GROUP D.7

ALIGHTING GEAR AND AIR BRAKE CONTROL (CODE UC AND AB)

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Introduction

1. This group contains the description and operation, of the alighting gear and air brake control circuits installed in this aircraft, together with information on the servicing required to maintain the equipment in an efficient condition. Routeing and theoretical circuit diagrams are included for both circuits. For a general description of the aircraft electrical system, reference should be made to Groups A.1, A.2 and A.3 of this chapter. Detailed information on the standard items of equipment used will be found in the Air Publications listed in Table 1.

DESCRIPTION

Equipment details *(Alighting gear)*

Electro-hydraulic valve

2. The alighting gear is retracted and extended electro-hydraulically as described in Section 3, Chapter 6 and is also provided with an electrical position indicator, together with a warning lamp, as explained in Section 5, Chapter 2. The flow of hydraulic fluid to the jacks which retract and extend the alighting gear, is controlled by a solenoid-operated, electro-hydraulic control valve, mounted on the front spar in the starboard wheel bay. This valve is controlled by a twin, interlock push-switch unit, which is situated on the port instrument panel.

Selector switch

3. The selector switch unit, consisting of a set of interlocked push-switches is

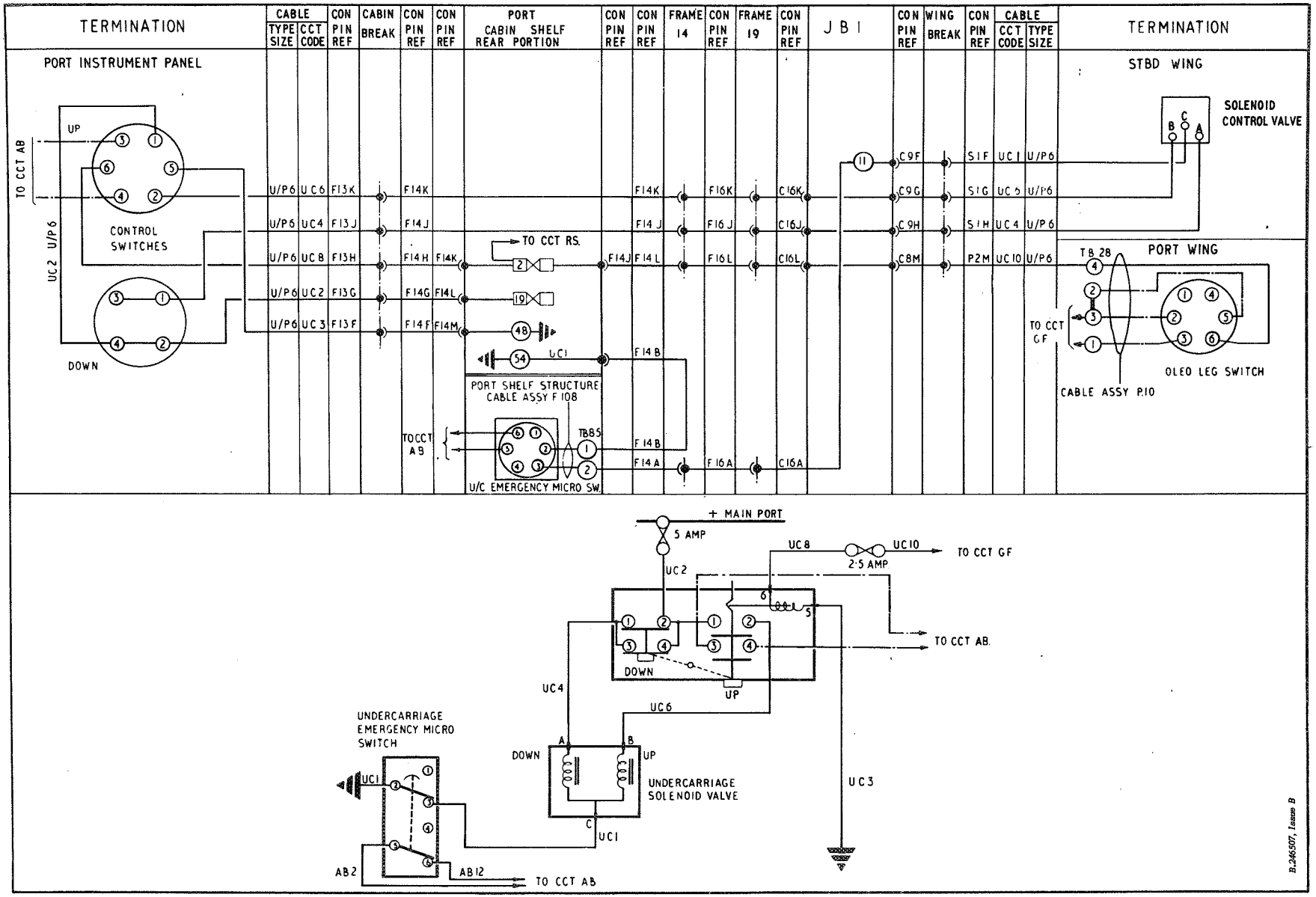

Fig.1 Alighting gear control (routeing and theoretical)

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designed so that operation of one switch automatically ejects that previously used. The upper push-switch button of the unit is marked UP and is used to retract the alighting gear. This switch incorporates a solenoid-operated safety lock. While the solenoid is de-energized, the lock prevents the operation of the undercarriage UP pushbutton. The supply for energizing the solenoid and freeing the lock is routed via compression switches on the port and starboard oleo legs. While the aircraft is on the ground, both compression switches are open and the solenoid is de-energized. The switches are in series and, therefore, UP cannot be selected until the aircraft is fully airborne with no weight on either leg. In an emergency this lock can be overridden by turning the knurled ring round the UP button and then pressing the button. The upper switches also control the supply to the air brake circuit *(para.10)* so that this supply is broken until the alighting gear is retracted thus rendering it impossible to extend the air brake while the alighting gear is lowered.

TABLE 1

Equipment type and Air Publications reference

Equipment	Air Publications
Alighting gear control	
◀ Selector switch, Dowty Type C.5182Y, Mk.2 or Mk.3D *(Mod.991)* ▶	A.P.4343C, Vol.1, Book 1, Sect.1
Leg compression and emergency microswitches Dowty Type 4A	A.P.4343C, Vol.1, Book 1, Sect.2
Solenoid control valve, Dowty Type 08817Y/A.06	A.P.1803D, Vol.1, Book 3, Sect.8
Air brake control	
Solenoid control valve, Dowty Type 08818Y/A.02 and 08818Y/A.03	A.P.1803D, Vol.1, Book 3, Sect.8
Pressure switch, Type 5300/2 or 1300	A.P.1275A, Vol.1, Sect.11
◀ Magnetic indicator, Type C.5165Y or A.2 ▶	A.P.113F - 0615 - 1
Microswitch, Type C.1831Y, Mk.102C *(U/c emergency valve)* Microswitch, Type 1A	A.P.4343C, Vol.1, Book 1, Sect.2
Tumbler switch, D.P./C.O., Type XD492 No.1 *(Test)*	A.P.4343C, Vol.1, Book 1, Sect.1
◀ Relays, Type 9B, No.1, and Type S, No.1 ▶	A.P.113D - 1309 - 1
Control switch *(Part of throttle control unit Type T.1 Mk.2A)*	A.P.1275E, Vol.1, Sect.5

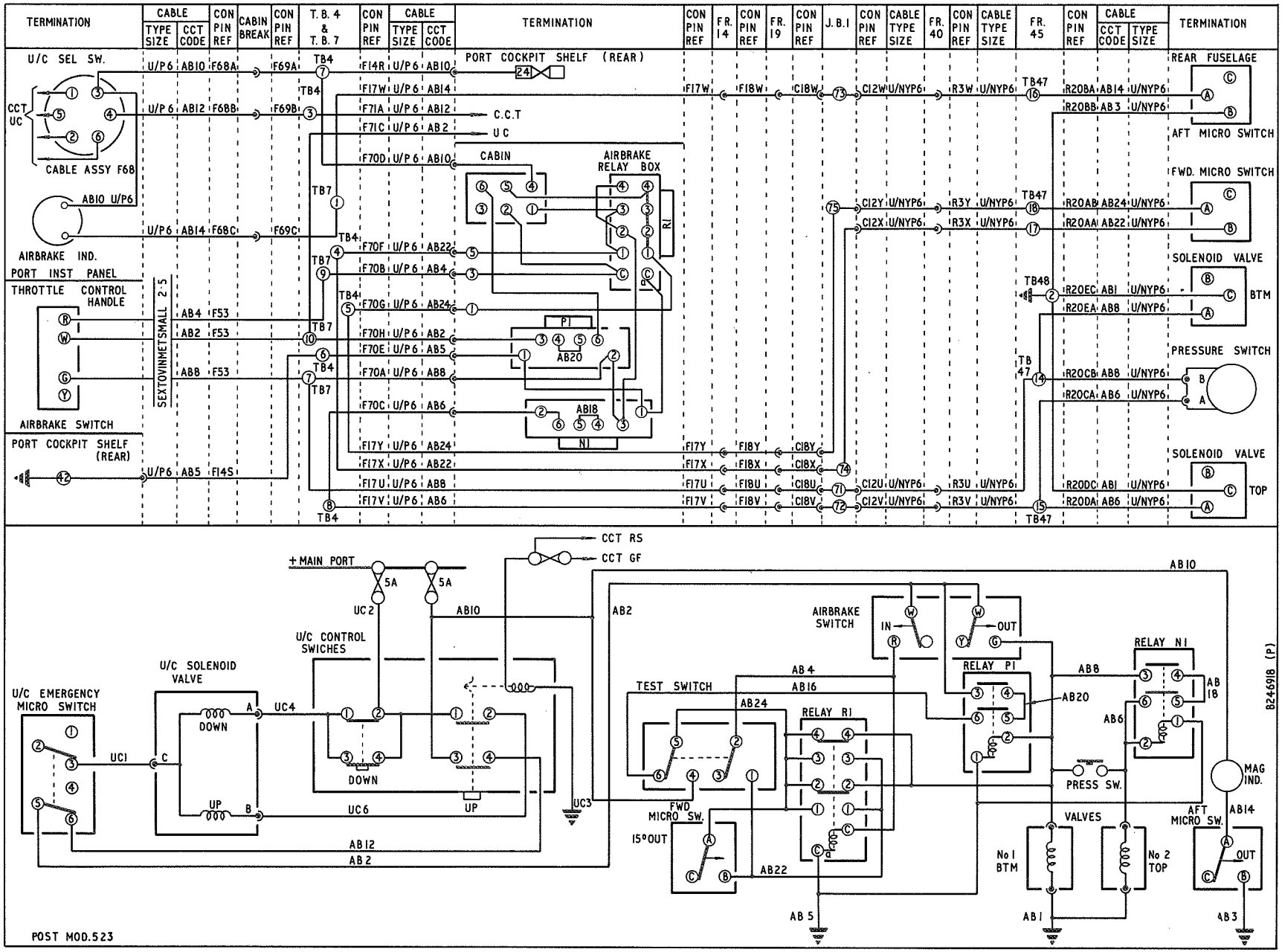

Fig.2. Air brake control (routeing and theoretical)

4. Should the alighting gear be lowered while the air brake is extended, this interconnection will immediately disconnect the supply to the air brake control switch, thereby retracting the air brake. This interconnection is an electrical interlock, to prevent damage to the air brake due to the limited ground clearance and must not normally be used to retract the air brake.

5. The lower push-switch button of the selector unit is marked DOWN. It is not provided with a lock or interconnected with any other circuit, being used only to extend the alighting gear.

Emergency control

6. The supply for the air brake circuit, in addition to being controlled by the alighting gear UP switch, is connected via one pair of contacts of a double-pole microswitch. The earth return of the alighting gear solenoids is routed via the other pair of contacts of this microswitch. When the alighting gear emergency lowering control is used the microswitch is changed over by the emergency air release valve and the air brake circuit and alighting gear solenoids are isolated from the supply. Thus, in emergency operation of the alighting gear, the air brake is retracted as in normal selection of DOWN; in addition, with both alighting gear solenoids de-energized the control valve slide moves to a neutral position to prevent loss of hydraulic fluid.

Operation *(Alighting gear)*

DOWN circuit

7. The diagrams of the circuit *(fig.1)* is shown for the condition when the aircraft is at rest on its alighting gear. From the position of the UP and DOWN push-switches of the selector unit, it will be seen that the DOWN switch is made to energize the down solenoid of the electro-hydraulic control valve, thus maintaining pressure in the down side of the hydraulic jacks. Due to the weight of the aircraft on its alighting gear, the compression switch contacts are open and the solenoid lock of the UP switch is de-energized. The lock is therefore, engaged to prevent the UP switch from being operated.

UP circuit

8. When the aircraft is airborne, its weight is taken off the alighting gear and the compression switch contacts close to supply the solenoid of the UP switch lock. The solenoid is thus energized and releases the lock, which allows the UP switch to be operated. Due to the interlock between the switches, operation of the UP switch will automatically release the DOWN switch, the contacts of which will open and de-energize the down solenoid of the electro-hydraulic control valve.

9. As the contacts of the UP switch close, the supply to the up solenoid of the control valve is completed. This energizes the solenoid which allows the hydraulic pressure to move the slide within the valve in such a direction as to supply hydraulic pressure to the up side of the hydraulic jacks thereby retracting the alighting gear.

Emergency operation

10. In emergency, the alighting gear may be lowered by introducing high pressure air into the hydraulic system. The emergency control is mounted on the cabin port shelf and is pulled to operate the alighting gear emergency air release valve When this valve moves the supply to the air brake circuit is disconnected by the operation of a microswitch which also disconnects the earth return of the alighting gear solenoids. In these conditions, the air brake is retracted and the alighting gear solenoids are both de-energized. The slide of the alighting gear control valve adopts a neutral position closing both ports and preventing loss of hydraulic fluid. The emergency system is described in Sect.1, Chap.3 and the hydraulic system is described in Sect.3, Chap.6.

Equipment details *(Air brake)*

Electro-hydraulic valves

11. The electrical control circuit for the hydraulically operated air brake is actuated by a thumb switch, marked IN and OUT, incorporated in the throttle twist grip. This switch controls two electro-hydraulic solenoid control valves located in the rear fuselage on the port side adjacent to frame 50, via a relay box and a hydraulic pressure switch. The relay box, which contains three control relays and a spring return test switch, is located in the cabin just aft of the hood control switch box. The hydraulic pressure

switch is mounted adjacent to the solenoid valves in the rear fuselage.

Position indicator

12. To indicate the position of the air brake, a magnetic indicator is installed on the port instrument panel adjacent to the undercarriage warning lamp. This instrument gives a white indication when the air brake is extended and black when retracted, and is controlled by a microswitch situated on a bracket attached to frame 47.

Air brake and alighting gear interlock

13. To prevent damage due to the limited ground clearance, the air brake control circuit is interconnected with the alighting gear circuit so that it is impossible to extend the air brake by the normal controls, while the air brake is extended, the air brake will automatically retract due to this interconnection.

14. The installation may, however, be tested on the ground while the alighting gear is down, by operation of the spring return test switch on the relay box. Operation of this switch, in conjunction with a microswitch located adjacent to the air brake port hinge, will permit partial extension and immediate retraction of the air brake sufficient to give indication on the magnetic indicator in the cabin that the system is operating satisfactorily.

Operation *(Air brake)*

OUT circuit

15. When the alighting gear is retracted, contacts 3 and 4 of the alighting gear control UP switch are made and supply the air brake control switch. Operation of the air brake control switch to the OUT position will now energize the solenoid of the main electro-hydraulic control valve *(No.1)* and hold-on relay P.1. A supply is also made to the hydraulic pressure switch, the contacts of which are open at this time. After the control switch is released, the circuit to this solenoid valve is maintained via the closed contacts 3,4,5 and 6 of relay P.1, contacts 5 and 6 of the test switch and contacts 2 and 4, of the de-energized relay R.1.

16. The air brake jack will now extend to put the air brake out, by differential action at high speed, until the rise in hydraulic pressure due to the air load on the air brake causes the hydraulic pressure switch to operate and close its contacts. The closing of these contacts completes the supply to the solenoid of the high speed electro-hydraulic control valve *(No.2)* and relay N.1. This circuit is maintained, once the pressure switch has operated, via contacts 3, 4, 5 and 6 of the hold-on relay N.1. The jack continues to extend to put the air brake out, but now at full power normal speed, until the full out position is reached. When the air brake starts to extend, the aft microswitch completes the earth return for the magnetic indicator which is then energized by a supply from the circuit fuse and shows white to indicate that the air brake is extended.

Air brake and alighting gear interlock

17. If the alighting gear is selected down, while the air brake is extended, the UP switch of the alighting gear control will immediately break contacts 3 and 4 to disconnect the supply to the air brake control switch and de-energize the electro-hydraulic control valves and hold-on relays, thereby automatically retracting the air brake. Air brake retraction must not normally be obtained by selecting alighting gear down.

IN circuit

18. When the air brake control switch is set to the IN position, relay R.1 is energized to open the circuit to the hold-on relays P.1 and N.1, thereby de-energizing the solenoids of the electro-hydraulic control valves. With the control valves de-energized, the air brake jack will retract and bring the air brake to the IN position. When the air brake is fully in, the aft microswitch contacts are open thus de-energizing the magnetic indicator, which will show black, to indicate that the air brake is retracted.

TEST circuit

19. The operation of the spring return test switch, used to test the air brake installation on the ground while the alighting gear is down, is such that when it is placed in the ON position, current is fed via the circuit fuse, through contacts 4 and 3 of relay R.1, to energize the solenoid of the main electro-hydraulic control valve. The air brake jack will now extend to put the air brake out until, at a position

of approximately 15 deg. out, the forward microswitch is operated by the air brake hinge arm. This microswitch then completes the supply via contacts A and B, to the coil of relay R.1, via contacts 1 and 2 in the test switch. When energized, this relay breaks the supply to the electro-hydraulic control valve and the air brake immediately retracts.

20. Relay R.1 is maintained in the energized state, by a hold-on circuit through its own contacts, until the test switch is released and returns to the OFF position. As the air brake extends, the magnetic indicator is energized by the operation of the aft microswitch, in a manner similar to that described in para.14, to provide indication that the installation is operating satisfactorily.

SERVICING

General

21. For general servicing of the aircraft electrical system, reference should be made to Group A.1 of this chapter. Apart from keeping all the components clean and carrying out the normal routine tests of security and serviceability, the only other servicing necessary is the adjustment of the microswitches, to ensure the correct operation of the installation and magnetic indicator as described in Section 3, Chapter 4, followed by the functioning checks of the installation as described in Section3, Chapter 6. The electrical tests of the electro-hydraulic control valves are described in the appropriate Air Publications listed in Table 1.

REMOVAL AND ASSEMBLY

General

22. Once access has been obtained, the removal and assembly of the components forming the alighting gear and air brake control circuits should present no difficulty. The location and access to all the components is indicated in Group A.3.