AIRBRAKES

1. Introduction

The airbrakes take the form of rectangular flaps secured to movable drag posts, which in the retracted position, fit into and form part of the upper and lower mainplane surfaces. The airbrake system allows for three positions of extension.

(a) MEDIUM DRAG - Drag posts partially extended and flaps tilted to 35°.

(b) HIGH DRAG (U/C 'UP') - Drag posts almost fully extended and flaps tilted to 55°

(c) HIGH DRAG (U/C 'DOWN') - Drag posts fully extended and flaps tilted to 80°.

Extension or retraction of the airbrakes to these positions is effected by a rotary actuator which consists of two motors coupled by a differential reduction gearbox to drive a common shaft. Reversing relays enable the motors to be rotated in either direction. Under normal conditions, both motors function in tandem to extend the airbrakes from the 'IN' to the initially selected drag position. Further extention or retraction will be effected by the 'A' motor only, the 'B' motor acting as a standby motor. Changeover to the standby motor is achieved by operation of the emergency switch.

2. Airbrake Motors

The airbrake actuator ROTAX type CA.1102 consists of two motors working at 200 volts A.C.3 phase, 400 cycles. The motor operation has been sufficiently described in paragraph 1.

3. Transformer Rectifier Units (Rotax Type U5201/1)

Two units are employed, one for each motor to operate the brake solenoid associated with the motor. The primary of the Transformer Rectifier unit is energised from the load current of the motor and after rectification is applied to the brake solenoid.

4. Time Delay Units

Two units are used in the control circuit of the motors, one unit per motor. The units are calibrated to give different time delays as follows:-

(a) 'A' motor - TDU - .25 seconds

(b) 'B' motor - TDU - 1.05 seconds

The purpose of the units and the reason for the differing delays is firstly to allow sufficient time for the motor brakes to operate during rapid airbrake reversing operations, and secondly, to prevent the starting loads of both motors being applied to a common supply source should generating conditions be other than normal.

The delay is achieved by a normal capacitor/resistance timing circuit working in conjunction with a transistor. (The transistor in this case acting as a switch).

5. Power Factor Correctors

Four units are fitted, two in the supply side of each motor. They provide power factor correction for the motor and Transformer Rectifier unit by reducing their combined components.

Cont/6. Reversing Relays. ....

6. Reversing Relays

These relays control the direction of rotation of their associated motors by interchanging A and C phases, sometimes referred to as natural-phase and anti-phase changes.

7. Limit Switches

Twelve micro-switches are disposed around the fixed section of the airbrake drag posts to control the travel of the airbrakes between extreme and intermediate settings.

The operation of the micro-switches if referred to on the diagram is self evident with the exception of micro-switches E and F. It will be seen that they are controlling the 35° setting. However, switch F operates at 34½° (airbrake moving out) and switch E operates at 35½° (airbrake moving in). This arrangement prevents airbrake 'hunting' around the mean setting of 35°.

8. Circuit Operation (Normal)

Reference to the diagram will show the circuit with the airbrakes selected 'IN'. In this condition the magnetic indicator is energised 'BLACK' via micro-switches [illegible] K. If the undercarriage is down a 28 volts D.C. supply is fed from fuse 679 via the nosewheel down micro-switch, and the test switch to energise R.240 thus allowing the airbrakes to be selected to 80°.

(a) Selection to Medium Drag (35°)

Placing the selector switch to 'MEDIUM' will place a 28 volts D.C. supply to terminal X3 of the 'A' motor reversing relay via fuse 551, the emergency switch, micro-switches E, F, C and M. In the case of the 'B' motor the 28 volts D.C. supply is conveyed to terminal X1 of the reversing relay via fuse 640, the other half of micro-switches E, F, D and L. Simultaneously the associated Time Delay Units are activated, and when the respective time cycles are complete, the supply contactors will operate to move the motors,

When the drag posts have been driven to the 35° position, micro-switch F changes over which breaks the supply to the 'A' and 'B' motors and energises the hold off relay (r203). Relay 203 will be held in since the 28 volts via A and J is also applied to the coil. The 'D' motor is now held off the circuit.

(b) Selection to 'IN'

Selecting the airbrake selector to 'IN' will place a 28 volts D.C. supply to terminal X1 of the 'A' motor reversing relay via fuse 551, emergency switch and the contacts of micro-switch K. The 'A' motor will commence to run after the appropriate delay and the drag posts retract, returning the circuit to the condition shown on the diagram.

(c) Emergency 'IN'

Considering the circuit condition arrived at in paragraph 8(a) at 35°. If for some reason the 'A' motor failed to operate to return the drag posts 'IN' when selected, then operation of the emergency switch to 'EMERGENCY' will cause the hold-off relay to de-energise. This action result in a 28 volts D.C. supply being fed to terminal X3 of the 'B' motor via fuse 640, the normal selector, micro-switches, B and the hold off relay (R203).. The 'B' motor will then run the drag posts in to the 'IN' position.

9. High Drag 55° and 80°

It is not considered necessary to describe these positions since in principle they are similar in action to the 35° position.

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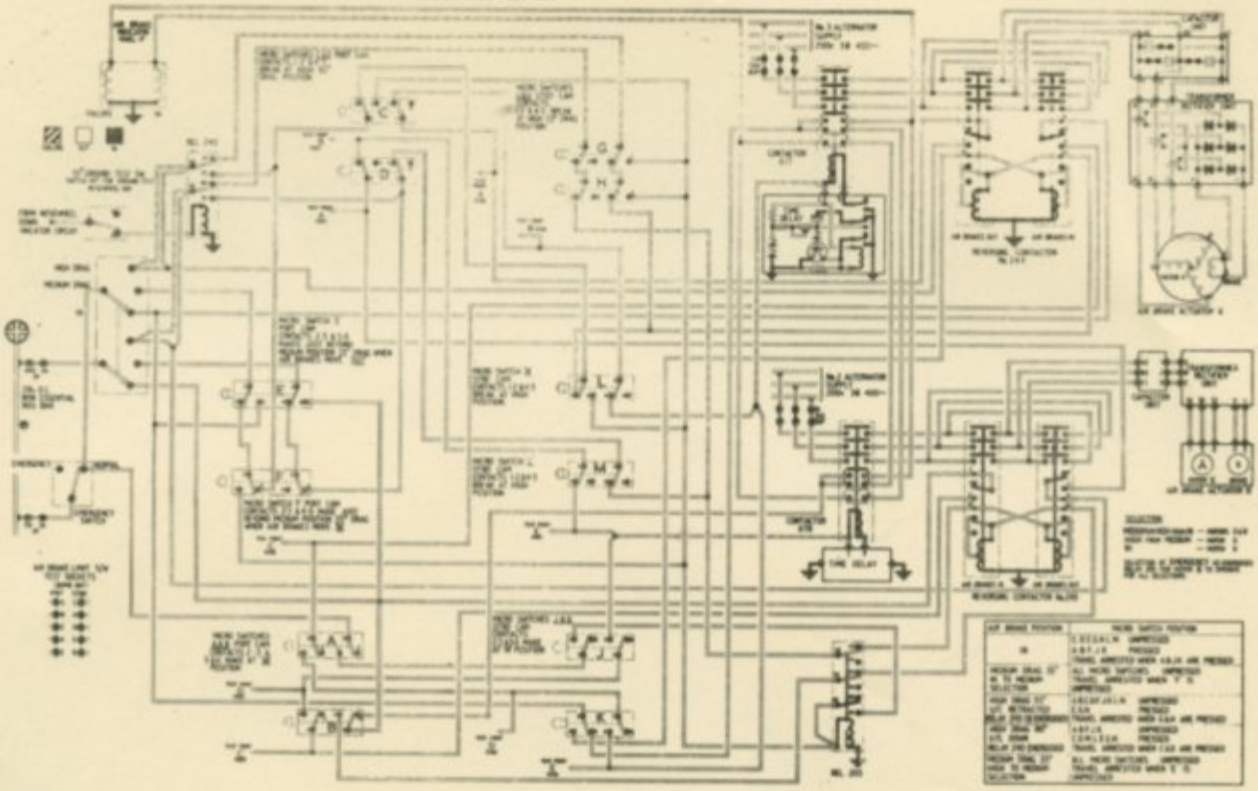
COMPONENT	NO.	LOCATION
Airbrake Motor	2	Bomb Arch 44
Transformer Rectifier Unit	2	Bomb Arch 44
Reversing Relay	2	Bomb Arch 44
Time Delay Units	2	Bomb Arch 44
Test Switch	1	Nosewheel Bay
Airbrake Selector	1	Throttle pedestal
Emergency Switch	1	Throttle pedestal
Power Factor Correctors	4	Bomb Arch 44



FAILURES

1. PRE-MOD.1340 Ignore references to FAILURE (Striped) indication. The remaining failures are the same.

2. MAGNETIC INDICATOR SHOWS FAILURE (Striped). Shows that airbrakes are IN but contacts of contactor 677 or 678 still closed (i.e., "welded"). Switch to EMERGENCY and check magnetic indicator:-
   (i) If now WHITE, contactor 677 still closed. Make any further selections on EMERGENCY (continuous WHITE indicator).
   (ii) If still STRIPED, contactor 678 still closed. Remove fuse 640 (3P) and make all further selections on NORMAL, (continuous WHITE indicator).

3. FUSE FAILURES 28 volt or 200 volt fuse failures prevent appropriate motor working. Rupture of fuse 551 (4P) is the same as selecting EMERGENCY and therefore airbrakes will move on all selections. The A.E.O. should check kW rises on appropriate alternators during the pre-flight checks to ensure that both motor systems are operating correctly. The Port motor ("B" on diagram) is fed from No.2 busbar and the Starboard ("A") from No.3 busbar (post Mod.1552) or No.4 busbar (pre Mod.1552). The following table gives the motor operation during normal and fuse failure circumstances, assuming that the normal pre-flight check is being carried out.

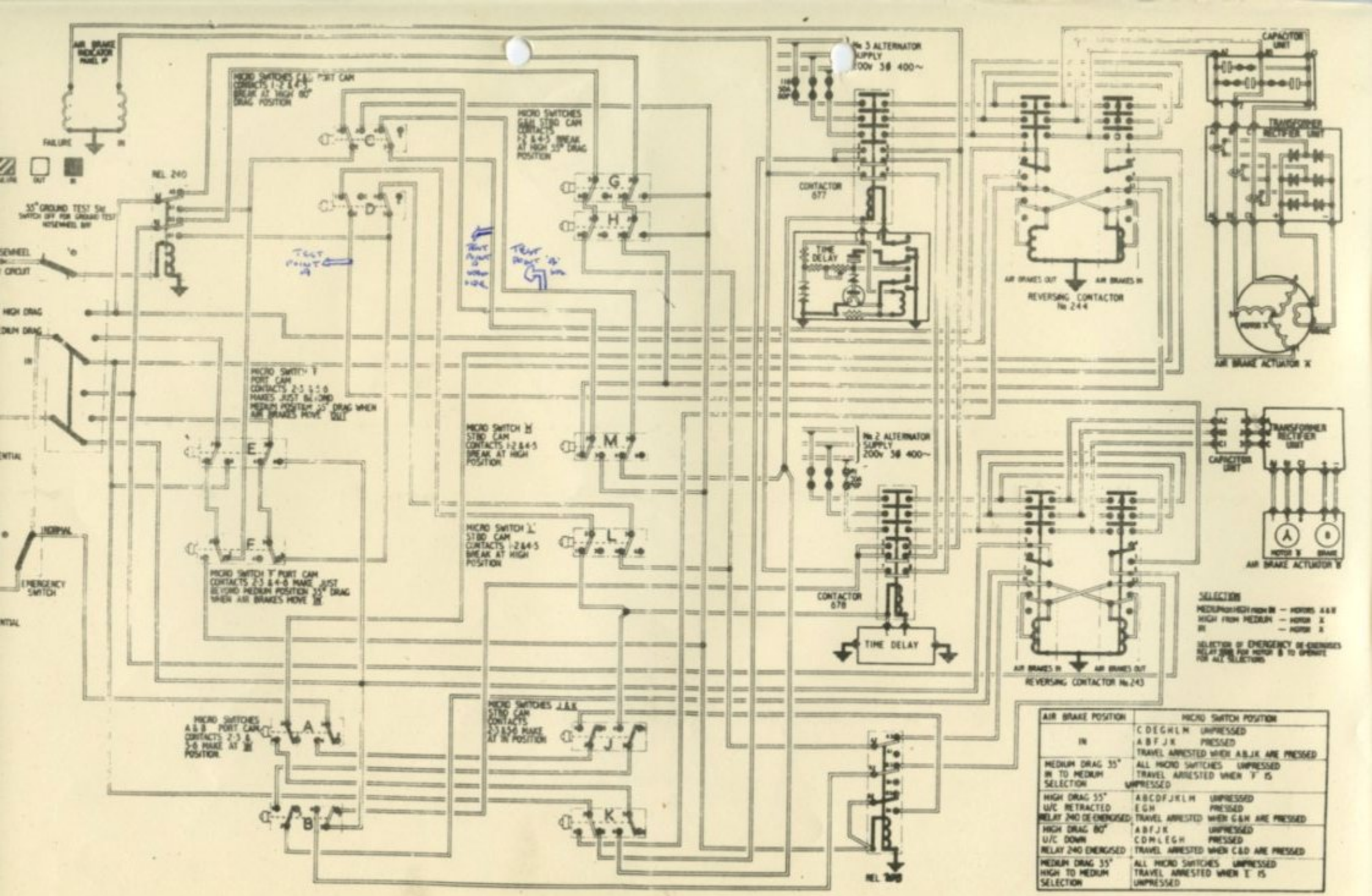
	MOTOR OPERATION				
SELECTION	1 NORMAL	2 IF F551(4P) U/S (SAME AS EMERGENCY)	3 IF F640(3P) U/S	4 IF F81(59P) U/S	5 IF F116(60P) U/S (F152(61P) PRE MOD 1552)
NORMAL: IN to MED.	BOTH (A and B)	PORT (B) ONLY	STBD (A) ONLY	STBD (A) ONLY	PORT (B) ONLY
NORMAL: MED to HIGH	STBD (A) ONLY	PORT (B) ONLY	STBD (A) ONLY	STBD (A) ONLY	NO MOVEMENT
NORMAL: HIGH to MED	STBD (A) ONLY	PORT (B) ONLY	STBD (A) ONLY	STBD (A) ONLY	NO MOVEMENT
EMERGENCY: MED to IN	PORT (B) ONLY	PORT (B) ONLY	NO MOVEMENT	NO MOVEMENT	PORT (B) ONLY

To differentiate between fuse failures in columns 3 and 4, bring airbrakes IN on NORMAL, switch to EMERGENCY and check magnetic indicator:-

(A) If BLACK:- fuse 640 (3P) must be serviceable.
(B) If WHITE:- fuse 640 (3P) may be unserviceable.

NOTE:- If airbrakes are IN, switch to EMERGENCY before checking 28 volt fuses. If left in NORMAL, the supply ends of the fuses are connected together as follows. From fuse 551 via N/E switch, IN position of selector switch, micro K2/3, contactor 677 5/6, 678 7/8, 677 7/8, 678 5/6, micro B 5/6, IN position of selector switch to fuse 640. This means that a light in the fuse tester would be obtained at both ends of an unserviceable fuse if the airbrakes were IN and NORMAL selected. Prior to Mod.1340, the same applies but the route is different (via switches and micros A and J).

4. AIRBRAKES CANNOT BE BROUGHT IN If any airbrake surfaces remain out after both NORMAL and EMERGENCY selections to IN have been made, then the 28 volt fuses should be checked. If both fuses are serviceable, then they should be removed to minimise the possibility of damage by keeping a motor running.



AIR BRAKE POSITION	MICRO SWITCH POSITION
IN	C D E G H L M UNPRESSED A B F J K PRESSED TRAVEL ARRESTED WHEN A B J K ARE PRESSED
MEDIUM DRAG 35° IN TO MEDIUM SELECTION	ALL MICRO SWITCHES UNPRESSED TRAVEL ARRESTED WHEN 'F' IS UNPRESSED
HIGH DRAG 35° U/C RETRACTED RELAY 240 DE-ENERGISED	A B C D F J K L M UNPRESSED E G H PRESSED TRAVEL ARRESTED WHEN G & H ARE PRESSED
HIGH DRAG 80° U/C DOWN RELAY 240 ENERGISED	A B F J K UNPRESSED C D M L E G H PRESSED TRAVEL ARRESTED WHEN C & D ARE PRESSED
MEDIUM DRAG 35° HIGH TO MEDIUM SELECTION	ALL MICRO SWITCHES UNPRESSED TRAVEL ARRESTED WHEN 'E' IS UNPRESSED