Chapter 7 ALIGHTING GEAR, ARRESTING HOOK AND WING FOLD

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Introduction

1. This chapter contains a description of the electrical circuits used in conjunction with the alighting gear, the alighting gear indication, nose wheel steering, circuit protection relays, arresting hook, arresting hook and alighting gear position indication and wing and nose fold indication, together with the method of operation. A routeing diagram of each circuit is included. Where relevant, the hydraulic systems are described in full in Book 1, Sect. 3, Chap. 6 and *microswitch adjustments in Book* 1, Sect. 2, Chap. 4. Detailed information on the standard components employed is contained in the Air Publications quoted in Chapter 1 of this Section.

Modification standard

2. This chapter includes the following modifications:-

08, 58, 59, 60, 155, 169, 173, 184, 185, ◀ 186, 206, 323, 502, 513 and 629. ▶

ALIGHTING GEAR RETRACTION AND EXTENSION

General

3. The alighting gear comprises two undercarriage units (port and starboard), a nose wheel unit and a tail skid. All are operated by hydraulic power, controlled by electro-hydraulic selector valves which are selected by a three-button switch unit marked UP – DOWN – EMERGENCY DOWN. This switch unit is located on the pilot's port control panel and has an interlocking device between the switch buttons to ensure that only one button can be depressed at a time. Also incorporated in the switch unit is a solenoid-operated locking device to prevent an alighting gear UP selection being made while the aircraft is on the ground. The locking device can be cancelled by rotating the UP button 60 deg and then depressing the button to close the switch contacts. To reset the lock, the DOWN button should be pressed and a special resetting tool or a length of stiff wire inserted in a small hole in the lock button and pressed down until the lock releases.

4. Three hydraulic selector valves are incorporated in the normal circuit, one to control retraction and extension of the undercarriage and nose wheel units, one to control the related door locks and release of the up-locks, and one to control the tail skid. Each valve has two solenoids, which are referred to in the following text as the 'lock' and 'unlock' solenoids in the case of the up-locks release and door locks selector valve, and the 'up' and 'down' solenoids in the case of the other two. Should the normal electrical or hydraulic system fail, an emergency circuit incorporating a further two electro-hydraulic selector valves can be brought into operation to extend the undercarriage and nose wheel units only. No further selection can then be made until the hydraulic release valve has been manually reset after the aircraft has landed (*Book* 1, *Cover* 2, *Sect.* 3, *Chap.* 6).

5. If an EMERGENCY DOWN selection fails to lower the landing gear, due to a failure of any of the door unlocked microswitches, an EMERGENCY OVERRIDE switch, located on the standby control panel C-D, can be selected to DOWN to connect a d.c. supply direct to the emergency selector valve.

◀ **Note...**

This switch is fitted with a frangible lock which must be broken before a selection can be made.

Normal operation *(fig 1 and 2 - 2a)*

6. A d.c. supply is fed from fuse D8 (panel C-Q) to the unlock solenoid of the up-locks release and door locks selector valve B-AP. The supply is also fed via the doors unlocked microswitches to the down solenoid of the undercarriage and nose wheel unit selector valve B-AQ and the tail skid selector valve R-BZ. With the aircraft on the ground, the circuit protection relays D and G are de-energized and the open contacts D1–1a and G1–1a break the circuit to the lock solenoid of the UP button, thereby preventing an UP selection. The lock solenoid circuit is *also broken by operation of the armament* ground test microswitch WS-BK (*para* 20) to prevent an UP selection being made when the circuit protection relays are energized for test purposes with the aircraft on the ground. The circuit protection relays circuit is described in para 17.

Up selection

7. When the aircraft becomes airborne, the circuit protection relays are energized; ◀ relay contacts D1–1a and G1–1a close and a 28V supply from fuse D8 – via contacts 1–2 and 4–5 of the armament ground test switch – is fed to the solenoid of the UP switch lock, releasing the lock and permitting an UP selection to be made. When the UP selection has been made, a supply is fed from fuse D8, via the ◀ contacts of the nose wheel retraction protection circuit, to the up solenoid of the undercarriage and nose wheel unit selector valve B-AQ and the up solenoid of the tail skid selector valve R-BZ. Hydraulic power then retracts the alighting gear. The doors are pulled up by mechanical linkage connected to the retracting legs which, when fully retracted, actuate three series-connected microswitches located one in each wheel bay and identified N-BC, WP-AE and WS-AE. These switches complete a circuit to energize the lock solenoid of the up-locks release and door locks selector valve B-AP, which operates the jacks to lock the doors in the closed position.

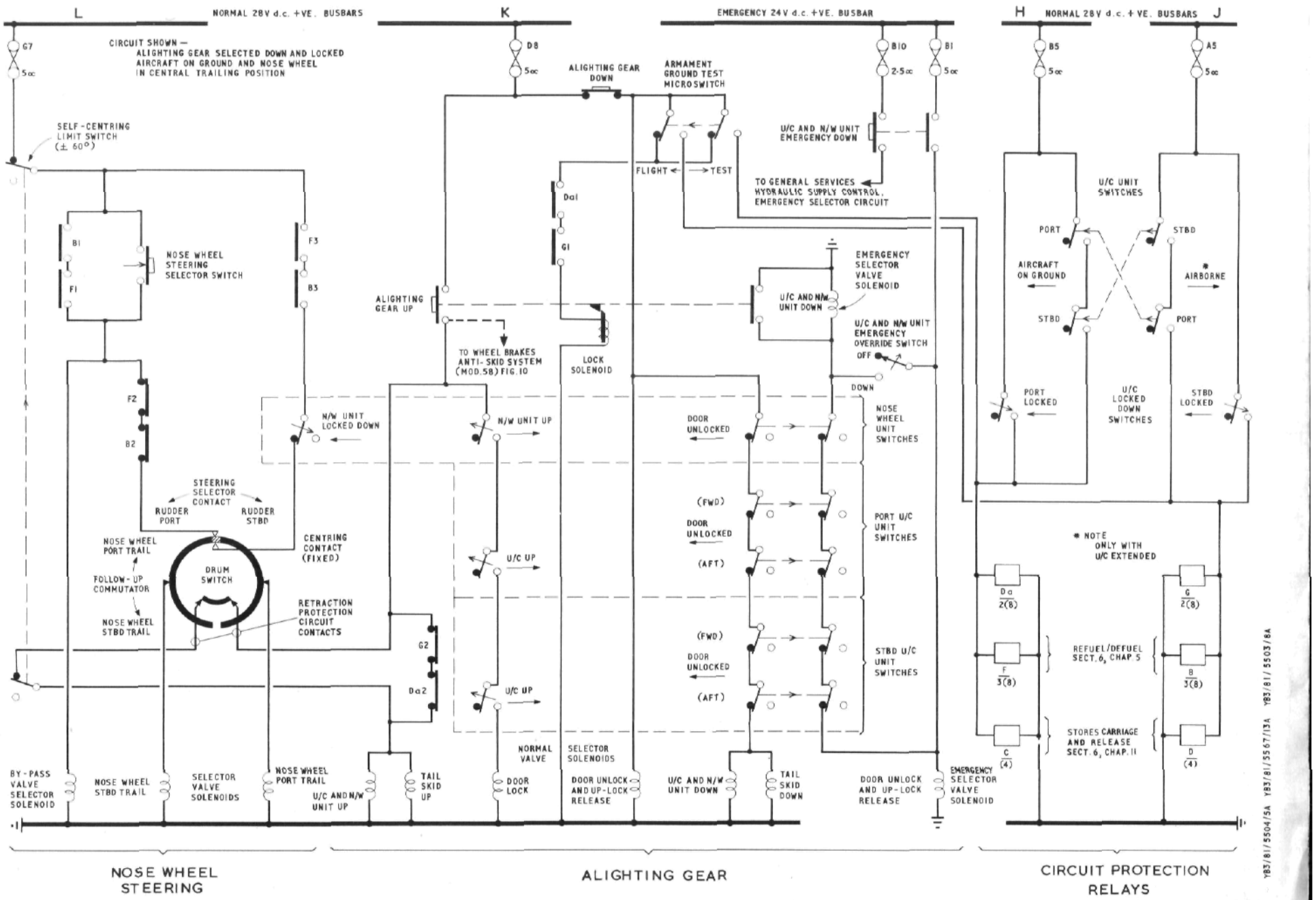

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Fig. 1. Alighting gear – theoretical

◀ Normal busbar wiring corrected – relay identities amended ▶

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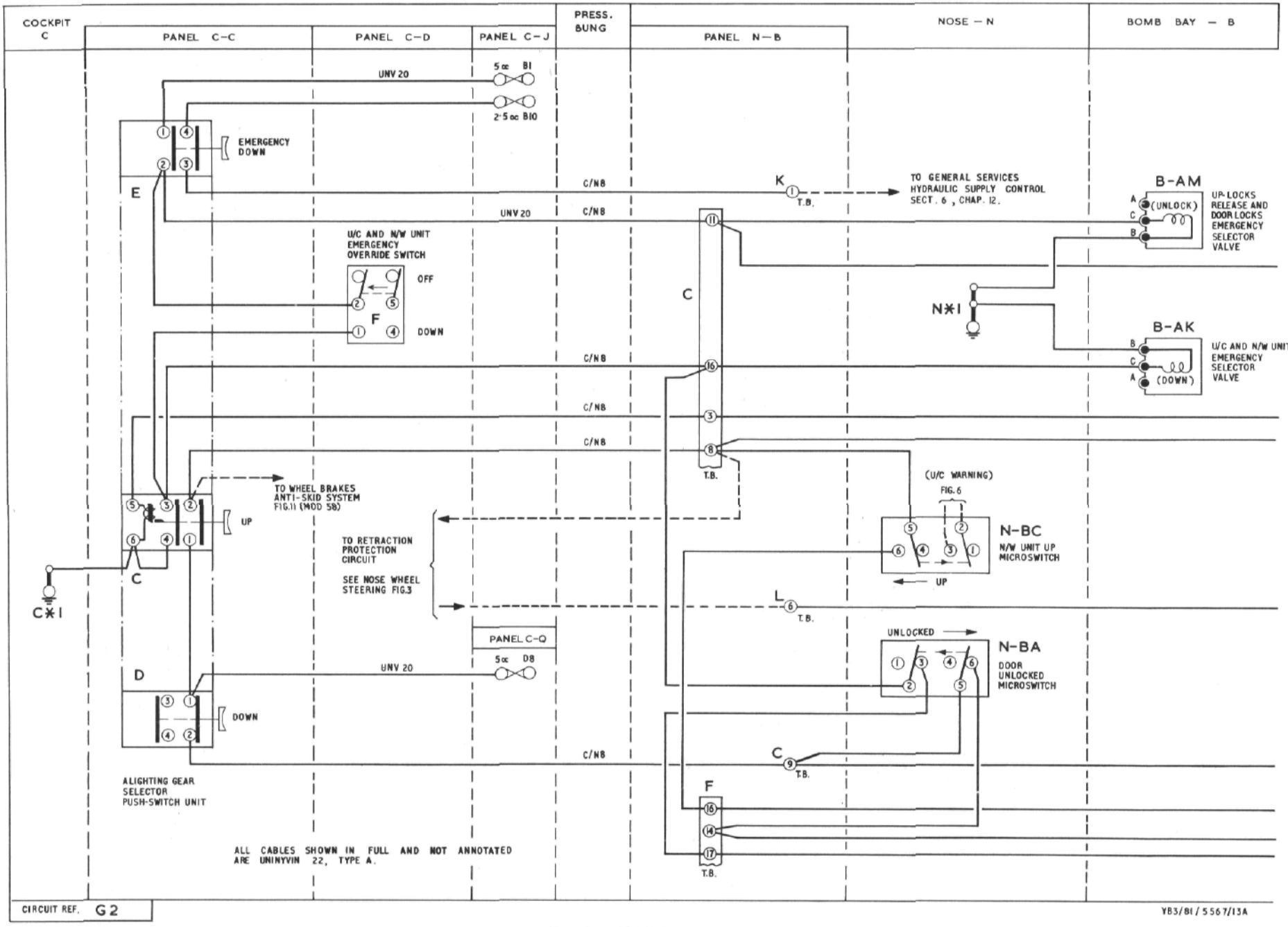

Fig. 2. Alighting gear

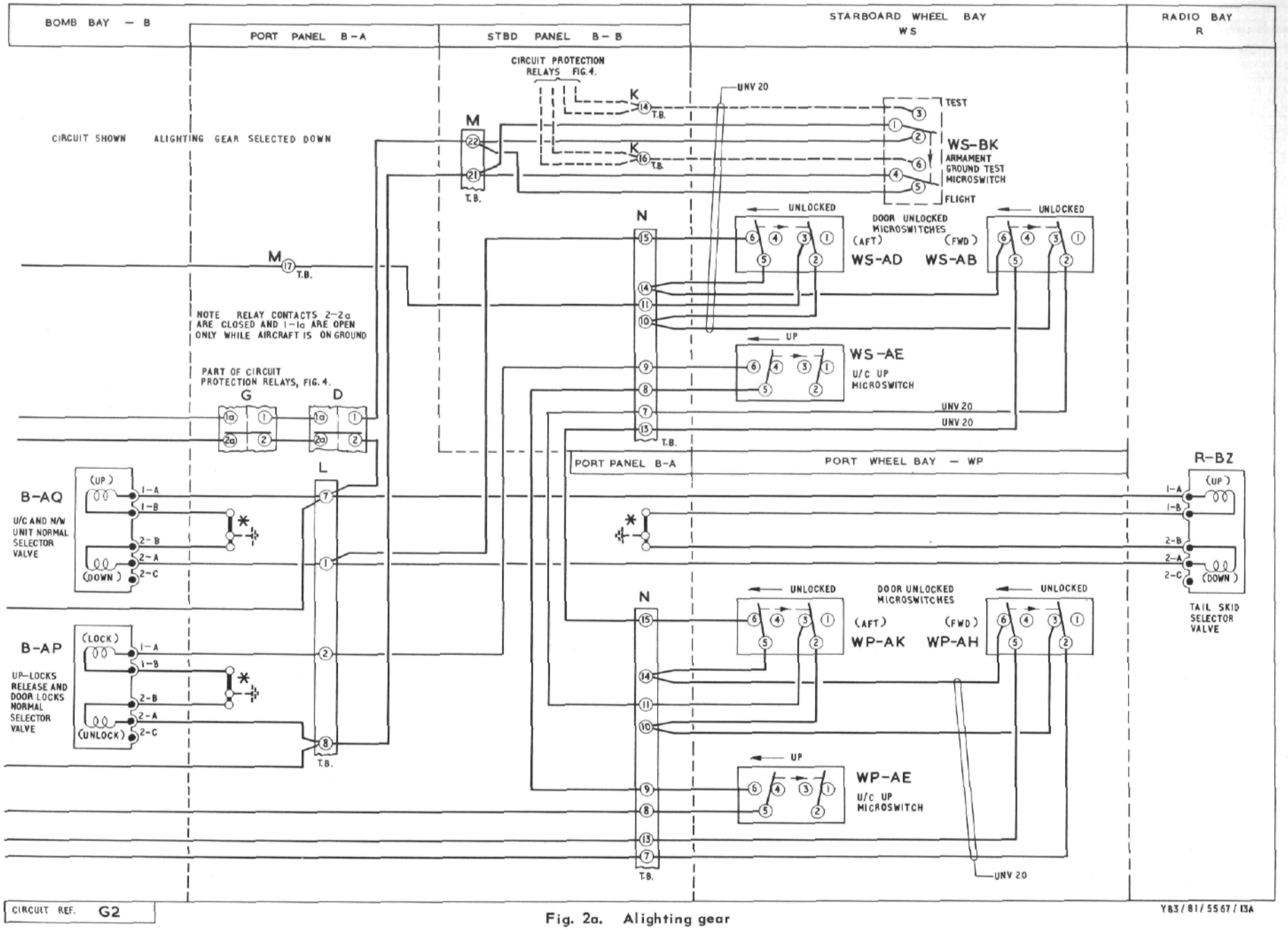

Fig. 2a. Alighting gear

Down selection

8. Depression of the DOWN button of the selector switch completes a circuit from fuse D8 to the unlock solenoid of the up-locks release and door locks selector valve B-AP which results in release of the up-locks and door locks. The microswitches N-BA, WP-AH, WP-AK, WS-AB and WS-AD are depressed and connect a supply to the down solenoids of the selector valves B-AQ and B-BZ which operate the jacks to lower the alighting gear.

Emergency operation

9. Should the normal electrical or hydraulic system fail to lower the alighting gear, the undercarriage and nose wheel units may be lowered by the emergency system. By depressing the EMERGENCY DOWN button, a supply is fed from fuse B10 (panel C-J), via terminals 4–3 of the emergency down switch, to the general services hydraulic control circuit, changing the normal hydraulic supply to emergency supply as described in Chap. 12 in this Cover. From fuse B1 (panel C-J) a supply is fed, via terminals 1–2 of the emergency switch, to the solenoid of the up-locks release and door locks emergency selector valve B-AM which releases the up-locks and door locks. The action of the door locks actuates the associated microswitches WS-AD, WS-AB, WP-AK, WP-AH and N-BA, completing a circuit to the undercarriage and nose wheel unit emergency selector valve B-AK. The emergency hydraulic system then lowers both undercarriage units and the nose wheel unit. The tail skid is not included in the emergency system.

Emergency override switch

10. Should any of the door unlocked microswitches fail to function, the selection of the emergency override switch to DOWN feeds a supply from fuse B1 via contacts 1 - 2 of the emergency down switch and contacts 2 - 1 of the emergency override switch, direct to the undercarriage and nose wheel unit emergency selector valve, so by-passing the door microswitch circuit.

Note...

The emergency down switch must be depressed before the emergency override circuit becomes operative.

Emergency retraction

11. Should an emergency necessitate the retraction of the alighting gear with the aircraft on the ground (e.g., during a landing run with total brake failure), the safety lock on the UP selector button can be overridden by rotating the button clockwise through 60 deg. Subsequent depression of the UP selector button completes a circuit from fuse D8 via contacts 2a - 2 of relays G and D to the up solenoid of the undercarriage and nose wheel unit selector valve B-AQ and the tail skid selector valve B-BZ, by-passing the nose wheel retraction protection circuit. The alighting gear will then retract, irrespective of whether the nose wheel is in the central trailing position or not.

NOSE WHEEL STEERING

General

12. This system is hydraulically operated and enables the nose wheel to be steered through 50 deg either side of the central trailing position when taxying, and to automatically centre the wheel after take-off.

Description

Drum switch

13. A drum switch, which controls the angle of movement of the nose wheel, incorporates input and follow-up levers operated by the rudder controls and the nose wheel pivot bracket respectively. The internal contacts are so arranged that one contact moves with the input lever for the purpose of making a steering selection and an insulated segment moves with the follow-up lever to cancel the selection at the desired steering angle. When the aircraft is airborne, a fixed contact on the drum switch enables the nose wheel to be automatically centred to the central trailing position in readiness for retraction. There are also two additional contacts in the drum switch which operate in conjunction with a separate segment; these contacts are wired in series with the up solenoids in the alighting gear selector valves and ensure that the alighting gear cannot be retracted before the nose wheel has reached the central trailing position.

Self centring limit microswitch

14. This switch, marked N-BF, is mounted on top of the nose wheel leg and and is operated by a cam rotated by the castering action of the nose wheel. When the maximum self-centring angle of 55-60 deg from the central trailing position is exceeded, the microswitch contacts open to prevent a steering selection being made, and to ensure that the nose wheel retraction protection safety circuit is not re-made.

Operation *(fig 1 and 3)*

◀**15.** With the aircraft on the ground and▶ the nose wheel steering push-switch depressed, a supply is fed from fuse G7 (panel C-Q) via the closed contacts of the nose wheel self-centring limit switch to the solenoid of the by-pass valve selector N-BE. The valve allows hydraulic fluid to close a by-pass valve which prevents the flow of hydraulic fluid between either side of the steering jack and prepares the system for a steering selection. A circuit

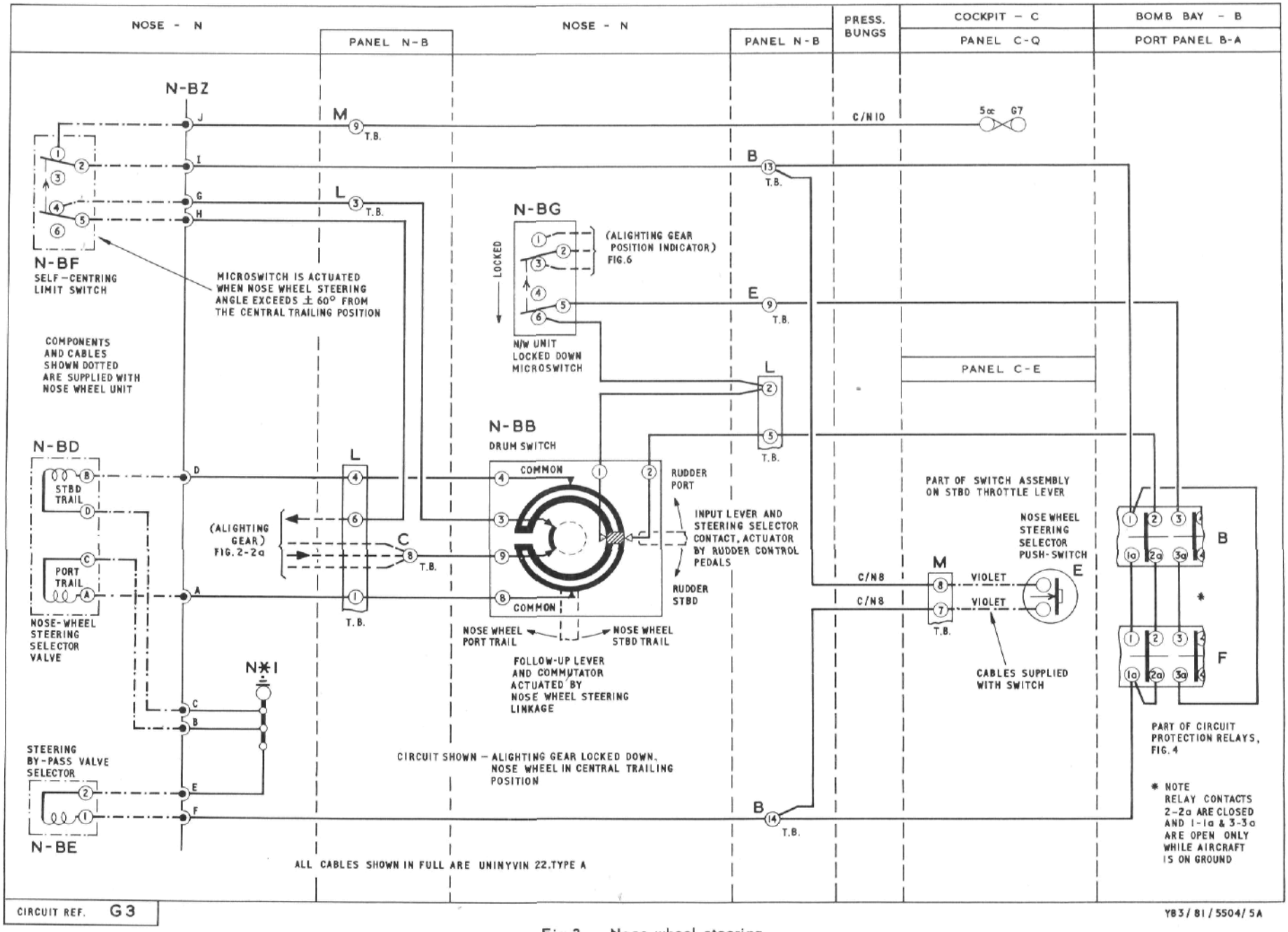

Fig.3. Nose wheel steering

is also completed via contacts 2a–2 of the circuit protection relays F and B to contact No. 2 on the drum switch. Movement of the rudder pedals now completes the circuit from contact No. 2 to contact No. 4 or 8, depending on the direction of movement, then to the appropriate solenoid in the steering selector valve N-BD. The hydraulic system is pressurized and turns the wheel in the selected direction. The circuit is broken by the operation of the follow-up lever or the release of the selector button.

Automatic centring

16. When the aircraft is airborne a supply is fed from fuse G7 via contacts 1 - 1a of relays B and F to the by-pass selector valve and via contacts 3a - 3 of the same relays, through the nose wheel unit locked down microswitch N-BG to terminal No. 1 on the drum switch. Any malalignment of the nose wheel is then detected by the drum switch which will complete the circuit to either contact No. 4 or 8 depending upon the position of the follow-up lever, then to the appropriate solenoid of the steering selector valve. The steering system then operates in the normal manner and aligns the nose wheel in readiness for retraction. When the alighting gear is selected UP, the supply to the drum switch is broken by the nose wheel locked down microswitch while the by-pass valve selector remains energized during flight to hydraulically lock the wheel in the central position.

CIRCUIT PROTECTION RELAYS

General

17. Six magnetic relays are incorporated in the electrical system to ensure that certain circuits function only when the aircraft is airborne and others function only when the aircraft is on the ground. Four of these relays are located on panel B-A and are identified B, D, F and G, while the remaining two are located on panel C-R and identified C and D. The circuits they affect are deck approach warning, alighting gear operation, nose wheel steering, windscreen heating, wing fold selector lever lock, refuel/defuel, fuel jettison and stores release, jettison and fuzing. The relays affect these particular circuits as described in the relevant chapters. Control of the relays is by microswitches operated by the wheel forks of the port and starboard undercarriage units or, for ground test purposes, by a manually-operated microswitch in the starboard wheel bay (*para* 18).

Armament ground test switch

18. To enable flight conditions to be simulated during ground testing with the aircraft resting on its wheels, the armament ground test microswitch WS-BK provides an alternative means of energizing the circuit protection relays. This microswitch, located in the starboard wheel bay on the stabilizer beam aft of the rear spar ring, is actuated by the insertion and rotation through 90 deg of a ground equipment key, Ref No. 26NA/95121, in the guide of the microswitch mounting bracket.

Caution...

(1) When the armament ground test switch is operated to simulate flight conditions with the aircraft on the ground, the attention of all personnel must be drawn to the fact that the safety provisions normally provided by the circuit protection relays are not effective.

◀*(2) Except for special servicing requirements, operation of the armament ground test switch is unnecessary when the aircraft is supported on jacks. However, should a circuit fault cause the rupture of any of the fuses listed below, while the aircraft is on jacks with the test switch operated, all three fuses must be tested for serviceability after removing the switch operating key.*

Panel R-C, fuse A5 (5 amp)
Panel R-C, fuse B5 (5 amp)
Panel C-Q, fuse D8 (5 amp) ▶

Operation (fig 1 and 4)

19. With the aircraft on the ground and the undercarriage units locked down, the relays are de-energized. After the aircraft becomes airborne and the undercarriage wheel forks fully extended, contacts 2 - 3 of microswitch WS-AA and contacts 5 - 6 of microswitch WP-AA are closed to complete a circuit from fuse A5 (panel R-C) to the solenoids of relays B and G (panel B-A) and relay D (panel C-R). The other two contacts of the same microswitches complete a circuit from fuse B5 (panel R-C) to energize relays F and D (panel B-A) and relay C (panel C-R). When the undercarriage starts to retract, the action of the shortening mechanism results in the wheel forks being raised; this causes microswitches WP-AA and WS-AA to revert to the weight-on-ground condition and break the circuit to the relay solenoids. These solenoids are still held energized, however, by a circuit from fuse A5 via contacts 4 - 5 of the starboard undercarriage unit locked down microswitch WS-AG and from fuse B5 via the port undercarriage unit locked down microswitch WP-AG.

20. Actuation of the armament ground test microswitch WS-BK extends a supply, via fuse D8 in the normal d.c. fuse panel C-Q, to all six relays which then operate to simulate flight conditions in all the associated circuits except that for the lock solenoid of the alighting gear UP push-button. As this circuit is routed through contacts of the ground test microswitch which are open when the ground equipment key is inserted, the lock solenoid remains de-en-

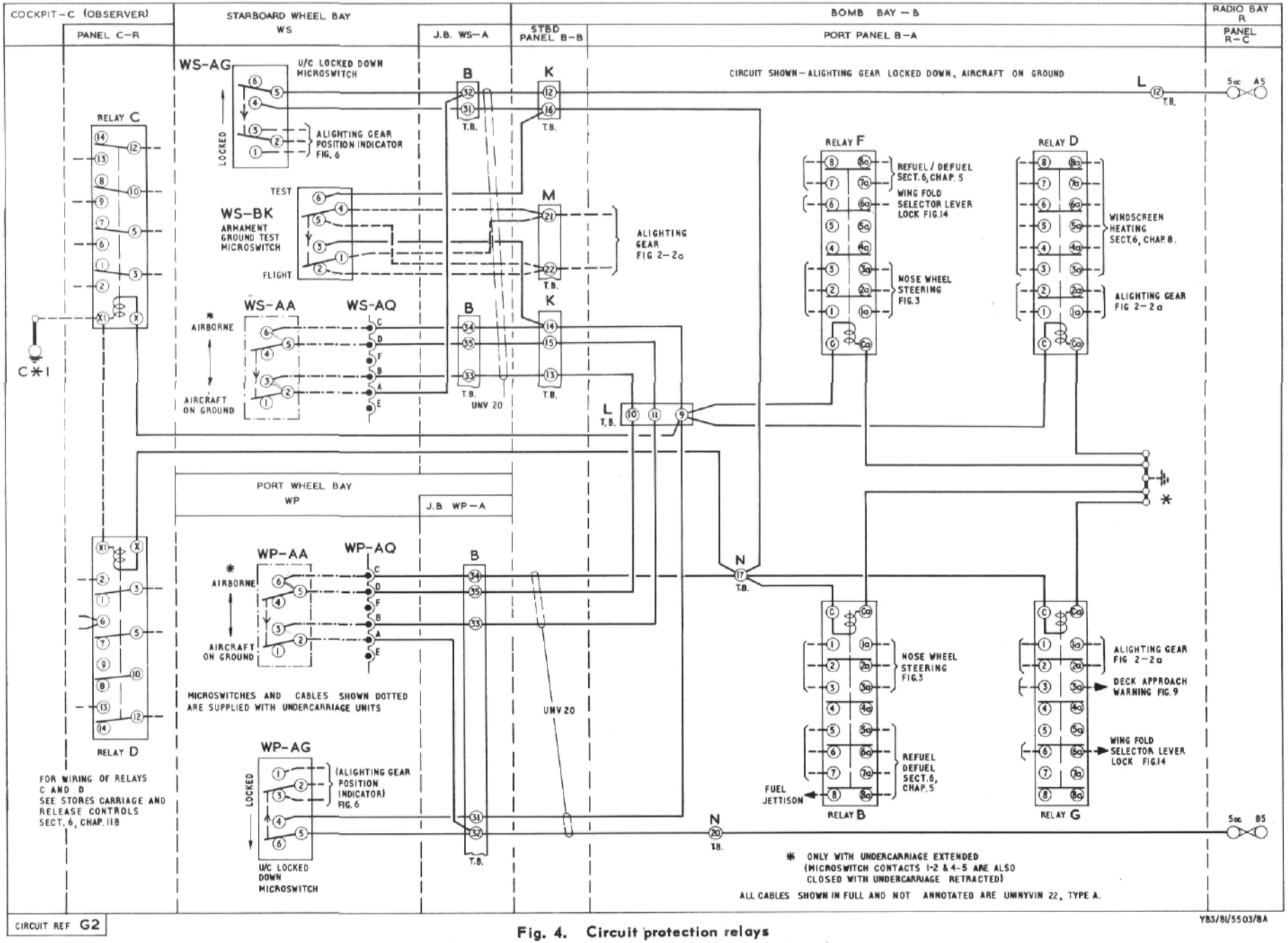

Fig. 4. Circuit protection relays

◀ Microswitch WS-AG amended to locked position ▶

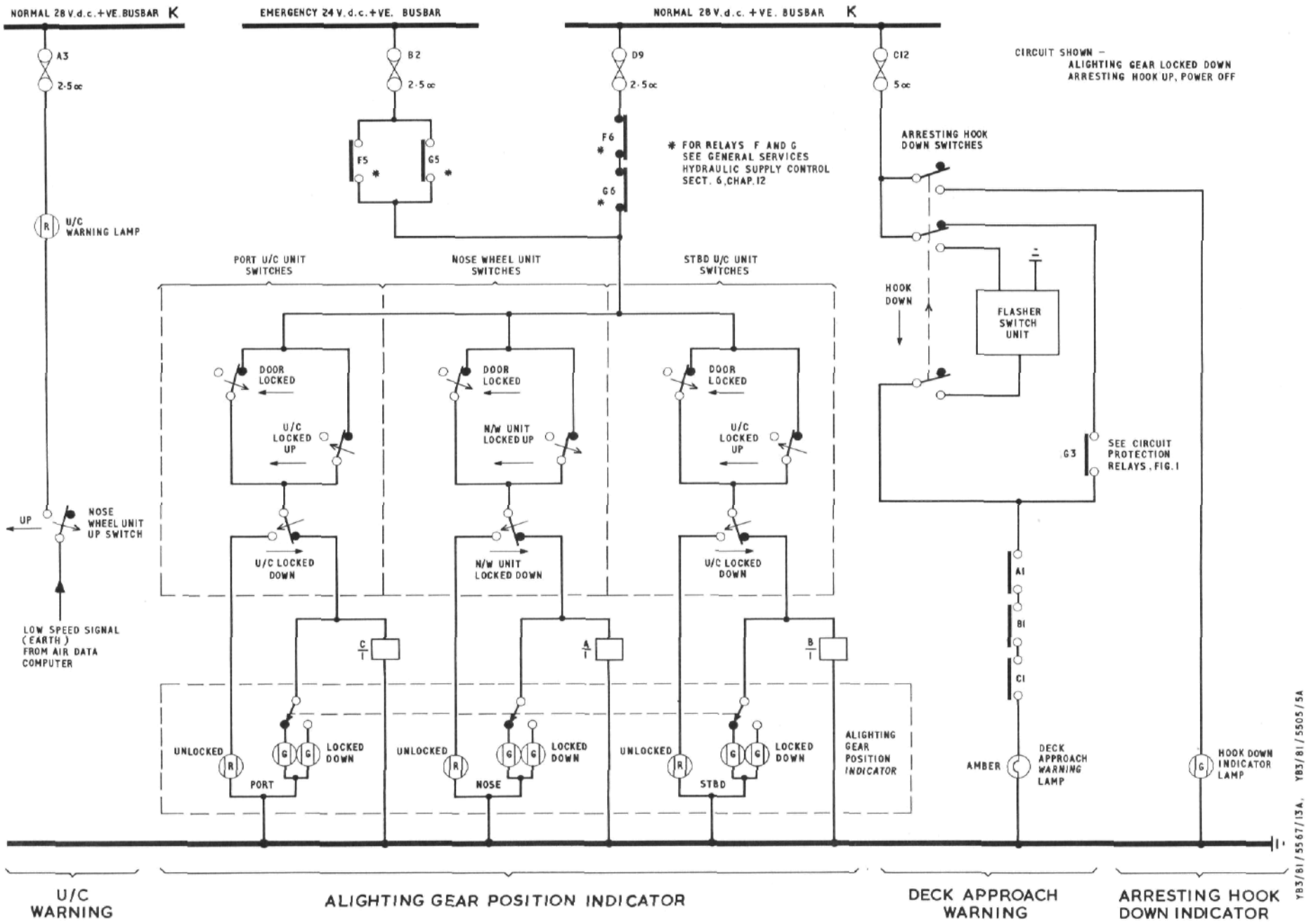

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Fig. 5. Alighting gear and arresting hook indication and deck approach warning

ergized to prevent an alighting gear UP selection being made.

ALIGHTING GEAR INDICATION

General

21. A position indicator and a warning lamp form an integral part of the alighting gear circuit; they are located on the pilot's port control panel and instrument panel respectively. The indicator provides visual indication of the position of each landing wheel and the state of the locking mechanism. Coloured screens incorporated in the indicator provide red and green displays, green to denote that the wheels are in the locked down position and the red display indicates that the wheels or doors are unlocked. When the wheels are in the up position and the doors closed and locked, all lights are extinguished.

Warning lamp

22. Should the aircraft speed fall below 0.25M with the nose wheel unit in the up position, a red warning light is displayed on the pilot's instrument panel. This lamp (5CX/1553) has a "night screen" incorporated.

Operation *(fig 5 and 6)*

23. With the undercarriage and nose wheel units locked down, the normal supply is fed from fuse D9 (panel C-Q) to terminals 6 - 6a of the changeover relays F and G, then to terminal F18 in the nose bay panel N-B. From here, the supply is continued via the nose wheel microswitches N-AZ, N-BG and N-CD to terminal 7 on the indicator and via the port wheel bay microswitches WP-AJ, WP-AF and WP-AG to terminal 6 on the indicator and via the starboard wheel bay microswitches WS-AC, WS-AF and WS-AG to terminal 2 on the indicator. Three green lights are displayed indicating that the alighting gear is locked down. From terminals 2, 5 and 6 of terminal block C a feed is taken to energize the solenoids of three relays within a relay unit marked N-BN. The three relays are energized when the two undercarriage units and the nose wheel unit respectively are locked down and are used to control the lamp in the deck approach warning circuit as described in para 34.

24. As the alighting gear starts to retract, microswitches N-BG, WP-AG and WS-AG are actuated and switch the supply to terminals 4, 5 and 3 of the indicator respectively, so displaying three red lights. When the alighting gear is locked up and the doors closed and locked, microswitches N-CD, N-AZ, WP-AJ, WP-AF, WS-AC and WS-AF are actuated and break the circuit to the indicator, thus extinguishing all the indicator lights. The supply to the warning lamp AH on the pilot's instrument panel is obtained via fuse A3 (panel C-Q), the earth return circuit being via the nose wheel unit up microswitch N-BC and a low-speed switching circuit within the ◀ the air data computer (*Cover 2, Sect. 7, Chap. 3*). Microswitches WP-AJ and WS-AC are also used in the a.c. power supplies ◀ circuit (*Chap. 3, this Section*). ▶

25. When the general services hydraulic system is operated by the emergency service, the alighting gear indication service operates in a similar manner to the normal, except that the power supply is fed from fuse B2 (panel C-J) via terminals 5 - 5a of the general services hydraulic control changeover relays F and G.

ARRESTING HOOK CONTROL

General

26. The arresting hook is recessed in the undersurface of the aircraft structure, aft of the radio bay and is raised and lowered by a hydraulic jack which is controlled by a solenoid-operated valve.

Function

27. Selection of the hook UP or DOWN is effected electrically by a switch, marked ARRESTER HOOK, UP – DOWN located on the pilot's port control panel C-C. In the event of a failure of the normal hydraulic or electrical systems, an emergency system can be utilized to lower the hook. This selection is effected by a switch on the pilot's standby control panel C-D marked ARRESTER HOOK, OFF – DOWN. Details of the arresting hook and the relevant hydraulic ◀ system are contained in A.P.101B-1201-1A, ▶ Cover 2, Sect. 3, Chap. 5 and 6.

Normal operation *(fig 7 and 8)*

Down selection

28. A selection to DOWN on the control switch completes a circuit from fuse E3 (panel C-Q) to the down solenoid of the selector valve R-BL. A hydraulic supply is then passed to the up-lock release jack to release the up-lock and the hook lowers under pressure from an associated accumulator.

Up selection

29. The hook can be raised by a selection to UP on the control switch, when the power is transferred to the up solenoid of the selector valve. The jack retracts causing the hook to rise until the up-lock operates automatically to secure the hook in the retracted position.

Emergency operation

30. Operation of the standby control switch to a DOWN selection completes a circuit from fuse A6 (panel C-J) to the ◀ hydraulic control circuit (*Chap. 12, this Section*) and from fuse A12 to the down ▶ solenoid of the emergency selector valve R-BM. The emergency hydraulic system releases the hook lock and the jack extends, lowering the hook. No further selection can

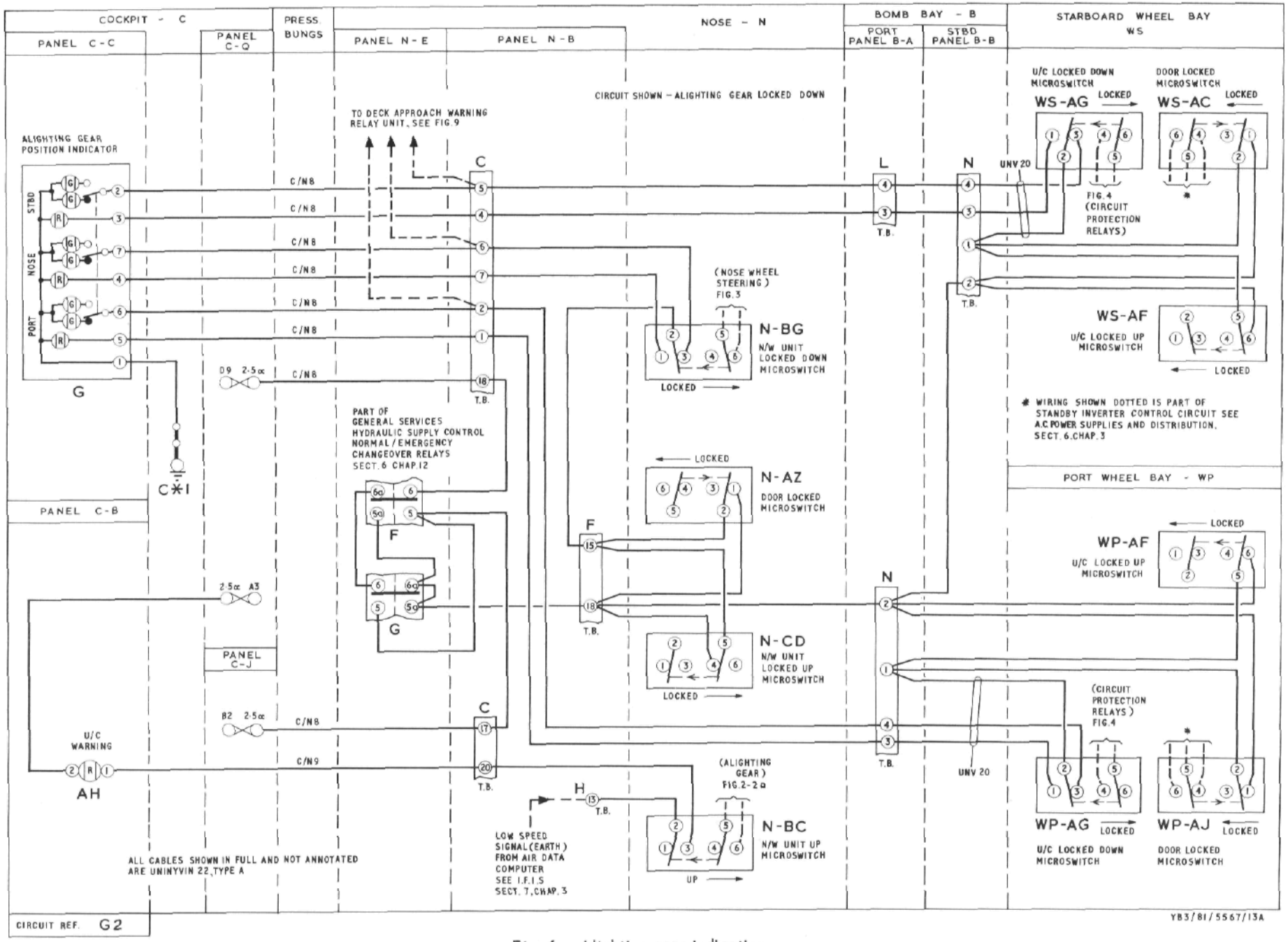

Fig. 6. Alighting gear indication

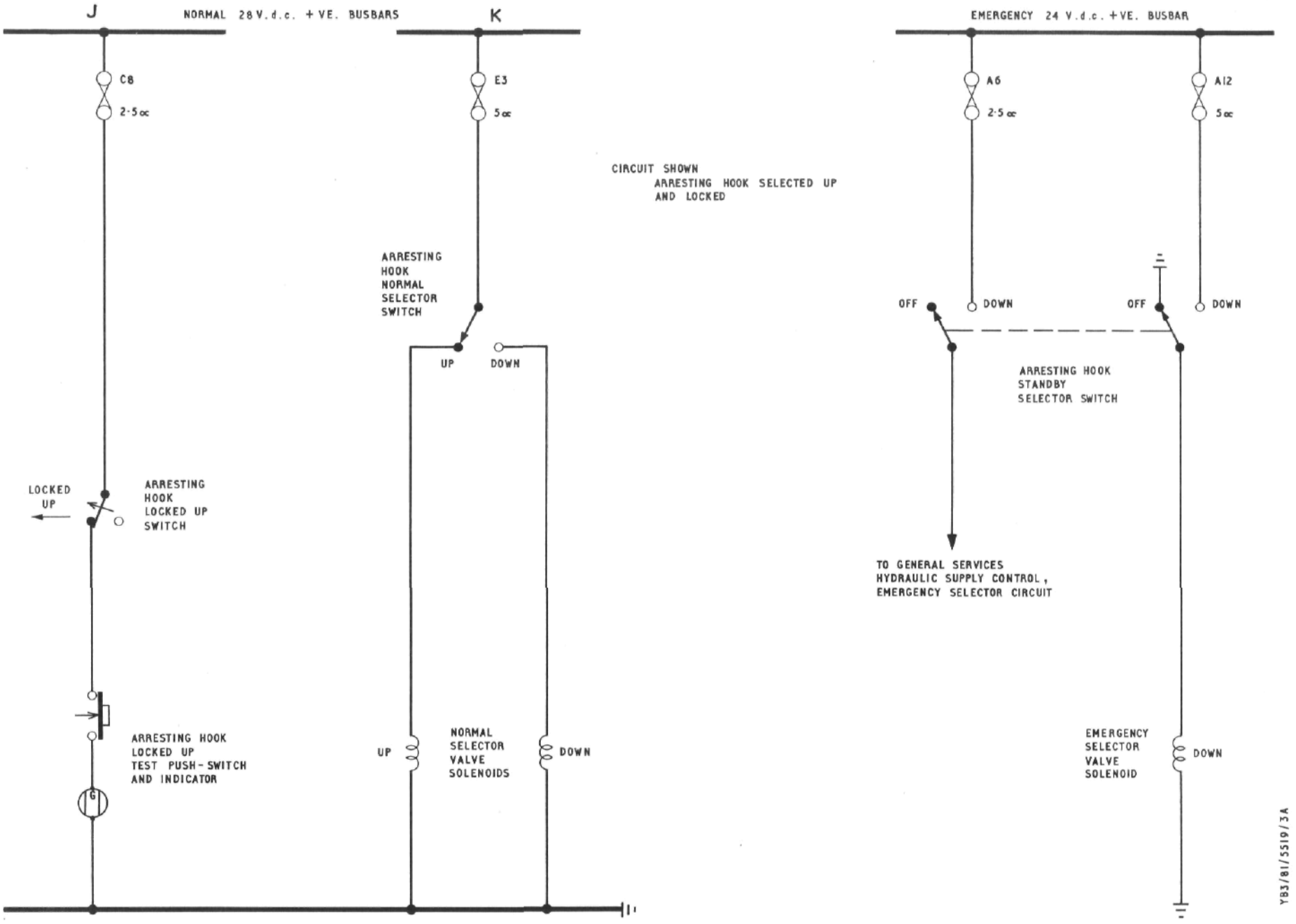

Fig. 7. Arresting hook control – theoretical

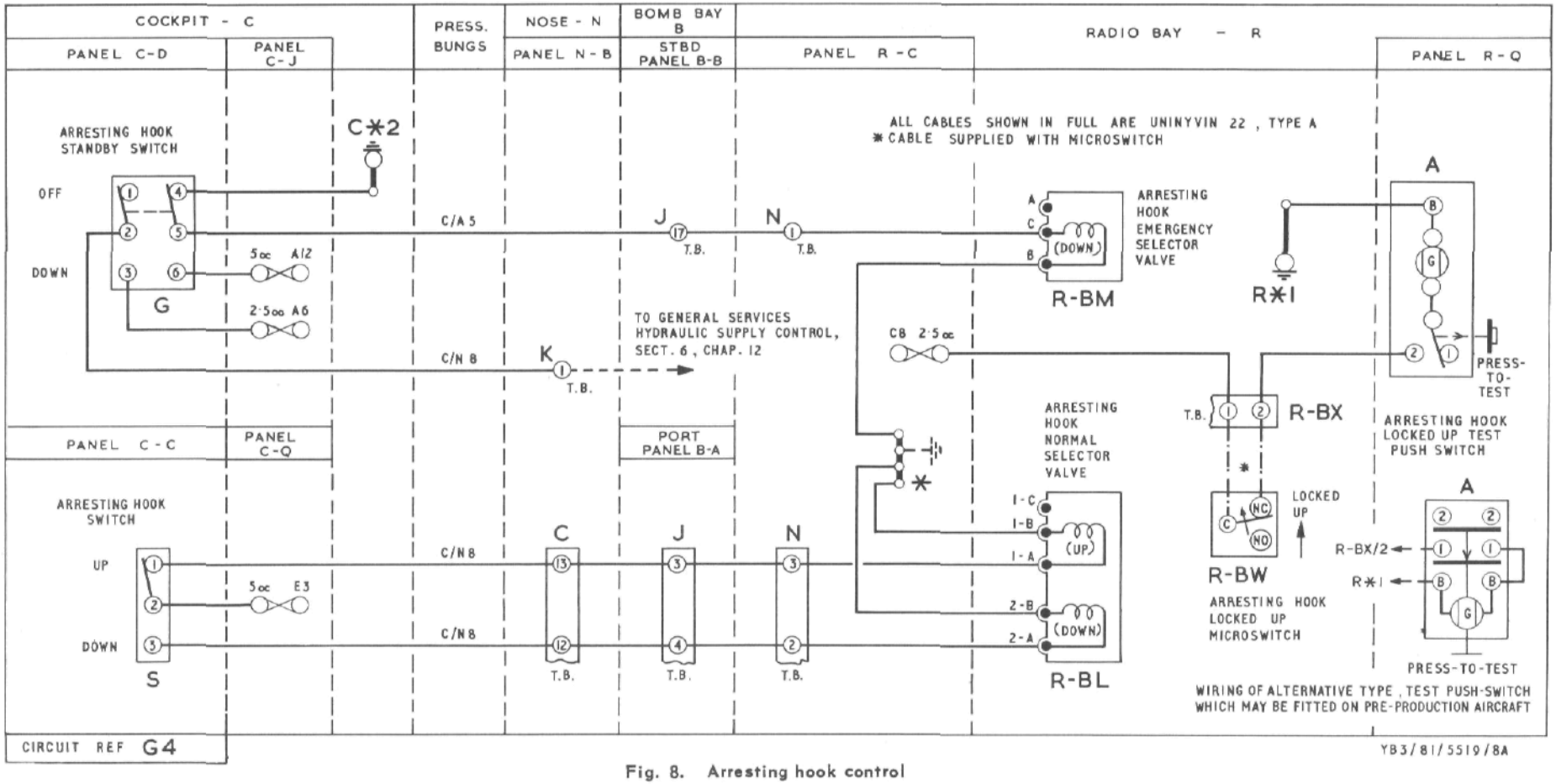

Fig. 8. Arresting hook control

be made until the emergency selector valve in the hydraulic system has been manually reset on the ground (*A.P.*101B-1201-1A, *Cover* 2, *Sect.* 3, *Chap.* 6).

Servicing

Up-lock test

31. A microswitch, fitted in the up-lock assembly, is operated by the up-lock mechanism. A supply is fed from fuse C8 (panel R-C), via the microswitch, to a test lamp push-switch located on panel R-Q in the radio bay, aft of the access hatch. When the push-switch is depressed, the green lamp within the button will illuminate if the arresting hook is securely locked up.

ARRESTING HOOK DOWN INDICATION AND DECK APPROACH WARNING

General

32. To indicate to the pilot when the arresting hook is in the fully-down position, a small indicator lamp, fitted with a green screen, is located at the top of the port control panel C-C. A second lamp, marked N-AM and known as the deck approach warning lamp, is located on the underside of the front fuselage forward of the nose wheel unit. Incorporating a 16 watt filament and an amber screen, this lamp is used to inform ground personnel whether or not the aircraft is in the correct landing configuration i.e. alighting gear only or alighting gear and arresting hook down.

Function

33. With the alighting gear locked down,

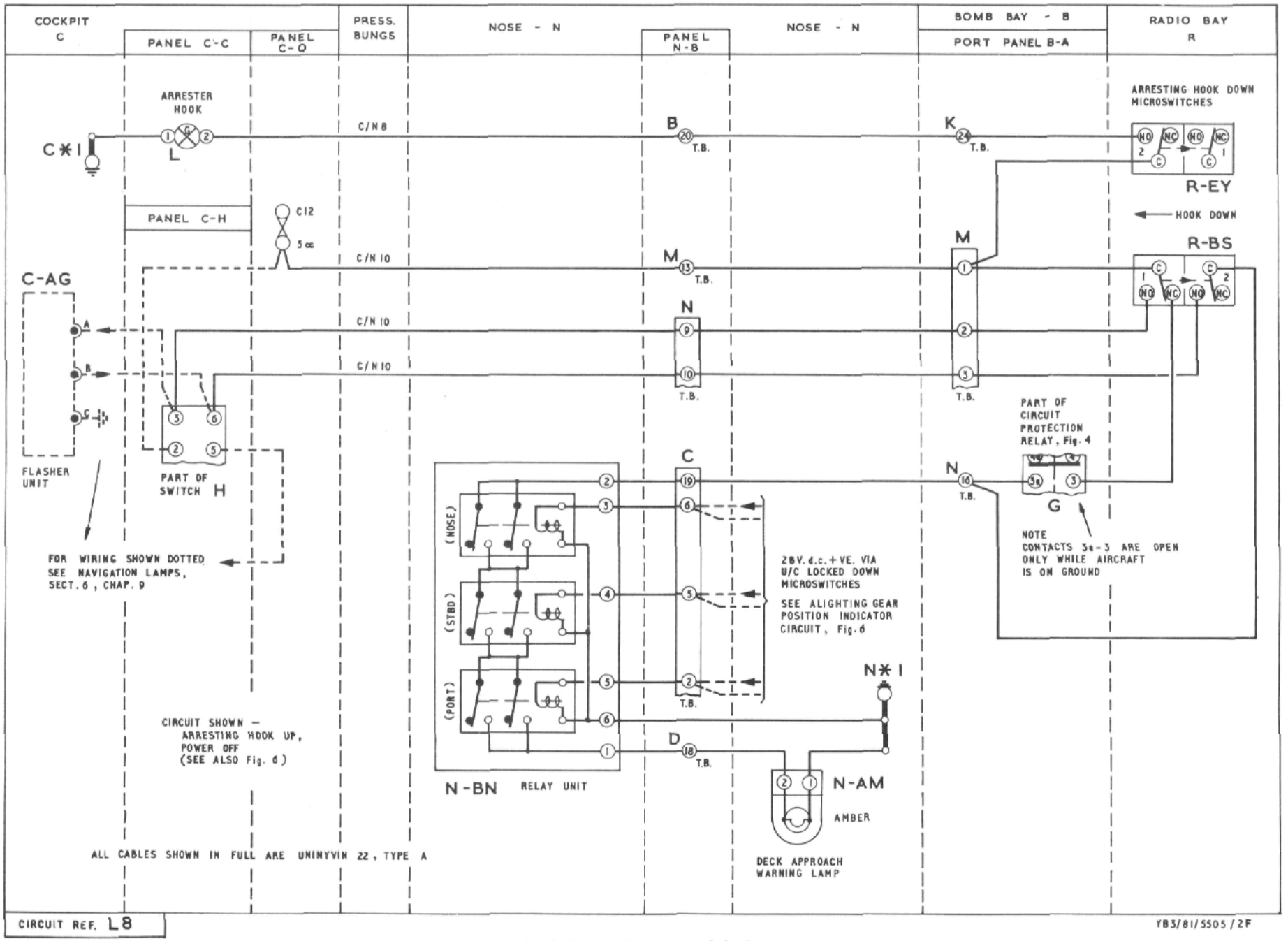

Fig. 9. Arresting hook down indication and deck approach warning

the amber lamp shows a steady light. When the arresting hook reaches the fully down position the amber lamp emits an intermittent flashing light and the green lamp a steady light.

Operation (fig 5 and 9)

34. As the alighting gear reaches the locked down position, the relay unit N-BN is energized as described in para 23. A circuit is then completed from fuse C12 (panel C-Q) via contacts C-NC of the arresting hook down microswitch R-BS1, contacts 3 - 3a of the energized circuit protection relay G, through the relay unit to the amber lamp N-AM which then emits a steady light. On reaching the fully down position the arresting hook actuates the microswitches R-EY and R-BS. This causes the supply to the amber lamp to pass through the flasher unit and also completes a circuit to the green indicator lamp. The amber lamp now emits an intermittent flashing light and the green lamp displays a steady light. When the aircraft lands, retraction of the arresting hook causes the microswitches R-EY and R-BS to revert to the C-NC position which breaks the circuits of both lamps and the de-energized relay G prevents the circuit to the amber lamp being made until the aircraft is again airborne.

Servicing

Microswitch function test

35. Microswitches R-BS and R-EY are located at the rear of the radio bay and are actuated by the radius arm of the arresting hook when in the fully down position. No adjustment is possible but, with the aircraft on jacks, a function test can be made at the nose bay panel N-B as follows:-

(1) Simulate aircraft weight on ground by removal of fuses A5 and B5 (panel R-C).

(2) Remove fuse C12 (panel C-Q) and ensure that the arresting hook is in the locked up position.

(3) Locate terminal B20 and M13 on panel N-B and connect one lead of a continuity test set to each. An open circuit of microswitch R-EY2 must be indicated.

(4) Connect the continuity test set leads to terminals C19 and N10 when an open circuit of microswitch R-BS2 must be indicated.

(5) The arresting hook should then be lowered and the tests repeated. In each case a closed circuit must be indicated, caused by the microswitches being actuated when the arresting hook is lowered.

(6) Replace fuses A5, B5 and C12 on completion of tests.

WHEEL BRAKES ANTI-SKID PROTECTION (MOD 58)

General

36. Mod 58 introduces improved wheel and brake equipment including a circuit which, by selection, effects the automatic release of the wheel brakes if the wheels show a tendency to skid, any such tendency being reflected in the output of a d.c. generator fitted to each wheel fork and friction driven by each wheel. The rate of fall of generator output due to the deceleration of the aircraft wheel with braking is detected in a control box and, if the rate falls to that which would cause a skid, causes the operation of the associated wheel brake solenoid which shuts off the hydraulic supply to, and releases the pressure from, the brake. On pre-Mod 58 aircraft, anti-skid protection is achieved by hydraulic and mechanical means only (*Book* 1, *Cover* 2, *Sect.* 3, *Chap.* 6).

Description

Anti-skid generator

37. An anti-skid generator, complete with its friction-driven driving wheel, is mounted on the inboard arm of each wheel fork and marked WP-BX (port) and WS-BX (stbd). The output of each generator is directly proportional to the angular velocity of its associated aircraft wheel and is fed to the control box for detection.

Control box

38. The control box is located on the starboard side of the observer's station between frames 181 and 186 and marked C-FC. It contains the detector circuits for both port and starboard wheel units and the amplifier circuits for the two solenoid valves. Connections to the units are made via a 10-pole plug and socket and the power supply is controlled by a single-pole changeover switch marked WHEEL BRAKES ANTI-SKID, ON – OFF located on the throttle box C-E.

Solenoid valves

39. The solenoid-operated shut-off valves are mounted in the wheel bay on the undercarriage diaphragm and marked WP-BJ (port) and WS-BJ (stbd). They are interposed in the hydraulic line to each brake and are normally open to permit the free flow of hydraulic fluid. When energized, the valves close and release the brakes. Details of the hydraulic functioning of the valves are given in Book 1, Cover 2, Sect. 3, Chap. 6 of this volume.

Operation *(fig 10 and 11)*

40. The functioning of the anti-skid circuit is dependent upon selection of the control switch to ON and the alighting gear push-button selector switch to DOWN. Only the starboard wheel circuit is described, the port side being identical.

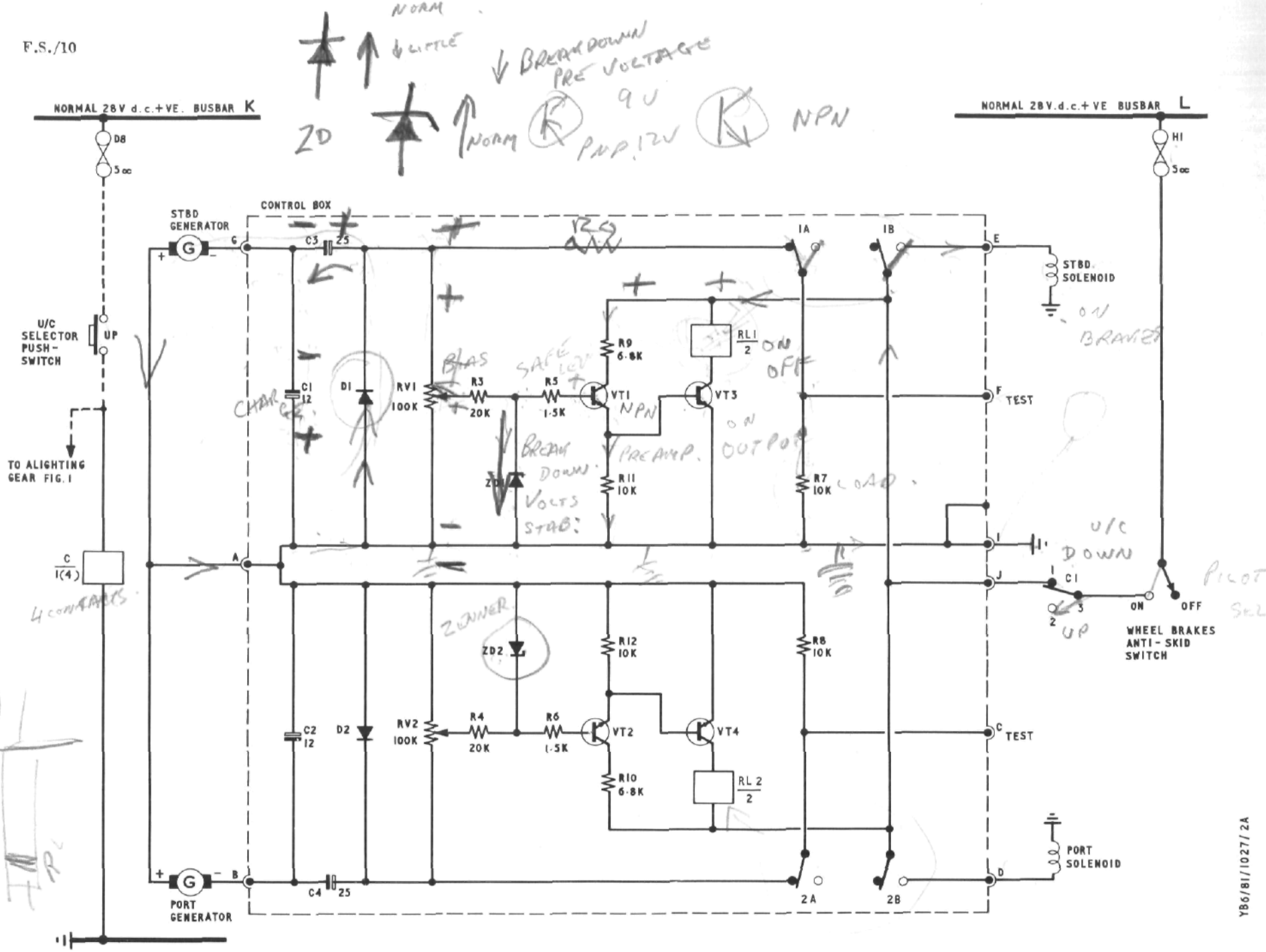

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Fig. 11. Wheel brakes anti-skid device – theoretical

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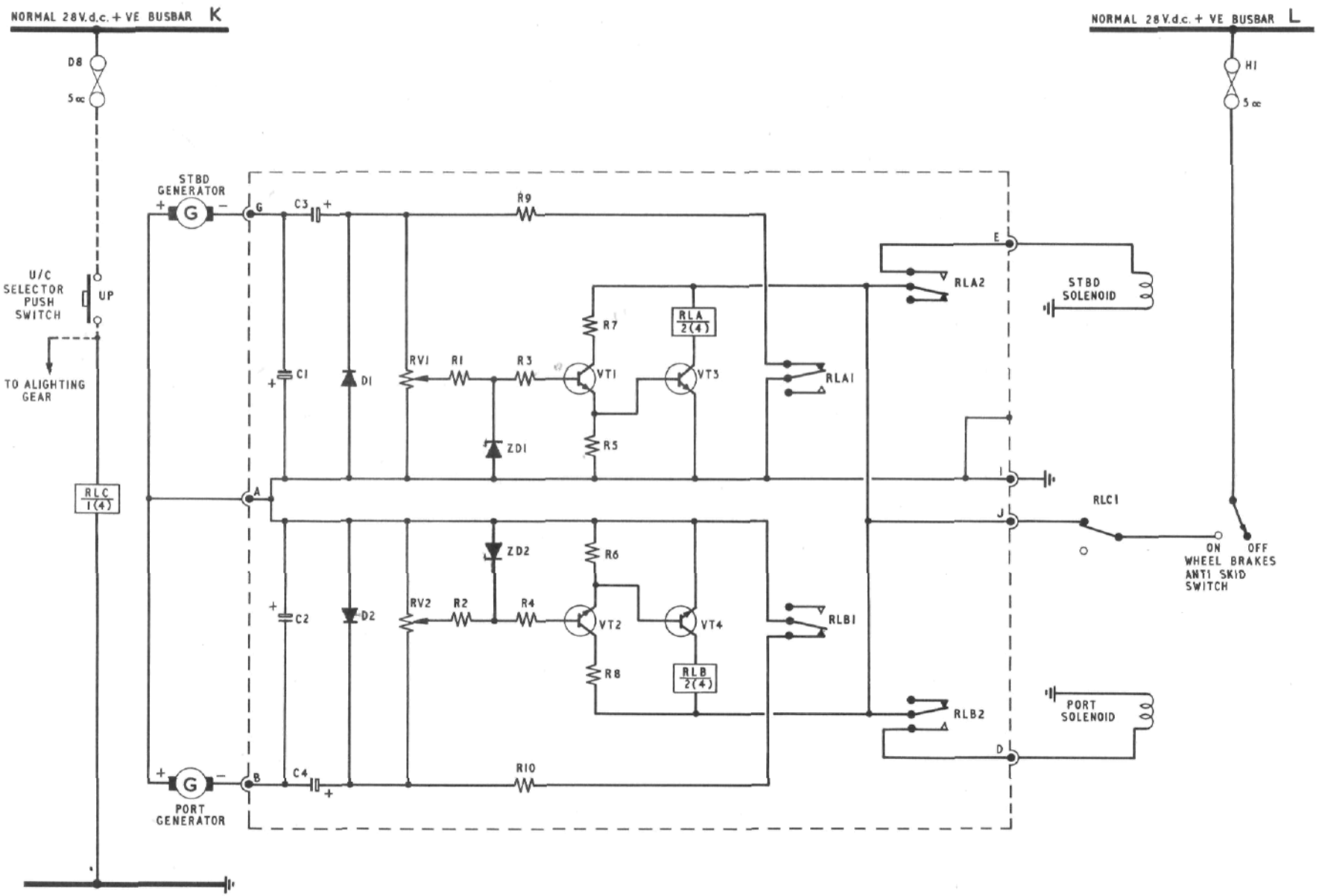

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Fig. 10. Wheel brakes anti-skid system – theoretical

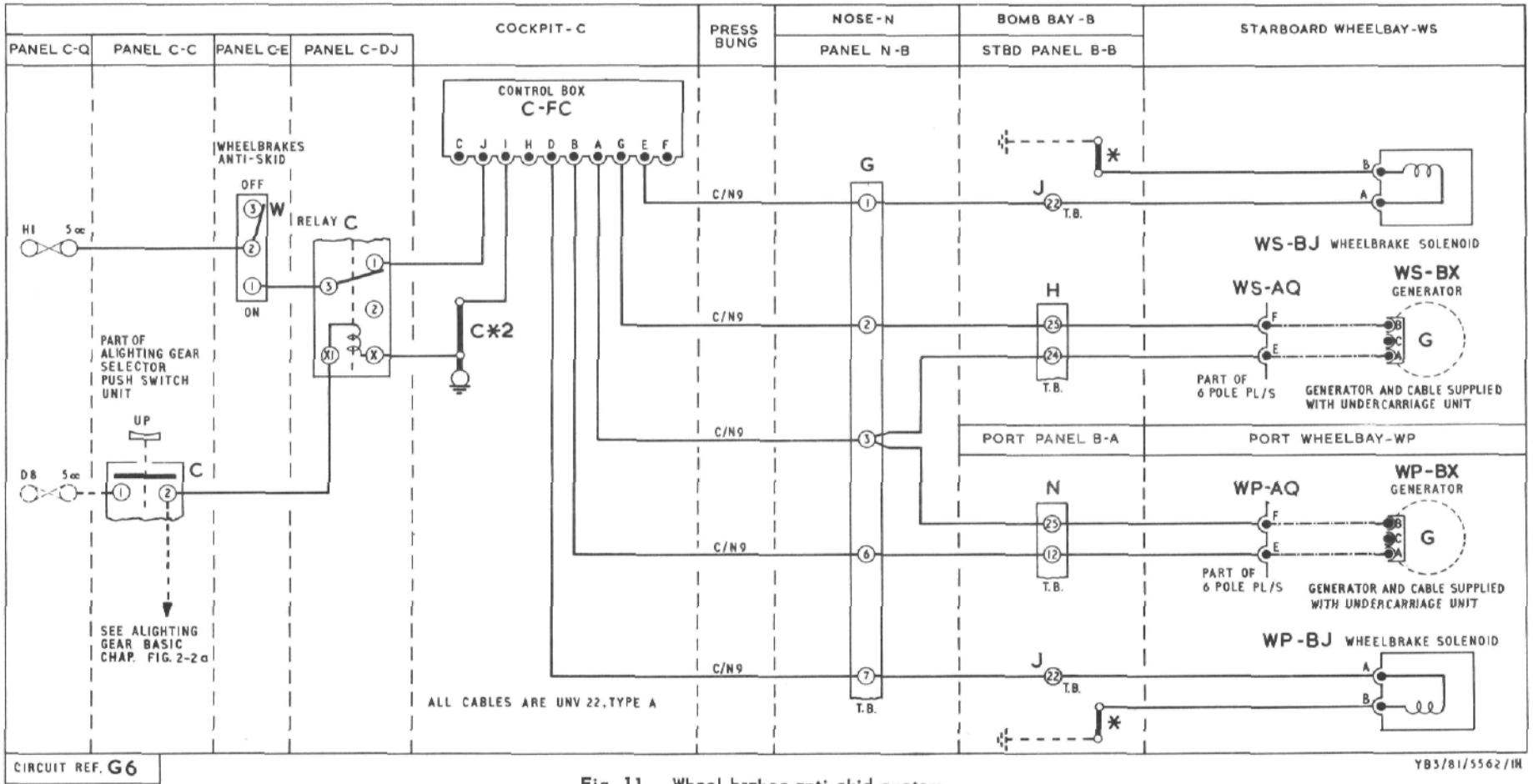

Fig. 11. Wheel brakes anti-skid system

41. When the aircraft "touches-down" the wheel accelerates from rest and, in so doing, drives the wheel generator. The output of the generator charges capacitor C3 via the diode D1 for as long as the output continues to rise with wheel acceleration. When the angular velocity of the wheel becomes constant the generator voltage is equal to that across C3 and charging ceases.

42. As the wheel decelerates with normal braking, the generator voltage falls below that of C3 which discharges slowly to earth via R9 and RV1 in parallel. If the wheel decelerates at a rate sufficient to cause a skid, the generator voltage falls rapidly below that of C3, which discharges at a greater rate and, as a result, the potential at the slider of RV1 rises.

43. Transistors VT1 and VT3 are normally in the cut-off condition but, if the potential at the slider of RV1 rises to a predetermined level, a current flows in the base-emitter circuit of VT1 causing it to conduct heavily. As a result, the potential at the emitter of VT1 and hence the base of VT3 rises causing VT3 to conduct and operate relay RLA. Contacts RLA1 disconnect resistor R9 leaving RV1 as the sole discharge path for C3 and, consequently, the discharge rate decreases. Contacts RLA2 connect a 28V d.c. supply, fed via fuse H1 in the normal d.c. fuse panel C-Q, to the wheel brake solenoid, which operates and shuts off the hydraulic supply to the brake.

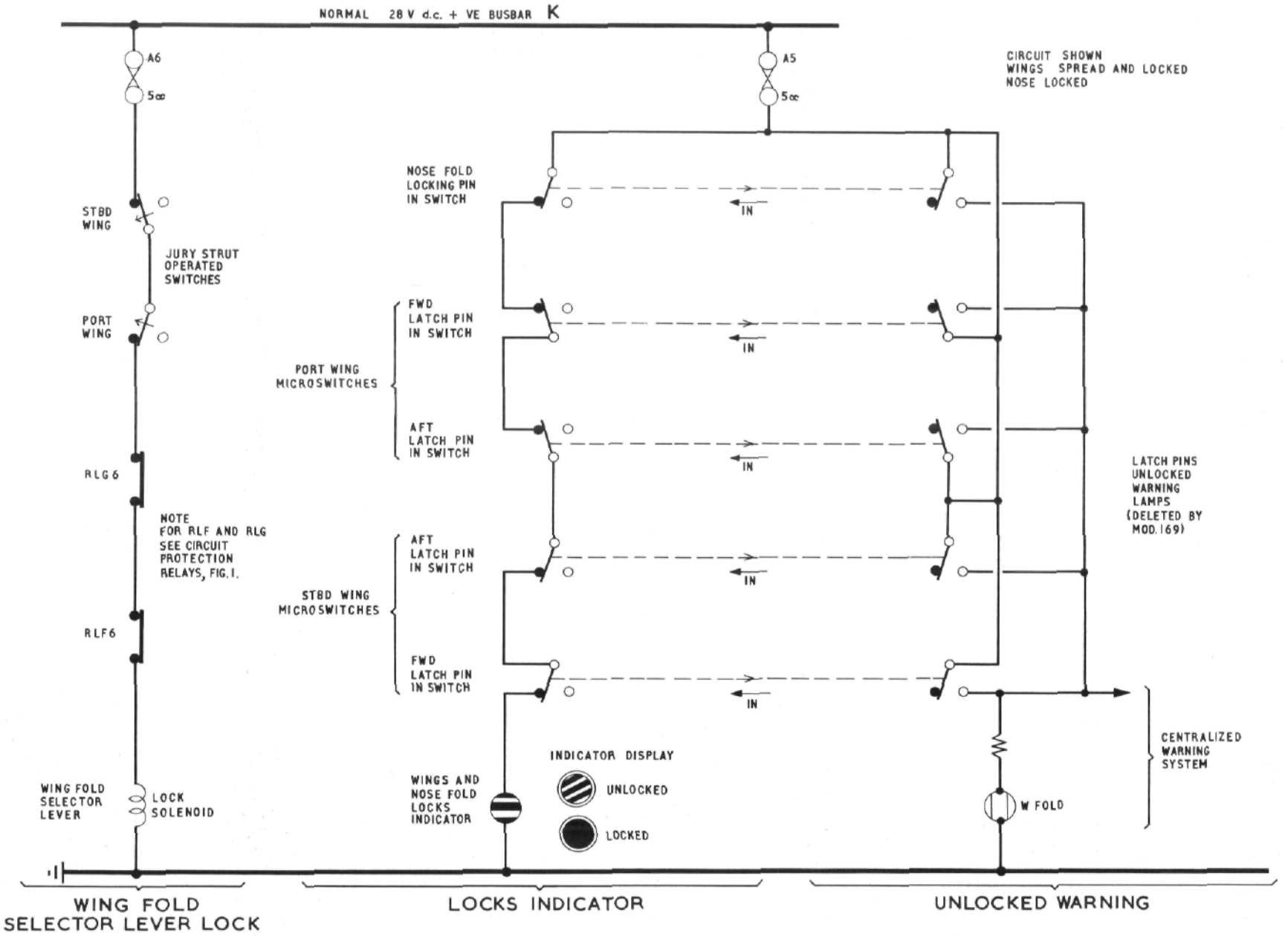

Fig. 12. Wing and nose fold indication – theoretical

◀ Indicates display included ▶

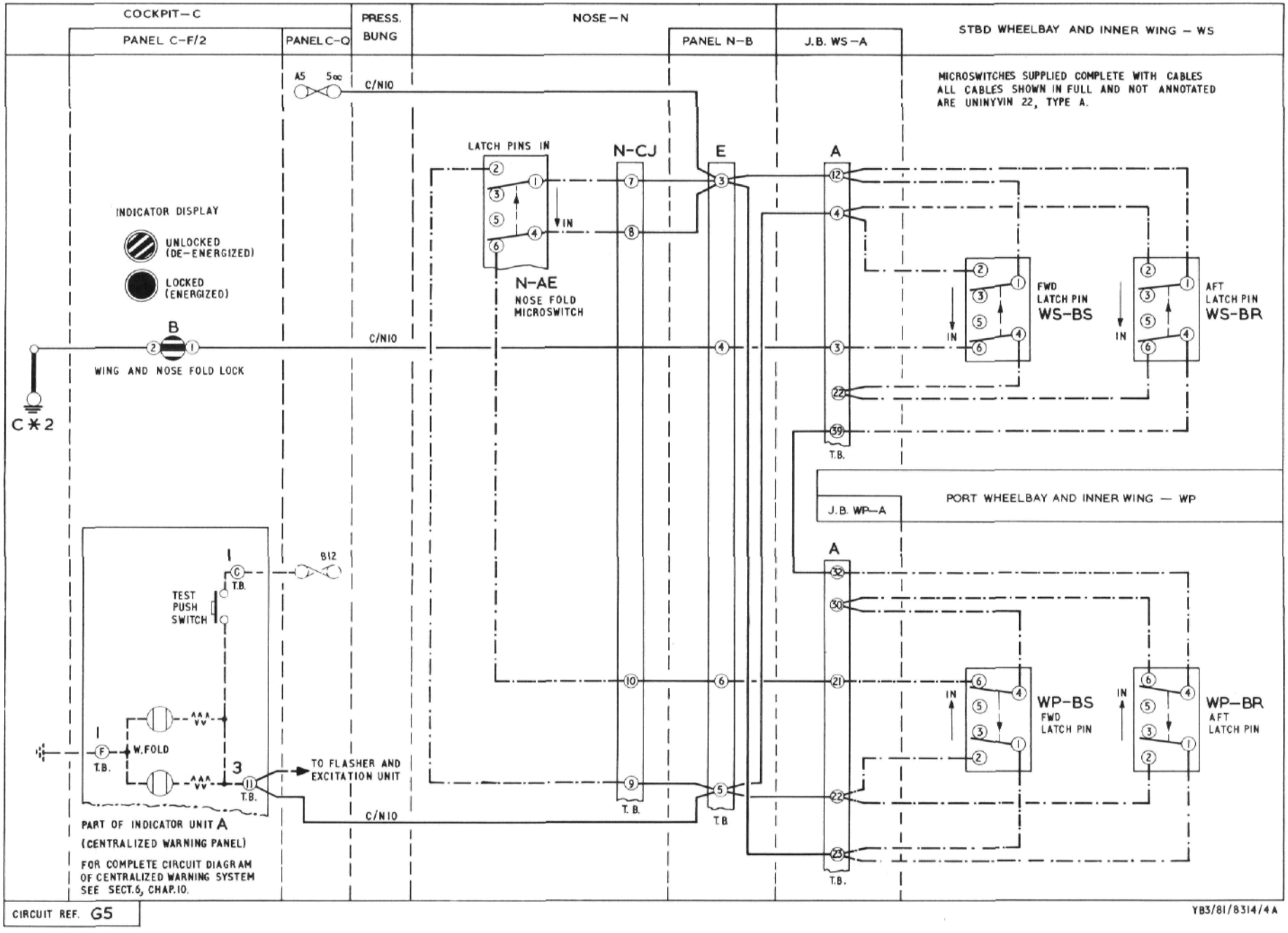

Fig. 13. Wing and nose fold indication

◀ Indicator display included ▶

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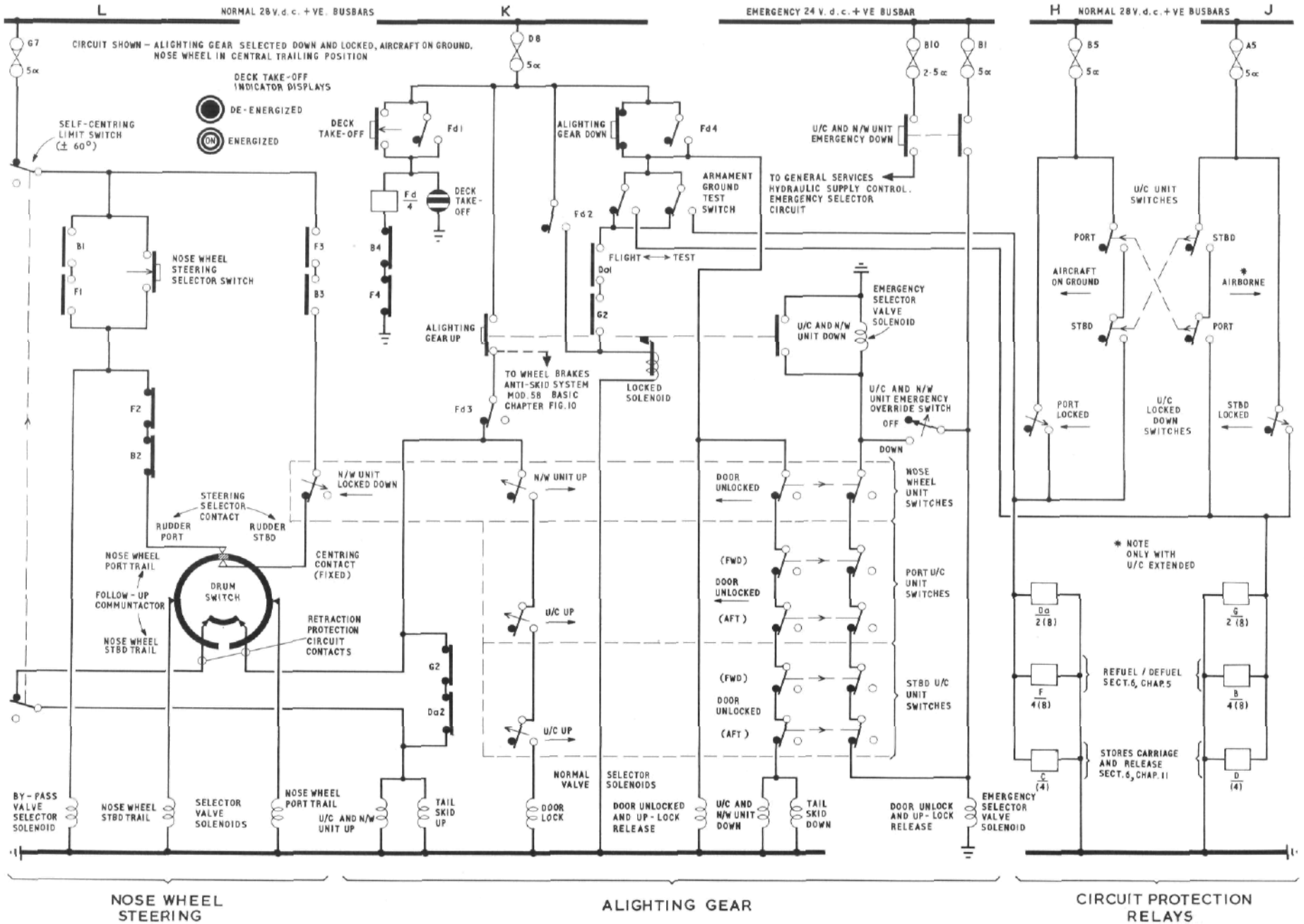

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Fig. 1. Alighting gear (post-Mod 689) – theoretical

◀ Indicator display corrected; relay identifies amended ▶

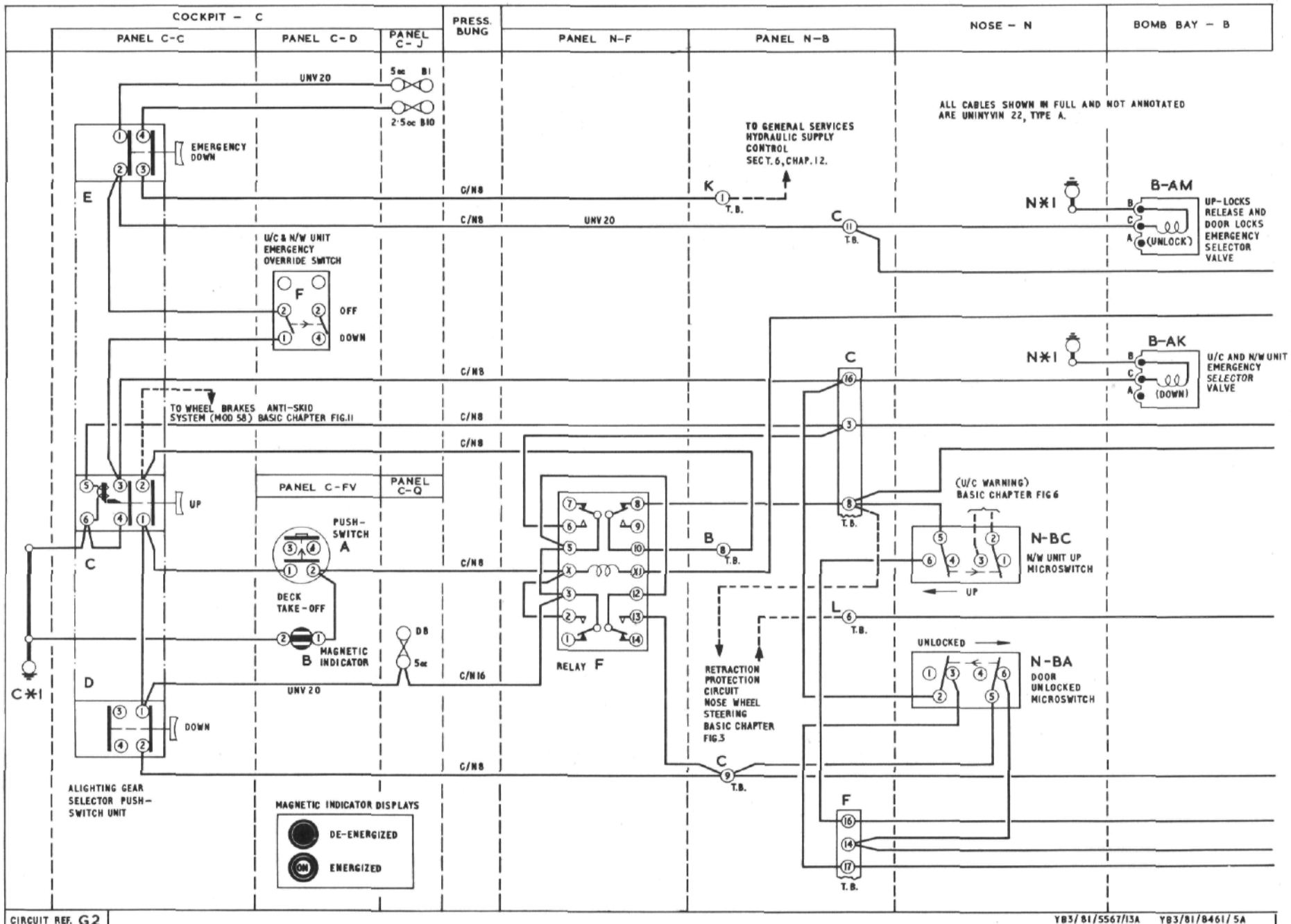

Fig. 2. Alighting gear

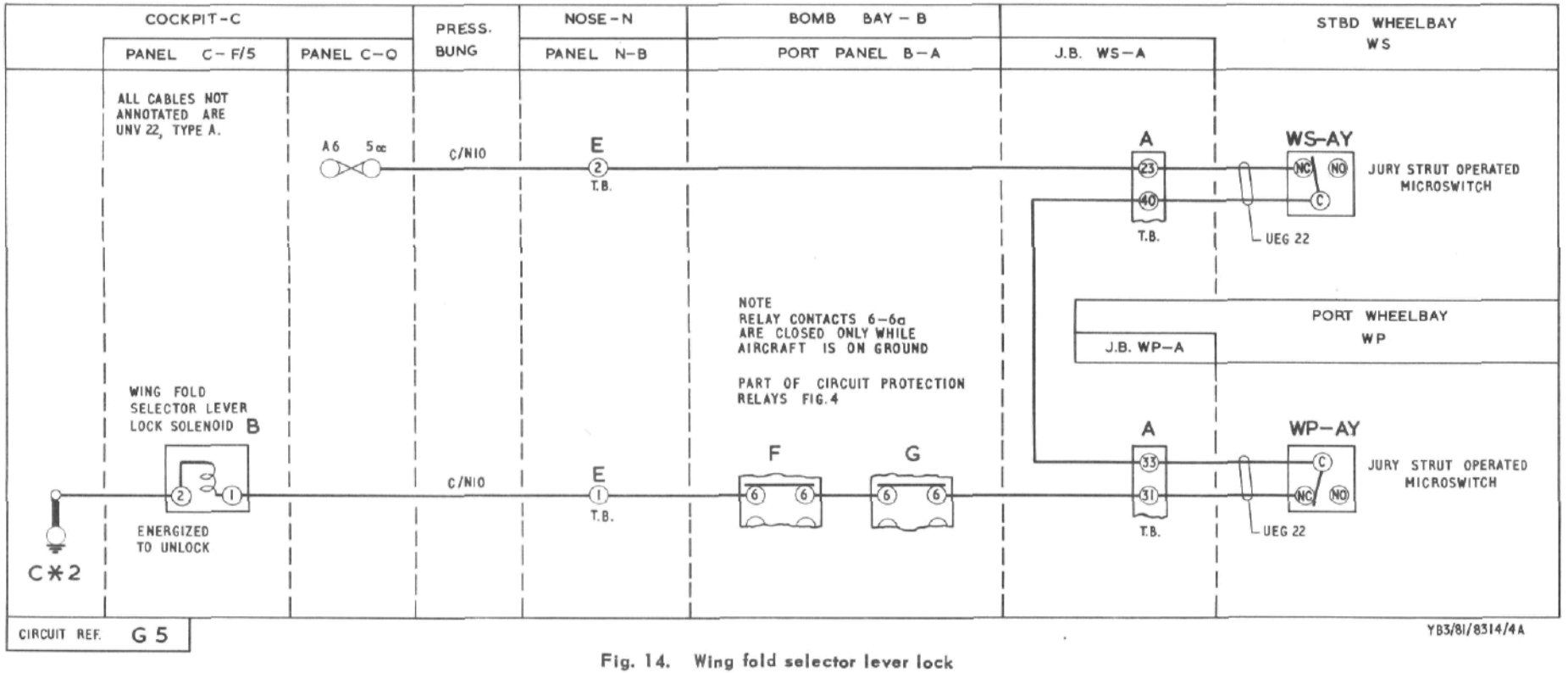

Fig. 14. Wing fold selector lever lock

44. Due to the brake pressure being released the aircraft wheel accelerates and the generator voltage rises proportionally. When the generator voltage equals the residual voltage across C3, discharge ceases and the potential at RV1 falls to zero causing transistors VT1 and VT3 to revert to the cut-off condition and relay RLA to release. Contacts RLA2 disconnect the wheel brake solenoid which is de-energized and permits the application of brake pressure.

45. Under extreme runway conditions and with the aircraft bouncing, or if the aircraft bounces as the brakes are applied, the wheels would tend to lock. Anti-skid protection is automatically applied and retained for a period of 3 – 4 seconds, this being the time taken for C3 to discharge through RV1 with no accelerating force available to produce a generator output.

46. With the alighting gear UP push-button depressed, a 28V d.c. supply is fed, via fuse D8 in the normal d.c. fuse panel C-Q, to relay RLC on panel C-DJ which operates and disconnects the 28V d.c. supply from the control box.

Servicing

47. A function test of this system is contained in Book 1, Cover 2, Sect. 3, Chap. 6, Service H.

WING AND NOSE FOLD INDICATION

General

48. The wings are secured in the spread position by hydraulically controlled latch pins. Engagement and disengagement of the latch pins is indicated to the pilot on a magnetic indicator and via the centralized warning system (CWS) which is fully described in Chap. 10 of this section.

49. The folding nose is secured by mating latch fittings which are retained by mechanically controlled locking pins. Engagement and disengagement of the locking pins is indicated electrically as described in para. 48 for the wing latch pins. The wing latch pin mechanism and the nose locking mechanism are described in Book 1, Cover 2, Sect. 3, Chap. 2 and 1 respectively.

50. Mounted at each wing break are two microswitches marked WP-BS and WP-BR in the port wing and WS-BS and WS-BR in the starboard wing. The two microswitches in each wing are actuated by the forward and aft latch pins respectively. A similar switch marked N-AE and actuated by the nose locking mechanism, is located between the two starboard male latch fittings for the folding nose (pre-Mod 59) or above the starboard upper male latch fitting (post-Mod 59).

Operation *(fig 12 and 13)*

51. With the battery master switch selected ON, the wings spread with latch pins engaged and the folding nose closed and locked, a supply is fed, via fuse A5 in the normal d.c. fuse panel C-Q, the nose fold microswitch and the port and starboard wing microswitches to the magnetic indicator, which is energized to show a black display. The indicator is marked B and located on the pilot's starboard console panel C-F/2.

52. A selection to WING FOLD causes the latch jacks to withdraw the latch pins. This releases the latch pin microswitches which disconnect the supply to the magnetic indicator and extend it to the CWS. The magnetic indicator is de-energized and shows black and white diagonal stripes.

53. Withdrawal of the nose locks only, prior to folding the nose, causes the same electrical indications as wing fold. A supply is fed, via fuse A5 and the nose lock microswitch, to the CWS and the supply is disconnected from the magnetic indicator.

Note...

The CWS gives an audible and visible warning when the nose locks are withdrawn and during wing spreading operations until the latch pins engage. During wing folding operations the supply from fuse A5 to the CWS audio warning unit and attention warning lamps is disconnected by a microswitch actuated by the wing fold selector lever.

WING FOLD SELECTOR LEVER LOCK

General

54. To prevent inadvertent operation of the wing folding system, the selector lever on the oxygen regulator panel C-F/5 on the pilot's starboard console is rendered immovable by a locking arrangement. Energizing a solenoid releases the lock, allowing the selector lever to be operated.

Operation *(fig 14)*

55. A supply is fed, via fuse A6 in the normal d.c. fuse panel C-Q, two microswitches located one below each jury strut socket in the port and starboard jet pipe nacelles and marked WP-AY (port) and WS-AY (starboard), contacts 6a - 6 of the circuit protection relays G and F to the lever lock solenoid B on panel C-F/5. Energizing this solenoid releases the lock on the wing fold selector lever which is now free to be operated.

56. When the jury struts are fitted to secure the wings in the folded position, the microswitches break the circuit to the lever lock solenoid and no further selection can be made until both jury struts are removed. When the aircraft becomes airborne, the circuit protection relays F and G break the circuit to the selector lever lock solenoid. The lever is then locked in the SPREAD position to prevent a selection being made during flight.

LIST OF APPENDIXES

Appendix 1 ALIGHTING GEAR INDICATION (Mod 331)

LIST OF ILLUSTRATIONS

1. On aircraft with Mod 331 incorporated a microswitch (5CW/6679 or 5CW/8475) is introduced in the alighting gear warning circuit to prevent the U/C warning lamp on the pilot's instrument panel illuminating after retraction of the alighting gear during take-off. The switch, annotated X, is fitted in the engine control box C-E and is connected between terminal 20 of terminal block C in panel N-B and the U/C warning lamp AH on panel C-B as shown in fig 1. The contacts of the switch are normally closed so that, in the event of the low speed signal circuit of the air data computer in the IFIS being completed, with the alighting gear retracted, the warning lamp will illuminate. The contacts of the microswitch are opened by the port engine throttle lever only when the throttles are fully open; this breaks the earth return circuit for the warning lamp thereby ensuring that it remains extinguished during take-off.

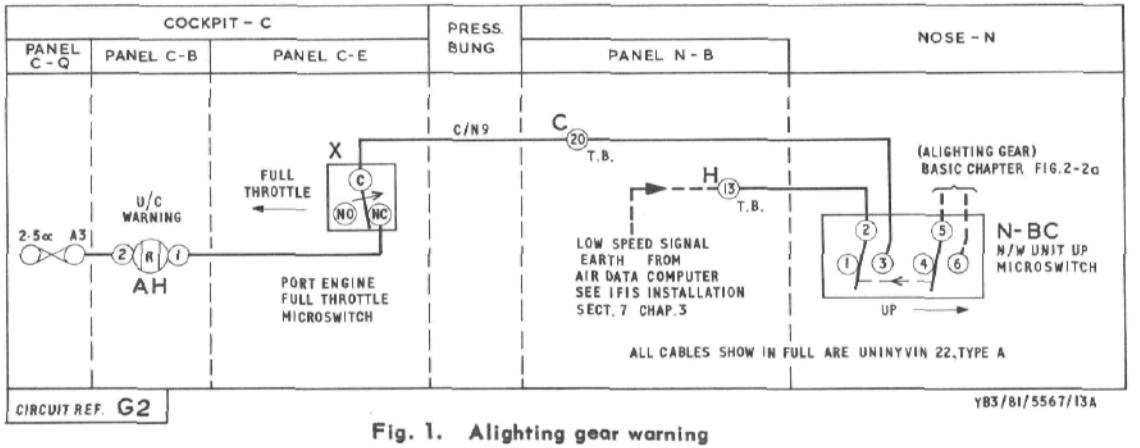

Fig. 1. Alighting gear warning

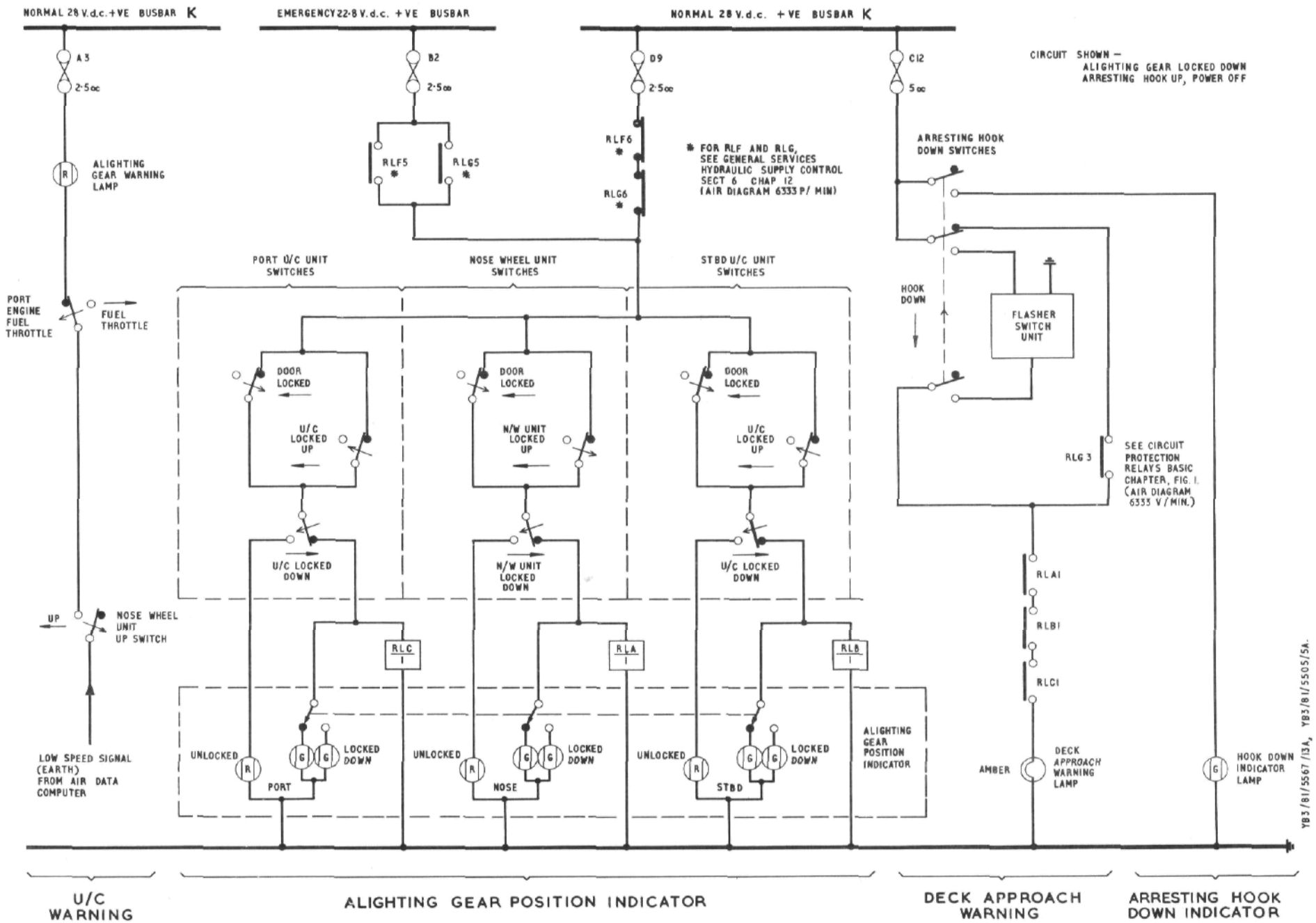

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Fig. 2. Alighting gear and arresting hook indication and deck approach warning (post-Mod 331) – theoretical

103/2/1/80 8237 7621 500 + 625 1/66 HSAL 1423

Appendix 2 ALIGHTING GEAR (Mod 689)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. Due to the lock solenoid of the alighting gear UP button being controlled by the circuit protection relays, which are in turn controlled by the undercarriage wheel forks, the lock is not withdrawn after take-off until the wheel forks have extended fully. On aircraft with Mod 689 incorporated, provision is made for the pilot to unlock the UP button prior to take-off, thus enabling the button to be depressed immediately the aircraft becomes airborne. The alighting gear is then retracted automatically when the undercarriage wheel forks become fully extended. This facility, and visual indication of its use, is provided by a sub-circuit incorporated within the alighting gear circuit.

Function

2. Depression of a push-switch triggers the operation of a magnetic indicator and a magnetic relay, both of which are then held energized by a hold-in circuit. The indicator then shows ON and contacts in the relay switch the alighting gear circuit in such a manner that an U/C UP selection can be preselected while the down selection is maintained.

3. Extension of the main wheel forks after take-off initiates the energizing of circuit protection relays which break the earth return of the hold-in circuit, thereby de-energizing the indicator and relay. The indicator then shows black (off) and the contacts of the relay disconnect the supply to the down selector circuit and complete the up selector circuit which, being pre-selected, causes the alighting gear to be retracted.

Description

4. The sub-circuit incorporates a push-switch, Type C.5162 Mk 3, with a protective guard, a 2-position electro-magnetic indicator, Type DN 1245 Z Mk 4, and a magnetic relay, Type BR 115 B1B-2C (Diamond H). Information regarding the push-switch and relay is contained in A.P. 4343C, Vol. 1, Books 1 and 2 respectively and information regarding the indicator is contained in A.P. 4343E, Vol. 1, Book 4. The push-switch A and indicator B are mounted on panel C-FV above the engine control box and are marked DECK TAKE-OFF. The indicator shows ON in black letters on a white ground when energized and shows black only when de-energized. The relay, marked F, is mounted on panel N-F which is aft of frame 151.5 in a compartment on the port side.

Operation *(fig 1, 2-2a and 3)*

5. Momentary depression of the deck take-off push-switch A connects a supply from fuse D8, in the normal d.c. fuse panel C-Q, to the indicator B and relay RL Fd. Once relay RL Fd has been triggered, the push-switch can be released as relay RL Fd and the indicator are held energized by a hold-in circuit completed by contacts RL Fd 1. When energized the indicator shows ON.

6. The action of the other contacts of relay RL Fd switch the alighting gear circuit as follows:-

(1) Contacts RL Fd 2 connect the supply from fuse D8 to the coil of the locking device in the up selector switch thereby releasing the lock which otherwise prevents an up selection being made while the aircraft is on the ground.

(2) Contacts RL Fd 3 isolate the up selector switch from the alighting gear retraction circuit.

(3) Contacts RL Fd 4 by-pass the contacts of the normal down selector push-switch thereby providing an alternative path for the supply to the normal down selector circuit.

Depression of the up selector switch will then pre-select the circuit for retracting the alighting gear while contacts RL Fd 3 hold-off the selection and contacts RL Fd 4 maintain the supply to the normal down selector switch.

7. Extension of the main wheel forks after take-off actuates microswitches which connect the supply to the coils of the circuit protection relays. Contacts 4 - 4a of the circuit protection relays RLB and RLF then break the negative return of the hold-in circuit controlling relay RL Fd and indicator B. When de-energized the indicator shows black and the contacts of RL Fd switch the alighting gear circuit as follows:-

(1) Contacts RL Fd 4 disconnect the supply to the normal down selector circuit.

(2) Contacts RL Fd 3 complete the up selector circuit.

(3) Contacts RL Fd 2 disconnect the supply energizing the locking device in the up selector switch.

(4) Contacts RL Fd 1 break the supply to the hold-in circuit.

Once the up selector circuit is restored the retraction of the alighting gear is effected in the manner described in the basic chapter.

WARNING...

After an aborted catapult take-off, if the deck take-off button and the undercarriage UP button have been depressed, ensure that the undercarriage DOWN button is pressed to cancel the UP selection and that the battery master switch is switched OFF before any servicing is carried out on the aircraft.

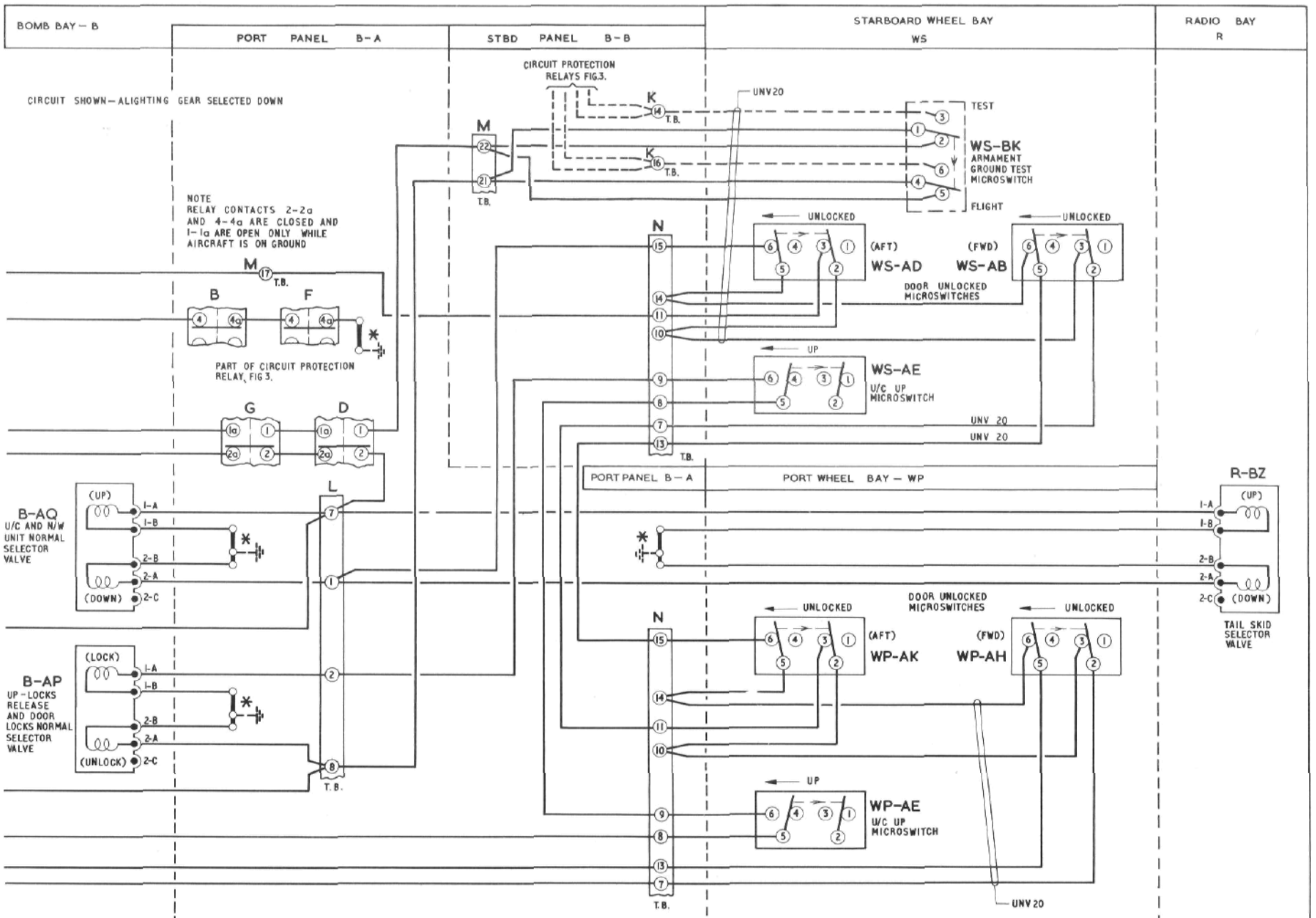

Fig. 2a. Alighting gear

◀ Location of T.B. M terminals 21 and 22 corrected to panel B-B ▶

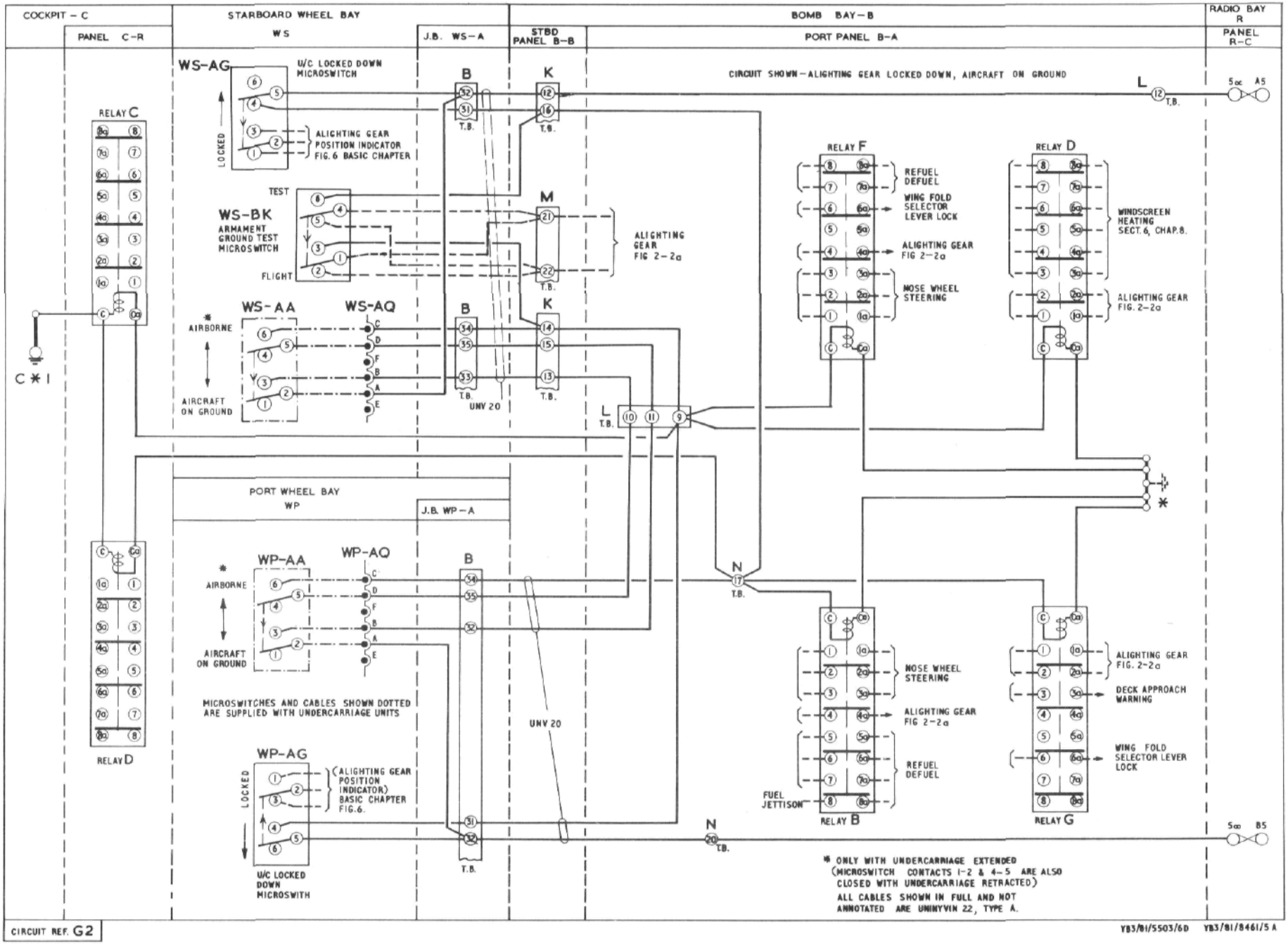

Fig. 3. Circuit protection relays

◀ Microswitch WS-BK and wiring added ▶

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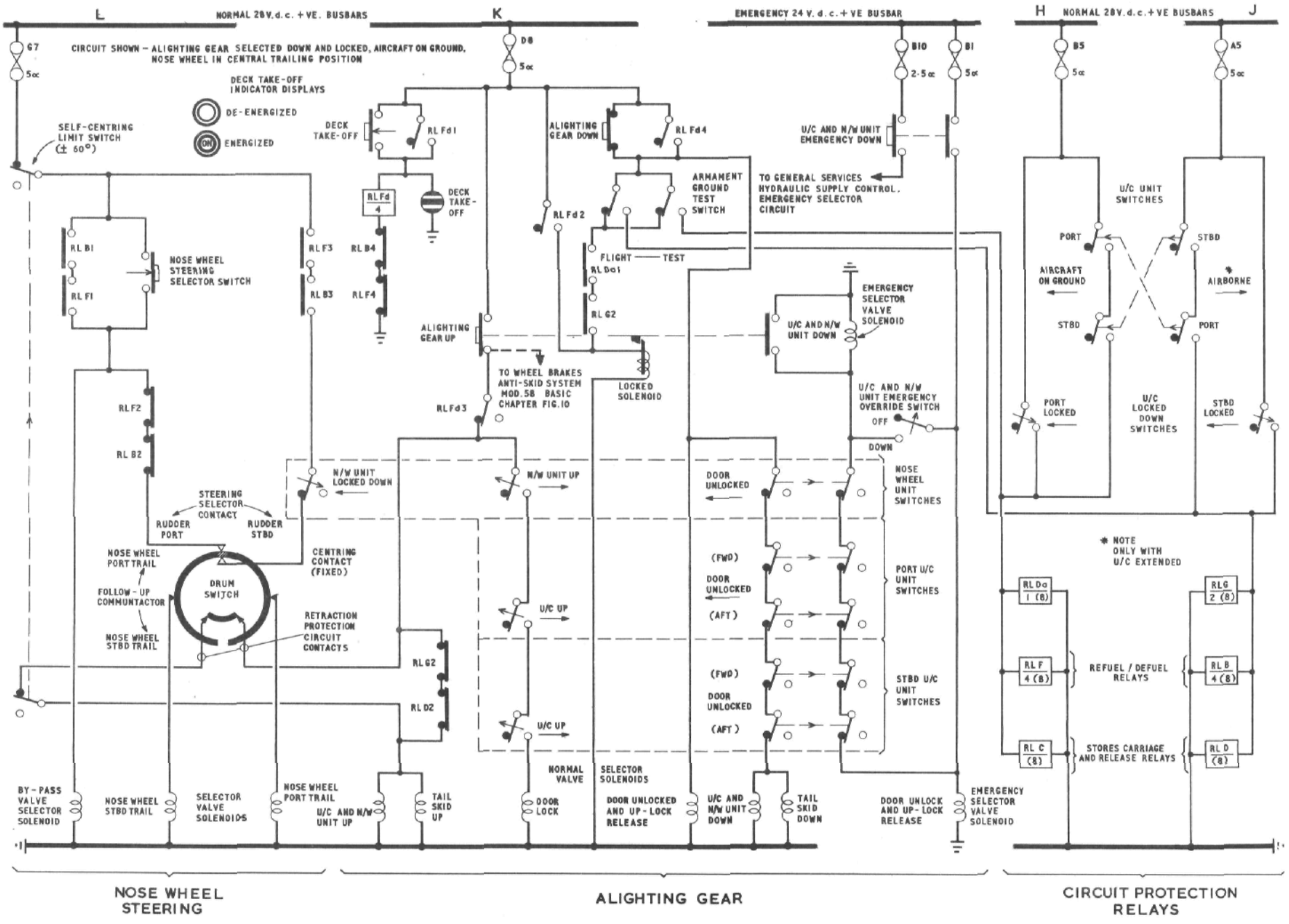

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Fig. 1. Alighting gear (post-Mod 689) – theoretical

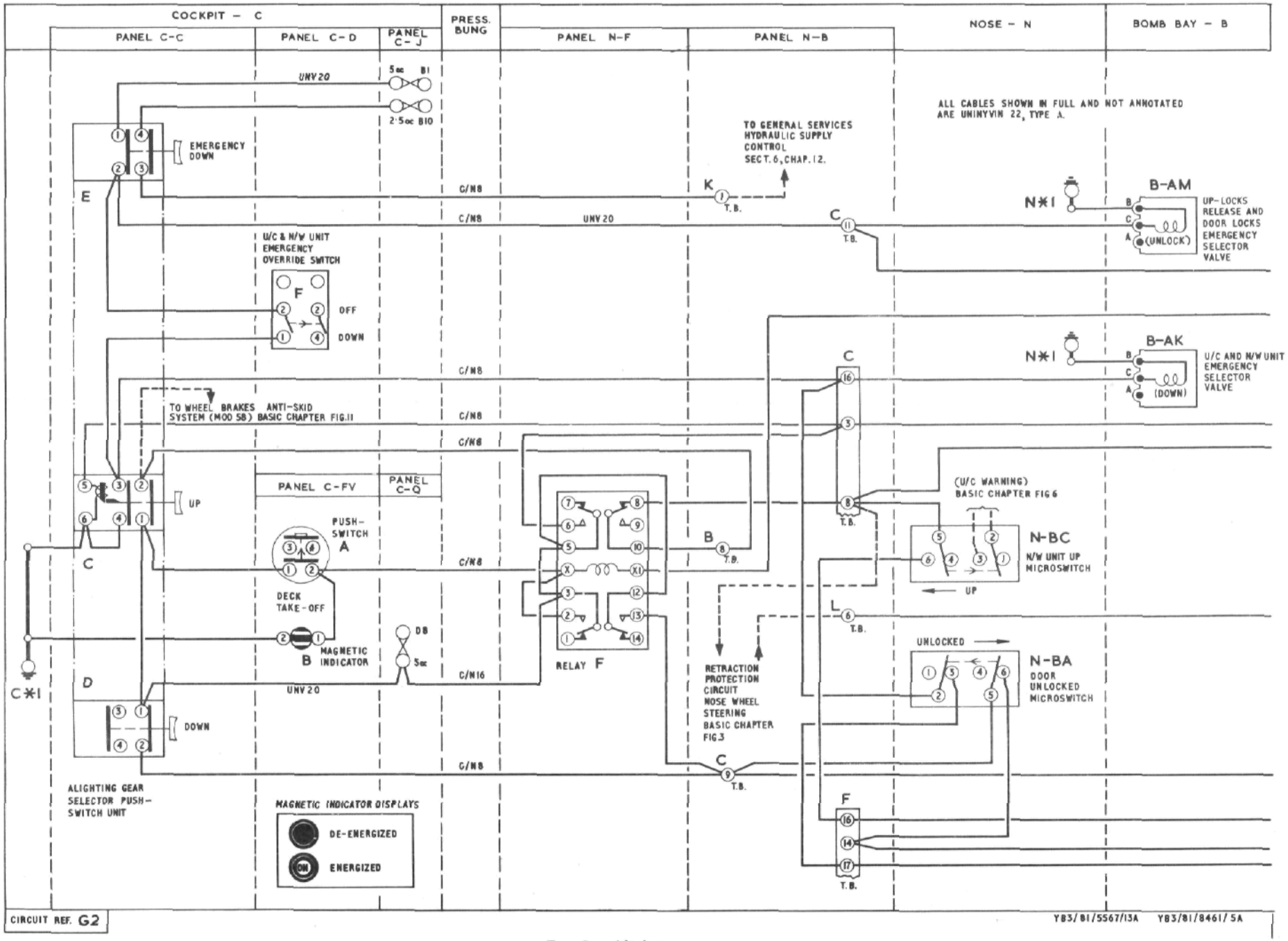

Fig. 2. Alighting gear

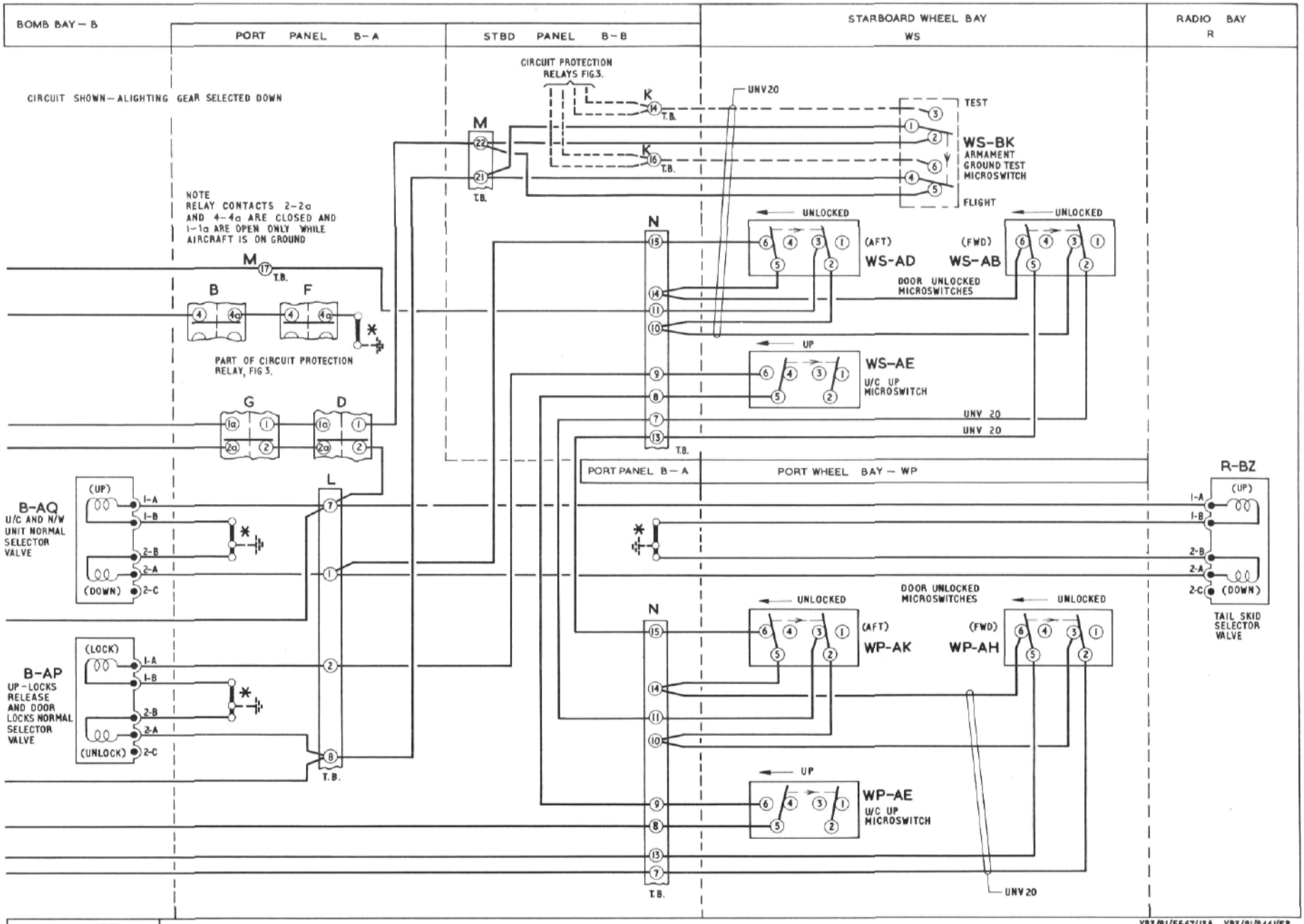

Fig. 2a. Alighting gear

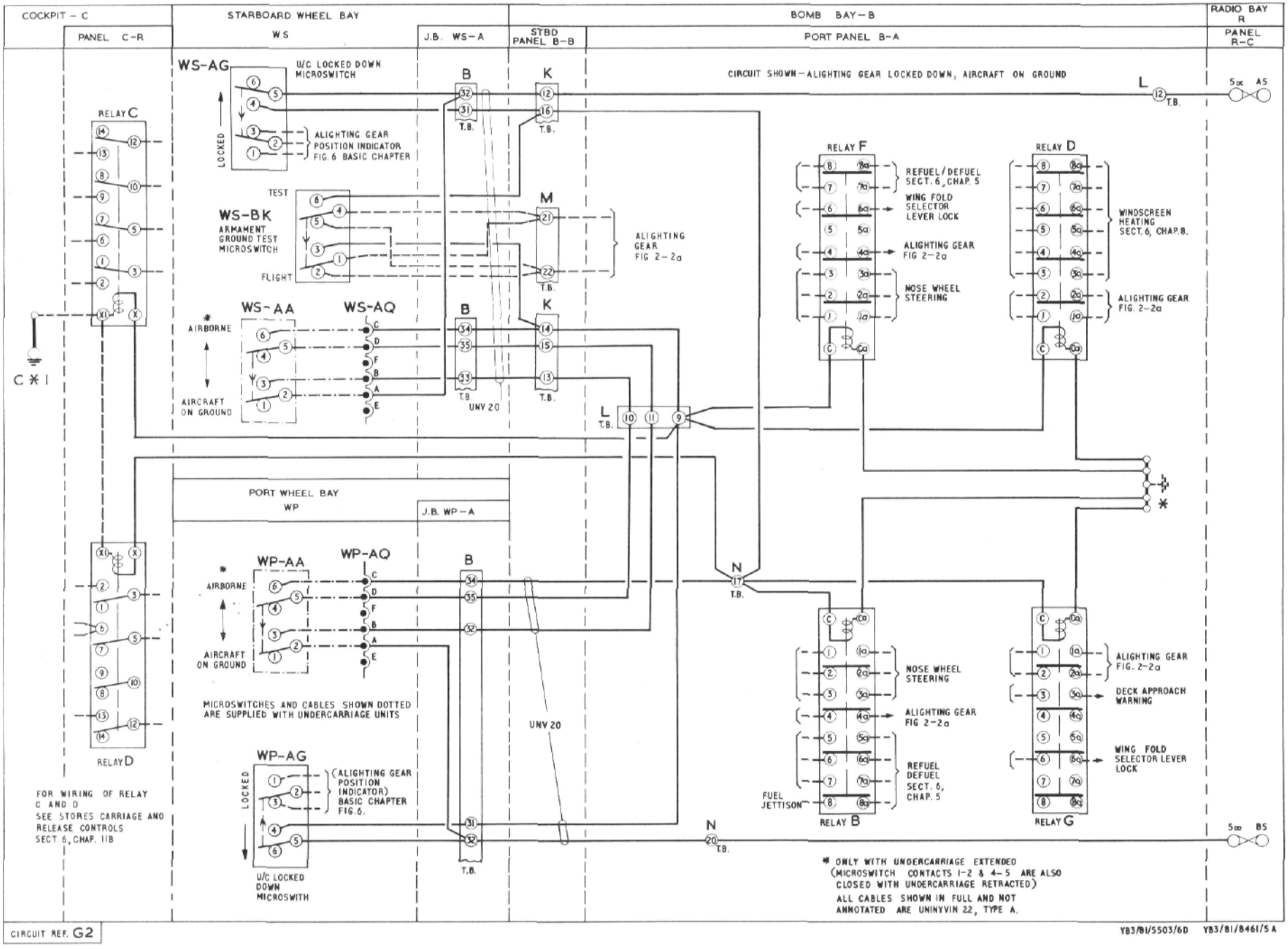

Fig. 3. Circuit protection relays

◀ Microswitch WS-AG amended to locked position ▶

Appendix 3 WHEEL BRAKES ANTI-SKID PROTECTION (Mod 791)

ILLUSTRATION

1. Mod 791 introduces an anti-skid control box, Type E31082, in lieu of the Type E31022, to increase the sensitivity of the system and to provide anti-skid protection at low speeds i.e., 8–10 knots. The changes in the circuitry of the replacement control box are shown in fig 1.

2. System operation is identical to that detailed in the basic chapter with the exception that capacitor C3 now discharges via R7 instead of R9, capacitor C4 now discharges via R8 instead of R10 and relays A and B are re-identified 1 and 2 respectively.

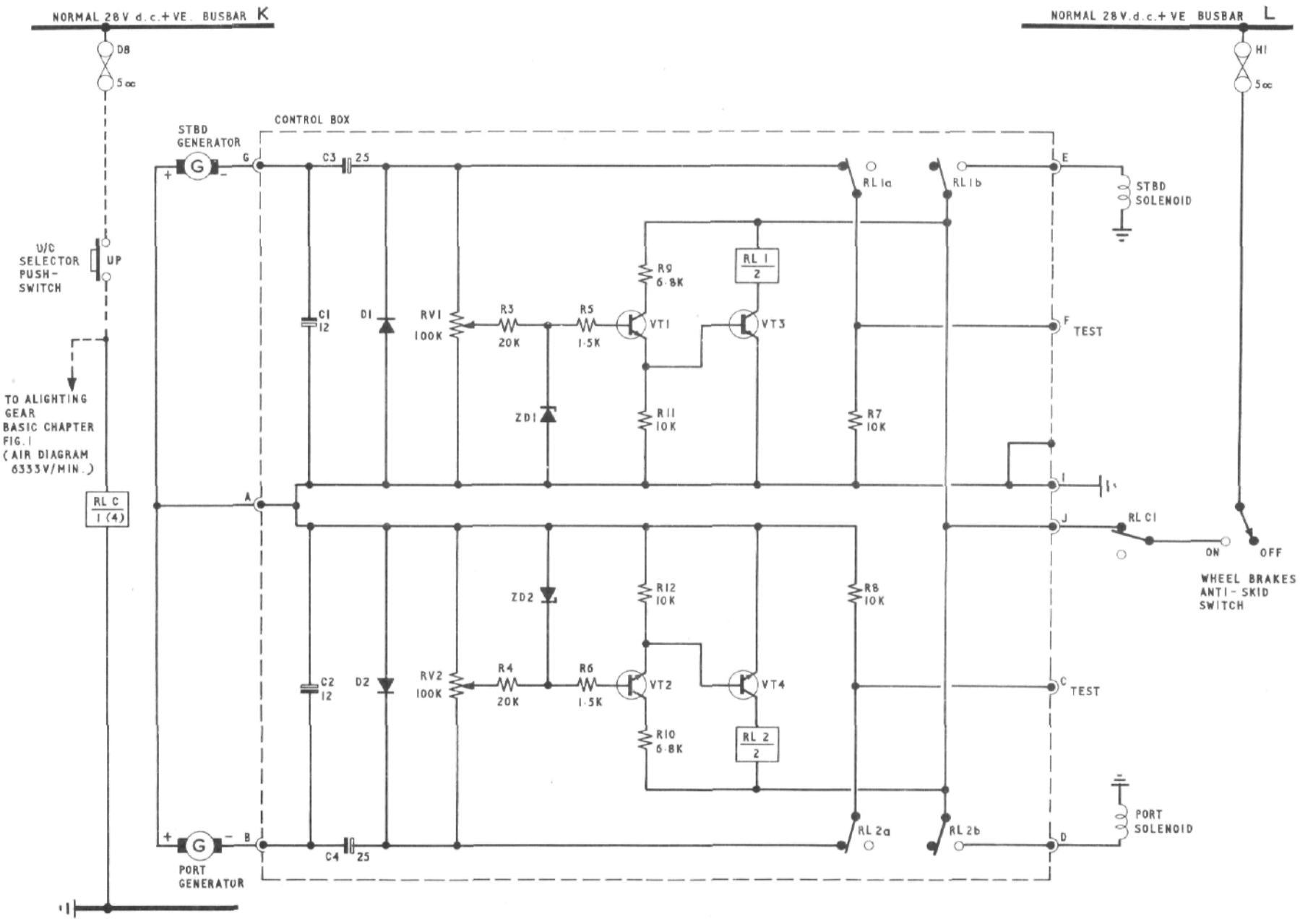

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Fig. 1. Wheel brakes anti-skid system (post-Mod 791) – theoretical

Appendix 4 NOSE WHEEL STEERING AND ALIGHTING GEAR INDICATION (Mod 922)

(Revised)

LIST OF ILLUSTRATIONS

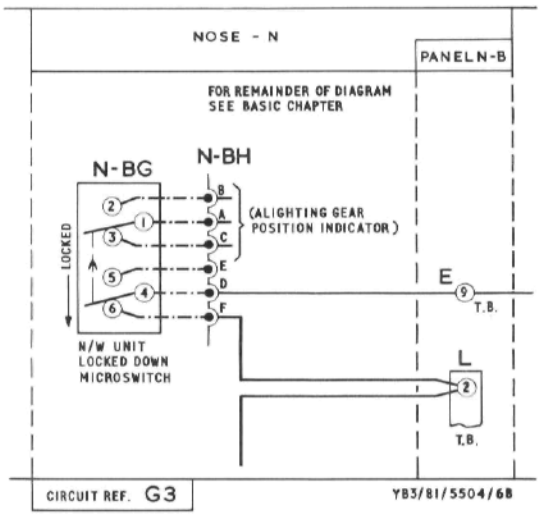

Fig. 1. Nose wheel steering

1. Mod 922 introduces a revised type of nose wheel unit lock strut which incorporates an improved 'locked down' microswitch. The cables supplied with the new microswitch terminate in a 6-pin plug which necessitates the addition of a mating socket onto the airframe wiring; this plug/socket connection is identified N-BH. Both the nose wheel steering and alighting gear indication circuits are affected as shown in fig 1 and 2.

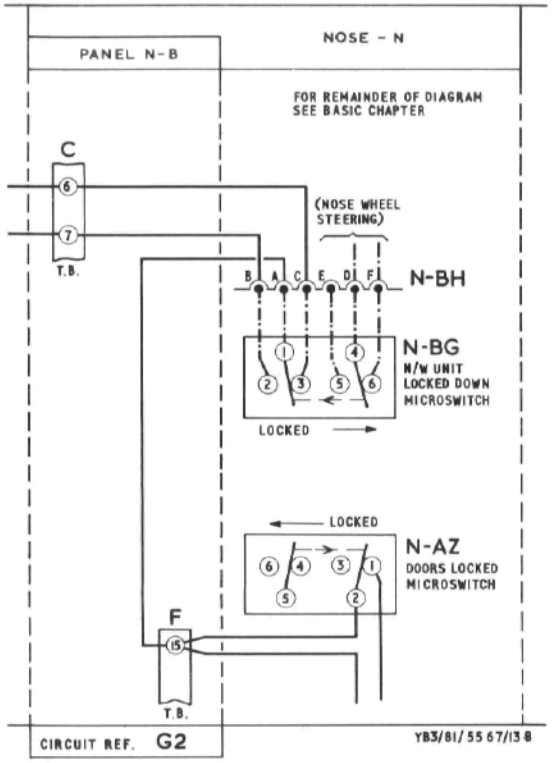

Fig. 2. Alighting gear indication