GROUP D.3
TAIL PLANE CONTROL AND POSITION INDICATOR (CODE T AND TD)

◀ (Including Mods.1145, 1218, 1295, 1304, 1341, 1350 and 1359) ▶

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Introduction

1. This group contains the description and operation of the tail plane control and position indicator 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 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 circuits 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. The tail plane actuator's main motor is energized via a reversing contactor, which is situated in the dorsal fin forward of the actuator and is supplied through a circuit breaker, which is incorporated within a switch box

assembly, located on the cabin port shelf. The supply for this actuator's standby motor is from a fuse also on this shelf.

Actuator main motor control

3. 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 cabin port shelf. These modes of operation are as follows:-

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

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

Tail plane and elevator linkage

4. The interconnected operation of the tail actuator main motor is controlled by a pantograph type linkage, which is attached to the elevator. This linkage carries a switch operating arm floating between two opposed micro switches fitted into a special housing, located in the dorsal fin below the tail plane.

Trim main control

5. Manual control of the main motor, for normal trimming purposes, is accomplished by use of the trim control switch situated on the control column handgrip. The trim switch controls the energizing of the reversing contactor which, in turn, controls the main motor.

Datum actuator

6. In addition to controlling the main motor, the trim switch also controls the 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 micro switch housing. This actuator changes the datum position of these micro switches, 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 position. While trimming, the relevant micro switch acts as a limit switch to keep the datum actuator in step with the tail plane actuator.

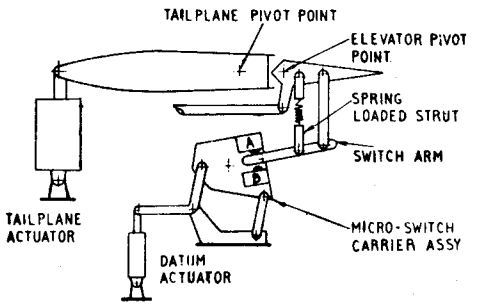

Fig.1 Tail plane and elevator linkage

Trim standby control

7. The tail plane actuator's standby motor is controlled manually, being operated by a separate circuit and reversing contactor. The standby reversing contactor is located beside that of the main motor and its supply is via a switch located, under a guard cover on a box assembly situated on the forward portion of the port cabin shelf. Raising the guard cover fully to use the switch also operates the trip button of the main motor's circuit breaker; thus breaking the supply to the contacts of the main contactor and preventing any fault in the main motor circuits from affecting the operation of the standby motor.

8. The incidence of the tail plane is shown on an indicator located on the flying instrument panel. Tail plane incidence indication is described in paragraph 25 of this group.

Operation

Automatic control

9. 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 column. This is accomplished by the switch operating arm, attached to the pantograph linkage on the elevator, actuating one or other of the two opposed micro switches as the elevator moves. This arm is then returned to its original position, between the two micro 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.

10. As an example, consider the case in which the elevator is raised. Micro switch B, of the opposed pair, will be operated by the switch arm, as the elevator moves, and will close its contacts D and E. The closing of these contacts will complete

the supply from the control circuit fuse and contacts C and B of micro switch A to pin B of the tail plane actuator, via the contacts 10 and 9 of the contactor and 1 and 2 of the tail plane selector switch. The current will then be fed 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 in the reversing contactor controlling the main motor. The negative return of this coil is taken to earth.

11. When this coil of the contactor is energized, contacts 1, 2 and 7 are closed. Contact 7 performs no function while the tail plane is in the automatic control as the supply is isolated at the micro switches. Contacts 1 and 2 complete a supply, via the circuit breaker, 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.

12. 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 micro switches due to the relative position of the tail plane and elevator hinges. This releases micro switch B to isolate the supply to the reversing contactor. With the contactor de-energized, contacts 1, 2 and 7 open to break the main positive supply to the field windings and stop the actuator.

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

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

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 D8723, D19501 *(Mod.1218)*, D19501/1 *(Mod.1341)*, D19501/2 *(Mod.1359)*	A.P.113D-1379-1
Microswitches, Type 1A, 4A and Pye 401/S *(Mod.521)* Microswitches, Type Dowty 1322Z Mk.2 *(Mod.1279)* Standby control switch, C.W.C. Type XD.777 No.4	A.P.4343C, Vol.1, Book 1, Sect. 1
Selector switch, Honeywell, Type TL1/3/D	A.P.113D-1201-1
Circuit breaker, B.T.H. Type LGA/24/B1/1	A.P.113D–0903–1
Control switch, part of Dunlop control handgrip, Type AC63482 (Mod.1295) or AC64614 (Mod.1350)	A.P.113D-1609-1
Position indicator, Smiths 587FL Desynn transmitter, Smiths 227FL	A.P.112G-0501-1

Trim control

15. The action of the tail plane actuator's main motor when manually controlled for normal trimming purposes depends upon the operation of the trim switch, located on the control column handgrip, 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 opposed micro switches with the elevator trailing, as the tailplane

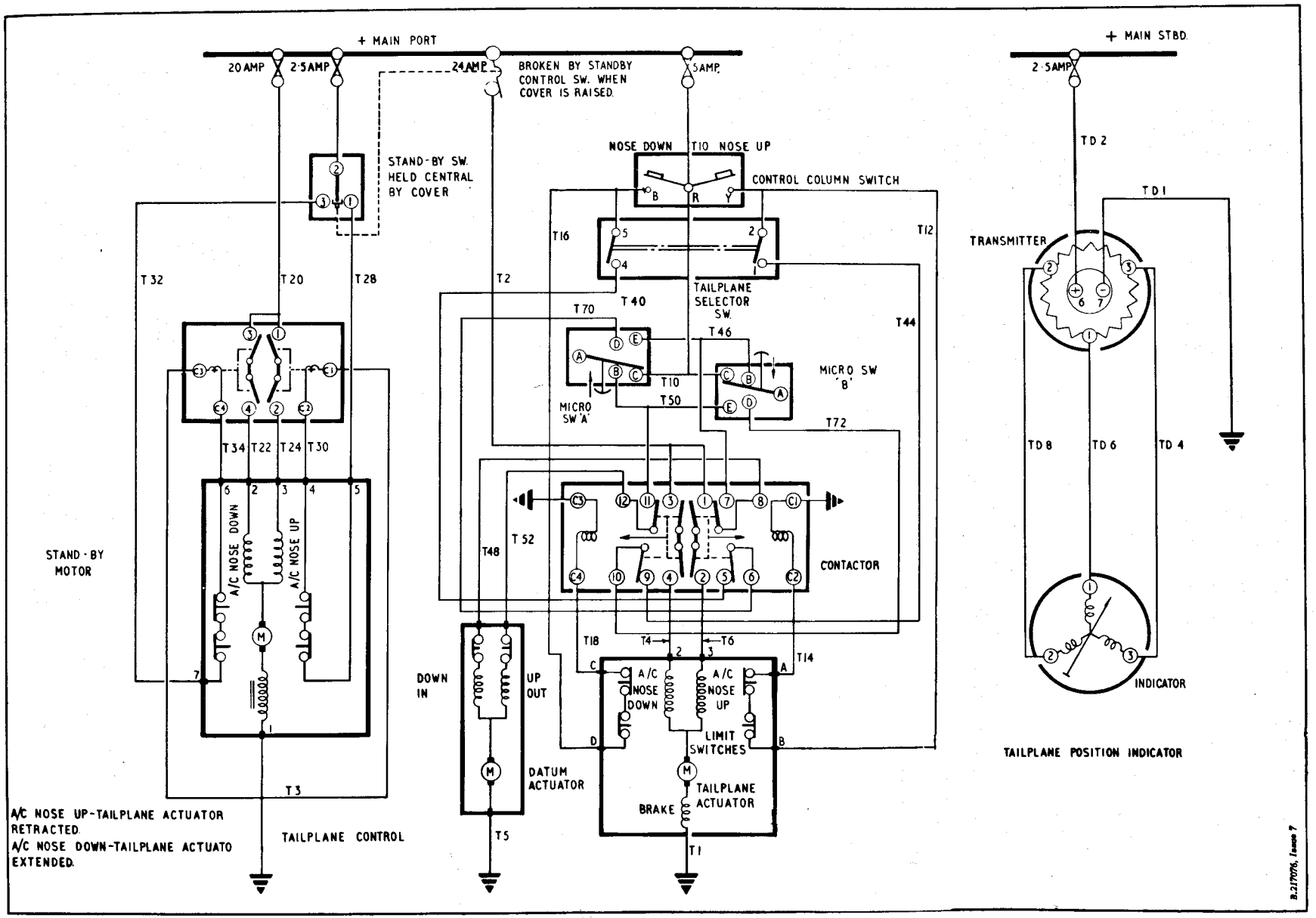

Fig.2 Tail plane control and tail plane position indicator (theoretical)

moves to its new trim position. While trimming, the opposed micro switches serve as limit switches to maintain the two actuators in step.

16. As an example of trim operation consider the case when the pilot's trim switch closes the "Nose Down" contacts. The closed contacts complete the supply from the control circuit fuse to pin D of the tail plane actuator's main motor.

17. 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 micro switches A and B. Because contacts B and C of micro switch A are closed, a supply will be available at contact 11 of the reversing contactor.

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

19. Contact 11 of the reversing contactor feeds the nose up (out) field windings of the datum actuator, via pin B and contact 12 of the reversing contactor. 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 micro switch housing and so maintain the switch operating arm central between the two opposed micro switches.

20. 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, micro switch A will be operated thus isolating the supply to the datum actuator which will stop until the tail plane actuator catches up again and centralizes the switch operating arm. In this manner the micro switches serve as limit switches to keep the two actuators in step.

21. The tail plane actuator will operate until switched off either, by allowing the trim switch to return to its central position thus breaking the "Nose Down" contacts 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.

22. Subsequent operation of the elevator control after manual trimming will operate the tail plane actuator automatically as described in paragraphs 9 to 14, but with the position of the housing carrying the two opposed micro switches changed. This change varies the relation between the tail plane and elevator travel to suit the new trim condition.

Independent trim control

23. The operations described in paragraphs 9 to 22 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 micro switches, 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 switch on the control column handgrip in this condition is similar to that described in paragraph 15 to 21, but after operation of the trim switch the tail plane will not follow the elevator movement.

Standby trim control

24. 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 button of the actuator's main motor circuit breaker, thus causing the supply to contacts 1 and 3 of the main contactor to be broken and so preventing any fault

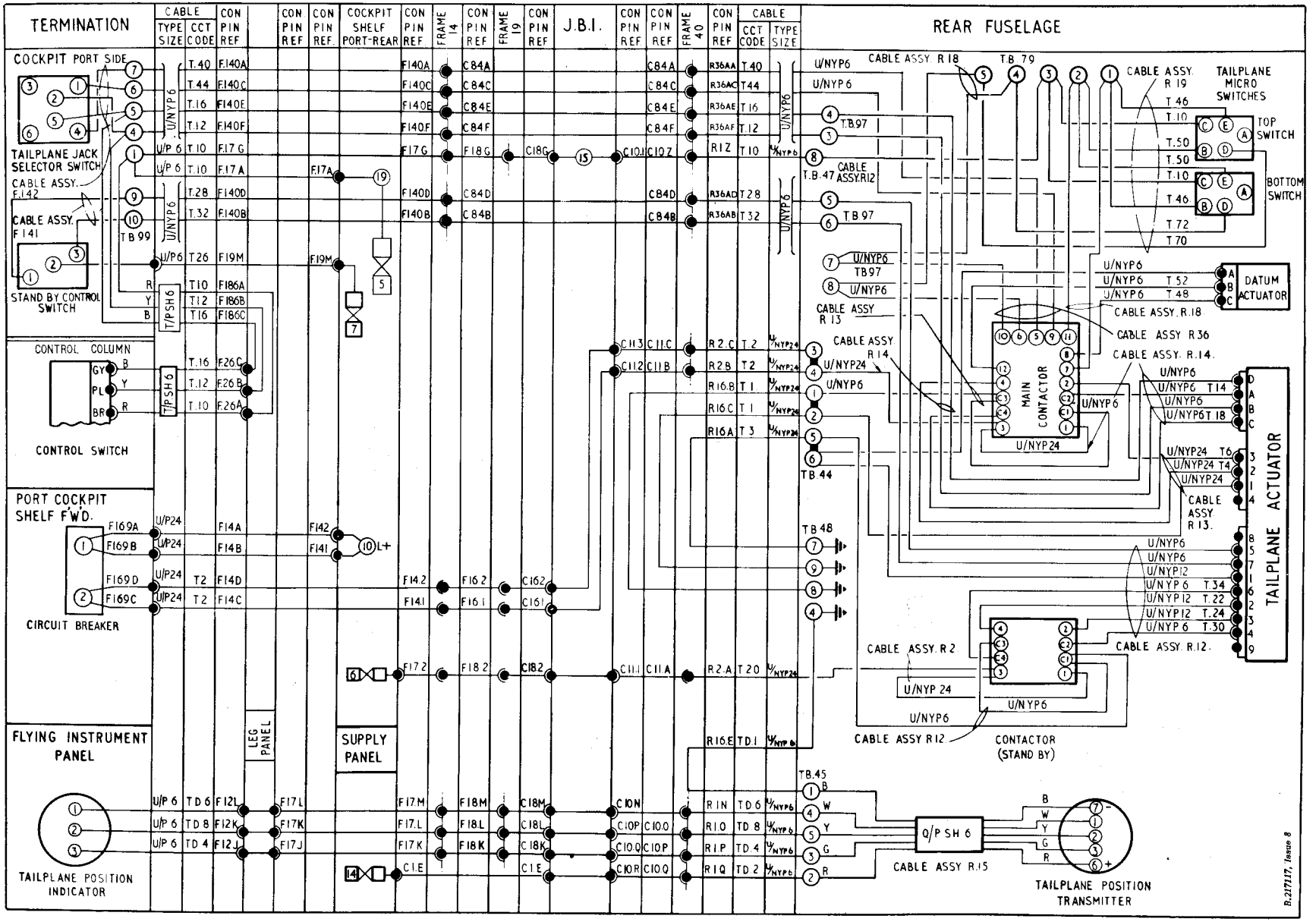

Fig.3 Tail plane control and tail plane position indicator (Routeing)

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in these circuits from affecting the operation of the standby control. When the guard cover is replaced, it presses the 'close' button of the circuit breaker, thus restoring the supply to the main contactor.

Runaway malfunctioning

25. The supply for nose up follow-up action of the tail plane *(para.10)* is taken through the reversing contactor contacts 10 and 9. In the event of a runaway failure due to faulty micro-switches or tail plane selector switch, selection of nose down trim at the pilot's 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 pilot's selection of nose up trim.

26. Tail plane runaway due to welded contacts of the contactor can be cancelled by lifting fully the cover of the standby trim switch *(para.24)*.

Tail plane position indication

General

27. The incidence of the tail plane is shown on a Desynn indicator located on the port side of the centre instrument panel. This indicator is operated by a Desynn transmitter situated just above the actuator in the dorsal fin structure and is linked to the actuator ram by a short operating rod.

Operation

28. For a full description of the Desynn system, together with the principle of operation, reference should be made to A.P.1275A, Vol.1.

SERVICING

General

29. For general servicing of the electrical system as a whole, 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, no further servicing should be necessary.

Tail plane actuator

30. 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 Section 3, Chapter 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.

31. 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 9). 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

Tail plane position indicator and transmitter

32. The standard routine serviceability tests, which should be applied to the Desynn indicator and its transmitter, will be found in the appropriate Air Publication quoted in paragraph 1, and the method of adjusting the linkage between the transmitter and the actuator ram is contained in Section 3, Chapter 4.

REMOVAL AND ASSEMBLY

General

33. 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 box assembly and 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

34 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) Disengage the standby switch box, complete with cable assembly F.169, from the shelf, by removing the four retaining nuts and bolts.

(3) Disconnect cable assembly F.169 from the circuit breaker.

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 must also be .003 in. – .010 in. ance 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.