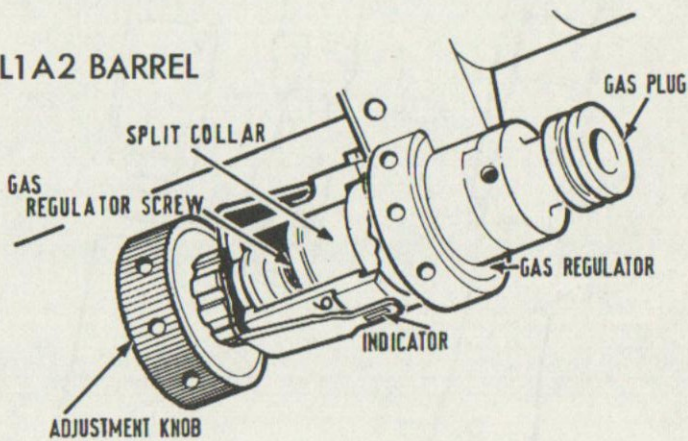


Fig 18 - 7.62-mm MG gas regulators

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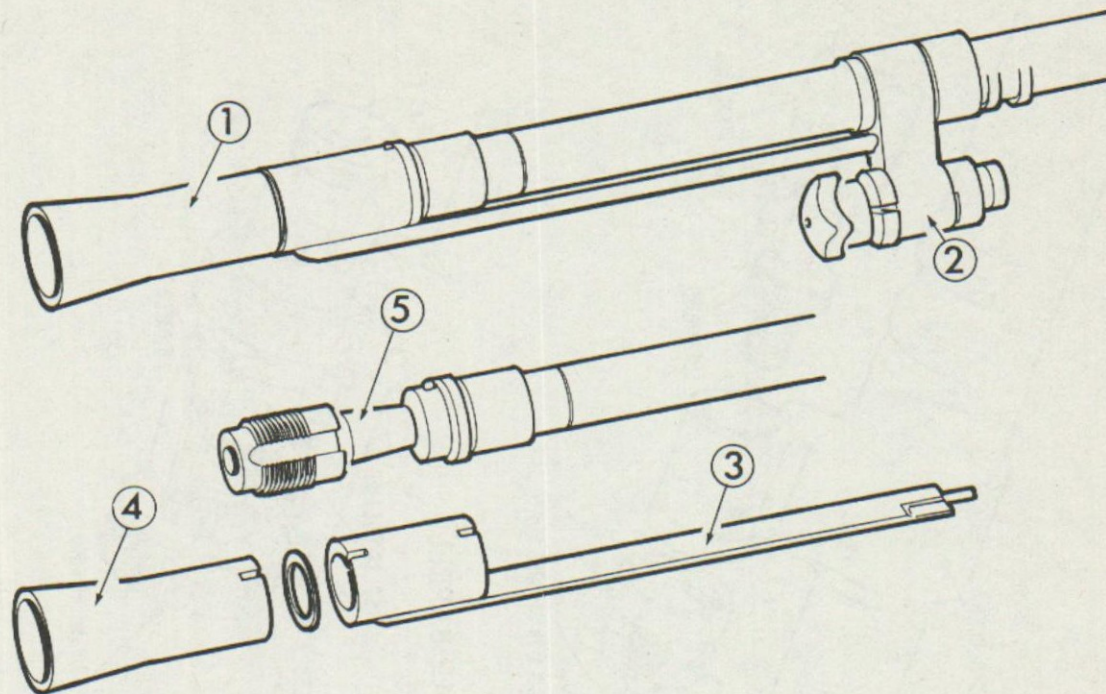


Fig 19 - 7.62-mm MG flash suppressor and excess gas duct

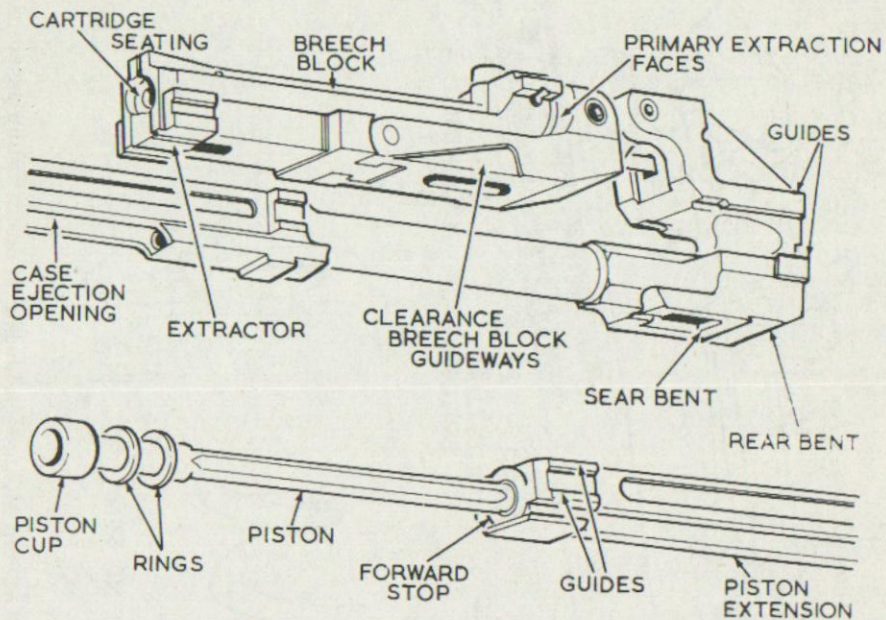


Fig 20 - 7.62-mm MG breech block and piston assembly

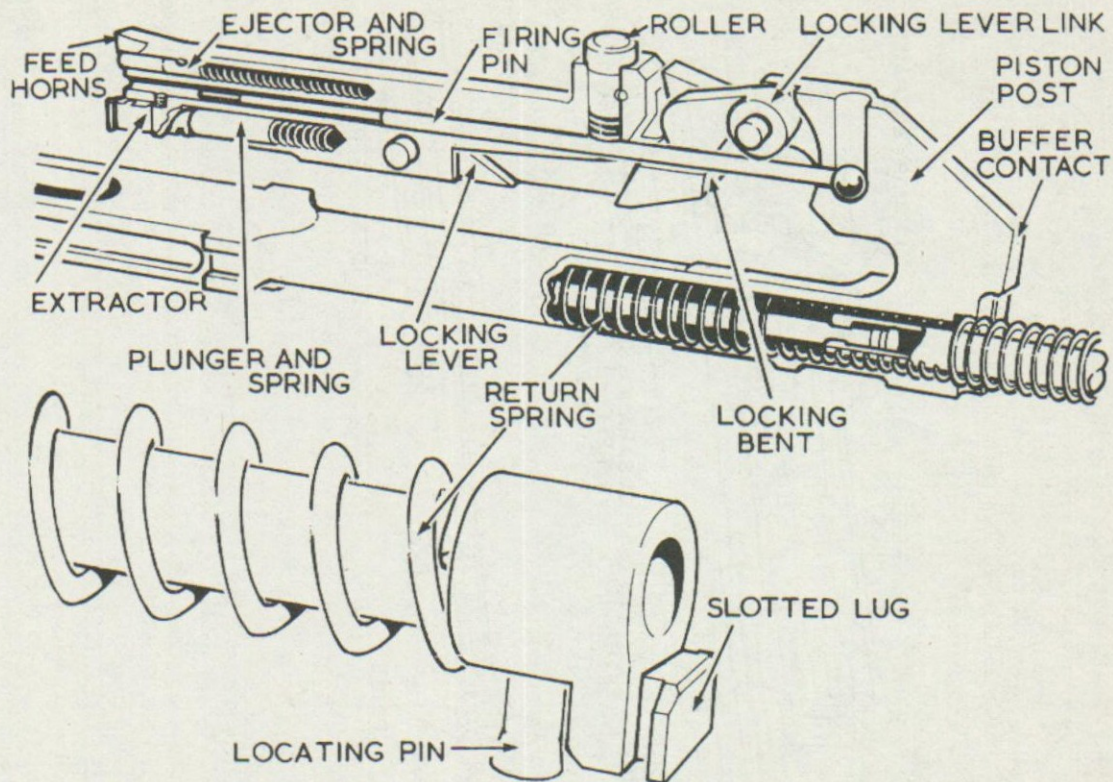


Fig 21 – 7.62-mm MG breech block and return spring assembly

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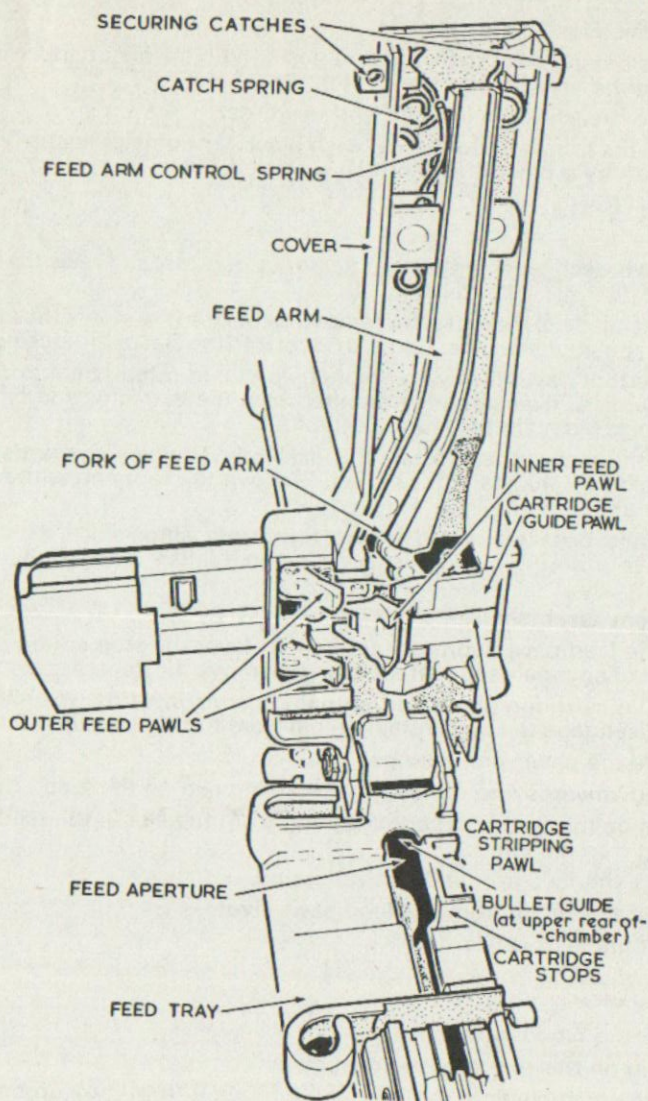


Fig 22 - 7.62-mm MG feed mechanism assembly

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Breech block (See Figs 20 and 21)

9. a. Push the breech block to its forward position on the piston assembly and push out the link pin from the piston post.
- b. Slide the breech block forward and upwards.
- c. Remove the firing pin from the breech block. On some guns the firing pin is secured by a pin and will not be removed.

Extractor

10. a. Hold the breech block with the extractor uppermost and raise the locking lever.
- b. Insert the blade of the extractor removing tool into the slot of the extractor plunger; position the other end of the tool into the slot of the locking lever.
- c. Hold the tool down firmly (see note below) and rotate the locking lever downwards to disengage the plunger from the extractor and compress the spring. Maintain pressure on the tool.
- d. Lift out the extractor and rotate the locking lever slowly upwards to ease the tension on the extractor spring. Remove the tool and withdraw the plunger and spring.

NOTE:- Care must be taken to hold the tool firmly in position since, if it slips, the plunger or spring may be lost, or personal injury may result.

Feed mechanism assembly (See Fig 22)

11. a. Push the feed pawl depressor to the left; lever the stop spring upwards and out of engagement with the cover. Remove the depressor to the left.
- b. Press the cartridge guide and stripping pawls inwards; maintain pressure; disengage the pawl retaining pin from the cover; pull out the pin.
- c. Remove the pawls and springs.
- d. Push downwards and remove the retaining clip on the feed arm pivot.
- e. Disengage the feed arm control spring from the slot in the feed arm by moving it to the left.
- f. Remove the feed arm and control spring.
- g. Remove the circlip from the feed pawl pivot.
- h. Lift out the feed pawls.

Dust cover

12. a. Unlock the bipod locking catch.
- b. Press in on the spring of the dust cover.
- c. Slide the dust cover to the rear and remove it from the gun body.

ASSEMBLING

Before assembling the gun, ensure that the body, the barrel and the breech block bear the same serial number.

Dust cover

13. a. With the rounded end forward, engage the dust cover with the guides in the gun body.
- b. Ensure that the bipod catch spring is in the forward position.
- c. Slide the dust cover forward until the spring reasserts itself.
- d. Lock the bipod locking catch.

Feed mechanism assembly

14. a. Ensure that the inner feed pawl is positioned correctly into the outer feed pawls.
- b. Place the inner and outer feed pawls on to the pivot and secure them with the circlip.
- c. Position the feed arm control spring on the feed arm pivot.
- d. Place the forked end of the feed arm over the roller on the feed pawl linkage.
- e. Fit the feed arm over the feed arm pivot, ensuring that the control spring remains correctly seated.
- f. Engage the feed arm control spring into the slot in the feed arm.
- g. Fit the retaining clip on to the feed arm pivot by pushing it upwards.
- h. Position the cartridge guide and stripping pawl springs on the projections in the cover.
- i. Place the pawls over the springs, press down on the pawls and fit the retaining pin to the cover, ensuring that it is locked.
- k. Check the operation of the feed mechanism assembly.
- l. Engage the feed pawl depressor with the grooves in the cover, with the stop spring uppermost, and push it to the right until the spring is engaged.

Extractor

15. a. Replace the plunger and spring in the breech block.
- b. Insert the blade of the tool into the slot of the plunger, raise the locking lever and hook the other end of the tool in the slot of the locking lever.
- c. Hold the tool down firmly and force the locking lever down to compress the extractor spring; replace the extractor.
- d. Release pressure from the plunger by rotating the locking lever away from the breech block. Remove the extractor removing tool.

Breech block

16. a. Insert the ball end of the firing pin into the recess in the piston post.
- b. Slide the breech block on to the firing pin.
- c. Align the link with the piston post and insert the link pin.

Piston assembly

17. a. Guide the piston into the lower part of the gun body, at the same time ensuring that the breech block is held fully forward and aligned with the guides in the upper part of the body.

- b. Position the breech block in the guides and push the assembly forward.

Return spring assembly

18. a. Insert the return spring assembly into the piston extension.
b. Push the rod forward and engage the locating pin with the recess in the gun body.

Recoil buffer

19. Engage the bottom of the recoil buffer with the guides on the gun body and press down until the securing latch engages.

Trigger mechanism assembly

20. a. Set the safety catch to FIRE.
b. Locate the assembly on to the gun body.
c. Insert the joint pin and secure it with the retaining pin.
d. Insert the mounting pin from the right.

Flash suppressor tube (L3A2 barrel)

21. a. Fit the excess gas duct over the inner cone and ensure that it is located with the pin fitting into the recess.
b. Fit the locking washer.
c. Screw the flash suppressor on to the barrel.
d. Tap the locking washer into the recesses in the flash suppressor and the excess gas duct.

Gas regulator

22. a. *L3A2 barrel* – Replace the gas regulator plug in to the gas block with gas port No. 2 positioned correctly. Replace the regulator nut and screw up tight.
b. *L1A2 barrel* – Replace the gas regulator plug in to the gas block. Fit the two collets and screw the spindle nut down as far as it will go. Unscrew until the indicator bar is against the figure 6.

Barrel assembly

23. a. Position the barrel on the barrel support with the gas regulator plug in line with the gas cylinder.
b. Ensure that the barrel locking nut is in the 12 o'clock position; this aligns the interrupted threads correctly with those in the gun body; pull the barrel to the rear to insert the barrel locking nut into the gun body.
c. Rotate the barrel locking nut to the right to lock the barrel to the gun body. The barrel catch should not be depressed, but allowed to operate freely to engage the ratchet teeth of the barrel locking nut. ENSURE THAT THE BARREL LOCKING NUT CATCH HAS ENGAGED CORRECTLY.

CHECKS

The eight point check

24. a. In order to ensure correct functioning of the machine gun mechanism, the following tests are made to the machine gun before firing:-
- (1) *The breech block*
 - (a) With the piston assembly complete but not mounted in the gun, hold the extension in one hand and pull the breech block fully to the rear. As this is done the firing pin should protrude through the bush in the front of the breech block.
 - (b) Pull the breech block fully forward and place an empty case so that it is held by the extractor and, by supporting the case with a finger, the ejector is compressed. When support for the case is removed it should be thrown from the face of the breech block by the action of the ejector spring reasserting itself.
 - (2) *The piston* – With the piston assembly still dismounted, rotate the rod slightly and confirm that it moves a small distance independently of the piston extension.
 - (3) *Piston head friction* – Place the piston assembly into the body; do not fit the return spring assembly. Push the piston assembly fully forward and then pull back on the piston post, checking for free movement of the piston in the gas cylinder.
 - (4) *Recoil buffer*
 - (a) Check that the cap is locked with a tab washer and that the securing latch operates correctly.
 - (b) Check the condition of the guides.
 - (5) *The trigger assembly*
 - (a) With the gun fully assembled, cock the gun, set the safety catch to SAFE and press the trigger. The working parts should not be released.
 - (b) Set the safety catch to FIRE, press the trigger and ease the working parts forward.
 - (6) *The feed mechanism* – With the cover open check the following:-
 - (a) That the securing catches are spring loaded.
 - (b) That the feed arm is spring loaded.
 - (c) That the feed arm retaining clip is secure.
 - (d) That the movement of the feed arm is reflected by movement of the feed pawls.
 - (e) That the feed pawls are spring loaded.
 - (f) That the guide and stripping pawls are spring loaded.
 - (g) That the bullet guide, feed aperture, cartridge stops, feed horns and feed tray are secure and not showing signs of burring.
 - (h) The security of the roller on the breech block; confirm that it is spring loaded.
 - (7) *The gas regulator* – Remove the barrel and check that the gas regulator is set on gas port No. 2 or the indicator No. 6; confirm that the gas regulator nut is secure.

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(8) *Flash suppressor and excess gas duct*

- (a) Check that the suppressor is secure and the washer has been fitted and tapped over.
- (b) Confirm that the excess gas duct is secure.

CLEANING

Equipment required

Tools, accessories and spares as per CES
Clean cloth, flannelette and oil, as required

25. The servicing of the 7.62-mm MG must be carried out in accordance with the Cheiftain Servicing Schedule.

Routine cleaning

26. The term routine cleaning applies to the cleaning required during the two monthly and weekly servicing. The cleaning should be carried out as follows:-

- a. Strip the MG.
- b. Clean the bore with a piece of flannelette (4-in x 2-in) attached to the cleaning rod /pull through.
- c. Clean the chamber with the chamber cleaning brush and flannelette.
- d. Inspect the bore and chamber for cleanliness, and re-oil.
- e. Attach the gas cylinder cleaning brush to the cleaning rod and wrap a piece of flannelette (4-in x 6-in) around the brush. Clean the gas cylinder from the front.
- f. Inspect the gas cylinder for cleanliness and re-oil it, using flannelette (4-in x 4-in) wrapped around the brush.
- g. Clean the remainder of the gun, re-oil and assemble. During assembly, complete the eight point check.
- h. Check and clean the spare parts.

Preparation for firing

27. a. Strip the gun. Clean, inspect and lubricate the gun, leaving the following parts dry clean:-
- (1) Bore and chamber.
 - (2) Flash suppressor.
 - (3) Gas cylinder and gas regulator.
 - (4) Face of the breech block.
 - (5) Piston, especially the cup and between the rings.
 - (6) Exterior of the weapon.
- b. Check the serial numbers, assemble the gun and complete the eight point check.

During firing

28. Every opportunity should be taken to clean, examine and lubricate the gun

during lulls in firing. Dusty conditions will demand extra attention. Special attention should be given to the chamber and gas affected parts; if possible the breech block and piston should be removed, cleared of fouling and then re-lubricated. If this is not possible, open the cover and apply a few drops of oil to the locking lever, the locking lever link, primary extraction faces and the guides. ENSURE THAT THE BARREL LOCKING NUT CATCH IS ENGAGED CORRECTLY.

After firing

29. a. The gun is easier to clean immediately after firing whilst it is still warm but if this is not possible, a thorough oiling of the gas affected parts will greatly assist later cleaning.
- b. The gun will be stripped and the cleaning should be carried out as follows:-
 - (1) *Barrel* – Clean the bore and chamber using the pull through and oiled flannelette (4-in x 1½-in). Dry clean and inspect. Clean the exterior of the barrel and, using the correct tools, clear all traces of fouling from inside and outside the gas regulator.
 - (2) *Gas cylinder* – Clean the cannellure at the front of the gas cylinder with the correct tool. Clean the cylinder with an oiled cylinder brush and dry out with a piece of flannelette wrapped around the brush.
 - (3) *Breech and feed mechanism* – Dry clean the rest of the body, paying special attention to the guides and the feed mechanism.
 - (4) *Piston assembly* – Thoroughly clean the face of the breech block and clean the piston cup with the correct tool.
 - (5) *Examination* – Examine all parts to ensure that all are free of flaws or burrs. If any are present or if any rivets are found to be loose, report the defect to the armourer.
 - (6) *Assembling* – Oil all parts and assemble the gun. During assembly complete the eight point check. If firing is anticipated in the immediate future the gas affected parts should be left dry clean.

Care after firing

30. The bore, chamber, gas cylinder and gas affected parts must be thoroughly cleaned, inspected and re-oiled daily for at least five days after firing. Inspection must be more frequent during humid conditions, keeping a careful watch for rust. In desert conditions of extreme dust and sand the gun should be wiped dry. The gun should be dried out by sweating in the sun and constantly wiping off any oil that remains. As the gun is dry, frequent inspection for rust is essential. If oil has to be used to remove rust, use it sparingly and remove all traces of oil when clean. Cleaning brushes should be washed in gasoline or kerosene and dried before use.

SECTION 4 – THE 7.62-MM MG MOUNTINGS

THE CO-AXIAL MOUNTING

Description

General

1. a. *The co-axial mounting* consists of a slide bracket and two lugs mounted on top of the gun cradle, with a hole drilled through the turret through

which passes the barrel. On the outside there is a flexible canvas sleeve which, when the MG is mounted, is held in place by a jubilee clip. A front mounting pin of a push /pull release type is provided. It is held to the mounting by a chain. The cocking gear is fitted on the right hand side of the mounting and the firing gear underneath the MG on the left. Protective asbestos sheeting is fitted above the mounting, on the turret roof. It is held at the bottom by a spring loaded pin and a clamping screw. Some protective sheets are held by catches. The sheeting extends to the ranging gun mounting on the left and to the right as far as the buffer.

- b. *The cocking gear* is fitted to the right hand side of the MG mounting. The manual cocking gear consists of a handle attached to a lever. The cocking claw moves in an open slide which acts as a guide. Incorporated with the lever is a spring which keeps the claw in the forward position when it is not in use. To cock the gun, push the handle forward and release it. The claw engages the cocking handle and takes it with it to the rear.
- c. *The firing gear* is fitted to the rear and underneath the mounting, and consists of an adjustable pivoted firing lever. This lever is operated by a solenoid or Bowden cable and foot pedal. When not in use, the foot pedal may be turned upwards to a vertical position to prevent it being pressed accidentally.
- d. *Ammunition feed* is from left to right. The ammunition to be used is stowed on the turret sill to the left of the ranging gun. The belt is fed over it by a feed tray. The empty cases are collected in a container situated on the turret floor. The upper part of the metal container chute incorporates a guide for the ammunition feed, a 'scoop' and a link chute.

To mount the co-axial MG

2.
 - a. Elevate the main armament to full elevation.
 - b. Remove the front mounting pin and the pin holding the feed tray.
 - c. Disengage the protective sheeting.
 - d. Slacken off the jubilee clip on the external canvas sleeve.
 - e. Ensure that the rear mounting pin is fitted in the trigger mechanism assembly.
 - f. Slide the MG into the mounting with a crewman externally guiding the flash suppressor through the canvas sleeve.
 - g. Ensure that the rear mounting pin is engaged in the slide bracket and tighten up on the jubilee clip outside.
 - h. Push in the front mounting pin until it is secure.
 - j. Secure the protective sheeting.
 - k. Replace the feed tray and its retaining pin.
 - l. Test the cocking mechanism.

To dismount the co-axial MG

3.
 - a. Unscrew the jubilee clip on the external canvas sleeve.
 - b. Disengage the protective sheeting.
 - c. Remove the feed tray.

- d. Remove the front mounting pin.
- e. Slide the gun rearwards out of the mounting.
- f. Fit the feed tray.
- g. Fit the front mounting pin.
- h. Secure the protective sheeting.

Servicing the co-axial mounting

- 4. a. Thoroughly clean the mounting.
- b. Inspect and check the security of all components.
- c. Lubricate the pivot points on the cocking and firing gears.

THE COMMANDER'S MOUNTING

Description

General

- 5. a. There are three possible types of mountings used on Chieftain, dependent on the Mark and state of modifications to the vehicle.
- b. *Mounting 7.62-mm MG (L37A1) No. 10, Mk 1* is mounted to the left of the commander's sight on the rotating cupola. The mounting can be rotated through 6400 mils and can be elevated just in excess of the vertical and depressed to below the horizontal. It consists of the following main components:-
 - (1) *Cradle* - This is a light steel construction pivoted at the rear on two trunnions. At the front is the front mounting pin held by a chain. Situated at the rear is a slide bracket into which fits the rear mounting pin of the MG. On the right hand side of the cradle is the cocking gear; above the gear is the link exit chute. Below the cocking gear is a plunger which, when pressed, will move the MG safety catch to the FIRE position. Mounted on the left of the cradle is the electrical solenoid with its armoured cable. Directly below the solenoid is the intermediate firing lever. This is in contact with a spring loaded firing lever which, when the MG is mounted, bears against the trigger of the gun. Bolted on to the cupola, to the left of the cradle, is the ammunition tray. On the left side plate, at the rear, is a spring loaded lever which, when pressed, will move the MG safety catch to the SAFE position.
 - (2) *Cradle trunnions* - At the rear of the cradle are two trunnion blocks. Attached to the right trunnion block is a shaft which extends across the top of the commander's sight. The commander's spot light is fitted to this shaft. Extending downwards from the right trunnion block is an adjustable link bar, which passes through a rubber gaiter into the inside of the cupola where it is linked to the commander's sight. The left trunnion block contains a balance spring which maintains the balance of the mounting at all angles of elevation. Also inside this trunnion block is the elevating mechanism, made up of a

shaft and worm drive system terminating at a block, inside the cupola, on to which is fitted the elevating handwheel and firing switch. On the rear face of this block is a clamping screw which, when applied, locks the mounting.

- (3) *Cocking gear* – A cocking piece on the right side of the cradle moves backwards and forwards on a slide bracket. It is moved to the rear by a cocking handle, positioned inside the turret below the cupola ring, attached to a steel cord connected to the cocking piece. When pulled to the rear the cocking piece pulls out a tensator spring fitted in a housing at the front of the cradle. When the cocking handle is released, the spring reasserts and returns the cocking piece to its forward rest position.
- c. *Mounting 7.62-mm MG No. 2, Mk 1* – This differs from the No. 10, Mk 1 in the following respects:-
- (1) The left trunnion block is smaller.
 - (2) The ammunition tray is attached to the cradle.
 - (3) There is no link exit chute.
 - (4) The cocking piece is attached to a chain housed in a tube.
 - (5) There is no balance spring in the left hand trunnion block. An equilibrator spring, fitted in a tube on the left side of the cradle, gives the balance required.
 - (6) The solenoid is mounted parallel to the cradle with the core forward. The core pushes a pivoted firing lever which bears directly against the trigger extension.
 - (7) There is no means of applying the safety catch.
 - (8) There is no clamping screw on the elevation block, instead a spring catch is fitted.
 - (9) The mounting can be elevated to 800 mils and depressed 178 mils.
 - (10) A modified No. 2 mounting incorporates the elevating clamp screw and the cocking gear of a No. 10 mounting.
- d. *Mounting 7.62-mm MG No. 8, Mk 1* – This is a combination of the No. 10 and No. 2 mountings.

To mount the commander's MG

6. The mounting of the MG is the same for all types of mountings. However, when the MG is fitted to the No. 2, Mk 1 mounting, the L8 trigger mechanism must be fitted and the bipod must be removed. The procedure for mounting is as follows:-

- a. Prove the gun and ensure that the safety catch is to FIRE.
- b. Fit the bipod and pistol grip.
- c. Fit the recoil buffer in place of the butt.
- d. Fit the rear mounting pin.
- e. Unclip the bipod.
- f. Remove the front mounting pin. Raise the carrying handle of the barrel, if fitted.

- g. Slide the gun into the mounting and ensure that the rear mounting pin engages in the slide bracket.
- h. Insert the front mounting pin. Lower the carrying handle of the barrel, if fitted.
- j. Clip the bipod under the gun and lock the bipod.
- k. Test the cocking gear.

To dismount the commander's MG

- 7. a. Unclip the bipod.
- b. Remove the front mounting pin.
- c. Remove the gun from the mounting.
- d. Replace the front mounting pin.
- e. Replace the butt on the MG, for the ground role.

Adjustment of the sight linkage

- 8. This adjustment will only be carried out by REME or under REME supervision. The method is given in Part Two, Chapter 17, Section 3.

Servicing the commander's MG mounting

- 9. a. Thoroughly clean the mounting.
- b. Inspect and check the security of all components.
- c. Lubricate all pivot points.
- d. Check that the rubber gaiters are serviceable.

THE GROUND MOUNTING

Description

General

- 10. a. When the 7.62-mm MG L37A1 is used in the ground role it must be fitted with the following components:-
 - (1) The MG barrel assembly L1A2.
 - (2) MG trigger mechanism assembly L7A2.
 - (3) The bipod assembly. (See Fig 23).
 - (4) The butt.
- b. *The barrel* has a flash hider in place of a flash suppressor and the gas regulator has ten settings.
- c. *The trigger mechanism* is of the pistol grip type.
- d. *The bipod* is fitted on lugs on the front of the gas cylinder. The legs can be placed and locked into a low or high position. Spades at the bottom of the legs ensure a firm footing on the ground. When the legs are in a folded position they are secured by hooks which engage with the gun body. The height of the gun can be adjusted by a thumb screw fitted between the legs.

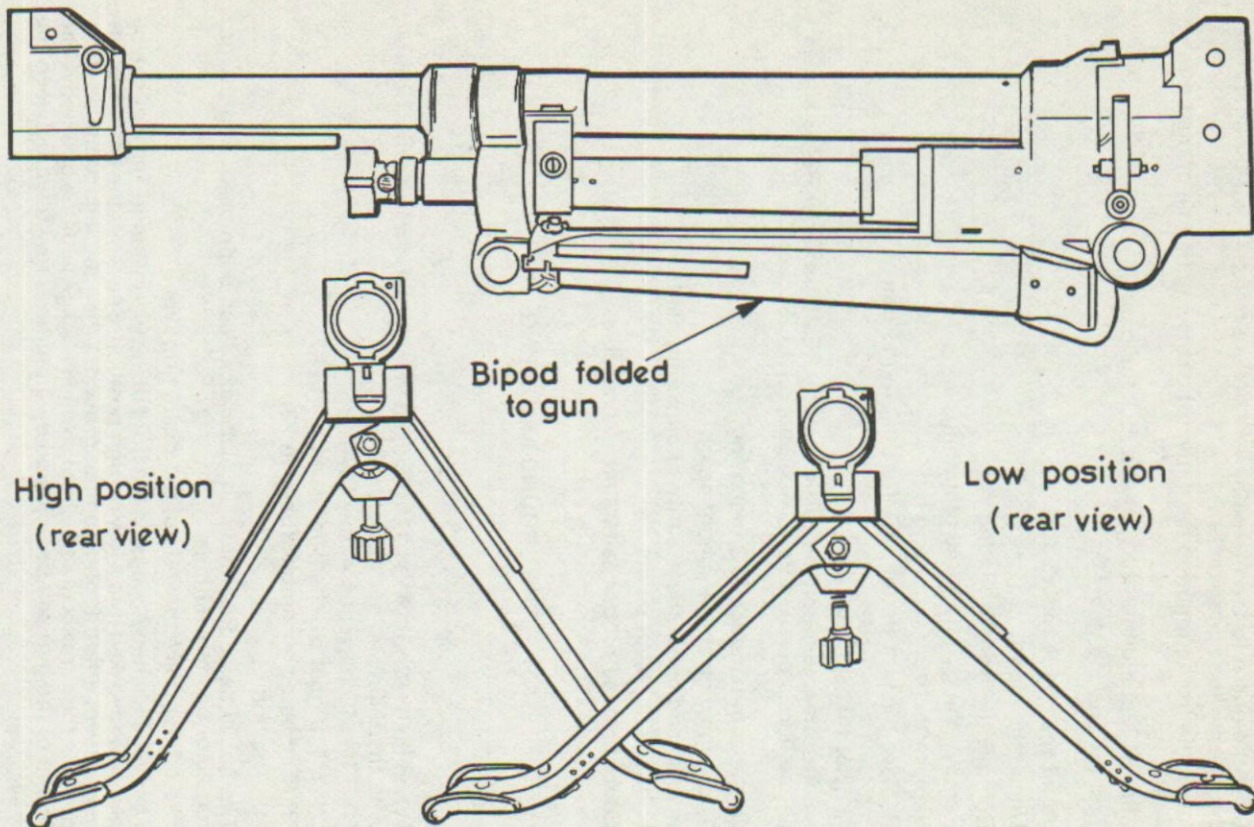


Fig 23 - 7.62mm MG Bipod assembly

- e. *The butt* replaces the recoil buffer; it is attached to the gun in the same manner as the recoil buffer. It is made of wood and is internally sprung; it has a rear rubber pad as a shoulder guard.

Gun balancing 7.62-mm MG L37A1

- 11. a. This will be carried out under REME supervision in the following circumstances:-
 - (1) To a new gun.
 - (2) To a gun where the required gas port setting is not known to the crew.
 - (3) When blank ammunition is to be used.
- b. The procedure for balancing the MG is detailed in Part Two, Chapter 17, Section 2.

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CHAPTER 5 – THE FIRING SYSTEM

SECTION 1 – INTRODUCTION

General

1. The main armament firing circuit is all electric. Finger operated switches cause the electric current to ignite the vent tube.
2. The ranging gun firing circuit is operated by a foot firing pedal or a firing button. Electric current energises a maxifort solenoid mounted on the .50-in ranging gun. Each time the foot pedal or firing button is pressed and held the gun will fire three rounds.
3. The co-axial machine gun electrical firing circuit is operated by the same switches that fire the main armament. Electric current energises a solenoid which fires the gun. In addition, the gunner is provided with a mechanical gear which is operated by a foot firing pedal and Bowden cable.
4. The cupola mounted commander's MG electrical firing circuit is operated by a firing switch which, when pressed, energises a solenoid to fire the MG.

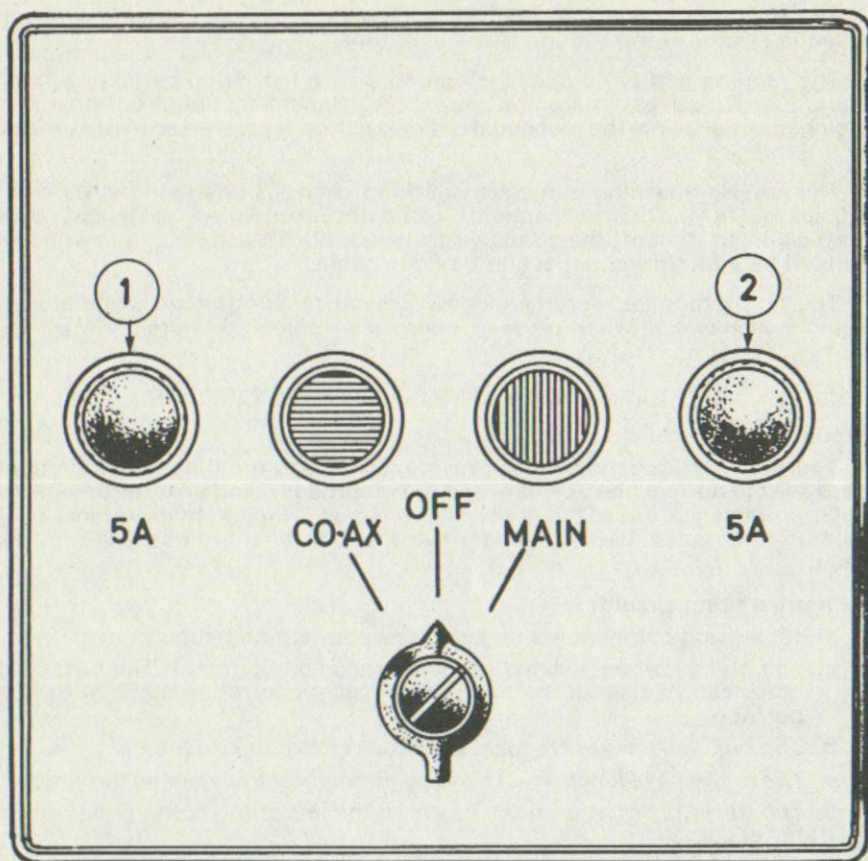
SECTION 2 – MAIN ARMAMENT FIRING CIRCUITS

Introduction

1. There are three circuits which provide facilities to fire the main armament. These are the normal, the auxiliary and the emergency, and all three are electrical. On some tanks, use of the normal firing circuit is limited to the gunner only, while on later tanks the commander has the facility to fire using the normal circuit.

The normal firing circuit

2. The following components make up the normal firing circuit:-
 - a. *The hull batteries*, located in the driver's compartment. The turret batteries can be used if the overriding master control switch is in the ON position.
 - b. *The hull master switch*, located to the right of the driver.
 - c. *The rotary base junction* – This is positioned centrally on the turret floor.
 - d. *The turret distribution box*. This is to the left of the commander on the turret sill.
 - e. *Turret services junction box* – This is to the right of the gunner on the turret wall and contains a large number of circuit breakers of which CB-1 protects the main armament firing circuit.
 - f. *The turret safety switch* is located on the left hand rear of the turret roof. The switch has two positions SAFE, marked in green, and LIVE, marked in red, and when SAFE is selected the firing circuit is broken.
 - g. *The gunner's selector switch box* (See Fig 24) – This is mounted to the right of the gunner, on the turret sill. The switch has three positions CO-AX – OFF – MAIN and two lights, an orange and a red which illuminate when CO-AX and MAIN respectively are selected. There are two circuit breakers, controlling the firing circuits.



1. CB-1 Ranging gun circuit breaker
2. CB-2 Main armament, coaxial MG circuit breaker

Fig 24 - Gunner's selector switch box

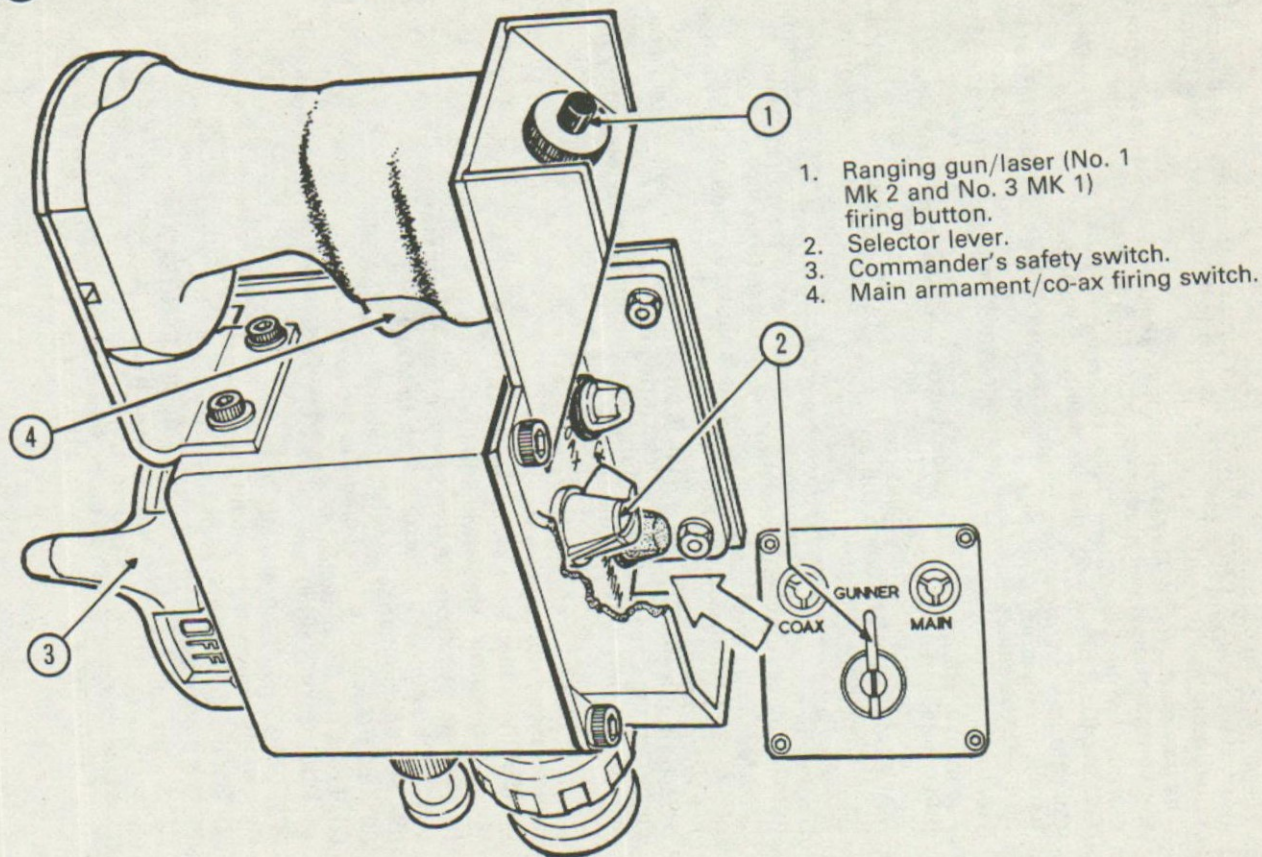


Fig 25 - Commander's firing control box

- h. *The loader's firing guard switch* – This is mounted on the guard plate on the left hand side of the gun. The switch is "made" when the guard is pulled fully to the rear.
- j. *The gun ready light* – This is mounted on the turret roof to the left front of the commander. It will illuminate when all switches are "made".
- k. *Gunner's firing switches* – They are located on the elevating handwheel and the fixed hand grip /gunner's firing controller.
- l. *Commander's firing switch* – This is located on the right hand end of the handle on the commander's firing control box; it is operated in conjunction with the selector lever on the right hand side of the control box. (See Fig 25).
- m. *The gun junction box* – This is located on the lower right hand side of the gun cradle, forward and below the quadrant fire control. It contains a 24 volt emergency battery and has a selector switch marked NORMAL /EMERGENCY. When the switch is in the NORMAL position, the battery is trickle charged.
- n. *The auxiliary /emergency firing button* – This is mounted on the terminal block which is inside the gunner's shield on the right of the gun. The terminal block supplies current direct to the breech ring electrical contact.
- o. *The breech ring electrical contact* – This is situated inside the breech ring on the right hand side, it contacts the terminal block.
- p. *The firing needle assembly* – This is positioned in the centre rear of the breech ring. It fits against the breech ring electrical contact and passes current to the base of the vent tube. The current is taken to earth by the case of the vent tube and the breech ring.

To fire

3. a. *Gunner using normal circuit*

- (1) Set the hull master switch to the ON position.
- (2) Set the turret safety switch to LIVE.
- (3) Set the switch on the gun junction box to NORMAL.
- (4) Set the gunner's selector switch to MAIN.
- (5) Set the commander's selector switch to GUNNER.
- (6) Pull the loader's firing guard to the rear.
- (7) Press the firing switch on the elevating handwheel or on the fixed grip; report "Firing now".

b. *Commander using normal circuit*

- (1) Set the hull master switch to the ON position.
- (2) Set the turret safety switch to LIVE.
- (3) Set the switch on the gun junction box to NORMAL.
- (4) Set the commander's selector switch to MAIN.
- (5) Pull the loader's firing guard to the rear.
- (6) Press the firing switch on the commander's firing control box; report "Firing now".

The auxiliary firing circuit

4. a. The components which make up the auxiliary firing circuit are the same as those included in the normal firing circuit with the exception of the following:-
- (1) The loader's firing guard switch.
 - (2) The gunner's firing switches.
 - (3) The commander's firing switch.

To fire, using the auxiliary firing circuit

5. The commander will fire the gun, using the auxiliary firing button, by reaching through the cut-away in the shield on the right of the gun.
- a. Set the hull master switch to the ON position.
 - b. Set the turret safety switch to LIVE.
 - c. Set the switch on the gun junction box to NORMAL.
 - d. Set the gunner's selector switch to MAIN.
 - e. Set the commander's selector switch to GUNNER.
 - f. Pull the loader's firing guard to the rear as a physical safety measure.
 - g. Press the auxiliary firing button; report "Firing now".

The emergency firing circuit

6. a. The emergency firing circuit is a self contained system independent of the normal or auxiliary firing circuits. It is made up of the following components:-
- (1) A 24 volt battery situated in the gun junction box.
 - (2) A selector lever positioned on the right of the gun junction box which, when moved forward, selects EMERGENCY.
 - (3) A firing button, situated on the rear of the terminal block, which has a protective cover.
- b. The emergency firing circuit will be used when the normal firing circuit fails. The button, when pressed by the commander, allows a flow of current from the battery, through the terminal block to the breech ring electrical contact and the firing needle assembly.
- c. Although it is possible to fire the main armament by means of the auxiliary/emergency firing button whilst the tank is on the move, the risk of injury to the commander's hand rules this out during training.

To fire, using the emergency firing circuit

7. The commander will fire the gun, using the emergency firing button, by reaching through the cut-away in the shield on the right of the gun.
- a. Set the switch on the gun junction box to EMERGENCY.
 - b. Pull the loader's firing guard to the rear as a physical safety measure.
 - c. Press the emergency firing button; report "Firing now".

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SERVICING

Equipment required

Circuit tester

Spare firing needle assembly

Spare breech ring electrical contact

To test the normal firing circuit

8.
 - a. Prove the gun; close the breech.
 - b. Set the hull master switch to the ON position.
 - c. Ensure that the gun is fully run out.
 - d. Fit the circuit tester to the firing needle assembly.
 - e. Ensure the following switches are positioned correctly:-
 - (1) Gunner's selector switch to MAIN.
 - (2) Commander's selector switch to GUNNER.
 - (3) Turret safety switch to LIVE.
 - (4) Gun junction box switch to NORMAL.
 - (5) Loader's firing guard is to the rear.
 - (6) Confirm the red light on the gunner's selector box and the gun ready light have illuminated.
 - f. Press the firing switch on the elevating handwheel while another crew member looks into the gap between the breech ring and the breech block. The bulb in the circuit tester should illuminate.
 - g. Repeat this test using the firing switch on the fixed grip.
 - h. Repeat the test with the commander's selector switch at MAIN and using the commander's firing switch.
 - j. Repeat the test completely after fitting the spare FNA and BREC.

To test the auxiliary firing circuit

9.
 - a. Test the normal firing circuit.
 - b. Press the emergency firing button on the terminal block and watch for the circuit tester bulb to illuminate.

To test the emergency firing circuit

10.
 - a. Test the normal and auxiliary circuits.
 - b. Set the switch on the gun junction box to EMERGENCY.
 - c. Set the hull master switch to the OFF position.
 - d. Press the emergency firing button on the terminal block and watch for the circuit tester bulb to illuminate.
11. If at any time the circuit tester bulb fails to illuminate, check the condition of the relevant circuit breakers. If they are correctly positioned and the circuit tester bulb is serviceable, report to REME.

SECTION 3 – THE RANGING GUN FIRING CIRCUIT

Introduction

1. The electrical circuit used for the ranging gun includes many of the components and switches that were employed to fire the main armament.

The firing circuit

2. The following components complete the firing circuit:-
 - a. *The foot firing pedal switch* – This is positioned on the turret floor in front of the gunner. It is the right hand of the two foot pedals.
 - b. *The commander's firing button* – This is a small black button positioned on the right hand end of the handle on the commander's firing control box.
 - c. *The rate of fire controller* – This is positioned behind the gunner's selector switch box. It produces three impulses each time the foot pedal or the commander's firing button is operated.
 - d. *The maxifort solenoid* – This is positioned on the right of the 50-in ranging gun receiver. When energised, a plunger protrudes into the receiver, disengages the sear and releases the firing pin.
 - e. *The circuit breakers* – There are two that protect the circuit:-
 - (1) CB-1 on the turret services junction box.
 - (2) CB-1 on the gunner's selector switch box.

To fire

3. a. *The gunner using the foot firing pedal switch*
 - (1) Set the hull master switch to the ON position.
 - (2) Set the turret safety switch to LIVE.
 - (3) Set the gunner's selector switch to MAIN.
 - (4) Set the commander's selector switch to GUNNER.
 - (5) Press down on the foot firing pedal switch and maintain pressure until three rounds have been fired; report "Firing now".
- b. *The commander using the firing button*
 - (1) Set the hull master switch to the ON position.
 - (2) Set the turret safety switch to LIVE.
 - (3) Set the commander's selector switch to MAIN.
 - (4) Press the firing button and maintain pressure until three rounds have been fired; report "Firing now".

SERVICING**To test the ranging gun firing circuit**

4. a. Prove the gun; do not release the firing pin.
- b. Set the hull master switch to the ON position.
- c. Set the turret safety switch to LIVE.
- d. Set the gunner's selector switch to MAIN.

- e. Set the commander's selector switch to GUNNER.
 - f. Press down on the foot firing pedal switch; listen for three distinct clicks from the rate of fire controller.
 - g. Check that the firing pin has been released.
 - h. Cock the gun.
 - j. Repeat the test with the commander's selector switch at MAIN and using the commander's firing button.
5. If the firing circuit fails to operate, check the circuit breakers. If they are correct, report to REME. If the firing pin fails to be released, check that the gun is assembled correctly.

SECTION 4 – THE CO-AXIAL MG FIRING GEARS

Introduction

1. The electrical firing circuit for the co-axial MG follows approximately the same circuit as that for the ranging gun and main armament. There is an alternative firing gear, which is completely mechanical, operated by the left hand foot pedal.

The electrical firing circuit

2. a. *The MG solenoid* – This is located below the co-axial MG and, when energised, a core protrudes which bears against a pivoted firing lever which presses the trigger of the gun.
- b. *The circuit breakers* – There are two that protect the circuit:-
- (1) CB-1 on the turret services junction box.
 - (2) CB-2 on the gunner's selector switch box.

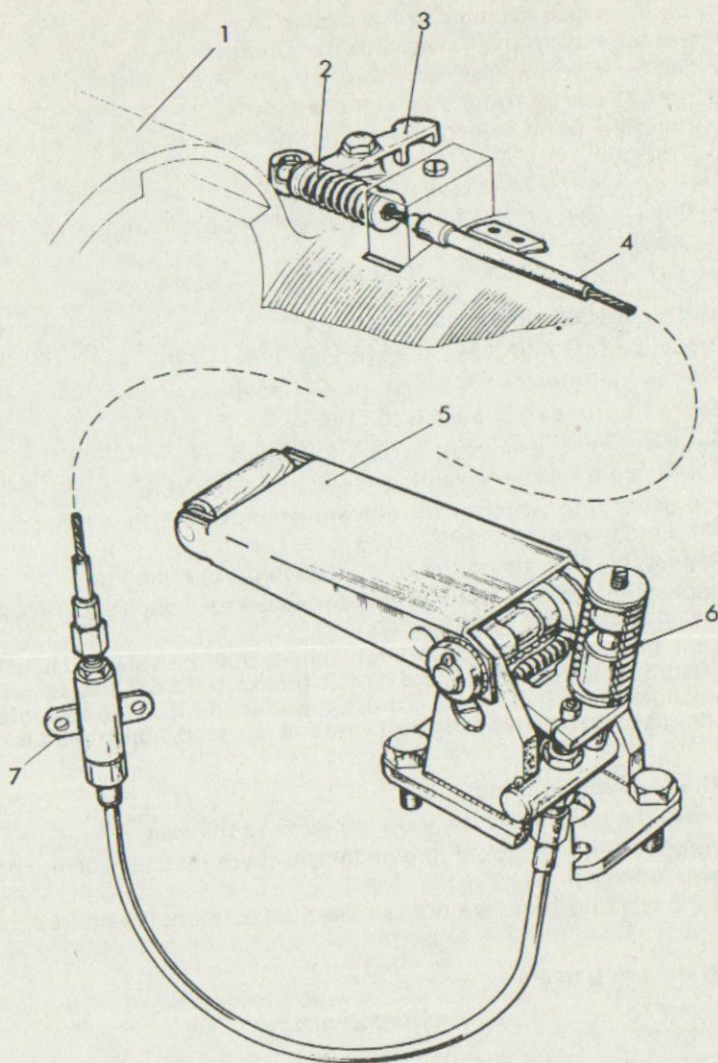
The mechanical firing gear (See Fig 26)

3. a. *The foot firing pedal* – This is positioned on the turret floor in front of the gunner.
- b. *The Bowden cable* – This extends from the foot pedal to a small block on the right of the co-axial MG mounting. The cable passes through the block and is attached to a pivot arm. The arm bears against the pivoted firing lever and, when the foot pedal is pressed, pushes the trigger of the gun. Situated on the cable, above the foot firing pedal, is the cable adjuster bracket.

To fire

4. a. *Gunner using the electrical circuit*
- (1) Set the hull master switch to the ON position.
 - (2) Set the turret safety switch to LIVE.
 - (3) Set the gunner's selector switch to CO-AX.
 - (4) Set the commander's selector switch to GUNNER.
 - (5) Press the firing switch on the elevating handwheel or the fixed grip; report "Firing now".

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- 1. Gun cradle
- 2. Cable spring
- 3. Pivot arm

- 4. Bowden cable
- 5. Foot pedal

- 6. Foot pedal return spring
- 7. Cable adjuster bracket

Fig 26 - 7.62-mm MG coaxial mechanical firing gear

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b. Commander using the electrical circuit

- (1) Set the hull master switch to the ON position.
- (2) Set the turret safety switch to LIVE.
- (3) Set the commander's selector switch to CO-AX.
- (4) Press the firing switch on the commander's firing control box; report "Firing now".

c. Gunner using the mechanical firing gear

- (1) Press down on the foot firing pedal; report "Firing now".

SERVICING**To test the electrical firing circuit**

5.
 - a. Prove the MG and leave the working parts to the rear.
 - b. Set the hull master switch to the ON position.
 - c. Set the turret safety switch to LIVE.
 - d. Set the gunner's selector switch to CO-AX.
 - e. Set the commander's selector switch to GUNNER.
 - f. Press the firing switch on the elevating handwheel. Check that the working parts have been released.
 - g. Repeat this test, using the firing switch on the fixed grip.
 - h. Repeat the test with the commander's selector switch at CO-AX and using the commander's firing switch.
 - j. If the firing circuit fails to operate, check that the solenoid is being energised. If it is not, check the circuit breakers. Check the security of the solenoid cable. If these are correct, report to REME. If the solenoid is being energised but the working parts are not released, adjustment is required.

To test the mechanical firing gear

6.
 - a. Prove the gun; leave the working parts to the rear.
 - b. Press the left hand foot firing pedal and check that the working parts have been released.
 - c. If the working parts are not released, adjustment is required.

To adjust the firing gears*Equipment required*

2 x spanner, OJ, $\frac{5}{16}$ -in x $\frac{3}{8}$ -in AF
 Spanner, OJ, $\frac{7}{16}$ -in x $\frac{1}{2}$ -in AF
 Screwdriver, cabinet

7. a. The electrical firing circuit

- (1) Prove the gun; leave the working parts to the rear.
- (2) Ensure that the front end of the solenoid is flush with its bracket and that the solenoid is secure.

- (3) Slacken the lock nut on the pivoted firing lever. Adjust the bolt head until it is just touching the solenoid core and the roller contacts the trigger extension. Tighten the lock nut.
- (4) Test the electrical circuit.
- b. *The mechanical firing gear*
 - (1) Prove the gun; leave the working parts to the rear.
 - (2) Slacken the lock nut on top of the cable adjuster bracket. Hold the lock nut and rotate the adjuster one half turn. Press the foot pedal; check if the working parts have been released.
 - (3) If the working parts are not released, repeat the adjustment, one half turn at a time, until the working parts are released. Tighten the lock nut.
 - (4) Test the mechanical firing gear.

SECTION 5 - THE COMMANDER'S MG FIRING GEAR

Introduction

1. The power for the firing circuit for the commander's MG reaches the turret in the same way as for the main armament firing circuit.

The firing circuit

2. The following components complete the firing circuit:-
 - a. *The cupola supplies junction box* - This is positioned to the right of the commander, on the turret wall, and controls all electrical power to the cupola. A 50 amp strip fuze protects all electrical power to the cupola.
 - b. *The cupola services switch box No. 2* - This is positioned to the right of the commander's sight mounting on the moveable part of the cupola ring. On the right hand end is a circuit breaker (CB-4), this protects the commander's MG firing circuit.
 - c. *The cupola services switch box No. 3* - This is positioned to the left of the commander's sight mounting on the moveable part of the cupola ring. On the right hand end is the MG selector switch and an AMBER warning light.
 - d. *The firing switch* - This is positioned on the elevating handwheel.
 - e. *The solenoid* - This is positioned on the cradle of the mounting.

To fire

3.
 - a. Set the hull master switch to the ON position.
 - b. Set the cupola master switch to the ON position.
 - c. Set the MG selector switch to ON; the amber light will illuminate.
 - d. Press the firing switch.

SERVICING

To test the commander's MG firing circuit

4.
 - a. Prove the gun; leave the working parts to the rear.

- b. Set the hull master switch to the ON position.
- c. Set the cupola master switch to the ON position.
- d. Set the MG selector switch to the ON position.
- e. Press the firing switch.
- f. If the firing circuit fails to operate, check that the solenoid is being energised. If it is not, check the circuit breaker and the 50 amp strip fuze. Check the security of the solenoid cable. If these are correct, report to REME.
- g. If the solenoid is being energised but the working parts are not released, adjustment is required.

To adjust the commander's MG firing circuit

- 5.
 - a. Prove the gun; leave the working parts to the rear.
 - b. Slacken the lock nut on the intermediate firing lever. Adjust the bolt head until it is just touching the solenoid core, and the firing lever contacts the trigger extension. Tighten the lock nut.
 - c. Test the firing circuit.

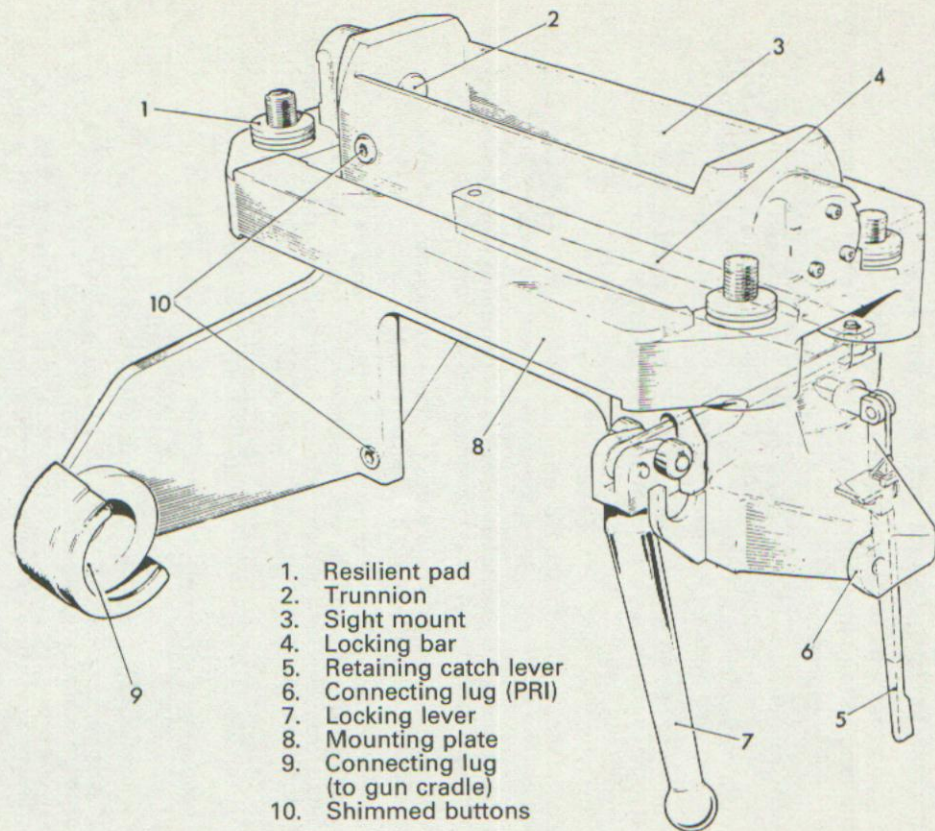


Fig 27 – Mount, periscopic sight, No. 39, Mk 1

- c. Ensure that the trunnion tilt compensator is LOCKED.
- d. Pull the locking lever fully down.
- e. Unscrew the wing nut retaining the fixed grip and swing the grip clear.
- f. Depress the main armament.
- g. Insert the sight into the sight mount as far as it will go.
- h. Maintaining an upward pressure on the sight, push up on the locking lever. Ensure that the sight is locked.
- j. Replace the fixed grip.
- k. Adjust the face mask or browpad; focus the eyepiece.

To dismount the sight from the No. 34 mounting

- 8. a. Depress the main armament.
- b. Swing the fixed grip clear.
- c. Ensure that the trunnion tilt compensator is LOCKED.
- d. Support the sight with the left hand, pull the locking lever fully down and withdraw the sight.
- e. Replace the fixed grip.

Tank laser sights (TLS)

General

9. The gunner is provided with one of the following periscopes; Sight, Laser Rangefinder, Periscopic, AV, No. 1C; or No. 1, Mk 1; or No. 1, Mk 2; or No. 3, Mk 1. Whichever sight is issued, it is mounted into the Mount, Periscopic Sight, No. 39, Mk 1. In construction the sights are similar.

Description (See Figs 34 and 36)

- 10. a. **The head** – This is a right angled prism contained in a light metal case. It is mounted to the main body of the sight and secured by four screws.
- b. *The body*
 - (1) This is a light metal case which contains the optical system.
 - (2) On the rear of the body is the X1 window, fitted with a blackout shutter. The shutter is raised or lowered by a lever. A circle defining the field of view of the X8/X10 eyepiece can be seen in the X1 window.
 - (3) The X8/X10 eyepiece is positioned below the X1 window. It has a heater and fixed focus. A filter is located to the right of the eyepiece and can be placed over the eyepiece when required.
 - (4) To the left of the X8/X10 eyepiece is another eyepiece to enable the gunner to see the laser range readout figures.
 - (5) Two graticule adjusters are fitted to the sight. The one for deflection is on the right side of the sight, the other, for elevation, is on the rear face of the sight. Both adjusters are calibrated in mils, numbered every mil and graduated in $\frac{1}{10}$ th of a mil intervals. The overall movement of the adjusters is 20 mils. Each adjuster has a locking lever.

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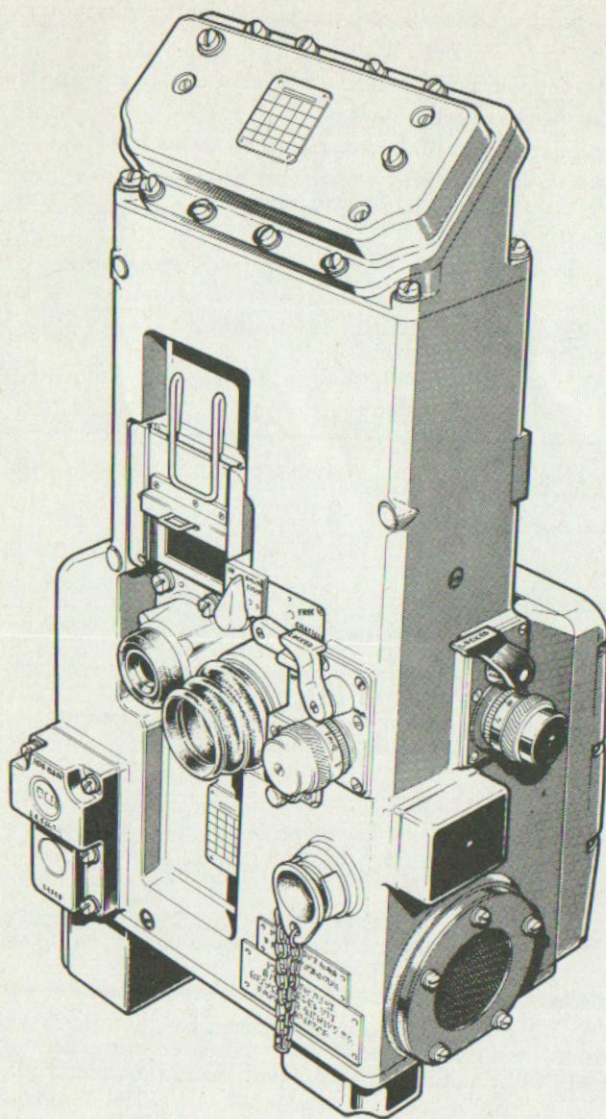


Fig 34 – Sight, Laser rangefinder, periscopic, AV, No. 1, Mk 1

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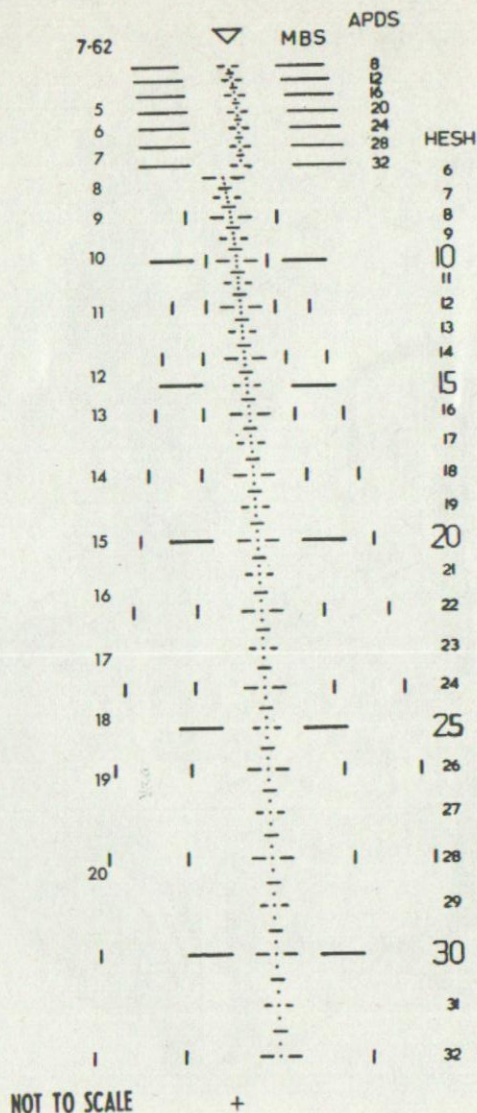


Fig 35 - TLS, No. 1, Mk 1 and No. 1c graticule pattern

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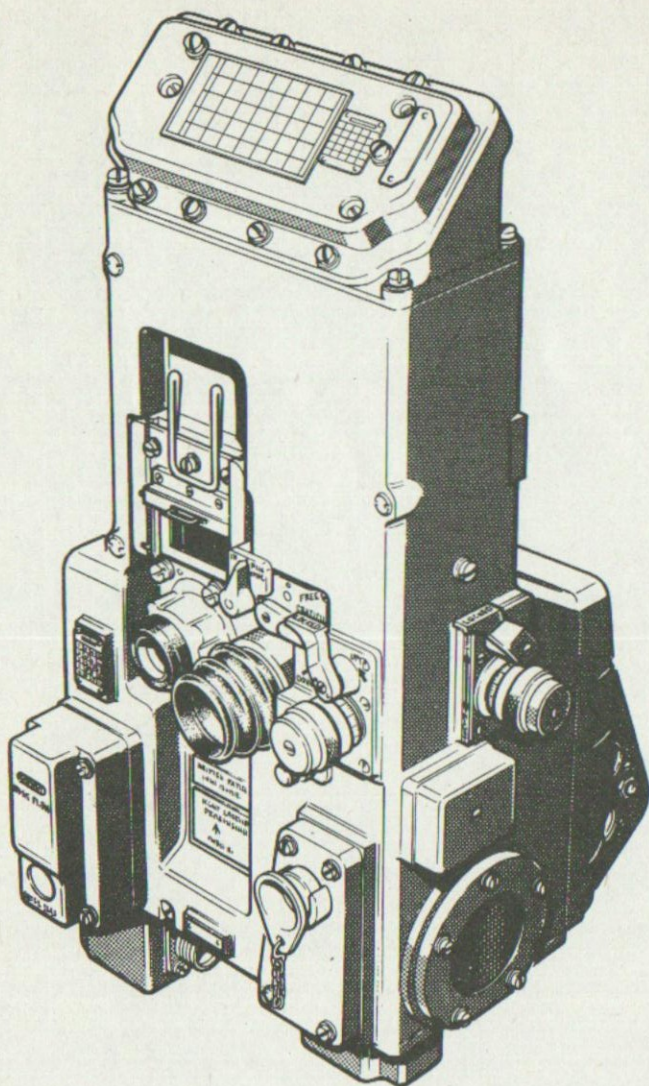
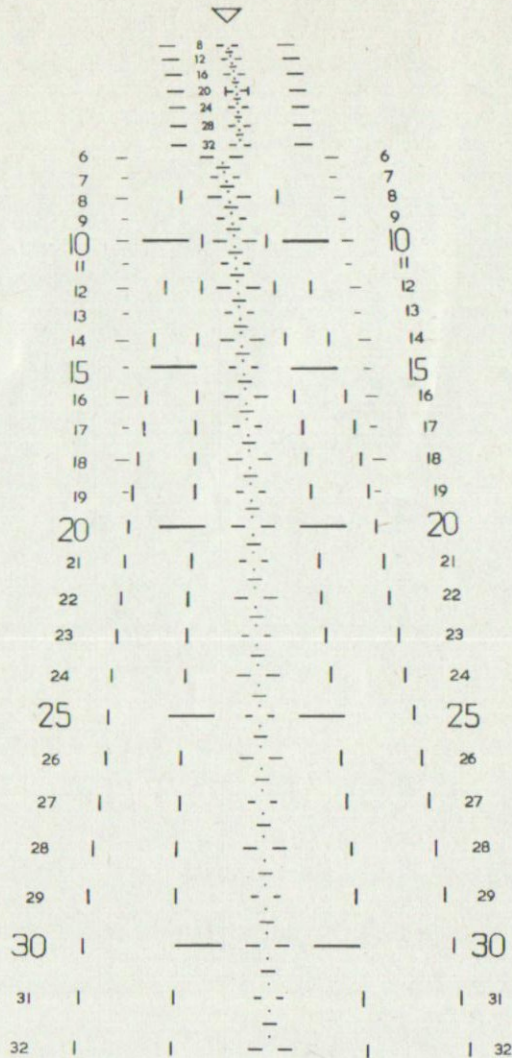


Fig 36 – Sight, Laser rangefinder, periscopic, AV, No. 1, Mk 2

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NOT TO SCALE

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Fig 37 – Tank laser sight No. 1, Mk 2 – Graticule pattern

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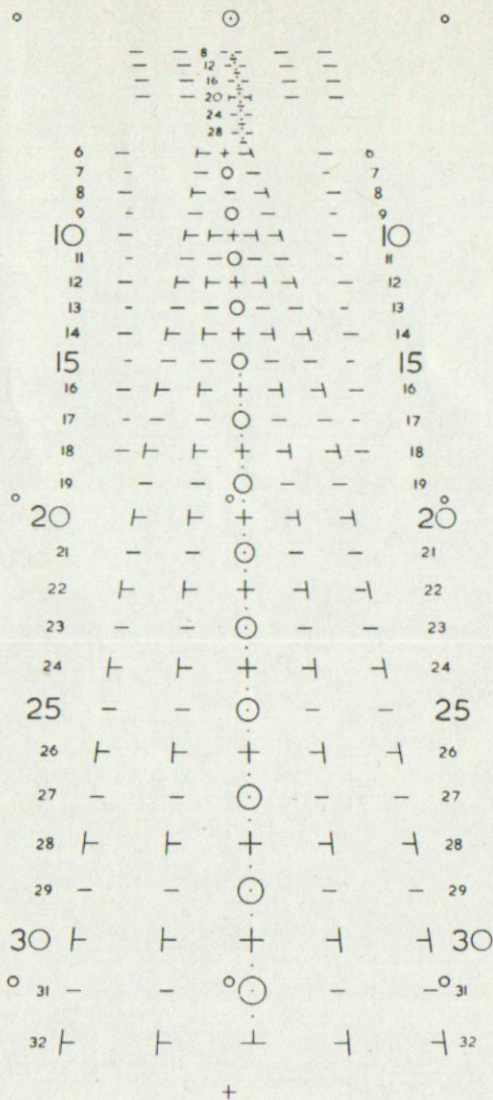


Fig 38 - Tank Laser sight No. 3, Mk 1 - Graticule pattern

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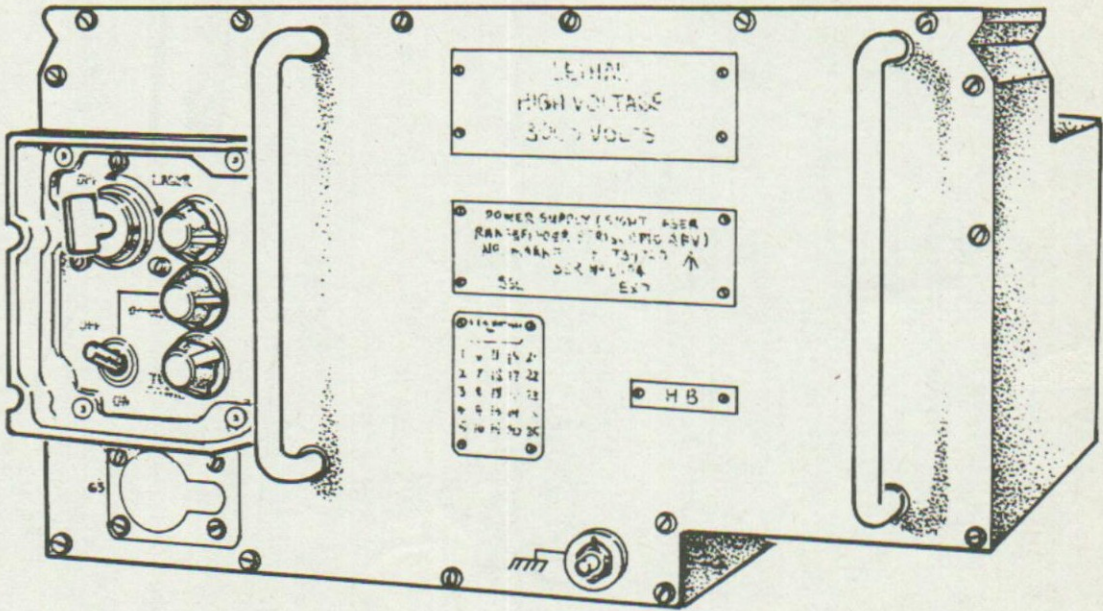


Fig 39 – Power supply unit (TLS) No. 1, Mk 2

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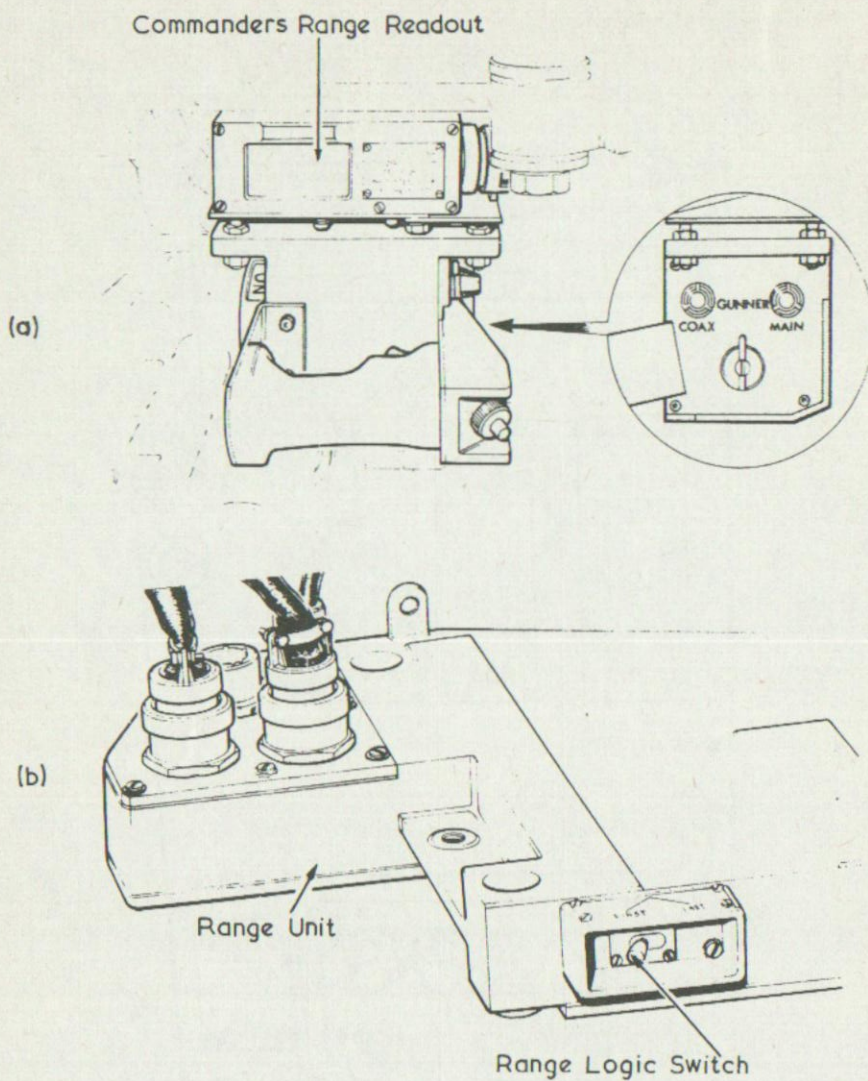


Fig 40 – Commander's range readout and the range unit

- (6) A lever operating the trunnion tilt compensator is positioned above the X8/X10 eyepiece. The lever has two marked positions, FREE and LOCKED. The tilt compensator should be set at FREE during firing.
 - (7) The X8/X10 graticule can be illuminated by a lamp unit situated to the right of the eyepiece. The unit is hinged to facilitate bulb changing and is retained by a screw. The bulb used is a midget flanged 28 volt .08 amp.
 - (8) A lever marked 'bore sight check' is situated to the right of the X1 window. This has two positions, marked IN and OUT; unless the muzzle reference system is being used, the lever must be set to the OUT position.
 - (9) Positioned on the rear face of the sight is the total flash counter; this records the total number of flashes made with the sight. At the bottom of the counter is the charge/flash button.
 - (10) On the lower right and left side of the sight are the cooling fan grills.
 - (11) There are three electrical sockets on the body into which fit leads from the power unit. One socket is on the front of the body, a further two are on the underside. In addition, on TLS No. 1 Mk 1 or Mk 2 and TLS No. 3 Mk 1, there are additional sockets which are used when a range unit and a commander's readout facility are provided.
 - (12) Included in the optical system is a ballistic graticule used for direct fire. (See Figs 35, 37 and 38)
- c. *Power supply units* – The power supply units used with TLS are positioned to the right of the gunner on the turret sill. The type of power unit used are as follows:-
- (1) *Power supply unit (TLS) No. 1C* – The switch and indicator lamp compartment is situated on the left front of the power supply unit and when not in use is covered by a locked door. The temperature control switch and its indicator lamp are positioned at the top of the compartment. The laser power supply switch and its indicator lamp are positioned at the bottom of the compartment. Between the two indicator lamps there is a black plastic cap marked 'PFN volts', this is for REME use only. Below the compartment is a rubber capped circuit breaker.
 - (2) *Power supply unit (TLS) No. 1, Mk 1* – The switch and indicator panel is situated on the left front of the power supply unit. The temperature control switch and its indicator lamp are positioned at the top of the panel. The key socket for the laser power supply switch and its indicator lamp are positioned at the bottom of the panel. When the key is inserted into the socket and turned to the ON position, the indicator lamp illuminates. Between the two indicator lamps there is a black plastic cap marked 'PFN volts'; this is for REME use only. Below the panel is a rubber capped circuit breaker.
 - (3) *Power supply unit (TLS) No. 1, Mk 2*. The switch and indicator lamp panel is situated on the left front of the power supply unit. The key socket of the laser power supply switch and its indicator lamp are positioned at the top of the panel. When the key is inserted into the socket and turned to the ON position, the indicator lamp illuminates. The temperature control switch and its indicator lamp are positioned at the bottom of the panel. Between the two indicator lamps, is a further lamp marked POWER. When the temperature control switch is

put to ON, the two lower lamps illuminate. Below the panel is a rubber capped circuit breaker. (See Fig 39.)

- d. *Commander's range readout.* Included in the No. 1, Mk 2 and No. 3, Mk 1 equipment is a commander's range readout display located to the front of the commander, below the cupola. (See Fig 40.)
- e. *Range unit.* This is included in the No. 1, Mk 2 and No. 3, Mk 1 sight equipment and is situated on the turret sill to the right of the gunner. Positioned on the range unit is the range logic selector switch; it is marked FIRST and LAST. (See Fig 40.)
- f. *TLS No. 1, Mk 2 and No. 3, Mk 1.* Included in this equipment are laser flash buttons fitted to the gunner's and commander's firing controls. Either of these switches will flash the laser, when pressed.

Electrical switches used with TLS

11. a. *The switches* which activate the eyepiece heater, graticule illumination, wipers and the gunner's sight washer are the same as those described in para 3 a. and b. above.
- b. *The circuit breakers* protecting the power to these components are the same as those described in para 3 c. above. In addition, the circuit breakers which protect the power supply to the laser sight are CB-11 and CB-12.

Component changing of TLS

12. a. *To change the periscope head.* Replacement of the head will normally be carried out by REME. However, if an operational requirement exists, the procedure is as follows:-
 - (1) Dismount the TLS, clean the body of the sight and the spare head.
 - (2) Remove the four screws that secure the damaged head to the body of the sight. Lift off the head.
 - (3) Secure the head to the body by means of the four screws; tighten in a diagonal sequence. Mount the TLS. Re-bore sight.
- b. *To change the graticule illumination bulb*
 - (1) Switch off the graticule illumination.
 - (2) Slacken the screw on the lamp unit cover plate.
 - (3) Remove the Midget flange bulb and fit the new one.
 - (4) Close the cover and secure it.

To mount and dismount the TLS

13. This is a crew task but, on some earlier mark vehicles, there may be a requirement to remove the elevating handwheel, traverse indicator and fixed grip in order to complete the task. Where the removal of these components is necessary, the task will be carried out by REME.

a. *To mount the TLS*

- (1) Traverse to the 3 or 9 o'clock position and fully depress the gun.
- (2) Set the hull master switch to the OFF position.
- (3) Ensure that the switches on the power supply unit are set to the OFF position.
- (4) Ensure that the mounting is clean and lightly lubricated.

- (5) Raise the locking lever to its fullest extent.
- (6) Ensure that the trunnion tilt compensator is LOCKED.
- (7) Insert the sight into the aperture in the sight mount as far as it will go.
- (8) Maintaining an upward pressure on the sight, pull down on the locking lever. Ensure that the sight is locked.
- (9) Connect the electrical cables to the appropriate connections on the sight. Ensure that all connections are tight.
- (10) Set the hull master switch to the ON position.

b. To dismount the TLS

- (1) Traverse to the 3 or 9 o'clock position and fully depress the gun.
- (2) Set the hull master switch to the OFF position.
- (3) Ensure that the switches on the power supply unit are set to the OFF position.
- (4) Disconnect each electrical cable in turn and fit each cable to the dummy socket in its stowage position. The Triax cable connector should be held against the turret sill to earth and discharge it.
- (5) Ensure that the trunnion tilt compensator is locked.
- (6) Support the sight with the left hand.
- (7) Raise the locking lever to its fullest extent.
- (8) Lower the sight; pull inwards on the retaining catch lever. Remove the sight from the mounting.
- (9) Set the hull master switch to the ON position.

Operating the TLS

14. Possession of the power supply unit key must be strictly controlled to personnel involved in the actual operation, testing and servicing of the equipment. The power supply unit key must not be left in unattended equipments. The laser rangefinder must be treated as a "live weapon" and the non-operational use of laser must be strictly controlled. It will only be activated in designated areas and then only under the normal range discipline in force at the time.

a. To switch on the TLS No. 1C, No. 1, Mk 1, No. 1, Mk 2 and No. 3, Mk 1.

- (1) Check that all electrical connections are secure.
- (2) Set the hull master switch to the ON position.
- (3) Unlock the door of the switch compartment (No. 1C), or insert the key into the socket of the power supply switch of the power supply unit (No. 1, Mk 1 and Mk 2).
- (4) Set the temperature control switch to ON. The indicator lamp will glow; the cooling fan in the sight will be heard to run. On the No. 1, Mk 2 power supply unit, the centre indicator lamp will also illuminate.
- (5) Set the power supply switch to the ON position. When using No. 1C equipment the switch is pushed down; on No. 1, Mk 1 and 2 PSU, the key is turned to the ON position. The indicator light will illuminate.
- (6) Look into the left eyepiece of the sight to ensure that the range readout is illuminated. On No. 1, Mk 2 and No. 3, Mk 1, check that the commander's range readout is also illuminated.
- (7) When using No. 1, Mk 2 or No. 3, Mk 1 sight, set the range logic selector switch to FIRST.
- (8) The laser is now ready for use.

b. To use the TLS No. 1C and No. 1, Mk 1

- (1) Switch on the TLS.
- (2) If the use of laser is required this will be indicated to the gunner by the commander's fire order.
- (3) The gunner will press the charge/flash button on the sight. This action "arms" the laser and a motor in the sight will be heard to start up.
- (4) When the laser is charged, the range readout markings in the left eyepiece will illuminate.
- (5) Lay the MBS mark of the sight correctly on to the target.
- (6) Press the charge/flash button for the second time. The figures on the total flash counter will increase by one. The first three figures of the range will be seen on the range readout in the left eyepiece. To obtain the range the figures are multiplied by 10, eg, 071 = range 710 metres, 456 = range 4560 metres. The range will remain displayed on the range readout until the TLS is lased again or switched off.
- (7) If the charge/flash button is not pressed during an interval of approximately 20 seconds, the charge is automatically discharged.

c. To use the TLS No. 1, Mk 2 and No. 3, Mk 1

- (1) Switch on the TLS.
- (2) If the use of laser is required this will be indicated to the gunner by the commander's fire order.
- (3) When either the gunner or commander set the selector switch to MAIN or CO-AX the laser will automatically charge.
- (4) After approximately two seconds, an illuminated legend 'CHRG' will appear in the left eyepiece of the sight and in the commander's range readout display. The laser is charged and ready to fire.
- (5) Lay the MBS mark of the sight correctly on to the target.
- (6) Press the flash button on either the sight, the commander's firing control or the gunner's firing control. The figures on the total flash counter will increase by one. The first three figures of the range will be seen on the range readout in the sight and on the commander's range readout display. The range will remain displayed on the range readout until the TLS is lased again or switched off.
- (7) If the flash button is not pressed during an interval of approximately 20 seconds, the charge is automatically discharged. If the selector switch remains set to MAIN or CO-AX the laser will recharge. At the end of an engagement, if the TLS is not required, the selector switch should be returned to the OFF position.
- (8) If the accuracy of the range reading is in doubt a check can be made as follows:-
 - (a) Set the range logic selector switch to the position marked LAST. The legend LAST will illuminate in the range readout.
 - (b) Lay the MBS mark of the sight correctly on to the target.
 - (c) Press the flash button.
 - (d) The true range will now be displayed on the range readout. The error in the first range given may have been caused by smoke, mist, bushes, etc.
 - (e) Set the range logic selector switch back to the position marked FIRST.

- d. *Time limits in the use of TLS.* A maximum of ten flashes per minute followed by a wait period of two minutes is permitted. If the figure of ten flashes is exceeded, the laser will over heat, give incorrect range data with possible malfunctioning.
- e. *To switch off the TLS*
 - (1) Set the power supply switch or turn the power supply switch key to the OFF position.
 - (2) Set the temperature control switch to the OFF position.
 - (3) Remove the power supply switch key from the socket or, when using the No. 1C equipment, close and lock the switch compartment door.

Muzzle reference system

General

- 15. a. The muzzle reference system (MRS) provides the facility (after initial setting by REME) for aligning the muzzle boresight (MBS) 120-mm mark in the sight graticule with the axis of the bore of the gun from within the vehicle. Thus eliminating the necessity to select a suitable boresighting target at a range of 1100 metres and to dismount from the vehicle to use the muzzle boresight.
- b. In addition, the MRS enables the gunner to check the gun/sight relationship at any time during firing. A loss of gun/sight relationship may occur due to sun, rain, wind, barrel heat, or barrel/cradle disturbance. Using the MRS, the gunner is able to carry out an almost immediate check and make an adjustment to correct the misalignment.

Description (See Fig 41.)

- 16. The MRS consists of the following components:-

- a. *The light source AV, No. 1, Mk 1* is mounted on the turret roof to the left of the gunner's periscopic sight hood. It is rectangular in shape and fully encases all the optical components within an iron case. The case has four external lugs which provide points for attachment to studs welded on the turret roof. The projected light source is provided by a Halogen type lamp (24 V 70 W) which is connected to an electrical socket positioned at the right rear of the case. Light rays from the lamp are focussed by a reflector on to the rear end of a large diameter fibre optic which is covered by a red filter. The front end of the fibre optic is fitted into a sleeve which makes the fibre optic conform to the shape of the 120-mm MBS mark in the sight, and to form the image (reference mark) that is projected. The front face of the case is sealed by a plate glass window which is provided with a thermostatically controlled heater.
- b. *The mirror assembly MRS No. 1, Mk 1 and Shroud assembly* is mounted at the muzzle end of the 120-mm gun. The deflecting mirror is machined from a round steel bar; the reflective face is highly polished, and is treated with reflective and protective coatings. The hood assembly protects the mirror from mud, spray, foliage, etc., in addition, it provides a dark non-reflective tunnel which aids good contrast for the reflecting face of the mirror.

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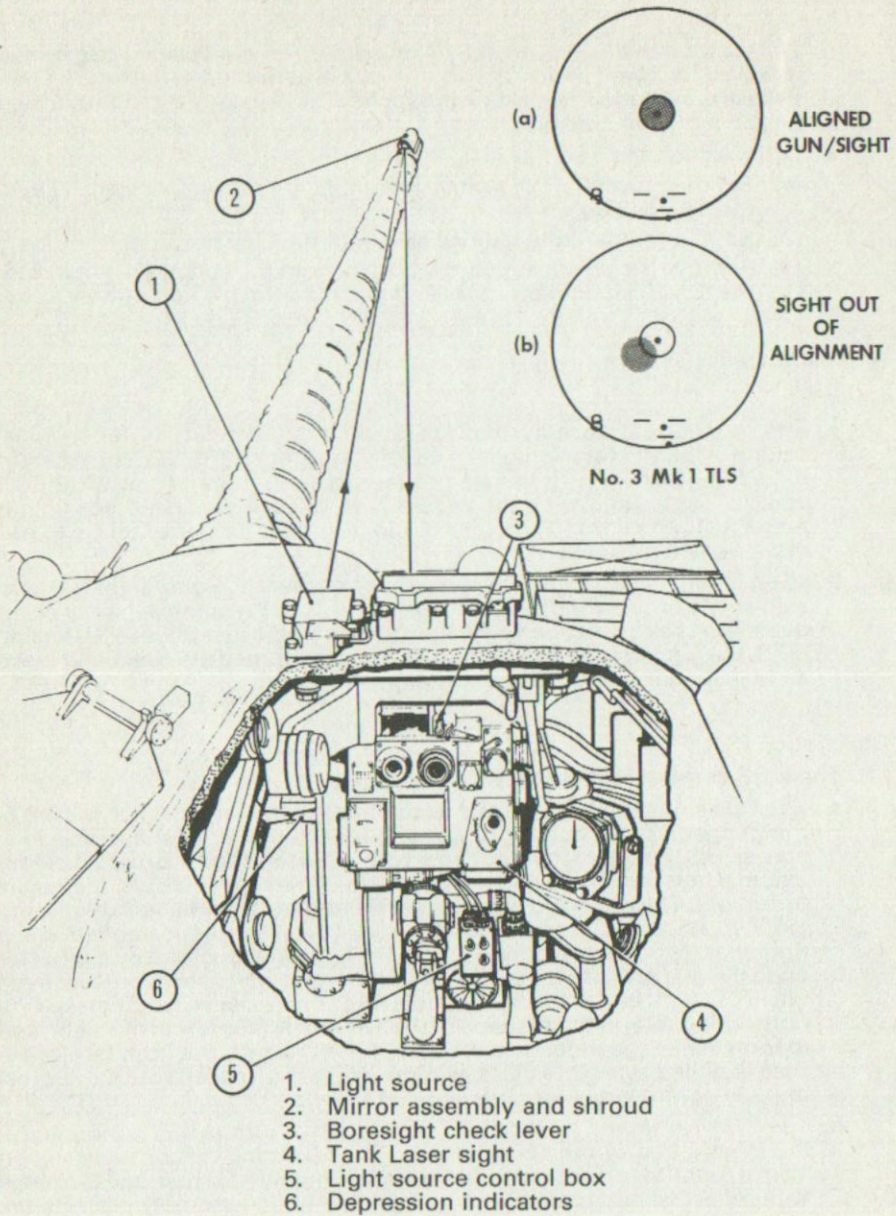


Fig 41 - Muzzle reference system layout

- c. *The switch box MRS No. 1, Mk 1* is mounted on a bracket forward of the gunner's position. There are three operating switches, situated on the control box, which are used as follows:-
- (1) *Light source switch.* This is the top right switch and is marked LIGHT. When pressed down and held in the ON position the light source is illuminated. The switch returns to the up OFF position when released.
 - (2) *Heater switch.* This is the bottom right switch and is marked HEAT. It controls the window heater and is an ON/OFF type switch.
 - (3) *Dimmer switch.* This is the top left switch and controls the brilliance of the light source lamp. It has three positions DIM - MEDIUM - BRIGHT.
- d. *The depression indicators* are mounted, one on the gun cradle, the second on a static bracket to the left of the gunner's periscopic sight. When the two indicators are aligned, they indicate the correct angle of depression of the main armament to enable the gunner to use the MRS.
- e. *"Bore sight check" lever;* this is a component of the Tank Laser Sight and is situated to the right of the X1 window. It has two positions marked IN and OUT. When set to IN, the gun is depressed and the depression indicator aligned; a view of the reference mark can be seen clearly in the X10 eyepiece. Unless the MRS is being used, the lever must be set to the OUT position.

Operation

- 17 a. When the light source switch is depressed, the lamp is illuminated. The light rays from the lamp are focussed by the reflector on to the rear of the fibre optic. The light rays pass through the fibre optic and project a red coloured reference mark on to the mirror fitted to the muzzle end of the gun. The mirror reflects back the reference mark into a small sector of the gunner's periscopic sight.
- b. When the gun is depressed to the position indicated by the depression indicators and the boresight check lever is set to the IN position, the gunner is able to see the reflected reference mark in his sight. When the reference mark is seen to be situated centrally within the MBS 120-mm mark, the gun/sight relationship is correct.
- c. If the reference mark is not situated centrally within the MBS 120-mm mark the sight requires adjustment.

To check the gun/sight relationship using MRS

18. a. Set the MRS light source window heater switch to the ON position.
- b. Depress the gun until the depression indicators are correctly aligned; complete the final lay in elevation.
- c. Set the boresight check lever to the IN position; ensure that it is fully engaged.
- d. Press down and hold the light source switch in the ON position.
- e. Look through the X10 eyepiece; check that the reference mark is visible.
- f. Set the dimmer switch to the brilliance position required.
- g. The reference mark should be positioned centrally within the MBS 120-mm mark.

- h. If the reference mark is not positioned centrally within the MBS 120-mm mark, the sight must be adjusted.

To adjust the gun/sight relationship using MRS

19. a. Maintain pressure on the light source switch.
- b. Adjust the sight graticule with the graticule adjusters until a position is obtained where the reference mark of the MRS is positioned centrally within the MBS 120-mm mark.
- c. Ensure that the graticule adjusters are firmly locked and that the adjustment has not been affected during the locking of the adjusters.
- d. Release the light source switch.
- e. Set the boresight check lever to the OUT position.
- f. Set the MRS light source window heater switch to the OFF position.

Initial setting up of MRS

20. This is carried out, when the barrel is cold, on the following occasions:-
 - a. After a change of barrel.
 - b. After a change of mirror assembly.
 - c. After a change of tank laser sight (TLS).
 - d. When, after a consistency check, the error is greater than 0.3 mil.
21. The following procedure will be used:-
 - a. Carry out sight adjustment of TLS as in Section 5, paras 14 and 15.
 - b. Do not remove boresight from barrel.
 - c. Set MRS light source window heater switch to ON.
 - d. Correctly align depression indicators.
 - e. Set boresight check lever to IN position, ensure it is fully engaged.
 - f. Press down and hold light source switch.
 - g. Look through X10 eyepiece of TLS; check reference mark is visible.
 - h. Set dimmer switch to brilliance position required.
 - j. Give directions to REME technician to adjust light source until reference mark is positioned centrally within MBS 120-mm mark of TLS.
 - k. Remove boresight; check that coincidence is still maintained; if not, achieve a coincidence by using the graticule adjusters on the TLS.
 - l. Carry out MRS consistency check.

MRS consistency check

22. This check is carried out, when the barrel is cold, on the following occasions:-
 - a. After initial set up.
 - b. As a periodic check (monthly).
 - c. If accuracy is suspected.
23. This following procedure will be used:-
 - a. Set temperature compensated link bar pump to ON (run for 20 minutes).

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- b. Ensure trunnion tilt compensator is LOCKED.
- c. Check MRS mirror for cleanliness and security.
- d. Test boresight check lever as follows:-
 - (1) Adjust TLS, using MRS.
 - (2) Set lever to OUT, then to IN.
 - (3) Check that adjustment is maintained.
 - (4) Repeat paras (1), (2) and (3) a further nine times; report any error to REME.
- e. Carry out sight adjustment of TLS with boresight eyepiece on left side. Record graticule adjuster readings.
- f. With boresight in barrel, make MRS coincidence. Record graticule adjuster readings.
- g. Rotate the boresight until the eyepiece is on the right side; carry out adjustment of TLS. Record graticule adjuster readings.
- h. With boresight in barrel, make MRS coincidence. Record graticule adjuster readings.
- j. Repeat paras e., f., g. and h. twice more.
- k. Total boresight and MRS readings.
- l. Calculate mean of boresight and MRS readings. The difference between them should not be greater than 0.3 of a mil.
- m. If error is greater than 0.3 of a mil, report to REME.

24. An example of the MRS consistency check recording proforma is set out below:-

DIRECTION	MUZZLE BORESIGHT		MUZZLE REFERENCE	
	ELEVATION (Mils)	DEFLECTION (Mils)	ELEVATION (Mils)	DEFLECTION (Mils)
LEFT				
RIGHT				
LEFT				
RIGHT				
LEFT				
RIGHT				
TOTAL				
AVERAGES				
DIFFERENCE				
FINAL MRS READING WITH MBS REMOVED				

Servicing the MRS

25. All adjustments to the light source, mirror and shroud assembly will be carried out by REME. The crew are required to clean, inspect and test the operation. Any defects will be reported to REME.

26. The mirror has a very thin reflective coating of aluminium which is extremely prone to damage. It is protected by the shroud into which fits a plastic cap. The cap must be correctly fitted at all times, except during firing. The mirror's reflectivity will be impaired by any form of abrasive, therefore, the only form of cleaning permitted is with water on a clean soft cloth or surgical cotton wool. Any discolouration will be reported to REME.

WARNING:- The depression indicators are provided with nuclear light sources for alignment purposes. There is no health hazard unless a light source breaks, and then only if the breakage occurs in a confined or poorly ventilated space; should this occur in peacetime conditions, all personnel should leave the vehicle for 30 minutes. On leaving, all hatches should be left open to allow the tritium gas to escape.

The temperature compensated link bar**Description**

21. The link bar connects the gunner's sight mount to the gun cradle. Movement of the gun in elevation or depression is transmitted through the link bar to the sight mount. The temperature compensated link bar consists of the following components:-

- a. *The link bar* – This consists of two hollow rods connected by a hollow tie rod. It is attached at one end to the sight mount and at the other to the gun cradle. At each end of the link bar are connection pipes and rubber hoses.
- b. *The header tank* – This is mounted in the turret roof immediately above the gunner's position. It has a capacity of 4 – 4½ pints; it is filled with a two to one mixture of water and anti-freeze. The header tank has two filler plugs mounted on the top exterior of the turret. Wire mesh filters are located in the filler plug housings. Rubber hoses connect the header tank to the link bar and to the pump and motor unit.
- c. *The pump and motor unit* – This is situated behind the gunner's lighting control box and is controlled by a switch on that box. When switched on, the pump circulates the liquid from the header tank, through the link bar and back to the header tank.
- d. *Operation* – The link bar is brought to the same temperature as the turret roof due to the fluid in the header tank being circulated through the link bar. Any distortion to the sight linkage due to the expansion or contraction of the turret roof is thereby compensated. The pump must be switched on at least 20 minutes prior to boresighting and must be on at all times during firing.

Servicing of the temperature compensated link bar**22. a. To top up**

- (1) Thoroughly clean the area around the two filler plugs; remove the plugs.

- (2) Remove the filters from the housings; check for cleanliness.
- (3) Replace the filters; top up through the higher of the two filler points until the level of the lower filler is reached.
- (4) Replace the lower filler plug; continue to top up until the mixture reaches the level of the higher filler.
- (5) Test the specific gravity, using a hydrometer. The reading should be between plus four and minus four.
- (6) Replace the filler plug.

b. To test the operation

- (1) Set the pump switch to the ON position; listen to ensure that the pump motor is operating.
- (2) Check all hoses and connections for leaks and for any signs of chafing.
- (3) With the pump motor running, remove the higher of the two filler plugs. Ripples should be seen on the surface of the liquid which confirms that the pump is circulating the liquid. Replace the filler plug.
- (4) If there are any faults, report to REME.

The gunner's sight unit and mounting

General

23. There are two sight unit mountings and four sight units that can be fitted to the Chieftain, dependent on the mark and state of modification to the vehicle.

24. Sight unit mountings

- a. The mount, sight unit, No. 21 or No. 43, consists of two separate supports, front and rear. The front support is secured to the turret, near the gun trunnions, by three shock absorber assemblies and receives the forward end of the sight unit. The rear support is secured to the turret roof and receives the rear end of the sight unit. The turret sight aperture is fitted with a rubber bung to keep out dirt and moisture. This bung is fitted with a window which, while not appreciably reducing the field of view, does reduce the amount of light getting into the sight unit.
- b. The front support of the No. 21 mounting consists of two assemblies, outer and inner. The outer assembly is secured to the turret by the three shock absorbers and supports the inner assembly in a bushed central aperture. The inner assembly is centrally bored to receive the sight unit head and is free to rotate in the outer assembly. The end of the inner assembly cylindrical body is slotted and provided with a clamping band which, when tightened, secures the sight head in its operating position. The clamping band is tightened by means of an Allen key secured to the outer assembly by a chain.
- c. The front support of the No. 43 mounting is generally similar to that of the No. 21 mounting, but the mounting bearing is assembled on the sight unit before fitting to the mounting bracket in the AFV and the clamping band has been replaced by a head screw.
- d. The inner assembly is provided with an arm which is connected to the gun mounting by a link bar so that the head of the sight unit moves in unison with gun movement.

- e. The rear support consists of a bracket secured to the turret roof. An arm on the front of the bracket supports the sight unit swivel bolt. An extension of the bracket supports a browpad which is clamped by two screws.
25. *The sight unit* – This sight may be any one of the following, depending on the state of modification to the vehicle.

- a. (1) *Sight unit, AV, No. 26, Mk 1* – This is the original sight unit.
- (2) *Sight unit, AV, No. 60, Mk 1* – This is a No. 26, Mk 1 sight unit with a modified graticule adjuster fitted as a modification.
- (3) *Sight unit, AV, No. 70, Mk 1*. This is a No. 26, Mk 1 or No. 60, Mk 1, having the modified graticule adjuster but, in addition, an extended range graticule. (See Figs 42 and 30.)
- (4) *Sight unit, AV, No. 80, Mk 1*. This is similar to the No. 70, Mk 1, but has a graticule pattern identical to that used in the Sight, Laser rangefinder No. 3, Mk 1. (See Fig 38.)
- b. *Description*. The sight unit consists of the following components:-
 - (1) *The sighting head* contains a mirror, the object glass, graticule and field lens, and is attached to the control head by a bearing which permits rotation of the sighting head.
 - (2) *The control head* encloses the base of the sighting head bearing housing and is fitted with the graticule adjusters. The adjuster dials are marked every fifth of a mil and numbered every single mil from 0 – 20. Two bushed recesses, adjacent to the graticule adjusters, accommodate the locating pin of a gear drive unit by which the graticule adjusters are operated through a flexible drive. A central aperture in the control head provides access for the object glass heater cable.
 - (3) *The main housing* contains a mirror, and is the optical link between the front and rear housings. Strapped to the rear end of the housing is the graticule adjuster control shaft and adjusting head.
 - (4) *The rear housing* is secured to the main housing and contains the fixed focus eyepiece assembly. The eyepiece is provided with a heater which is thermostatically controlled. The housing is provided with a socket for connecting the eyepiece and object glass heaters to the electrical supply. The switch for operating the heaters is the same as used for the gunner's periscopic sight.

Servicing the gunner's sighting equipment

Optical cleaning

26. Incorrect or careless cleaning of glass surfaces must be avoided. The following methods should be adopted:-

- a. *Object prisms and object glasses*. These are the glass components which are closest to the target, and exposed to the weather and traffic film. Remove all mud and film with clean cold water, and pat dry with a clean soft cloth or tissue paper (soft toilet paper is both clean and absorbent).
- b. *Ocular prism and eye lenses*. These are the glass surfaces nearest to the eye. They are not exposed to mud and traffic film, and are usually coated with a bluish anti-reflection coating. Great care must be taken to blow away any grit or dust before cleaning. Clean tissues will be used. A polish

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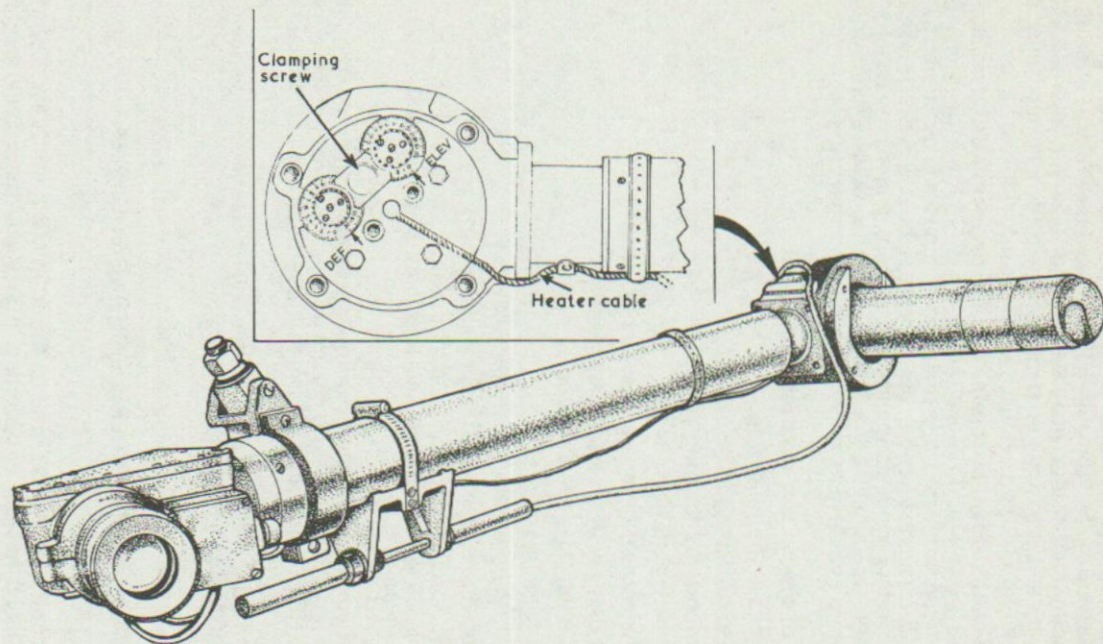


Fig 42 - Sight unit, AV, No. 70, Mk 1

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may be obtained by breathing on the glass, but there must be no hard rubbing or saturating with water. If it is not possible to clean an optical surface satisfactorily by the foregoing methods, REME should be informed. Methylated spirits, gasoline or other cleaning agents should only be used by suitably qualified persons, as excessive use of these can cause deterioration of the sealing and bonding materials.

NOTE:- No attempt should be made to wipe off mud or grit in a dry state, as this will scratch the glass surface and reduce the efficiency of the instrument. Any abrasions, chips or scratches, especially radial ones due to wiper action, should be reported to REME for investigation. Cotton waste must NEVER be used to clean glass surfaces. Even service flannelette (4-in x 2-in), which may well be the cleanest cloth available, is suspect, since its heavy woollen texture harbours grit but, if nothing better is available, it may be used with great caution.

General inspection of optical and sighting equipment.

27. Inspect and check for the following:-

- a. Missing, loose or damaged screws.
- b. Damaged seating and locating faces.
- c. Condition of external finish.
- d. Condition of electrical fittings and switches, etc.
- e. Condition of engraving on scales and readers.
- f. Condition of external glass surfaces.
- g. Condition of face masks.
- h. Efficiency of locking devices and safety catches.
- j. Graticules should be sharp and clearly defined.
- k. When looking through an instrument from the object end, the internal optics can be viewed; these should be clean, unfilmed and free from fungus or cracks.

WARNING:- Whenever hand-operated controls are fitted to an equipment, they should only be used by HAND. Under no circumstances must mechanical aids be used to force them. REME should be informed immediately of any difficulty or malfunction.

28. All sight mount mating surfaces and catches will be cleaned and wiped over with an oiled cloth (OM 13).

SECTION 3 – COMMANDER'S SIGHTING EQUIPMENT

Commander's sight

1. The Sight, Periscopic, AV, No. 37 may be found in Mk 1, Mk 2, Mk 3 or Mk 4 versions, but it is likely that the two earliest marks will have been modified internally, so that the graticule patterns are similar to those found in the Mk 3 and Mk 4 sights.

- a. *Sight, Periscopic, AV, No. 37, Mk 2* – The instrument is a binocular-type periscopic sight. It consists of three main castings. (See Fig 43.)

- (1) *The upper casting* houses the object reflector and is permanently fixed to the centre casting. Inside the object reflector there is a mirror which is linked to the commander's MG mounting.
 - (2) *The centre casting* contains the semi reflector for the injected graticule. A selector lever fitted on the left side of the sight enables the commander to select either X1 or X10 magnification. The lever is moved to the UP position to select X1 and to the DOWN position to select X10. Forward of the magnification selector lever is the mirror lever; when the sight is mounted this is connected to the commander's MG mounting linkage. When the sight is not mounted, the mirror lever is held by a keyed transit bar. When the sight is mounted the bar is removed and stowed on the front of the sight. A unitor plug is fitted to the front of the sight to supply power to the X1 graticule and eyepiece heaters. When the sight is mounted the plug enters a socket on the cupola. On the rear of the sight is a lamp housing which provides illumination for the X1 graticule; the bulb is a 28 v 18 w. Below the lamp housing is the X1 unity window. When the X1 graticule is illuminated it can be seen in this window. When the cupola is in the 'line up' position, the graticule from the projector, reticle image, can be seen on the right side of the X1 unity window.
 - (3) *The lower casting* houses the binocular system. On the rear of the sight are the fixed focus X10 eyepieces. These are covered by a face mask and are fitted with heaters. Interocular adjustment is achieved by moving a lever positioned to the right of the face mask. On the left of the face mask is the interocular scale. A rubber capped guard held by a chain can be fitted over the eyepieces. In the left eyepiece there is permanently fitted a graticule pattern marked in mils. In the right eyepiece is seen the graticule from the projector, reticle image. On the left and right side of the sight are the mounting hooks; these are attached to spring loaded fingerpieces. The hooks fit into the sight mount and the sight is locked in position by two clamping knobs.
- b. *Sight, Periscopic, AV, No. 37, Mk 3* – The two major changes incorporated in this sight are that the binocular optical system is changed to X15 magnification. The object reflector has been inclined forward so as to deflect reflection downward. (See Fig 44.)
 - c. *Sight, Periscopic, AV, No. 37, Mk 4* – This sight is similar to the Mk 3 sight but the binocular optical system has been changed to X10 magnification.
 - d. *Sight, Periscopic, AV, No. 37, Mk 1* – This was the original sight used on Chieftain Mk 2. It differs from the sight, periscopic, AV, No. 37, Mk 2 in the following respects:- (See Fig 46.)
 - (1) The sight is two inches shorter.
 - (2) There is no magnification selector lever.
 - (3) The X1 unity window consists of two parts, a longitudinal window and a vertical one to its right which are permanently sighted and have a hand controlled blackout shutter.
 - (4) The graticule patterns in the X1 unity window and the X10 eyepiece are different to those used in the later marks, although some sights have been modified to include the new graticule patterns.

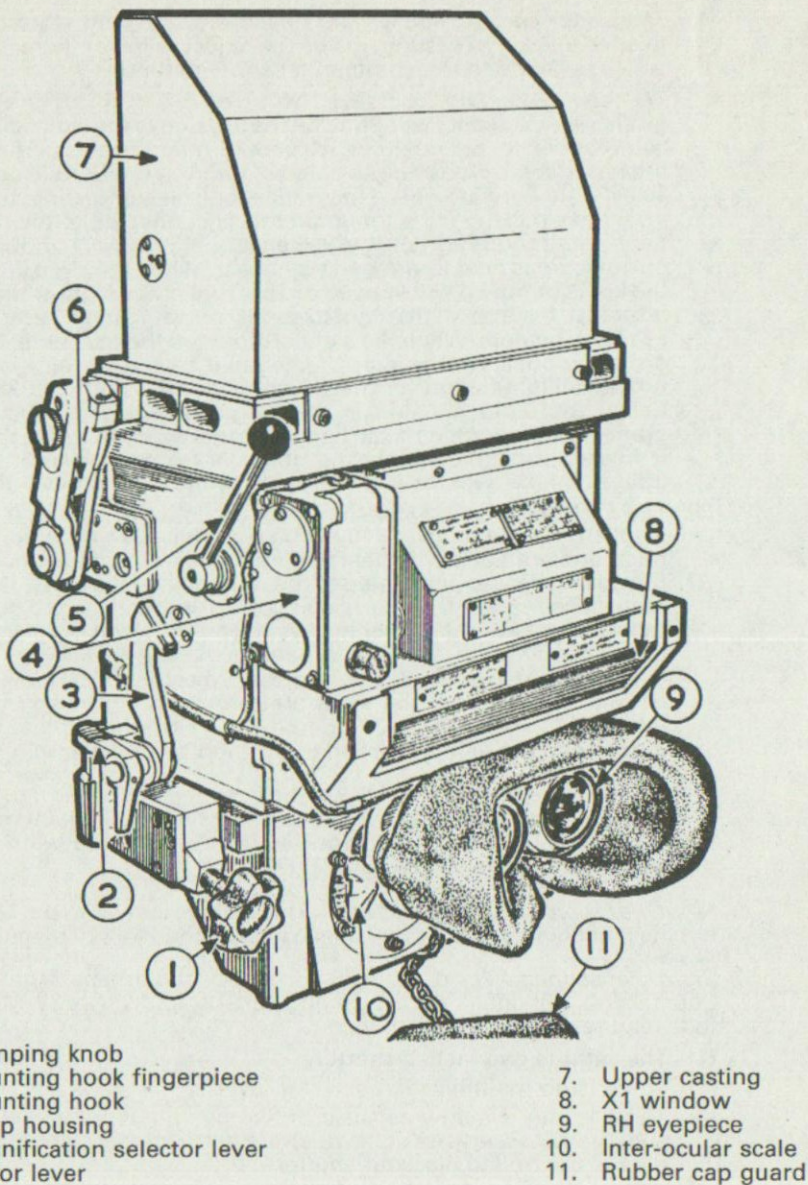
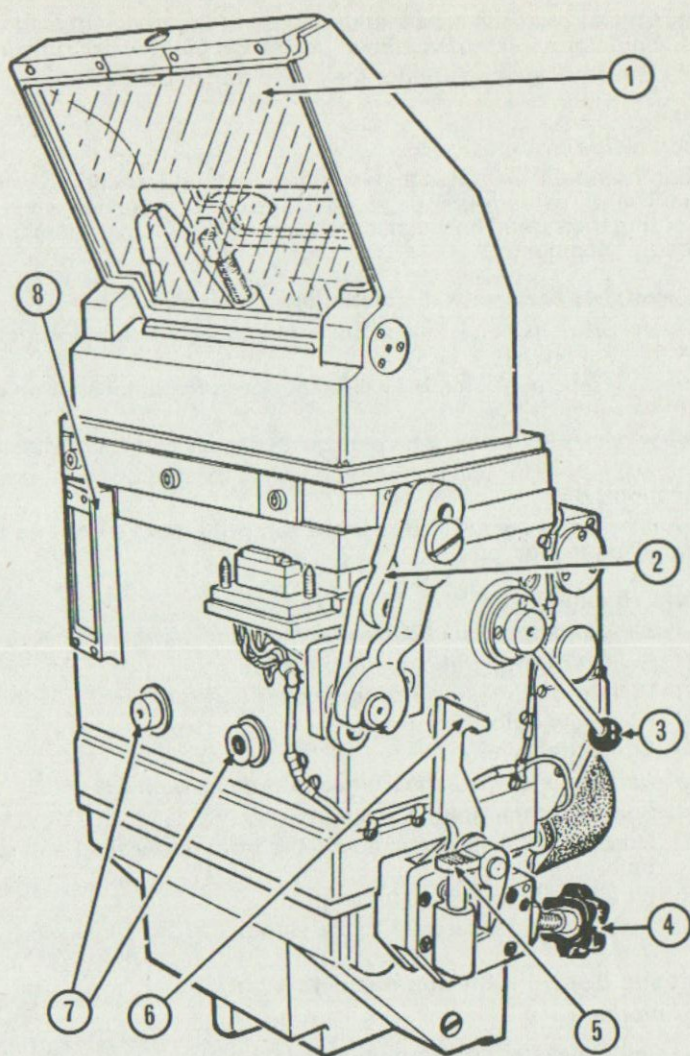


Fig 43 - Sight, periscope, AV, No. 37, Mk 2



- | | |
|---------------------------------|---------------------------------------|
| 1. Object reflector | 5. Mounting hook finger piece |
| 2. Mirror lever | 6. Mounting hook |
| 3. Magnification selector lever | 7. Keyed transit bar stowage position |
| 4. Clamping knob | 8. Semi reflector |

Fig 44 - Sight, periscopic, AV, No. 37, Mk 3 or 4

CHAPTER 7 – ELECTRICAL SUPPLY AND GUN CONTROL EQUIPMENT

SECTION 1 – ELECTRICAL SUPPLY

Description

General

1. The Chieftain is equipped with two sets of batteries, one in the hull and one in the turret. These work in conjunction with the generating units and provide the electrical power for the turret. A battle link switch and overriding master control switch (OMC) are included in the electrical circuit.

The generators

2. There are two generators fitted, one being driven by the main engine and the other by a generating unit. Charging of the batteries will only take place if ON LOAD is selected on either of the generators.

The batteries

3. There are two sets of batteries, one set in the driver's compartment consisting of four separate units, two on either side of the driver's position. Each unit being of 12 volts. The other set of batteries are located to the rear left of the turret and consist of two 12 volt units.

The battle link

4. The battle link has two positions, training and battle, it is located in the hull main junction box. It is normally locked, by a lead seal, in the training position. After completing a change to the battle position all normal electrical facilities are available.

5. The battle link is fitted to prevent the hull batteries being run down, when the vehicle is used in the training mode, with the main and generating unit generators out of use.

WARNING:- If full electrical facilities are used with the battle link in the 'battle' position and the main engine/generating unit not running ON LOAD, serious damage may be caused to the batteries. Failure of the light projector lamp to strike can be attributed to the low state of charge of the vehicle batteries.

The overriding master control switch (OMC)

6. The OMC is fitted to provide emergency electrical facilities. It is located on the turret distribution box and is normally locked, by a lead seal, in the OFF position. When the OMC switch is moved to the ON position the turret batteries are isolated from the hull batteries. All electrical facilities are available except for the striking of the light projector lamp. If heavy load equipment is used, ie, GCE, the turret batteries would very quickly become run down.

To start up the generating unit

7.
 - a. Ensure that the generator load switch is set to the OFF LOAD position.
 - b. Set the hull master switch to the ON position.
 - c. Check the following
 - (1) That the gun position indicator shows the position of the gun.
 - (2) That the red discharge light on the master switch box glows. If the light is out, press to TEST.

- (3) That the green charge light illuminates when pressed.
- (4) That the governor control lever is in the IDLE position.
- (5) That the fuel cut off lever is in the ON or RUN position.
- d. Set the TRIP/RESET switch on the generator panel to RESET
- e. Switch ON the generating engine switches, listen for the fuel pump to start and check the following:-
 - (1) That the generator and oil pressure warning lights illuminate.
 - (2) That the fuel and temperature gauges register.
 - (3) That the coolant warning light does not illuminate. Press to TEST.
- f. Press the generating unit engine starter button to start the engine.
- g. Check that the oil pressure warning light goes out. Allow the engine to run for one and a half minutes.
- h. Move the governor control lever SLOWLY to the ON LOAD or NORMAL SPEED charging position.
- j. Move the generator switch down from the OFF LOAD position and check the following:-
 - (1) That the generator warning light goes out.
 - (2) That the red discharge light goes out.
 - (3) That the green charge light illuminates.

To close down the generating unit

- 8. a. Move the generator switch to the OFF LOAD position.
- b. Move the governor control lever to the IDLE position.
- c. Move the fuel cut off lever to the OFF position and check that the oil pressure warning light glows.
- d. Set the generating engine switches to the OFF position.
- e. Set the hull master switch to the OFF position.

To use the battle link

- 9. a. *To select the battle position*
 - (1) Traverse the gun to the six o'clock position. Set the hull master switch to the OFF position.
 - (2) Remove the cover of the hull main junction box.
 - (3) Remove the extreme right hand top and bottom fuzes labelled FA and FC.
 - (4) Break the lead seal on the two plates and pivot these to the left. Two fuze recesses will now be seen.
 - (5) Insert fuzes FA and FC into these two exposed recesses.
 - (6) Refit the cover to the hull main junction box. Set the hull master switch to the ON position.
- b. *To select the training position*
 - (1) Traverse the gun to the six o'clock position, set the hull master switch to the OFF position, remove the cover on the hull main junction box.

- (2) Remove the two right hand fuzes.
- (3) Pivot the two cover plates to the right so that they are aligned vertically.
- (4) Fit the two fuzes into the recesses labelled FA and FC.
- (5) Refit the cover to the hull main junction box. Set the hull master switch to the ON position.

To use the overriding master control (OMC)

10. a. To engage the OMC

- (1) Break the wire seal holding the OMC in position on the turret distribution box.
- (2) Pivot the lever fully to the left.

b. To disengage the OMC

- (1) Pivot the lever fully to the right.

NOTE:- The overriding master control is provided for emergency use only and must not be operated unless directed by the commander. Its operating lever is mechanically linked to two of the relays, and when operated, isolates the turret batteries from the hull batteries and connects the turret services to the turret batteries.

SECTION 2 – GUN CONTROL EQUIPMENT

Introduction

1. The gunner is provided with the following equipment in order to lay the gun:-
 - a. Hand traverse and hand elevation.
 - b. Powered traverse and hand elevation.
 - c. Powered traverse and powered elevation which is stabilized for use on the move.
 - d. Powered traverse and travelling stabilizer.
2. The commander has similar facilities with the exception that he is unable to lay the turret/gun by hand. There also exists the facility for the commander to traverse his cupola independently of the turret and to re-align it by electrical means.
3. There is a separate emergency fixed rate traverse system which is powered directly from the batteries and can be used by either the gunner or the commander.

SECTION 3 – HAND LAYING EQUIPMENT

The hand traverse gear

1. Hand traverse is normally used for fine laying in stationary shooting or in an emergency, should power fail. The hand traverse gear consists essentially of the traverse handle and gearbox.
2. a. *The hand traverse handle* is conveniently situated to the right of the gunner's position and is connected to the driving shaft incorporated in the traverse gearbox. The hand traverse gear incorporates a two speed mechanism, giving a slow (fine) and fast (coarse) rate of traverse. The

speed of hand traverse can be selected by pulling down on the traversing handle for fast traverse and pushing up for slow traverse. The turret is moved to the right by hand by rotating the traverse handle clockwise and to the left, anti-clockwise.

- b. *The traverse gearbox* is bolted to the turret wall to the right front of the gunner's position. It conveys the drive from the hand traverse handle through a system of gearing to a pinion engaged with the turret rack. A dog clutch is incorporated between the traverse handle shaft and the gear train. This clutch is electrically operated and automatically disengages the drive from the hand traverse handle when powered traverse is employed, thus preventing the handle from being rotated by the traverse motor. The gearbox is protected from possible damage due to the gun striking some solid obstruction, while the vehicle is on the move, by a heavily spring loaded slipping clutch built into the gearbox. A combined oil filler and level plug is provided on the gearbox.

The hand elevation gear

3. Hand elevation is used when firing from a stationary position. The hand elevation gear consists essentially of the elevation handwheel and gearbox.
4.
 - a. *The elevating handwheel* is mounted to the left of the gunner's position convenient to his left hand. The drive from the handwheel is conveyed, via a shaft and gearing, to the elevating gearbox. The handwheel is fitted with a firing switch on the handle.
 - b. *The elevation gearbox* is mounted on a gimbal frame. Drive from the handwheel is transmitted through the gearbox to a toothed shaft which is connected to the right side of the gun cradle. Incorporated within the gearbox is an electrically operated clutch. When powered elevation, stabilizer or travelling stabilizer is brought into operation, the clutch is automatically disengaged and the handwheel will not rotate when the gun is elevated or depressed. A combined oil filler and level plug is provided on the gearbox.

To lay the gun by hand

5.
 - a. Ensure that the gun crutch is disengaged and that the turret is free from obstruction inside and out.
 - b. Traverse by rotating the traverse handle smoothly in the required direction, using whichever rate of traverse is preferred.
 - c. Elevate or depress by rotating the elevating handwheel.
 - d. Due to the gun being muzzle-heavy the final lay will always be one of elevation.

SECTION 4 – THE POWERED LAYING EQUIPMENT

WARNING:- The powered laying equipment requires a large supply of current and should therefore only be used when the generating unit is ON LOAD.

Main components

The power supply unit (PSU) and control cubicle

1. These are situated adjacent to each other behind the commander's position.

On the front of the PSU there is a small red light which will extinguish when the alternator has warmed up. On the front of the PSU there are a large number of fuzes and circuit breakers.

The metadyne units

2. Both units are mounted in the right rear of the turret behind the control cubicle. Each unit contains a metadyne generator which receives current from the tank batteries. One generator supplies power to the turret traverse motor, while the other supplies the elevation motor.

The traverse motor

3. This is bolted on to the left underside of the traverse gearbox. It is driven by current from the traverse metadyne and its speed and direction of rotation are controlled by the output of the metadyne generator. The drive from the motor is conveyed through the gearbox to the turret ring.

The elevation motor

4. This is mounted on top of the elevation gearbox. It is driven by current from the elevation metadyne, and its speed and direction of movement are controlled by the output of the metadyne generator. The drive from the motor is conveyed through the gearbox to the pinion engaged in the elevation shaft.

The traverse limit switch

5. This consists of a cam operated switch incorporated in the rotary base junction. The function of this switch is to prevent the gun striking the rear of the hull when traversing, using powered traverse, through the arc between approximately 5 and 7 o'clock. If the gun is at or below zero degrees elevation in this arc, the switch is operated thus stopping traverse and preventing the gun from striking any part of the hull. The gun must be elevated above zero degrees by hand before powered traverse can operate. When powered elevation is in operation the gun is automatically elevated until it is above zero degrees elevation when traverse re-commences.

The elevation limit switch

6. This switch is designed to prevent damage to the equipment when the gun is approaching maximum elevation or depression and the powered elevation is in operation. The switch is fitted to the elevation gearbox and operates when the gun is elevated to plus 320 mils or depressed to minus 142 mils. In addition there is a limit switch which operates when travelling stabilizer is in use. This maintains the gun between the arc of zero to plus 200 mils.

The tachometer generator

7. This is mounted on the turret ring, convenient to the loader's position. The function of the tachometer generator is to assist in eliminating, by electrical means, backlash in the traverse gear.

The gyroscope unit

8. This is mounted underneath the gun, it contains a twin axis gyroscope system. The gyroscopes begin to rotate when the selector switch is moved from the OFF position. When stabilizer or travelling stabilizer is used, the gyroscopes come into operation. If, due to movement of the hull the position of the gun is altered, the gyroscopes measure this movement and send signals through to the

control cubicle. This in turn causes the output of the metadyne generators to be altered to counteract the movement of the gun.

The controls

The powered laying control panel

9. The control panel is situated on the turret wall to the right and above the gunner's position. The switches on the control panel are as follows:-

- a. *Muffs ON/OFF* – This has now been disconnected.
- b. *Selector switch* – This has four positions OFF/NON STAB/STAB/TRAV.
- c. *Metadyne start switch* – This is a spring loaded toggle switch which when pressed upwards and held, starts the elevation metadyne. When pressed downwards and held, starts the traverse metadyne.
- d. *Metadyne stop switch* – This is a spring loaded toggle switch which when pressed upwards, stops both metadynes.

The commander's duplex controller

10. This control enables the commander to elevate and traverse the gun. It overrides the gunner's controller and is mounted to the right and forward of the commander's position. When the grip switch of the controller is pressed it automatically disengages the clutch in the traverse and elevation gearboxes. The direction and speed of elevation or traverse are controlled by the amount by which the controller is moved. The controller can also be used for emergency traverse, but in this case it does not override the gunner's controller.

The gunner's duplex controller

11. This control enables the gunner to elevate and traverse the gun. It is situated to the right of the gunner's position. When the selector switch is set to the NON STAB position, only powered traverse is available. When the selector switch is set to STAB or TRAV, both powered traverse and elevation are available. The direction and speed of elevation or traverse are controlled by the amount by which the controller is moved. When the grip switch of the controller is pressed, it automatically disengages the clutch in the traverse and elevation gearboxes. The controller can also be used for emergency traverse.

The emergency control switch

12. This is mounted on the control cubicle and has two positions, BATTERY and METADYNE. To obtain normal powered traverse and elevation, the switch should be set to METADYNE. To obtain emergency traverse, it should be set to BATTERY.

The gunner's traverse and elevation trimmers

13. These trimmers are mounted on a panel in front of the gunner's position. Each is in the form of a plastic knob and is used to eliminate any creep which may develop in traverse or elevation. There are four trimmers, the lower two for non-stabilized elevation and traverse and the upper two for stabilized elevation and traverse.

The safety switches

The driver's safety switch

14. This is mounted in the driver's compartment immediately to the front of the driver's position. It has two positions, SAFE and LIVE. At SAFE, it enables the driver to stop all movement of the turret except by hand traverse. It also prevents powered elevation.

The turret safety switch

15. This is mounted on the turret roof above the loader's position. It has two positions, SAFE and LIVE. At SAFE it enables the loader to stop all movement of the turret except by hand traverse and prevents the main armament, ranging gun and co-axial machine gun from being fired electrically. It also prevents powered elevation.

The commander's safety switch

16. The switch is mounted on the left end of the commander's firing control box or, on earlier marks of vehicles, on the turret roof forward of the commander's position. It is a three position switch, two positions are marked OFF, the other position marked ON. When OFF is selected all the powered laying equipment is automatically switched off. When the switch is reset to the ON position, only the PSU will restart. The gunner must restart the metadynes before the powered laying equipment can be used again.

Use

To start the powered laying equipment

17. a. Remove the gun from the gun crutch.
- b. Ensure that the turret is free from obstruction both internally and externally.
- c. Ensure that the following switches are set correctly:-
 - (1) Driver's and turret safety switch – LIVE.
 - (2) Commander's safety switch – ON.
 - (3) Emergency control switch – METADYNE
 - (4) Powered laying selector switch – OFF.
- d. Ensure that the cupola is NOT set for contra rotation.
- e. Start the generating unit engine.
- f. Check that no one is within the area swept by the gun in elevation and traverse, both inside and outside the vehicle.

WARNING:- TO CARRY OUT THE FOLLOWING DRILLS THE GUNNER MUST BE SEATED CORRECTLY IN THE GUNNER'S SEAT AND ENSURE THAT NO PART OF HIS BODY IS WITHIN THE SWEEPED AREA OF THE GUN.

- g. Set the powered laying selector switch to NON STAB, the PSU warning light will illuminate. Do not start the metadynes until the light has gone out.
- h. Press the metadyne switch to ELEVATION and hold it in position until the metadyne runs correctly.

- j. Start the traverse metadyne by the same process.
- k. If the PSU fails to run, the warning light does not illuminate or the metadynes fail to start, refer to the Fault Finding Table, Section 6 below.

18. Having started the powered laying equipment for the NON STAB condition, the equipment can be brought to the STAB or TRAV condition by moving the powered laying selector switch to the appropriate position. When TRAV condition is selected, the gun will position itself between zero and plus 200 mils irrespective of the previous position of the gun.

To close down the powered laying equipment

- 19. a. Press the metadyne stop switch upwards and hold it until both metadyne motors slow down and stop.
- b. Set the powered laying selector switch to the OFF position.
- c. Switch off the generating unit engine.

To start the emergency powered traverse

- 20. a. Start the generating unit engine.
- b. Set the emergency control switch to BATTERY.
- c. Set the commander's, driver's and turret safety switch to the ON/LIVE position.
- d. Traverse the turret using either the gunner's or commander's controller.

To close down the emergency powered traverse

- 21. a. Set the emergency control switch to METADYNE.
- b. Switch off the generating unit engine.

Servicing

22. The servicing of the powered laying equipment must be carried out in accordance with the Cheiftain Servicing Schedule.

Elevation gear

- 23. a. Top up the gearbox with the lubricant as stated in the schedule. The filler and level plug is reached from the driver's compartment.
- b. Lubricate with grease the two gimbal bearings one on either side of the gearbox.
- c. Lubricate the elevation rack and ball joint.
- d. Lubricate the elevation handwheel spindle.

Traverse gear

- 24. a. Top up the gearbox with the lubricant as stated in the schedule.
- b. Lubricate with grease the three turret ring rollers.
- c. Lubricate with grease the turret race, traverse while lubricating.
- d. Lubricate the traverse handwheel spindle.

Tachometer generator

25. Once every 12 months, lubricate each of the three lubricating nipples with not more than TWO PUMPS of the grease gun.

WARNINGS:-

1. **METADYNE OVERHEATING.** One of the contributory causes of metadyne overheating is incorrect stowage. Items of kit belonging to the crew should not be placed in the central ammunition racks as this prevents ventilation and cooling of the metadynes.
2. **SUDDEN UNCONTROLLABLE MOVEMENT OF TURRET OR GUN**
 - a. Where possible the design of the gun control equipment (GCE) is such that faults do not result in sudden uncontrollable movement of the gun/turret, but there are still a significant number of fault conditions that can result in full drive being applied in one direction with no control.
 - b. The driver's and turret safety switches will stop any gun/turret movement very rapidly in a fault free system. If a fault does exist these safety switches may not have any effect after movement has commenced.
 - c. The commander's safety switch (GCE master switch) will when set to the OFF position switch the GCE off in a controlled manner. This switch should always be used in the event of uncontrolled or violent gun/turret movement occurring. It will not stop the gun/turret abruptly, ie, considerable movement may occur before the system comes to rest.
 - d. The safety drills detailed below should be employed whenever the GCE is in operation.

Safety drills

26. a. If a crewman is in the turret the elevation and traverse metadynes may be left running as necessary. If the gun/turret move without a demand from the controllers the COMMANDER'S SAFETY SWITCH should be set to the OFF position and/or the metadyne stop switch pressed and held until both metadynes stop running. The fault is then to be reported to REME.
- b. If a turret is UNMANNED the elevation and traverse metadynes will be switched OFF.
- c. If a driver is entering or leaving the driver's compartment the elevation and traverse metadynes will be switched OFF.
- d. Additional safety drills to cover a fault condition on either the traverse or elevation servo output amplifier will be found in Section 5, para 15.

SECTION 5 - TESTING THE POWERED LAYING EQUIPMENT**Introduction**

1. These tests must be carried out to ensure that the powered laying equipment responds accurately and quickly when it is brought into use. During these tests crews must ensure that they are positioned correctly in their stations and that no part of their body is within the swept area of the gun.

TESTS - NON STAB AND EMERGENCY**General**

2. The starting up drill as detailed in Section 4, paras 17 and 20, must be completed prior to carrying out these tests.

To test the operation of the dog clutch

3.
 - a. Using the commander's controller, traverse left or right.
 - b. Check that the gunner's hand traverse handle does NOT rotate.
 - c. Repeat this test using the gunner's controller.
 - d. If there is any fault, refer to the Fault Finding Table, Section 6 below.

To test for creep - NON STAB powered traverse

4.
 - a. Lay the MBS 120-mm mark on to an aiming mark at not less than 1100 metres.
 - b. Squeeze the grip switch on the gunner's controller, maintain the controller in a central position. Note whether the sight moves off the aiming mark.
 - c. If the MBS 120-mm mark moves off the aiming mark, trim out creep by adjusting the NON STAB traverse trimmer on the gunner's trimmer panel. If creep cannot be eliminated, report to REME.
 - d. If it is not possible to use the sight for this test, the traverse indicator should be used instead.
 - e. Using the commander's controller, test for creep in elevation. Eliminate any creep by adjusting the NON STAB elevation trimmer.

To test the system for response

5.
 - a. Using the gunner's controller, ensure that the turret increases in speed of rotation as the controller is inclined to right or left.
 - b. Ensure that the turret ceases to rotate as soon as the controller is returned to the central position. A positive braking action should be felt.
 - c. Using the commander's controller, test both traverse and elevation for response.
 - d. If there are any faults, refer to the Fault Finding Table, Section 6 below.

To test the override of the commander's controller

6.
 - a. Using the gunner's controller, traverse the turret right or left.
 - b. Using the commander's controller, press the grip switch, the turret should stop traversing. Incline the commander's controller in the opposite direction to the gunner's controller and check that the turret traverses in the new direction.
 - c. Release the commander's controller and ensure that the turret can again be traversed using the gunner's controller.
 - d. If there are any faults report to REME.

test the safety switches**a. The driver's safety switch test**

- (1) Using the gunner's controller traverse the turret, confirm that the turret stops traversing when the driver's safety switch is set to SAFE.
- (2) Repeat the test using the commander's controller, in addition, confirm that the gun cannot be elevated by power.

b. The turret safety switch test

- (1) Repeat the driver's safety switch test using the turret safety switch.

c. The commander's safety switch test

- (1) Using the gunner's controller traverse the turret, confirm that the turret stops traversing when the commander's safety switch is set to OFF. Both the PSU and the metadynes will stop running when the switch is set to OFF.
- (2) Set the commander's safety switch to ON. Restart the metadynes.
- (3) Repeat the test using the commander's controller, in addition, confirm that the gun cannot be elevated by power.
- (4) Set the commander's safety switch to ON. Restart the metadynes.

d. If there are any faults during the safety switch tests, report to REME.**To test the limit switches****3. a. The traverse limit switch** - A member of the crew should be positioned outside the vehicle to warn the gunner to stop traversing should the gun be about to contact the resilient rail on the rear of the vehicle. The test is completed as follows:-

- (1) Fully depress the gun at the 3 or 9 o'clock position.
- (2) Using the gunner's controller, traverse slowly towards the 6 o'clock position.
- (3) Traverse should stop before the barrel contacts the resilient rail, at the same time the gun should automatically elevate clear of the resilient rail and traverse should commence.
- (4) Repeat the test in the opposite direction.
- (5) Using the commander's controller, fully depress the gun at the 3 or 9 o'clock position, traverse slowly towards the 6 o'clock position.
- (6) Traverse should stop before the barrel contacts the resilient rail, at the same time the gun should automatically elevate clear of the resilient rail and traverse should commence.
- (7) Repeat the test in the opposite direction.

b. To test the elevation limit switch

- (1) Using the commander's controller, fully depress the gun and check that the movement of the gun is cushioned prior to the breech ring contacting the depression stop pad.
- (2) Fully elevate the gun and check that the movement of the gun is cushioned prior to full elevation being obtained.

To test the speed of powered traverse

9. a. Place a chalk mark on the turret and hull.
- b. Traverse off to the left.
- c. Traverse to the right, timing the system when the chalk marks coincide, until they coincide again having traversed through 6400 mils.
- d. Repeat the test in the opposite direction.
- e. The timing for one rotation should be approximately 18 seconds. If there is any large discrepancy, report to REME.

To test the speed of emergency traverse

10. a. Prepare to traverse by emergency powered traverse.
- b. Using the same chalk marks as in para 9 above, traverse off to the left.
- c. Traverse to the right, timing the system when the chalk marks coincide, until they coincide again having traversed through 6400 mils.
- d. Repeat the test in the opposite direction.
- e. The timing for one rotation should be 68 seconds. If there is any large discrepancy, report to REME.

TESTS - STABILIZED AND TRAVELLING STABILIZER**General**

11. The starting up drill as detailed in Section 4, paras 17 and 18, and the tests for NON STAB must have been completed prior to carrying out these tests.

To test for creep in stabilized traverse and elevation

12. a. Lay the MBS 120-mm mark on to an aiming mark at not less than 1100 metres.
- b. Squeeze the grip switch on the gunner's controller, maintain the controller in a central position. Note whether the sight moves off the aiming mark in traverse or in elevation.
- c. If the MBS 120-mm mark moves off the aiming mark, trim out creep by adjusting the STAB trimmers on the gunner's trimmer panel. If creep cannot be eliminated, report to REME.

To test the operation of the stabilizer

13. a. *To test if the vehicle can be moved*
 - (1) Lay the MBS 120-mm mark on to an aiming mark.
 - (2) Squeeze the grip switch on the gunner's controller, maintain the controller in a central position.
 - (3) Order the driver to make a neutral turn of approximately 1600 mils to the right or left. Then turn back to the original position.
 - (4) The aiming mark should be seen within the field of view of the X10 eyepiece.

- (5) Using the gunner's controller, elevate and depress the gun and ensure that the movement is smooth and that the gun can be held steady at any angle of elevation.
- b. *To test if the vehicle cannot be moved*
 - (1) Switch on the traverse indicator.
 - (2) Adjust the stabilized traverse trimmer so that minimum creep is introduced into the system.
 - (3) If creep can be obtained at a rate as small as or less than 100 mils in 55 seconds, stabilization in traverse is satisfactory.
 - (4) Using the gunner's controller, elevate and depress the gun and ensure that the movement is smooth and that the gun can be held steady at any angle of elevation.
- c. Report any faults found during the test to REME.

To test the travelling stabilizer

14. a. The vehicle will be stationary during the test.
- b. Using the gunner's controller, fully elevate the gun. Release the controller.
- c. Set the powered laying selector switch to TRAV. The gun should move to between zero and 200 mils elevation.
- d. Set the powered laying selector switch to STAB, fully depress the gun, release the controller.
- e. Set the powered laying selector switch to TRAV. The gun should move to between zero and 200 mils elevation.
- f. Report any fault found during the test to REME.

Safety Drills

15. a. *Safety Switches.* When a driver's or turret safety switch is set to SAFE a wait period of 2 seconds must be observed before carrying out any further action.
 - (1) If movement of turret/gun has not occurred during this period the system is safe.
 - (2) If movement of turret/gun takes place during this period, set the commander's safety switch (GCE master switch) to OFF and report to REME.
- b. *Controller Grip Switch.* If movement of turret/gun takes place after the grip switch has been released, set the commander's safety switch (GCE master switch) to OFF and report to REME.

SECTION 6 – FUZES, CIRCUIT BREAKERS AND FAULT FINDING

Fuzes and circuit breakers

Turret distribution box

1. The following fuze and circuit breaker are positioned on this box:-
 - a. Fuze link (500 amp) – protects the gun control equipment.
 - b. CB-1 – protects the gun control equipment.

Control cubicle

2. The following fuzes and circuit breaker are positioned on the cubicle:-
 - a. No. 1 fuze (1 amp) – protects the master control circuit.
 - b. No. 2 fuze (1 amp) – protects the 28 v feed monitor.
 - c. No. 3 fuze (10 amp) – protects the elevation clutch.
 - d. No. 4 fuze (10 amp) – protects the traverse clutch.
 - e. No. 5 fuze (10 amp) – spare.
 - f. No. 6 fuze (1 amp) – protects the control relays of both controllers.
 - g. No. 7 fuze (3 amp) – protects the power/metadyne relays.
 - h. No. 8 fuze (1 amp) – protects the battery control circuit for the metadynes.
 - j. Circuit breaker (20 amp) – protects the emergency traverse.

Power supply unit (PSU)

3. The following fuze and circuit breaker are positioned on the PSU:-
 - a. Fuze No. 4 (1 amp) – protects the PSU supply.
 - b. Circuit breaker (20 amp) – protects the PSU supply.

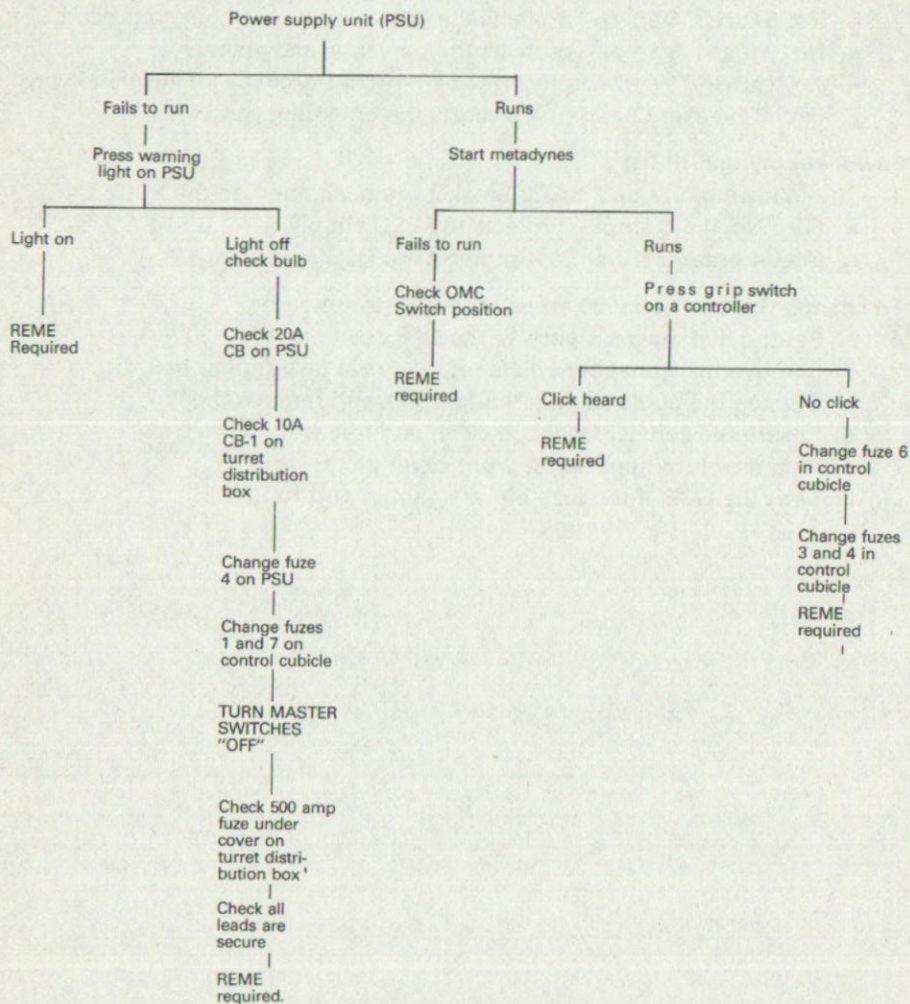
To change the fuze link (500 amps) in the distribution box

4.
 - a. Set the hull master switch to the OFF position.
 - b. Remove the front cover plate on the turret distribution box.
 - c. Slacken the nuts securing the fuze link and remove the link.
 - d. Ensure the contact faces are clean and free from burrs.
 - e. Fit a new fuze, replace the front cover plate.
 - f. Start the GCE. If the fuze blows again, report to REME.

Fault finding

Fault finding table

5. During the starting up or the testing of the powered laying equipment, the drills given in the following fault finding table, should be completed before requesting REME assistance if the equipment fails to operate.



SECTION 7 - CUPOLA TRAVERSE UNIT

Introduction

1. A hand traverse gear in the unit enables the commander to rotate the movable part of the cupola independent of the turret. When contra-rotation is used, the gear automatically traverses the turret but at the same time retains the movable part of the cupola in a stationary position. Contra-rotation is used by the commander to align the gun and the gunner's sight on to the same target as viewed through his own sight.

The cupola traverse unit

2. a. *The cupola traverse handle* is mounted on the gearbox which is situated to the right and forward of the commanders position. A lever on the handle, when pressed, brings the handle into engagement. On earlier marks of vehicles, the handle must be pulled down before it becomes engaged.
- b. *The gearbox* transmits the drive to the movable part of the cupola. A drive shaft extends from the bottom of the gearbox to a pinion engaged with the turret rack. On top of the gearbox is a spring loaded selector lever which when set, gives the following conditions:-
 - (1) *Contra-rotation* - The lever must be set to the forward position and allows contra-rotation to take place.
 - (2) *Neutral* - The lever must be set to the centre position. This position allows the commander to traverse the cupola by hand.
 - (3) *Locked* - The lever must be set to the rearward position, where it is held by a spring loaded plunger. The movable part of the cupola is now locked and cannot move independent of the turret.

The traverse cut-off switches

3. These are mounted above the gearbox. The switches cut off the electrical supply to the traverse motor just before the line-up position is reached. Line-up cannot be effected if the gun is already within the arc of 142 mils left or right of the line-up position.

The contra-rotation master switch

4. This is mounted in the top left of the gearbox and is operated when the selector lever is placed in the contra-rotation position.

The cam and release mechanism

5. This is attached to the top of the gearbox. The mechanism returns the selector lever to the neutral position when line-up has taken place. The line-up striker arm, a 'T' shaped bar secured to the rotating ring, fits into a locking plate when the cupola is in the line-up position.

The direction sensing switch

6. This is fitted to the fixed base ring of the cupola to the right rear of the commander's position. In conjunction with its operating cam, the switch selects the direction of rotation of the turret for the smallest amount of traverse which will align the gun with the commander's periscopic sight.

Use**To traverse by hand**

7. a. Put the selector lever in the neutral/central position.
- b. Pull down on the hand traverse handle or squeeze the lever and traverse as required.

To use contra-rotation

8. a. Set the selector lever to the central position and traverse the cupola until the X1 graticule is positioned on to a target.
- b. Set the selector lever to the contra-rotation position, squeeze the grip switch on the commander's controller until line-up is effected.

WARNING:- Whenever contra-rotation has been used and before the powered laying equipment is switched off and the crew stood down, ensure that the cupola and turret are lined up with the selector lever in the neutral or cupola locked position. If this is not done, then line-up will take place when the powered laying equipment is switched on and the commander's grip switch pressed, resulting in unexpected movement of the turret and possible accident.

To test the contra-rotation of the cupola.

9. a. Set the selector lever to the central position and traverse the cupola until the X1 graticule is positioned on to a target.
- b. Set the selector lever to the contra-rotation position, squeeze the grip switch on the commander's controller until line-up is effected.
- c. Once line-up has taken place, check the following:-
 - (1) That the gunner's sight is lined up on the target.
 - (2) That the selector lever automatically moved to the neutral position.

Servicing

10. The servicing of the cupola traverse gear will be carried out in accordance with the Chieftain Servicing Schedule.
11. Clean, inspect and lubricate the following:-
 - a. The drive shaft.
 - b. The selector lever.
 - c. The cam and release mechanism.
 - d. The rubber gaiters.

CHAPTER 8 – THE NBC PACK AND VENTILATION SYSTEM

SECTION 1 – INTRODUCTION

1. The NBC/ventilation filtration system fitted to current marks of vehicles is the pack No. 6, Mk 1 or 2. On earlier mark vehicles a slightly different system was installed using the Pack No. 2

SECTION 2 – THE NBC PACK NO. 6, MKs 1 AND 2

General

1. The NBC/ventilation filtration system fitted to current marks of vehicles is used either to ventilate the interior of the vehicle under normal conditions or to protect the crew from nuclear fall out, bacteriological or chemical attacks.
2. The NBC/ventilation pack (See Fig 59) is mounted on the inside of the hinged door of an armoured box attached to the rear of the turret.

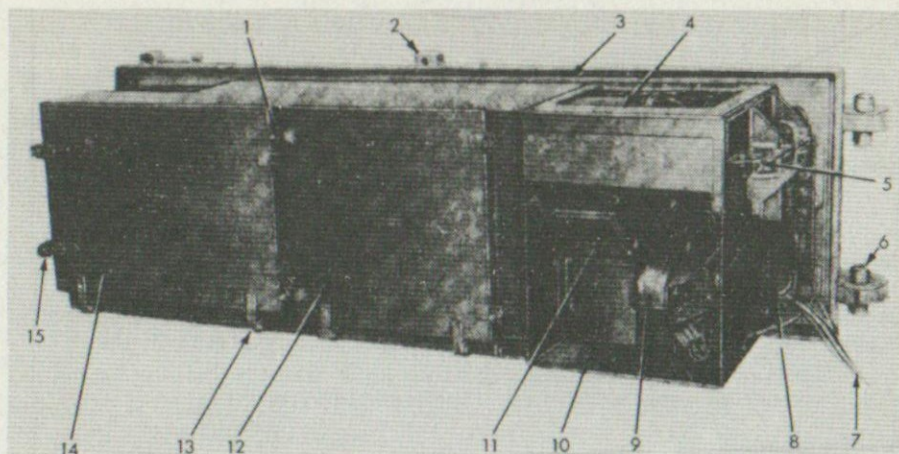
Main engine air cleaner

3. The air cleaner is positioned on the right side of the engine (see Fig 60). It is a two stage type cleaner. The first stage is a battery of cyclone tube elements and the second stage is a synthetic fibre panel element.
4. Air is drawn into the cleaner, via a two way flap valve mounted in the engine oil tank casing, by a scavenge blower. The alternative air inlets to the cleaner are through the right air inlet louvre or through an aperture in the fighting compartment right rear wall.
5. During normal running conditions the flap valve must be set for air to be drawn from the fighting compartment to deliver the cleanest air possible. Air should only be drawn through the engine air inlet louvres when the vehicle is operating fully closed down.
6. The main engine air cleaner two way change over valve (see Fig 61) is mounted on the projectile rack to the left of the driver's seat; earlier vehicles (Mk 3 (G) and 3/2) have the lever mounted on the right track sill in the fighting compartment. The lever operates the control cable of the flap valve situated in the airway tunnel through the engine oil tank.

Generating unit air duct valve

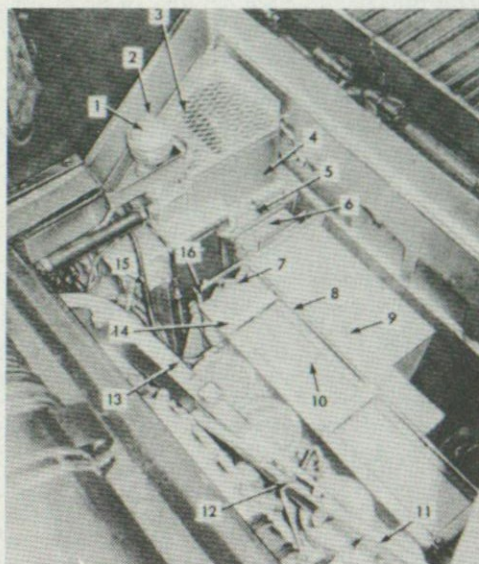
7. This valve is situated forward on the bulkhead, in front of the generating unit engine, it will normally provide relatively clean air from the fighting compartment. With the air duct valve closed, air is drawn by the fans through the engine louvres and circulated through the generators. The disadvantage of this arrangement is that dust laden air passes through the generators, but this has to be accepted at times when the vehicle must be pressurized, ie, for NBC conditions. Running with the air duct valve set for engine louvre breathing must be restricted to a minimum.

8. Current vehicles are fitted with a modified generator cooling air duct valve which is operated by a lever (see Fig 61) mounted on the projectile rack to the left of the driver. The modified valve will be retrospectively fitted to the earlier vehicles in due course. On unmodified vehicles, the change over valve lever is fitted centrally on the bulkhead inside the fighting compartment.



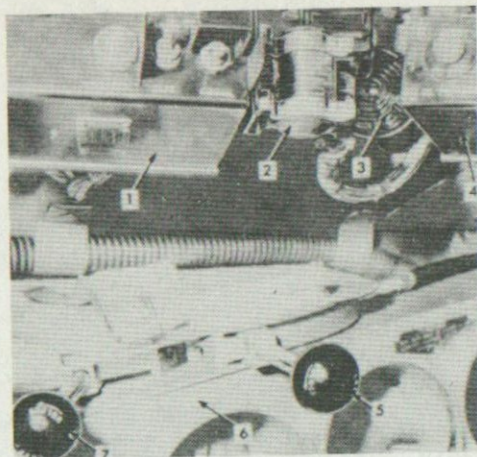
- | | | |
|------------------------------------|--------------------------------|--|
| 1. AV filter compartment clamp nut | 7. Pressure tapping tubes | 13. Door hinges |
| 2. Door securing bolt lug | 8. Electrical connector | 14. Pre-filter and UHE filter compartment door |
| 3. Door seal | 9. NBC/Vent flap solenoid | 15. Pre-filter and UHE filter compartment door clamp nut |
| 4. NBC fan | 10. NBC/Vent flap | |
| 5. Resilient mount | 11. NBC fan outlet | |
| 6. Door hinge pin | 12. AV filter compartment door | |

Fig 59 - NBC/Ventilation pack



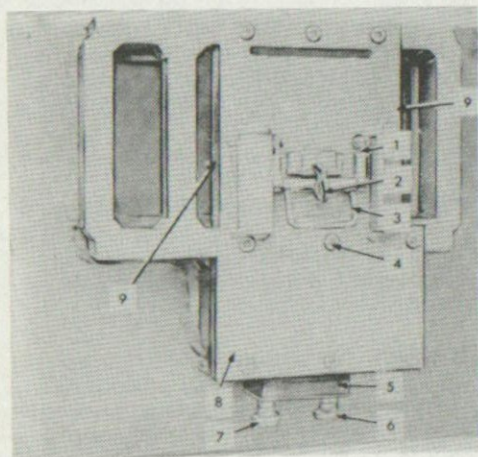
1. Filler/breather
2. Dipstick
3. Air inlet grille (from louvres)
4. Oil tank
5. Bellows connector clamp
6. Bellows connector
7. Element clamping screws
8. Second stage cover hinge bar
9. First stage compartment
10. Second stage cover
11. Radiator stay
12. Radiator stay lock bolt
13. Radiator support arm
14. Eyebolt clamps
15. Air restriction indication connecting pipe
16. Air cleaner lifting handle

Fig 60 - Engine compartment right (Mk 3/3 vehicle)



- | | |
|--|--|
| 1. Lights switchboard | 5. Main engine air cleaner valve lever |
| 2. Main engine air cleaner restriction indicator | 6. Projectile rack |
| 3. Fire alarm warning light | 7. Generator cooling duct valve lever |
| 4. Generating unit engine switchboard | |

Fig 61 – Main engine air cleaner and generator cooling duct valve levers



- | |
|-----------------------------------|
| 1. Knuckled rods |
| 2. Handle locking catch |
| 3. Blanking plate handle |
| 4. Socket head screws |
| 5. Scavenge outlet blanking plate |
| 6. Pivot/locking screw |
| 7. Locking screw |
| 8. Air inlet cover plate |
| 9. Air inlets |

Fig 62 – Armoured ballistic air inlet

The NBC/ventilation pack

9. The pack has four filtration stages, a cyclone separator (scavenge), a two layer synthetic fibre pre filter, an ultra high efficiency (UHE) glass fibre paper particulate filter and a battery of four cylindrical anti-vapour filters containing chemically activated charcoal and resin impregnated wool.

10. Two separate fans are provided to circulate the air, one for ventilation and one for NBC conditions, they are controlled by the same switch. Air is drawn through all four stages of filtration when operating under NBC conditions, but through the first two stages only for ventilation operation. A third fan, which scavenges the first stage compartment, is automatically switched on when using either the ventilation or the NBC fans.

11. Air is drawn into the first stage of the pack through slots in an armoured ballistic air inlet (see Fig 62) on the right side of the door.

12. Two blanking plates are fitted to the air inlet. One on the inner side of the cover plate opens or closes the inlet to the first stage compartment and is operated by a handle attached to two knuckled rods. The second plate is located on the bottom face of the armoured ballistic air inlet and when closed it covers the cyclone separator outlet, it is secured in either the open or closed position, by two thumbscrews, both blanking plates must be in the closed position before washing down the vehicle.

13. Filtered air leaves the box through an aperture in the left side of the turret rear and is then ducted to diffusers adjacent to each of the crew positions. Each diffuser has a respirator adaptor and blanking cover. The blanking covers are retained in position by spring loaded balls in detent grooves. The ducting branches rearwards from the rotary base junction and blows air on to the main engine and generating unit engine generator panels on the fighting compartment bulkhead.

Control box No. 6

14. The control box (see Fig 63) is mounted on the left wall of the turret, it is connected to the turret distribution box.

15. Mounted on the face of the box are the fan selector switch, differential pressure gauge switch, pre-filter by-pass valve switch and the differential pressure gauge. The differential pressure gauge switch couples the colour coded air pressure tubes from the filter compartments to the differential pressure gauge for checking purposes.

16. The differential pressure gauge registers the pressure drop over the second and third stage filters, it also registers the scavenge depression at the scavenge fan air inlet and the vehicle internal pressure, depending on the differential pressure gauge switch setting.

17. An atmospheric pressure tapping is located on the left side of the NBC/ventilation pack box. This allows the monitoring of ambient pressure conditions.

Pressure relief valve

18. The pressure relief valve (see Fig 64) is fitted to the underside of the turret roof, directly above the GCE control cubicle. It is protected by an armoured shield welded on the outside of the turret, to the rear of the commander's cupola. The valve ensures an adequate air flow by allowing excess air to escape to atmosphere.

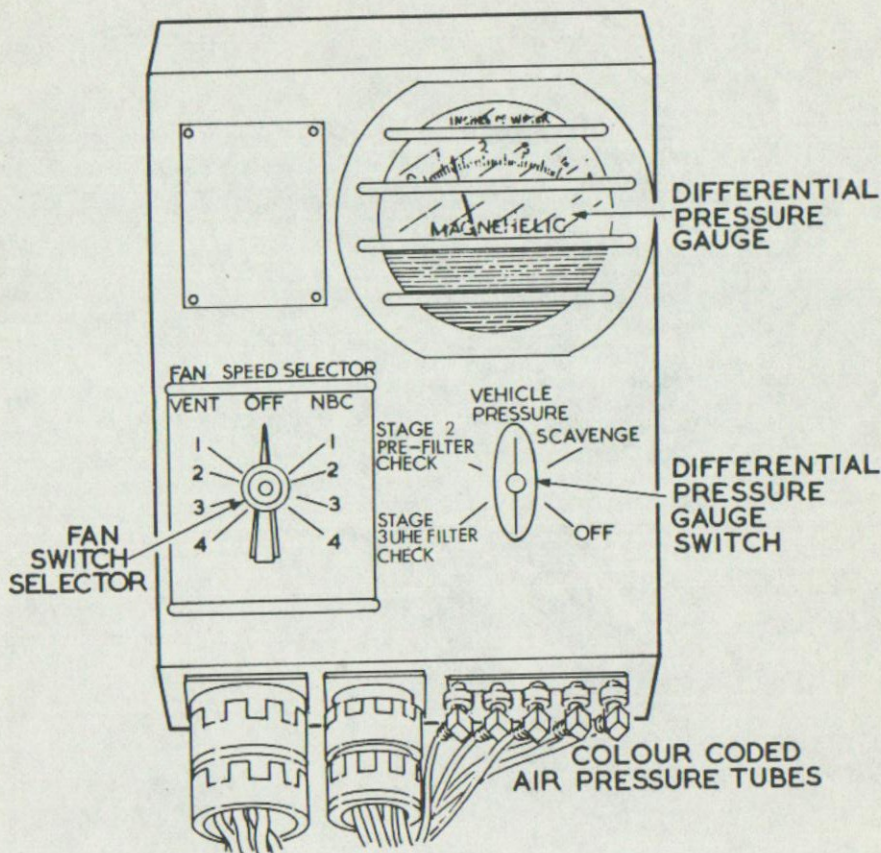
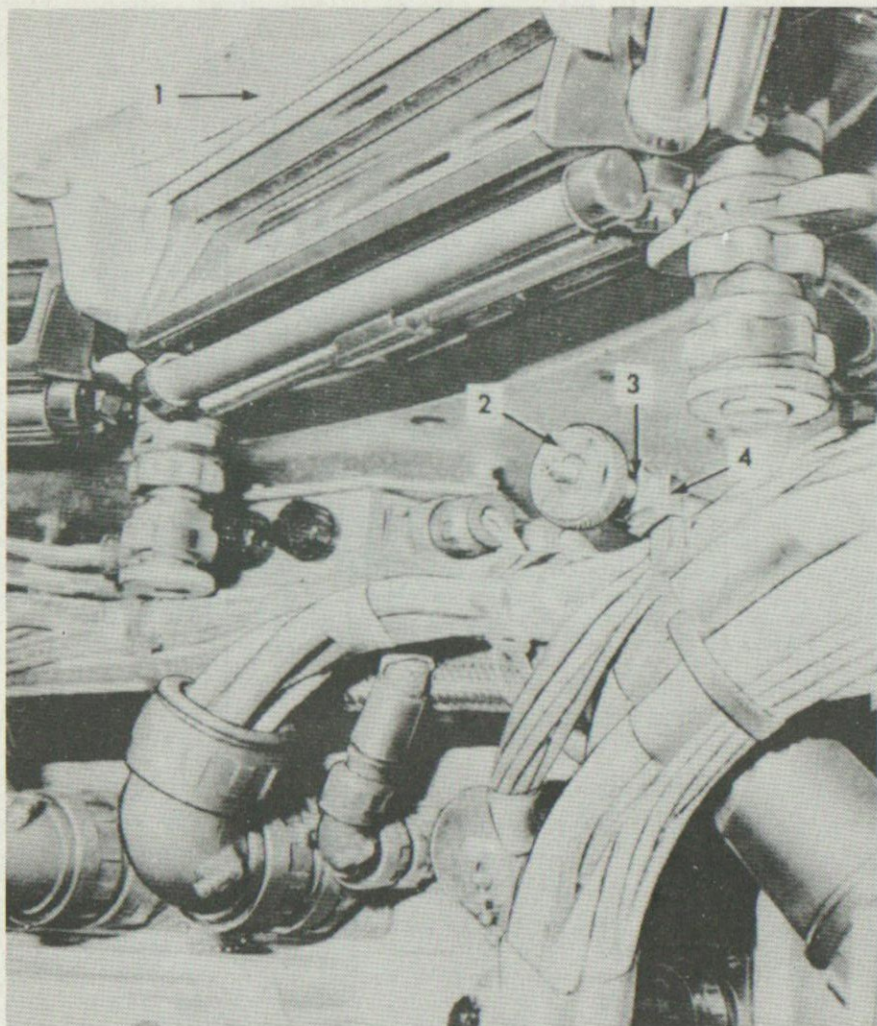


Fig 63 - Control box



- 1. Commander's cupola
- 2. Knurled stiff nut
- 3. Locknut
- 4. Control lever arm

Fig 64 – Pressure relief valve control

19. The valve adjustment (of 3.0 inches static water gauge (SWG)) is made during manufacture and must not be interfered with, except in an emergency.

20. Two settings are provided, one for ventilation and the other for NBC operation. The setting is changed by movement of the pressure relief valve control (see Fig 64) located above the GCE control cubicle. The lever is moved up for ventilation and down for NBC operation. The upper setting is regulated for a larger volume of air spillage, as the restriction to air flow through the NBC/ventilation pack is confined to the first two stages only. The lower setting will automatically allow spillage of air when the vehicle pressure reaches 3.0 inches SWG.

Operation

21. a. *Operation of the main engine air cleaner two way change-over valve lever*

- (1) To change the valve setting, unscrew the knob one turn anti-clockwise to release the lever, then move the lever to the alternative position and tighten the knob to lock the lever in position.
- (2) When the lever is forward, air is drawn in from the fighting compartment, and when the lever is pulled back, the air is drawn in through the right hand engine air inlet louvres. For fighting compartment mounted levers, the operating positions are reversed.

NOTES:- 1. Before the vehicle is closed down, the main engine air cleaner and generating unit air duct valves must be set to draw air through the engine louvres. Failure to do so can cause injury to the ear drums of the crew.

2. The main engine air cleaner must be set to TURRET BREATHING before any attempt is made to wash down the vehicle.

3. If it is necessary to switch the flap valve to ENGINE LOUVRE BREATHING when operating under dusty conditions, the main engine must be run at 1000 rpm. The driver must then open and close the valve a few times to clear dust from the bellows connector. This will prevent the sudden ingress of a large quantity of dust into the first stage of the main engine air cleaner.

b. *Operation of the generating unit air duct valve levers*

- (1) *For driver's compartment mounted levers*, proceed as for the main engine air cleaner change over valve lever (see para a. (1)). When the lever is in the rearward position, air is drawn from the fighting compartment.
- (2) *For bulkhead mounted levers*, with the lever downward at 6 o'clock the generating unit is drawing air from the engine louvres. If the air duct valve lever is pushed horizontal to the 9 o'clock position, then air is drawn through the fighting compartment.

c. *The fan selector switch*

- (1) When the fan selector switch (see Fig 63) is turned to one of the speed settings it operates the appropriate fan plus the scavenge fan. When it is turned to one of the VENT settings it also energises the NBC/VENT FLAP valve solenoid which operates the NBC/VENT flap valve to uncover the ventilation fan outlet. The solenoid is de-energised when

the switch is turned to OFF, or to one of the NBC speed settings. This allows the flap valve to drop and uncover the NBC fan outlet vent, thus ensuring a fail-safe condition.

d. The pre-filter by-pass switch

- (1) The pre-filter by-pass switch controls the pre-filter by-pass flap valve which is solenoid operated (see Note 1 below). It is situated in the bottom of the first and second stage compartment bulkhead. If the pre-filter becomes choked, and it is impractical to change it, the flap valve can be opened to by-pass the stage, but the filter must be cleaned or changed as soon as possible and the by-pass valve closed again.

- NOTES:-**
1. The pre-filter by-pass switch and flap valve will be discontinued on the Mk 2 NBC/ventilation system.
 2. The system must not be used or tested in still-air conditions if painting is taking place in the vicinity of the vehicle or where vapour from solvents is present, these vapours can seriously shorten the useful life of the filters.
 3. The fans cannot be operated unless the generator is ON LOAD.
 4. Efficient operation of the system is dependent upon the air inlets and outlets being kept clear of dirt, leaves and other debris. In addition, the doors and hatches must be properly sealed and the barrel gaiter must be kept in good repair. Frequent checks should be made. Correct pressurizing can only be maintained when the vehicle is closed down with the ranging gun, co-ax and all optical equipment fitted.
 5. Operating the system at a higher pressure than is necessary will shorten the effective life of the filter elements.

To switch on ventilation – hatches open

22. a. Start the generating unit engine and put it ON LOAD.
- b. Ensure that the pre-filter by-pass switch is in the CLOSED position.
- c. Turn the fan selector switch to VENT setting '1'.
- d. Switch the differential pressure gauge switch to SCAVENGE and check that the gauge reads at least 4.0 inches SWG.
- e. Turn the differential pressure gauge switch to VEHICLE PRESSURE and adjust the ventilation fan speed to the setting which will produce an airflow to suit the crew's requirements.

NOTE:- If the differential pressure gauge shows a reading of less than 4.0 inches SWG with the differential pressure gauge switch at SCAVENGE, take the following action:-

1. Switch off the ventilation system.
2. Check the armoured ballistic air inlets and scavenge outlet for obstruction.
3. If no obstruction is apparent, switch the ventilation system on and check the airflow at the scavenge outlet.
4. If the airflow is steady, switch off and report to REME.

5. If there is no airflow, switch off, open the pack door and change the scavenge fan motor fuze; start up the system, if the scavenge fan motor still fails to run, report to REME.

6. Should there be an internal obstruction, switch off the ventilation system, remove the armoured ballistic air inlet cover and carefully remove the obstruction from the cyclone tube elements.

To switch off the ventilation system – hatches open

23. a. Switch the differential pressure gauge switch to OFF.
b. Turn the fan selector switch to OFF.

To switch on ventilation – closed down

24. a. Set the main engine air cleaner flap valve to the engine louvre breathing position.
b. Close the generating unit cooling air duct valve.
c. Close all hatches.
d. Start the generating unit engine and put it ON LOAD.
e. Ensure that the pre-filter by-pass switch is in the closed position.
f. Set the pressure relief valve control to the ventilation position.
g. Turn the fan selector switch to VENT setting '1'.
h. Switch the differential pressure gauge switch to SCAVENGE and check that the gauge reads at least 4.0 inches SWG.
j. Turn the differential pressure gauge switch to VEHICLE PRESSURE and adjust the ventilation fan to the setting which will produce an airflow to suit the crew's requirements.

To switch off the ventilation system – hatches closed

25. a. Switch the differential pressure gauge switch to OFF.
b. Turn the fan selector switch to OFF.
c. Open the vehicle hatches.
d. Set the generating unit engine and main engine air duct valves to the turret breathing position.

To operate the system for NBC conditions

26. a. Carry out the procedure laid down in para 24, sub-paras a. to e.
b. Set the pressure relief valve control to the NBC position.
c. Turn the fan selector switch to NBC setting '1'.
d. Switch the differential pressure gauge switch to SCAVENGE and check that the gauge reads at least 4.0 inches SWG.
e. Turn the differential pressure gauge switch to VEHICLE PRESSURE and turn the fan selector switch to setting '4' to raise the vehicle pressure.
f. When the pressure has risen sufficiently, adjust the NBC fan speed to the lowest setting which will maintain a gauge reading of 3.0 inches SWG.

27. If the crew wish to have a pressurized air supply to their respirators, should it be necessary to wear them:-

- a. Turn the fan selector switch to NBC setting '1'.
- b. Remove the blanking cap from the respirator hose adaptor.
- c. Rotate the large collar, adjacent to the respirator canister, in a clockwise direction to close the bleed valve and fit it to the respirator canister.
- d. "Snap on" the free end of the respirator hose to the adaptor.
- e. Close the diffusers by rotating them upwards.
- f. Increase the NBC fan speed setting to suit the maximum demand of any crew member.
- g. Small adjustments can be made by each crew member by turning the bleed valve collar in an anti-clockwise direction to reduce his air supply.

NOTE:- Always replace the blanking cover for the adaptor after disconnecting the respirator hose.

To switch off the NBC system

28. a. Switch off as for the ventilation system when closed down (see para 25).

SERVICING

Daily in use or weekly out of use

29. a. Switch on each fan in turn and ensure that air is delivered from the scavenge outlet. (The scavenge fan circuit is protected by a 10 amp cartridge fuze located adjacent to the fan motor. If the fan fails to operate, check the fuze).
- b. Switch on the system for NBC conditions (see para 26).
- c. When the pressure is steady, turn the differential pressure gauge switch to PRE-FILTER CHECK ("PRE-FILTER PRESS DROP" on early models).
- d. If the gauge reading is above 3.0 inches SWG, the pre-filter must be cleaned or changed immediately.
- e. If the reading is between 2.0 and 3.0 inches SWG, the pre-filter must be cleaned at the earliest opportunity.
- f. If the reading is less than 2.0 inches SWG, the filter needs no attention.
- g. Turn the differential pressure gauge switch to UHE FILTER CHECK ("UHE FILTER PRESS DROP" on early models).
- h. If the gauge reading is above 1.5 inches SWG, the Ultra High Efficiency Filter must be changed. Report to REME.
- j. If the gauge reading is 1.5 inches SWG or below, the filter needs no attention.
- k. Switch the differential pressure gauge switch back to VEHICLE PRESURE.

- I. Switch off the system (see para 25).

NOTE:- When possible, both fans should be run alternately for 30 minutes before carrying out these checks.

Monthly servicing

30. a. Carry out weekly servicing and switch off the system.
b. Open the pack door and carry out the visual checks (see para 33).
c. Remove and clean the pre-filter, and check the pre-filter compartment (see para 34).
d. Check the UHE filter and clean out the compartment (see para 35).
e. Check the anti-vapour filters and compartment (see para 36).
f. Switch on the equipment and check the operation of:-
(1) The NBC/ventilation flap valve (see para 39).
(2) The pre-filter by-pass flap valve.
g. Switch off the equipment, close the pack door and check the scavenge fan discharge nozzle diaphragm seal (see para 37).

To open the pack door

31. a. Ensure that the vehicle is on level ground.
b. Traverse the gun to the 10 o'clock position.
c. Unscrew the four captive bolts (15/16-in AF).
d. Open the door and secure it by means of the stay bar.

To close the pack door

32. a. Check that the door seal and the box rim are clean, and that the cables and air pressure tubes are not kinked or nipped.
b. Unhook the stay bar and stow it.
c. Swing the door closed, taking care that the cables and tubes fold tidily into the box without kinking or fouling.
d. Engage the four captive bolts and tighten them evenly, working in a clockwise sequence until the door lugs contact the box.

Visual checks of the pack (See fig 66)

33. Check the security and serviceability of the pack door seal, filter compartment doors, mounting brackets, cables, air pressure tubes, fuze, terminals and connections, resilient mounts and cyclone pack seal bellows.

To check and clean the pre-filter (See Fig 67)

34. a. Unscrew the handnuts securing the pre-filter and UHE filter compartment door, and lower it.
b. Unscrew the pre-filter clamp frame handnuts and swing the frame aside.
c. Carefully withdraw the pre-filter element. Examine the seal; if it is damaged or loose, the element must be changed.

- d. If the filter is undamaged, gently tap the casing (against the direction of air flow) and shake it to remove as much dust as possible.
- e. Wash the filter in water, with or without detergent, and dry thoroughly.

NOTE:- Do not wash the filter in gasoline, or any spirit, nor use high pressure air to clean it; it must be dried carefully in a warm room or building for at least 48 hours; do not subject the filter to excessive heat.

- f. Ensure that the bulkhead seals are serviceable and the compartment clean. Remove any dust, using a clean damp cloth.
- g. Check that the air pressure tapping hole behind the valve flap is clear.
- h. Smear the element casing seal lightly with silicone grease.
- j. Insert the element with the seal against the cyclone stage bulkhead, engage the clamp frame and tighten the handnuts; **DO NOT OVERTIGHTEN.**

To check the UHE particulate filter (See Fig 67)

- 35. a. Open the compartment door.
- b. Pull out the two clamp handles to release the filter element, then carefully withdraw the element.
- c. Check the element for damage or deterioration of the seal. If any defect is found, the element must be exchanged for a new one.
- d. Ensure that the clamps work efficiently and that the air pressure tapping hole at the rear of the compartment is clear.
- e. Remove any dust or dirt from the compartment, using a clean damp cloth.
- f. Lightly smear the element seal with silicone grease.
- g. Check that the clamp handles are fully out, then insert the element with the handle outwards and the seal against the fourth stage bulkhead.
- h. Ensure that the element is fully home and push both clamp handles simultaneously to secure the element.
- j. Close the compartment door and tighten the handnuts until the doorstops make contact.

To check the anti-vapour (AV) filters (See Fig 68)

- 36. a. Unscrew the handnuts securing the AV filter compartment door and lower the door.
- b. Slacken the element clamping nuts, grip the carrying handle of each element in turn and check that it is tight, then re-tighten the clamp nuts.
- c. Remove any charcoal particles, using a clean damp cloth, with the filters in position. If the amount of particles appears excessive, report to REME.
- d. Ensure that the air pressure tapping hole in the bottom of the compartment is clear.
- e. Close the compartment door and secure the handnuts, until the door stops make contact.

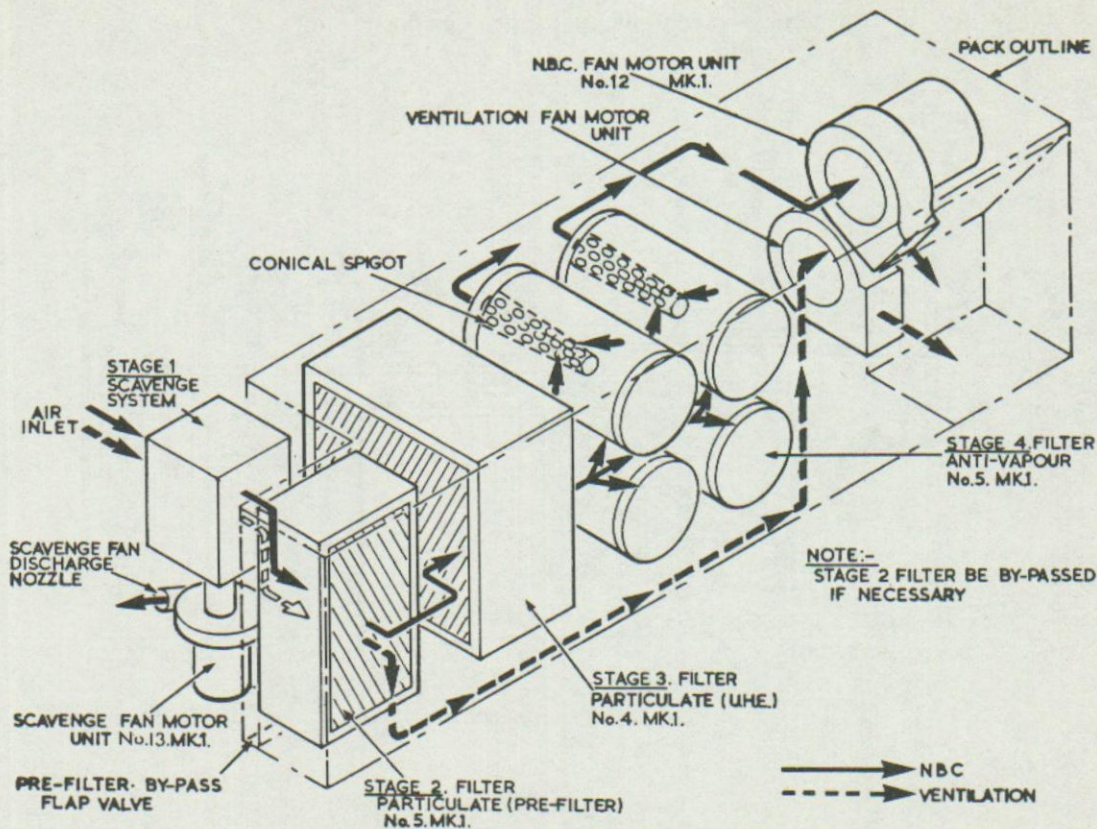
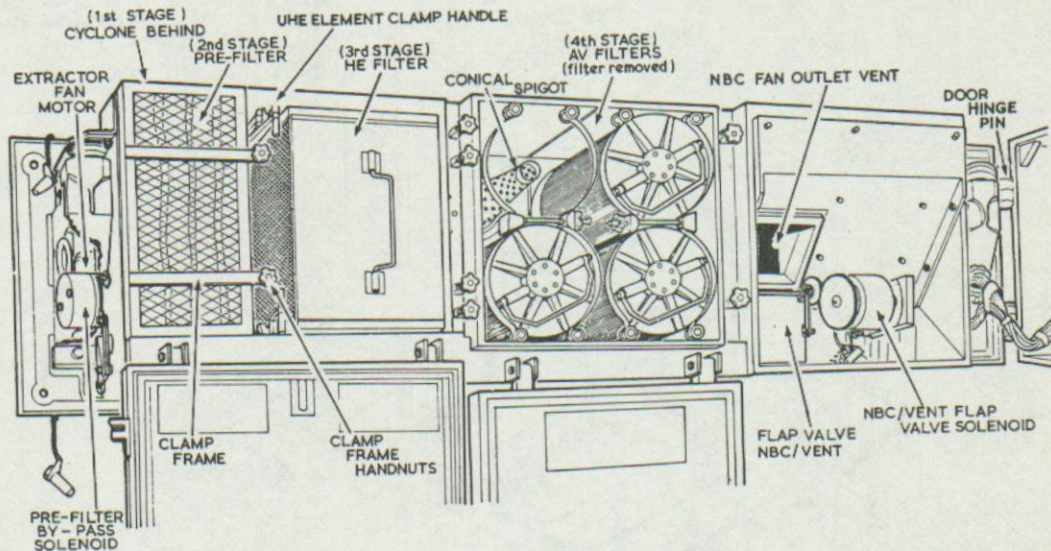


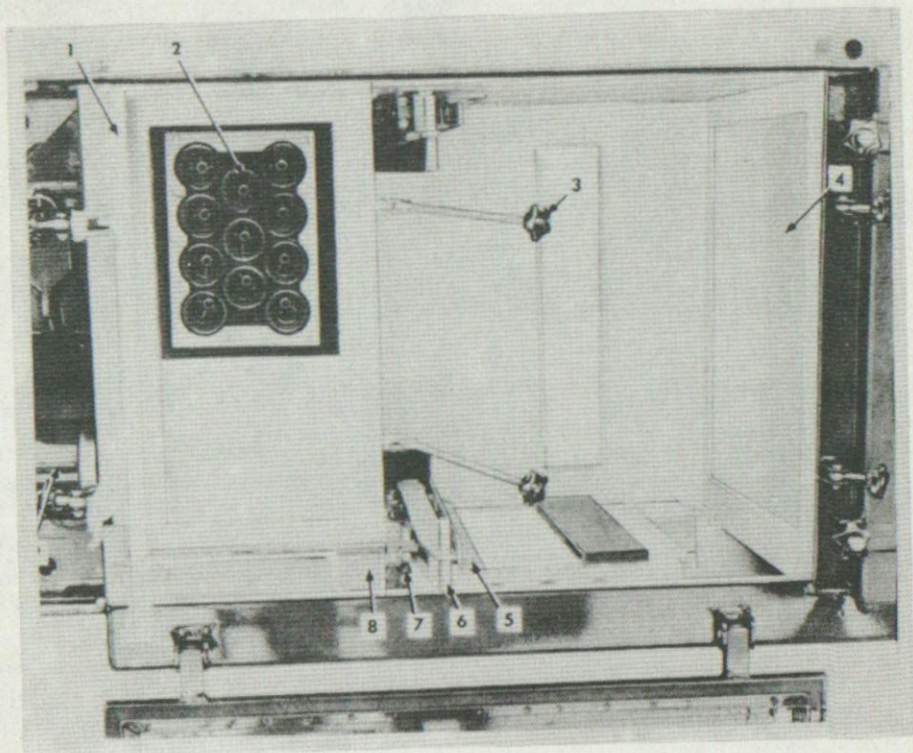
Fig 65 – Air flow of NBC/ventilation system

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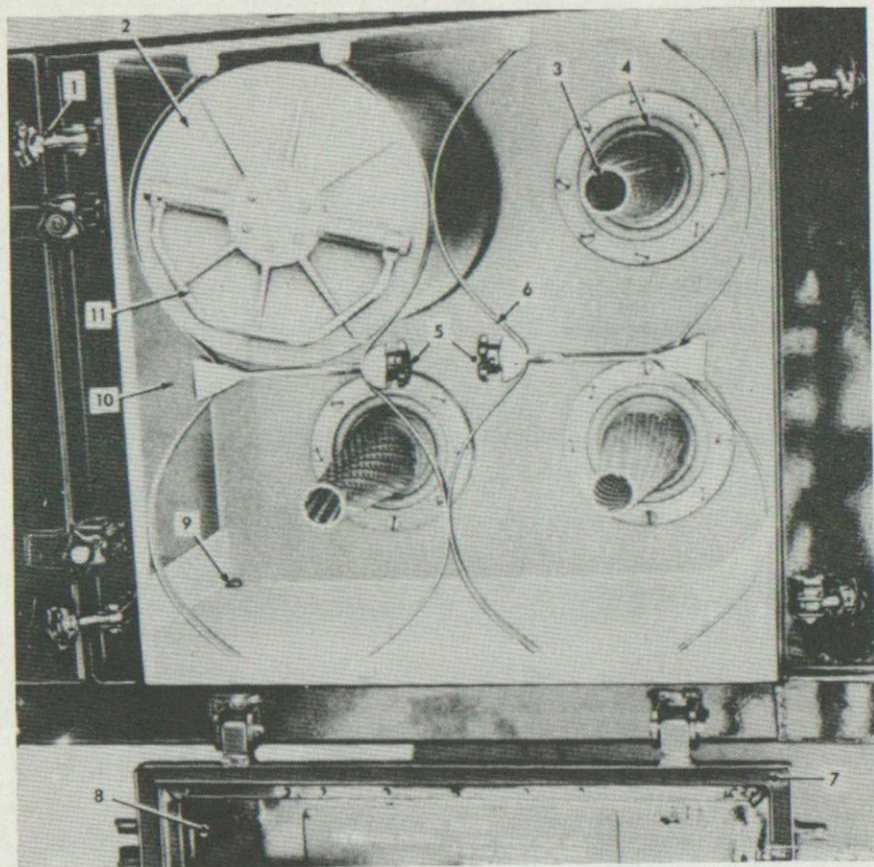
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Fig 66 - NBC/ventilation pack - filters



- | | |
|--------------------------|-------------------------------------|
| 1. Clamp frame | 6. Clamp handles |
| 2. Cyclone elements | 7. Pressure tapping holes |
| 3. Clamp frame hand nuts | 8. Pre-filter by-pass valve flap |
| 4. AV filter compartment | 9. Pre-filter by-pass flap solenoid |
| 5. Clamp guide | |

Fig 67 – Pre-filter and UHE filter compartment



1. AV filter compartment door hand nuts
2. AV filter element
3. Conical spigots
4. Filter 'O' ring seal
5. Element clamping nuts
6. Clamp straps
7. Compartment door seal
8. Compartment door (open)
9. Vent tapping hole
10. UHE filter compartment
11. Filter element handle

Fig 68 - AV filter compartment

To change the scavenge fan fuze

41. a. Switch off the NBC/ventilation system.
- b. Open the NBC/ventilation pack door.
- c. Unscrew the fuze carrier and withdraw the fuze.
- d. Fit a new fuze in the carrier (rating 10 amp).
- e. Replace the fuze and carrier.
- f. Obtain a replacement fuze and fit it in the spare carrier.
- g. Check the circuit. If the fuze blows again, report to REME.
- h. Close the NBC/ventilation pack door.

To change a fuze (150 A link type) in the turret distribution box

42. a. Set the differential pressure gauge switch to OFF.
- b. Set the fan selector switch to OFF.
- c. Set the hull master switch to the OFF position.
- d. Remove the front cover on the turret distribution box.
- e. Slacken the nuts securing the fuze link and remove the link.
- f. Ensure the contact faces are clean and free from burrs.
- g. Fit a new 150 A fuze, then replace the front cover plate. (The fuze is the second from the left.)
- h. Check out the system. If the fuze blows again, report to REME.

To reset a circuit breaker (CB-2 – turret distribution box)

43. a. Put the fan selector switch to OFF.
- b. Press the button of the circuit breaker to reset it.
- c. Test the circuit. If the circuit breaker trips again, report to REME.

SECTION 3 – NBC PACK NO. 2

General

1. The system is designed to provide filtered air and to pressurize the vehicle when operating under NBC conditions.
2. Clean air is drawn into the vehicle through two filters by an electric fan and is then circulated through the fighting and driver's compartments by ducting fitted with diffusers and respirator adaptors.
3. The fan unit and filters are located in a housing mounted on the outside of the turret bulge. Air intake apertures are provided in the hinged door at the bottom of the housing and a cowl for the fan motor cooling casing is fitted at the top. On some vehicles the cowl is also the air intake.
4. The outer filter (particulate) contains a paper element which extracts solid particles from the air passing through. The inner filter (charcoal anti-vapour) absorbs vapourized impurities. The anti-vapour filter may be replaced by a dummy insert for training.

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5. Air is ducted from the housing to the internal ducting of the turret by an elbow shaped section. The internal ducting carries the air to the crew positions and discharges it through diffusers which are fitted in pairs. Adjacent to each pair of diffusers is a respirator adaptor and an adaptor for stowing the blanking cover. The respirator hoses and blanking covers are retained in position by spring loaded balls in detent grooves.
6. A relief valve, mounted in the turret bulge is pre-set to open when the pressure in the vehicle rises to three inches static water gauge above that of the surrounding atmosphere.
7. A rotary switch for controlling the speed of the fan is located on the left wall of the turret. The switch provides a range of 11 speeds with an OFF position when the switch knob is at 12 o'clock. Switching on and increasing speeds are obtained by turning the knob clockwise. The switch backplate is marked to indicate the switch positions. Protection of the circuit is afforded by the 10A circuit breaker CB-2 and the 150A fuze, both located in the turret distribution box. A 10A cartridge fuze is located in the heating and ventilating junction box on the turret sill to the rear of the commander's position.
8. Mounted on the turret wall to the rear of the fan speed control switch are a pressure/vacuum gauge and a filter test button. When the vehicle is closed down and the system is in operation, the gauge registers the difference between the inside and outside air pressures but, when the test button is pressed, the gauge registers depression created between the fan and the filters. The scale is calibrated for a range of plus nine to minus nine inches static water gauge.

Air duct valve

9. The handle on the bulkhead should be in the horizontal position, which provides relatively clean air from the fighting compartment. With the lever downwards, ventilation is effected by air drawn by the fans through the engine louvres and circulated through the generators. The disadvantage of this arrangement is that dust laden air passes through the generators, but this has to be accepted at times when the vehicle must be pressurized, ie, for NBC conditions. Running with the change-over valve in this condition must be restricted to a minimum.

Operation

10. The fan cannot be used unless the generator is operating, and pressurizing can only be maintained when the vehicle is closed down. The fan speed setting must be the lowest at which the equipment operates efficiently, in order to conserve the filter life. The voltage regulator cooling air duct valve in the bulkhead must be closed when the system is operating.

To pressurize the vehicle

11. a. Close the hatches and the air duct valve, using the handle on the bulkhead.
- b. Turn the fan speed control switch clockwise to the lowest setting which will maintain the air pressure at plus 3 on the gauge; at this pressure the release valve at the rear of the turret will just lift off its seating.

- c. Adjust the diffusers as required.

NOTE:- To ensure correct operation of the pressurising system, the sealing of all access doors and hatches should be inspected frequently.

Filter check

12. To check the condition of the particulate filter with the fan running, press the test button and the gauge vacuum reading will give an indication of the dust build-up on the element. Should the reading on the gauge exceed 5 vacuum it is necessary to remove the filter for cleaning.

To remove and replace the filters

13. a. If necessary, traverse the turret to allow access to the filter housing door. Turn the hull master switch and the fan switch to OFF.
- b. Open the housing door, withdraw the box spanner and unscrew the centre bolt to release the clamping bar.
- c. Withdraw the filter holder with the particulate filter inside.
- d. Slide the filter from the holder, keeping it square. Clean the element by shaking until as much dirt as possible has been removed. If the element has already been cleaned three times by this method, the filter must be discarded and a replacement filter fitted.
- e. If a charcoal element filter is fitted, remove the gasket separating the two filters and withdraw the charcoal element filter using the rings provided, discard the filter. A new filter must be fitted.
- f. Replace the filters and the filter holder in the reverse order to which they were removed. Locating strips welded to the filter frames ensure that the filters are correctly fitted. Tighten the clamping bolt only as much as necessary to make an effective seal.
- g. Stow the spanner and close the filter housing door.
- h. Start the generating unit engine and the operation of the system.

To change a fuze (150 A link type) in the turret distribution box

14. a. Set the differential pressure gauge switch to OFF.
- b. Set the fan selector switch to OFF.
- c. Set the hull master switch to the OFF position.
- d. Remove the front cover on the turret distribution box.
- e. Slacken the nuts securing the fuze link and remove the link.
- f. Ensure the contact faces are clean and free from burrs.
- g. Fit a new 150 A fuze then replace the front cover plate. (The fuze is the second from the left.)
- h. Check out the system. If the fuze blows again, report to REME.

To reset a circuit breaker (CB-2 – turret distribution box)

15. a. Put the fan selector switch to OFF.
- b. Press the button of the circuit breaker to reset it.
- c. Test the circuit. If the circuit breaker trips again, report to REME.

CHAPTER 9 – NIGHT FIGHTING EQUIPMENT

SECTION 1 – INTRODUCTION

General

1. The gunner is provided with an infra red sight which incorporates a ballistic graticule. The commander has an infra red periscope purely for observation and target acquisition purposes; it has no graticule or facility to use the projector, reticle image. Both instruments replace the daylight periscopic sights during night operations.
2. Mounted to the left and on the outside of the turret is a light projector. This has a white light and an infra red capability. It is electrically linked to the gunner's sight mount and, when switched on, changes in elevation of the sight are transmitted to the light projector.
3. The commander is provided with a spotlight mounted on the movable part of the cupola. This light also has both white light and infra red facilities.
4. To the rear of the commander's cupola is mounted an infra red detector that is connected to a control box inside the turret which gives a visual and audible warning.
5. The driver is provided with an image intensified periscope for night operations.

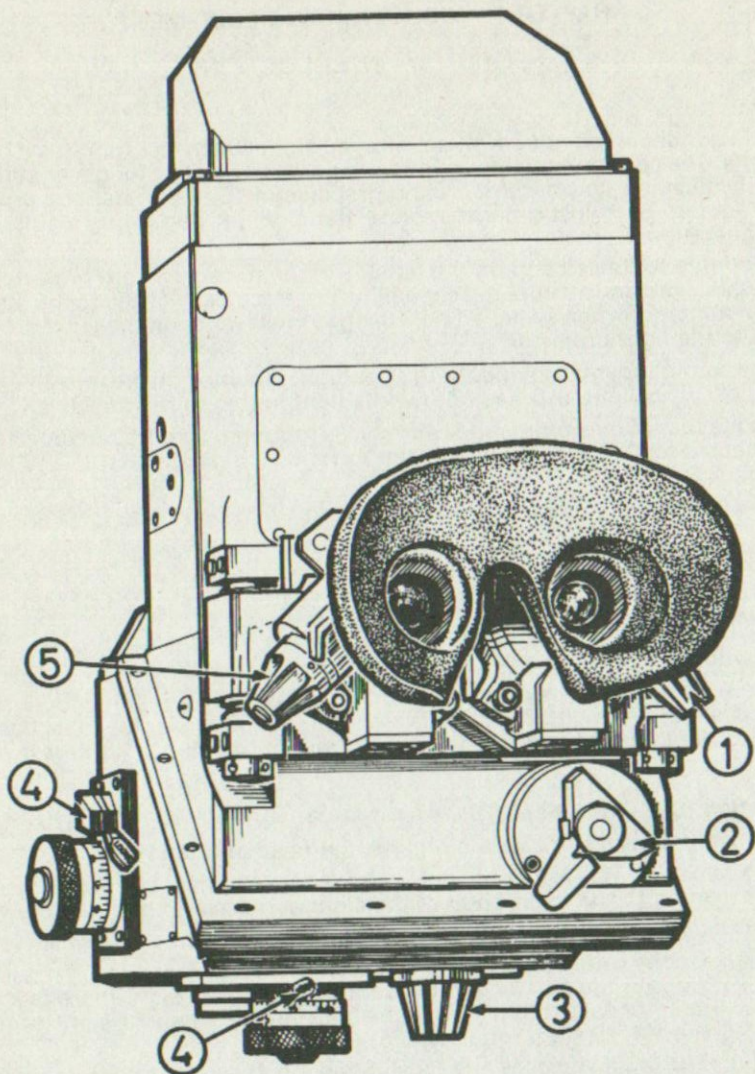
SECTION 2 – SIGHTING EQUIPMENT

The gunner's infra red sight**Introduction**

1. There are two sights in production, one is for use with the sight mount No. 34, Mk 1 and is the L1A1 sight. The other is identical except an adaptor collar has been fitted in order that it may be used with sight mount No. 39, Mk 1, this is the L4A1 sight.

Description (See Figs 69 and 70)

2. The sight consists of two main parts, the head and the body.
 - a. *The head* – This is a right angle prism contained in a light metal case. It is mounted to the main body of the sight and secured by four screws.
 - b. *The body* – This is a light metal case which contains the optical system.
 - (1) On the front of the L1A1 sight there is a catch plate which retains the sight in the No. 34 sight mount. On the L4A1 sight there is a large adaptor collar fitted around the body for use when the sight is fitted in the No. 39 sight mount.
 - (2) The X3 eyepieces are positioned on the rear of the sight. Each eyepiece has a heater and a focussing adjuster. A face mask fits over the eyepieces.
 - (3) Two graticule adjusters are fitted to the sight. The one for deflection is on the left side of the sight, the other, for elevation, is on the bottom of the sight. Both adjusters are calibrated in mils from zero to 40, numbered every two mils and graduated in fifth of a mil intervals. Each adjuster has a locking lever.



- | | |
|-----------------------------------|-----------------------------------|
| 1. RH eyepiece focussing adjuster | 4. Graticule adjuster |
| 2. Shutter lever | 5. LH eyepiece focussing adjuster |
| 3. Graticule illumination control | |

Fig 69 – Sight, periscopic, AV, L1A1

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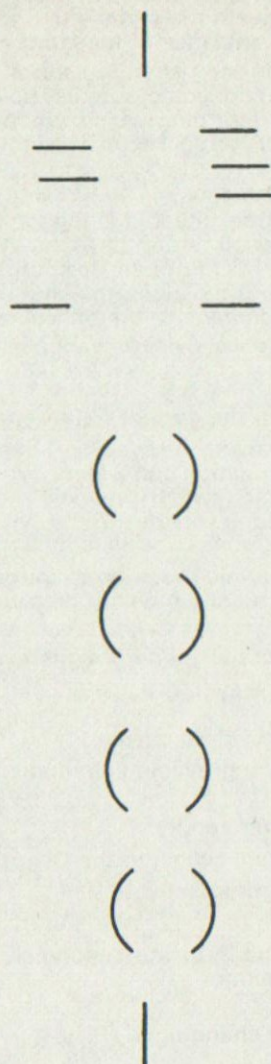


Fig 70 – Sight, periscopic, AV, L1A1 graticule pattern

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CHAPTER 9 – NIGHT FIGHTING EQUIPMENT

SECTION 1 – INTRODUCTION

General

1. The gunner is provided with an infra red sight which incorporates a ballistic graticule. The commander has an infra red periscope purely for observation and target acquisition purposes; it has no graticule or facility to use the projector, reticle image. Both instruments replace the daylight periscopic sights during night operations.
2. Mounted to the left and on the outside of the turret is a light projector. This has a white light and an infra red capability. It is electrically linked to the gunner's sight mount and, when switched on, changes in elevation of the sight are transmitted to the light projector.
3. The commander is provided with a spotlight mounted on the movable part of the cupola. This light also has both white light and infra red facilities.
4. To the rear of the commander's cupola is mounted an infra red detector that is connected to a control box inside the turret which gives a visual and audible warning.
5. The driver is provided with an image intensified periscope for night operations.

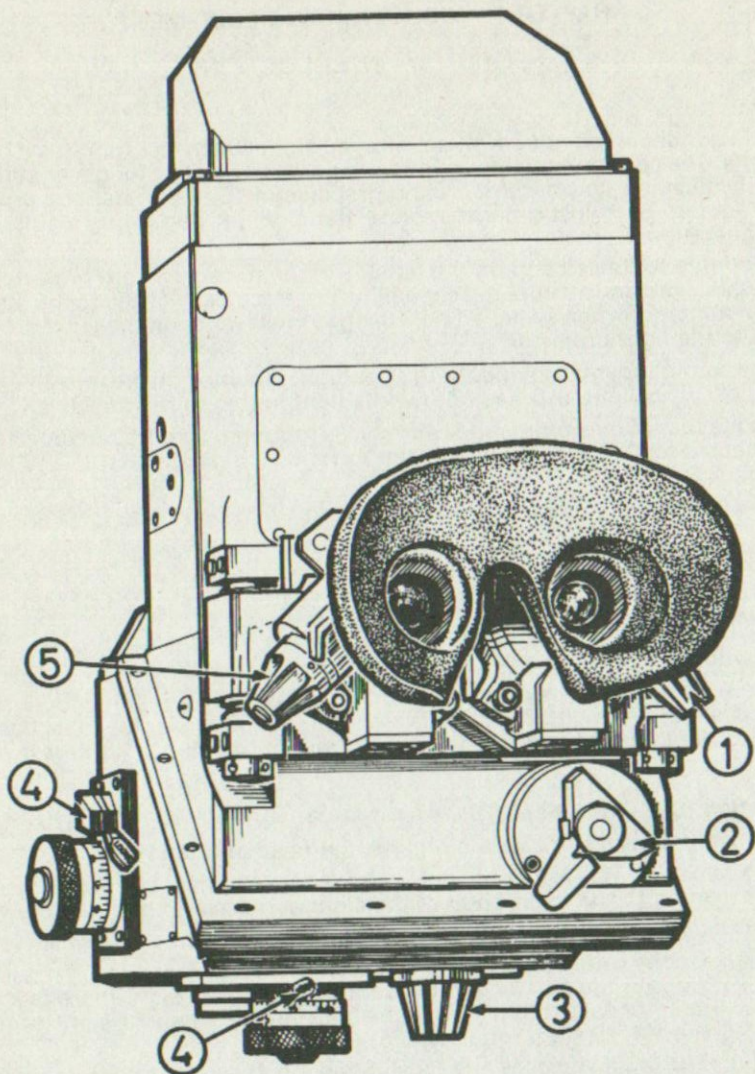
SECTION 2 – SIGHTING EQUIPMENT

The gunner's infra red sight**Introduction**

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Description (See Figs 69 and 70)

2. The sight consists of two main parts, the head and the body.
 - a. *The head* – This is a right angle prism contained in a light metal case. It is mounted to the main body of the sight and secured by four screws.
 - b. *The body* – This is a light metal case which contains the optical system.
 - (1) On the front of the L1A1 sight there is a catch plate which retains the sight in the No. 34 sight mount. On the L4A1 sight there is a large adaptor collar fitted around the body for use when the sight is fitted in the No. 39 sight mount.
 - (2) The X3 eyepieces are positioned on the rear of the sight. Each eyepiece has a heater and a focussing adjuster. A face mask fits over the eyepieces.
 - (3) Two graticule adjusters are fitted to the sight. The one for deflection is on the left side of the sight, the other, for elevation, is on the bottom of the sight. Both adjusters are calibrated in mils from zero to 40, numbered every two mils and graduated in fifth of a mil intervals. Each adjuster has a locking lever.



- | | |
|-----------------------------------|-----------------------------------|
| 1. RH eyepiece focussing adjuster | 4. Graticule adjuster |
| 2. Shutter lever | 5. LH eyepiece focussing adjuster |
| 3. Graticule illumination control | |

Fig 69 – Sight, periscopic, AV, L1A1

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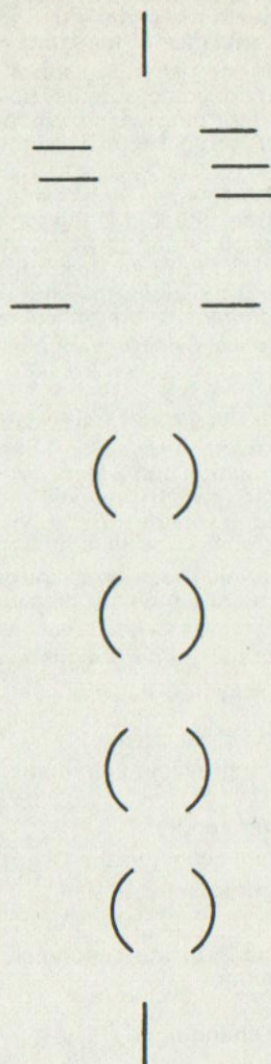


Fig 70 – Sight, periscopic, AV, L1A1 graticule pattern

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- (4) The graticule can be illuminated by a lamp unit situated on the front of the sight. Underneath the sight is the graticule illumination control which varies the brilliance of the lamp.
- (5) On the front of the L4A1 sight is a socket into which fits an electrical lead which, when connected, supplies power to the sight. On the L1A1 sight there is a unit plug which, when the sight is mounted, connects with an electrical socket on the sight mount, supplying power to the sight.
- (6) To the right and below the right hand eyepiece is a lever which operates the shutters situated in the top of the body. These shutters will always be closed during daylight. When the sight is in use, the shutters must be in the open position. However, if a strong light source shines on to the sight, the shutters must be closed immediately to prevent damage to the optical system.
- (7) Included in the optical system is a ballistic graticule used for direct fire.

Electrical switches used with the gunner's sighting equipment

3. a. *The switches* which activate the eyepiece heater, window heater, IR power supply, graticule illumination and wipers, are positioned on the gunner's lighting control box. Each switch is marked and each circuit is protected by a circuit breaker positioned on the turret services junction box. In addition, the graticule illumination is controlled by a rheostat switch on the sight.
- b. *The control button* which activates the gunner's sight washer is positioned on the turret sill. A circuit breaker protects the sight washer circuit.
- c. *The circuit breakers* for the gunner's sighting equipment are as follows:-
 - (1) CB-4 – protects the eyepiece heater, window heater and the window wiper.
 - (2) CB-5 – protects the sight washer.
 - (3) CB-7 – protects the graticule illumination and the IR power supply.

To switch on/off the IR power supply

4. a. Set the IR power supply switch to the ON position.
- b. Allow time for the sight to activate.
- c. Open the shutters.
- d. When switching off the IR power supply, close the shutters and set the switch to the OFF position.

Adjustment and component changing

To focus the eyepieces

5. a. In daylight with the shutter closed or at night with it open, switch on the sight.
- b. Rotate the focus adjusting knob on one eyepiece; adjust the focus until the grain in the sight can be seen clearly.
- c. Repeat the adjustment for the other eyepiece.

To change the periscope head

6. a. Clean the body of the sight and the spare head.
- b. Remove the four screws that secure the damaged head to the body of the sight. Lift off the head.
- c. Secure the head to the body by means of the four screws, tightening the screws in a diagonal sequence. Carry out sight adjustment.

To adjust the brilliance of the graticule

7. a. Set the IR power supply switch to the ON position.
- b. Turn the switch on the gunner's lighting control box fully clockwise.
- c. Adjust the graticule illumination control on the sight until the graticule is brought to the required brilliance.

To change the graticule illumination bulb

8. a. Switch off the gunner's IR sight and eyepiece heater switches.
- b. Unscrew the nut, holding the midget flange bulb, and fit a new bulb, using the tool removing lamp filament.
- c. Ensure that the nut is only finger tight when replaced.
- d. Switch on the gunner's IR sight and heater switches.

To mount and dismount the sight

9. The procedure is similar to that used when mounting the daylight sight (see Chapter 6, Section 2), except that the IR switch and the eyepiece heater switch, on the gunner's lighting control box, must be set to the OFF position.

Adjustment of the infra red sight**General**

10. The change-over from daylight to infra red sights should be made at last light. There are two methods of sight adjustment which can be used; the procedure is as follows:-

- a. *The direct method* in which the IR sight is made coincident with the sight unit on to a distant aiming mark.
- b. *The indirect method* in which the traverse indicator and the quadrant fire control are used to record the line and elevation of the gun when it is laid on to a distant aiming mark, using the daylight sight. This method is used when it is impossible to achieve coincidence between the daylight sighting periscope and the sight unit.

To adjust the IR sight - Direct method

11. a. Ensure that a correct coincidence exists between the daylight sight and the sight unit.
- b. Dismount the daylight sight and mount the gunner's IR sight.
- c. Lay the MBS 120-mm mark in the sight unit graticule on to an aiming mark at a distance exceeding 200 metres.
- d. Adjust the MBS 120-mm mark in the IR sight on to the same aiming mark. The gun must not be allowed to move during this adjustment. Ensure that the graticule adjusters are firmly locked when the adjustment is completed.

To adjust the IR sight – Indirect method

12. a. Lay the MBS 120-mm mark in the daylight sight on to an aiming mark at a distance exceeding 200 metres.
- b. Turn the range adjuster until the bubble in the sight clinometer is level.
- c. Zero the traverse indicator.
- d. Dismount the daylight sight and mount the gunner's IR sight.
- e. Using the elevation handwheel, level the bubble in the sight clinometer.
- f. Check that the traverse indicator is at zero. If it is not, traverse until the pointers are in the zero position.
- g. Adjust the MBS 120-mm mark in the IR sight on to the distant aiming mark. The gun must not be allowed to move during this adjustment. Ensure that the graticule adjusters are firmly locked when the adjustment is completed.

Commander's IR periscope**Introduction**

13. At present there is only one type of commander's IR periscope, this is the L1A1. In construction it is similar to the No. 37, Mk 1 daylight sight. No facility exists for the commander to use the projector, reticle image, when the L1A1 periscope is mounted.

Description (See Fig 71)

14. The periscope consists of the upper and lower castings.
 - a. *The upper casting* houses the object reflector and is permanently fixed to the lower casting. Inside the object reflector there is a mirror which is linked to the commander's MG mounting.
 - b. *The lower casting* houses the binocular system. On the rear of the periscope are the eyepieces. Each eyepiece has a heater and a focusing adjuster. A face mask fits over the eyepieces. A unitor plug is fitted to the front of the periscope to supply power to the eyepiece heaters and to activate the periscope. When the periscope is mounted, the plug enters a socket on the cupola. On the left side of the periscope is a mirror lever. When the periscope is mounted this is connected to the commander's MG mounting linkage. When the periscope is not mounted the mirror lever is held by a key transit bar. When the periscope is mounted, the bar is removed and stowed on the underside of the periscope. To the left of the eyepieces there is a shutter lever. These shutters will always be closed during daylight. When the periscope is in use, the shutters must be in the open position. However, if a strong light source shines on to the periscope, the shutters must be closed immediately to prevent damage to the optical system. Above the eyepieces there is a browpad. On the left and right side of the periscope are the mounting hooks; these are attached to spring loaded fingerpieces. The hooks fit into the sight mount and the periscope is locked in position by two clamping knobs.

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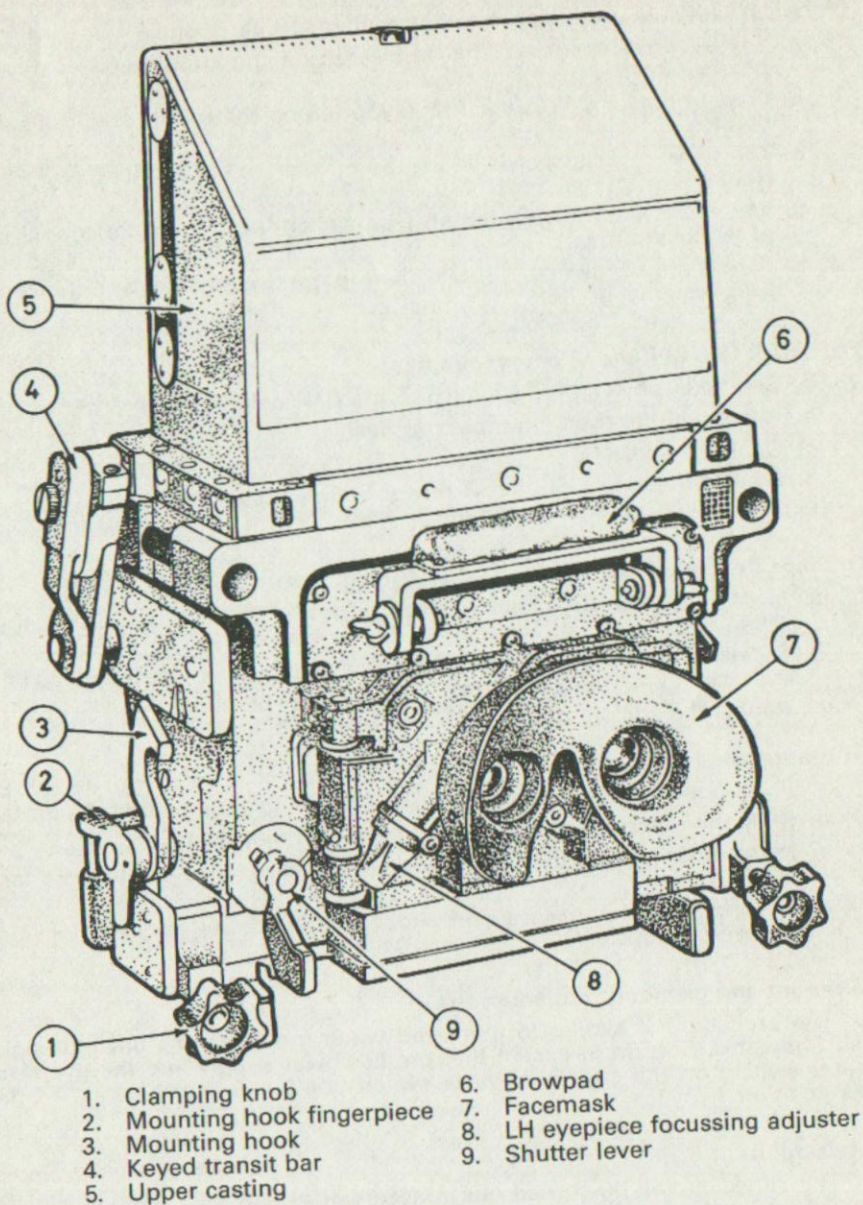


Fig 71 - Periscope, AV, L1A1

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Electrical switches used with the commander's IR periscope

15. a. *The eyepiece heater* – This is located on the cupola services switch box No. 3.
- b. *IR sight power ON/OFF* – This is located on the cupola services switch box No. 3.
- c. *The wiper* – This switch is located on the cupola services switch box No. 2.
- d. *The washer* – This is a button type switch located on the cupola supplies junction box.
- e. *Cupola master switch* – This is the top right hand switch on the cupola supplies junction box.

To switch ON/OFF the IR power supply

16. a. Set the IR power supply switch to the ON position.
- b. Allow time for the periscope to activate.
- c. Open the shutters.
- d. When switching OFF the IR power supply, close the shutters and set the switch to the OFF position.

To focus the eyepieces

17. a. In daylight with the shutter closed or at night with it open, switch on the periscope.
- b. Rotate the focus adjusting knob on one eyepiece, adjust the focus until the grain in the periscope can be seen clearly.
- c. Repeat the adjustment for the other eyepiece.

To change the face mask

18. a. Press down on the two spring loaded retaining clips behind the mask.
- b. Slide the mask upwards and lift it clear of the eyepieces.
- c. Press down on the two spring loaded retaining clips on the new face mask.
- d. Fit it over the eyepieces and slide downwards as far as it will go; release the clips.

To mount and dismount the periscope

19. The procedure is similar to that used when mounting the daylight sight (see Chapter 6, Section 3) except that the IR power supply and the eyepiece heater switch, on the cupola services switch box No. 3, must be set to the OFF position.

Servicing

20. The servicing will be carried out in accordance with the Chieftain Servicing Schedule; the procedure to be used is the same as described in Chapter 6, Section 2, paras 26, 27, 28 of this pamphlet.

SECTION 3 – LIGHT PROJECTOR NO. 2, MK 3 AND SPOTLIGHT No. 2, MK 1

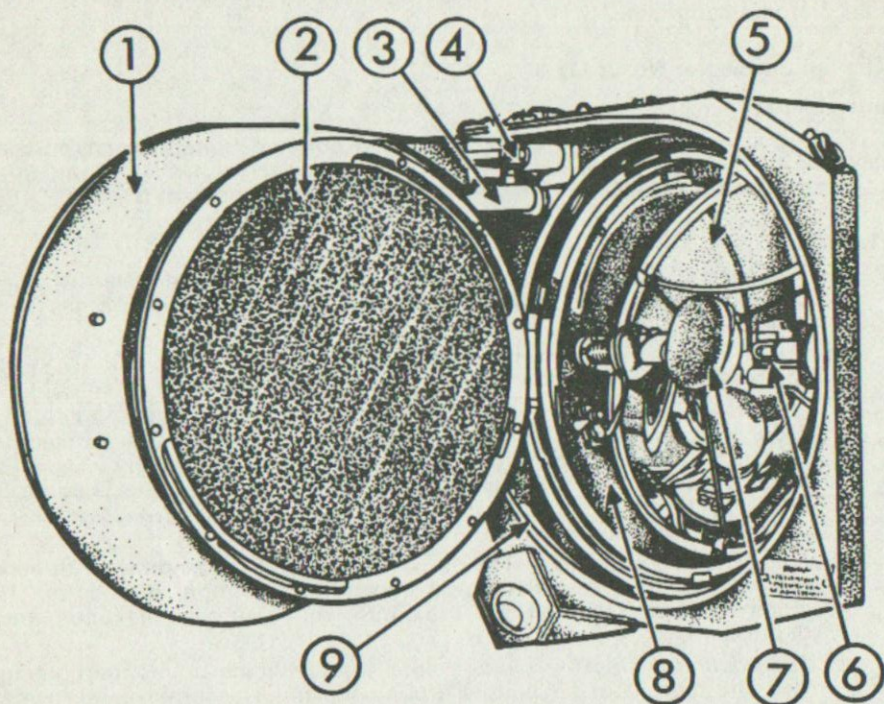
WARNING:- Part of the lamp in the light projector contains a radio active material. Should the lamp become damaged, a hazard may be created. If damage does occur the procedure for dealing with the lamp is covered in Part 2 of this pamphlet.

The light projector No. 2, Mk 3**Introduction**

1. The unit is encased in a lightly armoured box and bolted directly to the left side of the turret. The lamp will normally produce a 2 KW output; this can be increased to 3KW, but only for a period of 10 seconds at a time.

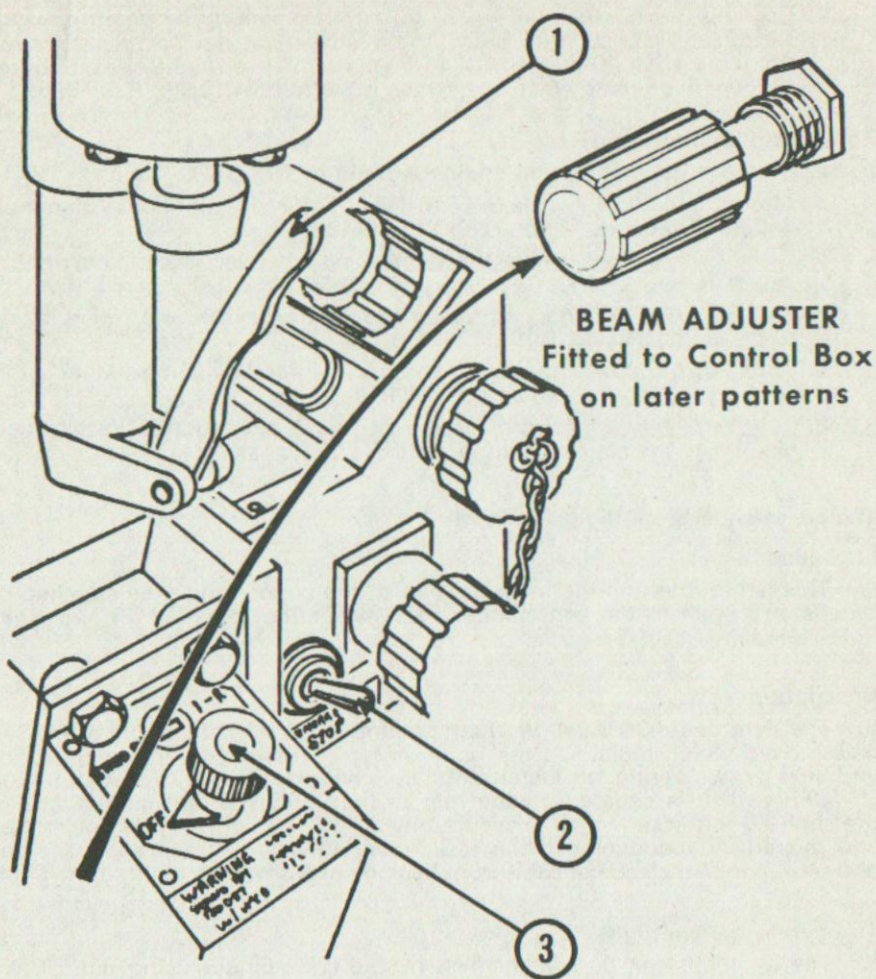
Description (See Fig 72)

2. a. *The case* – This is bolted to the left of the turret, externally. It has a pivoted armoured door which opens to the right to allow the passage of IR light.
- b. *The IR door* – This is mounted under the armoured door and pivots to the right to open. When opened, it allows the passage of white light.
- c. *The inner assembly* – This consists of an Xenon filled arc lamp mounted in front of a curved mirror. The lamp is started by an electrical surge causing a spark to cross the gap of the Xenon lamp. There is a servo control system linked to the inner assembly and this is controlled from the gunner's sight mount. The inner assembly is covered by a plate glass assembly.
- d. *The elevation gearbox* – This is part of the inner assembly. It directs the movement of the lamp and mirror for elevation. Rubber buffer stops are fitted to limit the maximum movement in elevation and depression.
- e. *The cooling system* – This is a small motor which drives the cooling fan. The current of air passes around the inner assembly and inside the IR door to maintain a steady temperature. There are two inlet/outlet openings in the casing. Cover plates are provided for these openings. The cover plates will normally remain in a stowed position on the case, they must not be fitted over the openings when the projector is switched on.
- f. *The servo control and beam adjuster* – The servo control transmitter is mounted on the left of the sight mount. When the light projector is switched on, the transmitter passes an electrical signal to the projector and the beam will move to the same angle as the sight mount. Mounted on the fixed grip or the control box unit, is a beam adjuster which moves the beam independently of the sight mount.
- g. *The control box unit* – This is mounted on the rear of the turret services junction box. On top of the box is a four position switch, OFF, STANDBY, IR and WH. The STANDBY position should not be used for more than five minutes otherwise the inner assembly will overheat. When the switch is moved to the IR position, the armoured door will open. When moved to WH (white) the IR door opens. If the switch is



1. Armoured door
2. IR door
3. Armoured door push rod
4. IR door push rod
5. Curved mirror
6. Xenon lamp
7. Heat shield
8. Plate glass assembly
9. Case

Fig 72 - Light projector, No. 2, Mk 3



1. Cupola traverse handle lever
2. Main engine emergency stop
3. Four position switch

Fig 73 - Control box unit

pressed down, when set to the IR or WH position, the beam power is increased from 2KW to 3KW. The switch must not be pressed down for more than 10 seconds at a time. A small red light on the control box will illuminate when the switch is set to STANDBY. (See Fig 73.)

To operate the light projector

3. a. Start the generating unit engine and put it ON LOAD.
- b. Move the control switch to STANDBY. The red light should illuminate within 10 seconds, if not, report to REME.
- c. *To obtain IR light*, move the control switch one click to the right to select IR.
- d. *To obtain white light*, pull up on the control switch and move it fully to the right to select WH.
- e. *To boost the power*, press down on the control switch in either the IR or WH position for a maximum of 10 seconds.
- f. *To switch the light projector off*, rotate the control switch anti-clockwise one stage at a time, until the OFF position is selected.

The commander's spotlight No. 2, Mk 1

Introduction

4. This is mounted on the movable part of the cupola ring. It is attached by means of a shaft to the commander's MG mounting. It has an IR and white light capability.

Description

5. The light has a 24 V 200 W Quartz Iodine lamp. At the front is a diffused glass shield which is held to the body by four screws. Fitted over the glass and held by two spring clips is an IR filter. A handle, fitted with a push button ON/OFF switch, is situated on the rear of the light. The light is attached to the shaft by a bracket which is secured by a pin. The light can be unclamped and moved independently of the MG mounting over a small angle for line and elevation. An electrical cable supplies power from the cupola to the light.

To operate the spotlight

6. The spotlight can be switched on by the commander using one of two switches.
 - a. *Externally* – Press down on the switch on the handle of the spotlight. The light will remain ON as long as pressure is maintained on the switch.
 - b. *Internally* – Move the spotlight ON/OFF switch, situated on the cupola services switch box No. 2, to the ON position.

Testing and servicing the infra red lights.

7. The testing of the infra red equipment will be carried out at night or in a darkened hangar.

To test the operation of the light projector

8.
 - a. Start the generating unit engine and put it ON LOAD.
 - b. Set the control switch to STANDBY; if the red light does not illuminate, report to REME.
 - c. Ensure that the cooling fan is operating by checking the outlet opening.
 - d. Check that the armoured and IR doors open and close when the control switch is operated.
 - e. Check that the beam of the light projector moves when the gun is elevated and depressed.
 - f. Test the boost operation.
 - g. Test that the beam adjuster aligns the beam with the sight when APDS dot 1 is laid on to a target at not less than 200 metres; repeat the test using ranging gun dot 4.
 - h. If any faults are found, report to REME.

To test the IR filters

9.
 - a. Switch on the light projector and select IR.
 - b. From a position which is not in a direct line with the beam, check that no white light can be seen. If white light is showing, a temporary repair can be carried out.
 - c. From a position 100 metres from the light projector, check if a reddish brown glow can be detected. This indicates a defective filter which must be changed.
 - d. Switch on the commander's spotlight and repeat the test as described in sub-para **b.** and **c.** above.

Servicing**To clean the light projector**

10.
 - a. Start the generating unit engine and put it ON LOAD.
 - b. Switch on the light projector, select IR.
 - c. Switch off the generating engine unit; the armoured door remains open but the light will go out.
 - d. Clean the outer surface of the IR filter with a damp clean soft cloth.
 - e. Rotate the control switch to the OFF position.
 - f. Start the generating unit engine and put it ON LOAD. The armoured door will close.
 - g. Switch on the light projector; select WH.
 - h. Switch off the generating unit engine; the armoured and IR doors will remain open but the light will go out.
 - j. Clean the inner surface of the IR filter and the front of the glass assembly with a damp clean soft cloth.
 - k. Rotate the control switch to the OFF position.
 - l. Start the generating unit engine and put it ON LOAD. Both doors will close.

To clean the spotlight

11. a. Remove the IR filter.
- b. Clean the filter and the glass shield with a clean damp soft cloth.

To change the lamp in the spotlight

12. a. Remove the IR filter.
- b. Remove the four screws and remove the glass shield.
- c. Slacken the knurled boss at the front of the lamp holder and remove the lamp.
- d. Using the paper sleeve, insert one end of the new lamp into the holder, ensuring it is located on the contact stud.
- e. Line up the other end of the lamp with the knurled boss and tighten the knurled boss finger tight.
- f. Position the seal; replace the glass shield and the IR filter.

To carry out a temporary repair to an IR filter

13. Repairs to the light projector IR filter will be carried out on the inner surface only. Repairs to the spotlight IR filter will be carried out on the outer surface only. The repair will be carried out as follows:-

- a. Cut three pieces, from a roll of insulating tape, large enough to give at least a half inch overlap all round the scratch, and place them one on top of the other, over it.
- b. Test the IR filter.
- c. Report to REME that temporary repairs have been carried out.

To change a fuze (150 A link type) in the turret distribution box

14. a. Rotate the control switch to the OFF position.
- b. Set the hull master switch to the OFF position.
- c. Remove the front cover on the turret distribution box.
- d. Slacken the nuts securing the fuze link and remove the link.
- e. Ensure the contact faces are clean and free from burrs.
- f. Fit a new 150 A fuze then replace the front cover plate. (The fuze is the third from the left.)
- g. Test the light projector. If the fuze blows again, report to REME.

To reset a circuit breaker (CB-3, 4, 6 - turret distribution box)

15. a. Rotate the control switch to the OFF position.
- b. Press the button of the circuit breaker to reset it.
- c. Test the circuit. If the circuit breaker trips again, report to REME.

SECTION 4 - INFRA RED DETECTOR

Introduction

1. The equipment will give a visual and, if required, an audible warning when IR rays strike the vehicle. The detector is mounted behind the cupola and is connected to a control box inside the turret.

Description (See Fig 74)

2. a. *The detector stalk* – This is mounted on a multi pin socket behind the cupola. When the stalk is not fitted, the socket is covered. The stalk is flexible and fitted to the top is the detector head. Housed in the head are three photo electric cells. Each cell is arranged so that the three cover 6400 mils. The cells are covered by an IR filter.
- b. *The control unit* – This is mounted forward of the light projector control box. On the top of the box are the power ON/OFF switch, an alarm lamp, three sensing switches marked left, front, right and, on the right of the box, the sensitivity control
- c. *The remote warning unit* – This is mounted on the inside left wall of the turret adjacent to the loader's position. It contains an alarm lamp and a buzzer ON/OFF switch.
- d. *Fuzes* – The detection equipment is protected by a 1 amp cartridge type fuze, housed in the emergency crew control junction box to the right and below the light projector control box, and a 10 amp cartridge type fuze in the radio junction box.

To mount and dismount the detector stalk

3. a. *To mount*
 - (1) Ensure that all relevant switches are set to the OFF position.
 - (2) Lift and rotate the socket cover.
 - (3) Place the detector into the socket and secure it.
- b. *To dismount*
 - (1) Switch off all relevant switches.
 - (2) Unscrew and remove the detector.
 - (3) Cover the socket with the cover. Stow the detector stalk in the driver's compartment.

To operate the detector unit**To switch on**

4. a. Set the hull and radio master switch to the ON position.
- b. Rotate the sensitivity control fully clockwise.
- c. Set the power switch to the ON position.
- d. Set the buzzer switch to BUZZER.

To adjust the sensitivity

5. a. Rotate the sensitivity control, one click at a time anti-clockwise, until the alarm lamps illuminate and the buzzer operates.
- b. Adjust the brilliance of the alarm lamps by rotating the lamp covers.
- c. Set the buzzer switch to the OFF position.
- d. Rotate the sensitivity control, one click at a time clockwise, until the lamps extinguish. Then rotate the control clockwise a further two clicks.
- e. Set the buzzer switch to the BUZZER position.

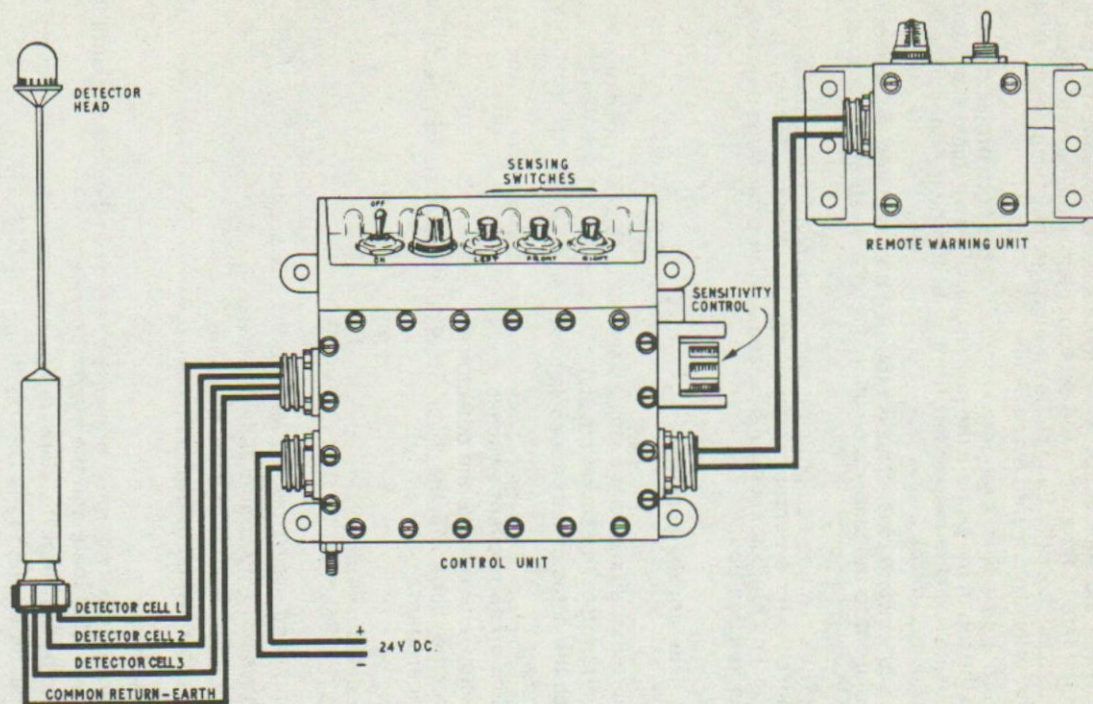


Fig 74 - Infra-red detector equipment

- f. If the sensitivity is adjusted on a bright night, and later the conditions change, the sensitivity will be affected. Under changing conditions, the sensitivity adjustment will have to be carried out frequently.

To determine the direction of warning signals

6. a. The alarm lamps illuminate and, if switched on, the buzzer will operate when a warning is received.
- b. Set the buzzer switch to the OFF position.
- c. Operate the sensing switches in turn. If, when the switch is operated, the alarm lamps go out, the warning is not coming from that direction.
- d. If the alarm lamps stay on when a switch is pressed, the warning must be coming from the centre of that area.
- e. If the alarm lamps stay on when two switches are pressed (in turn, never together), the warning is reaching two detector cells; this is the condition most frequently met. Turn the sensitivity control clockwise one click at a time, thus reducing progressively the sensitivity of the detector. After each click, check both switches; the one covering the sector that gives a warning, under the least sensitive condition, indicates the direction from which the warning is coming.
- f. If the alarm lamps stay on when all three switches are pressed, this may be due to a change in the conditions and the sensitivity must be readjusted.

Servicing

7. a. *The detector stalk*
 - (1) Clean the filter with a soft clean damp cloth.
- b. *To change a bulb in the alarm lamp*
 - (1) Switch off the detector.
 - (2) Unscrew the cover by turning the metal base ring.
 - (3) Remove the old bulb and fit a new one.
 - (4) Replace the cover.
 - (5) Test by switching on the detector. If the lamp still fails to illuminate, report to REME.
- c. *To change a fuze*
 - (1) Switch off the detector.
 - (2) Unscrew the fuze carrier and remove the old fuze.
 - (3) Fit a new fuze into the carrier.
 - (4) Switch on and test; if the detector still fails to operate, report to REME.

CHAPTER 10 – THE SMOKE GRENADE DISCHARGER

SECTION 1 – INTRODUCTION

General

1. There are two smoke grenade dischargers, No. 9, Mk 1, one fitted on either side of the front of the turret. They are mounted in a position which gives the grenades a lateral spread of 1812 mils at a range of 60 metres when both dischargers are fired together. The dischargers are operated electrically from firing buttons, one for each discharger, from inside the turret.

Purpose

2. The smoke grenade dischargers are designed to provide an immediate screen of short duration, at short range, for self-protection. For example, in a surprise encounter at close range.

SECTION 2 – DESCRIPTION

The discharger

1. Each discharger is a single casting and contains six grenade cups. The cups are fitted with a male adaptor which forms part of the electrical jack-type connection with the self-projecting grenade. There is a drain hole at the lowest point in each cup.
2. The dischargers are connected electrically to the firing button switch box situated to the right front of the commander's position.
3. When not in use, the dischargers are protected by canvas covers.
4. The electrical circuit for the dischargers is protected by CB-8 on the turret services junction box.

The grenade

5. The grenade contains the female part of the electrical connection, a fuze and a propelling charge. The types of grenades used are the L5 white, the L7 green, the L8 phosphorus smoke.

Operation

6. The grenades are discharged from the cups through the medium of an electric fuze and a charge of gun powder. The gun powder charge performs two functions:-
 - a. Igniting the main filling composition in the grenade.
 - b. Building up pressure to eject the grenade from the cup.
7. Rapid emission of smoke should commence immediately after the grenades leave the discharger.

SECTION 3 – HANDLING

To load

1.
 - a. Remove the canvas covers, if fitted.
 - b. Set the turret safety switch to the SAFE position, to prevent the turret being traversed.

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- c. Ensure that the electrical connections are clean; insert the grenades, pressing them into engagement with the cup adaptors.
- d. Set the turret safety switch to the LIVE position.

To fire

2.
 - a. Set the hull master switch to the ON position.
 - b. Press either one or both firing buttons as required.

To unload

3.
 - a. Set the turret safety switch to the OFF position.
 - b. Remove the grenades and stow them.
 - c. Set the turret safety switch to the LIVE position.
 - d. Fit the canvas covers to the dischargers.

SECTION 4 - SERVICING

Equipment required

Clean cloth and oil
Adaptor, firing circuit
Circuit tester
Piece of stiff wire

Cleaning

1.
 - a. Using the stiff wire, clear the drain hole in the discharger cup.
 - b. Dry and lightly oil the discharger cups inside and out.
 - c. Check all electrical connections.

To test the electrical circuit

2.
 - a. Set the hull master switch to the ON position.
 - b. Fit the circuit tester to the adaptor, firing circuit.
 - c. Fit the adaptor, firing circuit, to the electrical connection in the discharger cup. Earth the adaptor against the side of the discharger cup.
 - d. Press the appropriate firing button; the bulb should illuminate; if the bulb does not illuminate, check the circuit breaker; if this is correct, report to REME.
 - e. Repeat this procedure for each discharger cup.

CHAPTER 11 – AMMUNITION

SECTION 1 – 120-MM AMMUNITION

Introduction

1. The ammunition used with the 120-mm gun is of the breech loading type. The projectile and the charge propelling are separate. In order to ignite the charge, an electrically fired vent tube must be fitted into the gun.

Projectiles**Service ammunition**

2. a. *Armour piercing discarding sabot (APDS)* (See Fig 75) – the projectile incorporates a base, cored shot and sabot. The base accommodates the tracer, the nylon driving band and a rubber sealing ring. The cored shot houses the tungsten carbide core. The sabot is made up of the body and three segments which are held in position by a nylon centralizing band. It has a prominent nose on a short squat body with a pronounced shoulder. For recognition it is coloured black.
- b. *High explosive squash head (HESH)* (See Fig 76) – The projectile consists of a hollow steel body fitted with a copper driving band near the base. The nose of the body is recessed and is closed by a nose plug. The base of the projectile is threaded to accept a base adaptor. The base adaptor is made of aluminium alloy and is designed to take the fuze and the tracers. The nose of the projectile is filled with an inert substance, the remainder is filled with high explosive. For recognition, the upper half is coloured yellow, the lower half black.
- c. *Smoke* – The projectile consists principally of an empty HESH projectile. The body is filled with pellets of white phosphorus. The base adaptor is of slightly different construction since there is no tracer fitted. For recognition, it is coloured eau-de-nil with a yellow band positioned at the top of the body.

Practice ammunition

3. a. *Practice discarding sabot (Prac DS)* – The practice projectile is similar to the service projectile but has a mild steel core. For recognition, it is coloured blue.
- b. *Practice squash head (Prac SH)* – The projectile consists principally of an empty HESH projectile. The body is filled with a substitute for high explosive. For recognition, it is coloured blue.

Charges propelling

4. a. *APDS* – The charge bag is circular and made of calico or nitrocellulose/kraft. One end has a one inch tape lifting handle, the other end houses the ignitor pad. The ignitor pad consists of two pieces of red silk, stitched together to form four pockets. The charge itself is made of one bundle of propellant. The charge bag is coloured white and is stamped with the letters APDS in black. The nitrocellulose/kraft charge L4A2 is coloured orange throughout its length and is stamped APDS L4A2 in black.

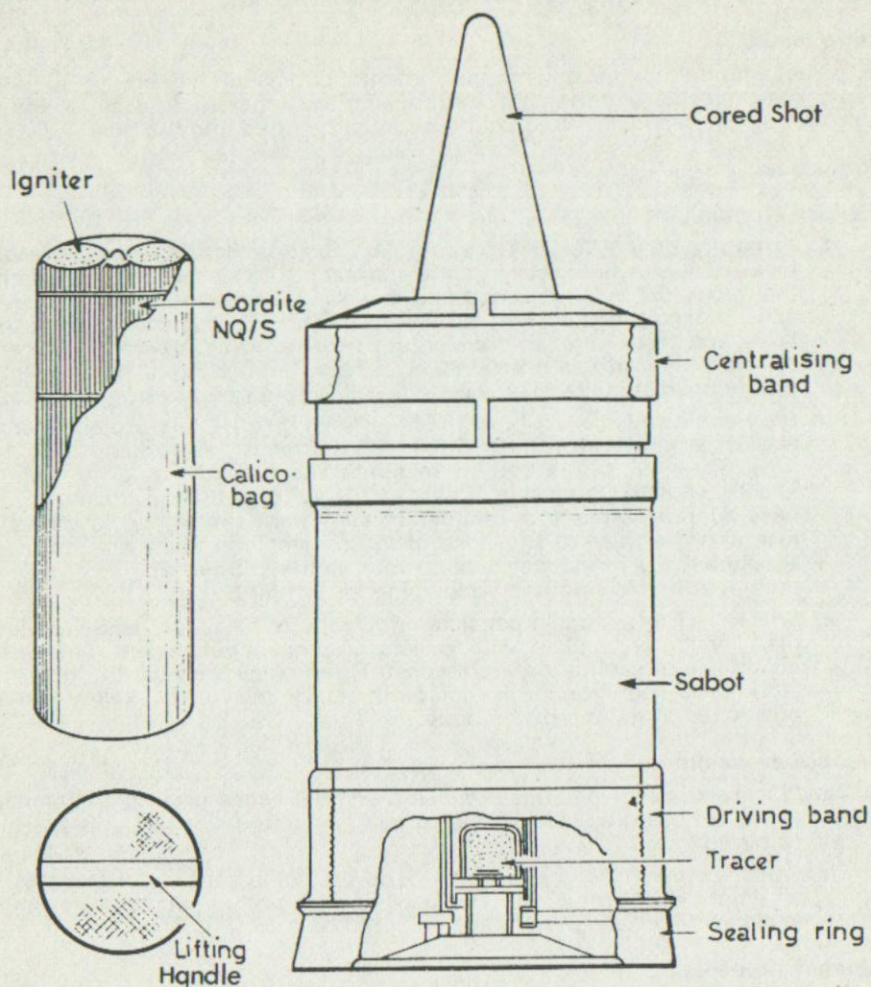


Fig 75 - 120-mm APDS projectile and charge

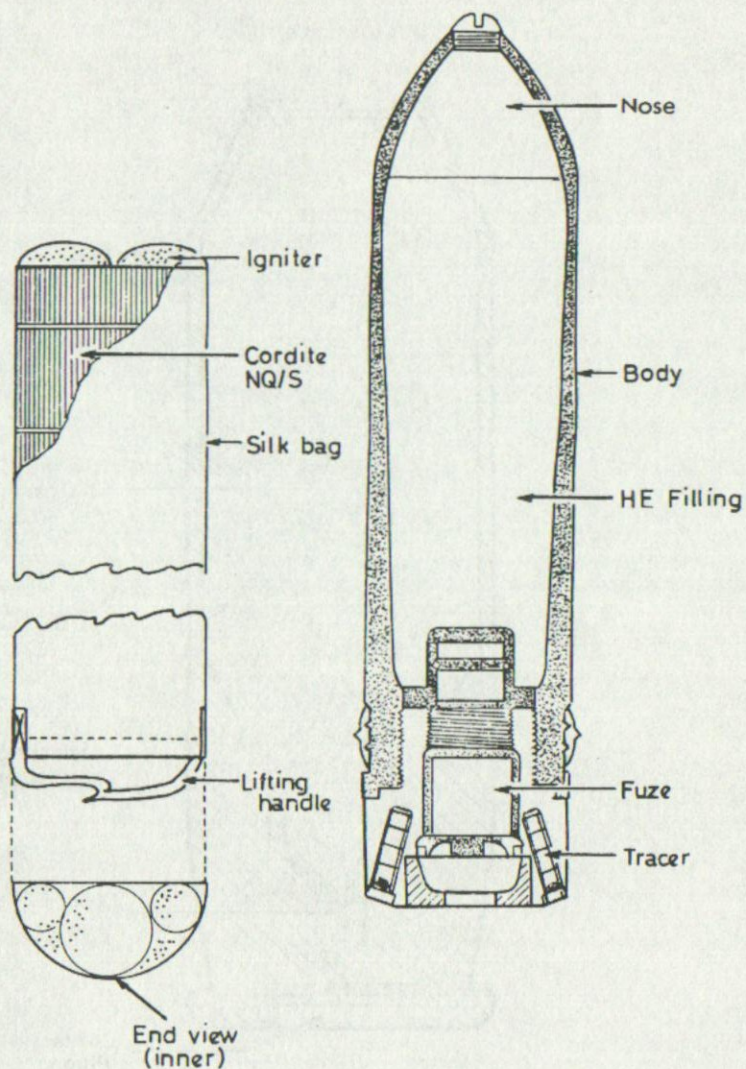


Fig 76 - 120-mm HESH projectile and charge

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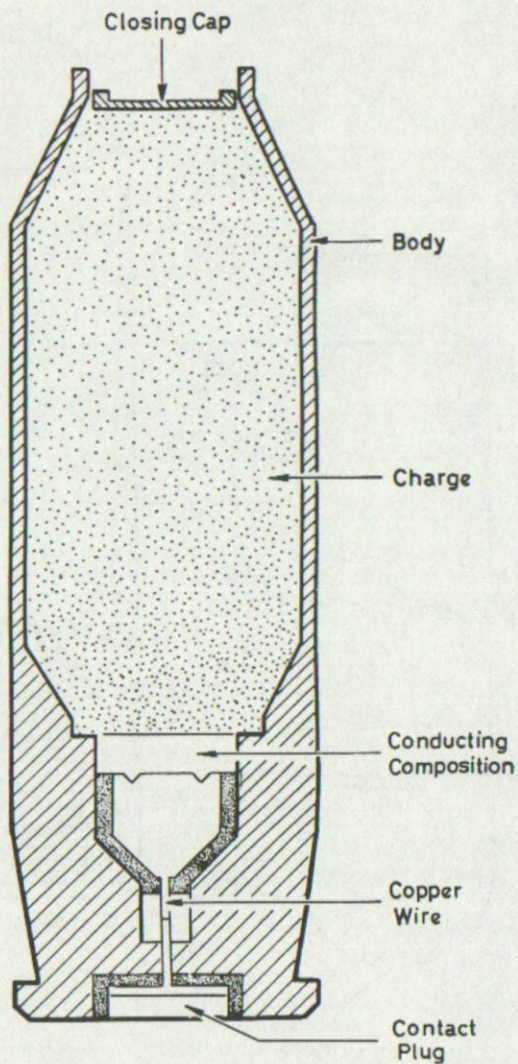


Fig 77 - Tube, vent, electric

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- b. *Practice DS* – The charge used with Practice DS is similar in construction to that described in para a. above. The L5A3 charge may be coloured all blue throughout its length (old system) or be coloured orange with a blue end cap (new system). Both these colour markings are acceptable and cleared for use. The charges are stamped with the letters PRAC DS L5A3 in black.
- c. *HESH – Practice SH – Smoke WP* – The charge bag is semi-circular and made of silk or nitrocellulose/kraft. One end has a one inch tape lifting handle and the other end houses the ignitor pad. The ignitor pad consists of three pockets, two large and one small. The charge itself is made up of bundles of propellant. The charge bag is coloured white or yellow and stamped with the letters HESH, PRAC SH & SMOKE WP. The nitrocellulose/kraft charge bag is rigid and is coated with a waterproof lacquer.

Tube, vent, electric

5. The vent tube consists of a brass body closed at one end by a closure cap. The main part contains a charge of neonite; in the base is a contact plug from which runs a copper wire to the conducting composition positioned below the charge. (See Fig 77.)

SECTION 2 – 50-IN RANGING GUN AMMUNITION

General

1. This ammunition has been specially produced to match the ballistic characteristics of the main armament. The L11A2 ammunition will be used when the 4 dot sight is fitted to the vehicle. The L13A1 ammunition must be used if the extended graticule (9 dot) sight is fitted.

Description (See Fig 78)

2. The two types of ammunition are similar in construction and consist of the following components:-

- a. *The bullet* – This contains an incendiary filling which produces a flash when striking a hard object. A trace, fitted into the base enables the bullet to be observed during flight.
- b. *The case* – This is of the rimless type, made of brass and contains the propellant charge. The bullet is crimped to the case at the front and in the base is a percussion cap.

Recognition

3. The nose of the bullet has a yellow tip and a red band painted on it. The base of the case is engraved with the type and mark of round.

SECTION 3 – SMALL ARMS AMMUNITION

Natures

1.
 - a. Cartridge SA, 7.62-mm, ball.
 - b. Cartridge SA, 7.62-mm, tracer.
 - c. Cartridge SA, 9-mm, ball.

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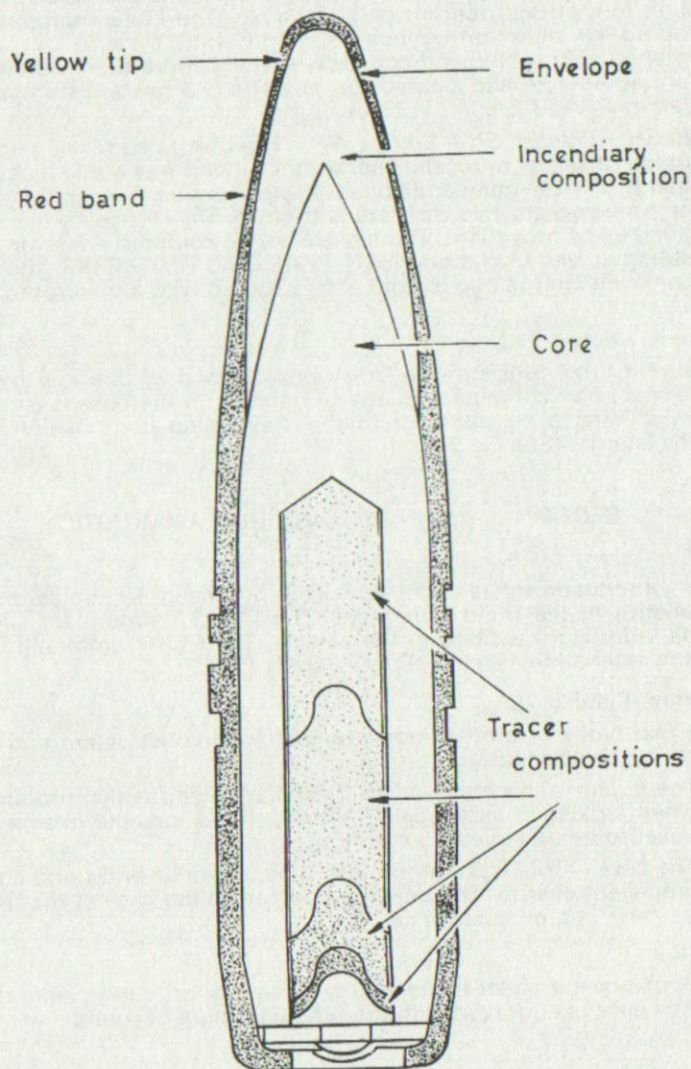


Fig 78 - .50-in ranging gun bullet

Description

Cartridge SA, 7-62-mm, ball

2. The complete round comprises the bullet, cartridge case with percussion cap, and the propellant charge. (See Fig 80).

- a. *The bullet* consists of a metal envelope containing a lead/antimony alloy core and is cannellured near the base for attachment to the case.
- b. *The case*, made of cartridge brass, is provided with a cannellure for extraction; in the base there is a percussion cap. The neck of the case is crimped to the bullet. The annulus of the cap is lacquered dark purple.
- c. *The propellant charge*, which is contained in the case, consists of a quantity of nitrocellulose powder.

Cartridge SA, 7-62-mm, tracer

3. The components, except for the bullet, are similar to those of ball. The annulus of the cap is lacquered red.

- a. *The bullet* consists of a metal envelope containing a lead core and a copper tube containing tracer and priming compositions. The tip of the bullet is coloured red for identification. (See Fig 81).

Cartridge SA, 9-mm, ball, Mk 1Z or Mk 2Z

4. The complete round comprises the bullet, cartridge case with percussion cap, and the propellant charge.

- a. *The bullet* consists of an envelope of either gilding metal or steel coated with cupro-nickel, which encloses a core of lead/antimony alloy.
- b. *The case*, made of cartridge brass, is provided with a cannellure for extraction; in the base there is a percussion cap. The neck of the case is crimped to the bullet. The annulus of the cap is lacquered dark purple.
- c. *The propellant charge*, which is contained in the case, consists of a quantity of nitrocellulose powder.

Recognition

5. The different types of small arms ammunition are identified by the colour of the bullet tip and the annulus on the base of the cartridge:-

- a. *7-62-mm*

Ball	plain tip and purple annulus.
Tracer	Red tip and red annulus.
- b. *9-mm*

Ball	Plain tip and purple annulus.
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6. *Stampings* – The base of the cartridge is stamped with the factory initials, the year of manufacture and mark of round, eg, RG 67 L2A2.

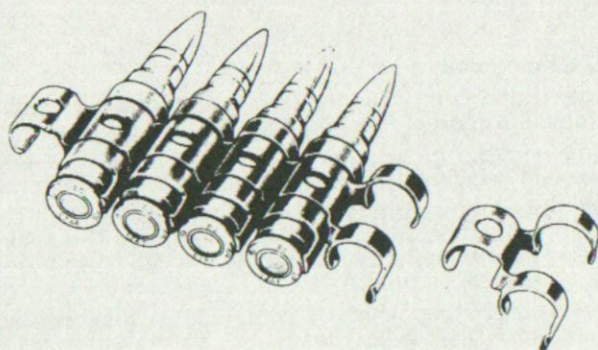


Fig 79 – 7.62-mm Rounds in disintegrating belt

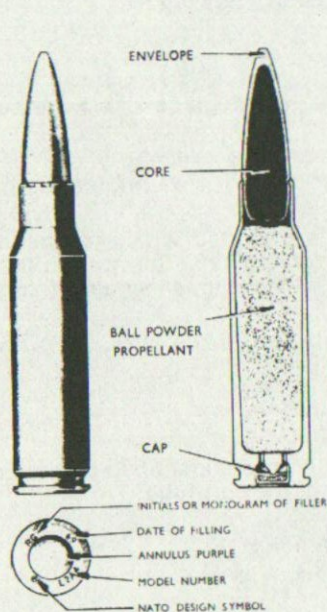


Fig 80 – 7.62-mm Ball

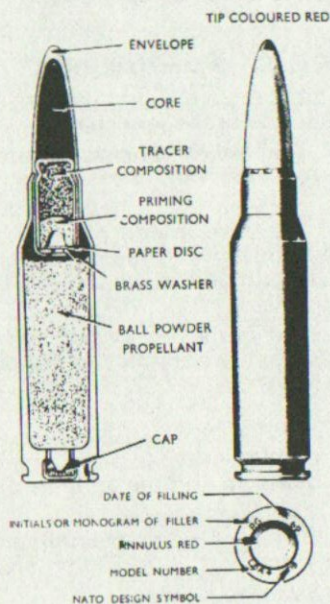


Fig 81 – 7.62-mm Tracer

SECTION 4 – GRENADES

Introduction

1. The grenades carried in the Chieftain fall into two categories, anti-personnel and smoke.

Natures

2. The following grenades may be issued:-
 - a. Grenade, hand, No. 36M.
 - b. Grenade, hand, anti-personnel, L2.
 - c. Grenade, discharger, smoke, screening, L5.
 - d. Grenade, discharger, smoke, screening, green, L7.
 - e. Grenade, discharger, smoke, screening, L8.

Description

Grenade, hand, No. 36M (See Figs 82 and 83)

3. a. *The No. 36M* is an anti-personnel grenade which, on explosion, breaks up into a large number of fragments. The fragments are propelled at high velocity and have a danger zone of approximately 275 metres radius. The grenade is initiated by a detonator assembly which has a four seconds delay.
- b. *The body* is oval and segmented externally to facilitate its breaking into a large number of fragments. A hole in one side, through which HE is filled, is screw threaded to take a closing plug. A threaded hole in the base takes the centre piece and base plug. The centre piece consists of a centre sleeve to accommodate the striker assembly and detonator head. There is also an offset chamber for the detonator proper and, on the outside, a safety lever and retaining pin. The body is painted dark brown and has a red or golden yellow band.
- c. *The detonator Mk 7* – The detonator consists of an aluminium tube containing detonating composition, a length of safety fuze, a cap chamber and a rim fire cap.
- d. *Operation* – The base plug is removed from the grenade, the detonator assembled and the plug replaced. Before throwing, the striker lever is held firmly in position by the hand and the retaining pin is withdrawn. On throwing, the lever is released by the striker spring which reasserts itself and forces the striker down to the rim fire cap. The resultant flame ignites the fuze, which, after four seconds delay, fires the detonator to initiate the HE filling of the grenade.

To prepare the No. 36M grenade for action

4. a. Strip and clean the grenade and striker mechanism.
- b. Reassemble, but do not replace the base plug.
- c. Carry out the striker test as follows:-
 - (1) With the open end of the grenade against the waist belt, release the lever without attempting to control it.

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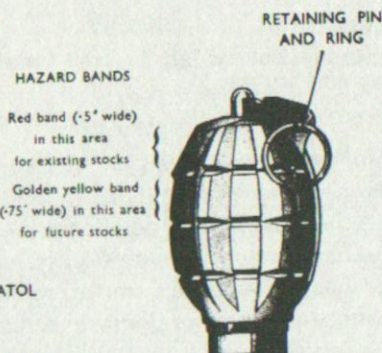
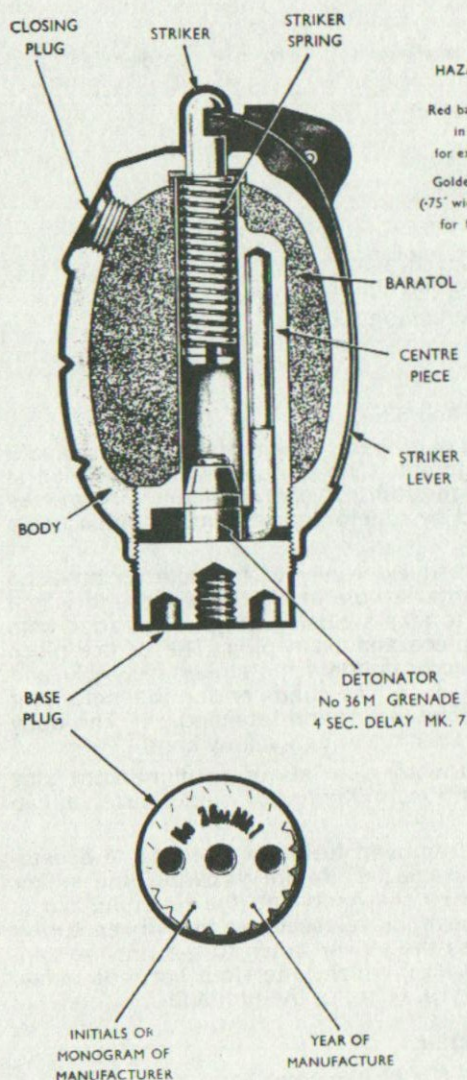


Fig 82 - Grenade, hand, No. 36M, Mk 1

Fig 83 - Detonator, No. 36M Grenade, 4-sec delay, Mk 7

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- (2) The striker should move sharply driven by the spring.
- (3) If the striker moves sluggishly, the cleaning may be insufficient, there is some fault in the grenade, in which case reject it.
- d. Reassemble the striker mechanism.
- e. If the grenade is required in the near future, prime it as follows:-
 - (1) Inspect the detonator to check it is free from dirt etc.
 - (2) Holding the detonator by the cap and fuze, squeeze them together gently.
 - (3) Insert the detonator into the recesses in the base of the grenade and push as far as it will go. (If it will not fit for any reason, reject both grenade and detonator.)

Grenade, hand, anti-personnel, L2 (See Figs 84 and 85)

- 5. a. *The L2 grenade will eventually supersede the grenade, hand, No. 36M. It is initiated by a fuze which gives a 3.8 - 5.5 seconds delay. When exploded a wire coil inside the casing breaks up into a large number of fragments which are propelled at a high velocity. The grenade is capable of causing casualties up to 15 metres; this distance may increase to about 190 metres if the grenade explodes on hard flat ground.*
- b. *The casing is oval shaped; the tinplate body is made in two halves and seamed together. An opening in the top of the casing is screw threaded internally to accept the adaptor of the fuze. A filling hole in the base of the casing is closed by a cap. The HE filling consists of layers of RDX/TNT. The body is painted deep bronze green and has a golden yellow band.*
- c. *The coil is made from steel wire and notched at intervals throughout its length.*
- d. *Fuze, grenade, percussion, L25 - This consists of the striker and adaptor assemblies. The striker assembly comprises a striker with its spring, a striker lever and a retaining pin, all mounted on the fuze body. The adaptor assembly consists principally of a body, containing the percussion cap and the delay composition, together with a detonator.*
- e. *Operation - The fuze is screwed into the threaded hole in the upper portion of the grenade. The striker lever is gripped firmly against the grenade by the throwing hand and the retaining pin removed. On throwing, the striker spring reasserts itself and throws off the striker lever. This brings the striker down sharply on to the percussion cap of the fuze. The flash from the cap ignites the priming composition which ignites the delay pellet. The burning pellet then initiates the detonator to actuate the HE filling in the grenade.*

To prepare the L2 grenade for action

- 6. a. Remove the grenade body from the packing and inspect for any damage.
- b. Remove the striker assembly from the packing and inspect; check that the pin ends are splayed over.

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CHAPTER 12 – 120-MM CHARGE BIN AND AMMUNITION STOWAGE

SECTION 1 – CHARGE BINS

General

1. When stowed inside the vehicle, the charges propelling are positioned inside water jacketed bins which are partitioned with charge containers. Each charge container is fitted with an individual lid and in the bottom of each container there is a spring loaded dashpot. In order to prevent rainwater entering the containers, the charge bin covers must be fitted at all times when the charge bins are not in use.
2. The liquid in the charge bins is held at a pressure of 7 lb/in by two Schröder type valves, one allows the liquid pressure to be built up, the other allows a pressure gauge to be fitted.
3. The purpose of the water jacketed type bin is to minimize the fire risk within the vehicle. The bins are filled and charged by a hand pressurizing kit.

To fill and pressurize, depressurize and empty the charge bins*Equipment required*

Maintenance Kit, Charge Bin (LV9/AHY/2590.99.817.4098) comprising:-

A stirrup pump

Connector pipe

Adaptors for the type of valve fitted

A pressure gauge with bleed hose, shut off cock connector and adaptor

A bin emptying probe complete with hose

A foot pump fitted with gauge, hose, connector and adaptor

A supply of spare dust caps, valve cores and core extractors

A CLEAN five gallon oil drum with opening large enough for a stirrup pump
Coolant mixture of seven parts water to three parts AL3

To check the pressure of the bins

4.
 - a. Remove the protective cover, if fitted, ensure that the top of the bin is clean and that the valve recess hole (in later bins) is not blocked.
 - b. Remove all charges from the bin.
 - c. Remove all dashpots from the containers.
 - d. Remove the dust cap from the BLEED valve; ensure that the shut off cock is closed (lever at 90 degrees to the pressure gauge handle), and fit the pressure gauge connector to the BLEED valve. Screw down the knurled knob on the connector to open the valve.
 - e. Note the pressure reading on the gauge, which should be 7 psi.
 - f. If the pressure is correct, close the valve by unscrewing the knurled knob on the connector and remove the connector. Wipe off any spilt extinguishant from the filler recesses and the tubes.
 - g. Replace the dashpots, charges and lids. Refit the cover.
 - h. Repeat the process on the remaining bins.
 - j. Wipe clean and stow the pressure gauge.

To pressurize a bin

5. If during the checking of the charge bin pressures (see para 4 e.) the gauge indicates below 7 psi, leave the pressure gauge/bleed tube assembly fitted to the bleed valve and proceed as follows:-

- a. Ensure that the five gallon container is clean. Place in the container enough extinguishant to top up and pressurize the bin, and place the container alongside the bin to be pressurized. (The extinguishant consists of seven parts of water to three parts of AL3.)
- b. Remove the stirrup pump from its transit case and insert it into the extinguishant container. Remove the dust cap from the FILL valve and fit the connector on the stirrup pump hose to the FILL valve. Screw the knurled knob on the connector to open the valve.
- c. Lead the bleed tube into the container and open the shut off cock.
- d. Using the stirrup pump, pump until air free extinguishant flows from the bleed tube, indicating that all air has been expelled from the charge bin.
- e. Close the shut off cock and continue pumping until the required 7 psi is reached.
- f. Immediately that 7 psi is reached, unscrew the knurled knob on the filler connector and remove the connector.

NOTE:- If this is not done immediately, then the extinguishant may flow back through the pump and pressure will be lost.

- g. With the shut off cock on the pressure gauge/bleed hose still closed, unscrew the knurled knob on the connector and remove the connector.
- h. Remove any surplus extinguishant from the valve recess and the tubes, and wipe clean.
- j. Replace all dashpots, charges and closures.
- k. Drain any extinguishant from the stirrup pump, pressure gauge and the hoses, and stow the equipment.

To depressurize a bin

6. a. Remove the protective cover, ensure that the top of the bin is clean and that the drain hole in the valve recess (in later bins) is not blocked.
- b. Remove any stowed charges.
- c. Remove all dashpots from the tubes.
- d. Remove the dust cap from the FILL valve, fit the pressure gauge/bleed tube assembly, ensuring that the shut off cock is closed, and screw down the knurled knob on the connector.
- e. Feed the bleed tube into a suitable container, open the shut off cock and allow the pressurized extinguishant to bleed off.

To empty a bin

NOTE:- Charge bins fitted with the ball type valve (stage five) have a built in emptying probe under the FILL valve and do NOT require the probe in the kit to be fitted. In the case of the ball type valves, the pressure gauge/bleed tube is used in its capacity as a bleed tube.

7. The following procedure will be followed when emptying bins fitted with Schrader valves.

- a. When all extinguishant has ceased to flow (see para 6 e.) close down the shut off cock, unscrew the knurled knob on the connector and remove the pressure gauge.
- b. Remove the valve core from the FILL valve and insert the emptying probe into the valve body. Hand tighten the gland nut. Feed the end of the attached bleed tube into a suitable container.
- c. Connect the foot pump to the BLEED valve and screw down the knurled knob on the connector.
- d. Using the foot pump, pump until the extinguishant is all forced from the bin into the container.

NOTE:- With energetic use of the foot pump, it is possible to build up excessive pressure in the charge bin and cause damage; care should therefore be taken to ensure that the pressure registered on the foot pump pressure gauge does not rise above 10 psi.

- e. Unscrew the knurled knob on the connector, and remove the foot pump and probe.
 - f. Remove any spilt extinguishant from the valve recess and tubes, and wipe them dry.
 - g. Replace the valve core into the FILL valve and fit both dust caps.
 - h. Replace the dashpots, charges (if any), closures and protective cover.
 - j. Drain the equipment and stow.
8. The following procedure will be followed when emptying bins fitted with ball type valves:-

- a. When the extinguishant ceases to flow (see para 6 e.), connect the foot pump to the BLEED valve and screw down the knurled knob on the connector.
- b. Using the foot pump, pump until all the extinguishant is forced from the bin into the container. (See note to para 7 c.).
- c. Unscrew the knurled knobs on both the connectors, remove the foot pump and the pressure gauge/bleed hose assembly.
- d. Carry out the operations in sub-para 7 f. to j..

SECTION 2 – AMMUNITION STOWAGE

1. The amount of ammunition carried on Cheiftain is dependent on the mark and state of modification to the vehicle. There are stowage positions on the vehicle for:-

	<i>Mk 2 and 3</i>	<i>Mk 5</i>
a. Charge containers	36	42
b. Projectiles	53	64
c. Vent tubes – 6 magazines	84	84
d. Boxes of .50-in RG	6	3

RESTRICTED

e. Boxes of 7-62-mm MG	30	31
f. Smoke grenades	24	24
g. Anti personnel grenades	6	6
h. Cartridges, signal/illuminating	12	12
j. SMG magazines	14	14

2. The charge containers will accept one APDS charge or two HESH/SMOKE charges.
3. It is possible to vary the proportion of rounds stowed on the vehicle. If, however, more than a certain number of APDS rounds are carried, insufficient charge containers will be available to match the number of HESH/SMOKE rounds.
4. The following ammunition loads are recommended:-
 - a. *Mk 2 and 3 vehicles* (See Fig 90) – 19 APDS, 34 HESH, 30 boxes of 7-62-mm, 6 boxes of .50-in RG.
 - b. *Mk 5 and later vehicles* – There are three suggested loads:-
 - (1) 20 APDS, 44 HESH, 31 boxes of 7-62-mm, 3 boxes of .50-in RG. This loading will mean a lack of APDS in the turret, as 10 APDS projectiles will have to be stowed in the external bin. (See Fig 91).
 - (2) 25 APDS, 34 HESH, 31 boxes of 7-62-mm, 3 boxes of .50-in RG. This loading will mean that five APDS projectiles will have to be stowed in the external bin. (See Fig 92.)
 - (3) 30 APDS, 24 HESH, 31 boxes of 7-62-mm, 3 boxes of .50-in RG. This loading gives a bias to APDS within the turret. (See Fig 93.)

Stowage positions

Main armament

5. The ammunition stowage diagrams shown in Figs 90, 91, 92 and 93 illustrate the positions to be occupied by the various natures of ammunition. The restrictions imposed by certain projectile racks make it necessary to follow the stowage diagrams if a full complement of main armament ammunition is to be stowed.

Stage V charge containers transparent closures

6.
 - a. The stage V charge containers transparent closure comprises a closure disc and a grip ring. The grip ring is located on the disc by three pegs and the two parts are held together by a three-legged star shaped spring.
 - b. In some instances, users try to open the closure by pulling it up, instead of unscrewing it. This pulls the spring through the grip ring and causes the two halves to separate. The closure is specifically designed to separate if a charge ignites in the charge container.
 - c. Users are reminded that the closure should be opened by unscrewing it, but if the two halves do separate:-
 - (1) Undo the nut which holds the spring.
 - (2) Remove spring.
 - (3) Drop grip back on to its locating pegs.
 - (4) Fit spring back on to securing bolt which holds the centre swivel.
 - (5) Replace and tighten nut.

19 APDS 34 HESH

<u>HESH</u>		<u>APDS</u>		7-62	RG
CHARGE	PROJ	CHARGE	PROJ		
⊗	○	⊙	⊗	G	.50

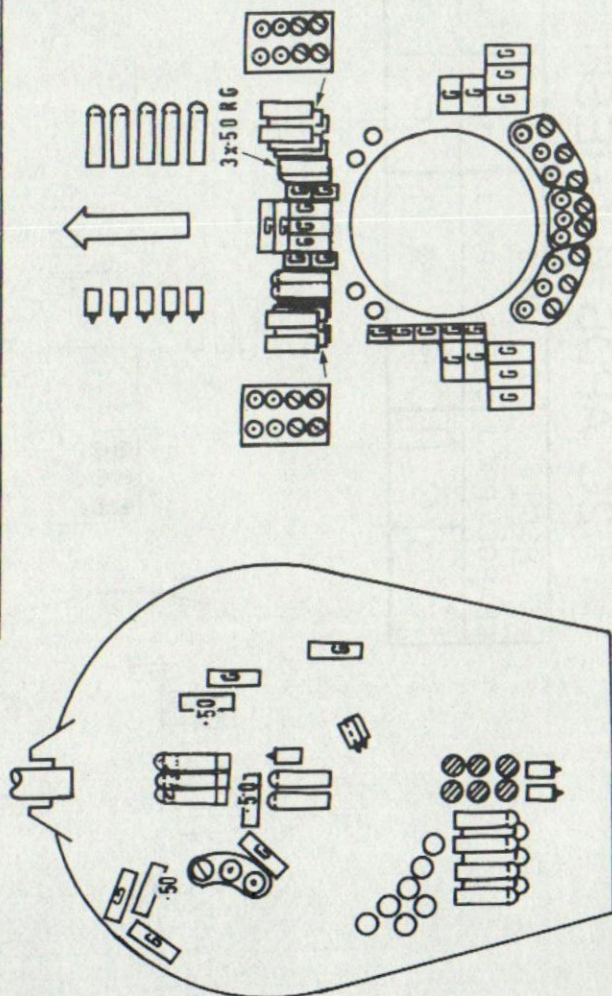


Fig 90 — Stowage of ammunition Mk 2 and Mk 3 vehicles

20 APDS 44 HESH

HESH		APDS			
CHARGE	PROJ	CHARGE	PROJ	762	RG
				G	.50

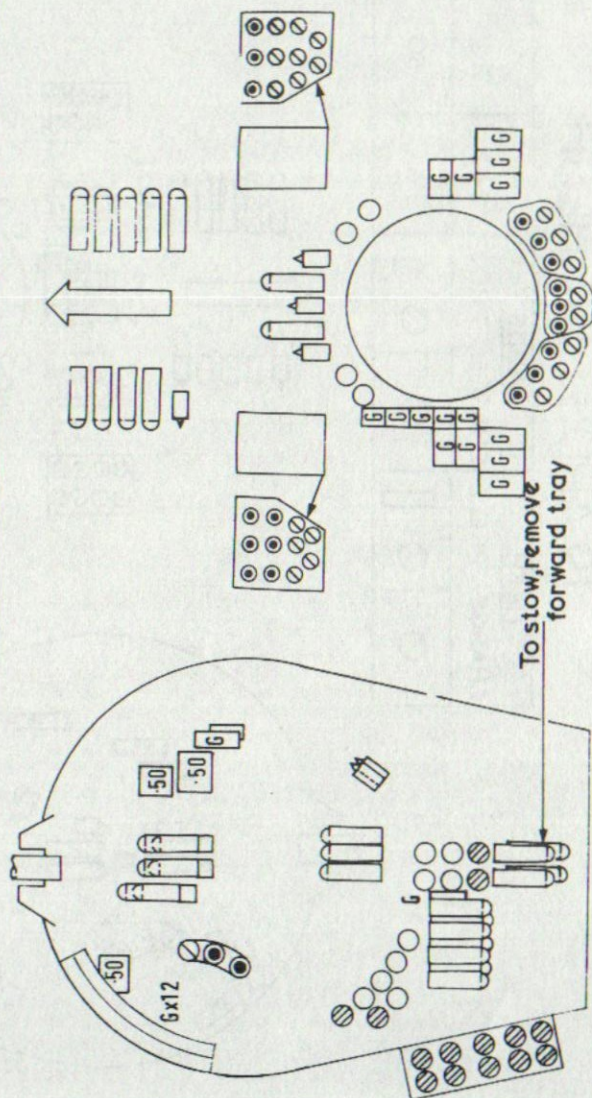


Fig 91 – Stowage of ammunition Mk 5 vehicle

25APDS 34 HESH

<u>HESH</u>		<u>APDS</u>			
CHARGE	PROJ	CHARGE	PROJ	762	RG
⊗	○	●	⊗	G	50
	⌐		⌐		

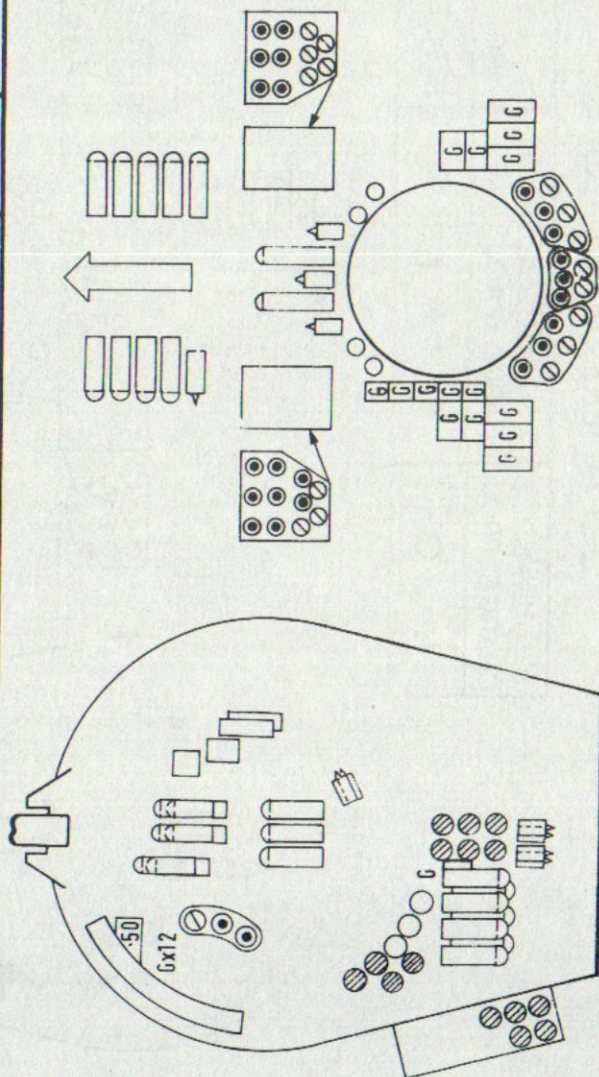


Fig 92 – Stowage of ammunition Mk 5 vehicle

Vent tube magazine

7. The six magazines are stowed on the left side of the turret in a container on the turret sill.

50-in RG and 7-62-MM AMMUNITION

8. The stowage positions for these natures are illustrated on the stowage diagrams. One box of 7-62-mm ammunition is stowed in the ammunition tray for the commander's MG.

Smoke grenades

9. Twelve grenades are loaded in the dischargers, the remaining 12 are stowed in containers on the outside of the turret.

Anti-personnel grenades

10. Three grenades are stowed in a container positioned on the left side of the turret wall. The other three are stowed to the right rear of the commander's position.

Cartridges, signal/illuminating

11 These are stowed in a container to the rear of the commander's position.

SMG magazines

These are stowed in three positions on the turret sill.

CHAPTER 13 – SUMMARY OF ARMAMENT SERVICING

SECTION 1 – INTRODUCTION

General

1. Armament servicing is divided into:-
 - a. Weekly
 - b. Two monthly.
 - c. Immediately before firing.
 - d. During firing.
 - e. Immediately after firing.
2. The correct servicing of the armament is the direct responsibility of the commander.
3. If, during servicing, any defects are discovered their repair out of a serial sequence is left to the commander's discretion.
4. There are points not specifically mentioned which may require occasional servicing. Any controls, catches and hatches which are stiff to operate, clogged with dirt or rusting, should be cleaned and then lubricated with the appropriate oil or grease.
5. Servicing may have to be carried out more frequently in adverse conditions. Circumstances will also affect the type of oils used in extremes of temperature and abnormal weather conditions. Notification of changes will be made to all concerned through normal channels.

SECTION 2 – LUBRICANTS

Oils

1.
 - a. *OM 13*. This is a thin oil for use in the recoil system.
 - b. *OX 18*. This is used for small arms.
 - c. *OM 58*. This is used in the traverse and elevation gearboxes.
 - d. *OMD 75/110*. This is a mineral detergent oil which is used for general cleaning and lubrication.

Greases

2.
 - a. *XG 264*. This is a graphite grease and is used on the fume extractor.
 - b. *XG 279*. This is a general purpose grease.
 - c. *XG 315*. This is a silicone grease.

CHAPTER 14 – GUN DRILL

In order to provide a uniform system of orders and actions for handling the weapons and equipment, the following drills have been devised. These drills must be carried out as laid down in order to:-

- a. Save time and reduce the possibility of misunderstanding an order.
- b. Ensure an automatic reaction to a familiar order.
- c. Reduce the likelihood of injury to the crew.

SECTION 1 – STANDING ORDERS

"Action"

1. The order "Action" will be given by the commander to bring the weapons into a state of readiness. If the smoke grenade dischargers are required to be loaded, this action will be completed by the commander and loader prior to completing the following drills:-

a. *The commander will:-*

- (1) Ensure that there are no obstructions to the muzzle of all weapons.
- (2) Half load the commander's MG; set the MG selector switch to the ON position.
- (3) Ensure that the commander's safety switch is set to the ON position.
- (4) Ensure that the selector switch, on the commander's firing control box, is set to GUNNER.
- (5) Illuminate the PRI and the X1 graticule; adjust the brilliance.

b. *The gunner will*

- (1) Ensure that all necessary lights are switched ON.
- (2) Start the powered laying equipment; eliminate creep as soon as possible.
- (3) Set the gunner's selector switch to the OFF position.
- (4) Ensure that the RG and MG foot pedals are in the DOWN position.
- (5) Ensure that the selector lever, on the gun junction box, is set to NORMAL.
- (6) Set the temperature compensated link bar switch to the ON position.
- (7) Ensure that the trunnion tilt compensator is set to the UNLOCKED position.
- (8) Switch on the TLS (if fitted).

c. *The loader will:-*

- (1) Set the turret safety switch to the SAFE position.
- (2) Ensure that the traverse indicator clutch is engaged.
- (3) Half load the ranging gun and the co-axial MG.
- (4) Open the breech of the 120-mm gun, check that the bore and chamber are clear. Report "Bore clear" or "Bore fouled" as applicable. (See note below.)
- (5) Insert a full magazine into the vent tube loader; pull back the rammer handle; strike the plunger; ensure that the rammer is fully forward.

- (6) Carry out a visual check for any obstruction to traverse.
- (7) Set the turret safety switch to the LIVE position.

NOTE:- The term "Bore clear" indicates that no obstruction is visible throughout the length of the bore and chamber. An obstruction means not only large objects such as cotton waste but also small particles of grit, grease or similar substances. During night firing, the bore must be checked by shining a torch into the barrel from the muzzle and chamber in turn.

d. The driver will:-

- (1) Start the generating unit engine.
- (2) Set the driver's safety switch to the LIVE position.
- (3) Ensure that the driver's hatch is closed.

"Replenish"

2. The commander will order "Replenish" when it becomes necessary to replace the ready rounds from other stowage positions. The loader will warn the commander that replenishment is required when there are only three APDS and three HESH charges available. When the commander orders "Replenish" the loader will carry out the following drill:-

- a. Order the gunner to traverse the turret to the required position.
- b. Set the turret safety switch to the SAFE position.
- c. Replenish the ready round stowage.
- d. If time permits, jettison any links and empty cases.
- e. Fit a full magazine to the vent tube loader.
- f. Set the turret safety switch to LIVE; report "Replenished".

"Check guns"

3. This order will be given by the commander whenever an opportunity exists for the crew to check the weapons. This order may be combined with "Replenish".

a. The loader will:-

- (1) Set the turret safety switch to the SAFE position.
- (2) Lubricate the working parts of the co-axial MG and the ranging gun.
- (3) Ensure that the barrel locking nut catch on the MG is engaged correctly.
- (4) Wipe clean and re-oil any parts of the main armament breech mechanism that have become dirty.
- (5) Check the security of the crank retaining screw and the cam control.
- (6) Set the turret safety switch to the LIVE position.

b. The commander will:-

- (1) Lubricate the working parts of the commander's MG.
- (2) Ensure that the barrel locking nut catch on the MG is engaged correctly.
- (3) Check the security of the thermal sleeve.

"Make Safe"

4. This order will be given by the commander whenever it is necessary to keep loaded guns laid on to an area likely to be occupied by own troops.

a. *The commander will:-*

- (1) Ensure that the commander's MG is half-loaded or, on the No. 8/10 mounting, that the safety catch is set to SAFE.

b. *The loader will:-*

- (1) Set the turret safety switch to the SAFE position.
- (2) Make safe the co-axial MG; report "Co-ax safe".
- (3) Make safe the ranging gun; report "Ranging safe".
- (4) Make safe the main armament; report "Main safe".
- (5) Set the turret safety switch to the LIVE position.

c. *The gunner will:-*

- (1) Set the selector switch to the OFF position.
- (2) Switch off the TLS (if fitted).

"Still"

5. This emergency cry may be given by any member of the crew who observes any defect or hazard likely to imperil them or the vehicle. On hearing this cry the members of the fighting compartment will freeze. The crew member who gave the order will report to the commander the nature of the defect or hazard and the commander will order the appropriate action to be taken. Under most normal conditions the vehicle will be stationary, but should the vehicle be moving, the commander will order the driver to halt, unless of course, this would aggravate the situation. The order "Carry on" is given by the commander after remedial action has been taken.

"Clear guns"

6. This order will be given by the commander when firing is no longer anticipated. When the commander orders "Clear guns", the following drill will be completed by the crew. If the smoke grenade dischargers require to be unloaded, the commander and loader will not attempt to clear them until all other weapons have been cleared.

a. *The commander will:-*

- (1) Unload the commander's MG.
- (2) Set the PRI and X1 graticule switches to the OFF position.

b. *The gunner will:-*

- (1) Ensure that all unnecessary lights are switched OFF.
- (2) Close down the powered laying equipment.
- (3) Set the gunner's selector switch to the OFF position.
- (4) Ensure that the RG and MG foot pedals are in the UP position.
- (5) Set the temperature compensated link bar switch to the OFF position.
- (6) Ensure that the trunnion tilt compensator is set to the LOCKED position.
- (7) Switch off the TLS (if fitted).

c. The loader will:-

- (1) Set the turret safety switch to the SAFE position.
- (2) Unload the ranging gun and the co-axial MG.
- (3) Unload the main armament.
- (4) Report "Guns clear".
- (5) Disengage the traverse indicator clutch.

"Ease springs"

7. The commander will only give this order when he has physically checked that the co-axial MG, ranging gun, vent tube chamber and the main armament bore and chamber are clear of any round or obstruction. When the commander orders "Ease springs", the following drill will be completed by the crew.

a. The commander will:-

- (1) Inform the driver that it is safe to open up.

b. The gunner will:-

- (1) Switch off the maintenance lights.

c. The loader will:-

- (1) Ease springs on the ranging gun and co-axial MG.
- (2) Fit the vent tube loader on to the breech ring and ease springs on the main armament.
- (3) Jettison all empty cases and links.

Safety precautions

To minimise the fire hazard

8. **a. The commander will:-**

- (1) Ensure that the lids of the charge bins are kept CLOSED.
- (2) Except during servicing, ensure that the battery terminal and other electrical covers are fitted at all times.

To reduce the likelihood of injury to crew members when powered laying equipment is to be operated.

9. **a. Crew members must be in their correct stations, where applicable.**

- b. No part of the body is to be within the swept area of the gun both for elevation and traverse.**

SECTION 2 - 120-mm MISFIRE DRILL

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
1	1. Gun fails to fire. <i>Firing needle assembly indicator pin not protruding.</i>	2. Report "Misfire" and check that the selector switch is set to MAIN, that the indicator light glows and that the circuit breakers are intact.	3. Check that the turret safety switch is set to LIVE. 4. Check that the firing guard is fully to the rear. 7. Set the turret safety switch to SAFE. 8. Restow the projectile that is being held; open the firing guard. 9. Remove the firing needle assembly. 10. Place a vent tube on the firing needle assembly. 11. Replace the firing needle assembly. 12. Change the vent tube magazine. 13. Pick up the projectile.	5. Check that the commander's selector switch is set to GUNNER. 6. Check the firing needle assembly indicator. Report "No vent tube".	If the commander's selector switch is NOT set to GUNNER the gunner's firing circuit will not operate.

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
		17. Relay, report "Firing now" and fire.	14. Pull the firing guard to the rear. 15. Set the turret safety switch to LIVE. 16. Report "Loaded".		The gun fires.
2	1. Gun fails to fire. <i>Firing needle assembly indicator pin protruding.</i>	2. Report "Misfire" and check that the selector switch is set to MAIN, that the indicator light glows and that the circuit breakers are intact. 8. Relay, report "Firing now" and fire.	3. Check that the turret safety switch is set to LIVE. 4. Check that the firing guard is fully to the rear. 7. Report "Loaded".	5. Check that the commander's selector switch is set to GUNNER. 6. Check the firing needle assembly indicator. Report "Indicator out".	If the commander's selector switch is NOT set to GUNNER, the gunner's firing circuit will not operate. The gun may fire.
3	1. Gun still fails to fire.	2. Report "Misfire". 3. Set the selector switch to EMERGENCY and report "Emergency on".			

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
		4. Relay and report "Fire".		5. Report "Firing now" and press the emergency firing button.	The gun may fire.
4	1. Gun still fails to fire.	3. Set the selector switch to NORMAL and report "Emergency off".	4. Restow the projectile that is being held.	2. Order "Misfire, wait thirty minutes, emergency off".	
THE CREW WILL NOW WAIT FOR 30 MINUTES					
			5. Set the turret safety switch to SAFE. 6. Open the firing guard. 7. Remove the firing needle assembly. 8. Remove the vent tube and determine whether or not the tube has been fired.		Complete serial 5 or 6, dependent on the condition of the vent tube.
5	1. Vent tube fired.		2. Discard the fired vent tube. 3. Replace the firing needle assembly.		

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
			4. Remove the magazine from the vent tube loader. 5. Open the breech; remove and discard the charge. 6. Fit the vent tube magazine and ram a vent tube. 7. Load a new charge; close the breech. 8. Select the next projectile. 9. Pull the firing guard to the rear. 10. Set the turret safety switch to LIVE. 11. Report "Loaded".	13. As soon as possible, check charge containers for leaks.	The gun fires.
6	1. Vent tube NOT fired.	12. Relay, report "Firing now" and fire.	2. Fit the circuit tester to the firing needle assembly. 3. Replace the firing needle assembly.		

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
7	1. The circuit tester illuminates.	6. Report "Firing now" and press the firing switch.	<p>4. Pull the firing guard to the rear.</p> <p>5. Set the turret safety switch to LIVE; report "Check circuit".</p> <p>7. Determine whether or not the circuit tester illuminates.</p> <p>2. Open the firing guard.</p> <p>3. Remove the firing needle assembly; remove the circuit tester.</p> <p>4. Place a vent tube on the firing needle assembly.</p> <p>5. Replace the firing needle assembly.</p> <p>6. Select the next projectile.</p> <p>7. Pull the firing guard to the rear.</p> <p>8. Check that the turret safety switch is set to LIVE.</p>		Complete serial 7 or 8, dependent on the result of the test.

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
		10. Relay, report "Firing now" and fire.	9. Report "Loaded".		The gun fires.
8	1. The circuit tester does not illuminate.	4. Remove the breech ring contact. 5. Fit the spare breech ring contact.	2. Open the firing guard. 3. Remove the firing needle assembly. 6. Fit the circuit tester to the spare firing needle assembly. 7. Fit the spare firing needle assembly. 8. Pull the firing guard to the rear and report "Check circuit". 10. Determine whether or not the circuit tester illuminates.		
9	1. The circuit tester illuminates.	9. Report "Firing now" and press the firing switch.	2. Open the firing guard.		Complete serials 9 and 10, dependent on the result of the test.

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
			3. Remove the firing needle assembly, remove the circuit tester. 4. Place a vent tube on the firing needle assembly. 5. Replace the firing needle assembly. 6. Select the next projectile. 7. Pull the firing guard to the rear. 8. Check that the turret safety switch is set to LIVE. 9. Report "Loaded".		
		10. Relay, report "Firing now" and fire.			The gun fires.
10	The circuit tester does not illuminate.			The commander will report to REME.	

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
			3. Remove the firing needle assembly, remove the circuit tester. 4. Place a vent tube on the firing needle assembly. 5. Replace the firing needle assembly. 6. Select the next projectile. 7. Pull the firing guard to the rear. 8. Check that the turret safety switch is set to LIVE. 9. Report "Loaded".		
10	The circuit tester does not illuminate.	10. Relay, report "Firing now" and fire.		The commander will report to REME.	The gun fires.

- c. He will then complete the loading drill as in para 5 c. above.
7. At the earliest opportunity the vent tube alignment adjustment must be carried out by REME.

Subsequent action

8. At a convenient stage after the stoppage, the discarded magazine should be examined for:-
- a. Correct positioning of the top vent tube.
 - b. Damage to the front of the top vent tube.
 - c. Correct functioning of the springs. Check these by pressing evenly down and then releasing sharply, the springs should reassert themselves immediately and the vent tubes should return to their correct position.
 - d. Damage to the lips of the magazine.
9. If there is any damage to the vent tube then it should be discarded, and if there are any faults to the magazine, it should be exchanged.

SECTION 4 - STOPPAGE DRILLS -50-IN RANGING GUN

General

1. A stoppage on the -50-in ranging gun may be caused by incorrect drills, a failure in the firing circuit mechanism or by an obstruction or a fault within the weapon. Obviously the gun will also stop firing when the ammunition is expended (end of belt). The stoppage will normally be found by the gunner when there is no reaction to his pressing the firing switch. However, the loader may notice that a faulty feed is liable to cause a stoppage. In either case the person concerned will report "Stoppage" and the gunner will not attempt to fire until the appropriate drills have been carried out.

Stoppage drills

2. Stoppage drills are to be carried out in accordance with the tables set out below. The drill in each serial follows numerical sequence.

Serial	Indication	Action by gunner	Action by loader	Remarks	Cause
(a)	(b)	(c)	(d)	(e)	(f)
1	1. Gun fails to fire when the foot firing pedal is pressed for the initial burst.	2. Report "Stoppage" and check that the selector switch is set to MAIN. 4. Relay, report "Firing now" and fire.	3. Check that the turret safety switch is set to LIVE; report "Loaded".	The commander must check that his selector switch is set to GUNNER. The gun fires.	Incorrectly set switches.
2	1. Gun stops firing during an engagement	2. Report "Stoppage". 4. Relay, report "Firing now" and fire.	3. Cock the gun twice and report "Loaded".	The gun may fire.	Defective round.

Serial	Indication	Action by gunner	Action by loader	Remarks	Cause
(a)	(b)	(c)	(d)	(e)	(f)
3	1. Gun fails to fire after the drill in Serial 2 has been completed.	2. Report "Pro-longed stoppage".	3. Rotate the buffer sleeve clockwise. Cock the gun, push the retracting slide handle forward. Open the cover, remove the belt and rounds. Clear the face of the bolt. Check for trapped links. Check the belt and rounds. Remove any damaged rounds or links. Reload and report "Loaded".	The commander must now decide whether to allow the loader to clear the stoppage or to continue the engagement with the main armament and clear the stoppage later.	Trapped links or damaged rounds.
		4. Relay, report "Firing now" and fire.	5. If no fault is found when inspecting the belt, rounds and links, check for an obstruction and for a separated case. Clear the fault. Reload and report "Loaded".	The gun fires. If a separated case is found, the cartridge headspace must be checked.	Obstruction or separated case.
		6. Relay, report "Firing now" and fire.		The gun fires.	

Serial	Indication	Action by gunner	Action by loader	Remarks	Cause
(a)	(b)	(c)	(d)	(e)	(f)
			7. If no fault is found when inspecting for an obstruction or separated case, check the feed mechanism; rectify any fault. Reload and report "Loaded".		Defective feed mechanism.
		8. Relay, report "Firing now" and fire.	9. If no fault is found when inspecting the feed mechanism, change the bolt. Reload and report "Loaded".	The gun fires.	Defective bolt.
		10. Relay, report "Firing now" and fire.		The gun fires.	

SECTION 5 – STOPPAGE DRILLS 7-62-MM – CO-AXIAL MG

General

1. A stoppage on the co-axial MG may be caused by an incorrect drill, a failure in the firing circuit, an obstruction or fault in the gun, or by a misfired round. The gun will also stop firing when the ammunition is expended (end of belt). A stoppage will normally be found by the gunner when there is no reaction to pressing the firing switch. However, the loader may notice that a faulty feed is liable to cause a stoppage. In either case the person concerned will report "Stoppage" and the gunner will not attempt to fire until the appropriate drill has been carried out.

Stoppage drills

2. Stoppage drills are carried out in accordance with the tables set out below. The drill in each serial follows numerical sequence.

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
1	1. Gun fails to fire on pressing firing switch for initial burst.	2. Report "Stoppage". 3. Relay, report "Firing now" and fire using MG foot firing pedal.	Nil	Nil	Incorrectly set switches. Circuit failure.

NOTE:- If it is known that the mechanical firing gear is inoperative or if the gun fails to fire on pressing the foot firing pedal, the gunner will report "Stoppage, switches". The crew must then check the various selector/safety switches applicable to the MG electrical firing circuit and, if necessary, an inspection is to be made of the MG and mounting. When the fault is found and rectified, the gunner will relay, report "Firing now" and fire.

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
2	1. Gun stops firing during an engagement.	2. Report "Stoppage".	4. Belt and rounds correct.	3. Check belt/rounds. Push feed pawl depressor to right. 5. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fires, report "Loaded".	Obstruction which was cleared by drill.
3	1. Gun stops firing during an engagement.	2. Report "Stoppage".	4. Belt and rounds correct. 6. If breach explosion (cook off) occurs, gun must not be handled until it has been examined by REME and ATO.	3. Check belt/rounds. Push feed pawl depressor to right. 5. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fails to fire, cock gun, make safe, report "Wait ten minutes".	

CHAPTER 14 – GUN DRILL

In order to provide a uniform system of orders and actions for handling the weapons and equipment, the following drills have been devised. These drills must be carried out as laid down in order to:-

- a. Save time and reduce the possibility of misunderstanding an order.
- b. Ensure an automatic reaction to a familiar order.
- c. Reduce the likelihood of injury to the crew.

SECTION 1 – STANDING ORDERS

"Action"

1. The order "Action" will be given by the commander to bring the weapons into a state of readiness. If the smoke grenade dischargers are required to be loaded, this action will be completed by the commander and loader prior to completing the following drills:-

a. *The commander will:-*

- (1) Ensure that there are no obstructions to the muzzle of all weapons.
- (2) Half load the commander's MG; set the MG selector switch to the ON position.
- (3) Ensure that the commander's safety switch is set to the ON position.
- (4) Ensure that the selector switch, on the commander's firing control box, is set to GUNNER.
- (5) Illuminate the PRI and the X1 graticule; adjust the brilliance.

b. *The gunner will*

- (1) Ensure that all necessary lights are switched ON.
- (2) Start the powered laying equipment; eliminate creep as soon as possible.
- (3) Set the gunner's selector switch to the OFF position.
- (4) Ensure that the RG and MG foot pedals are in the DOWN position.
- (5) Ensure that the selector lever, on the gun junction box, is set to NORMAL.
- (6) Set the temperature compensated link bar switch to the ON position.
- (7) Ensure that the trunnion tilt compensator is set to the UNLOCKED position.
- (8) Switch on the TLS (if fitted).

c. *The loader will:-*

- (1) Set the turret safety switch to the SAFE position.
- (2) Ensure that the traverse indicator clutch is engaged.
- (3) Half load the ranging gun and the co-axial MG.
- (4) Open the breech of the 120-mm gun, check that the bore and chamber are clear. Report "Bore clear" or "Bore fouled" as applicable. (See note below.)
- (5) Insert a full magazine into the vent tube loader; pull back the rammer handle; strike the plunger; ensure that the rammer is fully forward.

- (6) Carry out a visual check for any obstruction to traverse.
- (7) Set the turret safety switch to the LIVE position.

NOTE:- The term "Bore clear" indicates that no obstruction is visible throughout the length of the bore and chamber. An obstruction means not only large objects such as cotton waste but also small particles of grit, grease or similar substances. During night firing, the bore must be checked by shining a torch into the barrel from the muzzle and chamber in turn.

d. The driver will:-

- (1) Start the generating unit engine.
- (2) Set the driver's safety switch to the LIVE position.
- (3) Ensure that the driver's hatch is closed.

"Replenish"

2. The commander will order "Replenish" when it becomes necessary to replace the ready rounds from other stowage positions. The loader will warn the commander that replenishment is required when there are only three APDS and three HESH charges available. When the commander orders "Replenish" the loader will carry out the following drill:-

- a. Order the gunner to traverse the turret to the required position.
- b. Set the turret safety switch to the SAFE position.
- c. Replenish the ready round stowage.
- d. If time permits, jettison any links and empty cases.
- e. Fit a full magazine to the vent tube loader.
- f. Set the turret safety switch to LIVE; report "Replenished".

"Check guns"

3. This order will be given by the commander whenever an opportunity exists for the crew to check the weapons. This order may be combined with "Replenish".

a. The loader will:-

- (1) Set the turret safety switch to the SAFE position.
- (2) Lubricate the working parts of the co-axial MG and the ranging gun.
- (3) Ensure that the barrel locking nut catch on the MG is engaged correctly.
- (4) Wipe clean and re-oil any parts of the main armament breech mechanism that have become dirty.
- (5) Check the security of the crank retaining screw and the cam control.
- (6) Set the turret safety switch to the LIVE position.

b. The commander will:-

- (1) Lubricate the working parts of the commander's MG.
- (2) Ensure that the barrel locking nut catch on the MG is engaged correctly.
- (3) Check the security of the thermal sleeve.

"Make Safe"

4. This order will be given by the commander whenever it is necessary to keep loaded guns laid on to an area likely to be occupied by own troops.

a. *The commander will:-*

- (1) Ensure that the commander's MG is half-loaded or, on the No. 8/10 mounting, that the safety catch is set to SAFE.

b. *The loader will:-*

- (1) Set the turret safety switch to the SAFE position.
- (2) Make safe the co-axial MG; report "Co-ax safe".
- (3) Make safe the ranging gun; report "Ranging safe".
- (4) Make safe the main armament; report "Main safe".
- (5) Set the turret safety switch to the LIVE position.

c. *The gunner will:-*

- (1) Set the selector switch to the OFF position.
- (2) Switch off the TLS (if fitted).

"Still"

5. This emergency cry may be given by any member of the crew who observes any defect or hazard likely to imperil them or the vehicle. On hearing this cry the members of the fighting compartment will freeze. The crew member who gave the order will report to the commander the nature of the defect or hazard and the commander will order the appropriate action to be taken. Under most normal conditions the vehicle will be stationary, but should the vehicle be moving, the commander will order the driver to halt, unless of course, this would aggravate the situation. The order "Carry on" is given by the commander after remedial action has been taken.

"Clear guns"

6. This order will be given by the commander when firing is no longer anticipated. When the commander orders "Clear guns", the following drill will be completed by the crew. If the smoke grenade dischargers require to be unloaded, the commander and loader will not attempt to clear them until all other weapons have been cleared.

a. *The commander will:-*

- (1) Unload the commander's MG.
- (2) Set the PRI and X1 graticule switches to the OFF position.

b. *The gunner will:-*

- (1) Ensure that all unnecessary lights are switched OFF.
- (2) Close down the powered laying equipment.
- (3) Set the gunner's selector switch to the OFF position.
- (4) Ensure that the RG and MG foot pedals are in the UP position.
- (5) Set the temperature compensated link bar switch to the OFF position.
- (6) Ensure that the trunnion tilt compensator is set to the LOCKED position.
- (7) Switch off the TLS (if fitted).

c. The loader will:-

- (1) Set the turret safety switch to the SAFE position.
- (2) Unload the ranging gun and the co-axial MG.
- (3) Unload the main armament.
- (4) Report "Guns clear".
- (5) Disengage the traverse indicator clutch.

"Ease springs"

7. The commander will only give this order when he has physically checked that the co-axial MG, ranging gun, vent tube chamber and the main armament bore and chamber are clear of any round or obstruction. When the commander orders "Ease springs", the following drill will be completed by the crew.

a. The commander will:-

- (1) Inform the driver that it is safe to open up.

b. The gunner will:-

- (1) Switch off the maintenance lights.

c. The loader will:-

- (1) Ease springs on the ranging gun and co-axial MG.
- (2) Fit the vent tube loader on to the breech ring and ease springs on the main armament.
- (3) Jettison all empty cases and links.

Safety precautions

To minimise the fire hazard

8. **a. The commander will:-**

- (1) Ensure that the lids of the charge bins are kept CLOSED.
- (2) Except during servicing, ensure that the battery terminal and other electrical covers are fitted at all times.

To reduce the likelihood of injury to crew members when powered laying equipment is to be operated.

9. **a.** Crew members must be in their correct stations, where applicable.
- b.** No part of the body is to be within the swept area of the gun both for elevation and traverse.

SECTION 2 - 120-mm MISFIRE DRILL

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
1	1. Gun fails to fire. <i>Firing needle assembly indicator pin not protruding.</i>	2. Report "Misfire" and check that the selector switch is set to MAIN, that the indicator light glows and that the circuit breakers are intact.	3. Check that the turret safety switch is set to LIVE. 4. Check that the firing guard is fully to the rear. 7. Set the turret safety switch to SAFE. 8. Restow the projectile that is being held; open the firing guard. 9. Remove the firing needle assembly. 10. Place a vent tube on the firing needle assembly. 11. Replace the firing needle assembly. 12. Change the vent tube magazine. 13. Pick up the projectile.	5. Check that the commander's selector switch is set to GUNNER. 6. Check the firing needle assembly indicator. Report "No vent tube".	If the commander's selector switch is NOT set to GUNNER the gunner's firing circuit will not operate.

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
		17. Relay, report "Firing now" and fire.	14. Pull the firing guard to the rear. 15. Set the turret safety switch to LIVE. 16. Report "Loaded".		The gun fires.
2	1. Gun fails to fire. <i>Firing needle assembly indicator pin protruding.</i>	2. Report "Misfire" and check that the selector switch is set to MAIN, that the indicator light glows and that the circuit breakers are intact. 8. Relay, report "Firing now" and fire.	3. Check that the turret safety switch is set to LIVE. 4. Check that the firing guard is fully to the rear. 7. Report "Loaded".	5. Check that the commander's selector switch is set to GUNNER. 6. Check the firing needle assembly indicator. Report "Indicator out".	If the commander's selector switch is NOT set to GUNNER, the gunner's firing circuit will not operate. The gun may fire.
3	1. Gun still fails to fire.	2. Report "Misfire". 3. Set the selector switch to EMERGENCY and report "Emergency on".			

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
		4. Relay and report "Fire".		5. Report "Firing now" and press the emergency firing button.	The gun may fire.
4	1. Gun still fails to fire.	3. Set the selector switch to NORMAL and report "Emergency off".	4. Restow the projectile that is being held.	2. Order "Misfire, wait thirty minutes, emergency off".	
THE CREW WILL NOW WAIT FOR 30 MINUTES					
			5. Set the turret safety switch to SAFE. 6. Open the firing guard. 7. Remove the firing needle assembly. 8. Remove the vent tube and determine whether or not the tube has been fired.		Complete serial 5 or 6, dependent on the condition of the vent tube.
5	1. Vent tube fired.		2. Discard the fired vent tube. 3. Replace the firing needle assembly.		

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
			4. Remove the magazine from the vent tube loader. 5. Open the breech; remove and discard the charge. 6. Fit the vent tube magazine and ram a vent tube. 7. Load a new charge; close the breech. 8. Select the next projectile. 9. Pull the firing guard to the rear. 10. Set the turret safety switch to LIVE. 11. Report "Loaded".	13. As soon as possible, check charge containers for leaks.	The gun fires.
6	1. Vent tube NOT fired.	12. Relay, report "Firing now" and fire.	2. Fit the circuit tester to the firing needle assembly. 3. Replace the firing needle assembly.		

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
		6. Report "Firing now" and press the firing switch.	4. Pull the firing guard to the rear. 5. Set the turret safety switch to LIVE; report "Check circuit". 7. Determine whether or not the circuit tester illuminates.		Complete serial 7 or 8, dependent on the result of the test.
7	1. The circuit tester illuminates.		2. Open the firing guard. 3. Remove the firing needle assembly; remove the circuit tester. 4. Place a vent tube on the firing needle assembly. 5. Replace the firing needle assembly. 6. Select the next projectile. 7. Pull the firing guard to the rear. 8. Check that the turret safety switch is set to LIVE.		

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
		10. Relay, report "Firing now" and fire.	9. Report "Loaded".		The gun fires.
8	1. The circuit tester does not illuminate.	4. Remove the breech ring contact. 5. Fit the spare breech ring contact.	2. Open the firing guard. 3. Remove the firing needle assembly. 6. Fit the circuit tester to the spare firing needle assembly. 7. Fit the spare firing needle assembly. 8. Pull the firing guard to the rear and report "Check circuit". 10. Determine whether or not the circuit tester illuminates.		
9	1. The circuit tester illuminates.	9. Report "Firing now" and press the firing switch.	2. Open the firing guard.		Complete serials 9 and 10, dependent on the result of the test.

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
			3. Remove the firing needle assembly, remove the circuit tester. 4. Place a vent tube on the firing needle assembly. 5. Replace the firing needle assembly. 6. Select the next projectile. 7. Pull the firing guard to the rear. 8. Check that the turret safety switch is set to LIVE. 9. Report "Loaded".		
10	The circuit tester does not illuminate.	10. Relay, report "Firing now" and fire.		The commander will report to REME.	The gun fires.

Serial	Indication	Action by gunner	Action by loader	Action by commander	Remarks
(a)	(b)	(c)	(d)	(e)	(f)
			3. Remove the firing needle assembly, remove the circuit tester. 4. Place a vent tube on the firing needle assembly. 5. Replace the firing needle assembly. 6. Select the next projectile. 7. Pull the firing guard to the rear. 8. Check that the turret safety switch is set to LIVE. 9. Report "Loaded".		
10	The circuit tester does not illuminate.	10. Relay, report "Firing now" and fire.		The commander will report to REME.	The gun fires.

- c. He will then complete the loading drill as in para 5 c. above.
7. At the earliest opportunity the vent tube alignment adjustment must be carried out by REME.

Subsequent action

8. At a convenient stage after the stoppage, the discarded magazine should be examined for:-
- a. Correct positioning of the top vent tube.
 - b. Damage to the front of the top vent tube.
 - c. Correct functioning of the springs. Check these by pressing evenly down and then releasing sharply, the springs should reassert themselves immediately and the vent tubes should return to their correct position.
 - d. Damage to the lips of the magazine.
9. If there is any damage to the vent tube then it should be discarded, and if there are any faults to the magazine, it should be exchanged.

SECTION 4 - STOPPAGE DRILLS -50-IN RANGING GUN

General

1. A stoppage on the -50-in ranging gun may be caused by incorrect drills, a failure in the firing circuit mechanism or by an obstruction or a fault within the weapon. Obviously the gun will also stop firing when the ammunition is expended (end of belt). The stoppage will normally be found by the gunner when there is no reaction to his pressing the firing switch. However, the loader may notice that a faulty feed is liable to cause a stoppage. In either case the person concerned will report "Stoppage" and the gunner will not attempt to fire until the appropriate drills have been carried out.

Stoppage drills

2. Stoppage drills are to be carried out in accordance with the tables set out below. The drill in each serial follows numerical sequence.

Serial	Indication	Action by gunner	Action by loader	Remarks	Cause
(a)	(b)	(c)	(d)	(e)	(f)
1	1. Gun fails to fire when the foot firing pedal is pressed for the initial burst.	2. Report "Stoppage" and check that the selector switch is set to MAIN. 4. Relay, report "Firing now" and fire.	3. Check that the turret safety switch is set to LIVE; report "Loaded".	The commander must check that his selector switch is set to GUNNER. The gun fires.	Incorrectly set switches.
2	1. Gun stops firing during an engagement	2. Report "Stoppage". 4. Relay, report "Firing now" and fire.	3. Cock the gun twice and report "Loaded".	The gun may fire.	Defective round.

Serial	Indication	Action by gunner	Action by loader	Remarks	Cause
(a)	(b)	(c)	(d)	(e)	(f)
3	1. Gun fails to fire after the drill in Serial 2 has been completed.	2. Report "Prolonged stoppage".	3. Rotate the buffer sleeve clockwise. Cock the gun, push the retracting slide handle forward. Open the cover, remove the belt and rounds. Clear the face of the bolt. Check for trapped links. Check the belt and rounds. Remove any damaged rounds or links. Reload and report "Loaded".	The commander must now decide whether to allow the loader to clear the stoppage or to continue the engagement with the main armament and clear the stoppage later.	Trapped links or damaged rounds.
		4. Relay, report "Firing now" and fire.	5. If no fault is found when inspecting the belt, rounds and links, check for an obstruction and for a separated case. Clear the fault. Reload and report "Loaded".	The gun fires. If a separated case is found, the cartridge headspace must be checked.	Obstruction or separated case.
		6. Relay, report "Firing now" and fire.		The gun fires.	

Serial	Indication	Action by gunner	Action by loader	Remarks	Cause
(a)	(b)	(c)	(d)	(e)	(f)
			7. If no fault is found when inspecting for an obstruction or separated case, check the feed mechanism; rectify any fault. Reload and report "Loaded".		Defective feed mechanism.
		8. Relay, report "Firing now" and fire.	9. If no fault is found when inspecting the feed mechanism, change the bolt. Reload and report "Loaded".	The gun fires.	Defective bolt.
		10. Relay, report "Firing now" and fire.		The gun fires.	

SECTION 5 – STOPPAGE DRILLS 7-62-MM – CO-AXIAL MG

General

1. A stoppage on the co-axial MG may be caused by an incorrect drill, a failure in the firing circuit, an obstruction or fault in the gun, or by a misfired round. The gun will also stop firing when the ammunition is expended (end of belt). A stoppage will normally be found by the gunner when there is no reaction to pressing the firing switch. However, the loader may notice that a faulty feed is liable to cause a stoppage. In either case the person concerned will report "Stoppage" and the gunner will not attempt to fire until the appropriate drill has been carried out.

Stoppage drills

2. Stoppage drills are carried out in accordance with the tables set out below. The drill in each serial follows numerical sequence.

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
1	1. Gun fails to fire on pressing firing switch for initial burst.	2. Report "Stoppage". 3. Relay, report "Firing now" and fire using MG foot firing pedal.	Nil	Nil	Incorrectly set switches. Circuit failure.

NOTE:- If it is known that the mechanical firing gear is inoperative or if the gun fails to fire on pressing the foot firing pedal, the gunner will report "Stoppage, switches". The crew must then check the various selector/safety switches applicable to the MG electrical firing circuit and, if necessary, an inspection is to be made of the MG and mounting. When the fault is found and rectified, the gunner will relay, report "Firing now" and fire.

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
2	1. Gun stops firing during an engagement.	2. Report "Stoppage".	4. Belt and rounds correct.	3. Check belt/rounds. Push feed pawl depressor to right. 5. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fires, report "Loaded".	Obstruction which was cleared by drill.
3	1. Gun stops firing during an engagement.	2. Report "Stoppage".	4. Belt and rounds correct. 6. If breach explosion (cook off) occurs, gun must not be handled until it has been examined by REME and ATO.	3. Check belt/rounds. Push feed pawl depressor to right. 5. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fails to fire, cock gun, make safe, report "Wait ten minutes".	

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
			7. No breech explosion occurs within 10 minute wait period.	8. After 10 minute wait, ensure working parts are to rear and safety catch is applied. Open cover, remove belt and rounds. Clear gun of rounds or obstruction, then inspect for faults or damage in following sequence. If a fault is found at any stage it should be rectified if possible a. Trapped links. b. Belt and rounds for damage. c. Feed mechanism to include cover, feed tray and bullet guide. d. Remove piston assembly, check for damage, to include feedhorns, extractor, ejector, firing pin and feed roller. 9. If fault rectified, reload, press trigger; if gun fires report "Loaded". 11. If fault cannot be rectified, report to REME.	An obstruction could be a build up of empty cases/links or a round in chamber. If a round is chambered, close cover, attempt to fire. Cock gun, make safe, open cover. If chamber is empty, continue as in para 8 a. If round is still chambered, use tool removing chambered round to clear and continue as at 8 a. if NO TOOL AVAILABLE THEN REPORT TO REME. Should more than one chambered round occur, report to REME to have extractor spring replaced.
		10. Relay, report "Firing now" and fire.			

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
4	1. Gun stops firing during an engagement.	2. Report "Stoppage". 6. Relay, report "Firing now" and fire.	4. No belt/rounds in gun.	3. Check belt/rounds. Push feed pawl depressor to right. 5. Cock gun. Push feed pawl depressor to left. Press trigger. Gun may fire. Clear gun; reload; press trigger. If gun fires, report "Loaded".	Ammunition expended/misfired round. If on opening cover a round is chambered, close cover and attempt to fire. a. If gun fires, clear gun. Then carry out drill as in Serial 3, para 8 above. b. If gun fails to fire, cock gun, make safe, wait 10 minutes, then carry out drill as in Serial 3, para 8 above.
5	1. Gun stops firing during an engagement.	2. Report "Stoppage".	4. Feed pawl depressor will not move.	3. Check belt/rounds. Push feed pawl depressor to right. 5. Attempt to cock gun and make safe. Under some circumstances	

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
				<p>this may not be possible. In either case report "Wait ten minutes".</p> <p>6. After 10 minutes, proceed according to condition of gun:-</p> <p>a. If gun has been made safe, open cover, remove belt and rounds. Clear gun of rounds or obstruction, inspect for faults or damage in following sequence. If a fault is found at any stage it should be rectified if possible.</p> <p>(1) Trapped links. (2) Belt and rounds for damage. (3) Feed mechanism, to include cover, feed tray and bullet guide. (4) Remove piston assembly, check for damage; to include feedhorns, extractor, ejector, firing pin and feed roller.</p>	<p>Note:- If during 10 minute wait period a breach explosion occurs, gun must not be handled until it has been examined by REME and ATO.</p>

Serial	Primary indication	Action by gunner	Secondary indication	Action by loader	Cause/remarks
(a)	(b)	(c)	(d)	(e)	(f)
				<p>b. If gun has NOT been made safe, cock gun as cover is being opened. Failure to do this may result in a round being fired. Make safe and proceed as in para a. above.</p> <p>7. If fault is rectified, reload, press trigger, if gun fires report "Loaded".</p> <p>9. If fault cannot be rectified, report to REME.</p>	
		8. Relay, report "Firing now" and fire.			

NOTE:- If belt and rounds fall away from gun when carrying out stoppage drill, proceed as if belt and rounds are correct, attempt to fire, if gun fires, carry out no belt/rounds drill. If gun fails to fire, cock gun, make safe, report "Wait ten minutes", then proceed as in Serial 3, para 8 above.

SECTION 6 - STOPPAGE DRILLS 7-62-MM - COMMANDER'S MG

General

1. A stoppage on the commander's MG may be caused by an incorrect drill, a failure in the firing circuit, or by an obstruction or a fault in the gun or by a misfired round. The gun will also stop firing when the ammunition is expended, (end of belt). It is appreciated that the drills require the commander to expose himself from the turret. During 'active service' the drill may have to be terminated at the stage when the gun must be handled and therefore the gun will remain out of action until an opportunity to complete the drill presents itself.
2. During open range training, drills will be completed in order to conform with range safety regulations.

Stoppage drills

3. Stoppage drills are to be carried out in accordance with the table set out below. The drill in each serial follows numerical sequence.

Serial	Primary indication	Secondary indication	Action by commander	Cause/remarks
(a)	(b)	(c)	(d)	(e)
1	1. Gun fails to fire on pressing firing switch for initial burst.	3. Selector switch set to OFF.	2. Check selector switch. 4. Select MG, relay and fire.	Incorrectly set switch.
2	1. Gun fails to fire on pressing firing switch for initial burst.	3. Selector switch set to ON. 5. Warning light is not illuminated.	2. Check selector switch. 4. Check if warning light is illuminated. 6. Check circuit breaker, relay and fire.	Circuit failure.
3	1. Gun fails to fire on pressing firing switch for initial burst.	3. Selector switch set to ON.	2. Check selector switch. 4. Check if warning light is illuminated.	Firing gear out of adjustment.

RESTRICTED

RESTRICTED

Serial	Primary indication	Secondary indication	Action by commander	Cause/remarks
(a)	(b)	(c)	(d)	(e)
		5. Warning light is illuminated.	6. Check solenoid core is operating the firing lever. Adjust as necessary. Relay and fire.	
4	1. Gun stops firing during an engagement.	3. Belt and rounds correct.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fires, relay and fire.	Obstruction which was cleared by drill.
5	1. Gun stops firing during an engagement.	3. Belt and rounds correct. 5. If breech explosion (cook off) occurs, gun must not be handled until it has been examined by REME and ATO. 6. No breech explosion occurs within 10 minute wait period.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fails to fire, cock gun, make safe, wait ten minutes.	

Serial	Primary indication	Secondary indication	Action by commander	Cause/remarks
(a)	(b)	(c)	(d)	(e)
			<p>7. After 10 minute wait, ensure working parts are to rear and safety catch is applied. Open cover, remove belt and rounds. Clear gun of rounds or obstruction; inspect for faults or damage in following sequence. If a fault is found at any stage it should be rectified if possible.</p> <p>a. Trapped links. b. Belt and rounds for damage. c. Feed mechanism to include cover, feed tray and bullet guide. d. Remove piston assembly, check for damage, to include feed-horns, extractor, ejector, firing pin and feed roller.</p> <p>8. If fault rectified, reload, press trigger; if gun fires, relay and fire.</p> <p>9. If fault cannot be rectified, report to REME.</p>	<p>An obstruction could be a build up of empty cases/links or a round in chamber.</p> <p>If a round is chambered, close cover, attempt to fire. Cock gun, make safe, open cover. If chamber is empty continue as in para 7 a.</p> <p>If round is still chambered, use tool removing chambered round to clear and continue as at 7 a. IF NO TOOL AVAILABLE THEN REPORT TO REME.</p> <p>Should more than one chambered round occur, report to REME to have extractor spring replaced.</p>

Serial	Primary indication	Secondary indication	Action by commander	Cause/remarks
(a)	(b)	(c)	(d)	(e)
6	1. Gun stops firing during an engagement.	3. No belt/rounds in gun.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Cock gun. Push feed pawl depressor to left. Press trigger. Gun may fire. Clear gun, reload, press trigger. If gun fires, relay and fire.	Ammunition expended/misfired round. If on opening cover a round is chambered close cover, attempt to fire. a. If gun fires, clear gun. Then carry out drill as in Serial 5, para 7 above. b. If gun fails to fire, cock gun, make safe, wait 10 minutes, then carry out drill as in Serial 5, para 7 above.
7	1. Gun stops firing during an engagement.	3. Feed pawl depressor will not move.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Attempt to cock gun and make safe. Under some circumstances this may not be possible. In either case wait ten minutes. 5. After 10 minutes, proceed according to condition of gun:- a. If gun has been made safe, open cover, remove	Note:- If during 10 minute wait period a breech explosion occurs gun must not be handled until it has been examined

Serial	Primary indication	Secondary indication	Action by commander	Cause/remarks
(a)	(b)	(c)	(d)	(e)
			belt and rounds. Clear gun of rounds or obstruction, inspect for faults or damage in following sequence. If a fault is found at any stage it should be rectified if possible. (1) Trapped links. (2) Belt and rounds for damage. (3) Feed mechanism, to include cover, feed tray and bullet guide. (4) Remove piston assembly, check for damage, to include feedhorns, extractor, ejector, firing pin and feed roller. b. If gun has NOT been made safe, cock gun as cover is being opened. Failure to do this may result in a round being fired. Make safe and proceed as in para a. above. 6. If fault is rectified, reload, press trigger; if gun fires, relay and fire.	by REME and ATO.

Serial	Primary indication	Secondary indication	Action by commander	Cause/remarks
(a)	(b)	(c)	(d)	(e)
			7. If fault cannot be rectified, report to REME.	

- NOTES:-**
1. If belt and rounds fall away from gun when carrying out stoppage drill, proceed as if belt and rounds are correct; attempt to fire; if gun fires, carry out no belt/rounds drill. If gun fails to fire, cock gun, make safe, wait ten minutes, then proceed as in Serial 5, para 7 above.
 2. If during firing a number of stoppages are caused by trapped cases, or the gun fails to re-cock correctly, the gun balance must be checked.

SECTION 7 - STOPPAGE DRILLS 7-62-MM - GROUND MOUNTING

General

1. A stoppage on the ground mounted MG may be caused by an incorrect drill, an obstruction or fault in the gun, or by a misfired round. The gun will also stop firing when the ammunition is expended (end of belt).

Stoppage drills

2. Stoppage drills are to be carried out in accordance with the table set out below. The drill in each serial follows numerical sequence.

Serial	Primary indication	Secondary indication	Action by firer	Cause/remarks
(a)	(b)	(c)	(d)	(e)
1	1. Gun stops firing during an engagement.	3. Belt and rounds correct.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fires, aim and fire.	Obstruction which was cleared by drill.
2	1. Gun stops firing during an engagement.	3. Belt and rounds correct. 5. If breech explosion (cook off) occurs, gun must not be handled until it has been examined by REME and ATO.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Cock gun. Push feed pawl depressor to left. Press trigger. If gun fails to fire, cock gun, make safe, wait ten minutes.	

Serial	Primary indication	Secondary indication	Action by firer	Cause/remarks
(a)	(b)	(c)	(d)	(e)
		6. No breech explosion occurs within 10 minute wait period.	<p>7. After 10 minute wait, ensure working parts are to rear and safety catch is applied. Open cover, remove belt and rounds. Clear gun of rounds or obstruction, inspect for faults or damage in following sequence. If a fault is found at any stage it should be rectified if possible.</p> <p>a. Trapped links. b. Belt and rounds for damage. c. Feed mechanism to include cover, feed tray and bullet guide. d. Remove piston assembly, check for damage, to include feed-horns, extractor, ejector, firing pin and feed roller.</p> <p>8. If fault rectified, reload, press trigger; if gun fires, aim and fire.</p> <p>9. If fault cannot be rectified, report to REME.</p>	<p>An obstruction could be a build up of empty cases/links or a round in chamber.</p> <p>If a round is chambered, close cover, attempt to fire. Cock gun, make safe, open cover. If chamber is empty, continue as in para 7 a.</p> <p>If round is still chambered, use tool removing chambered round to clear, and continue as at 7 a. If NO TOOL AVAILABLE THEN REPORT TO REME.</p> <p>Should more than one chambered round occur, report to REME to have extractor spring replaced.</p>

Serial	Primary indication	Secondary indication	Action by firer	Cause/remarks
(a)	(b)	(c)	(d)	(e)
3	1. Gun stops firing during an engagement.	3. No belt/rounds in gun.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Cock gun. Push feed pawl depressor to left. Press trigger. Gun may fire. Clear gun, reload, press trigger. If gun fires, aim and fire.	Ammunition expended/misfired round. If on opening cover a round is chambered, close cover, attempt to fire. a. If gun fires, clear gun. Then carry out drill as in Serial 2, para 7 above. b. If gun fails to fire, cock gun, make safe, wait 10 minutes, then carry out drill as in Serial 2, para 7 above.
4	1. Gun stops firing during an engagement.	3. Feed pawl depressor will not move.	2. Check belt/rounds. Push feed pawl depressor to right. 4. Attempt to cock gun and make safe. Under some circumstances this may not be possible. In either case wait ten minutes. 5. After 10 minutes proceed according to condition of gun:- a. If gun has been made safe, open cover, remove	Note:- If during 10 minute wait period a breach explosion occurs gun must not be handled until it has been examined by REME and ATO.

Serial	Primary indication	Secondary indication	Action by firer	Cause/remarks
(a)	(b)	(c)	(d)	(e)
			<p>belt and rounds. Clear gun of rounds or obstruction, inspect for faults or damage in following sequence. If a fault is found at any stage it should be rectified if possible.</p> <p>(1) Trapped links. (2) Belt and rounds for damage. (3) Feed mechanism, to include cover, feed tray and bullet guide. (4) Remove piston assembly, check for damage; to include feedhorns, extractor, ejector, firing pin and feed roller.</p> <p>b. If gun has NOT been made safe, cock gun as cover is being opened. Failure to do this may result in a round being fired. Make safe and proceed as in para a. above.</p> <p>6. If fault is rectified, reload, press trigger; if gun fires, aim and fire.</p>	

Serial	Primary indication	Secondary indication	Action by firer	Cause/remarks
(a)	(b)	(c)	(d)	(e)
			7. If fault cannot be rectified, report to REME.	

NOTES:- 1. If belt and rounds fall away from gun when carrying out stoppage drill, proceed as if belt and rounds are correct; attempt to fire; if gun fires, carry out no belt/rounds drill. If gun fails to fire, cock gun, make safe, wait ten minutes, then proceed as in Serial 2, para 7 above.

2. If during firing a number of stoppages are caused by trapped cases, or the gun fails to re-cock correctly, the gun balance must be checked.

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PART TWO

ADDITIONAL INFORMATION

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CHAPTER 15 – ORDNANCE, BL 120-MM TK L11

SECTION 1 – PARTICULARS OF ARMAMENT AND MOUNTING

The main armament

- | | | |
|------|---|--|
| 1. a | Nomenclature | Ordnance, BL, 120-mm, Tk, L11
(A1 – A7) |
| b. | Total weight unloaded | 3,920 lb (1778-0815 kg) |
| c. | Calibre | 120-mm |
| d. | Breech mechanism | Vertical sliding block |
| e. | Length of barrel | 260-in (660.4 cm) |
| f. | Length of shot travel (APDS) | 232.05-in (589.29 cm) |
| g. | Length of rifling | 221.32-in (562.67 cm) |
| h. | Length overall (less breech mechanism) | 270.2-in (686.308 cm) |
| j. | Inboard length | 56.5-in (143.51 cm) |
| k. | Rifling:- | |
| | (1) Twist | 1 turn in 18 calibres (total 2.616 turns) |
| | (2) Number of grooves | 32 |
| l. | A semi-automatic gear is fitted. | |
| m. | The fume extractor:- | |
| | (1) Length | 21.50-in (54.6 cm) |
| | (2) Diameter | 11.05-in (28.067 cm) (8.09-in (22.606 cm) L3A1 only) |
| | (3) Number of ports | Eight |
| | (3) Size of ports | 0.135-in (3.429-mm) |
| | (5) Distance of ports to muzzle | 80-in (203.2 cm) |
| n. | Muzzle velocities:- | |
| | (1) APDS | 1370 ms |
| | (2) HESH | 670 ms |
| | (3) Smoke | 670 ms |
| | (4) Practice DS | 1460 ms |
| | (5) Practice SH | 670 ms |
| o. | Condemning limits:- | |
| | (1) Barrel (mean diameter at 1-in C of R):- | |
| | (a) Under service conditions | 4.810-in (12.2174 cm) |
| | (b) For training only | 4.885-in (12.4079 cm) may be used, provided that only one nature of ammunition is stowed on the vehicle. |
| | (2) Breech block:- | |
| | (a) Flash channel at mid length | 332-in (8.4328-mm) |

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p. Ammunition values (EFC):-

(1) APDS	1.0 – 0.4 (L4A2 charge)
(2) HESH	0.01
(3) Smoke	0.01
(4) Practice DS	0.11 – 0.044 (L5A2 charge)

q. Barrel life:-

- (1) 120 EFCs (A further 85 EFCs may be fired using HESH, Smoke or Practice only; APDS must not be fired.
- (2) 1st quarter 4.700-in (11.938 cm) to 4.730-in (12.0142 cm)
2nd quarter 4.731-in (12.0143 cm) to 4.760-in (12.0904 cm)
3rd quarter 4.761-in (12.0905 cm) to 4.790-in (12.1666 cm)
4th quarter 4.791-in (12.1667 cm) to 4.810-in (12.2174 cm)
Extended 4th quarter 4.811-in (12.2175 cm) to 4.885-in (12.4079 cm)
life for training only.

r. Interval between gun examinations 60 EFCs or 200 rounds

s. Weights:-

(1) Barrel (A2/A3)	1073 kg
(A5)	1074.6 kg
(2) Breech ring and breech mechanism	600 kg
(3) Breech block	63 kg
(4) Obturator (insert and sleeve)	5 kg
(5) Fume extractor	40 kg
(6) Thermal insulator	27 kg

t. Total weights:-

(1) Ordnance L11A2/A3 with L2A1 fume extractor	1808 kg
(2) Ordnance L11A5 with L2A1 fume extractor	1809.6 kg.
(3) Ordnance L11A5 with L3A1 fume extractor	1787.6 kg

SECTION 2 – SUMMARY OF CHIEFTAIN ORDNANCE MARKS

Ordnance, BL, 120-mm, Tk, L11 (A1 – A7)

L11A1

1. Limited issue of 130 guns.

L11A2

2. a. *Breech ring interlock* – Preventing breech closure in the absence of an obturator sleeve.
b. *Insert indicator* – Preventing loading in the absence of an obturator insert.

c. *Other changes prior to 1962*

- (1) *Actuating shaft stop* – Preventing excessive rotation of the shaft during operation resulting in the breech block falling clear of the breech ring.
- (2) *Vent tube electric filling changed* – Obturation problems were encountered due to build-up of deposits from the products of combustion using gunpowder in early tubes.
- (3) *Flash channel dimensions* – Sporadic high pressures were traced to the break-up of the charge by ignition flash. This was overcome by slightly increasing the size of the flash channel, counterboring the forward end, and cutting a large pocket in the face of the breech block.
- (4) *Obturator sleeve protector* – Initially conceived as a sleeve to protect the obturator during loading, this developed into split hinged arms tripped by a plunger in the obturator sleeve, preventing loading in the event of an obturator primary seal failure.
- (5) *Breech ring material* increase from 35 to 37 ton/sq in.
- (6) Introduction of the 14 tube magazine.

L11A3

- a. *Design of breech ring* – Thickness of section between the base of the shot guide and the firing needle boring increased to obviate tendency to fatigue cracking.
- b. *Projectile stop* – Not fitted.

L11A4

4. A requirement to detect the presence of a vent tube, electric, in the breech block, hence assisting misfire drill, led to the 'Blackburn interlock' proposal. The A4 mark was expected to be issued for rings and blocks machined for the interlock. The A5 mark was expected to define ordnance finally fitted with the interlock. As a result of the 'Edge' indicator modification to the firing needle assembly fulfilling the same role, the interlock was not introduced and the A4 mark was not issued.

L11A5

5. a. *Present production mark* – With forged upstand muzzle for the muzzle reference sight.
- b. Incorporates a reduced diameter/volume/weight fume extractor with the following balance weights:-
 - 2 x 15.50 lb
 - 10 x 1 lb
 - 2 x 0.50 lb

L11A6

6. a. Proposed conversion of L11A3 barrels using retro-fit shrunk sleeve for MRS.

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- b. Incorporates lightweight fume extractor, as described in para 5 b. above, with the following balance weights:-

4 x 1 lb

1 x 0.50 lb

L11A7

7. Proposed mark for L11A5 ordnance with a semi-automatic plunger fitted to the vent tube loader.

SECTION 3—THE MOUNTING, 120-MM GUN, .50-IN RG AND 7.62-MM MG NO. 3

Mounting

1. The mounting is designed to provide an elevation of 356 mils above the horizontal of the vehicle and 178 mils depression. 6400 mils traverse is obtained by rotation of the turret.
2. The mounting is supported in the turret by the cradle trunnions. A mantlet is not fitted, the crew being protected by splinter-proof splash plates located inside the turret.
3. Movement of the mounting in the vertical plane is obtained by means of a rack and pinion type elevating gear secured to the turret in a gimbal mounting, while movement in the horizontal plane is obtained by means of an electrically operated rack and pinion type traversing gear.
4. The recoil system consists of diagonally mounted twin hydraulic buffers and a hydro-pneumatic recuperator, all pistons being connected to the gun yoke.

Cradle

5. The cradle is of the ring type and is supported in the turret by trunnions on needle roller bearings. The cradle is prepared to carry the gun, recoil system, loader's firing guard, semi-automatic bracket, anti-rotation bracket, MG mountings and various other smaller components for the efficient functioning of the armament. (See Fig 94.)

Gun liners

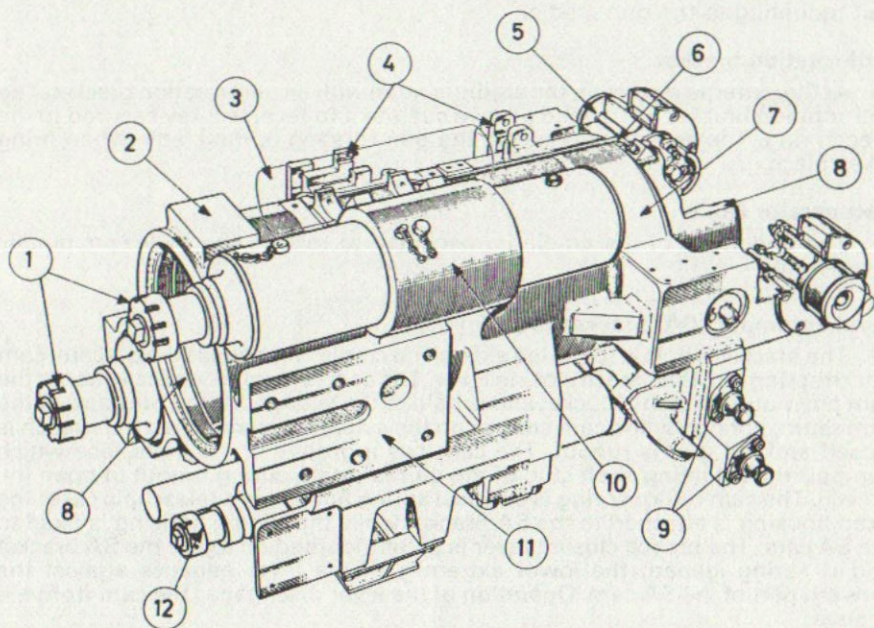
6. The cradle bore contains a front and rear bronze liner in which the gun slides on recoil and runout. The liners are grooved internally for the retention of lubricant. The front liner is lubricated through a pipe from the nipple block on the left rear of the cradle.

Gun depression stop

7. On the top rear of the cradle is a welded block which, in conjunction with a pad on the turret roof, forms the gun depression stop. The welded block is also used to anchor the stop running back, when required. Immediately in front of the depression stop is a cradle type mounting for the replenisher of the recoil system.

Buffer housings

8. The housings are machined diagonally on the cradle to receive the twin buffers. Clover leaf projections inside the housings secure the buffer cylinders in position. The buffers are prevented from rotating by anti-rotation bolts on the outside of the housing.



1. Gun nuts
2. Depression stop
3. Replenisher
4. Co-axial MG mounting
5. Trunnion
6. Lubrication feedpipe
7. Gun cradle
8. Front liner
9. Gun control linkage spigots
10. Buffer housing
11. Anti-rotation bracket
12. Recuperator

Fig 94 – Cradle assembly

Control linkage spigots

9. On the right side of the cradle, at the front, are two spigots secured by bolts to a welded lug which connects the temperature compensated link bar and the sight unit mounting to the gun cradle.

Anti-rotation bracket

10. At the extreme right rear, the cradle is fitted with an anti-rotation bracket. The anti-rotation bracket has a lined groove cut into it to receive a key secured to the breech ring. The assembly prevents the gun rotating in the cradle when firing takes place.

Recuperator No. 8

11. The underside of the cradle is machined to receive the hydro-pneumatic recuperator.

Semi-automatic (SA) bracket (See Fig 95)

12. The bracket is bolted to the left side of the cradle and houses the SA cam, cam return spring and the breech closing lever. The cam is pivoted vertically about the cam pin mounted in the bracket and is held to the left against the pressure of the cam return spring, by the cam control on the actuating shaft, when the breech is closed and the gun is runout. The cam has a groove on its inner face which compels the actuating shaft stud of the gun to rotate during runout to open the breech. The cam return spring is a helical spring housed in a telescopic case; the fixed housing is attached to the SA bracket while the sliding housing is fixed to the SA cam. The breech closing lever is pivot mounted on top of the SA bracket and is spring loaded; the lower extremity of the lever engages against the forward part of the SA cam. Operation of the lever disengages the cam from the groove.

The loader's firing guard (see Fig 96)

13. The loader's guard, bolted to the top of the SA bracket, is semi-automatic in operation, ie, it is placed in position by hand but is returned to the OPEN position automatically by the recoil of the gun. The guard consists mainly of a fixed plate and a moving plate with the operating components located between the two plates.

14. *Operating components* – Operating handle, on the sliding plate. A micro switch on the fixed plate, operated by a cam on the sliding plate. Four tensator springs mounted on the inside of the fixed plate and attached to a block on the sliding plate; the springs are tensioned when the sliding plate is pulled to the rear. A spring loaded locking lever pivoted on the sliding plate; the forward end of the lever engages with a bushed recess in the fixed plate when the operating handle is pulled fully to the rear. The other end of the locking lever carries a roller which is struck by a cam on the breech ring, during gun recoil, to disengage the locking lever from the fixed plate.

15. *Operation* – On pulling the sliding plate to the rear, the tensator springs are unwound and the plate moves along its slides until stopped by a buffer spring. At this moment the locking lever engages in its recess in the fixed plate. The cam at the front of the sliding plate rides along the micro switch plunger, depressing the plunger to complete the gun firing circuit. On recoil of the gun the cam on the

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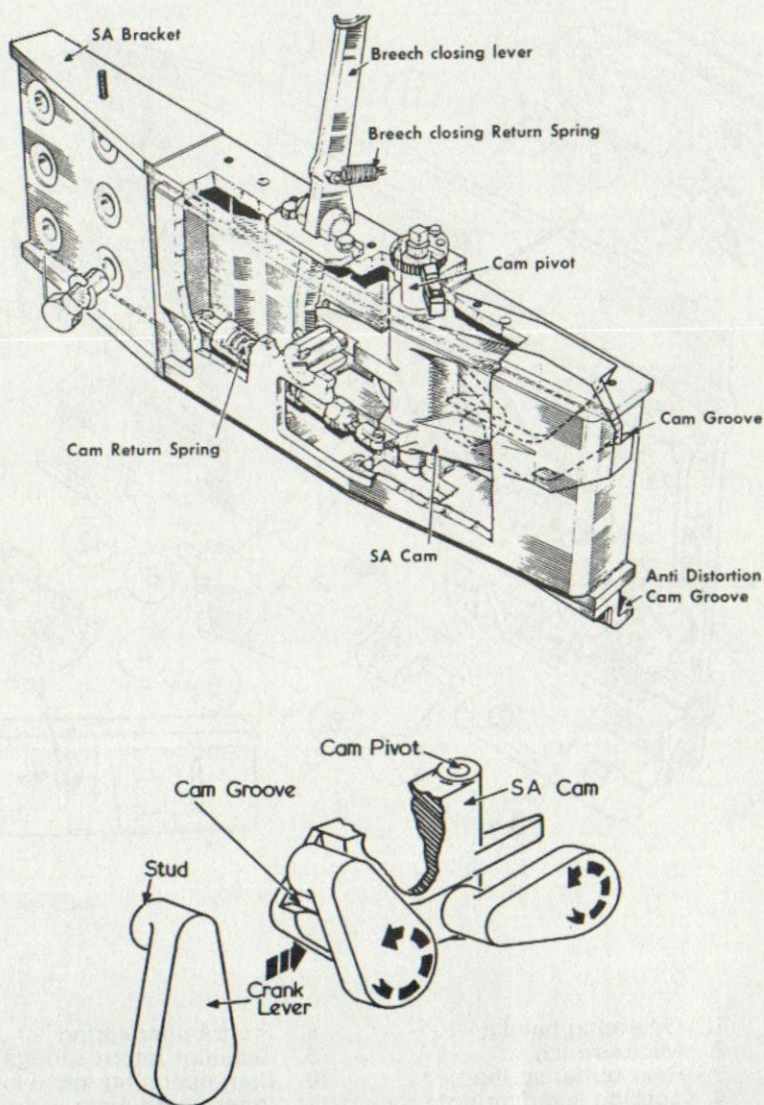
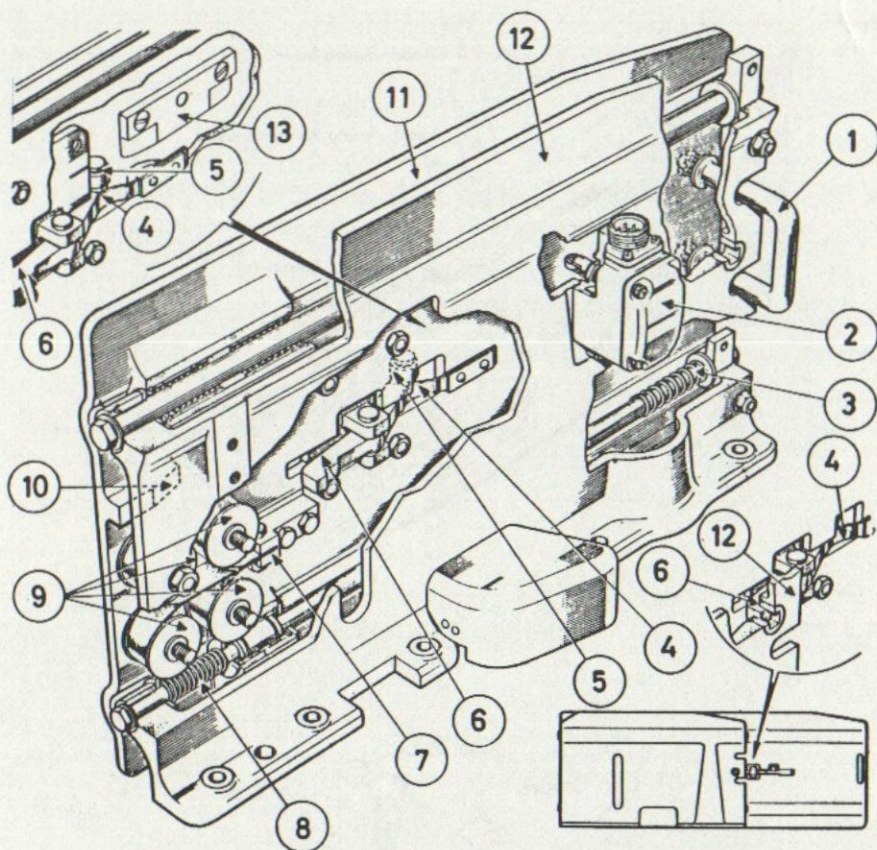


Fig 95 - S A bracket and action

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- | | |
|----------------------------|--|
| 1. Operating handle | 8. Front buffer spring |
| 2. Micro-switch | 9. Tensator return springs |
| 3. Rear buffer spring | 10. Cam operating micro-switch |
| 4. Locking lever spring | 11. Inner guard plate |
| 5. Locking lever roller | 12. Outer guard plate |
| 6. Locking lever | 13. Cam plate disengaging (on breech ring) |
| 7. Return spring anchorage | |

Fig 96 - Loader's firing guard

breech ring bears on to the locking lever roller and withdraws the end of the lever from its recess in the fixed plate. The tensator springs return the sliding plate to the OPEN position. The micro switch plunger is released thus breaking the firing circuit, a front buffer spring brings the sliding plate to rest.

SECTION 4 – THE RECOIL SYSTEM

Description

The buffers No. 6

1. The buffer cylinders are housed in the cradle either side of the gun at 2 and 8 o'clock. Two holes, at the top and bottom rear of each cylinder, are tapped to receive the filler and drain plugs. A release hole in the filler plugs allows oil or air to escape when they are slackened. Internally, each cylinder is bored for the piston, and tapered grooves are machined throughout its working length. A threaded portion at each end of each cylinder is prepared for the front and rear end caps. The front end cap houses the control plunger. The rear end cap houses the gland and chevron packing. The buffer piston rod has a screwed portion on its head, on to which is fitted a hardened steel ring to form a bearing surface. The front of the piston head is bored to receive the control chamber and retaining ring. The rear end of the piston rod is secured to the yoke.

The recuperator No. 8

2. The recuperator cylinders are secured to the underside of the cradle. The high pressure cylinder is fitted with a floating piston which separates high pressure air on one side of it from oil on the other. The liquid cylinder is fitted with a piston which is attached to a piston rod secured to the yoke. The liquid cylinder is filled with oil OM 13. The cylinders are connected so that oil may flow from one to the other.

- a. *The high pressure cylinder* is plain bored for the floating piston. A hole bored at the side midway along the cylinder forms a connection for the air pressure gauge. The front end cap houses the air charging valve and plug, and the rear cap the gland, chevron packings and wiper rings. Screwed to the rear cap is the rod cover which is slotted and engraved with setting lines for NORMAL and CEASE FIRE. At the rear an internal threaded portion forms the means of attaching a tool. The floating piston separates the liquid from the air in the cylinder. The rod passes through the rear end cap and acts as a tell-tale, indicating the position of the piston in the cylinder. The piston head is fitted with chevron packings, one set facing front and the other rear. The packings are separated and supported by rings and glands; they are retained in position by a nut. The rod is flanged at the front end and secured to the head by a screwed ring.
- b. *The liquid cylinder* is plain bored and houses the recuperator piston. At the front end it is closed by a filter and the rear end is threaded to the rear end cap. The rear end cap houses the gland chevron packings. The piston head is fitted with chevron packings and the piston rod is attached to the yoke.

The replenisher No. 2

3. The replenisher cylinder is plain bored and is positioned to the left of the right

hand buffer. Internally it contains a piston, single helical spring and an indicator rod. The cup shaped piston houses a guide for the rod. The front end cap of the cylinder has a connector with oil pipes leading to each buffer cylinder. The rear end cap is drilled to allow the passage of the indicator rod. A chevron packing in the piston and an oil seal on the front end cap prevent any loss of oil contained forward of the piston. A filler plug is located on the forward top surface of the cylinder.

The recoil indicator

4. The indicator is fitted to the right hand gun shield. It consists of a bracket and slide. The slide has a pointer on it which is struck by the anti-rotation key on the breech ring during the recoil of the gun.

Operation

5. a. *Recoil* – During recoil, the buffer pistons, attached to the gun yoke, are pulled to the rear, forcing the oil forward through the grooves in the cylinder walls. As the grooves gradually decrease in depth and restrict the oil flow, the recoil energy is absorbed. When the grooves taper out, the piston is brought to rest against a buffer of oil between the piston head and the packing in the rear end cap. During recoil, oil is displaced from the liquid cylinder of the recuperator into the high pressure cylinder, and the floating piston moves forward, further compressing the air. During the period of recoil, air is drawn into the oil cylinder through the gauze filter. The length of recoil is registered on the recoil indicator by the rear of the anti-rotation key striking the indicator slide.
- b. *Run out* – The compressed air in the high pressure cylinder reasserts itself, driving the floating piston back. Oil is displaced from the cylinder, driving the piston forward and with it the gun. As the gun is returned to the run out position by the recuperator, oil in the buffer cylinders is forced to flow from the front to the rear of the piston heads through the cylinder grooves. The resistance to the flow of oil decreases as the pistons move forward due to the increasing depth of the grooves. At approximately two and a half inches from the run out position, the control chamber in the head of the piston passes over the control plunger in the front end cap of the cylinder. The control plunger displaces the oil in the control chamber, bringing the gun to the run out position where it contacts the beating faces of the cradle.
- c. *The replenisher* – During firing, the oil in the buffer cylinders becomes heated and expands. This expansion is relieved by the oil forcing its way via the oil pipes into the replenisher. The pressure of oil forces the replenisher piston to the rear and compresses the piston spring. The piston guide having moved a short distance commences to push the indicator rod rearwards, causing it to protrude through the rear end cap of the replenisher. A spring on the end cap prohibits excessive protrusion of the rod. When the oil in the buffers cools and contracts, the pressure on the replenisher piston is relaxed and its spring now begins to reassert, forcing the piston forward and, thereby, replenishing or topping up the buffers via the connecting pipes.

SECTION 5 – MECHANISM, 120-MM

Action on opening the breech, using the breech opening tool.

1. a. Withdrawal of the plunger in the gearbox cover plate, on the right lower face of the breech ring, frees the plunger from the worm wheel and enables the breech opening tool to be operated.
- b. Turning the handle clockwise rotates the worm wheel, bringing a lug on the worm wheel into contact with a corresponding lug on the actuating shaft and causing the shaft to rotate.
- c. The initial movement of the actuating shaft brings the crank from its position at forward of top dead centre, thus breaking the mechanical lock, withdrawing the firing needle and commencing to release the tension of the torsion springs.
- d. Simultaneously, the movement of the actuating shaft causes the upper parts of the obturator retracting levers to bear against the obturator sleeve, thereby compressing the obturator sleeve springs which are interposed between the rear face of the barrel and the front face of the sleeve. (See Fig 97.)
- e. Continued rotation of the breech opening tool causes the breech block to fall. The cam control on the crank lever moves away from the SA cam plate allowing it to move inward, driven by its spring.
- f. The breech block is now in the open position. (See Figs 98 and 99.)
- g. Anti-clockwise rotation of the opening tool loads the breech closing spring which lifts the breech block to the loading position where it is held by the stud on the crank lever contacting the SA cam.

Action on closing the breech

2. a. When the breech closing lever is pulled to the left, the SA cam is moved to the left, releasing the stud on the crank lever of the actuating shaft.
- b. The torsion spring, initially under load, now reasserts itself and causes the actuating shaft to rotate forward and the breech to close through the action of the actuating crank and the sliding blocks.
- c. The ends of the crank enter the recesses at the base of the obturator sleeve retracting levers and the crank arms, being forward of top dead centre, form the mechanical lock. The top front faces of the obturator retracting levers are withdrawn and retained rearwards of the obturator sleeve, thus allowing the obturator springs to reassert themselves and press the sleeve against the breech block insert. (See Fig 99.)
- d. The firing needle now moves forward, under the influence of its spring, and contacts the plug in the base of the vent tube. Simultaneously the indicator pin in the firing needle assembly is held to the rear.
- e. On closing the breech, the very last movement of the actuating shaft allows the stud of the firing needle actuating crank to move off its cam on to the small flat; all parts are returned to the forward position, under pressure from the spring loaded plunger of the firing needle link plate and the spring of the firing needle. The cam control on the actuating shaft retains the SA cam to the left against the pressure of the cam return spring. (See Fig 100.)

PART TWO

ADDITIONAL INFORMATION

CHAPTER 15 – ORDNANCE, BL 120-MM TK L11

SECTION 1 – PARTICULARS OF ARMAMENT AND MOUNTING

The main armament

- | | | |
|------|---|--|
| 1. a | Nomenclature | Ordnance, BL, 120-mm, Tk, L11
(A1 – A7) |
| b. | Total weight unloaded | 3,920 lb (1778-0815 kg) |
| c. | Calibre | 120-mm |
| d. | Breech mechanism | Vertical sliding block |
| e. | Length of barrel | 260-in (660.4 cm) |
| f. | Length of shot travel (APDS) | 232.05-in (589.29 cm) |
| g. | Length of rifling | 221.32-in (562.67 cm) |
| h. | Length overall (less breech mechanism) | 270.2-in (686.308 cm) |
| j. | Inboard length | 56.5-in (143.51 cm) |
| k. | Rifling:- | |
| | (1) Twist | 1 turn in 18 calibres (total 2.616 turns) |
| | (2) Number of grooves | 32 |
| l. | A semi-automatic gear is fitted. | |
| m. | The fume extractor:- | |
| | (1) Length | 21.50-in (54.6 cm) |
| | (2) Diameter | 11.05-in (28.067 cm) (8.09-in (22.606 cm) L3A1 only) |
| | (3) Number of ports | Eight |
| | (3) Size of ports | 0.135-in (3.429-mm) |
| | (5) Distance of ports to muzzle | 80-in (203.2 cm) |
| n. | Muzzle velocities:- | |
| | (1) APDS | 1370 ms |
| | (2) HESH | 670 ms |
| | (3) Smoke | 670 ms |
| | (4) Practice DS | 1460 ms |
| | (5) Practice SH | 670 ms |
| o. | Condemning limits:- | |
| | (1) Barrel (mean diameter at 1-in C of R):- | |
| | (a) Under service conditions | 4.810-in (12.2174 cm) |
| | (b) For training only | 4.885-in (12.4079 cm) may be used, provided that only one nature of ammunition is stowed on the vehicle. |
| | (2) Breech block:- | |
| | (a) Flash channel at mid length | 332-in (8.4328-mm) |

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p. Ammunition values (EFC):-

(1) APDS	1.0 – 0.4 (L4A2 charge)
(2) HESH	0.01
(3) Smoke	0.01
(4) Practice DS	0.11 – 0.044 (L5A2 charge)

q. Barrel life:-

- (1) 120 EFCs (A further 85 EFCs may be fired using HESH, Smoke or Practice only; APDS must not be fired.
- (2) 1st quarter 4.700-in (11.938 cm) to 4.730-in (12.0142 cm)
 2nd quarter 4.731-in (12.0143 cm) to 4.760-in (12.0904 cm)
 3rd quarter 4.761-in (12.0905 cm) to 4.790-in (12.1666 cm)
 4th quarter 4.791-in (12.1667 cm) to 4.810-in (12.2174 cm)
 Extended 4th quarter 4.811-in (12.2175 cm) to 4.885-in (12.4079 cm)
 life for training only.

r. Interval between gun examinations 60 EFCs or 200 rounds

s. Weights:-

(1) Barrel (A2/A3) (A5)	1073 kg 1074.6 kg
(2) Breech ring and breech mechanism	600 kg
(3) Breech block	63 kg
(4) Obturator (insert and sleeve)	5 kg
(5) Fume extractor	40 kg
(6) Thermal insulator	27 kg

t. Total weights:-

(1) Ordnance L11A2/A3 with L2A1 fume extractor	1808 kg
(2) Ordnance L11A5 with L2A1 fume extractor	1809.6 kg.
(3) Ordnance L11A5 with L3A1 fume extractor	1787.6 kg

SECTION 2 – SUMMARY OF CHIEFTAIN ORDNANCE MARKS

Ordnance, BL, 120-mm, Tk, L11 (A1 – A7)

L11A1

1. Limited issue of 130 guns.

L11A2

2. a. *Breech ring interlock* – Preventing breech closure in the absence of an obturator sleeve.
 b. *Insert indicator* – Preventing loading in the absence of an obturator insert.

c. *Other changes prior to 1962*

- (1) *Actuating shaft stop* – Preventing excessive rotation of the shaft during operation resulting in the breech block falling clear of the breech ring.
- (2) *Vent tube electric filling changed* – Obturation problems were encountered due to build-up of deposits from the products of combustion using gunpowder in early tubes.
- (3) *Flash channel dimensions* – Sporadic high pressures were traced to the break-up of the charge by ignition flash. This was overcome by slightly increasing the size of the flash channel, counterboring the forward end, and cutting a large pocket in the face of the breech block.
- (4) *Obturator sleeve protector* – Initially conceived as a sleeve to protect the obturator during loading, this developed into split hinged arms tripped by a plunger in the obturator sleeve, preventing loading in the event of an obturator primary seal failure.
- (5) *Breech ring material* increase from 35 to 37 ton/sq in.
- (6) Introduction of the 14 tube magazine.

L11A3

- a. *Design of breech ring* – Thickness of section between the base of the shot guide and the firing needle boring increased to obviate tendency to fatigue cracking.
- b. *Projectile stop* – Not fitted.

L11A4

4. A requirement to detect the presence of a vent tube, electric, in the breech block, hence assisting misfire drill, led to the 'Blackburn interlock' proposal. The A4 mark was expected to be issued for rings and blocks machined for the interlock. The A5 mark was expected to define ordnance finally fitted with the interlock. As a result of the 'Edge' indicator modification to the firing needle assembly fulfilling the same role, the interlock was not introduced and the A4 mark was not issued.

L11A5

5. a. *Present production mark* – With forged upstand muzzle for the muzzle reference sight.
- b. Incorporates a reduced diameter/volume/weight fume extractor with the following balance weights:-
 - 2 x 15.50 lb
 - 10 x 1 lb
 - 2 x 0.50 lb

L11A6

6. a. Proposed conversion of L11A3 barrels using retro-fit shrunk sleeve for MRS.

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- b. Incorporates lightweight fume extractor, as described in para 5 b. above, with the following balance weights:-

4 x 1 lb

1 x 0.50 lb

L11A7

7. Proposed mark for L11A5 ordnance with a semi-automatic plunger fitted to the vent tube loader.

SECTION 3—THE MOUNTING, 120-MM GUN, .50-IN RG AND 7.62-MM MG NO. 3

Mounting

1. The mounting is designed to provide an elevation of 356 mils above the horizontal of the vehicle and 178 mils depression. 6400 mils traverse is obtained by rotation of the turret.
2. The mounting is supported in the turret by the cradle trunnions. A mantlet is not fitted, the crew being protected by splinter-proof splash plates located inside the turret.
3. Movement of the mounting in the vertical plane is obtained by means of a rack and pinion type elevating gear secured to the turret in a gimbal mounting, while movement in the horizontal plane is obtained by means of an electrically operated rack and pinion type traversing gear.
4. The recoil system consists of diagonally mounted twin hydraulic buffers and a hydro-pneumatic recuperator, all pistons being connected to the gun yoke.

Cradle

5. The cradle is of the ring type and is supported in the turret by trunnions on needle roller bearings. The cradle is prepared to carry the gun, recoil system, loader's firing guard, semi-automatic bracket, anti-rotation bracket, MG mountings and various other smaller components for the efficient functioning of the armament. (See Fig 94.)

Gun liners

6. The cradle bore contains a front and rear bronze liner in which the gun slides on recoil and runout. The liners are grooved internally for the retention of lubricant. The front liner is lubricated through a pipe from the nipple block on the left rear of the cradle.

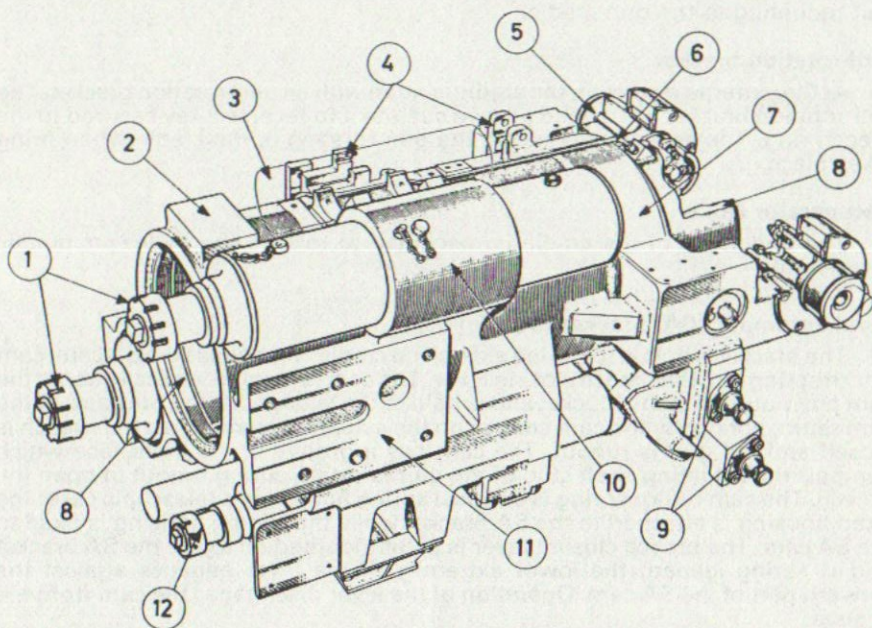
Gun depression stop

7. On the top rear of the cradle is a welded block which, in conjunction with a pad on the turret roof, forms the gun depression stop. The welded block is also used to anchor the stop running back, when required. Immediately in front of the depression stop is a cradle type mounting for the replenisher of the recoil system.

Buffer housings

8. The housings are machined diagonally on the cradle to receive the twin buffers. Clover leaf projections inside the housings secure the buffer cylinders in position. The buffers are prevented from rotating by anti-rotation bolts on the outside of the housing.

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1. Gun nuts
2. Depression stop
3. Replenisher
4. Co-axial MG mounting
5. Trunnion
6. Lubrication feedpipe
7. Gun cradle
8. Front liner
9. Gun control linkage spigots
10. Buffer housing
11. Anti-rotation bracket
12. Recuperator

Fig 94 – Cradle assembly

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Control linkage spigots

9. On the right side of the cradle, at the front, are two spigots secured by bolts to a welded lug which connects the temperature compensated link bar and the sight unit mounting to the gun cradle.

Anti-rotation bracket

10. At the extreme right rear, the cradle is fitted with an anti-rotation bracket. The anti-rotation bracket has a lined groove cut into it to receive a key secured to the breech ring. The assembly prevents the gun rotating in the cradle when firing takes place.

Recuperator No. 8

11. The underside of the cradle is machined to receive the hydro-pneumatic recuperator.

Semi-automatic (SA) bracket (See Fig 95)

12. The bracket is bolted to the left side of the cradle and houses the SA cam, cam return spring and the breech closing lever. The cam is pivoted vertically about the cam pin mounted in the bracket and is held to the left against the pressure of the cam return spring, by the cam control on the actuating shaft, when the breech is closed and the gun is runout. The cam has a groove on its inner face which compels the actuating shaft stud of the gun to rotate during runout to open the breech. The cam return spring is a helical spring housed in a telescopic case; the fixed housing is attached to the SA bracket while the sliding housing is fixed to the SA cam. The breech closing lever is pivot mounted on top of the SA bracket and is spring loaded; the lower extremity of the lever engages against the forward part of the SA cam. Operation of the lever disengages the cam from the groove.

The loader's firing guard (see Fig 96)

13. The loader's guard, bolted to the top of the SA bracket, is semi-automatic in operation, ie, it is placed in position by hand but is returned to the OPEN position automatically by the recoil of the gun. The guard consists mainly of a fixed plate and a moving plate with the operating components located between the two plates.

14. *Operating components* – Operating handle, on the sliding plate. A micro switch on the fixed plate, operated by a cam on the sliding plate. Four tensator springs mounted on the inside of the fixed plate and attached to a block on the sliding plate; the springs are tensioned when the sliding plate is pulled to the rear. A spring loaded locking lever pivoted on the sliding plate; the forward end of the lever engages with a bushed recess in the fixed plate when the operating handle is pulled fully to the rear. The other end of the locking lever carries a roller which is struck by a cam on the breech ring, during gun recoil, to disengage the locking lever from the fixed plate.

15. *Operation* – On pulling the sliding plate to the rear, the tensator springs are unwound and the plate moves along its slides until stopped by a buffer spring. At this moment the locking lever engages in its recess in the fixed plate. The cam at the front of the sliding plate rides along the micro switch plunger, depressing the plunger to complete the gun firing circuit. On recoil of the gun the cam on the

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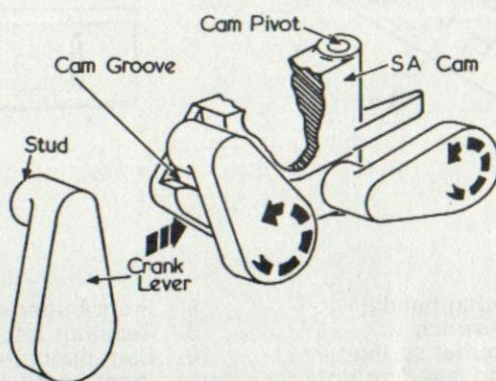
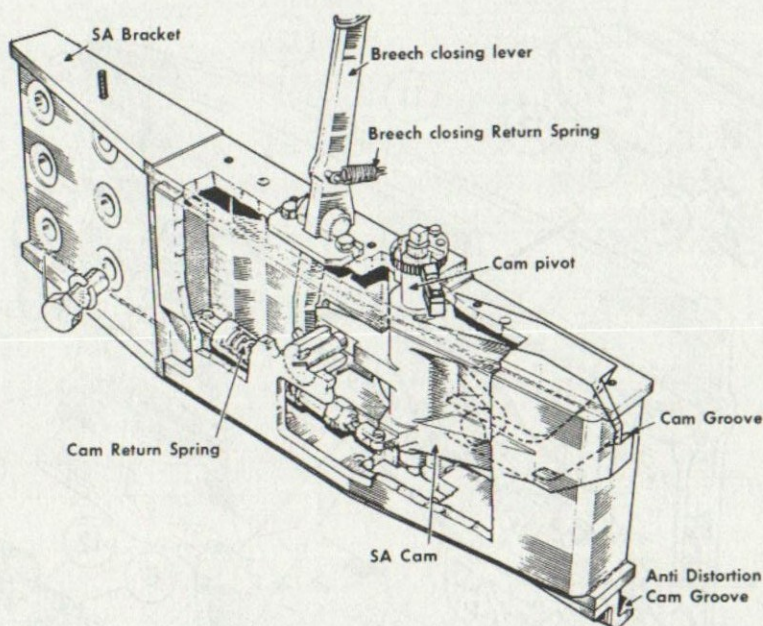
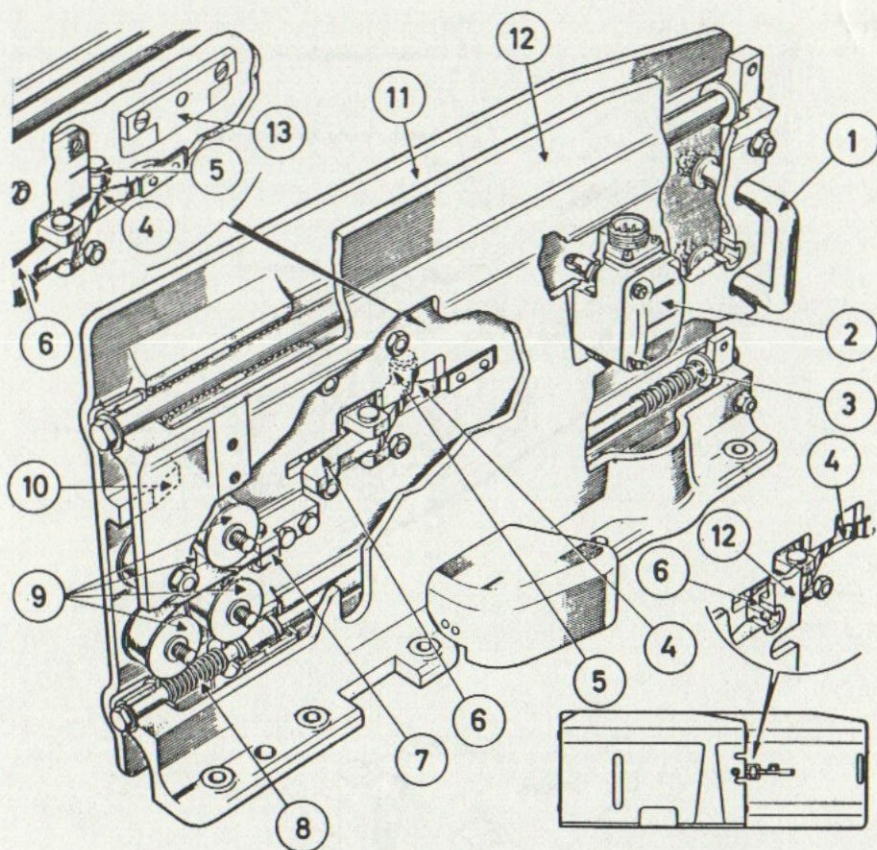


Fig 95 – S A bracket and action

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- | | |
|----------------------------|--|
| 1. Operating handle | 8. Front buffer spring |
| 2. Micro-switch | 9. Tensator return springs |
| 3. Rear buffer spring | 10. Cam operating micro-switch |
| 4. Locking lever spring | 11. Inner guard plate |
| 5. Locking lever roller | 12. Outer guard plate |
| 6. Locking lever | 13. Cam plate disengaging (on breech ring) |
| 7. Return spring anchorage | |

Fig 96 – Loader's firing guard

breech ring bears on to the locking lever roller and withdraws the end of the lever from its recess in the fixed plate. The tensator springs return the sliding plate to the OPEN position. The micro switch plunger is released thus breaking the firing circuit, a front buffer spring brings the sliding plate to rest.

SECTION 4 – THE RECOIL SYSTEM

Description

The buffers No. 6

1. The buffer cylinders are housed in the cradle either side of the gun at 2 and 8 o'clock. Two holes, at the top and bottom rear of each cylinder, are tapped to receive the filler and drain plugs. A release hole in the filler plugs allows oil or air to escape when they are slackened. Internally, each cylinder is bored for the piston, and tapered grooves are machined throughout its working length. A threaded portion at each end of each cylinder is prepared for the front and rear end caps. The front end cap houses the control plunger. The rear end cap houses the gland and chevron packing. The buffer piston rod has a screwed portion on its head, on to which is fitted a hardened steel ring to form a bearing surface. The front of the piston head is bored to receive the control chamber and retaining ring. The rear end of the piston rod is secured to the yoke.

The recuperator No. 8

2. The recuperator cylinders are secured to the underside of the cradle. The high pressure cylinder is fitted with a floating piston which separates high pressure air on one side of it from oil on the other. The liquid cylinder is fitted with a piston which is attached to a piston rod secured to the yoke. The liquid cylinder is filled with oil OM 13. The cylinders are connected so that oil may flow from one to the other.

- a. *The high pressure cylinder* is plain bored for the floating piston. A hole bored at the side midway along the cylinder forms a connection for the air pressure gauge. The front end cap houses the air charging valve and plug, and the rear cap the gland, chevron packings and wiper rings. Screwed to the rear cap is the rod cover which is slotted and engraved with setting lines for NORMAL and CEASE FIRE. At the rear an internal threaded portion forms the means of attaching a tool. The floating piston separates the liquid from the air in the cylinder. The rod passes through the rear end cap and acts as a tell-tale, indicating the position of the piston in the cylinder. The piston head is fitted with chevron packings, one set facing front and the other rear. The packings are separated and supported by rings and glands; they are retained in position by a nut. The rod is flanged at the front end and secured to the head by a screwed ring.
- b. *The liquid cylinder* is plain bored and houses the recuperator piston. At the front end it is closed by a filter and the rear end is threaded to the rear end cap. The rear end cap houses the gland chevron packings. The piston head is fitted with chevron packings and the piston rod is attached to the yoke.

The replenisher No. 2

3. The replenisher cylinder is plain bored and is positioned to the left of the right

hand buffer. Internally it contains a piston, single helical spring and an indicator rod. The cup shaped piston houses a guide for the rod. The front end cap of the cylinder has a connector with oil pipes leading to each buffer cylinder. The rear end cap is drilled to allow the passage of the indicator rod. A chevron packing in the piston and an oil seal on the front end cap prevent any loss of oil contained forward of the piston. A filler plug is located on the forward top surface of the cylinder.

The recoil indicator

4. The indicator is fitted to the right hand gun shield. It consists of a bracket and slide. The slide has a pointer on it which is struck by the anti-rotation key on the breech ring during the recoil of the gun.

Operation

5. a. *Recoil* – During recoil, the buffer pistons, attached to the gun yoke, are pulled to the rear, forcing the oil forward through the grooves in the cylinder walls. As the grooves gradually decrease in depth and restrict the oil flow, the recoil energy is absorbed. When the grooves taper out, the piston is brought to rest against a buffer of oil between the piston head and the packing in the rear end cap. During recoil, oil is displaced from the liquid cylinder of the recuperator into the high pressure cylinder, and the floating piston moves forward, further compressing the air. During the period of recoil, air is drawn into the oil cylinder through the gauze filter. The length of recoil is registered on the recoil indicator by the rear of the anti-rotation key striking the indicator slide.

b. *Run out* – The compressed air in the high pressure cylinder reasserts itself, driving the floating piston back. Oil is displaced from the cylinder, driving the piston forward and with it the gun. As the gun is returned to the run out position by the recuperator, oil in the buffer cylinders is forced to flow from the front to the rear of the piston heads through the cylinder grooves. The resistance to the flow of oil decreases as the pistons move forward due to the increasing depth of the grooves. At approximately two and a half inches from the run out position, the control chamber in the head of the piston passes over the control plunger in the front end cap of the cylinder. The control plunger displaces the oil in the control chamber, bringing the gun to the run out position where it contacts the beating faces of the cradle.

c. *The replenisher* – During firing, the oil in the buffer cylinders becomes heated and expands. This expansion is relieved by the oil forcing its way via the oil pipes into the replenisher. The pressure of oil forces the replenisher piston to the rear and compresses the piston spring. The piston guide having moved a short distance commences to push the indicator rod rearwards, causing it to protrude through the rear end cap of the replenisher. A spring on the end cap prohibits excessive protrusion of the rod. When the oil in the buffers cools and contracts, the pressure on the replenisher piston is relaxed and its spring now begins to reassert, forcing the piston forward and, thereby, replenishing or topping up the buffers via the connecting pipes.

SECTION 5 – MECHANISM, 120-MM

Action on opening the breech, using the breech opening tool.

1.
 - a. Withdrawal of the plunger in the gearbox cover plate, on the right lower face of the breech ring, frees the plunger from the worm wheel and enables the breech opening tool to be operated.
 - b. Turning the handle clockwise rotates the worm wheel, bringing a lug on the worm wheel into contact with a corresponding lug on the actuating shaft and causing the shaft to rotate.
 - c. The initial movement of the actuating shaft brings the crank from its position at forward of top dead centre, thus breaking the mechanical lock, withdrawing the firing needle and commencing to release the tension of the torsion springs.
 - d. Simultaneously, the movement of the actuating shaft causes the upper parts of the obturator retracting levers to bear against the obturator sleeve, thereby compressing the obturator sleeve springs which are interposed between the rear face of the barrel and the front face of the sleeve. (See Fig 97.)
 - e. Continued rotation of the breech opening tool causes the breech block to fall. The cam control on the crank lever moves away from the SA cam plate allowing it to move inward, driven by its spring.
 - f. The breech block is now in the open position. (See Figs 98 and 99.)
 - g. Anti-clockwise rotation of the opening tool loads the breech closing spring which lifts the breech block to the loading position where it is held by the stud on the crank lever contacting the SA cam.

Action on closing the breech

2.
 - a. When the breech closing lever is pulled to the left, the SA cam is moved to the left, releasing the stud on the crank lever of the actuating shaft.
 - b. The torsion spring, initially under load, now reasserts itself and causes the actuating shaft to rotate forward and the breech to close through the action of the actuating crank and the sliding blocks.
 - c. The ends of the crank enter the recesses at the base of the obturator sleeve retracting levers and the crank arms, being forward of top dead centre, form the mechanical lock. The top front faces of the obturator retracting levers are withdrawn and retained rearwards of the obturator sleeve, thus allowing the obturator springs to reassert themselves and press the sleeve against the breech block insert. (See Fig 99.)
 - d. The firing needle now moves forward, under the influence of its spring, and contacts the plug in the base of the vent tube. Simultaneously the indicator pin in the firing needle assembly is held to the rear.
 - e. On closing the breech, the very last movement of the actuating shaft allows the stud of the firing needle actuating crank to move off its cam on to the small flat; all parts are returned to the forward position, under pressure from the spring loaded plunger of the firing needle link plate and the spring of the firing needle. The cam control on the actuating shaft retains the SA cam to the left against the pressure of the cam return spring. (See Fig 100.)

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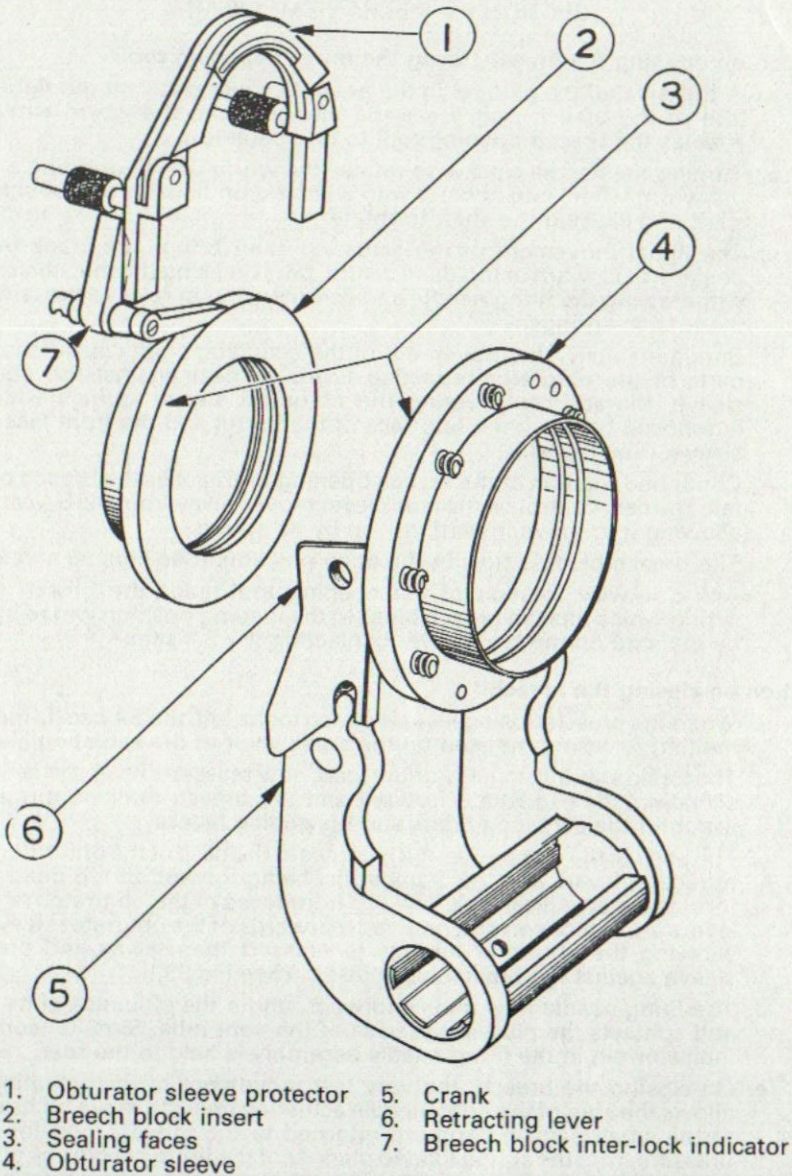
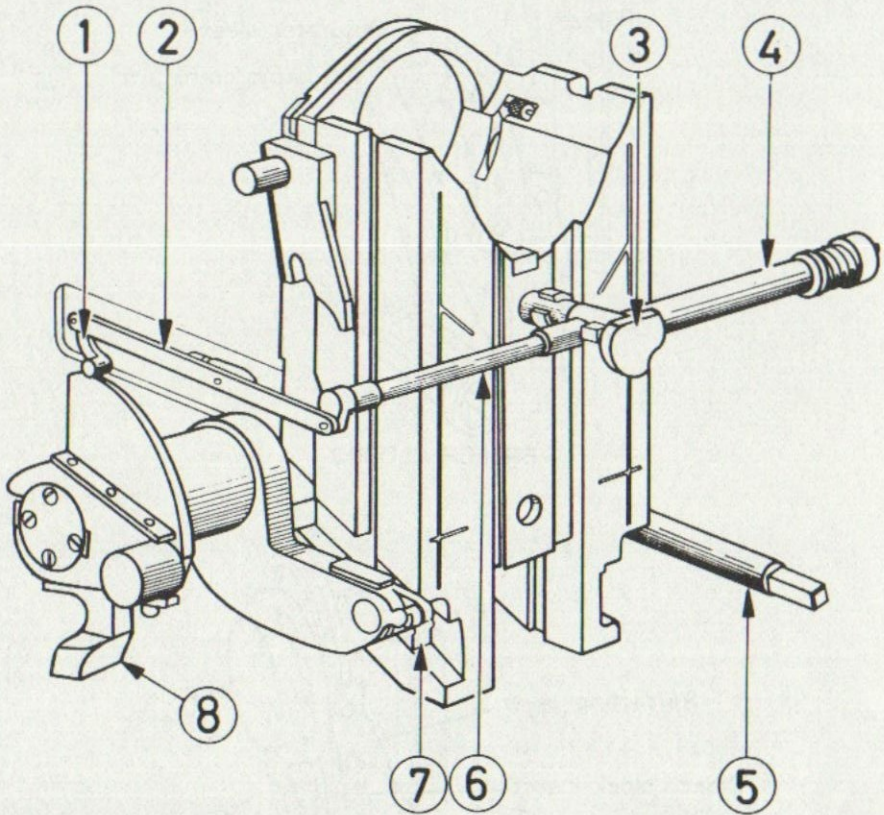


Fig 97 – Obturator mechanism



- | | |
|-----------------------------------|----------------------------------|
| 1. Firing needle actuating crank | 5. Worm shaft |
| 2. Firing needle link plate | 6. Firing needle actuating shaft |
| 3. Firing needle assembly | 7. Sliding block |
| 4. Breech ring electrical contact | 8. Cam control |

Fig 98 – Breech mechanism (breech open)

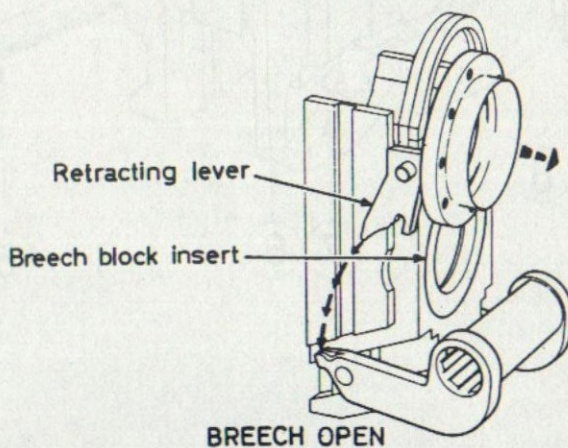
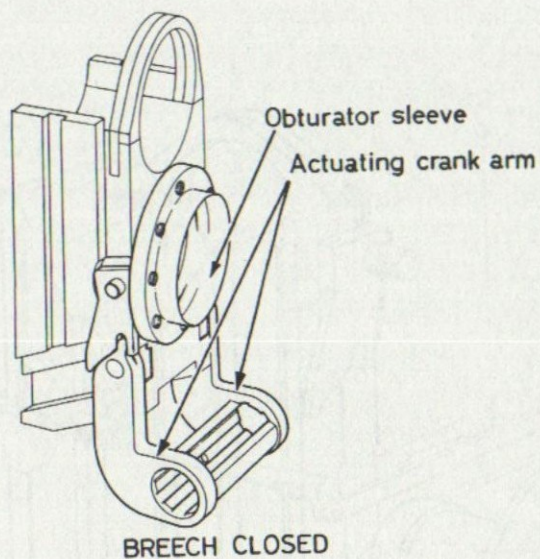
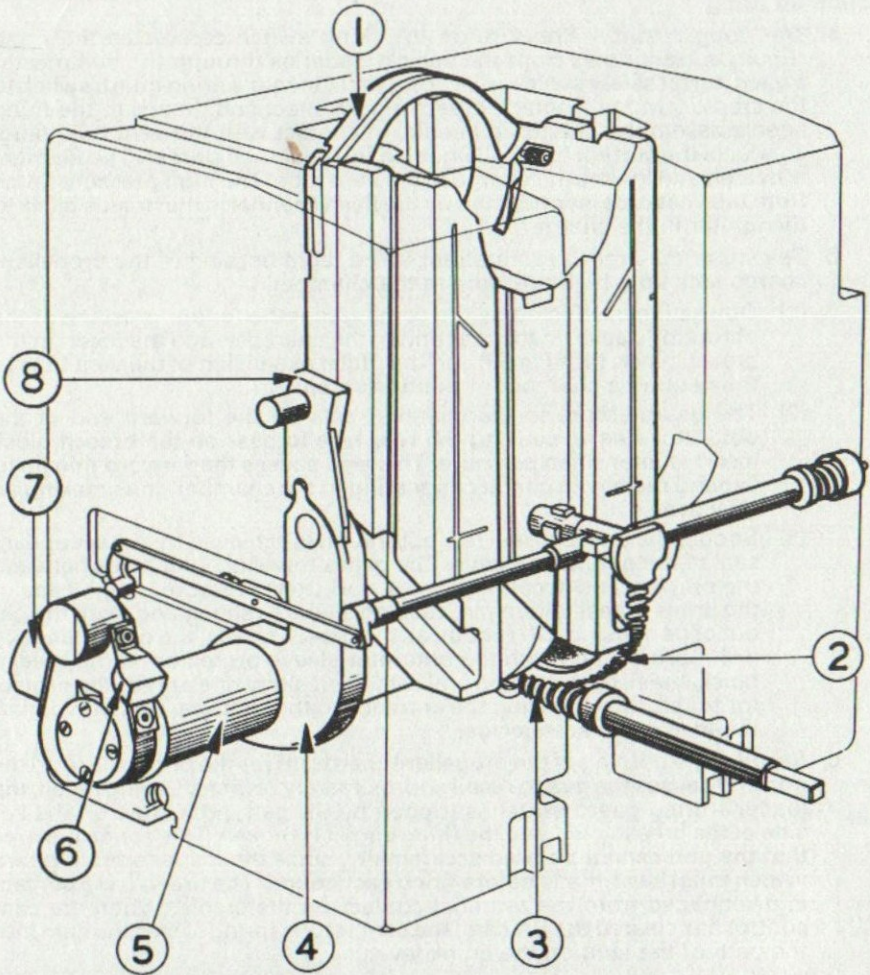


Fig 99 – Obturator mechanism (breech closed and open)

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- | | |
|-------------------------------|--------------------------------|
| 1. Obturator sleeve protector | 5. Actuating shaft |
| 2. Worm wheel | 6. Cam control |
| 3. Worm | 7. Firing needle actuating cam |
| 4. Crank | 8. Retracting lever |

Fig 100 – Breech mechanism (breech closed)

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Action on firing

3. a. *The firing circuit* – Pressure on the firing switch completes the firing circuit; current flows from the vehicle batteries through the hull master switch, turret safety switch, selector switch, loader's firing guard switch to the cradle terminal contact, breech ring contact and thence to the firing needle assembly. The firing needle, in contact with the vent tube plug, conducts the current to the filament in the vent tube primer. The filament is heated and ignites the charge in the vent tube. The high pressure flame from the vent tube is conducted by the flash channel in the breech block to the igniter in the charge.
- b. *Sealing of the breech* (obturation) – The rapid burning of the propellant charge sets up a high pressure in the chamber.
 - (1) Obturation is effected by the coming together under pressure of the obturator sleeve, in the rear end of the chamber, and the insert in the breech block, (see Fig 99) and the radial expansion of the vent tube in the vent tube chamber of the breech block.
 - (2) The gas pressure in the chamber acts on the forward end of the obturator sleeve, causing the rear face to bear on the breech block insert at intensified pressure. This also causes the forward thin lip to expand radially to contact its seating in the chamber, thus making an effective seal.
 - (3) Should the primary seal fail, obturation is achieved by the secondary seal of the obturator sleeve. The gases travel up vent holes between the primary and secondary seals, and exert pressure on the base of the primary seal failure pin, causing a wire to shear, and push the pin out of its housing. On runout, as the breech opens, the protruding pin will make contact with the obturator sleeve protector on the breech block, break the retaining ball catch and allow one arm of the protector to fall, thus blocking the entrance to the chamber and preventing the loading of a projectile.
- c. *Recoil* – The burning of the propellant charge drives the projectile from the gun and causes the gun to recoil approximately 35.5 cm. During recoil, the loader's firing guard switch is tripped by the cam projection on the left side of the breech ring, and the firing circuit is broken. This action ensures that the gun cannot be fired accidentally, since the loader's firing guard switch must be re-made before firing each round. The breech ring contact is disengaged from the terminal contact on the cradle. When the cam control has cleared the SA cam, the cam return spring forces the cam into the path of the stud on the crank lever.
- d. *Action of the fume extractor* – As the projectile travels through the bore of the gun, some of the propellant gas enters the fume extractor through the ports in the barrel and builds up a pressure in the extractor cylinder. The gas, under pressure, is stored in the fume extractor until the projectile leaves the muzzle. The gas pressure in the bore then falls below that in the extractor, and the trapped gas re-enters the bore to cause a flow of air from breech to muzzle to force any residual gases out at the muzzle.

Action on opening the breech by the SA cam

4. a. *Action of the SA cam* – As the gun runs out, the stud on the crank lever of

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the actuating shaft enters the SA cam. The cam groove, acting on the stud, rotates the crank lever to the rear and with it the actuating shaft and crank.

- b. *The withdrawal of the firing needle* – As the crank lever rotates, the firing needle actuating cam on the crank lever causes the firing needle actuating crank to rotate and force the firing needle link plate forward compressing its spring. The rear of the link plate is connected to a lever on the firing needle actuating shaft and so rotates it. The cam face on the inner end of the firing needle actuating shaft rolls on the contact holder of the firing needle and forces it, together with the firing needle, to the rear, compressing the needle springs. Any forward movement of the firing needle is prevented by the stud on the firing needle actuating crank being held in the UP position by the cam on the crank lever.
- c. *The unlocking of the breech* – When the actuating shaft rotates, the actuating crank rotates to the rear, and the sliding blocks are moved back from the mechanical lock position. The ends of the crank arms move out of the recesses in the obturator retracting levers and the eccentric shoulder on the arms moves along the lower face of the retracting levers, forcing them to pivot. The cam faces on the retracting levers contact the obturator sleeve and force it forward out of contact with the breech block insert. During this movement the obturator sleeve springs are compressed.
- d. *The opening of the breech* – Continued rotation of the actuating shaft and crank causes the sliding blocks on the crank to move in the inclined recesses in the block, forcing the block downwards. During this movement, tension is applied to the breech closing spring due to the spring being held in the fixed seating in the worm wheel.
- e. The breech closing spring is held in tension by the stud on the crank lever being engaged with the SA cam.

Action of the breech mechanism lever (BML)

5. a. The breech mechanism lever on the left hand side of the semi-automatic bracket is attached at its lower end to a sprocket shaft. At its upper end is a pivoting hand lever which, when pushed forward, releases a retaining catch by means of an adjustable spring loaded rod.
- b. A chain connects this sprocket shaft to the intermediate lever sprocket wheel, so that rotation of the BML is thus transmitted to the intermediate lever shaft.
- c. The intermediate lever at the inner end of the shaft is in contact with the stud on the crank lever. When the intermediate lever rotates to the rear, the actuating shaft is also caused to rotate, through the medium of the stud.
- d. This action is, in fact, similar to that which occurs when the gun runs out after firing, and so the effect on the breech mechanism is as described in para 4 above.

Action of the vent tube loader

6. a. *Tube extraction, ejection and loading.* The extraction and ejection of a spent tube and the loading of a fresh tube is automatic, providing the vent tube magazine is charged and loaded in the rammer housing (See Figs 101, 102, 103 and 104).

- b. When the breech is opened, the downward movement of the breech block causes the rim of the fired vent tube to enter the recesses in the extractors. Continued lowering of the block brings the projections on the body of the escapement mechanism into engagement with the heels of the extractor actuating cranks, forcing the heels downwards. The cranks, being pivoted at their base, rotate about their axes, causing the lower sliding blocks and actuating levers to move to the rear. The actuating springs are compressed during this movement.
- c. The tops of the actuating levers, moving rearwards, cause the extractors, extractor bar and sliding blocks to move rearwards, bringing the fired vent tube with them. When the extractors reach the wedge shaped projection at the top rear of the vent tube loader, the extractors open and the fired vent tube is ejected. The left hand upper sliding block now comes into contact with the vent tube loader plunger holding the sliding block to the rear, this in turn holds the actuating levers to the rear.
- d. When the plunger on the vent tube loader is struck, the left hand sliding block is released and this allows the actuating springs to reassert.

Safety arrangements

- 7. The gun cannot be fired until the breech is locked because the firing needle is withdrawn and out of contact with the contact plug in the vent tube.

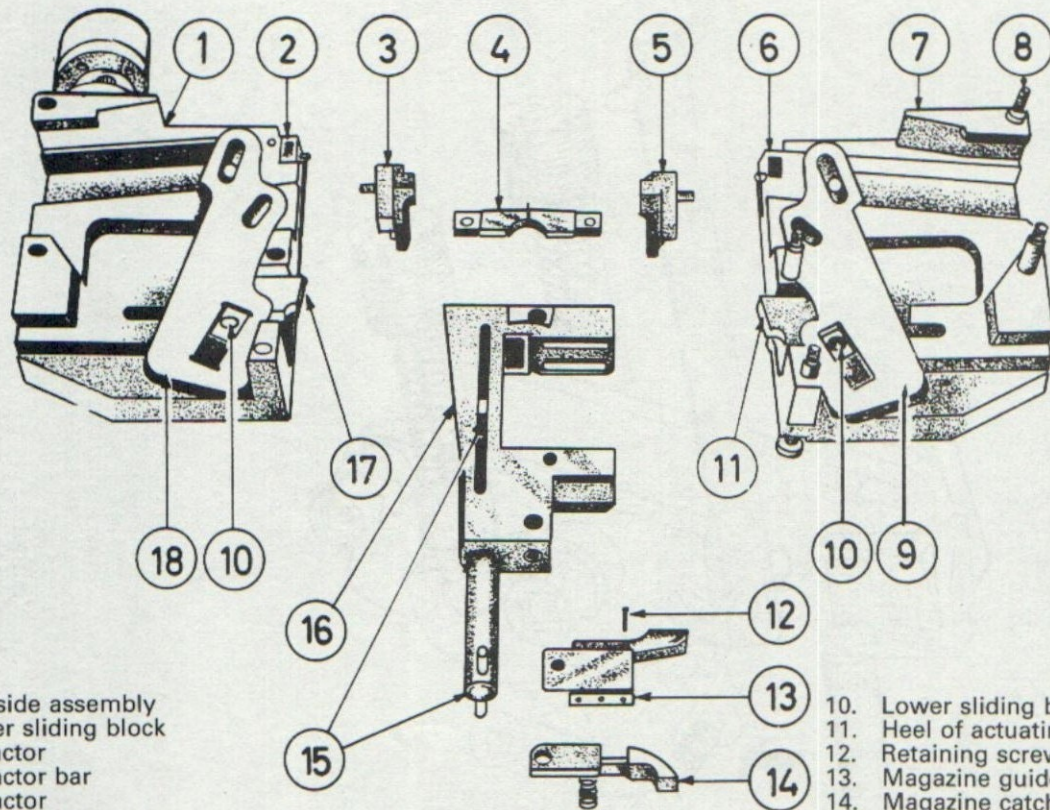
SECTION 6 – 120-MM GUN PULL BACK TEST

Introduction

- 1. The pulling back of the 120-mm gun is a REME task, however, crew participation and assistance of a GNRMECH CHIEF is necessary. Full details of the procedure and equipment is set out in EMER ARMAMENT X171; details given below are to enable GNRMECH CHIEF to render assistance.
- 2. A gun is pulled back in order to exercise the recoil system and to check co-ordination of breech action and operation of the loader's firing guard.
- 3. The occasions when a gun is pulled back are as follows:
 - a. At intervals of 30 days, unless fired during previous 21 days.
 - b. After repair to recoil system or breech mechanism.
 - c. When external damage to the gun is suspected, ie, gun striking an obstruction.
 - d. If, during firing, recoil system or breech mechanism fail to function correctly.
 - e. During pre-firing checks carried out by REME.

Crew preparation for pull back test

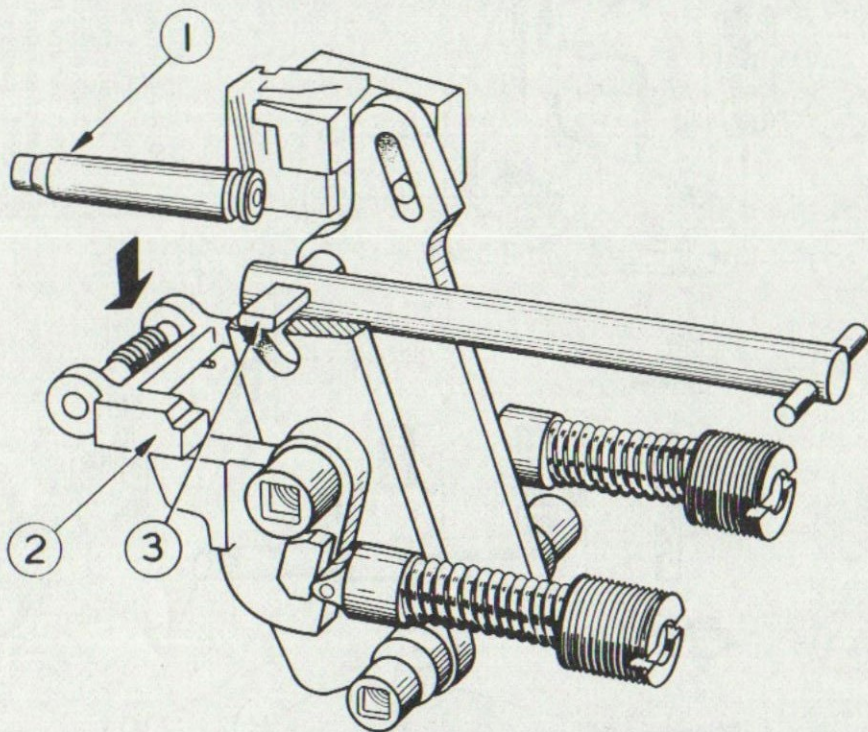
- 4.
 - a. Prove gun.
 - b. Top up buffers and replenisher.
 - c. Check recuperator.
 - d. Remove stop running back.
 - e. Charge vent tube magazine with prepared DRILL vent tubes; fit magazine to vent tube loader.



1. Left side assembly
2. Upper sliding block
3. Extractor
4. Extractor bar
5. Extractor
6. Upper sliding block
7. Wedge shaped projection
8. Retaining screw
9. Actuating lever

10. Lower sliding blocks
11. Heel of actuating crank
12. Retaining screw
13. Magazine guide
14. Magazine catch
15. Rammer and link plate
16. Rammer housing
17. Heel of actuating crank
18. Actuating lever

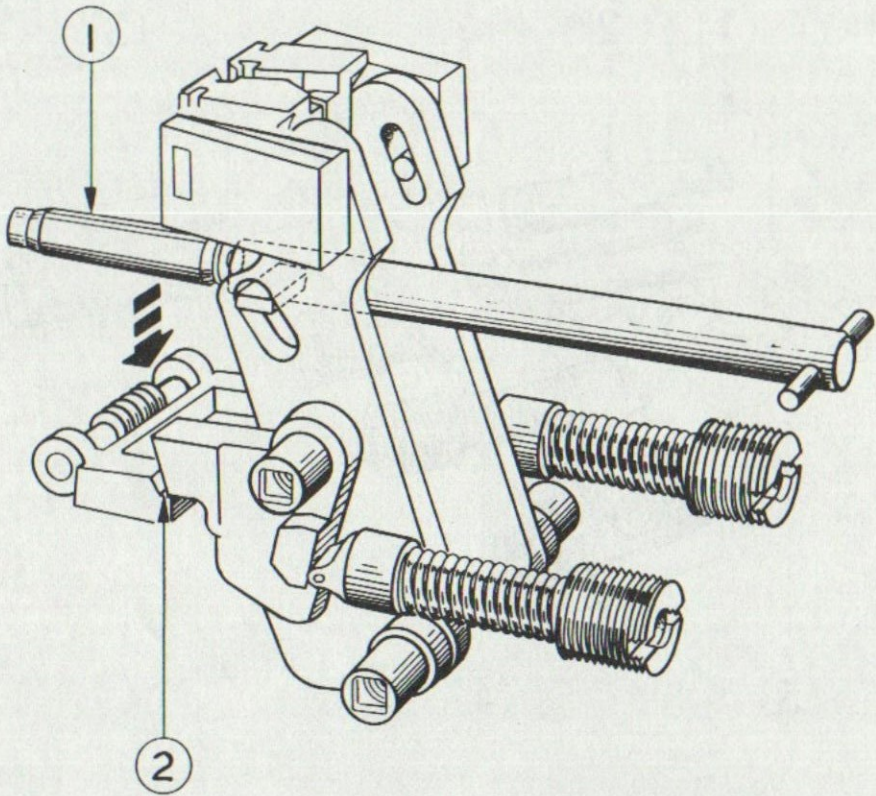
Fig 101 – Vent tube loader (exploded view)



1. Vent tube
2. Escapement mechanism projections
3. Link plate

Fig 102 – Vent tube loader (breech opening, extraction commenced)

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1. Vent tube
2. Escapement mechanism projections

Fig 104 – Vent tube loader (breech open)

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Documentation

9. REME will now complete the documentation of the pull back test by recording it on an insert within the AB 402.

SECTION 7 – 120-MM GUN GAUGE PLUG BORE

Introduction

1. The passing of a gauge, plug bore (GPB) through the barrel of a 120-mm gun is a REME task, however, crew participation and assistance of a GNRMECH CHIEF are necessary.

Full details of the procedure and equipment are set out in EMER ARMAMENT A522, paragraph 98; details given below are to enable GNRMECH CHIEF to render assistance.

2. The GPB is passed through a barrel to ensure that no obstruction exists that could interrupt or restrict the passage of a projectile. The construction of the GPB, in length, ensures that it will be prevented from free passage should the barrel become bent. The diameter of the GPB is 0.0100-in less than the plan diameter of the bore, when new, measured across the lands. Free passage will be prevented by any obstruction which decreases the diameter of the bore.

3. The occasions when a GPB is used are as follows:-

- a. Daily, prior to firing.
- b. If suspected or known damage has occurred.
- c. Hostile fire striking gun barrel.
- d. After a premature.

Crew preparation for GPB

4. The crew will ensure that the bore is thoroughly dry cleaned prior to passing the GPB through the barrel.

Method of use of GPB

5. The GPB will be thoroughly dry cleaned before passing it through the barrel. The GPB can be attached to a rope or to sectionized rods. The latter is preferred since it provides the user with the opportunity to determine the position of any obstruction. The GPB will be used in accordance with current EMER under REME supervision. Firing is not permitted with any barrel that fails the GPB test.

Care and maintenance of GPB

6. The GPB is a precision gauge; it must be handled with care. After use it must be lubricated. Annually or at any time when it may have been damaged, it is subjected to a calibration inspection.

SECTION 8 – 120-MM GUN BARREL CHANGE

Introduction

1. The changing of the 120-mm gun barrel is a REME task, however, crew participation, and assistance of a GNRMECH CHIEF who will carry out the duties of Fitter C, is necessary.

Full details of the procedure and equipment is set out in EMER ARMAMENT H293; details given below are to enable GNRMECH CHIEF to fulfil the duties of Fitter C.

2. A barrel change is completed as and when necessary to replace a shot out or damaged barrel.

Crew preparation for barrel change

3. The crew, with the guidance of GNRMECH CHIEF, are required to carry out the following points of vehicle/gun preparation in order that REME can complete the barrel change.

- a. Remove radios, if necessary.
- b. Remove ammunition racks positioned in the tunnel of the turret bustle.
- c. Remove armoured air ducting cover (NBC Pack No. 6 – open rear door).
- d. Open rear access door.
- e. Remove thermal sleeve and fume extractor, if L11A2 or A3 barrel is fitted.

NOTE:- REME requirements, if L11A5 barrel is fitted, will be given verbally.

- f. Remove mantlet cover.
- g. Strip the 120-mm gun breech mechanism completely. Lower breech block to turret floor.
- h. Remove gunner's guard and quadrant fire control.
- j. Remove terminal block and recoil indicator.
- k. Remove loader's firing guard.
- l. Assist REME in setting up barrel removing equipment.

Preparation of replacement barrel

4. The replacement barrel will be prepared under REME supervision with attention being given to the following:-

- a. Removal of all external preservative grease.
- b. Removal of all preservative grease from the bore.
- c. Remove the preserving screws from the gas ports of the replacement barrel. These will be fitted to the gas ports of the old barrel.
- d. Pass the gauge plug bore through the replacement barrel.
- e. Grease the barrel chase.

Removal/replacement of barrel

5. REME are responsible for the removal and replacement of the barrel; during this operation GNRMECH CHIEF will act as "Fitter C". When the old barrel has been removed, the gun cradle liners must be thoroughly cleaned and then greased prior to the replacement barrel being fitted.

6. When the replacement barrel has been fitted, the crew, under the guidance of the GNRMECH CHIEF, will assemble all components removed during preparation. When all components are fitted, the gun cradle liners will be greased through the lubricating nipples and the gun subjected to pull back test.

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Documentation

7. REME will now complete the documentation of the change of barrel, in accordance with EMER ARMAMENT A520, by inserting the new AFB 2562/1 (1975) into the AB 402.

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CHAPTER 16 – .50-IN RANGING GUN

SECTION 1 – MECHANISM

Backward movement

1. a. *Sealing of the breech* – When the gun is loaded and the trigger pressed, the firing pin strikes the cap. The case expands radially and seals the breech.
- b. *Recoil* – The pressure of the gases that force the bullet out of the bore is felt equally on the face of the bolt. The barrel, barrel extension and bolt recoil as a unit for approximately one inch.
- c. *Oil buffer* – As the barrel extension moves to the rear, the shank on the barrel extension, which is engaged with the piston on the oil buffer body, compresses the oil buffer spring.
- d. *Unlocking of the breech* – The breech is not unlocked until the bullet leaves the bore. When the breech lock clears the breech lock cam, in the body of the gun, the breech lock is forced down by the breech lock depressors, on the buffer body, bearing on the breech lock pin and disengaging the breech lock from the recess in the bolt. The bolt is now unlocked from the barrel extension and continues its movement to the rear. A live round is withdrawn from the belt by the extractor and the empty case is removed from the chamber by the bolt. The driving springs are compressed during this movement.
- e. *Action of the accelerator* – The barrel extension, as it moves to the rear, bears against the accelerator which strikes the accelerator face on the bolt and speeds its movement to the rear. The shoulders on the shank of the barrel extension engage behind the claws of the accelerator and lock the barrel extension to the oil buffer body.
- f. *Limit of the backward movement* – The bolt is limited in its movement when it strikes the buffer in the backplate.

Forward movement

2. a. *Action of the driving springs* – The driving springs reassert themselves and force the bolt forward.
- b. *Rotation of the accelerator* – The accelerator face on the bolt strikes the accelerator and causes it to turn forward so that the barrel extension is unlocked from the oil buffer body.
- c. *Oil buffer* – The oil buffer spring forces forward the barrel extension and barrel.
- d. *Locking of the breech* – The breech lock is forced up the breech lock cam and engages in the recess under the bolt. The breech is thus locked just before the parts reach the firing position.

Cocking action

3. As the bolt moves to the rear, the upper end of the cocking lever is forced forward by the bracket on the underside of the top plate. The lower end of the cocking lever draws the firing pin to the rear, thus compressing the firing pin spring against the sear stop pin. The shoulder of the firing pin engages with the

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notch of the sear. When the bolt moves forward, the cocking lever rotates on its axis so that its lower end moves forward in the slot of the firing pin extension. When the breech is locked, the sear slide is in contact with the firing plunger of the firing solenoid (see Fig 105).

Firing action

4. The fingerpiece is locked down, thus raising the bolt latch. When the firing switch is pressed, the plunger in the firing solenoid forces the sear slide across to the left, thus disengaging the sear from the shoulder of the firing pin. The firing pin spring reasserts itself and forces the firing pin forward, firing the cap of the round. If the firing pin were prematurely released, it would move forward under control of the cocking lever so that the round would not be fired until the breech was locked.

Action of feed

5. a. *Movement of the feed lever* – As the bolt moves to the rear, the lug on the feed lever is moved by the cam groove on the bolt, causing the feed pawl and slide to move to the left behind the round held by the holding pawl. As the bolt moves forward, the lug on the feed lever moves the feed pawl and slide to the right. The next round in the belt is thus moved to the right against the cartridge and bullet stops, and is ready to be gripped by the extractor. During this movement the holding pawl is depressed as the next round passes over it.
- b. *Action of the extractor* – As the bolt moves to the rear, the extractor withdraws a live round from the belt and the bolt brings an empty case out of the chamber. The extractor moves along the extractor switch on the left side plate. When the bolt is fully to the rear, the extractor is forced down under the extractor switch by means of the cover ramps so that the rim of the round is engaged with the guides on the face of the bolt. The empty case, if it has not previously fallen off, is forced off by the ejector. The extractor, moving along the top of the barrel extension, supports the round being carried forward into the chamber by the bolt. The round is released by the extractor when it rides up the front cam to grip the next round. The upward movement of the extractor is limited by the extractor spring in the cover.

NOTE:- If the round is not withdrawn from the belt, double feed is prevented by the action of the feed pawl arm, which rides over the round and disengages the feed pawl from the belt.

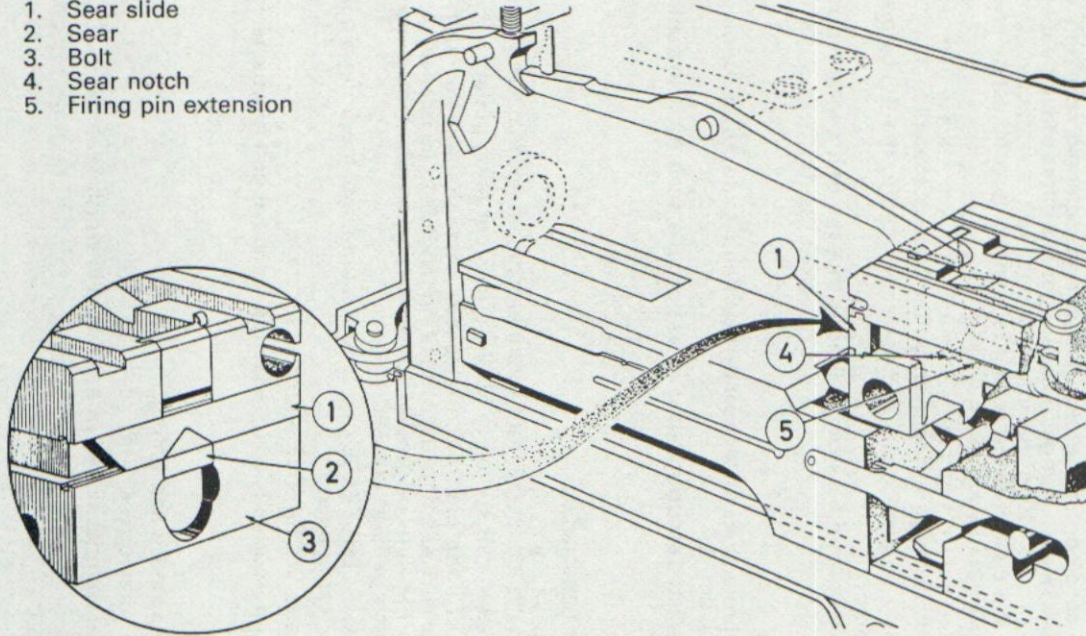
SECTION 2 – ADJUSTMENT OF .50-IN RG SOLENOID

Introduction

1. The adjustment of the .50-in RG solenoid (Maxifort Unit) is a task that may be completed by a GNRMECH CHIEF without REME supervision. The procedure given below has been extracted from EMER – Small Arms and Machine Guns F163.

2. A GNRMECH CHIEF may be called upon to make the adjustment when the crew, having completed the test of the RG firing circuit, report that the .50-in RG fails to fire.

1. Sear slide
2. Sear
3. Bolt
4. Sear notch
5. Firing pin extension



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Fig 105 – .50-in ranging gun – firing and cocking action

General

2.
 - a. The solenoid unit is secured to the right side of the receiver. It comprises a cast aluminium case containing electrical wiring, solenoid core and a spring loaded sear release plunger. The plunger has a free movement of 0.120-in minimum to 0.140-in maximum; movement is restricted by a locating pin. In the centre of the casing is a rotary type adjuster; one complete rotation equates to twelve clicks.
 - b. Prior to fitting and before adjusting a solenoid, the sear release plunger should be flush with the protruding rib on the base of the solenoid.
 - c. The solenoid must be serviceable and correctly fitted to the RG before attempting to adjust.
 - d. An unserviceable solenoid is not repaired within the unit and must be exchanged.

To fit solenoid to RG

3.
 - a. Engage the two projections on the rear of the solenoid into corresponding slots in the receiver.
 - b. Tighten the castellated securing nut as far as possible, secure it with a split pin.

To adjust solenoid

4.
 - a. Adjust cartridge headspace.
 - b. Cock the gun, leave cover open.
 - c. Press the bolt to the left (away from solenoid) against inside of receiver.
 - d. Set the gunner's selector switch to MAIN, press foot firing pedal.
 - e. Check position of firing pin, if it is released, rotate the adjuster ANTI-CLOCKWISE one click at a time until the firing pin fails to be released on the first impulse. Pressure, on the bolt, to the left must be maintained each time the foot firing pedal is pressed.
 - f. Rotate the adjuster CLOCKWISE one click at a time until the firing pin is released on the first impulse.
 - g. Rotate the adjuster CLOCKWISE a further six clicks.
 - h. The solenoid is now correctly adjusted to the particular gun to which it is fitted.

Equipment required

5.
 - a. .50-in gauge, headspace and timing.
 - b. London pattern screwdriver, 5-in.
 - c. Small adjustable spanner in lieu of a 3/8-in Whitworth spanner.

CHAPTER 17 – 7.62-MM MACHINE GUN

SECTION 1 – MECHANISM

Forward movement

1. a. *Trigger mechanism* – When the trigger extension is operated it actuates the trigger and its control springs are compressed. The sear tripper is pulled down by the trigger and the sear actuating roller pushes the front end of the sear upwards until it engages the upper bent of the sear tripper. Simultaneously, the sear is depressed and disengaged from the bent of the piston extension (see Fig 106).
- b. *The piston assembly* – The compressed return spring being free to reassert itself forces the piston assembly and breech block forward.
- c. *Feeding the round* – As the piston assembly is driven forward, the feed horns of the breech block force the round out of the belt into the chamber. The round is guided by the cartridge guide pawl and the bullet guide.
- d. *Locking of the breech* – As the round is fed into the chamber, the locking lever contacts the locking cams and slows down the forward movement of the breech block. This contact and the continued forward movement of the piston assembly causes the locking lever link to rotate downwards and backwards, thus forcing the locking lever down to its fullest extent in front of the locking shoulder. The breech is thus mechanically locked with the round fully chambered.
- e. *Action of the extractor* (as the breech closes) – During the final movement of the breech block the round is positioned on the cartridge seating, its rim is engaged by the extractor and its base depresses the ejector.
- f. *Firing the round* – The final forward movement of the piston drives the firing pin through the firing pin hole on to the cartridge cap and fires the round. The front face of the piston extension contacts the stop face on the body.

Backward movement.

2. a. *Sealing of the breech* – When the round is fired, the explosion causes the cartridge to expand radially against the walls of the chamber to seal the breech.
- b. *Action of gases* – The gases drive the bullet through the barrel; after the bullet has cleared the gas vent some of the gases pass through the gas vent into the gas cylinder. Thence, they pass into the cup of the piston head where expansion takes place to drive the piston to the rear.
- c. *Unlocking of the breech* – Immediately the piston begins to move, the firing pin, held by the piston post, is withdrawn from the base of the fired cartridge. During the next 5/8-in of movement the breech remains fully locked while the bullet travels the remaining distance from the gas vent to the muzzle. Continued movement of the piston causes the locking lever link to rotate forward and upwards and lift the locking lever. As the locking lever is lifted out of engagement with the locking shoulder, the primary extraction faces on the lever strike the locking cams in the body. The breech block is jerked back slightly by this action which causes primary

extraction, ie, easing of the empty case in the chamber. The locking lever then clears the face of the locking shoulder and the breech is unlocked. (See Fig 107.)

- d. *Extraction and ejection* – As the breech block commences its rearward movement, the cartridge case is withdrawn from the chamber by the extractor. When the case is clear of the chamber the ejector forces it out through the ejection opening in a forward and downward movement. The piston assembly continues to the rear and compresses the return spring.
- e. *Action of the recoil buffer* – The rearward movement of the piston assembly ceases when the piston post contacts the anvil of the buffer which later assists in the forward movement. The anvil recoils on impact and the movement is communicated to the tapered bushing which is forced into the packing causing it to expand slightly and contact the walls of the buffer housing. This causes a braking effect which, assisted by the compressed spring washers, absorbs most of the shock of recoil (see Fig 108).
- f. *Subsequent rounds and end of burst* – For as long as pressure on the trigger extension is maintained the sear tripper and sear are held down allowing the piston assembly to move to and fro automatically feeding and firing the subsequent rounds. When pressure is released the control springs force the trigger extension forward thus pivoting the trigger forward which forces the sear tripper upwards. The sear remains depressed because its forward end is engaged on the upper bent of the sear tripper. As the piston extension is propelled to the rear it rotates the sear tripper rearwards and disengages from the front end of the sear. This causes the sear to rise and engage with the sear bent of the piston extension thus holding the piston assembly in the cocked position.

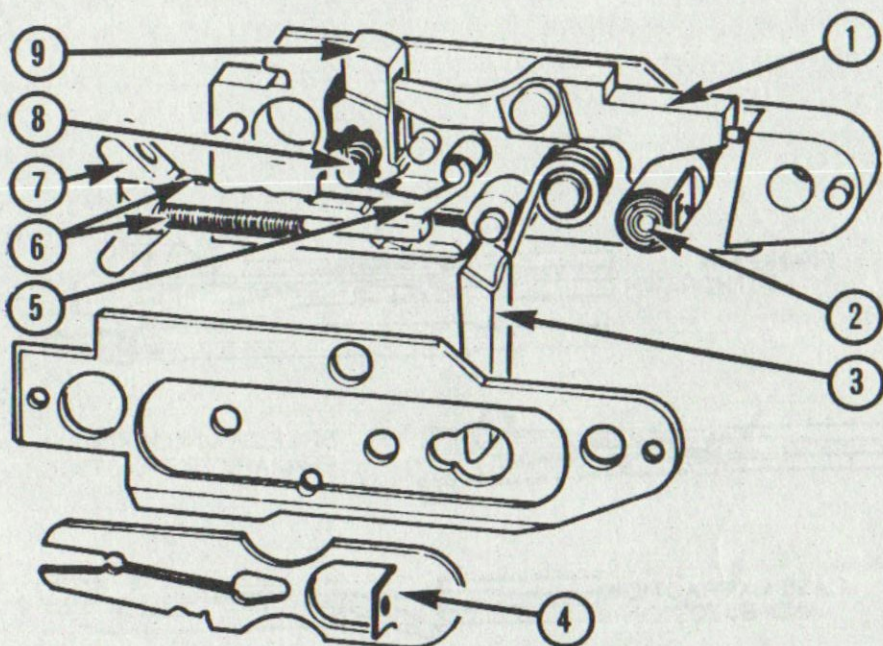
Action of feed (See Fig 109)

3. a. *Forward movement* – When the piston assembly has moved forward approximately three inches the actuating roller on the breech block starts to pivot the feed arm. Continued movement causes the forward end of the feed arm to be forced fully to the right and at the same time the inner pawl moves to the left and engages behind the next round in the belt. Simultaneously the outer pawls carry that round from left to right, to the half feed position, and at this stage both inner and outer pawls are engaged behind one round.
- b. *Backward movement* – During the first two inches of the rearward travel of the breech block, the feed actuating roller operates the forward end of the feed arm from right to left. This causes the inner pawl to move to the right and carry the next round from the half feed to the fully fed position. Simultaneously the outer pawls move to the left and engage with the next round in the belt.
- c. *The feed pawl depressor* – When the feed pawl depressor is pushed from left to right it disengages the inner and outer pawls from the first and second rounds in the belt. This will isolate feed in the event of a 'runaway' gun.

The safety catch

4. a. When the safety catch is at 'F' (fire) its recess is directly under the sear lug. Thus giving clearance for the operation of the sear.

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1. Sear
2. Safety catch
3. Hand lever
4. Axis pins retaining plate
5. Trigger
6. Trigger springs
7. Trigger extension
8. Sear tripper spring
9. Sear tripper

Fig 106 – 7.62-mm MG trigger mechanism assembly

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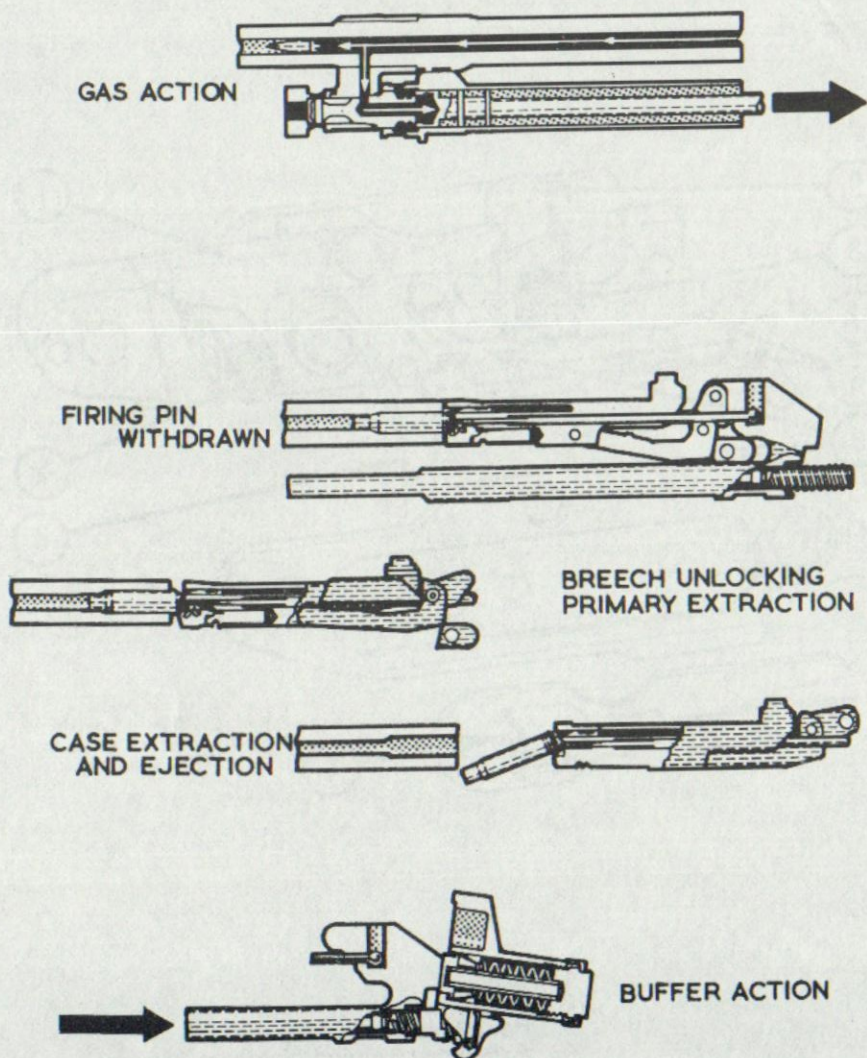


Fig 107 - 7.62-mm MG actions during backward movement

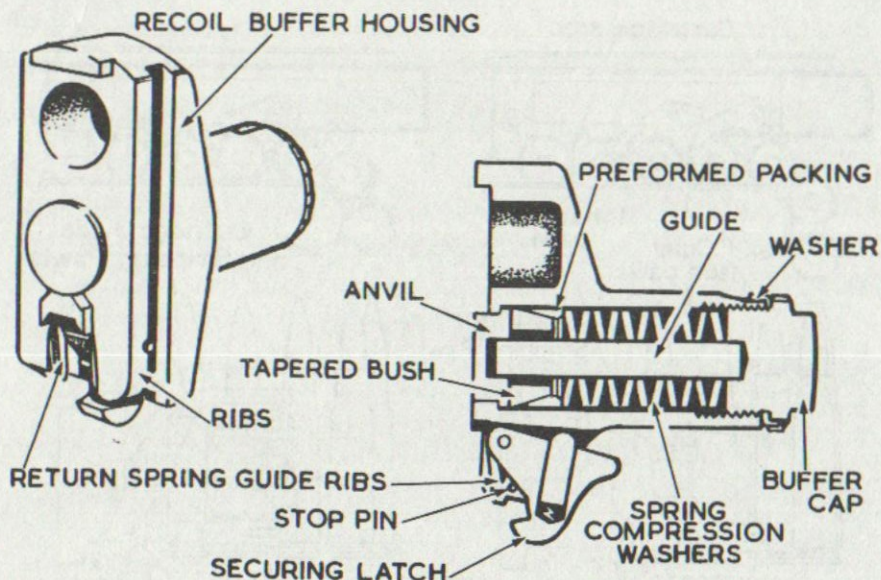


Fig 108 – 7.62-mm MG recoil buffer

- b. When the safety catch is at 'S' (safe) its recess is to the right hand side of the sear lug. Therefore with no clearance, the sear cannot operate.

The flash suppressor (L3A2 barrel)

5. a. The flash suppressor is a bell-mouthed extension fitted to the muzzle and allows the propellant gases to expand and cool slightly before reaching atmosphere, to reduce flash.
- b. Projecting rearwards from the underside of the suppressor is a duct which draws excess gas from the areas of the gas regulator and conveys it via the tube into the open, thus minimising the presence of gas in the turret.

The flash hider (L1A2 barrel)

6. The flash hider is a slotted extension fitted to the muzzle. It allows the propellant gases to expand and cool slightly before reaching atmosphere, to reduce flash.

SECTION 2 – GUN BALANCING 7-62-MM MG L37A1 and L8A1

Introduction

1. The balancing of the 7-62-mm MG is a task that may be completed by a GNRMECH CHIEF without REME supervision. It must, however, be appreciated

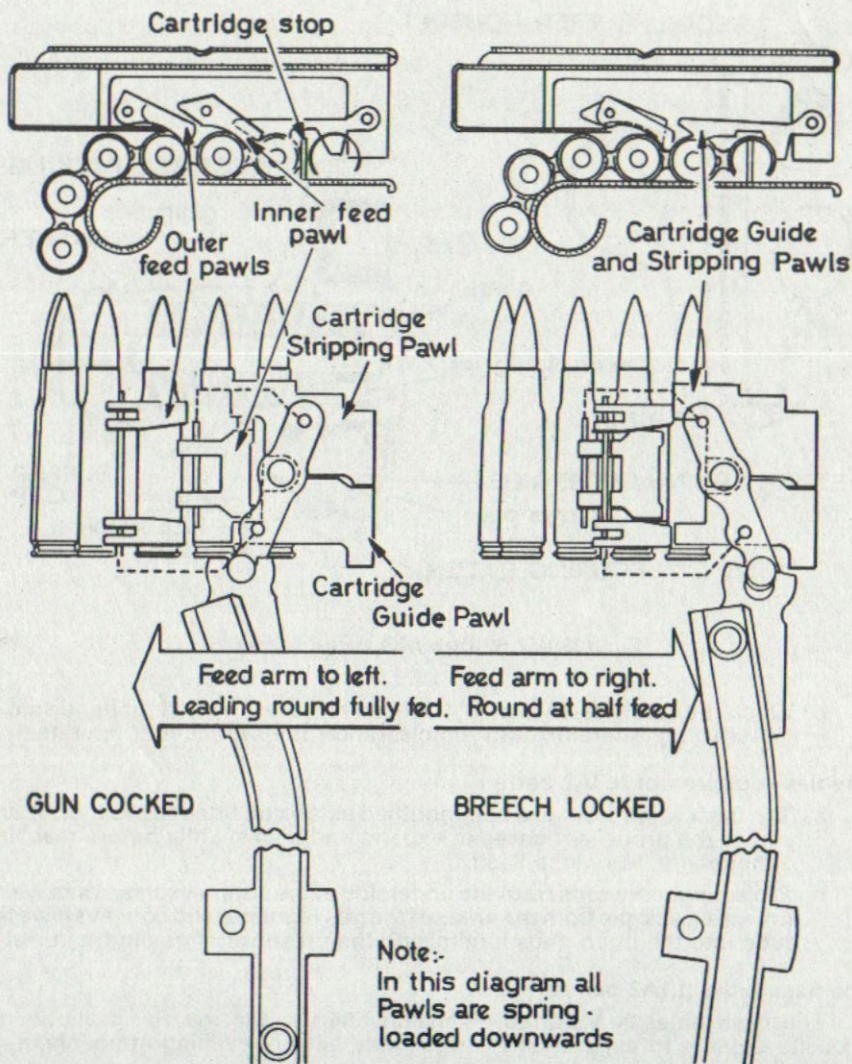


Fig 109 – 7.62-mm MG action of the feed mechanism

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that normal range procedure, safety regulations and supervision must be enforced. The procedure given below has been extracted from EMER – Small Arms and Machine Guns.

2. A GNRMECH CHIEF may be called upon to check the balance of an MG by a crew in order to establish the correct setting of the gas regulator fitted to L1A2 barrels, or to determine that gas port No. 2 of a gas regulator fitted to an L3A2 barrel enables the gun to function correctly.

General

3. The 7.62-mm MG is fitted with a two-bent sear and it is possible for the gun to cock on either the front or rear bent on the termination of a burst. The front bent is intended as a safety measure only and should not come into operation during normal functioning. Therefore, it is essential to establish that the piston is cocking on the rear bent whenever a burst is completed.

4. Correct cocking is dependent on the right balance between the gas force on the piston and the resisting forces of the return spring being obtained. Because the return spring and gas regulator assemblies have a definite bearing on the performance of the gun, these assemblies should be kept to their mated gun wherever possible. Return springs must be checked for serviceability before the gun is balanced.

5. To establish which bent the gun is cocking on, a simple check involving the use of a scribe line is used.

To position scribe line

6. a. Prove gun.
- b. Pull cocking handle fully to rear and mark the side of gun body in line with the cocking handle.

Balancing 7.62-mm MG L37A1

7. The 7.62-mm MG L37A1 must be balanced in the ground role; once balanced, it is then correct when fitted to the commander's MG mounting. Particular attention is to be paid to balancing when blank ammunition is to be fired. **BLANK AMMUNITION GIVES INCREASED RECOIL AT ALL GAS REGULATOR SETTINGS** and may cause serious damage to the gun, with possible injury to the firer, if not correctly balanced for this type of ammunition.

Procedure

8. a. Prepare gun for firing with L1A2 barrel fitted. Mark gun body with scribe line.
- b. Complete eight point check; ensure gas regulator is set at No. 6 gas setting.
- c. Load gun and fire four to five bursts of approximately ten rounds to warm the gun and eliminate stoppages when gas force is reduced.
- d. Set safety catch to SAFE.
- e. Draw cocking handle carefully to rear and determine position at which contact with the piston is made.
 - (1) If cocking handle is in line with scribe line, the piston is engaged with the rear bent of the sear.

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- (2) If cocking handle is forward of scribe line, the piston is engaged with the front bent of the sear. Continue procedure as given in sub-para g. below.
- f. If the piston is engaged with the rear bent, the gas regulator must be adjusted to ensure engagement with the front bent as follows:-
 - (1) Ensure safety catch is set to SAFE; unscrew gas regulator two notches, ie, gas setting No. 6 to No. 8, thereby decreasing the amount of gas.
 - (2) Set safety catch to FIRE, fire a burst and repeat sub-para d. and e. until piston is engaged with the front bent.
- g. Set safety catch to SAFE, screw in gas regulator four notches.
- h. Set safety catch to FIRE, fire a burst and check that piston is engaged with the rear bent.
- j. Clear gun; ease springs.
- k. The final setting of the gas regulator is to be NOT LESS than No. 4. If it is, report to REME.
- l. Record the gas setting and, during subsequent preparation for firing, the recorded setting should be applied to the gas regulator.

Procedure for checking balance of 7-62-mm MG L8A1

9. The 7-62-mm MG L8A1, when mounted co-axially, must be checked for balance in order to determine that gas port No. 2 allows the gun to function correctly. The following procedure will be followed:-

- a. Prepare gun for firing. Mark gun body with scribe line.
- b. Complete eight point check; ensure gas regulator is set at gas port No. 2.
- c. Load gun and fire a short burst of approximately 10 rounds.
- d. Set safety catch to SAFE.
- e. Check that gun is cocked on rear sear; if not report, to REME.
- f. Clear gun; ease springs.

SECTION 3 – ADJUSTMENT OF THE COMMANDER'S MG SIGHT LINKAGE

Introduction

- 1. The adjustment of the commander's MG sight linkage is a task that may be completed by a GNRMECH CHIEF without REME supervision. The procedure given below has been extracted from EMER H293.
- 2. A GNRMECH CHIEF may be called upon to make the adjustment when the crew report inaccuracies in the alignment of the commander's MG sight linkage.

General

- 3.
 - a. Prove the MG.
 - b. Ensure commander's sight is correctly mounted.
 - c. Ensure MG is correctly mounted.
 - d. Test elevating gear over full range of movement and report any stiffness in operation to REME.

Adjustment of link bar

4. a. *MG mountings No. 8 and No. 10*

- (1) Set commander's linkage adjusting lever to central zero position by aligning two red scribe marks.
- (2) Illuminate X1 graticule.
- (3) Select suitable aiming mark which has angle of depression.
- (4) Using cupola controls, align MG on aiming mark by looking along the fore and back sight. Ensure back sight is set to ZERO and last movement of elevating handwheel is one of elevation.
- (5) Loosen sight linkage turnbuckle lock nuts. Rotate turnbuckle until X1 graticule is on centre of aiming mark.
- (6) Select suitable aiming mark which has angle of elevation, using cupola controls lay on to it as described in sub-para (4) above.
- (7) If necessary, rotate turnbuckle adjuster until X1 graticule is on centre of aiming mark. Tighten lock nuts.
- (8) Lay on to aiming mark in depression, any error should be corrected by halving the adjustment in both positions until a mean is reached. Final adjustment can be achieved by moving the commander's linkage adjusting lever.
- (9) View through left eyepiece of sight, the target should appear in centre of field of view.

b. *MG mounting No. 2.* Due to a different type of linkage from mounting to sight there is no turnbuckle adjuster or commander's linkage adjusting lever.

c. The adjustment is carried out as follows:-

- (1) Illuminate X1 graticule.
- (2) Select suitable aiming mark which has angle of depression.
- (3) Using cupola controls, align MG on aiming mark by looking along the fore and back sight. Ensure back sight is set to ZERO and last movement of elevating handwheel is one of elevation.
- (4) Loosen lock nut at lower end of connecting arm. Rotate adjusting nut until X1 graticule is on centre of aiming mark.
- (5) Select a suitable aiming mark, which has angle of elevation; using cupola controls lay on to it as described in sub-para (3) above.
- (6) If necessary, rotate adjusting nut until X1 graticule is on centre of aiming mark. Tighten lock nut.
- (7) Lay on to aiming mark in depression; any error should be corrected by halving the adjustment in both positions until a mean is reached.
- (8) View through left eyepiece of sight; the target should appear in centre of field of view.

Equipment required

5. a. MG 7-62-mm L37A1 fitted with L1A2 barrel.
- b. Spanners OJ AF $\frac{1}{2}$ -in x 7/16-in (2).
- c. Spanner OJ AF $\frac{3}{4}$ -in x 7/8-in.

SECTION 4 – RENEWAL OF 7-62-MM MG BOWDEN CABLE

Introduction

1. The renewal of the 7-62-mm MG Bowden cable for the mechanical firing gear is a task that may be completed by a GNRMECH CHIEF without REME supervision. The procedure given below has been extracted from EMER Armament H293, Chapter 3.
2. A GNRMECH CHIEF may be called upon to renew a Bowden cable when the crew, having completed the test and adjustment of the mechanical firing gear, report that the 7-62-mm MG fails to fire.

To remove Bowden cable

3.
 - a. Traverse turret until gunner's foot plate is behind driver's compartment.
 - b. Depress gun.
 - c. Slacken lock nut on cable adjuster bracket; take off all adjustment to cable.
 - d. Remove cable adjuster bracket securing bolts from gunner's foot rest.
 - e. Remove foot firing pedal.
 - f. When sufficiently slack, remove inner cable from foot firing pedal.
 - g. Remove retaining clips from around gun cradle.
 - h. Elevate gun.
 - j. Release the protective asbestos sheeting (splash curtain).
 - k. Remove cable from pivot arm of the manual cocking gear.

To assemble Bowden cable

4.
 - a. Connect cable to pivot arm of the manual cocking gear.
 - b. Secure the protective asbestos sheeting (splash curtain).
 - c. Depress gun.
 - d. Secure retaining clips around gun cradle.
 - e. Connect inner cable to foot firing pedal.
 - f. Secure foot firing pedal.
 - g. Secure cable adjuster bracket securing bolts to gunner's foot rest.

To adjust mechanical firing gear

5.
 - a. Prove gun; leave working parts to rear.
 - b. Slacken lock nut on top of cable adjuster bracket.
 - c. Rotate adjuster one half turn.
 - d. Press foot pedal and check working parts have been released.
 - e. If working parts are not released, repeat adjustment half a turn at a time until working parts are released.
 - f. Tighten lock nut and test mechanical firing gear.

Equipment required

6.
 - a. Spanner OJ AF 5/16-in x 3/8-in (2).
 - b. Spanner OJ AF 7/16-in x 1/2-in.

CHAPTER 18 – FIRE CONTROL EQUIPMENT

SECTION 1 – THE TRUNNION TILT COMPENSATOR

Introduction

1. If the gun trunnions are not cross-level when the gun is laid, errors in line and elevation will be introduced. To compensate for any trunnion tilt, ie, one trunnion higher than the other, a compensator is incorporated in the optical system of the sight.

Description

2. *Sight periscopic, AV, No. 59 and 69.* The compensator consists of a parallel glass plate, mounted in a holder, located between the object glass and eyepiece prism. The holder, which is supported on trunnions, is free to pivot about an axis parallel to the line of sight. A weight, suspended from the holder, maintains the glass plate in the true horizontal position when the sight is not vertical in the lateral plane. The angular displacement of the glass plate relative to the sight gives a lateral deviation of the field of view, relative to the graticule, thus automatically applying compensation for tilt up to 124 mils left/right from the vertical positions.

3. *Sight, Laser, rangefinder.* The prism, upon which the graticule pattern is etched, is mounted in a holder which automatically compensates for trunnion tilt. The graticule pattern remains vertical even when the sight is not vertical. The compensation is achieved by the weighted holder being rotated in its mounting within the sight. The compensator can accommodate a tilt angle of 178 mils left/right from the vertical position.

SECTION 2 – TANK LASER SIGHTS (TLS)

Brief description of the operation

1.
 - a. When the flash button is pressed, or in the case of the No. 1, Mk 2 TLS, the selector switch is moved from the OFF position, the PSU provides the high electrical power required by the laser generator.
 - b. When the laser button is pressed to FLASH, the laser pulse passes out of the laser tube, through the prisms in the sight to the target.
 - c. Some of the laser pulse is diverted into the range circuit system in order to start it and prepare it for the arrival of the returning beam.
 - d. When the laser pulse hits the target, some of it is scattered but some is reflected back to the sight where it passes through to the range unit stopping the range circuit. The range data is then transmitted back to the sight and to the commander's range readout for display.
 - e. This time delay, between the starting and stopping of the range circuit, is measured and plotted on the digital counter as a three figure number, ie, the range in metres.
 - f. If the beam returns too quickly, ie, the target is less than 600 metres, then the range circuit is not ready to receive and a false reading is given.
 - g. If the beam returns too slowly, ie, the target is beyond 10,000 metres, the range circuit will have stopped and again a false reading is given.

SECTION 3 – ADJUSTMENT OF SIGHTS

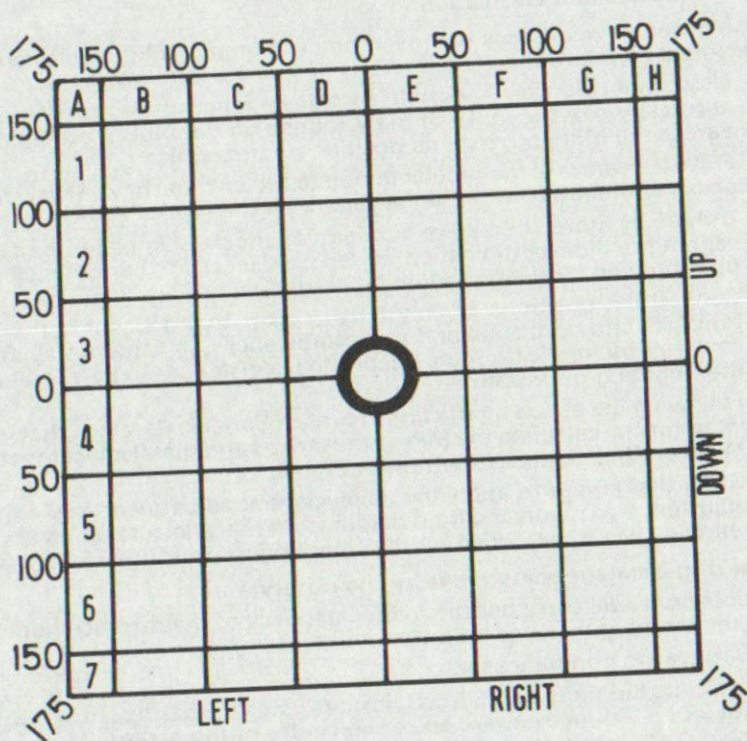
General

1. The precise adjustment of sights is vital if accurate shooting is to be obtained.
2. Normally the procedure as detailed on Pages 155-157 will give optimum results. Occasionally, especially when APDS is fired or when a barell is new, it will not suffice and gun/sight relationship must be established by 'Shooting in'. As a guide, this should be done if less than 60% of APDS or PRAC DS rounds, fired on an occasion, hit the target and there is no obvious explanation for misses.
3. A qualified observer must control the firing when Shooting-in. He should be positioned upwind to a flank and in radio contact with the crew of the firing tank. He must be in possession of a correctly scaled replica of the Shooting-in screen, a circular template (see Fig 110) and a Chieftain 120-mm Shooting in proforma (see Fig 111).
4. The Shooting in screen, constructed of a wooden frame and hessian, must be positioned at a measured range of 1100 metres. The dimensions of the screen are 350 x 350 centimetres, gridded in 50 x 50 centimetres squares and having a central aiming circle with an inner diameter of 30 centimetres (see Fig 110).

Procedure for Shooting-in a 120-mm gun

5.
 - a. Allow a period of at least 30 minutes, after earlier firing, for the barrel to cool.
 - b. Complete the preparation and the adjustment of the gunner's periscopic sight, as detailed on Pages 155-157.
 - c. The gunner will inform the observer of the readings on the graticule adjusters BEFORE applying the adjustment given on the colour symbol system plate for the sight/barrel combination. The readings will be recorded, by the observer, in Para 1 of the Shooting-in proforma.
 - d. Adjust the periscopic sight in accordance with the colour symbol system plate.
 - e. Adjust the gunner's sight unit and the commander's PRI as detailed on Pages 157-158.
 - f. Load with the required ammunition (APDS or PRAC DS).
 - g. Lay APDS dot 2 or 1100 metre mark on to the centre of the screen, ending the lay in elevation. Inform the observer when the gunner is ready; fire when ordered.
 - h. The observer must now control the procedure as appropriate with sub-para (1) or (2) below.
 - (1) If the first strike is at least one square's width inside the edge of the screen then, under the observer's control, the gunner will fire a further 6 rounds, using precisely the same lay irrespective of the fall of shot.
 - (2) If the first round misses or strikes so near the edge of the screen that subsequent rounds may miss, order an adjustment to the graticule that will ensure that the next round falls within the required area of the screen. Then, under the observer's control, the gunner will fire a further 7 rounds, using precisely the same lay irrespective of the fall of shot. In this procedure the very first round fired under sub-para g. will be ignored when recording strike positions.

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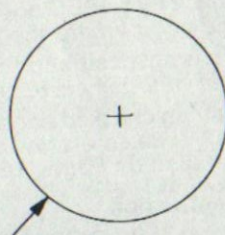
DIMENSIONS

'Screen'.... 350cm x 350cm (square)

circle ... diam, inside, 30cm
outside, 45cm

grid squares.... 50cm

lines..... 2cm wide



circular template
(equivalent to 60cm radius, full size on actual screen)

Fig 110 - 120mm Shooting - in Screen

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MPI and displacement calculation

6. The observer will assess the mean point of impact (MPI) and calculate the displacement as follows:-

- a. Using binoculars or, if possible, by a down range inspection of the screen, accurately plot the strike of the 7 rounds on the replica screen. Visually assess the MPI and mark its position on the replica.
- b. Place the centre of the circular template, which must have a scale radius of sixty centimetres, on to the MPI mark on the replica screen.
- c. If three or more strikes are outside the circular template, the tank/barrel/ammunition combination is most suspect for consistency and an investigation by REME should be carried out.
- d. Convert the positions of only those strikes that are within the circular template into horizontal and vertical distances, in centimetres, from the centre of the replica screen. Record these distances in Para 2, Serial 1 of the Shooting-in proforma.
- e. Following the action instructions for each Serial in Para 2 of the Shooting in proforma, calculate the MPI of the strikes and the displacement of that MPI from the centre of the screen in mils.
- f. Order the gunner to apply the displacement adjustment to the graticule adjusters and report the final readings on the graticule adjusters. These readings will be recorded on the Shooting-in proforma in Para 3.

Check of displacement adjustment by the observer

7. The observer will carry out the following check of the displacement adjustment made by the gunner as follows:-

- a. Occupy the gunner's seat.
- b. Look into the sight unit (telescopic) and, using the hand controls, lay APDS dot 2 or 1100 metre mark on to the centre of the screen.
- c. Taking care not to disturb the lay, look into the gunner's periscopic sight; check that APDS dot 2 or 1100 metre mark is positioned on the screen at the point where the MPI was calculated to be.
- d. If it is not positioned correctly, the displacement has been applied wrongly and must be corrected.
- e. Having checked and accepted the displacement adjustment, the observer will order the crew to adjust the sight unit and commander's PRI, as detailed on Pages 157-158.

Subsequent action

8. The total ZERO DISPLACEMENT is determined by working out the difference between the boresighted and shot-in readings on the graticule adjusters. Care must be taken to include the direction or movement, ie, left/right, clock/anti-clock.

9. On subsequent occasions, with the same tank/barrel/sight combination, the correct gun/sight relationship can be established as follows:-

- a. Adjust the sight as detailed on Pages 155-157.
- b. Apply the zero displacement in lieu of the colour symbol system adjustment.

CHIEFTAIN 120-MM SHOOTING IN PROFORMA (WORKED EXAMPLE)

Veh No.

Barrel No.

Date

1. **Boresighted readings**
(before making colour symbol system adjustments)

Def	Elev
19.4	11.6

2. **MPI and displacement calculation**

Serial	Action	Horizontal		Vertical	
		Left	Right	Up	Down
1	Record in cms distance and direction of strikes from centre	60	—	40	—
		75	—	20	—
		50	—	20	—
		75	—	10	—
		55	—	—	15
2	Total	315	—	90	15
3	In each plane enter smaller figure below larger	—		15	
4	Subtract	315		75	
5	For Posn of MPI divide by No. of strikes recorded	63		15	
6	For displacement in mils divide MPI by 100 (decimal point moves 2 places left) and round off to nearest tenth	0.6	—	0.2	—
		LEFT	RIGHT	ANTI CLOCK WISE	CLOCK WISE

- NOTES:-** 1. In this worked example 2 strikes are omitted as they fell outside the circle.
2. The displacement in mils should be now applied to the sight.

3. **Shot in readings.** (These include the colour symbol system adjustment and displacement found on shooting in.)

Def	Elev
20.0	12.1

4. **Zero displacement.** Calculate by difference between para 1 and 3 readings and record with direction of adjustment.

Def	Elev
0.6	0.5
LEFT	CLOCKWISE

Fig 111

CHIEFTAIN 120-MM SHOOTING IN PROFORMA

Veh No.

Barrel No.

Date

1. **Boresighted readings**
(before making colour symbol system adjustments)

Def	Elev

2. **MPI and displacement calculation**

Serial	Action	Horizontal		Vertical	
		Left	Right	Up	Down
1	Record in cms distance and direction of strikes from centre				
2	Total				
3	In each plane enter smaller figure below larger				
4	Subtract				
5	For Posn of MPI divide by No. of strikes recorded				
6	For displacement in mils divide MPI by 100 (decimal point moves 2 places left) and round off to nearest tenth	LEFT	RIGHT	ANTI CLOCK WISE	CLOCK WISE

3. **Shot in readings.** (These include the colour symbol systems adjustments and displacement found on shooting in.)

Def	Elev

4. **Zero displacement.** Calculate by difference between para 1 and 3 readings and record with direction of adjustment.

Def	Elev

Fig 112

SECTION 4 – FIELD OF VIEW AND MAGNIFICATION

Sight Eyepiece	Field of View		Magnification
	X1 window	Eyepiece	Eyepiece
Gunner's sighting equipment			
1. a. Sight periscopic, AV, No. 38, Mk 1	746 mils	195 mils	X8
b. Sight periscopic, AV, No. 56, Mk 1	746 mils	195 mils	X8
c. Sight periscopic, AV, No. 69, Mk 1	746 mils	122 mils	X10
d. Sight periscopic, AV, No. 59, Mk 1	746 mils	122 mils	X10
e. Sight, laser rangefinder, periscopic, No. 1, Mk 1 and 2, No. 3, Mk 1	746 mils	151 mils	x10
f. Sight periscopic, AV, L1A1		250 mils	X3
g. Sight unit, AV, No. 26, 60, 70 and 80		125 mils	X7
Commander's sighting equipment			
2. a. Sight periscopic, AV, No. 37, Mk. 1, 2 and 4.	1386 mils	138 mils	X10
b. Sight periscopic, AV, No. 37, Mk 3	1386 mils	92 mils	X15
c. Periscope, AV, L1A1		250 mils	X3
Loader's sighting equipment			
3. Periscope No. 30	220 mils		X1
Miscellaneous equipment			
4. a. Binoculars, prismatic No. 2		142 mils	X6
b. Binoculars, prismatic No. 5		137.3 mils	X7
c. Boresight, No. 6 and No. 9		107 mils	X7

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CHAPTER 19 – ELECTRICAL SUPPLY AND GUN CONTROL EQUIPMENT

SECTION 1 – CUPOLA TRAVERSE UNIT NO. 2

Description

1. A hand traverse gear in the unit enables the commander to rotate the cupola. A contra gear in the unit maintains the cupola stationary while the turret is traversed to align the gun with the commander's periscopic sight. The cupola and turret are automatically locked together when the gun and sight are in alignment. The cupola can be released from the turret by pulling downwards, or squeezing the lever, on the cupola traverse handle. The unit consists of the following main components:-

- a. The gearbox and selector lever.
 - b. The clutch drive shaft and pinion.
 - c. The cupola rotating ring drive shaft and cupola traverse handle.
 - d. The direction sensing switch and cam.
 - e. Traverse cut-off switches.
 - f. The contra-rotation master switch.
 - g. The cam and release mechanism.
2. a. *The gearbox*, which incorporates a clutch, transmits powered drive from the turret traversing rack to the cupola rotating ring. The gearbox clutch is controlled by means of a selector lever which can be set for the following conditions:-
- (1) FORWARD for CONTRA-ROTATION.
 - (2) CENTRE for NEUTRAL (cupola free).
 - (3) REARWARD for LOCKED (cupola locked).

The selector lever is locked in the contra-rotation position by a spring-loaded catch. When the selector lever is in the contra-rotation position, the clutch transmits the powered drive from the turret traversing rack. In the neutral position, the clutch is disengaged and no drive is transmitted. In the locked position the clutch plate is in contact with a fixed friction lining in the clutch housing, no drive is transmitted and the gearing is locked to prevent movement when travelling (see Fig 113).

- b. *The clutch drive shaft pinion* is engaged with the turret traversing rack and transmits the drive from the rack to the gearbox.
- c. *The cupola rotating ring drive shaft* is connected to a double compound spur gear in the gearbox and, through couplings, with a driving pinion in the cupola. The double spur gear is in constant mesh with a clutch drive pinion in the gearbox and can be meshed with a hand traverse pinion. The hand traverse pinion is engaged with the double spur by pulling down, or squeezing the lever, on the cupola traverse handle.
- d. *The direction sensing switch* is fitted to the fixed base ring of the cupola to the right rear of the commander's position. In conjunction with its operating cam, the switch selects the direction of rotation of the turret for the smallest amount of traverse which will align the gun with the commander's periscopic sight.

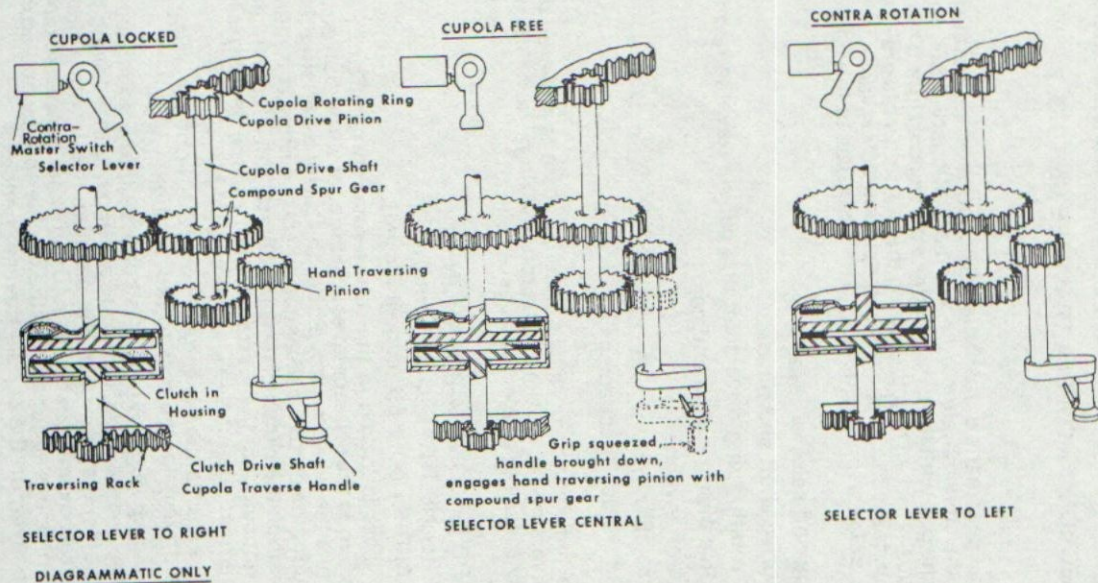


Fig 113 – Cupola traverse unit – operation

- e. *The traverse cut-off switches* are mounted above the gearbox. The switches cut off the electrical supply to the traverse motor just before the line-up position is reached. Line-up cannot be effected if the gun is already within the arc of 142 mils left or right of the line-up position set by these switches.
- f. *The contra-rotation master switch* is mounted in the top left of the gearbox and is operated when the selector lever is placed in the contra-rotation position.
- g. The cam and release mechanism is attached to the top of the gearbox. The mechanism returns the selector lever to the neutral position when line-up has taken place. The line-up striker arm, a 'T' shaped bar secured to the rotating ring, fits into a locking plate when the gun is in the line-up position.

Operation

3. When the cupola is traversed by hand, the striker becomes disengaged from the locking plate. The direction sensing switch and cut-off switch are closed by this movement. Placing the selector lever in the contra-rotation position closes the contra-rotation master switch and engages the power drive in the gearbox. When the grip switch on the commander's controller is pressed, the powered traverse circuit is completed and the turret moves in the direction dictated by the direction sensing switch at a set speed. The ratios of gears in the contra-rotation assembly are such that the cupola will contra rotate at the same speed, thus allowing the target to stay in the commander's field of view. When the striker bears against the cam, the trip lever is actuated and releases the selector lever and opens the contra-rotation master switch and cut-off switch. The powered traverse system is now neutralised and line-up is completed by the momentum of the turret.

SECTION 2 – AVAILABILITY OF ELECTRICAL SERVICES IN THE TURRET

Hull master switch OFF

1. With the hull master switch set to the OFF position, the turret master switch set to the ON position and the radio master switch set to the ON position, the following services in the turret are available:-

- a. Supply to radio.
- b. Supply to radio maintenance light.
- c. Supply to IR detector.

Hull master switch ON

2. With the hull master switch set to the ON position, supply is given to the following:-

- a. The 'X' relay in the turret distribution box, which transfers the services described in para 1 above, on to the hull batteries.
- b. Gun firing circuits.
- c. Turret lighting.
- d. Sight washer system.

- e. Sight illumination and heaters.
- f. Traverse indicator and quadrant fire control illumination.
- g. Smoke grenade dischargers.
- h. Cupola supplies.
- j. Main engine EMERGENCY STOP.
- k. Fire warning system. (Audible warning and flashing lights.)

Main engine running with the main engine generator ON LOAD

3. The following additional services become available when the main engine generator is ON LOAD:-

- a. Boiling vessels.
- b. Powered laying equipment.
- c. NBC pack and ventilation system.
- d. Light projector.
- e. The turret batteries being charged in parallel with the hull batteries.

Generating unit engine running ON LOAD

4. All services described in paras 1, 2 and 3 above can be obtained without running the main engine, providing the generating unit engine is running ON LOAD.

CHAPTER 20 – NIGHT FIGHTING EQUIPMENT

SECTION 1 – GENERAL INFORMATION

Introduction

1. The infra-red sighting equipment enables the crew of the Chieftain tank to aim and fire, observe and manoeuvre during hours of darkness without making use of visible light. This is made possible by using the infra-red radiation from the light projector (searchlight), driving headlights and spotlight; this radiation, being invisible to the human eye without auxiliary means, illuminates the target, or scene, which is observed by using the IR sight and periscopes.
2. Each sight and periscope is fitted with a shutter which, during normal night viewing, is opened to expose the full viewing area of the objective lens of the optical system. When viewing a high intensity light source, such as an enemy searchlight, the shutter is closed to reduce the viewing objective aperture to a pin point to prevent 'Black-out' of the sight.

Principles of operation

3. A heated filament such as in an incandescent lamp emits both infra-red and visible radiations. By placing a special filter in this beam, the visible light is cut off whilst the infra-red radiations are allowed to pass. These infra-red rays are invisible to the naked eye.
4. Infra-red rays passing through the filter are reflected back from objects in the beam, in the same manner as normal visible light. These reflected rays enter the periscope via the glass-fronted sighting head and are reflected by the upper mirror, or prism, downward through the optical system.
5. The object lens of the optical system forms an invisible infra-red image on the front face of the electron discharge tube (known as the image converter tube). The image so formed releases in the tube a stream of electrons which are greatly accelerated by an applied high tension voltage (12000 volts) and are focussed on to a screen at the other end of the tube, causing it to become fluorescent. The visible fluorescent image is then viewed through the eyepiece of the periscope. An illuminated ballistic graticule is superimposed into the right eyepiece of the gunner's sight, there is no graticule pattern in the commander's periscope.

SECTION 2 – THE LIGHT PROJECTOR NO. 2, MK 3

WARNING:- (Extracted from EMER C293, Supp 1)

1. The Xenon lamp starter assembly in the light projector is fitted with a spark gap SG1, Arrestor, electrical surge, which contains a small quantity of a radio-active material, Tritium.
2. There is no danger from this spark gap in normal use but care should be exercised when servicing the equipment since breakage of the glass envelope will create a hazard.
3. The entry of radio-active material into the body, through the mouth or nose in the form of air-borne particles or gas, or by cuts or abrasions, can cause serious damage to health.

4. Should the glass envelope of the spark gap be broken the following precautions will be observed:-
 - a. Avoid breathing radio-active vapour or dust released by the breakage; cover the mouth and nose immediately with a cloth.
 - b. Protect the hands (gloves, barrier cream, etc) before clearing away debris.
 - c. Decontaminate the area, using damp cloths.
 - d. Any cuts or abrasions caused by the breakage, or sustained during the cleaning-up process, must be dealt with as follows:-
 - (1) Wash damaged area with soap and running water to remove any foreign matter.
 - (2) Send casualty to the nearest medical officer AS SOON AS POSSIBLE with a report on the nature of the injury and how sustained.
5. Instructions for the disposal of unserviceable radio-active valves are given in DCIs.

Description

6. *The outer case assembly* – The searchlight is designed for mounting externally on the left hand side of the turret. The outer case assembly is of welded steel construction and contains a cooling fan motor, the armoured door, the door drive actuator, together with push-rod and cams. This assembly is bolted on and rotates with the turret. The approximate weight of the complete assembly is 500 lb. Four sling points are fitted to the top of the assembly to facilitate fitting and removal.
7. *Armoured and IR doors* – Two power-operated doors are fitted to the assembly. The outer armoured door is made of steel to protect the equipment when not in use, and provides a rapid shut down which is necessary since the Xenon lamp continues to glow after switch-off. The infra red door consists of a metal frame surrounding a glass infra red filter which, when closed, produces an infra red beam, and when open permits a normal white light to pass. Both doors are opened and closed by a single actuating motor, a cam and two spring loaded push rods, the springs ensuring a good seal for the doors when closed and preventing rattle when open.
8. *The inner assembly* – The inner assembly contains a 19 inch diameter aluminium paraboloid mirror, the Xenon lamp, lamp starter assembly, servo control unit and its associated gearbox. The position of the mirror in its frame is pre-set so that the light source is correctly positioned at the mirror's focal point. The elevation drive from the servo gearbox to the mirror frame is by means of pretensioned steel tapes or, on later models, steel chains.
9. *The elevation gearbox* – The elevation gearbox incorporates two micro-switches which are set to operate the normal limits of operation (minus 230 mils and plus 357 mils); their connections are such that the driving torque is reduced at these points. Outside these limits a further plus or minus 72 mils is provided during which compression of rubber buffer stops takes place and these decelerate the mirror frame assembly, reducing impact at the dead stops.
10. *The cooling fan* – A cooling fan, driven by a 0.4 hp motor, provides cooling for the lamp compartment and the IR filter door, when closed, whenever the lamp is on. The cooling air is taken in at the top right rear corner and discharged from the underside of the outer case. Some of the cooling air is blown across the space

between the plate glass assembly and the infra red door, cooling the filter and absorbing heat from the light beam. The remainder of the cooling air is blown about the lamp compartment.

11. *Air inlet and outlet covers* are provided in stowage positions on the exterior of the projector for use when the vehicle is to be waded; it is essential to remove these covers before operating the light, since the cooling will be rendered ineffective.

12. A means is provided for disconnecting the mechanical drive from the doors so that manual operation is possible (for REME use only).

13. *Control box unit* – The control box unit, located within the turret convenient to the commander, consists of a four position rotary switch, a single pole boost switch and an indicator light (the light indicates the lamp is struck). The four positions of the switch are OFF, STAND BY, IR and WH, the latter position indicates white light. The single pole boost switch provides means whereby the lamp power may be temporarily increased from 2 KW to 3 KW for target identification. This switch is operated by pressing the rotary switch knob when it is in the IR (infra red) or WH (white light) position. (Boost should not be applied for more than 10 seconds.)

14. *The beam adjuster* – The beam adjuster is mounted either on the side of the gunner's fixed grip or on the control box unit. Rotation of this adjuster enables the light beam to be tilted in the vertical plane independent of sight mount.

15. *The servo control (sight to mirror)* – The light mirror is required to follow the gunner's sight in elevation to a fairly high degree of accuracy. Since all related equipment is located in or on the rotating turret no remote control in traverse is necessary. A control transmitter is attached to the turret and its rotor is coupled to the sight mounting. Providing the control box switch is set to STAND BY, IR or WH, an electrical output is passed to the light mirror moving the light beam to the same angle as the sight mounting.

SECTION 3 – TO REPLACE IR FILTER OF LIGHT PROJECTOR

Introduction

1. The replacement of the IR filter, fitted to the light projector, is a task that may be completed by a GNR MECH CHIEF without REME supervision. The procedure given below has been extracted from EMER – Instruments and Searchlights C293.

2. A GNRMECH CHIEF may be called upon to replace the IR filter if it has become damaged or if, during the crew tests, a reddish brown glow has been detected, indicating a defective filter.

To open armoured and IR doors of light projector

3. In order to gain access to the IR filter, both the armoured and IR doors must be opened, either by power or manually. To avoid accidents or damage the following procedure and safety precautions must be used:-

a. To open the doors by power

- (1) Start the generating unit engine (GUE) and put it ON LOAD.
- (2) Switch on light projector; select WH, the doors will open.
- (3) Switch off the GUE, the doors will remain open but the light will go out.

- (4) Set the hull master switch to OFF.
 - (5) On no account should the hull master switch be set to ON or the GUE started until the replacement of the IR filter has been completed.
- b. *To open the doors manually*
- (1) Both doors are heavily spring loaded and extreme care must be taken to ensure that fingers and thumb of the free hand are kept well clear of the seating rings. This is particularly so if the light projector has been removed from the vehicle and is not rigidly anchored.
 - (2) The doors may be very stiff to move from their spring loaded position and it is important to ensure that the armoured door is fully opened before attempting to open the IR door.
 - (3) Set the hull master switch to OFF, remove the rear cover of the light projector by undoing the NINE captive bolts and lifting the cover clear. On some vehicles it may be necessary to remove the stowage rack positioned behind the light projector.
 - (4) Pull the actuator release catch downward and engage it in the locked position. This will cause the spring loading on the armoured door to be released with an audible snap. The door can now be swung open. As it approaches the fully open position it will snap on to its stop and be spring loaded open.
 - (5) Pull the IR door outwards to overcome the spring loading. This will occur suddenly with an audible snap. The IR door can now be swung open but will not be spring loaded open.

To remove and replace IR filter

4. a. Remove the IR door clamp ring (twelve screws). The filter can then be removed together with the 'U' section rubber channel.
- b. Prior to fitting a new filter, ensure that the edge of the glass is protected all round with adhesive tape; the tape to encroach on the filter 0.13-in maximum from the edge. The rubber channel should be stuck to the filter over the tape using adhesive MS 2705.
- c. The filter can then be fitted to its frame by the clamp ring and twelve screws ensuring that the Infra-red coated side is nearest to the lamp glass. To indicate the NON IR coated side the filter is marked with a yellow spot.

To close the armoured and IR doors

5. a. *To close the doors by power*
 - (1) Rotate the light projector control switch to the OFF position.
 - (2) Ensure that the path of the IR and armoured doors is clear of obstruction.
 - (3) Set the hull master switch to ON.
 - (4) Start the GUE and put it ON LOAD.
 - (5) Both doors will close.
- b. *To close the doors manually*
 - (1) Pull the IR door towards the lamp glass; as it nears the fully closed position it will snap shut and be held against its rubber seal.

- (2) Pull the armoured door towards the lamp glass, to overcome the spring loading. This will occur with a sudden snap.
- (3) The armoured door can then be moved to the closed position. It will not become spring loaded until it is operated by power.
- (4) After closing the door move the actuator release catch out of its locked position.
- (5) Check the correct functioning of the armoured and IR doors by opening and closing them by power.

Test efficiency of replacement filter

6. The light projector should be operated either at night or in a darkened hanger to ensure the efficiency of the IR filter.

Equipment required

7.
 - a. London pattern screwdriver 5-in.
 - b. Adjustable spanner, 6-in.
 - c. Masking tape.
 - d. Adhesive MS 2705.
 - e. Replacement filter and seal.

SECTION 4 – ADJUSTMENT OF LIGHT PROJECTOR

Introduction

1. The adjustment of the light projector, **FOR LINE DEVIATION ONLY**, is a task that may be completed by a GNRMECH CHIEF without REME supervision. The procedure below has been extracted from EMER – Instruments and Searchlights C293.
2. A GNRMECH CHIEF may be called upon to make the adjustment when the crew report inaccuracies in the alignment of the beam relative to the point of aim.

To test operation of light projector

3.
 - a. Start generating unit engine (GUE) and put it ON LOAD.
 - b. Set control switch to STANDBY; if red light fails to illuminate within 10 seconds, report to REME.
 - c. Switch to IR; check armoured door operates.
 - d. Switch to WH; check IR door operates.
 - e. Observe beam through gunner's periscopic sight.
 - f. Using the beam adjuster, move the beam until it is positioned centrally in the sight.
 - g. Elevate and depress the gun, checking that beam follows.
 - h. Rotate the beam adjuster, checking that beam follows.
 - j. Rotate the beam adjuster to the central position.
 - k. Lay the MBS mark in the gunner's periscopic sight on to a target.
 - l. Check that the centre of the beam is aligned with the point of aim for line. If it is not, the beam must be adjusted.

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To adjust the light projector (line only)

4.
 - a. Remove the protective threaded bolt from the outside of the light projector.
 - b. Using a screwdriver 350-mm, rotate the adjuster, on orders from the gunner, until the beam is correctly aligned with the point of aim.
 - c. Replace the protective bolt.

Equipment required

5.
 - a. Adjustable spanner.
 - b. Screwdriver, 350-mm.

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CHAPTER 21 – AMMUNITION

SECTION 1 – COLOUR CODING

Table 1 – Basic NATO colour

NOTE:- Basic recognition colour may not cover the entire projectile but may be shown as a coloured band(s) on top of an overall camouflage colour.

Colour	Type of round
Black	Armour defeating.
Yellow	High explosive.
Light blue	Practice.
Eau-de-nil	Smoke.
Bronze green	Canister.
White	Illuminating.
Pink	Incendiary of highly inflammable content.
Magenta (purple)	Nuclear or radio active hazard.
Light grey	Chemical.
Silver/aluminium	Counter measure, eg, leaflets, anti-radar, foil, etc.
Brown	Low explosive content.

Table 2 – Additional NATO colour markings used with chemical ammunition.

One red band	Non persistent harassing.
Two red bands	Persistent harassing agent.
One green band	Non persistent casualty agent.
Two green bands*	Persistent casualty agent.
Three green bands	Nerve agent.

* If this round is camouflaged painted, then the two green bands will be accompanied by a grey band as well.

SECTION 2 – CARE AND HANDLING OF AMMUNITION

Electrical and radio frequency hazards

- It should be noted that electrical radio frequency hazards are totally different hazards from those electrical hazards brought about by unguarded electrical contacts, eg, batteries, within the vehicle.
- Radio frequency electrical currents may initiate any unscreened electrical primer.
- In order to counter the RF hazard, the following procedure will be followed:-
 - Vent tubes will be kept in their tins, with the lid properly screwed down, on all occasions when they are not actually inside the vehicle. The charging of vent tube magazines will take place **INSIDE THE VEHICLE**, and on completion of firing, unexpended vent tubes will be replaced in the tin before being removed from the vehicle.
 - Smoke grenades will be restowed in the containers on removal from the vehicle.

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'Bombing-up' drills – Safety aspect

4. The practice of stacking 120-mm charges on the vehicle engine decks is extremely hazardous.
5. The charge for the 120-mm gun is contained in a cloth bag with an igniter filled with gunpowder sewn on at the end. Heat, friction and sparks can ignite gunpowder spilled from damaged igniters and possibly the complete charge. This might well cause death by burning of personnel in the immediate vicinity and could result in the loss of the vehicle.
6. The attention of Commanding Officers is drawn to Ammunition and Explosive Regulations, Pamphlet No. 2.

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TABLE 1 – MARKS OF VEHICLE

Equipment	Mark of Vehicle								
	1	1/2	2	3	3(G)	3/2	3(S)	3/3	5
Power pack	Mk4A	Mk4A	Mk4A	Mk5A	Mk5A	Mk5A	Mk6A	Mk6A	Mk7A
GU engine	Mk7A	Mk7A	Mk7A	Mk10A	Mk10A	Mk10A	Mk10A	Mk10A	Mk10A
Hydraulic starting system	Mk4	Mk4	Mk4	Mk5	Mk5	Mk5	Mk5	Mk5	Mk5
Commander's cupola	No. 11 Mk2	No. 15 Mk1	No. 15 Mk1	No. 15 Mk2	No. 15 Mk2	No. 15 Mk2	No. 15 Mk2	No. 15 Mk2	No. 15 Mk3
Parking brake	Direct pull	Direct pull	Direct pull	12:1 ratio	12:1 ratio	12:1 ratio	12:1 ratio	12:1 ratio	12:1 ratio
Headlight/IR light system	Single unit	Single unit	Single unit	Twin units	Twin units	Twin units	Twin units	Twin units	Twin units
Main engine air cleaner type	Std.	Std.	Std.	Std.	Low loss	Low loss	Low loss	Low loss	Low loss
NBC system	No. 2 Mk1	No. 2 Mk1	No. 2 Mk1	No. 2 Mk1	No. 2 Mk1	No. 2 Mk1	No. 2 Mk1	No. 6 Mk1	No. 6 Mk2

The marks of Chieftain beyond Mk 5 depend on the results of Totem Pole (see Table 2).

'X' programme represents the modification of sights from 4 dot to 9 dot.

'Y' programme represents the modification of sight mounts from the No. 34 to the No. 39 and corresponding modification to the sights, eg, sight peri, AV, No. 69 to No. 59. It also includes the fitting of turret air breathing facility and a low loss air cleaner.

'Z' programme is the up-rating of the power pack, fitting of the No 6 NBC pack and modification to the metadynes.

TABLE 2 – MARKS OF VEHICLE AFTER TOTEM-POLE

Production vehicle nomenclature	Fire-control mod programme on 'Y' Totem-Poled Tanks prior to completion of 'Z' mods			Fire-control and KE round mod programmes on 'Z' Totem-Poled and Mk 5 tanks					
	On completion of 'L' kit fitting for TLS 'C' or No 1 Mk 1	F-C Phase 1		On completion of 'L' kit fitting for TLS 'C' or No 1 Mk 1	F-C Phase 1		F-C Phase 2	Improved KE Round	F-C Phase 3
		On completion of TLS No 1 Mk 2 or No 3 Mk 1 vehicle changes and MRS preparatory mods	On completion of TLS No 1 Mk 2 or No 3 Mk 1 vehicle mods and MRS installation		On completion of TLS No 1 Mk 2 or No 3 Mk 1 vehicle changes and MRS preparatory mods	On completion of TLS No 1 Mk 2 or No 3 Mk 1 vehicle mods & complete MRS installation	On completion of TLS, MRS and IFCS installation plus limited cupola improvements	On completion of sight graticule and ammunition stowage changes for FSAPDS	On fitment of night surveillance equipment
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(k)
Mk 2	2(Y)/L	2(Y)/1	2(Y)/2	6/L	6/1	6/2	6/3	6/4	9
Mk 3	3(Y)/L	3(Y)/1	3(Y)/2	7/L	7/1	7/2	7/3	7/4	10
Mk 3/G	3/G(Y)L	3/G(Y)1	3/G(Y)2	7/L	7/1	7/2	7/3	7/4	10
Mk 3/2	3/2(Y)L	3/2(Y)1	3/2(Y)2	7/L	7/1	7/2	7/3	7/4	10
Mk 3/S	3/S(Y)L	3/S(Y)1	3/S(Y)2	7/L	7/1	7/2	7/3	7/4	10
Mk 3/3	3/3(Y)L	3/3(Y)1	3/3(Y)2	8/L	8/1	8/2	8/3	8/4	11
Mk 5	—	—	—	5/L	5/1	5/2	5/3	5/4	12

Note 1. Mk 1 tanks or their variants are not being modified with KE Round or F-C improvements.

Note 2. Any Mk 2-12 tank with Clansman Basic Harness installed will be identifiable by the letter (C) after its Mark No.