GROUP D.2. ELEVATOR AND AILERON POWER CONTROLS AND HYDRAULIC PRESSURE INDICATOR

(CODE PE, PA AND HP)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Equipment employed

1. The major components employed in the elevator and aileron power controls and hydraulic pressure indicator circuits are listed below, together with the relevant Air Publications to which reference should be made for a detailed description and the necessary servicing required to maintain them in an efficient condition.

Selector valve (*aileron*), Dowty, Type 08808Y.B02 Selector valve (*elevator*), Dowty, Type 08808Y.B04	*A.P.1803D, Vol. 1, Book 3, Sect. 18*
Magnetic indicator	*A.P.4343E, Vol. 1, Sect. 18*
Micro-switch, Type 4A	*A.P.4343C, Vol. 1, Book 1, Sect. 2*
Tumbler switch, S.P/3-way, Rotax, Type D.10002 (*aileron and elevator control*) Pushbutton switch, Type C5162Y, Mk. 2	*A.P.4343C, Vol. 1, Book 1, Sect. 1*
Relay, Type 9B, No. 2 (*audio warning*)	*A.P.4343C, Vol. 1, Book 2, Sect. 3*
Tumbler switch, S.P./C.O., Type XD737/2 (*audio warning cut-out*)	*A.P.4343C, Vol. 1, Book 1, Sect. 1*
Warning lamp, Type B (*hydraulic pressure*)	*A.P.4343E, Vol. 1, Sect. 18*
Lamp filament, 28V, 3·5W	*A.P.4343E, Vol. 1, Sect. 7*
Pressure switch, Type TP5555	*A.P.1275A, Vol. 1, Sect. 24A*

DESCRIPTION

Elevator and aileron power controls

2. The electrical circuits for the elevator and aileron power-operated controls incorporate a special 'fail safe' feature *(described in para. 8)*. The controls consist of two spring-return, 3-position ON/OFF selector switches, one of which is mounted on the centre instrument panel to control the elevator electro-hydraulic selector valve and the other, located on the port instrument panel, to control the aileron selector valve.

Electro-hydraulic valves

3. The elevator selector valve is located between frames 54 and 55 in the rear fuselage lower fin structure. The aileron selector valve is mounted on the front spar in the starboard wheel bay. These valves control the supply of hydraulic power to the elevator booster jack and release unit, located between frames 52 and 55 in the rear fuselage lower fin structure, and to the aileron booster jacks and release units, located one in each outer wing.

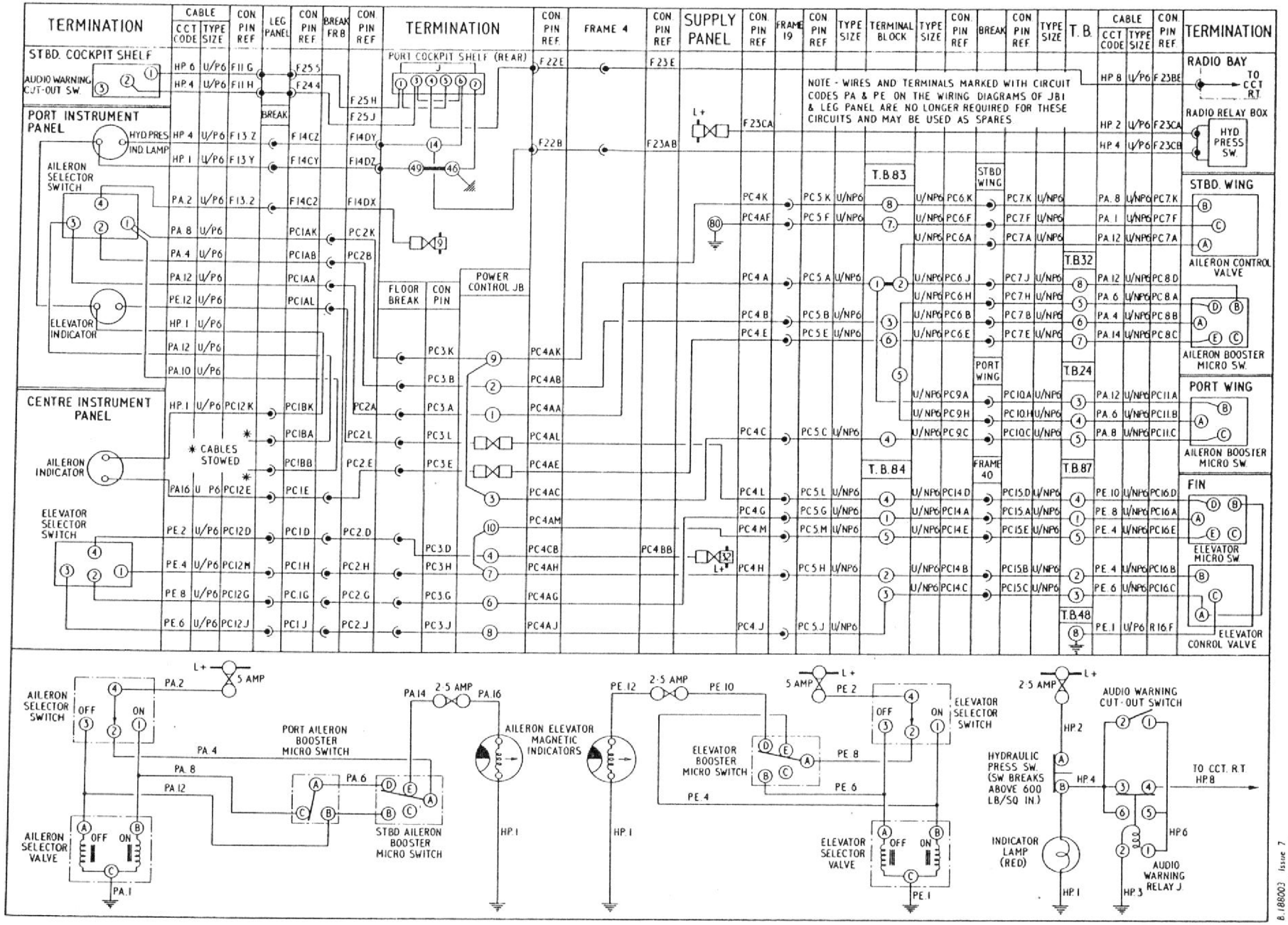

Fig. 1. Elevator and ailerons power controls and hydraulic indicator (routing and theoretical)

Control indicators and audio warning

4. Two magnetic indicators, located one on the port instrument panel and the other on the centre instrument panel, are provided to indicate when the elevator and aileron booster jacks are disengaged, due either to operation of the selector switches or to a hydraulic or electrical failure. These indicators, which are separately fused, are controlled by micro-switches operated by the release units on each booster jack. An audio warning is also given when hydraulic power fails. The audio signal can be cut out by operation of the audio warning cut out switch *(para. 14)*. For a full description of the elevator and aileron power controls, reference should be made to Sect. 3, Chap. 4.

Operation

Power ON

5. As the operation of the elevator and aileron power control electrical circuits are similar, only the function of the aileron circuit will be described. When the aileron selector switch is held in the ON position, current will be fed through the switch and energize the ON solenoid of the aileron electro-hydraulic selector valve. When this solenoid is energized, it allows the hydraulic supply pressure to move the slide valve within the selector in such a direction as to supply hydraulic pressure to the aileron booster jack servo valves and release units.

6. As the control column is moved from side to side, to engage the pawls of the release units with the booster jack rams, the booster unit micro-switches will be operated. This allows a power supply to be fed via the ON/OFF switch, which must still be held in the ON position, through the aileron magnetic indicator which when energized shows BLACK indicating both pawls engaged. The selector switch may now be released and allowed to return to the centre position under the spring return action.

7. Hydraulic power is now engaged and movement of the control column will open one of two orifices in the servo valves. The orifice which is opened depends upon the direction in which the control column is moved. Hydraulic pressure will then be directed to one side of the booster jack rams and this pressure will move the booster jack bodies. These, being in connection with the ailerons will move the ailerons in the required direction.

Fail Safe

8. When the selector switch is in the centre, that is in the safe position, the electro-hydraulic selector valve is maintained in the energized state by a feed from the centre contact of the selector switch, through the two micro-switches. The magnetic indicator is also maintained in the energized state by a feed, via the micro-switches; this forms the fail safe feature of the circuit. For example, should the port release unit pawl disengage from the booster jack ram, for any reason, its micro-switch will operate to break the supplies to the ON solenoid of the selector valve and the magnetic indicator. A supply to the OFF solenoid will then be made via contacts A and B of the micro-switch, causing the starboard release units pawl to disengage immediately from its booster jack ram and operate its micro-switch. Current is now fed to the OFF solenoid of the selector valve across contacts A and B of the starboard micro-switch so by-passing the port micro-switch and the magnetic indicator becomes de-energized.

9. A similar series of operations takes place should the starboard release units pawl disengage first. It will be seen, therefore, that this safety feature renders it impossible for only one pawl to engage or a false anchorage to occur.

Power OFF

10. When the aileron selector switch is held in the OFF position, current will be fed through the switch and energize the OFF solenoid of the aileron electro-hydraulic selector valve. When the OFF solenoid is energized, it allows the hydraulic supply pressure to move the slide valve within the selector in such a direction as to cut off the hydraulic pressure to the booster jack servo valves and release units. The slide valve movement also allows the pressure in these units to flow back into the return line. As the pressure in the release units discharges into the return line, the release unit pawls disengage from the booster jack rams.

11. While disengaging the release units operate the micro-switches, which in turn de-energize the aileron magnetic indicator, thus indicating that the power is disengaged and manual effort alone must be used to move the ailerons. When the power controls have disengaged, the selector switch may be released and allowed to return to the centre, safe position. The OFF solenoid will be maintained in the energized state by a feed from the centre contact of the switch, through the contacts of the two micro-switches which are made while the release units are disengaged,

Hydraulic failure

12. In the event of hydraulic failure, the hydraulic pressure indicator lamp will illuminate and the audio warning system operate to indicate that only a limited number of power operations of the controls are available from the hydraulic accumulator in the system. When the accumulator is exhausted, the booster jacks will be automatically disengaged and the release units will operate the micro-switches to de-energize the ON solenoid of the electro hydraulic selector valve and the magnetic indicator. At the same time, to prevent hydraulic pressure from being trapped in the

booster jacks, the OFF solenoid of the selector valve will be energized. This is achieved by a feed from the centre contact of the selector switch, through the contacts of the micro-switches which are made when the release unit is disengaged from the booster jack ram.

Electrical failure

13. In the event of an electrical failure, the selector switch will be ineffective and both the solenoids of the electro-hydraulic selector valve and the magnetic indicator will be de-energized. In these circumstances it will be impossible to engage or dis-engage the power controls by use of the selector switch. The power controls will remain in the 'power ON' or 'power OFF' condition obtaining at the time of the electrical failure.

Note

The operation of the emergency dis-engage push-switches must NOT be tested at anytime other than during a ground function check as the control circuit fuse usually blows due to a back feed through the standby batteries.

Audio warning cut-out

14. Relay J may be energized to cut-out the aural warning by the operation of an audio warning cut-out switch located on the starboard instrument panel. Once relay J has been energized it is held locked-on by a circuit through its own contacts. The audio warning cut-out switch is of the single pole, change-over type.

SERVICING

General

15. For general servicing of the electrical system as a whole, 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 electrical tests of the electro-hydraulic selector valves as described in the relevant Air Publication *(listed in para. 1)*.

REMOVAL AND ASSEMBLY

General

16. Once access has been obtained, the removal of the electrical components forming the elevator and aileron power controls and hydraulic pressure indicator circuits, should present no difficulties. The location and access to all the components is indicated in Group A.3.