Group D.3.

TAIL PLANE CONTROL (CODE T)

◀ (Including Mods. 1125, 1145, 1218, 1296, 1304, 1341, 1351 and 1359) ▶

LIST OF CONTENTS

	Para.
Introduction	1
Description	
Tail plane control	
Actuator power supply	2
Actuator main motor control	4
Tail plane and elevator linkage ...	5
Trim, main control	6
Datum actuator	7
Trim standby control	8
Operation	
Automatic control	10
Trim control	16
Instructor's override	17
Independent trim control	25
Standby, trim control	26
Runaway malfunctioning	27
Servicing	
General	28
Tail plane actuator	29
Removal and Assembly	
General	31
Tail plane switch box assembly	32

LIST OF ILLUSTRATIONS

	Fig.
Tail plane control (theoretical) ...	1
Tail plane control (routeing sheet 1)	2
Tail plane control (routeing sheet 2)	3

TABLE

	Table
Equipment type and Air Publication reference	1

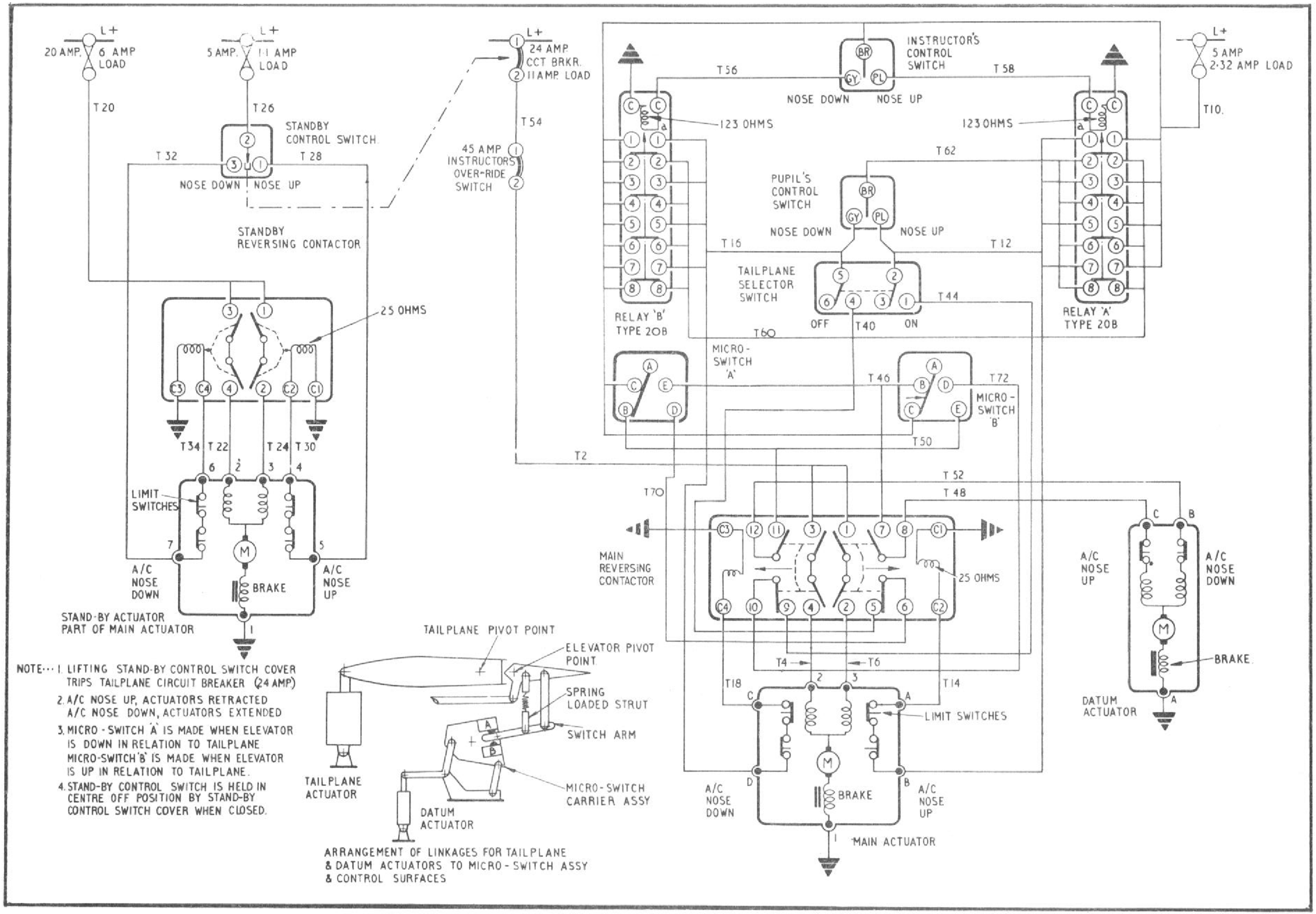

Fig. 1 Tail plane control (theoretical)

T.P.(E) 11887

Introduction

1. This Group contains the description and operation of the tail plane control circuit, together with information on the servicing required to maintain the equipment in an efficient condition. Routeing and theoretical circuit diagrams are also included. For a general description of the aircraft 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.

DESCRIPTION

Tail plane control

Actuator power supply

2. The incidence of the tail plane is varied in flight by the action of an electric actuator located in the dorsal fin, between frames 51 and 52, below the tail plane. This actuator, which incorporates internal limit switches to control its range of movement, has a standby motor to maintain operation at a reduced speed, to enable the tail plane to be trimmed to a safe angle should the main motor or its control circuit fail.

3. The tail plane actuator's main motor is energized via a reversing contactor, which is supplied via a circuit breaker and an override switch. The reversing contactor is situated in the dorsal fin, forward of the actuator and the circuit breaker is located in the tail plane standby switch box mounted on the forward portion of the cabin port shelf. The override switch, which is a flap protected circuit breaker, is located on the cabin starboard shelf and is provided for the instructor's use in an emergency.

Actuator main motor control

4. The control circuit of the tail plane actuator's main motor has two modes of operation, which are selected by using the tail plane selector switch located on the centre instrument panel. The operating methods are as follows:–

(1) Tail plane and elevator electrically interconnected to form an electrically operated flying tail, having normal trimming facilities.

(2) Tail plane trim control, independent of the elevator.

Tail plane and elevator linkage

5. The interconnected operation of the tail plane actuator main motor is controlled by a pantograph type linkage, which is attached to the elevator. This linkage

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Tail plane actuator, Rotax Type A.1612 *(Mod.1145)* Datum actuator, Western Type EJ.25, Mk.1C, Mk.1D or Mk.1F *(Mod.1304)*	A.P.4343D, Vol.1 Book 3, Sect.14
Main and standby reversing contactor, Rotax Type D.8723, D.19501 *(Mod.1218)*, D.19501/1 *(Mod.1431)* or D.19501/2 *(Mod.1359)*	A.P.113D-1379-1
Selector switch, Honeywell., Type 2TL1/3/D *(Mod.1125)*	A.P.113D-1201-1
Standby control switch, C.W.C. Type XD.777, No.4	A.P.4343C, Vol.1, Book 1, Sect.1
Microswitches, Type 4A	A.P.4343C, Vol.1, Book 1, Sect.2
Relays, Type 20B	A.P.113D-1309-1
Control switches, part of Dunlop control handgrip, Type AC.63484 *(Mod.1296)* or AC.64616 *(Mod.1351)*	A.P.113D-1609-1
Override switch, circuit breakers, Type A.6 Circuit breaker, B.T.H. Type LGA.24.B.1.	A.P.113D-0903-1

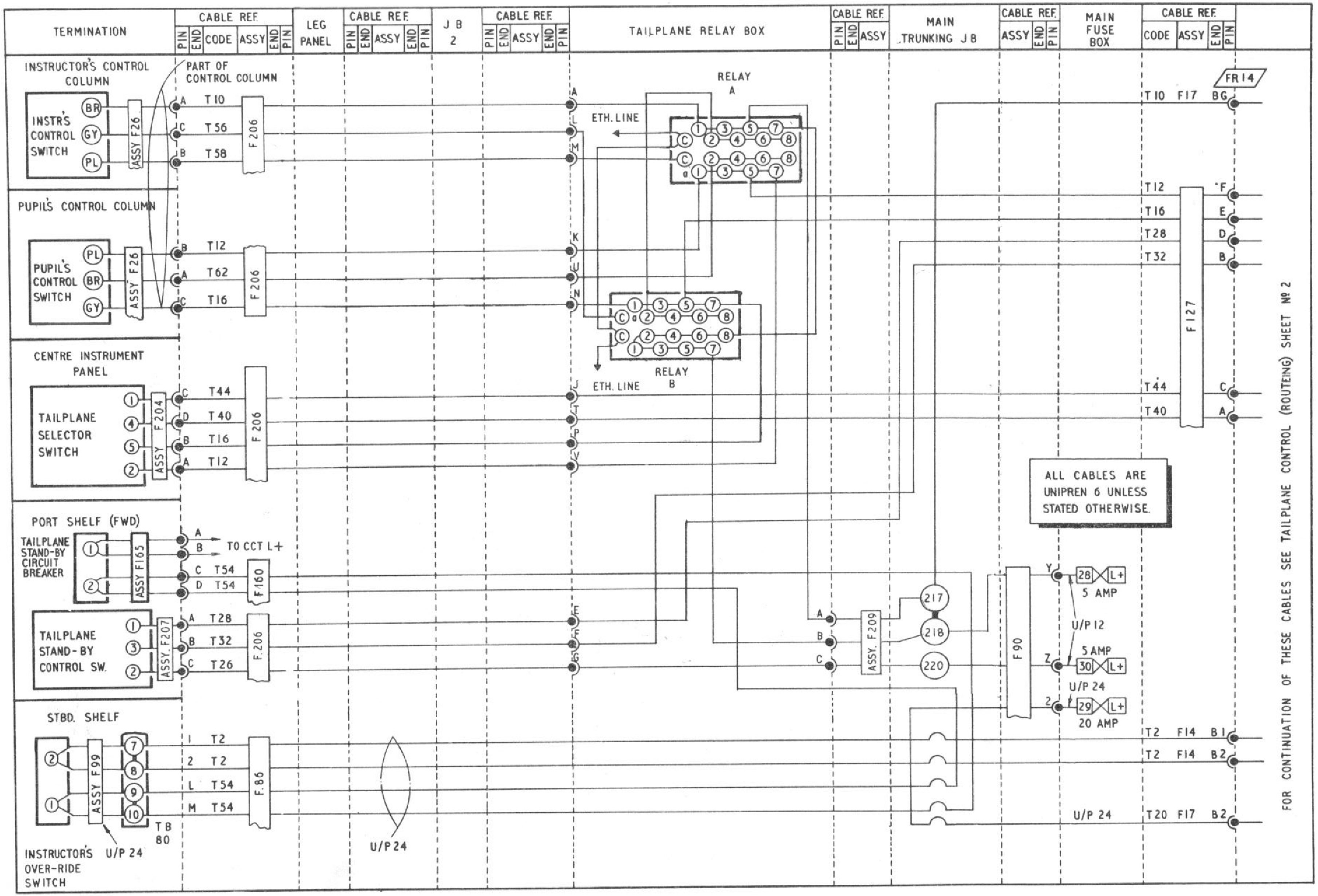

Fig. 2 Tail plane control (routeing sheet 1)

T.P.(E) 11889

carries a switch operating arm floating between two opposed microswitches fitted into a special housing, located in the dorsal fin below the tail plane.

Trim, main control

6. Manual control of the main motor, for normal trimming purposes is accomplished by use of the trim switches situated one on each control column handgrip. The instructor's trim control switch energizes the reversing contactor which, in turn, controls the main motor, via two relays situated in the tail plane relay box. The power supply to the pupil's trim control switch is taken through these relays in such a manner that operation of the instructor's switch automatically isolates the pupil's switch.

Datum actuator

7. In addition to controlling the main motor, the trim switches also control a small datum actuator. One end of this actuator is anchored to the aircraft's structure below the tail plane, and the other end is attached to the flying tail microswitch housing. This actuator changes the datum position of the microswitches, to keep both switches in the open, or neutral position with respect to the switch operating arm as the tail plane moves to its new trim position. While trimming, the relevant microswitch acts as a limit switch to keep the datum actuator in step with the tail plane actuator.

Trim, standby control

8. The tail plane actuator's standby motor is controlled manually, being operated by a separate circuit and reversing contactor. The reversing contactor is located beside that of the main motor and its supply is via a switch located, under a guard cover, on the standby control switch box mounted on the forward portion of the cabin port shelf. Raising the guard cover to use this switch, also trips the tail plane actuator's main circuit breaker, thus automatically isolating the main control circuit. This interlock prevents any fault to the main motor circuits from affecting the operation of the standby motor.

9. The incidence of the tail plane is shown on an indicator located on the pupil's flying instrument panel as described in Sect.5, Chap.2.

Operation

Automatic control

10. The automatic operation of the tail plane actuator's main motor when the tail plane selector switch is in the ON position, moves the tail plane relative to the elevator, for all positions of the control columns. This is accomplished by the switch operating arm, attached to the pantograph linkage on the elevator, actuating one or other of the two opposed microswitches as the elevator moves. This arm is then returned to its original position, between the two switches, as the tail plane moves to take up its new position. The tail plane thus follows up any movement of the elevator until it reaches the limit of its travel.

11. As an example, consider the case in which the elevator is raised. Microswitch B, of the opposed pair, will be operated by the switch arm as the elevator moves, and will close its contacts D and E. Closing these contacts will complete the supply through contacts C and B of microswitch A, to pin B of the actuator via contacts 10 and 9 of the reversing contactor and contacts 1 and 2 of the tail plane selector switch. The current will then be conducted from pin B of the actuator, through the internal limit switches, which are closed until the actuator is fully retracted, to pin A and thence to one coil of the reversing contactor controlling the main motor. The negative return of this coil is taken to earth.

12. When this coil of the contactor is energized, contacts 1, 2 and 7 are closed. Contact 7 performs no function at this point as the supply is isolated at the microswitches. Contacts 1 and 2 complete a supply via the circuit breaker and override switch, to pin 3 of the main motor, which connects to the retracting field windings of the motor. Negative return to earth is via pin 1 of the unit.

13. The motor will now rotate in such a direction as to retract the actuator ram and decrease the tail plane incidence. As the elevator and tail plane move to their new position, the switch operating arm is centralized between the two microswitches due to the relative position of the tail

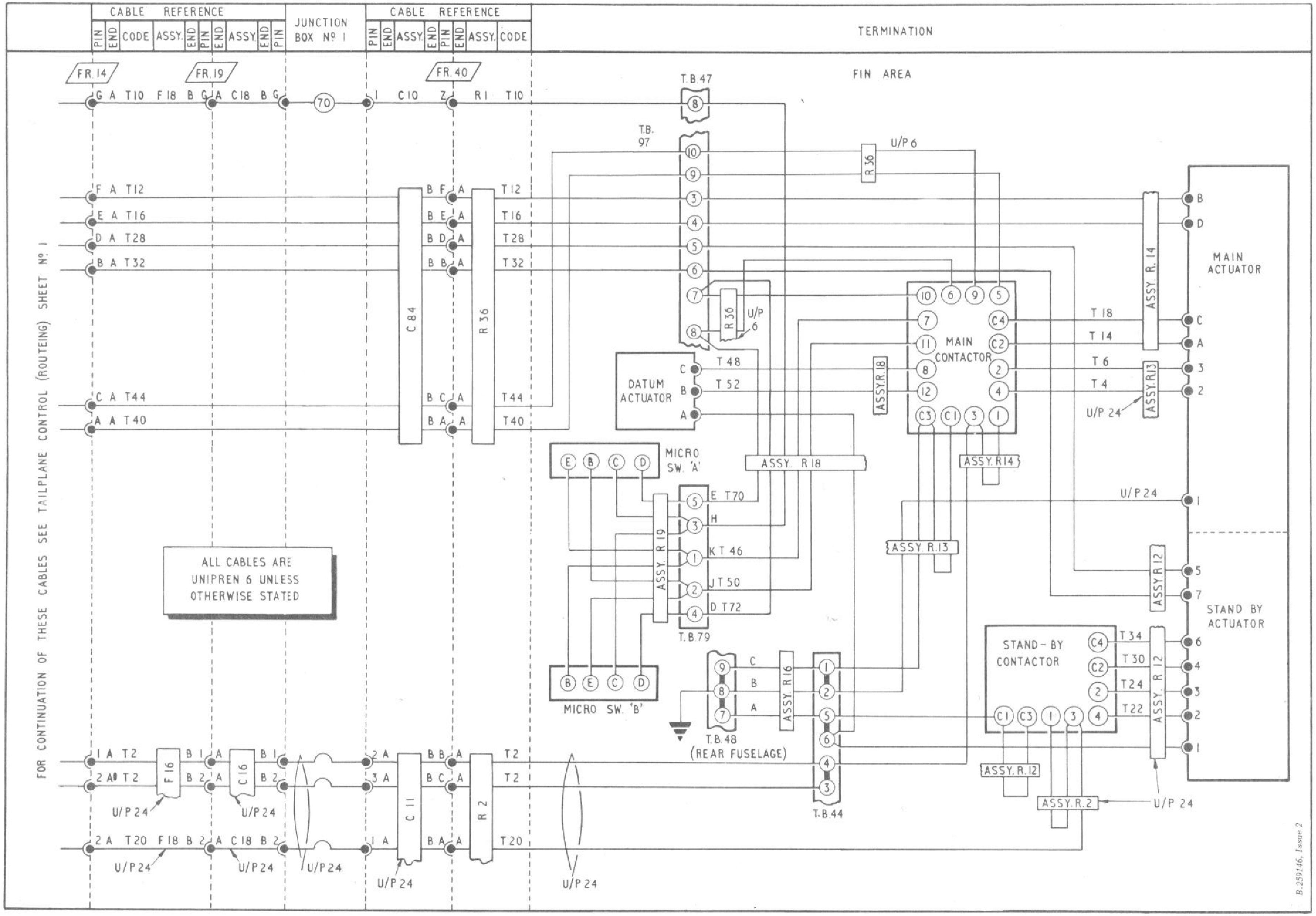

Fig. 3. Tail plane control (routeing sheet 2)

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plane and elevator hinges. This releases microswitch B to isolate the supply to the reversing contactor. With the contactor de-energized, contact 1, 2 and 7 open to break the main positive supply to the field windings and stop the actuator.

14. If the elevator is moved to such a degree that the tail plane actuator reaches the limit of its travel, before the switch operating arm is centralized between the microswitches, the internal limit switches in the actuator will open and de-energize the reversing contactor in a manner similar to the action of the microswitches.

15. A similar sequence of events occurs to increase the tail plane incidence when the elevator is moved downwards. Microswitch A then operates to energize the other coil of the reversing contactor, via contacts of microswitch B. This, in turn, feeds the extend windings of the actuator.

Trim control

16. The action of the tail plane actuator's main motor when manually controlled for normal trimming purposes depends upon the operation of either trim switch on the control column handgrips causing the tail plane actuator and the datum actuator to operate simultaneously. The movement of the datum actuator maintains the switch operating arm of the pantograph linkage central between the two opposed microswitches, with the elevator trailing, as the tail plane moves to its new trim position. While trimming, the opposed microswitches serve as limit switches to maintain the two actuators in step.

Instructor's override

17. In addition to controlling the actuator, the trim switch on the instructor's handgrip also controls relays A and B, which are so wired as to isolate the power supply to the pupil's control whenever the instructor's switch is used.

18. As an example of trim operation, consider the case when the instructor's trim switch closes contacts BR and GY, to energize relay B. With this relay energized contacts 1, 3, 5 and 7 are all made and the remaining contacts, which supply the pupil's trim switch via relay A are broken, so isolating the pupil's switch. The closed contacts of relay B complete the supply from the control circuit fuse to pin D of the tail plane actuator's main motor.

19. From pin D the current passes through the limit switches, which are made until the actuator is fully extended, to pin C of the actuator and thence to one coil of the reversing contactor which controls the main motor. The negative return of this coil is taken to earth. A supply is also made to contacts C of the microswitches A and B. Because contacts B and C of microswitch A are closed, a supply will be available at contact 11 of the reversing contactor.

20. When this contactor is energized its contacts 3, 4 and 11 are closed. Contacts 3 and 4 will complete a circuit, via the circuit breaker and override switch to pin 2 of the actuator, which connects to the extend field windings of the main motor, negative return being taken to earth, via pin 1 of the unit.

21. Contact 11 of the reversing contactor feeds the nose down field windings of the datum actuator, via pin B and the internal limit switch. The negative return is taken to earth from pin A of the datum actuator. Both actuators are now energized and the tail plane actuator rotates in a direction to extend the actuator ram and increase the tail plane incidence, while simultaneously, the datum actuator rotates to move the microswitch housing and so maintain the switch operating arm central between the two opposed microswitches.

22. If the two actuators become out of step, due to the datum actuator moving too fast, the switch operating arm will not be maintained central between the switches. With the tail plane moving to increase the angle of incidence, microswitch A will be operated thus isolating the supply to the datum actuator, which will cease to operate until the tail plane actuator catches up, and again centralizes the switch operating arm. In this manner the microswitches serve as limit switches to keep the two actuators in step.

23. The tail plane actuator will operate until switched off either, by allowing the trim switch to return to its central position thus breaking contact BR and GY or, by the operation of a limit switch when the actuator reaches the limit of its travel. In both cases the coil of the reversing contactor is de-energized, opening contacts 3, 4 and 11 to break the main positive supply to the field windings of both actuators which then stop with the tail plane in its new trim position.

24. Subsequent operation of the elevator control after manual trimming will operate the tail plane actuator automatically as described in para.10 to 15, but with the position of the housing carrying the two opposed microswitches changed. This change varies the relation between the tail plane and elevator travel to suit the new trim condition.

Independent trim control

25. The operations described in para.10 to 24 apply when the tail plane selector switch is in the ON position. When placed in the OFF position, this switch isolates the supply to contacts D of the two opposed microswitches, thus cutting out the electrical interlock of the flying tail linkage. This action permits reversion to independent elevator control with a trimmable tail plane. Operation of the trim switches on the control column handgrips in this condition is similar to that described in para.16 to 23, but after operation of the trim switches the tail plane will not follow the elevator movement.

Standby, trim control

26. The operation of the tail plane actuator's standby motor, via the standby control switch and reversing contactor, can be followed by reference to the theoretical diagram. When the guard cover locking the standby switch is lifted fully, it presses the trip plunger of the tail plane actuator's main circuit breaker. This isolates the electrical supply from the actuator's main motor, thus preventing any fault in this circuit from affecting the operation of the standby control.

Runaway malfunctioning

27. As described in para.11, the supply for nose up follow-up action of the tail plane is taken through the reversing contactor contacts 10 and 9. In the event of a runaway failure due to faulty microswitches or tail plane selector switch, selection of nose down trim at the pilots trim switch will energize the nose down coil of the reversing contactor and break the nose up circuit at contact 9. Similarly a nose down runaway can be cancelled ◀ by the selection of nose up trim. Tail plane runaway due to welded contacts of the contactor can be cancelled by lifting fully the cover of the standby trim switch as described in paragraph 26. ▶

SERVICING

General

28. For general servicing of the aircraft electrical system, reference should be made to Group A.1. All the components should be kept clean and inspected periodically for signs of damage and to ensure that they are securely mounted. Apart from the servicing described in the following paragraphs, together with the standard routine bench testing of the components, as described in the appropriate Air Publications listed in Table 1, no further servicing should be necessary.

Tail plane actuator

29. This actuator is manufactured to give the required range of travel and since the internal limit switches incorporated are pre-set, no further adjustment may be made. The functioning of the unit, however, should be checked over its full range to ensure that the correct travel, as quoted in Book 1, Sect.3, Chap.4 is obtained. This check should be made with the tail plane selector switch in the OFF position, and by using both the main and standby control switches in turn. During the check of the main motor, the current and operating time must be checked in both directions of rotation. The load current and operating time for both directions must not exceed 11.0 amp. and 8.6 seconds respectively at 28 volts.

30. The actuator current may be recorded by connecting an 0 to 50 amp. ammeter into the negative return cable at the rear fuselage earthing point *(T.B.48 terminal 8)*. If a fault is reported in either the main or standby control circuits, the cause must be investigated and rectified before the next flight. Should a fault be found in the actuator, the unit must be removed and replaced with a fully serviceable unit and no attempt must be made to service the actuator in-situ.

Note . . .

It is important that the actuator must *not be bench tested unless a complete control circuit, such as that in the aircraft is available, because serious internal damage to the component can result from incorrect or incomplete connection.*

REMOVAL AND ASSEMBLY

General

31. Once access has been obtained, the removal and assembly of the electrical components forming the tail plane control circuit should present no difficulties. The removal of the forward portion of the cabin port shelf, which carries the standby control switch and tail plane circuit breaker, is described in Group A.2. The location and access to all the components is indicated in Group A.3.

Tail plane switch box assembly

32. When renewing or replacing the circuit breaker within the standby switch box assembly, proceed as follows:–

(1) Remove the forward portion of the cabin port shelf as described in Group A.2.

(2) Remove the four retaining nuts and bolts and lift the standby switch box, complete with cable assembly F.165 from the shelf.

(3) Disconnect cable assembly F.165 from the circuit breaker.

◀ **CAUTION**

In order to ensure adequate clearance from the throttle connecting rod, port group, cable assembly F.165 must be routed inboard of the Aileron and Rudder Trim Control plug. ▶

Note . . .

When installing the circuit breaker, ensure that the clearance between the underside of the cover lever and the 'close' button of the circuit breaker, when fully depressed is .003 in. - .010 in. The clearance between the underside of the cover lever and the 'trip' button, when fully depressed, must also be .003 in. - .010 in. After adjustment of the circuit breaker, electrically check its operation for positive action, with a test lamp and battery connected between terminal 1 and 2.

(4) The method of re-assembly is in general the reverse of the removal sequence.


49