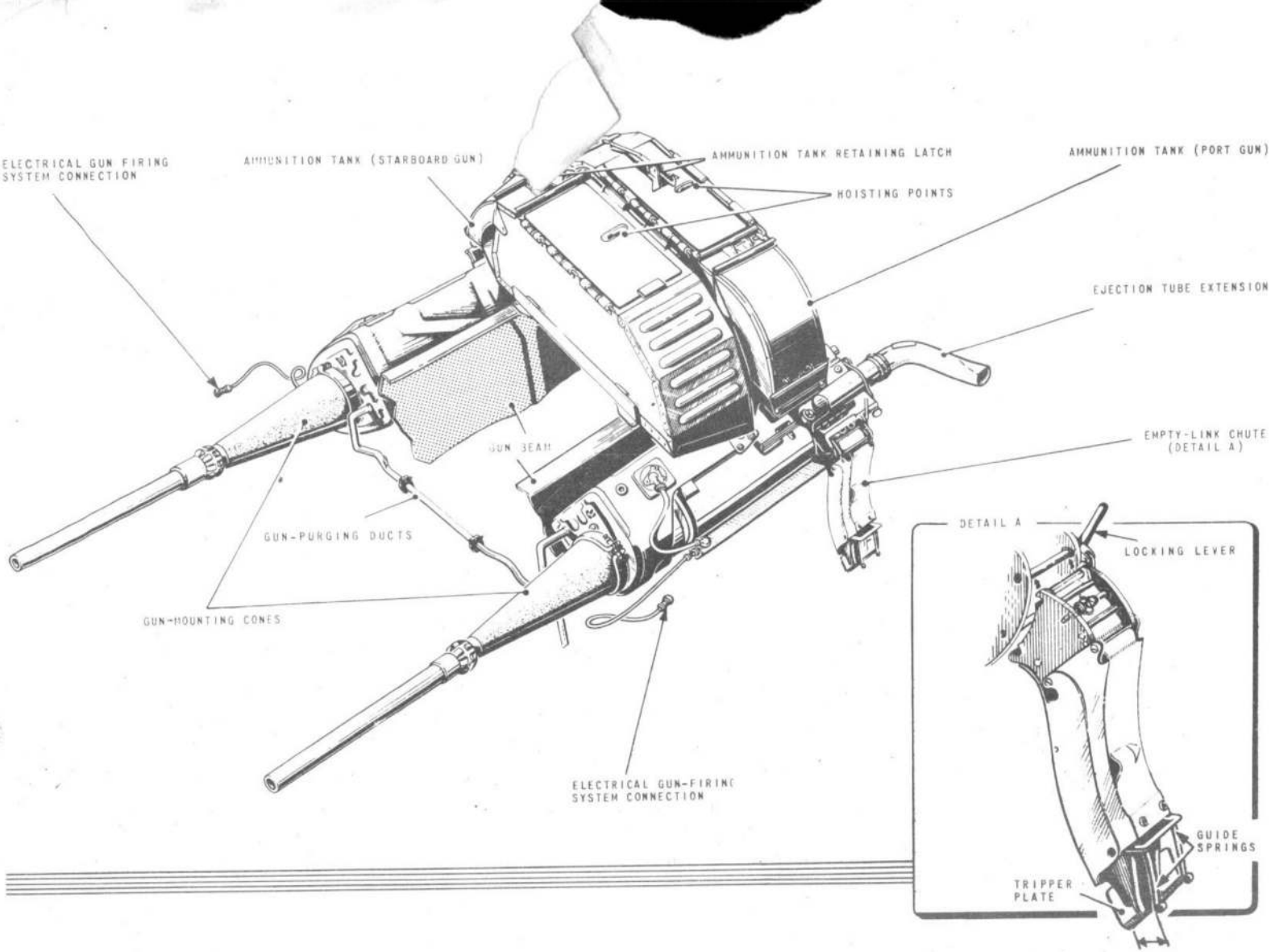
Chapter 3 GUNNERY EQUIPMENT

(completely revised)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS



IMPORTANT:-
BEFORE INSTALLING THE CHUTE IT MUST BE ENSURED THAT THE GAP BETWEEN THE LINK GUIDE SPRINGS AND THE LIP OF THE TRIPPER PLATE IS BETWEEN 0.95 IN. AND 0.75 IN.

FIG. 1. UPPER GUN INSTALLATION

1367

DESCRIPTION

General information

1. In the full gunnery role, the aircraft carries four Mk.4 Aden 30 mm guns, two in the upper portion of the front fuselage and two in the lower armament bay. The upper guns are fed by two ammunition tanks mounted transversely above the gun positions, the spent cases and empty links being guided into built-in containers in the aircraft. The lower guns are attached to the roof of the lower armament bay, the ammunition tank and spent-case and empty-link containers being housed in a removable gun pack fitted in the bay. This chapter describes that portion of the installation remaining in the aircraft when the guns, gun pack and ammunition tanks are removed; the removable parts of the installation, including the guns and their servicing, are dealt with in A.P.1641S, Vol.1.

Upper gun installation *(fig.1)*

Gun bays

2. The two upper gun bays extend from the rear pressure bulkhead to frame 21, one on each side of the gun beam, the vertical sides of the beam forming the inner walls. Upward-hingeing doors, giving access to the bays, are retained in the open position, when so required, by stays having stowages in the door frames. A socket in each lower door frame member and an eye fitting in the upper provide the points of attachment for the derricks used for gun and ammunition tank hoisting. Within the bays the guns are shielded on the outer side by metal covers, panels being provided in the covers for access to the gun cocking adapters, barrel catches and 'gun loaded' indicators. For access to other gun components, or for removal of the guns, the covers, secured by Dzus fasteners, must be removed.

Gun forward mountings

3. The gun forward mountings fitted in the aircraft, support the gun-mounting cones. Each mounting is bored at the forward end to receive the rear end of the blast tube *(para.5)*. An internal flange has six grooves through which are inserted corresponding lugs of the mounting cones, the latter then being turned through 30 degrees to lock. The spherical forward ends of the cones and the bearing surfaces in the mountings permit limited movement of the guns when adjustment is necessary during harmonization.

Harmonization units

4. The units form an adjustable link between the brackets on the guns and the aircraft gun-mounting plates within the gun beam. The units are identical except for handing and are attached to the mounting plates by the nuts and locknuts on the horizontal adjustment spindles, the gun attachment lugs projecting into the gun bays. Provision is made for wire-locking the locknuts after final adjustment.

Blast tubes (fig.2)

5. The blast-tube assemblies for the upper guns extend from the forward gun mountings to aperture plates fitting flush with the fuselage skin. The assemblies each comprise a short fixed portion at the rear which accepts the centre section of the tube (this being fitted with a sealing ring to ensure a gas-tight fit), and centre and forward sections joined by a threaded coupling ring engaging a mating fitting on the end of the forward section. A convex flange on the centre sections permits limited movement of the joint to accommodate slight malalignment of the aperture plate when this is being fitted to the fuselage skin. The overall length of the tube necessitates the provision of an aperture for the use of the gun-aligning instrument during harmonization, the rod of the instrument being fitted into the gun barrel from the forward end of the tube, and the viewing attachment fitted to the instrument through the aperture. The aperture is normally covered by a double sleeve assembly, the inner portion being a semi-circular-section spring and the outer being in the form of a clamp secured by eight special-to-type bolts.

6. To counter the effects of aerodynamic heat build-up in the tube, a bevelled section, into which is welded a short air duct, is inserted between the open ends of the clamp, the bolts passing through the bevelled section and into the clamp blocks. Excessive air pressure in the tube is relieved to atmosphere by the duct through a louvred access panel in the fuselage skin. A clip to which a spigot is attached locates the assembly on the tube, the spigot mating with a recess in the duct assembly, to prevent rotational creep. With the removal of the securing bolts, the bevelled insert may be removed and the outer and inner sleeves moved for-

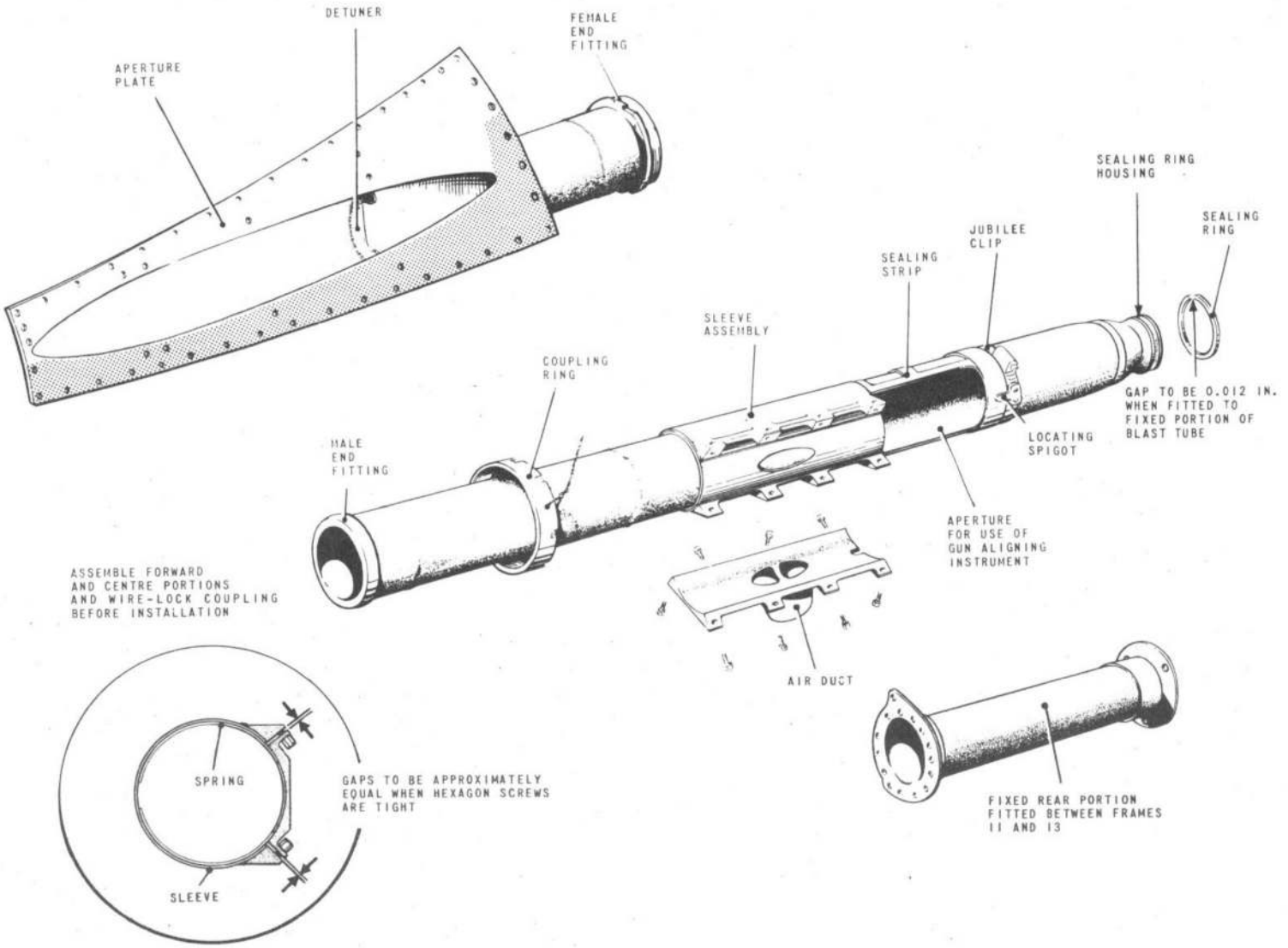


FIG.2. UPPER GUN BLAST TUBE

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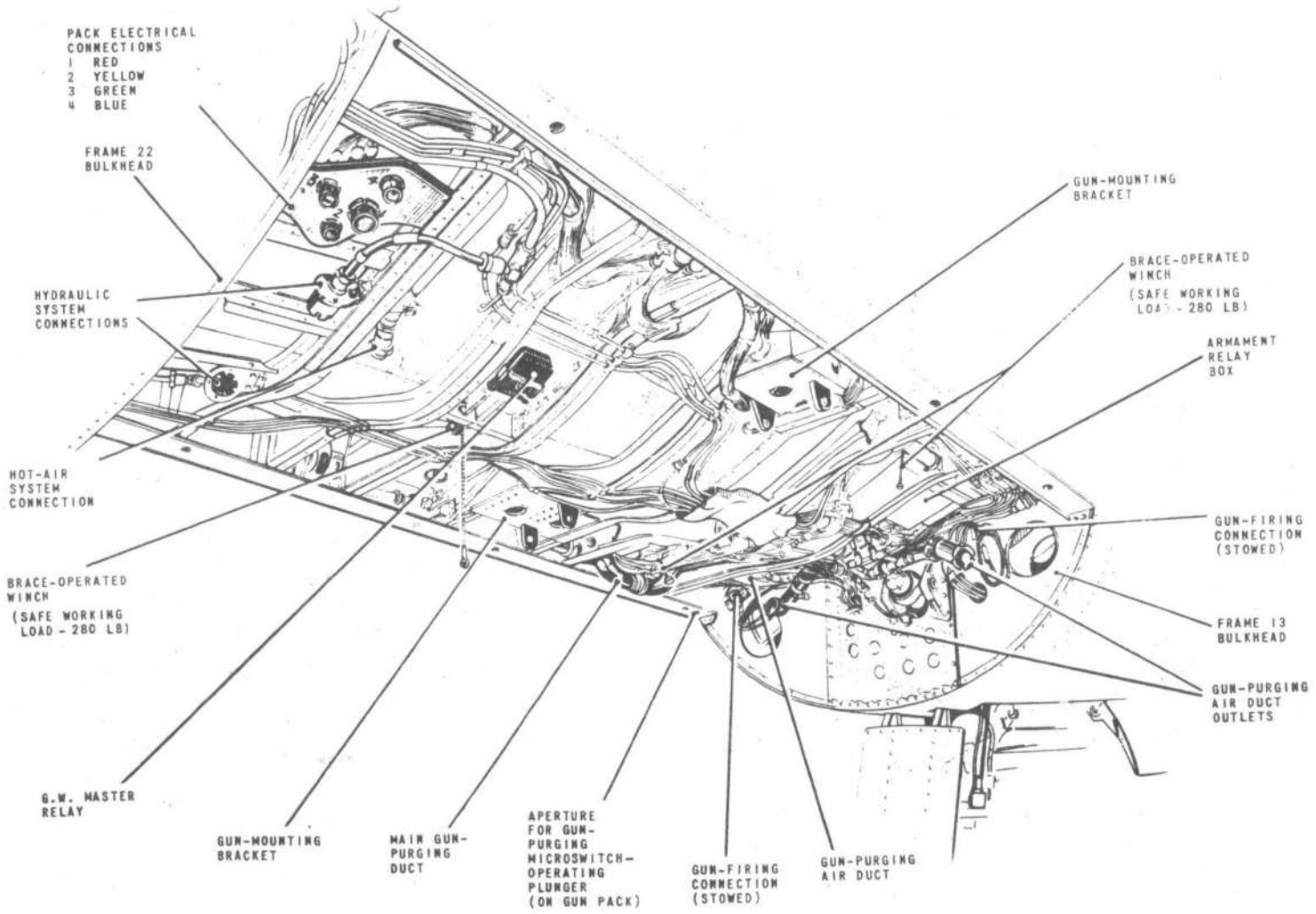

FIG.3. LOWER ARMAMENT BAY

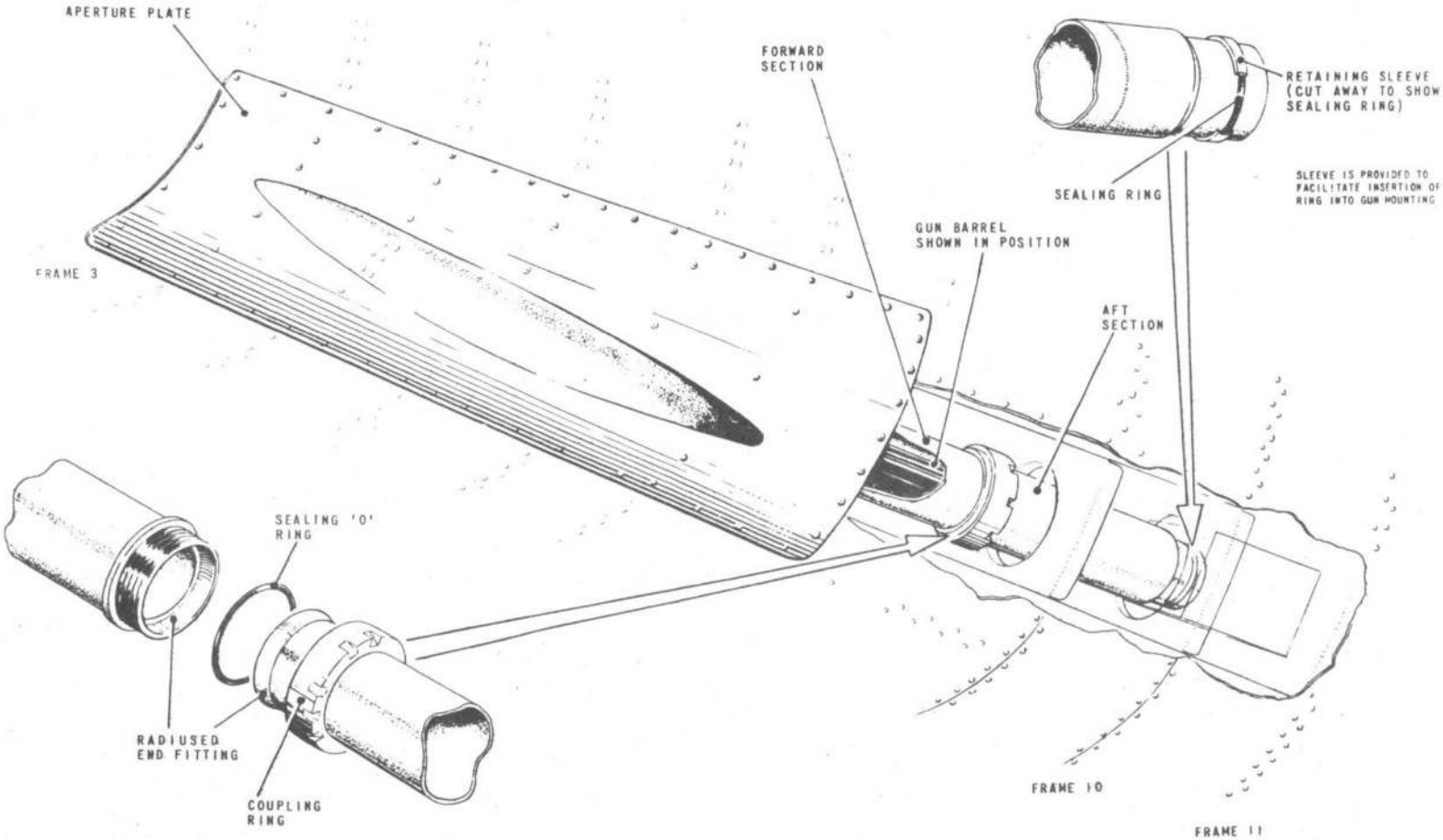

FIG.4. LOWER GUN BLAST TUBE

ward along the tube to expose the access aperture.

Spent-case and empty-link containers

7. The spent-case containers are located in the wing roots, access panels for their removal being provided in the under-surface of each leading edge. The cases ejected by the guns are led through extensions attached to the gun ejection tubes and outwards through guide tubes leading into the containers. The empty-link containers extend down the inner sides of the fuselage beneath the gun positions. The upper ends are aligned with the empty-link guides attached to the guns, the lower ends being closed by louvred access panels which provide the means of emptying the containers.

Lower gun installation

Armament bay (fig.3)

8. The lower armament bay extends from frame 13 to frame 22, immediately forward of No.1 engine bay, the frames in this area terminating at the lower longerons. The recess in the fuselage so formed is normally occupied by one of the alternative armament packs. The underside of the engine air-intake duct forms the roof of the bay, that portion of the fuselage extending downward from the air intake forming the walls. The bay is bounded fore and aft by bulkheads, two apertures in the forward bulkhead accepting the cone mountings of the port and starboard guns. The harmonization units are attached to gun-mounting brackets bolted between frames 17 and 18 in the roof of the bay, the horizontal adjustment spindles passing through the brackets and being secured by the nuts and locknuts on the spindles. The main gun-purging air duct enters the roof on the port side and branches to outlets immediately forward of the gun body positions. Electrical leads from the gun-firing unit located in the roof at the forward end connect the firing circuit through flexible leads to the units on the guns. The connecting plugs, when not in use are stowed on the forward bulkhead. Three recesses in the underside of each longeron accept the locating spigots on the edge members of the pack, a tapped hole in the bottom of each recess receiving the securing bolts. Three built-in winches, one on each side of the bay at the forward end, and one positioned centrally at the rear, are employed to raise and lower the pack, ammunition tank and guns; apertures for the insertion of the operating braces are on the outer side of the fuselage, two port and one starboard, each covered by a spring-loaded flap.

Gun pack

9. The gun pack contains a removable ammunition tank and spent case and empty-link compartments with their associated chutes and guides. Gun bays are formed, one on each side, bounded on the inner side by the walls of the ammunition tank housing and on the outer by hinged access doors. With the gun pack installed the harmonization units *(para.12)* may be fitted to the aircraft gun-mounting brackets which project into the gun bays. For a description of the gun pack and ammunition tank refer to A.P.1641S, Vol.1, Part 1, Chap.7F.

Gun forward mountings

10. The gun forward mountings fitted in the aircraft, support the gun-mounting cones. Each mounting is bored at the forward end to receive the rear end of the blast tube *(para.13)*. An internal flange has six grooves through which are inserted the corresponding lugs of the mounting cones, the latter then being turned through 30 degrees to lock. The spherical forward ends of the cones, and the bearing surfaces in the mountings, permit limited movement of the guns when adjustment is necessary during harmonization.

Gun-mounting brackets

11. The gun-mounting brackets, which provide points of attachment for the harmonization units, are fitted in the roof of the armament bay *(fig.3)* between frames 17 and 18. Each bracket has two attachment lugs, the outer lugs being drilled above the hole for the purpose of wire-locking the harmonization unit lateral adjustment locknut.

Harmonization units

12. The units form adjustable links between the aircraft gun-mounting brackets and the guns. They are similar to the units provided for the upper guns *(para. 4)* with variations in the design to suit the installation.

Blast tubes (fig.4)

13. The blast tubes extend from the front ends of the forward mountings to aperture plates secured to the fuselage skin, between frames 3 and 8. Each tube is in two sections, the forward section consisting of the aperture plate and a

length of tube threaded at the rear end for a coupling ring. The aft section of the tube has a radiused fitting at the forward end which, in conjunction with the coupling ring, enables the assembly to be adjusted, for fitting, to accommodate any malalignment between the points of attachment in the aircraft. The rear end of the aft section is reduced in diameter for a short distance for insertion into the gun forward mounting, a sealing ring being fitted to the tube to ensure a gas-tight fit. To facilitate assembly, a sleeve is provided to retain the sealing ring in position whilst the tube is being inserted; upon contact with the gun mounting the sleeve is moved along and remains on the tube when this is installed.

Blast-tube seals and blanking plates

14. When an alternative armament pack is to be fitted, or the lower guns are not installed, the blast tubes are blanked off by insertion of a seal assembly in the rear end of each gun forward mounting. Instructions for fitting the seal are given in para. 28. If the guns are not to be fitted for an extended period, the blast tubes may be removed and blanking plates Ref.No. 26DK/7644 *(port)* and 26DK/7447 *(starboard)* fitted. The blast tubes are removed by unfastening the flush-fitting screws around the edges of the aperture plates and withdrawing the tubes from the aircraft. The screws removed are used for fitting the blanking plates.

Gun-firing controls

15. The gun is fired by the passage of an electric current from the contact firing pin through an initiator in the base of the cartridge when this is in correct alignment with the barrel. The electrical firing unit fitted to the gun is described in A.P.1641S, Vol.1, Part 1, Chap.3. The firing circuit is controlled, through a system of electrical relays, by the weapons trigger on the control column handle, with GUNS selected on the ARMAMENT MASTER SELECTOR switch. An electrical supply is directed to the P.A.S. Mk.1 installation when the selection is made. Connection of the firing circuit with the firing units on the gun is made by two-pin plugs on flexible leads, stowages being provided for the plugs when these are disconnected. With the CAMERA MASTER switch set to ON the Type G90 camera mounted in the radome pylon will operate in conjunction with gun firing, as will the G.G.S. recorder. The firing circuit is normally inoperative until alighting gear UP has been selected, but for ground test or servicing purposes the switch can be by-passed by the insertion of a key, Ref.No.1E/5245, into the GROUND ARMING LINK, accessible beneath access panel 25P. The panel also gives access to the ARMAMENT SAFETY BREAK, a plug and socket which, when disconnected, breaks the electrical supply to all the armament firing circuits. The weapons trigger, when not in use, is made safe by a catch on the control column handle. Details of the electrical circuits are given in Book 2, Sect.6, Chap.2.

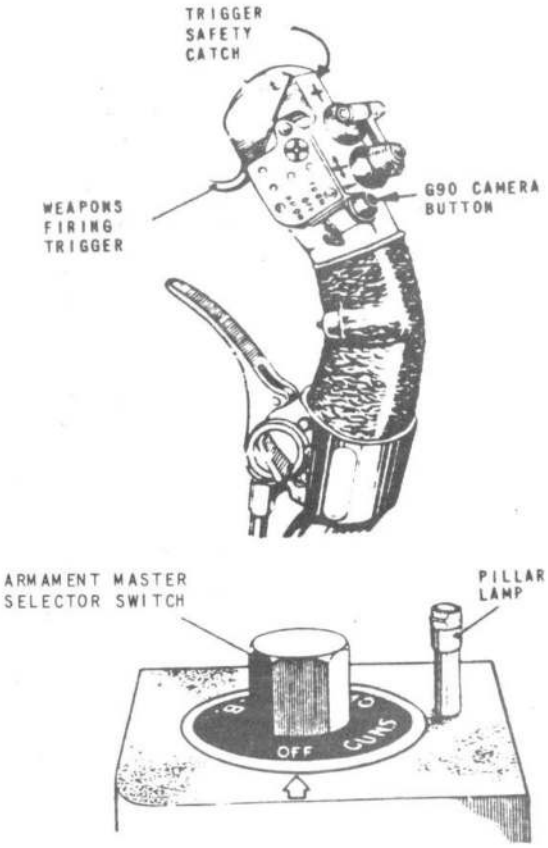

Fig.5. Gun-firing controls

Gun-purging system *(fig.6)*

16. The purpose of the gun-purging system is to prevent an accumulation of explosive gases in the gun bays when the guns are firing. The purging air is ducted from the aircraft hot-air system through a solenoid-operated constant-flow valve and purging valve, from which the ducts branch to the upper and lower gun bays, the outlets being located immediately forward of the gun bodies. The flow of purging air is initiated by the weapons trigger on the control

column handle with GUNS selected on the ARMAMENT MASTER SELECTOR switch. The constant-flow valve is normally set to supply sufficient purging air for the upper gun installation. Double the quantity is required when four guns are fitted, this setting being achieved by operation of a microswitch, by a spigot on the gun pack, in circuit with the constant-flow valve solenoid. When the gun pack is fitted, the microswitch is closed and the circuit is completed between the solenoid and the purging overrun control unit. Subsequent pressure on the weapons trigger will energize the solenoid and set the constant-flow valve to deliver sufficient air for the four-gun installation.

17. When the gun pack is removed the microswitch operating spigot, being fitted to the pack, becomes disengaged from the microswitch on the aircraft and permits the switch to open and break the circuit to the constant-flow valve. In this condition the valve is set to supply sufficient purging air for the two upper guns only. To prevent this issuing from the lower purging-air-outlets also, these must be blanked off. To do this, unfasten the clamp securing the port duct elbow, fit a blanking cap and secure it with the clamp, as shown in fig.6. Similarly, blank off the starboard duct; the latter elbow is not removed. The blanking components, when not in use, are stowed in the change-of-role kit box.

18. The main components of the purging system and their respective functions are:-

(1) Gun purging valve - Controls the flow of purging air.

(2) Constant-flow valve - Controls the volume of air for two or four guns in accordance with the setting

(3) Selector relay - Operates in conjunction with the armament master selector switch.

(4) Interlock relay - Completes the circuit from the weapons trigger to the gun power unit relay and in conjunction with the pressure switch, to the gun-purging airflow indicating lamp

(5) Camera relay - Controls the operation of the G90 camera and the gun-purging overrun control unit

(6) Overrun control unit - Ensures a flow of purging air for two seconds after the weapons trigger is released.

(7) Pressure switch - With purging air flowing, closes and energizes the interlock relay to illuminate the indicating lamp

(8) Microswitch - Closes automatically when the gun pack is fitted, energizing a solenoid to set the constant-flow valve to supply sufficient air for four guns.

19. Air for gun purging is required only when the guns are firing and, to ensure complete purging, for two seconds after the trigger has been released. When GUNS is selected on the ARMAMENT MASTER SELECTOR switch, the selector relay is operated to put the weapons trigger in circuit with the camera relay and a contact of the interlock relay is energized when the trigger is pressed and, with the camera master switch on, the G90 camera will run. The overrun control unit is also energized and this, in turn, energizes the solenoid of both the gun-purging and constant-flow valves, thus supplying pressure air to the system. For as long as there is pressure in the system the gun-purging pressure switch is closed, energizing the interlock relay which causes the indicating lamp on the starboard support panel to light. At the same time the circuit from the gun trigger to the gun power unit is com-

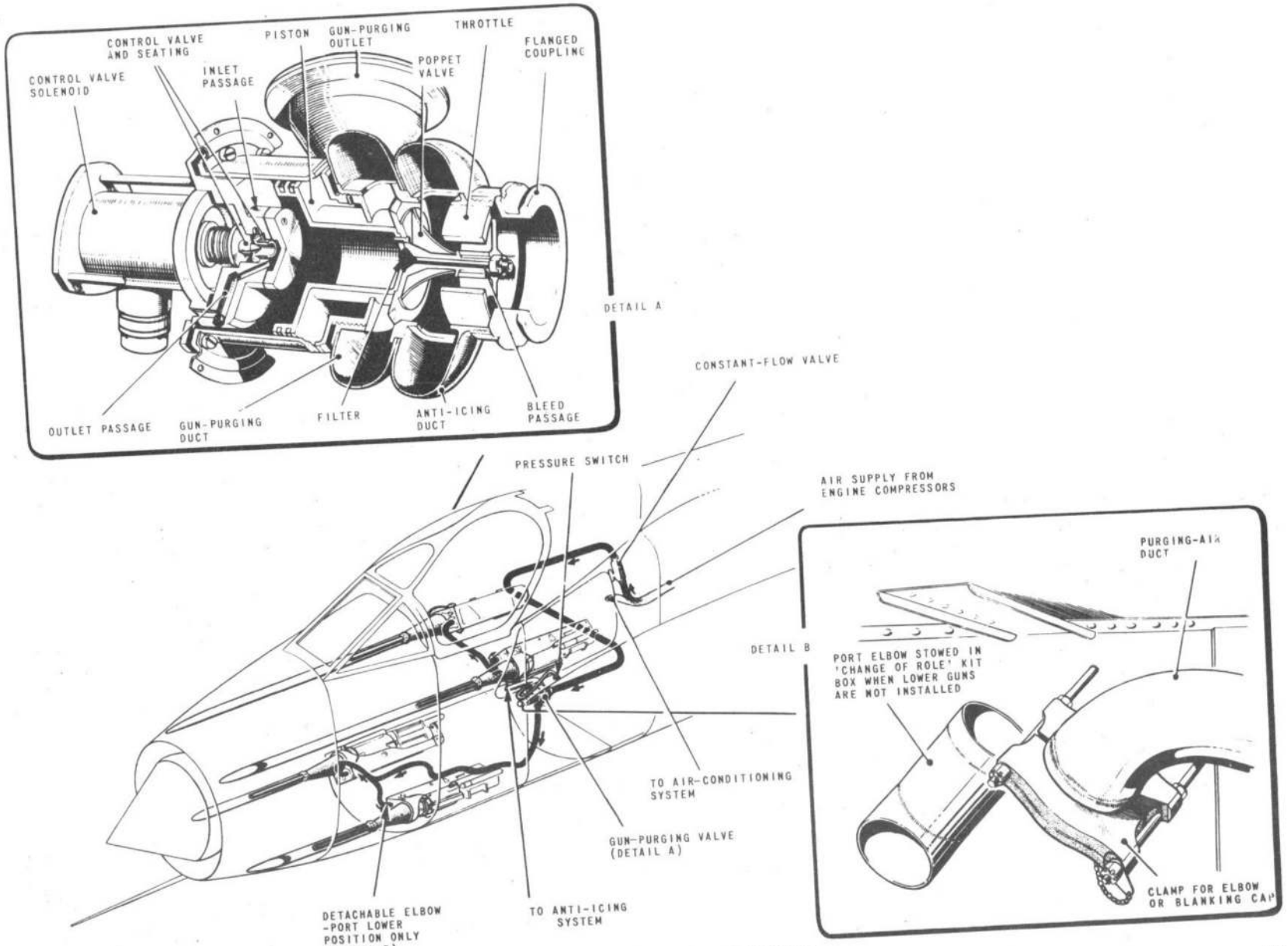

FIG. 6. GUN - PURGING SYSTEM

1410

pleted, causing the guns to fire. When the trigger is released, the gun power unit is de-energized and the guns will cease firing.

20. The camera relay is also de-energized, releasing the purging overrun control which holds the purging valve open for a further two seconds. When the valve closes and air ceases to flow, the pressure switch opens to de-energize the interlock relay causing the indicating lamp to go out. The pressure switch also acts as a safety device in that, should the purging valve remain closed when the trigger is pressed, with, consequently, no flow of purging air, the gun-firing circuit will be broken at the switch and the guns will not fire. Should the gun-purging valve remain open after the trigger has been released, as evidenced by the lamp remaining on, the pilot must immediately return the ARMAMENT MASTER SELECTOR switch to the off position, thus breaking the circuit to the valve.

SERVICING

WARNING

The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cockpit or performing any operations upon the aircraft.

General information

21. For instructions on servicing the guns, the electrical firing system and for re-arming the aircraft, refer to A.P.1641S, Vol.1.

Preparation of the aircraft for harmonization of the guns, G90 camera, radar head and P.A.S. unit

General information

22. Preparation for harmonization entails removal of the radar head, fitting the aircraft weapon aligning instrument and preparing the weapons, G90 camera and radar head mountings for alignment with their respective aiming marks on the diagram. Using the aircraft weapon aligning instrument obviates the necessity for leveling the aircraft either longitudinally or laterally, the readings obtained from the aircraft datums being transferred to the leveling platforms of the instrument. The unit is offset 28 inches to port of the aircraft centre line; the vertical sighting datum on the harmonization diagram is also offset to this amount. Before the commencement of harmonization operations it is important to ensure that the upper engine hatch is fitted and properly secured.

The following equipment is required:-

DESCRIPTION	REF.NO.
Level, spirit, adjustable	1B/4235
Stands, gun harmonization, universal, Mk.2	4G/7224
Sets basic, aircraft harmonization	4G/7224
Adapter set, Lightning aircraft	4G/7176
Pin, lateral leveling, port	26DK/95414
Pin, lateral leveling, stbd.	26DK/95099
Gauge, aircraft, lateral leveling	26DK/95100

Fitting the aircraft weapon-aligning instrument

23. For the procedure for fitting the instrument to the aircraft and for a description of the harmonization equipment listed in para.22 refer to A.P. 4483A, Vol.1.

Alignment of the guns, G90 camera, radar head and P.A.S. unit

24. The guns, G90 camera and the radar head must be correctly aligned with their respective aiming marks on the diagram by adjustment of their mountings, the line of sight from each unit being determined with the instrument provided. The following equipment is required:-

DESCRIPTION	REF.NO.
Instrument, gun-aligning, Aden gun	7R/754
Sighting instrument, periscopic, G90 camera	14A/5054
Gauge alignment, radar head	26DK/95098
Spanner, rear gun-mounting azimuth adjustment	26DK/95173
Spanner, rear gun-mounting elevation adjustment	26DK/95174

Proceed as follows:-

Guns

(1) Remove panels 11P and 11S giving access to each of the upper gun blast tube assemblies, remove the eight special-to-type bolts and the bevelled insert and slide the outer and inner sleeves forward to expose the apertures in the tubes.

Note...

Extreme care must be taken to avoid

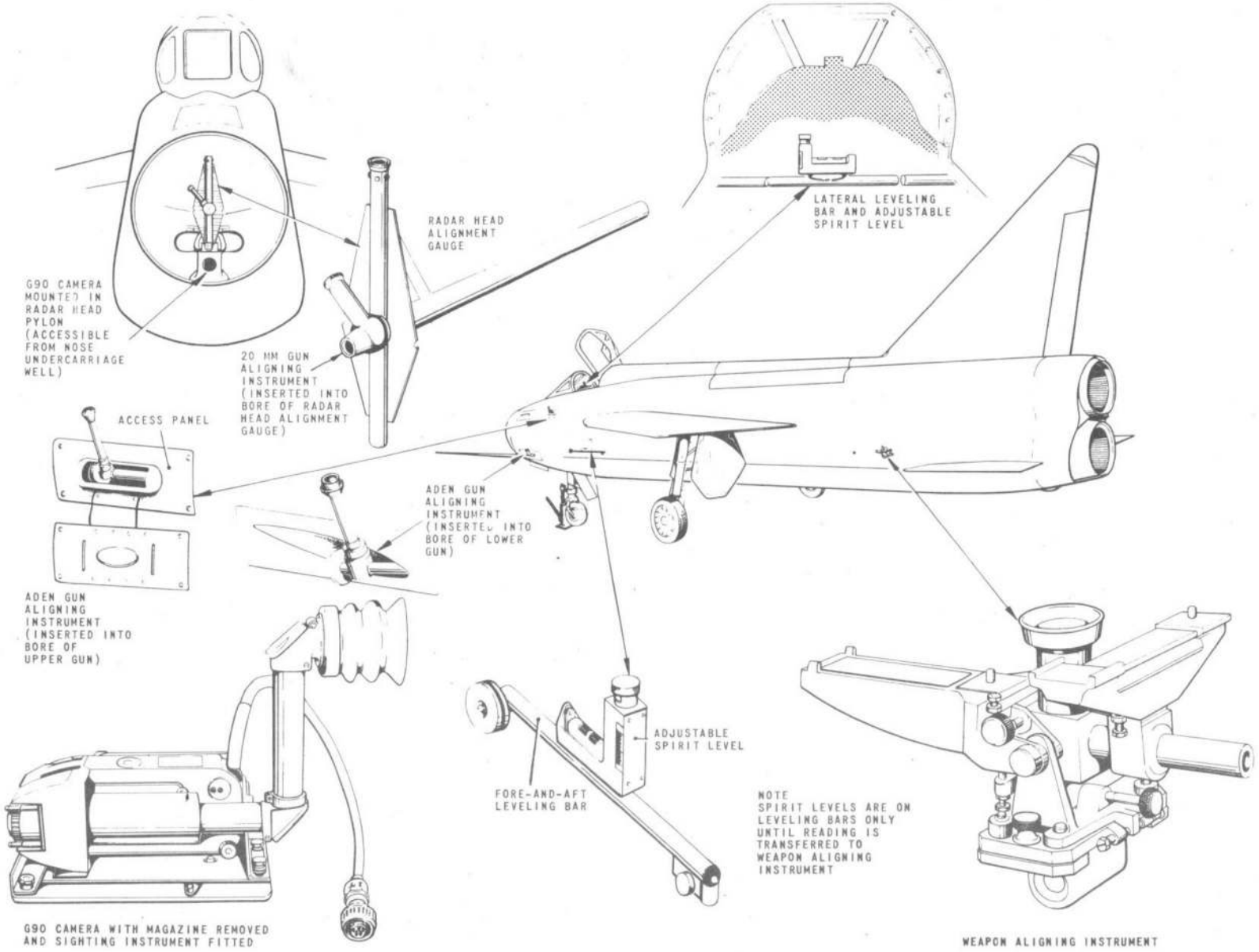

FIG. 7. HARMONIZATION PROCEDURE

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sliding the sleeve too far forward and allowing the spring to engage the front face of the forward landing. Should this happen, great difficulty will be experienced in returning the spring to its position on the landing.

(2) From the forward end of either blast tube insert the rod of the gun-aligning instrument into the barrel of the gun until the tapered portion of the rod is in firm contact with the muzzle. If necessary withdraw the rod and adjust the expander to eliminate any play.

(3) Attach the eye piece to the instrument through the access aperture in the blast tube and check that the intersection of the lines of the graticule is aligned with the appropriate gun-aiming mark on the diagram.

(4) If adjustment is necessary, remove the locking wire from the harmonization unit and adjust the unit as required with the spanners provided. When adjustment is complete, tighten the locknuts, re-check the alignment and wire-lock the adjusting nuts.

(5) Repeat for the remaining upper gun and refit the blast tube sleeve assemblies and access panels.

(6) From the forward end of the blast tubes insert the rod of the gun-aligning instrument into the barrel of each of the lower guns in turn and, viewing through the eye piece, check the alignment of the barrels with the appropriate aiming marks on the diagram.

(7) If necessary adjust the harmonization units, tighten the locknuts, re-check the alignment and wire-lock the adjusting nuts.

P.A.S. unit

(1) Select G.W. on the armament selector switch and, viewing through the reflectors, check that the sighting spots are aligned with their aiming mark on the diagram.

(2) If adjustment is necessary, slacken the locknuts on each side of the pivot(s) of the reflector(s) and, using a small screwdriver, turn the pivot screws as required. Tighten the locknuts and re-check the alignment.

G90 camera

(1) Remove the two 2 B.A. screws securing the G90 camera access panel in the forward end of the nose-wheel well and remove the panel.

(2) Turn the knurled knob at the port rear end of the camera anti-clockwise and remove the magazine from its housing.

(3) Press in and turn the knurled knob at the starboard rear end of the camera anti-clockwise until the shutter opens.

(4) Fit the periscopic sighting instrument into the magazine housing and, viewing through the periscope, check that the intersection of the lines of the graticule is correctly aligned with the camera aiming mark on the diagram.

(5) If horizontal adjustment is necessary, slacken the two 2 B.A. nuts at the rear of the camera mounting and move the lever on the port side of the mounting until the vertical line of the graticule coincides with the centre line of the aiming mark. Tighten the nuts.

(6) If vertical adjustment is necessary slacken the two 2 B.A. nuts at the rear starboard side of the mounting and move the lever on the same side until the horizontal lines of the graticule and aiming mark coincide. Tighten the nuts.

(7) When the camera is correctly aligned, remove the sighting instrument, close the shutter by further rotation of the shutter control knob and refit the magazine and access panel.

Radar head mounting

(1) With the radar head alignment gauge fitted to the mountings, insert the rod of the gun-aligning instrument into the bore of the gauge.

(2) Unlock and adjust the rear mounting eccentric until the intersection of the lines of the instrument graticule in the instrument coincides with the camera aiming mark on the diagram. Lock the eccentric and re-check.

(3) Remove the instrument and the alignment gauge in preparation for fitting the radar head.

REMOVAL AND ASSEMBLY

General information

25. For instructions for the removal and re-fitting of the upper guns and ammunition tanks, and for the lower guns, gun pack, and ammunition tank, refer to A.P.1641S, Vol.1, Part 1 and 3.

Upper gun harmonization units removal

26. To remove a unit:-

(1) Remove the locking wire. Slacken the locknut of the lateral adjuster and adjust the unit to the fully inboard position.

(2) Remove the five ¼ in. B.S.F. bolts securing the outboard reinforcing plate to the gun beam and remove the plate.

(3) Remove the locknut and lateral adjuster from the spindle, withdraw the unit from the inboard bracket, and re-fit the adjuster and locknut.

Lower gun harmonization units removal

27. To remove a unit:-

(1) Remove the four ¼ in. B.S.F. bolts securing the inboard mounting bracket to the aircraft structure and remove the bracket.

(2) Remove the locking wire and the locknut and the lateral adjuster from the outboard end of the spindle.

(3) Withdraw the unit from the outboard bracket, and refit the adjuster and locknut on the spindle.

Fitting the lower blast-tube seals

28. The seals are fitted into the lower gun-mounting sockets to blank off the blast tubes when the guns are not installed.

To fit a seal:-

(1) Slacken the wing nut and insert the seal into the gun-mounting socket from the lower armament bay.

(2) Press on the wing nut to compress the spring and turn the seal through 30 degrees to position the fibre block behind two opposite socket lugs.

(3) Release pressure on the spring and tighten the wing nut.