Group D.7

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

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LIST OF ILLUSTRATIONS

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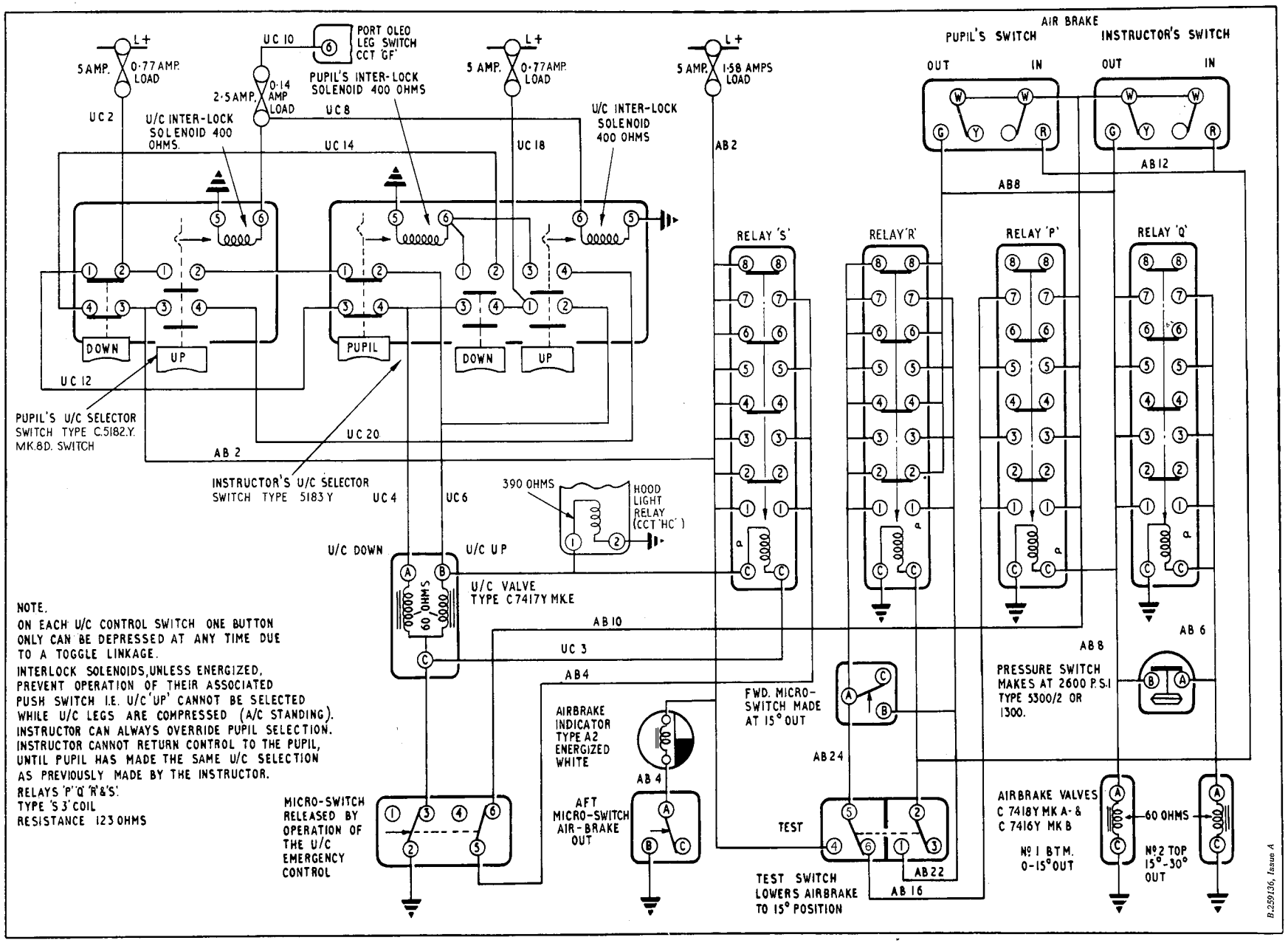

Fig. 1. Alighting gear and air brake control (theoretical)

Introduction

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

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Alighting gear control	
Instructor's selector switch, Dowty Type C.5183Y. / Pupil's selector switch, Dowty Type C.5182Y, Mk.8D.	... ... A.P.4343C, Vol.1, Book 1, Sect.1.
Leg compression and emergency microswitches, Dowty Type C.1831Y,Mk.2	... A.P.4343C, Vol.1, Book 1, Sect.2.
Solenoid control valve, Dowty Type C.7417Y, Mk.E or 08817Y-A06	... A.P.1803D, Vol.1, Book 3, Sect.8.
Air brake control	
Solenoid control valve, Dowty Type C.7416Y, Mk.B and C.7418Y, Mk.A or 08818Y-A02 and 08816Y-A03	... 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 A.2	A.P.4343E, Vol.1, Book 4, Sect.18.
Microswitches, Type 1.A or Pye Type 430S	... A.P.4343C, Vol.1, Book 1, Sect.2.
Test switch, Pye Type 2082 Ganged	... A.P.4343C, Vol.1, Book 1, Sect.1.
Relays P,Q,R&S, Type S, No.3	...A.P.3232C, Vol.1, Book 2, Sect.3.

DESCRIPTION

Alighting gear control

Electro-hydraulic valve

2. The alighting gear is retracted and extended electro-hydraulically as described in Book 1, Sect.3, Chap.6 and is also provided with an electrical position indicator, together with a warning lamp, as explained in Sect.5, Chap.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 two selector switch units, one being a twin interlock unit, which is situated on the port instrument panel for the pupil's use, the other being a triple unit mounted on the starboard side instrument panel, for the use of the instructor.

3. The earth return for the control valve solenoid is taken through the closed contacts of a microswitch, 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.

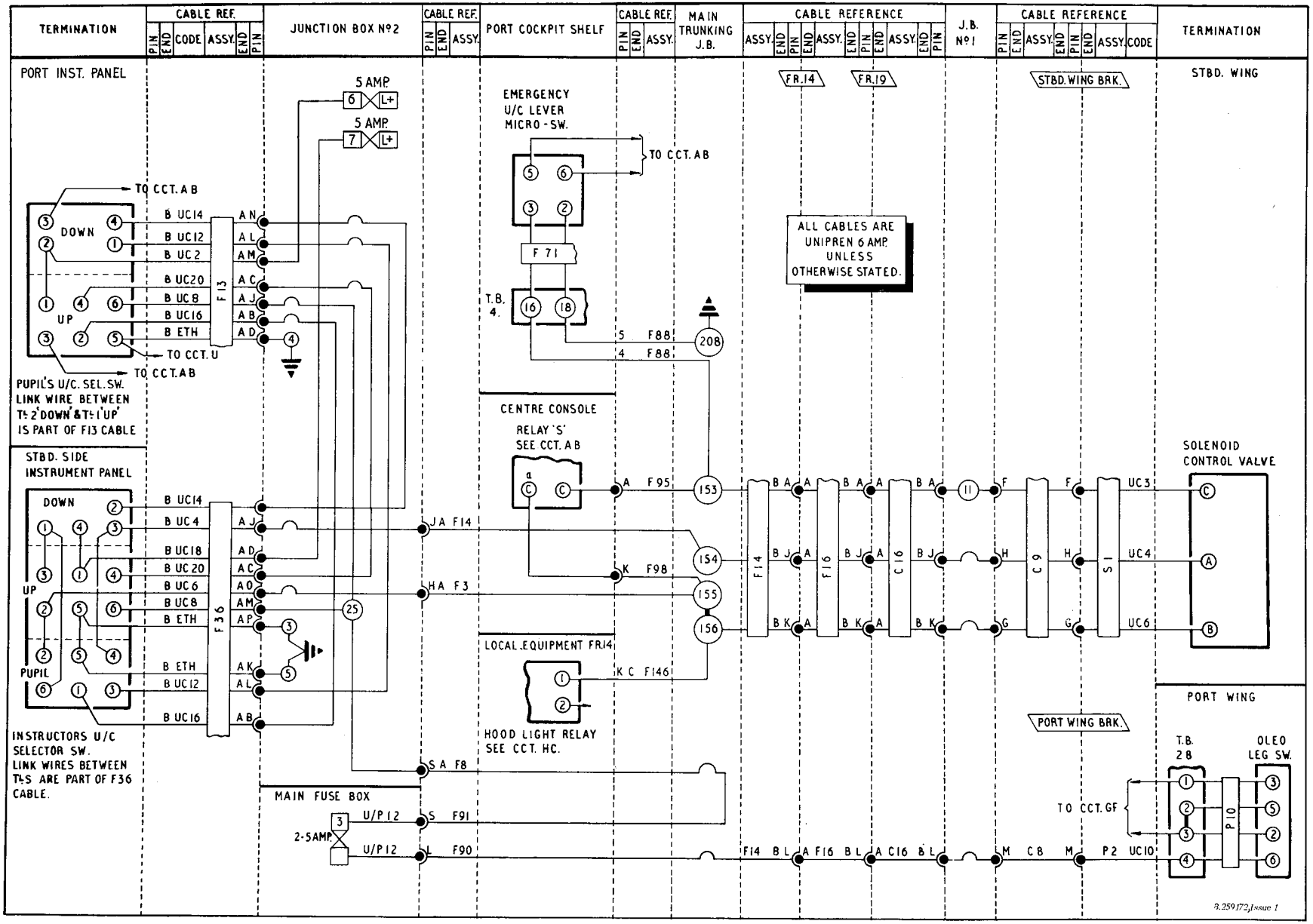

Fig.2. Alighting gear control (routeing)

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Selector switches

4. Each selector switch unit, consisting of a set of interlocked push-switches, is designed so that operation of any one switch automatically ejects that previously used. The upper push-switch button of both the pupil's and the instructor's unit is marked UP and is used to retract the alighting gear. Each of these switches incorporates a solenoid safety lock, which is controlled by a compression microswitch 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.14)* 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 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.

6. The lower push-switch button of the pupil's selector unit and the centre push-switch button of the instructor's unit are both marked DOWN. They are not provided with locks and must be pressed to extend the alighting gear. The lower push-switch button of the instructor's selector switch unit, is marked PUPIL and is provided as an instructor's override enabling him to counteract any selection made by the pupil. This push-switch is also provided with an electrical safety lock which is so connected that the switch will not operate, to give the pupil control, unless the switches in the pupil's selector unit are in the same condition as those in the instructor's selector unit at the time of operation.

Operation

DOWN circuit

7. The diagram of the circuits *(fig.1)* is shown for the condition when the aircraft is at rest on its alighting gear. From the position of the selector switches it will be seen that the pupil has control, and that contacts 2-1 of the pupil's DOWN switch are closed. This energizes the down solenoid of the electro-hydraulic control valve, via the PUPIL switch of the instructor's selector unit, thus maintaining pressure in the down side of the hydraulic jacks.

8. Due to the weight of the aircraft on its alighting gear, the compression switch contacts are open and the solenoid locks of both the pupil's and instructor's UP switches are de-energized. The locks are, therefore, engaged to prevent the UP switches from being operated. A supply is also available at contact 2 of the DOWN switch in the instructor's selector unit, via contacts 3-4 of the pupil's DOWN switch, in preparation for energizing the solenoid lock of the PUPIL switch when the instructor's DOWN switch is operated.

9. Should the instructor's DOWN switch now be operated, the PUPIL switch will automatically release, due to the mechanical interlock between the switches, and break the circuit from the pupil's selector switch to the down solenoid of the control of the control valve, which will, however, be maintained in the energized state by a feed from the instructor's DOWN switch, The solenoid lock of the PUPIL switch will be energized by the supply from the pupil's DOWN switch permitting the PUPIL switch to be operated again. The instructor now has full control of the alighting gear, but may pass control back to the pupil at any time, providing that the instructor's and pupil's switches are in the same condition.

UP circuit

10. When the aircraft is airborne, its weight is taken off the alighting gear and the compression switch contacts close to supply the solenoid of both UP switch locks. These solenoids are then energized and release the locks, which allow either UP switch to be operated. The pupil's switch unit, is however, out of circuit when the instructor has control due to the position of the PUPIL switch. Due to the interlock between the switches, operation of the UP switch will automati-

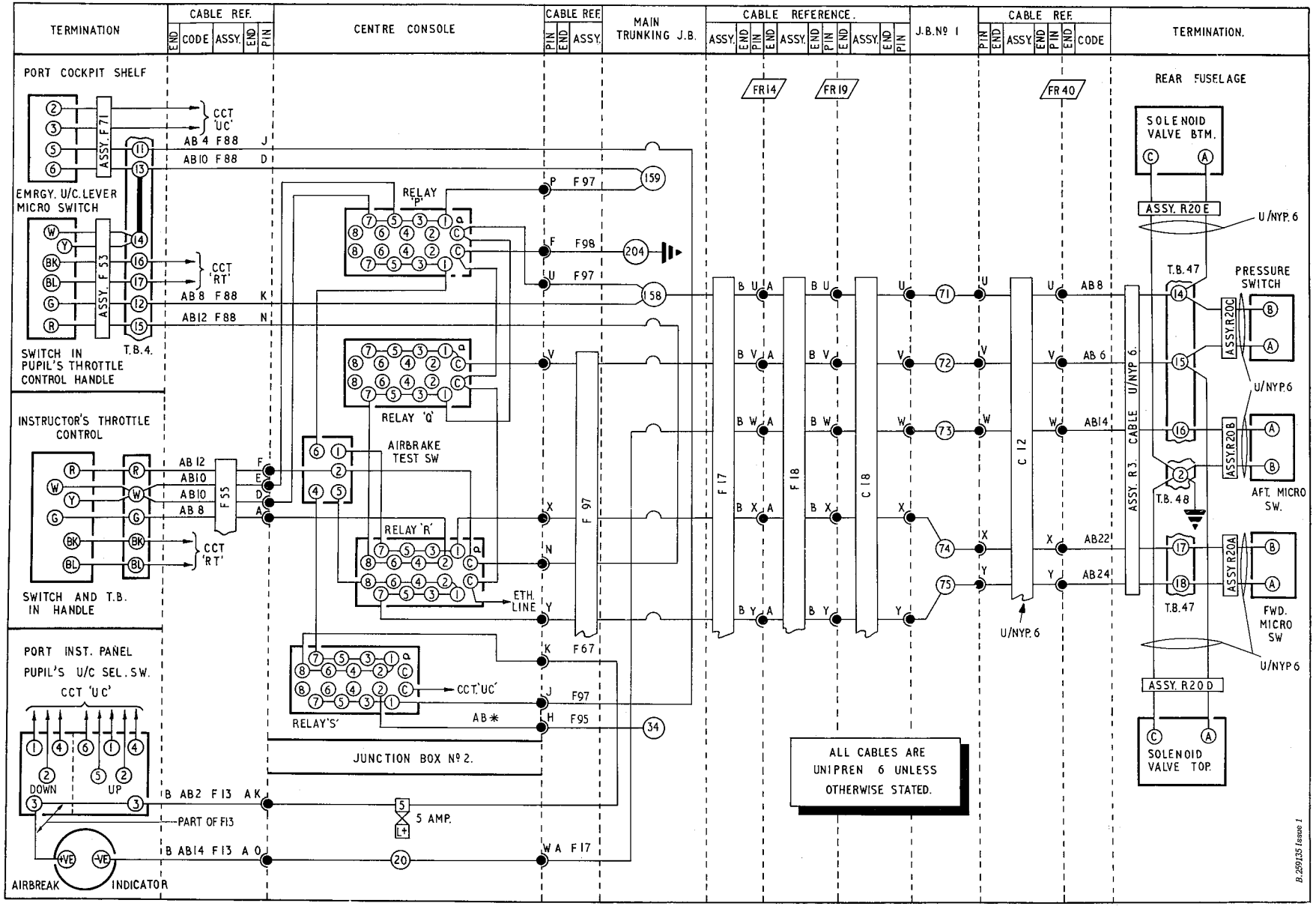

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Fig.3 Air brake control (routeing)

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cally release the DOWN switch, contacts 4-3 of which will open and de-energize the down solenoid of the electro-hydraulic control valve, while contacts 2-1 open circuit the solenoid lock of the PUPIL switch, which is then locked in the un-operated position.

11. As contacts 1-2 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. At the same time, the hood light relay is energized to extinguish the HOOD LOCKED warning light as described in Group D.5.

Selector switch interlock

12. Before the instructor can operate the PUPIL switch, to return control to the pupil, he must ensure that the pupil's UP switch is operated, so energizing the solenoid and releasing the lock of the PUPIL switch, by a supply which is fed via contacts 3-4 of both UP switches when in the operated position. Operation of the PUPIL switch will now automatically release the instructor's UP switch and open the circuit to the up solenoid of the control valve, which will, however, be maintained in the energized state by a feed from the pupil's UP switch via the instructor's PUPIL switch.

13. The PUPIL switch solenoid lock is also de-energized when the instructor's UP switch is released. The pupil now has full control of the alighting gear, but may be overridden at any time by the instructor operating his UP or DOWN switches, so releasing the PUPIL switch and isolating the pupil's selector switch unit.

Air brake control

Electro-hydraulic valves

14. The electrical control circuit for the hydraulically operated air brake is actuated by thumb switches, marked IN and OUT, incorporated one in each throttle twist grip. These switches control two electro-hydraulic solenoid control valves located in the rear fuselage on the port side adjacent to frame 50, via relays and a hydraulic pressure switch. The relays are contained in the centre console and a spring return test switch is located on this console. The hydraulic pressure switch is mounted adjacent to the solenoid valves in the rear fuselage.

Position indicator

15. 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

16. 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 microswitch, 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.

17. 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 centre console. 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

OUT circuit

18. When an UP button of the alighting gear selector switches is operated, relay S *(fig.1)* is energized, contacts 1-1a, 3-3a, 5-5a and 7-7a of which then complete the supply to the air brake control switches, via the normally closed contacts of the alighting gear emergency air valve microswitch. Operation of either 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. 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 of relay P, contacts 6 and 5 of the test switch and the contacts of the de-energized relay R.

19. 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 Q. This circuit is maintained, once the pressure switch has operated via contacts 1-1a, 3-3a, 5-5a and 7-7a of the hold-on relay Q. 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.

Airbrake and alighting gear interlock

20. If the alighting gear is selected down, while the air brake is extended, relay S will be de-energized to disconnect the supply to the air brake control switches 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 microswitch operated by the emergency air valve. Air brake retraction must not normally be obtained by selecting alighting gear down.

IN circuit

21. On operation of either air brake control switch to the IN position, relay R is energized to open the circuit to the hold-on relays P and Q, 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

22. 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 TEST position, current is fed via the circuit fuse, through contacts 4 and 5 of the test switch and contacts 2-2a, 4-4a, 6-6a and 8-8a of relay R, 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, via contacts 1 and 2 of the test switch. When energized, this relay breaks the supply to the electro-hydraulic control valve and the air brake immediately retracts.

23. Relay R 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.19, to provide indication that the installation is operating satisfactorily.

SERVICING

General

24. For general servicing of the aircraft electrical system, reference should be made to Group A.1. 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 Book 1, Sect.3, Chap.4, followed by the functioning checks of the installation as described in Book 1, Sect.3, Chap.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

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