

## GROUP D.7

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

## LIST OF CONTENTS

	Para.
Equipment employed . . . . .	1

## DESCRIPTION

Alighting gear control	
Electro-hydraulic valve ... ..	2
Selector switches . . . . .	4
Operation	
DOWN circuit ... ..	7
UP circuit ... ..	8

## Equipment employed

1. The major components employed in the alighting gear and air brake control circuits are listed below, together with the appropriate Air Publications to which

## Alighting gear control

Selector switch, Dowty Type C.5182Y, Mk 2D or Mk.3D (Mod.991) ... ..	A.P.4343C, Vol.1, Book 1, Sect. 1
Leg compression and emergency micro switches, Type 4A ... ..	A.P.4343C, Vol.1, Book 1, Sect. 2
Solenoid control valve, Dowty Type 08817YA06 ... ..	A.P.1803D, Vol.1, Book 3, Sect. 8

## Air brake control

Solenoid control valve, Dowty Type 08816YA03 & 08818YA02 ... ..	A.P.1803D, Vol.1, Book 3, Sect.8
Pressure switch, Type T.P.5566 ... ..	A.P.1275A, Vol.1, Sect.11
Magnetic indicator, Type C.5165Y Mk.1 ... ..	A.P.4343E, Vol.1, Sect.18
Micro switches, Type 1.A ... ..	A.P.4343C, Vol.1, Book 1, Sect.2
Test switch, double-pole changeover spring return one position Type No.3 (Ref.5.CW/6441) ..	A.P.4343C, Vol.1, Book 1, Sect.1
Relays, Type 9B. No.1 ... ..	A.P.4343C, Vol.1, Book 2, Sect.3

Air brake control	
Electro-hydraulic valves... ..	10
Position indicator .. ..	11
Air brake and alighting gear interlock ... .	12
Operation	
OUT circuit ... ..	14
Air brake and alighting gear interlock .. ..	16
IN circuit ... ..	17
TEST circuit ... ..	18

reference should be made for a detailed description and the necessary servicing required to maintain them in an efficient condition.

Para.

## SERVICING

General ... ..	20
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## REMOVAL AND ASSEMBLY

General .. ..	21
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## LIST OF ILLUSTRATIONS

	Fig.
Alighting gear control (routeing and theoretical) ... ..	1
Air brake control (routeing and theoretical) ... ..	2

## DESCRIPTION

## Alighting gear control

## 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 inter spar rib D in the starboard wheel bay. This valve is controlled by a twin interlock push-switch unit, which is situated on the port instrument panel.



3. The earth return for the control valve solenoid is taken through the closed contacts of a micro switch, which is operated to open circuit the earth return when the alighting gear emergency lowering control is used. This ensures that the valve is de-energized when emergency action is taken, to prevent the loss of hydraulic fluid via the jettison valve in the hydraulic emergency system. With the valve solenoid de-energized, only the fluid in the lower ends of the jacks will be jettisoned thus preventing the possibility of manual reversion of the powered flying controls occurring due to loss of hydraulic fluid.

#### *Selector switch*

4. The selector switch unit, consisting of a set of interlocked push-switches, is 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 safety lock, which is controlled by a compression micro switch on the port undercarriage leg, to prevent undercarriage UP selection while the aircraft is on the ground. In an emergency these locks 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.

5. Should the alighting gear be lowered while the air brake is extended, this inter-connection will immediately disconnect the supply to the air brake control switch, thereby retracting the air brake. This inter-connection 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.

6. 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.

#### *Operation*

##### *DOWN circuit*

7. The diagram 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 inter-lock 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.

#### *Air brake control*

##### *Electro-hydraulic valves*

10. 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.

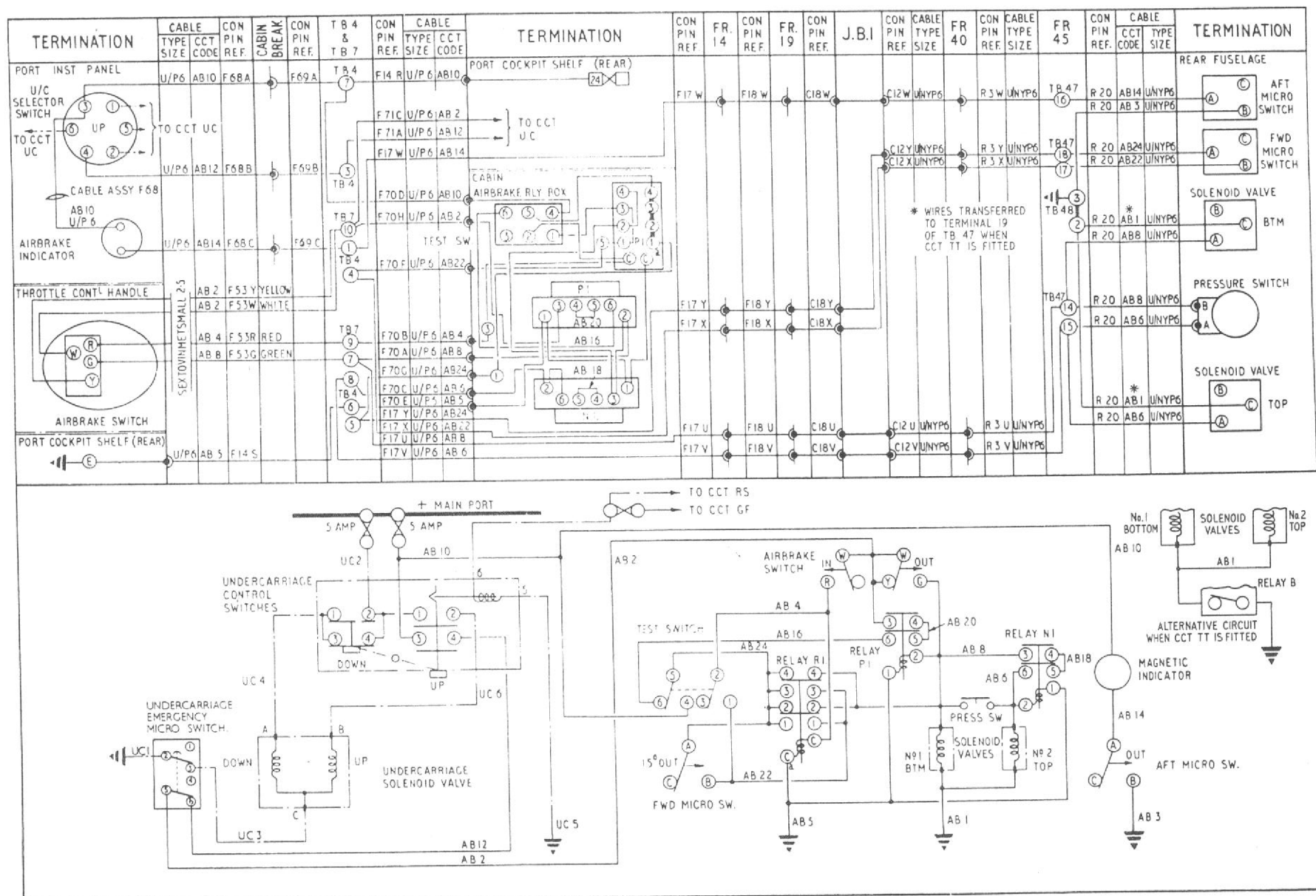


Fig.2. Air brake control (routing and theoretical)

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#### *Position indicator*

11. 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 micro switch situated on a bracket attached to frame 47.

#### *Air brake and alighting gear interlock*

12. 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 alighting gear is lowered. If the alighting gear is lowered while the air brake is extended, the air brake will automatically retract due to this interconnection. Similar action will also be obtained by the closing of a micro switch, located below the cabin port shelf, which is operated by the alighting gear emergency air valve, when the alighting gear emergency lowering system is used.

13. 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 micro switch 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*

##### *OUT circuit*

14. 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, via the normally closed contacts of the alighting gear emergency air valve micro 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.

15. 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 micro switch 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.

#### *Airbrake and alighting gear interlock*

16. 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. Similar action is also obtained on using the alighting gear emergency lowering system, by the opening of the contacts of the micro switch operated by the emergency air valve. Air brake retraction must not normally be obtained by selecting alighting gear down.

##### *IN circuit*

17. On operation of the air brake control switch 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 micro switch contacts are open thus de-energizing the magnetic indicator, which will show black, to indicate that the air brake is retracted.

#### *TEST circuit*

18. 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 5 of the test switch and contacts 2 and 4 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 micro switch is operated by the air brake hinge arm. This micro switch 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.

19. 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 micro switch, in a manner similar to that described in para.15, to provide indication that the installation is operating satisfactorily.

### SERVICING

#### *General*

20. For general servicing of the 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 micro switches, 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 Section 3, Chapter 6 of this volume. The electrical tests of the electro-hydraulic control valves are described in the appropriate Air Publications quoted in para.1 of this group.

### REMOVAL AND ASSEMBLY

#### *General*

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



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