Chapter 5 FLIGHT INSTRUMENTS

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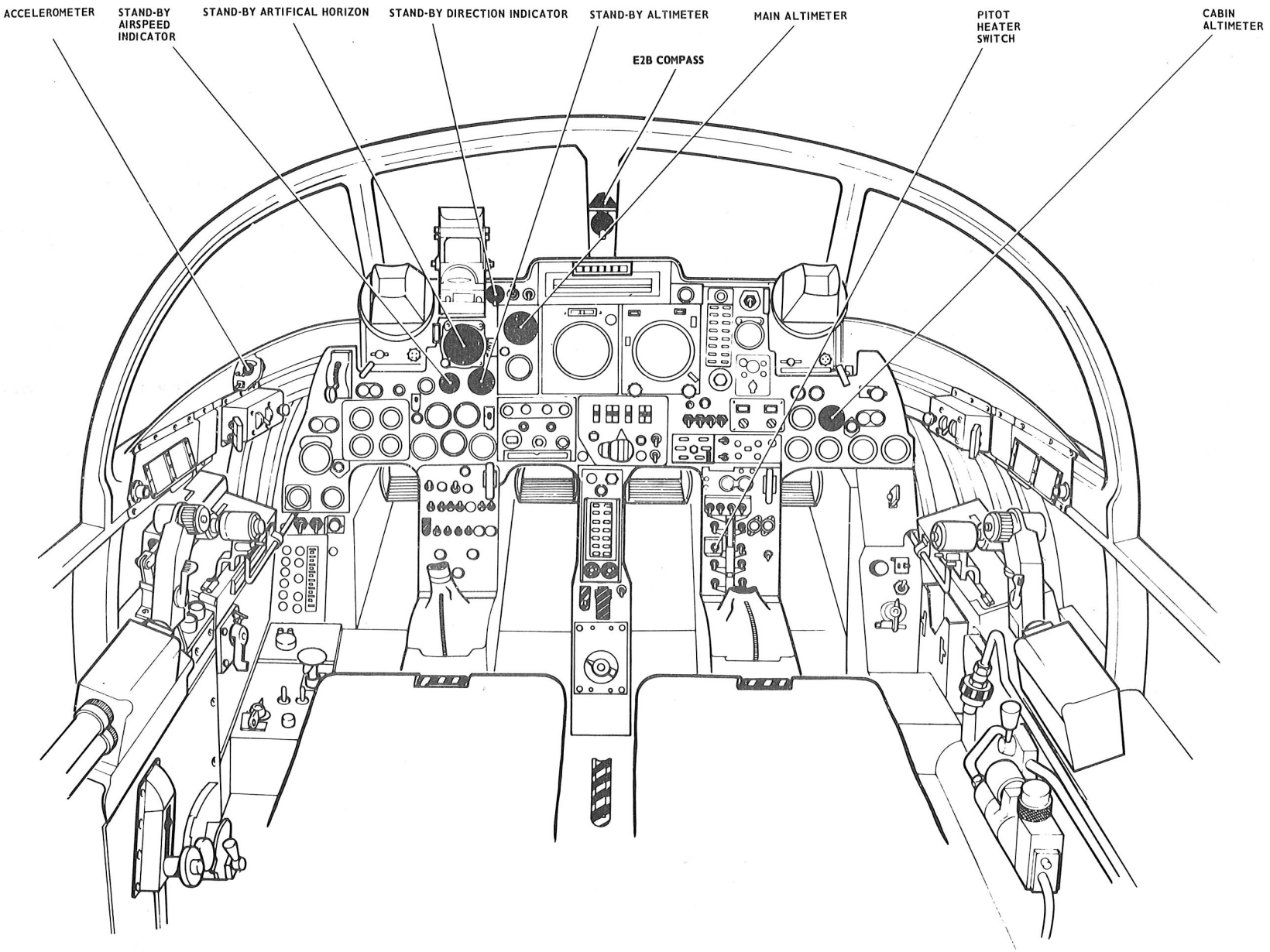

FIG.1. FLIGHT INSTRUMENTS

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◀ MOD.4559 ADDED ▶

DESCRIPTION

General

1. This chapter describes the pitot and static systems and their servicing; and the flight instruments other than those used in the integrated flight instrument and control system *(Chap.3)*.

◀ It has been amended to include the following modifications:-

Mod.4022 Repositions the type C pressure controller to frame 5.

Mod.4302 Cuts off 3 phase instrument supplies in the event of a single phase failure.

Mod.4377 Changes type of instrument master switch.

Mod.4398 Changes 150 kt pressure switch to a 165 kt pressure switch.

Mod.4559 Repositions Accelerometer from panel A1 port side, to the port canopy arch. ▶

PITOT AND STATIC SYSTEMS

General

2. Two seperate pitot and static systems, a main and a secondary, are provided for the instruments and equipment that require these pressures for their operation. The pitot and static pressures originating in the pressure heads are distributed to each individual instrument or unit via a system of pipelines. The pipelines consist mainly of 5/16 in. diameter low pressure aluminium tubing, connected together by straight, elbow, or tee unions embodying rubber seals. Where pipelines run to instruments mounted on anti-vibration mountings, the connections are made through flexible tubes. Reducing unions, from 5/16 in. to 1/4 in., are in use at a number of points and the service is then continued with the smaller diameter tubing. All pitot and static pipelines are bonded to the aircraft structure and it is important that upon the reassembly of any dismantled pipelines, the bonding is efficiently remade.

Pitot and static system (main)

3. The main system provides the pitot and static pressures required to operate the pressure switches, transducers, feel simulator and the altitude and air speed unit. The pressures are taken from a Type KPF0301 pressure head, extended on a probe and located under the bottom lip of the nose air intake.

4. In addition to supplying pitot pressure to the instruments, the head provides two sources of static pressure, one which supplies the instruments and the other which serves the fuel venting system. To prevent icing up of the pressure head, it is equipped with a heater element which is controlled by a switch in the cabin *(Sect.6, Chap.6)*.

Pitot and static system (secondary)

5. Pitot/static pressure required to operate the stand-by air speed indicator and the static pressure for the stand-by altimeter, is derived from a secondary system which serves the cabin area only. The pitot pressure is taken from a modified Type PH1233/B pressure head, located on the radar head top strut in the nose air intake.

6. Static vents, located between fr.9-10 just below the centre line of the aircraft, supply both the stand-by air speed indicator and stand-by altimeter with secondary static pressure. The vents, consisting of polished brass plates shaped to the curvature of the aircraft, port and starboard, are linked by pipeline and teed up to the instruments on panel A1 in the cabin.

Static vent plugs

7. Both static vents are provided with blanking plugs and warning pennants, to prevent ingress of moisture and dirt whilst the aircraft is grounded. Before flight or during testing, the blanking plugs are to be removed.

Drain traps

8. Accumulated condensation in the pitot and static pipelines is collected by drain traps installed at the lowest levels of the pipeline runs. The location and details of the drain traps are illustrated on fig.2 and 3.

FLIGHT INSTRUMENTS

General

9. The flight instruments, other than those described in Chap.3, consist of the accelerometer, Mk.E2B compass, and the stand-by instruments comprising the altimeter, artificial horizon, and dir-

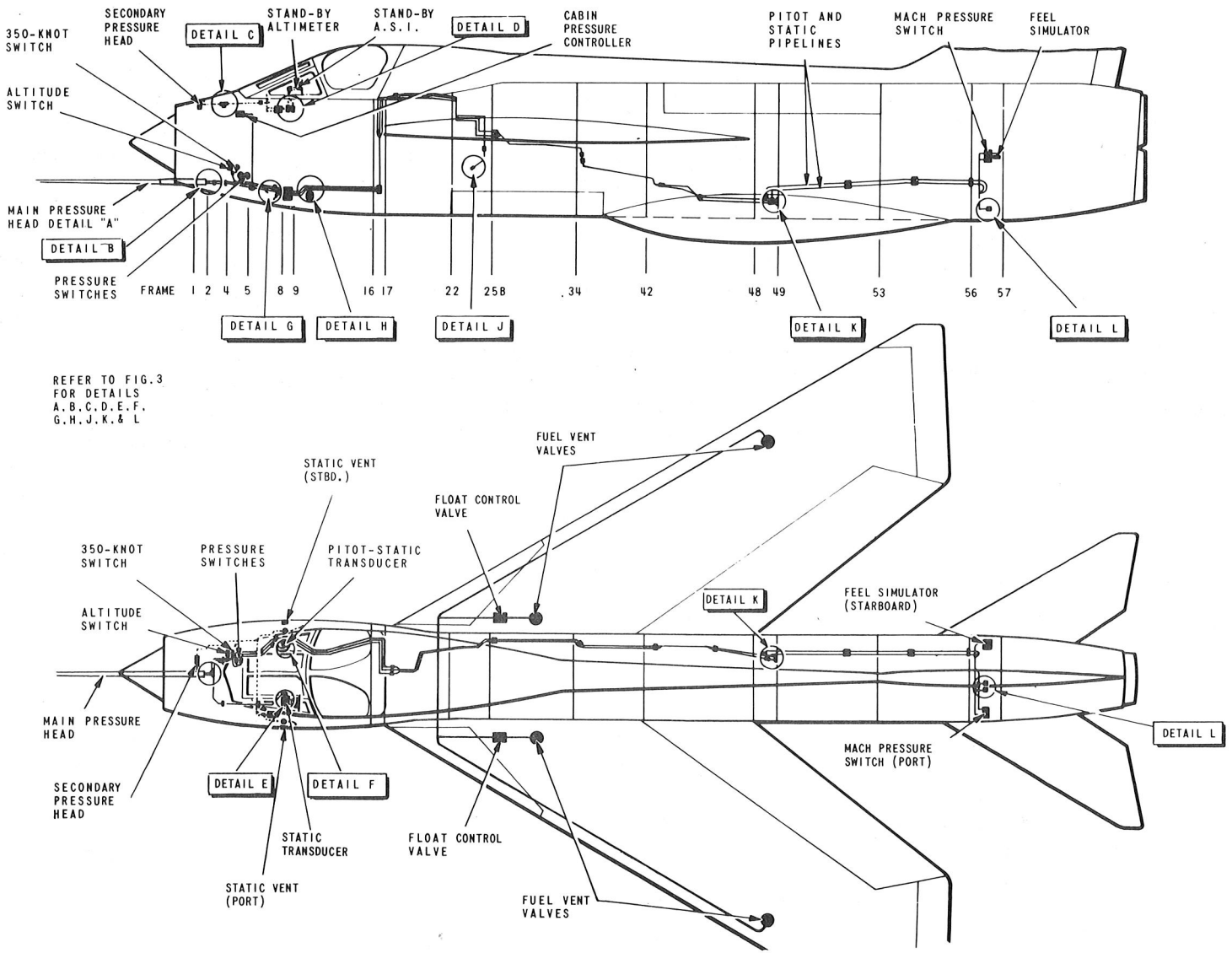

FIG.2. PITOT AND STATIC SYSTEM

◀ MOD.4022 ADDED ▶

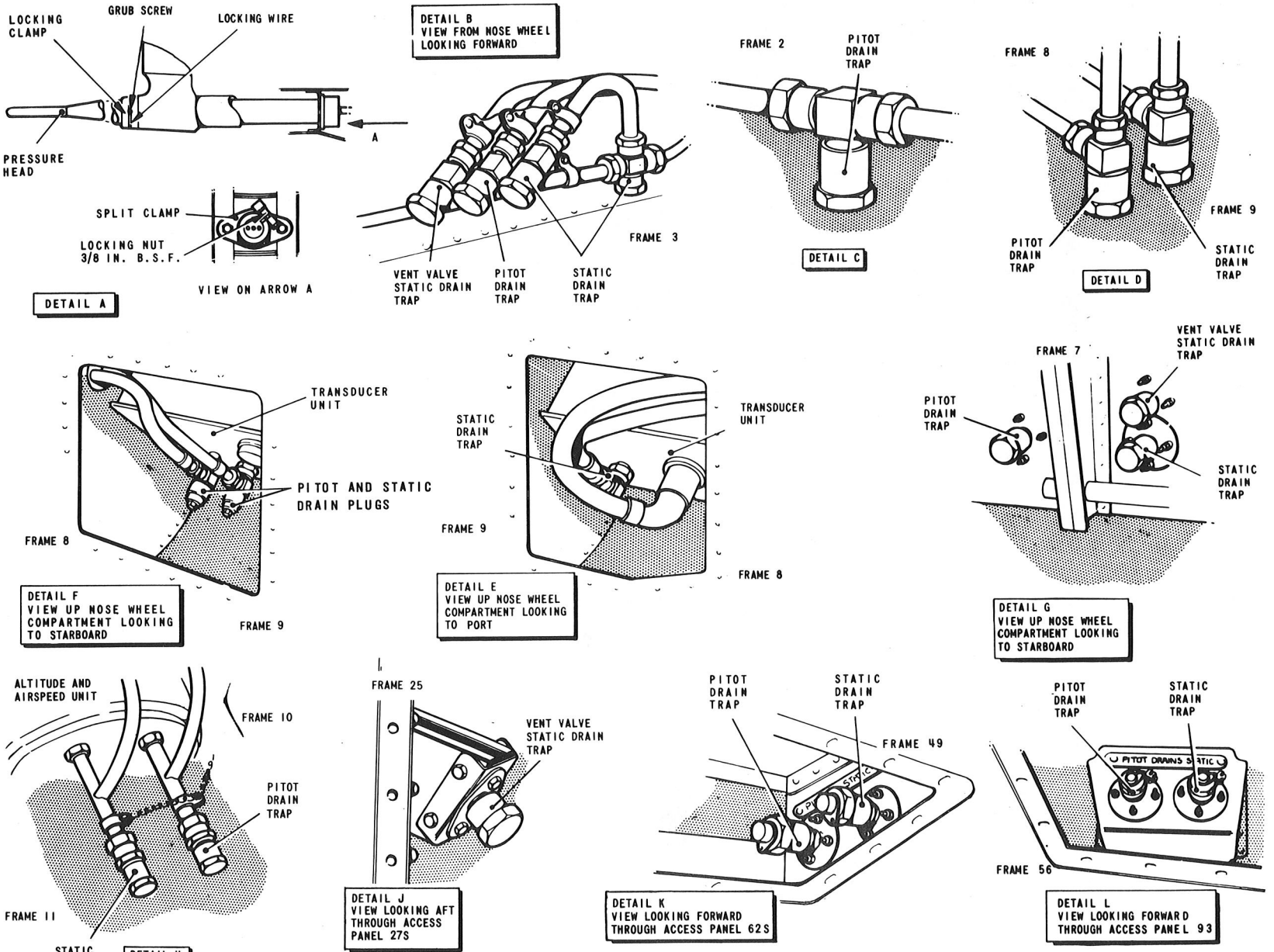

FIG.3. PITOT AND STATIC SYSTEM DETAILS

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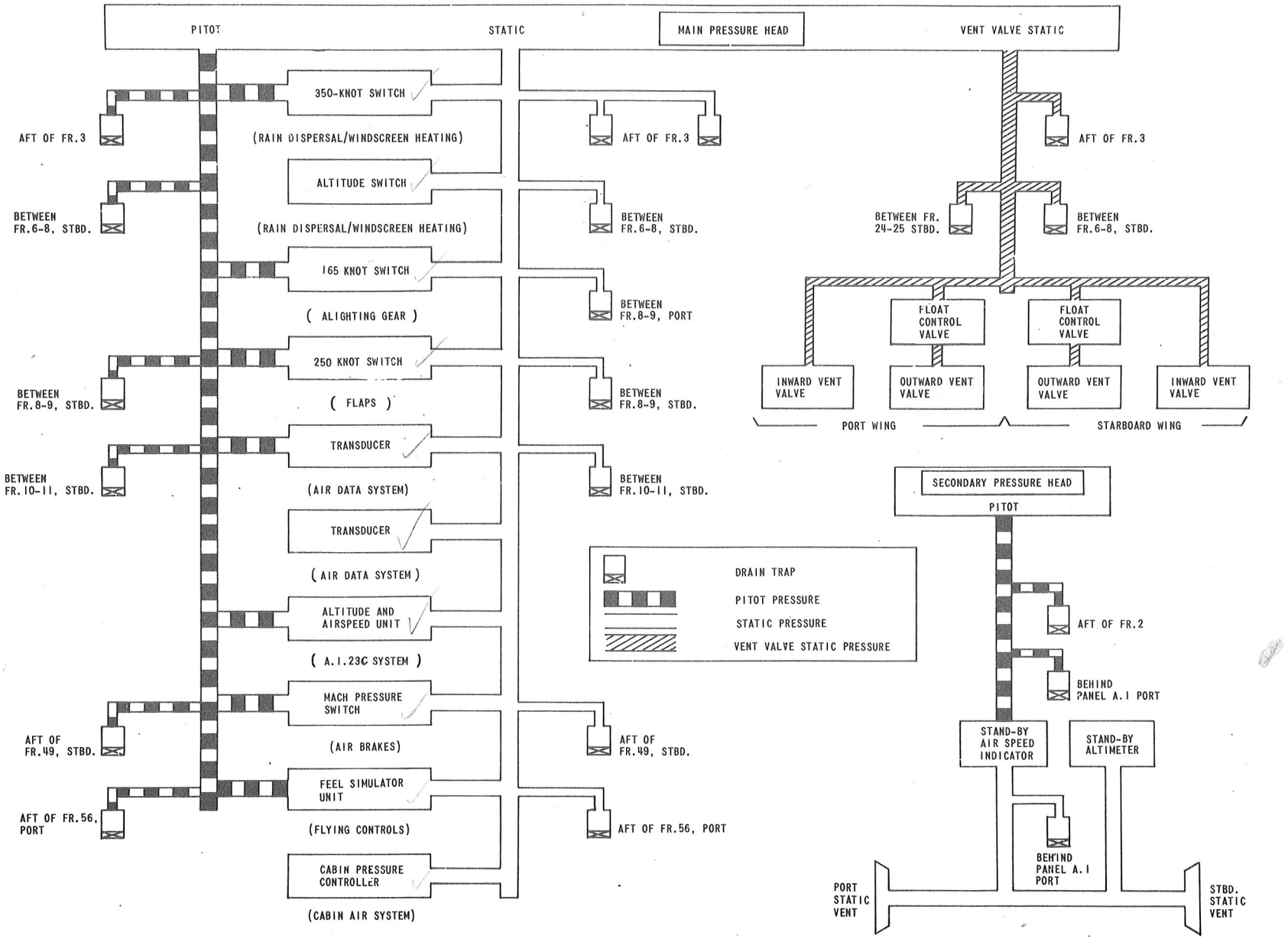

FIG.4. PITOT AND STATIC DIAGRAMMATIC CIRCUIT

5-9214-1

◄ MOD. 4785 ADDED ►

ection indicator, and the stand-by A.S.I.

Accelerometer

◀ **10.** The accelerometer, mounted on the port canopy arch, provides visual indication of the acceleration forces applied to the aircraft during flight.

Compass Type E2B

11. The emergency or stand-by compass, fitted to the windscreen longeron, is an E2B type, providing direct reading from a compass card within a plastic bowl, illuminated by an internal lamp.

12. Under normal operation, illumination of the compass is controlled by the port dimmer switch *(Sect.6, Chap.8)*, but should a failure of the lighting occur, it may be transferred to the emergency lighting circuit.

13. The lamp filament embodied in the E2B compass is a special non-magnetic type, identified by its Ref.No. and a red spot. It is important that no other type of lamp be used on replacement, otherwise errors will occur in the compass readings.

Stand-by altimeter

14. Should the height display of the air data system fail to operate, a Mk.26 altimeter is provided for stand-by use. It is located on panel A1 port side, and is a direct reading instrument calibrated in feet. The presentation is in the form of a 3-pointer display and the calibrations are in feet. A zero height adjustment knob, in the bottom corner of the dial is manually used to compensate for ground pressure variation.

Stand-by A.S.I.

15. Should a fault occur in the speed display of the air data system, the aircraft speed can be read from the stand-by A.S.I. Mk.14 which is fitted on panel A1, port side. The instrument is connected into the pitot and static pipelines of the secondary system.

Stand-by directional gyro system

General

16. In the event of failure of the integrated flight instrument system, provision is made to give continuous indications of aircraft attitude in both pitch and roll, and also continuous azimuth heading information. These readings are supplied by a stand-by directional gyro system comprising a control unit, a direction indicator, and an artificial horizon.

Control unit

17. The control unit, housed in the forward equipment compartment on a quick-release mounting tray, comprises a gyro which operates the direction indicator, a control circuit for the gyro and also the artificial horizon, and a 28-volt d.c. operated transistorized inverter unit which provides a.c. to the instruments in the event of failure of the normal a.c. supply.

Power supplies

18. The power supplies fed to the control unit include 115-volt, 400 Hz, 3-phase a.c. and two sources of 28-volt d.c. taken from separate busbars but controlled by the instrument master switch.

19. The artificial horizon and the integral gyro in the control box normally operate from the a.c. supply. If this fails, they are automatically transferred to an a.c. supply derived from the transistorized inverter operated by one of the d.c. supplies (PF2). In the event of failure of this d.c. supply, there is an automatic change-over to the other d.c. supply (PK) which is the emergency battery busbar.

Artificial horizon

20. A Mk.6H artificial horizon is mounted on panel A1 and is fed with supplies from the control inverter circuit.

Direction indicator

21. The direction signals from the gyro in the control unit are routed to a Type B direction indicator in the cabin housed on top of the main panel shroud. The dial presentation is lit by an internal red lamp. Under normal conditions the lamp is controlled from the port dimmer switch *(Sect.6, Chap.8)*, but should failure of the lighting occur, it may be transferred to the emergency lighting circuit. A fast erection warning lamp is also mounted on the front of the instrument behind a blue tinted window. ▶

SERVICING

WARNING

The relevant safety precautions detailed on the LETHAL WARNING marker card must always be observed before entering the cockpit or performing any operations upon the aircraft.

Pitot and static systems

Equipment required

22.

Pitot and static test set, Mk.2, Ref. No.6C/2048 complete with the appropriate adapters.

Blanking plugs for the static vents (EB5-88-10223)

Aneroid barometer, portable, Ref.No. 6C/2154.

Note...

Both the pitot and static test set and the aneroid barometer are described in A.P.1275T, Vol.1, Sect.3.

Test precautions

23. Before commencing the following servicing checks, ensure that the flap switches in the cabin and the flaps are in the UP position, and that the alighting gear is selected DOWN.

(1) Ensure that the atmosphere and balance valves on the test set are ◀closed and wire-locked.▶

(2) Care must be taken when applying suction or pressure to the system that rates of 1500 ft/min or 5 knots are not exceeded. This also applies when relieving suction or pressure.

(3) Ensure that the capacity selector on the test set is OUT.

(4) Upon initial application of pressure or suction, ensure that all instruments operate in the correct direction, and that there is no undue lag between the readings of the aircraft instruments and the test set instruments.

(5) The test set vibrator should be switched on momentarily after each test.

Leak testing (stand-by system)

24.

(1) Connect the test set to the stand-by pressure head and one static vent, and blank off the other vent with an adapter plug.

(2) Open the pressure and suction control valves and turn the selector valve to SAFE to relieve the system of any pressure or suction.

(3) Turn the selector valve to 'P' and operate the hand pump until the test set A.S.I. reads 130 knots (using correction card) and then close the pressure control valve - the reading must not fall to 125 knots in less than 3 minutes. Upon initially applying pressure, check that the aircraft stand-by A.S.I. reading increases and the stand-by altimeter reading remains at zero.

(4) Turn the selector valve to SAFE and relieve the pressure by carefully opening the pressure control valve, checking that the aircraft stand-by A.S.I. reading decreases without undue lag.

(5) Turn the selector valve to 'S' and operate the hand pump until the test set A.S.I. reads 130 knots (using correction card) and then close the suction control valve. The reading must not fall to 125 knots in less than 3 minutes. Upon the initial application of suction check that both the stand-by A.S.I. and stand-by altimeter show increasing readings.

(6) Turn the selector valve to SAFE and relieve suction by carefully opening the suction control valve - check that both the stand-by A.S.I. and stand-by altimeter readings decrease without undue lag and that both instruments read within their zero ranges when suction is exhausted.

Leak testing (main system)

25.

(1) Ensure that both transducer units are connected, and that the rate-of-climb and the speed display are installed in their rack, also that fuses 187 and 195, in the a.c./d.c. fuse and relay box, are fitted and serviceable.

(2) Check that the MRG is switched off and the pilot's controller master switch is off. Ensure that the electrical power supplies are switched on and that the instrument master switch is on. Check that the A.S.I. and height and rate-of-climb display power failure flags show power 'ON'.

Note...

Should a continuous rapid movement of the height and rate-of-climb display occur, switch off the instrument master switch and investigate the fault.

(3) Connect the test set to the main pressure head.

(4) Carry out, on the main instruments, the tests described in para.24 (3)-(6) for the stand-by instruments. The main instruments should indicate in a similar manner to the stand-by instruments (i.e. where a stand-by A.S.I. reading increases the main A.S.I. reading should increase).

Vent valve static and float valve leakage tests

26.

(1) Uncouple the 2-way connection in the auxiliary air pressure pipe to the float valves, behind access panel 45P, at fr.29-31 port side. Blank off pipe to float valves.

(2) Connect test set static line, including in-line fuel trap, to vent valve static holes.

(3) Turn the selector valve to 'S' and open the pressure and suction control valves. Operate the hand pump until the test set A.S.I. reads 130 knots. Close the suction control valve and check that the A.S.I. reading does not fall to 117 knots in less than 3 minutes.

(4) Repeat (3) for an A.S.I. reading of 500 knots and check that the reading does not fall to 480 knotes in less than 4 minutes. Turn the selector valve to SAFE. Open the suction control carefully, and when suction is exhausted turn the selector valve to 'S' and close the suction control valve.

(5) Remove the blank from the pressure pipe and leave open to atmosphere.

(6) Open the suction control valve and operate the hand pump until the test set A.S.I. reads 500 knots. Close the suction control valve and check that the A.S.I. reading does not fall to 400 knots in less than 80 seconds.

(7) Turn the selector valve to SAFE and open the suction control valve carefully to relieve the suction.

(8) Recouple the two-way connection in the auxiliary air pressure pipe to the float valve.

Note...

Should fuel be observed to be entering the fuel trap at any stage during operations (3) and (4), then the tests should be immediately terminated for rectification or replacement of the faulty vent valve.

Functional tests (stand-by system)

27.

(1) Using the portable barometer, check the ambient pressure by initially setting the micrometer scale on the instrument to 1000 millibars and then adjusting the scale until the required reading is found.

(2) Connect the Mk.2 test set to the stand-by pressure head and one static vent (the other vent is to be blanked off with an adapter plug).

(3) Turn the selector valve to SAFE and open the pressure and suction control valves.

(4) Set the stand-by and test set altimeter millibar scales to the reading shown by the portable barometer *(para. (1))* - the stand-by altimeter should now read zero ± 100 ft.

(5) Turn the selector valve to 'P' and operate the hand pump until the A.S.I. reads 600 knots (applying correction cards) - the aircraft stand-by A.S.I. should read 600 knots ± 25 knots, then shut the pressure control valve.

(6) Turn the selector valve to SAFE and relieve the pressure gradually by carefully opening the pressure control valve - check that the stand-by A.S.I. reading returns to zero without undue lag whilst pressure is exhausting.

(7) Turn the selector valve to 'S' and operate the hand pump until the test set altimeter reads 5000 ft (use correction card) - the stand-by altimeter should now read 5000 ft ± 100 ft, then shut the suction control valve.

(8) Turn the selector valve to SAFE and relieve the suction gradually by carefully opening the suction control valve - check that the stand-by altimeter reading returns to zero ± 100 ft. without undue lag when exhausting suction.

Stand-by gyro instruments

Preparation for tests

28.

(1) Select the aircraft power supply switches, the instrument master switch and the M.R.G. switch to OFF.

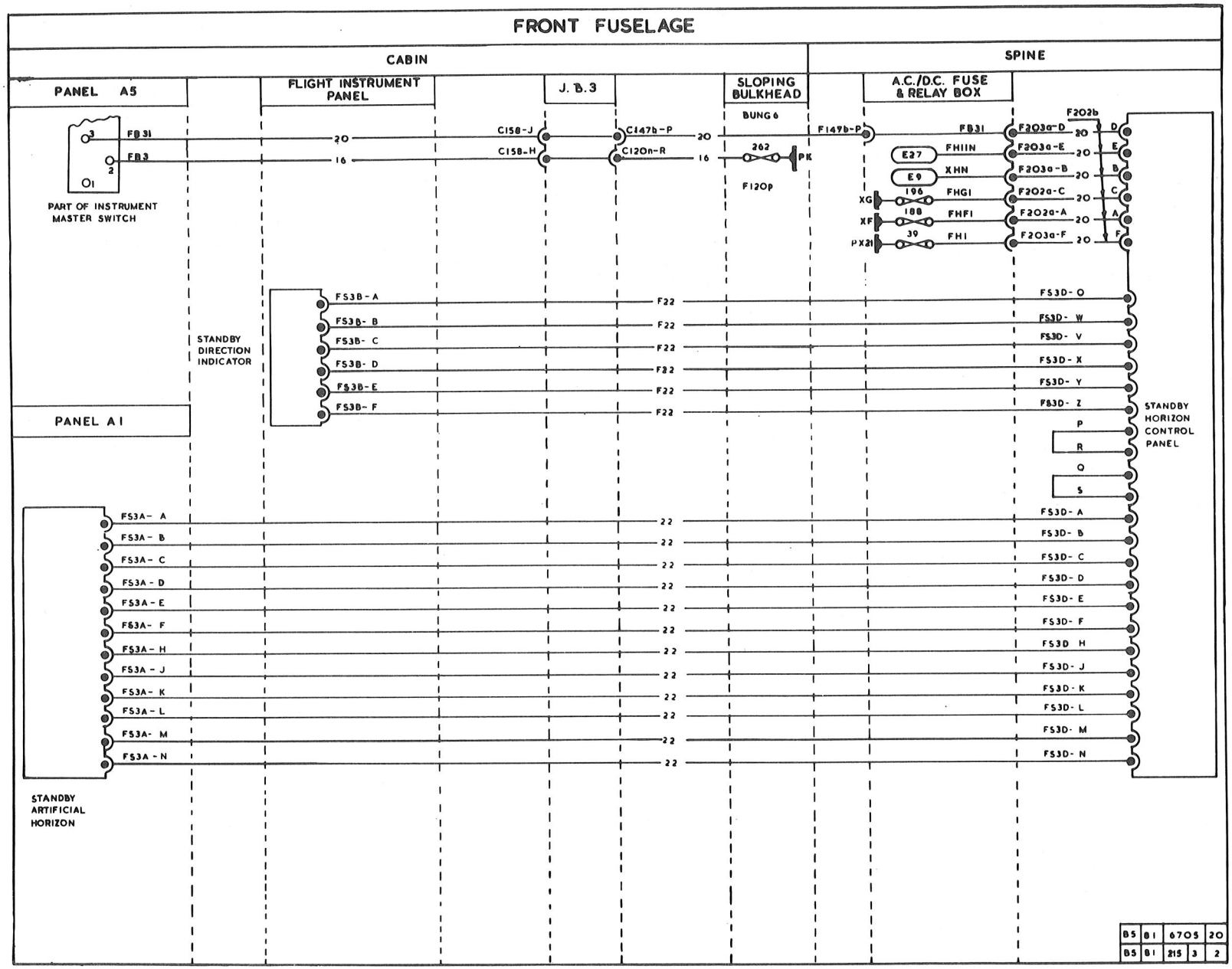

FIG.5. STAND-BY DIRECTIONAL GYRO SYSTEM

◄ MOD 4302, 4377 ADDED ►

(2) Connect a.c. and d.c. external power supplies to the aircraft.

(3) Ensure that the aircraft is rigged within 15 minutes of horizontal in the 'pitch' and 'roll' attitudes.

Operation

29. .

(1) Switch the a.c. and d.c. external power supplies ON.

(2) Select the instrument master switch ON and check the functioning of the artificial horizon and stand-by direction indicator - the gyros in both instruments should commence to run up and after approximately 10 seconds the power failure flag in the artificial horizon should disappear.

Note...

If the power failure flag is still visible after 15 seconds switch off the instrument master switch and investigate. The artificial horizon roll pointer and horizon bar should erect to within 1 deg of straight and level flight.

(3) Operate the direction indicator dial lamp dimmer switch and check that the lamp brightness varies with movement of the dimmer.

(4) Push in the fast-erection button on the direction indicator and check ◀ that the warning lamp illuminates.

(5) Release the fast-erection button - the warning lamp should extinguish if the direction indicator gyro has erected to within 15 deg of the horizontal datum.

(6) If the warning lamp does not extinguish when the fast-erection button is released the gyro will be more than 15 deg from the horizontal datum and should be erecting at 120 deg per minute.

Note...

If the gyro was erected to a position greater than 15 deg the warning lamp should extinguish within one minute of pushing in the fast-erection button, but if this condition cannot be satisfied, the instrument master switch should be switched off and the reason investigated. ▶

(7) Rotate the direction indicator dial by turning the fast-erection button - the dial should rotate smoothly throughout its 360 deg movement.

(8) With the instrument master switch selected ON, switch off the a.c. power supply - after 10 minutes have elapsed check that the artificial horizon and direction indicator are still functioning. (The instruments should now be operating from the d.c. supply and the artificial horizon power failure flag should not be visible).

(9) Select the instrument master switch OFF and disconnect the external power supplies.

Direction indicator check

Note...

This check is to be carried out during a normal compass 'swing' operation.

30.

(1) Switch on the a.c. and d.c. power supplies.

(2) Select the instrument master switch ON.

(3) Press in and then release the direction indicator fast-erection button and check that the instrument erects to within 15 deg of the horizontal datum - the warning lamp should go out when the gyro has erected to within 15 deg of the horizontal datum.

(4) Upon the completion of the four-point compass correction swing, rotate the fast-erection button of the direction indicator and align the dial to the aircraft bearing as indicated by the lamp compass (reciprocal bearing). The aircraft should nowbe heading west.

(5) Swing the aircraft through 45 deg to a NW heading and record the direction indicator reading. Align the aircraft bearing and then swing the aircraft through a further 45 deg to a N heading and again record the indicator reading. The time to swing through 45 deg should not be longer than 2 minutes. In both cases the direction indicator should indicate aircraft heading ± 4 deg.

◀ REMOVAL AND ASSEMBLY

Pressure head removal

31. The sequence of operations for removal of the pressure head is as follows: -

(1) Remove access panel 1, forward of nose-wheel compartment.

(2) Ensure that the pressure head heater switch on the starboard console is OFF, and remove the relevant circuit fuses. ▶

◀ (3) Disconnect the heater electrical leads at the terminal block on the forward face of frame 3.

(4) Remove the bolts securing the pipeline clamp on the forward face of frame 3, and remove the clamp.

(5) Disconnect the pressure head pitot and static pipelines at the tee unions on the aft face of frame 3, Blank off the tee unions to prevent ingress of dirt and moisture into the systems, Remove the rubber bushes and union nuts from the pressure head pipes.

(6) Through the aperture of access panel 1, slacken the 3/8 in. B.S.F. bolt securing the split clamp.

(7) At the nose ring, remove the locking wire and grubscrew, and slacken the clamping nut. The pressure head is now free to be eased out of its housing. Care must be taken not to damage the pitot and static pipelines at the rear end.

Pressure head installation

32. The sequence of operations for the installation of the pressure head is as follows:-

(1) Insert the aft end of the pressure head through the collar at the nose ring until it is held in the split clamp at frame 2 and tighten the clamp securing bolt. Tighten the clamping nut at the nose ring, and fit the grubscrew so that it engages in the slot of the split clamp, then fit a length of 22 s.w.g. locking wire in the groove of the clamping nut, locking the screw by its screwdriver slot, and tucking the twisted end into one of the 'C' spanner holes. Cover the twist of the locking wire with Araldite and secure the wire in the groove with spots of Araldite approx. 90 deg apart.

(2) Trim the pitot and static pipes if necessary, so that when bent to pass through the pipeline clamp they are the correct length for connection to their tee unions. From the nose-wheel, looking forward, the pitot union is the centre of the three, with the instrument static to starboard and the vent valve static to port.

(3) Remove any swarf and thoroughly clean the pipes. Fit the union nuts and new rubber bushes, remove the blanks on the tee unions, and secure the union nuts.

(4) Replace and secure the pipeline clamp.

(5) Connect the heater electrical leads to the terminal block, and replace the circuit fuses.

(6) Switch on the heater and check its operation by feel, then set the control switch to OFF.

(7) Carry out the functional and leakage tests on the pitot/static system detailed in para. 25

(8) Replace access panel 1. ▶

TABLE 1
Equipment details

Equipment	Location	Access	Air Publications
◀ Pressure head (main), Type KPF0301	Probe protruding from bottom lip of air intake	Nose air intake	112G-0102-1
Pressure head (stand-by), Type PH1223/B	On radar head, top strut, air intake	Nose air intake	
Static vents	Between fr.9-10, port and starboard	Outer skin of aircraft	
Static vent plugs	Used in the static vents		EB5-88-10223
Drain traps, A.G.S.838-6	At the locations detailed on fig.2 & 3		
Accelerometer, Mk.3 Ref.No.6A/6418	Panel A1, port side	Via cabin	1275A, Vol.1, Sect.12, Chap.2
Compass, Type E2B Ref.No.6B/2754	On windscreen longeron, centre	Via cabin	112B-0201-1
Lamp filament, Ref.No.5LX/959121	Inside the E2B compass	Via cabin	
Stand-by altimeter, Mk.26	On panel A1, port side	Via cabin	1129-1013-1
Stand-by A.S.I. Mk.14	On panel A1, port side	Via cabin	1275A, Vol.1, Sect.21
Stand-by directional gyro system			
Control unit, Type B Ref.No.6B/3219	Fwd. equip. comp.	Access panel 3	112G-0307-1
Artificial horizon, Type 6H Ref.No.6A/6819	Panel A1	Via cabin	
Direction indicator, Type B, Ref.No.6B/3104	Panel A1 shroud	Via cabin	

TABLE 2
Fuses, circuits, and locations

Fuse No.	Rating	Code	Circuit	Location
39	10A	FH1	28-volt supply to stand-by gyro system	A.C./D.C. fuse and relay box
188	5A	FHF1	Stand-by gyro system control box	
196	5A	FHG1	Stand-by gyro system control box	
262	5A	FB3	Emergency battery supply to the stand-by gyro system	Fuse block on the aft face of sloping bulkhead