Para

# Chapter 5A

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# CAMERAS

### (Completely revised)

### LIST OF CONTENTS

				Para.			Para.		
Intraduction	-11:52	19076	200	1	Camera heatina		9	Night oblique photography 3	<b>7</b> .
· · · ·			•••		Day vertical photography		10	Circuit operation 3	9
					Control unit, Type 35, No.8A		11		
DESCRIPTION A	ND (	DPER	ATION	4	Circuit operation		12	SERVICING	
					Night vertical photography	•••	16		
Camera cupolas				2	Control unit, Type 35, No.20A		17	General 4	5
Cupala doors				3	Circuit operation		19	and the second	
Cameras				4	Day oblique photography		24	·	
Camera fittina				5	Control unit, Type 35, No.40		25	REMOVAL AND INSTALLATION	
Night photography				6	Control unit, Type 48		26	the second s	
Selection of comeros				7	Circuit operation		30	General 4	10

# LIST OF TABLES

<b>6</b>		Table
control units	• •••	 1
Major items of equipment		 2

				Fig
Location of equipment			<i></i>	1
Camera control panel		•••		2
Control circuit - day/n vertical photography	ight 			3

# Introduction

1. The aircraft is equipped for day and night, flow and medium range photography. By utilizing the available combinations of

# Camera cupolas

2. The cameras are installed in two cupolas situated immediately forward of the rear observer's station. The cupolas are normally stowed within the fuselage

#### LIST OF ILLUSTRATIONS

				Fig.
Control circuit - d photography	ay c	bliq 	ue 	 4
Control circuit - n photography	ight 	ob1i	ique 	 5

# suitable cameras and control units it is possible to engage in day and night vertical or oblique photography. The

# DESCRIPTION AND OPERATION

but when required for use they are extended, by means of pneumatic jacks, so that they protrude beyond the surface of the fuselage. Control of the pneumatic jacks is by means of electro-pneumatic

#### RESTRICTED

Routing charts		Fig.
Camera doors operation	 	6
Camera and pyrotechnics	 7(1)a	nd(2)

following text describes the camera installations. Location of components is given in fig.1 and 2.

selector valves, which are energised when a selection is made on the camera doors control switch. The selector valves are fitted on a small panel on the port side of the aircraft (fig.1).



#### Cupola doors

3. Two sets of doors (upper and lower) are fitted to each cupola. The lower set protect the lens with the cupola retracted and open when the cupola is extended. The upper set open upwards into the fuselage to provide access to the cameras and controls.

#### Cameras

4. The forward cupola is intended for low level night oblique photography using the Type F97 camera. The aft cupola is intended primarily for day vertical photography using the F24 camera, but may also be used for medium level night photography with the F24 camera. Both the F97 and F24 cameras are operated from camera control units situated on the right of the tactical navigator's station.

#### Camera fitting

5. The method of fitting the cameras in their mountings is outlined in A.P. 1355C, Vol.1, Sect.1. Servicing lamps and control switches are fitted in each cupola. These are described in Sect.6, Chap.3L of this publication.

#### Night photography

Since night photography requires 6. the use of artificial light, a system of flash dischargers is employed to give photo-flash co-incident with shutter operation. For oblique photography, 1.75 in. photo-flashes are used, these being stored at and discharged from the signal discharger's station. For vertical photography 4.5 in. camera flares are used, these being stored and released from the bomb bay. Discharge of either the photoflash flares or camera flares is an automatic function of the camera operation. The control of the photo-flashes and camera flares is described in Sect.6, Chap.3M of this publication.

# Selection of cameras

7. Only one camera may be brought into operation at a time. Selection of the required camera is via a double-pole, 3position switch located on the camera control panel. The switch, labelled FORWARD - OFF - AFT, serves to prepare the camera for operation by causing the selected cupola to extend. When fully extended an indicator, adjacent to the selector switch, will show OPEN and the aircraft 28 volt d.c. supply will be connected to the camera control circuit.

8. In all cases, other than day vertical photography, provision is made whereby camera operation may be initiated by remote control i.e., by the bomb firing switches at the first and second pilot's, navigator's and air bomber's stations.

### Camera heating

9. Heating for the cameras is provided for by the inclusion in each cupola of a 2-pin socket supplied from the aircrafts 28-volt d.c. supply and controlled from a switch on the camera control panel. Camera heater mats are connected to the sockets. Thermostats connected into the heater circuits ensure that temperature conditions remain stable. To prevent misting of camera windows, hot air from the No.3 heater unit is ducted to the cupolas (Sect.3, Chap.8).

#### DAY VERTICAL PHOTOGRAPHY

10. From Table 1 it will be seen that a camera, Type F24, in conjunction with a control unit, Type 35, No.8A is used for day vertical photography. The camera is fitted to its mounting in the aft cupola in the manner described in A.P.1355C, Vol.1. The control unit is mounted on its wedge plate on the tactical navigator's panel. The supply plug is connected to the 3-pole supply socket on the control unit and the

inter-connecting loom from the camera, Type 24 connected to the 5-pole socket on the control unit.

### Control unit, Type 35, No.8A

11. The camera control unit, Type 35, No.8A, consists of an electrically driven chronometric switch mechanism which may be set to operate the camera at predetermined regular intervals by completing the camera operating solenoid circuit. Provision for single exposures is also provided for by a manually operated pushswitch.

### **Circuit** operation

12. The camera is prepared for operation by selecting the camera doors control switch to AFT. Reference to fig.3 will show that a 28-volt d.c. supply from fuse BS9 will be applied across terminals 2-3 of the switch to pin 1 of the 3-pin supply plug on the control unit, Type 35, No.8A. This point is common to the control unit motor, the red warning lamp, the camera release solenoid and the camera contact disc. Terminals 2-3 of the switch also connect the supply to the coil of relay No.345, but since remote control of the camera is not required for this role, this relay plays no part in the control of the cameras. A 28-volt d.c. supply across terminals 5-6 of the control switch will be fed to the camera doors valve solenoid, which opens the supply line to a pneumatic jack. The cupola is extended and a micro switch will be operated to make across contacts A-C which will connect the supply to the indicator on the camera control panel at the tactical navigator's station.

13. If the control unit main switch is now closed, the circuit through the control unit motor is completed, the earth return being through the switch and pin 2 of the control unit supply plug. As the



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Fig.3 Control circuit-day/night vertical photography RESTRICTED motor rotates the camera "operating" and "warning" contacts are periodically operated, the "warning" contacts to complete the circuit to the red lamp, and the camera "operating" contacts to complete the circuit through the Type F24 camera release solenoid. The camera contact disc is moved and the spring contact arms (marked A-B for ease of reference), switch the 28-volt d.c. supply to the camera motor and the green lamp. The camera motor now drives the contact disc. When the tongue on the contact disc engages with the third spring contact arm (C), a supply is connected via pin 3 of the 5-pin plug to the counter solenoid. The cycle is completed when spring contact arm B again coincides with the slot in the contact disc, thus cutting off the supplies to the camera motor and the green lamp.

Since the control unit motor will 14. continue to run as long as the main switch is closed, the above sequence will be repeated each time the camera "operating" contacts are made. To stop the camera, the control unit main switch is opened to break the supply to the motor. Alternatively, if the camera doors control switch is operated to OFF, the supply to the control unit is broken and camera operation stopped. At the same time, the cupola will be retracted due to the deenergising of the camera doors control valve. When the cupola is retracted the micro switch contacts A-C will open to cut off the supply to the camera doors indicator.

15. If the camera is to be used for single exposure, then the control unit motor and interrupter contacts need not be brought into operation. The control unit embodies a single exposure pushswitch. When pressed, this switch completes the circuit through the camera release solenoid which moves the contact disc so that contact arms A-B switch on the supply to the camera motor and to the green lamp. The push-switch may then be released. Operation of the camera is terminated as before when contact arm B ' coincides with the slot in the contact disc. The sequence is repeated each time the single exposure push-switch is pressed.

#### NIGHT VERTICAL PHOTOGRAPHY

16. The installation is prepared for night vertical photography by fitting a control unit, Type 35, No.20A, in place of the Type 35, No.8A. The two 2-pin plugs (F2549 and F2559), coloured red and yellow, should be connected in addition to the 3-pin supply plug and the 5-pin interconnecting plug.

#### Control unit, Type 35, No.20A

17. This control unit is fitted to meet the requirements of bomb strike night photography. The control when connected into the bomb firing circuits starts its timing cycle immediately the bombs and flash are released, the circuit to the camera operating solenoid being completed and a frame wound into position at the same time.

18. When desired the control may be started by the main on-off switch on the control unit.

#### **Circuit** operation

Selection of the camera doors con-19. trol switch to AFT will prepare the camera circuit by extending the cupola and connecting the 28-volt d.c. supply to the control unit in the manner already described (Para.12 and 13) and also to relay contacts 342/1 via contacts A-C of the door micro switch. The selection also connects a supply to the coil of relay No.345 so that relay contacts 345/1 close to prepare the circuit for remote control of the camera. The photo-flash master switch on the camera control panel must be switched on to connect a 28-volt d.c. supply from fuse BS12 to the coil of relay No.346 and the bomb doors opened to

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supply the coil of relay No.347 from fuse CC10 via contacts 2-3 of the bomb door micro switches. Relay contacts 346/1 and 347/1 will close to prepare the camera flares circuit.

20. To set the camera in motion any one of the bomb release switches is pressed. A supply from fuse CG2, 8, 9 or 10 (depending on which release switch has been pressed), will energise relay No.342 to close contacts 342/1 and connect a supply from fuse BS9 through relay contacts 345/1 to pins 2 of the yellow and red plugs on the control unit, Type 35, No. 20A. The control unit release solenoid is energised to set in motion the control unit mechanism, at the same time the supply via pin 2 of the yellow plug, relay contacts 346/1 and 347/1 is connected to the camera flares auto-selector to discharge one flare. Whilst the bomb release switch is pressed the red lamp is switched on.

Having initiated the camera control 21. sequence, the bomb firing switch need no longer be pressed since the control unit will be held in for one cycle of operation in the manner described in A.P.1355C, Vol.1 (2nd Edn.) Sect.20. During this period, four pulses are passed to the camera release solenoid resulting in four sequences of camera operation similar to those described in para.13. The cycle is terminated after the fourth sequence when the main switch on the control is opened by the sequential operation of the control switch mechanism. One complete cycle will be repeated each time the bomb firing switch is pressed.

22. When the camera is no longer required, the camera doors control switch is operated to the OFF position. The cupola will retract and the camera control circuits will be isolated.

23. Detailed information on the construction and operation of the control unit, Type 35, No.20A is contained in A.P. 1355C, Vol.1 (2nd Edn.) Sect.20.



Fig. 4 Control circuit - day oblique photography **RESTRICTED** 

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# DAY OBLIQUE PHOTOGRAPHY

24. For this role the Type F24 camera is operated in conjunction with a control unit, Type 35, No.40 or a control unit Type 48.

# Control unit, Type 35, No.40

25. The Type 35, No.40 camera control unit may be started remotely from the bomb firing circuit and operates the camera for a sequence of four fixed interval exposures during a bombing run and prevents wastage of film during training sorties. Operation is similar to the Type 35 No.20A described in para.17.

# Control unit, Type 48

26. The Type 48 control unit has been designed so that exposure sequence is limited only by the rate at which the camera gear box will function with the shortest possible time interval between exposures.

27. The camera is installed in the forward cupola and the control unit mounted on the wedge plate on the tactical navigator's panel. To bring the camera to its working position, the camera doors selector switch is selected to FORWARD. This results in the forward cupola being extended, and the cupola door micro switch is operated to connect the 28-volt d.c. supply from fuse BS9 to the camera doors indicator.

28. Initiation of camera operation is by means of a start/stop switch on the control unit, Type 48: through the medium of the bomb release push-switches. If starting is to be by remote control, the red plug will have to be connected to the control unit.

29. The Type 48 control unit consists essentially of two relays, a start/stop switch, a stop push-switch and a green lamp. One of the relays is a start relay

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for use with a remote control switch and the other a slugged relay which is necessary to provide the delay essential for the correct operation of the camera shutter. Details of the operation of this control unit are contained in A.P.1355C, Vol.1 (2nd Edn.) Sect.20.

### Circuit operation

30. Reference to fig.4 will show that, in selecting the FWD position on the camera doors selector switch, a 28-volt, d.c. supply from fuse BS9 is applied to pin 1 of the control unit, Type 48, supply plug and to the fwd. camera doors electropneumatic control valve. At the same time relay No.345 is energised to open contacts 345/2 and close contacts 345/1. The cupola is extended in the normal manner and the fwd. door micro switch is operated to energise the camera doors indicator on the camera control panel.

31. When any one of the bomb release switches is pressed a supply from fuse CG2, 8, 9 or 10, (depending on which bomb release switch has been pressed), will energise relay No.342. Contacts 342/1 close to complete the circuit from fuse BS9 via the camera doors selector switch, the doors micro switch and relay contacts 345/1 to pin 2 of the red plug on the control unit, Type 48. The start relay will thus be energised to initiate camera operation.

32. The bomb release switch may then be released, since the start relay will remain energised due to a supply across its own contacts and the contacts of the stop push-switch from fuse BS9 via terminals 5-6 of the camera doors selector switch and pin 1 of the control unit supply plug.

33. As soon as the start relay is energised, the camera will be operated due to the action of the camera release solenoid. The solenoid will be energised by a supply from pin 1 of the control unit supply plug, pin 1 of the 5-pin plug, pin 1 of the camera-5-pin plug and through the release coil to earth via pin 4 of the camera and control unit 5-pin plugs, normally closed contacts of the slugged relay, the now closed contacts of the start relay and pin 2 of the control unit supply plug.

34. The initial movement of the contact disc due to the influence of the camera release solenoid will connect the supply across spring contact arms A and B. A supply is then available across the terminals of the motor which maintains the drive on the contact disc. At the same time a supply via pin 5 of the camera and control unit 5-pin plug will be fed to the green lamp and to the main coil of the slugged relay. The main contacts of the slugged relay are opened to interrupt the current through the camera release solenoid and the auxiliary contacts are closed to complete the circuit through the slug coil of the slugged relay.

35. When the contact disc has been turned through one revolution, spring contact arm B will again coincide with the slot in the disc. The supply to the motor green lamp and the main coil of the slugged relay is thus cut off. Re-energising of the camera release solenoid is delayed due to the action of the slugged relay. Cutting off the main supply to the main coil induces in the slug coil an e.m.f. so that the relay armature is held for a short period of time and then releases to close the main contacts and again completes the camera release solenoid circuit to start another cycle of operations.

36. Continued functioning of the camera is determined by the start relay. If the stop switch is pressed, the hold circuit to this relay is interrupted. The main contacts open to prevent re-energising of the camera release solenoid at the end of the cycle and the opening of the auxiliary contacts ensures that the relay coil will not be re-energised when the stop switch

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Fig. 5 Control circuit - night oblique photography Mod. 1375 P **RESTRICTED**  is released. If the camera doors selector switch is operated to the OFF position the camera is stopped and the cupola will be retracted.

## NIGHT OBLIQUE PHOTOGRAPHY

37. The camera, Type F97 is used for night oblique photography. The earlier Type F91 camera may also be used. The aircraft wiring installation makes provision for either type, but in the following text only the operation of the Type F97 camera will be described. Details of the F91 camera installation will be found in A.P.4267C, Vol.1, Book 2, Sect.5, Chap.2, Group 6.

38. Since the F97 camera requires the use of photo-flashes to produce satisfactory results, it is used in conjunction with a flash discharger fitted in the roof at the signal discharger station. Release of the photo-flashes is controlled by a distributor, Type 9, Mk.2 at the signal discharger panel and a control unit fitted at the camera control panel.

#### Circuit operation

39. As a preliminary to night photography it is essential that the photoflash master switch is switched ON.

40. The camera, Type F97, will be fitted in the forward cupola as an alternative to the F24 camera. The cupola is prepared for camera operation by operating the camera doors selector switch to FWD. the resulting sequence then being as follows:-

 Fuse BS9 feeds the pneumatic valve via terminals 5-4 of the camera doors selector switch, to open the forward camera doors.

- (2) The camera doors micro switch will make to connect the supply to the camera doors indicator and prepare the circuit to the Type C relay unit.
- (3) The supply across terminals 2-1 of the camera doors selector switch prepares the camera for remote control.
- (4) With the photoflash master switch selected to ON, a 28-volt d.c. supply from fuse BS12 will be fed to terminal 2 of the Type C relay unit and to pins A and C of plug S on the distributor, Type 9.

41. Two methods may be employed to switch on the camera. The control unit is fitted with a 3-position switch identified ON - OFF - REMOTE. Local control is effected at the ON - OFF positions. Remote control is from any one of the bomb firing switches as follows:-

- (1) Control unit 3-position switch at REMOTE.
- (2) Operation of any one bomb firing switch energises relay No.342.
- (3) Closing of relay contacts 342/1 energises the coil of the Type C relay unit from fuse BS9, camera doors micro switch, closed relay contacts 345/2, and the closed relay contacts 405/1.
- (4) Contacts of the Type C relay unit now being closed provide a holdon supply from the photoflash master switch and the bomb release switch may be disengaged.
- (5) A supply also across the Type C relay contacts energises relay No.348 to close contacts 348/1 to

start the camera motor via the REMOTE position on the F97 control unit.

42. The camera motor will run at a rate determined by the control unit setting and in doing so drives a cam-shaft. As this rotates, a series of cam-operated contacts are made or broken. Each time the photoflash contacts are closed, a pulse from the positive supply, via pin C of the 12-pin plug, pin D of the 4-pin plug and pin A of plug R on the Type 9 distributor will be fed to the coil of relay R. Contacts R2 close to connect a 28-volt d.c. supply from fuse BS12 via the photoflash master switch and pins A and C of plug S on the distributor, to contact No.1 of the uniselector. After three pulses this is connected, via pin D of plug B1, to the flash discharger and one flash is released. A flash will be released with each of the subsequent five pulses from the camera.

43. After six more pulses the supply is connected to plug B4, poles A, B and C, to energise relay No. 405. Contacts 405/1 open to break the earth to the coil of the relay, Type C. Relay No. 348 will be de-energised, contacts 348/1 open to cut off the supply to the F97 camera control unit and the camera motor will stop.

44. The camera may be stopped at any time by switching off the switch on the control unit, by switching off the camera doors selector switch, or by switching off the photoflash master switch, when the coil of the relay unit Type C will be de-energised with the consequent deenergising of relay No.348. As before opening of relay contacts 348/1 stops the camera motor.

# A.P.101B-1703-1B3, Sect.7, Chap.5A A.L.25, Oct.68

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# General

General

The servicing of cameras and 45. control units should be carried out in accordance with the instructions contained in the relevant sections of A.P.1335C Vol.1, (2nd. Edn.). All cables, switches, relays, etc., should be checked in accordance with the Servicing Schedule. Where a component fails to give a satisfactory performance, it should be bench tested and adjusted in the manner described in the relevant Book of the A.P.4343 series.

46. Camera control units are mounted

on wedge plates on the camera control

# SER VICING

Setting of the camera doors micro switches is contained in Book 1, Sect.3, Chap.8 of this publication.

## WARNING ...

It requires an extremely small electric current to fire the 1.75 in. photoflash The explosion of a precartridae. maturely fired photoflash is extremely dangerous and probably lethal, par-

# REMOVAL AND INSTALLATION

panel at the tactical navigators station and their removal presents little difficulty. Instructions for the installation of the

ticularly since the delay before the explosion is very short. To guard against leakage currents which may fire the cartridge prematurely, frequent tests of the firing circuit should be made with the photoflash master switch on the F97 control unit locked in the OFF position. Ensure that all cables from the socket inside the camera control are clear of the potentiometer windings. Cable looms may be bent back where necessary to ensure adequate clearance.

#### camera mountings are contained in A.P.1355C, Vol.1.

# TABLE 1

#### Correlation of cameras and control units

Role	Camera	Control unit	Cupola
Day vertical	F24	Type 35, No.8A	Aft
Day oblique	F24	Type 40 or 48	Aft
Night vertical (medium level)	F24	Type 35, No.20A	, Aft
Night oblique (low level)	F97	F97	Forward
Night vertical (low level)	F97	F97	Forward

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# TABLE 2

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# Major items of equipment

Item	Туре	A.P.reference		
Camera	F24	A.P.1355C, Vol.1 (2nd Edn.), Sect.1		
Control Unit	35, No.8A			
Control unit	35, No.20A	A.P.1355C,Vol.1(2nd Edn.),Sect.20		
Control unit	40 or 48			
Camera	F97 ]			
Control unit	F97	A.P.1355C,Vol.1 (2nd Edn.),Sect.7		

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A.P. 1018 - 1703 - 183, Sect. 7, Chap.SA A.L. 25, Oct. 68



Fig. 6 Camera doors operation 4 Camera doors control switch - terminal No. correction >

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Fig.7 (1) Cameras and pyrotechnics
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A.P. 101B - 1703 - 183, Sect. 7. Chap. SA A.L. 25, Oct. 68



Fig.7 (2) Cameras and pyrotechnics