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ENGINE INSTALLATION

General

Before an engine is removed or installed, the rigging angle of the aircraft must be checked, the procedure being as follows : -

- (1) Gain access to the undercarriage bay where two spaced $\frac{3}{8}$ inch diameter holes will be found drilled in the inboard rib.
- (2) Insert a $\frac{3}{8}$ inch diameter steel rod in each hole and lay across them a straight edge.
- (3) Using a Clinometer check the aircraft rigging angle which, although normally is plus 5° , will vary according to surface level, tyre pressure etc.
- (4) This rigging angle should be recorded as when the engine is installed, the sum of the aircraft angle plus 2 degrees 45 minutes, becomes the true aircraft/engine linearity. e.g. if the aircraft rigging angle is found to be four degrees 17 minutes then the true angle would be 7 degrees 02 minutes. Inversely, if the aircraft rigging angle is 5 degrees 44 minutes then the true engine angle would be 8 degrees 26 minutes.
- (5) When it is necessary to change an engine already installed, a simplified procedure would be to check the engine angle prior to removal. This enables the new engine to be installed in the original position.

Preparation of engine for installation

The engine should be mounted in a mobile stand, securely fastened during transport, and lined up beneath the engine bay into which it is to be installed.

The present.....

(Note: the present type of engine winch calls for the E.C.U. to be mounted in a high mobile stand due to the length of winch cable which does not provision for the aircraft being on hydraulic jacks).

(1) Engage the hooks at the top of the winches with the attachment points provided in the engine bay. The winches should be engaged with the front hooks facing rearwards, and the rear hooks facing forward, whilst the winding end of the winches should face 'away' from the engine. At this stage the front winches must be positioned in front of the air intake casing.

(2) With a suitable number of personnel stationed at each winch and another man to act in a supervisory capacity, the E.C.U. may be lifted from its stand by giving each winch a simultaneous number of turns, taking special care that the common engine breather pipe and other engine attachments do not foul the stand whilst lifting is in progress. When the E.C.U. has been raised high enough, the stand may be removed.

(3) When the stand has been removed the fixed trunnion bearing can be assembled, the procedure for this being as follows : -

- (a) Fit a .3 inch distance piece on the trunnion ensuring that the bore radius is nearest to the engine.
- (b) Lubricate the trunnion and fit the phosphor bronze bearing.
- (c) Fit spacing washers. The Contractor supplies two .100 inch spacing washers, but additional shims may be required to ensure that the bearing is being 'nipped'.
- (d) Assemble the end plate, tab washer and belt to the threaded portion of the trunnion, ensuring that the tab of the locking washer has fully engaged with the hole provided in the trunnion.

With a



- (e) With a $\frac{3}{4}$ inch spanner tighten the complete assembly and turn back the locking tab in the usual manner.
- (f) Fit the free floating phosphorbronze bearing to the trunnion on the opposite side of the engine, no distance piece or spacing washers being required.

(NOTE: The fixed bearing when attached to the engine bay centre rib is positioned on the port side of Nos. 2 and 4 engines, and the Starboard side of Nos. 1 and 3)

Installation of E.C.U.

At the call of the operator in charge of the E.C.U. installation, each winch is given a simultaneous number of turns, and just before the E.C.U. enters the engine bay the front winches, port side first, should be brought from the front of the air intake casing and positioned behind the front mounting trunnions.

The E.C.U. is now brought into the engine bay in easy stages, half or quarter turns only being given on the winches careful attention being paid to those items which are likely to foul aircraft fittings.

With the E.C.U. approximately half way into the bay the front winches only are given 18 full turns in order that the angle of the E.C.U. will become approximately parallel to that of the aircraft, and this can be checked by the use of a Clinometer. At the same time it is necessary for one man to position himself above the engine in order to observe that the E.C.U. bulkheads are engaging correctly with those of the aircraft.

(Note: The figure of 18 turns given above is based on an aircraft angle of 5° , for a greater or lesser angle the number of turns must be proportional)

The E.C.U. is now raised slightly above its correct position and the fixed bearing trunnion housing swivelled into position to mate up with the engine phosphor bronze bearing. The bottom housing bolt is now fitted, and the engine lowered until the fixed bearing is seated in its housing. With the aid of a torch and mirror ensure that the bearing is seating correctly.

The same procedure is now adopted for the free floating bearing, and after ensuring that both bearings have seated correctly, the top halves of the bearing housings should be bolted into position.

(Note: Experience has shown that by fitting the fixed bearing in its housing first, the amount of engine maneuvering is reduced to a minimum.)

The front link may now be fitted, making sure that (a) the flange of the floating bush is outside the bracket, and (b) there are an equal number of threads visible either side of the turnbuckle.

The four hoisting winches may now be removed.

Place a straight edge across the front face of the air intake casing, and with the use of a Clinometer check the angle of the engine and make such adjustments to the front link which may be found necessary in order to obtain the required angle as described in the 'General'.

After the angle of the engine has been set, finally ensure that the front link is in safely, the lock nuts tight, and the turnbuckle wire-locked and sealed. The rear trunnion bearing housings and mounting bracket bolts should be checked for tightness and split-pinned.



INSTALLATION OF JET PIPE

Using the approved web sling place the jet pipe in a mobile stand designed to carry the pipe on its fore and aft rollers, on which they are free to slide into the jet pipe tunnel. The stand has four ratchet type adjustable jacks which are used for varying the angle of the jet pipe to suit the angle of the aircraft.

After placing the stand in position ease the jet pipe into the tunnel, locating the rollers on the guide rails and pushing the jet pipe into a position approximately three inches from the end of the E.C.U.

It is to be noted that the top roller is also used on the outboard installations their use being to counteract side thrust, whilst the centre rollers of all jet pipes must be 'proud' of the guide rails when in position, their sole use being to facilitate the fitting or removal of the jet pipe.

Remove the blank from the end of the E.C.U. and then (a) disconnect the exhaust cone shroud securing wires and remove the top half of the shroud, (b) push the bellows joint assembly towards the front of the engine as far as possible, (c) apply Squires High Temperature jointing compound to the jet pipe flange and also to that of the bellows joint flange.

With two men at the nozzle end of the jet pipe and two others at the attachment end, push the jet pipe forward until there is full engagement with the exhaust cone flange, and providing that the E.C.U./ aircraft

linearity has been set accurately, no difficulty should be encountered.

Fit the two retaining channels and hold in position by hand, pull the jet pipe rearwards where a movement of .4 inches must be observed; the effect of this movement will be to 'nip' the retaining channels.

After ensuring that this .4 inch movement is positive leave the jet pipe in the rear position. The bellows joint can now be pushed back over the retaining channels to mate up with the jet pipe flange ensuring that the 3/16 inch dowel in the bellows joint flange engages correctly with the hole in the jet pipe flange.

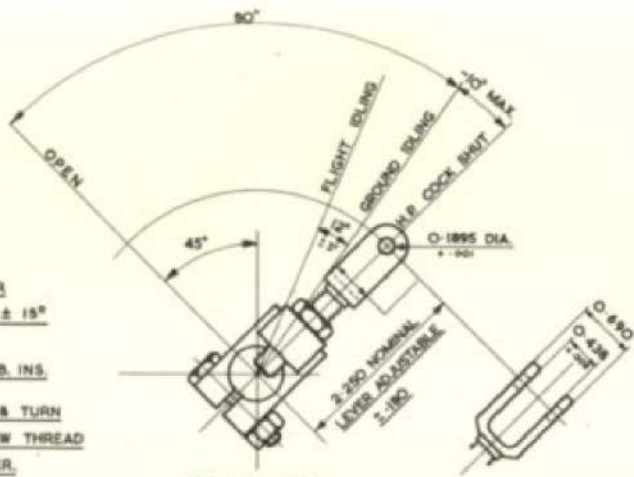
Fit the double manacle clamp and tighten the tensioning belts sufficiently to hold the assembly in position. The front bellows single manacle clamp is now fitted and the tensioning bolt tightened. It is now necessary to torque load both sets of clamps, this should be carried out using an appropriate torque spanner set at 80.lbs.ins., after which the bolts are to be wire locked.

Check that the jet pipe is still free to move, and that the fore and aft rollers are resting on the guide rails. The original .4 inch movement will now only become effective when jet pipe expansion or contraction takes place under engine running conditions, but a certain amount of free movement of the bellows joint can be felt.

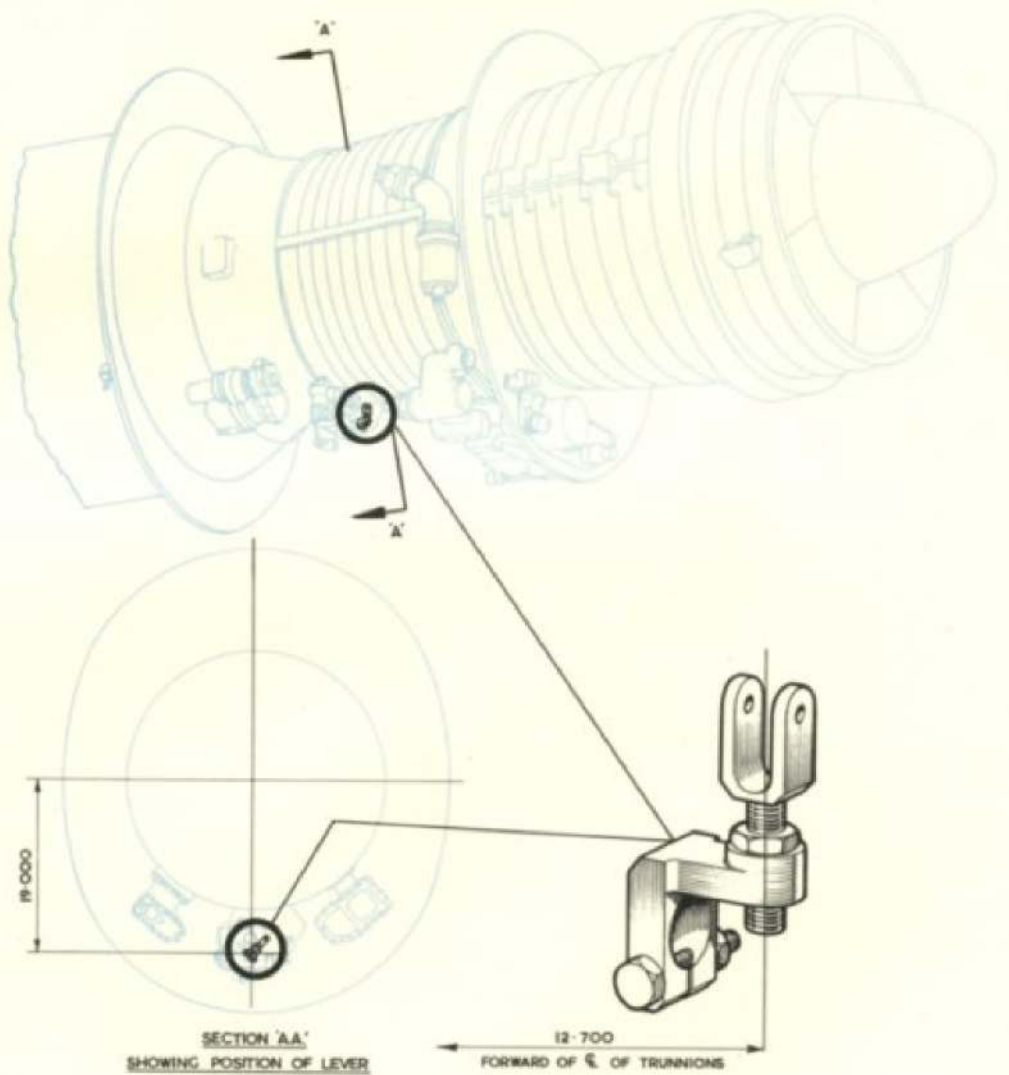
Refit the exhaust cone shroud ensuring that the correct securing wires are in their appropriate positions, the longest wire being placed in the front channel.

Fit a blank to the jet pipe nozzle and connect the flexible fuel drain pipe to the adaptor provided on the bellows joint and wire-lock.

ANGULAR POSITION OF LEVER
INFINITELY VARIABLE WITHIN $\pm 15^\circ$
OF POSITION SHOWN.
MAX. OPERATING TORQUE 10 LB. INS.
NOTE - SLACKEN LOCK NUT & TURN
CLAMP BOLT TO GIVE SCREW THREAD
WORM ADJUSTMENT OF LEVER.



THROTTLE LEVER
 (VIEW LOOKING AFT)



SECTION 'AA'
 SHOWING POSITION OF LEVER

12.700
 FORWARD OF C. OF TRUNNIONS

OLYMPUS 101
POWER CONTROL



FILLING OIL TANK

The oil tank is pressure filled from a mobile tank pump unit.

Disconnect the avery self sealing coupling of the scavenge oil return pipe which passes through No.3 vane of the air intake casing. Connect a self sealing coupling with a suitable length of hose attached to drain the overflow oil into the mobile tank unit.

Disconnect the avery self sealing coupling between the suction side of the main oil pump and oil tank. Connect the self sealing coupling incorporated in the mobile tank unit to the self sealing coupling of the oil tank and fill the tank by operating the mobile tank pump.

When oil commences to flow through the overflow pipe, cease pumping, remove the two slave self sealing couplings and connect the couplings between the scavenge oil return pipe also between the suction side of the oil pump and oil tank



BLEEDING THE ENGINE AND FUEL SYSTEM

The system must be bled before engine start after installation, or whenever the system has been disconnected in any way, or if the L.P. cocks have been inadvertently closed before engine ceases to rotate, and must be carried out in the following manner.

1. The main fuel filter bleed valve is situated at the top of the main fuel filter housing, remove the locking wire and screw out the bleed union one complete turn. Attach a suitable rubber hose pipe to the bleed union to drain fuel away from the engine. Switch on the main fuel tank booster pumps to "manual", turn the H.P. and L.P. Compressors all the time that bleeding is in progress until bubble free fuel flows. Screw in the bleed valve one complete turn, take care not to crush the nipple.
2. The main fuel pump bleed valve is situated above the H.P.C. governor adjustment and consists of a spring loaded non-return valve. Remove locking wire and blanking cap and connect the special bleed pipe connection. Switch on main fuel tank booster pumps until bubble free fuel flows from the connection. Remove bleed pipe, refit blanking cap and wire lock.
3. The blanking plug on the underside of the L.P.C. governor is used as a bleed connection. Remove the locking wire and blanking plug and connect a suitable drain pipe. Switch on fuel tank booster pumps and turn the L.P. and H.P. compressors until bubble free fuel is flowing. Switch off L.P. cocks then tank pumps after bleeding operation is complete. Remove drain pipe and refit blanking plug and wire lock.



ENGINE RUNNING INSTRUCTIONS

GENERAL

1. Engine ground running should be restricted to a minimum to avoid fouling the compressor with dust laden air.
2. Position the aircraft so that the jet efflux is away from tarmac-covered surfaces, buildings, or other aircraft.
3. Remove all intake, outlet, and all breather blanks, etc., from each engine as necessary and check that the engine oil and fuel tanks have been replenished.
4. Ensure that there are no loose objects, paper etc., in the area in front of the aircraft.
5. Inspect air intake tunnels for suspect rivets etc., also air brake access panel screws.
6. Keep a check on compressor blade cleanliness.
7. Keep a check on compressor or turbine blades, for any signs of cracks, or nicks etc.,
8. Check that zone 2A collector tanks are drained.
9. Check that the aircraft fuel system has not been broken down to rectify any snag, if so, and cross-feeds have not been operated, bleed the engine fed by that particular fuel tank group. If in doubt at any time, re-bleed all engines.
10. If for any reason the engine bay access doors are to be left open for checks during engine runs, check that all jury struts are in position.
11. Check that

11. Check that all aircraft starting checks have been made, i.e. brakes on, chocks in position, etc., etc.,

12. Initial run or whenever an engine or jet pipe has been replaced.

(a) Carry out one motoring cycle, to check revolutions, Oil Press and H.P. cock.

(b) Carry out two deliberate false starts to check the bellows seal.

(c) Carry out one motoring cycle.

These cycles will be carried out in accordance with the instructions given later in these notes, but must always be carried out before lighting engine. If only jet pipe has been replaced, check on bellows seal only.



COCKPIT CHECKS

1. Ensure that the safety pins (2 off) are fitted to the ejector seat.
2. Ensure that the D/V windows are locked
3. Ensure that the canopy is locked
4. Ensure that the four off Teddington gate valves are in the closed position.
5. Check that all anti-icing switches are in the closed position.
6. Check that the fuel tank pressurisation and nitrogen switches are in the closed position.
7. Check that the parking brake is in the 'ON' position, and that you have hydraulic pressure.
8. Check that your throttles are in the H.P. closed position.
9. Check that your automatic starting panel, ignition and master switches are switched 'OFF'.
10. Pull out your main control console, which houses the fuel system controls, flying controls etc.,
11. Check that your L.P. cocks are in the 'OFF' position
12. Check that your fuel system is set to manual; that all your pulsometer pumps are switched off; that your transfer cocks from No.1 to No.7 tanks are closed; that your cross feed cocks are closed; that your flying controls are out of operation; that your air brakes are closed.
13. Check each fuel group for fuel contents - i.e., the total reading against individual tank contents, and record the readings.

14. Check that your generators are out of operation.
15. Ensure that your electrical ground supply for 112 and 28V is in operation, and that all electrical services for the ground runs are in operation. Do not load the generators, i.e. keep on ground supply.
16. Ensure that L.P.W. doll's eyes show low pressure.
17. Ensure that your intercom is in operation and that you are fully in touch with the ground crew.
18. (a) Select No.1 tank 'ON' in No.1 group with control at manual.
 (b) Open No.1 L.P. cock; your L.P.W. doll's eye should change to normal.
 (c) Open the cross feed cock from 1 to 2 groups, and open No.2 L.P. cock; your L.P.W. doll's eye should change to normal.
 (d) Open port to starboard cross feed cock and open No.3 L.P. cock; your L.P.W. doll's eye should change to normal.
 (e) Open the cross feed cocks from 3 to 4 groups, and open No.4 L.P. cock; your L.P.W. doll's eye should change to normal. i.e. with only one pump in operation you have checked :-
 - i. L.P.W. doll's eyes
 - ii. L.P. cocks
 - iii. Cross feed cocks
- (f) Now close all cross feed cocks.
- (g) Switch each fuel group to 'AUTO'
- (h) Switch on all fuel pumps



(i) You are now in the following position :-

- i. L.P. Cocks 'ON'
- ii. H.P. Cocks 'CLOSED'
- iii. Fuel system set for ground runs
- iv. All L.P.W. doll's eyes at normal

and are in a position to either cycle or start whichever engine is required, by the appropriate selection on the automatic starting panel.

MOTCRING CYCLE

1. Plug into ground starter unit
2. Starting master switch 'ON'
3. Set engine selector switch to appropriate engine
4. Igniter isolating switch to 'OFF'
5. Check that throttle is at 'H.P. cock shut' position.
6. Press starter button (this will hold in for 30 seconds)
7. Check that your oil pressure rises to approximately

30 p.s.i. You will not observe any L.P.C.

R.P.M. as the starter motor only drives the H.P.C., also you should never, with the ignition isolation 'OFF' be able to light the engine. One word of warning, never during deliberate false starts or motoring cycles, inadvertantly operate the relight buttons, mounted in the top of each throttle control lever.



DELIBERATE FALSE START.

Make a leakage check of the outer cone unit bellows joint in the following manner : -

With the engine cold, carry out two deliberate false starts consecutively and check for leakage from the cone clamp of the bellows joint. If leakage exceeds 0.5 c.c. per second, fit a new strap and bolt assembly and repeat the test.

CAUTION : The strap bolts must never be retightened

after the initial tightening to 80 lbs.ins.torque.

1. Starting master switch 'ON'
2. Set engine selector switch to appropriate engine.
3. Check that igniter isolation switch is 'OFF'
4. Throttle open to 'H.P.Cock open' gate
5. Press starter button (This will hold in for 30 seconds)
6. Close H.P. cock when starter panel button throws out.

Repeat 'Motoring Cycle' and 'Deliberate False Start' on all engines.

N.B. After three successive operations of the starter, the starter motor must be allowed to cool off for fifteen minutes, before another start is made, also on initial engine runs, when these false starts etc., are being carried out, see that the starter panel buzz bar in the power bay does not overheat and melt.

Check that all surplus fuel has been drained from the engine, and jet pipe tunnel end caps, etc.

Motoring Cycle

Repeat motoring cycle on each engine.

STARTING THE ENGINES

1. Starting master switch 'on'
2. Set engine selector switch to appropriate engine.
3. Igniter isolation switch to 'on'
4. Throttle open to 'H.P. Cock open' gate
5. Press starter button (this will hold in for 30 seconds) or until overspeed relay operates.) Engine should 'light-up' within four to six seconds and finally run at ground idling speed.
6. Repeat operations 4, 5, 6, and 7 on other engines.
7. Starter master switch 'off'
8. Open throttle gradually to flight idling R.P.M.

Note: If, on starting, 600° C, jet pipe temperature is obtained and temperature continues to rise, return throttle to 'H.P. Cock shut' position immediately and turn starter master switch to 'OFF'. When engine has come to rest, check for trouble and when ready repeat normal starting sequence.

Warning

If the engine does not start, the next attempt to start must not be made until a MOTORING CYCLE has been carried out, the engine cleared of unburnt fuel and checks have been carried out.

When the



FIRST ENGINE RUN AFTER INSTALLATION

When the installation of the engine has been completed, carry out the first engine run in the following manner : -

1. Check that the ground idling speed is satisfactory.
2. Open up gradually to the flight idling position and again check the engine speed.
3. Open up to the maximum continuous r.p.m. rating and run the engine at this condition for three minutes (minimum), check the engine speed, oil and fuel pressures, and jet pipe temperature.
4. Open up to the take-off rating for 10 seconds and check the engine speed and jet pipe temperature.

NORMAL PROCEDURE FOR STOPPING ENGINE

1. Close throttle to 'H.P. Cock shut' position.
2. When H.P. compressor has ceased to rotate close L.P. cocks and switch off tank pumps.
3. Disconnect ground batteries
4. Check fuel tank contents, etc., etc.

INSPECTION

Fuel System

1. Inspect the pipe lines and fuel system units for leakage, security and condition, and all unions for security and locking.

2. Check that

- CONFIDENTIAL DATA
2. Check that all fuel drain outlets are unobstructed (This can normally be seen by the discharge of fuel from the drains during engine 'run-down')

Oil System

1. Remove, inspect and clean the oil sump scavenge filter. Replace the filter and lock securely.
2. Make visual check for evidence of oil leakage.
3. Remove, inspect and clean the auxiliary oil scavenge pump filters. Replace and secure the filters.
4. Check the oil level of the engine oil tank, top up to replace oil lost when the filter is removed.

Engine

1. Check the security and condition of all external nuts and components.
2. Inspect the turbine centre mounting drum for general condition and signs of gas leakage, and check, as far as possible the security of all bolts, nuts, clamps, etc.
3. Check the H.T. lead/igniter plug connections for security
4. Examine all turbine casing, exhaust duct and jet pipe flanges for gas leakage, general condition and security of all nuts and bolts.
5. Check the jet pipe thermocouples for condition of insulation and security.

Examine the



6. Examine the engine mountings for cracks and check their security.

Engine Bay Doors

1. Clean all sections of the engine bay doors and check for cracks, damage and loose rivets.
2. Check the engine bay door locking equipment for security and condition.

Controls

Examine the throttle control for condition and check it for freedom of operation.

Electrical System

1. Check that the starter leads are connected to the starter securely and are serviceable.
2. Examine all instruments and thermocouple leads for condition of the insulation and check their security.

FOR FURTHER PARTICULARS OF ELECTRICAL SYSTEM SEE B.77034.

H.P. COMPRESSOR TACHOMETER
GENERATOR.

GENERATOR
(22.5 kW)

CLAMP BLOCK ON FRONT BULKHEAD
FOR ATTACHMENT OF STARTER CABLES.

BREEZE CONNEXION ON FRONT BULKHEAD
FOR HOT AIR VALVE ANTI-ICING ACTUATORS
& L.P. COMPRESSOR TACHOMETER GENERATOR.

STARBOARD
SIDE

PORT
SIDE

IGNITER PLUG.

ENGINE ANTI-ICING ACTUATOR.

H.P. COMPRESSOR TACHOMETER GENERATOR
(PROTOTYPES ONLY)

ENGINE OIL PRESSURE TRANSMITTER.

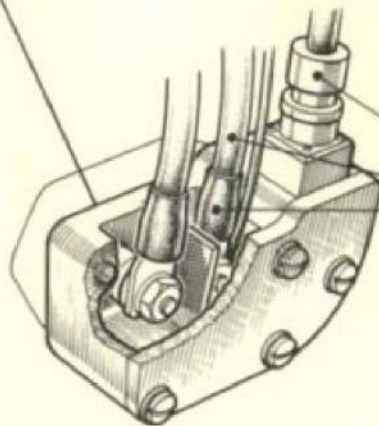
FUEL LOW PRESSURE
WARNING LIGHT SWITCH.

IGNITER PLUG.

BREEZE SOCKET CABLES
AND CABLE ENDS.
AIRCRAFT SUPPLY.

HOT AIR VALVE
ACTUATOR.

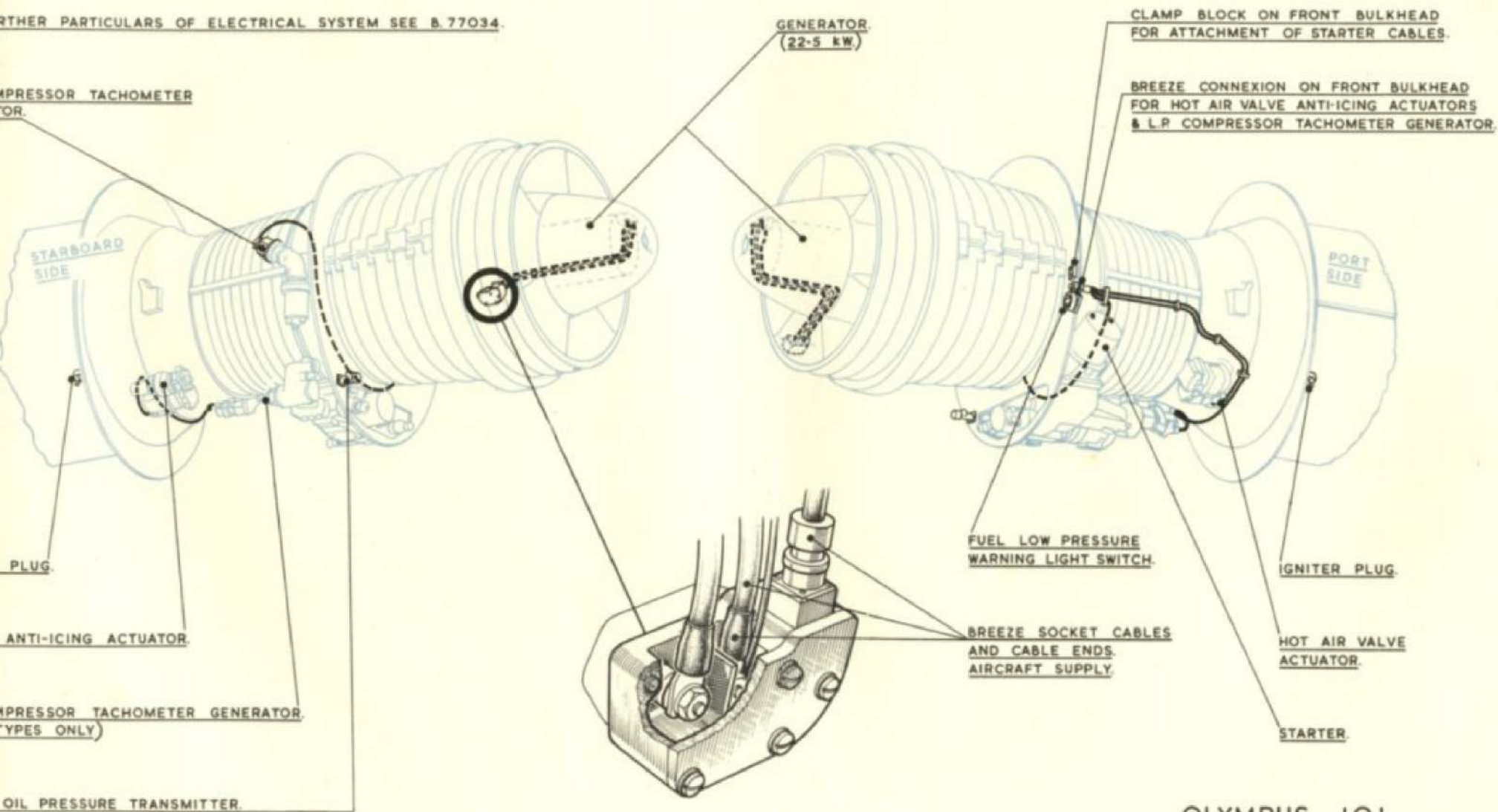
STARTER.



GENERATOR CABLES JUNCTION BOX.

OLYMPUS 101
ELECTRICAL CONNEXIONS

FOR FURTHER PARTICULARS OF ELECTRICAL SYSTEM SEE B. 77034.



GENERATOR CABLES JUNCTION BOX.

OLYMPUS 101
ELECTRICAL CONNEXIONS

FOR FURTHER PARTICULARS OF ELECTRICAL SYSTEM SEE B. 77034.

GENERATOR
(22.5 KW)

L.P. COMPRESSOR TACHOMETER
GENERATOR

CLAMP BLOCK ON FRONT BULKHEAD
FOR ATTACHMENT OF STARTER CABLES
BREEZE CONNECTION ON FRONT BULKHEAD
FOR HOT AIR VALVE ANTI-ICING ACTUATOR
& L.P. COMPRESSOR TACHOMETER

STARBOARD SIDE

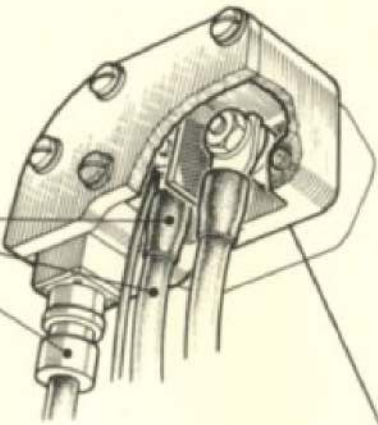
PORT SIDE

IGNITER PLUG

ENGINE ANTI-ICING ACTUATOR

H.P. COMPRESSOR TACHOMETER GENERATOR
(PROTOTYPES ONLY)

ENGINE OIL PRESSURE TRANSMITTER



BREEZE SOCKET CABLES
AND CABLE ENDS
AIRCRAFT SUPPLY

FUEL LOW PRESSURE
WARNING LIGHT SWITCH

STARTER

HOT AIR VALVE
ACTUATOR

IGNITER PLUG

OLYMPUS 101

ELECTRICAL CONNECTIONS

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