Chapter 1A

BRISTOL OLYMPUS 301 ENGINE

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LIST OF ILLUSTRATIONS

DESCRIPTION

Introduction

1. This chapter contains information on the Bristol Olympus 301 installation, its associated systems and components and outlines changes which occur when the engine is introduced. Relevant information already available in Chapter 1 will be referred to whenever possible.

2. Fixed fittings, introduced by Mod.905, are additional to or common with the requirement of the existing 201 - 203 engine installation and make part provision for the introduction of the 301 series engine. The modification also provides additional front hoisting and suspension fittings, re-routes certain electrical cable and hydraulic pipe runs and introduces strengthening members in the engine bay and centre section structures. When Mod.906 is incorporated, the part provision is completed and the 301 series engine introduced.

3. The 301 series engine is basically similar to the existing 201-203 series engines but incorporates an additional

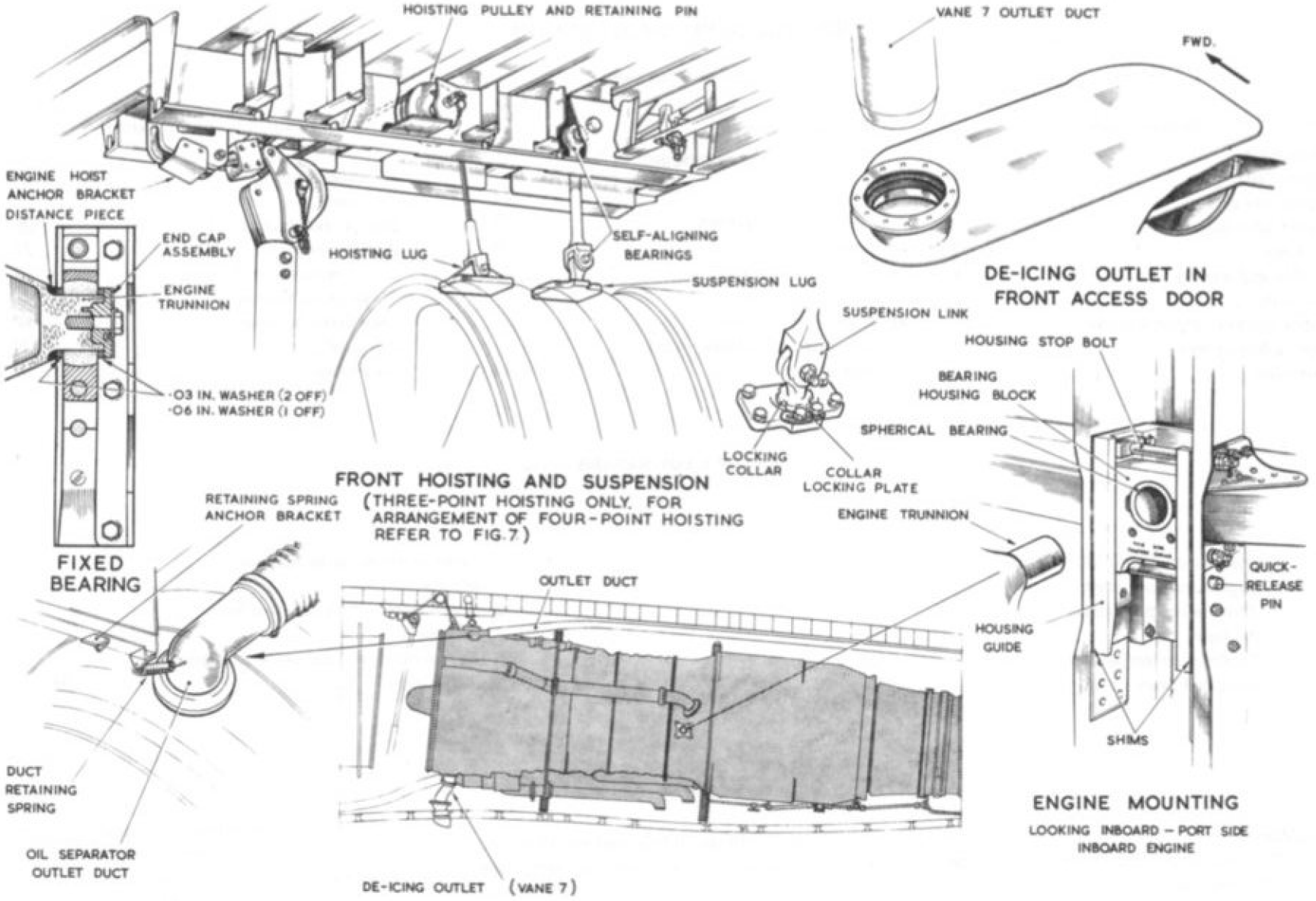

Fig. 1. Engine installation (301 Series)

◄ *Reference to four-point hoisting arrangement on fig. 7.* ►

L.P. compressor stage (uprating the engine) and redesigned engine lubricating and anti-icing systems. The engine and associated systems are fully described in A.P.102C-0403-1.

Engine starting

4. Engine starting is by compressed air delivered through the hot air system or, when required, from the rapid start system air storage cylinders within the aircraft. These starting systems are identical with those described in Sect.4, Chap.1 of this book. Additional information on starter system components will be found in A.P.102C-0403-1, Sect.1, Chap.6 and A.P.1181G, Vol.1 and 6. Use of the A.A.P.P. as an alternative source of supply for engine starting is discontinued.

Engine fuel system

5. The fuel system in this engine differs only slightly from that in the 201 - 203 series and is controlled in a similar manner. Information on the engine fuel system is to be found in A.P.102C 0403-1 Sect.1, Chap.2. The engine throttle control systems are described in subsequent paragraphs of this chapter, and disposition of the fuel system controls and indicators may be seen in the illustrations in Sect.1, Chap.1 of this book.

Engine lubricating system

6. The engines embody a complete oil system, the oil tank of which is located on the port side of the L.P. compressor and, is secured with two straps. For information on this system refer to A.P. 102C-0403-1, Sect.1, Chap.3.

Jet pipes

7. Jet pipes are attached to the engine exhaust outer cone in an identical manner to that employed on the 201 - 203 series engine installation and method of installation and/or adjustment remains the same.

Cooling and venting

8. With the exception of the oil separator breather outlet, engine cooling and venting arrangements are as described in Chapter 1. The oil separator breather outlet is as described for the 203 series engine installation, i.e., subsequent to Mod. 934.

Anti-icing

9. The L.P. compressor air intake guide vanes, struts and nose bullet are protected against icing by the induction of hot air from the H.P. compressor. This anti-icing protection is similar to that employed on the 201 - 203 engines except that, after flowing through the internal air-ways of the aforementioned components, air exhausts to atmosphere through an outlet duct at vane 7, which mates with an aperture in the engine front access door. This outlet duct and door aperture assembly is shown in fig.1. For information on the engine air system reference must be made to A.P.102C-0403-1, Sect.1, Chap.5.

Engine control - throttle system

10. Though similar in layout, this system differs slightly from that described in Chapter 1 and originally installed for the 201 engines. Various changes have been made by modification action (Mod. 889, 980, 1204 and 1544) to reduce friction and backlash, improving the system generally in preparation for inclusion in the automatic landing facility.

Flight idling detent

11. A flight idling detent, providing slightly more r.p.m. than that at normal ground idling is automatically inserted into the inboard engine throttle control systems when the aircraft reaches an altitude of 15,000 ft. This altitude auto-stop facility, introduced by Mod. 1649, consists of a solenoid operated stop-pin assembly under the control of an ambient altitude switch set to operate at 15,000 ft. Solenoid and stop-pin assemblies are mounted on the front face of former 316, below the pilots' floor, one to each inboard system. Fig.3 shows the starboard side assembly.

Operation

12. When the altitude switch is operated (15,000 ft.) the solenoid is energised to retract against its internal spring loading. This movement, conveyed through a simple link lever mechanism, causes the detent plunger to emerge from its housing into the path of the control system rod ex-extension. As the throttle lever is retracted toward the slow running range, the rod extension travels forward until it abuts the exposed detent plunger. This is the flight idling stop for inboard engines when the aircraft is flying at altitudes above 15,000 ft. The pilot can override this detent should it be necessary to run the engines at low r.p.m. or to shut the H.P. fuel cock, in which case, the detent plunger is forced to ride the chamfer on the system rod extension as the throttle lever is moved to the rearward position. In the event of electrical system failure during flight, the solenoid will extend on being de-energised and the detent plunger will be withdrawn. The control system is then handled in the normal manner, i.e., as in pre mod. flight condition.

Engine mountings

13. Engines are mounted in the aircraft in a similar manner to that already described in Chapter 1, a trunnion and spherical bearing on each side of the

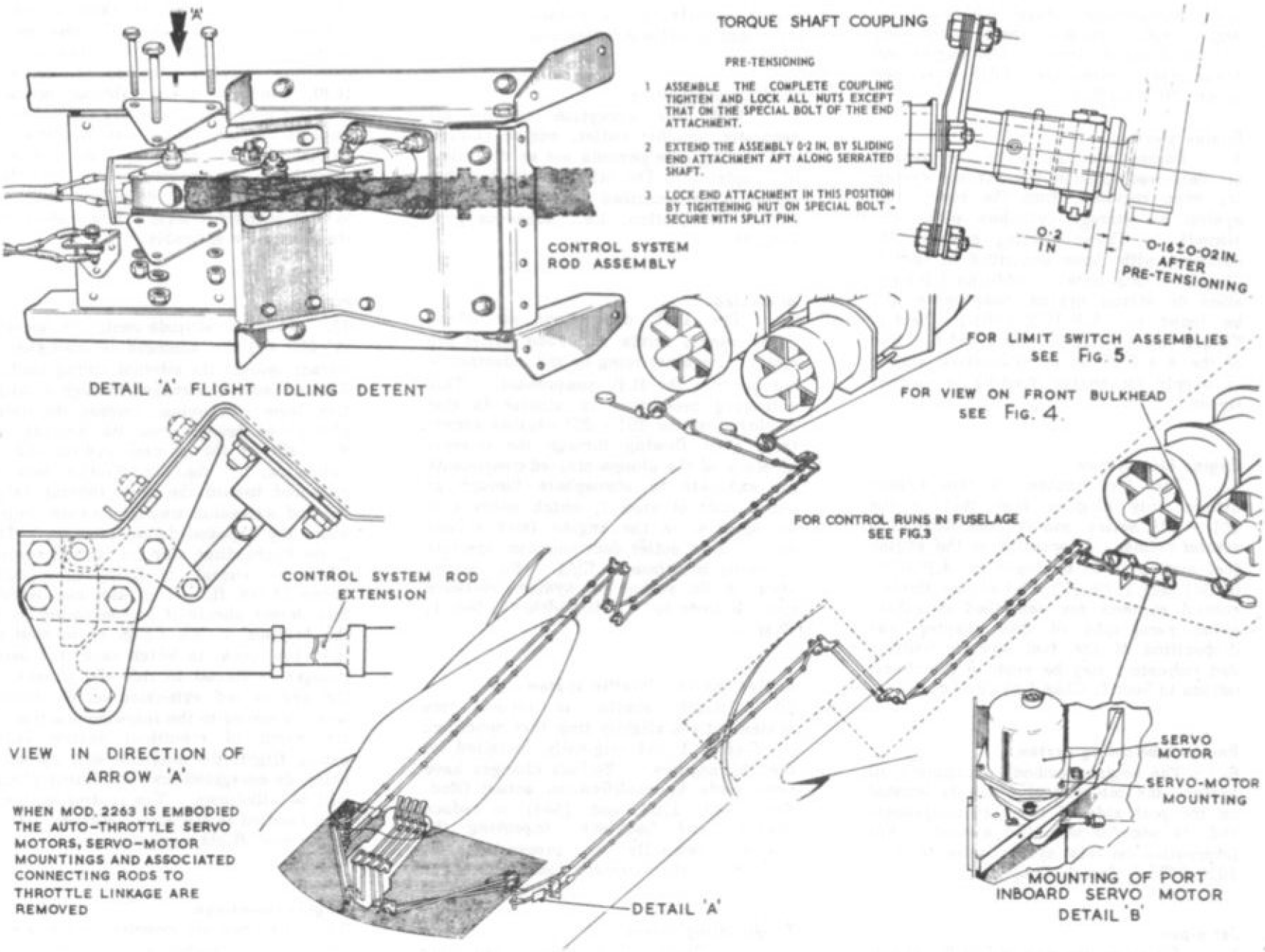

Fig. 2. Engine control system

◂ Note added ▸

engine and single suspension link at the front. Engine position can be adjusted to suit installation requirements by permutating the distance washers and shims fitted at the side trunnion bearings. The distance washers are fitted to the bearings at the engine centre rib as described in Chapter 1. Shims are fitted between the housing guide and the structure at ribs 63.5 and 162.5. The front suspension link is a fixed length solid bar, therefore, adjustment for correct engine angle is made at the suspension lug (eye bolt) assembly on top of the engine front casing. Side trunnion bearing and front suspension group assemblies are shown on fig.1.

SERVICING

Introduction

14. Preliminary instructions given in the Servicing section of Chapter 1 remain applicable when the 301 series engine is installed and must be adhered to. When an engine or engine component is to be removed or any engine servicing done refer to A.P.102C-0403-1.

15. Bleeding the fuel system, cleaning the fuel filters and draining collector tanks, are operations which are similar on 201 and 301 series engine installations; instructions given in Chapter 1 are applicable. Information regarding security and lubrication of engine mountings, examination of jet pipes and mountings and the inhibiting of engines also remains applicable when the 301 series is fitted. Oil filters are cleaned in accordance with the appropriate chapter of A.P.102C-0403-1.

ENGINE CONTROL SYSTEM

16. The setting of one throttle control system is given in the following paragraphs as, except for the flight idling detent mechanism in the inboard control, the four systems are similar. Slight differences do exist however, and notes dealing with these are inserted where necessary.

17. Initial setting of the throttle control rod and lever system in the neutral position ensures that full and free travel, with adequate clearance, is available at all lever assemblies when the system is 'married up' to the engine throttle unit and operated over its full range.

Basic setting

NOTE . . .
Servo motors and associated connecting rods, Part No.124/03948, 125/03948, 126/03948 and 127/03948, are removed by Mod.2263. Redundant control rods, Part No. 106/03948 (with associated levers, Part No. 139/03948 (Port) and 107/03948 (Starboard)), are removed by Mod.2452.

18. To set the port outboard throttle refer to fig.3 and proceed:-

(1) Adjust the connecting rod, between the throttle lever and the lower arm of the countershaft lever assembly, to a nominal length of 18.375 in., and connect the two levers.

(2) Set the throttle lever so that its centre line is in line with the neutral mark on the throttle console and lock the levers by moving the throttle locking lever upward and forward.

(3) Adjust the connecting rod, between the top lever of the countershaft lever assembly and the forward arm of the bell-crank lever assembly below the pilot's floor, to a nominal length of 18.375 in., and connect the two levers. The centre line of the lower arm of the bell-crank lever below the pilot' floor should now be at an angle of 90 deg. to the floor (fig. 3, detail B).

NOTE . . .
When setting this rod on an inboard engine control system the nominal setting dimension is 19.61 in.

(4) Secure the control rod between the lower arm of the pilots' floor bell-crank lever and the upper arm of the inner torque shaft lever on the torque shaft assembly, also situated below the pilots' floor, adjacent to the fuselage wall. Adjust as control rod, to position the centre line of the upper torque shaft lever arm at an angle of 20 deg. to the centre line of the control rod.

(5) Secure the control rod between the lower arm of the inner torque shaft assembly and the take-off link on the lower complementary control rod. Adjust, as necessary, on the forward end of the control rod to position the take-off link pin centre six inches from the datum face of former 316F (fig.3, detail D).

(6) Complete the assembly of the four control rods, beginning at the torque shaft assembly, and connect them to the upper arm of the upper inboard bell-crank lever at former 115-5F. Adjust, as necessary, on the last but one rod, until the centre line of the upper arm of the inboard bell-crank lever is at an angle of 90 deg. to the centre line of the last control rod (fig.3, detail E).

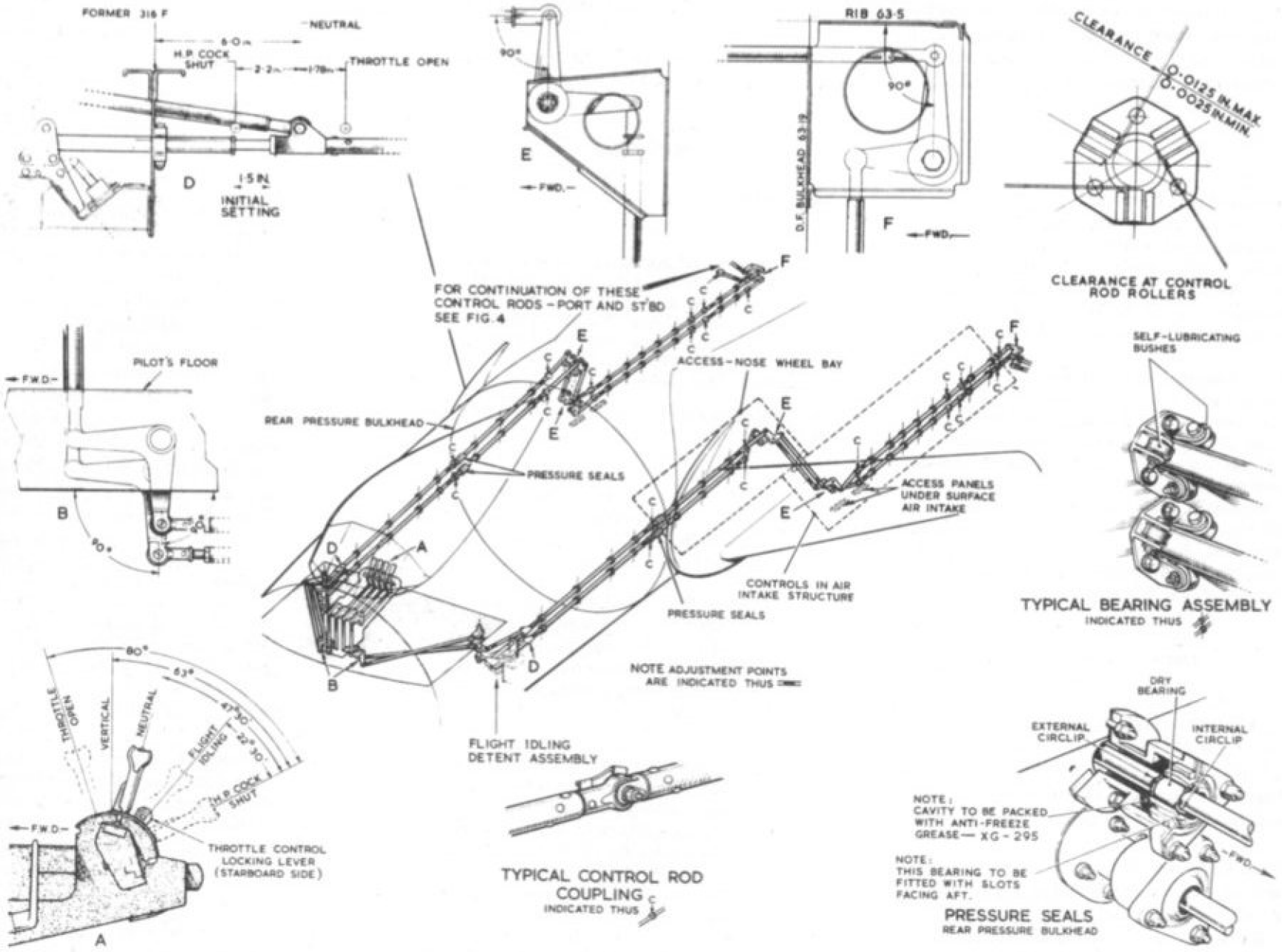

Fig. 3 Throttle control system - fuselage

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(7) Secure the control rod between the rear arm of the upper inboard bell-crank lever and the forward arm of the lower inboard bell-crank lever situated at former 115-5F, and adjust, as necessary, at the lower end of the rod, until the centre line of the forward arm of the inboard lower bell-crank lever is at an angle of 90 deg. to the centre line of the control rod. This setting is similar to that in op.(6) and shown in fig.3, detail E.

(8) Connect the rear arm of the lower inboard bell-crank lever, situated at former 115-5F and the lower bell-crank lever, situated at the junction of the bomb bay rib and former 63-19 in the engine bay, with a set of five control rods. Adjust, as necessary, on the adjusters until the centre line of the rear arm on the lower bell-crank lever is at an angle of 90 deg. to the rib web (fig.3, detail F).

NOTE . . .
This lever is the connecting point between the halves of the control system, i.e. fuselage and wing portions. As the H.P. cock SHUT position is indicated and, therefore readily obtained in the wing portion, final setting and marry-up is achieved with the system in this condition.

(9) Release the throttle lever friction lock (throttle console) and set the throttle lever to the H.P. cock SHUT position - fully rearward and re-apply the lock.

(10) Fit connecting rod (Pt.No.171/03948) between the lower bell-crank lever and the intermediate lever – just inboard of rib 113-3. This is a fixed length rod which will position the intermediate lever correctly and enable the next rod to be anchored for any necessary adjustment.

(11) Adjust connecting rod (Pt.No.172/03948) to obtain a nominal length of 19.88 in. between centre, pass the non-adjustable end through the aperture provided in rib 113-3 and connect to the intermediate lever already positioned in (10).

(12) Position the bearing lever so that one arm is inboard of and abuts the bearing housing. Connect the rod (11) to the lower arm of the lever. Note that the lever must remain in contact with the stop. Slight adjustment required being obtained by lengthening or shortening the rod at the adjuster.

(13) Set the torque shaft lever assembly to the H.P. cock shut position, by placing the uncut serration on the coupling at T.D.C.

(14) Adjust connecting rod (Pt. No.123/03948) to obtain a nominal length of 14.23 in. between centre, then connect one end to the top arm of the bearing lever.

(15) Adjust the fork-end lever, on the torque shaft lever assembly, until the rod (14) can be connected. Lock the fork-end adjusting bolt.

(16) Check that the servo-motor spindle is in the correct position, i.e., motored fully clockwise – looking on the spindle. Check also that the operating lever is placed in the position shown on fig.4 but is free to move on the spindle.

(17) Adjust connecting rod (Pt.No.124/03948) to obtain a nominal length of 12.94 in. between centre, then connect one end to the lower non-adjustable lever on the torque shaft lever assembly.

(18) Taking care not to rotate the servo motor spindle, connect the free end of the rod (17) with the operating lever on the spindle. Secure the lever on the spindle by tightening the clamping bolt.

(19) Set the engine throttle control unit to the H.P. cock SHUT position. An indicator plate and pointer, linked with the engine mounted control system, is located just aft of the fuel metering valve assembly on the lower port side of the engine. Positioning of the uncut serration on the torque shaft coupling also assures this condition.

NOTE . . .
Slight adjustment of connecting rods outside the nominal lengths given may be required and this is permissible providing all connectors are in safety and correctly locked.

(2) Assembly the connecting torque shaft assembly between the engine mounted control unit spindle and the aircraft system torque shaft lever assembly.

NOTE . . .
When fitting an inboard engine torque shaft, a pre-tensioning load is applied to the torque shaft coupling in the manner shown in fig.2.

(21) Release the throttle lever friction lock and check each throttle control system for freedom of movement.

(22) Check the co-ordination between the pilots' levers and the engine throttle units of each engine/

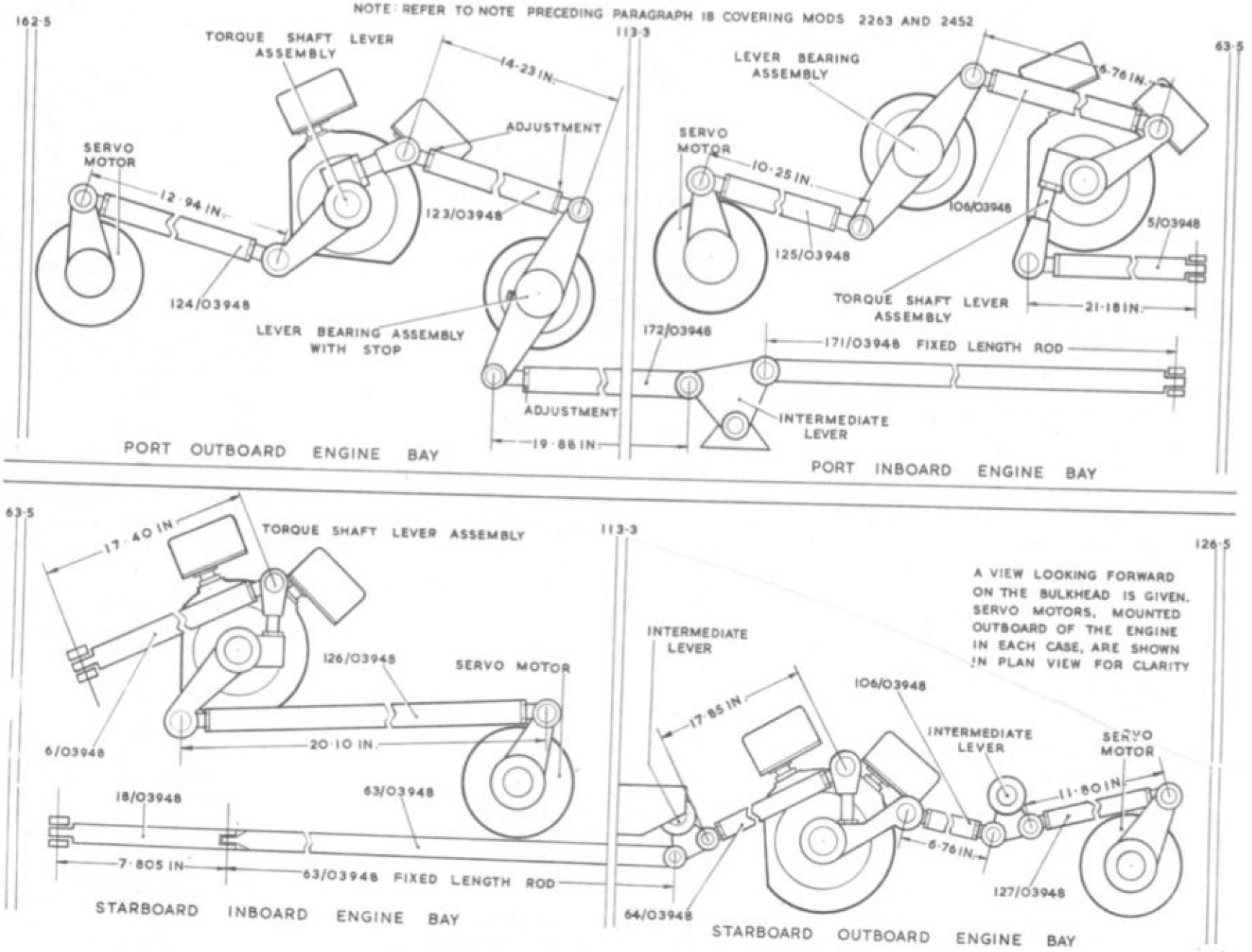

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Fig. 4. Throttle control system — front bulkhead
(Note added)

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throttle control installation in the following manner:-

(a) Set the pilots' throttle lever at IDLING and check that the pointer on the engine F.R.F.C. indicates 22 deg. ± 4 deg.

(b) Set pilots' throttle lever fully OPEN and check that the F.R.F.C. pointer indicates 90 deg.

(c) Set pilots' throttle lever at H.P. COCK SHUT and check that the F.R.F.C. pointer is at 0 deg.

NOTE . . .
Ensure that there is an additional ¼ in. spring movement at each end of the range of the pilots' throttle lever.

(d) If the settings are not satisfactory, adjustments must be made on the aircraft throttle control rods

NOTE . . .
Setting and checking of the engine mounted controls to the throttle valve is described in A.P.102C-0403-1.

(23) Fine adjustment may be obtained by screwing in or out the fork-end attachment lever on the torque shaft coupling assembly.

(24) Ensure that all discarded materials, split pins, tab washers, cleaning cloths etc., are removed from the aircraft.

(25) Check the complete engine control system for full range and freedom of movement and all locking devices for safety.

Flight idling detent

19. The detent mechanism normally operates at an altitude of 15,000 ft. therefore for adjustment and/or test purposes a similar condition must be created on the ground. This is obtained by by-passing the altitude switch, which normally governs the solenoid, with an electrical supply from a test switch on the starboard console. When this switch is operated, the solenoid is energized and retracts. This movement, conveyed through the simple link lever mechanism of the detent, causes the plunger to emerge from its housing. With the plunger in this position, set the inboard engine throttle lever to the position which would provide 55 per cent rev/min (approx), then adjust the control system rod extension (below the pilots' floor) until it abuts the detent plunger. Secure the rod with the lock nut.

NOTE . . .
The flight idling detent mechanism can be tested on the ground but correct functioning of the system can be proved only during flight at 15,000 ft. (plus), therefore a test flight is necessary after adjustment.

20. To ensure correct interpretation of test flight results, it is recommended that, prior to flight, small strips of masking tape be applied to the console adjacent to the inboard engine throttle control levers thus enabling the pilot (by request) to mark the exact position of each throttle lever when correct flight idling rev/min are obtained. Subsequent to the flight, place the throttle levers forward of the flight idling range, select the detent test switch ON, then position the throttle levers to correspond with the markings on the console (masking tape). Inspection of the detent mechanism will reveal any error in adjustment. The chamfer on the throttle system rod extension should be just in contact with that of the detent plunger. If a gap exists between these two components it must be closed by extending the rod, i.e., screwing out. Should the detent plunger be partially depressed, the rod must be screwed in (retracted). Ensure that lock nuts are secure after adjustment.

Maximum friction

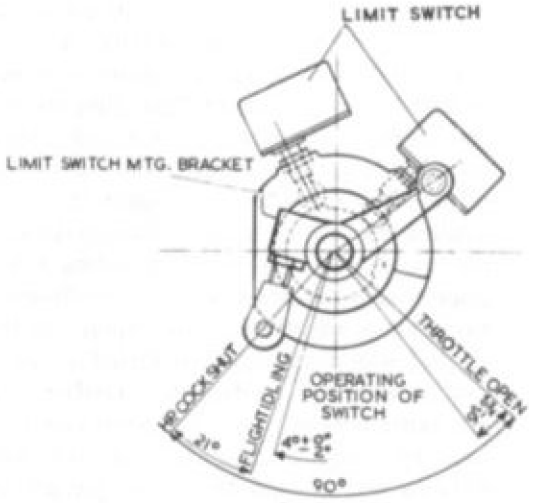
21. Friction values may be checked, progressively, during the installation of a throttle control system, when the system is complete and before the engines are started or with the aircraft pressurized, i.e., the in-flight condition. Circuit friction values under various conditions are as follows:-

Throttle levers at quadrant - system disconnected - 4 oz. per lever.

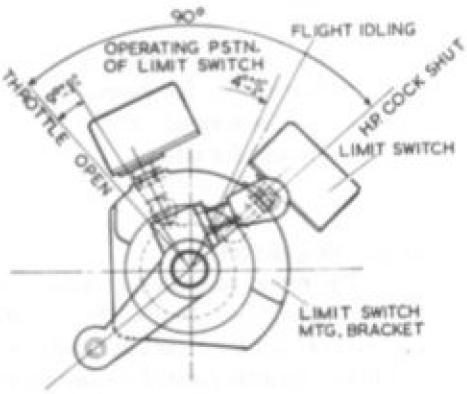
Fuselage section connected - 8 oz. per lever.

System complete and connected to cold engine - 2½ lb. per lever.

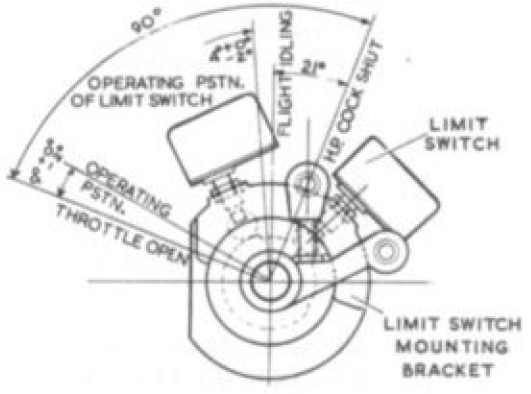
In flight condition, i.e., cabin pressurized - Total of 14 lb. with no one throttle lever to exceed 4 lb.



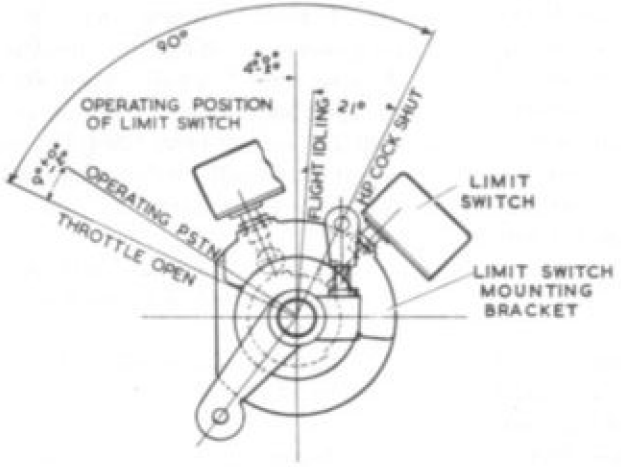
PORT INBOARD



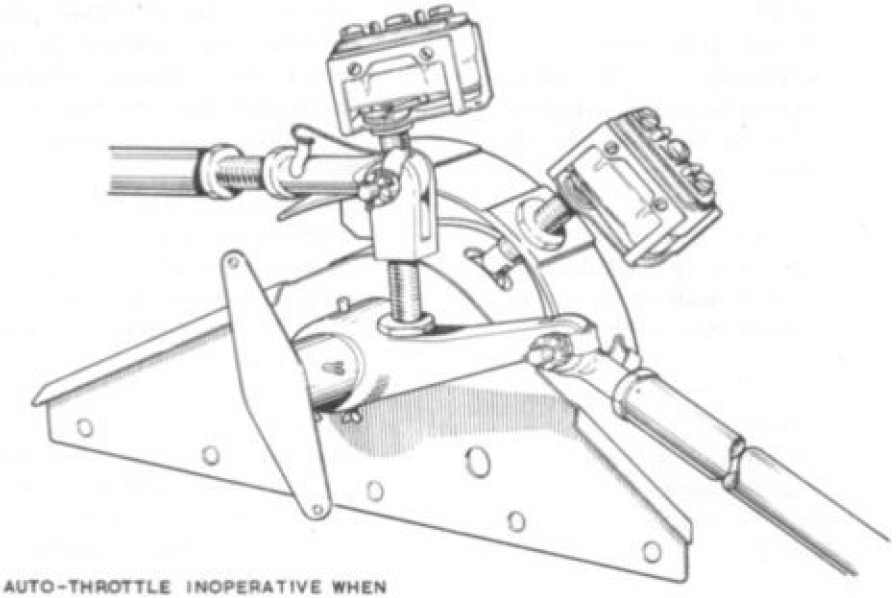
PORT OUTBOARD



STBD. OUTBOARD.



STBD. INBOARD



NOTE:- AUTO-THROTTLE INOPERATIVE WHEN MOD. 2263 IS EMBODIED.

Fig. 5. Limit switches — auto-throttle control

Throttle detent override - 13 lb. $^{+0}_{-2}$ lb.

These tests may be done using a suitable spring balance with its hook engaged in the throttle lever re-light button recess. When checking detent override, the detent test switch must be held in the ON position for the duration of the check.

◀ **STARTING PROCEDURES**

22. The normal and rapid starting procedures for the Olympus 301 engines is, except for idling R.P.M. checks, identical to the normal and rapid starting procedures for the Olympus 200 series engines (Chap.1). Idling R.P.M. differences are as follows:-

200 series engines	301 engines
(Accessory load on)	
29.5 30 per cent	24.5 - 25 per cent
(Accessory load off)	
32 - 35 per cent	27 - 27.5 per cent

Servicing precautions - rapid start system

23.

WARNING . . .

The rapid start system contains air at high pressure. No attempt must be made to disconnect pipes or remove components from the system until all pressure has been released by using an inflation adapter (Ref.No. 4G/6246) on the system charging point. ▶

REMOVAL AND ASSEMBLY

HYDRAULIC PUMPS

24. Hydraulic pumps are removed in accordance with instructions contained in A.P.102C-0403-1.

JET PIPES

25. Procedures given in Chap.1 regarding the disconnection, removal and/or fitment of jet pipes are relevant to the 301 engine installation.

ENGINE CHANGE UNIT (E.C.U.)

26. The following paragraphs give the sequence for the removal of an e.c.u.

Preparation for removal

27. Before an e.c.u. is removed certain precautionary measure must be taken to prevent damage being caused to the aircraft and/or injury to personnel. As various electrically-operated systems are involved the procedures must be done in conjunction with an electrical tradesman.

WARNING . . .
Read the Lethal Warnings at the front of this A.P.

(1) Fit jury struts in the undercarriage bays (Sect.2, Chap.1).

(2) Remove the engine bay access doors.

(3) Ensure that L.P. fuel cocks are closed.

(4) Remove L.P. fuel cock system fuses.

(5) Remove the high energy ignition system fuses.

(6) Disconnect the L.T. supply leads from ignition unit.

28. Disconnect the following

(1) Engine anti-icing control

(2) Fuel flow meter.

(3) L.P. compressor tachometer.

(4) Fuel system electro-pressure control.

(5) L.P. compressor governor.

(6) Combuster igniter cable.

(7) Aircraft hot air ON/OFF valve.

(8) Cooling air inducer valve.

(9) Engine oil temperature transmitter.

(10) Fuel low pressure warning switch.

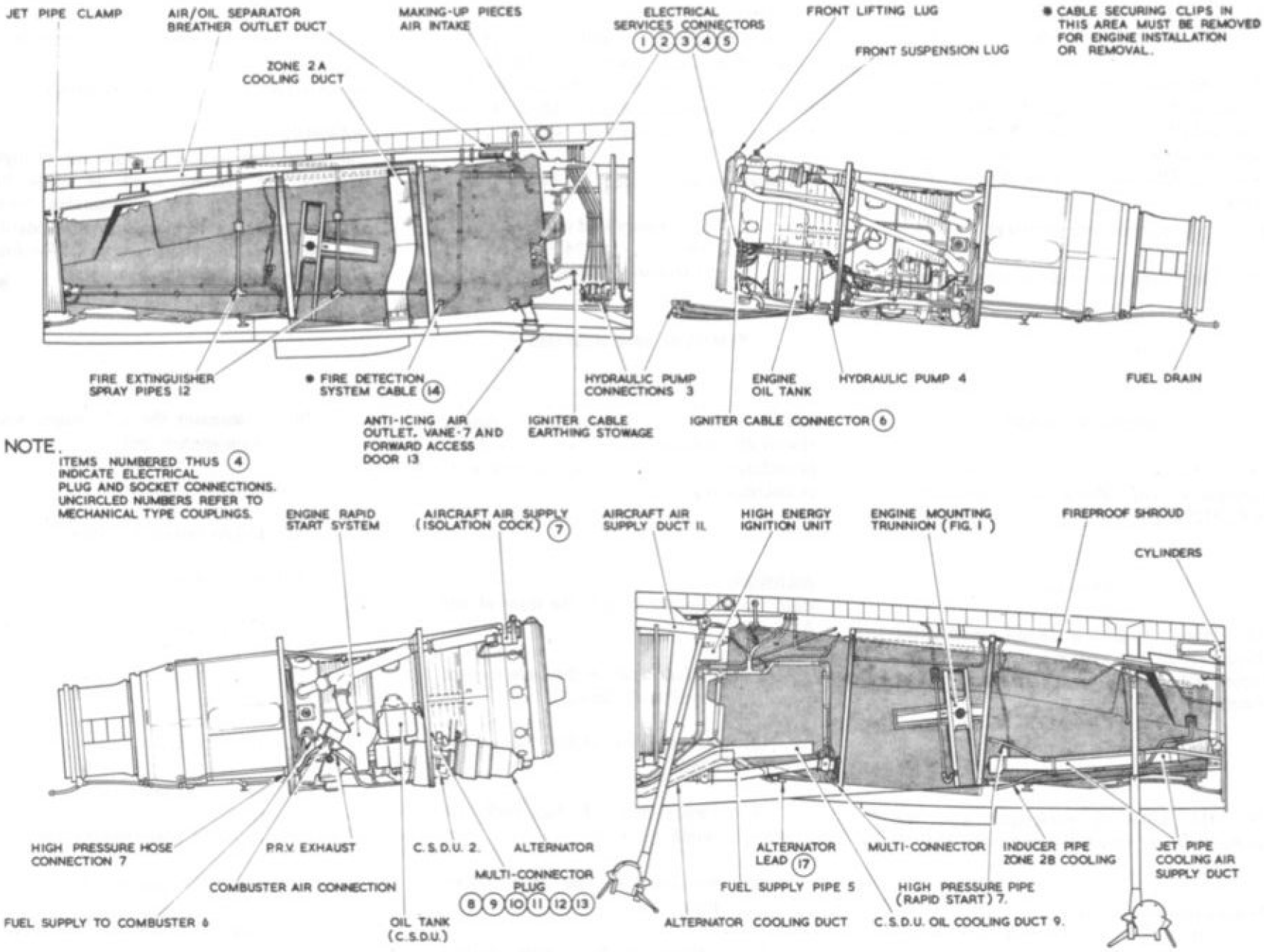


Fig. 6 Engine removal (three point hoisting) 301 series

◄ *Title change* ►

(11) Air starter overspeed governor switch.

(12) Air starter control valve.

(13) Fuel dipping valve.

(14) Fire detection system (four plugs).

(15) C.S.D.U. overspeed and underspeed switch.

(16) C.S.D.U. oil temperature gauge.

(17) Alternator leads.

29. When the electrical services have been disconnected the aircraft/engine system pipes, fuel, fuel tank pressurisation air system, etc., and engine mounted components may be disconnected and/or removed

(1) Alternator

(2) Constant speed drive unit.

(3) Hydraulic pump pipes (at Avery couplings).

(4) Hydraulic pump.

(5) Fuel supply pipe (forward of engine).

(6) Fuel supply pipe to combuster.

(7) Air supply pipe to reducing valve (rapid start system).

(8) Throttle torque shaft.

(9) C.S.D.U. oil cooler air inlet duct.

(10) Alternator air inlet duct.

(11) Aircraft hot air supply duct.

(12) Fire extinguisher pipes.

(13) Air intake de-icing air outlet duct.

(14) Engine air intake clamp rings and making up pieces.

(15) Disconnect and move jet pipe rearward.

◀ **E.C.U. removal equipment**

30. Two methods, using different sets of equipment, are used for e.c.u. removal and also for installation One method uses a three-point hoisting arrangement and the other which caters for an increased all-up weight of the e.c.u. uses a four-point hoisting arrangement. Either method can be used on all engines.

Three-point hoisting

31. Three engine hoists Ref.No. 26DC/95266 are positioned round the e.c.u., one at the front and two at the rear as follows:-

NOTE . . .
A slinging bracket Part No 26/U.1579 must be attached to the cable end fitting of the forward hoist in place of the hook Ref.No. 26DC/95705 Hooks are only used on the rear hoists. A stowage is provided on the body of the hoist winch to accommodate either the bracket or the hook, whichever is not in use.

(1) Engage the forward hoist top hook with the lifting hoist attachment assembly in the roof of the engine bay, just above the engine nose cone. The hook will engage correctly only when offered with its point at the top and forward.

(2) Secure the forward hoist by fitting the guard rail Ref.No. 26DC/95400 across the engine bay.

(3) Withdraw the pivot pin from the front lift point pulley in the engine bay roof and remove the pulley.

(4) Route the hoist cable rearward and upward through the roof structure intercostals then down through the lift pulley housing.

(5) Assemble the lift point pulley so that the cable passes over it from front to rear. Secure the pulley with the pivot pin

(6) Engage the slinging bracket with the forward lifting lug on top of the engine air intake casing and secure with pin provided.

(7) Engage the rear lifting hoists, one at each side of the engine, with their appropriate hook attachment assemblies in the rear section of the engine bay roof. The point of the hook must face forward

(8) Engage the hoist cable terminal hooks with the lifting points on port and starboard sides of the engine. ▶

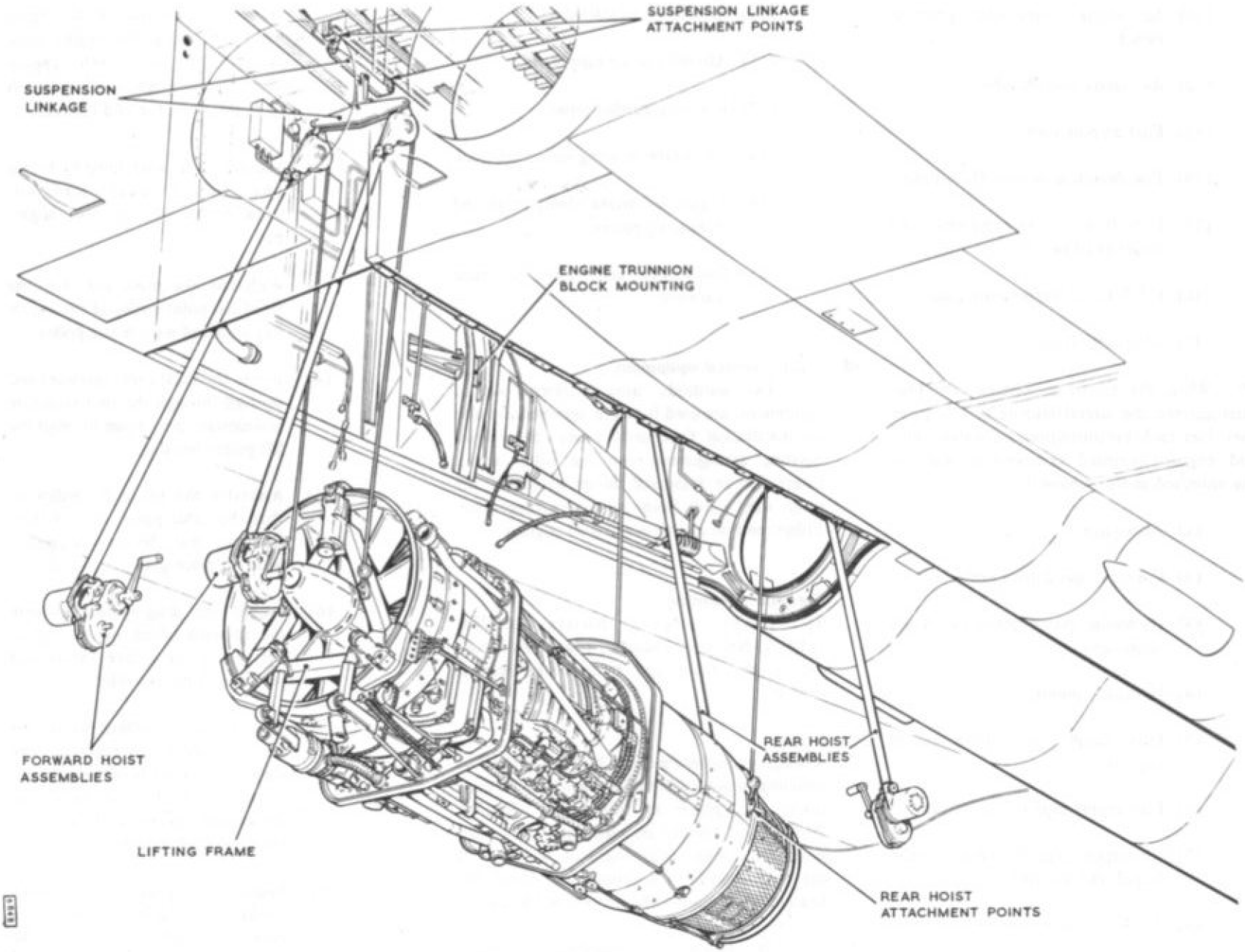


Fig. 7 Engine removal (four-point hoisting) 301 series

Four-point hoisting

32. Four hoist assemblies each comprising an 18 cwt hoist Ref.No. 4GC/1276060, a top pulley sheath Ref.No. 4GC/1275820, an extension tube Ref.No. 4GC/1276891 and a handle Ref.No. 4GC/1275819 are positioned round the e.c.u., two at the front and two at the rear. The two forward hoists are attached to the e.c.u. using a lifting frame Ref.No. 4GC/1275823 and to the aircraft structure using a two-piece suspension linkage Ref.No. 4GC/1275822.

To attach the four hoists proceed as follows:-

(1) Assemble the four hoist assemblies.

(2) Engage the hooks on the sheath of the two rear lifting hoists with the appropriate port and starboard attachment assemblies in the rear section of the engine bay roof. The hooks must face forward.

(3) Engage the hoist cable terminal hooks with the rear lifting points on port and starboard sides of the engine.

(4) Fit the lifting frame to the front of the engine air intake casing as follows:-

(a) Position the lifting frame with the two lower external shoes of the suspension packs around the outside rim of the engine intake casing V flange and the centre line of the top toggle in line with the top centre line of the engine.

(b) Tighten the internal shoes of the suspension packs against the inside of the engine intake casing flange using the knurled nuts.

NOTE . . .
The top knurled nut has a left-hand thread.

(c) Swing the top toggle over and secure to the engine forward lifting lug with the attached Pip pin.

(5) Withdraw the pivot pin from the forward lift point pulley in the engine bay roof and remove the pulley.

(6) Fit the top beam of the suspension linkage in the engine bay roof with the hook facing forward and engaging the lifting hoist attachment in the engine bay roof structure. Secure the beam rear link to the lift point pulley attachment using the Pip pin provided.

(7) Secure the bottom beam of the suspension linkage to the top beam with the Pip pin provided. Use the forward hole in the top beam when the aircraft is in rigging position and the rear hole when the aircraft is at normal standing angle.

(8) Engage top sheath hooks of the two forward hoists with the attachment points on the extremities of the suspension linkage bottom beam, with the hooks facing inward.

(9) Engage the forward hoist cable terminal hooks with the lifting lugs on the lifting frame.

(10) Proceed with the sequence of operations given in para.33.

Removal

33. With a suitable number of personnel stationed at each hoist and another person acting in a supervisory capacity, take the weight of the engine on the hoists and proceed as follows:-

(1) Remove the split pins and nuts from the two rear bearing assembly bolts, i.e., the one above the quick-release pin, and the split pin and nut from the front suspension lug on the e.c.u

(2) Withdraw the bearing assembly bolts and disconnect the front suspension link.

(3) Operate the two rear hoists until the trunnion bearing housings contact the bearing housing stops, and withdraw the quick-release pins.

(4) All hoists may now be operated, slowly, to lower the e.c.u., continuous checks being made to ensure that engine equipment and components are clear and in no danger of fouling the aircraft structure. When the e.c.u. is

approximately half-way out of the engine bay, the lowering should be retarded on the rear hoists until the e.c.u. is horizontal. Special attention must be given to ensure all round clearance before resuming lowering operations.

(5) When the e.c.u. is clear of the engine bay, remove the bearing assemblies from the side trunnions on both sides of the engine.

◀ (6) Position a servicing trolley/stand Ref.No. 4G/5570 below the aircraft, to receive the e.c.u.

(7) Operate hoists to lower e.c.u. evenly onto stand, ensuring no fouls.

(8) Remove the lifting hooks and secure e.c.u. to stand.

(9) Move stand away from aircraft and, if four-point hoisting had been applied, remove 'A' frame from intake casing.

Installation

34. In addition to reversing the procedures given in para. 27 to 33 the following instructions are considered necessary for installing an engine change unit.

(1) The interior and surrounding structure of engine bay must be inspected for damage. Any evidence of damage, cracks, skin ripples, loose rivets etc., must be thoroughly investigated and the cause rectified before replacement e.c.u. is positioned below engine bay.

(2) After such rectification, remove all loose materials, rags, tools etc., these would be hidden from view by installed engine, and position replacement e.c.u. and stand below engine bay.

(3) Free the e.c.u. from stand and check that all fittings and components are clear of and will not foul stand when lifting operations begin.

(4) Where the four point hoisting method is to be used, fit the 'A' frame to engine intake casing (para.32).

(5) Engage hoist lifting cables to respective attachment points on e.c.u. With a simultaneous number of turns on hoists by each operator, raise e.c.u. clear of stand. The lift must be carried out slowly with continuous checks until clear.

(6) Fit bearing housing assemblies to the two rear mounting trunnions of the e.c.u. Care must be taken on this operation and the following instructions are provided as a guide to correct assembly.

(a) The fixed bearings are fitted to the inboard trunnion of the outboard engine and the outboard trunnion of the inboard engine.

(b) Lubricate engine trunnions with grease XG-277.

(c) Fit distance piece Ref.No. 26DC/8545, with bore radius towards the engine, on the fixed bearing trunnion.

(d) Fit bearing assembly to fixed bearing trunnion, following the instruction - THIS SIDE TOWARDS ENGINE - etched on face of bearing housing, together with two 0.03 in. distance washers (Ref.No. 26DC/8543) and a 0.06 in. distance washer (Ref.No. 26DC/8544), on each side of bearing assembly.

NOTE . .

The distance washer position in (5)(d) gives a correct theoretical engine location. The distance washer combination may be permutated to give an adjustment of up to 0.12 in. in each direction to suit installation requirements.

(e) Assemble end-cap, tab washer and bolt to fixed bearing trunnion, ensuring that locating pin on end-cap fully engages hole in trunnion.

(f) Tighten end-cap securing bolt.

(g) Fit bearing assembly to floating bearing trunnion. ▶

(7) Lift engine, taking care to ensure a clean lift. When side trunnion bearing assemblies enter housing guides on engine bay side walls, entry must be smooth and even, the engine being raised only until bearing housings abut housing stop bolts. When this contact is made in both housings, insert quick-release pins then carefully lower the engine sufficiently to allow fitment of bearing assembly bolts. Fit bolts and check for security.

(8) Release tension on rear lifting hoists only.

(9) Check that adjustable eyebolt of suspension lug mounted on top of engine front casing is in safety (sufficient threads engaged). Raise or lower front of engine until fixed length suspension link mates with adjustable eye-bolt. Insert shear bolt through link and eye-bolt and secure with a castellated nut, finger tight at this stage.

(10) Allow weight of engine to be taken on suspension link.

(11) Check engine installed angle by using an inclinometer and straightedge across face of engine intake casing.

NOTES . . .

1. *With the aircraft in rigging position (chord line 5 deg. up from horizontal) the correct setting angle is 10 deg. up from the horizontal i.e. plus 5 deg. up from the chord.*

2. *With the aircraft on its wheels, the chord line angle must first be determined, since uneven ground, tyre pressures etc., affect the altitude of the aircraft to the horizontal. To determine the chord line angle, locate the two 3/8 in. dia. holes in the inboard rib web of the main wheel bay, insert a 3/8 in. dia. rod in each hole, place a straightedge across the rods and use an inclinometer on the straightedge. The angle indicated by the inclinometer is the cord line angle. This angle plus 5 deg. is the correct setting angle for the engine.*

3. *A tolerance of $^{+5}_{-8}$ minutes on the plus 5 deg. allows for aligning the engine to the air intake making up pieces.*

(12) If the engine angle is outside permitted tolerance (Note 3 above), take up hoist cable slack and remove shear bolt from suspension link and suspension lug. Swing suspension link clear of suspension lug eyebolt, slacken eyebolt locking collar and adjust eyebolt to give required engine setting angle. Attach suspension link to suspension lug, using shear bolt and castellated nut, finger tight. Allow suspension link to take weight of engine then check engine setting angle. Repeat procedure until engine setting angle is within specified tolerance.

(13) Tighten and split-pin shear bolt nut. Tighten eyebolt locking collar. Lock collar using locking plate (fig.1). The locking plate must be so positioned that the maximum interference is provided by the locking plate lug.

NOTE . . .
The plane of locking plate adjustment is slightly inclined to that of the castellations on the locking collar hence the amount of interference provided will vary with the angular position of the lug.

(14) Check for engine alignment with jet pipe and air intake. Adjust, if necessary, on shims and distance washers at mounting trunnions. The shims Pt. No. 11/0.3987 are normally fitted three on each side of bearing housing but can be permutated to suit installation requirements. In the event of maximum shimming on one side, the existing bolts will be too short and must be replaced with one of the following:-

A 59-5E, ATO-6E, A 59-8E, 2SE/SS.4167 and 4E/SS.4167

(15) Remove engine hoists and, if four-point hoisting was used,

◀ remove 'A' frame from intake casing.

(16) Complete engine installation by reversing removal procedure (para.33). Before installing air intake guide ring lubricate the ring, using grease ZX-28. When connecting the king coupling of the main fuel feed (para.29 (5)) torque load the manacle clamp stiffnut to 27 $^{+3}_{-0}$ lb. in. ▶