CHAPTER 14

PHOTOGRAPHIC EQUIPMENT

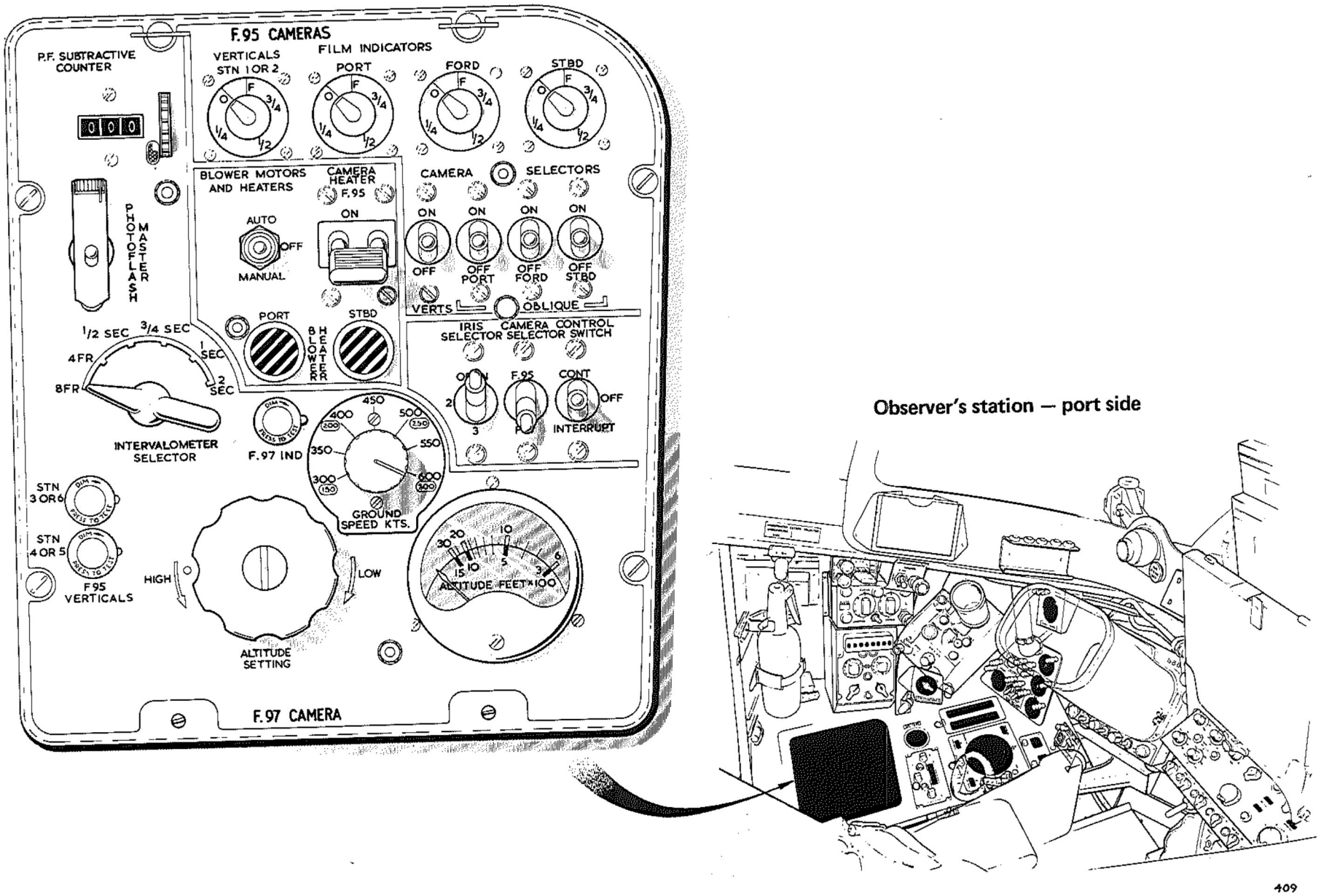
Chapter 14 PHOTOGRAPHIC EQUIPMENT

LIST OF CONTENTS

	Para
Description	
General	1
Controls and instruments	5
Camera crate	6
Camera mounting equipment	10
Heating and de-misting system	11
Camera window guards	13
Photoflash crate	14
Discharger unit mounting	15
Bomb door fairing	16
Servicing	
Lowering the crates to the servicing position	18
Replacement of silica gel	19
Finish and external markings	20
Installation and removal	
Camera – installation	21
Camera – removal	22
Discharger unit – installation	23
Discharger unit – removal	24

LIST OF ILLUSTRATIONS

	Fig
Photographic role control panel	1
Camera crate	2 - 2a
Photoflash crate	3
Bomb door fairing	4
Camera arrangements	5
Servicing facilities	6
External markings	7
Photoflash discharger nozzle plates – blanking	8



Observer's station — port side

409

Fig.1. Photographic role control panel
(Pre-Mod 1136 detail deleted)

DESCRIPTION

General

1. When the aircraft is converted to a photographic reconnaissance role, the bomb door is equipped with a crate carrying vertically and obliquely-mounted cameras, and either a crate carrying photoflash discharger units or a lightweight fairing, depending on whether or not the reconnaissance is to be performed during daylight. A role control panel housing the controls and instruments required to operate the photographic equipment is also fitted to the observer's port console. The role control panel and bomb distributor may be installed in the aircraft at the same time, this arrangement enabling the aircraft to carry external armament while operating in the photographic reconnaissance role.

2. A list of the photographic reconnaissance role equipment – which is introduced by Mod 5006 and Mod 5183 – together with instructions for installing it on the aircraft, is in Cover 1, Sect 2, Chap 5B of this publication.

3. Installed in tandem and extending the full length of the bomb door, the two crates are shaped to blend with the external contour of the fuselage when the bomb door is open for taking photographs, and to clear the bomb bay structure when the door is rotated to the closed position. The aft crate, which contains photoflash units, is only used for nocturnal photography, its position on the bomb door being relieved in the event of daylight photography by a fairing (Mod 5183) which is shaped to blend with the external contour of the aircraft. Both crates are of light-alloy construction and are each provided with a large access door. The camera crate which is mounted forward, is fitted with a self-contained hot air system which, although mainly designed to de-mist the camera windows, is also employed to maintain an optimum temperature within the crate. For daylight photography, various combinations of F95 cameras are used, while a single F97 camera in conjunction with the photoflash units is used for night photography.

4. Descriptions of the cameras, together with loading instructions and procedures before and after flight, are in AP 112P-0202-1A and AP 112P-0211-1. Particulars of the photoflash discharger units and cartridges are in AP 1641H, Vol 1 and AP 110E-0401-1 respectively. AP 101B-1202-1B, Cover 2, Sect 7, Chap 5 contains full details of the electrical circuits associated with the camera and photoflash crates.

Controls and instruments

5. The following sub-paragraphs give a brief description of the photographic controls and instruments, most of which are mounted on the specially-installed role control panel on the observer's port console (*Fig*.1). The remainder of the controls are mounted at the pilot's station and illustrated in Cover 1, Sect 1, Chap 1.

(1) *Deleted (pre-Mod 1136 information).*

(2) *Camera master control switch*. Master control of the cameras is by a CAMERA CONTROL switch, marked PILOT – OFF – OBS, on the engine control box. With the switch selected to PILOT, the cameras are controlled by the weapons release trigger switch, momentary operation of which ensures continuous operation of the cameras. With the switch selected to OBS, the cameras are controlled by the control switch on the role control panel, thus permitting continuous or interrupted operation as required. An OFF selection renders the cameras inoperative.

(3) *Weapons release and target accept trigger switch*. Operation of the selected cameras by the pilot is effected by depressing the weapons release and target accept trigger switch on the front of the control column.

(4) *Target reject switch*. This push-switch, mounted on the starboard throttle lever handle and marked REJECT, can be used to cancel the operation of the PR cameras, regardless of a PILOT or OBS selection on the camera master control switch.

Note...

All the controls and instruments described in the following sub-paragraphs are mounted on the role control panel at the observer's station.

(5) *Camera mode selector switch*. A single-pole, changeover switch marked

CAMERA SELECTOR, F95 – F97 provides for selection of either of the two camera installations as requried.

(6) *Control switch*. A single-pole changeover switch marked CONTROL SWITCH, CONT – OFF – INTERRUPT, controls the operation of either the F95 or F97 cameras, whichever installation is selected on the camera mode selector switch. The switch is spring-returned to OFF from the INTERRUPT position.

(7) *Camera selector switches.* A single-pole on–off switch, marked VERTS, ON–OFF, is used to select all three vertically-mounted cameras, and three further switches marked OBLIQUE, and ON–OFF, PORT, FORD and STBD respectively, provide independent selection of each of the three obliquely-mounted cameras.

(8) *Film indicators.* Four indicators show the quantities of unexposed film remaining in the magazines of the F95 cameras. Three indicators, marked PORT, FORD and STBD respectively, are operated by the relevant oblique cameras, and the other indicator, marked VERTICALS, STN 1 OR 2, covers all three vertically-mounted cameras and is operated by the camera at either station 1 or 2, depending on which camera combination is installed.

(9) *Film indicator lamps*. Two green lamps, marked F95 VERTICALS, and STN 3 OR 6 and STN 4 OR 5 respectively, flash intermittently when the related cameras are operating.

(10) *Intervalometer selector switch.* The speed selector control for the F95 cameras is a 2-pole rotary switch marked INTERVALOMETER SELECTOR. A camera speed of 8 or 4 frames per second for all cameras, or single frame operation at 1/2, 3/4, 1 or 2 second intervals for the vertical and forward oblique mounted cameras, can be selected. Mod 5208 provides the single frame facility for the side oblique cameras also.

(11) *Iris selector switch.* A single-pole changeover switch, marked IRIS SELECTOR, OPEN – 2 – 3, is used for setting the irises of all the F95 cameras simultaneously to any of three preset apertures as lighting conditions require.

(12) *Heating selector switch*. A double-pole on–off switch, marked CAMERA HEATER, F95, ON–OFF, is the master switch for the electrical heating elements in the gearbox of each camera.

(13) *Blower motors and heaters selector switch*. Master control of the camera crate blower-heater units is by a 4-pole changeover switch marked BLOWER MOTORS AND HEATERS, AUTO–OFF–MANUAL. With the switch selected to MANUAL the port and starboard blower motors run continuously and each of the heater elements is automatically switched on or off by its associated thermostat. When AUTO is selected, both blower motors run only during the period when one or both heater elements are switched on thermostatically.

(14) *Blower-heater indicators.* Two indicators marked BLOWER HEATER, PORT – STBD show black and white diagonal stripes when the blower motors and heaters switch is OFF, and change to black when the switch is selected to AUTO or MANUAL. In the event of over-heating, the related indicator will revert to black and white diagonal stripes.

(15) *Film indicator lamp.* A green lamp marked F97 IND is connected electrically to a microswitch in the film magazine and illuminates intermittently when the film is being wound over.

(16) *Ground speed selector.* The potentiometer marked GROUND SPEED KTS is associated with the F97 camera installation and has two scales. One scale marked in white covers the range 300–600 knots and the other, marked in black, covers the range 150–300 knots. Any ground speed within the range 150–600 knots can be set on the selector by an integral control knob.

(17) *Altitude selector.* The altitude selector, marked ALTITUDE SETTING, HIGH (anti-clockwise), LOW (clockwise), is a potentiometer used to adjust the voltage applied to the F97 camera drive motor. The selector is set so that the speed of the motor causes the pointer on the altitude indicator to register the height of the aircraft over the target area. In this way, the correct compensating speed at which the camera is driven is selected.

(18) *Altitude indicator.* An a.c. voltmeter marked ALTITUDE FEET x 100 is used to measure a voltage, in terms of feet, relative to the speed of the motor-driven generator in the F97 camera and the resistance set by the ground speed selector.

(19) *Photoflash master switch.* A single-pole on–off switch, marked PHOTOFLASH MASTER, ON–OFF, is provided to isolate the power supply from the pyrotechnic distributors when not in use, and is normally locked in the OFF position. When selected to ON, 28 V d.c. is available for operating the two distributor units as required.

(20) *Photoflash subtractive counter.* A three-digit counter unit, marked PF SUBTRACTIVE COUNTER, is manually set to display the total number of photoflash cartridges loaded into the disharger units. As each cartridge is fired, an impulse from the distributor causes the counter to subtract 1 and so indicate the number of cartridges remaining.

Camera crate (fig 2 - 2a)

6. Covered with 18 s.w.g. skin panels, the camera crate primary structure comprises two side assemblies and seven bulkheads. Interspaced throughout the length of the crate, the bulkheads divide the interior into six separate compartments (A to F). The access door, at the top of the structure, extends from compartment B to compartment F between the side assemblies. With the exception of compartment A, which is covered by an access panel and houses heating and de-misting components (*para* 11), each compartment has structural provision for camera mounting equipment. The inside of the crate and access door are insulated with glass wool and glass cloth padding.

7. The access door consists of two side channels and six frames covered by a 20 s.w.g. skin. Hinged to the starboard side of the crate, the door is locked in the closed position by a handle-operated latch pin mechanism. With the door closed and the latch pins engaged, the handle can be locked in position by a quick-release pin inserted through the handle and adjacent brackets.

8. The camera windows on the undersurface of the crate, in the floors of compartment B, C, D, E and F, are specially ground optical flats, secured to the structure by frames. Three of the windows, in compartments B, C and D, are fitted centrally and horizontally to suit vertically-mounted cameras, while the remainder, for oblique cameras, are fitted one in a blister beneath compartment E and two in the floor of compartment F, one port and one starboard.

9. At the top of the crate, a hoisting beam bridges the access door at a point approximately coincident with the CG, being used in conjunction with the hydraulic winching arrangement when the crate is being installed or removed (*Cover* 1, *Sect.* 2, *Chap.* 5B), or lowered to a drooped position for servicing (*para* 18). The beam is secured to brackets on the two side assemblies and must be detached from the starboard side before opening the access door, the free end of the beam then being attached to a retractable fork fitting in the access door edge member to support the door in the open position.

Camera mounting equipment (fig 2 - 2a)

10. The number and type of cameras installed in the crate are varied to suit each particular operational requirement. Fig 5 shows the different camera combinations which may be used. A forward and rear mounting frame, supplied with the crate, must be fitted to the F97 camera to form a complete unit, before installing it in compartment D. Mounting frames, Part No. YB3-80-749, must also be fitted to all the F95 cameras prior to installation. Each of the five camera compartments is equipped as follows:-

(1) *Compartment B (Stn 1, 2 and 3).* Guide rails, bolted to both the bulkheads of this compartment, accommodate either one F95 camera with 4 in. lens or two F95 cameras with 12 in. lens. The mounting frame, bolted to each camera, is secured to the guide rails by quick-release locking handles.

(2) *Compartment C (Stn 4, 5 and 6).* The arrangement for mounting and securing the cameras in this compartment is similar to that of compartment B. In this case, however, the camera installation can be either one F95 camera with 12 in. lens or two F95 cameras with 4 in. lens.

(3) *Compartment D (Stn 7).* In this compartment, a tubular light-alloy mounting frame forms a platform for the F97 camera unit. Four shock-absorbing isolators, one at each corner of the mounting frame, are bolted to channels on the floor structure. The camera unit is secured to the isolator mounting frame by four knurled hand screws.

(4) *Compartment E (Stn 8).* The forward-facing oblique camera in this compartment, either F95 – 12 in. or 4 in. lens, is housed in a mounting tray which can be pivoted and set at any one of four angular positions (5, 10, 15 or 20 deg depending on the lens fitted). Two guide rails, bolted to the walls of the tray, accommodate the camera unit. Quick-release locking handles are provided to secure the unit within the guide rails.

(5) *Compartment F (Stn 9 and 10).* The side-facing oblique cameras in this compartment, both F95 – 12 in. or 4 in. lens, are housed in mounting trays which can be pivoted and set at any one of three angular positions (10, 15 or 20 deg). The mounting and method of adjustment are similar to that of the forward-facing oblique camera in compartment E.

Heating and de-misting system (fig 2)

11. The heating and de-misting system in the camera crate comprises two Plannair

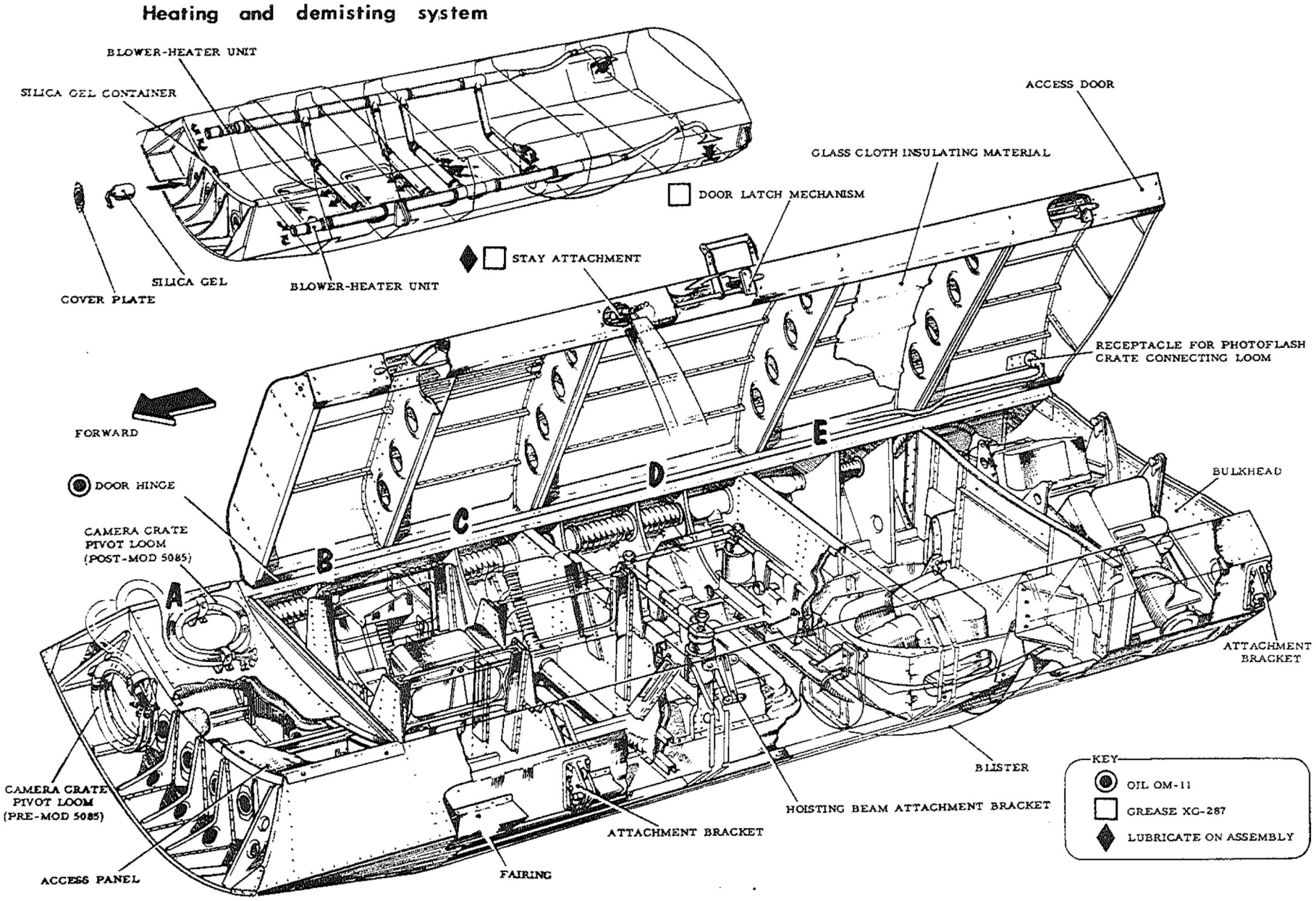


Fig.2. Camera crate

(AMT 5262 incorporated; lubrication symbols and key amended)

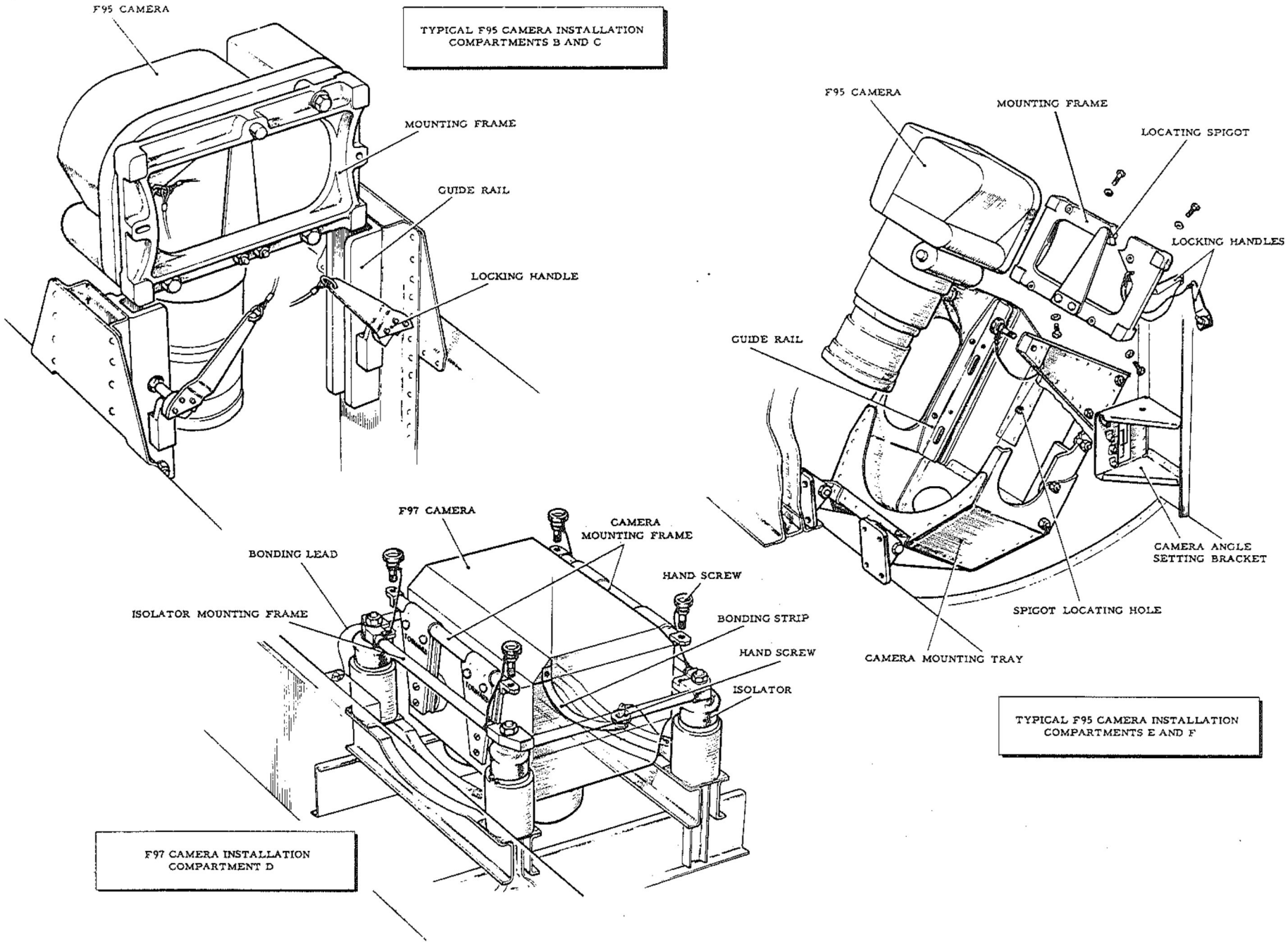


Fig. 2a. Camera crate

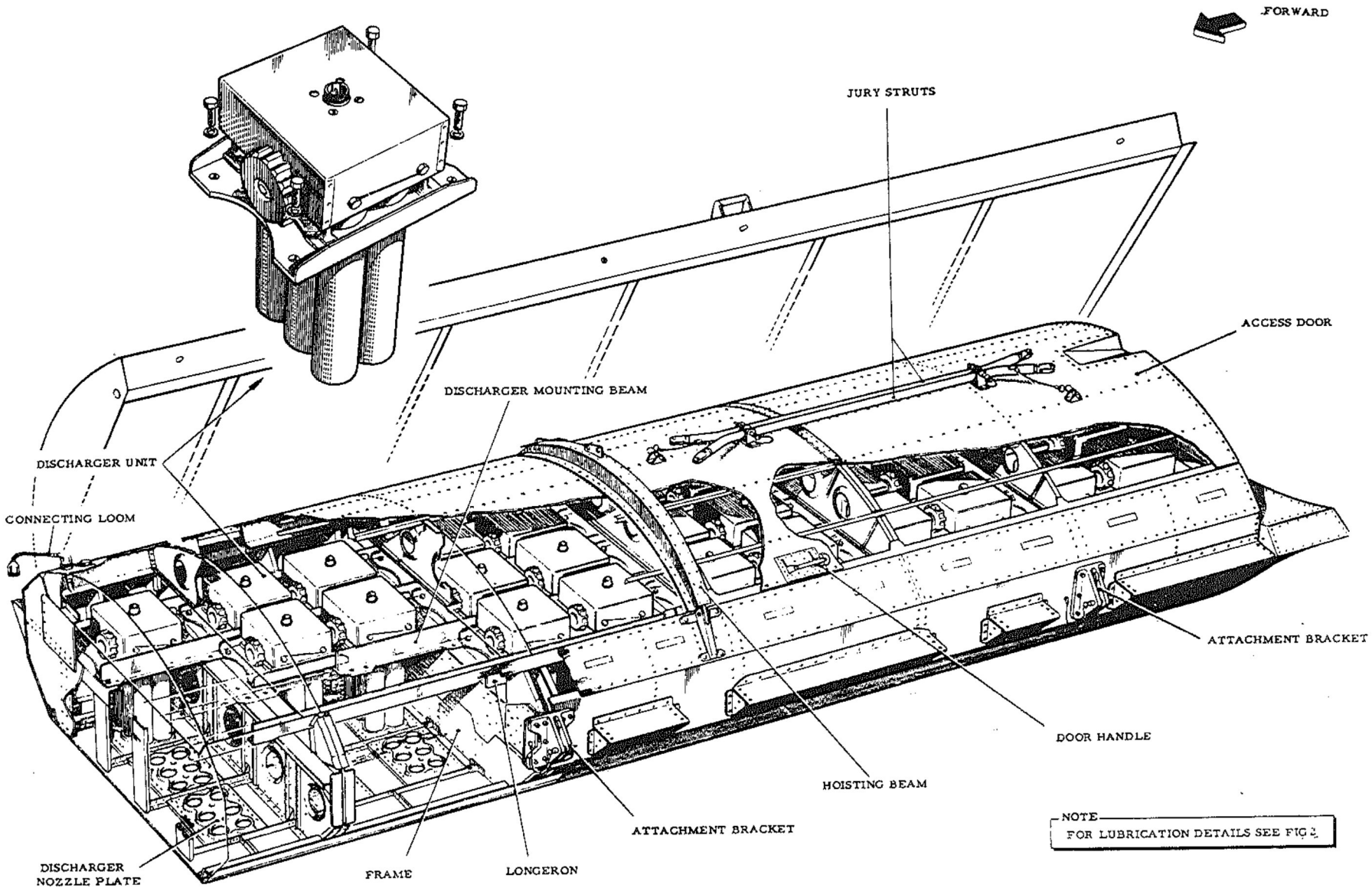


Fig. 3. Photoflash crate

blower-heater units and an arrangement of flexible piping for distributing warm air over the six camera windows. Heating elements and fan blowers within the blower-heater units are automatically controlled by thermostats to deliver warm air when the prevailing ambient condition causes the crate temperature to fall below 15 ± 2 deg C. Fitted on the front bulkhead of compartment A, four intakes allow an influx of air to balance the crate pressure with that of ambient when the aircraft makes a rapid descent from altitude. Each intake incorporates a silica gel container to reduce the humidity of the air passing into the crate. The flexible piping includes two gallery pipes, one from each blower-heater unit, which pass along the sides of the crate and incorporate branches extending to metal diffusers adjacent to the camera windows. In each of compartments B, C, D and E, two branches, one from each gallery, are joined to their respective diffuser to provide an integrated supply. Diffusers at the side windows in compartment F are supplied through branches from the ends of the galleries. The integration of supplies from the two galleries ensures adequate heating and de-misting in the event of a single blower-heater unit failure.

12. When the blower motors and heaters switch is selected to AUTO, the heating elements and blower fans are thermostatically controlled to deliver warm air to the camera windows when necessary. A MANUAL selection operates in a similar manner except that only the heater elements are thermostatically switched on and off; the blower fans will remain operative. If an electrical fault in one of the blower-heater units causes the elements to exceed their normal operating temperature, the current to the elements is automatically cut off by an overheat thermostat within the blower-heater unit, thus leaving the blower fan still running and the other blower-heater unit operating normally.

Camera window guards

13. To prevent damage to the camera crate windows while the aircraft is on the ground, the special guards listed below must be fitted one to each window immediately the aircraft returns from a flight:-

(1) YB3-88-477 – vertical windows (3)

(2) YB3-88-478 – side-facing oblique windows (2)

(3) YB3-88-479 – forward-facing oblique window

Photoflash crate *(fig 3)*

14. The photoflash crate forms a compact housing for thirty-three photoflash discharger units and their associated electrical equipment. The crate structure, covered with 18 s.w.g. skin panels, comprises two longerons, two end frames and five intermediate frames. Diaphragms, struts and stiffeners add further strength to the main structure. Incorporated in the floor structure of the crate are thirty-three plates each having six holes for the location of the photoflash discharger unit nozzles. Hinged to the starboard longeron, a large access door extends the full length of the crate, and incorporates a handle-operated latch pin mechanism similar to that fitted to the camera crate door. The hoisting beam, attached to brackets on the port and starboard longerons, is also similar to that fitted to the camera crate.

Discharger unit mounting

15. The discharger units are mounted in threes – port, centre and starboard – in eleven rows identified by the letters A to H and J to L, starting from the forward end of the crate, and the cartridges are numbered in their firing order A1 to L198 from port to starboard. 1.75 in. No. 2, Mk. 1 type discharger units are used and are each secured to longitudinally-mounted support beams by four bolts. The support beams are secured to the main crate structure at each frame by the discharger attachment bolts, which pass through the beams at these positions, and screw into anchor nuts in the frames.

Bomb door fairing *(fig 4)*

16. The bomb door fairing (Mod 5183) is a lightweight construction which replaces the photoflash crate on the bomb door when the crate is not required for use in the photographic reconnaissance role. The fairing consists of a light alloy structure in the form of a main centre section and two reclining side sections, the underside of the main section being covered in 20 s.w.g. skin, while its upper surface is open structure. Five formers and two frames are laterally positioned and interspaced by stringers to compose the basic framework of the fairing. The four fairing attachment brackets which locate with the photoflash crate mounting brackets

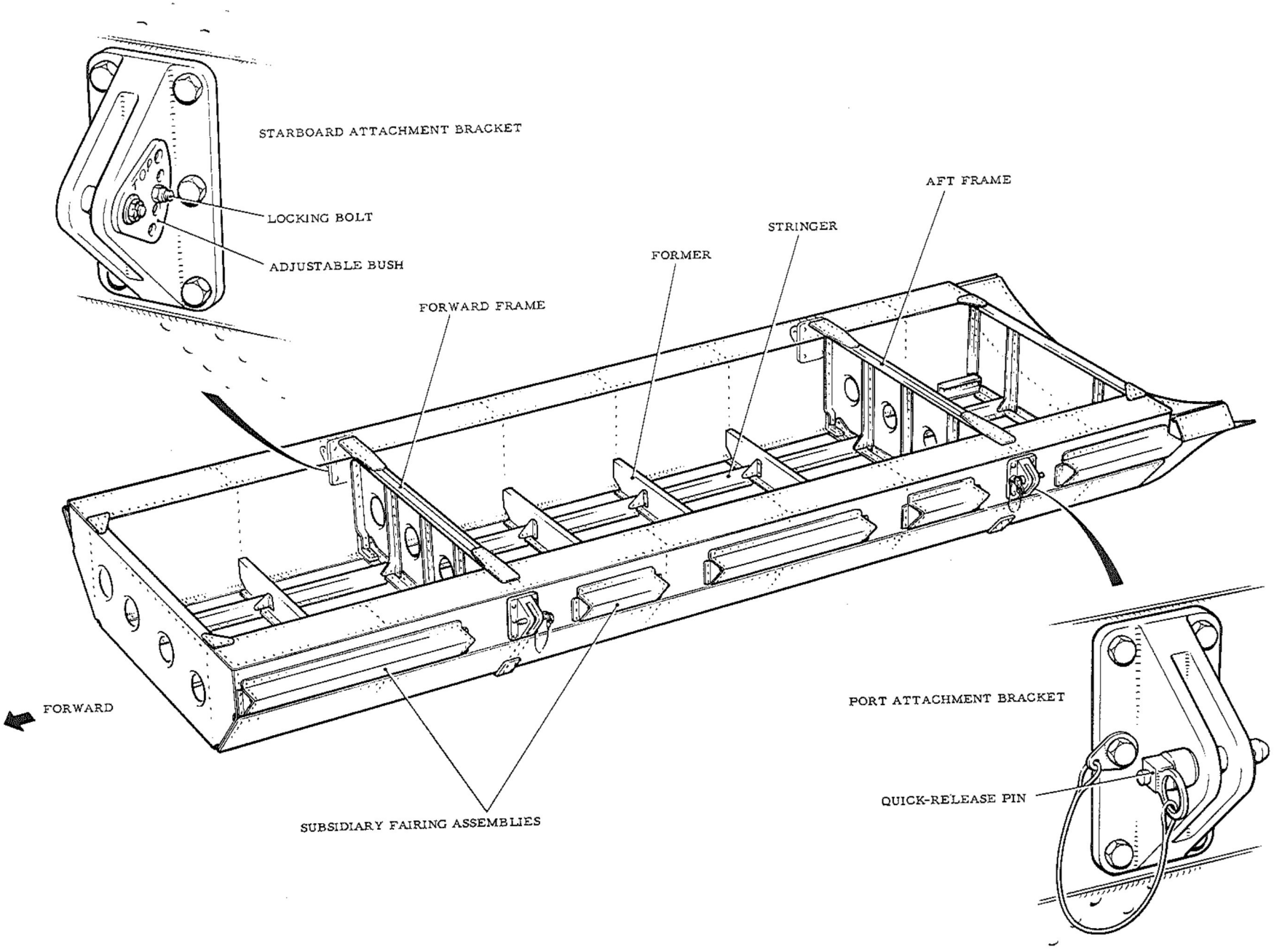


Fig. 4. Bomb door fairing

on the bomb door are bolted two on each side of the fairing, each port side bracket being accompanied by a single quick-release pin which is anchored to the fairing by a 6 in. long wire cable. The two starboard side attachment brackets are each supplied with a trunnion, nut and adjustable bush, which are fitted following the identical procedure for the camera and photoflash crates. Five subsidiary fairing assemblies are attached at intervals along each side of the fairing and eliminate any airflow into the bomb bay past the side of the fairing.

SERVICING

17. The only servicing required is on the camera and photoflash crates and is a periodic examination of the silica gel air driers and lubrication of the hinges and latch pin mechanisms on the access doors. Servicing instructions for the F95 and F97 cameras are in A.P.112P-0202-1ABC and A.P.112P-0211-1.

Lowering the crates to the servicing position

18. To enable the access doors to be opened for servicing operations, both crates can be lowered to a drooped position from their port attachments and secured in this position by jury struts (*fig* 6) which are normally stowed on top of the doors. If the weight of the crates and the number of personnel available prohibit manual lowering, the hydraulic winching arrangement used for installing and removing the crates (*Cover* 1, *Sect.* 2, *Chap.* 5B), may also be used to lower the crates to the servicing position.

Note...

The lifting hook can be passed through one of two holes in each hoisting beam; the port hole is used when installing the crate and the starboard hole is used when lowering the crate to the servicing position.

Replacement of silica gel

19. The silica gel, Ref No. 33C/790, contained in the four camera crate air intakes, is of an indicator type initially coloured cobalt blue. When the silica gel becomes saturated with moisture the colour will change to pink, thus indicating that replacement is necessary.

Finish and external markings *(fig 7)*

20. The positions and dimensional details of the external markings on the camera and photoflash crates are shown on fig 7. Instructions in A.P.101B-1202-1A, Cover 1, Sect. 2, Chap. 4, regarding painting external surfaces are applicable to the bomb door fairing, camera and photoflash crates. The painting and marking instructions for post-Mod 1698A aircraft are applicable to post-Mod 5342A/5358 equipment. The surfaces exposed on bomb door rotation are painted dark sea grey to specification:-

DTD 5580/GLOSS (post-Mod 5259)

DTD 5580/MATT (post-Mod 5270)

DTD 5599A/MATT (post-Mod 5342A)

INSTALLATION AND REMOVAL

Camera - installation

21. Mounting frames must be bolted to all cameras prior to installation (*para* 10). The attachment of a mounting frame to a camera, forming a complete unit, is shown in fig 2a. With the armament master safety break disconnected (*Cover* 3, *Sect.* 5, *Chap.* 4) each unit is installed as follows:-

Note...

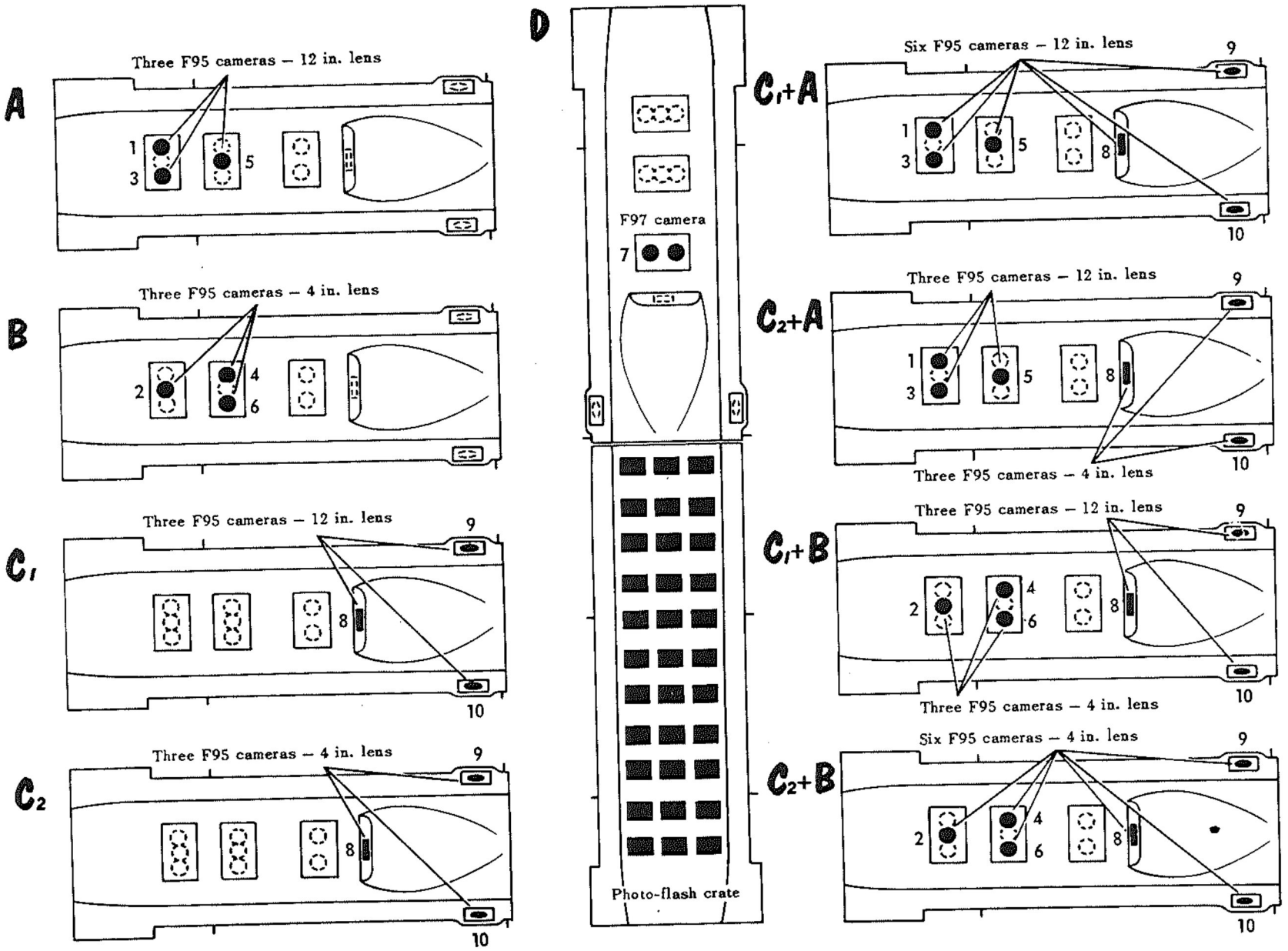
The F95 cameras are supplied fitted with a horizontal adapter. Before installation, this adapter must be replaced by the vertical adapter in the camera transit case. The change-over is effected by detaching the Cannon plug from the horizontal adapter, removing the adapter and replacing it with the vertical adapter, and refitting the Cannon plug to the new adapter. After fitting the vertical adapter, the grub screw on the latter is used to align and secure the plug so that its keyway points towards the narrowest point of the adapter, i.e. towards the magazine, on the line of film travel.

(1) *Compartment B and C (Stn 1 to 6).* The camera units in these compartments are each fitted by inserting the unit into the respective guide rails and fitting the locking handles, turning them in a clockwise or anti-clockwise direction as appropriate, to positively secure the camera unit in position.

(2) *Compartment D (Stn 7).* The F97 camera unit is secured to its mounting frame by four knurled hand-screws one at each corner of the unit.

Note...

On post-Mod 5085 crates, the bonding strip at the rear of the camera must also be secured to the rear mounting channel member with the hand-screw provided.



INVERTED PLAN VIEW

Fig.5. Camera arrangements

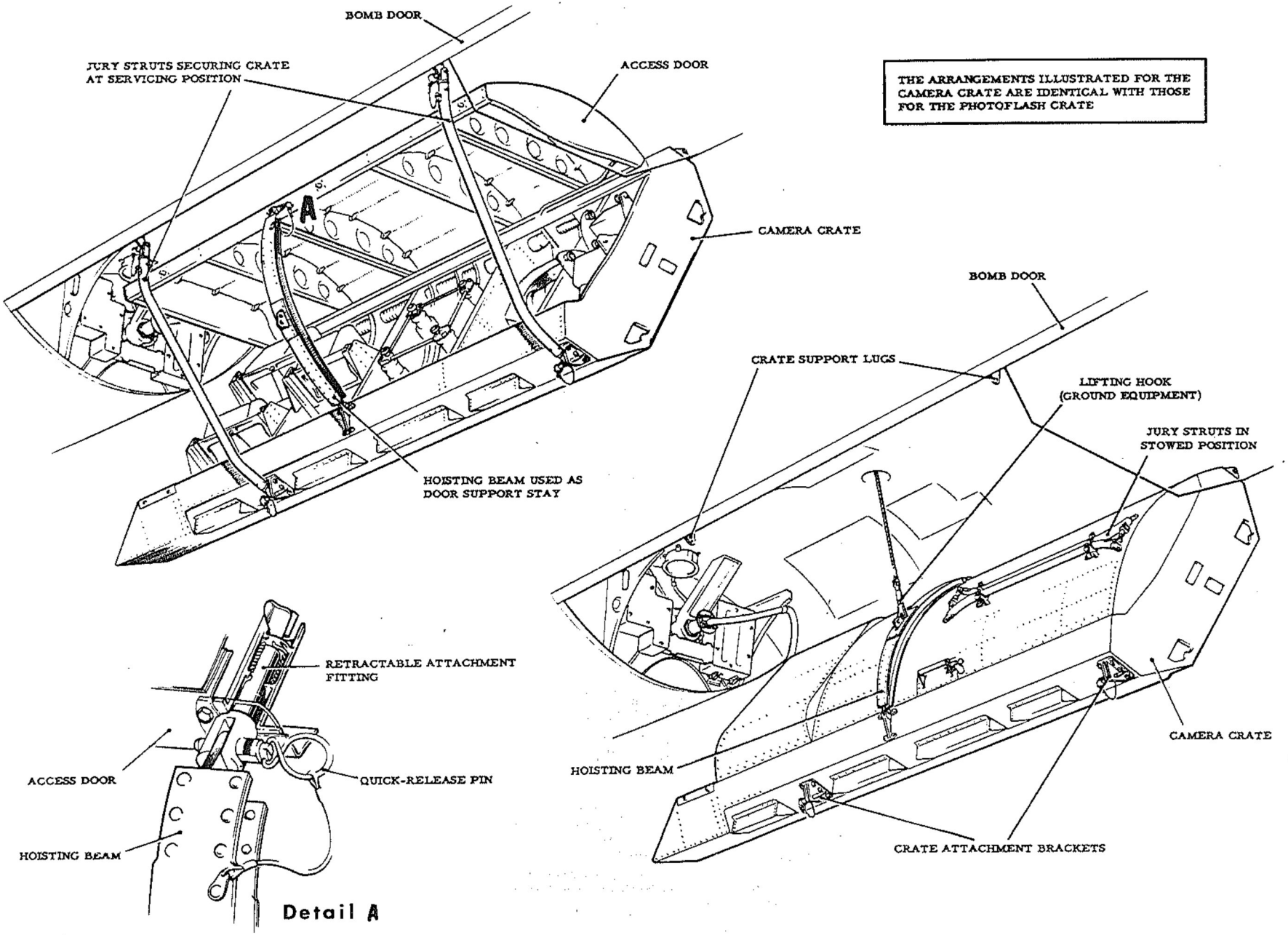


Fig. 6. Servicing facilities

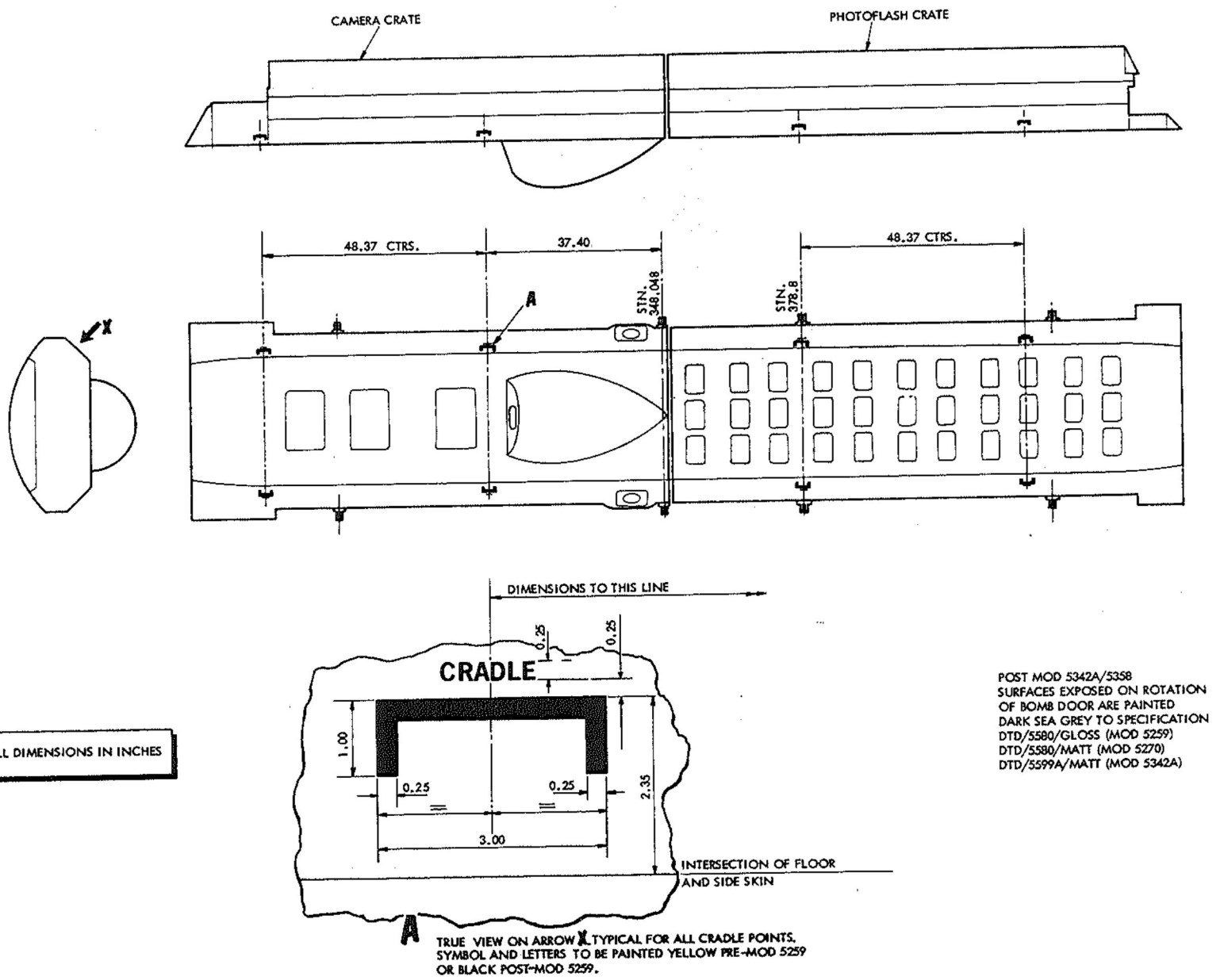


Fig.7. External markings
(Mod 5358 incorporated)

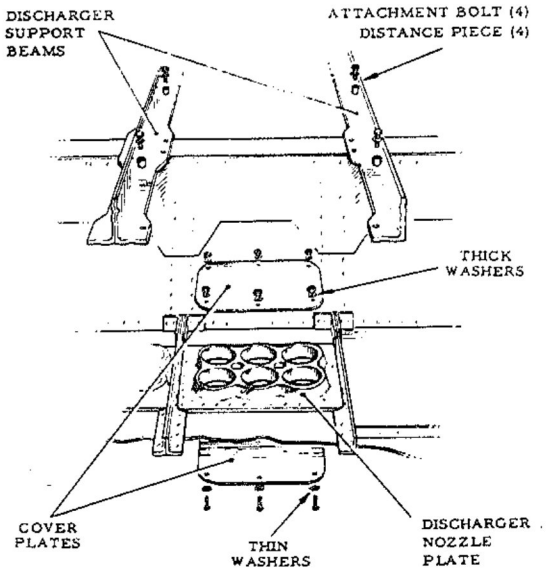


Fig.8. Photoflash discharger nozzle plates – blanking

(3) *Compartments E and F (Stn 8 to 10).* The three camera units in these compartments are each installed as follows:-

(a) Lift the tray and insert the camera unit into the guide rails.

(b) Secure the unit with the locking handles as in operation (1).

(c) Lower the tray and secure it in the required position, using the knurled hand-screws provided.

(4) When the camera installation is complete, connect the electrical plugs and sockets, and stow those not in use on the appropriate dummy receptacles. Function test the cameras as instructed in A.P. 1355C, Vol. 1.

Camera – removal

22. In all cases the cameras can be removed by reversing the installation procedure, providing that the electrical circuits to the cameras are first isolated by disconnecting the armament master safety break.

Discharger unit – installation

23. Each photoflash discharger unit is installed with its knurled hand-wheel facing forward, and is secured to support beams within the crate structure by four bolts (*fig* 3). The anchor nuts to which the discharger units are secured, are staggered to prevent incorrect installation. After installation, connect the Cannon plugs to their respective sockets on the dischargers and perform the function test detailed in A.P. 101B-1202-1B, Cover 2, Sect. 7, Chap. 5.

Discharger unit – removal

24. Before removing one or more of the discharger units, the PHOTOFLASH MASTER switch must be in the OFF position and all cartridges withdrawn. If the dischargers have been operated in conjunction with the F97 camera, allow a period of 30 seconds to elapse before withdrawing the cartridges, examining each one as it is taken from its barrel; any misfired cartridges must be stowed in a safe place and reported in accordance with current regulations. To remove a discharger unit, disconnect the electrical Cannon plug and remove the four attachments bolts (*fig* 3).

WARNING...

If the above procedure is not observed any remaining cartridges may be ejected if the camera is inadvertently operated on the ground. These cartridges will explode almost immediately and could seriously injure personnel or damage the aircraft.

25. Whenever the discharger units are removed, each nozzle plate in the floor of the crate must be blanked off as shown in fig 8 using the cover plates, Part No. YB3-80-1662, bolts, Part No. A113/7C, thick washers, Part No. SP125/C, thin washers, Part No. SP124/C, and nuts, Part No. H10-08, supplied with the crate. In addition, a distance piece, Part No. AS.2309/025 or YB3-80-1665, must be fitted to each discharger attachment bolt, and the bolts replaced in their respective anchor nuts.

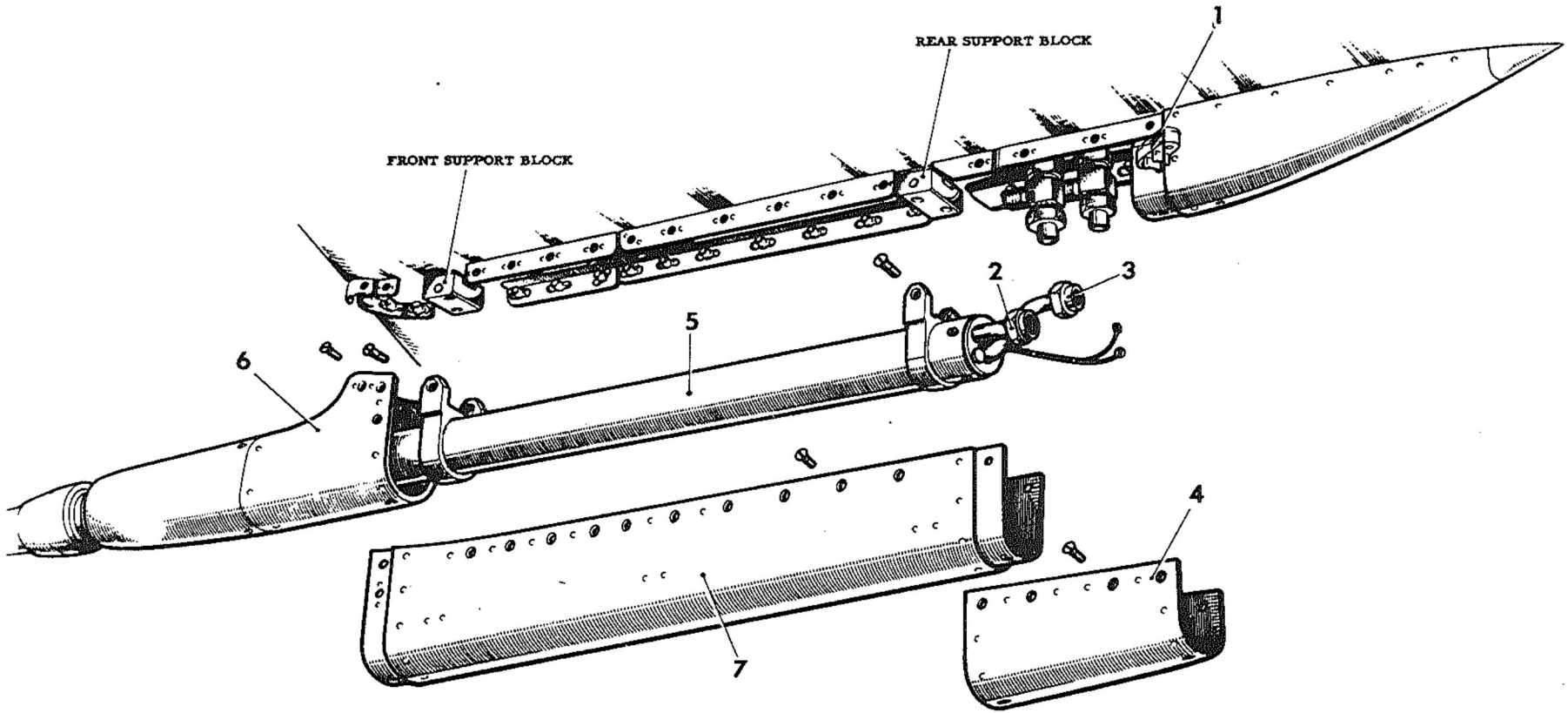


Fig. 25. Pressure head mounting – removal