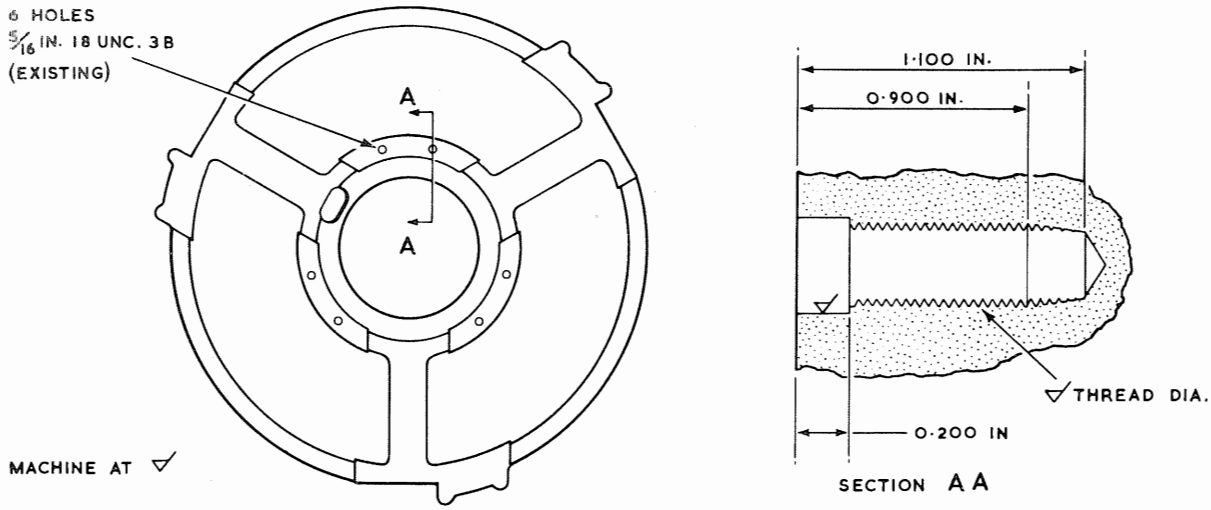


SALVAGE NUMBER	STUD FAST END OVERSIZE	DRILL SIZE	COUNTERBORE SIZE	3B TAP SIZE	NON-STANDARD STUD REQUIRED
V.27242	STANDARD	0·2570 IN.	0·3281 IN.	5/16 IN.– 18 UNC.	V.27245
V.27243	0·0050 IN.		0·3281 IN.	0·3175 IN.– 18 UNC.	V.27246
V.27244	0·0100 IN.		0·3437 IN.	0·3225 IN.– 18 UNC.	V.27247

9092

Section through typical stud location
Fig. 801

* * *

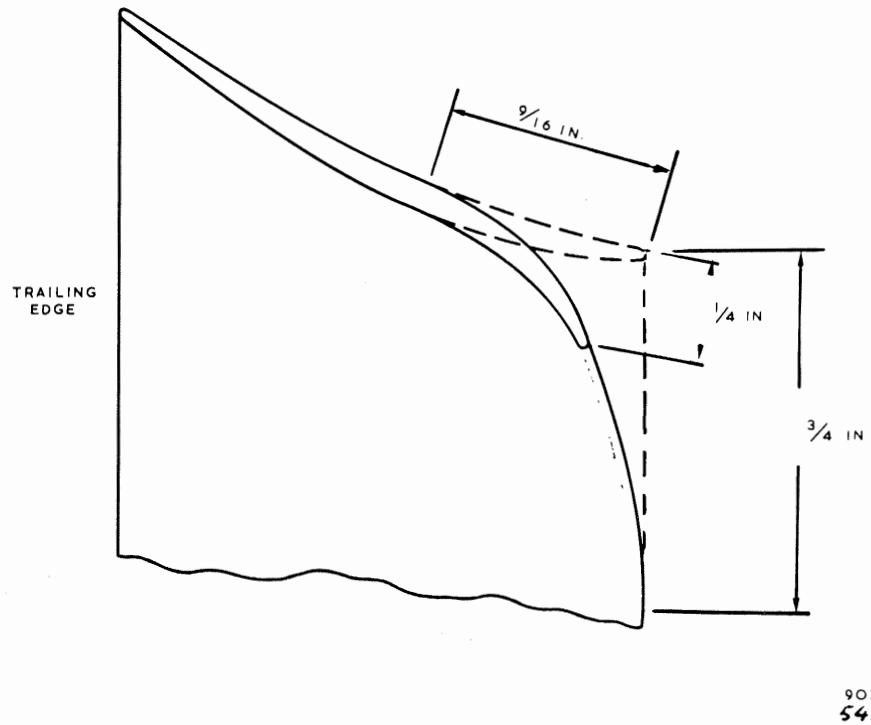
1. Inspection/Check

A. Acceptance check for compressor blade damage

NOTE : This check is confined to the zero stage rotor blades, the condition of which is taken as indicative of the remaining stages. The type of damage which is acceptable is that characteristic of ice injection.

(1) Visually examine zero stage rotor blades for damage; bent leading edge tips, up to a maximum of 4 blades - each within the limits shown on Fig.201, are acceptable providing the damage is not accompanied by torn edges or cracks.

NOTE : There is no restriction on the proximity of damaged blades.



Zero stage compressor rotor blades - Acceptance limits for leading edge tip bending
Fig.201

(2) Using a dye penetrant, crack detect all damaged blades; cracks are not acceptable.

continued...

...Compressor - Inspection/Check continued

(3) Clear engines for further running, without rectification, if they have suffered damage which is within the limits specified.

NOTE : If the damage is beyond the acceptance limit consult Bristol Siddeley Engines Ltd.

* * *

COMPRESSOR - REMOVAL/INSTALLATION

1. Removal/Installation of compressor top half casing

Special tools and equipment

Dummy trunnion	.. ..	PE.21428
Jury strut	.. ..	PE.26788
Extraction sleeve	.. ..	PE.21456
Alignment bullet	.. ..	PE.21447
Extractor tool (to remove fitted bolts)		PE.16211 or PE.11442
Spanner	.. ..	PE.8653
Spanner	.. ..	T2 DU1107SN
Torque wrench	.. ..	PE.25491 or T2 EM1986BR

NOTE : If the compressor is damaged or suspect the top half of the compressor casing can be removed to examine the stator, rotor and straightener blades with the engine installed or removed as follows :-

A. Remove compressor top half-casing (engines installed in aircraft)

(1) It is recommended that the aircraft is supported by hydraulic jacks as detailed in Chapter 7. Alternatively, ban access to aircraft to avoid depression of the oleos which may affect operation 8.

(2) Remove the four bolts and blanking plate from the outboard, unused trunnion housing on the centre section.

(3) Install the dummy trunnion to the trunnion housing and secure with the four bolts removed in operation (2).

(4) Remove the cabin air elbow together with the aircraft cabin air pipe (right engine only).

(5) Remove the following items :

NOTE : Install blanks on all components, pipes and apertures immediately they are removed and/or exposed.

(a) Anti-icing air valve assembly together with anti-icing elbow (attached to the centre section).
(b) Connecting pipes.
(c) Anti-icing elbow (attached to the air intake casing).
(d) P2 to thrust limiter pipe (Mk.522 only).

NOTE : Do not disconnect the 'P' clip at the anti-icing elbow location.

...Compressor - Removal/Installation continued

(6) Support the outboard side of the engine by placing a suitable hydraulic jack beneath the dummy trunnion jack location spigot. Alternatively, use a light crane attached to the dummy trunnion shackle.

NOTE : The aircraft wheel change hydraulic jack mounted on a suitable rigid trestle will be adequate, since the weight will not exceed 500 lbs.

(7) Before taking any positive weight, remove the split pin and nut from the bolt securing the top aircraft link to engine mounting bracket attached to the top half of the compressor casing. Install alignment bullet to the bolt.

(8) Carefully take the weight of the engine, then move the top mounting bolt to ensure that the engine weight is off the bolt.

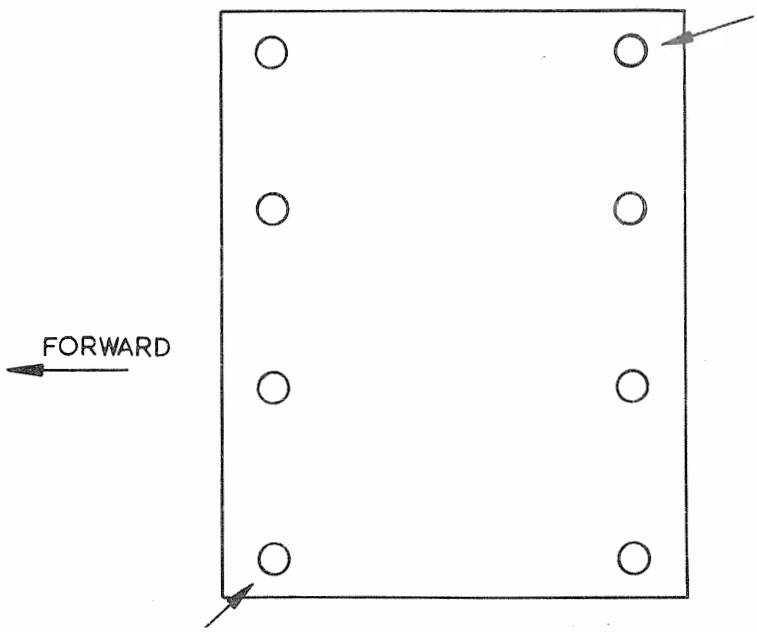
NOTE : If using the hydraulic jack ensure that the safety collar is used in conjunction.

(9) Remove the bolt from the mounting bracket/top aircraft link location.

(10) Remove the bolt attaching the link arm to the aircraft bracket on the fuselage.

(11) Locate jury strut plate on the anti-icing elbow pad of the centre section and secure with eight nuts. Loosely connect the turnbuckle end to the aircraft bracket.

NOTE : Right engine only :-
Position the turnbuckle barrel to clear the studs at the cabin air elbow location. It may be necessary to remove the two studs indicated in Fig.401.



Cabin air elbow location
Fig.401

...Compressor - Removal/Installation continued

(12) Adjust the turnbuckle sufficiently to take the weight of the engine, ensure that the turnbuckle is in safety.

(13) Remove the hydraulic jack (or crane if used) from the outboard engine support.

(14) Disconnect the electrical harness sufficiently to allow removal of the top half compressor casing.

(15) Drain the oil tank (see Chapter 72, LUBRICATION SYSTEM).

(16) Disconnect the following pipes from the oil tank :-

(a) Scavenge return pipe.
(b) Oil tank to pump pipe.
(c) Tank to engine breather pipe.
(d) Tank overflow pipe.

(17) Remove the following air pipes :-

(a) P2 to blow-off valve pipe.
(b) P2 to P1/P2 switch pipe.
(c) P1 pressure to P1/P2 switch pipe.
(d) Switch to blow-off valve pipe.
(e) P2 to P1 heater pipe.

NOTE : It may be necessary to remove the P1, b.f.c.u. pipe to gain access to the lower connection.

(18) Remove the compressor blade shield rear unit (upper half).

(a) Release the blade shield from the compressor axial flange.

(b) Remove the stiffnuts, bolts and fitted bolts, then lift the blade shield, together with oil tank and p.r.s. switch, away from the engine.

(19) Remove the compressor blade shield front unit (upper half).

(a) Remove the bolts securing the upper half compressor casing to the air intake casing radial flange.

(b) Remove the four set-bolts securing the blade shield at its axial joint then lift the upper shield away from the engine.

(20) Remove the following components from the centre section casing front wall :

(a) Blanking plug at mid-top position.
(b) P2 elbow adjacent to anti-icing pad.
(c) Triangular blank plate adjacent to anti-icing pad.

...Compressor - Removal/Installation continued

(21) Release the automatic thrust limiter (Mk.522 only) and the electro pressure control (Mks.521 and 522) from the compressor casing, bottom. Do not disconnect the associated pipes.

NOTE : Store the rubber mountings and distance pieces in suitable container.

(22) Remove the top half compressor casing.

(a) Remove the axial joint bolts, stiffnuts and Firewire together with support brackets. The rearmost bolt but one in each axial joint is a fitted bolt, remove these with the extractor tool.

(b) Remove the bolts securing the top half casing to the centre section and the remaining bolts in the air intake casing joint flange.

(c) Mod.CV.7136 standard and Mk.522 engines : withdraw the eight locating sleeves from the compressor casing rear flange sufficiently to clear the centre section casing. Use the extraction sleeve in conjunction with a 5/16 in. UNF bolt.

CAUTION : EVERY PRECAUTION SHOULD BE TAKEN TO PREVENT FOREIGN MATERIALS ENTERING THE COMPRESSOR DURING THE FOLLOWING OPERATIONS.

(d) Carefully lift away the top half casing from the engine. Ensure that the casing is withdrawn squarely to avoid damage to the blade carrier ring ends and prevent fouling of stator and rotor blades.

(23) Examine the rotor blades, and the stator and straightener blades, which are visible, for damage. If damaged, refer to page 601 block.

(24) Complete repairs as necessary if damage is within acceptable limits.

B. Install compressor top half-casing (engine installed in aircraft)

(1) (a) Apply grease to a 1/4 UNF (28 TPI) tap then run the tap into the centre section and air intake casing inserts to clean out the insert threads.

(b) Clean the joint faces of the compressor, centre section and air intake casings.

(c) Apply jointing compound (see Chapter 71, SERVICING MATERIALS) to the exposed joint faces.

(d) Align the compressor top half-casing with the compressor rotor then ease the casing into position.

...Compressor - Removal/Installation continued

(e) Install a compressor/centre section bolt to each side of the compressor casing adjacent to the compressor axial joint.

(f) Assemble the axial joint bolts, including the fitted bolts, to the compressor casing. Torque-tighten the nuts to 70 to 80 lbf.in.

(g) Mod.CV.7136 standard and Mk.522 engines : insert the locating sleeves to the compressor top half-casing rear flange. Install the setbolts, plain washers and spring washers. Torque-tighten the nuts to 70 to 80 lbf.in.

(2) Install the compressor blade shield front unit.

(3) Install the compressor blade shield rear unit.

(4) Secure the automatic thrust limiter and the electro pressure control to the compressor casing interposing rubber mountings and distance pieces.

(5) Install the following components to the centre section casing front wall :

(a) Blanking plug at mid-top position, using a new sealing washer.
(b) P2 elbow connection, using a new joint washer.
(c) Triangular blanking plate using a new joint washer.

(6) Install the air pipes, removed in para.1.A.(17), interposing new O-seals.

(7) Reconnect the oil pipes, disconnected in para.1.A.(16), interposing new O-seals.

(8) Reconnect the electrical harness.

(9) Replenish the oil tank (see Chapter 12, SERVICING - ENGINE OIL).

(10) Repeat operations (1), (6) and (8) of para.1.A.Ensure sufficient weight is taken to allow the support assembly to be removed from the aircraft bracket.

(11) Assemble the aircraft link arm, using the alignment bullet (see Chapter 71, MOUNTS).

(12) Install the anti-icing air valve and associated pipe and elbows (see Chapter 75, AIR).

(13) Install the P2 to thrust limiter pipe.

(14) Right engine only : refit the studs, if removed in para.1.A.(11), then re-install the cabin air pipe and elbow using a new O-seal and joint washer.

(15) Ground run the engine to check for leaks then complete ground running tests (see Chapter 71, POWER PLANT - GENERAL).

...Compressor - Removal/Installation continued

C. Remove compressor top half-casing (engines removed from aircraft)

(1) Remove the cabin air elbow together with aircraft cabin air pipe (right engine only).

(2) Remove the following items :-

NOTE : Install blanks on all components, pipes and apertures immediately they are removed and/or exposed.

(a) Anti-icing air valve assembly together with anti-icing elbow (attached to the centre section).

(b) Connecting pipes.

(c) Anti-icing elbow (attached to the air intake casing).

(d) P2 thrust limiter pipe.

NOTE : Do not disconnect the 'P' clip at the anti-icing elbow.

(3) Complete operations and instructions given in para. A. (14) to (24).

D. Install compressor top half-casing (engine removed from aircraft)

(1) Complete operations and instructions given in para.B., excluding operations (10) and (11).

* * *

COMPRESSOR - INSPECTION/CHECK

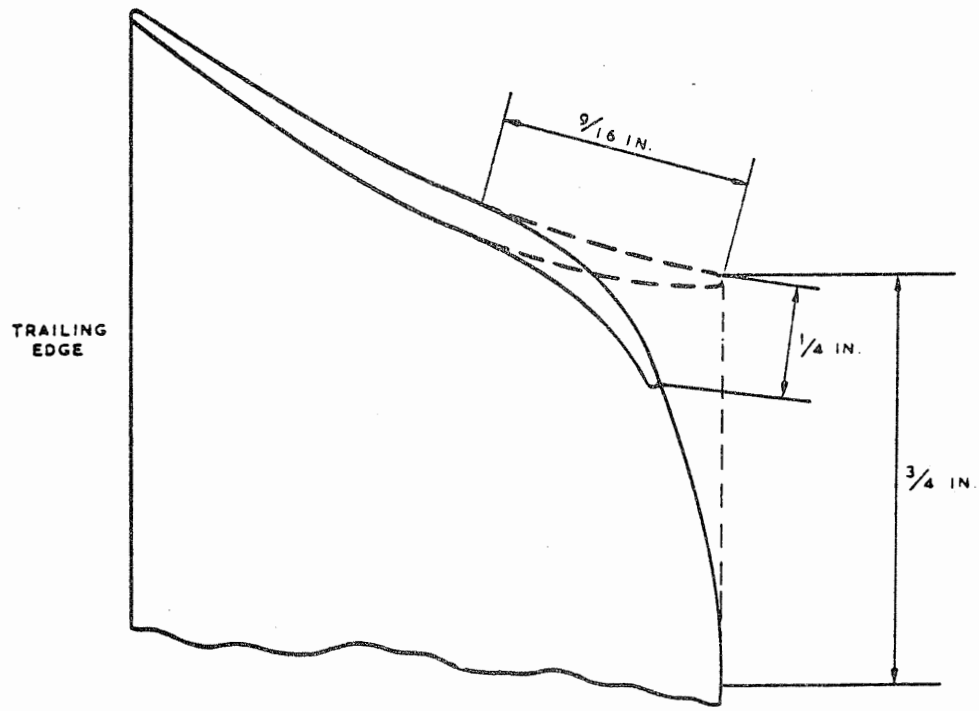
1. Inspection/Check

A. Acceptance check for compressor zero stage blade damage

NOTE : This check is confined to the zero stage rotor blades, the condition of which is taken as indicative of the remaining stages. The type of damage which is acceptable is that characteristic of ice ingestion.

(1) Visually examine zero stage rotor blades for damage; bent leading edge tips, up to a maximum of 4 blades - each within the limits shown on Fig.601, are acceptable providing the damage is not accompanied by torn edges or cracks.

NOTE : There is no restriction on the proximity of damaged blades.



Zero stage compressor rotor blades - Acceptance limits for leading edge tip bending
Fig.601

(2) Using the dye penetrant method (see Chapter 72, COMMON PROCEDURES) crack detect all damaged blades; cracks are not acceptable.

(3) Clear engines for further running, without rectification, if they have suffered damage which is within the limits specified.

NOTE : If the damage is beyond the acceptance limit refer to Chapter 72-30-141 and straighten blades as detailed.

B. Acceptance standards for compressor blade impact damage

NOTE : These acceptance standards cover engines which have sustained damage to the compressor rotor, stator, or the straightener blades in service. Refer to page block 401 of Chapter 72, COMPRESSOR for details of removing the compressor top half-casing.

(1) Damage to blades which is not acceptable :-

(a) Cracks in blades.

(b) Twisting of blades.

(c) Indentations which are not confined to the leading or trailing edges of the blades.

(d) Damage within 0.25 in. of a rotor or stator blade fillet radius (measured from the fillet radius to the blended edge).

(e) More than three identations per leading or trailing edge of blade.

(f) Damage within 2 in. of the zero stage rotor blade platform (measured from the platform to the blend centre) which exceeds 0.05 in. in depth.

(g) Damage to leading or trailing edges at the blade tip which is greater than 20% of the blade length (when blended).

(h) Damage which exceeds the following standards.

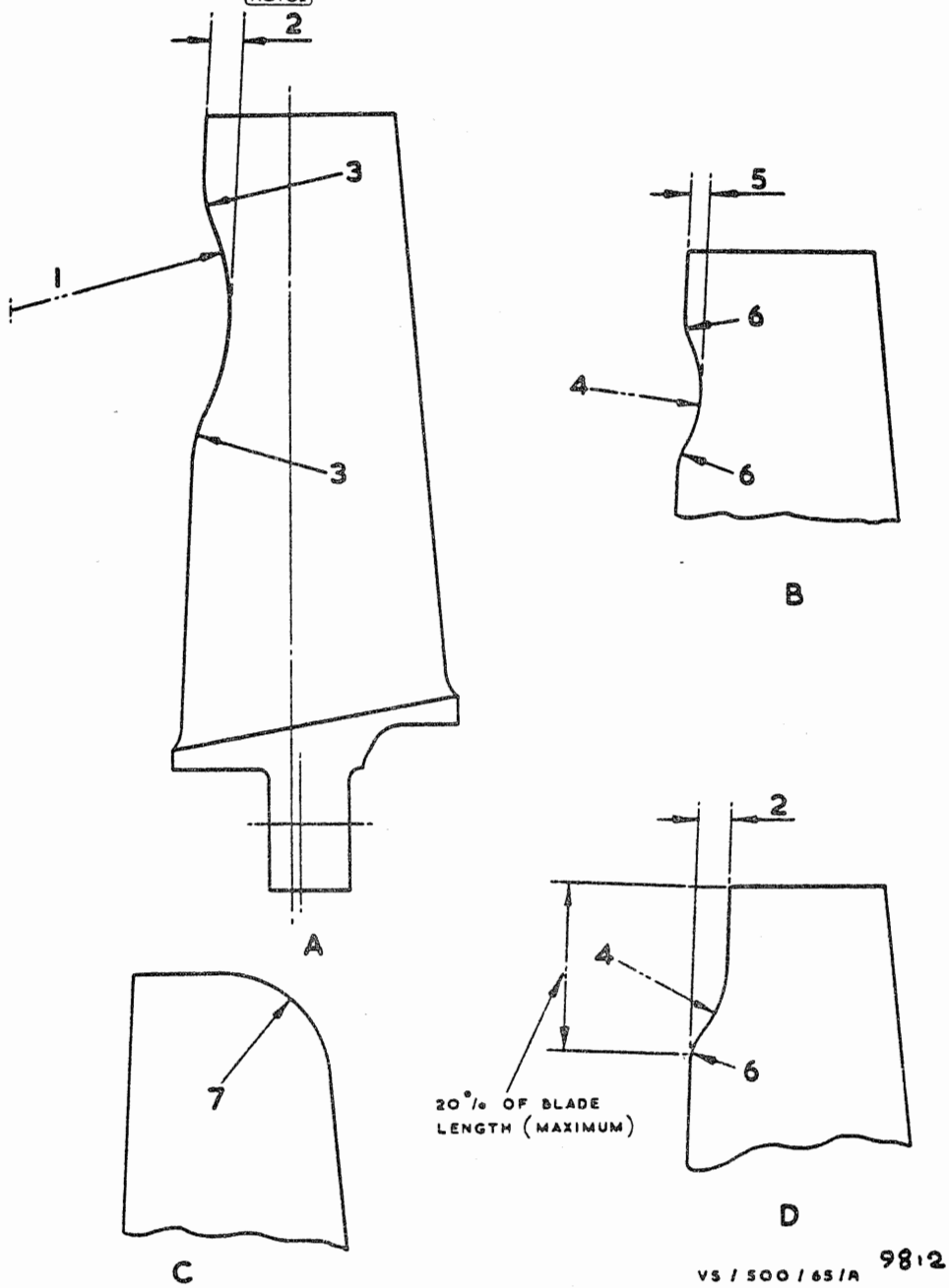
(2) Damage to rotor blades which is acceptable (subject to blending).

(a) Limits for leading or trailing edges of stages 0, 1 and 2 (Fig.602) :-

(i) One blend per blade to a depth of 0.15 in. up to 25% of disc blades which may be either consecutive or intermixed.

(ii) Two blends on the same chord provided the sum total depth does not exceed 0.15 in.

(iii) Three blends per leading or trailing edge provided the sum total depth does not exceed 0.20 in. Blends may be in a combination of two leading and one trailing edge or vice-versa, or three blends per leading or trailing edge.



1. 1.0 in. radius.
2. 0.15 in.max. (stages 0, 1 and 2)
   0.10 in.max. (stages 3,4,5,6 and 7)
   one per blade.
   0.040 in. max. leading edge to tip (stage 4) one per blade only.
3. 0.625 in. radius.
4. 0.5 in. radius.
5. 0.1 in. (stages 0, 1 and 2)
   0.05 in.(stages 3,4,5,6 and 7)
   up to 4 per blade, except stage 4 leading edge to tip where the blend is restricted to 0.040 in.
6. 0.25 in. radius.
7. 0.5 in. max. radius.

NOTE : Tip blending may be as shown in Figure "C" or "D", on either the leading or trailing edge, not on both edges and not in combination of the same edge.

(iv) Four blends per blade to a depth of 0.10 in. each. Blends may be in any combination, but a maximum quantity of three blends per edge. Up to 50% of blended blades per disc may be either consecutive or intermixed.

(b) Limits for leading or trailing edges for stages 3, 4, 5, 6 and 7 (Fig.602) :-

(i) One blend per blade to a depth of 0.10 in., except stage 4 blade leading edge to tip, where the blend is restricted to 0.040 in. Blending may be to 25% of blades, consecutive or intermixed in any disc.

(ii) Two blends on the same chord provided the sum total depth does not exceed 0.10 in. and that stage 4 blade leading edge to tip is restricted to 0.040 in. maximum.

(iii) Three blends per leading or trailing edge provided the sum total depth does not exceed 0.10 in. and that the stage 4 leading edge to tip is restricted to 0.040 in. maximum. Blends may be in a combination of two leading edge and one trailing edge or vice versa, or three blends per leading or trailing edge.

(iv) Four blends per blade to a depth of 0.050 in. each except stage 4 leading edge to tip, where the blend is restricted to 0.040 in. Blends may be in any combination, but a maximum quantity of three blends per leading or trailing edge. Blending may be to 50% of blades either consecutive or intermixed in any disc.

(3) Damage to stator blades which is acceptable (subject to blending).

(a) Limits for leading or trailing edges of stages 0, 1 and 2 (Fig.603):-

(i) One blend per blade to a depth of 0.150 in. up to 25% of row blades, which may be either consecutive or intermixed.

(ii) Two blends on the same chord provided the sum total depth does not exceed 0.150 in.

(iii) Three blends per leading or trailing edge provided the sum total depth does not exceed 0.20 in. Blends may be in a combination of two leading edge, one trailing edge or vice versa, or three blends per leading or trailing edge.

(iv) Four blends per blade to a depth of 0.10 each. Blends may be in any combination, but a maximum quantity of three blends per edge. Up to 50% of blended blades per disc may be either consecutive or intermixed.

(b) Limits for leading or trailing edges of stages 3, 4, 5 and 6 (Fig.603):-

(i) One blend per blade to a depth of 0.10 in. up tp 25% of row blades, which may be either consecutive or intermixed.

(ii) Two blends on the same chord provided the total depth does not exceed 0.10 in.

(iii) Three blends per leading or trailing edge provided the sum total depth does not exceed 0.10 in. Blends may be in a combination of two leading and one trailing edge or vice versa, or three blends per leading or trailing edge.

(iv) Four blends per blade to a depth of 0.050 in. each. Blends may be in any combination, but a maximum quantity of three blends per edge. Blending may be up to 50% in any row either consecutive or intermixed.

(4) Damage to straightener blades which is acceptable (subject to blending):-

(a) Apply the following limits to blades which are accessible (Fig.604):-

(i) One blend per blade to a depth of 0.1 in., up to 25% of blade row, either consecutive or intermixed.

(ii) Two blends on the same chord, provided the sum total depth does not exceed 0.1 in.

(iii) Three blends per leading or trailing edge, provided the sum total depth does not exceed 0.1 in. Blends may be in a combination of two leading and one trailing edge or vice versa, or three per leading or trailing edge.

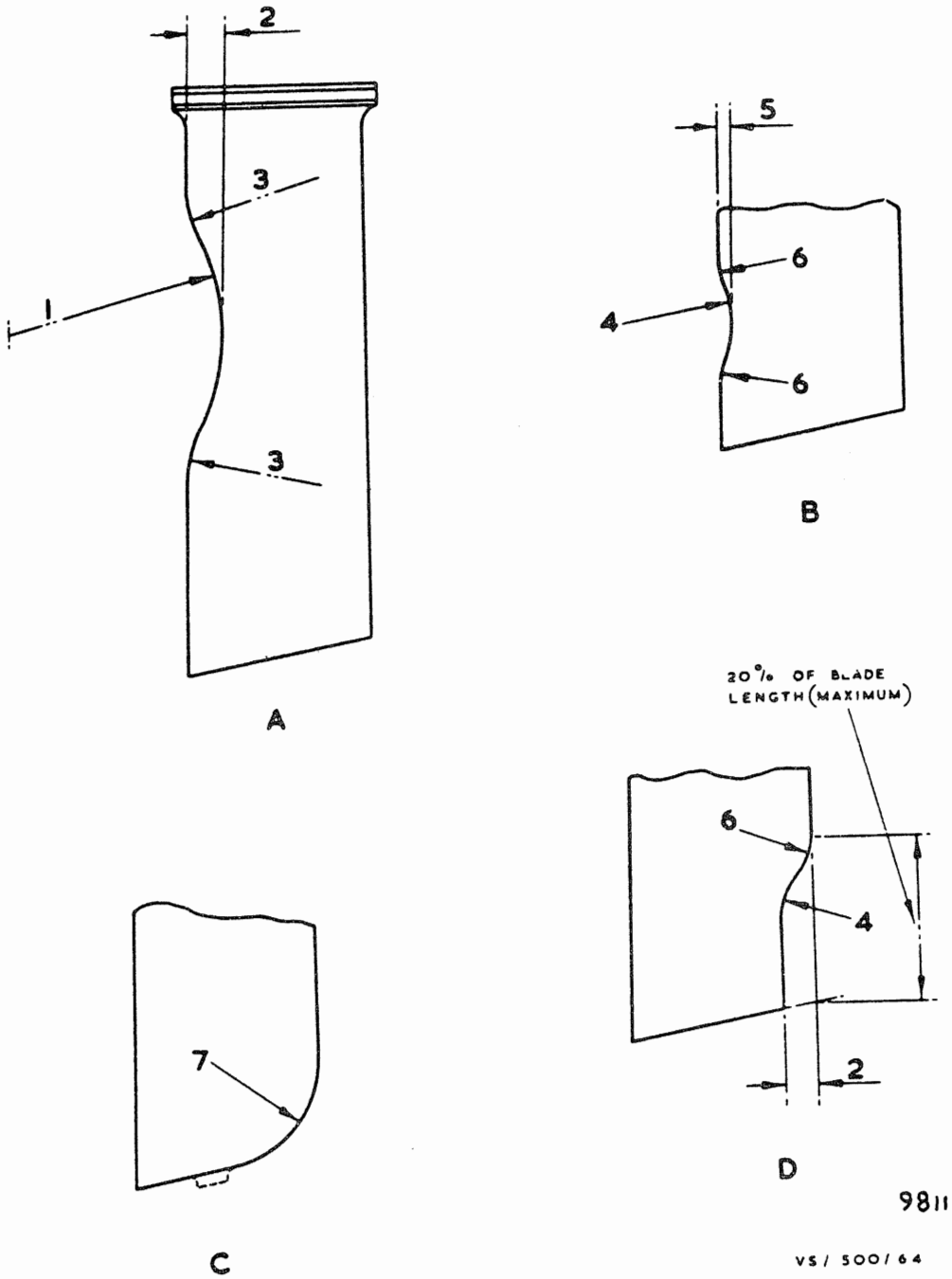
(iv) Four blends per blade to a depth of 0.05 in. Blends may be in any combination, but a maximum quantity of three blends per leading or trailing edge. Blending may be to 50% of blades either consecutive or intermixed.

(v) Leading edge damage adjacent to the fillet radius (detail 'D' of Fig.604) must be blended to extend over the full leading edge to a depth not greater than 0.015 in.

(5) Blending procedure :-

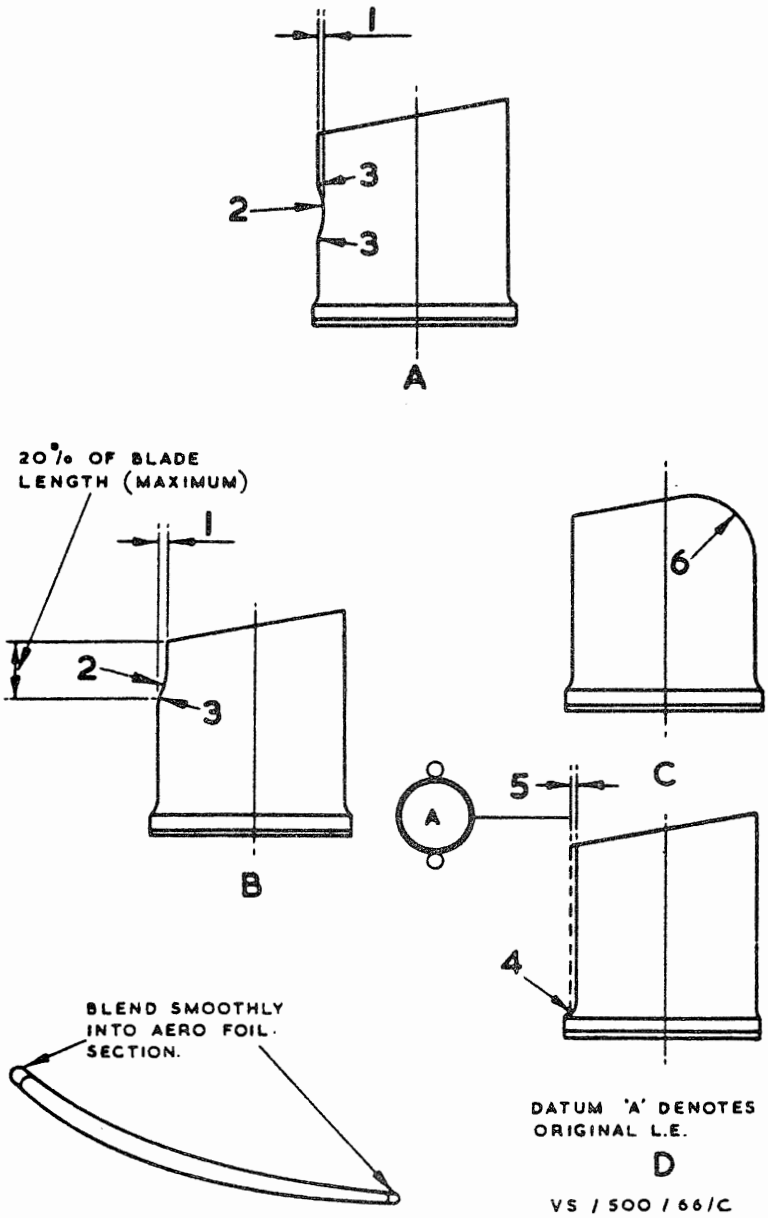
CAUTION : EVERY PRECAUTION SHOULD BE TAKEN TO PREVENT FOREIGN MATERIALS ENTERING THE COMPRESSOR DURING THIS OPERATION.

(a) Using masking tape, protect blades adjacent to the blade to be blended.



1. 1.0 in. radius
2. 0.15 in.max.(stages 0, 1 and 2)
   0.10 in.max.(stages 3,4,5 and 6)
   one per blade.
3. 0.625 in. radius.
4. 0.5 in. radius
5. 0.1 in. (stages 0, 1 and 2)
   0.5 in. (stages 3,4,5 and 6)
   up to 4 per blade.
6. 0.25 in. radius.
7. 0.5 in. max. radius.

72-30



1. 0.10 in.max. (one per blade)
2. 0.75 in. radius
3. 0.275 in. radius
4. 0.08 in. radius
5. 0.015 in.(full length of blade).
6. 0.25 in. radius (Viper 522)
   0.25 in. radius (Viper 521)Mod.CV.3878
   0.50 in. radius (Viper 521)Pre-Mod.CV.3878
   0.25 in. radius (Viper 520)Mod.CV.3996
   0.50 in. radius (Viper 520)Pre-Mod.CV.3996

(b) When blending rotor blades or straightener blades, wrap a fluff-free cloth around the base of the blades to collect swarf.

(c) Use a fine file for the initial blending. Where possible, impart a slight twisting motion to the file to produce a smooth radius.

(d) Complete the blending using fine or worn emery cloth to ensure all scratches are removed.

(e) Always radius the blend edge into the aerofoil section of the blade.

(f) When blending close to a rotor or stator blade platform take care not to extend the blending towards the fillet radius (a blend closer than 0.25 in. is not acceptable).

(g) When blending is complete remove all masking tape and cloths.

(h) If blending stator blades in top half-casing, remove swarf particles using moisture-free air blast.

(6) Crack detection procedure :-

(a) Crack detect all blended or suspect blades using the dye penetrant method (see Chapter 72, COMMON PROCEDURES).

(7) Reprotect aluminium blade surfaces (protection removed during blending).

(a) Degrease the affected areas (see Chapter 71, SERVICING MATERIALS).

(b) Prepare protective Epihard clear varnish :-

(i) Mix the varnish with the catalyst (see Chapter 71, SERVICING MATERIALS) :-

1 part - Varnish Base
1 part - Catalyst

(ii) Stir the mixture thoroughly. If necessary add thinners to obtain a consistency suitable for brushing.

NOTE : The solution must be used within 8 hours of mixing.

(c) Apply an even coating of varnish to the affected areas; allow 16 hours for varnish to dry hard.

NOTE : The maximum chemical resistance will be attained in 7 days of application.

C. Tip rock limits for compressor straightener blades

NOTE : The following limits should be applied whenever the compressor top half casing is removed for inspection.

(1) Straightener blade tip rock.

(a) Blades which appear to have excessive tip rock should be measured. The tip rock must not exceed 0.150 in. Pre-Mod.CV.3996.
0.075 in. Mod. CV.3996.

(2) Straightener blade fretting on stator casing :

NOTE : This is not detrimental to engine running. There is no limitation, but where possible the fretting should be carefully blended.

* * *

COMPRESSOR - APPROVED REPAIRS - SALVAGE SCHEME No. V.27289

1. Restore damaged 5/16 in. UNF wire thread insert at the l.p. fuel filter position

A. General

(1) Applicable to the following units :-

Viper 520	VU.19525	V.20522	VU.19820	V.22325	V.24632	V.26712	V.26900	V.27373
Viper 521	-	-	VU.19820	-	V.24632	V.26712	V.26900	V.27373
Viper 522	V.27331	-	-	-	-	-	-	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged 5/16 in. UNF wire thread insert location at the low pressure fuel filter attachment position by fitting steel inserts.

B. Prepare location

(1) Remove and discard the damaged wire thread insert, use a standard 5/16 in. UNF wire thread extractor.

(2) Drill the insert location.

(a) Drill, tap and counterbore the location to the dimensions shown on Fig.801. Employ the following tools.

Standard 0.3906 in.dia drill
Standard 7/16 in. - 20 UNF - 3B taps.
Standard 0.4400/0.4450 in.dia counterbore.

(b) Clean the location, then check for dimensions and finish.

(3) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Installing insert

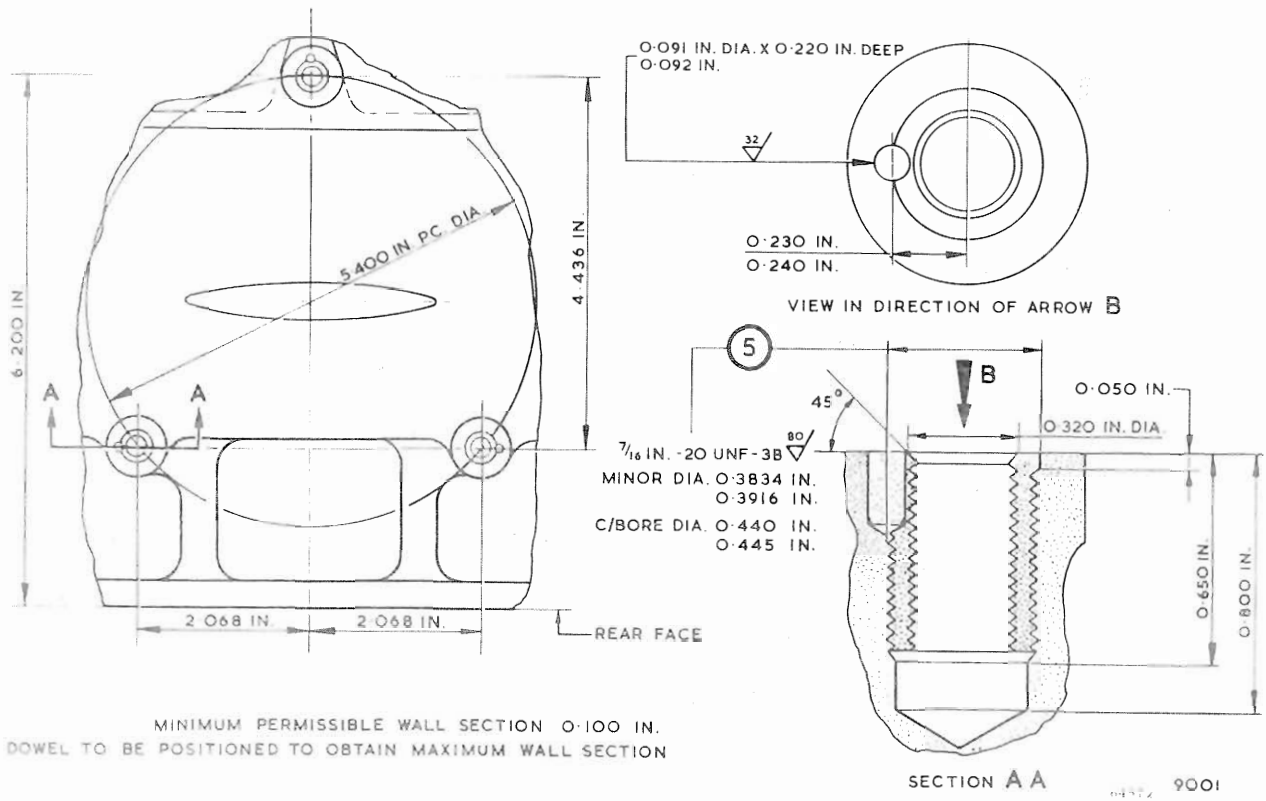
(1) Screw the insert V.26090 into the location, file the insert flush with the casing.

(2) Peg the insert.

(a) Mark off, drill and ream the dowel location to the dimensions shown on Fig.801. Employ the following tools.

Standard 0.890 in.dia drill
Standard 0.0912 in.dia reamer.

(b) Clean the location, then insert the dowel B.362690.



Section through typical insert location
Fig. 801

(c) Drive the dowel below the surface of the casing and lightly peen the surrounding metal over the top of the dowel.

(3) Chamfer the insert to the dimension shown on Fig. 801.

(4) Locally treat the exposed surfaces of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the salvage number V. 27289 in the engine log book.

* * *

COMPRESSOR - APPROVED REPAIRS -
SALVAGE SCHEME No. V29651

1. Restore damaged 3/8 in. UNF steel insert locations at the engine mounting position

A. General

(1) Applicable to the following units :-

Viper 520	VU. 19820	V. 19525	V. 20522	V. 22325	V. 24632	V. 26712	V. 26900	V. 27373
Viper 521	VU. 19820	-	-	-	V. 24632	V. 26712	V. 26900	V. 27373
Viper 522	V. 27331	-	-	-	-	-	-	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore the damaged 3/8 in. - UNF steel insert locations at the engine mounting bracket position by fitting replacement steel inserts.

(3) This repair may be applied to any or all of the 32 similar locations.

B. Prepare location

(1) Drill out the insert locking screw, remove and discard the damaged insert.

(2) Machine the location.

(a) Counterbore the location to the dimensions shown in detail B of Fig. 801, then clean the thread location. Employ the following tools.

Standard 0. 3700 in. /0. 3800 in. dia counterbore
Standard 3/8 in. - 24 UNF - 3B plug tap.

(b) Clean the location, then check for dimensions and finish.

(3) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install insert

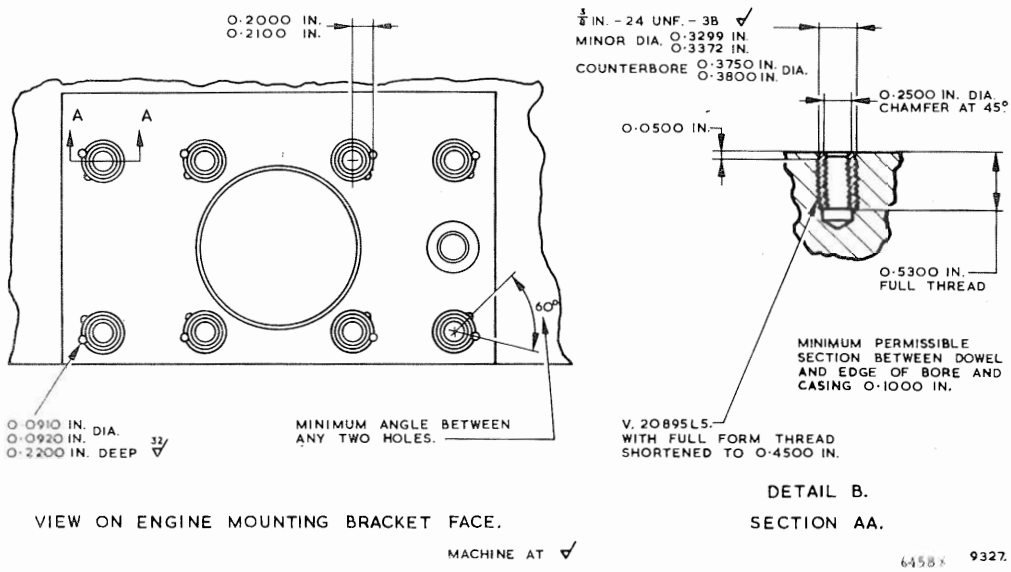
(1) Screw the insert V. 20895L5 into the location; file the insert flush with the casing.

(2) Peg the insert.

(a) Mark off, drill and ream the location to the dimensions shown on Fig. 801. Employ the following tools.

Standard 0. 0890 in. dia drill
Standard 0. 0912 in. dia reamer.

(b) Clean the location, then check for finish and dimensions.



Section through typical insert location
Fig. 801

(c) Insert the dowel B. 362690 into the location.

(d) Drive the dowel below the surface of the casing and lightly peen the surrounding metal over the top of the dowel.

(3) Chamfer the insert to the dimensions shown on Fig. 801.

(4) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

D. Completing repair

(1) Finally inspect the assembly.

(2) Record the salvage number V. 29651 in the engine log book.

* * *

COMPRESSOR - APPROVED REPAIRS ZERO-STAGE BLADES

1. General

Ingestion of ice, water or birds may bend the zero-stage rotor blade tips. Adopt the following procedure where the bend (blade tip leading edge displacement) does not exceed 0.375 in. The appropriate Rolls-Royce (1971) Service Dept. should be consulted if beyond limit.

A. Restore blade tip profile (Fig.801)

Special tools and equipment

Anvil (for bolting to air intake casing flange) .. C2T1186185

(1) Remove the top half of the compressor casing (refer to page block 401 of this chapter).

(2) Insert the anvil tool in a suitable position to locate and support the damaged blade (Fig.801) and bolt in position.

(3) Select a suitably shaped aluminium drift then proceed to restore the blade profile using a minimum of hammering effort.

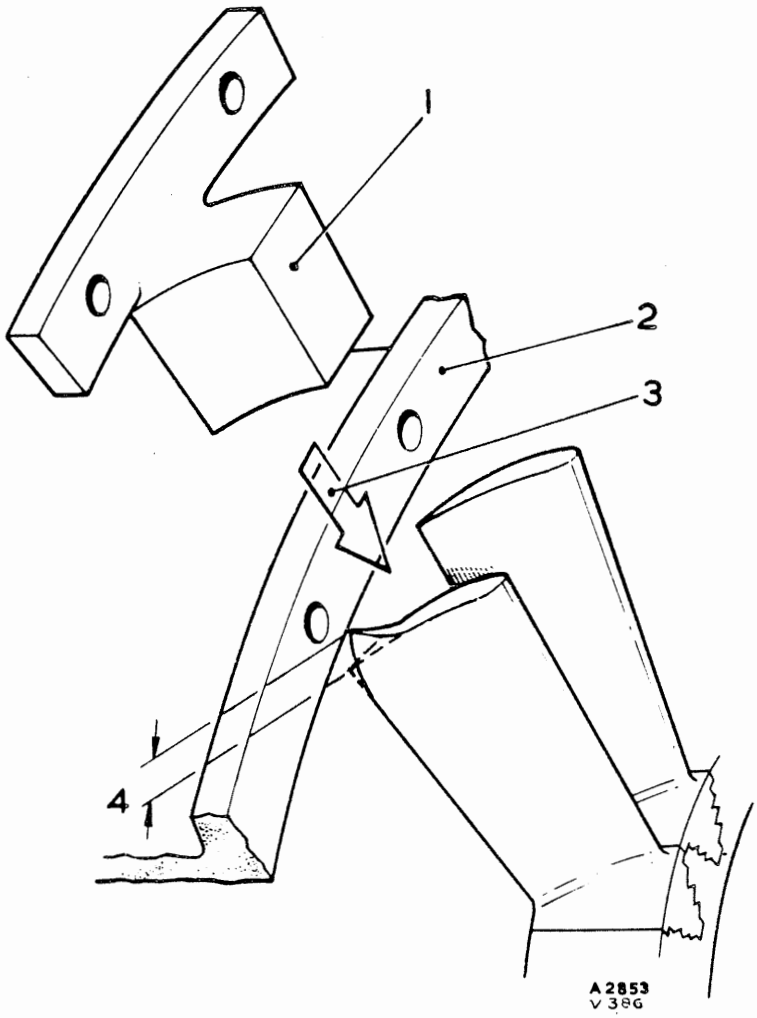
NOTE : Blades with a tip displacement up to 0.25 in. can be straightened to almost as new standard, but above this a slight wave (approx. 0.0625 in.) can be expected on the leading edge. This is considered acceptable.

(4) If the anvil tool is not available, straightening may be carried out with soft jawed pliers and grips.

(5) When the affected blades are straightened, refer to Chapter 72-09-13 to check each blade for evidence of cracking. Cracks are not acceptable.

(6) Refer to page block 601 for acceptance standards for other compressor stages and if acceptable, clear the area and install the top half of the compressor casing.

Fig.801 overleaf



1. Anvil tool
2. Air intake casing rear flange
3. Location for Anvil tool
4. Typical blade tip damage displacement

Restoring bent zero-stage rotor blade leading edge tips
Fig.801

* * *

1. Inspection/Check

A. Acceptance standards for turbine rotor blade impact damage

Although specific turbine rotor inspections are not required, rotor blade impact damage may be observed following exhaust cone removal. When damage is located apply the following standards :-

(1) Damage to blades which is not acceptable :-

(a) Cracks in blades.

(b) Twisted or distorted blades.

(c) Damage which exceeds the following standards.

(2) Damage to blades which is acceptable (Fig.201).

NOTE : The engine must have completed at least half of its overhaul life to apply these standards.

(a) Damage to the leading or trailing edges within 0.4 in. of the blade tip (proportionally less if cropped blade) provided the damage does not exceed 0.05 in. in depth and 0.25 in. in length.

(b) Damage to the aerofoil surface within 0.4 in. of the blade tip, provided damage does not exceed 0.02 in. in depth.

(c) If the damage to the leading or trailing edges is acceptable but in the form of sharp or deep nicks, i.e. depth and length approximately equal, blend out smoothly until the length is at least twice the depth.

NOTE : Take care not to exceed the limits during blending operation.

(d) If the damage to the aerofoil surface is acceptable but has sharp edges, blend the edges as necessary.

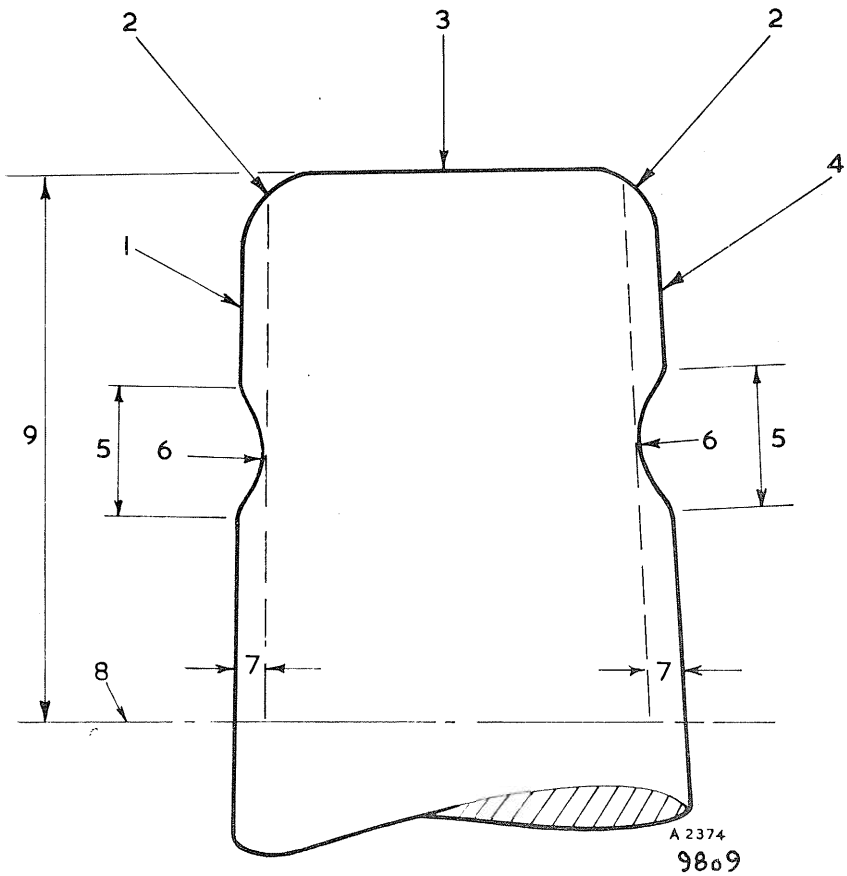
(3) Blending procedure :-

(a) Use a fine grade carborundum stone to smooth out indentations and sharp edges.

(b) Always radius the blend edge into the aerofoil section of the blade.

(c) Lightly polish the affected areas to remove scratches, using a fine grade emery cloth.

...Turbine - Maintenance practices continued



THESE DIMENSIONS ARE MAXIMUM PERMISSIBLE (EXCEPT ITEM 6) AND APPLY WHETHER DAMAGE IS BLENDED OR NOT

1. Blade leading edge
2. 0.25 in. radius
3. Blade tip
4. Blade trailing edge
5. 0.25 in. damage (length)
6. 0.1 in. min. radius
7. 0.05 in. damage (depth)
8. No damage allowed below line
9. 0.4 in. blade tip area

Turbine rotor blade impact damage acceptance standard
Fig.201

...Turbine - Maintenance practices continued

B. Acceptance standard for turbine stator segments

NOTE: Provided there is no performance deterioration and j.p.t. limits are not exceeded, cracks and/or erosion (burning) observed in the vane trailing edges of the turbine stator segments are acceptable within the following limitations.

(1) Provided a visible 25% of the vane chord remains intact the engine may continue in service.

(2) If the limits of sub-paragraph (1) are exceeded the engine may continue in service; but a report must be submitted to Rolls-Royce Service Department giving exact details and positions of the defective segments.

NOTE: This report will enable our Service Department to determine whether or not the segments have been salvaged by brazing. If the segments have been salvaged (confirmed by Rolls-Royce Service Department), the engine must be changed within 50 flying hours.

(3) If the segments have not been salvaged by brazing, the engine may continue in service provided the cracking and/or erosion is within the following limits.

(a) A maximum of two vanes in any one segment or up to a total of six vanes per engine may be cracked and/or eroded through the vane chord from leading to trailing edge.

(b) There is no limit to the amount of cracks that do not extend through a vane chord (on any number of vanes) provided that 0.750 in. of chordal crack-free metal remains, separating a leading edge crack from a trailing edge crack (or a leading edge crack from the trailing edge or trailing edge crack from the leading edge).

C. Acceptance standard for fractured turbine wheel blade damper rod units

NOTES: 1. The damper wire is assemblied in five segments, each segment being referred to as a unit.

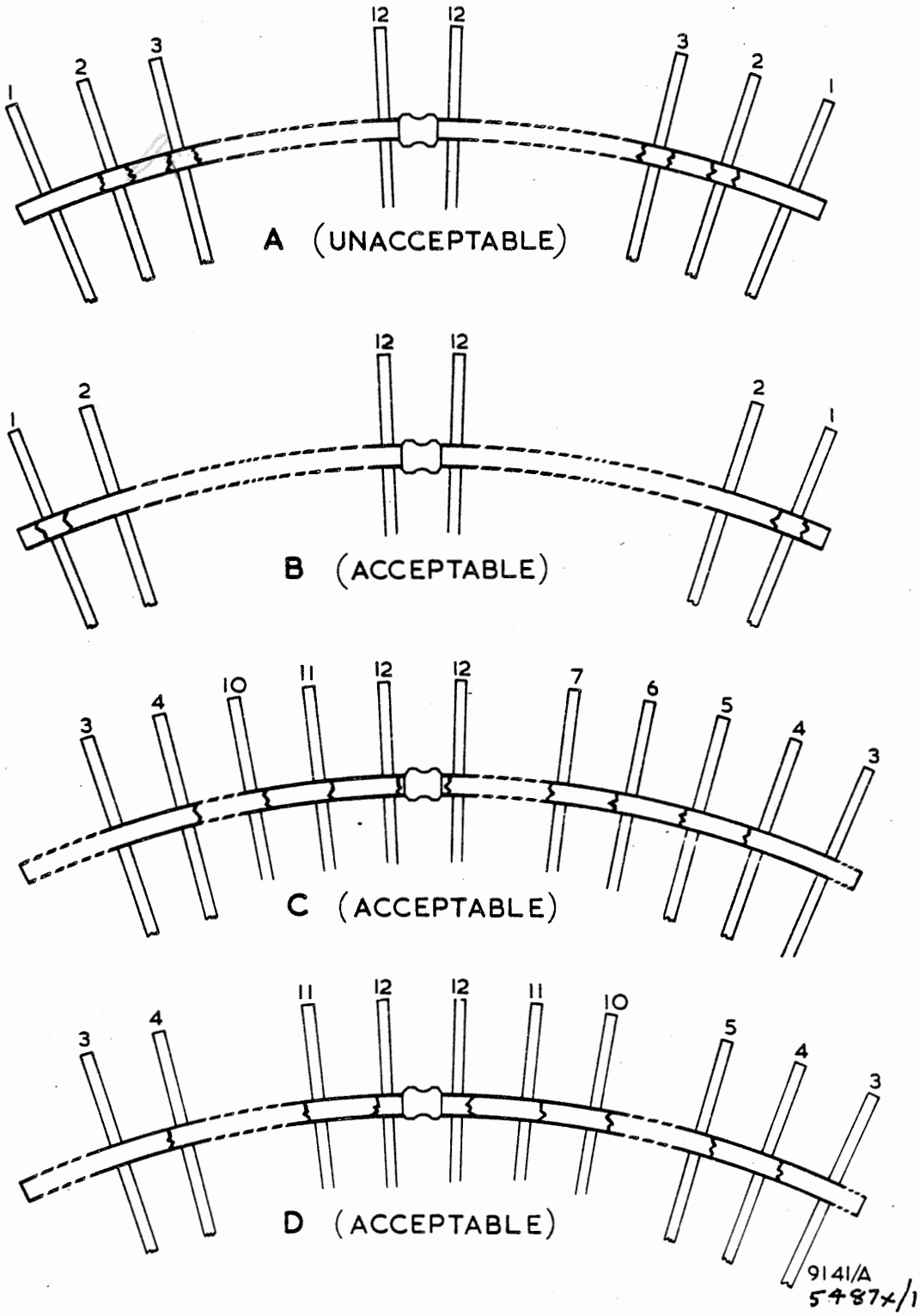
2. Report all fractures to Rolls-Royce Service Department to ensure early rectification action is taken. An engine may continue in service pending rectification provided that the location of the fracture is within the following limits.

(1) Unacceptable - Blade Nos.2 and 3 (A of Fig.202)

(a) A fracture on either side and adjacent to the second or third blade from the end of a rod unit. Reject the engine.

(2) Acceptable on one engine per aircraft only - Blade No.1 (B of Fig. 202).

...Turbine - Maintenance practices continued



Standard of acceptance for fractured turbine wheel blade damper rod units
Fig.202

...Turbine - Maintenance practices continued

(a) A fracture, on either side and adjacent to the first blade from either end of a rod unit, provided no impact damage has been sustained by adjacent blades and that (if not already ejected) the small portion of broken rod can be extracted.

(3) Acceptable on one engine per aircraft only - Blade Nos.4-12 (C of Fig. 202).

(a) A fracture on the same side as the bobbin and adjacent to any one of the blades 4-12 inclusive from either end of a rod unit.

(4) Acceptable on both engines per aircraft - Blades 4-12 (D of Fig.202).

(a) A fracture on the side of the blade remote from the bobbin and adjacent to any one of the blades 4-12 inclusive from either end of the rod unit.

* * *

TURBINE - REMOVAL/INSTALLATION

Tools and Equipment Required

Test set (or its equivalent)	ES.1201

NOTE : This test set is C.A.A. approved and gives accuracy to test bed standards using a digital junction compensated thermometer for j.p.t., Racal engine speed counter and a pressure transducer for jet pipe pressure.

Spanner for turbine clamp bolt	PE.16083
Torque wrench for tightening clamp bolt	PE.25479
Releasing/tightening fixture for turbine clamp bolt	PE.11432
Lifting eye for removing/installing turbine disc unit	PE.16082
Indelible ink	Speed Drymarking type OV or similar
Marking agent	Spectra Color or tailors chalk

NOTE : If necessary contact your nearest overhaul base or a Rolls-Royce Service Department representative for a loan of these tools.

A. Change turbine stator segments

NOTE : This procedure is permitted where stator segments have deteriorated beyond the existing acceptance standards given in Inspection/Check, Chapter 72-50.

(1) Fit test equipment.

(2) Start the engine, see Chapter 71-00 ADJUSTMENT/TEST, and run at 95% rev/min for five minutes.

NOTE : The ground run should not be carried out in conditions where the wind exceeds 20 knots or is generally gusty.

(3) Record O.A.T. and ambient pressure then record test equipment readings of engine speed, j.p.t. and P4 at 97%, 99%, 100% and 98% rev.min. Ensure that the throttle movement is directionally continuous and is not against the direction of travel to come to the point.

NOTE : If the original exhaust cone is fitted, thrust can be obtained from the pass-off test thrust/jet pipe pressure relationship; using the pressure readings obtained and applying TO corrections to thrust values.

If the exhaust cone has been changed during service, a plot of jet pipe pressure/ambient pressure against j.p.t. should be produced, j.p.t. being corrected to I.S.A. conditions and TO applied.

...Turbine Removal/Installation continued

(4) Stop engine and allow it to cool.

(5) Remove the exhaust cone,see Chapter 72-00-01 page block 401.

(6) Check the turbine radial tip clearance at eight equidistant positions and record the clearance obtained at each point.

(7) Mark the turbine disc assembly so that it can be reassembled in its original position in relation to the rotating assembly.

(a) Identify a single compressor zero-stage rotor blade and a single turbine rotor blade by attaching a piece of masking tape or similar adhesive tape.

(b) Using an indelible ink (such as Speed Drymarking type OV) mark the air intake casing and turbine outer casing exactly in line with the leading edge tip of the selected (taped) blades.

NOTE : Ensure the rotating assembly does not turn whilst performing this operation.

(8) Remove the turbine clamp bolt (Fig.401).

(a) Disengage the locking washer from the disc flat and bolt flats.

(b) Release the latch plates of the fixture on tool PE.11432 and remove the hinged locking plate from the fixture.

(c) Locate the hinged locking plate under the clamp bolt head to engage the machined flats on the turbine disc. Secure the locking plate with the hexagon nut.

(d) Position the release fixture gearbox over the hinged locking plate engaging the dowels.

(e) Turn the latch plates to engage with the dowel grooves.

(f) Secure the release fixture gearbox to the turbine outer casing/ combustion chamber flange with slave nuts and bolts.

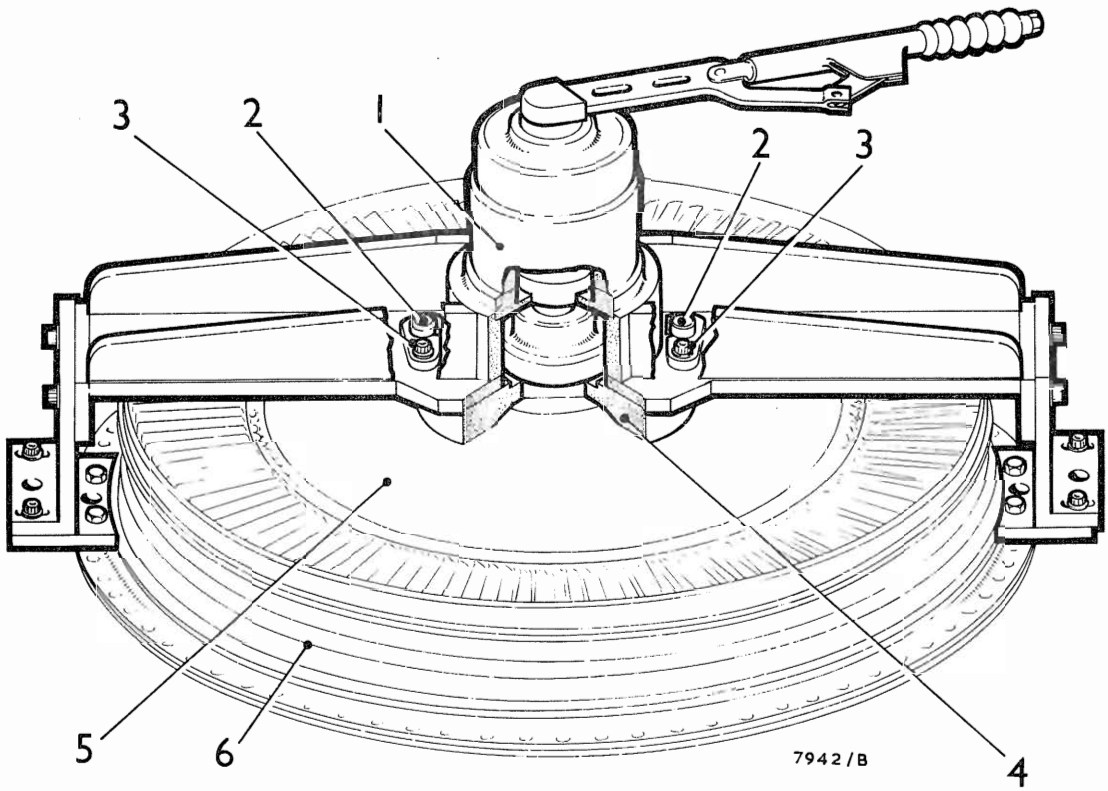
(g) Engage a reversible 0.5 inch square drive ratchet spanner and release the clamp bolt.

(h) Remove the release fixture.

(j) Remove the hinged locking plate, then unscrew and remove the clamp bolt and its locking washer.

CAUTION : SUPPORT THE TURBINE DISC UNIT TO ENSURE IT REMAINS IN POSITION WHILST THE BOLT IS BEING WITHDRAWN.

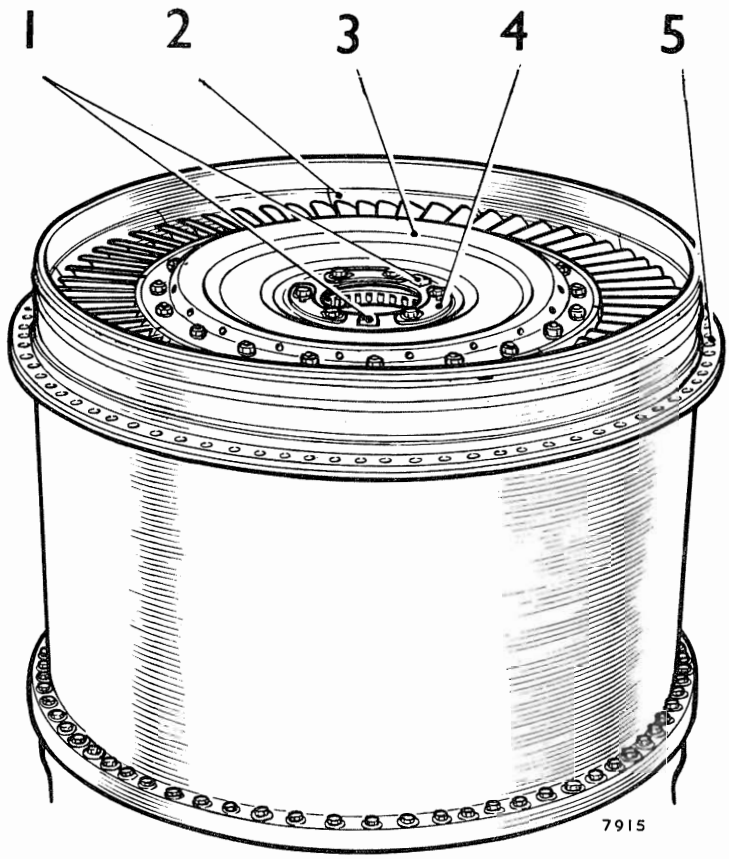
...Turbine - Removal/Installation continued



1. Releasing/Tightening fixture
2. Dowels
3. Latch Plates
4. Hinged Locking Plate
5. Turbine Disc
6. Turbine Outer Casing

Method of Releasing/Tightening Turbine Clamp Bolt
Fig.401

...Turbine - Removal/Installation continued



1. Thermocouple Blocks
2. Segmented Stator Units
3. Rear Diaphragm
4. Retaining Plates
5. Turbine Outer Casing

Turbine Rear Diaphragm, Stator Segments and Outer Casing Details
Fig.402

...Turbine - Removal/Installation continued

(k) Using Spectra Color or tailors chalk; make correlating marks on the disc hub bore and mainshaft bore. This will provide a further check to ensure the disc is refitted in its original position to maintain balance.

CAUTION : DO NOT USE LEAD PENCIL, WAX CRAYON OR ANY OTHER MEDIUM WHICH LEAVES A CARBON DEPOSIT.

(9) Remove the turbine disc unit.

(a) Screw the lifting eye PE.16082 onto the disc centre hub, then by holding the eye, withdraw the disc carefully rearwards.

(b) Place the disc unit in a clean, safe position on a bench, with the Hirth coupling uppermost. Ensure the blades and the Hirth coupling serrations are protected.

(10) Remove the turbine rear diaphragm (Fig.402).

(a) Release and remove the outer ring of nuts and inner ring of bolts which retain the diaphragm and discard the tabwashers.

(b) Withdraw the four retaining plates and the eight distance washers fitted beneath the inner bolts.

(c) Remove the diaphragm unit.

(d) Re-install the nuts on the outer ring of studs to a finger tightness.

NOTE : This will enable the stator assembly and conical support to be removed as an assembly.

(11) Remove the rear conical support.

(a) Release the tabwashers and remove the ring of bolts which secure the support to the centre section extension.

(b) Extract the conical support with No.10 UNF threaded bolts using the extraction holes at the flange position.

(c) Remove the four countersunk screws and nuts which locate the turbine outer casing and stator outer support ring, and withdraw the casing.

NOTE : The amount of shimming used should be noted to ensure the same amount is used on re-assembly.

(d) Withdraw the conical support turbine stator assembly carefully to avoid damaging the thermocouple block and lead.

...Turbine - Removal/Installation continued

(12) Replace unserviceable stator segments.

(a) Examine the stator segments for signs of cracking and/or erosion.

(b) Substitute new or serviceable segments in the positions of those which are cracked and/or eroded. Ensure that the distance pieces are restored to the inner stud locations.

(13) Rebuild the turbine stator assembly (Fig.402).

(a) Ensure the stator assembly is correctly engaged with the outer dogs and inner bolt holes, then locate the rear conical support over the centre section extension interposing the shimming to the same thickness as removed.

(b) Using new siamese tabwashers install the bolts and torque-tighten them to 80 to 90 lbf. in. Engage the tabwashers to lock the bolts.

(c) Install and locate the turbine outer casing, then secure with the four countersunk screws and nuts.

(14) Install the rear diaphragm.

(a) Align the inner cut-away portions with the thermocouple blocks and install the diaphragm.

(b) Install the inner eight distance washers and the four retaining plates, then using new tabwashers engage the bolts.

(c) Install new tabwashers on the outer ring of studs and engage the nuts.

(d) Torque-tighten the inner ring of bolts to 100 to 110 lbf. in. and the outer ring of nuts to 80 to 90 lbf. in., then engage the tabwasher legs to lock the nuts and bolts.

(15) Install the turbine disc unit.

(a) Check the disc Hirth coupling to ensure it is clean and undamaged.

(b) Check the correlating mark position on the disc to ensure correct alignment can be made with the mainshaft mark.

(c) Screw the lifting eye PE.16082 onto the disc centre hub and carefully engage the disc Hirth coupling serrations with the mainshaft serrations.

(d) Support the disc; then remove the lifting eye and check to ensure correlating marks are aligned.

...Turbine - Removal/Installation continued

(e) Lubricate the turbine clamp bolt threads with graphite grease and install a new locking washer.

(f) Insert the turbine clamp bolt to engage the mainshaft then tighten as far as possible using spanner PE.16083, ensuring that the lock-washer is centralised.

(16) Torque-tighten the turbine clamp bolt (Fig.401).

(a) Release the latch plates of the tightening fixture tool PE.11432 and remove the hinged locking plate from the fixture.

(b) Locate the hinged locking plate under the clamp bolt head to engage the machined flats on the turbine disc. Secure the locking plate with the hexagon nut.

(c) Position the tightening fixture gearbox over the hinged locking plate engaging the dowels.

(d) Turn the latch plates to engage with the dowel grooves.

(e) Secure the fixture gearbox to the turbine outer casing/combustion chamber flange with slave nuts and bolts.

(f) Using torque-wrench PE.25479, torque-tighten the clamp bolt to 26 to 28 lbf.ft. This will give an actual loading of 650 to 700 lbf.ft. through the gearbox ratio which is 25 to 1.

CAUTION : ENSURE THE TORQUE WRENCH SETTING IS ACCURATE AS ANY ERROR WILL BE MULTIPLIED 25 TIMES.

(17) Check the radial clearance between the turbine blade tips and the inner face of the turbine casing at four equidistant positions. Using feeler gauges check that the clearance is between 0.020 and 0.040 in. paying particular attention to the b.d.c. position.

NOTE : It may be necessary to adjust the position of the turbine casing (by releasing the four countersunk screws) to achieve the necessary clearance.

(18) Lock the turbine clamp bolt by bending the lock washer to engage one flat on the turbine disc and two flats on the clamp bolt.

(19) Install the exhaust cone, see Chapter 72-00-01, page block 401.

(20) Test engine, as detailed in operations (1), (2) and (3).

(21) Send the results of both test runs to Rolls-Royce Ltd., Service Department, Aero Division, Parkside, Coventry, for assessment by performance engineers.

* * *

TURBINE - INSPECTION/CHECK

1. Acceptance standards for turbine rotor blade impact damage

Although specific turbine rotor inspections are not required, rotor blade impact damage may be observed following exhaust cone removal. When damage is located apply the following standards :-

(1) Damage to blades which is not acceptable :-

(a) Cracks in blades.

(b) Twisted or distorted blades.

(c) Damage which exceeds the following standards.

(2) Damage to blades which is acceptable (Fig.601).

NOTE : The engine must have completed at least half of its overhaul life to apply these standards.

(a) Damage to the leading or trailing edges within 0.4 in. of the blade tip (proportionally less if cropped blade) provided the damage does not exceed 0.05 in. in depth and 0.25 in. in length.

(b) Damage to the aerofoil surface within 0.4 in. of the blade tip, provided damage does not exceed 0.02 in. in depth.

(c) If the damage to the leading or trailing edges is acceptable but in the form of sharp or deep nicks, i.e. depth and length approximately equal, blend out smoothly until the length is at least twice the depth.

NOTE : Take care not to exceed the limits during blending operation.

(d) If the damage to the aerofoil surface is acceptable but has sharp edges, blend the edges as necessary.

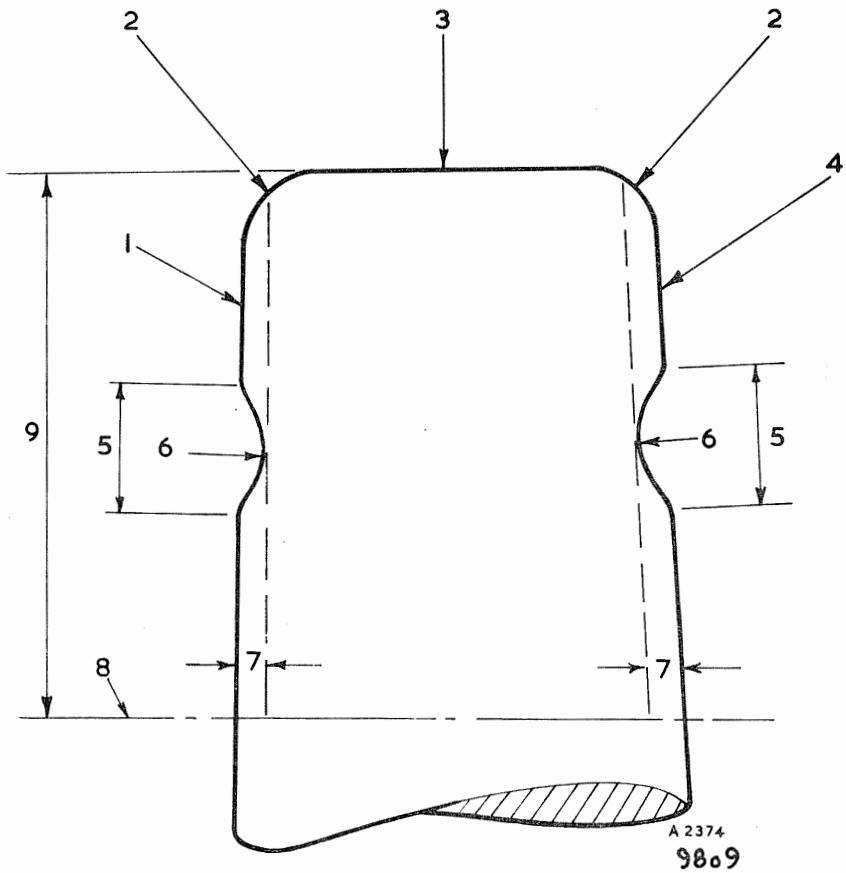
(3) Blending procedure :-

(a) Use a fine grade carborundum stone to smooth out indentations and sharp edges.

(b) Always radius the blend edge into the aerofoil section of the blade.

(c) Lightly polish the affected areas to remove scratches, using a fine grade emery cloth.

...Turbine - Inspection/Check continued



THESE DIMENSIONS ARE MAXIMUM PERMISSIBLE (EXCEPT ITEM 6) AND APPLY WHETHER DAMAGE IS BLENDED OR NOT

1. Blade leading edge
2. 0.25 in. radius
3. Blade tip
4. Blade trailing edge
5. 0.25 in. damage (length)
6. 0.1 in. min. radius
7. 0.05 in. damage (depth)
8. No damage allowed below line
9. 0.4 in. blade tip area

Turbine rotor blade impact damage acceptance standard
Fig.601

...Turbine - Inspection/Check continued

2. Acceptance standard for turbine stator segments

NOTE: Provided there is no performance deterioration and j.p.t. limits are not exceeded, cracks and/or erosion (burning) observed in the vane trailing edges of the turbine stator segments are acceptable within the following limitations.

(1) Provided a visible 25% of the vane chord remains intact the engine may continue in service.

(2) If the limits of sub-paragraph (1) are exceeded the engine may continue in service; but a report must be submitted to Rolls-Royce Service Department giving exact details and positions of the defective segments.

NOTE: This report will enable our Service Department to determine whether or not the segments have been salvaged by brazing. If the segments have been salvaged (confirmed by Rolls-Royce Service Department), the engine must be changed within 50 flying hours.

(3) If the segments have not been salvaged by brazing, the engine may continue in service provided the cracking and/or erosion is within the following limits.

(a) A maximum of two vanes in any one segment or up to a total of six vanes per engine may be cracked and/or eroded through the vane chord from leading to trailing edge.

(b) There is no limit to the amount of cracks that do not extend through a vane chord (on any number of vanes) provided that 0.750 in. of chordal crack-free metal remains, separating a leading edge crack from a trailing edge crack (or a leading edge crack from the trailing edge or trailing edge crack from the leading edge).

3. Acceptance standard for fractured turbine wheel blade damper rod units

NOTES: 1. The damper wire is assemblied in five segments, each segment being referred to as a unit.

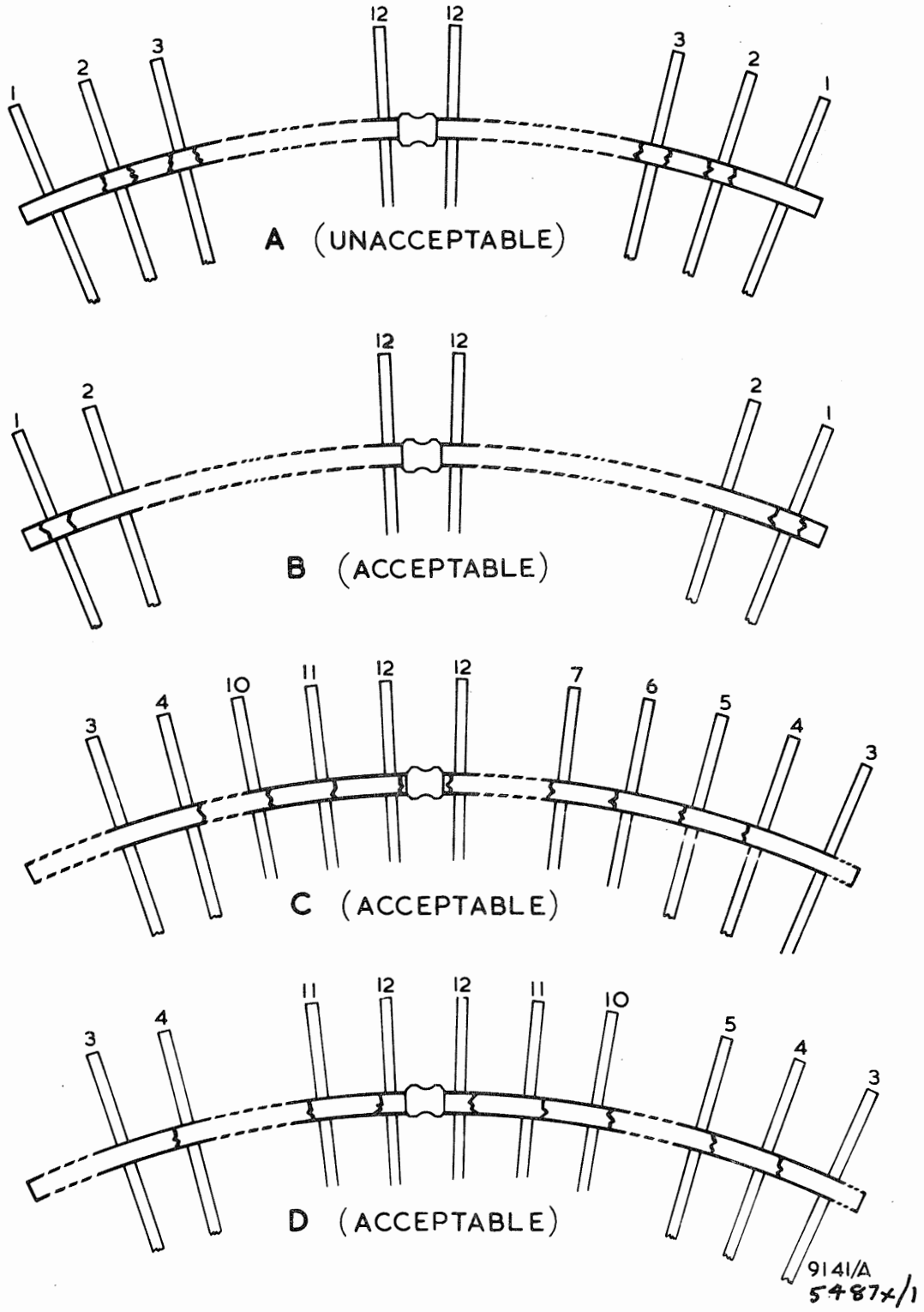
2. Report all fractures to Rolls-Royce Service Department to ensure early rectification action is taken. An engine may continue in service pending rectification provided that the location of the fracture is within the following limits.

(1) Unacceptable - Blade Nos.2 and 3 (A of Fig.602)

(a) A fracture on either side and adjacent to the second or third blade from the end of a rod unit. Reject the engine.

(2) Acceptable on one engine per aircraft only - Blade No.1 (B of Fig. 602).

...Turbine - Inspection/Check continued



Standard of acceptance for fractured turbine wheel blade damper rod units
Fig.602

...Turbine - Inspection/Check continued

(a) A fracture, on either side and adjacent to the first blade from either end of a rod unit, provided no impact damage has been sustained by adjacent blades and that (if not already ejected) the small portion of broken rod can be extracted.

(3) Acceptable on one engine per aircraft only - Blade Nos.4-12 (C of Fig. 602).

(a) A fracture on the same side as the bobbin and adjacent to any one of the blades 4-12 inclusive from either end of a rod unit.

(4) Acceptable on both engines per aircraft - Blades 4-12 (D of Fig.602).

(a) A fracture on the side of the blade remote from the bobbin and adjacent to any one of the blades 4-12 inclusive from either end of the rod unit.

* * *

1. Repair of weld or skin crack in exhaust outer cone

A. General

This repair may be used where a crack in the skin exists or original welding is cracked; only one crack is allowed to be welded or rewelded, the length of the crack must not exceed 5 inches.

B. Procedure

(1) Prepare location (Fig.801) :-

(a) Determine the length of the crack using the dye penetrant method (see Chapter 72, COMMON PROCEDURES).

(b) If the crack is along an existing weld; remove the old welding material from the full length of the crack plus 0.25 in. at the forward end of the crack.

NOTE : Ensure that the thickness of the original material is not reduced.

(c) Drill a 0.063 in. diameter hole at the crack rear end.

(d) Lightly V-groove the full extent of the crack and dress to bring crack edges level.

(2) Weld crack :-

(a) Butt weld employing the argon arc method, using filler rods to BS.2901 A8 Nb (American equivalent AMS.5680).

(b) Check for distortion; then submit the repair to crack detection using dye penetrant method, followed by the radiographic method.

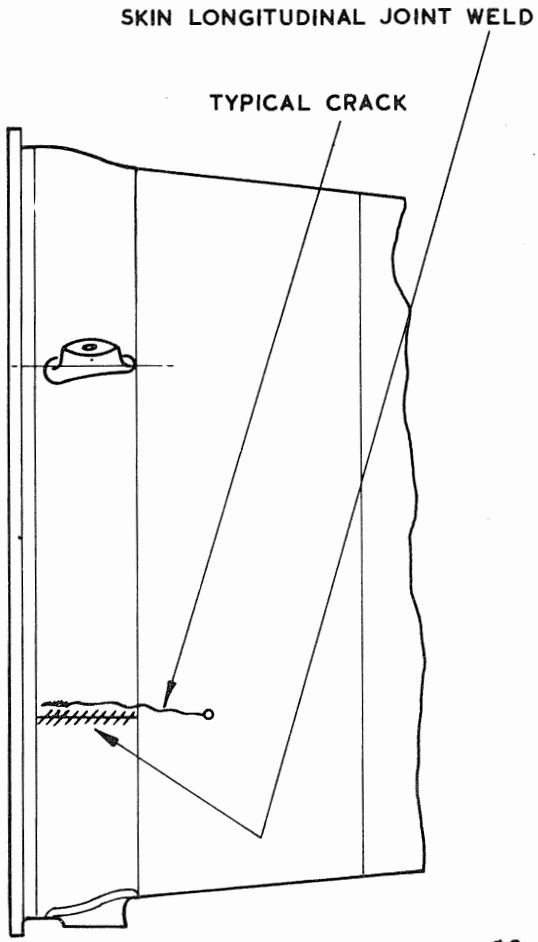
(3) Complete repair :-

(a) Mark SAL.V.39720 adjacent to the unit part number (see Chapter 72, COMMON PRACTICES).

(b) Finally inspect the repair.

Fig.801 overleaf

...Turbine - Approved repairs continued



OUTER CONE UNIT — FRONT END

VS/500/73/A

Repair of weld or crack in outer exhaust cone skin
Fig.801

ACCESSORY DRIVES - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment

Torque wrench	T2EM1992BR or PE.25494
Torque wrench	T2EM1987BR or PE.25492
Stud extractor (drive shaft extension - oil seal housing)	PE.17452
Immobilizer	PE.12118
Spanner (drive shaft bearing locknut)	PE.12119
Spanner/extractor assembly	PE.12117
Spanner (accessory gearbox removal/installation)	PE.18599
Bolt 10 UNF (2) (oil seal housing extraction)	A104/20½D
Extractor (drive shaft from intake casing)	PE.8678
Extractor (drive shaft from gearbox)	PE.8679

A. Remove starter/generator extension drive shaft

(1) Drain the accessory gearbox to the level of the gearbox level plug: (see Chapter 72, LUBRICATION SYSTEM).

(2) Remove the starter/generator and the air outlet casing (see Chapter 24, D.C. GENERATION).

(3) Release the tabwashers locking the extension cover retaining nuts.

(4) Remove the nuts and tabwashers. Discard the tabwashers.

(5) Remove the extension cover uppermost retaining stud and the two accessory gearbox retaining nuts and washers within the gearbox, to provide withdrawl clearance for the cover; use the stud extractor to remove the stud.

(6) Withdraw the extension cover using two 10 UNF bolts approximately 2½ in. long.

(7) Remove and discard the O-seal around the bearing housing flange in the gearbox.

(8) Release the cupwasher securing the starter/generator bevel pinion bearing retaining nut.

(9) Release the bevel pinion retaining nut.

(a) Position the immobilizer over the air outlet casing retaining studs, simultaneously engaging the immobilizer dogs in the retaining nut slots.

(b) Secure the immobilizer with slave nuts.

...Accessory drives - Maintenance practices continued

(c) Engage the serrations on the spanner with those in the extension drive shaft then release the retaining nut by rotating in a clockwise direction.

(d) Remove the spanner and immobilizer.

NOTE : Do not remove the bevel pinion retaining nut at this stage.

(10) Unlock the extension drive shaft special bolt cupwasher.

(11) Remove the extension drive shaft.

(a) Position the spanner/extractor over the air outlet casing retaining studs, simultaneously engaging the spanner dogs in the special bolt slots.

(b) Secure the spanner/extractor with slave nuts.

(c) Unscrew the special bolt until its threads are disengaged.

(d) Remove the slave nuts securing the spanner/extractor then lift it away from the gearbox complete with the special bolt and extension drive shaft.

(e) Remove the extension drive shaft and special bolt from the spanner/extractor.

(f) Remove the special bolt and cupwasher from the extension drive shaft.

CAUTION : ENSURE THAT THE TWO STRAIGHT PINS REMAIN IN POSITION IN THE EXTENSION DRIVE SHAFT COUNTERBORE.

(12) Remove the bevel pinion retaining nut and cupwasher.

(13) Remove the retaining ring securing the oil seal in the extension cover.

(14) Extract the oil seal from the extension cover. Discard the oil seal.

B. Install starter/generator extension drive shaft

(1) Check the extension cover retaining studs in the accessory gearbox for security and damage.

(2) Check the bevel pinion gear bore serrations for fretting.

(3) Examine the extension cover for damage. Minor damage and withdrawal marks can be blended. Restore protective surfaces locally (see Chapter 71, SERVICING MATERIALS).

...Accessory drives - Maintenance practices continued

(4) Check the cupwashers for damage.

NOTE : Reject the cupwasher if the lugs are damaged or there are signs of cracking. File out previous peening indentations, but enough material must remain to provide a peening position not less than twice the width of one flat from the peening position. Evidence of previous peening is acceptable after blending.

(5) Press a new oil seal into the extension cover and secure it with the retaining ring. Check that the retaining ring is fully expanded in its groove.

NOTE : If possible, heat the extension cover and/or freeze the oil seal. Do not attempt to install the extension cover until it has returned to a normal temperature.

(6) Lubricate the threads (see Chapter 71, SERVICING MATERIALS) on the bevel pinion gear, then install the cupwasher and retaining nut. Do not tighten the retaining nut at this stage.

(7) Lubricate the serrations of the extension drive shaft (see Chapter 71, SERVICING MATERIALS).

(8) Ensure that the two straight pins are in the extension drive shaft counterbore then insert the extension into the bevel pinion gear.

(9) Install the cupwasher within the extension drive shaft counterbore, locating it on the two straight pins.

(10) Lubricate the special bolt threads with clean engine oil then screw it into the extension drive shaft.

(11) Torque-load the extension drive shaft special bolt.

(a) Position the spanner/extractor over the air outlet casing retaining studs, simultaneously engaging the spanner dogs, in the special bolt slots.

(b) Secure the spanner/extractor with slave nuts.

(c) Torque-load the special bolt to 140 to 160 lb.in.

(d) Remove the spanner/extractor.

(e) Peen the cupwasher at two equally-spaced positions.

(12) Torque-load the bevel pinion retaining nut.

(a) Position the immobilizer over the air outlet casing studs, simultaneously engaging the immobilizer dogs in the retaining nut slots.

...Accessory drives - Maintenance practices continued

(b) Secure the immobilizer with slave nuts.

(c) Engage the serrations on the spanner with those in the extension drive shaft.

(d) Torque-load the bevel pinion retaining nut to 70 to 80 lb.ft.

(e) Remove the spanner and immobilizer.

(f) Peen the cupwasher at three symmetrically spaced positions, as near as possible.

(13) Install the extension cover.

(a) Lubricate a new O-seal (see Chapter 71, SERVICING MATERIALS) and position it around the periphery of the bearing housing flange in the gearbox.

(b) Locate the extension cover over the end of the extension drive shaft and press fully home.

CAUTION : TAKE CARE NOT TO DAMAGE THE OIL SEAL IN THE EXTENSION COVER.

(c) Install the extension cover retaining stud in the accessory gearbox.

(d) Lubricate the retaining studs with clean engine oil then install new tabwashers and nuts.

(e) Torque-load the retaining nuts to 70 to 80 lb.in. Lock the tabwashers.

(14) Lubricate the accessory gearbox retaining stud threads, within the gearbox, with clean engine oil then install the plain washers and retaining nuts.

(15) Torque-load the retaining nuts to 250 to 280 lb.in.

(16) Install the starter/generator (see Chapter 24, DC GENERATION).

NOTE : Ensure that the engine accessory gearbox, starter/generator and/or AC generator apertures are wiped clean to remove any residual oil or contaminate before fitting the generators.

(17) Prime the oil system (see Chapter 72, LUBRICATION SYSTEM).

(18) Complete Test A of Chapter 71, POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS.

C. Remove accessory gearbox

(1) Isolate and disconnect the electrical supplies to the Firewire, starter/generator, tachometer synchronizer A. C. generator, the oil pump L. P. warning switch and, on right-hand engines only, the A. C. generator.

(2) Release the Firewire from the accessory gearbox.

(a) Disconnect the Firewire elements from the coupling on the front face of the accessory gearbox.

(b) Install transit caps on each end of the coupling and on the ends of the element.

(c) Release the clipping from the element where it is attached to the accessory gearbox and fuel pump.

(d) Support the disconnected ends of the elements by attaching them to a convenient part of the air intake casing to avoid damage to the elements.

CAUTION : DO NOT KINK OR MAKE SHARP BENDS IN THE ELEMENTS WHEN SUPPORTING THEM.

(3) Drain the oil system (see Chapter 72 LUBRICATION SYSTEM).

(4) Remove the starter/generator (see Chapter 24 D. C. GENERATION), and adapter, tachometer/synchronizer A. C. generator (see Chapter 77), hydraulic pump (see Chapter 29), oil pumps assembly (see Chapter 72) and fuel pump (see Chapter 73) from their respective mounting faces and blank the faces except for the starter/generator location.

(5) On right-hand engines only, remove the A. C. generator (see Chapter 24 RANDOM FREQUENCY SYSTEM) from its mounting face and blank the mounting face.

(6) Disconnect the oil supply pipe (gearbox to oil pressure transmitter) from the transmitter.

(7) Remove the two retaining nuts and washers from within the starter/generator housing then blank the mounting face.

(8) Remove the remaining gearbox retaining nuts.

(9) Support the accessory gearbox and remove the waisted bolt, together with the component drain pipes support bracket, from the bottom of the gearbox.

(10) Withdraw the accessory gearbox from the air intake casing.

NOTE : If the radial drive shaft comes away from the air intake casing use the extractor and remove the shaft from the gearbox.

(11) Disconnect the oil supply pipe (gearbox to oil pressure transmitter) from the gearbox.

D. Install accessory gearbox

(1) If the radial drive shaft came away from the air intake casing with the previous accessory gearbox, and therefore has been removed from it, install the shaft.

(a) Assemble the shaft through the bottom air intake support vane, and engage the shaft serrations with the serrations in the bevel gear.

(b) Check that there is a clearance between the radial drive shaft and the air intake casing support vane.

(2) Remove the blank from the starter/generator location on the rear face of the accessory gearbox.

NOTE : The blank is removed to provide access to the retaining studs within the housing.

(3) Connect the oil supply pipe (gearbox to oil pressure transmitter) to the gearbox.

(4) Lubricate a new O-seal with clean engine oil and assemble it to the accessory gearbox mounting face oil transfer bobbin.

(5) Lubricate the threads of the studs and waisted bolts with clean engine oil.

(6) Apply a film of jointing compound (see Chapter 71 SERVICING MATERIALS) to the accessory gearbox mounting face.

(7) Offer the accessory gearbox into position over the retaining studs of the air intake casing.

NOTE : Make sure that the serrations of the Coniflex bevel gear are aligned with the radial drive shaft serrations.

(8) Secure the gearbox with the plain washers and stiffnuts and with the waisted bolts, plain washers and spring washers. Position the component drain pipes support bracket under the lowermost waisted bolt.

(9) Torque-load the nuts and waisted bolts to the following figures :

(a) 0.375 in. nuts and bolts to 250 to 280 lb in.

(b) 0.3125 in. nuts and bolts to 140 to 160 lb in.

NOTE : It is not possible to torque-load the nuts adjacent to the oil transfer bobbin and at the oil pump location. Tighten these nuts with the special spanner.

(10) Connect the oil supply pipe (gearbox to oil pressure transmitter) to the transmitter.

...Accessory drives - Maintenance practices continued

(11) Remove the blanks from the mounting faces and install the starter/generator (see Chapter 24, DC GENERATION) and adapter, tachometer/synchronizer AC generator (see Chapter 77), hydraulic pump (see Chapter 29), oil pumps assembly (see Chapter 72) and fuel pump (see Chapter 73).

NOTE : Ensure that the engine accessory gearbox, starter/generator and/or AC generator apertures, are wiped clean to remove any residual oil or contaminate before fitting the generators.

(12) On right-hand engines only, remove the blank from the mounting face and install the AC generator (see Chapter 24, RANDOM FREQUENCY SYSTEM).

(13) Assemble the Firewire to the accessory gearbox.

(a) Unroll the Firewire elements and remove the transit caps.

(b) Attach the Firewire to the clipping where it is assembled to the accessory gearbox and fuel pump.

(c) Connect the Firewire elements to the coupling on the front face of the accessory gearbox.

(14) Connect and restore electrical supplies to the Firewire, starter/generator, tachometer synchronizer, AC generator, oil l.p. warning switch and on right-hand engines only, the AC generator.

(15) Fill the oil tank (see Chapter 12, SERVICING ENGINE OIL) and gearbox then prime the oil system (see Chapter 72).

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEMES No. V29628 TO V.29631

1. Restore damaged standard $\frac{1}{4}$ in. UNC stud locations at the tachometer/synchronizer attachment position

A. General

(1) Applicable to the following units :-

Viper 520	VU.17167	VU.20474	V.21825
Viper 521	-	-	V.21825
Viper 522	-	-	V.21825

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged $\frac{1}{4}$ in. - 20 UNC stud locations, at the tachometer/synchronizer attachment position, by fitting oversize and/or stepped studs.

(3) One repair of either type is permitted at any of the locations.

B. Prepare location

(1) Drill the location.

(a) Drill, counterbore and tap the location to the dimensions shown on Fig.801.

(b) Clean the location, then check for finish and dimensions.

(2) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install oversize stud

(1) Select the correct size stud, see Fig.801 and Chapter 72, APPROVED REPAIRS - COMMON PROCEDURES, for dimensions and identification.

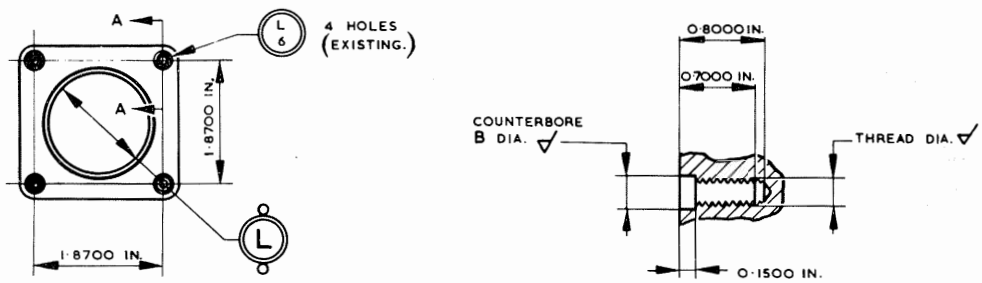
(2) Screw the stud into the location.

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the relevant salvage number (Fig.801) in the engine log book.



VIEW ON TACHOMETER MOUNTING FACE.

MACHINE AT

SECTION AA.

SALVAGE NUMBER	STUD FAST END OVERSIZE	DRILL DIA.	COUNTERBORE DIA	3B TAP SIZE	NON-STANDARD STUD REQUIRED
V.29628	STANDARD	0·2010 IN.	0·2656 IN.	$\frac{1}{4}$ IN. -20 UNC	V.28712 L095
V.29629	0·005 IN.		0·2656 IN.	0·2550 IN. -20 UNC	V.28713 L095
V.29630	0·010 IN.		0·2812 IN.	0·2600 IN. -20 UNC	V.28714 L095
V.29631	STEPPED	0·2570 IN.	0·3281 IN.	$\frac{5}{16}$ IN. -18 UNC	V.28718 L095

9316

6459x

Section through typical stud location
Fig.801

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEMES No. V.28779 TO V.28782

1. Restore damaged standard $\frac{1}{4}$ in. UNC stud locations at the fuel pump position

A. General

(1) Applicable to the following units :-

Viper 520	V.21825	VU.17167	VU.20474
Viper 521	V.21825	-	-
Viper 522	V.21825	-	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged standard $\frac{1}{4}$ in. - 20 UNC stud locations at the fuel pump mounting face position, by fitting oversize and/or stepped studs.

(3) One repair of either type is permitted at any of the six locations.

B. Prepare location

(1) Drill, counterbore and tap the location to the dimensions shown on Fig.801.

(2) Clean the location, then check for finish and dimensions.

(3) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install oversize stud

(1) Select the correct size stud; see Fig.801 and Chapter 72, APPROVED REPAIRS - COMMON PROCEDURES, for dimensions and identification.

(2) Screw the stud into the location.

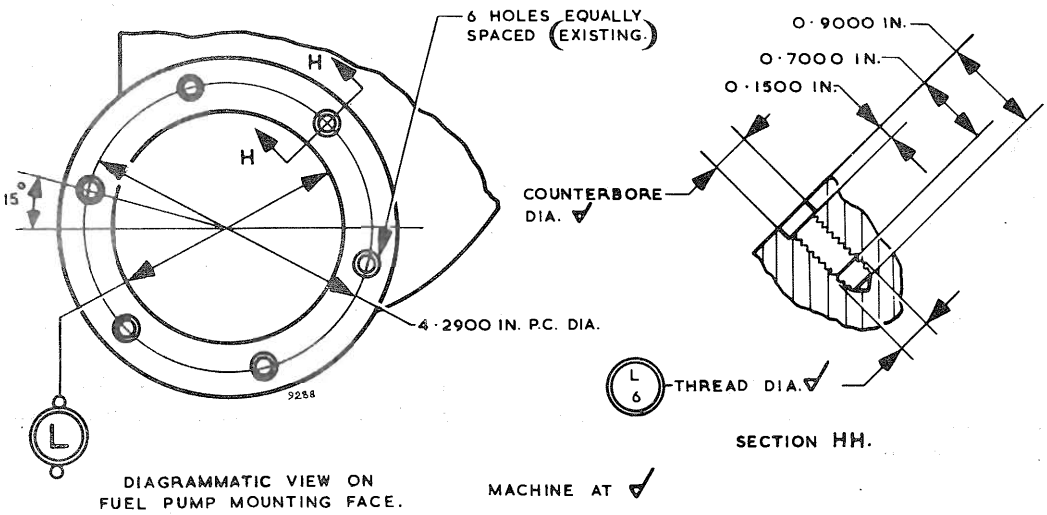
(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the relevant salvage number (Fig.801) in the engine log book.

Fig.801 overleaf



SALVAGE NUMBER	STUD FAST END OVERSIZE	DRILL DIA.	COUNTERBORE DIA.	3B TAP SIZE	NON-STANDARD STUD REQUIRED
V.28779	STANDARD	0·2010 IN.	0·2656 IN.	$\frac{1}{4}$ IN - 20 UNC	V.28712 LO85 V.28712 LO95
V.28780	0·0050 IN.	———	0·2656 IN.	0·2550 IN - 20 UNC	V.28713 LO85 V.28713 LO95
V.28781	0·0100 IN.	———	0·2812 IN.	0·2600 IN. - 20 UNC	V.28714 LO85 V.28714 LO95
V.28782	STEPPED	0·2570 IN.	0·3281 IN.	$\frac{5}{16}$ IN - 18 UNC	V.28718 LO85 V.28718 LO95

6460x 9288

Section through typical stud location
Fig.801

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEME No. V.28783 TO V.28786

1. Restore damaged standard $\frac{1}{4}$ in. UNC stud location at the oil pump position

A. General

(1) Applicable to the following units :-

Viper 520	VU.17167	VU.20474	V.21825
Viper 521	-	-	V.21825
Viper 522	-	-	V.21825

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged standard $\frac{1}{4}$ in. - 20 UNC stud location at the oil pump mounting face position, by fitting oversize and/or stepped studs.

(3) One repair of either type is permitted on nine locations; but on the No. 2 location (Fig. 801) only the oversize stud repair is permitted.

B. Prepare location

(1) Drill the location.

(a) Drill, counterbore and tap the location to the dimensions shown on Fig. 801.

(b) Clean the location, then check for finish and dimensions.

(2) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install oversize stud

(1) Select the correct size stud, see Fig. 801 and Chapter 72, APPROVED REPAIRS - COMMON PROCEDURES, for dimensions and identification.

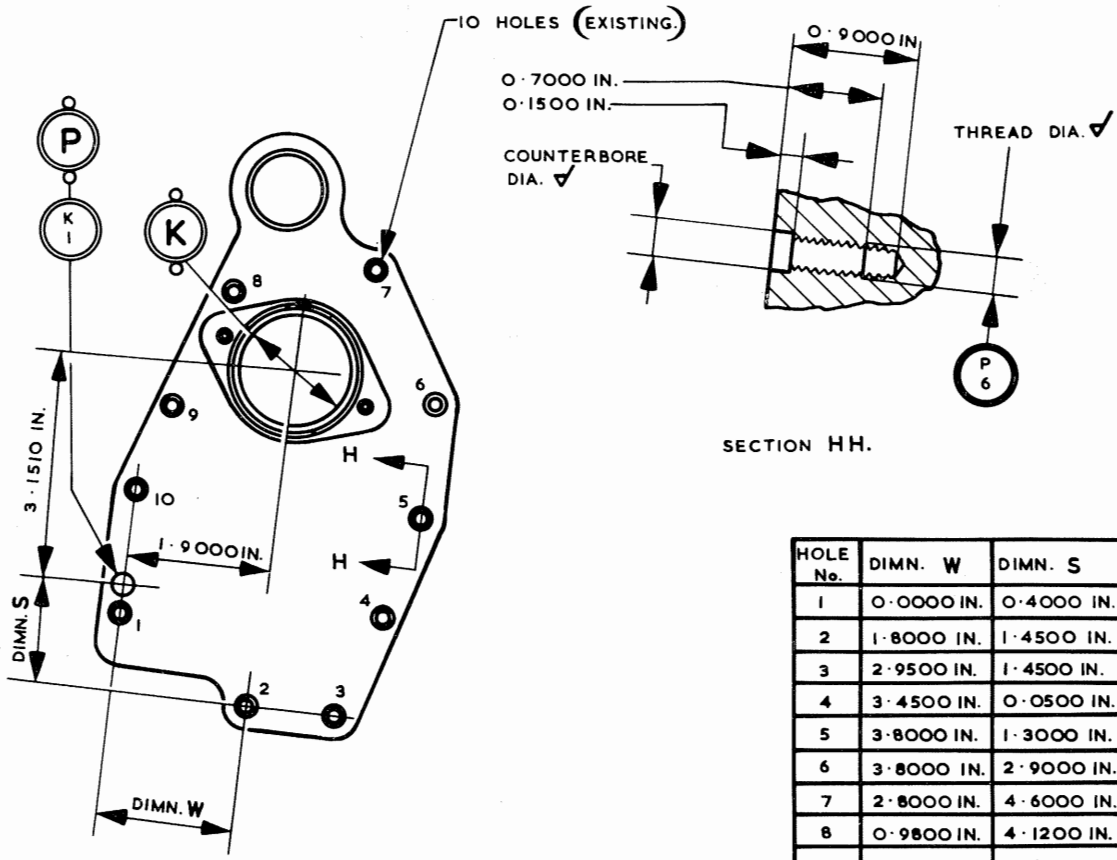
(2) Screw the stud into the location.

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the relevant salvage number (Fig. 801) in the engine log book.



SECTION HH.

DIAGRAMMATIC VIEW ON OIL PUMP MOUNTING FACE.

HOLE No.	DIMN. W	DIMN. S
1	0·0000 IN.	0·4000 IN.
2	1·8000 IN.	1·4500 IN.
3	2·9500 IN.	1·4500 IN.
4	3·4500 IN.	0·0500 IN.
5	3·8000 IN.	1·3000 IN.
6	3·8000 IN.	2·9000 IN.
7	2·8000 IN.	4·6000 IN.
8	0·9800 IN.	4·1200 IN.
9	0·3500 IN.	2·4500 IN.
10	0·0000 IN.	1·3000 IN.

MACHINE AT ∀.

SALVAGE NUMBER	STUD FAST END OVERSIZE	DRILL DIA.	COUNTERBORE DIA.	3B TAP SIZE	NON-STANDARD STUD REQUIRED
V. 28783	STANDARD	0·2010 IN.	0·2656 IN.	$\frac{1}{4}$ IN. – 20 UNC	V. 28712 L 285 V. 28712 L 295 V. 28712 L 305 V. 28712 L 315 V. 28712 L 325 V. 28712 L 335 V. 28712 L 345
V. 28784	0·0050 IN.	——	0·2656 IN.	0·2550 IN. – 20 UNC	V. 28713 L 285 V. 28713 L 295 V. 28713 L 305 V. 28713 L 315 V. 28713 L 325 V. 28713 L 335 V. 28713 L 345
V. 28784	0·0100 IN.	——	0·2812 IN.	0·2600 IN. – 20 UNC	V. 28714 L 285 V. 28714 L 295 V. 28714 L 305 V. 28714 L 315 V. 28714 L 325 V. 28714 L 335 V. 28714 L 345
V. 28785	STEPPED	0·2570 IN.	0·3281 IN.	$\frac{5}{16}$ IN. – 18 UNC	V. 28716 L 285 V. 28716 L 295 V. 28716 L 305 V. 28716 L 315 V. 28716 L 325 V. 28716 L 335 V. 28716 L 345

9290

6461

Section through typical stud location
Fig. 801

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEMES No. V.29645 TO V.29647

1. Restore damaged standard 5/16 in. UNC stud locations at the hydraulic pump position

A. General

(1) Applicable to the following units :-

Viper 520	VU.17146	V.22209	V.25121	V.25946	V.26996
Viper 521	-	V.22209	-	-	V.26996
Viper 522	-	-	-	V.25946	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore the damaged standard 5/16 in. - 18 UNC stud locations, at the hydraulic pump position, by fitting oversize studs.

(3) Only one repair of this type is permitted on any of the locations.

B. Prepare location

(1) Drill the location.

(a) Drill, counterbore and tap the location to the dimensions shown on Fig.801.

(b) Clean the location, then check for finish and dimensions.

(2) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install oversize stud

(1) Select the correct size stud, see Fig.801 and Chapter 72, APPROVED REPAIRS - COMMON PROCEDURES, for dimensions and identification.

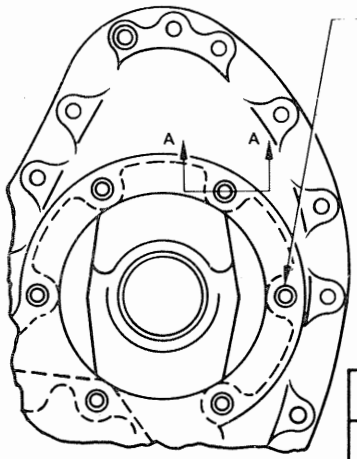
(2) Screw the stud into the location.

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

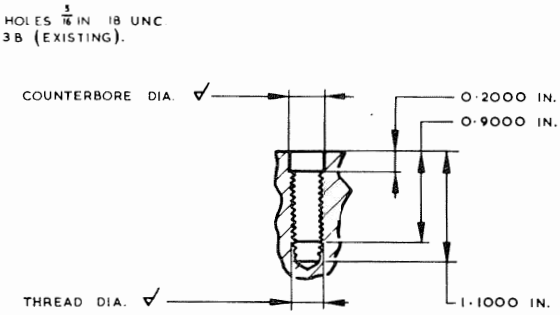
D. Complete repair

(1) Finally inspect the assembly.

(2) Record the relevant salvage number in the existing engine log book.



DIAGRAMMATIC VIEW ON HYDRAULIC PUMP OR BLANKING COVER JOINT FACE.



SECTION AA.

SALVAGE NUMBER	STUD FAST END OVERSIZE	DRILL DIA.	COUNTERBORE DIA.	3B TAP SIZE	NON STANDARD STUD REQUIRED
V.29645	STANDARD	0·2570 IN.	0·3281 IN.	5/16 IN. -18 UNC.	B.307255LO85
V.29646	0·0050 IN.	—	0·3281 IN.	0·3175 IN. -18 UNC.	B.307256LO85
V.29647	0·0100 IN.	—	0·3437 IN.	0·3225 IN. -18 UNC.	B.307257LO85

MACHINE AT ✓

6462 X 9325.

Section through typical stud location
Fig. 801

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEME No. V.29648

1. Restore damaged standard 5/16 in. UNC stud location at the hydraulic pump position

A. General

(1) Applicable to the following units :-

Viper 520	VU.17146	V.22209	V.25121	V.25946	V.26996
Viper 521	-	V.22209	-	-	V.26996
Viper 522	-	-	-	V.25946	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore the damaged 5/16 in. - 18 UNC stud locations, at the hydraulic pump attachment position, by fitting wire thread inserts.

(3) This repair is not applicable to locations which have been previously repaired.

(4) Standard studs must be fitted after this repair and torque-tightened to 65 lb/in. Stud standout of 0.0300 in. below drawing minimum is acceptable, provided full nut engagement is obtained.

B. Prepare location

(1) Drill the location.

(a) Drill, chamfer and tap the location to the dimension shown on Fig.801. Employ the following tools.

Standard 0.3281 in. dia drill
Standard 0.3800 in. x 145 deg. chamfer tool
Standard 0.3847 in. - 18 UNC - 2B taps.

(b) Clean the location, then check for finish and dimensions.

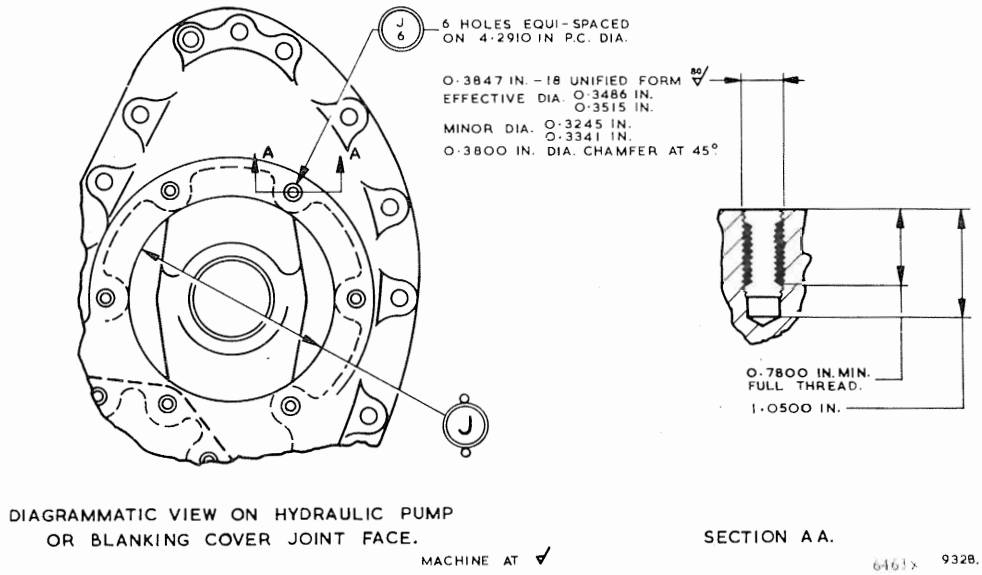
(2) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install insert

(1) Screw the wire thread insert AS.8452/28 into the location; use a standard 5/16 in. UNC wire thread insert tool.

(2) Break off the tang when the insert is $2\frac{1}{2}$ to $2\frac{3}{4}$ turns below the surface of the casing. Remove and discard the tang.

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.



Section through typical insert
Fig. 801

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the salvage number V.29648 in the engine log book

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEME No. V.29644

1. Restore damaged $\frac{1}{2}$ in. UNF wire thread insert locations at the oil level plug position

A. General

(1) Applicable to the following units :-

Viper 520	VU.17146	V.22209	V.25121	V.25946	V.26996
Viper 521	-	V.22209	-	-	V.26996
Viper 522	-	-	-	V.25946	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore the damaged $\frac{1}{2}$ in. - 20 UNF wire thread insert locations, at the oil level plug position, by fitting a steel insert.

B. Prepare location

(1) Remove and discard the damaged wire thread insert, use a standard $\frac{1}{2}$ in. UNF wire thread extractor tool.

(2) Drill the location.

(a) Drill, chamfer and tap the location to the dimensions shown in detail B of Fig.801. Employ the following tools.

Standard 0.6250 in.dia drill
Standard 0.6900 in. x 45 deg. chamfer tool
Standard 11/16 in. - 16 UNF - 3B taps.

(b) Clean the location, then check for finish and dimensions.

(3) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install insert

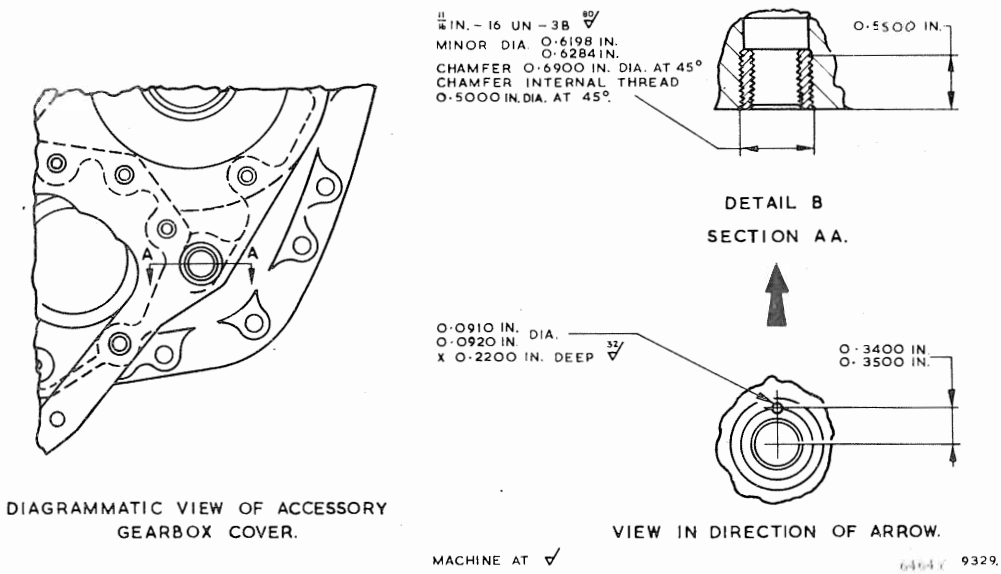
(1) Screw the insert V.28768L7 into the location, then file the insert flush with the casing.

(2) Peg the insert.

(a) Mark off, drill and ream the dowel location to the dimensions shown on Fig.801. Employ the following tools.

Standard 0.0890 in.dia drill
Standard 0.0912 in.dia reamer.

(b) Clean the location, then check for finish and dimensions.



Section through typical insert location
Fig. 801

(c) Insert the dowel B.362690 into the location.

(d) Drive the dowel below the surface of the casing, then lightly peen the surrounding metal over the top of the dowel.

(3) Chamfer the insert to the dimensions shown on Fig. 801.

(4) Locally treat the exposed surfaces of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the salvage number V.29644 in the engine log book.

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEME No. V.41939

1. Restore damaged standard $\frac{1}{4}$ in. UNC stud location at the extension cover position

A. General

(1) Applicable to the following units :-

Viper 520	VU.17167	VU.20747	V.21825
Viper 521	-	-	V.21825
Viper 522	-	-	V.21825

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged $\frac{1}{4}$ in. UNC stud locations at the starter/generator extension cover position, by fitting wire thread inserts.

(3) This repair is not applicable to locations with deepened counterbores if the counterbore diameter is greater than 0.2750 in.

(4) Standard studs must be fitted after this repair and torque-tightened to 45 lb in. Stud standout 0.0300 in. below the drawing minimum is acceptable, provided full nut engagement is obtained.

B. Prepare location

(1) Drill the insert location.

(a) Drill, chamfer and tap the location to the dimensions shown on Fig.801. Employ the following tools.

Standard 0.2610 in. dia flat bottom tool
Standard 0.3200 in. dia chamfer tool
Standard 0.3150 in. - 20 UNC - 2B taps.

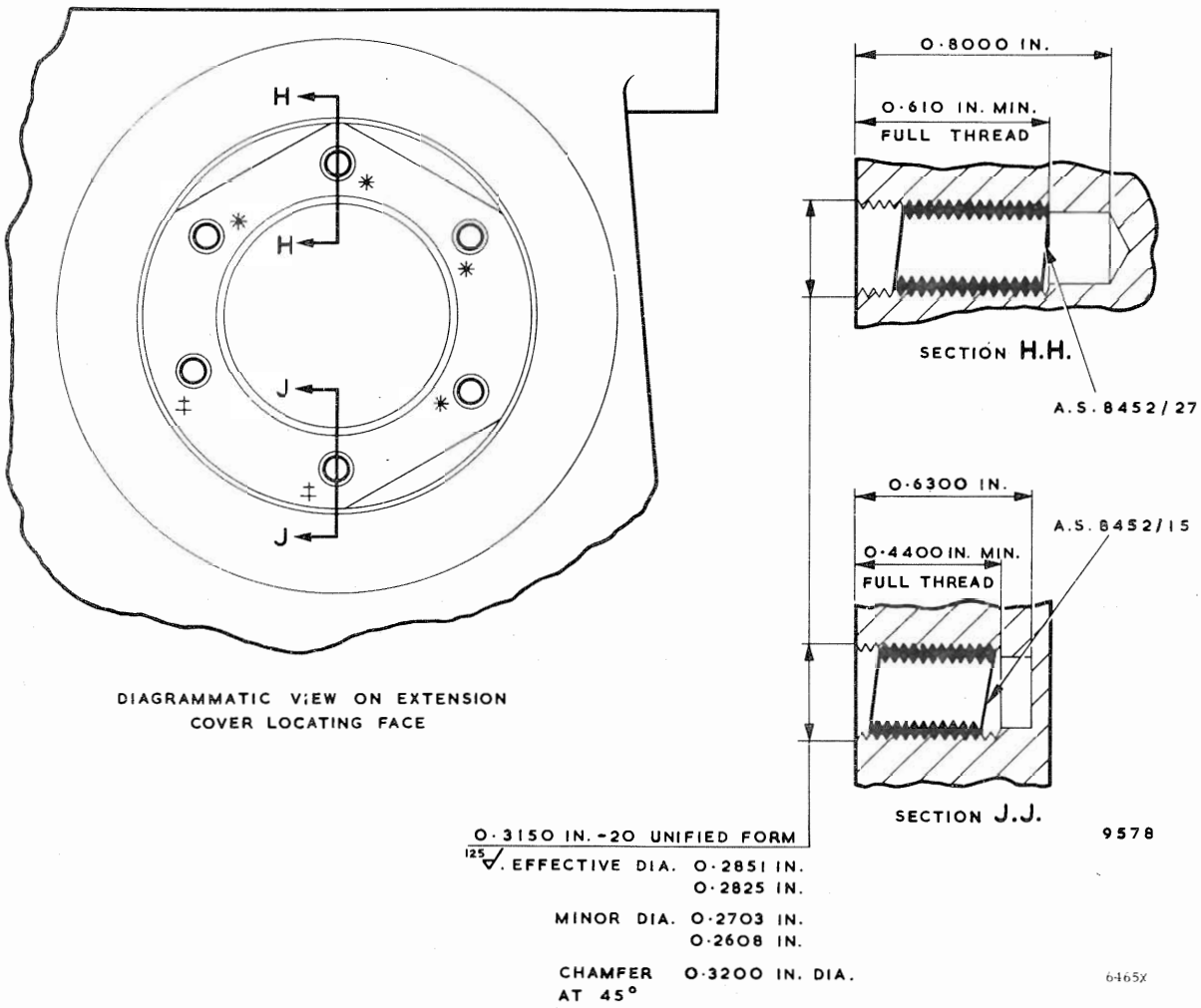
(b) Clean the location, then check for finish and dimensions.

(c) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install insert

(1) Screw the wire thread insert AS.8452/27 into the locations marked with an asterisk or insert AS.8452/15 into the remaining locations. Use a standard $\frac{1}{4}$ in. UNC insert tool.

(2) Break off the tang when the insert is 2 to $2\frac{1}{4}$ turns below the surface for insert AS.8452/27 and 1 to $1\frac{1}{4}$ turns below the surface of the casing for insert AS.8452/15. Use a standard break-off tool. Remove and discard the tang.



Section through typical insert location
Fig. 801

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the salvage number V.41939 in the engine log book.

* * *

ACCESSORY DRIVES - APPROVED REPAIRS - SALVAGE SCHEME No. V.27248

1. Restore damaged standard 3/8 in. UNC stud locations

A. General

(1) Applicable to the following units :-

Viper 520	VU.17167	VU.20474	V.21825
Viper 521	-	-	V.21825
Viper 522	-	-	V.21825

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged standard 3/8 in. UNC stud locations at the starter/generator attachment position, by fitting wire thread inserts.

(3) This repair is not applicable to locations which have been previously salvaged.

(4) Standard studs must be fitted to the location after this repair and torque-tightened to 80 lb in. Stud standout 0.0300 in. below drawing minimum is acceptable, provided full nut engagement is obtained on assembly.

B. Prepare location

(1) Drill the location.

(a) Drill, chamfer and tap the location to the dimensions shown on Fig.801. Employ the following tools.

Standard 0.3906 in. dia drill
Standard 0.4600 in. dia chamfer tool
Standard 0.4562 in. - 16 UNC - 2B taps.

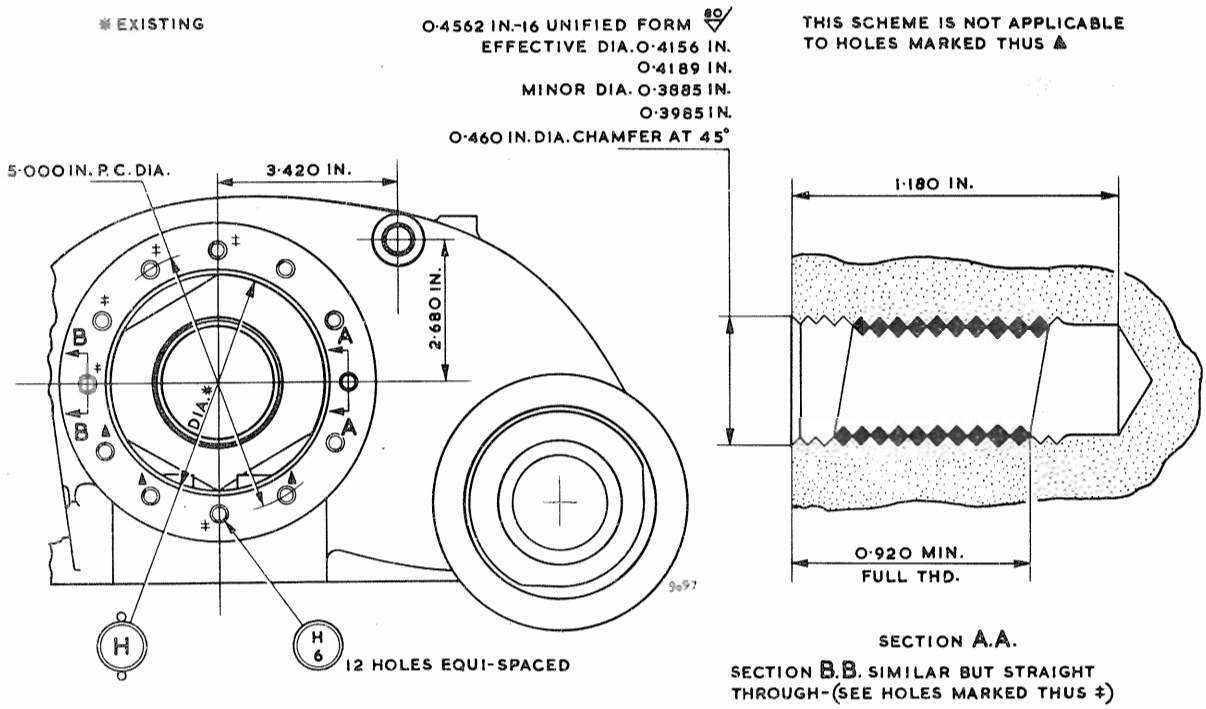
(2) Clean the location, then check for dimension and finish.

C. Install insert

(1) Screw the insert AS.8452/29 into the location; use a standard 3/8 in. UNC insert tool.

(2) Break off the tang when the insert is $2\frac{1}{4}$ to $2\frac{1}{2}$ turns below the surface of the casing. Remove and discard the tang.

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.



Section through typical insert location
Fig. 801

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the salvage number V.27248 in the engine log book.

* * *

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Chapter 73

ENGINE FUEL AND CONTROL

TABLE OF CONTENTS

* No separate description
\+ No separate maintenance practices

Continued...

...Contents continued

* * *

ENGINE FUEL AND CONTROL - GENERAL

1. Description and operation

A. General

The Viper 522 fuel system comprises, basically, three systems; the supply and control system, the starting system and the main system. The supply and control system is common to the starting and main systems, and feeds whichever is functioning. The complete fuel system is of the 'low pressure' type which employs main burners of the vaporizing type. Under maximum flow conditions, pressure to the burners does not exceed 600 lb/sq.in. Components which form parts of the fuel system instrumentation are indicated thus* in the text; a brief description of these components is given later in this chapter under the heading 'Indicating'.

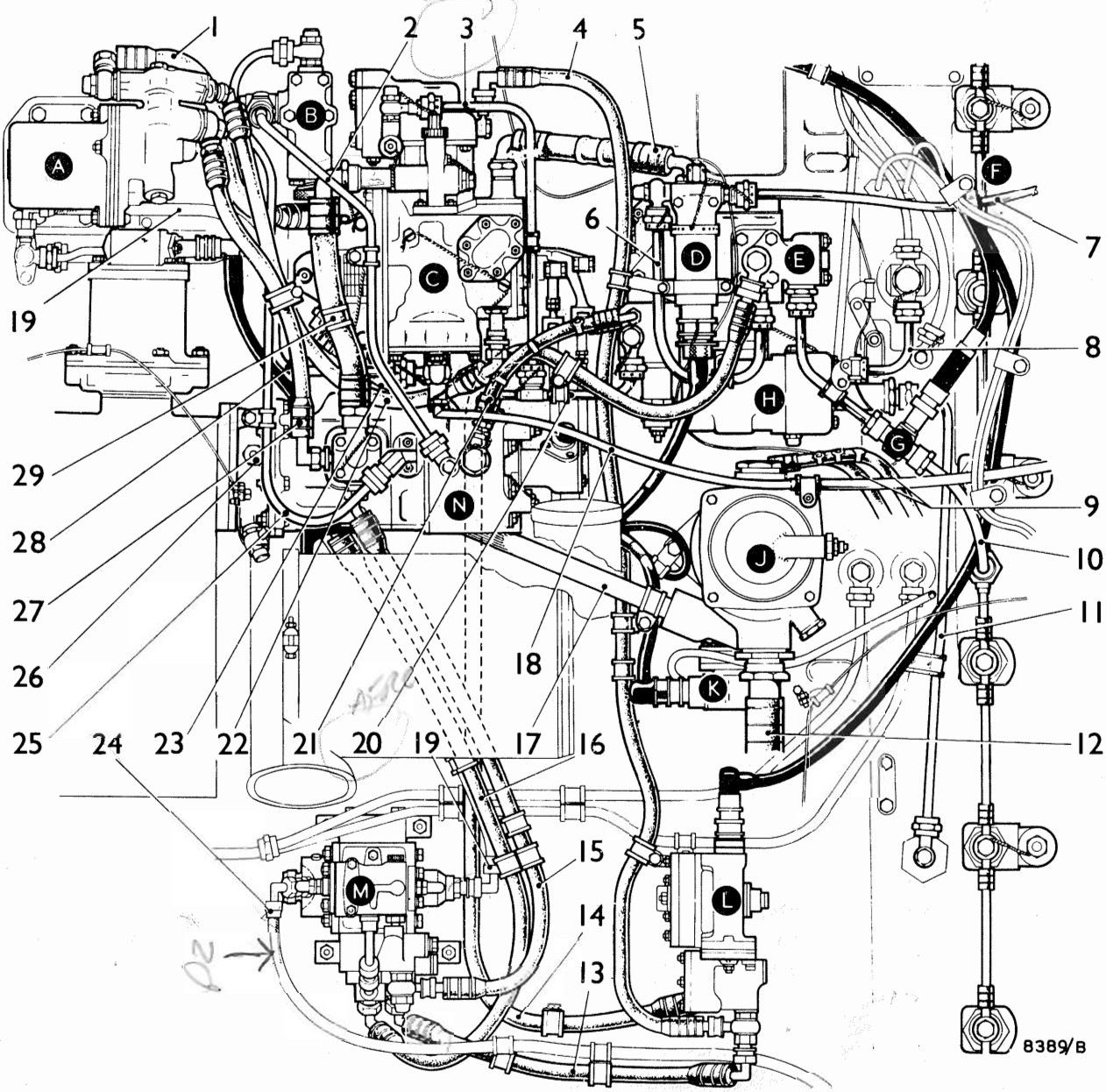
B. Supply and control

Comprises :-

Low pressure filter
* Fuel pressure differential switch (aircraft supply item)
* Low pressure warning switch
Fuel pump
Rate reset valve
Rate reset valve isolating solenoid valve (Mod.CV3600)
Barometric flow control unit (incorporating the h.p. fuel cock and throttle valve)
Air/fuel ratio control
Synchronizer corrector unit (left-hand engine only).
Top temperature control (part of top temperature control system)
Pressure increasing valve
Automatic thrust limiter (incorporating a servo amplifier sub-unit).

Fuel from the aircraft tank(s) (see Chapter 28) flows through the fabric element of the low pressure filter and into the engine-driven pump. The output of this swashplate type pump (determined initially by the throttle lever setting), is modified to suit engine requirements by an internal servo mechanism which is actuated by two external components (that is, the barometric flow control unit and the air/fuel ratio control) and an adjustable hydro-mechanical governor (embodied in the pump) which governs maximum engine speed.

At ambient temperatures above approximately 15°C. (ISA) with the engine at full throttle, the pump maximum speed governor overrides the other servo controls and operates the pump servo system to limit pump output and hence engine speed. At ambient temperatures below approximately 15°C., maximum engine speed is reduced due to the flow limiting characteristics of the automatic thrust limiter, in conjunction with the barometric flow control unit. At altitude, the maximum engine speed is controlled by the pump governor, but, due to the fact that for a fixed engine speed, the fuel pump delivery pressure decreases with increasing altitude, the pump maximum speed governor setting tends to increase. To prevent this governor 'creep', a rate reset valve (r.r.v.) is embodied in the pressure supply to the governor chamber. The valve incorporates a variable orifice, the area of which is increased as pump delivery pressure falls, so that the supply pressure to the governor



A. SYNCHRONIZER CORRECTOR UNIT
B. RATE RESET VALVE (R.R.V.)
C. BAROMETRIC FLOW CONTROL UNIT (B.F.C.U.)
D. PRIMER SOLENOID
E. PRESSURE INCREASING VALVE (P.I.V.)
F. FUEL FEED PIPES MANIFOLD
G. FLOWMETER (AIRCRAFT SUPPLY)
H. AIR/FUEL RATIO CONTROL (A.F.R.C.)
J. FUEL LOW PRESSURE FILTER
K. FUEL LOW PRESSURE WARNING SWITCH
L. TOP TEMPERATURE CONTROL (T.T.C.)
M. AUTOMATIC THRUST LIMITER (A.T.L.)
N. FUEL PUMP

1. FUEL SPILL PIPE - SYNCHRONIZER CORRECTOR UNIT TO B.F.C.U. (LEFT-HAND ENGINE ONLY)
2. R.R.V. FEED PIPE - FUEL PUMP TO R.R.V.
3. SERVO PRESSURE PIPE - FUEL PUMP TO B.F.C.U.
4. SIGNAL PRESSURE PIPE - B.F.C.U. SPRING HOUSING TO T.T.C.
5. FUEL FEED PIPE - B.F.C.U. TO A.F.R.C.
6. P.I.V. TO PRIMER SOLENOID FUEL PIPE
7. PRIMER SOLENOID TO PRIMER MANIFOLD FUEL PIPE
8. P2 HEATER PIPE - CENTRE SECTION TO A.F.R.C. ANTI-ICING CUP
9. FUEL FEED PIPES - FILTER TO DIFFERENTIAL PRESSURE SWITCH (AIRCRAFT MOUNTED)
10. FUEL FEED PIPE - P.I.V. TO FUEL FEED PIPE MANIFOLD
11. P2 PRESSURE PIPE - CENTRE SECTION TO A.F.R.C. BELLOWS CHAMBER
12. FUEL INLET PIPE (FROM AIRCRAFT)
13. SIGNAL PRESSURE PIPE - B.F.C.U. SPRING HOUSING TO A.T.L. (VIA T.T.C.)
14. FUEL BLEED PIPE - T.T.C. TO P.I.V.
15. FUEL DELIVERY PRESSURE PIPE - FUEL PUMP TO A.T.L.
16. FUEL RETURN PIPE - A.T.L. TO FUEL PUMP
17. FUEL INLET PIPE - FILTER TO FUEL PUMP
18. B.F.C.U. CAPSULE CHAMBER DRAIN PIPE
19. P1 TOTAL AIR PRESSURE PIPE - INTAKE PITOT TO A.T.L.
20. SERVO PRESSURE PIPE - FUEL PUMP TO A.F.R.C.
21. SERVO SPILL PIPE - A.F.R.C. TO FUEL PUMP
22. FUEL SUPPLY PIPE - SYNCHRONIZER CORRECTOR UNIT TO B.F.C.U. OUTLET CHAMBER (LEFT-HAND ENGINE ONLY)
23. SERVO SPILL AND WASTE FLOW PIPE - B.F.C.U. TO FUEL PUMP
24. P2 STATIC AIR PRESSURE PIPE - CENTRE SECTION TO A.T.L.
25. GOVERNOR PRESSURE PIPE - R.R.V. TO FUEL PUMP GOVERNOR CHAMBER
26. FUEL PUMP GLAND DRAIN PIPE CONNECTION
27. FUEL DELIVERY PIPE - FUEL PUMP TO SYNCHRONIZER CORRECTOR UNIT (LEFT-HAND ENGINE ONLY)
28. P1 PRESSURE PIPE - INTAKE PITOT TO B.F.C.U. CAPSULE CHAMBER
29. FUEL DELIVERY PIPE - FUEL PUMP TO B.F.C.U.

...Engine fuel and control - General continued

chamber is maintained at a constant datum. Under certain conditions, however, the engine will be controlled below governed speed either by the automatic thrust limiter or the top temperature control system.

Mod CV3600 introduces a r.r.v. isolating solenoid valve to shut-off the fuel supply from the fuel pump to the r.r.v. during starting; this improves the starting characteristics, especially when operating in colder climates.

When the throttle is at a fixed setting, at all conditions other than governed speed, the b.f.c.u. is the control which maintains the correct fuel flow. Essentially, the air mass flow through the engine is dependent upon the engine rotational speed (as dictated by the throttle valve setting) and the forward speed and altitude of the aircraft. The b.f.c.u. incorporates the h.p. fuel cock, the throttle valve and augmentor valve, the by-pass valve (idling adjustment) and a barometric control. The h.p. fuel cock provides the normal means of stopping the engine. The h.p. fuel cock and the throttle valve are linked mechanically to separate levers in the flight compartment (see Chapter 76). The augmentor valve is of the spring-loaded poppet type and is located in the fuel inlet of the unit. It closes under the low flow conditions of starting and idling to maintain the fuel system responsive to throttle movement.

The throttle lever position determines the throttle valve setting which, in turn, determines the pressure drop across an orifice member and hence the fuel flow through its ports. To modify this flow to suit the altitude and forward speed of the aircraft, the barometric control actuates an internal servo system to adjust the effective area of the metering ports. As a result, the main servo system operates to adjust the fuel pump stroke to maintain a constant pressure drop across the orifice member (provided the throttle lever is not moved).

The a.f.r.c. is a controlling unit incorporated to prevent overfuelling the engine when the throttle is opened rapidly. It senses compressor delivery pressure and engine bay pressure and limits the overfuelling accordingly. Under steady running conditions it is inoperative. Basically, the size of a metering orifice is controlled by a system of bellows and an internal servo system, and the pressure drop across this orifice is sensed by a piston. If this pressure drop exceeds a pre-set figure (which can be adjusted to vary the acceleration time) the main servo system is operated to limit the fuel pump stroke to give no more than the pre-set pressure drop across the a.f.r.c.

The a.f.r.c. also has a pressure increasing valve (p.i.v.) mounted on the fuel outlet. During starting, the spring-loaded plunger of the p.i.v. allows fuel to flow to the starting system but prevents fuel flowing to the main system until adequate pressure is achieved.

Engine speed synchronization is provided by a corrector unit (mounted on the left-hand engine) which functions to synchronize this engine speed with that of the right-hand (master) engine. The corrector motor unit contains two

...Engine fuel and control - General continued

stators and a rotor, the rotor being linked by a gear-train to a plunger type valve positioned in a fuel line linking pump delivery direct to the b.f.c.u. outlet. Each stator is supplied with a reference signal from the engine-driven tachmoeter synchronizer generator on each engine. When the speeds of both engines is in synchronism, the rotor remains stationary. If however, the engine speeds are not synchronized, the rotor will rotate in the phase direction of the stator receiving the higher frequency signal and the plunger valve will be moved to adjust the quantity of fuel fed to the b.f.c.u. outlet (i.e. by-passing the b.f.c.u.) until synchronization is restored.

The top temperature control system automatically reduces fuel flow to the engine in the event of a high jet pipe temperature. The system functions on a double datum, 'take-off' or 'climb', selected by a three position switch (off/take-off/climb) in the flight compartment. In the fuel system, the operative part of the top temperature control system is the top temperature control which comprises a solenoid operated spill valve. During operation the solenoid is energized by an amplified signal received from five thermo-couples (see Chapter 77) installed in the exhaust cone propelling nozzle. During normal conditions, the e.m.f. generated by the thermocouples is below the reference e.m.f. in the amplifier and no signal is passed to the solenoid. If an over-temperature condition occurs the thermocouple e.m.f. exceeds the amplifier reference e.m.f. and a signal is passed to the solenoid of the top temperature control, which opens the spill valve. When the spill valve is opened, fuel is bled from the low pressure side of the b.f.c.u. throttle servo diaphragm to the a.f.r.c. outlet. The resultant pressure differential created across the diaphragm causes the b.f.c.u. servo spill valve to open and increase the servo flow from the pump, thereby reducing the fuel pump stroke and hence its delivery. The double datum aspect of the system is obtained by biasing the amplifier so that, when 'take-off' is selected, the reference e.m.f. is higher than that at the climb selection. Throughout the Chapter, the abbreviation 't.t.c.' is used for the top temperature control. The unit is known by the manufacturer, however, as an 'l.p.c.'.

The flow calibration of the system is such that maximum rev/min. is available at ambient temperatures above 15^{o}C (ISA). To prevent the excessive full throttle thrust which would be realised at temperatures below ISA, an automatic thrust limiter is embodied in the system, the unit remaining operative at altitudes up to 8000 ft., depending on ambient temperatures.

The limiter evaluates P2 (compressor delivery) static pressure against P1 (intake) total pressure to operate a spill valve. The pressure signal from the spill valve is fed to an amplifier sub-unit which increases the signal magnitude to the required rate for effective operation. Thus when the P2/P1 relation exceeds the predetermined limit, the spill valve opens and the amplified signal regulates the b.f.c.u. spring housing pressure to control the engine fuel flow (and hence speed and thrust) in the same manner as described previously for the top temperature control.

...Engine fuel and control - General continued

C. Starting system

Comprises :-

Primer solenoid
Primer units - 6

During engine starting, the fuel flow is diverted past the p.i.v. and through the primer solenoid, which has been energized electrically to the open position (see Chapter 80). In the initial stage of the starting cycle, fuel pressure is insufficient to open the p.i.v.; therefore the fuel flows only to the primer units, where it is atomized and injected into the combustion chamber to initiate combustion. Once light-up is achieved and engine speed increases, the fuel pressure will force open the p.i.v. and the main flow system will start to function. The flow to the primer units ceases only when the primer solenoid is de-energized on completion of the starting cycle. The primer drain line is normally vented to atmosphere but mod 252367 introduces an electrically-actuated valve which is energized closed during engine starting and relighting; this prevents fuel flowing into the drains tank from the primer drain line.

D. Main system

Comprises :-

*Flowmeter
Feed pipe units - 12 (Burners)

As engine speed increases after light-up, fuel pressure rises until it is adequate to open the p.i.v. and fuel can then flow through the flowmeter to the fuel feed pipe units, thence into the primary air tubes where it is mixed with air and vaporized. Air from the secondary tubes combines with this to form a combustible mixture which is ignited by the flame initiated by the primer units and is thereafter self-supporting.

* * *

ENGINE FUEL AND CONTROL - MAINTENANCE PRACTICES

1. Servicing

WARNING : WHERE AVTAG OR AVGAS FUELS ARE IN USE, ENSURE ADEQUATE FIRE PREVENTION MEASURES ARE TAKEN. SPILLAGE IN A CONFINED SPACE IS PARTICULARLY HAZARDOUS AS AN EXPLOSION COULD OCCUR. ALL FUEL SHOULD BE KEPT CLEAR OF HEAT, NAKED FLAME AND/OR ANY ELECTRICAL EQUIPMENT WHICH HAS NOT BEEN FLAME-PROOFED.

A. Bleed the fuel system

Special tools and equipment required :-

Bleed tool for fuel pump and l.p. filter	PE.25368
Bleed tool for rate reset valve...	PE.11026

(1) Gain access to the engine, and place a tray beneath the engine.

(2) Connect the bleed tool (with its attached drain pipe) to the drain valve on the filter cover; this will open the valve.

(3) Direct the end of the pipe into a container.

(4) Ensure that the LP FUEL COCK is in the ON position.

(5) Energize PE busbar (see Chapter 24, GENERAL)and switch the FUEL BOOSTER PUMP ON.

(6) When all inhibiting fluid and/or air has been expelled and clear fuel is flowing from the pipe, release the filter drain valve.

(7) Transfer the bleed tool to the bleed valve on the fuel pump.

(8) When clear fuel is flowing from the pipe (free from inhibiting fluid, air and water), release the fuel pump drain valve.

(9) Unscrew the knurled locknut on the rate reset valve (r.r.v.) bleed valve.

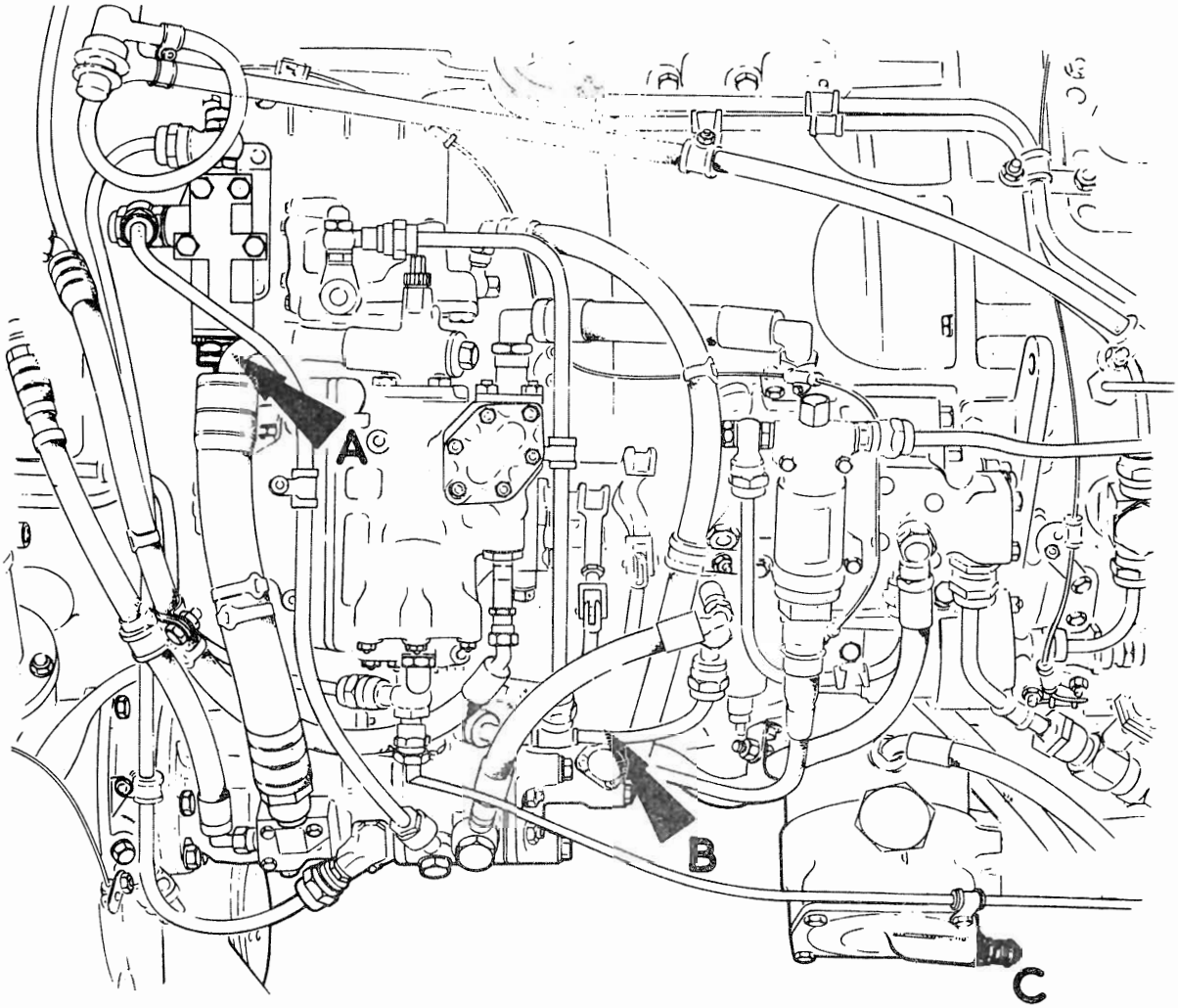
(10) Connect the rate reset valve bleed tool to the drain valve on the r.r.v. and bleed the valve until all the inhibiting fluid and/or air has been expelled and clear fuel is flowing.

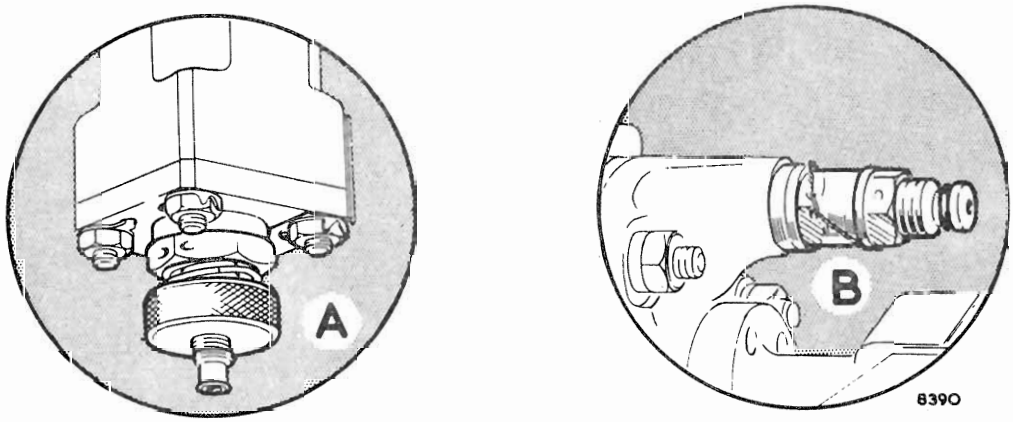
(11) Disconnect the r.r.v. bleed tool and tighten the knurled locknut.

(12) Switch the FUEL BOOSTER PUMP OFF and select the LP FUEL COCK to OFF.

NOTE : If, during the engine run, instability of rev/min occurs, bleed the fuel pump and rate reset valve while the engine is running.

(13) Complete Tests A and D of Chapter 71 - POWER PLANT GROUND RUNNING TESTS.





A. RATE RESET VALVE BLEED VALVE
B. FUEL PUMP BLEED VALVE
C. L.P. FUEL FILTER DRAIN VALVE

Fuel system bleed points
Fig.201

...Engine fuel and control - Maintenance practices continued

B. Change 'left-hand' system to 'right-hand'

Equipment required:

Torque wrench ... ... PE.25492 or T2EM1987BR

NOTE: This procedure details the work necessary on the engine fuel and control system when changing the 'handing' of an e.c.u. from left to right. It is assumed that the e.c.u. is mounted in a transit stand.

(1) Disconnect and remove the following pipes from the synchronizer corrector unit. It will be necessary to disconnect and reconnect the fuel inlet pipe at the b.f.c.u. connection.

Fuel delivery pipe - fuel pump to corrector unit.
Fuel supply pipe - corrector unit to b.f.c.u.
Fuel spill pipe - corrector unit to b.f.c.u.
Corrector unit drain pipe.

(2) Fit approved union nuts and blanking nipples to all apertures and, as necessary, wire-lock. Discard 'O' seal from drain pipe.

(3) Support the corrector unit and remove the retaining bolts. Lift the unit away from the engine.

(4) Clean the jointing compound from the unit mounting face on the air intake casing.

(5) Remove the mounting plate unit from the air intake casing.

(6) Remove the engine and e.c.u. name plates from the mounting plate unit, reverse the e.c.u. name plate, then install the name plates on the air intake casing; torque-tighten the retaining bolts to 40 to 45 lbf.in.

(7) Remove the inlet union body, plug and bonded seals from the l.p. fuel filter.

(8) Fit a new bonded seal and the inlet union body to the opposite side of the filter.

(9) Fit a new bonded seal and the plug to the opposite aperture. Wire-lock the plug to the adjacent web on the filter.

C. Change 'right-hand' system to 'left-hand'

Equipment required:

Torque wrench ... ... PE.25492 or T2EM1987BR

NOTE: This procedure details the work necessary on the engine fuel and control system when changing the 'handing' of an engine from right to left. It is assumed the engine is mounted in a transit stand.

(1) Remove the engine and e.c.u. name plates from the air intake casing, reverse the e.c.u. name plate, then re-install the name plates to the synchronizer mounting plate unit; torque-tighten the retaining bolts to 40 to 45 lbf.in.

...Engine fuel and control - Maintenance practices continued

(2) Apply approved jointing compound (see Chapter 71, SERVICING MATERIALS) to the mounting face on the air intake casing and the unit mounting bracket.

(3) Install the synchronizer corrector unit mounting plate unit on the air intake casing and torque tighten the retaining bolts to 40 to 45 lbf.in.

(4) Install the corrector unit, in the horizontal position and with the pipe connections at the top, on the mounting plate unit. Torque tighten the retaining bolts to 80 to 90 lbf.in.

(5) Lubricate (see Chapter 71, SERVICING MATERIALS) and install new 'O' seals on the corrector unit drain pipe.

(6) Connect the following pipes. It will be necessary to disconnect and reconnect the fuel inlet pipe at the b.f.c.u. connection.

Fuel spill pipe - corrector unit to b.f.c.u.
Fuel supply pipe - corrector unit to b.f.c.u.
Fuel delivery pipe - fuel pump to corrector unit.
Corrector unit drain pipe.

(7) Tighten and wire-lock all pipe connections.

(8) Remove the inlet union body, plug and bonded seals from the l.p. fuel filter.

(9) Fit a new bonded seal and the inlet union body to the opposite side of the filter.

(10) Fit a new bonded seal and the plug to the opposite aperture. Wire-lock the plug to the adjacent web on the filter.

2. Adjustment/Test

A. Test the fuel system pressure

NOTE: These tests are called for in 'Trouble Shooting' (Chapter 71) to diagnose certain starting faults.

Equipment required:

Pressure gauge, 0 - 200 lb/sq.in.

(1) Remove the 3/8 UNF blanking plug and sealing washer from the fuel pump body immediately beneath the outlet elbow and install pressure gauge.

(2) Isolate the ignition circuit (Chapter 24).

(3) Carry out a wet motoring cycle (Chapter 71). If the fuel system is serviceable, the gauge will register a fuel pressure of 120 lb/sq.in. (approximately) at the climax of the motoring cycle, that is, at approximately 15% rev./min.

(4) If the gauge registers high (for example, 160 lb/sq.in.) check the pressure increasing valve (p.i.v.):-

(a) Remove the nuts, plain and spring washers securing the end cover to the p.i.v. Remove the end cover from the valve body. Remove the shims from the cover.
NOTE: Make a nose of the number of shims used, and retain them carefully pending re-installation.

...Engine fuel and control - Maintenance practices continued

(b) Withdraw the valve return spring.

(c) Remove the sealing ring from the valve body counterbore and withdraw the valve and sleeve assembly.

(d) Check the movement of the valve in the sleeve. If the valve sticks, remove and change the p.i.v., otherwise reassemble the p.i.v. using a new sealing ring.

CAUTION : PRE-MOD. CV.7328 ENGINES REQUIRE SEAL having RECTANGULAR CROSS-SECTION AND MOD. CV.7328 ENGINES REQUIRE SEAL having CIRCULAR CROSS-SECTION.

(5) If gauge registers low (less than 120 lb/sq.in.) spill test the half ball valves in the a.f.r.c. and b.f.c.u. :-

(a) Disconnect from the fuel pump the air/fuel ratio control and barometric flow control servo pressure pipes. Direct each pipe into a container. Blank the servo connection on the fuel pump.

(b) Ensure that the LP FUEL COCK is in the ON position.

(c) Energize busbar PE.

(d) Switch the FUEL BOOSTER PUMP ON.

(e) Check for spill from each servo pipe. Any spill indicates that the relevant unit half ball valve is leaking.

(f) If b.f.c.u. half ball valve is leaking disconnect the signal pressure pipe from the top temperature control and blank the pipe end. Check whether b.f.c.u. half ball valve is still leaking.

(g) If no spillage occurs from the b.f.c.u. reconnect the signal pressure pipe (b.f.c.u. to t.t.c.) to the t.t.c. then disconnect the signal pressure pipe (t.t.c. to a.t.l.) from the a.t.l. and blank the pipe end.

(h) Check whether spillage occurs when the a.t.l. is isolated. If spillage occurs change the t.t.c., if no spillage occurs change the a.t.l.

(j) Switch the FUEL BOOSTER PUMP OFF and set the LP FUEL COCK to OFF.

(k) De-energize busbar.

(l) Connect servo pipes, disconnected from serviceable units in operation (a).

(m) Remove the gauge from the fuel pump and re-install the 3/8 UNF blanking plug and sealing washer. Wire-lock the blanking pipe.

(6) Change the unit from which the fuel spillage was observed or if no spillage was observed, change the fuel pump.

* * *

PIPES AND MANIFOLDS - MAINTENANCE PRACTICES

1. General

For general procedures for installing pipes, see Chapter 71 Pipes - general.

2. Removal/installation

Equipment required :-

Bleed tool for l.p. filter	.. ..	PE.25368
Spanner for fuel inlet feed pipe	.. ..	T2AA2070ST
Tension wrench	.. ..	T2EM1987BR

A. Remove fuel inlet pipe (fuel filter to fuel pump)

(1) Ensure that the L.P. FUEL COCK is in the OFF position.

(2) Gain access to, and place a tray beneath, the engine.

(3) Connect the tool kit bleed tool to the fuel filter drain valve; this will open the valve.

NOTE : To increase the rate of drainage, release the union nut of the fuel inlet pipe at the filter. Use the tool kit pipe union spanner.

(4) Remove the bleed tool when the draining is complete.

(5) Viper 521 & 522 only release and remove the bolts securing pipe support clips to the t.t.c. signal pressure and bleed pipes support clips.

(6) Detach the bonding cable from its clip on the fuel inlet pipe.

(7) Remove the fuel low pressure warning switch. (See Chapter 73 - L.P. WARNING SWITCH).

(8) Release the fuel filter outlet elbow retaining bolts, spring washers plain washers and the differential pressure switch electrical lead support clip.

(9) Withdraw the filter outlet elbow in a rearward direction, together with the fuel inlet pipe, until the pipe disengages the fuel pump inlet elbow.

(10) Discard the fuel inlet pipe O-seals and the joint washer from the l.p. fuel filter outlet elbow.

(11) Assemble blanks to all apertures.

...Pipes and manifolds - Maintenance Practices continued

B. Install fuel inlet pipe (fuel filter to fuel pump)

(1) Lubricate (see Chapter 71 - SERVICING MATERIALS) and assemble new O-seals to the fuel inlet pipe ends.

(2) Remove the blanks from the fuel pump inlet elbow and filter outlet elbow location.

(3) Insert one end of the fuel inlet pipe into the fuel filter outlet elbow. Locate the opposite end of the pipe in the fuel pump inlet elbow and push the pipe fully home.

(4) Assemble a new joint washer to the filter outlet elbow. Secure the outlet elbow with the plain washers, spring washers and retaining bolts, interposing the differential pressure switch electrical lead support clip under lower rearmost bolt.

(5) Install the fuel low pressure warning switch. (See Chapter 73 - L.P. WARNING SWITCH).

(6) Secure the bonding cable to its clip on the fuel inlet pipe.

(7) Viper 521 and 522 only. Secure the t.t.e. signal pressure and bleed pipe support clips to the support clips on the fuel inlet pipe.

(8) Bleed the fuel system (see Chapter 73, ENGINE FUEL AND CONTROL - GENERAL).

C. Remove fuel feed pipe manifold pipe

NOTE : To remove a fuel feed pipe manifold pipe it will be necessary to remove both of the connecting pipes.

(1) Gain access to, and place a tray beneath, the engine.

(2) Disconnect bonding cables from the pipes to be removed.

(3) Remove the retaining rings securing the fireproof sleeve to each end of the pipe to be removed and from each of the adjacent connecting pipes.

(4) Remove the fireproof sleeves.

(5) If the manifold bottom pipe has to be removed, release and remove the fuel feed pipe (p.i.v. to fuel feed pipe manifold).

(6) Release the two filter pivot bolts using the tool kit spanner).

(7) Withdraw the filter pivot bolts, discard the bonded seals.

(8) Lift away the two banjos, simultaneously withdrawing the three adjacent pipes. Discard the O-seals.

...Fuel Pipes - Maintenance Practices Continued

D. Install Fuel Feed Pipe Manifold Pipe

(1) Lubricate (see Chapter 71 - SERVICING MATERIALS) and assemble new O-seals on the ends of each pipe.

(2) Locate the three manifold pipes in the removed banjos.

(3) Locate the free end of the manifold pipes in the banjo connections on the engine then ease the three pipes and banjos into position.

(4) Lubricate the banjo bolt threads with clean engine oil.

(5) Position a new bonded seal each side of the banjos, then insert the filter pivot bolts and screw them in as far as possible by hand.

(6) Torque-load the filter pivot bolts to 90 to 100 lb. in. and wire-lock the bolts. If necessary, install the fuel feed pipe (p.i.v. to fuel feed pipe manifold). Tighten and wire-lock the pipe union nuts.

(7) Install the bonding cables on the pipes.

(8) Start the engine (see Chapter 71 GROUND RUNNING), and check the manifold pipe for leaks.

* * *

LOW PRESSURE FILTER - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment :

Bleed tool for l.p. filter ...	...	PE.25368
Spanner for fuel inlet feed pipe ...	T2 AA2070ST	or PE.25392
Torque wrench	T2 EM1987BR	or PE.25492

A. Remove low-pressure fuel filter element

(1) Ensure that the LP FUEL COCK is in the OFF position.

(2) Gain access to the engine and place a tray beneath the engine.

(3) Connect the bleed tool to the fuel filter drain valve; this will open the valve and drain the filter.

NOTE : To increase the rate of drainage, release the union nut of the fuel inlet pipe at the filter. Use the tool kit pipe union spanner.

(4) Remove bleed tool when draining is complete.

(5) Remove the bolts, plain and spring washers securing the filter cover; this will also release the clip supporting the air drain pipe.

NOTE : On right-hand installations, the clip supporting the starter/generator cables will also be released.

(6) Withdraw the filter cover and remove the element. If cover is tight place a screwdriver in the slots provided and carefully prise off the cover. Discard the seals.

NOTE : No servicing is permissible. If there is any doubt concerning the serviceability of the element, install a new element.

B. Install low-pressure filter element

(1) Lubricate a new O-seal with the approved compound (see Chapter 71 - SERVICING MATERIALS) and install it on the filter cover.

(2) Lubricate the filter cover securing - bolt threads with clean engine oil.

(3) Position the element on the filter cover and assemble the element and cover to the filter body.

...Low pressure filter - Maintenance practices continued

(4) Secure the filter cover with bolts, plain and spring washers; secure the air drain pipe clip. Torque-load the bolts to 70 to 80 lb. in.

NOTE : On right-hand installations, the clip holding the starter/generator cables must also be secured.

(5) Tighten and wire-lock the fuel inlet pipe unit.

(6) Bleed the fuel system (see Chapter 73 ENGINE FUEL AND CONTROL - GENERAL).

C. Remove bleed valve

(1) Ensure that the L.P FUEL COCK is in the OFF position.

(2) Gain access to the engine and place a tray beneath the engine.

(3) Connect the bleed tool to the fuel filter drain valve; this will open the valve.

NOTE : To increase the rate of drainage, release the union nut of the fuel inlet pipe at the filter. Use the tool kit pipe union spanner.

(4) Remove and discard the O-seal from the bleed valve outer end.

(5) Unscrew the bleed valve from the adapter in the fuel filter cover. Discard the bonded seal.

(6) Remove and discard the O-seal on the bleed valve inner end.

D. Install bleed valve

(1) Lubricate the new O-seals with the approved compound (see Chapter 71 SERVICING MATERIALS).

(2) Install a new bonded seal over the threaded portion of the bleed valve.

(3) Install a new O-seal on the inner end of the bleed valve.

(4) Screw the bleed valve into the adapter in the filter cover.

(5) Install a new O-seal on the bleed valve outer end.

(6) Bleed the fuel system (see Chapter 73 ENGINE FUEL AND CONTROL - GENERAL).

* * *

LOW PRESSURE FUEL FILTER - APPROVED REPAIRS - SALAVAGE SCHEME NO. V40164

1. Restore 2 B.A. Wire thread insert locations in the outlet elbow unit joint face

A. General

(1) Applicable to Unit No. VU.15814.

(2) This repair may be used to restore 2 B.A. wire thread insert locations in the outlet elbow unit joint face on the filter casing, by fitting steel inserts.

(3) Any number of four similar locations may be restored in this manner.

(4) The dowel must be positioned to give the maximum possible wall section. The minimum wall section must not be less than 0.0800 in.

B. Prepare location

(1) Remove and discard the damaged insert; use a standard 2 B.A. wire thread extractor.

(2) Drill the insert location.

(a) Drill, counterbore, then tap the location to the dimensions shown on Fig. 801.

Employ the following tools:

Standard 0.2720 in. dia. drill.
Standard 0.3150/0.3260 in. dia. counterbore.
Standard 5/16 in. - 24 UNF - 3 B taps.

(b) Clean the location, then check for dimensions and finish.

(3) Locally treat the location - See Chapter 71, - SERVICING MATERIALS.

C. Install insert

(1) Screw the insert V.20897L3 into the location and file flush with the joint face.

(2) Peg the insert.

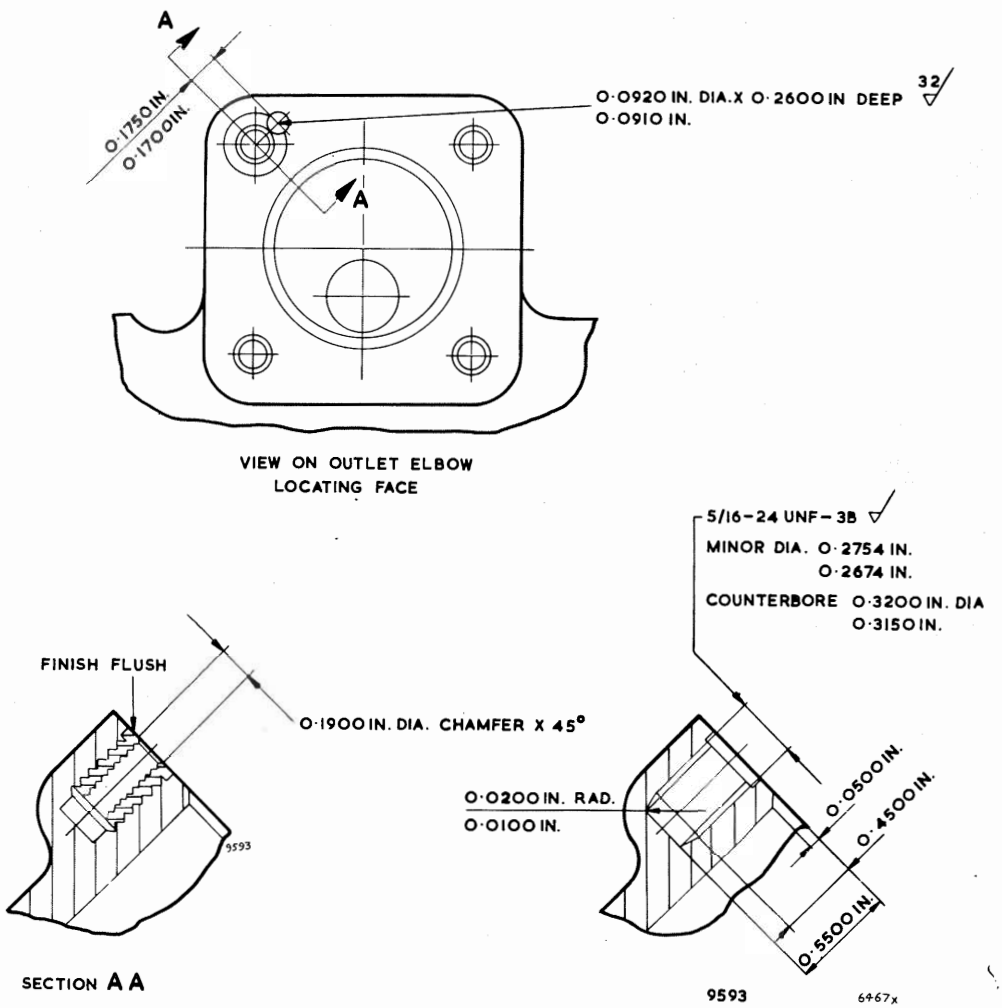
(a) Drill and ream the dowel location to the dimensions shown on Fig. 801. Employ the following tools:

Standard 0.0890 in. dia. drill.
Standard 0.0912 in. dia. reamer.

(b) Clean the location, then insert the dowel FB.93521.

(c) Drive the dowel below the surface of the casing and lightly peen the surrounding surface over the top of the dowel.

...Low pressure fuel filter - Approved repairs Continued



Insert Location Repair Details
Fig. 801

(3) Chamfer the insert to the dimensions shownon Fig. 801.

(4) Locally treat the exposed surface of the joint face - See Chapter 71, - SERVICING MATERIALS.

D. Complete Repair

(1) Finally inspect the assembly.

(2) Record the salvage number V.40164 in the engine Log Book.

* * *

PRIMER UNITS - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment :-

Tension wrench PE.25492

A. Remove primer unit

(1) Gain access to the engine.

(2) If the inboard primer unit of the left-hand engine is to be removed, first remove the adjacent igniter plug (see Chapter 80).

(3) Release the pipe support clip and bonding cables from the interconnecting pipe each side of the primer unit to be removed.

(4) Disconnect both ends of each pipe, then remove the two pipes. Discard the O-seals. If the lowermost primer unit is being removed, disconnect and remove the drain pipe.

(5) Remove the banjo pivot bolt and banjo from the primer unit. Discard the sealing washers.

(6) Unscrew and withdraw the primer unit body from its adapter in the centre section.

B. Install primer unit

(1) Screw the primer unit body into its adapter in the centre section. Torque-load the primer unit body to 220 to 240 lb in.

(2) Install the banjo, with new sealing washers on each side, over the pivot bolt.

(3) Install the pivot bolt in the primer unit body. Do not tighten the pivot bolt at this stage.

(4) Lubricate (see Chapter 71 - SERVICING MATERIALS) and assemble new O-seals to the ends of the primer unit interconnecting pipes.

(5) Assemble the pipes to the unit and tighten the union nuts.

(6) Torque-load the pivot bolt to 70 to 80 lb in.

(7) Wire-lock the pipe union nuts and pivot bolts.

(8) Secure the pipe support clips and bonding cables to the pipes.

(9) If the bottom primer unit is being installed, connect the drain pipe to the primer unit.

...Primer units - Maintenance practices continued

(10) If the inboard primer unit of the left-hand engine has been installed, install the adjacent igniter plug (see Chapter 80).

(11) Complete tests A and G given in POWER PLANT - ADJUSTMENT/TEST, ground running tests (Chapter 71).

* * *

FUEL PUMP - MAINTENANCE PRACTICES

1. Removal/Installation

CAUTION : WHENEVER IT IS SUSPECTED THAT THE FUEL PUMP HAS SUFFERED INTERNAL DAMAGE IT IS ESSENTIAL TO ENSURE THAT ANY RESULTANT DEBRIS HAS BEEN CONTAINED BY THE BFCU INLET FILTER. IN SUCH CASES, REMOVE AND EXAMINE THE FILTER. REMOVE ANY CONTAMINANT, CLEAN THE FILTER AND ENSURE THAT THE FILTER IS UNDAMAGED AND IN PARTICULAR THAT THE FILTER GAUZE IS INTACT. IF SATISFACTORY, REFIT THE FILTER. SHOULD THE FILTER BE CONTAMINATED AND DAMAGED, OR IF IT IS SUSPECTED THAT ANY CONTAMINANT HAS PASSED THROUGH THE FILTER, ALL FUEL SYSTEM ACCESSORIES MUST BE REMOVED FOR DISASSEMBLY, CLEANING, RE-ASSEMBLY AND RE-CALIBRATION AND ALL FUEL PIPES REMOVED FOR CLEANING BEFORE REFITMENT.

Equipment required :-

Spanner for pump retaining nuts .. .. S3S10113000 or PE.15841

A. Remove fuel pump

(1) Ensure that the LP FUEL COCK is in the OFF position.

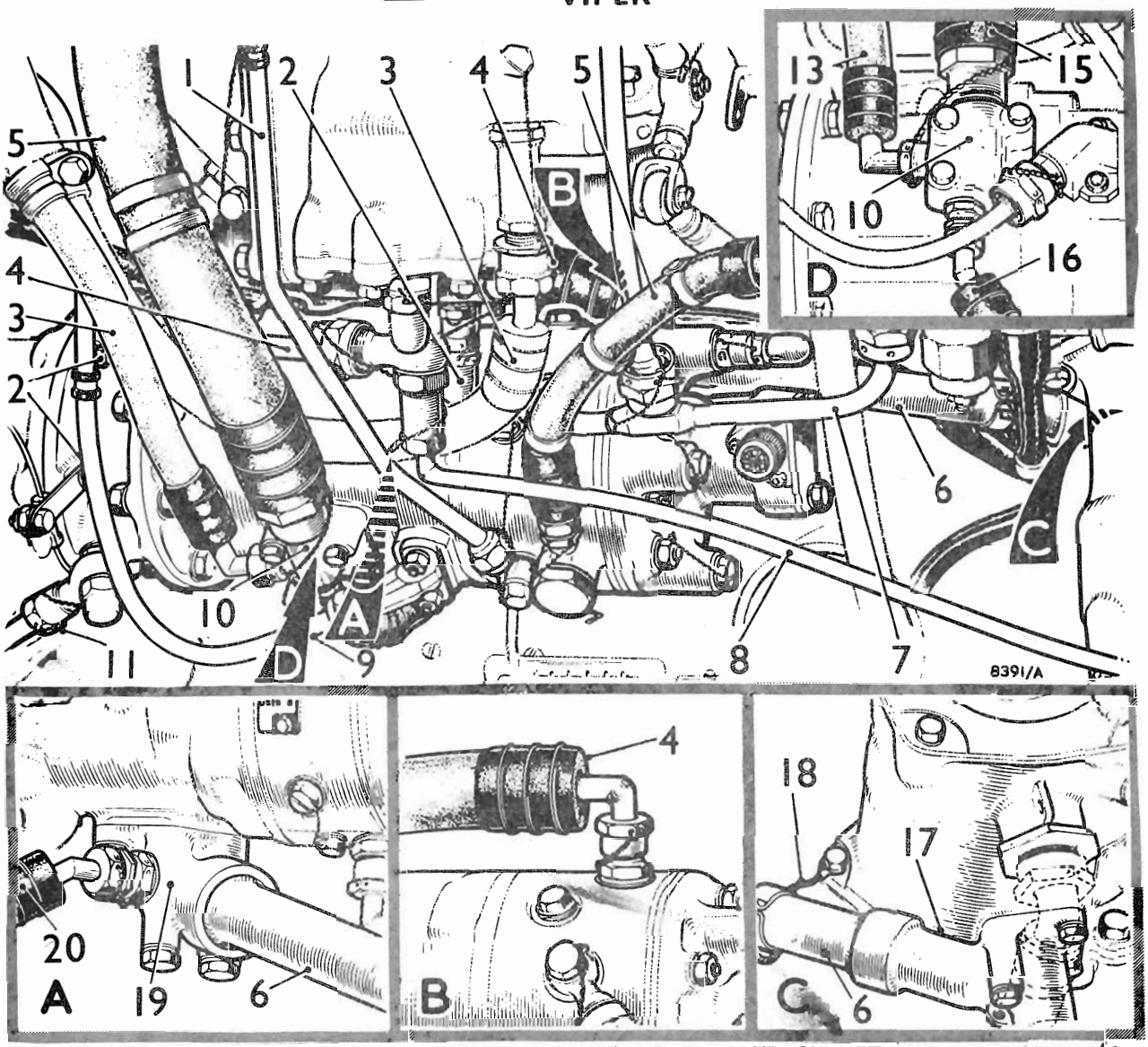
(2) Gain access to the engine and place a tray beneath the engine.

(3) Disconnect the following pipes (Fig.201) :-

Governor pressure pipe - r.r.v. to fuel pump
RRV feed pipe - fuel pump to r.r.v.
Fuel delivery pressure pipe - fuel pump to a.t.l.
Fuel return pipe - a.t.l. to fuel pump
Fuel delivery pipe - fuel pump to b.f.c.u.
Fuel delivery pipe - fuel pump to synchronizer corrector unit (left-hand engine only)
P1 pressure air pipe to b.f.c.u. capsule chamber
BFCU capsule chamber drain pipe
Fuel pump gland drain pipe
Servo spill and waste flow pipe - a.f.r.c. to fuel pump
Servo spill and waste flow pipe - b.f.c.u. to fuel pump. Disconnect this pipe from the b.f.c.u. only.
Servo pressure pipe - fuel pump to a.f.r.c. - disconnect the b.f.c.u. pipe at the T-piece.

(4) Release the two clips supporting the governor pressure pipe (r.r.v. to fuel pump). Disconnect pipe from the r.r.v. and remove the fuel pipe. Blank off all pipe ends and apertures.

(5) Release the two clips supporting the r.r.v. feed pipe (fuel pump to r.r.v.). Disconnect pipe from the r.r.v. and remove the fuel pipe. Blank off all pipe ends and apertures.



1. R.R.V. FEED PIPE - FUEL PUMP TO R.R.V.
2. B.F.C.U. THROTTLE SERVO PISTON ADJUSTER CAPNUT
3. FUEL SUPPLY PIPE SYNCHRONIZER CORRECTOR UNIT TO B.F.C.U. (LEFT-HAND ENGINE ONLY)
4. SERVO SPILL AND WASTE FLOW PIPE - B.F.C.U. TO FUEL PUMP
5. SERVO SPILL PIPE - A.F.R.C. TO FUEL PUMP
6. FUEL INLET PIPE
7. SERVO PRESSURE PIPE - FUEL PUMP TO A.F.R.C.
8. B.F.C.U. CAPSULE CHAMBER DRAIN PIPE
9. GOVERNOR PRESSURE PIPE - R.R.V. TO FUEL PUMP
10. FUEL PUMP OUTLET ADAPTER
11. FUEL PUMP GLAND DRAIN PIPE
12. FUEL PUMP RETAINING NUTS
13. FUEL DELIVERY PIPE - FUEL PUMP TO SYNCHRONIZER CORRECTOR UNIT (LEFT-HAND ENGINE ONLY)
14. P1 PRESSURE AIR PIPE TO B.F.C.U. CAPSULE CHAMBER
15. FUEL DELIVERY PIPE - FUEL PUMP TO B.F.C.U.
16. FUEL DELIVERY PRESSURE PIPE - FUEL PUMP TO A.T.L.
17. FUEL FILTER OUTLET ELBOW
18. BONDING CABLE
19. FUEL PUMP INLET ELBOW
20. FUEL RETURN PIPE - A.T.L. TO FUEL PUMP

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...Fuel pump - Maintenance practices continued

(6) Disconnect bonding cable from fuel inlet pipe.

(7) Remove the fuel low-pressure warning switch from the l.p. fuel filter outlet elbow (see Chapter 73, LP WARNING SWITCH).

(8) Release the outlet elbow retaining bolts, spring washers, plain washers and the differential pressure switch electrical lead support clip.

(9) Withdraw the filter outlet elbow in a rearward direction, together with the fuel inlet pipe, until the pipe disengages the fuel pump inlet elbow.

(10) Discard the fuel inlet pipe O-seals and the joint washer from the l.p. fuel filter outlet elbow.

(11) Assemble blanks to all apertures and pipe ends.

(12) Release the two electrical cable support clips from the brackets on the fuel pump inlet elbow.

(13) Mod CV7348 engines only - release and remove the accessory gearbox drain plug lockwire.

(14) Remove the retaining stiffnuts with the tool kit spanner, and remove the plain washers; this will release the Firewire support clip, and Mod CV7348 engines, the wire locking tab.

(15) Withdraw the fuel pump from the accessory gearbox and install a blank over the drive aperture. Discard the joint washer.

(16) Remove the servo spill pipe from the fuel pump (Detail B on Fig.201).

(17) If the fuel pump is not to be re-installed :-

(a) Remove the pump inlet elbow and discard the joint washer.

(b) Pre-mod.CV7272 only - Remove pump outlet adapter and discard ring seal.

(18) Blank the pump inlet and outlet apertures.

B. Install fuel pump

CAUTION : A PRE-MOD CV7272 FUEL PUMP MUST NOT BE INSTALLED WITH A POST MOD CV7272 AUTOMATIC THRUST LIMITER OR VICE-VERSA.

(1) Remove the blanks from the pump inlet and outlet apertures.

...Fuel pump - Maintenance practices continued

(2) If a replacement pump is to be installed :-

(a) Pre-mod.CV7272 only - Lubricate with clean engine oil and assemble a new ring seal to the pump outlet adapter. Install the adapter on the fuel pump and secure it with plain washers, spring washers and retaining bolts.

(b) CAUTION : DO NOT USE JOINT WASHER PROVIDED WITH INLET BLANK ON REPLACEMENT PUMP.

Assemble a new joint washer to the pump inlet aperture and install the inlet elbow. Secure the inlet elbow with the plain washers, spring washers and retaining bolts. Install the electrical cable support clip in its original position.

(3) Remove the blanks from the fuel pump servo spill connection and associated pipe and install the pipe. Tighten and wire-lock the union nut.

(4) Remove the blank from the fuel pump location on the accessory gearbox and install a new joint washer.

(5) Lubricate the pump splines with clean engine oil and locate the pump over the studs. Make sure that the fuel pump drive-shaft splines are engaged correctly with the engine drive before pushing the pump fully home.

(6) Locate the Firewire support clip over the appropriate stud and assemble the plain washers and stiffnuts. Mod.CV7348 engines only - Fit wire-locking tab under the stiffnut adjacent to the accessory gearbox drain plug.

(7) Mod.CV7348 engines only - Wire-lock the accessory gearbox drain plug to the wire-locking tab under the fuel pump stiffnut.

(8) Connect the two electrical cables support clips to the brackets on the fuel pump inlet elbow.

(9) Remove all blanks from the pipe ends and the fuel pump connections.

(10) Lubricate (see Chapter 71, SERVICING MATERIALS) and assemble new O-seals to the pipe ends where applicable.

(11) Insert one end of the fuel inlet pipe into the fuel filter outlet elbow. Locate the opposite end of the pipe in the fuel pump inlet elbow and push the pipe fully home.

(12) Assemble a new joint washer to the filter outlet elbow. Secure the outlet elbow with the plain washers, spring washers and retaining bolts, interposing the differential pressure switch electrical lead support clip under the rear, lowermost bolt.

...Fuel pump - Maintenance practices continued

(13) Connect bonding cable to the fuel inlet pipe.

(14) Install the fuel low-pressure warning switch. See Chapter 73, LP WARNING SWITCH.

(15) Position governor pressure pipe (r.r.v. to fuel pump) and connect to the r.r.v. Support the pipe with the two clips.

(16) Connect the fuel pump to r.r.v. fuel pipe to the r.r.v. Position and secure the support clip.

(17) Connect the following pipes :-

Servo pressure pipe - fuel pump to a.f.r.c. Connect the b.f.c.u. pipe to the T-piece.
S Servo spill and waste flow pipe - b.f.c.u. to fuel pump. Connect this pipe to the b.f.c.u.
Servo spill pipe - a.f.r.c. to fuel pump.
Fuel pump gland drain pipe.
BFCU capsule chamber drain pipe.
P1 pressure air pipe to b.f.c.u. capsule chamber.
Fuel delivery pipe - fuel pump to synchronizer corrector unit (left-hand only).
Fuel delivery pipe - fuel pump to b.f.c.u.
Fuel return pipe - a.t.l. to fuel pump.
Fuel delivery pressure pipe - fuel pump to a.t.l.
RRV feed pipe - fuel pump to r.r.v.
Governor pressure pipe - r.r.v. to fuel pump.

(18) Tighten and wire-lock all pipe connections.

(19) Bleed the fuel system. See Chapter 73, ENGINE FUEL AND CONTROL - GENERAL.

* * *

PRIMER SOLENOID - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment :-

Tool for dismantling and assembling electrical plug adapter ...	UM.12679
Tension wrench	PE.25492

A. Remove primer solenoid

(1) Isolate electrical circuit to primer solenoid (see Chapter 24).

(2) Gain access to, and place a tray beneath, the engine.

(3) Disconnect the electrical cable from the adapter on the primer solenoid (Fig.201).

(4) Remove the primer solenoid to primer manifold fuel pipe.

(5) Disconnect the p.i.v. to primer solenoid fuel pipe from the banjo connection on the primer solenoid.

(6) Discard the O-seals.

(7) Support the primer solenoid, then remove the retaining bolts, spring washers, plain washers and detach the retaining strap; this will release the signal pressure pipe (b.f.c.u. spring housing to t.t.c.) support clip.

(8) Lift the primer solenoid away from its mounting bracket.

(9) If the primer solenoid is not to be re-installed, remove the adapter from the electrical connection.

(a) Prise the peened rim of the locking washer away from the slots in the adapter.

(b) Unscrew the adapter with the dismantling and assembling tool, withdraw the adapter, locking washer and locking ring; discard the locking washer.

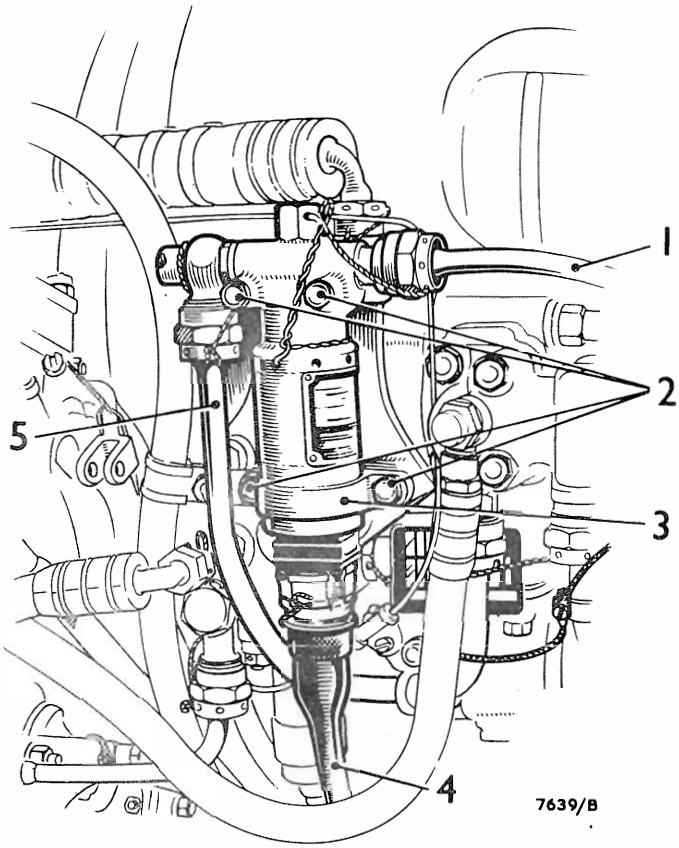
B. Install primer solenoid

(1) If a replacement primer solenoid is to be installed, assemble the adapter to the electrical connection.

(a) Locate the locking ring over the electrical plug body. Position a new locking washer over the end of the ring, engaging the washer tabs in the ring slots.

(b) Screw in the adapter and tighten it with the dismantling and assembling tool.

(c) Reverse the tool and punch the rim of the locking washer into the slots in the adapter flange.



1. PRIMER SOLENOID TO PRIMER MANIFOLD FUEL PIPE
2. PRIMER SOLENOID RETAINING BOLTS
3. RETAINING STRAP
4. ELECTRICAL CABLE
5. P.I.V. TO PRIMER SOLENOID FUEL PIPE

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Primer solenoid details
Fig. 201

...Primer solenoid - Maintenance practices continued

(2) Remove the blanks from the primer solenoid and its associated pipes. Lubricate (see Chapter 71 - SERVICING MATERIALS) and install new O-seals on the pipe ends.

(3) Lubricate the primer solenoid retaining bolt threads with clean engine oil. Locate the primer solenoid on its mounting bracket and retain it by assembling two retaining bolts, plain washers and spring washers to the upper bolt locations.

(4) Position the retaining strap and the fuel pipe support clip; fit and tighten the two remaining bolts, plain washer and spring washers. Insert the signal pressure pipe (b.f.c.u. spring housing to t.t.c.) support clip under the retaining strap front bolt.

(5) Torque load all the retaining bolts to 40 - 45 lb in.

(6) Connect the two fuel pipes to the primer solenoid. Tighten and wire-lock the union nuts.

(7) Connect the electrical cable to the primer solenoid adapter; wire-lock the connection.

(8) Restore electrical supplies to the primer solenoid.

(9) Complete Tests A, G and H of POWER PLANT, GROUND RUNNING TESTS, Chapter 71.00 PG 541

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PRESSURE INCREASING VALVE - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment :-

Tension wrench ... ... PE. 25492

A. Remove pressure increasing valve

(1) Gain access to the engine and place a tray beneath the engine.

(2) Disconnect the following fuel pipes at the p.i.v. (See Chapter 73 - AIR FUEL RATIO CONTROL UNIT).

PIV to primer solenoid pipe.
Fuel feed pipe - p.i.v. to fuel feed pipes manifold.
Fuel bleed pipe - t.t.c. to p.i.v.

(3) Support the p.i.v. Remove the special bolts, retaining bolts, spring washers and plain washers.

(4) Lift the valve away from the a.f.r.c.

(5) Remove and discard the seal ring from the p.i.v. and the O-seals from the pipes. Assemble blanks to the valve, valve mounting and pipe ends.

B. Install pressure increasing valve

(1) Remove the blanks from the p.i.v. and its associated pipes.

(2) Lubricate (see Chapter 71 - SERVICING MATERIALS) and assemble new O-seals to the pipes and a new ring seal to the p.i.v.

(3) Lubricate the p.i.v. retaining bolt threads with clean engine oil. Mount the p.i.v. on the a.f.r.c. and retain it with plain washers, spring washers, special bolts and the retaining bolts.

NOTE : Fit the special bolts at the two positions nearest the primer solenoid.

(4) Torque load the bolts to 80 - 90 lb in.

(5) Connect the following pipes to the p.i.v :-
Fuel feed pipe - p.i.v. to fuel feed pipes manifold.
PIV to primer solenoid pipe.
Fuel bleed pipe - t.t.c. to p.i.v.

(6) Tighten and wire-lock the pipes.

(7) Complete Tests A and D of POWER PLANT - GROUND RUNNING TESTS, Chapter 71.

* * *

BAROMETRIC FLOW CONTROL UNIT - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove barometric flow control unit

(1) Ensure that the LP FUEL COCK is in the OFF position.

(2) Gain access to the engine and place a tray beneath the engine.

(3) Disconnect the h.p. fuel cock and throttle lever linkages.

(4) Disconnect the bonding cable from the servo pressure pipe (fuel pump to b.f.c.u.).

(5) Disconnect the following pipes from the b.f.c.u. (Fig.201) :-

Fuel delivery pipe - fuel pump to b.f.c.u.
Fuel feed pipe - b.f.c.u. to a.f.r.c.
Servo spill and waste flow pipe - b.f.c.u. to fuel pump.
Servo pressure pipe - fuel pump to b.f.c.u. (remove this pipe)

P1 pressure air pipe to b.f.c.u. capsule chamber.
BFCU capsule chamber drain pipe.
Fuel supply pipe - synchronizer corrector unit to b.f.c.u. outlet chamber (left-hand engine only).
Fuel spill pipe - synchronizer corrector unit to b.f.c.u. (left-hand engine only).
Signal pressure pipe - b.f.c.u. spring housing to t.t.c.

(6) Disconnect, unclip and remove the r.r.v. feed pipe - fuel pump to r.r.v.

(7) Remove the three retaining bolts and washers, then withdraw the b.f.c.u. carefully to avoid loss of mounting bushes.

(8) Discard all O-seals. Assemble blanks to all apertures and pipe ends.

(9) Withdraw the six rubber bushes from the b.f.c.u. retaining bolt holes. Check the bushes for condition; if any are damaged, discard them.

B. Install barometric flow control unit

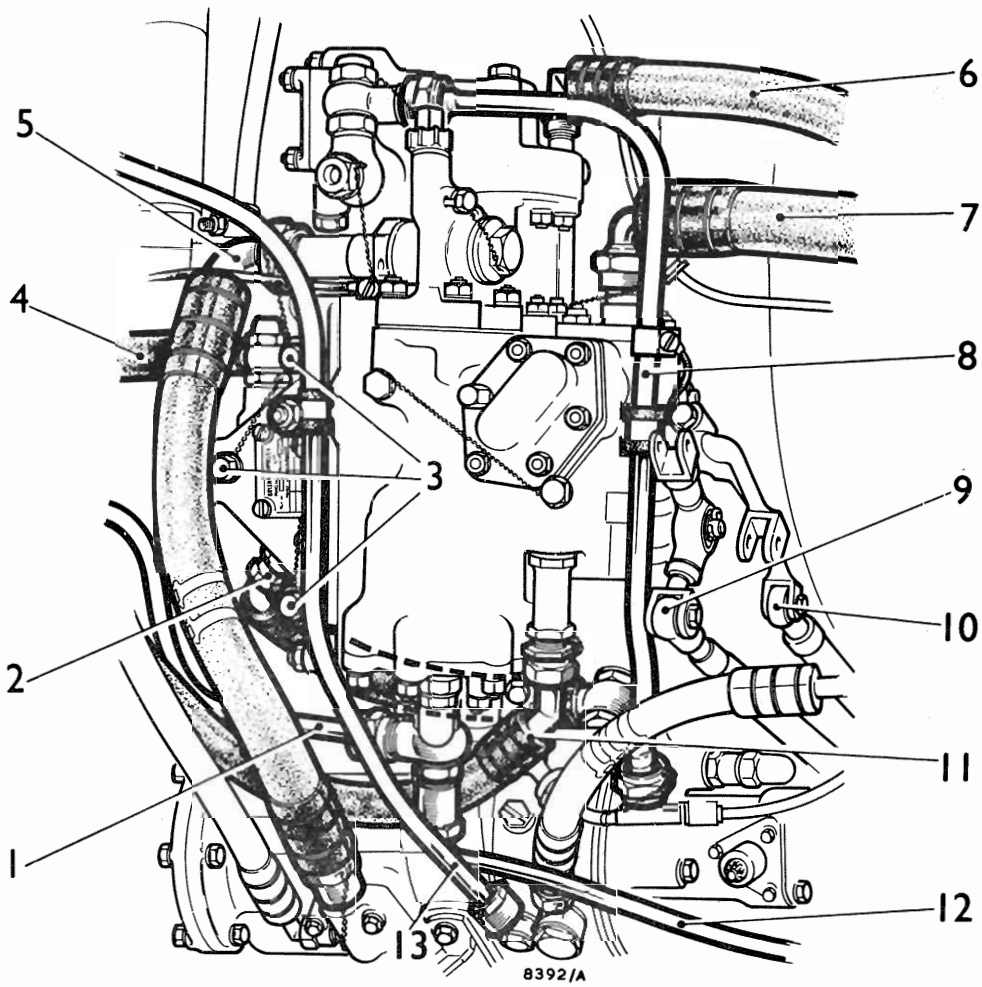
Special tools and equipment :-

Torque wrench ... ... PE.25491 or T2 EM 1986 BR

(1) Install serviceable rubber bushes in the b.f.c.u. retaining bolt holes.

NOTE : Contact adhesive (Chapter 71, SERVICING MATERIALS) may be used to retain the rubber mounting bushes during assembly.

(2) Lubricate the b.f.c.u. retaining bolts threads with clean engine oil. Locate the unit carefully in its position on the blade shield unit and secure it with plain washers and the retaining bolts.



1. P1 PRESSURE AIR PIPE TO B.F.C.U. CAPSULE CHAMBER
2. SERVO SPILL AND WASTE FLOW PIPE - B.F.C.U. TO FUEL PUMP
3. B.F.C.U. RETAINING BOLTS (3 OFF)
4. FUEL SPILL PIPE - SYNCHRONIZER CORRECTOR UNIT TO B.F.C.U. (LEFT HAND ENGINE ONLY)
5. FUEL DELIVERY PIPE - FUEL PUMP TO B.F.C.U.
6. SIGNAL PRESSURE PIPE - B.F.C.U. SPRING HOUSING TO T.T.C.
7. FUEL FEED PIPE - B.F.C.U. TO A.F.R.C.
8. SERVO PRESSURE PIPE - FUEL PUMP TO B.F.C.U.
9. THROTTLE LEVER LINKAGE
10. H.P. FUEL COCK LEVER LINKAGE
11. FUEL SUPPLY PIPE - SYNCHRONIZER CORRECTOR UNIT TO B.F.C.U. OUTLET CHAMBER (L.H. ENG. ONLY)
12. B.F.C.U. CAPSULE CHAMBER DRAIN PIPE
13. R.R.V. FEED PIPE - FUEL PUMP TO R.R.V.

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BFCU details
Fig.201

...Barometric flow control unit - Maintenance practices continued

(3) Torque load the bolts to 35 - 40 lb in. and wire-lock the bolts.

(4) Remove all blanks from the unit and pipe ends.

(5) Lubricate (see Chapter 71 - SERVICING MATERIALS) and assemble new O-seals to the appropriate pipes.

(6) Connect the following pipes :-

Servo spill and waste flow pipe - b.f.c.u. to fuel pump.
Fuel feed pipe - b.f.c.u. to a.f.r.c.
Servo pressure pipe - fuel pump to b.f.c.u.
P1 pressure air pipe to b.f.c.u. capsule chamber.
BFCU capsule chamber drain pipe.
Fuel delivery pipe - fuel pump to b.f.c.u.
Fuel supply pipe - synchronizer corrector unit to b.f.c.u. outlet chamber (left-hand engine only).
Fuel spill pipe - synchronizer corrector unit to b.f.c.u. (left-hand engine only).
Signal pressure pipe - b.f.c.u. spring housing to t.t.c.

(7) Position and connect the governor pressure pipe - fuel pump to r.r.v.

(8) Secure the servo pressure pipe (fuel pump to b.f.c.u.) support clip to the b.f.c.u. On engines incorporating Mod.CV7231, secure the servo pressure pipe to the bracket on the b.f.c.u.

(9) Tighten and wire-lock all pipe connections.

(10) Secure the bonding cable to the servo pressure pipe (fuel pump to b.f.c.u.).

(11) Connect the h.p. fuel cock and throttle lever linkages (see Chapter 76 - POWER CONTROL).

(12) Bleed the fuel system. (see Chapter 73 - ENGINE FUEL AND CONTROL - GENERAL). In addition to tests called for in bleeding, complete Tests A and D of POWER PLANT, GROUND RUNNING TESTS, Chapter 71.

* * *

AIR/FUEL RATIO CONTROL - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove air/fuel ratio control

(1) Ensure that the LP FUEL COCK is in the OFF position.

(2) Gain access to the engine and place a tray beneath the engine.

(3) Remove the primer solenoid.

(4) Disconnect the bonding cables from the p.i.v. to primer solenoid pipe and the fuel feed pipes (p.i.v. to flowmeter).

(5) Disconnect the following pipes from the pressure increasing valve and air/fuel ratio control :-

Fuel feed pipe - b.f.c.u. to a.f.r.c.
P2 heater pipe - centre section to a.f.r.c. anti-icing cup.
P2 pressure pipe - centre section to a.f.r.c. bellows chamber.
Fuel feed pipe - p.i.v. to fuel feed pipe manifold.
Servo spill pipe - a.f.r.c. to fuel pump.
Servo pressure pipe - fuel pump to a.f.r.c.
Fuel bleed pipe - t.t.c. to p.i.v.

(6) Release the fuel feed pipe (p.i.v. to primer solenoid) support clip from its attachment bracket on the a.f.r.c.; also release the adjacent Firewire support clip. Disconnect and remove the pipe.

(7) Release the Firewire support clip from the b.f.c.u. to a.f.r.c. fuel feed pipe inlet elbow and reposition the Firewire so that the a.f.r.c. is clear of obstruction.

(8) Support the a.f.r.c. complete with p.i.v. and remove the three retaining bolts, and special washers.

NOTE : The three retaining bolts secure both the primer solenoid mounting bracket and a.f.r.c. to the compressor casing.

(9) Lift away the mounting bracket and the a.f.r.c.

NOTE : Withdraw the unit carefully, otherwise the rubber bushes will be dislodged from the mounting locations and may be lost.

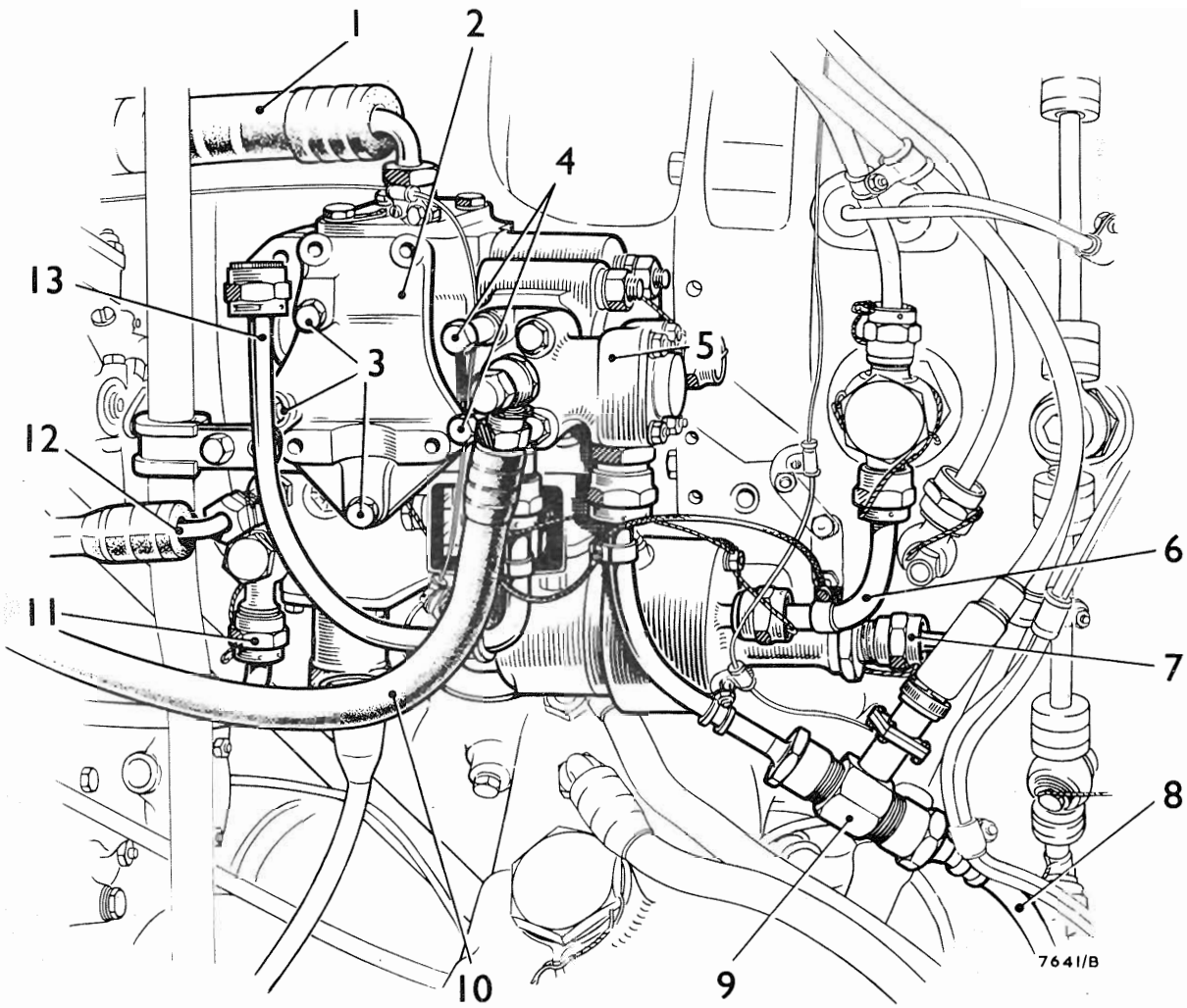
(10) Applicable if a.f.r.c. is not to be re-installed - Remove the pressure increasing valve, then remove the fuel inlet adapter; discard the ring seal.

(11) Release and remove the pipe clip attachment bracket; refit the nut and washer on the a.f.r.c.

(12) Blank all apertures and pipe ends.

(13) Discard all O-seals.

(14) Withdraw the six rubber bushes from the a.f.r.c. securing bolt holes. Check the bushes for condition; if any are damaged, discard them.



1. FUEL FEED PIPE - B.F.C.U. TO A.F.R.C.
2. PRIMER SOLENOID MOUNTING BRACKET (SOLENOID REMOVED)
3. A.F.R.C. RETAINING BOLTS
4. SPECIAL BOLTS
5. PRESSURE INCREASING VALVE (P.I.V.)
6. P2 HEATER PIPE - CENTRE SECTION TO A.F.R.C. ANTI-ICING CUP
7. P2 PRESSURE PIPE - CENTRE SECTION TO A.F.R.C. BELLOWS CHAMBER
8. FUEL FEED PIPE - P.I.V. TO FUEL FEED PIPES MANIFOLD
9. FUEL FLOWMETER
10. FUEL BLEED PIPE - T.T.C. TO P.I.V.
11. SERVO PRESSURE PIPE - FUEL PUMP TO A.F.R.C.
12. SERVO SPILL PIPE - A.F.R.C. TO FUEL PUMP
13. P.I.V. TO PRIMER SOLENOID

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...Air/fuel ratio control - Maintenance practices continued

B. Install air/fuel ratio control

Special tools and equipment :-

Torque wrench ... ... PE.25491 or T2EM 1986 BR

NOTE : Operations (1) to (4) are applicable if a new a.f.r.c. is being fitted.

(1) Assemble the pressure increasing valve to the a.f.r.c.; do not install the associated pipes at this stage.

(2) Lubricate (see Chapter 71 - SERVICING MATERIALS) and install a new ring seal on the fuel inlet adapter.

(3) Remove the blank from the a.f.r.c. fuel inlet aperture, locate the inlet adapter on the a.f.r.c. and secure it with the retaining bolts, spring washers and plain washers.

(4) Install the pipe clip attachment bracket on the lower of the two studs carrying the modification plate.

NOTE : To remove the retaining nut and washers from the stud, it will first be necessary to sever the wire-locking between the nut and the bolt head at the base of the pressure ratio switch chamber. Re-lock the bolt head after installing the clip attachment bracket.

(5) Install serviceable rubber bushes in the a.f.r.c. securing bolt holes.

NOTE: Contact adhesive (Chapter 71, SERVICING MATERIALS) may be used to retain the rubber mounting bushes during assembly.

(6) Lubricate the a.f.r.c. and primer solenoid mounting bracket securing bolt threads with clean engine oil.

(7) Assemble the a.f.r.c., together with the primer solenoid mounting bracket, to the location on the compressor casing.

(8) Secure the components with the retaining bolts, and special washers.

(9) Torque load the bolts to 35 - 40 lb in. and wire-lock them.

(10) Remove the blanks from the pipes, then lubricate (see Chapter 71 - SERVICING MATERIALS) and install appropriate new O-seals.

(11) Connect the fuel feed pipe - p.i.v. to primer solenoid, loosely to the p.i.v.

(12) Secure the support clip to the attachment bracket on the a.f.r.c. and tighten and wire-lock the union nuts.

(13) Secure the Firewire support clip to the clip on the p.i.v. to primer solenoid pipe.

(14) Restore the Firewire to its original position over the a.f.r.c. then secure the support clip to the a.f.r.c. fuel feed pipe inlet adapter.

(15) Connect, tighten and wire-lock the following pipes :-

Servo pressure pipe - fuel pump to a.f.r.c.
Servo spill pipe - a.f.r.c. to fuel pump.
Fuel feed pipe - p.i.v. to fuel feed pipe manifold or flowmeter.
P2 pressure pipe - centre section to a.f.r.c. bellow chamber.
P2 heater pipe - centre section to a.f.r.c. anti-icing cup.
Fuel feed pipe - b.f.c.u. to a.f.r.c.
Fuel bleed pipe - t.t.c. to p.i.v.

(16) Secure the bonding cables to the p.i.v. to primer solenoid pipe and the fuel feed pipe (p.i.v. to flowmeter).

(17) Install the primer solenoid.

(18) Bleed the fuel system (see Chapter 73 - ENGINE FUEL AND CONTROL - GENERAL). In addition to tests called for in bleeding, complete Tests F and H of POWER PLANT, GROUND RUNNING TESTS, Chapter 71.

* * *

RATE RESET VALVE - MAINTENANCE PRACTICES

1. Removal/Installation (Fig.201)

A. Remove rate reset valve

(1) Ensure that the LP FUEL COCK is in the OFF position.

(2) Gain access to the engine and place a tray beneath the engine.

(3) Mod. CV.3600 engines only :-

(a) Remove the isolating valve, see 73-21-51.
(b) Disconnect the governor pressure pipe - r.r.v. to fuel pump.

(4) Pre Mod. CV.3600 engines only :-

(a) Release the r.r.v. feed pipe (fuel pump to r.r.v.) support clip from the b.f.c.u. mounting bracket and disconnect the pipe from the fuel pump.

(b) Disconnect the following pipes from the r.r.v.

RRV feed pipe - fuel pump to r.r.v. (remove the pipe).
Governor pressure pipe - r.r.v. to fuel pump.

(5) Discard the O-seals from the pipe ends.

(6) Support the r.r.v. then remove the retaining bolts, spring washers and plain washers. Withdraw the r.r.v. and solenoid mounting plate, if fitted.

(7) Blank off the r.r.v. inlet and outlet apertures.

B. Install rate reset valve

(1) Remove the blanks from the rate reset valve inlet and outlet banjos.

(2) Lubricate the rate reset valve retaining bolt threads with clean engine oil.

(3) Locate the rate reset valve (bleed valve downward) on its mounting, and if fitted, the solenoid valve attachment plate, then install the retaining bolts, plain washers and spring washers.

(4) Lubricate (see Chapter 71, SERVICING MATERIALS) and assemble new O-seals to the pipes.

(5) Pre Mod. CV.3600 engines :-

(a) Connect the following pipes to the r.r.v.

Governor pressure pipe - r.r.v. to fuel pump.
RRV feed pipe - fuel pump to r.r.v.

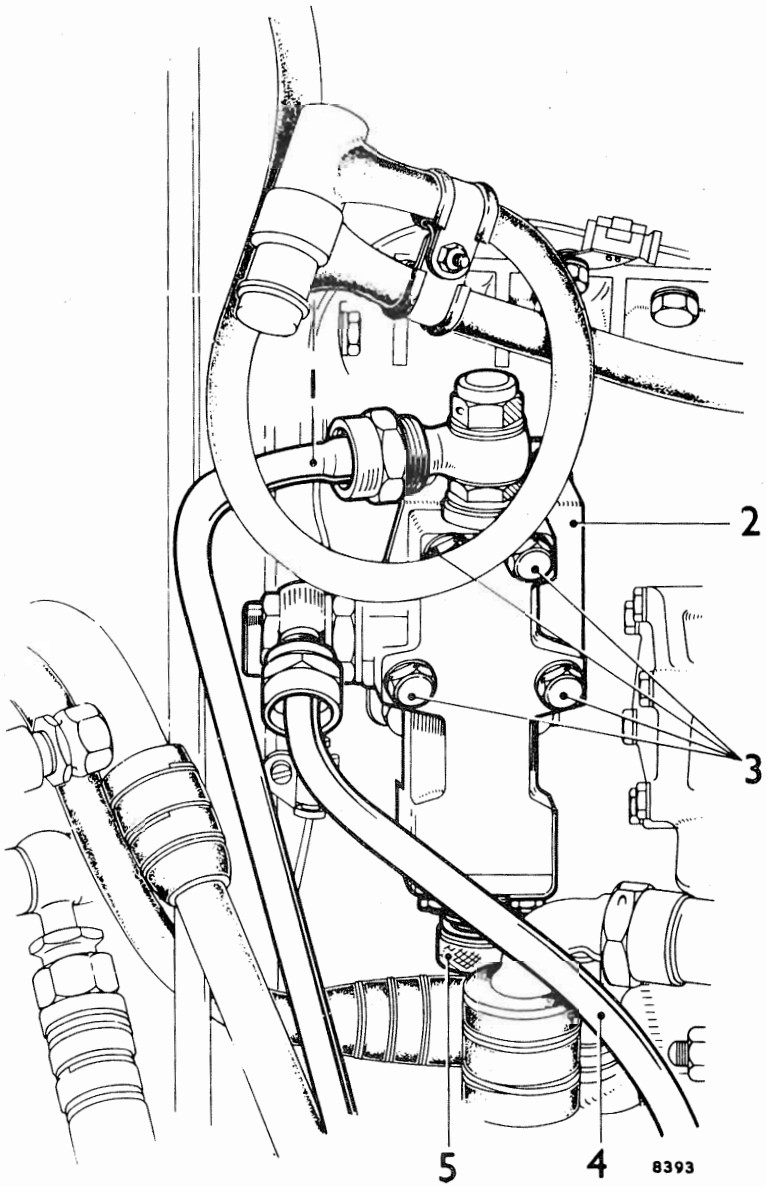
(b) Secure the r.r.v. feed pipe (fuel pump to r.r.v.) support clip to the b.f.c.u. mounting bracket and connect to the fuel pump.

(6) Mod. CV.3600 engines only :-

(a) Connect the governor pressure pipe - r.r.v. to fuel pump.
(b) Install the isolating valve, see 73-21-51.

(7) Tighten and wire-lock all union nuts.

(8) Bleed the fuel system. See Chapter 73, ENGINE FUEL AND CONTROL.



1. GOVERNOR PRESSURE PIPE - R.R.V. TO FUEL PUMP.
2. RATE RESET VALVE MOUNTING BRACKET.
3. RETAINING BOLTS.
4. R.R.V. FEED PIPE - FUEL PUMP TO R.R.V.
5. R.R.V. BLEED VALVE.

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Rate reset valve connections
(Pre Mod.CV.3600)
Fig.201

* * *

RATE RESET ISOLATING SOLENOID VALVE - MAINTENANCE PRACTICES

1. Removal/Installation (Fig.201)

A. Remove isolating valve

(1) Ensure the LP FUEL cock is in the OFF position.

(2) Gain access to, and place a tray beneath the engine.

(3) Disconnect the electrical cable from the valve adapter.

(4) Release and remove the locking wire from the solenoid to r.r.v. fuel feed union capnuts.

(5) Release the fuel feed pipe union (fuel pump to solenoid valve) at the solenoid valve end.

(6) Remove the valve retaining bolts, washers and the retaining strap.

(7) Withdraw the valve and support block from its mounting plate, disengaging the fuel connecting liner and feed pipe.

(8) Blank-off the valve inlet and outlet banjos and associated pipe connections.

B. Install isolating valve

(1) Remove the blanks from the valve inlet and outlet banjos and associated pipe connections.

(2) Install new O-seals on the fuel feed liner and pipe end, lubricate with clean engine oil.

(3) Locate the valve, engaging the fuel feed liner and pipe.

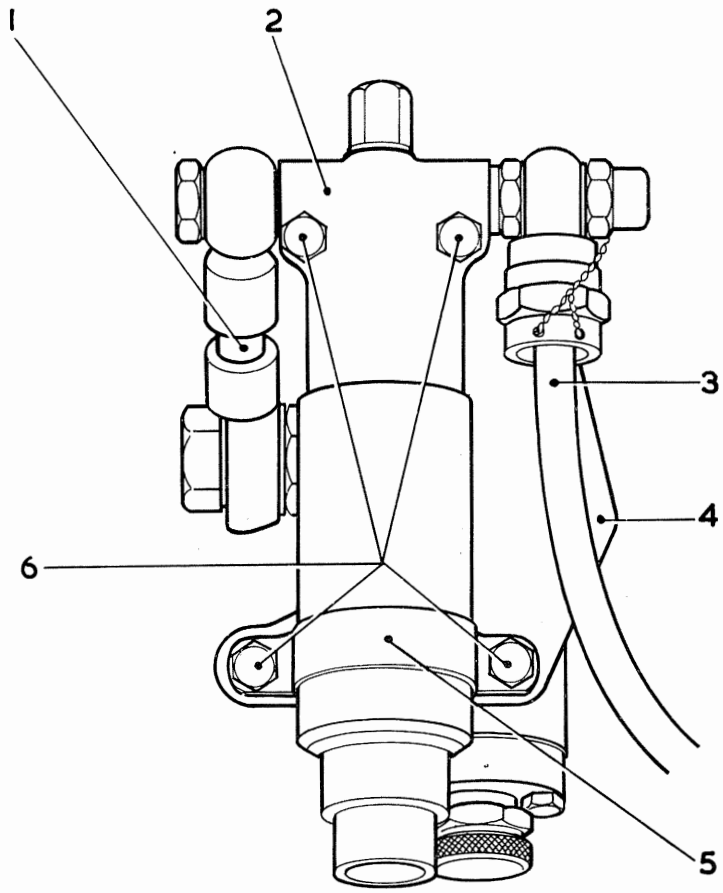
(4) Position the support block and retaining strap, then secure the valve with the retaining bolts and washers, torque tighten the bolts to 40-45 lb in.

(5) Tighten and wirelock the fuel pipe unions, banjo bolts and capnuts.

(6) Connect the electrical cable to the valve adapter and wirelock.

(7) Bleed the fuel system (see Chapter 73, ENGINE FUEL AND CONTROL).

...Rate reset isolating solenoid valve - Maintenance practices continued



1. FUEL FEED (ISOLATOR TO RRV)
2. ISOLATING SOLENOID VALVE
3. FUEL FEED (FUEL PUMP TO ISOLATING VALVE)
4. ISOLATING VALVE ATTACHMENT BRACKET
5. ISOLATOR VALVE RETAINING STRAP
6. ISOLATOR VALVE RETAINING BOLTS

RRV Isolating Solenoid Valve Connections
Fig.201

TOP TEMPERATURE CONTROL SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Calibrate system - engine static

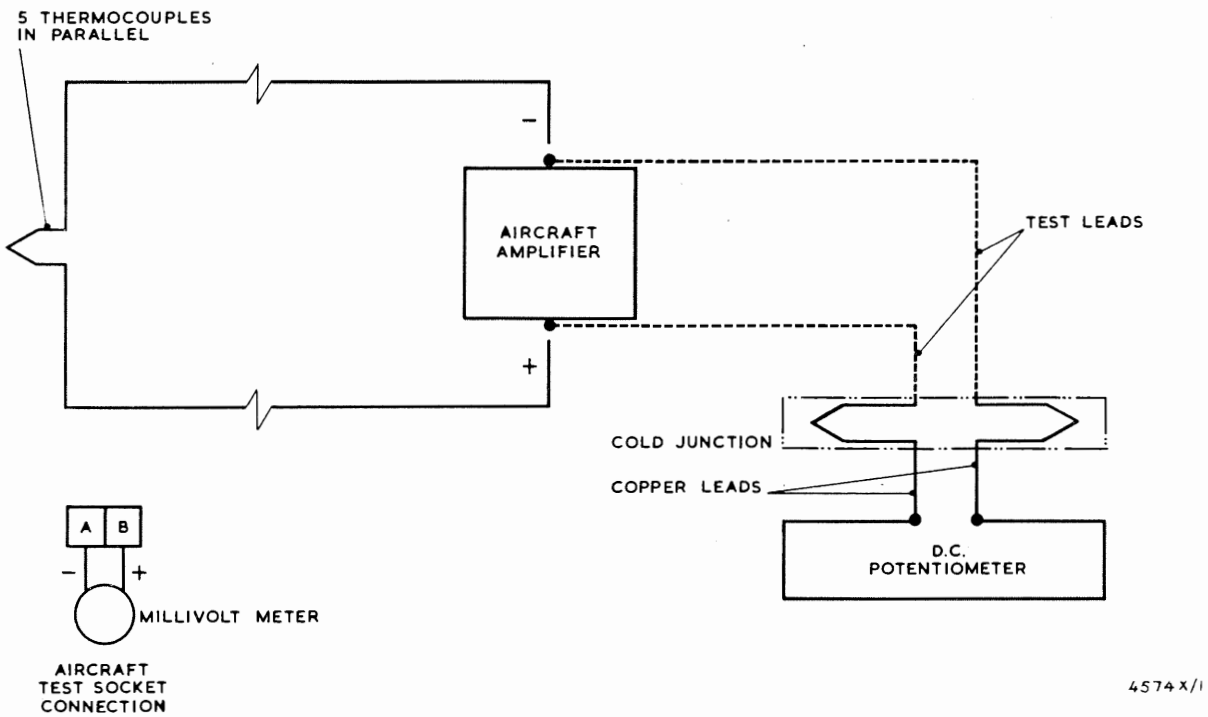
Equipment required :-

Standard d.c. potentiometer test set
Two ice flasks
Two copper test leads
One chromel test lead
One alumel test lead
B.S.89 standard milli-volt meter (0.250 mv) and Cannon socket MS3106E-18-15.
or
Compensated test set, for example Ultra QT 223 with appropriate accessories.

NOTE : If test set is to be used, complete operation (1) below and then connect test set to the appropriate test plug. Refer to test set manufacturers manual for the procedure required to complete this test. Fit blank to test plug on completion of test.

(1) Test continuity and insulation resistances of thermocouple harness and take-off leads (See chapter 77, THERMOCOUPLES AND HARNESS)

(2) Disconnect the thermocouple leads from the amplifier (Rear equipment bay) (Fig. 201)



Test circuit - engine static
Fig.201

...Top temperature control system - Maintenance practices continued

(3) Connect one copper test lead to the chromel test lead, and the second copper test lead to the alumel test lead; place each junction in an ice flask.

(4) Check that the total resistance of the test leads does not exceed 12.0 ohms.

(5) Connect the test leads (chromel to positive and alumel to negative) to the amplifier terminals.

(6) Connect the copper test leads to the d.c. potentiometer.

(7) Connect millivolt meter, via test plug and low resistance leads, to connectors A & B of the amplifier test socket in the aircraft rear equipment bay (Fig. 201).

(8) Ensure that the amplifier adjuster is at position K.

(9) Energize aircraft d.c. busbar (Chapter 24)

(10) Switch inverter to INV. 1 or 2 and select TOP TEMP CONTROL to T/O, and allow 15 minutes stabilizing period.

(11) Check that amplifier standing current is within 60 to 80 ma (30 to 40 mv reading) with no temperature injected into the system.

(12) Set the potentiometer to obtain an amplifier output of 225 ma (112.5 mv) and check that the injected signal is between :-

Viper 522 - 30.52 to 30.65 ($735 \pm \frac{1}{2}$ °C)

NOTE : If necessary, adjust the amplifier 'click stop' adjuster to obtain this condition; normally 2 clicks in either direction are sufficient.

(13) Select TOP TEMP CONTROL to CLIMB.

(14) Set the potentiometer to obtain an amplifier output of 225 ma (112.5 mv); and check that the injected signal is between :-

Viper 522 - 27.87 to 28.29 mv (675 ± 5° C)

(15) Select TOP TEMP CONTROL to T/O.

(16) Set the potentiometer to obtain an amplifier output of 100 ma (50 mv); record temperature equivalent in °C of injected signal (Table 1).

(17) Set the potentiometer to obtain an amplifier output of 350 ma (175 mv); record temperature equivalent in °C of injected signal (Table 1).

...Top temperature control system - Maintenance practices continued

Table 1

Temperature/ Millivolt equivalent

°C	0	1	2	3	4	5	6	7	8	9	10	°C
500	20.65	20.69	20.73	20.77	20.82	20.86	20.90	20.94	20.99	21.03	21.07	500
510	21.07	21.11	21.16	21.20	21.24	21.28	21.32	21.37	21.41	21.45	21.50	510
520	21.50	21.54	21.58	21.63	21.67	21.71	21.75	21.80	21.84	21.88	21.92	520
530	21.92	21.97	22.01	22.05	22.09	22.14	22.18	22.22	22.26	22.31	22.35	530
540	22.35	22.39	22.43	22.48	22.52	22.56	22.61	22.65	22.69	22.73	22.78	540
550	22.78	22.82	22.86	22.90	22.95	22.99	23.03	23.07	23.12	23.16	23.20	550
560	23.20	23.25	23.29	23.33	23.38	23.42	23.46	23.50	23.54	23.59	23.63	560
570	23.63	23.67	23.72	23.76	23.80	23.84	23.89	23.93	23.97	24.01	24.06	570
580	24.06	24.10	24.14	24.18	24.23	24.27	24.31	24.36	24.40	24.44	24.49	580
590	24.49	24.53	24.57	24.61	24.65	24.70	24.74	24.78	24.83	24.87	24.91	590
600	24.91	24.95	25.00	25.04	25.08	25.12	25.17	25.21	25.25	25.29	25.34	600
610	25.34	25.38	25.42	25.47	25.51	25.55	25.59	25.64	25.68	25.72	25.76	610
620	25.76	25.81	25.85	25.89	25.93	25.98	26.02	26.06	26.10	26.15	26.19	620
630	26.19	26.23	26.27	26.32	26.36	26.40	26.44	26.48	26.53	26.57	26.61	630
640	26.61	26.65	26.70	26.74	26.78	26.82	26.86	26.91	26.95	26.99	27.03	640
650	27.03	27.07	27.12	27.16	27.20	27.24	27.28	27.33	27.37	27.41	27.45	650
660	27.45	27.49	27.54	27.58	27.62	27.66	27.71	27.75	27.79	27.83	27.87	660
670	27.87	27.92	27.96	28.00	28.04	28.08	28.13	28.17	28.21	28.25	28.29	670
680	28.29	28.34	28.38	28.42	28.46	28.50	28.55	28.59	28.63	28.67	28.72	680
690	28.72	28.76	28.80	28.84	28.88	28.93	28.97	29.01	29.05	29.10	29.14	690
700	29.14	29.18	29.22	29.26	29.30	29.35	29.39	29.43	29.47	29.52	29.56	700
710	29.56	29.60	29.64	29.68	29.72	29.77	29.81	29.85	29.89	29.93	29.97	710
720	29.97	30.02	30.06	30.10	30.14	30.18	30.23	30.27	30.31	30.35	30.39	720
730	30.39	30.44	30.48	30.52	30.56	30.60	30.65	30.69	30.73	30.77	30.81	730
740	30.81	30.85	30.90	30.94	30.98	31.02	31.06	31.10	31.15	31.19	31.23	740
750	31.23	31.27	31.31	31.35	31.40	31.44	31.48	31.52	31.56	31.60	31.65	750
760	31.65	31.69	31.73	31.77	31.81	31.85	31.90	31.94	31.98	32.02	32.06	760
770	32.06	32.10	32.15	32.19	32.23	32.27	32.31	32.35	32.39	32.43	32.48	770
780	32.48	32.52	32.56	32.60	32.64	32.68	32.72	32.76	32.81	32.85	32.89	780
790	32.89	32.93	32.97	33.01	33.05	33.09	33.13	33.18	33.22	33.26	33.30	790
800	33.30	33.34	33.38	33.42	33.46	33.50	33.54	33.59	33.63	33.67	33.71	800
810	33.71	33.75	33.79	33.83	33.87	33.91	33.95	33.99	34.04	34.08	34.12	810
820	34.12	34.16	34.20	34.24	34.28	34.32	34.36	34.40	34.44	34.48	34.53	820
830	34.53	34.57	34.61	34.65	34.69	34.73	34.77	34.81	34.85	34.89	34.93	830
840	34.93	34.97	35.02	35.06	35.10	35.14	35.18	35.22	35.26	35.30	35.34	840
850	35.34	35.38	35.42	35.46	35.50	35.54	35.58	35.63	35.67	35.71	35.75	850
860	35.75	35.79	35.83	35.87	35.91	35.95	35.99	36.03	36.07	36.11	36.15	860
870	36.15	36.19	36.23	36.27	36.31	36.35	36.39	36.43	36.47	36.51	36.55	870
880	36.55	36.59	36.63	36.67	36.72	36.76	36.80	36.84	36.88	36.92	36.96	880
890	36.96	37.00	37.04	37.08	37.12	37.16	37.20	37.24	37.28	37.32	37.36	890
900	37.36	37.40	37.44	37.48	37.52	37.56	37.60	37.64	37.68	37.72	37.76	900
910	37.76	37.80	37.84	37.88	37.92	37.96	38.00	38.04	38.08	38.12	38.16	910
920	38.16	38.20	38.24	38.28	38.32	38.36	38.40	38.44	38.48	38.52	38.56	920
930	38.56	38.60	38.64	38.68	38.72	38.76	38.80	38.84	38.88	38.92	38.95	930
940	38.95	38.99	39.03	39.07	39.11	39.15	39.19	39.23	39.27	39.31	39.35	940
950	39.35	39.39	39.43	39.47	39.51	39.55	39.59	39.63	39.67	39.71	39.75	950
960	39.75	39.79	39.83	39.86	39.90	39.94	39.98	40.02	40.06	40.10	40.14	960
970	40.14	40.18	40.22	40.26	40.30	40.34	40.38	40.41	40.45	40.49	40.53	970
980	40.53	40.57	40.61	40.65	40.69	40.73	40.77	40.81	40.85	40.89	40.92	980
990	40.92	40.96	41.00	41.04	41.08	41.12	41.16	41.20	41.24	41.28	41.31	990
1000	41.31	41.35	41.39	41.43	41.47	41.51	41.55	41.59	41.63	41.67	41.70	1000

... Top temperature control system - Maintenance practices continued

(18) Check that the difference between the two temperatures obtained in operations (16) and (17) is 8 ± 2°C.

(19) Select TOP TEMP CONTROL to OFF.

(20) Switch inverter off and de-energize d.c. busbars.

(21) Remove test equipment.

(22) Connect amplifier leads.

B. Calibrate system - engine running

NOTE : For post installational ground run only, complete operations (1) to (8) inclusive and operation (20). Ignore remaining operations unless a fault is encountered.

Equipment required :-

Standard d.c. potentiometer
or
Compensated test set; for example, Ultra QT 223 with appropriate accessories.

NOTE : If compensated test set is not used, correct all potentiometer readings for ambient temperature. (See Chapter 77, EXHAUST GAS TEMPERATURE INDICATION).

If test set is to be used refer to test set manufacturers manual for procedure required to complete this test.

(1) Remove shroud panel from bottom of fillet (see Chapter 71, POWER PLANT - GENERAL, Fig. 1 and 2).

(2) Connect compensating leads (Chromel to positive terminal No. 3 and Alumel to negative terminal No. 4) to the terminal block in the fillet.

(3) Connect free ends of compensating leads to the potentiometer.

(4) With engine fully cowled and aircraft facing into wind, start the engine (see Chapter 71, POWER PLANT).

(5) Switch inverter to INV 1 or 2.

(6) Select TOP TEMP CONTROL to T/O.

(7) Open throttle to 99.5% rev/min. allow engine to stabilize at this speed for 3 minutes and check exhaust gas temperature (as registered by indicator) and potentiometer is within limits. (See Chapter 71, POWER PLANT - ADJUSTMENT/TEST, Fig. 502).

(8) Record temperature readings of e.g.t. indicator and potentiometer; see NOTE after operation (10).

(9) Reduce engine speed to 90% rev/min.

... Top temperature control system - Maintenance practices continued

(10) Select air bleeds and open throttle, as necessary, until engine is controlled by top temperature control.

CAUTION : OBSERVE EGT AND ENGINE SPEED LIMITATIONS

NOTE : At a low ambient air temperature the maximum governed speed and take-off e.g.t. may not be attainable therefore, if the e.g.t. is restricted in this way isolate the automatic thrust limiter (by disconnecting the P2 pipe - see Chapter 73), and also, if necessary, pressurize the b.f.c.u. capsule to increase the maximum speed (see Chapter 71, POWER PLANT - ADJUSTMENT/TEST. Adjust maximum speed governor).

At 0°C ambient air temp., selection of engine anti-icing alone will increase e.g.t. by approx. 60°C. If air conditioning is also selected e.g.t. will rise another 20°C approx. A further increase in e.g.t. may be obtained by permanently opening the compressor air bleed valve (by disconnecting the P2 pipe, see Chapter 75). With the bleed valve open and both air conditioning and anti-icing selected, a total rise of approx. 90°C may be obtained.

(11) Note setting of amplifier and record e.g.t. as registered by indicator and potentiometer.

(12) Adjust amplifier until the potentiometer reading is equivalent to maximum take-off e.g.t. $\pm \frac{1}{2}$ °C:-

Viper 522 - 30.81 mv (740°C), 30.73 to 30.85 mv (740 $\pm \frac{1}{2}$ °C)

(13) Adjust e.g.t. indicator as necessary, via mechanical zero adjuster, until instrument registers maximum take-off e.g.t.:-

Viper 522 - 740°C

NOTE : If an adjustment of more than 10°C is required use a potentiometer in lieu of indicator, and check the thermocouple output.

(14) Adjust amplifier until it is controlling at the take-off datum $\pm \frac{1}{2}$ °C. Check that the potentiometer reading is :-

Viper 522 - 30.52 to 30.65mv (735 $\pm \frac{1}{2}$ °C)

(15) Record reading of e.g.t. indicator; it must agree with the temperature equivalent of the potentiometer reading in operation (14).

(16) Close throttle until e.g.t. is 15°C above the climb datum :-

Viper 522 - 690°C

... Top temperature control system - Maintenance practices continued

(17) Select TOP TEMP CONTROL to CLIMB.

(18) Check that potentiometer is reading climb datum $\pm$ 10°C :-

Viper 522 - 27.66 to 28.50 mv (675 $\pm$ 10°C)

(19) Stop engine (see Chapter 71, POWER PLANT).

(20) Remove test equipment.

(21) As necessary - restore automatic thrust limiter and/or compressor air bleed valve systems to operational state by connecting P2 pipe to each unit.

(22) If compressor air bleed valve was rendered inoperative :- Test operation of compressor air bleed valve (see Chapter 71, POWER PLANT - ADJUSTMENT/TEST).

(23) If automatic thrust limiter was rendered inoperative - Test automatic thrust limiting system (see Chapter 71, POWER PLANT - ADJUSTMENT/TEST).

* * *

TOP TEMPERATURE CONTROL - MAINTENANCE PRACTICES

1. Removal/Installation (Fig.201)

Special tools and equipment :-

Tool for dismantling and assembling electrical plug adapter PE.3424

Torque wrench ... ... PE.25492 or T2 EM 1987 BR

A. Remove top temperature control (t.t.c.)

(1) Isolate the t.t.c. electrical circuit (Chapter 24).

(2) Ensure that the LP FUEL COCK is in the OFF position.

(3) Gain access to the engine and place a tray beneath the engine.

(4) Disconnect the electrical cable from the adapter on the t.t.c.

(5) Disconnect the following fuel pipes from the unit (Fig.201) :-

Signal pressure pipe - b.f.c.u. spring housing to t.t.c.
Fuel bleed pipe - t.t.c. to p.i.v.
Signal pressure pipe b.f.c.u. spring housing to a.t.l. via t.t.c.

(6) Support the t.t.c., then remove the retaining nuts, spring washers and plain washers and bonding cable tag.

NOTE: One retaining nut is behind the solenoid housing of the unit.

(7) Lift the t.t.c. away from the comparator casing carefully to avoid loss of mounting bushes.

(8) Remove the eight rubber bushes and four steel spacers from the t.t.c. securing stud holes; check the bushes for condition, and discard any which are damaged.

(9) Blank-off the t.t.c. connections and the pipe ends.

(10) If the t.t.c. is not to be re-installed, remove the adapter from the electrical connection.

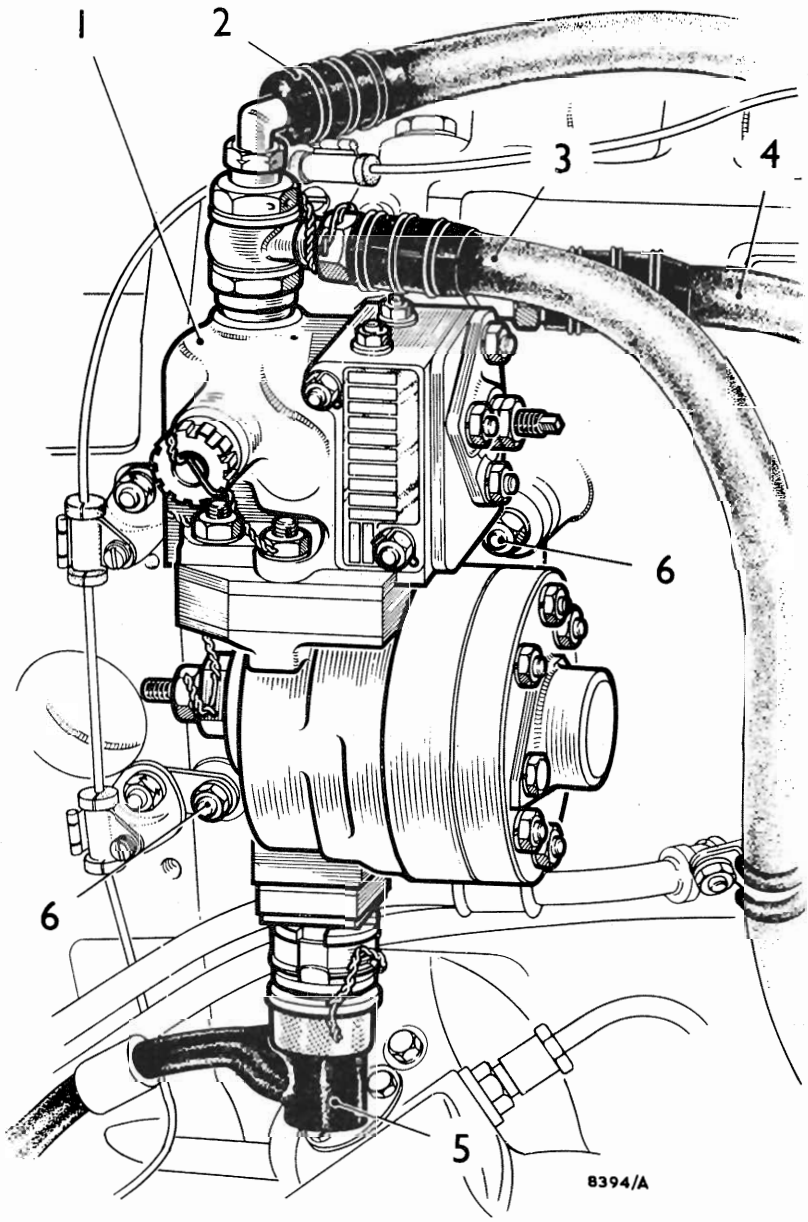
(a) Prise the peened rim of the locking washer away from the slots in the adapter.

(b) Release the adapter with the dismantling and assembling tool, withdraw the adapter, locking washer and locking ring; discard the locking washer.

B. Install top temperature control

(1) If a replacement t.t.c. is to be installed, assemble the adapter to the electrical connection.

(a) Locate the locking ring over the electrical plug body. Position a new locking washer over the end of the ring, engaging the washer tabs in the ring slots.



1 TOP TEMPERATURE CONTROL (T.T.C.)
2 SIGNAL PRESSURE PIPE – B.F.C.U. SPRING HOUSING TO A.T.L. (VIA T.T.C.)
3 SIGNAL PRESSURE PIPE – B.F.C.U. SPRING HOUSING TO T.T.C.
4 FUEL BLEED PIPE – T.T.C. TO P.I.V.
5 ELECTRICAL CONNECTION
6 RETAINING NUTS (4 OFF)

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Top temperature control details
Fig.201

...Top temperature control - Maintenance practices continued

(b) Screw in the adapter and tighten it with the dismantling and assembling tool.

(c) Reverse the tool and punch the rim of the locking washer into the slots in the adapter flange.

(2) Remove the blanks from the t.t.c. and its associated pipes.

(3) Install eight serviceable rubber bushes in the t.t.c. securing stud holes, then position the four steel spacers.

NOTE: Contact adhesive (Chapter 71, SERVICING MATERIALS) may be used to retain the rubber mounting bushes during assembly.

(4) Lubricate the t.t.c. locating stud threads with clean engine oil.

(5) Locate the t.t.c. over its securing studs and install the plain washers, spring washers and nuts. Position the rear main bearing oil feed pipe support clip and bonding cable tag on the t.t.c. front lower retaining stud.

(6) Torque load the nuts to 80 - 90 lb in.

(7) Connect the following fuel pipes :-

Fuel bleed pipe - t.t.c. to p.i.v.
Signal pressure pipe - b.f.c.u. to t.t.c.
Signal pressure pipe - b.f.c.u. spring housing to a.t.l. via t.t.c.

(8) Tighten and wire-lock the pipe connections.

(9) Connect the electrical cable to the adapter on the t.t.c.

(10) Restore the t.t.c. electrical supplies.

(11) Bleed the fuel system (see Chapter 73, ENGINE FUEL AND CONTROL). In addition to tests called for in bleeding, complete Test L of POWER PLANT, GROUND RUNNING TESTS Chapter 71.

* * *

AMPLIFIER - MAINTENANCE PRACTICES

1. Removal/Installation

NOTE : If an amplifier is to be changed, remove the datum plug and transfer it to the replacement amplifier.
After the installation of an amplifier calibrate the system - engine static and also engine running (see TOP TEMPERATURE CONTROL SYSTEM).

* * *

SYNCHRONIZER CORRECTOR UNIT - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment :-

Tension wrench PE.25492

A. Remove synchronizer corrector unit

(1) Ensure that the L.P. FUEL COCK is in the OFF position.

(2) Gain access to, and place a tray beneath, the engine.

(3) Disconnect the electrical cable from the corrector unit.

(4) Disconnect the following pipes from the unit (Fig.201 overleaf) :-

Fuel delivery pipe - fuel pump to corrector unit.
Fuel supply pipe - corrector unit to b.f.c.u. outlet chamber.
Fuel spill pipe - corrector unit to b.f.c.u.
Corrector unit drain pipe.

(5) Support the unit, remove the retaining bolts, spring and plain washers and lift the unit away from its mounting plate.

(6) Discard all O-seals from the pipes, including corrector unit drain pipe.

(7) Assemble blanks to all apertures and pipe ends.

B. Install synchronizer corrector unit

(1) Remove the blanks from the synchronizer corrector unit and its pipes.

(2) Lubricate (see Chapter 71 - SERVICING MATERIALS) and assemble new O-seals to the pipes including the corrector unit drain pipe , lubricate the unit retaining bolt threads with clean engine oil.

(3) Place the unit on its mounting plate and retain it with the plain washers, spring washers and retaining bolts; torque load the bolts to 80 to 90 lb.in.

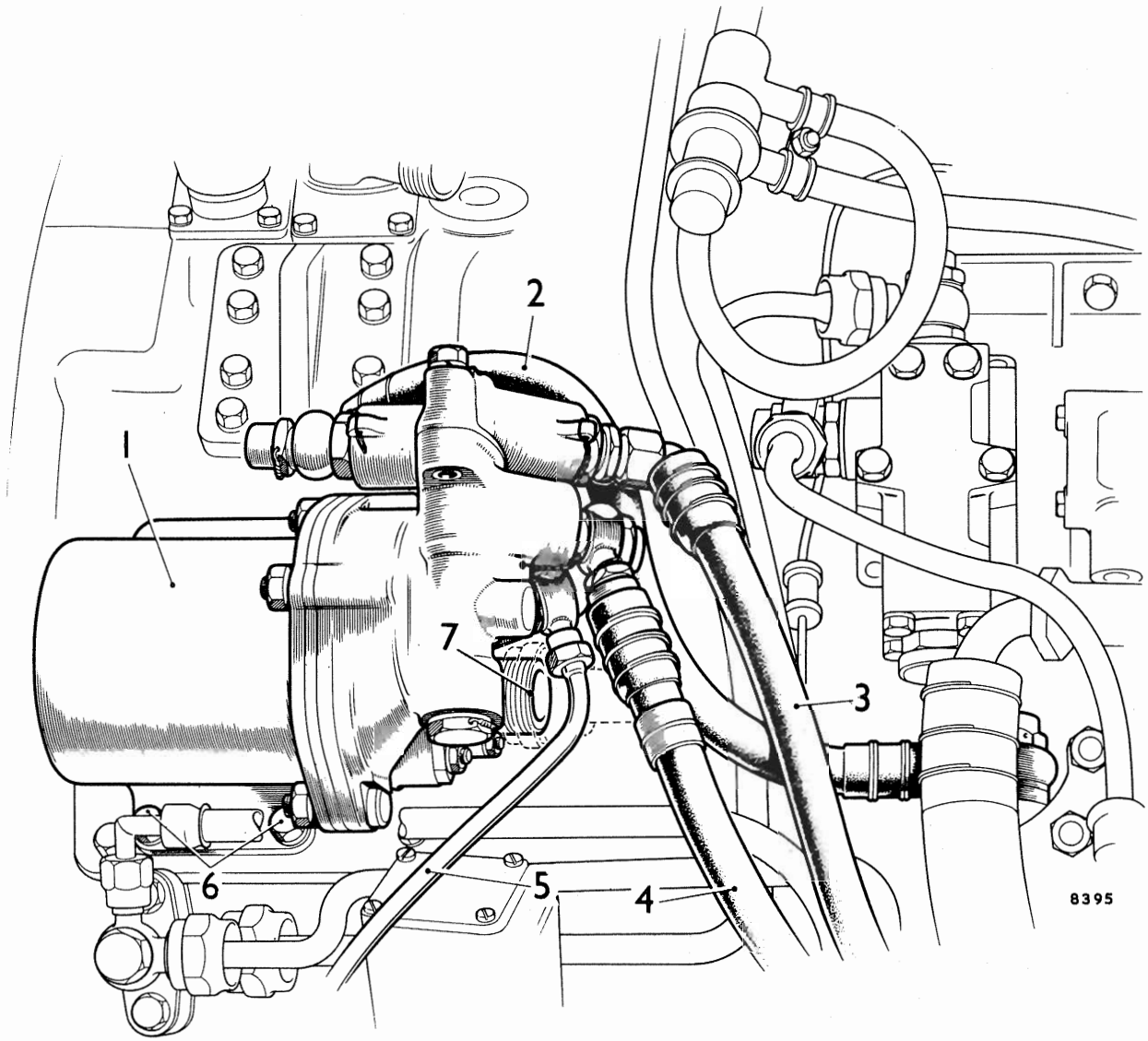
(4) Connect the following pipes :-

Corrector unit drain pipe.
Fuel spill pipe - corrector unit to b.f.c.u.
Fuel supply pipe - corrector unit to b.f.c.u. outlet chamber.
Fuel delivery pipe - fuel pump to corrector unit.

(5) Tighten and wire-lock all pipe connections.

(6) Connect the electrical cable to the unit.

(7) Bleed the fuel system. See Chapter 73 ENGINE FUEL AND CONTROL - GENERAL. In addition to tests called for in bleeding, complete Test K of POWER PLANT - ADJUSTMENT/TEST, GROUND RUNNING TESTS, Chapter 71.



1. SYNCHRONIZER CORRECTOR UNIT.
2. FUEL SPILL PIPE - SYNCHRONIZER CORRECTOR UNIT TO B.F.C.U.
3. FUEL SUPPLY PIPE - SYNCHRONIZER CORRECTOR UNIT TO B.F.C.U.
4. FUEL DELIVERY PIPE - FUEL PUMP TO SYNCHRONIZER CORRECTOR UNIT.
5. SYNCHRONIZER CORRECTOR UNIT DRAIN PIPE.
6. RETAINING BOLTS (4 OFF).
7. ELECTRICAL SOCKET (AIRCRAFT ELECTRICAL SERVICES).

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Synchronizer corrector unit details (left hand engine only)
Fig.201

... Synchronizer corrector unit - Maintenance practices continued

(6) Tighten and wire-lock all pipe connections.

(7) Connect the electrical cable to the unit.

(8) Bleed the fuel system. See ENGINE FUEL AND CONTROL - MAINTENANCE PRACTICES. In addition to tests called for in bleeding, complete Test K of POWER PLANT - ADJUSTMENT/TEST, GROUND RUNNING TESTS.

* * *

AUTOMATIC THRUST LIMITER - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove automatic thrust limiter

(1) Ensure that the LP FUEL COCK is in the OFF position.

(2) Gain access to the engine and place a tray beneath the engine.

(3) Disconnect the following fuel and air pipes from the unit :-

CAUTION : DO NOT ALLOW FUEL TO CONTAMINATE THE AIR CAPSULE CHAMBER AND DIAPHRAGM.

P2 static air pressure pipe.
P1 total air pressure pipe.
Fuel delivery pressure pipe - fuel pump to a.t.l.
Fuel return pipe - a.t.l. to fuel pump.
Signal pressure pipe - b.f.c.u. spring housing to a.t.l. (via t.t.c.)

(4) Support the unit and remove the four waisted retaining bolts, spring washers and plain washers.

(5) Lift the unit away from its mounting location carefully to avoid loss of mounting bushes.

(6) Discard all O-seals from the pipes.

(7) Assemble blanks to all apertures and pipe ends.

(8) Withdraw the eight rubber bushes and four steel spacers from the a.t.l. securing bolt holes. Check the bushes for condition; if any are damaged, discard them.

B. Install automatic thrust limiter

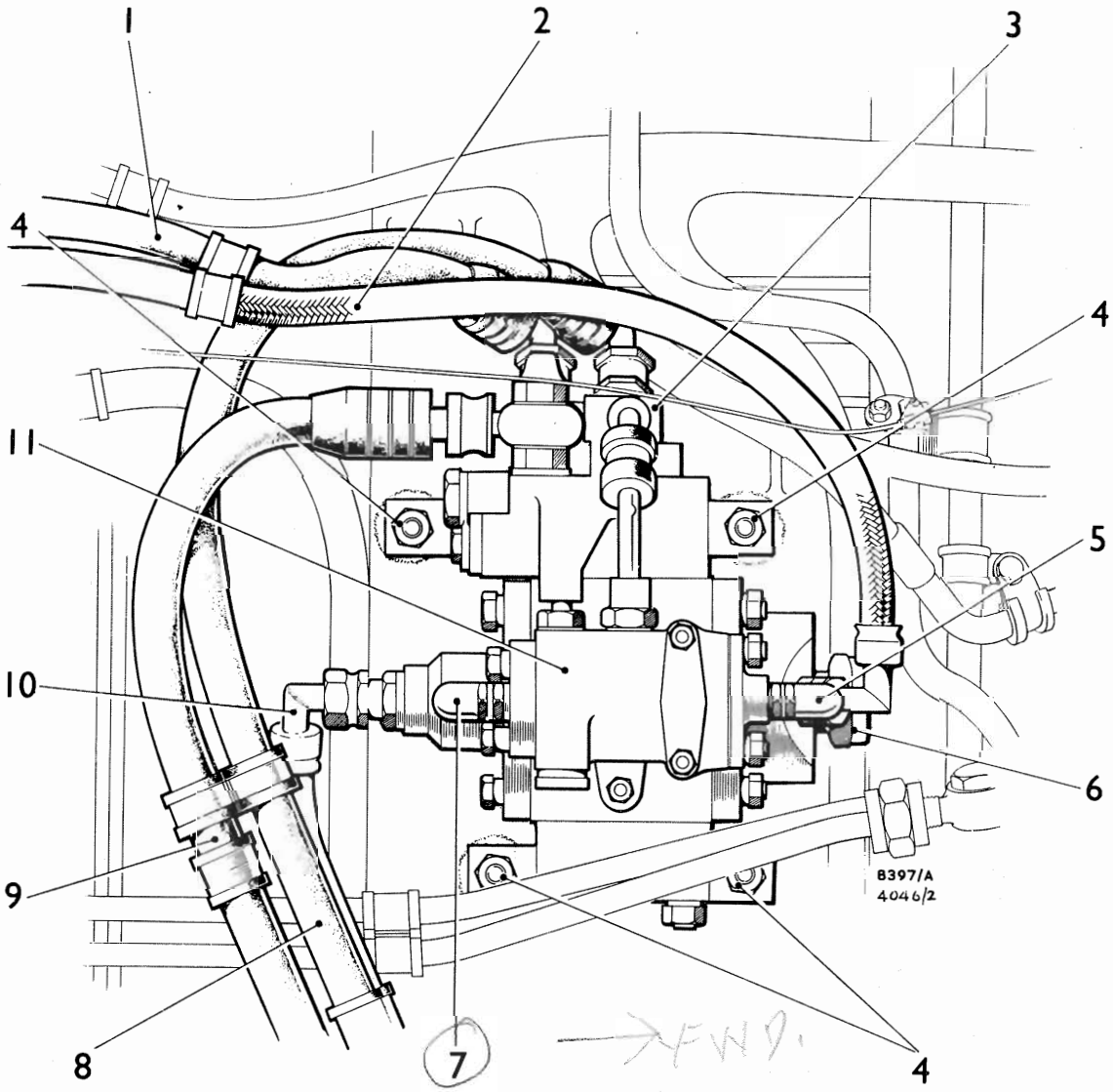
CAUTION: A PRE MOD.CV.7272 AUTOMATIC THRUST LIMITER MUST NOT BE INSTALLED WITH A POST MOD CV.7272 FUEL PUMP OR VICE-VERSA.

(1) Install eight serviceable rubber bushes and the four steel spacers in each end of the a.t.l. retaining bolt holes.

NOTE: Contact adhesive (Chapter 71, SERVICING MATERIALS) may be used to retain the rubber mounting bushes during assembly.

(2) Remove the blanks from the a.t.l. and its associated pipes.

CAUTION: DO NOT ALLOW FUEL OR OIL TO CONTAMINATE THE AIR CAPSULE CHAMBER AND DIAPHRAGM.



1. SIGNAL PRESSURE PIPE - B.F.C.U. SPRING HOUSING TO A.T.L. (VIA T.T.C.)
2. P2 STATIC AIR PRESSURE PIPE
3. SERVO AMPLIFIER SUB-UNIT
4. RETAINING BOLTS (4 OFF)
5. MAXIMUM FLOW STOP ADJUSTER) THESE ADJUSTERS ARE SET BY THE MANUFACTURER
6. BELLOWS TENSION ADJUSTER) AND MUST NOT BE TOUCHED
7. TRIMMING SPRING ADJUSTER
8. FUEL RETURN PIPE - A.T.L. TO FUEL PUMP
9. FUEL DELIVERY PRESSURE PIPE - FUEL PUMP TO A.T.L.
10. P1 TOTAL AIR PRESSURE PIPE - FUEL PUMP TO A.T.L.
11. AUTOMATIC THRUST LIMITER (A.T.L.)

Automatic thrust limiter details
Fig. 201

...Automatic thrust limiter - Maintenance practices continued

(3) Lubricate the waisted bolt threads with clean engine oil then install the spring washers and plain washers on the bolts.

(4) Insert the waisted bolts in the four unit bolt holes. Take care not to dislodge the rubber bushes.

(5) Position a special washer over the threads of each waisted bolt.

(6) Position the unit on the right-hand side of the blade shield unit and tighten the waisted bolts.

(7) Connect the following fuel and air pipes to the unit :-

Signal pressure pipe - b.f.c.u. spring housing to a.t.l. (via t.t.c.)
Fuel return pipe - a.t.l. to fuel pump.
Fuel delivery pressure pipe - fuel pump to a.t.l.
P1 total air pressure pipe.
P2 static air pressure pipe.

(8) Tighten and wire-lock all pipe connections.

(9) Bleed the fuel system. See Chapter 73, ENGINE FUEL AND CONTROL.

(10) Check a.t.l. setting (para. 2.A.).

2. Adjustment/Test

A. Check automatic thrust limiter setting

Equipment required :- Mercury in glass thermometer
Manometer
Slave vacuum air supply (incorporating a control valve)

(1) Record the ambient temperature.

(2) Record the ambient pressure as registered by the aircraft altimeter.

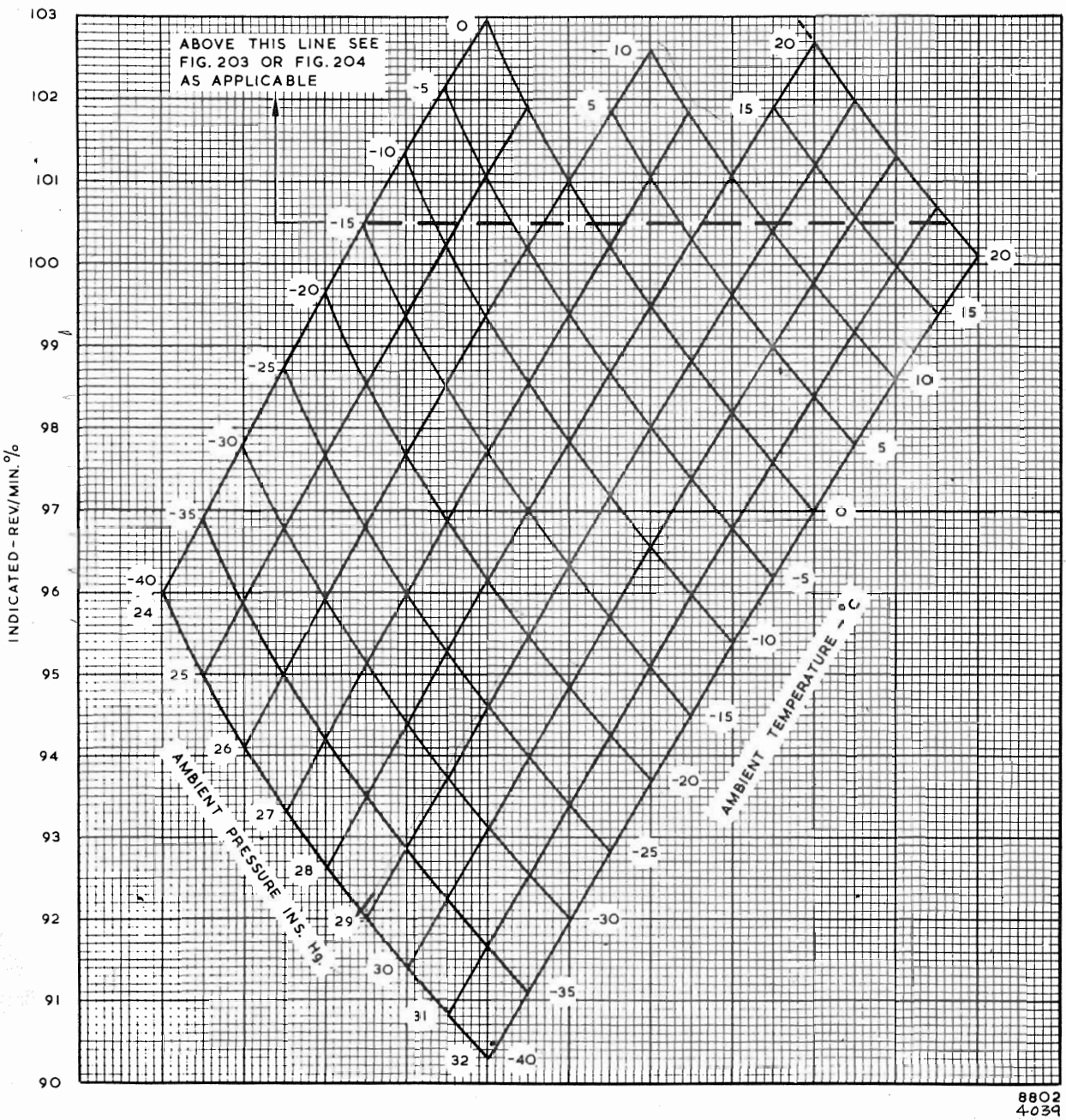
(a) Set the altimeter to zero altitude.

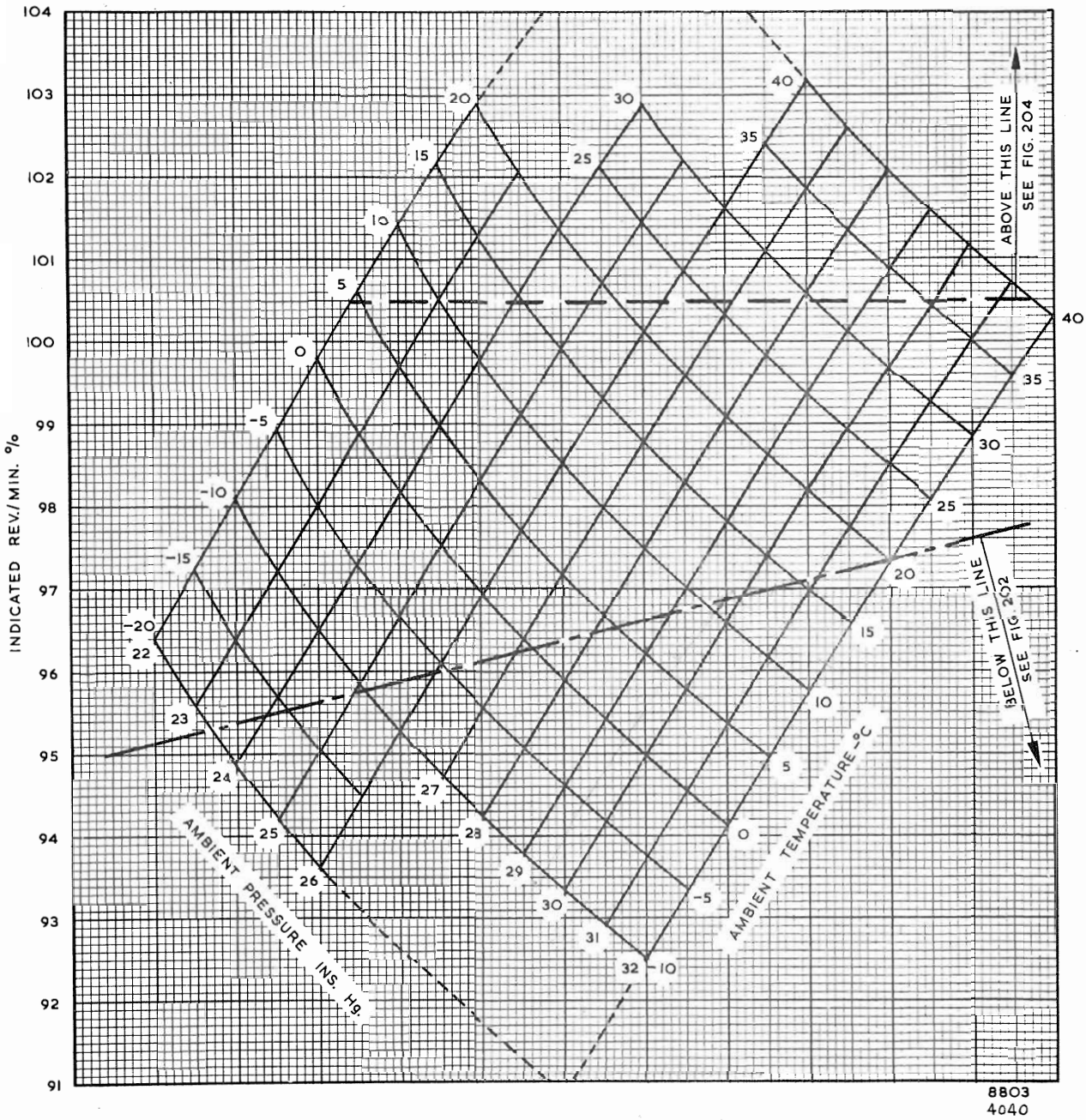
(b) Record the reading in millibars on the setting scale.

(c) Convert the ambient pressure recorded in millibars into ambient pressure in in.Hg. using the formula :-

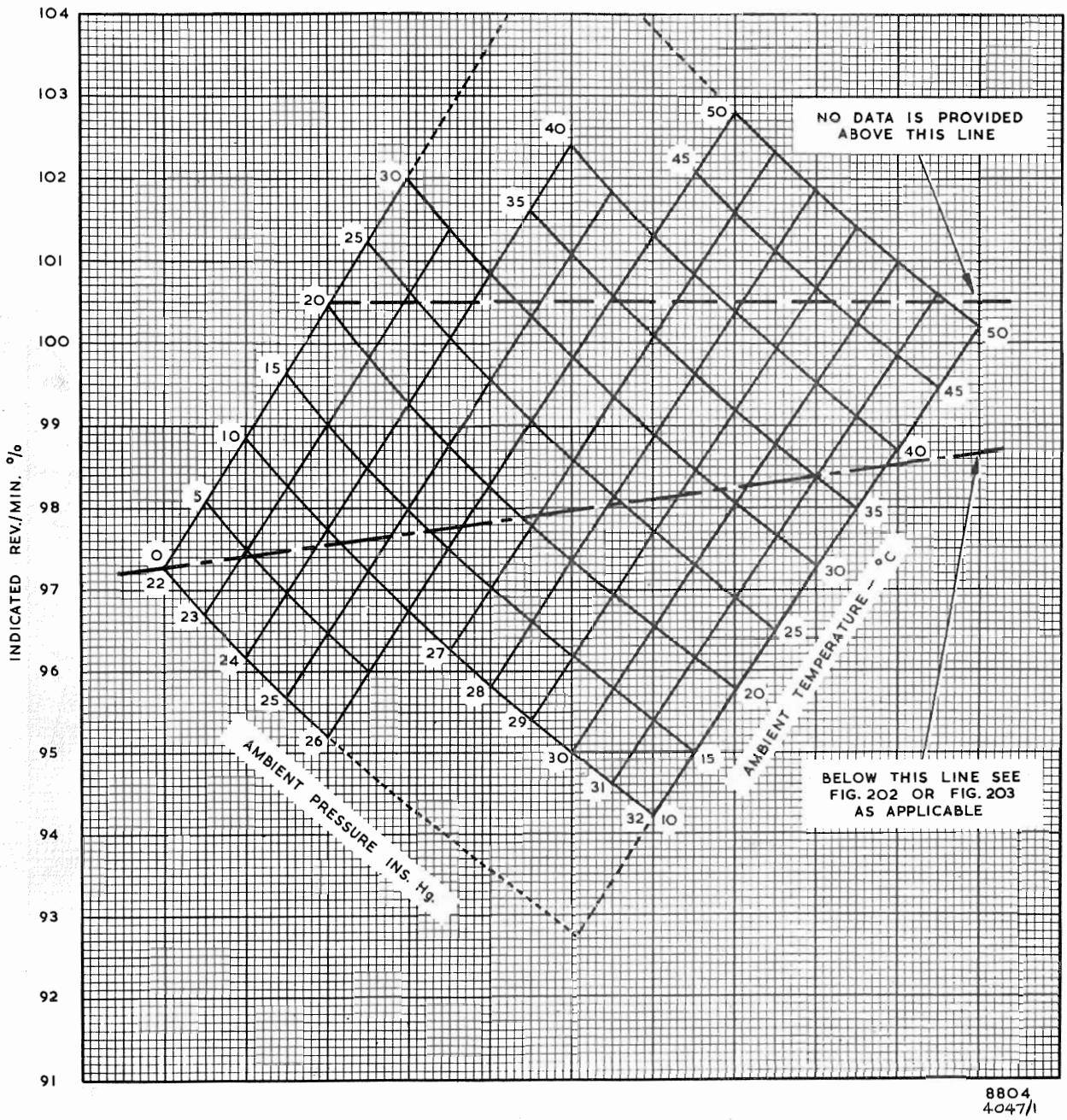
$$\text{ambient pressure in.Hg.} = \frac{\text{ambient pressure in millibars}}{33.86}$$

(3) Refer to the relevant graphs in Fig.202, 203 and 204, and ascertain which is required to check the a.t.l. setting.


ABOVE THIS LINE SEE FIG. 203 OR FIG. 204 AS APPLICABLE
INDICATED - REV/MIN. %
103
102
101
100
99
98
97
96
95
94
93
92
91
90
AMBIENT PRESSURE INS. Hg.
24
25
26
27
28
29
30
31
32
AMBIENT TEMPERATURE - °C
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
8802
4039



A.T.L. rev/min. setting curve - slave PI signal of minus 2 lb./sq. in. applied
Fig. 203



A.T.L. rev/min setting curve - slave PI signal of minus 3lb./sq. in. applied
Fig. 204

...Automatic thrust limiter - Maintenance practices continued

(4) If the ambient temperature and pressure is such that it necessitates the use of a graph in either Fig.203 or 204, connect the slave vacuum air supply.

(a) Gain access to the a.t.l. Remove the bottom front cowl, if installed.

(b) Disconnect the P1 total air pressure pipe from the a.t.l.

(c) Connect the slave vacuum air supply to the P1 connection.

(d) Reduce the ambient pressure by 2 lb/sq.in. if graph in Fig.203 is to be used, or by 3 lb/sq.in. if graph in Fig.204 is to be used.

(5) Refer to the relevant graph in either Fig.202, 203 or 204 and ascertain the rev/min at which the a.t.l. should control for the pre-determined ambient temperature and pressure.

(6) Ensure that the top temperature control system is selected to OFF.

CAUTION : OBSERVE TEMPERATURE AND TIME LIMITS WHEN RUNNING ENGINE.

(7) Adjust the fuel pump governor so that 103% rev/min can be obtained when running the engine.

(8) Select all air bleeds OFF and start the engine.

(9) Move the throttle lever to OPEN.

(10) Compare the controlling rev/min obtained from the graph to the actual rev/min of the engine.

(11) Adjust the a.t.l. trimming spring to cancel out any difference between the two figures.

NOTE : Turn anti-clockwise to increase the controlling rev/min and clockwise to decrease controlling rev/min. One turn alters the speed by approximately 1% rev/min.

(12) Decelerate to 60% rev/min and stop the engine.

(13) Move the throttle lever to CLOSED.

(14) If the slave vacuum air supply is connected, release the pressure and disconnect the equipment. Connect the P1 total air pressure pipe to the a.t.l.

(15) Reset the fuel pump governor. See Chapter 71 POWER PLANT GROUND RUNNING - ADJUSTMENTS.

(16) Re-install the bottom front cowl.

...Automatic thrust limiter - Maintenance practices continued

B. Isolate automatic thrust limiter

NOTE : This procedure may be required during tests on the top temperature control system and/or exhaust gas temperature indicating system.

(1) Disconnect P2 pipe from a.t.l. (Fig.201).

NOTE : Connect and wire-lock pipe on completion of ground test.

* * *

INDICATING - DESCRIPTION AND OPERATION

1. General

Indication is given, in the flight compartment, of fuel filter obstruction, low fuel pressure and fuel flow.

2. Fuel filter obstruction

A differential pressure switch serves a warning lamp in the flight compartment and also, when the fuel filter de-icing system is selected to auto, switches on the de-icing pump should the filter become obstructed with ice and the differential across the filter exceed 3.0 ± 0.3 lb/sq.in. The switch is mounted, Pre-mod. 25/1393, on a bracket on the side of the filter or, Mods. 25/1393 and 25/1744 on the detachable panel on the front underside of the rear cowl. Two flexible pipes convey pressure supplies from each side of the filter element to the switch. For details of the fuel filter de-icing system see Chapter 28.

3. Low fuel pressure

A low-pressure warning switch, mounted on the outlet elbow of the filter, serves a warning lamp in the flight compartment and activates the 'central attention getting' system, whenever the fuel pressure is at 3 ± 0.5 lb/sq.in. or below.

4. Fuel flow

Two types of fuel flow indicating system are available; the system having a transmitter attached to the engine is described in this chapter under its own subject number. The system which has no engine mounted transmitter is described in Chapter 28.

* * *

DIFFERENTIAL PRESSURE SWITCH - MAINTENANCE PRACTICES

1. Removal/Installation

NOTE: During removal or installation of the differential pressure switch avoid bending the thermocouple wires of the turbine overheat warning system. These wires should run directly aft from the thermocouple terminal block and then loop horizontally round (between the differential pressure switch and the zone 1 rear firewall) until the wires run forward. Avoid strain on these wires.

Equipment required:

Tension wrench T2EM1509BR

A. Remove differential pressure switch

(1) Gain access to the switch and place a tray beneath the engine.

(2) Move the LP FUEL COCK to OFF.

(3) Isolate electrical circuit to the differential pressure switch (see Chapter 24, GENERAL) then disconnect the electrical plug from the switch.

(4) Disconnect and remove the fuel feed pipes from the switch.

(5) Release the strap securing bolt and remove the switch. Blank all connections.

B. Install differential pressure switch

(1) Remove the blanks from the switch and its associated pipe connections.

(2) Lubricate the strap-securing bolt thread with clean engine oil, then locate the switch on the mounting bracket and engage the strap-securing bolt.

(3) Torque-load the bolt to 15 to 17 lbf.in. Wire-lock the bolt.

(4) Connect the fuel feed pipes to the switch; wire-lock the union nuts.

(5) Connect and wire-lock the electrical cable to the switch.

(6) Restore electrical supplies to the differential pressure switch.

(7) Bleed the fuel system (see Chapter 73, ENGINE FUEL CONTROL).

...Differential pressure switch - Maintenance practices continued

2. Adjustment/Test

A. Functionally test differential pressure switch

Equipment required:

Bleed tool for l.p. filter PE25368
Container for drainage
1/8 in. BSP blank (female) for filter adapter

(1) Check relevant LP FUEL COCK is selected OFF.

(2) Place a drip tray beneath the engine.

(3) Gain access to l.p. filter.

(4) Fit bleed tool on pipe, drain l.p. filter and then remove tool.

(5) At l.p. filter disconnect uppermost hose leading to differential pressure switch.

NOTE: Use spanner to prevent adapter rotating.

(6) Fit blank to l.p. filter.

(7) Select relevant LP FUEL COCK to ON.

(8) Energize PE busbar (see Chapter 24, GENERAL).

(9) Select FILTER AUTO/OFF/MANUAL switch to AUTO.

(10) Select appropriate booster PUMP switch to ON and observe FUEL LP warning lamp goes out and FILTER blocked warning lamp comes on.

NOTE: Filter blocked warning should occur almost immediately after l.p. warning ceases.

(11) Select booster PUMP and FILTER switches to OFF.

(12) Select LP FUEL COCK to OFF.

(13) Fit bleed tool on pipe and drain filter.

(14) Remove blank from l.p. filter, connect and wire-lock hose.

(15) Bleed the fuel system (see Chapter 73, ENGINE FUEL AND CONTROL).

* * *

LP WARNING SWITCH - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment:-

Tool for dismantling and assembling electrical plug adapter ... UM.12679

A. Remove fuel low-pressure warning switch

(1) Gain access to the engine and place a tray beneath the engine.

(2) Move the LP FUEL COCK to OFF.

(3) Isolate electrical power supply to the fuel low-pressure warning switch (see Chapter 24, GENERAL). Disconnect the electrical cable plug from the adapter on the switch.

(4) Pre-mod.252085 only :- Disconnect the fuel drain pipe from the switch.

(5) Support the switch and remove the pivot bolt securing the switch to the LP fuel filter outlet elbow. Lift the switch away from the fuel filter; discard the sealing washers.

(6) Applicable only if the switch is not to be re-installed — Remove the adapter from the switch electrical connection:

(a) Prise the peened rim of the locking washer away from the slots in the adapter.

(b) Unscrew the adapter with the dismantling and assembling tool, then withdraw the adapter, locking washer and locking ring; discard the locking washer.

(7) Blank all exposed connections.

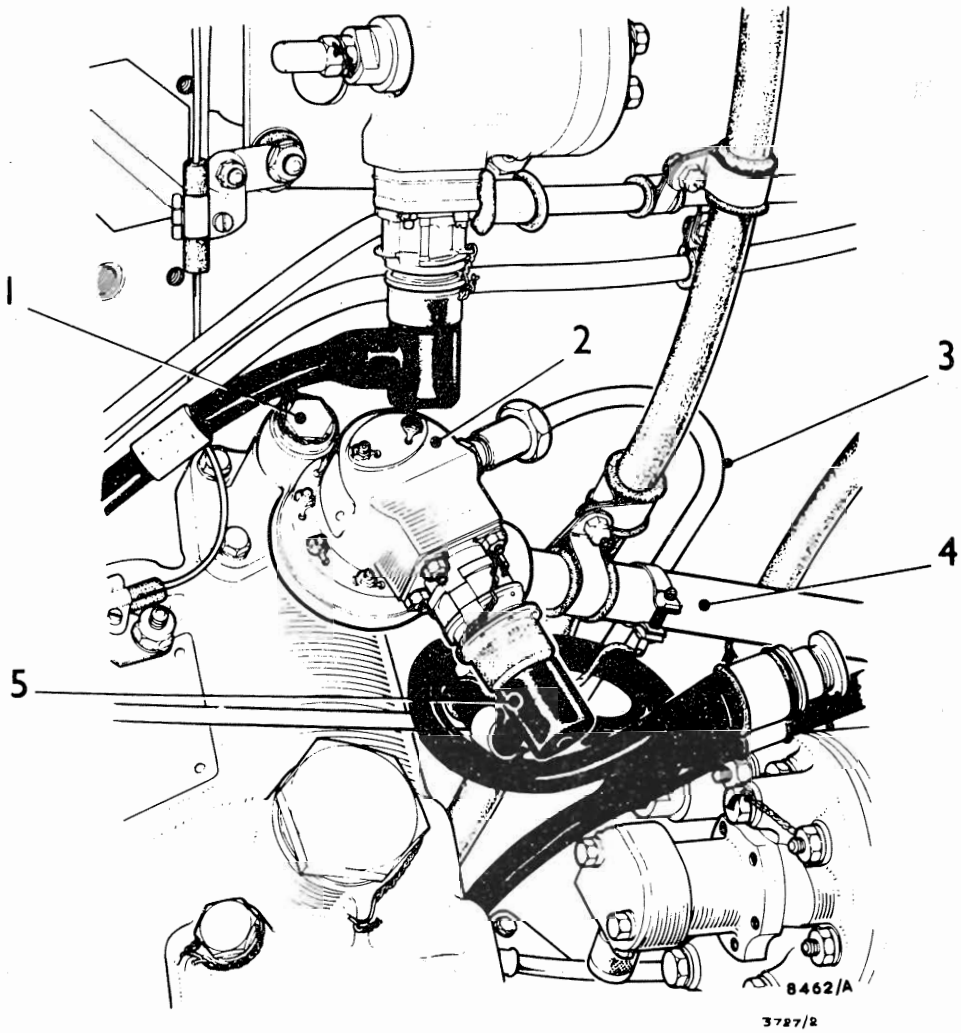
B. Install fuel low-pressure warning switch

(1) Remove all blanks.

(2) If a replacement switch is to be installed, assemble the adapter to the electrical connection:

(a) Locate the locking ring over the electrical plug body and position a new locking washer over the end of the ring, engaging the washer tabs in the ring slots.

(b) Screw in the adapter and tighten it with the dismantling and assembling tool.



1. PIVOT BOLT
2. L.P. WARNING SWITCH.
3. FUEL DRAIN PIPE (PRE-MOD 252085).
4. FUEL INLET PIPE (FILTER TO FUEL PUMP).
5. ELECTRICAL SERVICES PLUG.

L.P. warning switch details
Fig.201

...LP warning switch - Maintenance practices continued

(c) Reverse the tool and punch the rim of the locking washer into the slots in the adapter flange.

(3) Assemble the pivot bolt, together with two new sealing washers, to the switch banjo. Screw the pivot bolt into the fuel filter outlet elbow. Tighten and wire-lock the pivot bolt.

(4) Pre-mod.252085 only :- Connect the fuel drain pipe to the switch and wire-lock the union nut.

(5) Connect the electrical cable plug to the adapter on the switch and secure with lock wire.

(6) Restore electrical supplies to the fuel low-pressure warning switch.

(7) Bleed the fuel system. See Chapter 73 ENGINE FUEL CONTROL.

* * *

ENGINE FUEL FLOW INDICATING SYSTEM - DESCRIPTION AND OPERATION

1. General

This system comprises an engine mounted flowmeter, a frequency d.c. converter operating on a nominal 24 volts d.c., a d.c. supply filter and, mounted in the flight compartment, a fuel flow indicator.

A voltage impulse, relative to the actual fuel flow, is fed by the flowmeter to the converter. The converter provides a d.c. output which is fed to the indicator.

2. Flowmeter

The flowmeter consists of a free running six-bladed rotor assembly housed in a non-magnetic stainless steel body, and a magnet and coil assembly with a plug connection. The magnet and coil are mounted on one face of the body so that the magnetic field embraces the high permeability stainless steel blades of the rotor. When fuel flows through the body of the flowmeter the rotor is caused to rotate and each blade of the rotor cuts across the lines of flux of the magnet and coil assembly; the resultant flux changes create a series of voltage impulses within the coil.

3. Frequency d.c. converter

This unit comprises a printed circuit, mounted on three boards enclosed within a sealed container; a single six pin plug provides the input and output connections. Voltage impulses fed into the converter are converted to a d.c. output. The converter operates on a 22-29 volt d.c. supply taken from the aircraft supplies.

4. D.c. supply filter

The filter consists of a choke and two capacitors it is wired into the d.c. supply to the frequency d.c. converter, to prevent interference, producing incorrect readings on the flow indicator. The complete unit is fitted adjacent to the d.c. converter.

5. Fuel flow indicator

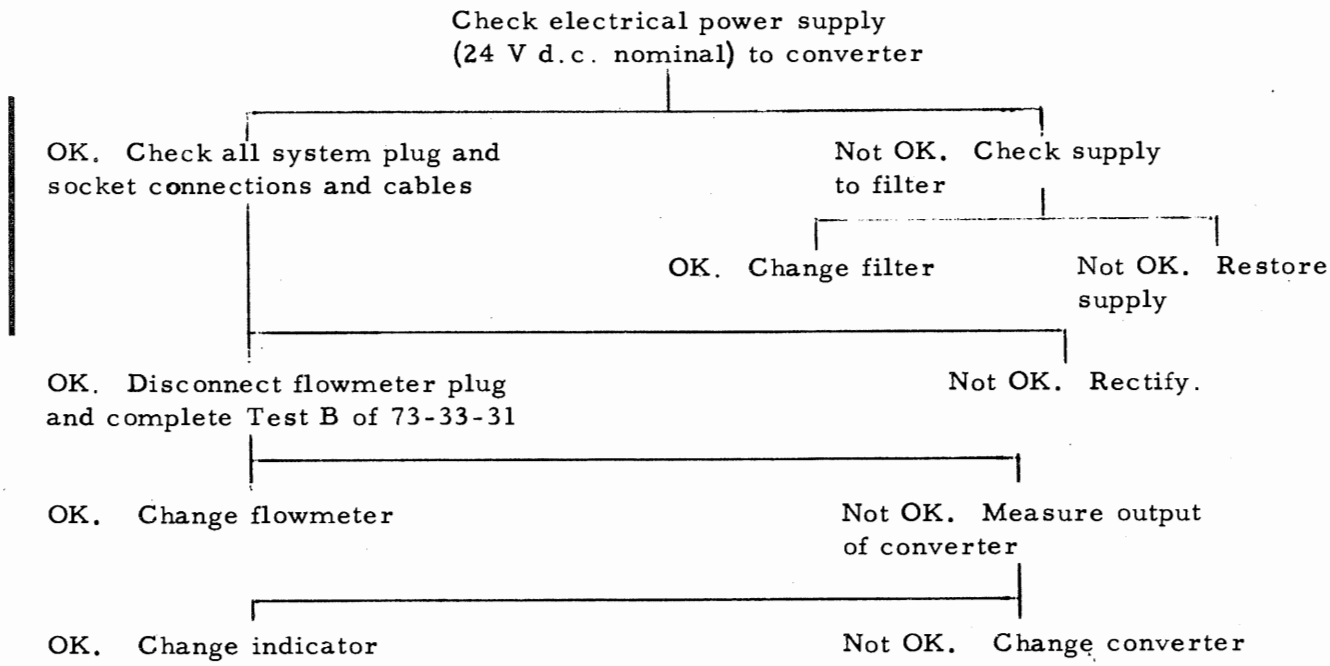
The indicator is a d.c. permanent magnet moving coil instrument with a dial calibrated in pounds per hour.

The indicator functions as a normal moving coil instrument; pointer deflection being proportional to the current flowing through the moving coil.

* * *

ENGINE FUEL FLOW INDICATING SYSTEM - TROUBLE SHOOTING

NO FLOW OR LOW FLOW INDICATED



* * *

FUEL FLOWMETER - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Test coil resistance

(1) Connect a resistance testing instrument across the two pins of the flowmeter output plug.

(2) Measure the coil resistance; it should be approximately 1100 ohms.

B. Test insulation resistance

(1) Connect a 250 volt insulation resistance tester between one pin of the flowmeter output plug and the case of the pick-up assembly.

(2) Measure the insulation resistance; it should be greater than 50 megohms.

* * *

FREQUENCY DC CONVERTER - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Test insulation resistance

(1) Connect a 250 volt insulation resistance tester between each pole of the plug and chassis in turn.

(2) Measure the insulation resistance; it should be greater than 40 megohms. in each instance.

B. Test calibration

(1) Connect an audio frequency signal generator to the converter.

NOTE : Connect via flowmeter cable plug.

(2) Inject a signal of 1111 ± 1 c/s 1 volt r.m.s.

(3) Switch on the d.c. input.

(4) Measure the current output; it should be 1 mA.

NOTE : If fuel flow indicator is used in lieu of potentiometer it should indicate a flow of 4000 lb/hr.

* * *

FUEL FLOWMETER SYSTEM (FOXBORO) - DESCRIPTION AND OPERATION

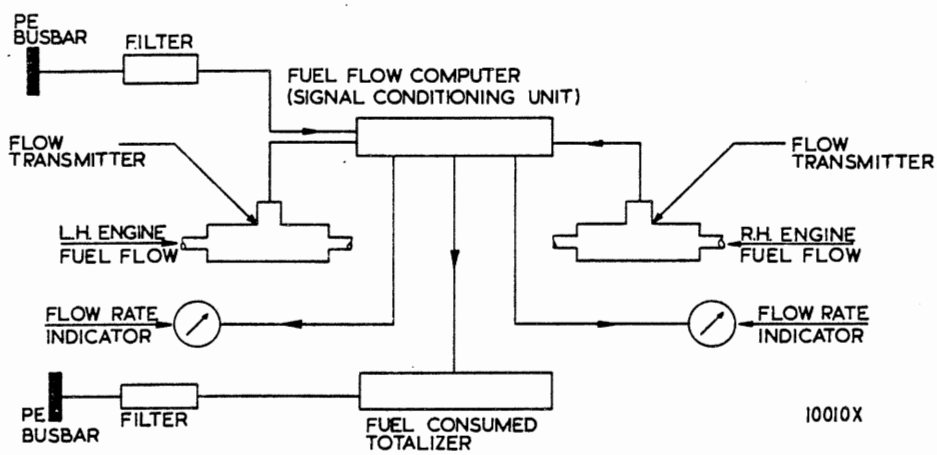
1. Description

The flowmeter system is based on a turbine transmitter whose output is proportional to volumetric flow. The output is converted into units of mass for flight compartment presentation by the assumption of a fixed specific gravity (sg) in the design of the indicating system (assumed s.g. 0.81). To correct the indicated reading of variations from this value of s.g. a density correction factor is required in accordance with the following formual:-

Mass indication (flow rate or fuel consumed) corrected for s.g.

$$= \frac{\text{actual s.g.}}{0.81} \times \text{indicated reading}$$

The system comprises a turbine flow transmitter in the high pressure fuel system on each engine, a computer (signal conditioning unit), and the flight compartment presentation consisting of a fuel flow rate indicator for each engine and a single indicator for total aircraft fuel consumed (Fig.1). The latter instrument can be reset to zero by an integral control.



Fuel flowmeter system - Diagrammatic
Fig.1

2. Operation

Fuel flowing through each flow transmitter rotates a turbine wheel at a speed proportional to the fuel velocity. The rotation of the turbine generates electrical pulses, which vary in frequency with turbine speed. These pulses

...Fuel flowmeter system (Foxboro) - Description and operation continued

are fed to the computer which conditions and converts them to an analog signal which drives a standard deflection type flow indicator showing flow rate lbs/hr. Simultaneously, the conditioned pulses within the computer from each flow transmitter are converted and transmitted to an electro-mechanical totalizer which registers the total amount of fuel consumed by both engines. The flow indicators and the totalizer are mounted on the pilots' centre instrument panel. Calibration, of the system on component replacement is not required.

3. Electrical supplies (Fig.1)

The totalizer and computer have their own independent 28V d.c. power supply. Each supply is taken from PE busbar and controlled by its own circuit breaker and routed through a filter to the component. The filter consists of a choke and two capacitors wired into the d.c. supply to reduce the effect of d.c. fluctuations producing incorrect presentations.

* * *

FUEL FLOWMETER SYSTEM (FOXBORO) - TROUBLE SHOOTING

1. General

The following table provides aid to pinpoint faulty system components and the corrective action to be taken. Before proceeding satisfy the following points first :-

(a) Check that the relevant circuit breakers on panel DA, sub panel D, are set.

(b) Check the power supplies from PE busbar to computer and totalizer. It should be 28V d.c; check computer at pin E, totalizer at pin P, plug and socket CC-2, which is situated on left side of front pressure bulkhead in front of left main instrument panel. Change appropriate filter on panel GG if necessary.

(c) Make continuity checks on system wiring.

(d) Verify earth connections; totalizer-terminal CN-3L left hand instrument panel through pin S of plug and socket CC-2, totalizer power supply filter AK - terminal D3 earth point No.6, computer and computer power supply filter AJ - combined to terminal C3 earth point No.6.

Table 101 overleaf

...Fuel flowmeter system (Foxboro) - Trouble shooting continued

FAULT	PROBABLE CAUSE	REMEDY
Erratic flow rate indications	Input wiring from transmitters to computer shorting between wire core and shields; or incorrect connections.	Trace and rectify.
	Defective flow transmitter turbine bearings.	Renew flow transmitter (see 73-34-11).
No flow rate indication from one or both indicators - totalizer indication normal	Defective flow rate indicator(s)	Test indicator(s) as detailed in 73-34-31. IF OK renew computer (see 73-34-21).
Totalizer not indicating, flow rate. Indicators reading normally.	Defective totalizer	Test totalizer (see 73-34-31). If not OK on test - renew totalizer. If OK - renew computer (see 73-34-21).
No flow rate or totalizer indications	Defective computer	Renew (see 73-34-21).
	Foreign matter preventing flow rate transmitter turbines rotating	Remove and flush flow transmitters (see 73-34-11). Renew transmitters if the requirements of 73-34-11 para. B are not met.
Flow indication - electrical power on but engines not running	Defective earth - computer	Check and remake connection
	Strong ac interference	Trace and isolate interference and/or re-route or install cable(s) through a conduit.

Table 101

* * *

FUEL FLOWMETER SYSTEM (FOXBORO) - MAINTENANCE PRACTICES

1. General

For more detailed servicing and testing of the system, which is not covered in this chapter, refer to the FOXBORO INSTRUCTION MANUAL, SC10-0119.

* * *

TURBINE FLOW TRANSMITTER (FOXBORO) - MAINTENANCE PRACTICES

1. Removal/Installation

Material required :-

Isopropyl alcohol - A/R

A. Remove turbine flow transmitter

(1) Isolate relevant electrical circuit (see Chapter 24, GENERAL).

(2) Place a drip tray beneath the engine and lower the hinged side cowlings.

(3) Disconnect electrical plug at top of transmitter and temporarily tape aperture on transmitter for protection.

(4) Using a suitable spanner, restrain the transmitter hexagon body and disconnect the connecting fuel pipes; remove transmitter.

(5) Blank off open ends of fuel pipes.

B. Checks/Tests before installation

(1) Inspect transmitter for damage and ingress of foreign matter.

(2) If ingress of foreign matter is suspected, flush transmitter with isopropyl alcohol ensuring that no liquid enters electric plug and coil assembly.

(3) CAUTION : DO NOT USE AIR HOSE TO SPIN TURBINE ROTOR. EXCESSIVE PRESSURE WILL DAMAGE TRANSMITTER.

Blow lightly into the transmitter inlet end and observe that rotor spins freely and continues spinning freely for several seconds.

C. Install turbine flow transmitter

(1) Remove blanks from fuel pipes.

(2) Position transmitter with arrow on body pointing in direction of flow and engage pipe union nuts; screw as tight as possible with fingers.

(3) Using a spanner, restrain transmitter hexagon body and tighten pipe union nuts.

(4) Remove tape from transmitter electrical connection and fit electrical plug.

(5) Restore electrical circuits (see Chapter 24, GENERAL).

(6) Start the engine (see Chapter 71, POWER PLANT).

...Turbine flow transmitter (Foxboro) - Maintenance practices continued

(7) Check for leaks at disturbed pipe joints and rectify as necessary. Check that relevant flow indicator is operating.

* * *

FLOWMETER SYSTEM (FOXBORO) COMPUTER - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove computer

(1) Isolate relevant electrical circuits (see Chapter 24, GENERAL).

(2) Locate panel GG in rear equipment bay, forward of access door. On panel GG, identify computer marked SIGNAL CONDITIONING UNIT and disconnect electrical connectors.

(3) Remove four stiffnuts securing computer to mounting bracket and remove computer.

(4) Blank off connector apertures on computer.

B. Install computer

(1) Remove connector blanks (2 off).

(2) Position computer on mounting bracket, with securing studs through attachment holes, fit and tighten stiffnuts to secure.

(3) Fit electrical connectors.

(4) Ensure totalizer is set to zero; start engines (see Chapter 71, POWER PLANT).

(5) Check flow rate indicators and totalizer for functioning. Shut down engines when satisfied.

* * *

FLOW RATE INDICATORS AND TOTALIZER (FOXBORO) - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Test flow rate indicator

Equipment required :-

1.5 volt battery
3K ohm resistor

(1) Release centre instrument panel (see Chapter 31, INSTRUMENT PANELS).

(2) Disconnect flow rate electrical connector at rear of instrument.

(3) Connect battery in series with resistor and connect positive side to pin A, negative to pin B of flow rate indicator.

(4) Check that flow rate pointer indicates in upper half of scale. If not, renew faulty indicator.

(5) Remove battery and resistor and refit electrical connector.

(6) Refit centre instrument panel.

B. Test totalizer

Equipment required :-

A 28v d.c. power source and 3 test leads one positive, two negative

(1) Release centre instrument panel (see Chapter 31 INSTRUMENT PANELS) and support in a position to provide access to electrical connections on front pressure bulkhead.

(2) Disconnect plug and socket CC-2, ensuring that there is sufficient slack cable for manoeuvrability and positive pin identification; disconnecting CC-1 plug and socket will provide more free cable.

(3) Temporarily secure plug CC-2 with pins facing rearward for test purposes.

(4) Connect positive test lead to 28v d.c. power supply and pin P on CC-2.

(5) Using a convenient earth point, connect one earth lead to it and CC-2 pin S.

(6) CAUTION : DO NOT ALLOW LEAD TO REMAIN IN CONTACT WITH PIN d FOR LONGER THAN A FRACTION OF A SECOND OTHERWISE DAMAGE TO THE INSTRUMENT MAY RESULT.

Connect one end of remaining lead to earth point and hold other end clear of plug CC-2; momentarily touch pin d with lead end and remove

in rapid succession and check that totalizer registers at each application. If not, renew faulty totalizer.

(7) Disconnect 28v power supply lead at power source and disconnect test leads from plug and earth point.

(8) Release CC-2 plug from temporary secured position and refit to its socket. Refit plug CC-1 if disconnected.

(9) Refit centre instrument panel.

* * *

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Chapter 75

AIR

TABLE OF CONTENTS

* No separate description
\+ No separate maintenance practices

* * *

AIR - GENERAL

1. Description and operation

A. General

Air is bled from various stages of the compressor (Fig. 1 overleaf) to provide a supply for the aircraft services; to anti-ice the engine and nose cowl, to cool the turbine wheel and pressurize engine seals and, also, to operate the compressor control system. The air used to cool and pressurize the internal engine components is bled continuously whenever the engine is running; all remaining air bleeds are used intermittently as required.

B. Aircraft services

Air for the aircraft air conditioning and pressurization systems (Chapter 21) is tapped from the final stage of the compressor and taken, via an elbow, from the left side of the engine centre-section casing. Handed aircraft ducting conducts the airflow to a duct in the inboard side of the pod fillet.

C. Engine anti-icing and compressor and control systems

These systems are described separately, later in this chapter.

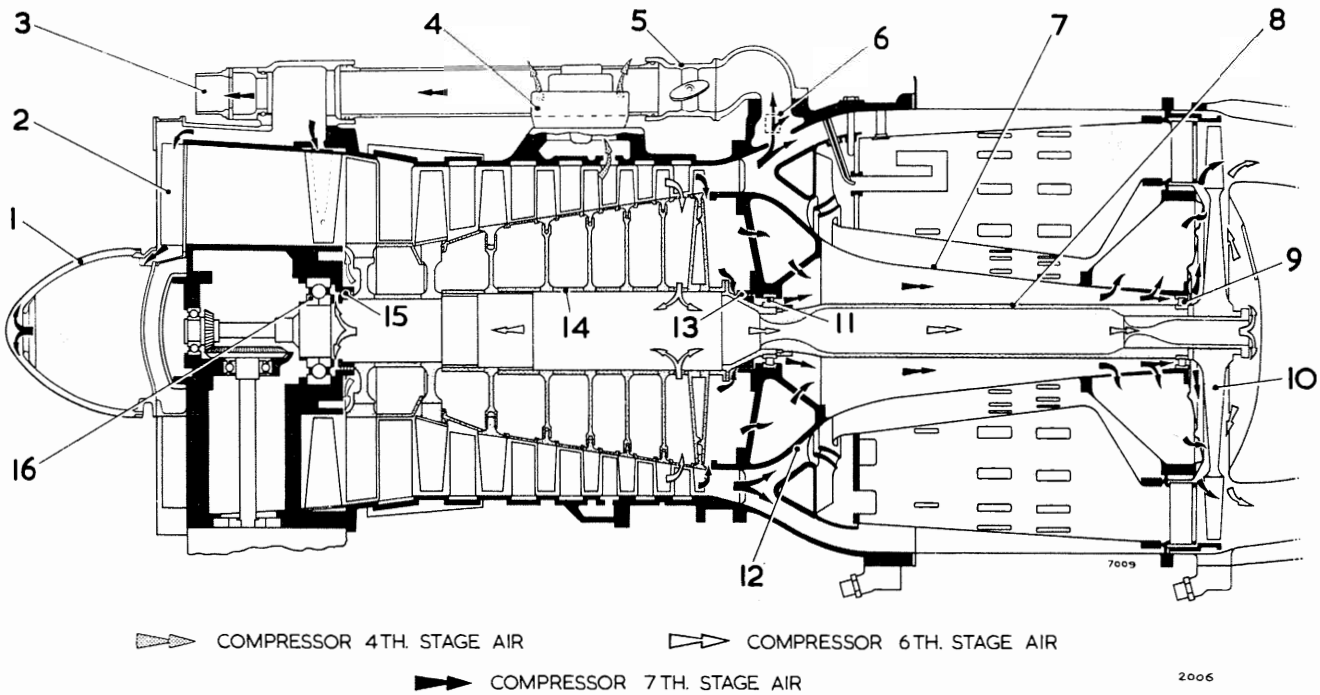
D. Seal pressurization and turbine cooling

Air is tapped from the sixth and seventh stages of the compressor.

Air bled from the sixth stage is fed into the bore of the compressor shaft, where the supply divides into the fore and aft flows. The forward flow pressurizes the labyrinth seal of the front bearing and prevents oil entering the compressor from the bearing. Air escaping from the seal re-enters the compressor via the roots of the zero-stage compressor blades. The rearward flow of sixth stage air passes through the bore of the turbine mainshaft, radiates outward to cool the rear face of the turbine wheel and, finally, is discharged into the exhaust gas stream.

The seventh-stage bleed air flows radially inward over the rear of the compressor rotor pressurizing the labyrinth seal of the centre main bearing. Part of the air flow passes through the bearing, scavenging oil en route, and into the centre-section extension. The remainder of the seventh-stage bleed also flows into the interior of the centre-section extension, but it by-passes the bearing by flowing rearward through ports in the centre-section casing. The entire, re-united, seventh-stage bleed then flows rearward through the centre-section extension, cooling the area enclosed by the combustion chamber. A proportion of the air passes through the rear bearing, cooling the bearing and scavenging oil from it; the remainder flows into the space forward of the diaphragm and discharges through holes in the periphery of the diaphragm. Air leaving the rear bearing flows radially outward, cooling the front face of the turbine wheel and finally discharges into the exhaust gas stream.

...Air - General continued



1. Nose bullet
2. Air intake support vane extension.
3. Air supply to nose cowl.
4. Compressor air bleed valve.
5. Anti-icing butterfly valve.
6. Air supply to aircraft services (on left side of engine only).
7. Centre section extension.
8. Turbine mainshaft
9. Rear main bearing.
10. Turbine wheel.
11. Centre main bearing.
12. Centre section.
13. Centre main bearing labyrinth seal.
14. Compressor rotor.
15. Front main bearing labyrinth seal.
16. Front main bearing.

Engine air bleeds
Fig.1

* * *

PIPES AND DUCTS - MAINTENANCE PRACTICES

1. General

For general procedures for installing pipes, see Chapter 71 Pipes - General.

2. Removal/Installation

A. Remove P1 pressure pipe

(1) Gain access to the engine.

(2) Disconnect the bonding cable from the P1 pressure pipe.

(3) Slacken the P1 pressure pipes (air intake casing pitot to float chamber and float chamber to b.f.c.u.) at all four union nuts.

(4) Release the pipe support clip secured to the tachometer/synchronizer a.c. generator (alternator) retaining bolt.

(5) Disconnect the union nuts from the air intake casing pitot and the b.f.c.u. then lift the assembly away from the engine.

(6) Disconnect the pipes from the float chamber. Discard the O-seals.

(7) Blank all apertures.

B. Install P1 pressure pipe

(1) Lubricate (see Chapter 71 - SERVICING MATERIALS) and install new O-seals on the P1 pressure pipes.

(2) Remove the blanks from the air intake casing pitot and the b.f.c.u. connection.

(3) Connect the P1 pressure pipes to the air intake casing pitot and b.f.c.u. and tighten the union nuts as far as possible by hand.

(4) Install the float chamber between the P1 pipes and screw the union nuts on as far as possible by hand.

(5) Tighten and wire-lock the union nuts.

(6) Secure the P1 pipe support clip to the tachometer/synchronizer a.c. generator (alternator) retaining bolt.

(7) Connect bonding cable to the P1 pressure pipe.

* * *

ENGINE ANTI-ICING - DESCRIPTION AND OPERATION

1. Description

Anti-icing is confined to the air inlet of the compressor, and the nose cowl (Fig.1). Air, bled from the final stage of the compressor, is fed into the system via an electrically actuated butterfly valve assembly.

The reversible actuator of the butterfly valve assembly incorporates two limit switches which change-over when the actuator has moved the valve to the fully open and fully closed positions respectively.

A selector switch and a valve position indicator are fitted in the flight compartment.

2. Operation

Control of the system is provided by a three position OFF/ON/ABOVE 92% selector switch in the flight compartment. When switched OFF, the reversible actuator drives the butterfly valve to the fully closed position. When switched ON, the actuator motor drives the valve to the fully open position. The ABOVE 92% position is used to ensure positive closure of the compressor air bleed valve at altitudes above 15000 ft. when the engine speed is above 92% rev/min. (see COMPRESSOR CONTROL).

3. Distribution of anti-icing airflow

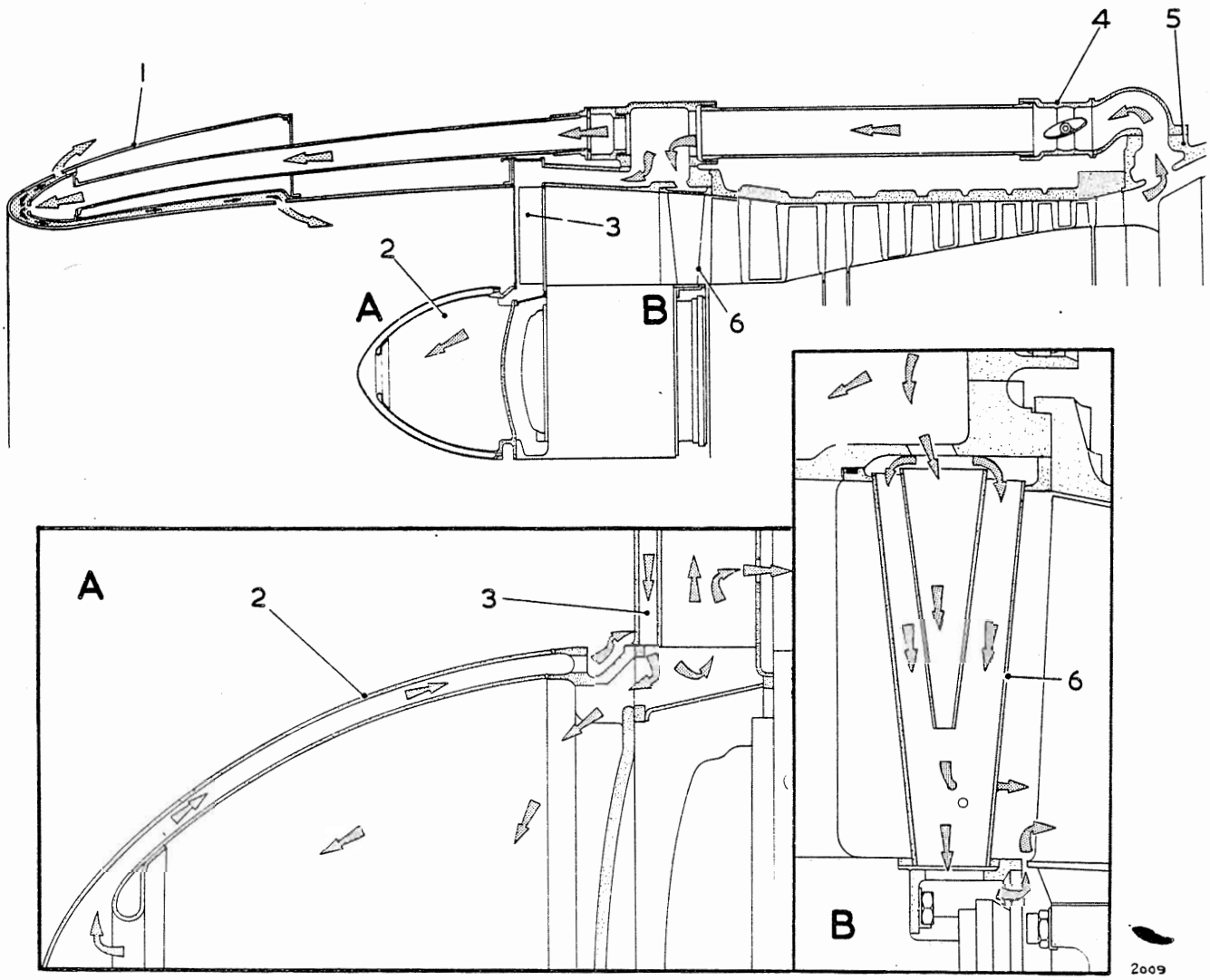
Hot air is tapped from the engine centre-section casing and fed through the butterfly valve and ducting to an elbow on the air intake casing. An adapter sleeve on the front of the elbow receives a branch duct which diverts a portion of the airflow to anti-ice the nose cowl.

Anti-icing air entering the intake casing circulates around the casing, flows through the compressor entry guide blades, the leading edges of the three casing support vanes and the nose bullet and, finally, exhausts into the compressor through holes in the entry guide blades and casing support vanes, and louvres at the rear of the bullet.

The anti-icing air which passes into the nose cowl flows through a manifold, inside the nose cowl, into the double-skinned lip and intake ducting of the nose cowl; the air disperses, some to atmosphere through holes in the outer periphery of the lip and the remainder into the engine air intake, through holes at the rear of the double-skinned section of the intake ducting.

Fig. 1 overleaf

...Engine anti-icing - Description and operation continued



1. Nose cowl.
2. Nose bullet.
3. Air intake support vane extension.
4. Anti-icing butterfly valve.
5. Engine centre section casing.
6. Compressor entry guide blade.

Airflow through engine anti-icing system
Fig.1

ENGINE ANTI-ICING - MAINTENANCE PRACTICES

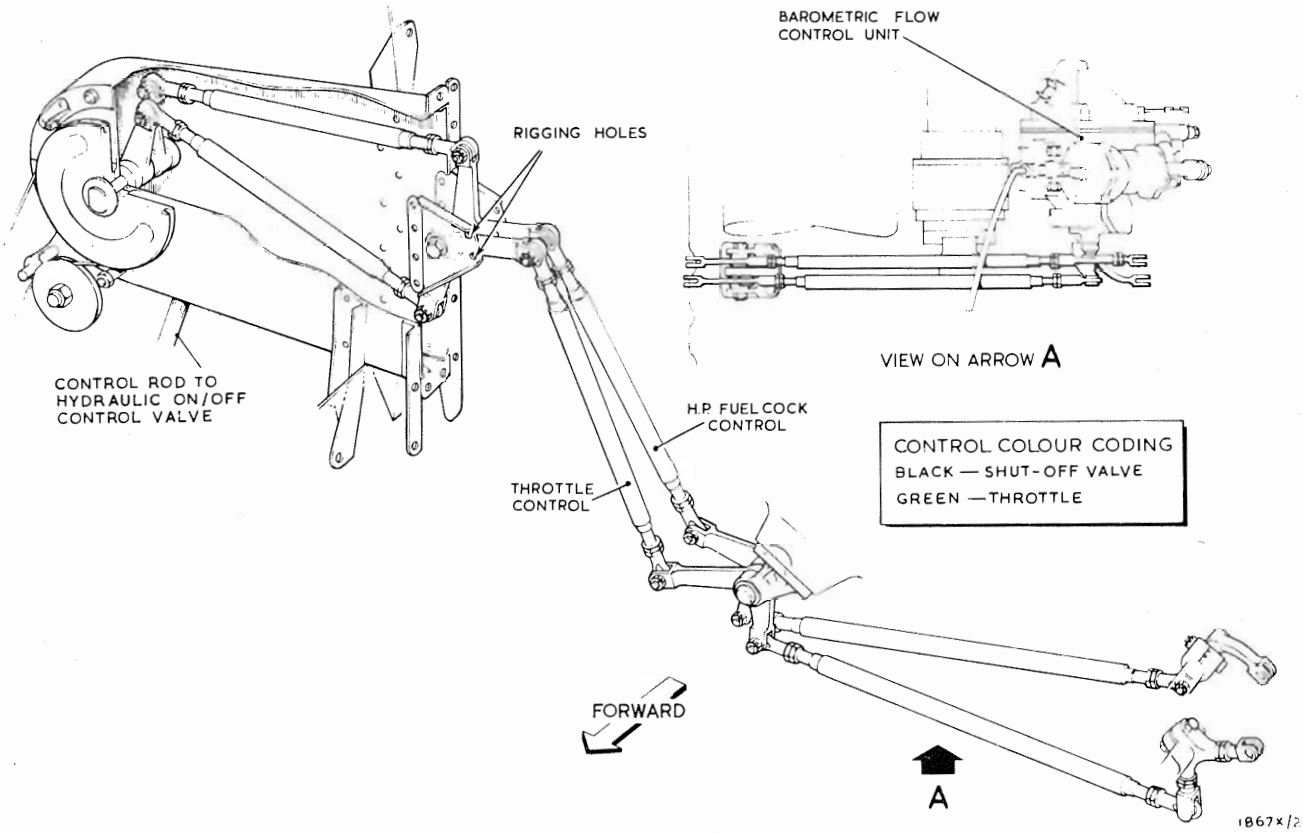
1. Adjustment/Test

A. Functionally test engine anti-icing system

See POWER PLANT ADJUSTMENT/TEST GROUND RUNNING TESTS.

* * *

...Throttle and high-pressure fuel valve control continued



Power control - left-hand engine
Fig.2

* * *

POWER CONTROL - MAINTENANCE PRACTICES

DUPLICATE INSPECTION

WHENEVER ANY PART OF THIS SYSTEM IS DISMANTLED, ADJUSTED, REPAIRED OR RENEWED, DETAILED INVESTIGATION MUST BE MADE ON COMPLETION TO ENSURE THAT DISTORTION, TOOLS, RAG OR ANY OTHER LOOSE ARTICLES OR FOREIGN MATTER SUCH AS COULD IMPEDE THE FREE MOVEMENT AND SAFE OPERATION OF THE SYSTEM ARE NOT PRESENT AND THAT THE SYSTEM AND INSTALLATION IN THE WORK AREA ARE CLEAN.

WHENEVER ANY PART OF EITHER THE MAIN OR ANY ASSOCIATED SYSTEM IS DISMANTLED ADJUSTED, REPAIRED,OR RENEWED, THAT PART OF THE SYSTEM WHICH HAS BEEN DISTURBED SHALL BE SUBJECTED TO A DUPLICATE INSPECTION FOR SECURITY OF LOCKING DEVICES, FULL AND FREE MOVEMENT, DIRECTION AND TENSION CHECKS AND FOR AIRCRAFT ON THE BRITISH REGISTER THE COMPLETION OF THIS WORK SHALL BE CERTIFIED IN ACCORDANCE WITH BRITISH CIVIL AIRWORTHINESS REQUIREMENTS SECTION A, CHAPTER A5-3.

1. Adjustment/Test

Special tools and equipments :-

Rigging Pin 25Y493A
Tensiometer

A. Rig throttle control before engine is installed

(1) Set throttle control lever stops to protrude 0.12 in.

(2) Insert rigging pin through operating bell-crank lever and mounting bracket.

NOTE : Throttle rigging hole in mounting bracket is the top hole for the right hand engine and the bottom hole for the left hand engine.

(3) Set connecting rod between cable drum and bell-crank lever to 7.88 in. pin centre length. Fit connecting rod.

(4) Rig control cables to bring control lever onto its CLOSED stop. Evenly tension control cables to 25-30 lb.

(5) Check even tension of control cables by carefully removing rigging pin at bell-crank lever. Ensure bell-crank lever does not move.

...Power control - Maintenance practices continued

(6) Check all adjusters for safety and lock.

(7) Check throttle control for full and free movement. Check adjustment of airbrak and main landing gear warning horn microswitches (see Chapters 27 and 32).

B. Rig high-pressure fuel cock control before engine installed

Special tools and equipment :-

Rigging pin 25Y493A
Tensiometer

(1) Set high-pressure fuel cock control lever to OFF position.

(2) Insert rigging pin through operating bell-crank lever and mounting bracket.

NOTE : High-pressure fuel cock control rigging hole is the bottom hole for the right-hand engine and the top hole for the left-hand engine.

(3) Set connecting rod between cable drum and bell-crank lever to 8.84.in. pin centre length. Fit connecting rod.

(4) Evenly tension control cables to 25-30 lb.

(5) Check even tension of control by carefully removing and inserting rigging pin at bell-crank lever. Ensure bell-crank lever does not move.

(6) Remove rigging pin.

(7) Check all adjusters for safety and lock.

(8) Check high-pressure fuel cock control for full and free movement.

C. Rig throttle control after engine installed

(1) Check throttle control is rigged as described in para. 1.A.

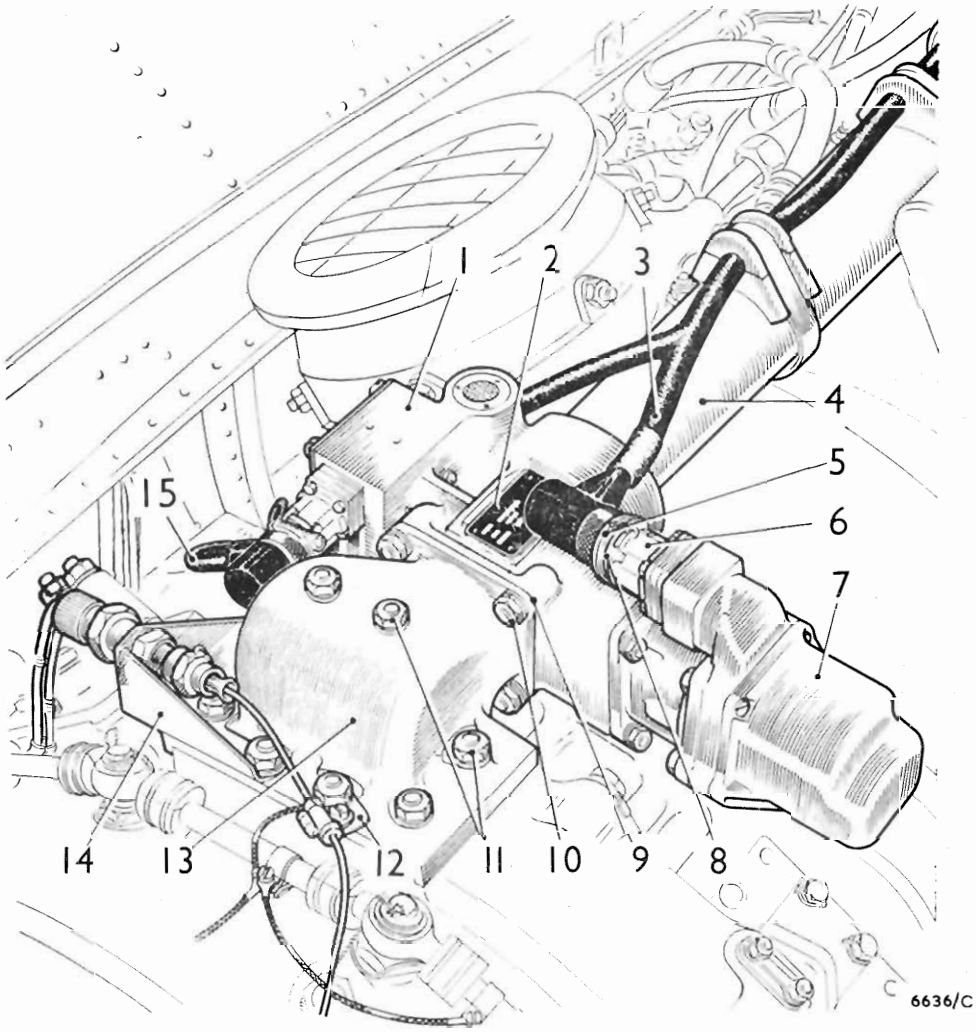
(2) Insert rigging pin through operating bell-crank lever and mounting bracket (see Note in para. 1.A, operation (3)).

(3) Left-hand engine only - Set horizontal connecting rod, passing beneath engine, to 18.35in. pin centre length. Fit connecting rod.

(4) Fit and adjust vertical connecting rod so that engine control lever contacts its closed stop.

(5) Remove rigging pin inserted at operation (2).

(6) Set OPEN and CLOSED stops at throttle control lever to give 0.062in. spring on the lever when engine control levers contact their stops.



1. VALVE PRESSURE SWITCH
2. BUTTERFLY VALVE
3. ACTUATOR ELECTRICAL CABLE
4. TRANSFER DUCT
5. ADAPTER
6. LOCKING RING
7. ACTUATOR
8. LOCKING WASHER
9. SEALING WASHER
10. RETAINING BOLTS, PLAIN AND SPRING WASHERS
11. OUTLET ELBOW RETAINING NUTS
12. FIREWIRE SUPPORT CLIP
13. OUTLET ELBOW
14. FIREWIRE SUPPORT BRACKET
15. SWITCH ELECTRICAL CABLE

Butterfly valve
Fig.201

...Butterfly valve assembly - Maintenance practices continued

(2) Isolate the engine anti-icing electrical circuit (see Chapter 24, GENERAL).

(3) Gain access to the engine.

(4) Disconnect the electrical cable from the actuator (Fig.201).

(5) Remove the retaining nuts, spring and plain washers from the valve attachment studs. Withdraw the actuator.

(6) Only applicable if the actuator is not to be re-installed - Remove the adapter from the electrical plug (see para.1E).

D. Install butterfly valve actuator

Special tools and equipment:

Key for turning valve drive shaft PE.4727

(1) Examine the actuator for damage, distortion, corrosion and security of locking devices.

(2) Connect a nominal 24-volt d.c. supply across the A and C pins of the actuator connector plug. Connect the positive lead to pin C and the negative to pin A. Run the actuator to its limit of travel. Disconnect leads.

(3) Move the butterfly valve plate to the fully closed position by rotating the drive shaft with the tool kit key.

NOTE: As a result of items (2) and (3) the actuator output quill and valve drive will be in approximately correct relationship to each other and it should be possible to engage them so that the quill meshes correctly with the spline on the valve shaft.

(4) Offer the actuator to butterfly valve engaging the actuator quill with the valve shaft, and locating the actuator over the valve studs.

(5) Secure the actuator with plain washers, spring washers and retaining nuts. Fully tighten nuts.

(6) Only applicable if a replacement actuator is being installed - Assemble the adapter to the electrical plug (see para.1.F.).

(7) Connect, tighten and wire-lock the electrical cable connector to the actuator.

(8) Restore the engine anti-icing system electrical supplies (see Chapter 24, GENERAL).

(9) Complete Test E of POWER PLANT GROUND RUNNING TESTS Chapter 71.

BUTTERFLY VALVE ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove butterfly valve assembly

(1) Check that the valve is in the fully closed position (selector switch OFF; indicator displaying SHUT).

(2) Isolate the engine anti-icing electrical circuit (see Chapter 24, GENERAL).

(3) Gain access to the engine.

(4) Disconnect the electrical cables from the valve pressure switch and actuator (Fig.201).

(5) Release the two rearmost nuts and bolts securing the actuator to the valve. This will permit the subsequent removal of the sealing washer between the valve and support bracket. Do not remove the bolts completely.

(6) Remove the retaining nuts, spring washers, plain washers and bonding cable tag securing the outlet elbow to the centre-section casing. Detach the Firewire support clip and the terminal support bracket from the securing studs.

(7) Remove the retaining nuts, spring washers and plain washers securing the valve to the outlet elbow.

(8) Support the valve and withdraw the retaining bolts. Lift the outlet elbow, together with the sealing washer interposed between the valve and support bracket, away from the centre-section casing. Discard the sealing washer.

(9) Withdraw the valve rearward until it disengages the air duct and lift the valve (complete with its actuator) away from the engine. Remove and discard the O-seal from the duct.

(10) Only applicable if valve and actuator are to be separated - Remove the nuts, washers, bolts and support bracket securing valve to actuator and separate the components.

(11) Fit blanks over the centre-section casing aperture, the valve ports and the air duct.

(12) Only applicable if valve and actuator are not to be re-installed - Remove the electrical plug adapters from the valve pressure switch and actuator (see para. 1.E.).

(13) Remove the blank temporarily from the centre-section casing, clean the jointing compound (see Chapter 71, POWER PLANT - SERVICING materials) from the mounting face and re-install the blank. Clean the attachment face of the air outlet elbow in a similar manner.

B. Install butterfly valve assembly

Special tools and equipment :-

Torque wrench ... ... T2 EM1987BR or PE.25492

...Butterfly valve assembly - Maintenance practices continued

(1) Examine the assembly externally for corrosion and other damage.

(2) Only applicable if valve and actuator have been separated - Complete operations (2) to (4) inclusive of para. 1.D.

(3) Only applicable if a replacement valve and actuator assembly is to be installed- Assemble the electrical plug adapters to the pressure switch and actuator (see para. 1.F.).

(4) Remove the blank from the rear end of the air duct. Lubricate (see Chapter 71, SERVICING MATERIALS) and install a new O-seal on the duct.

(5) Remove the blank from the valve ports and centre-section casing. Offer the valve assembly into position and engage the valve outlet port over the end of the transfer duct. Support the valve in position temporarily.

(6) Apply approved jointing compound to the mating faces of the outlet elbow and centre-section casing and locate the outlet elbow over the retaining studs on the centre-section casing.

(7) Insert a new sealing washer between the valve and support bracket. Secure the valve to the elbow with the retaining bolts, plain washers, spring washers and retaining nuts. Do not torque-load the nuts at this stage.

(8) Locate the Firewire support clip and terminal support bracket over the outlet elbow retaining studs.

(9) Secure the elbow with the plain washers, spring washers and retaining nuts. Position the bonding cable tag on the rearmost right-hand stud.

(10) Torque-load the elbow nuts to 70 to 80 lb in.

(11) Tighten the four valve retaining nuts.

(12) Tighten the two rearmost nuts and bolts securing the actuator and support bracket to the valve.

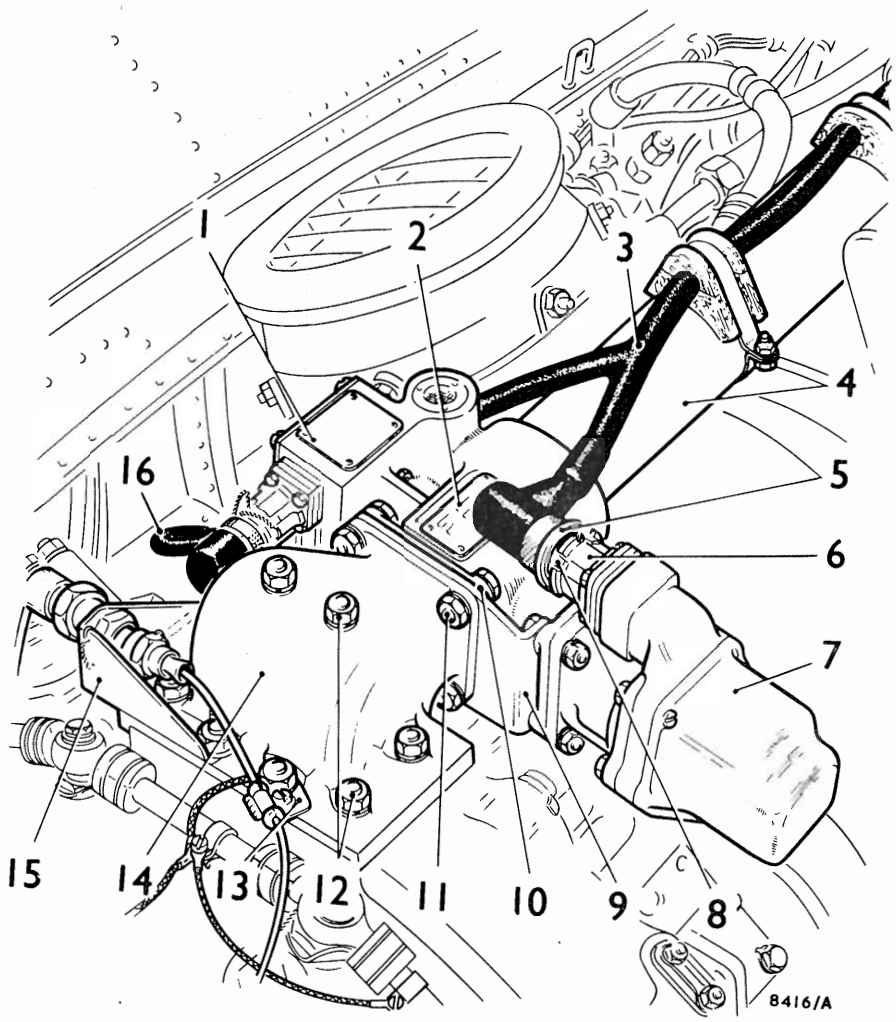
(13) Connect the electrical cables to the valve pressure switch and actuator. Tighten and wire-lock the connections.

(14) Restore the engine anti-icing electrical supplies (see Chapter 24, GENERAL).

(15) Complete Test E of POWER PLANT - GROUND RUNNING TESTS(Chapter 71).

C. Remove butterfly valve actuator

(1) Check that the valve is in the fully closed position (selector switched OFF; indicator displaying SHUT).



1. VALVE PRESSURE SWITCH
2. BUTTERFLY VALVE
3. ACTUATOR ELECTRICAL CABLE
4. TRANSFER DUCT
5. ADAPTER
6. LOCKING RING
7. ACTUATOR
8. LOCKING WASHER
9. SUPPORT BRACKET
10. SEALING WASHER
11. RETAINING BOLTS, PLAIN AND SPRING WASHERS
12. OUTLET ELBOW RETAINING NUTS
13. FIREWIRE SUPPORT CLIP
14. OUTLET ELBOW
15. FIREWIRE SUPPORT BRACKET
16. SWITCH ELECTRICAL CABLE

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Butterfly valve
Fig.201

...Butterfly valve assembly - Maintenance practices continued

(2) Isolate the engine anti-icing electrical circuit (see Chapter 24, GENERAL).

(3) Gain access to the engine.

(4) Disconnect the electrical cable from the actuator (Fig.201).

(5) Support the actuator, remove the retaining nuts, spring washers, plain washers and retaining bolts. Withdraw the actuator.

(6) Only applicable if the actuator is not to be re-installed - Remove the adapter from the electrical plug (see para. 1E).

D. Install butterfly valve actuator

Special tools and equipment :-

Key for turning valve drive shaft PE.4727

(1) Examine the actuator for damage, distortion, corrosion and security of locking devices.

(2) Connect a nominal 24-volt d.c. supply across the A and C pins of the actuator connector plug. Connect the positive lead to pin C and the negative to pin A. Run the actuator to its limit of travel. Disconnect leads.

(3) Move the butterfly valve plate to the fully closed position by rotating the drive shaft with the tool kit key.

NOTE : As a result of items (2) and (3) the actuator output quill and valve drive will be in approximately correct relationship to each other and it should be possible to engage them so that the quill meshes correctly with the spline on the valve shaft.

(4) Fit and tighten the retaining bolts, plain washers, spring washers and retaining nuts.

(5) Only applicable if a replacement actuator is being installed - Assemble the adapter to the electrical plug (see para. 1.F.).

(6) Connect, tighten and wire-lock the electrical cable connector to the actuator.

(7) Restore the engine anti-icing system electrical supplies.

(8) Complete Test E of POWER PLANT ADJUSTMENT/TEST - GROUND RUNNING TESTS (Chapter 71).

E. Remove adapter from electrical plug

Special tools and equipment :-

Dismantling and assembling tool for size Z electrical plug adapter ... PE.7483
Dismantling and assembling tool for size A electrical plug adapter ... UM.12579 or PE.3424

...Butterfly valve assembly - Maintenance practices continued

(1) Prise open the peened edge of the locking washer from the slots in the adapter.

(2) Unscrew the adapter with the tool kit dismantling and assembling tool, and withdraw the adapter, locking washer and locking ring from the plug. Discard the locking washer.

F. Assemble adapter to electrical plug

(1) Position a new locking ring over the actuator electrical plug, align the slots in the locking ring with the actuator electrical plug retaining nuts.

(2) Assemble the locking washer over the locking ring and screw the adapter into the electrical plug and tighten it with the tool kit dismantling and assembling tool.

(3) Reverse the dismantling and assembling tool and punch the rim of the locking washer into the slots in the adapter; this will secure the adapter.

2. Adjustment/Test

A. Test insulation resistance

Using a 500-volt d.c. Megger, check the insulation resistance between the pins of the actuator connector plug and its shroud, and between the valve switch connector plug and its shroud. The resistance must not be less than 30 megohms in each instance.

B. Test bonding resistance

Check that the bonding resistance between the following points does not exceed 0.05 ohm.

(1) Between the shrouds of the actuator connector plug and the valve connector plug and both inlet and outlet connections on the valve body, when checking as a complete assembly.

(2) Between the shroud of the connector plug and the actuator mounting face, when checking the actuator only.

(3) Between the shroud of the connector flanges and both inlet and outlet connections when checking the valve unit separately.

* * *

COMPRESSOR CONTROL - DESCRIPTION AND OPERATION

1. General

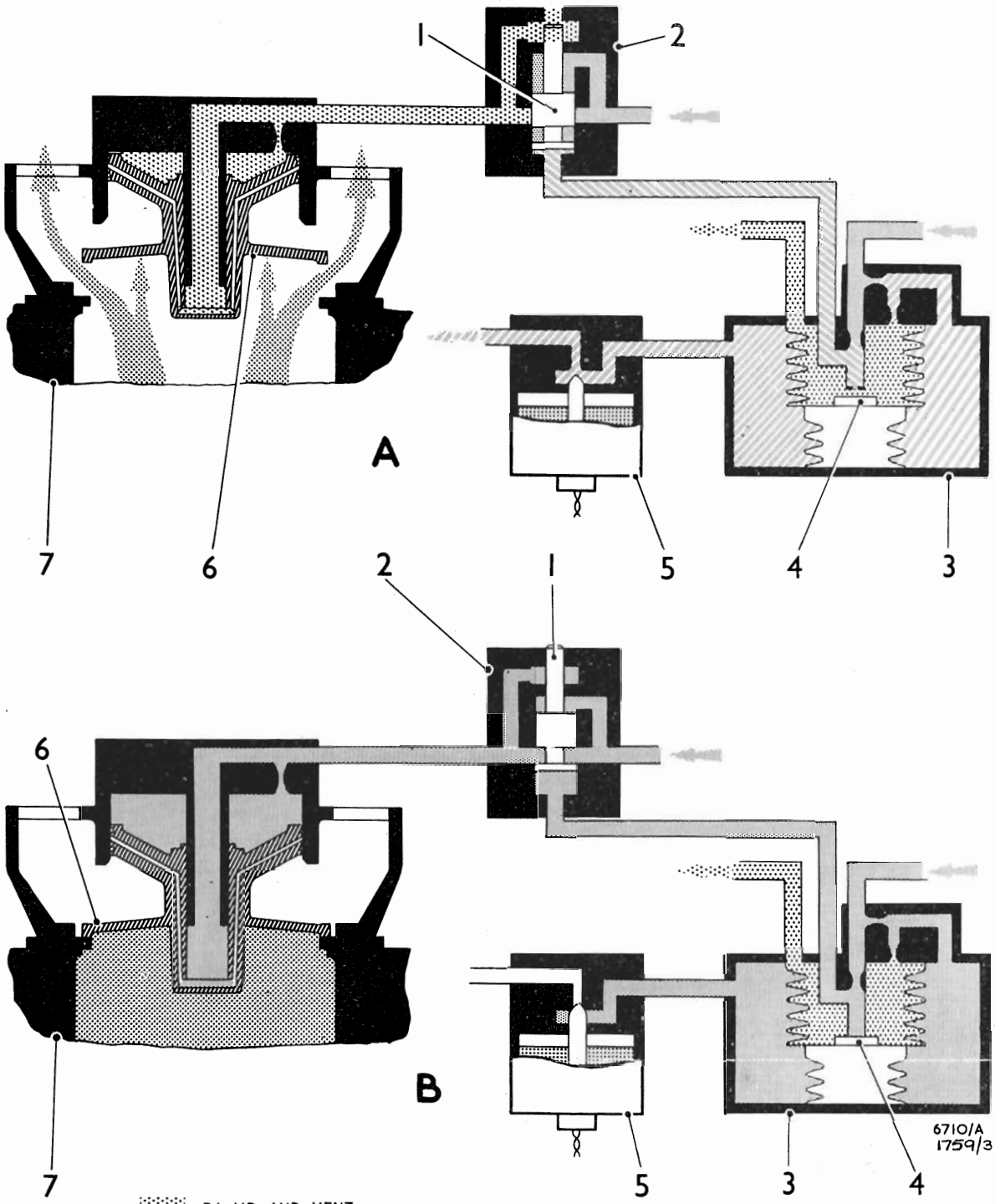
To promote optimum acceleration in the lower speed range, air is bled from the compressor fourth stage through a piston-type bleed valve mounted on the compressor casing. Operation of the valve is governed pneumatically by a piston type control valve carried on the bleed valve housing, the control valve functioning in conjunction with a pressure ratio switch mounted on the compressor blade shield unit. The position of the control valve piston valve governs the supply of compressor delivery pressure (P2) air to the outer face of the bleed valve piston, to close the valve against the lower pressure of the fourth stage air, acting upon its inner face. Movement of the control valve piston valve is achieved by compressor delivery pressure (P2) air applied to one end of the piston valve, in opposition to a proportion of P2 air pressure (from the pressure ratio switch) applied to its opposite end, which is of greater surface area.

At low engine speed (A of Fig.1 overleaf) the pressure ratio switch is open and a proportional value of P2 air is applied to the control valve piston valve. This pressure is insufficient to move the piston valve against the opposing full value of P2 air. The piston valve therefore remains in the closed position and there is no flow of P2 air to the bleed valve. Under these conditions, the bleed valve piston is held open by the pressure of compressor fourth stage air acting on its underside, the air venting to atmosphere. During the later stages of engine acceleration, however, the pressure in the bellows chamber of the pressure ratio switch rises sufficiently to close the switch plate valve (B of Fig. 1) and the full value of P2 air is applied to the larger end face of the control valve piston valve to move it to the open position. This permits P2 air to pressurize the bleed valve piston chamber and close the valve, thereby cutting off the fourth stage air bleed.

Air bled from the compressor bleed valve is discharged to atmosphere via a guard duct which aligns with an aperture in the top cowl. A toroidal seal, attached to the duct and interposed between the duct and top cowl, prevents the leakage of bleed air into Zone 1 of the installation (see Cowlings).

When operating at altitudes above 15000 ft. and with anti-icing selected ON , it is essential to maintain the air bleed valve in the open position at all engine speeds up to 92% rev/min. : To cater for this requirement, a semi-automatic override control of the air bleed valve operating system is provided. This consists of a solenoid valve which, when energized, vents the bellows chamber of the pressure ratio switch to atmosphere and prevents the bleed valve from closing. The solenoid valve is energized via an altitude-sensitive switch and a ganged section of the three position anti-icing selector switch. At engine speeds above 92% rev/min. the air bleed valve may be closed by setting the anti-icing selector switch to its third position. Closure of the valve then avoids any unacceptable increase in fuel consumption and deterioration in rate of climb which may occur under these operating conditions with continued compressor air bleed.

At altitudes above 15000 ft., the override system is armed by the altitude-sensitive switch. When, subsequently the anti-icing selector switch is set to 'ON', this position is appropriate to the 'below 92% rev/min'. engine operating condition.



1. CONTROL VALVE PISTON VALVE
2. CONTROL VALVE
3. PRESSURE RATIO SWITCH
4. SWITCH PLATE VALVE
5. DATUM RESET SOLENOID VALVE
6. AIR BLEED VALVE PISTON
7. AIR BLEED VALVE

I

Diagram of compressor air bleed valve operation
Fig.1

...Compressor control - Description and operation continued

At this setting the solenoid valve is energised and the compressor air bleed valve is opened. While the engine is operating at this speed below 92% rev/min. the switch must remain in this position. Should, however, the engine speed be increased to above 92% rev/min., the anti-icing selector switch may be repositioned to ABOVE 92%. At this setting the solenoid is de-energised, whereupon the air bleed valve closes and a warning light in the flight compartment is illuminated. Should an engine speed below 92% rev/min. be selected, subsequently, the anti-icing selector switch must be returned to the 'ON' position immediately.

COMPRESSOR AIR BLEED VALVE - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove compressor air bleed valve

(1) Gain access to the engine.

(2) Remove the guard from the valve.

(3) Disconnect the P2 pressure pipe and the balance pipe from the control valve housing.

(4) Remove the bleed valve retaining bolts, spring washers and plain washers and withdraw the valve from the compressor casing.

(5) Blank the valve connections, the pipe ends and the compressor casing aperture.

(6) If the bleed valve is not to be re-installed, remove the adapter ring.

(a) Remove the retaining bolts, spring washers and plain washers from the control valve housing and withdraw the housing sufficiently to disengage the air transfer bobbin.

(b) Lift the adapter ring away from the valve.

(c) Locate the end of the air transfer bobbin in the valve connection and position the control valve housing and secure it with the plain washers, spring washers and retaining bolts.

(7) Remove the blank temporarily from the compressor casing, clean the jointing compound from the mounting face (see POWER PLANT - SERVICING MATERIALS) and re-install the blank.

(8) If the original air bleed valve is to be re-installed, remove the jointing compound from the valve attachment face.

B. Install compressor air bleed valve.

Special tools and equipment :-

Tension wrench PE.25492

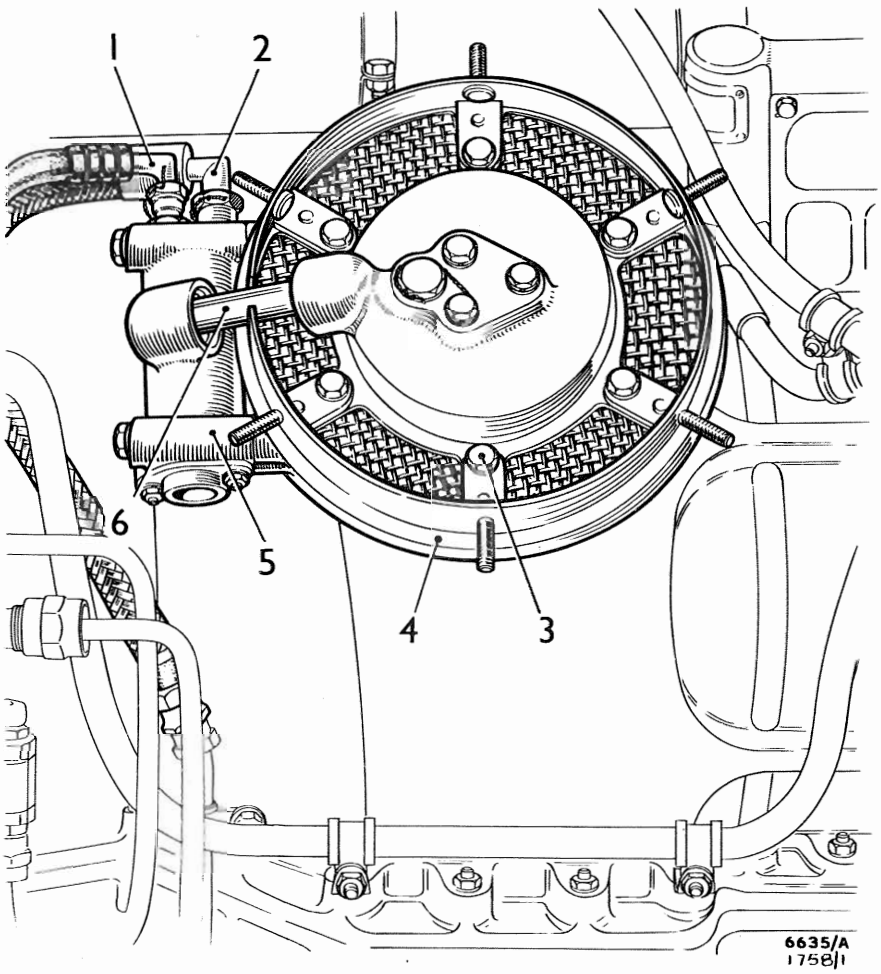
(1) If a new valve is to be installed, assemble the adapter ring to the valve.

(a) Remove the retaining bolts, spring washers and plain washers from the control valve housing and withdraw the housing sufficiently to disengage the air transfer bobbin.

...Air bleed valve - Maintenance practices continued

(b) Position the adapter ring on the valve. Align the cut-away in the adapter ring with the bobbin connection in the bleed valve housing.

(c) Remove the O-seals from the bobbin and discard them. Lubricate and install new O-seals (see POWER PLANT - SERVICING MATERIALS).



1. BALANCE PIPE
2. P_2 PRESSURE PIPE
3. VALVE RETAINING BOLTS
4. ADAPTER RING
5. CONTROL VALVE
6. AIR TRANSFER BOBBIN

Air bleed valve
Fig.201

...Compressor air bleed valve - Maintenance practices continued

(d) Locate one end of the air transfer bobbin in the bleed valve piston housing. Locate the other end of the bobbin in the control valve housing and position the control valve housing on the bleed valve and secure it with the plain washers, spring washers and retaining bolts. Torque-load the retaining bolts to 70 to 80 lb.in.

(2) Remove the blank from the compressor casing and apply approved jointing compound to the mounting faces of the casing and air bleed valve.

(3) Lubricate the valve securing bolt threads with clean approved engine oil and locate the valve on the compressor casing. Fit the plain washers, spring washers and retaining bolts and torque-load to 70 to 80 lb. in.

(4) Connect the P2 pressure pipe and the balance pipe to the air bleed valve. Tighten and wire-lock the union nuts.

(5) Install the aircraft guard on the air bleed valve.

(6) Complete Test C of POWER PLANT ADJUSTMENT/TEST - GROUND RUNNING TESTS. (Chapter 71).

2. Adjustment/Test

A. Permanently open compressor air bleed valve.

NOTE : This procedure may be required during tests on the exhaust gas temperature indicating system and/or, Viper 521 and 522 only, the top temperature control system.

(1) Disconnect P2 pipe from air bleed valve (Fig.201).

NOTE : Connect and wire-lock pipe on completion of ground test.

* * *

CONTROL VALVE - MAINTENANCE PRACTICES

1. Unit servicing

A. Service control valve (Fig.201)

Special tools and equipment required :-

Control valve piston sleeve extractor	...	PE.16004 or 16117
Torque wrench	...	PE.25492 or T2 EM1986BR
Socket spanner	...	T2 BJ1044SN

NOTE : Complete this servicing if it is considered that malfunctioning of the compressor air bleed valve is due to defective operation of the control valve.

(1) Gain access to the engine.

(2) Extract the retaining ring from the control valve piston sleeve, then withdraw the filter unit.

(3) Remove the two nuts, spring washers and plain washers retaining the control valve piston sleeve.

(4) Position the extractor over the control valve piston sleeve engaging it in the two machined slots in the sleeve flange.

(5) Screw in the extractor bolt and withdraw the control valve piston sleeve.

(6) Remove and discard the O-seal from the control valve housing.

(7) Withdraw the piston valve stop and O-seal from the control valve housing. Discard the O-seal.

(8) Withdraw the piston valve from the sleeve.

CAUTION : AVOID DAMAGE TO THE VALVE AND INTERNAL BORE OF THE SLEEVE SINCE THEY ARE GROUND SURFACES.

(9) Wash the piston valve, piston stop and sleeve in white spirit.

(10) Dry the valve, stop and sleeve with clean dry compressed air.

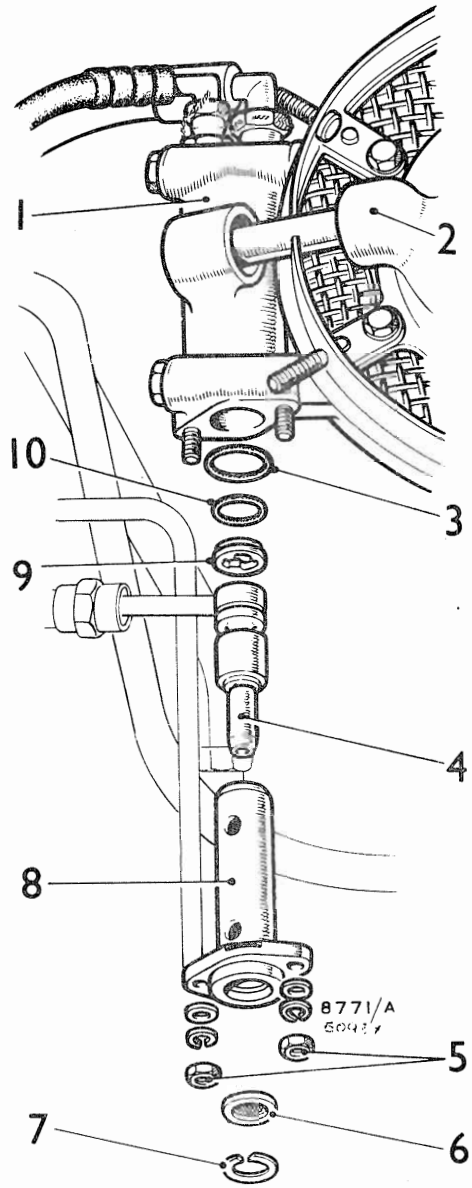
(11) Inspect the valve surfaces and sleeve bore for damage, corrosion and build-up of lacquer substance.

(12) Rectify faults as necessary :-

(a) Carefully dress light damage and/or corrosion using a fine grade oil stone. Do not remove the sharp edges of the piston.

(b) Remove the lacquered areas on the piston and sleeve by lightly polishing with rouge cloth, if available, or grade 00 emery cloth, taking care not to polish the sharp edges of the piston.

...Control valve - Maintenance practices continued



1. CONTROL VALVE HOUSING UNIT.
2. COMPRESSOR AIR BLEED VALVE ASSEMBLY.
3. O-SEAL (CONTROL VALVE HOUSING LOCATION)
4. CONTROL VALVE PISTON.
5. RETAINING NUTS.
6. FILTER UNIT.
7. RETAINING RING.
8. CONTROL VALVE PISTON SLEEVE.
9. PISTON VALVE STOP.
10. O-SEAL (PISTON VALVE STOP LOCATION).

Control valve assembly
Fig.201

...Control valve - Maintenance practices continued

(c) Wash the piston and sleeve in white spirit to remove all trace of abrasive materials.

(13) Reject the control valve unit if damage and/or corrosion is excessive. Install a new/serviceable valve as detailed in para.2.

(14) Insert the piston, smaller end first into the sleeve and esure that the piston will move freely backwards and forwards in the sleeve bore when the assembly is tilted 15° to 30° from the horizontal.

NOTE : Do not lubricate the piston valve, piston stop or sleeve.

(15) Using clean engine oil lightly lubricate and assemble a new O-seal to the piston valve stop then install it in its location in the control valve housing on the side of the compressor air bleed valve.

(16) Using clean engine oil lightly lubricate and install a new O-seal in its location in the bore of the control valve housing.

(17) Install the control valve assembly in the housing.

(18) Lubricate the studs with clean engine oil then secure the assembly with plain and spring washers and two retaining nuts.

(19) Torque-tighten the retaining nuts to 40 to 45 lbf.in.

(20) Install the filter unit in the end of the control valve piston sleeve.

(21) Secure the filter in the piston sleeve with the retaining ring.

(22) Complete Test C of Chapter 71 - POWER PLANT - ADJUSTMENT/TEST, Ground running tests.

2. Removal/Installation

A. Remove control valve

(1) Gain access to the engine.

(2) Disconnect the P2 pressure pipe and balance pipe from the control valve housing.

(3) Blank the control valve connections and pipe ends.

(4) Support the control valve and remove the three retaining bolts, spring washers and plain washers.

(5) Lift the control valve away from the air bleed valve body, simultaneously withdrawing the air transfer bobbin from the air bleed valve.

(6) Withdraw the air transfer bobbin from the control valve. Discard the O-seals.

...Control valve - Maintenance practices continued

B. Install control valve

(1) Lubricate and install new O-seals on the air transfer bobbin (see Chapter 71, POWER PLANT - SERVICING MATERIALS).

(2) Locate one end of the air transfer bobbin in the bleed valve piston housing.

(3) Locate the free end of the air transfer bobbin in the control valve housing and position the control valve on the bleed valve.

(4) Secure the control valve with plain washers, spring washers and retaining bolts. Torque-load the retaining bolts to 70 to 80 lbf.in.

(5) Remove the blanks from the control valve connections and pipe ends.

(6) Connect the P2 pressure pipe and balance pipe to the control valve connections. Tighten and wire-lock the union nuts.

(7) Complete Test C of Chapter 71-00 - POWER PLANT - ADJUSTMENT/TEST, Ground running tests (page block 541).

* * *

PRESSURE RATIO SWITCH - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove pressure ratio switch

(1) Gain access to the engine.

(2) Disconnect the following pipes from the pressure ratio switch PRS 108 (Fig.201) :-

P2 pressure
Balance
Pressure ratio switch to solenoid valve.

(3) Disconnect the following pipes from the pressure ratio switch PRS 102 (pre-Mod.CV.3315) :-

P1 pressure
P2 pressure
Balance
Pressure ratio switch to solenoid valve.

(4) Discard the O-seals, then blank the pipe ends and switch connections.

(5) Support the switch and remove the retaining bolts, spring washers and plain washers. Remove the switch from the compressor blade shield unit.

B. Install pressure ratio switch

Special tools and equipment required :-

Torque wrench ... ... T2EM1986BR or PE.25492

(1) Lubricate the switch securing bolt threads with clean approved engine oil.

(2) Position the switch on the blade shield unit and secure it with the plain washers, spring washers and retaining bolts. Torque-tighten the bolts to 40 to 45 lbf.in.

(3) Remove the blanks from the switch connections and pipe ends.

(4) Lubricate (see Chapter 71, POWER PLANT - SERVICING MATERIALS) and install new O-seals on the rigid pipes.

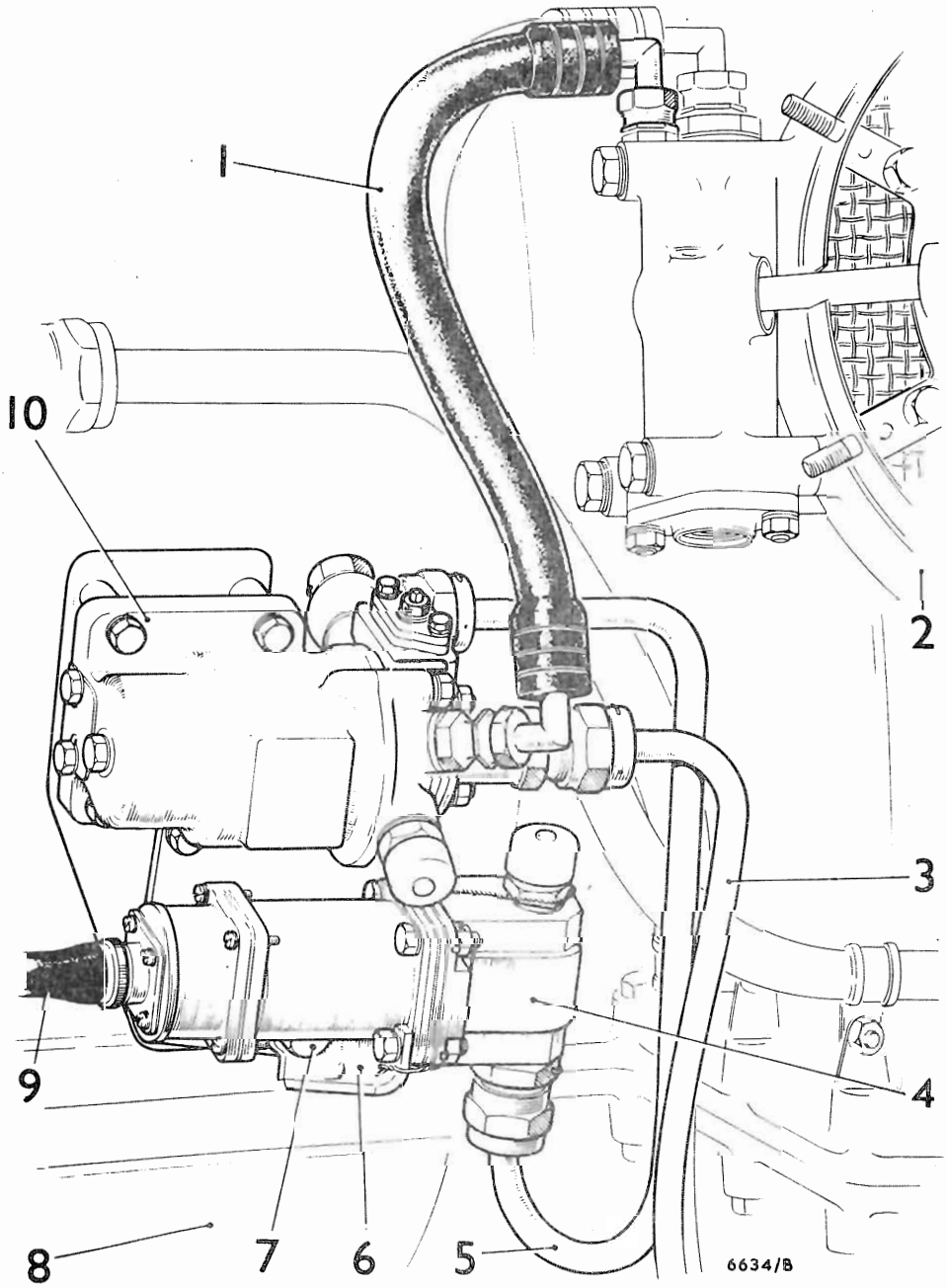
(5) Connect the following pipes to the switch PRS 108 :-

Balance
P2 pressure
Pressure ratio switch to solenoid valve.

(6) Connect the following pipes to the switch PRS 102 :-

Balance
P2 pressure
P1 pressure
Pressure ratio switch to solenoid valve.

...Pressure ratio switch - Maintenance practices continued



1. BALANCE PIPE
2. COMPRESSOR AIR BLEED VALVE
3. P_2 PRESSURE PIPE
4. DATUM RESET SOLENOID VALVE
5. PRESSURE RATIO SWITCH TO SOLENOID VALVE PIPE
6. MOUNTING BRACKET
7. RETAINING BOLTS
8. COMPRESSOR BLADE SHIELD UNIT
9. DATUM RESET SOLENOID VALVE ELECTRICAL CABLE
10. PRESSURE RATIO SWITCH

Pressure ratio switch and datum reset solenoid valve
Fig.201

...Pressure ratio switch - Maintenance practices continued

(7) Tighten and wire-lock the union nuts.

(8) Complete Test C of Chapter 71, POWER PLANT ADJUSTMENT/TEST - Ground running tests.

* * *

DATUM RESET SOLENOID VALVE - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove solenoid valve

(1) Gain access to the engine.

(2) Isolate the engine anti-icing electrical circuit (see Chapter 24, GENERAL).

(3) Disconnect the pressure ratio switch to solenoid valve pipe from the solenoid valve (Fig.201).

(4) Disconnect the electrical cable from the solenoid valve.

(5) Blank the pipe end and valve connections.

(6) Support the valve and remove the bolts and spring washers securing the mounting bracket to the mounting plate.

(7) Remove the valve, complete with its mounting bracket, from the mounting plate.

B. Install solenoid valve

(1) Lubricate the solenoid valve retaining bolts with clean approved engine oil.

(2) Position the valve, complete with its mounting bracket, on the mounting plate and retain it with bolts and spring washers.

(3) Remove the blanks from the solenoid valve and its associated pipes.

(4) Connect the pressure ratio switch to solenoid valve pipe to the solenoid valve.

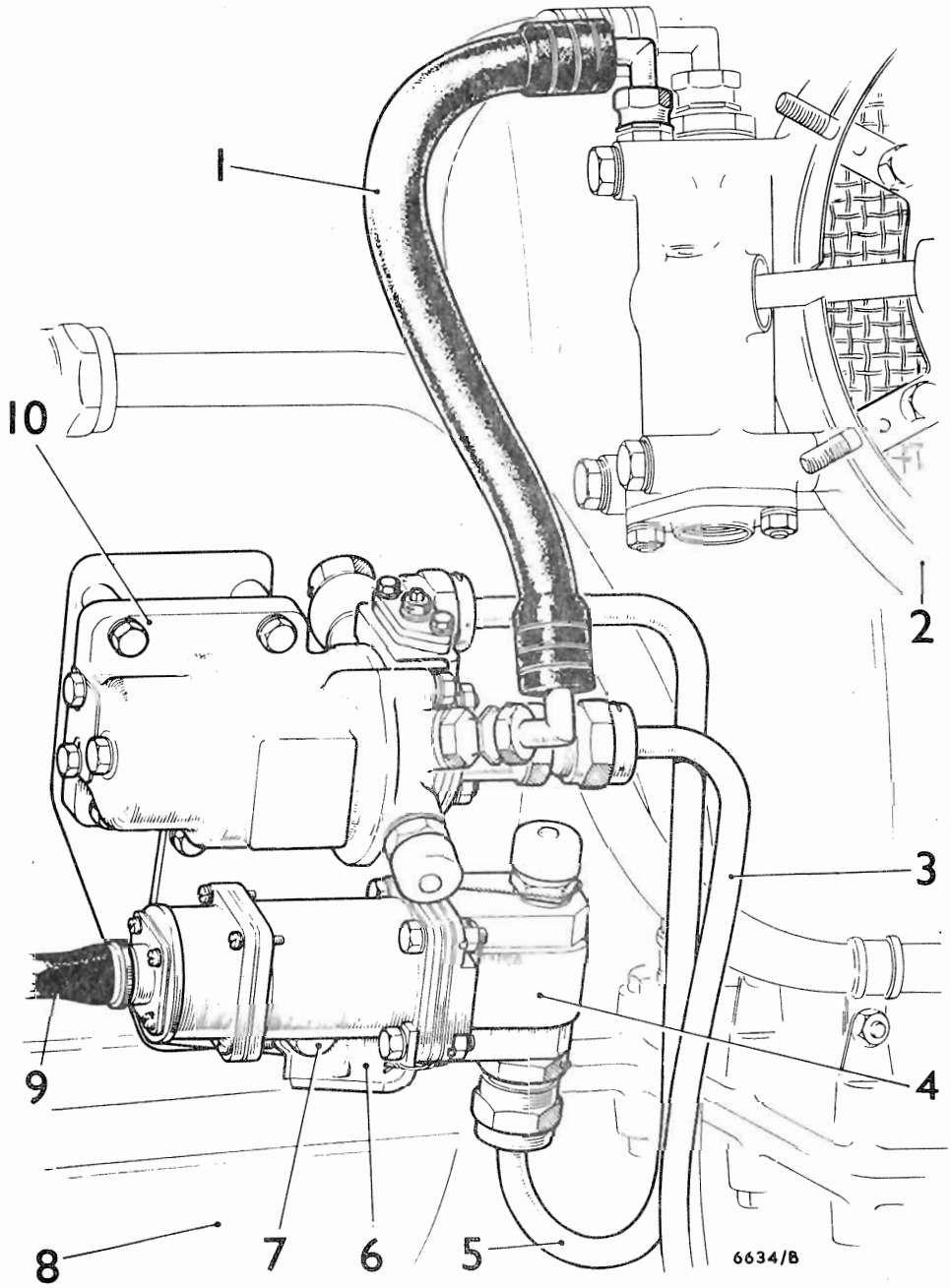
(5) Connect the electrical cable to the solenoid valve.

(6) Tighten and wire-lock the pipe connection and the electrical connection.

(7) Restore the engine anti-icing electrical circuit.

(8) Complete Test C of Chapter 71, POWER PLANT ADJUSTMENT/TEST - Ground running tests.

...Datum reset solenoid valve - Maintenance practices continued



1. BALANCE PIPE
2. COMPRESSOR AIR BLEED VALVE
3. P_2 PRESSURE PIPE
4. DATUM RESET SOLENOID VALVE
5. PRESSURE RATIO SWITCH TO SOLENOID VALVE PIPE
6. MOUNTING BRACKET
7. RETAINING BOLTS
8. COMPRESSOR BLADE SHIELD UNIT
9. DATUM RESET SOLENOID VALVE ELECTRICAL CABLE
10. PRESSURE RATIO SWITCH

Pressure ratio switch and datum reset solenoid valve
Fig.201

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Chapter 76

ENGINE CONTROLS

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* No description
+ No maintenance practices

* * *

POWER CONTROL

THROTTLE AND HIGH-PRESSURE FUEL VALVE CONTROL

1. General

The power controls are grouped on the pilot's control pedestal; they comprise a throttle control lever and a high-pressure fuel cock lever for each engine. Movement of the throttle control levers is controlled by an adjustable stop at the OPEN and CLOSED positions. Each high-pressure fuel cock control lever incorporates a spring-loaded plunger which engages in a recess at each end of the quadrant to lock the levers in either the ON or OFF positions. All control levers are connected to the engine controls by a system of cables, connecting rods and bell-crank levers (Fig.1).

The fuel cock lever arms are of fixed length, whereas the fork-ends of the throttle valve lever arms are screw-threaded to provide adjustment of the operating levers (Fig.2).

The hydraulic system on/off valve is interlocked with the high pressure fuel cock controls so that the hydraulic pump is isolated whenever the high pressure fuel cock is closed (see Chapter 24, MAIN SYSTEM).

2. Throttle control

Each throttle control lever is mounted on a cable drum in the control pedestal. The required resistance to movement of the cable drum is obtained by means of a THROTTLE FRICTION adjuster.

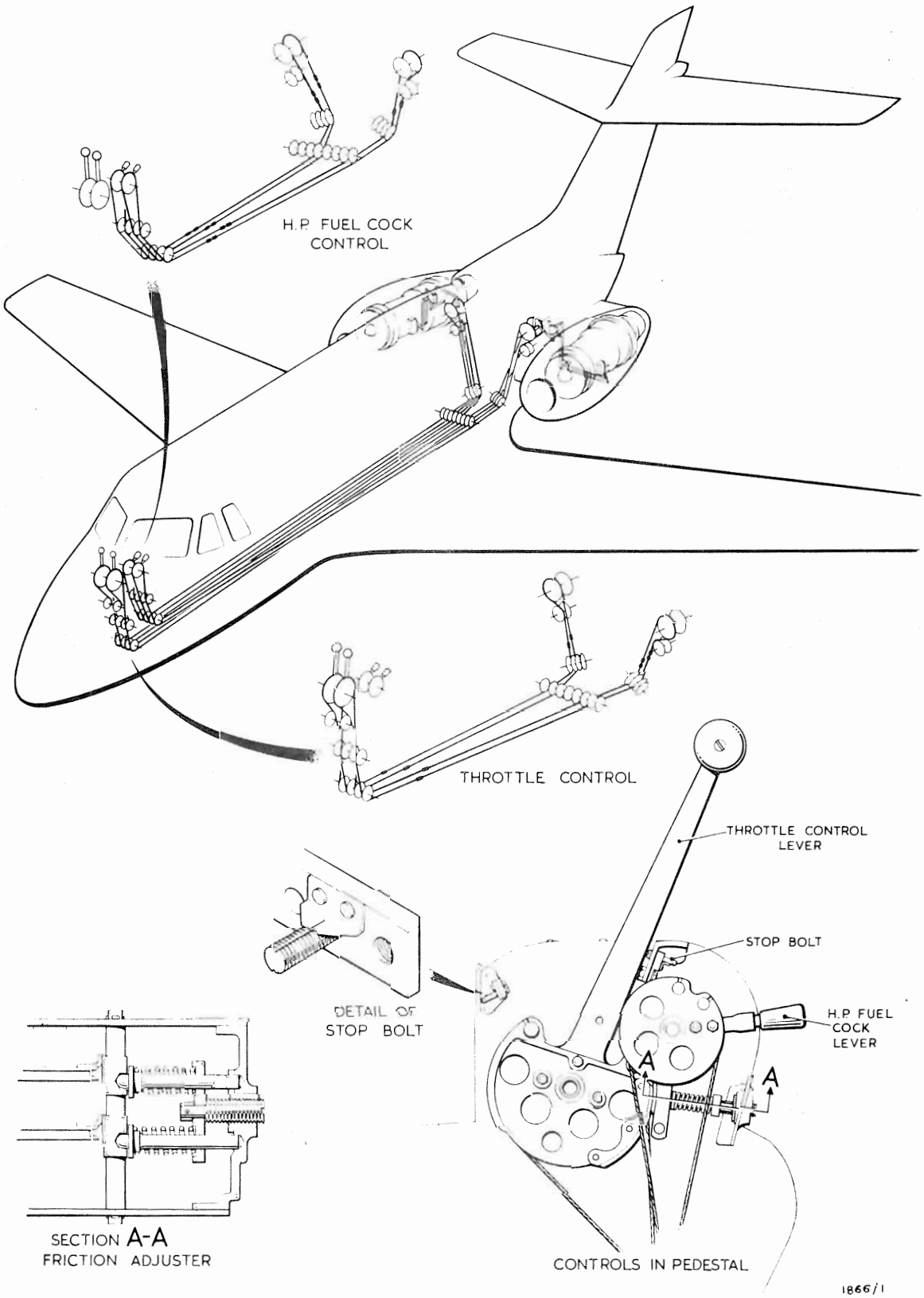
Control cables are routed underneath the cabin floor and up the rear face of the pressure dome to a cable drum, which is connected to the barometric flow control unit throttle lever on the engine, by a system of connecting rods and bell-crank levers (Fig.2).

The barometric flow control valve operating lever and the position of the lever on its centre is set on a rig to provide the correct range and position of travel. All adjustments and limit stop screws are subsequently wire-locked and sealed before the engine is dispatched for installation in the aircraft.

3. High-pressure fuel shut-off cock control

High-pressure fuel shut-off cock control levers are mounted on cable drums in the control pedestal. Control routing to the fuel shut-off cock of the barometric flow control unit is similar in all respects to the routing of the throttle controls.

Figure 1 overleaf



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Power control
Fig.1

...Power control - Maintenance practices continued

(7) Check all adjusters for safety and lock.

(8) Check throttle controls for full and free movement.

(9) Adjust alignment of throttle control levers (see Para.1.E).

D. Rig high-pressure fuel cock control after engine installed

(1) Check high-pressure fuel cock control is rigged as described in para. 1.B.

(2) Left-hand engine only - Set horizontal connecting rod, passing beneath engine, to 17.79 in. pin centre length. Fit connecting rod.

(3) Fit and adjust vertical connecting rod so that high-pressure fuel cock lever on engine contacts the stop at the OFF position.

(4) Set high-pressure fuel cock control lever to the ON position. Check clearance between high-pressure fuel cock lever on engine and its stop. Readjust vertical connecting rod to obtain half this clearance at each end of lever travel. Check clearance between 0.005 in. and 0.025 in.

(5) Check all adjusters for safety and lock.

(6) Check high-pressure fuel cock control for full and free movement.

E. Adjust alignment of throttle control levers

(1) Check that throttle control levers are rigged as described in paras. 1.A. and 1.C.

(2) Run engines at 75% rev/min. Mark position of throttle control levers. Stop engine.

(3) Adjust right-hand and left-hand vertical connecting rods an equal amount to bring throttle control levers level at the 75% rev/min. position.

(4) If necessary, reset OPEN and CLOSED stops at throttle control levers to give 0.062 in. spring on the levers when engine control levers contact their stops.

(5) Complete test A and D of POWER PLANT ADJUSTMENT/TEST - GROUND RUNNING TESTS.

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Reference	Page & Date

* Indicates pages revised, added or deleted by the current revision.

Chapter 77

ENGINE INDICATING

TABLE OF CONTENTS

* No separate description
† No separate maintenance practices

* * *

ENGINE INDICATING - GENERAL

1. General

Indication is given in the flight compartment of engine speed, exhaust gas temperature, turbine overheat and power loss.

2. Engine speed

Indication of engine speed, in percentage of maximum permissible, is provided by an engine-driven tachometer/synchronizer a.c. generator. This supplies an electrical signal to an indicator in the flight compartment at a frequency and voltage proportional to engine speed. The generator drive ratio is such that, with the engine running at maximum permissible speed, the flight compartment indicator will register 100%. The tachometer/synchronizer a.c. generator also supplies a reference signal to the synchronizer corrector unit (Chapter 73).

3. Exhaust gas temperature

Indication of exhaust gas temperature is provided by a single instrument in the flight compartment which indicates the mean temperature reading of five thermocouples installed in the exhaust cone propelling nozzle. The indicating circuit embodies a ballast resistor, for trimming the circuit, and a test plug. Each thermocouple unit embodies twin elements; the other set of five thermocouples supply a temperature reference signal to the engine top temperature control system (Chapter 73).

The colour coded indicator has a scale divided into main divisions of 100°C (up to 800°C) with sub-divisions of 20°C and cardinal operating temperatures (e.g. max. cruise and climb) highlighted by special division marks. The widths of the various division marks are not all the same but the centre line of each is indicative of the particular temperature.

The pointer has a square tip and a datum line runs down the centre of the pointer.

The widths of the pointer tip, centre line and the various scale divisions, in terms of temperature equivalent, are as follows :-

Pointer tip	10°C
Pointer centre line	2.5°C
100°C main divisions	5°C
20°C sub-divisions	2.5°C
Cardinal temperature divisions	10°C

When the centre line of the pointer is aligned with the centre of a scale marking the indicated temperature will be obvious but, if the pointer is not so aligned, it is possible to read directly to within 2.5°C and estimate to within 1.25°C by reference to the leading or trailing edge of the pointer tip.

4. Turbine overheat warning

This system comprises two thermocouples (mounted in the region of the rear bearing) a warning unit, a combined warning lamp and 'press to test' switch. A 115 volt,

...Engine indicating - General continued

400 c.p.s. a.c. supply and 28 volt d.c. supply are required for system operation.

The warning unit consists of a comparator, amplifier and switch circuit all enclosed within one case. The thermocouple signal received by the warning unit is corrected for cold junction temperature and compared with a stable datum voltage, equivalent to the specified operating temperature.

If the warning unit detects an excess temperature the warning lamp lights, the 'central attention getting system' is activated (see chapter 33) and, mod.251924 aircraft only, the relevant h.p. fuel valve control lever warning lamp also lights. Operation of the 'press to test' facility proves thermocouple continuity and correct functioning of the warning unit.

5. Power loss indication

A pitot head is mounted in the exhaust cone propelling nozzle of each engine. Each pitot head is linked by a capillary to a pressure indicator in the flight compartment and enables power loss to be determined by direct comparison of the indicator readings.

6. Exhaust cone static pressure measurement. (Mod. CV7135)

Static pressure in the exhaust cone is measured via a pipe assembly installed around the exhaust cone linking four tapping points and connected to instruments in the flight compartment.

* * *

TACHOMETER/SYNCHRONIZER AC GENERATOR (ALTERNATOR) - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove tachometer/synchronizer a.c. generator

(1) Gain access to the engine and place a tray beneath the engine.

(2) Disconnect the electrical cable from the unit.

(3) Remove the stiffnuts, spring washers and plain washer securing the unit to the accessory gearbox; this will also release the Firewire support clip and the P1 pressure pipe support clip.

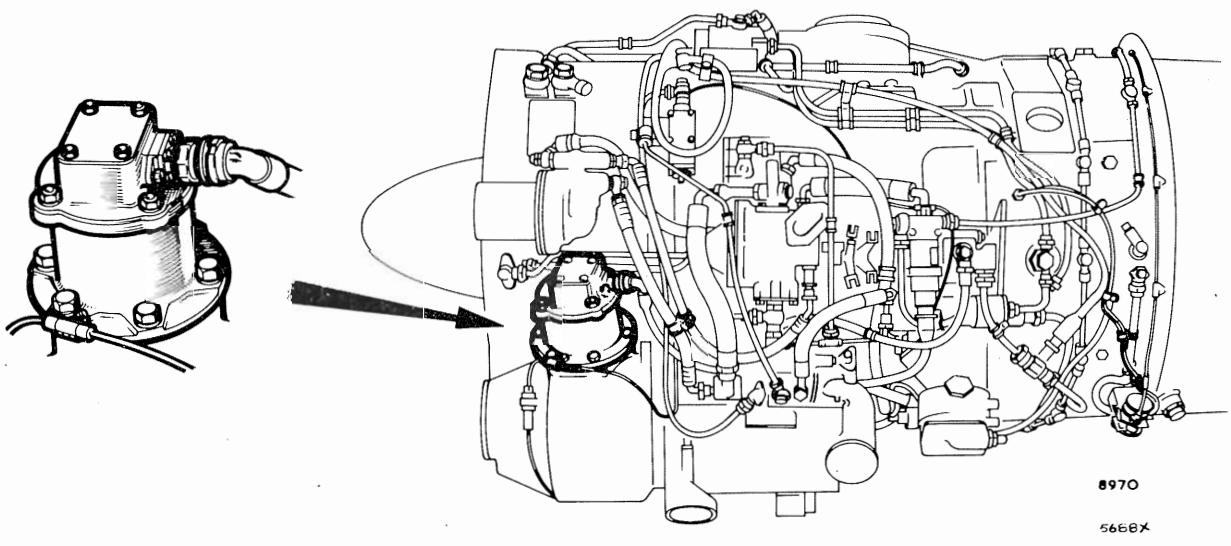
(4) Remove the unit from the accessory gearbox and discard the joint washer. Assemble blanks to all apertures.

B. Install tachometer/synchronizer a.c. generator

(1) Examine the generator to ensure that it is undamaged. Check by hand that the drive shaft rotates freely.

(2) Check insulation resistance of generator (para.2A).

(3) Ensure that the generator and engine accessory gearbox mounting faces are clean and undamaged, and that the male and female drive members engage correctly.



Tachometer/synchronizer a.c. generator location
Fig.201

...Tachometer/Synchronizer a.c. generator (alternator) - Maintenance practices continued

(4) Lightly lubricate the generator drive shaft with approved engine oil, place a new joint washer on the accessory gearbox mounting face and install the unit.

(5) Locate the Firewire and P1 pressure pipe support clip and secure the generator to the accessory gearbox with the stiffnuts, plain washers and spring washers. Torque-load the nuts to 70 to 80 lb.in.

(6) Connect, tighten and wire-lock the electrical connection to the unit.

(7) Complete Tests A, D and K or POWER PLANT GROUND RUNNING TEST, Chapter 71.

2. Adjustment/Test

A. Test insulation resistance of tachometer/synchronizer a.c. generator

Using a 500-volt d.c. Megger tester, measure the resistance between the electrical plug pins and the generator frame and between the plug pins and the plug shell. The resistance must not be less than 5 megohms.

B. Test electrical output of tachometer/synchronizer a.c. generator

(1) Disconnect the electrical plug adapter from the tachometer/synchronizer generator on the left-hand engine.

(2) Start the engine and move the THROTTLE lever to obtain 100% rev/min.

(3) Use a suitable electrical meter and check that the generator is producing an electrical output of 23.33 volts $\pm$ 1.0 volt in both tachometer and synchronizer circuits.

(4) Stop the engine.

(5) Reconnect the electrical plug adapter to the tachometer/synchronizer generator.

(6) Repeat the above operations for the right-hand engine.

* * *

EXHAUST GAS TEMPERATURE INDICATION - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Test continuity resistance of circuit

Equipment required :-

Precision Wheatstone bridge.

NOTE : Engine must be cold before proceeding with this test.

(1) Disconnect both leads from exhaust gas temperature indicator and connect a Wheatstone bridge to the leads.

(2) Note the circuit resistance, reverse the polarity of the bridge and again note the resistance.

(3) Subtract the resistance of the bridge test leads, from the readings obtained in operation (2); the mean of the circuit resistances must be within 25.0 $\pm$ 0.1 ohms.

(4) Adjust circuit resistance as necessary. (See chapter 77 BALLAST RESISTOR).

(5) Remove test equipment.

(6) Connect indicator leads to their terminals.

NOTE : If system calibration (engine static) is to follow, leave positive lead disconnected.

B. Calibrate system - engine static

Equipment required :-

Standard d.c. potentiometer test set or compensated test set, for example Ultra QT 223 with appropriate accessories.

If test set is to be used, connect it to the appropriate test plug, and refer to test set manufacturers manual for procedure required to complete this test.

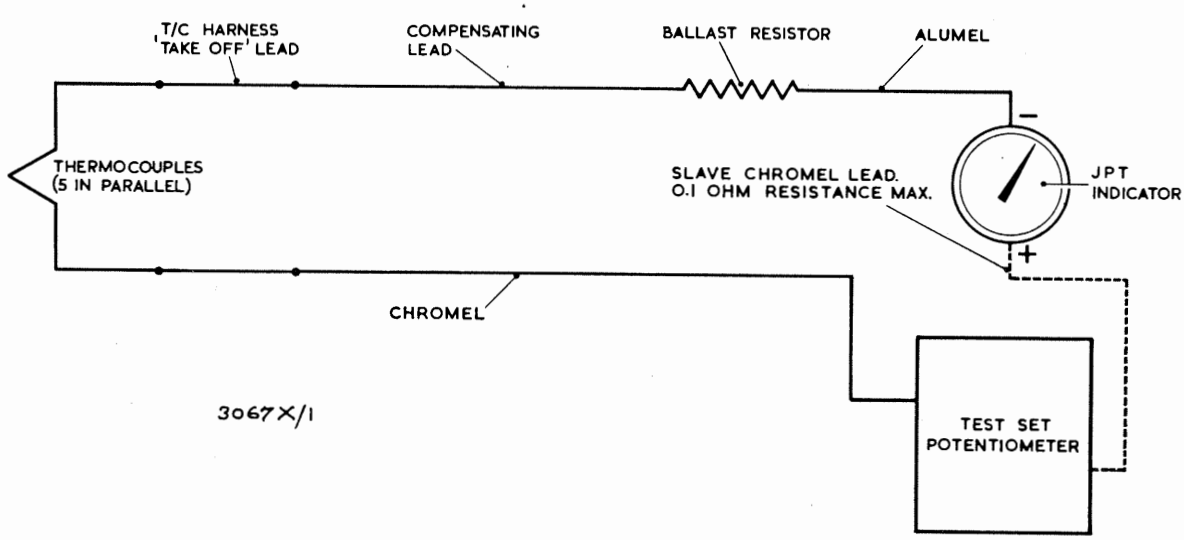
NOTE : Engine must be cold before proceeding with this test.

(1) Test continuity and insulation resistances of thermocouple harness and take off leads (see THERMOCOUPLES AND HARNESS).

(2) Test continuity resistance of exhaust gas temperature (e. g.t.) indicating circuit.

(3) Connect e. g.t. indicator positive lead to the negative terminal of the potentiometer.

...Exhaust gas temperature indication - Maintenance practices continued



Test circuit
Fig.201

(4) Connect a slave Chromel lead to the positive terminal of the potentiometer (Fig.201).

NOTE : Resistance of lead not to exceed 0.1 ohms.

(5) Connect free end of slave Chromel lead to positive terminal of e.g.t. indicator.

(6) Allow ten minutes to elapse to allow temperature to stabilize.

(7) Using the main scale rheostat of the potentiometer, adjust the injected e.m.f. to the value of the take-off temperature (Table 1), corrected for ambient temperature (Table 2).

(8) Check indicator reading and, if necessary, mechanically adjust the pointer until take-off temperature is registered.

NOTE : Pointer adjustment screw is on rear of indicator.

(9) Adjust the injected e.m.f., in turn, to the values of the max. continuous, max. climb and max. cruise temperatures (corrected for ambient temperature) and check that indicator readings are within limits (Table 1).

(10) Remove test equipment.

(11) Connect e.g.t. indicator positive lead to indicator.

...Exhaust gas temperature indication - Maintenance practices continued

TABLE 1

Engine type	Take-off		Max. cont.		Max. climb		Max. cruise	
	Applied MV	Indicator °C	Applied MV	Indicator °C	Applied MV	Indicator °C	Applied MV	Indicator °C
522	30.81	740 ± 0	29.77	715 ± 7	28.08	675 ± 7	26.82	645 ± 7

NOTE : The applied millivolts quoted are correct only when an ice cold junction is in the circuit. For ambient temperature corrections see Table 2.

TABLE 2

To correct applied MV for ambient temperature

(1) Take MV for appropriate cardinal e.g. 30.81 at 740°C
(2) Subtract MV for ambient temperature e.g. 0.80 at 20°C

30.01

Therefore 30.01 is applied MV corrected for 20°C ambient temperature.

°C	0	1	2	3	4	5	6	7	8	9	10	°C
0	0.00	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.40	0
10	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	10
20	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	20
30	1.20	1.24	1.28	1.32	1.36	1.40	1.44	1.49	1.53	1.57	1.61	30
40	1.61	1.65	1.69	1.73	1.77	1.81	1.85	1.90	1.94	1.98	2.02	40
50	2.02	2.06	2.10	2.14	2.18	2.23	2.27	2.31	2.35	2.39	2.43	50
60	2.43	2.47	2.51	2.56	2.60	2.64	2.68	2.72	2.76	2.80	2.85	60

...Exhaust gas temperature indication - Maintenance practices continued

C. Calibrate system - engine running

NOTE : Calibrate system in conjunction with TOP TEMPERATURE CONTROL SYSTEM - See Chapter 73.

* * *

THERMOCOUPLES AND HARNESS - MAINTENANCE PRACTICES

1. Removal/Installation

Equipment required :-

Tension wrench (40-280 lb in.)	...	PE.25492
Tension wrench (5-25 lb in.)	...	PE.15391

A. Remove thermocouples and harness

(1) Remove shroud panel from bottom of fillet and remove access panel in jet pipe fairing. (See Chapter 71 POWER PLANT - GENERAL, Fig.1 and 2).

(2) Disconnect harness take-off leads from terminal blocks on fillet.

(3) Slacken clamp bolts on jet pipe fairing and withdraw harness leads into jet pipe fairing.

(4) Remove jet pipe fairing

(5) Release the tabwashers and unscrew the attachment bolts securing the four harness clamp assemblies to the propelling nozzle.

(6) Release the harness clamps from the cables.

(7) Release the tabwashers and unscrew the attachment bolts from the five thermocouple housings and the junction box.

(8) Free the thermocouple housings from the propelling nozzle, then withdraw the thermocouple probes consecutively; start with the probe at the six o'clock position.

(9) Lift the harness away from the propelling nozzle.

(10) Blank the apertures in the propelling nozzle and assemble rubber sleeves over the thermocouple probes to cover the gas entry holes.

B. Install thermocouples and harness

(1) Remove the blanks from the apertures in the propelling nozzles.

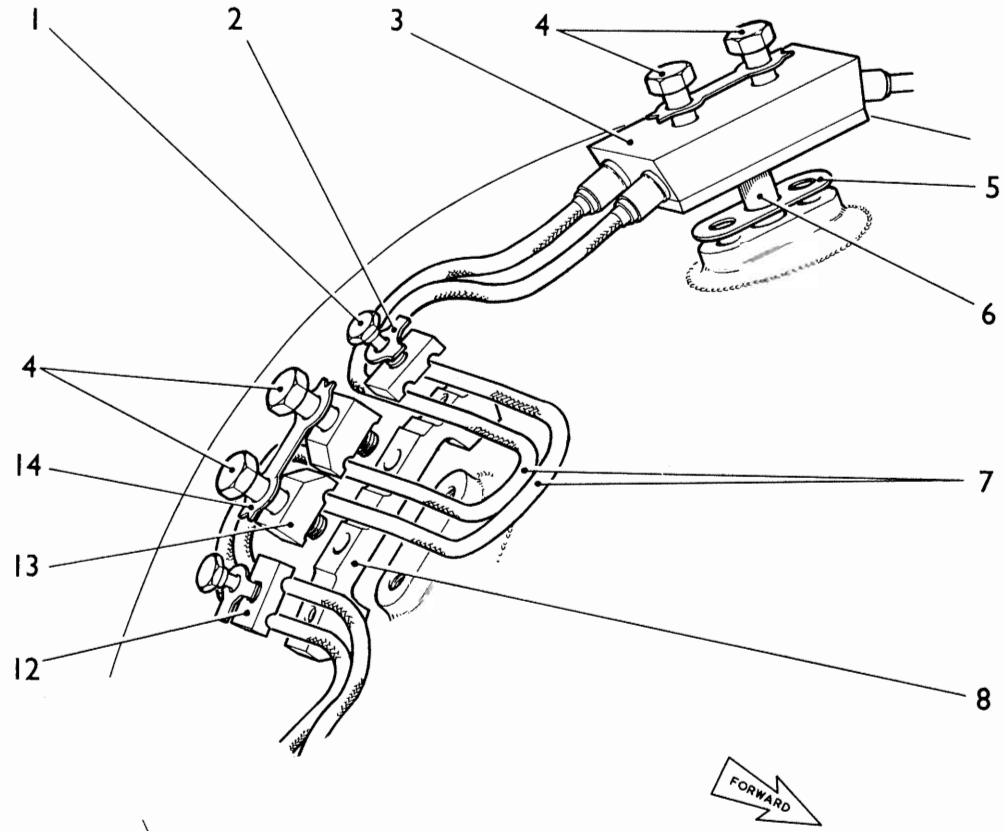
(2) Remove the rubber sleeves from the thermocouple probes. Examine the gas entry holes in the probes and ensure that they are not obstructed.

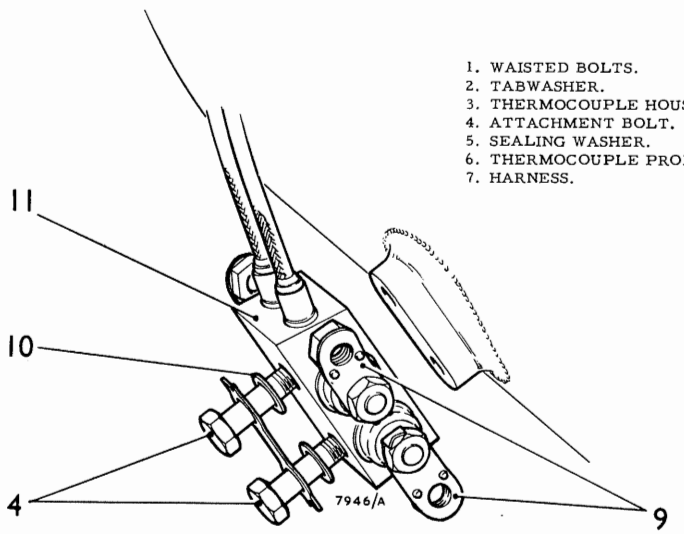
(3) Fit a new tabwasher to each pair of bolts on the thermocouple housings and a tabwasher and plain washers to the bolts on the junction box. Lubricate and assemble the attachment bolts (see POWER PLANT - SERVICING MATERIALS).

NOTE : The bolt holes in the junction box and housings are threaded.

(4) Fit a new sealing washer over each thermocouple probe.

(5) Ensure the gas entry hole in the thermocouple probes are facing the turbine wheel, then locate the probes in the propelling nozzle; insert the probes consecutively starting from the six o'clock position.





1. WAISTED BOLTS.
2. TABWASHER.
3. THERMOCOUPLE HOUSING.
4. ATTACHMENT BOLT.
5. SEALING WASHER.
6. THERMOCOUPLE PROBE.
7. HARNESS.
8. CLAMP BASE.
9. AIRCRAFT TAKE-OFF TAGS.
10. PLAIN WASHER.
11. TERMINATION FITTING.
12. CLAMP.
13. CLAMP.
14. TABWASHER.

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...Thermocouples and harness - Maintenance practices continued

(6) Locate the clamp base under the thermocouple harness; align the attachment bolt holes with the tappings in the propelling nozzle.

(7) Assemble the clamps, tabwashers, attachment bolts and waisted bolts. Finally position the clamps, then screw in the bolts. Repeat operations (6) and (7) for the remaining clamp assemblies.

(8) Torque-load the waisted bolts to 30-35 lb in. and the attachment bolts to 70-80 lb in. Lock the bolt heads with the tabwashers.

(9) Connect the aircraft take-off leads to their respective locations on the junction box with setbolts. Tighten the bolts to 20-25 lb in. Do not lubricate these bolt threads.

(10) Fit jet pipe fairing.

(11) Feed harness take-off leads through clamp on jet pipe fairing.

(12) Connect harness leads to terminal blocks on fillet (Fig.202).

(13) Tighten harness clamp on jet pipe fairing.

(14) Fit shroud panel to bottom of fillet.

(15) Complete Tests A and D of POWER PLANT - ADJUSTMENT/TEST, GROUND RUNNING TESTS.

2. Adjustment/Test

A. Test continuity resistance of thermocouples and harness

Equipment required :-

Precision Wheatstone bridge.

NOTE: Engine must be cold before proceeding with this test.

(1) Record ambient air temperature.

(2) Remove shroud panel from bottom of fillet. (See Chapter 71, POWER PLANT - GENERAL, Fig.1 and 2).

(3) Disconnect, in turn, both sets of thermocouple harness leads from terminal blocks on fillet.

NOTE : On aircraft without top temperature control connect leads to harness take-off terminals (adjacent to thermocouple) when checking unused thermocouple circuit. Gain access via panel.

...Thermocouples and harness - Maintenance practices continued

(4) Using Wheatstone bridge note the resistance between each pair of positive and negative leads; reverse the polarity of the bridge and again note the resistances.

(5) Subtract the resistance of the bridge test lead from the readings obtained in operation (4).

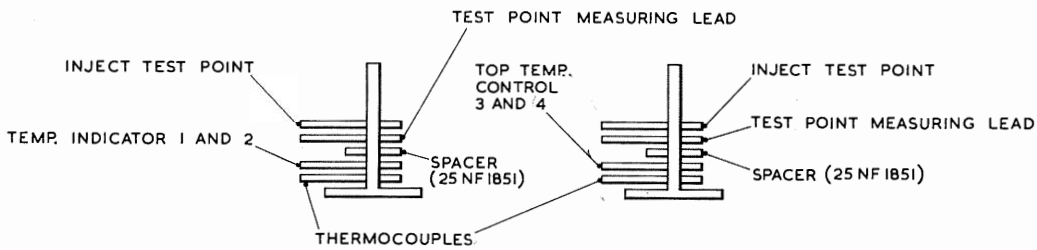
(6) Average both resistance readings per circuit; the readings must be 2.75 $\pm$ 0.25 ohms at 20°C.

NOTE : For each 1°C ambient is above 20°C add 0.002 ohms; subtract 0.002 ohms for each 1°C ambient is below 20°C.

(7) Disconnect test equipment.

(8) Connect harness leads to terminal block (Fig.202).

(9) Fit shroud panel to fillet.



NOTE: TERMINAL BLOCKS LETTERED 'LD' ON LEFT FILLET AND 'MD' ON RIGHT FILLET. TOP TEMP. CONTROL ONLY FITTED ON VIPER 521 AND 522

4596x/1

Stacking thermocouple cables
Fig.202

...Thermocouples and harness - Maintenance practices continued

B. Test insulation resistance of thermocouples and harness

Equipment required :-

250 volt d.c. resistance tester

(1) Remove shroud panel from bottom of fillet (See Chapter 71, POWER PLANT - GENERAL, Fig.1 and 2).

(2) Disconnect, in turn, both sets of thermocouple harness leads from terminal blocks in fillet.

(3) Using resistance tester note the resistance between each take-off lead and earth; resistance must not be less than 20,000 ohms.

NOTE : If reading is less than this, check again after engine run.

(4) Disconnect test equipment.

(5) Connect harness leads to connect terminal (Fig.202).

(6) Fit shroud panel to fillet.

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THERMOCOUPLES AND HARNESS - MAINTENANCE PRACTICES

1. Removal/Installation

Equipment required :-

Torque wrench (40-280 lb in.)	...	PE25492
Torque wrench (30-35 lb in.)		

A. Remove thermocouples and harness

(1) Remove shroud panel from bottom of fillet and remove access panel in jet pipe fairing (see Chapter 71, POWER PLANT - GENERAL, Fig. 1 and 2).

(2) Disconnect harness take-off leads from terminal blocks on fillet.

CAUTION : DO NOT DISCONNECT TAKE-OFF LEADS FROM TERMINATION FITTING ON HARNESS.

(3) Slacken clamp bolts in jet pipe fairing and withdraw harness leads into jet pipe fairing.

(4) Remove jet pipe fairing.

(5) Remove attachment bolts securing the four harness clamp assemblies to propelling nozzle.

(6) Release and remove harness clamps from conduits.

(7) Release tabwashers and unscrew attachment bolts from the thermocouple housings and the termination fitting.

(8) Free thermocouple housings from propelling nozzle, then withdraw thermocouple probes consecutively; start with probe adjacent to termination fitting.

(9) Lift harness away from propelling nozzle.

(10) Blank the apertures in propelling nozzle.

(11) Assemble the harness clamps loosely to their respective positions on the conduits.

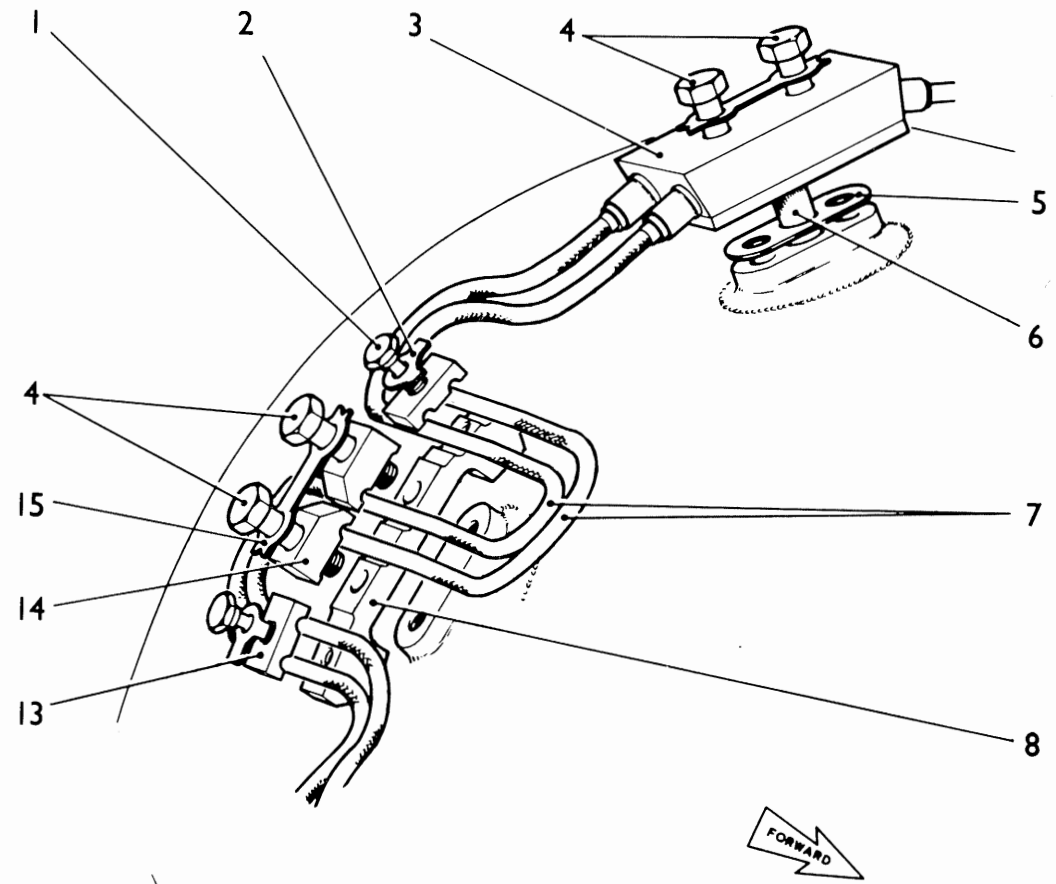
B. Install thermocouples and harness

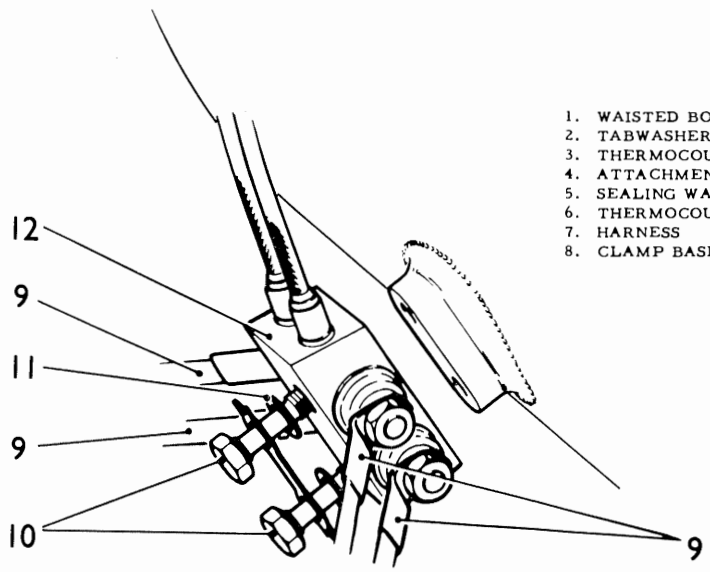
(1) Remove blanks from apertures in propelling nozzle.

(2) Examine gas entry holes in probes and ensure that they are not obstructed.

(3) Remove the loosely assembled harness clamps.

... Thermocouples and harness - Maintenance practices continued





1. WAISTED BOLTS
2. TABWASHER
3. THERMOCOUPLE HOUSING
4. ATTACHMENT BOLTS
5. SEALING WASHER
6. THERMOCOUPLE PROBE
7. HARNESS
8. CLAMP BASE
9. TAKE-OFF LEADS (NOT TO BE REMOVED FROM THE HARNESS)
10. WAISTED ATTACHMENT BOLTS
11. PLAIN WASHER
12. TERMINATION FITTING
13. CLAMP
14. CLAMP
15. TABWASHER

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4512/1

Thermocouple harness details
Fig. 201

... Thermocouples and harness - Maintenance practices continued

(4) Fit new tabwasher to each pair of bolts on thermocouple housings and tabwasher and plain washers to bolts on termination fitting. Lubricate and assemble the attachment bolts (see Chapter 71, SERVICING MATERIALS).

(5) Fit a new sealing washer over each thermocouple probe, then offer up harness.

(6) Starting with probe adjacent to termination fitting, assemble thermocouple probes in propelling nozzle with blue leads facing forward. Ensure that termination fitting is correctly located according to engine position (Fig. 202).

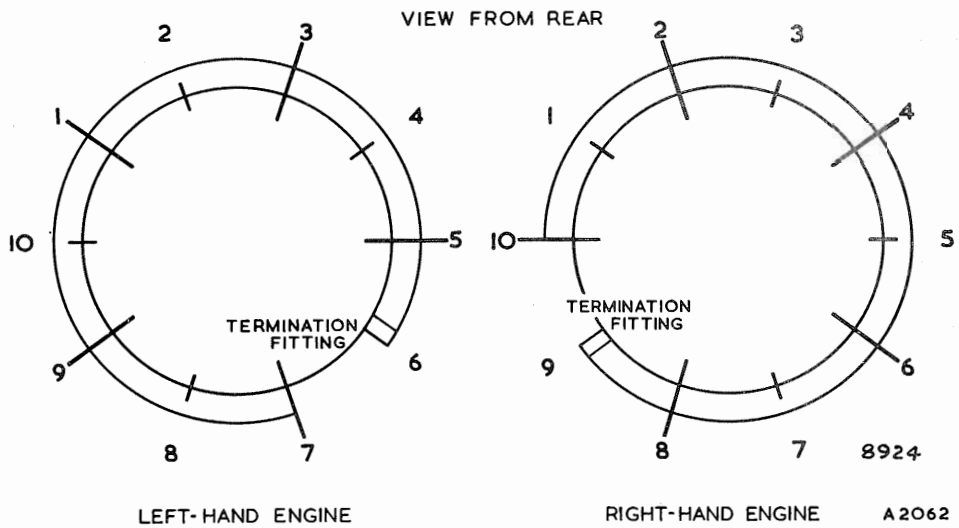
(7) Fit bolts and tabwashers to secure probes and termination fitting. Torque-tighten probe attachment bolts to 70-80 lbf in. and waisted termination fitting attachment bolts to 60-70 lbf in.; engage the tabwashers.

(8) Locate a clamp base under the thermocouple harness, aligning attachment bolt holes with tappings in propelling nozzle.

(9) Assemble the clamps, tabwashers, attachment bolts and waisted bolts. Finally position clamps, then screw in bolts.

(10) Repeat operations (8) and (9) on remaining clamp assemblies; torque-load the waisted bolts to 30-35 lbf in. and the attachment bolts to 70-80 lbf in. Engage the tabwashers.

(11) Ensure that clearance between rear loops of harness and exhaust cone skin is within limits of 0.20 in. plus/minus 0.050 in.



... Thermocouples and harness - Maintenance practices continued

(12) Fit jet pipe fairing; check clearance between thermocouple harness conduit and fairing frame is not less than 0.25 in.

NOTE : Dress fairing, if necessary, to obtain this fairing.

(13) Feed harness leads through clamp on jet pipe fairing.

(14) Connect take-off leads to terminal blocks on fillet, ensuring that leads do not foul aircraft structure (Fig. 203 and Table 201). Do not lubricate bolt threads.

(15) Tighten harness clamp on jet pipe fairing.

(16) New harness fitted. Calibrate exhaust gas temperature indicating system - engine running (see Chapter 77, EXHAUST GAS TEMPERATURE INDICATION).

(17) Original harness fitted. Complete Tests B(8) and L of Ground Running Tests - Chapter 71.

(18) Fit shroud panel to bottom of fillet.

2. Adjustment/Test

A. Test continuity resistance of thermocouples and harness

Equipment required :-

Precision Wheatstone bridge

(1) Record ambient air temperature.

NOTE : Engine must be cold before proceeding with this test.

(2) Remove shroud panel from bottom of fillet (see Chapter 71, POWER PLANT - GENERAL, Fig. 1 and 2).

(3) Disconnect in turn both sets of thermocouple harness leads from terminal blocks on fillet.

(4) Using Wheatstone bridge, note the resistance between each pair of positive and negative leads; reverse the polarity of the bridge and again note the resistances.

(5) Subtract the resistance of the bridge test lead from the readings obtained in operation (4).

(6) Average both resistance readings per circuit; the readings must be 3.05 $\pm$ 0.05 ohms at 20°C.

NOTE : For each 1°C ambient above 20°C add 0.002 ohms; subtract 0.002 ohms for each 1°C ambient below 20°C.

(7) Disconnect test equipment.

(8) Connect harness leads to terminal block (Fig. 203 and Table 201).

(9) Fit shroud panel to fillet.

...Thermocouples and harness - Maintenance practices continued

TB and circuit	Cable coding			Circuit details	Stack order
	TB end	Both	Away end		
LD4 TTC	4LD : M1	63	G	Inject, test point	1
	4LD : M1	63	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	F4 : LD4	4063	-A : TX	Amplifier -ve; blue tracer	4
				Take-off lead -ve; blue	5
LD2 JPT	2LD : M1	28	G	Inject, test point	1
	2LD : M1	28	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	M1 : LD2	4028	R10K : GG	Indicator -ve; blue tracer	4
				Take-off lead -ve; blue	5
LD3 TTC	3LD : M1	63	D	Inject, test point	1
	3LD : M1	63	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	F4 : LD3	4063	+A : TX	Amplifier +ve; red tracer	4
				Take-off lead +ve; red	5
LD1 JPT	1LD : M1	28	D	Inject, test point	1
	1LD : M1	28	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	M1 : LD1	4028	R6K : GG	Indicator +ve; red tracer	4
				Take-off lead +ve; red	5

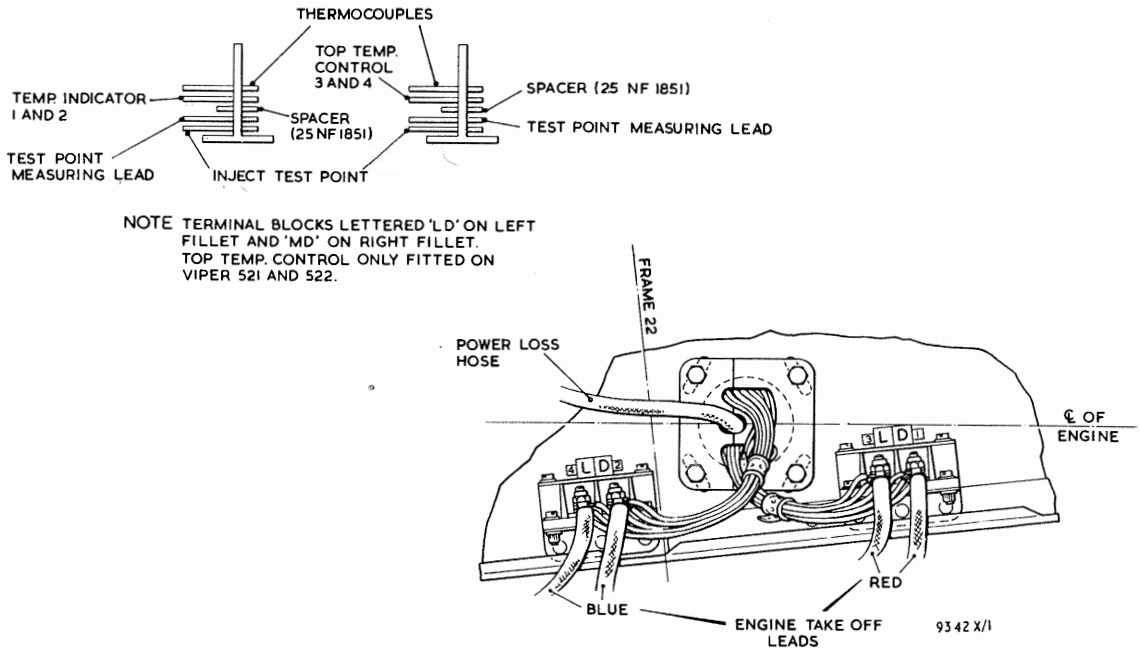
Engine No.1 Terminal block details (Left fillet)
Table 201 - sheet 1

...Thermocouples and harness - Maintenance practices continued

TB and circuit	Cable coding			Circuit details	Stack order
	TB end	Both	Away end		
MD1 JPT	1MD : M2	28	D	Inject, test point	1
	1MD : M2	28	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	M2 : MD1	4028	R1K : GG	Indicator +ve; red tracer	4
				Take-off lead +ve; red	5
MD3 TTC	3MD : M2	63	D	Inject, test point	1
	3MD : M21	63	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	F4 : MD3	4063	+A : TX	Amplifier +ve; red tracer	4
				Take-off load +ve; red	5
MD2 JPT	2MD : M2	28	G	Inject, test point	1
	2MD : M2	28	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	M2 : MD2	4028	R5K : GG	Indicator -ve; blue tracer	4
				Take-off load -ve; blue	5
MD4 TTC	4MD : M2	63	G	Inject, test point	1
	4MD : M2	63	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	F4 : MD4	4063	-A : TY	Amplifier -ve; blue tracer	4
				Take-off lead -ve; blue	5

Engine No.2 Terminal block details (Right fillet)
Table 201 - sheet 2

... Thermocouples and harness - Maintenance practices continued



Stacking thermocouple cables
Fig. 203

B. Test insulation resistance of thermocouples and harness

Equipment required :-

250V d.c. resistance tester

(1) Remove shroud panel from bottom of fillet (see Chapter 71, POWER PLANT - GENERAL, Fig. 1 and 2).

(2) Disconnect in turn, both sets of thermocouple harness leads from terminal blocks in fillet.

(3) Using resistance tester note the resistance between each take-off lead and earth; resistance must not be less than 20 000 ohms for a new harness and 10 000 ohms for a used harness.

NOTE : If reading is less than this, check again after engine run.

(4) Disconnect test equipment.

(5) Connect harness leads to correct terminal (Fig. 203).

(6) Fit shroud panel to fillet.

THERMOCOUPLES AND HARNESS - MAINTENANCE PRACTICES

1. Removal/Installation

Equipment required :-

Torque wrench (40-300 lbf in.) ... T2EM1987BR

A. Remove thermocouples and harness

(1) Remove shroud panel from bottom of fillet and remove access panel in jet pipe fairing (see Chapter 71, POWER PLANT - GENERAL, Fig. 1 and 2).

(2) Disconnect both sets of harness take-off leads from terminal blocks on fillet.

CAUTION : DO NOT DISCONNECT TAKE-OFF LEADS FROM TERMINATION FITTING ON HARNESS.

(3) Slacken clamp bolts in jet pipe fairing and withdraw harness leads into jet pipe fairing.

(4) Remove jet pipe fairing.

(5) Remove attachment bolts securing the four harness clamp assemblies, blanking plates and seal washers to propelling nozzle.

(6) Release and remove harness clamps from conduits.

(7) Release tabwashers and unscrew attachment bolts from the five thermocouple housings and the termination fitting.

(8) Free the thermocouple housings from propelling nozzle, then withdraw thermocouple probes consecutively; start with probe adjacent to termination fitting.

(9) Lift harness away from propelling nozzle.

(10) Remove blanking plate from each clamp base location and discard its sealing washer.

(11) Blank the apertures in the propelling nozzle.

(12) Assemble blanking plates and harness clamps loosely to their respective positions on the conduits.

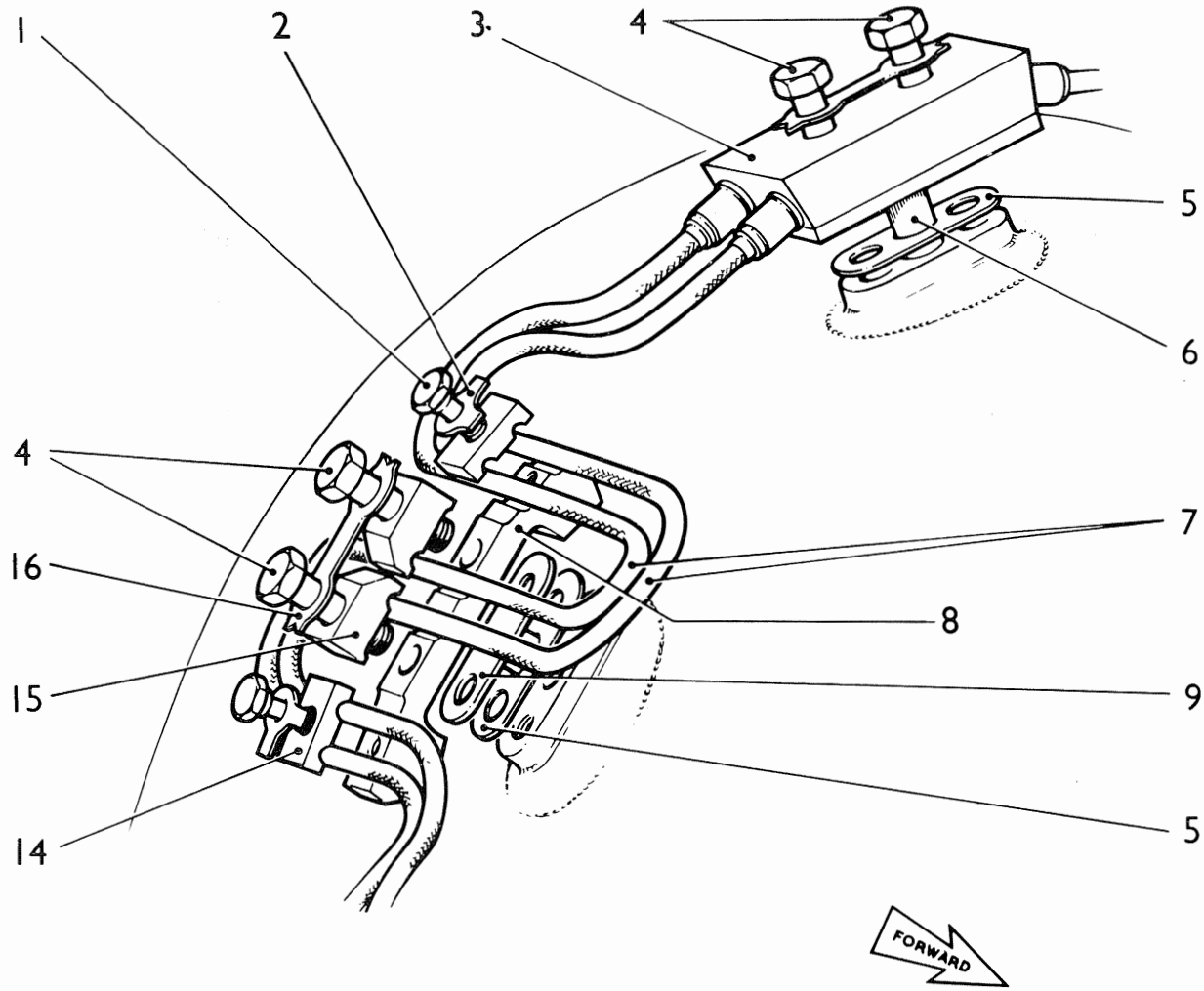
B. Install thermocouples and harness

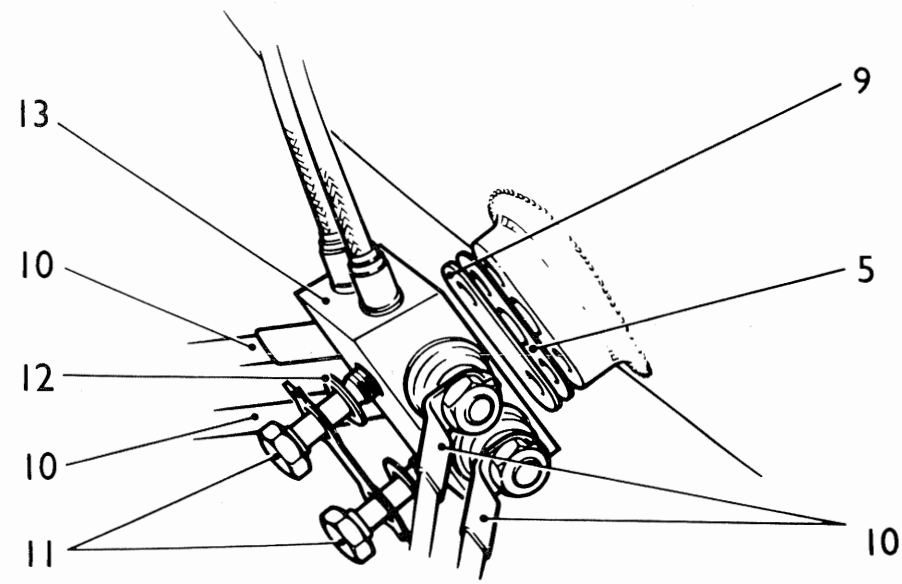
(1) Remove blanks from apertures in propelling nozzle.

(2) Examine gas entry holes in probes and ensure that they are not obstructed.

(3) Remove the loosely assembled harness clamps and blanking plates.

... Thermocouples and harness - Maintenance practices continued





1. WAISTED BOLTS.
2. TABWASHER.
3. THERMOCOUPLE HOUSING.
4. ATTACHMENT BOLTS.
5. SEALING WASHER.
6. THERMOCOUPLE PROBE.
7. HARNESS.
8. CLAMP BASE.
9. BLANKING PLATE.
10. TAKE-OFF LEADS (NOT TO BE REMOVED FROM THE HARNESS).
11. WAISTED ATTACHMENT BOLTS.
12. PLAIN WASHER.
13. TERMINATION FITTING.
14. CLAMP.
15. CLAMP.
16. TABWASHER.

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Thermocouple harness details
Fig. 201

... Thermocouples and harness - Maintenance practices continued

(4) Fit a new tabwasher to each pair of bolts on thermocouple housings and a tabwasher and plain washers to bolts on termination fitting. Lubricate and assemble attachment bolts (see Chapter 71, SERVICING MATERIALS).

(5) Fit a new sealing washer over each thermocouple probe, and a blanking plate and new sealing washer at termination fitting position. Offer up harness.

(6) Starting with probe adjacent to termination fitting, assemble thermocouple probes in propelling nozzle with blue leads facing forward. Ensure that termination fitting is correctly located according to engine position (refer to Fig. 202).

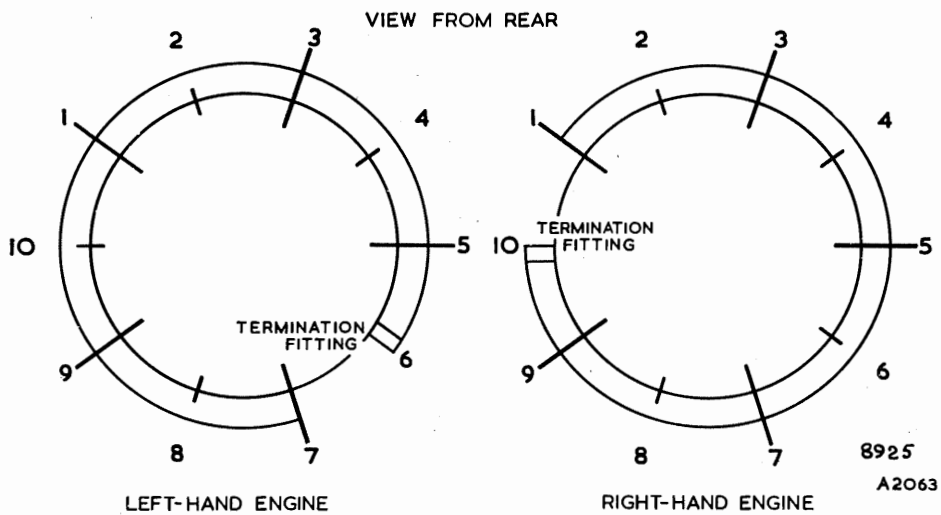
(7) Fit bolts and tabwashers to secure probes and termination fitting. Torque-tighten probe attachment bolts to 70-80 lbf in. and waisted termination fitting attachment bolts to 60-70 lbf in.; engage the tabwashers.

(8) Locate a clamp base under thermocouple harness; align attachment bolt holes with the tappings in propelling nozzle.

(9) Assemble a new sealing washer, blanking plate, clamps, tabwashers, attachment bolts and waisted bolts. Finally position clamps, then screw in bolts.

(10) Repeat operations (8) and (9) on remaining clamp assemblies. Torque-tighten waisted bolts to 30-35 lbf in. and attachment bolts to 70-80 lbf in.; engage tabwashers.

(11) Ensure that clearance between rear loops of harness and exhaust cone skin is within limits of 0.20 in. plus/minus 0.05 in.



... Thermocouples and harness - Maintenance practices continued

(12) Fit jet pipe fairing; check clearance between thermocouple harness conduit and fairing frame is not less than 0.25 in.

NOTE: Dress fairing if necessary to obtain this clearance.

(13) Feed harness leads through clamp on jet pipe fairing.

(14) Connect take-off leads to terminal blocks on fillet, ensuring that the leads do not foul aircraft structure (Fig.203 and Table 201). Do not lubricate bolt threads.

(15) Tighten harness clamp on jet pipe fairing.

(16) New harness fitted. Calibrate exhaust gas temperature indicating system with engine running (see Chapter 77,EXHAUST GAS TEMPERATURE INDICATION).

(17) Original harness refitted. Complete Tests B (8) and L of POWER PLANT GROUND RUNNING TESTS, Chapter 71

(18) Fit shroud panel to bottom of fillet.

2. Adjustment/Test

A. Test continuity resistance of thermocouples and harness

Equipment required :-

Precision Wheatstone bridge

(1) Record ambient air temperature.

NOTE : Engine must be cold before proceeding with this test.

(2) Remove shroud panel from bottom of fillet (see Chapter 71, POWER PLANT - GENERAL, Fig. 1 and 2).

(3) Disconnect in turn both sets of thermocouple harness leads from terminal blocks on fillet.

(4) Using Wheatstone bridge, note the resistance between each pair of positive and negative leads; reverse the polarity of the bridge and again note the resistances.

(5) Subtract the resistance of the bridge test lead from the readings obtained in operation (4).

(6) Average both resistance readings per circuit; the readings must be 3.05 $\pm$ 0.05 ohms at 20°C.

NOTE : For each 1°C ambient above 20°C add 0.002 ohms; subtract 0.002 ohms for each 1°C ambient below 20°C.

(7) Disconnect test equipment.

(8) Connect harness leads to terminal block (Fig. 203 and Table 201).

(9) Fit shroud panel to fillet.

... Thermcouples and harness - Maintenance practices continued

TB and circuit	Cable coding			Circuit details	Stack order
	TB end	Both	Away end		
LD4 TTC	4LD : M1	63	G	Inject, test point	1
	4LD : M1	63	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	F4 : LD4	4063	-A : TX	Amplifier -ve; blue tracer	4
				Take-off lead -ve; blue	5
LD2 JPT	2LD : M1	28	G	Inject, test point	1
	2LD : M1	28	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	M1 : LD2	4028	R10K : GG	Indicator -ve; blue tracer	4
				Take-off lead -ve; blue	5
LD3 TTC	3LD : M1	63	D	Inject, test point	1
	3LD : M1	63	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	F4 : LD3	4063	+A : TX	Amplifier +ve; red tracer	4
				Take-off lead +ve; red	5
LD1 JPT	1LD : M1	28	D	Inject, test point	1
	1LD : M1	28	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	M1 : LD1	4028	R6K : GG	Indicator +ve; red tracer	4
				Take-off lead +ve; red	5

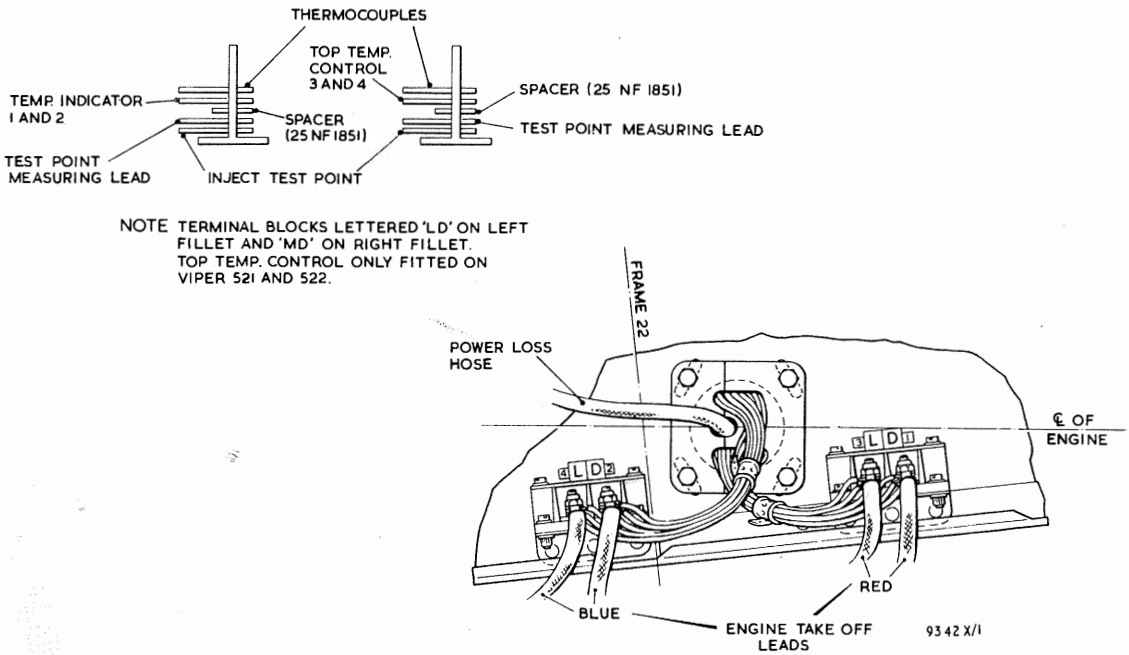
Engine No. 1 Terminal block details (Left fillet)
Table 201 - sheet 1

... Thermocouples and harness - Maintenance practices continued

TB and circuit	Cable coding			Circuit details	Stack order
	TB end	Both	Away end		
MD1 JPT	1MD : M2	28	D	Inject, test point	1
	1MD : M2	28	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	M2 : MD1	4028	R1K : GG	Indicator +ve; red tracer	4
				Take-off lead +ve; red	5
MD3 TTC	3MD : M2	63	D	Inject, test point	1
	3MD : M2	63	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	F4 : MD3	4063	+A : TX	Amplifier +ve; red tracer	4
				Take-off lead +ve; red	5
MD2 JPT	2MD : M2	28	G	Inject, test point	1
	2MD : M2	28	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	M2 : MD2	4028	R5K : GG	Indicator -ve; blue tracer	4
				Take-off lead -ve; blue	5
MD4 TTC	4MD : M2	63	G	Inject, test point	1
	4MD : M2	63	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	F4 : MD4	4063	-A : TY	Amplifier -ve; blue tracer	4
				Take-off lead -ve; blue	5

Engine No. 2 Terminal block details (Right fillet)
Table 201 - sheet 2

... Thermocouples and harness - Maintenance practices continued



Stacking thermocouple cables
Fig. 203

B. Test insulation resistance of thermocouples and harness

Equipment required :-

250V d.c. resistance tester.

(1) Remove shroud panel from bottom of fillet (see Chapter 71, POWER PLANT GENERAL, Fig. 1 and 2).

(2) Disconnect in turn, both sets of thermocouple harness leads from terminal blocks in fillet.

(3) Using resistance tester note the resistance between each take-off lead and earth; resistance must not be less than 20 000 ohms for a new harness or 10 000 ohms for a used harness.

NOTE : If reading is less than this, check again after engine run.

(4) Disconnect test equipment.

(5) Connect harness leads to correct terminal (Fig. 203 and Table 201).

(6) Fit shroud panel to fillet.

THERMOCOUPLES AND HARNESS - MAINTENANCE PRACTICES

1. Removal/Installation

Equipment required:

Torque wrench (40-300 lbf.in.) T2EM1987BR

A. Remove thermocouple and harness

(1) Remove shroud panel from bottom of fillet and remove access panel in jet pipe fairing (see Chapter 71, POWER PLANT - GENERAL, Fig.1 and 2).

(2) Disconnect both sets of harness take-off leads from terminal blocks on fillet.

CAUTION: DO NOT DISCONNECT TAKE-OFF LEADS FROM TERMINATION FITTING ON HARNESS.

(3) Slacken clamp bolts in jet pipe fairing and withdraw harness leads into jet pipe fairing.

(4) Remove jet pipe fairing, exercising care to avoid fouling thermocouple flexible take-off leads.

(5) Remove attachment bolts securing the four harness clamp assemblies to propelling nozzle.

(6) Release and remove harness clamps from conduits.

(7) Release tabwashers and unscrew attachment bolts from the four thermocouple housings and combined thermocouple housing and termination fitting.

(8) Free thermocouple housings from propelling nozzle, then withdraw thermocouple probes consecutively; start with probe adjacent to termination fitting.

(9) Lift harness away from propelling nozzle.

(10) Mod. CV.7284 engines (Viper 522) Remove blanking plate from each clamp base and discard its sealing washer.

(11) Blank the apertures in propelling nozzle.

(12) Assemble harness clamps loosely to their respective positions on conduits.

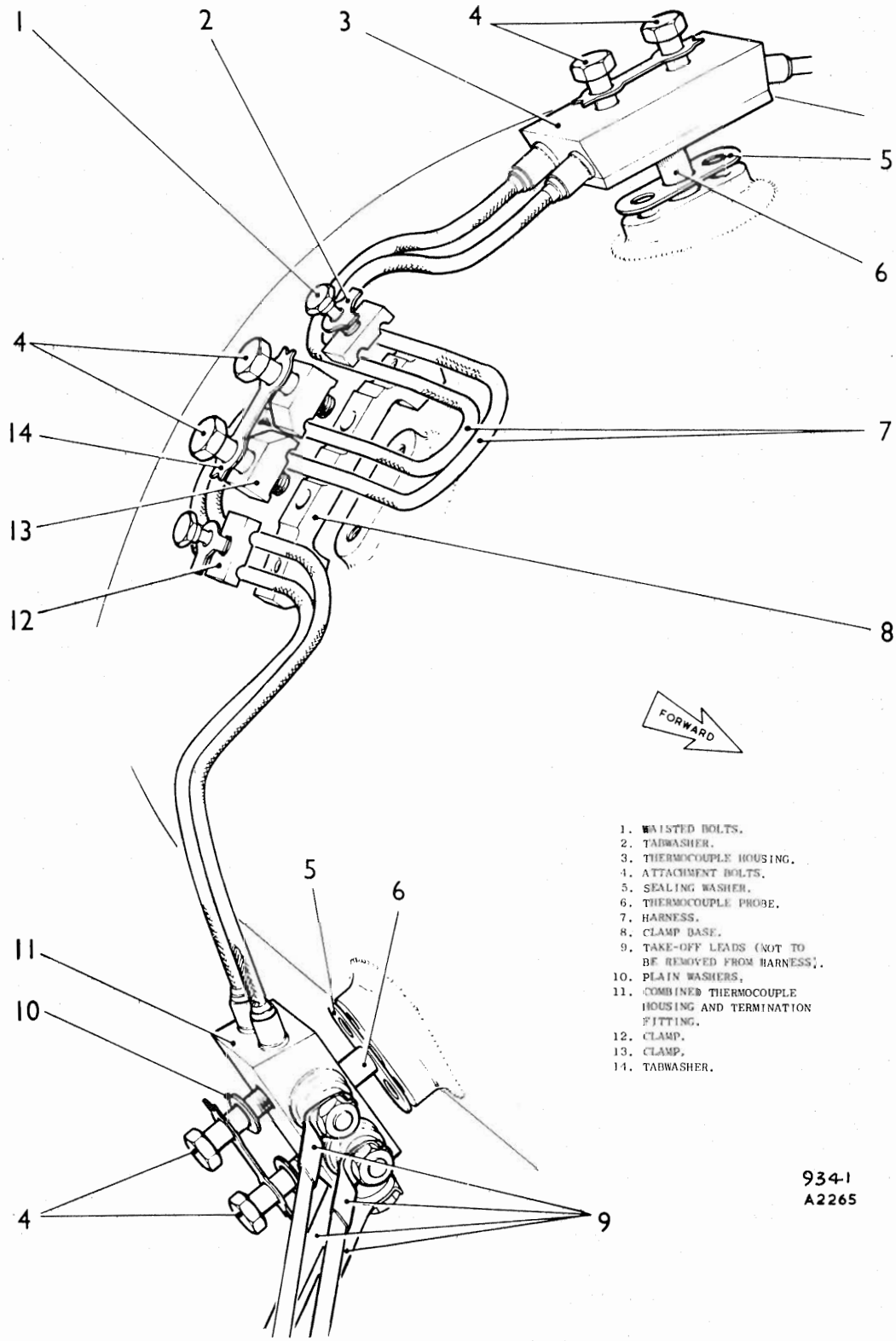
B. Install thermocouples and harness

(1) Remove blanks from the apertures in propelling nozzles.

(2) Examine gas entry holes in probes for freedom from obstruction.

(3) Remove the loosely assembled harness clamps and (Mod. CV. 7284 engines - Viper 522) the associated blanking plates.

...Thermocouples and harness - Maintenance practices continued



1. WAISTED BOLTS.
2. TABWASHER.
3. THERMOCOUPLE HOUSING.
4. ATTACHMENT BOLTS.
5. SEALING WASHER.
6. THERMOCOUPLE PROBE.
7. HARNESS.
8. CLAMP BASE.
9. TAKE-OFF LEADS (NOT TO BE REMOVED FROM HARNESS).
10. PLAIN WASHERS.
11. COMBINED THERMOCOUPLE HOUSING AND TERMINATION FITTING.
12. CLAMP.
13. CLAMP.
14. TABWASHER.

Thermocouple harness
Fig.201

...Thermocouples and harness - Maintenance practices continued

(4) Fit new tabwasher to each pair of bolts on thermocouple housings, and tabwasher and plain washers to bolts on termination fitting. Lubricate and assemble attachment bolts (see Chapter 71, SERVICING MATERIALS).

(5) Fit new sealing washer over each thermocouple probe, then offer up harness.

(6) Starting with combined probe and termination fitting, assemble thermocouple probes in propelling nozzle with blue leads facing forward. Ensure that combined probe and termination fitting is correctly located according to engine position and modification standard (refer to Fig.201).

(7) Fit bolts and tabwashers to secure probes and combined probe and termination fitting. Torque-tighten attachment bolts to 70 - 80 lbf.in.; engage the tabwashers.

(8) Locate a clamp base under thermocouple harness, aligning attachment holes with the tappings in propelling nozzle. On Mod. CV.7284 engines (Viper 522) fit a blanking plate and new sealing washer (see Chapter 77-21-14, Fig.201).

(9) Assemble clamps, attachment bolts, waisted bolts and tabwashers; engage the bolts.

(10) Repeat operations (8) and (9) on remaining clamp assemblies. Torque-tighten clamp attachment bolts to 70 - 80 lbf.in. and waisted bolts to 30 - 35 lbf.in.; engage the tabwashers.

(11) On Mod. CV.7284 engines (Viper 522) ensure that redundant boss is properly blanked with blanking plate and sealing washer.

(12) Ensure that distance between rear loops of harness and exhaust cone skin is within limits of 0.20 in. plus/minus 0.05 in.

(13) Fit jet pipe fairing, exercising care not to damage the thermocouple harness take-off leads. Check clearance between thermocouple harness conduit and fairing frame is not less than 0.25 in.

NOTE: Dress fairing, if necessary, to obtain this clearance.

(14) Remove the tape holding the flexible take-off leads to the engine and feed harness leads through clamp on jet pipe fairing.

(15) Connect take-off leads to terminal blocks on fillet (Fig.203 and Table 201) ensure that leads do not foul aircraft structure. Do not lubricate bolt threads.

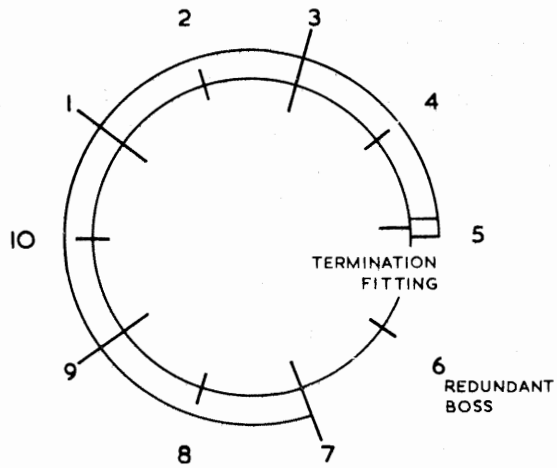
(16) Tighten harness clamp on jet pipe fairing.

(17) New harness fitted. Calibrate exhaust gas temperature indicating system - engine running (see Chapter 77, EXHAUST GAS TEMPERATURE INDICATION).

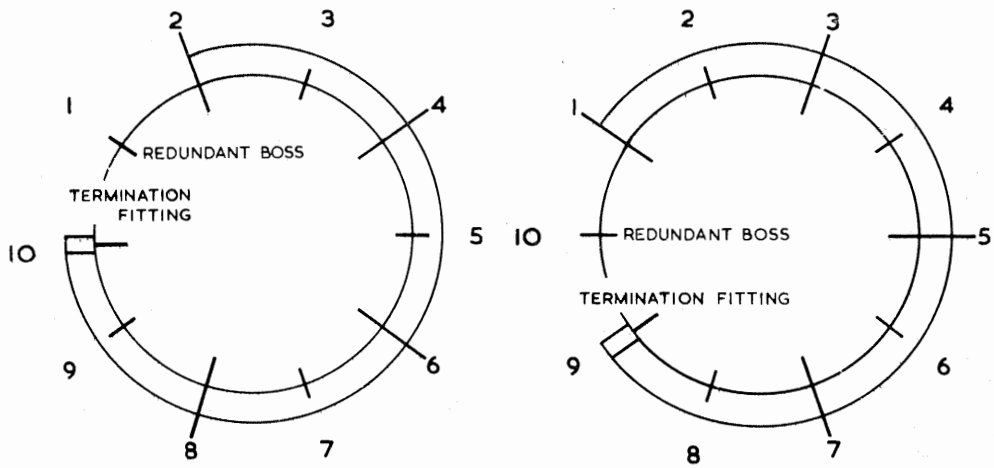
(18) Original harness fitted. Complete Tests B(8) and L of Ground Running Tests - Chapter 71.

(19) Fit shroud panel to bottom of fillet.

...Thermocouples and harness - Maintenance practices continued



LEFT-HAND ENGINE
(VIEWED FROM REAR)



PRE-MOD CV 7284

RIGHT-HAND ENGINE
(VIEWED FROM REAR)

MOD CV 7284
(VIPER 522 ONLY)

Fitting thermocouple harness
Fig.202

...Thermocouples and harness - Maintenance practices continued

TB and circuit	Cable coding			Circuit details	Stack order
	TB end	Both	Away end		
LD4 TTC	4LD : M1	63	G	Inject, test point	1
	4LD : M1	63	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	F4 : LD4	4063	-A : TX	Amplifier -ve; blue tracer	4
				Take-off lead -ve; blue	5
LD2 JPT	2LD : M1	28	G	Inject, test point	1
	2LD : M1	28	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	M1 : LD2	4028	R10K : GG	Indicator -ve; blue tracer	4
				Take-off lead -ve; blue	5
LD3 TTC	3LD : M1	63	D	Inject, test point	1
	3LD : M1	63	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	F4 : LD3	4063	+A : TX	Amplifier +ve; red tracer	4
				Take-off lead +ve; red	5
LD1 JPT	1LD : M1	28	D	Inject, test point	1
	1LD : M1	28	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	M1 : LD1	4028	R6K : GG	Indicator +ve; red tracer	4
				Take-off lead +ve; red	5

Engine No.1 Terminal block details (Left fillet)
Table 201 - Sheet 1

...Thermocouples and harness - Maintenance practices

TB and circuit	Cable coding			Circuit details	Stack order
	TB end	Both	Away end		
MD1 JPT	1MD : M2	28	D	Inject, test point	1
	1MD : M2	28	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	M2 : MD1	4028	R1K : GG	Indicator +ve; red tracer	4
				Take-off lead +ve; red	5
MD3 TTC	3MD : M2	63	D	Inject, test point	1
	3MD : M2	63	I	Measure, test point (CH red)	2
	-	-	-	Spacer	3
	F4 : MD3	4063	+A : TX	Amplifier +ve; red tracer	4
				Take-off lead +ve; red	5
MD2 JPT	2MD : M2	28	G	Inject, test point	1
	2MD : M2	28	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	M2 : MD2	4028	R5K : GG	Indicator -ve; blue tracer	4
				Take-off lead -ve; blue	5
MD4 TTC	4MD : M2	63	G	Inject, test point	1
	4MD : M2	63	J	Measure, test point (AL blue)	2
	-	-	-	Spacer	3
	F4 : MD4	4063	-A : TY	Amplifier -ve; blue tracer	4
				Take-off lead -ve; blue	5

Engine No.2 Terminal block details (Right fillet)
Table 201 - Sheet 2

...Thermocouples and harness - Maintenance practices continued

2. Adjustment/Test

A. Test continuity resistance of thermocouples and harness

Equipment required :-

Precision Wheatstone bridge

(1) Record ambient air temperature.

NOTE : Engine must be cold before proceeding with this test.

(2) Remove shroud panel from bottom of fillet (see Chapter 71, POWER PLANT - GENERAL, Fig.1 and 2).

(3) Disconnect, in turn, both sets of thermocouple harness leads from terminal blocks on fillet.

(4) Using Wheatstone bridge, note the resistance between each pair of positive and negative leads; reverse the polarity of the bridge and again note the resistances.

(5) Subtract the resistance of the bridge test lead from the readings obtained in operation (4).

(6) Average both resistance readings per circuit; the readings must be 3.05 $\pm$ 0.05 ohms at 20°C.

NOTE : For each 1°C ambient above 20°C add 0.002 ohms; subtract 0.002 ohms for each 1°C ambient below 20°C.

(7) Disconnect test equipment.

(8) Connect harness leads to terminal block (Fig.203 and Table 201).

(9) Fit shroud panel to fillet.

B. Test insulation resistance of thermocouples and harness

Equipment required :-

250V d.c. resistance tester

(1) Remove shroud panel from bottom of fillet (see Chapter 71, POWER PLANT - GENERAL, Fig.1 and 2).

(2) Disconnect, in turn, both sets of thermocouple harness leads from terminal blocks in fillet.

...Thermocouples and harness - Maintenance practices continued

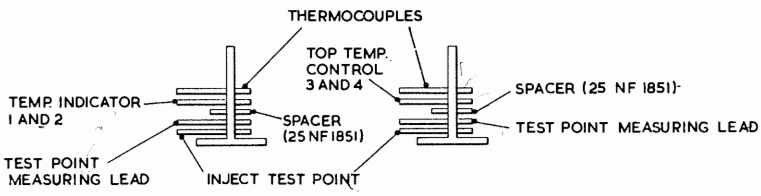
(3) Using resistance tester note the resistance between each take-off lead and earth; resistance must not be less than 20,000 ohms for a new harness or 10,000 ohms for a used harness.

NOTE : If reading is less than this, check again after engine run.

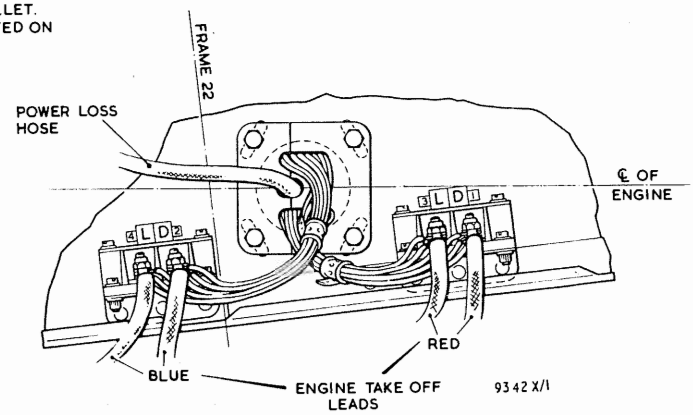
(4) Disconnect test equipment

(5) Connect harness leads to correct terminal (Fig.202).

(6) Fit shroud panel to fillet.



NOTE TERMINAL BLOCKS LETTERED 'LD' ON LEFT FILLET AND 'MD' ON RIGHT FILLET. TOP TEMP. CONTROL ONLY FITTED ON VIPER 521 AND 522.



Stacking thermocouple cables
Fig.203

* * *

INDICATOR - MAINTENANCE PRACTICES

1. Removal/Installation

NOTE : After installing a new indicator calibrate the system - engine static (see EXHAUST GAS TEMPERATURE INDICATION). On completion of static calibration calibrate the indicating system (in conjunction with the t.t.c.) with the engine running (see TOP TEMPERATURE CONTROL SYSTEM, Chapter 73).

* * *

BALLAST RESISTOR - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Adjust resistance of ballast resistor

NOTE : This procedure is necessary when the circuit resistance test is unsatisfactory (see Chapter 77, EXHAUST GAS TEMPERATURE INDICATION)

(1) Gain access to rear equipment bay.

(2) Locate terminal block K, on panel GG, situated on rear face of pressure dome.

NOTE : The resistor for No.1 engine is mounted on terminals K7 and K8, while that for No.2 engine is on terminals K2 and K3.

(3) Unscrew the two retaining nuts and remove the resistor.

(4) If circuit resistance is too high - Reduce length of wire on spool.

(a) Slacken screw on ballast resistor and disconnect wire.

(b) Unwind and cut off appropriate length of wire from spool.

NOTE : Wire resistance is approximately 4.9 ohms/yd.

(c) Remove cotton and shellac insulation from free end of wire.

(d) Connect wire to ballast resistor frame and tighten screw.

(e) Install resistor, torque-tighten retaining nuts to 9 lb. in.

(f) Test circuit resistance, and repeat operations (3) and (4), if necessary, until resistance is within limits.

(5) If resistance is low - Install serviceable resistor and reduce length as necessary; see operation (4).

* * *

TURBINE OVERHEAT WARNING SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test

NOTE : Avoid bending the thermocouple wires.

A. Test system - with engine static

(1) Energize d.c. and a.c. busbars to system - see Chapter 24.

(2) Depress test switch, and check that warning lamp lights and remains alight.

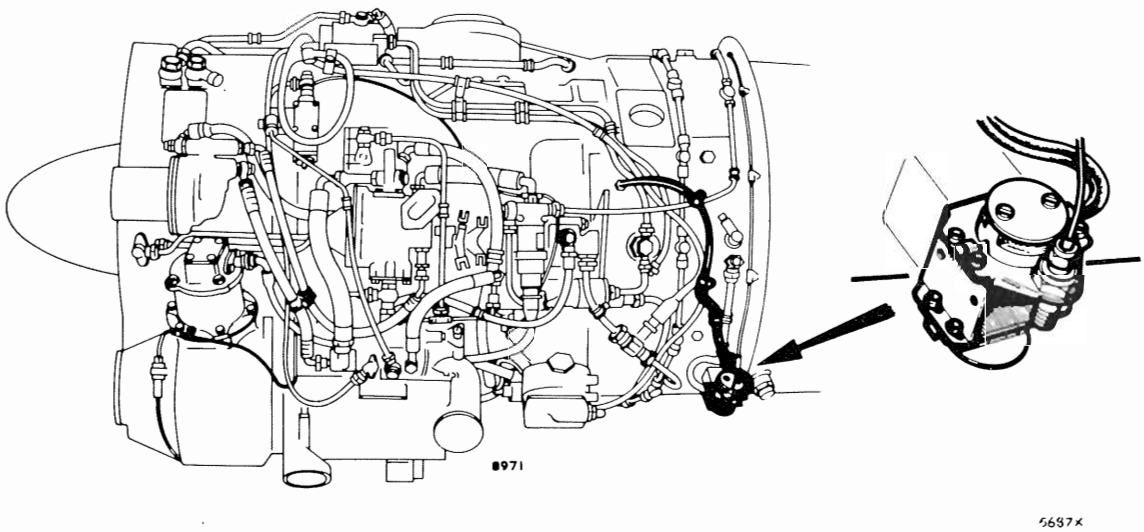
(3) Release test switch, and check that warning lamp goes out.

B. Test failure warning unit

(1) Disconnect the thermocouple leads from the thermocouple cable connector.

(2) Connect a standard thermocouple test set, in series, to the thermocouple terminals.

(3) Switch on the test set and gradually increase its output, and check that when the warning lamp lights the temperature indicated by the test set is $300 \pm 4^{o}C$.



Location of turbine overheat thermocouple cable connector
Fig.201

(4) Switch off and disconnect test set.

(5) Connect the thermocouple leads to the failure warning unit.

(6) Test system - see para.1.A.

* * *

TURBINE OVERHEAT WARNING SYSTEM THERMOCOUPLE CABLE - APPROVED REPAIRS - SALVAGE SCHEME No. V40161

1. Restore turbine overheat thermocouple cable unit outer casing

A. General

(1) Applicable to Unit No. B.342616

(2) This repair may be used to restore the thermocouple cable unit outer casing by binding with Rapidon binder.

B. Disconnect cable

(1) Release the lock screws securing the terminal block cover. Remove the cover.

(2) Release the lock screws and the cable clamp securing the thermocouple leads to the terminal block.

C. Repair cable outer casing

(1) Expand a sleeve MP.102268 or MP.107093

(2) Feed the cable through the sleeve smallest diameter until the sleeve has passed over, and is clear of the damaged area.

(3) Bind the damaged area of cable with Rapidon binder.

(4) Reposition the sleeve so that its largest diameter overlaps the Rapidon binder.

(5) Expand a sleeve MP.107093

NOTE : Use sleeve MP.707717 if the sleeve already installed is MP.102268.

(6) Feed the cable through the sleeve large diameter until it overlaps the Rapidon binder.

D. Connect cable

(1) Position the cable terminal eyelets on the terminal block and secure them with lock screws and washers.

NOTE : The positive lead has a 2 B.A. eyelet and the negative lead has a 4 B.A. eyelet.

(2) Secure the cable to the terminal block with the cable clamp.

(3) Secure the terminal block cover with the lock screws.

E. Complete salvage

(1) Record the salvage number V.40161 in the engine log book.

* * *

POWER LOSS INDICATION - MAINTENANCE PRACTICES

1. Servicing

Drain water from power loss system pressure piping (Fig.201)

NOTE : Malfunctioning of the power loss system (particularly in flight, due to icing) is likely if water is allowed to accumulate in the system piping. The following procedure is intended to be used at intervals as specified in the Maintenance Schedule or if the system malfunctions.

(1) Disconnect power loss hose at adapter on engine exhaust .

(2) Disconnect hose at power loss indicator.

(3) Connect a dry air supply to the power loss hose - indicator end.

(4) Apply an air pressure of 10 lb/sq.in. approx. to the power loss system.

(5) With pressure maintained, open drain in nose gear bay until all water is drained; close drain.

(6) Repeat operation (5) for drain in wing fillet and then rear equipment bay.

(7) With all drains closed connect power loss hose at adapter on engine exhaust and allow air to blow through.

(8) Switch off air supply and disconnect from the power loss hose.

(9) Connect hose to power loss indicator.

(10) During next engine run, check power loss indicator functions satisfactorily.

2. Adjustment/Test

NOTE : For tests on static pressure piping see Chapter 34 PITOT/STATIC SYSTEM.

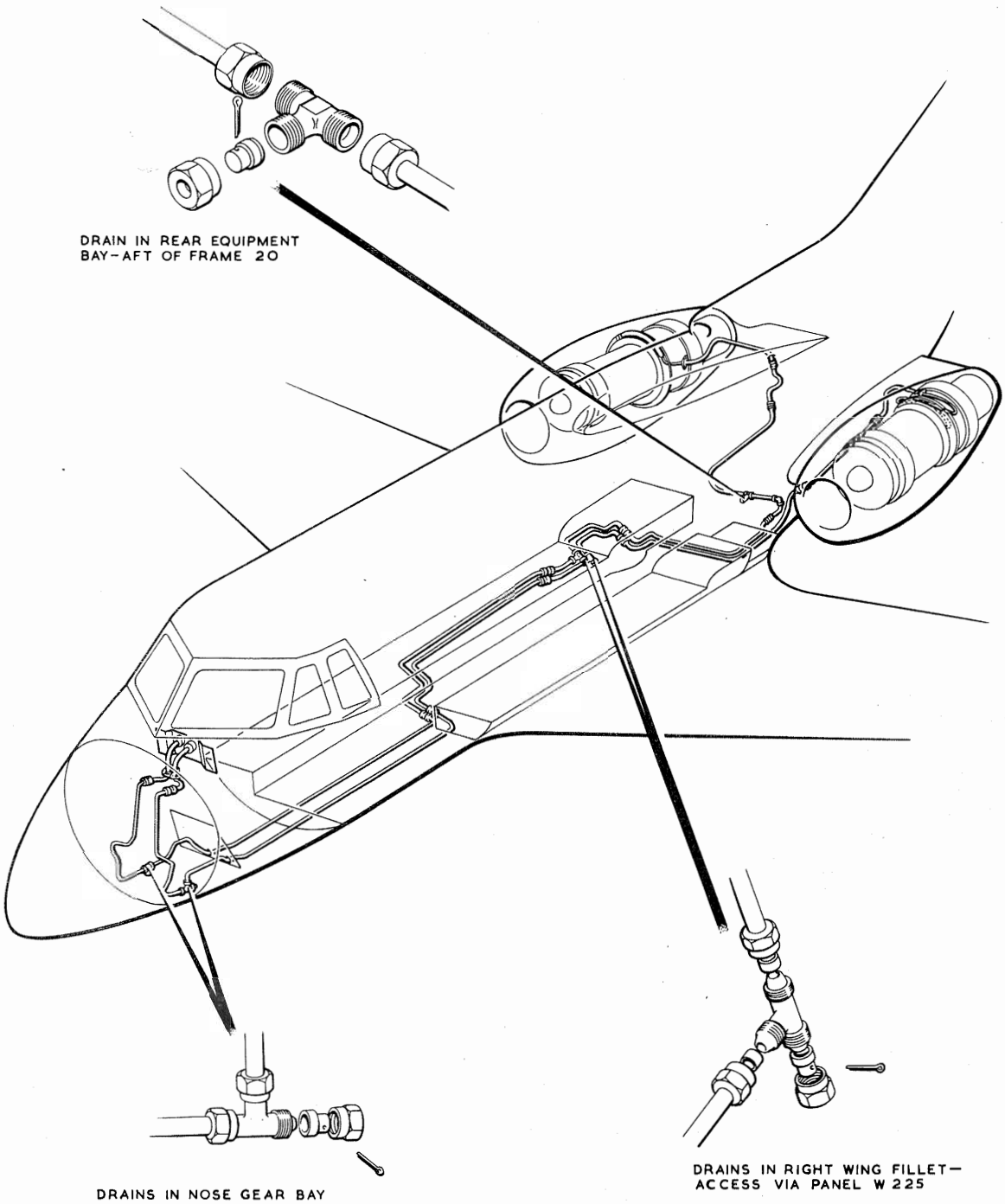
A. Pressure test power loss system pressure piping

(1) Disconnect power loss hose at appropriate power loss indicator.

(2) Disconnect power loss hose at adapter on engine exhaust.

(3) Connect a clean, dry air supply to the power loss system pressure piping (engine end) and check that the pipeline is unobstructed.

(4) Connect and lock power loss hose to power loss indicator.


DRAIN IN REAR EQUIPMENT BAY-AFT OF FRAME 20
DRAINS IN NOSE GEAR BAY
DRAINS IN RIGHT WING FILLET-ACCESS VIA PANEL W 225
5928

...Power loss indication - Maintenance practices continued

(5) Gradually apply a pressure of 25 lb/sq.in. to power loss piping and check that power loss indicator registers full pressure and there are no leaks.

NOTE: If leaks exist locate with a 5% solution of Lensodel A in distilled water and rectify as necessary. Clean off leak detecting fluid with distilled water.

(6) Release pressure and disconnect test equipment.

(7) Connect and lock power loss hose to adapter on engine exhaust.

3. Removal/Installation

A. Power loss pitot

NOTE: This component is on the engine exhaust cone; see Chapter 72 ENGINE GENERAL - SERVICING.

* * *

POWER LOSS PIPING - MAINTENANCE PRACTICES

1. Removal/Installation

Special Tools and Equipment

Tension wrench PE.25491

A. Remove Power Loss Pitot

(1) Disconnect the power loss hose from the power loss pitot elbow.

(2) Remove the retaining bolts securing the elbow and pitot to the propelling nozzle.

(3) Remove the elbow and its seal washer then withdraw the pitot together with the second seal washer, from the propelling nozzle. Discard the seal washers.

B. Install Power Loss Pitot

(1) Position a new seal washer on the power loss pitot then insert the pitot into the propelling nozzle and position it so that its inlet faces towards the turbine wheel.

(2) Position a new seal washer on the pitot mounting flange then install the elbow with its connection facing forward.

(3) Install the retaining bolts then torque-load them to 60 to 70 lb.in.

(4) Wire-lock the retaining bolts together.

(5) Connect the power loss hose to the power loss pitot.

* * *

PIPE ASSEMBLY (EXHAUST CONE STATIC PRESSURE INDICATION) - MAINTENANCE PRACTICES

NOTE : For removal/installation of these pipes see Chapter 72-00-01 page 301 block.

* * *

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Chapter 79

OIL

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* No separate description
\+ No separate maintenance practices

* * *

OIL - GENERAL

General

Refer to Chapter 72 for description and maintenance practices of all parts of the lubrication system except for 'Indicating', which is given in this chapter, and 'Servicing - Engine Oil' (replenishment) which is given in Chapter 12.

* * *

PIPES - MAINTENANCE PRACTICES

1. General

For general procedures for installing pipes, see Chapter 71 - Pipes - General.

2. Removal/Installation

Special tools and equipment :-

Drain adapter and pipe for oil tank PE.22712

A. Remove oil outlet pipe (oil tank to oil pump assembly)

(1) Gain access to the engine and place a tray beneath the engine.

(2) Drain the oil tank (see Chapter 72 - LUBRICATION SYSTEM).

(3) Release the outlet pipe support clips and bonding cable. Take care not to lose the distance piece from the scavenge oil return pipe support clip.

NOTE : The outlet pipe support clip attached to the scavenge oil return pipe also secures the Firewire support clip.

(4) Release the outlet pipe union nuts then lift the pipe away from the engine.

(5) Remove and discard the O-seals from the outlet pipe and the bonded seal from the oil pump inlet union.

(6) Blank all apertures.

B. Install oil outlet pipe (oil tank to oil pump assembly

(1) Lubricate (see Chapter 71 - SERVICING MATERIALS) and install new O-seals on the outlet pipe.

(2) Remove the blank from the oil tank outlet union and the oil pump inlet union.

(3) Position a new bonded seal on the oil pump inlet union.

(4) Connect the outlet pipe to the oil tank and oil pump and tighten the union nuts as far as possible by hand.

(5) Tighten and wire-lock the pipe union nuts. Do not over-tighten the pipe union nuts.

(6) Secure the pipe support clip to the support on the oil tank filler drain pipe.

(7) Insert a retaining bolt through the scavenge oil return pipe support clip then position the distance piece, outlet pipe support clip and Firewire support clip on the bolt. Secure the clips together with a stiffnut.

...Oil pipes - Maintenance practices continued

(8) Connect the bonding cable to the outlet pipe.

(9) Replenish the oil system (see Chapter 12, SERVICING - ENGINE OIL).

(10) Complete Test J given in Chapter 71 POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS.

* * *

INDICATING - DESCRIPTION AND OPERATION

1. General

Indication is given, in the flight compartment, of engine oil pressure, low oil pressure and oil temperature (Fig.1).

Ratiometer type instruments are used for oil pressure and temperature indication. A red lamp indicates low oil pressure.

2. Oil pressure

The oil pressure transmitter comprises a hydraulically-operated bellow unit which in turn operates a variable resistor.

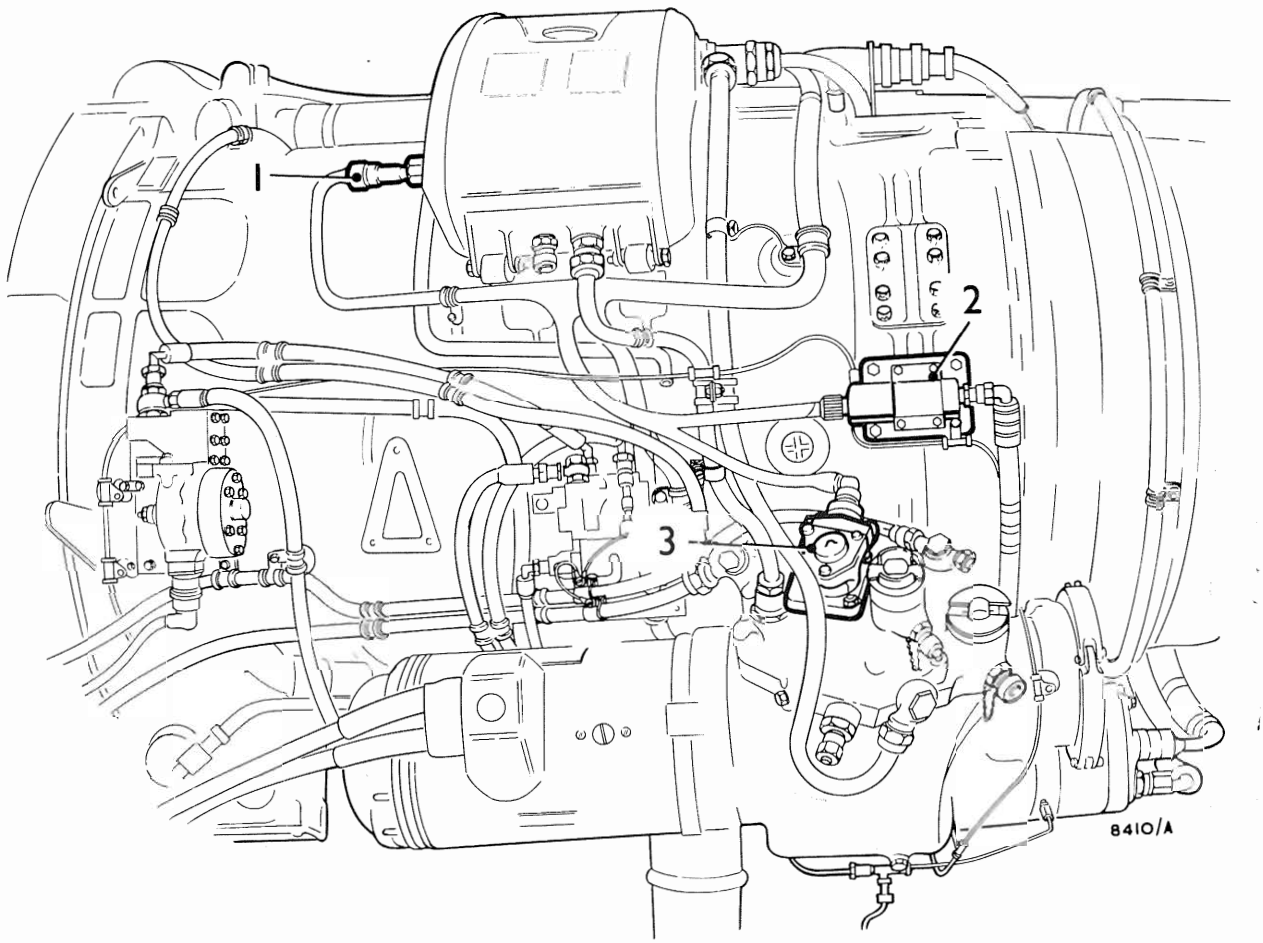
3. Low oil pressure

The low oil pressure switch, of the non-differential type, is set to operate at pressures of 6 ± 0.5 lb/sq.in. and below. One channel, of a three channel delay unit, is interposed between the transmitter and indicators. If low oil pressure occurs the relevant warning lamp lights, the 'central attention getting system' is activated (see Chapter 33) and, on aircraft pre-mod.252053 but post mod.251924, the relevant h.p. fuel valve control lever warning lamp lights.

4. Oil temperatures

The oil temperature transmitter is a platinum wire wound resistance bulb.

Fig.1 overleaf



1. OIL TEMPERATURE BULB
2. OIL PRESSURE TRANSMITTER
3. OIL LOW-PRESSURE WARNING SWITCH 3735/1

Lubricating system indicating transmitter
Fig.1

OIL PRESSURE TRANSMITTER - MAINTENANCE PRACTICES

1. Removal/Installation

Materials required :

For lubricants, jointing compounds, etc. see Chapter 71, SERVICING MATERIALS.

A. Remove oil pressure transmitter

(1) Isolate the transmitter electrical circuit (see Chapter 24, GENERAL).

(2) Gain access to the engine.

(3) Disconnect the electrical cable from the transmitter.

(4) Disconnect the flexible oil pipe from the transmitter and blank the connections.

(5) Support the unit and remove the retaining nuts and spring washers; this will also release the two Firewire support clips.

(6) Withdraw the transmitter complete with its mounting bracket.

(7) Clean the jointing compound from the mounting faces on the transmitter mounting bracket and air intake casing.

B. Install oil pressure transmitter

(1) Examine the unit for cleanliness and freedom from damage. Pay particular attention to the pressure inlet port and three-pin socket connector.

(2) Apply approved jointing compound to the transmitter mounting bracket and air intake casing.

(3) Lubricate the transmitter securing-stud threads and position the transmitter and mounting bracket over the studs on the air intake casing.

(4) Locate the two Firewire support clips on the two top studs. Fit the spring washers and retaining nuts. Torque-load the nuts to 40 to 45 lbf.in.

(5) Remove the blanks and connect and tighten the flexible oil pipe to the transmitter. Wire-lock the union nut.

(6) Connect and tighten the electrical cable to the transmitter. Check that the leaf-spring locking of the cable nut is effective.

(7) Restore the transmitter electrical circuit.

NOTE : If the type of transmitter installed is S.122-1-124 AA it will be necessary to bleed the system as follows :-

...Oil pressure transmitter - Maintenance practices continued

(8) Release the locking wire securing the bleed screw at the unit data plate position, noting the locking method used.

(9) With the engine running at idle, open the bleed screw until oil emerging from the bleed screw is free from air bubbles.

(10) Tighten the bleed screw to 5 lbf.in. and wire-lock using the method noted on removal.

(11) Complete Test J of Chapter 71, POWER PLANT ADJUSTMENT/TEST - Ground running tests.

C. Remove anti-vibration mountings

(1) Remove oil pressure transmitter from the engine (see para.1.A.).

(2) Release and remove the four special nuts and locking plates from the transmitter retaining studs; take care not to lose the four plain washers located between the transmitter base and the anti-vibration mountings. Discard the locking plates.

(3) Release and remove the special nuts securing the anti-vibration mountings to the transmitter mounting block.

(4) Withdraw the anti-vibration mountings from their locations on the transmitter mounting block; take care not to lose the plain washers located between the anti-vibration mountings and the mounting block.

(5) Discard the rejected anti-vibration mountings.

D. Install anti-vibration mountings

(1) Examine the anti-vibration mountings for cleanliness, signs of deterioration in the rubber cushions and freedom from damage.

NOTE : Renew all anti-vibration mountings where the rubber cushions are cracked, damaged or showing any other signs of deterioration.

(2) Lubricate the anti-vibration mounting studs with clean approved engine oil.

(3) Assemble the plain washers to the anti-vibration mounting studs then locate the mountings on the transmitter mounting block.

(4) Secure the anti-vibration mountings to the transmitter mounting block with special nuts.

(5) Install the plain washers to the transmitter retaining studs then locate the transmitter over the studs.

(6) Secure the transmitter to the anti-vibration mounting with the special nuts and locking plates.

(7) Install the oil pressure transmitter to the engine (see para.1.B.).

* * *

OIL TEMPERATURE BULB - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove oil temperature bulb

(1) Isolate temperature bulb electrical circuit (see Chapter 24, GENERAL).

(2) Gain access to the engine.

(3) Drain the oil tank.

(4) Disconnect the electrical cable from the bulb.

(5) Release the temperature bulb retaining nut and withdraw the bulb from the oil tank. Blank the tank connection.

B. Install oil temperature bulb

(1) Examine the glass seal and connection pins for freedom from damage and ensure that the glass seal is free from moisture.

(2) Insert the temperature bulb into the oil tank and secure it with the retaining nut. Torque load the retaining nut to 8-10 lbf.in. and wire-lock.

(3) Connect and secure the electrical connection to the temperature bulb. Secure with locking wire.

(4) Fill the oil tank (see Chapter 12, OIL).

(5) Restore the temperature bulb electrical supplies (see Chapter 24, GENERAL).

(6) Complete Test J of POWER PLANT ADJUSTMENT/TEST ground running tests Chapter 71.

2. Adjustment/Test

A. Test continuity resistance of oil temperature bulb

(1) Use an ohmmeter to measure the continuity resistance between the electrical plug pins. The resistance at 20°C should be approximately 140 ohms.

CAUTION: THE CURRENT FROM THE OHMMETER MUST NOT EXCEED 20 MILLIAMPERES.

(2) Reject the temperature bulb if the correct resistance value is not obtained.

B. Test insulation resistance of temperature bulb

(1) Using a 250 volt Megger, measure the insulation resistance between either plug pin and the stainless steel tube. The resistance must not be less than 20 megohms.

(2) Reject the temperature bulb if the insulation is defective.

* * *

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Chapter 80

STARTING

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STARTING - GENERAL

(Mod.2511971)

1. Description

The engine starting system enables each engine to be cranked to self-sustaining speed through the use of its starter generator operating in the starter mode. Electrical supply for the starter may be derived from external or internal d.c. sources. The system comprises master and selector switches, contactors, relays, lamps and equipment to ignite the fuel.

Whenever possible, an external power supply of 28.5V d.c., having a capacity sufficient to withstand the heavy current drain made upon it during starting, should be used for cranking. In the absence or failure of external power supplies, a switch and contactors arrangement designed into the system permits cranking by utilizing supplies from the aircraft batteries; during internal starting No.1 and No.2 aircraft batteries are connected in series, so providing a nominal 48 volts d.c. for starting but which is considerably reduced during the initial start period by the large voltage drop across the starter motor.

The igniter or standby battery, 24 volts 2.5 A.H., ensures that a 24 volt potential is available to provide electrical power for the selector, master, and time delay switches, and the igniters and spray rings.

An internal start must not be attempted should the INTERNAL START AVAILABLE lamp remain unlit after selection of the BATTERY CHANGE-OVER switch to the START position. The system is designed to prohibit the direct use of the output from one engine's generator during cranking of the remaining engine.

2. Operation (See Fig.1)

A. Preparation for cranking using external ground supply

With the external ground supply connected to the aircraft system via the ground supply plug, switching 'on' the supply, with the GROUND/FLIGHT switch set to GROUND, will cause energization of the GROUND SUPPLIES, PS/STARTER BUSTIE and PE/PS BUSTIE contactors, with the consequent energization of PS, PE, and STARTER busbars. The aircraft voltmeter will register external ground supply voltage.

It must be noted that when using external supplies for cranking, both generators will be held off-line until the GROUND/FLIGHT switch is set to FLIGHT; this action will cause de-energization of the PS/STARTER BUSTIE contactor and thus allow completion of each g.s.u. main contactor coil supply through the PS/STARTER BUSTIE auxiliary contacts, and normal operation of the g.s.u. will ensue.

B. Preparation for cranking using internal start facility

In order to utilize this facility, the GROUND/FLIGHT switch must be set to FLIGHT and the BATTERY CHANGE-OVER switch set to START. A supply drawn from No.2 battery via the de-energized GROUND SUPPLIES contactor,

...Starting - General continued

BATTERY CHANGE-OVER switch, PS/STARTER BUSTIE auxiliary contacts and the EMERGENCY contactor, is used to energize the START contactor. As a result, No.1 and No.2 batteries are connected in series, No.2 battery positions being connected to No.1 battery negative via terminals A3 and A1, and No.1 battery positive being connected to the STARTER busbar via terminals B1 and B3. Busbar PE is energized from No.2 battery via contacts C1 and C3 and the aircraft voltmeter registers No.2 battery voltage.

Simultaneously with the START contactor energization, a supply is fed via the BATTERY and START contactors to energize the BUS TIE COIL ISOLATING relay; this ensures that busbars PS and PE remain in mutual isolation during internal start operations.

The INTERNAL START AVAILABLE and BUSTIE warning lamps are lit and the starting sequence may now be initiated.

When using this facility the generators come on-line as they achieve normal output and the g.s.u's are operated.

C. Switching sequence to initiate cranking

Table 1 indicates the sequence of operations when the ENGINE SELECTOR and MASTER START switches are set to the 'relevant engine' and 'start' position respectively.

TABLE 1 - SEQUENCE OF OPERATIONS

TIME (secs)	SWITCH	POSITION	RESULTS
	ENG.SEL^{R}	Relevant engine.	(1) ENGINE SELECTED lamp lights. (2) 24V at START switch (3) Relevant SELECTOR relay coil 'selected' not energized.
0	MASTER START	START	(4) Time switch mechanism energized, sequence initiated. (5) 24V at FIELD CONTACTOR, and when latched through terminal 4 to OVERSPEED relay coil.
0.5			(6) TIME DELAY switch No.1 contacts made. (7) Relevant SELECTOR relay coil energized

continued

...Starting - General continued

TIME (secs)	SWITCH	POSITION	RESULTS
2.0 25	MASTER SWITCH	OFF	(8) STARTER OPERATING lamp lit. (9) Energization of FIELD CHANGE-OVER relay via contacts SE and P of OVERSPEED relay. (10) STARTER contactor energized. (11) FIELD circuit completed, by-passing REGULATOR. (12) Contacts 2 and 3 of TIME DELAY switch made, causing energization of PRIMING SOLENOID and IGNITERS. (13) TIME DELAY switch contacts 1, 2 and 3 open, sequence completed.

D. Boost charging of aircraft batteries

If, after one engine has been successfully started, and an external supply is unavailable for starting the remaining engine, it is found that the aircraft batteries are in a state of charge incapable of powering an internal start, the following procedure should be adopted.

Ensure that the GROUND/FLIGHT switch is set to FLIGHT, set BATTERY CHANGE-OVER switch to NORMAL and the BATTERY switch to ON. Set the GENERATOR/BATTERY switch to BATTERY, and by reference to the ammeter ensure that the batteries are being charged. Allow the engine to run for 5 to 10 minutes to charge the batteries to a state when they will sustain the demands of an internal start, then follow the requirements laid down for an internal start.

E. General

With the energization of the starter/generator armature and the starter field circuit, the starter/generator operating in its starter mode will drive the engine up to a self sustaining speed of rotation. During this period, the current drawn from external or internal sources will gradually decrease. The reduced current flow in the series coil of the OVERSPEED relay will finally allow the OVERSPEED relay contacts to 'open', thus breaking supply to the FIELD CHANGE-OVER relay. De-energization of this relay causes de-energization of the STARTER contactor, completion of the starter/generator field circuit (for generator mode of operation) through the regulator, the passing of an initiation pulse to the regulator and the energization of the GENERATOR contactor via an interlock circuit in the STARTER contactor.

STARTING - TROUBLE SHOOTING

1. General

The trouble shooting charts have been compiled on the assumption that the following conditions are automatically complied with :-

(1) That trouble shooting is not to be attempted without reference to the relevant routeing chart or charts.

(2) That No. 1 and No. 2 aircraft batteries, and the igniter battery, are correctly connected and in a satisfactory state of charge.

(3) That external ground supplies, where used, are completely serviceable.

(4) That electrical connections to suspect units will be verified before removal of such units.

(5) That all relevant earth connections will be verified at the various stages of fault location.

(6) That continuity checks will be carried out as required.

(7) That all relevant filaments, fuses and/or circuit breakers are serviceable and correctly fitted.

(8) That where the term 'check unit' is used in connection with switches, relays, contactors, etc., it implies that the operator will check the input and output voltages at the 'in-use' terminals in the inoperated and operated states of the specified unit.

(9) That the reported faulty system will be checked by the operator to ensure that the fault is not due to incorrect switching procedures.

(10) When a fault has been discovered and rectified, the system must be given a functional test as laid down in the appropriate system Maintenance Practices.

2. Trouble shooting

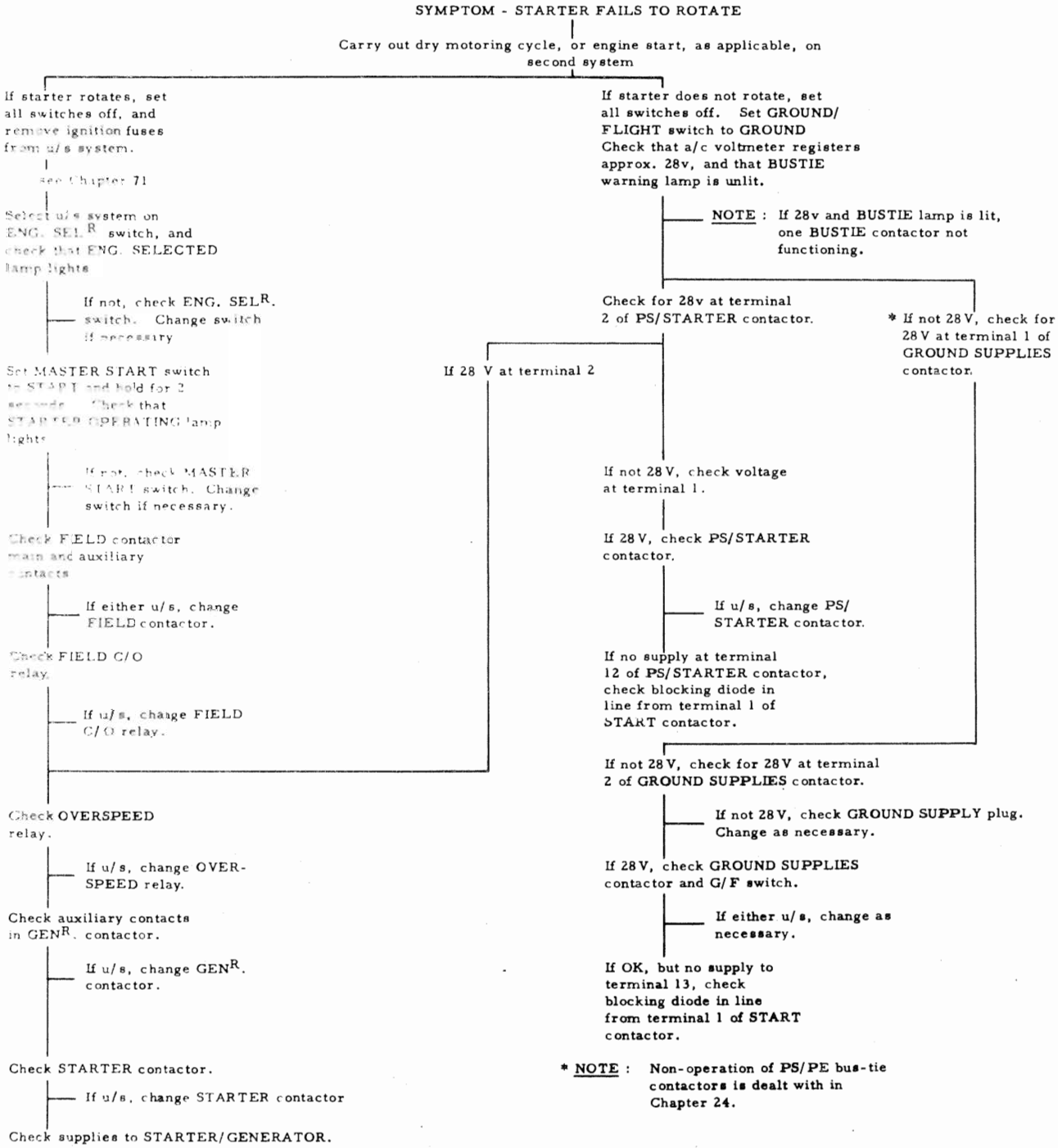
CAUTION : PRIOR TO ATTEMPTING ENGINE STARTS, OBSERVE ALL NECESSARY SAFETY PRECAUTIONS (see Chapter 71).

A. Failure using external supply

Since the two engine starting systems are parallel systems from the ENGINE SELECTOR switch onward, and share a common supply, the general whereabouts of a fault can be quickly located.

Carry out dry motoring cycle or engine start as applicable on second system (see Chapter 71). If starter fails to rotate then fault is common to both systems and lies within the supply/ENG. SELECTOR switch boundary. If starter rotates, then fault in faulty system is between ENG. SELECTOR switch and starter/generator.

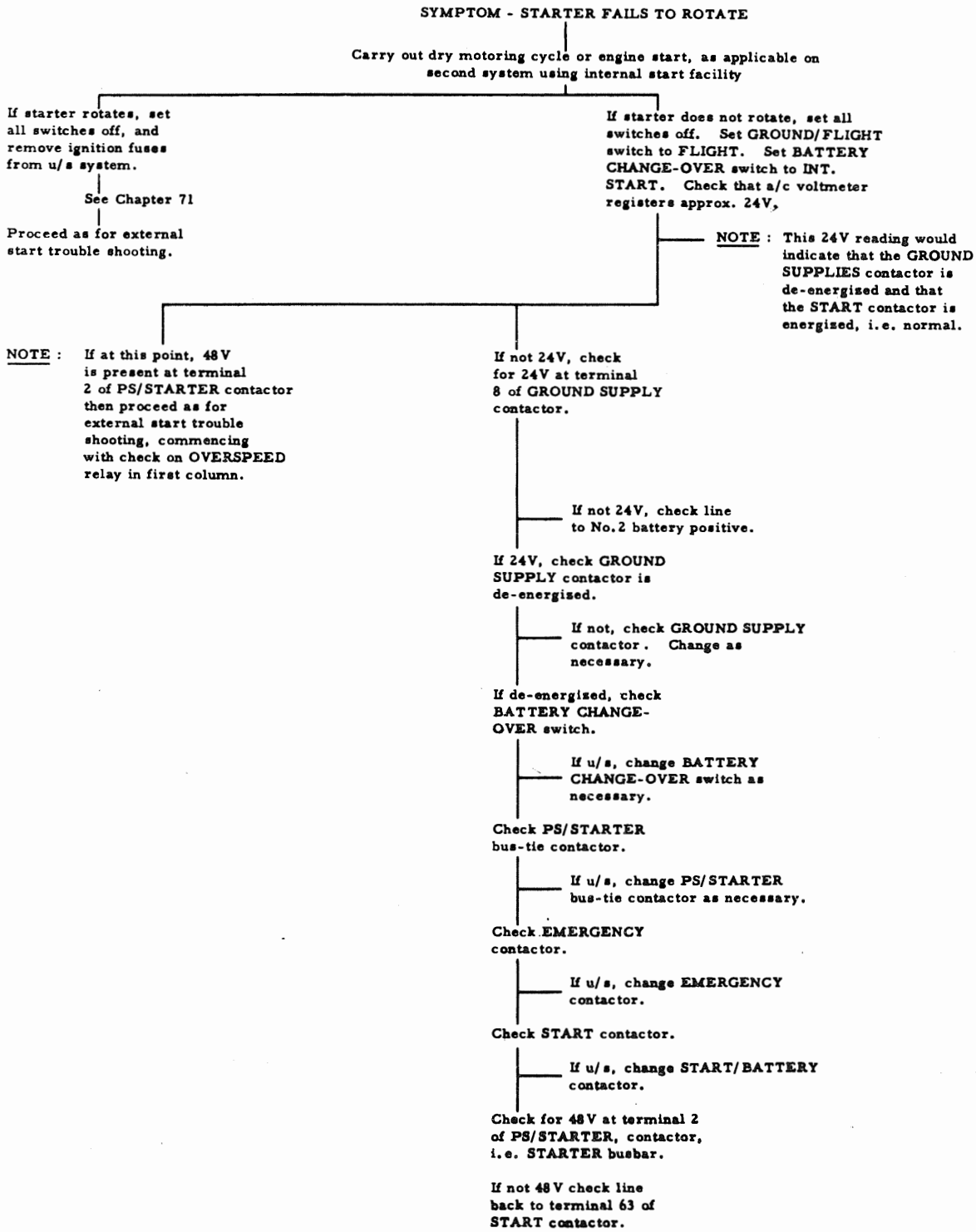
. . . Starting - Trouble shooting continued



...Starting - Trouble shooting continued

B. Using internal start facility

(B) Using internal start facility



STARTING - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Functionally test starting system

To functionally test the starting system, effect the engine starting check (see POWER PLANT - ADJUSTMENT/TEST).

If this is impracticable, effect the engine motoring 'dry' cycle check (see POWER PLANT - ADJUSTMENT/TEST) during which, check by feel that the primer solenoid operates.

* * *

STARTING - GENERAL
(Mod.251335)

1. Description

The engine starting system comprises the equipment required to motor the engine to self-sustaining speed, energize the fuel primer solenoid and ignite the fuel. There is also a facility to relight a windmilling engine and, Mod. 252367, to actuate an ecology drains system valve to 'close' whenever the engine services relay is operated.

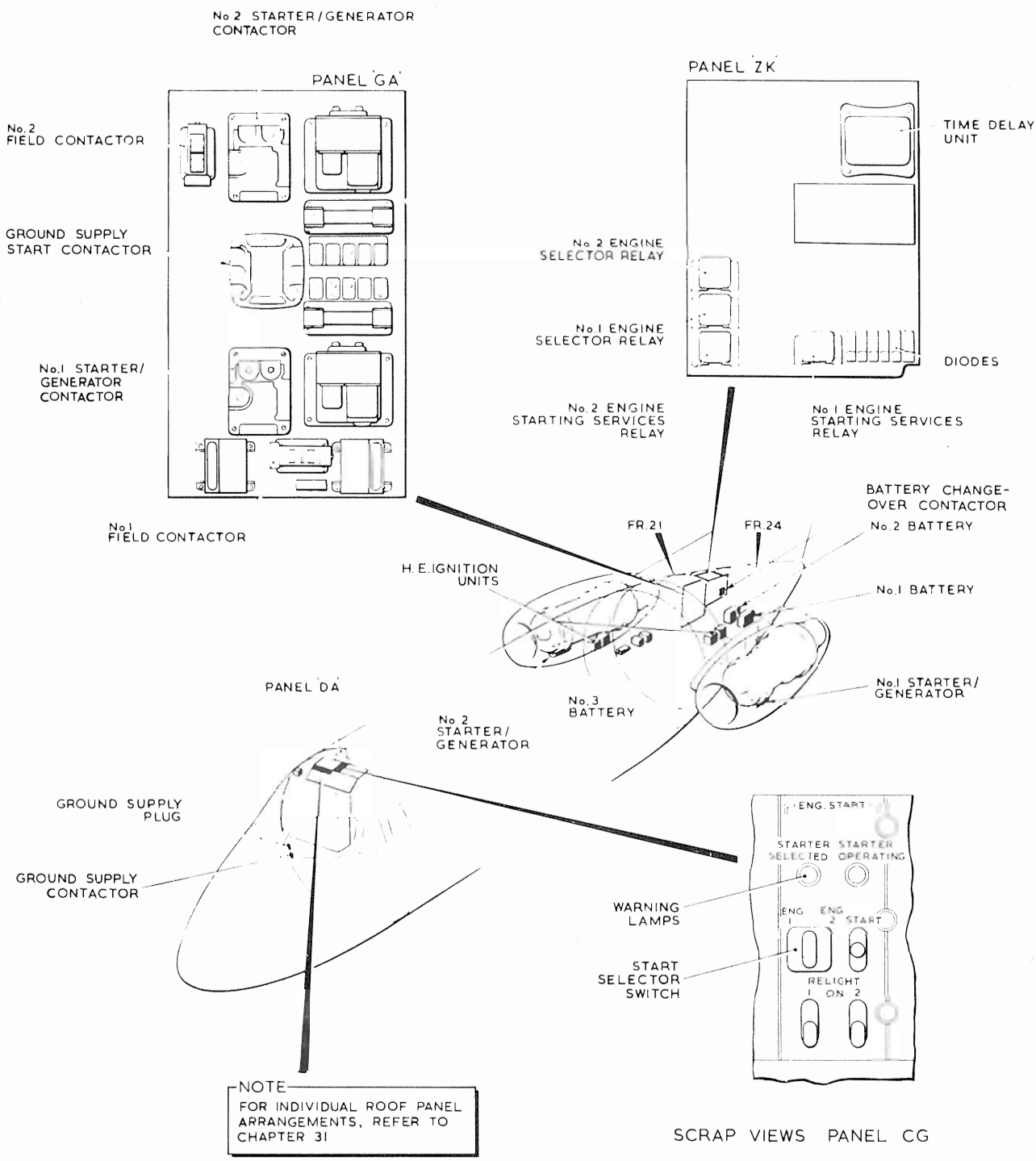
Each engine is rotated by an electrical starter/generator, powered by internal or external supplies. External 28 volts d.c. (nominal) supply is routed from the aircraft external ground supply socket via a ground supply contactor, to the aircraft PE, PS1 and PS2 busbars. During an external start, PS1 and PS2 busbars are paralleled and fed to the appropriate starter/generator, via the No.1 or No.2 starter/generator contactor. Supply to the starter/generator during an internal start is from the No.1 and No.2 aircraft batteries via the No.1 or 2 starter/generator contactors; the batteries are connected in series to provide a 48-volt d.c. (nominal) supply, but as the power demanded by a starter/generator is very heavy, a considerable voltage drop occurs.

The system is designed so that the output from one generator cannot be utilized to start another engine. However, if one engine has been started, and the aircraft batteries will not initiate another start, the generator of the running engine may be used to charge the batteries sufficiently to permit another start.

Control of the system is effected through the battery change-over, ground supply master, engine selector and start switches, which when operated, route the electrical supplies from either the PE busbar or No.3 battery to the relays and time switch to energize the contactors, solenoids and high energy ignition units.

Engine starting using internal batteries causes a reduction in PE busbar voltage. As the PE busbar is the normal source of power to the high energy units and fuel primer solenoid during an external start, No.3 battery is fitted to provide an additional source of power to these components during an internal start.

Indicator lamps, supplied by the control circuit, light when an engine is selected, a starter/generator is rotating or when an internal start is selected. During starting the fuel pressure is insufficient to operate the main flow system therefore fuel is delivered to the engine via a fuel primer solenoid, and is ignited by two igniter plugs, supplied with a high voltage, from the two high energy ignition units. The fuel primer solenoid, and the high energy units, are energized during the starting cycle by the engine services relay which is operated by the time switch. On introduction of Mod.252367 - Ecology drains system - the service relay when de-energized opens the drain system primer drain valve and when energized closes the valve. Fuel and ignition is provided for relight in flight, via the same circuit, but the engine services relay is energized by operation of a RELIGHT switch instead of the starting time switch.



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Starting - location of components
Fig.1

...Starting - General continued

2. Operation (Fig.2)

A. External start

With an external supply connected, power is available at the ground supply master switch. Selecting GROUND, with the battery change-over switch set at NORMAL, completes the circuit via closed contacts of the battery change-over contactor to energize the ground supply start and ground supply contactors.

With the ground supply contactor energized (closed) ground power is connected to all busbars. The outputs of PS1 and PS2 busbars are paralleled by the energized ground supply start contactor and routed to the de-energized No.1 and No.2 starter/generator contactors.

Power supplies from the PE busbar or the No.3 battery are available at the engine selector switch, the No.1 contacts of the time switch and to certain contacts of the de-energized engine selector and services relays. Post Mod. 252367, a contact of the latter relay also supplies power to the 'open' circuit of the primer drain valve. Normally, the potential of the PE busbar is greater than that of the No.3 battery, and therefore, under these circumstances the busbar provides the source of power.

When either No.1 or No.2 engine is selected, the circuit is made to the START switch and to the STARTER SELECTED indicator lamp. Selecting START energizes the winding mechanism of the time switch and supplies power to other contacts of the selector relays.

Approximately 0.5 of a second after selecting START, No.1 contacts of the time switch close and a supply is routed to light the STARTER OPERATING indicator lamp, and to energize the engine selector relay (via contacts of the opposite engine selector relay). With the engine selector relay energized, currect from PE busbar or No.3 battery energizes the relevant field and starter/generator contactors, the field contactor becoming mechanically latched on. Power is now fed from PS1 and PS2 busbars to the starter/generator which turns to rotate the engine. The starter/generator contactor will remain energized, by virtue of the series connected coil, after the start switch is released and until the armature current drops to a predetermined value.

Approximately 2 seconds after selecting START, No.2 and 3 contacts of the time switch close to energize the engine services relay, via the relevant selector relay, thus completing the circuit to the fuel primer solenoid at the high energy ignition units and Post Mod.252367, the primer drain valve which closes.

The time switch contacts open 25 seconds after START is selected, and the control circuit becomes de-energized. The field contactor however remains latched on to be utilized in the generating mode.

...Starting - General continued

B. Internal start

Supply from No.3 battery is routed to the battery change-over switch via the de-energized ground supply contactor; selecting INT. START energizes the battery change-over contactor (the circuit being through the closed contacts of the de-energized ground supply start and emergency contactors). Energization of the battery change-over contactor, connects the No.1 and No.2 aircraft batteries in series, routes power to the de-energized No.1 and No.2 starter/generator contactors, and connects No.1 battery to the PE busbar.

Depending on the state of No.1 and No.3 aircraft batteries, power is supplied from either PE busbar or No.3 battery to the engine selector switch, the No.1 contacts of the time switch and to the contacts of the de-energized selector and services relays.

When either No.1 or No.2 engine is selected, the circuit is completed to the start switch and the STARTER SELECTED indicator lamp. Selecting START energizes the winding mechanism of the time switch and supplies power to other contacts, of the selector relays.

The No.1 contacts of the time switch close approximately 0.5 of a second after START is selected, to light the STARTER OPERATING lamp, and energize the appropriate engine selector relay. With the engine selector relay energized, supplies from either PE busbar or No.3 battery, energize the relevant field and starter/generator contactors. Power is now supplied from the No.1 and No.2 aircraft batteries to the starter/generator which rotates to turn the engine. The starter/generator contactor will remain energized by virtue of the series connected coil after the start switch is released and until the starter/generator current drops to a predetermined value. The field contactor remains latched on and is utilized in the generating mode.

After approximately 2 seconds, the No.2 and No.3 contacts of the time switch close and route supplies from the relevant engine selector relay to energize the engine services relay, this completes the circuit from either the PE busbar or the No.3 battery to energize the fuel primer solenoid and high energy units.

25 seconds after selecting START, the time switch contacts open and the engine selector and services relays are de-energized.

C. Relight in flight

Relight in flight is effected by operation of the relevant RELIGHT switch, which makes the circuit from PE busbar to energize the appropriate engine services relay and the STARTER OPERATING lamp. The fuel primer solenoid and high energy units are powered from PE busbar via the closed contacts of the engine services relay.

* * *

STARTING - TROUBLE SHOOTING

1. General

The trouble shooting charts have been compiled on the assumption that :-

(1) The reported faulty system will be checked by the operator to ensure that the fault is not due to incorrect switching procedures.

(2) All relevant circuit breakers are made, and that the circuit fuses and filaments are serviceable.

(3) External ground supplies, where used, are completely serviceable.

(4) All aircraft batteries are correctly connected and in a satisfactory state of charge.

(5) Where the term 'check' is used in connection with switches, relays, contactors etc., it implies that the operator will check the input and output voltages at the 'in use' terminals in the inoperated and operated state.

(6) The electrical connections to suspect units will be verified before removal of such units.

(7) All relevant earth connections will be verified at the various stages of fault location.

(8) Continuity checks will be carried out as required.

(9) Trouble shooting is not attempted without reference to the relevant routing charts.

(10) When a fault has been discovered and rectified, the system must be given a functional test as laid down in the appropriate system Maintenance Practices.

CAUTION : PRIOR TO ATTEMPTING ENGINE STARTS, OBSERVE ALL NECESSARY SAFETY PRECAUTIONS (Chapter 71).

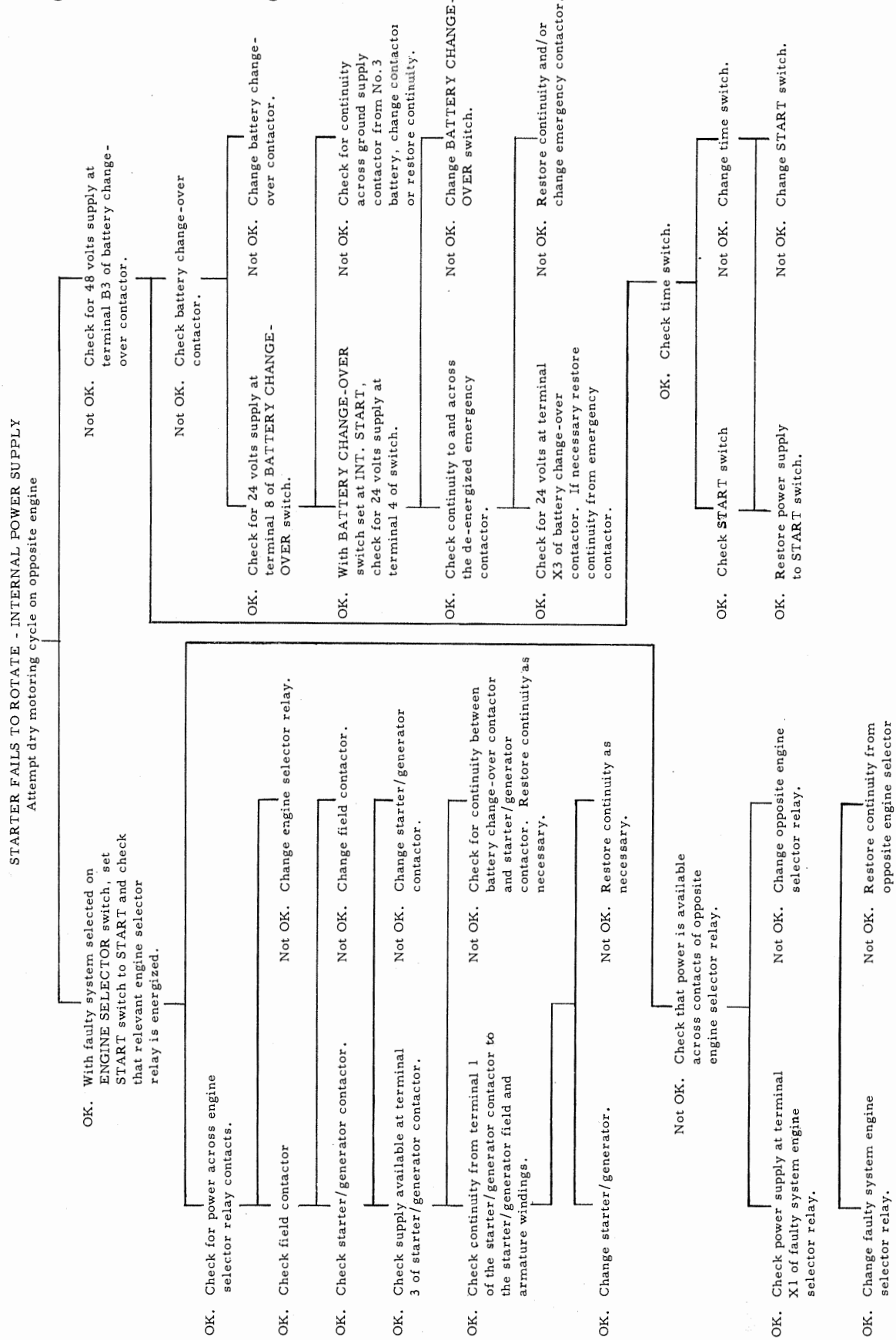
Charts overleaf

STARTER FAILS TO ROTATE - EXTERNAL POWER SUPPLY

Check voltmeter reading to ensure busbars are powered

- OK. Operate ENGINE SELECTOR switch, check that ENGINE SELECTED indicator lamp lights.
  - Not OK. Restore electrical power (See Chapter 24).
  - OK. Carry out dry motoring cycle on opposite engine.
    - OK. With faulty system selected on ENGINE SELECTOR switch, set START switch to START and check that relevant engine selector relay is energized.
      - OK. Check for power across engine selector relay contacts
        - OK. Check field contactor
          - OK. Check starter/generator contactor.
            - OK. Check supply available at terminal 3 of starter/generator contactor
              - OK. Check continuity from terminal 1 of the starter/generator contactor to the starter/generator field and armature windings.
                - OK. Change starter/generator.
                - Not OK. Restore continuity.
              - Not OK. Check for continuity between ground supply start contactor and starter generator contactor. Restore continuity as necessary.
            - Not OK. Change starter/generator contactor.
          - Not OK. Change field contactor.
        - Not OK. Change engine selector relay
      - Not OK. Check for 28-volts supply at contacts of ground supply start contactor.
        - OK. Check time switch.
          - OK. Restore energization supply from GROUND SUPPLY MASTER switch.
            - OK. Check START switch.
              - OK. Restore power supply to START switch.
              - Not OK. Change START switch.
            - Not OK. Change time switch.
          - Not OK. Change ground supply start contactor.
        - Not OK. Check ground supply start contactor.
    - Not OK. Check power supply to ENGINE SELECTOR switch.
      - OK. Change ENGINE SELECTOR switch.
      - Not OK. Restore electrical power supply.
      - Not OK. Check that power is available across contacts of opposite engine selector relay.
        - OK. Check power supply at terminal X1 of faulty system engine selector relay
          - OK. Change faulty system engine selector relay
          - Not OK. Restore continuity from opposite engine selector relay.
        - Not OK. Change engine selector relay.

...Starting - Trouble shooting continued



STARTING - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Functionally test starting system

To functionally test the starting system, effect the engine starting check (see POWER PLANT - ADJUSTMENT/TEST.)

If this is impracticable, effect the engine motoring 'dry' cycle check (see POWER PLANT - ADJUSTMENT/TEST) during which, check by feel that the primer solenoid operates.

* * *

STARTING - GENERAL

(Mod 251728)(Mod 252367)

1. Description

The engine starting system comprises a starter/generator to motor the engine up to self-sustaining speed and a means of operating the high-energy ignition system. In addition, because the main engine burners are of the vapourizing type, fuel for starting is supplied to primer units via a primer solenoid, which is also energized by the starting system. An in-flight relighting facility is provided. The system which is powered either by an external 28 V d.c. (nominal) supply or by the aircraft's own batteries, is controlled by a battery changeover switch, a ground supply master switch, an engine selector switch and a start switch. The output of one engine generator cannot be used directly to start the other engine. However, if absolutely necessary, either a main engine generator or, when an a.p.u. is fitted, the a.p.u. generator can be used to charge the batteries to permit another start.

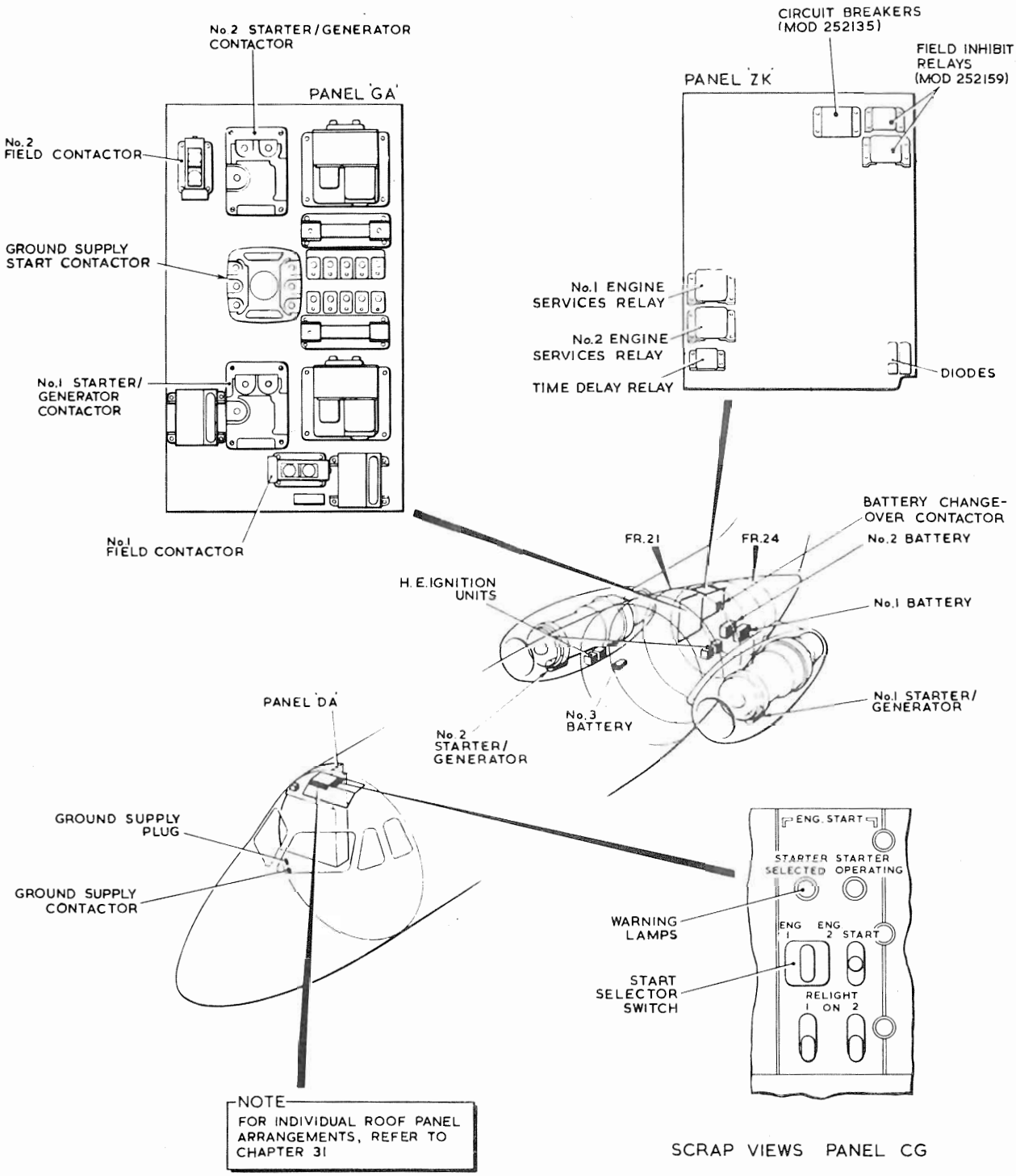
There are three indicator lamps: one (INTERNAL START) lights when an internal start is selected and the battery changeover contactor operates, another (STARTER SELECTED) lights when No.1 or No.2 engine is selected, and the third (STARTER OPERATING) lights when the START switch is operated. On each engine, the two H.E. igniter units, the fuel primer solenoid and, Mod 252367, an ecology drains system valve, are supplied from an engine services relay. For 'in flight' relighting this relay is energized via the RELIGHT switch.

2. Operation

A. External start

With an external supply connected, power is available at the ground supply master switch and, when GROUND is selected (with the battery changeover switch at NORMAL) a circuit is completed through the closed contacts of the battery changeover contactor to energize the ground supply and ground supply start contactors. The ground supply contactor routes power to PS1, PS2 and PE busbars, PS1 and PS2 being linked in parallel through the ground supply start contactor, which also supplies power to the contacts of the de-energized starter/generator contactors. Pre-mod 251721 and 252065, No.3 battery powers the starting control circuit and the engine services relay contacts for the primer solenoid and both igniter units. Mod 251721 powers one igniter unit per engine from PE busbar, and mod 252065 powers the control circuit and the engine services relay contacts from either No.3 battery or PE busbar, whichever is at the higher voltage. If an a.p.u. is fitted, its generator output, which is normally fed to PS2 busbar, is disconnected by means of the generator switching unit when the ground supply contactor is energized.

When an engine is selected on the starter selector switch, power from No.3 battery (or PE busbar) is fed to the START switch, the STARTER SELECTED indicator lamp and the relevant field contactor which energizes and is mechanically latched on. When the START switch is operated, power is fed through the field contactor to energize the starter/generator contactor and the time delay relay which, when operated lights the STARTER OPERATING lamp. Operation of the starter/generator contactor routes power from PS1 and PS2 busbars to the starter/generator, thus rotating the engine; a hold-on



SCRAP VIEWS PANEL CG

6105/1

Location of starting components
Fig.1

...Starting - General continued

circuit keeps the starter/generator contactor closed after the start switch has been released. Power routed through the time delay relay passes through a 2-sec time delay unit and is supplied through a set of contacts in the starter/generator contactor to the coil of the engine services relay, which energizes and supplies power to the primer solenoid, igniter units and with mod.252367, the primer drain motorized valve which, normally open, closes. (The time delay relay is only energized when No.1 engine is selected, power to the time delay unit and the STARTER OPERATING lamp being routed through the relaxed contacts of the relay when No.2 engine is selected and the start switch operated). The hold-on circuit for the starter/generator contactor comprises a set of relay contacts operated by a coil in the main supply to the starter/generator. As the engine reaches self-sustaining speed, the fall in starter/generator current allows the contacts in the hold-on circuit to relax, and the starter/generator contactor therefore de-energizes, breaking the supply to the starter/generator and the engine services relay coil. The starter/generator then reverts to the generating mode, the field contactor remaining mechanically latched on. With the services relay coil de-energized, a supply from PE busbar, routed through the services relay contacts, opens the primer drain valve when Mod.252367 is embodied.

B. Internal start

When the battery changeover switch is moved to INT.START, power from No.3 battery or (mod 252065 and if an a.p.u. is fitted and running) PE busbar energizes the battery changeover contactor through the relaxed contacts of the emergency ground supply start contactors. Operation of the battery changeover contactor connects Nos.1 and 2 batteries in series, and routes their power to the contacts of the de-energized starter contactor. In addition, No.1 battery is connected to PE busbar although during a start the battery voltage is much depressed. Power from No.3 battery, or (mod 252065) PE busbar is supplied to the starter selector switch and the contacts of the de-energized engine services relays. If an a.p.u. is fitted and running, mod 252065 permits a start to be made even if No.3 battery voltage is low. Operation of the circuit when an engine is selected and the start switch operated is as described in para.A. above, except that the power to the starter generators comes from the series-connected batteries.

C. In-flight relighting

Operation of the RELIGHT switch supplies power from No.3 battery or (mod 252065) from PE busbar to energize the engine services relay and the STARTER OPERATING lamp. The engine services relay routes power from No.3 battery or (mod 252065) PE busbar to the fuel primer solenoid and igniter units. Mod 251721 powers one igniter per engine from PE busbar.

D. Motoring the engine

After the start switch has been released, if the engine does not reach self-sustaining speed (e.g. during a motoring cycle or an abortive start) it will continue to motor until the starter selector switch is turn off (the mid-position).

* * *

STARTING - TROUBLE SHOOTING

1. General

The trouble shooting charts have been compiled on the assumption that :-

(1) The reported faulty system will be checked by the operator to ensure that the fault is not due to incorrect switching procedures.

(2) All relevant circuit breakers are made, and that the circuit fuses and filaments are serviceable.

(3) External ground supplies, where used, are completely serviceable.

(4) All aircraft batteries are correctly connected and in a satisfactory state of charge.

(5) Where the term 'check' is used in connection with switches, relays, contactors etc., it implies that the operator will check the input and output voltages at the 'in use' terminals in the inoperated and operated state.

(6) The electrical connections to suspect units will be verified before removal of such units.

(7) All relevant earth connections will be verified at the various stages of fault location.

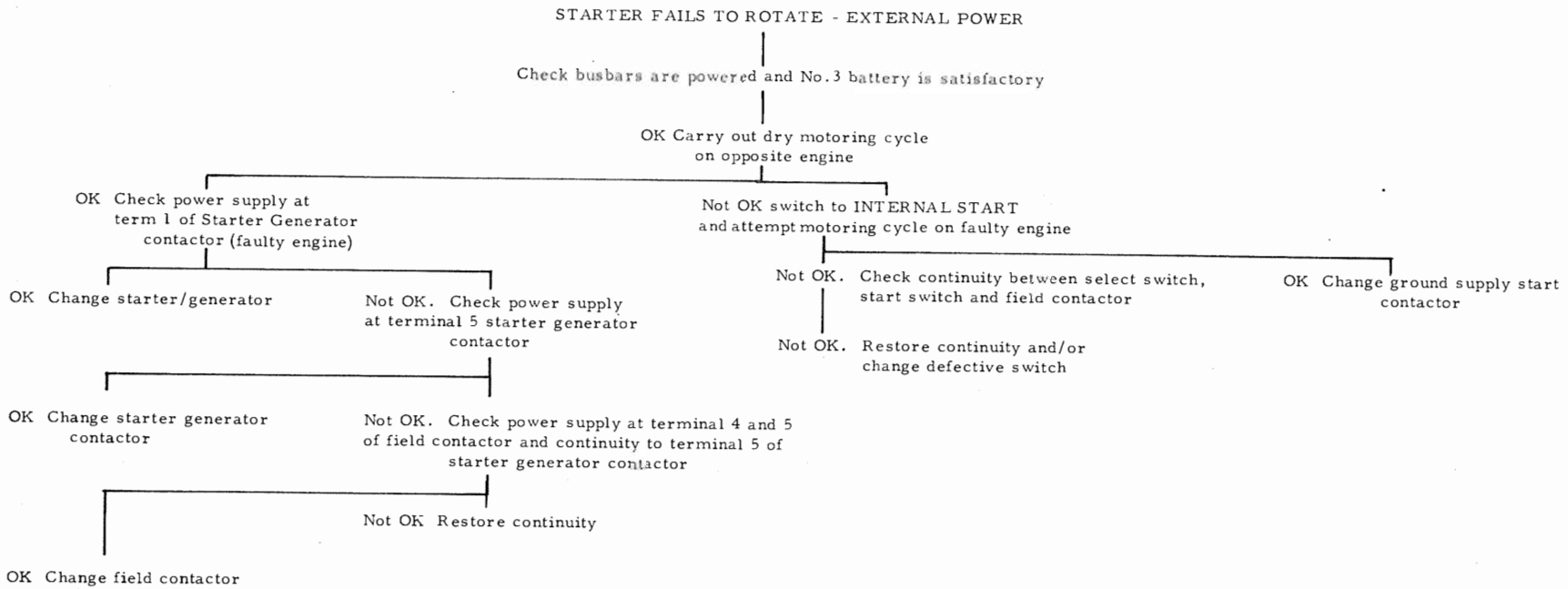
(8) Continuity checks will be carried out as required.

(9) Trouble shooting is not attempted without reference to the relevant routing charts.

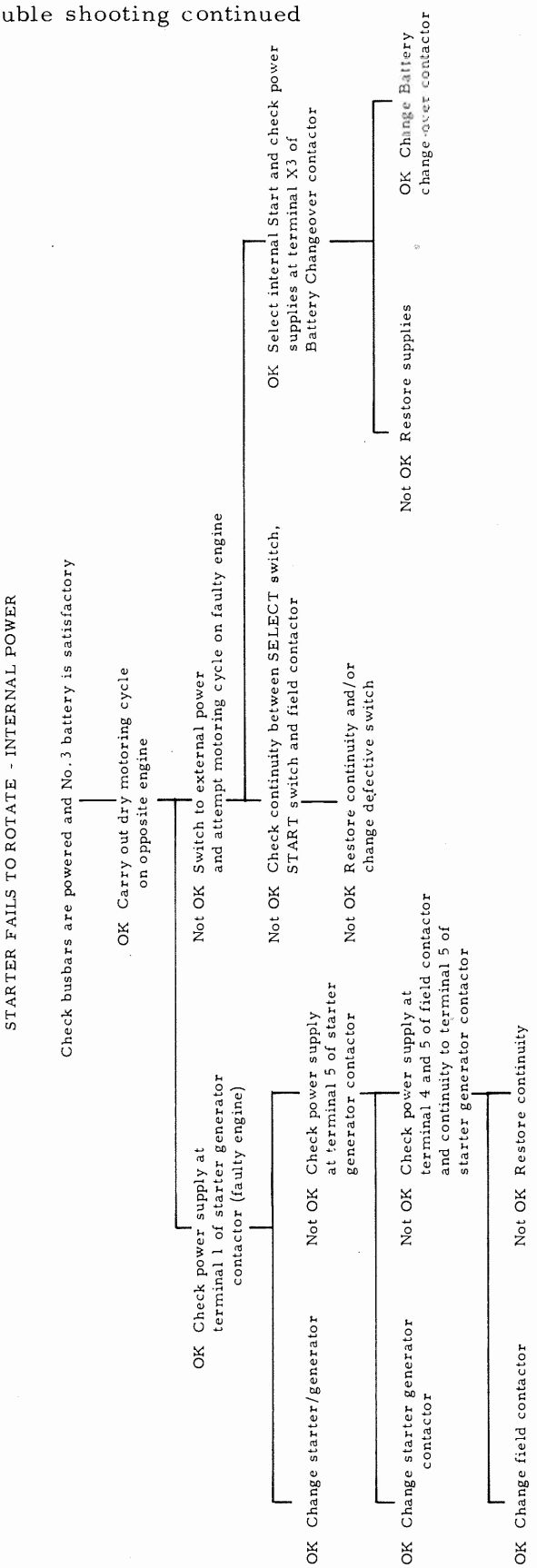
(10) When a fault has been discovered and rectified, the system must be given a functional test as laid down in the appropriate system Maintenance Practices.

CAUTION : PRIOR TO ATTEMPTING ENGINE STARTS, OBSERVE ALL NECESSARY SAFETY PRECAUTIONS (Chapter 71).

Charts overleaf


STARTER FAILS TO ROTATE - EXTERNAL POWER
Check busbars are powered and No.3 battery is satisfactory
OK Carry out dry motoring cycle on opposite engine
OK Check power supply at term 1 of Starter Generator contactor (faulty engine)
Not OK switch to INTERNAL START and attempt motoring cycle on faulty engine
OK Change starter/generator
Not OK. Check power supply at terminal 5 starter generator contactor
Not OK. Check continuity between select switch, start switch and field contactor
OK Change ground supply start contactor
Not OK. Restore continuity and/or change defective switch
OK Change starter generator contactor
Not OK. Check power supply at terminal 4 and 5 of field contactor and continuity to terminal 5 of starter generator contactor
Not OK Restore continuity
OK Change field contactor

...Starting - Trouble shooting continued



STARTING - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Functionally test starting system

(1) Start the engine or carry out a 'dry' motoring cycle, see Chapter 71 POWER PLANT - ADJUSTMENT/TEST.

NOTE : If a 'dry' motoring cycle is carried out check, by feel, that the primer solenoid operates.

* * *

STARTING - GENERAL

(Mod. 252159, 252248 and 252367)

1. Description

The engine starting system comprises a starter/generator to motor the engine up to self-sustaining speed and a means of operating the high-energy ignition system. In addition, because the main engine burners are of the vapourizing type, fuel for starting is supplied to primer units via a primer solenoid, which is also energized by the starting system. An in-flight relighting facility is provided. The system, which is powered either by an external 28 V d.c. (nominal) supply or by the aircraft's own batteries, is controlled by a battery changeover switch, a ground supply master switch, an engine selector switch and a start switch. The output of one engine generator cannot be used directly to start the other engine. However, if absolutely necessary, either a main engine generator or, when an a.p.u. is fitted, the a.p.u. generator can be used to charge the batteries to permit another start.

There are three relevant indicator lamps: one, INTERNAL START AVAILABLE, lights when an internal start is selected and the battery changeover contactor operates to direct a positive supply from No.2 battery to the starter busbar. Another lamp, START SELECTED, lights when either No.1 or No.2 engine is selected. A third lamp, STARTER OPERATING, lights when the START sequence is selected.

Two H.E. igniter units and a fuel primer solenoid, and when Mod.252367 is embodied, an ecology drains system motorized valve, are supplied from an engine services relay. For in-flight relighting of a windmilling engine, the engine services relay is energized via a RELIGHT switch.

2. Supply

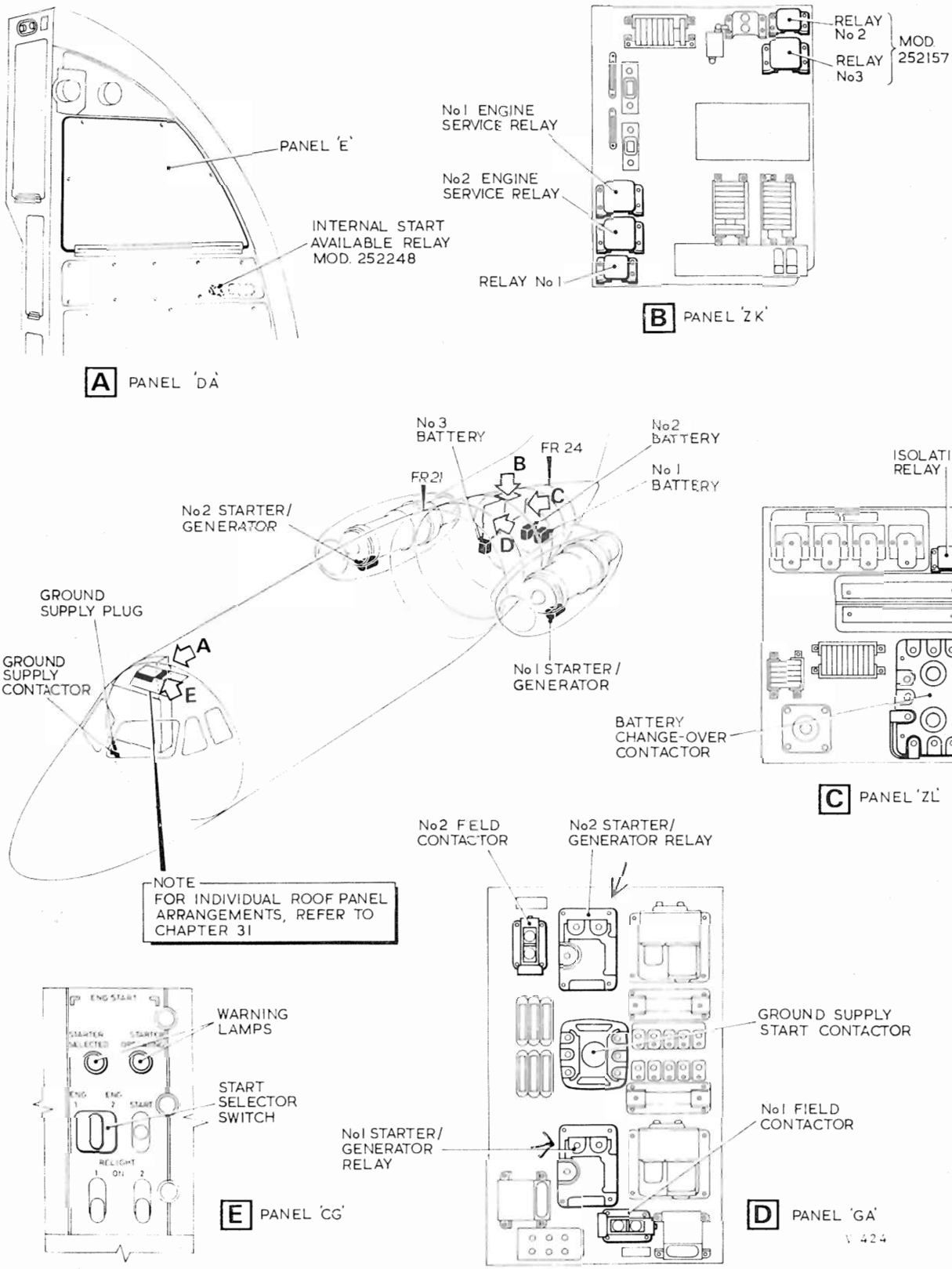
A. External start supplies

With an external supply connected at the aircraft ground supply plug, power is available at the ground supply master switch. When GROUND is selected on the switch, with the battery selector switch at NORMAL, a circuit is completed through the relaxed contacts of the battery changeover contactor to energize the ground supply and ground start contactors. The ground supply contactor routes power to PS1, PS2 and PE, busbars; PS1 and PS2 busbars being linked in parallel through the ground start contactor which also supplies power to the contacts of the de-energized starter/generator contactors ready for the starting sequence.

Operation of the ground supply contactor also isolates the batteries from the busbars and opens the emergency switching circuit.

B. Internal start supplies

Placing the battery selector switch to the INT START position connects No.3 battery busbar via the de-energized contacts of the ground supply contactor, the ground start contactor and the emergency contactor, to the coil of the 'start' side of the start/battery contactor.



Location of starting components
Fig.1

...Starting - General (Mods.252159, 252248 and 252367) continued

The contacts of the energized 'start' side of the start / battery contactor connects No.2 battery in series with No.1 battery making available 48 volts at the starter busbar. At the same time a 24 volt supply from No.1 battery is connected to PE busbar.

Pre Mod.252248 : an amber indicator lamp connected across the starter busbar and the negative side of No.2 battery indicates INTERNAL START AVAILABLE.
Mod.252248 : The INTERNAL START AVAILABLE amber lamp is illuminated by a supply from the starter busbar routed through the operated contacts of an internal start available relay to the negative side of No.2 battery. The internal start relay is energized by the same supply that energizes the start side of the battery/start contactor.

3. Start sequence

The start sequence is the same for internal or external supplies. However, it should be noted that the No.3 PE busbar will be at No.3 battery potential, and the starter busbar will initially be at 48 volts falling to 28 volts when the 'start' switch is closed.

The starting cycle may be interrupted at any time by centralizing the engine selector switch; this will break the supply to the start/generator relay which interrupts the supply to the starter. The engine service relay will also be de-energized, breaking the supplies to the igniter units, the priming solenoid and, Mod.252367, the primer drain valve 'close' circuit.

Mod.252367 : on busbar PE initially receiving power from either internal or external sources, a supply is taken from the busbar via the engine service relay relaxed contacts B2-B3 to energize the 'open' circuit of the engine primer drain valve which motors open.

Placing the starter selector switch to ENG 1 passes a supply from busbar PE to :-

(a) The start selected green indicator lamp.
(b) Contact B1 of No.1 relay.
(c) Contacts A1, B1 and C1 of No.3 relay.
(d) Contact A1 of No.2 relay.
(e) The input terminals of the start switch.

Holding the spring-loaded start switch to the START position for 2 seconds passes a supply to :-

(a) No.1 relay operating coil.
(b) Terminal 4 of No.1 field contactor.
(c) The operating coil of No.3 relay via contacts B1-B2 of the energized No.1 relay.

Page 4 intentionally left blank

...Starting - General (Mods.252159, 252248 and 252367) continued

With No.3 relay energized, a supply from the engine start switch is completed through contacts C1-C2 of No.3 relay to :-

(a) Terminal 4 of No.1 start/generator relay.
(b) The operating coil of No.1 field contactor which remains latched in.

On No.1 field contactor latching in, a supply from the start switch is applied through No.1 field contactor contacts 4-3 to the operating coil on No.1 starter generator relay which is energized. The same supply by way of No.1 relay contacts A1-A2 passes to the two-second time delay unit and lights the STARTER OPERATING amber lamp.

At this stage power is supplied to the starter motor. The high current passing through the starter generator relay current coil causes the relay to be self-holding, the start switch requiring to be held closed for two seconds to achieve the hold-on stage.

With the starter-generator relay energized :-

(a) The supply is completed to the field coil of the starter-generator through contacts 3-1 and 13-11 of the starter generator relay and contacts 1-2 of the field contactor.
(b) The supply is completed from the starter busbar to the starter motor via the starter-generator contacts 3-1.

After the two-second time delay unit times out, the supply from the start switch is completed through contacts 7-8 of the starter generator relay to the operating coil of No.1 engine service relay and the 'close' circuit of the primer drain motorized valve.

On No.1 engine service relay being energized :-

(a) Mod.252367: the supply to the primer drain valve 'open' circuit is terminated when contacts B2-B3 break.
(b) The supply to the operating coil is also directed through the relay contacts D2-D1 to the amber STARTER OPERATING lamp.
(c) A supply from busbar PE is directed through contacts A2-A1 to the priming solenoid.
(d) A supply from busbar PE is directed through contacts B2-B1 and C2-C1 to the engine igniter units.

On release of the start switch, the supply from the start switch is removed from both the No.1 starter/generator relay operating coil and the time delay unit. But, as the current coil in the starter/generator relay is energized, the supply from the engine select switch at terminal 4 passes via the start/generator relay auxiliary contacts to supply the starter generator operating coil and through the field contactor contacts 3-4 to maintain the operating coil of No.1 relay energized. The supply from terminal 4 is also directed to the two-second delay unit through No.1 relay contacts A1-A2.

...Starting - General (Mods.252159, 252248 and 252367) continued

On completion of the start sequence and when the engine reaches self-sustaining speed, the current demand of the starter motor decreases, the starter/generator relay de-energizes and disconnects the supply to the starter motor. This also removes the supply from No.1 relay coil, the time delay unit and the engine service relay coil and the generator is connected to the related PS busbar.

Upon engine select switch being returned to the 'OFF' position, the supply is removed from :-

(a) Terminal A1 and B1 of No.3 relay.
(b) Input side of the engine start switch and terminal C1 of No.3 relay.
(c) The SELECTED START green light.

Relight

To relight a windmilling engine, the appropriate switch on the roof panel is made which energizes the engine service relay from PE/No.3 busbar. The contacts of the relay pass supplies to the two high energy igniter units and the priming solenoid. To re-instate the power supply the generator close/trip switch is held to the CLOSE position. This will supply terminal No.3 of the voltage regulator to start operation.

Operation of the relight switches puts a supply to the amber STARTER OPERATING lamp via engine services relay contacts D1-D2 and with Mod.252367 embodied, a supply to the primer drain valve 'close' circuit.

* * *

STARTING - TROUBLE SHOOTING

1. General

The trouble shooting charts have been compiled on the assumption that :-

(1) The reported faulty system will be checked by the operator to ensure that the fault is not due to incorrect switching procedures.

(2) All relevant circuit breakers are 'made', and that the circuit fuses and filaments are serviceable.

(3) External ground supplies, where used, are completely serviceable.

(4) All aircraft batteries are correctly connected and in a satisfactory state of charge.

(5) Where the term 'check' is used in connection with switches, relays, contactors etc., it implies that the operator will check the input and output voltages at the 'in use' terminals in the inoperated and operated state.

(6) The electrical connections to suspect units will be verified before removal of such units.

(7) All relevant earth connections will be verified at the various stages of fault location.

(8) Continuity checks will be carried out as required.

(9) Trouble shooting is not attempted without reference to the relevant routing charts.

(10) When a fault has been discovered and rectified, the system must be given a functional test as laid down in the appropriate system Maintenance Practices.

CAUTION : PRIOR TO ATTEMPTING ENGINE STARTS, OBSERVE ALL NECESSARY SAFETY PRECAUTIONS (Chapter 71).

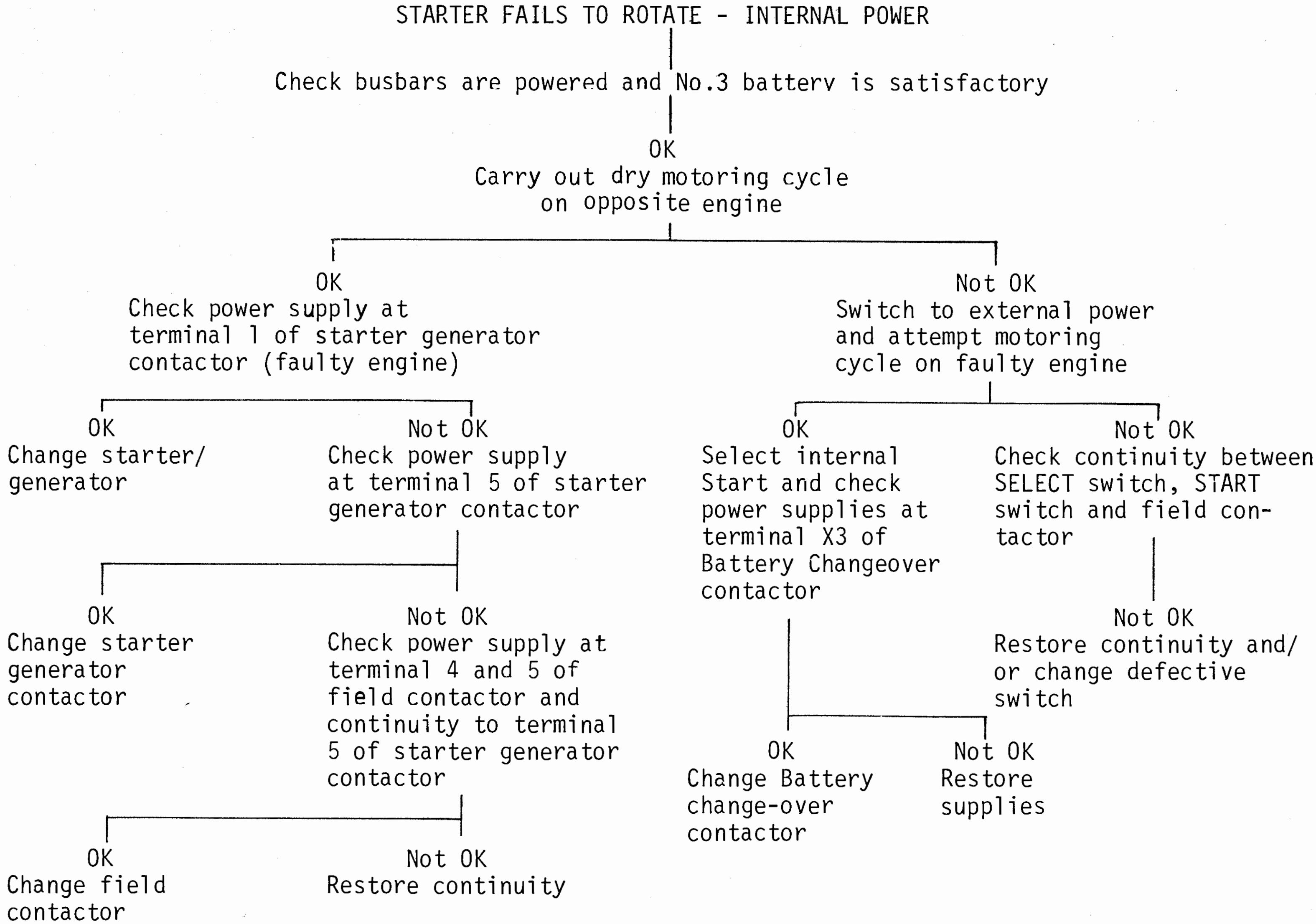
Charts overleaf

...Starting - Trouble shooting continued

STARTER FAILS TO ROTATE - EXTERNAL POWER

- Check busbars are powered and No.3 battery is satisfactory
  - OK: Carry out dry motoring cycle on opposite engine
    - OK: Check power supply at term 1 of Starter Generator contactor (faulty engine)
      - OK: Change starter/generator
      - Not OK: Check power supply at terminal 5 starter generator contactor
        - OK: Change starter generator contactor
        - Not OK: Check power supply at terminal 4 and 5 of field contactor and continuity to terminal 5 of starter generator contactor
          - OK: Change field contactor
          - Not OK: Restore continuity
    - Not OK: Switch to INTERNAL START and attempt motoring cycle on faulty engine
      - OK: Change ground supply start contactor
      - Not OK: Check continuity between select switch, start switch and field contactor
        - Not OK: Restore continuity and/or change defective switch

...Starting - Trouble shooting continued



* * *

1. Adjustment/Test

A. Functionally test starting system

(1) Start the engine or carry out a 'dry' motoring cycle, see Chapter 71 POWER PLANT - ADJUSTMENT/TEST.

NOTE : If a 'dry' motoring cycle is carried out check, by feel, that the primer solenoid operates.

* * *

IGNITING - DESCRIPTION AND OPERATION

1. General

During the starting cycle ignition is provided by two high energy units, installed in the aircraft rear fuselage equipment bay, each serving individual igniter plugs. The igniter plugs are mounted in the engine centre section casing, at the 5 and 7 o'clock positions, adjacent to two of the six fuel system primer units. Conventional screened cables, with threaded end fittings, link the high energy units to the igniter plugs.

Power supplies to the high energy units and the primer solenoid (see Chapter 73) are routed via the contacts of the starting services relay. During normal starting the holding coil of this relay is energized by supplies controlled by the time switch, but when the relight switch is operated supplies are fed directly to the relay. When the relight switch is depressed the 'starter operating' light is illuminated.

2. High energy unit

This unit is operated by the aircraft d. c. supplies and will function between the limits of 16 to 29 volts over a temperature range of -50°C to +100°C. A protective resistor is connected across the output circuit to limit the value to which the reservoir capacitor will rise, should an open circuit occur in the h. t. circuit. Discharge resistors fitted across the capacitor ensure the dissipation of stored energy if the capacitor is left in charged condition when the unit is not in use.

When the unit is in operation an induction coil energized via a trembler mechanism, charges a reservoir capacitor through high voltage rectifiers. When the capacitor voltage reaches a pre-determined value, it breaks down a sealed discharge gap in the output circuit; a discharge takes place which produces a spark at the torch igniter. The capacitor is then recharged and the process repeated at a frequency of not less than two discharges per second.

3. Igniter plug

Each igniter plug is connected to its igniter cable via a right angled terminal housing embodied in the plug body.

The central electrode of the igniter plug is housed in, but insulated from, an outer sleeve which forms the earth electrode. A pellet of semi-conducting material is interposed between the ends of the electrodes. When current flows from the high energy units an initial small electrical leakage, across the igniter plug pellet, creates an ionised path along which the main discharge occurs.

* * *

IGNITING - MAINTENANCE PRACTICES

1. Adjustment/Test

A. Functionally test ignition system

(1) Check that both igniter plugs are fitted to the engine.

(2) Disconnect input supply to the ignition unit which is not under test.

(3) Check engine is free from inflammable vapours.

NOTE : It is recommended that this test is completed in the open, that is outside the hangar.

(4) Energize PE busbar (see Chapter 24).

(5) Check busbar voltage is not more than 28 volts or less than 24 volts.

(6) Depress the relight switch and check, aurally, that the rate of discharge at the igniter plug is not less than :-

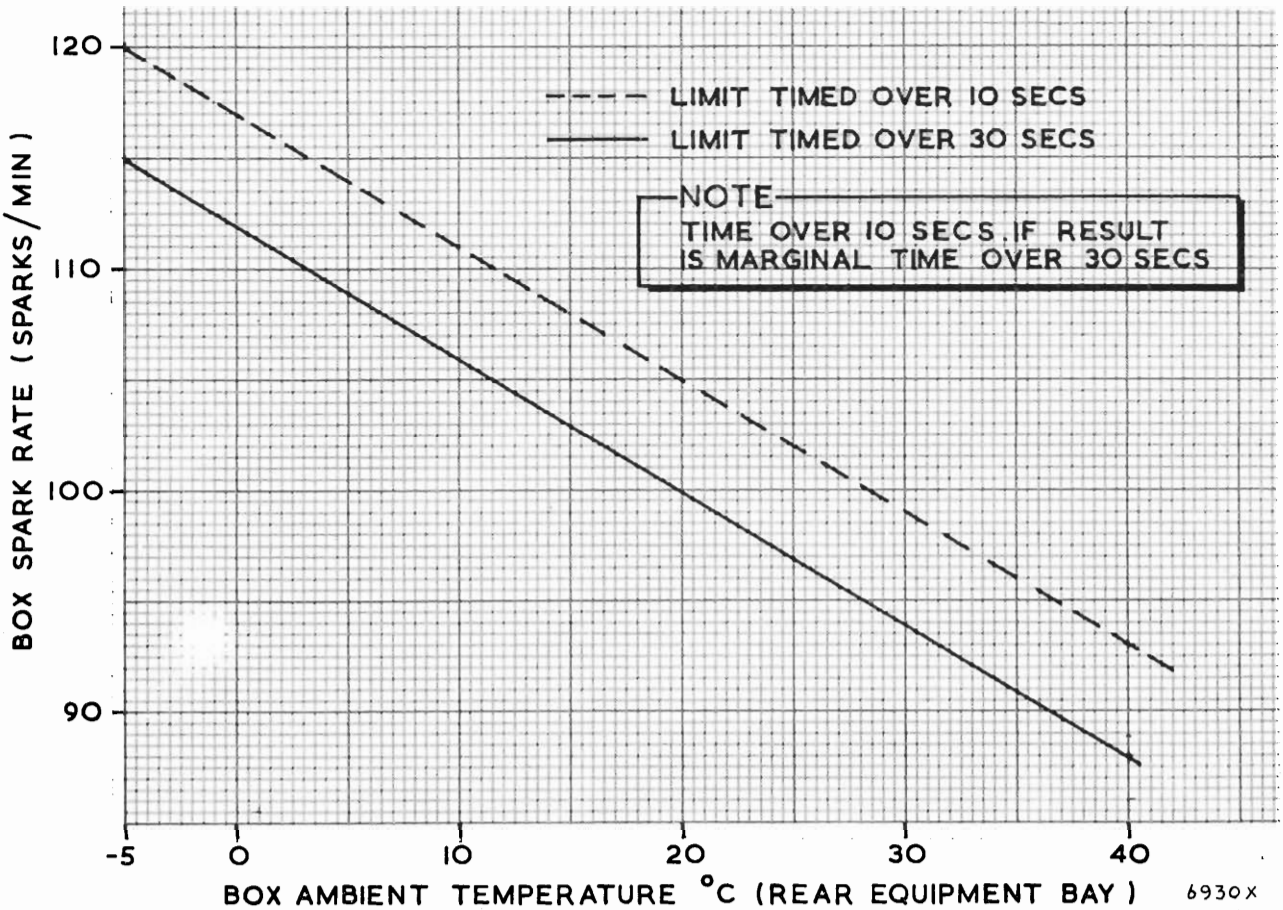
(a) Pre-mod. 257274 - 120 discharges per minute.

(b) Mod. 257274 - see Fig. 201 (overleaf).

(7) Connect input to ignition unit not under test.

(8) Repeat operations (1) to (7), as necessary, to check remainder of ignition systems.

Fig. 201 on page 202



Minimum acceptable spark rate (mod. 257274)
Fig. 201

IGNITER PLUGS AND CABLES - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment

Spanner for igniter plug ring nut ..	..	PE.2617
Ratchet spanner for use with PE.2617	..	PE.2621
Tension wrench (40 to 280 lb in.) ..	..	PE.25492

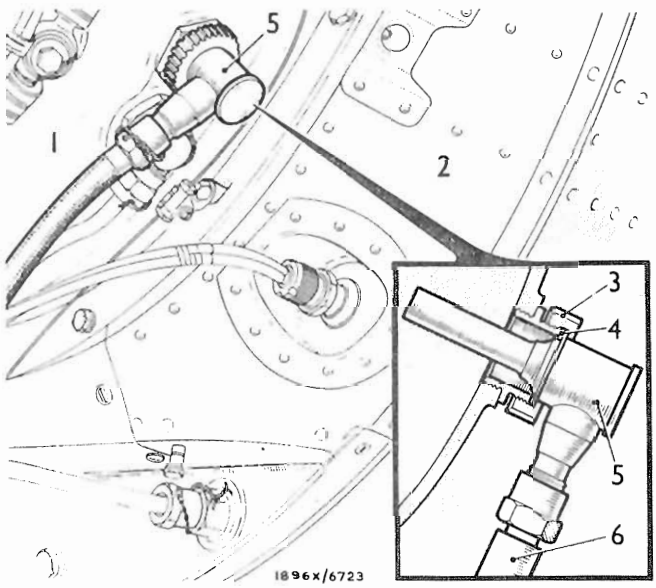
A. Remove igniter plug

WARNING : BEFORE TOUCHING ANY PART OF THE HIGH ENERGY CIRCUIT, DISCONNECT THE LOW TENSION INPUT FROM THE HIGH ENERGY IGNITION UNITS, THEN WAIT AT LEAST ONE MINUTE BEFORE PROCEEDING.

(1) Gain access to the engine.

(2) Unscrew the HT cable connector from the plug body and install a sealing cap over the exposed terminal gland (Fig.201).

(3) Unscrew the serrated ring nut with the tool kit spanner, then withdraw the igniter plug from the centre section. Discard the copper washer. Blank the plug location.



1. Centre section casing
2. Engine rear cowl
3. Serrated ring nut
4. Copper washer
5. Igniter plug
6. HT cable

Igniter plug installation
Fig.201

...Igniter plugs and cables - Maintenance practices continued

B. Install igniter plug

(1) Unpack the plug and inspect it for damage, corrosion and cleanliness. Pay particular attention to the insulating sleeve within the terminal housing and to the electrical contact.

(2) Apply approved grease to the threads of the serrated ring nut in POWER PLANT - SERVICING MATERIALS.

(3) Remove the blank from the plug location.

(4) Assemble a new copper washer to the igniter plug, then insert the plug into its location in the centre section; make sure that the plug engages the ferrule in the outer flame tube.

(5) Torque-load the ring nut to 240 to 260 lb.in. Use the special spanner in conjunction with the tool kit ratchet spanner and tension wrench.

NOTE : Set the tension wrench to operate at between 210 and 230 lb in. This will provide the required loading when used with the ratchet spanner.

(6) Connect and tighten the HT cable.

(7) Test igniters via relight switch.

2. Adjustment/Test

A. Check igniter plug resistance

Using a 500-volt Megger, test the overall resistance between the high tension electrode and the igniter plug body. Reject any igniter plug in which the resistance exceeds 0.5 megohms; there is no minimum limit.

3. Inspection/Check

A. Check condition of igniter plug

(1) Visually examine the plug for damage, cracking and distortion; pay particular attention to the housing flange.

(2) Examine the electrodes for erosion by visual comparison with a new igniter plug. Reject the plug if more than 50 per cent erosion is apparent.

CAUTION : THE IGNITER PLUG DOES NOT NORMALLY REQUIRE CLEANING, IF CARBON DEPOSITS PREVENT AN ACCURATE ASSESSMENT OF ELECTRODE EROSION. REMOVE THE DEPOSITS WITH A SCRAPER, TAKING CARE NOT TO TOUCH THE SEMI-CONDUCTING SURFACE.

* * *

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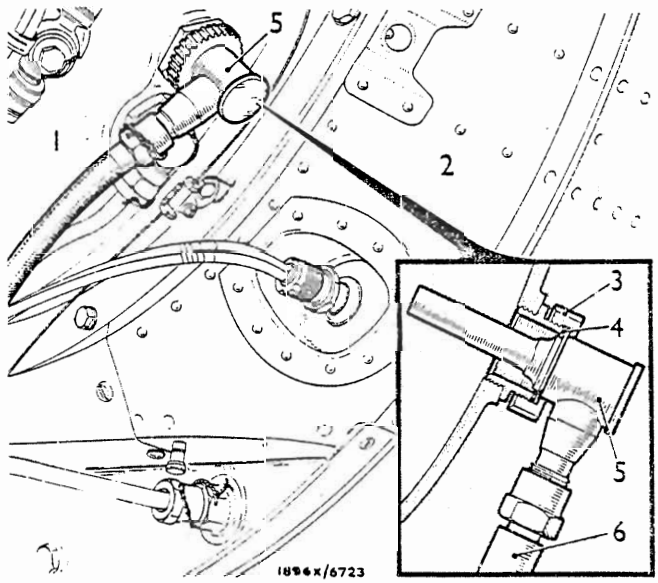

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Igniter plug installation
Fig.201

...Igniter plugs and cables - Maintenance practices continued

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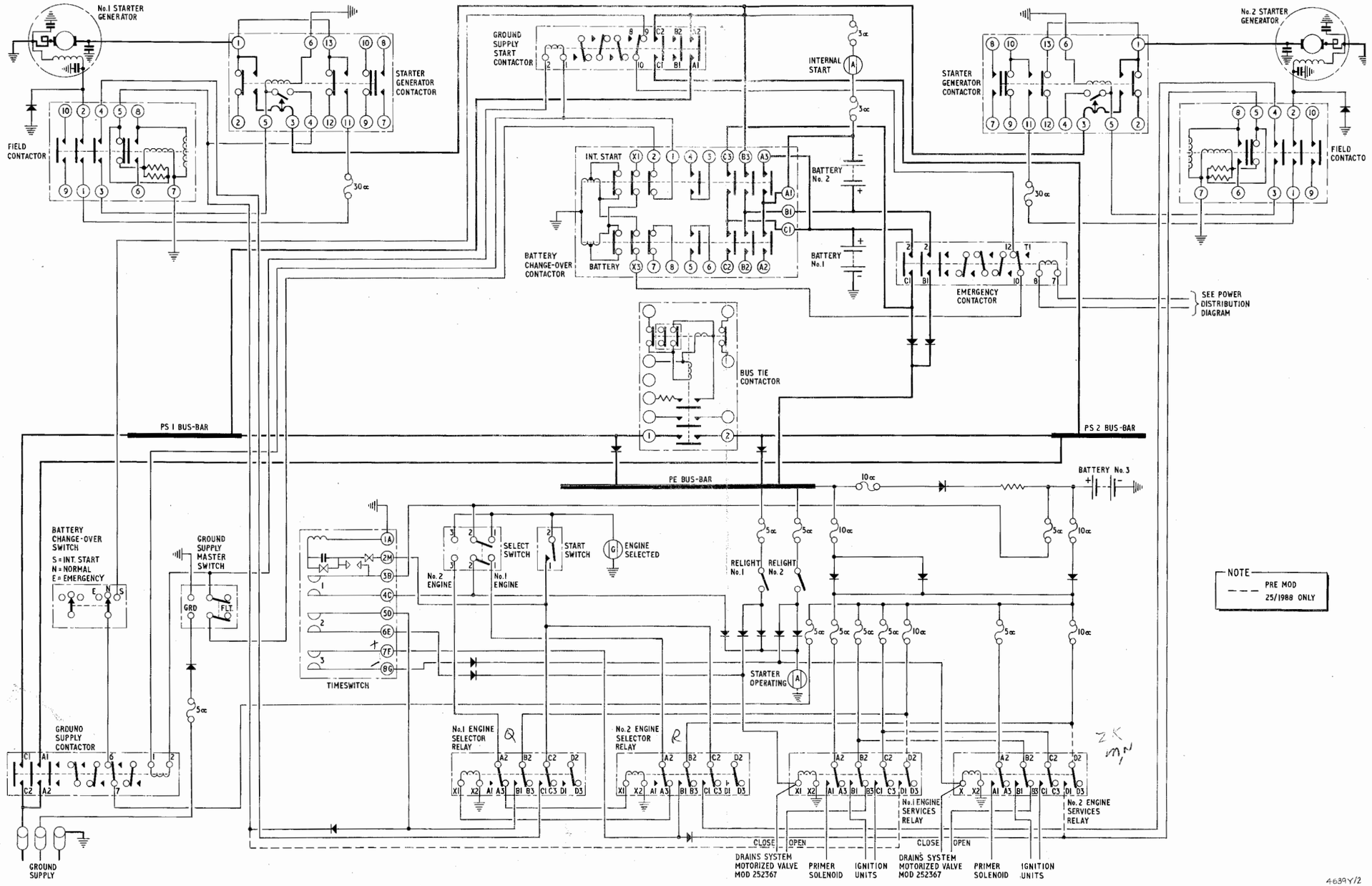
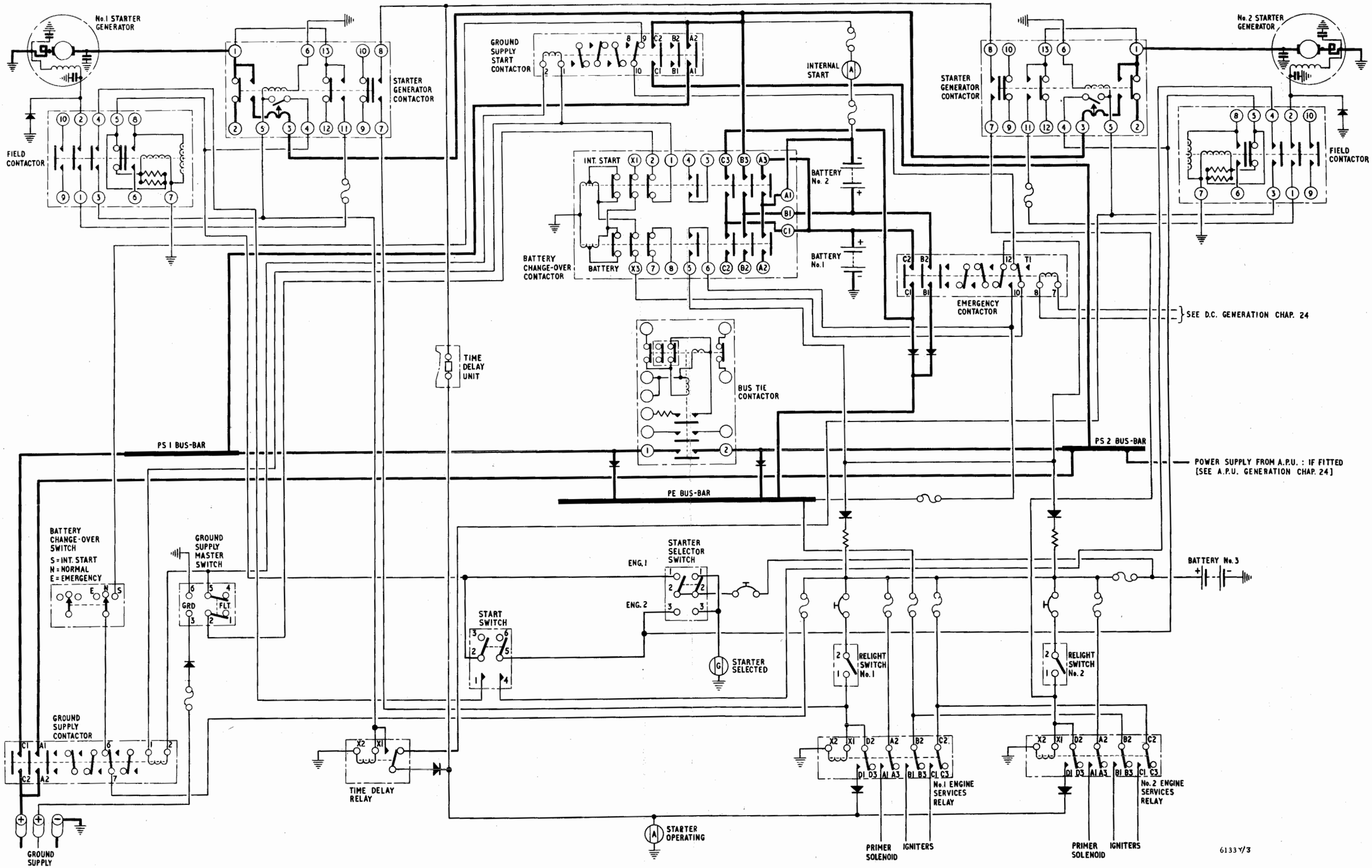
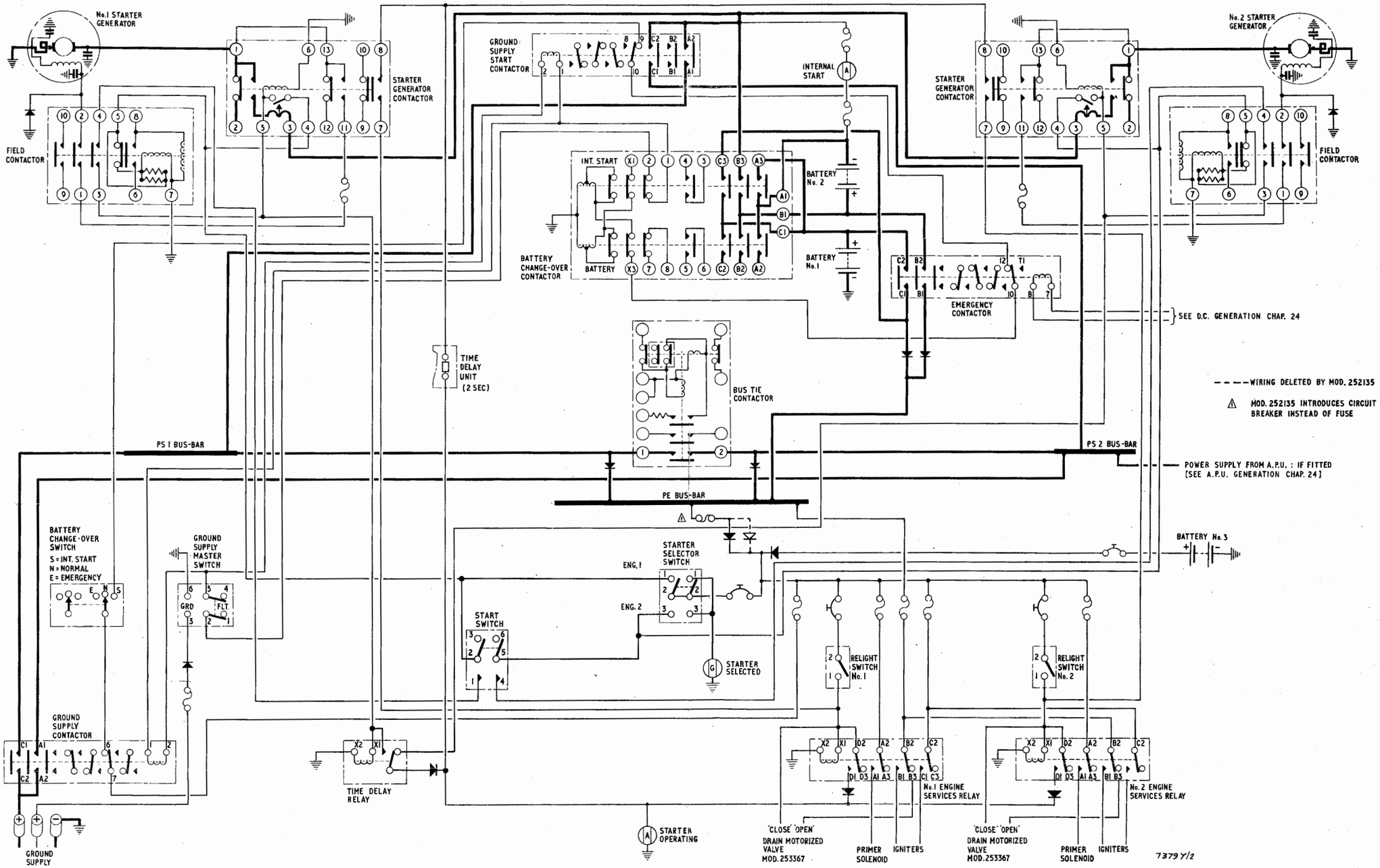
* * *



Starting - schematic diagram
Fig.2



Starting-schematic diagram (pre mod.252065)
Fig.2

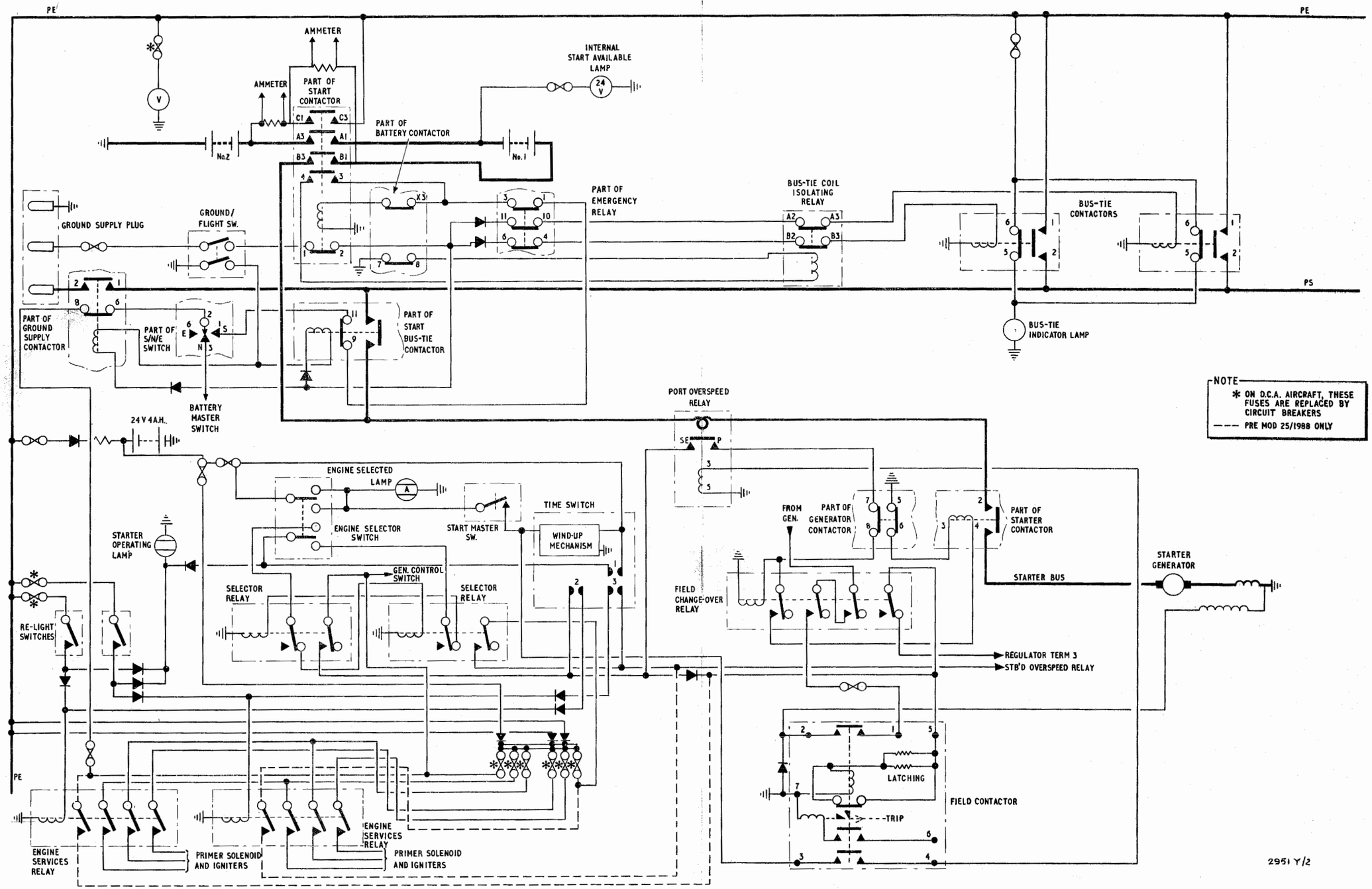


—— — —WIRING DELETED BY MOD. 252135

⚠ MOD. 252135 INTRODUCES CIRCUIT BREAKER INSTEAD OF FUSE

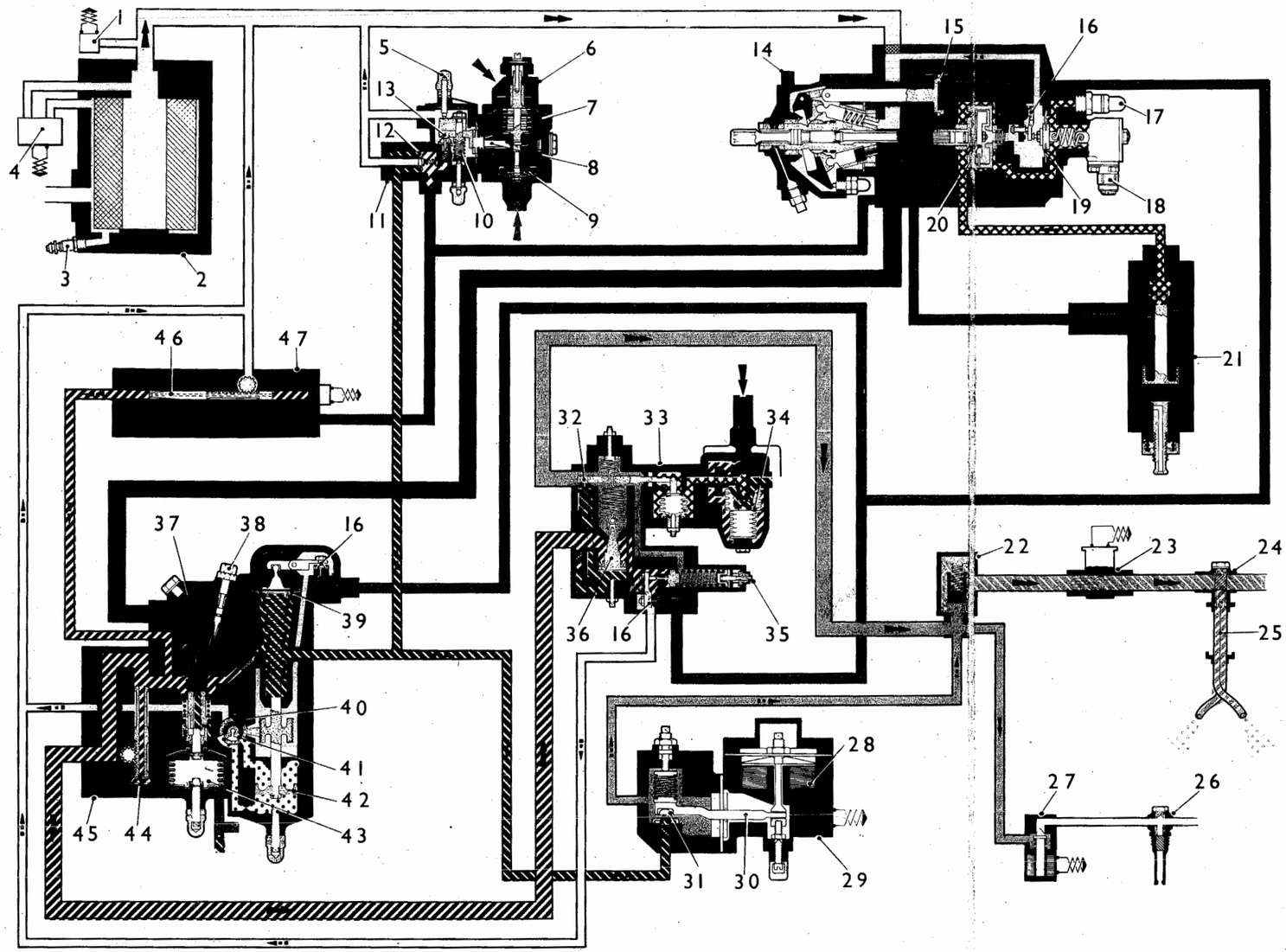
Starting - schematic diagram (mod 252065)
Fig.3

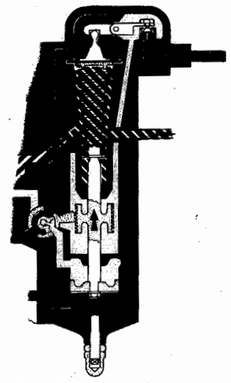
PRINTED IN ENGLAND



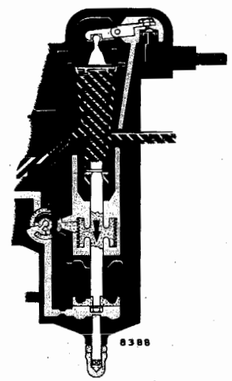
Start and relight circuit–schematic diagram
Fig. 1

- PUMP INLET
- SERVO RETURN
- PUMP DELIVERY
- PUMP DELIVERY PRESSURE
- GOVERNOR
- B.F.C.U. OUTLET
- SYNCHRONIZER DELIVERY
- SERVO CONTROL SPRING CHAMBER PRESSURE
- A.T.L. AMPLIFIER CONTROL PRESSURE
- TRAPPED FUEL
- A.F.R.C. OUTLET
- E.P.C. BLEED
- FUEL MANIFOLD
- FUEL FEED PIPE
- PUMP SERVO
- SERVO (OTHER UNITS)
- P.2. AIR
- K.P.2. AIR
- SWITCH REGULATING PRESSURE
- P.O. AIR
- P.I. AIR
- RESTRICTOR
- FILTER





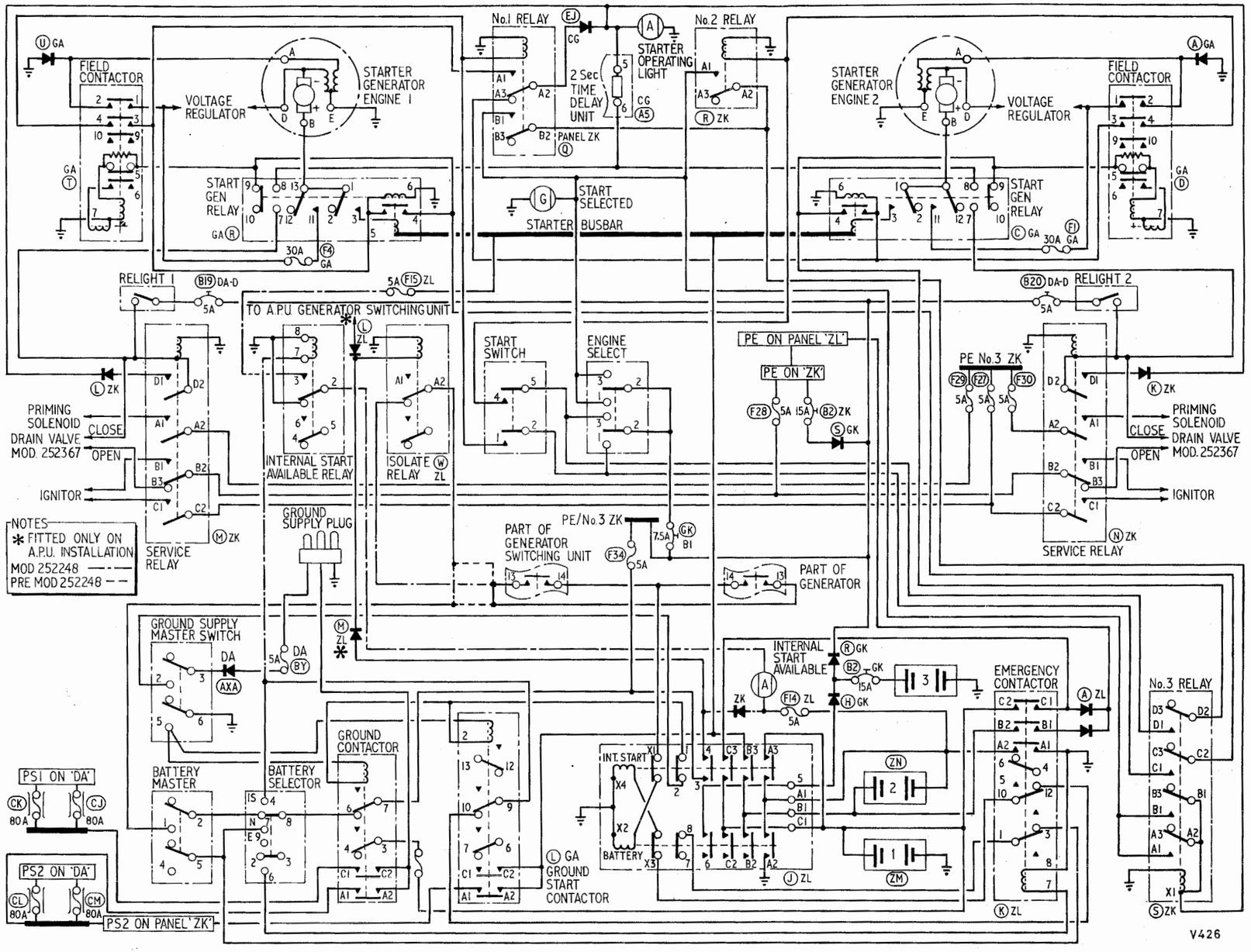
THROTTLE OPENING



THROTTLE CLOSING

4038Y

1. Fuel Low Pressure Warning Switch.
2. Low Pressure Fuel Filter.
3. Fuel Filter Bleed Valve.
4. Fuel Filter Differential Pressure Switch.
5. Maximum Flow Stop.
6. Automatic Thrust Limiter.
7. Bellows.
8. Rocker Lever.
9. P1/P2 Diaphragm.
10. Trimming Spring.
11. Servo Amplifier Sub Unit.
12. Servo Amplifier Diaphragm.
13. Half Ball Valve.
14. Fuel Pump.
15. Servo Piston.
16. Servo Spill Valve.
17. Pump Bleed Valve.
18. Maximum Speed Control Adjuster. } Governor
19. Spring-loaded Diaphragm. } Governor
20. Hydro/Mechanical Governor Rotor.
21. Rate Reset Valve.
22. Pressure Increasing Valve.
23. Flowmeter.
24. Fuel Feed Pipes Manifold.
25. Fuel Feed Pipe Unit (12 off).
26. Primer Unit (6 off).
27. Primer Solenoid.
28. Solenoid.
29. Electro Pressure Control.
30. Rocker Lever.
31. Half Ball Valve.
32. Internal Servo Spill Valve.
33. Air/Fuel Ratio Control.
34. Differential Bellows Assy. (Pressure Ratio Switch).
35. Acceleration Rate Adjuster.
36. Piston and Metering Plunger Assy.
37. Augmentor Valve.
38. By-pass Valve (Idling Adjustment).
39. Throttle Servo - Diaphragm.
40. Throttle Valve Sleeve.
41. Throttle Valve.
42. Throttle Servo Piston.
43. Barometric Pressure Control.
44. High Pressure Fuel Shut-off Cock.
45. Barometric Flow Control Unit.
46. Sychroniser Throttle Valve Plunger.
47. Synchroniser Corrector Unit.



Starting - schematic diagram
(Mods.252159, 252248 and 252367)
Fig.2