

Chapter 1 **POWER UNIT**

LIST OF CONTENTS

	Para.	Para.
Introduction 1		
DESCRIPTION AND OPERATION		
Engine bay 2		
Engine mounting 3		
Air intakes 4		
Jet pipe 5		
Accessories gear box 6		
Engine starter 7		
SERVICING		
General 8		
Precautions 9		
REMOVAL AND ASSEMBLY		
Engine controls 10		
Throttle lever friction damper 11		
Accessories gearbox universal drive couplings ... 11A		
General 12		
Unpacking and slinging 15		
Engine removal 16		
Engine installation 17		
Jet pipe removal 18		
Jet pipe installation 19		

LIST OF ILLUSTRATIONS

	Fig.		Fig.
Engine installation ...	1	Engine removal (3) ...	6
Engine controls ...	2	Engine installation trolley ...	7
Accessories gearbox ...	3	Engine sling and transit stand ...	8
Engine removal (1) ...	4	Jet pipe removal ...	9
Engine removal (2) ...	5		

Introduction

1. The Hunter F Mk. 4 power unit consists of a single Avon Mk. 113 axial flow gas turbine (A.P.4821G & J) installed centrally in the fuselage. The air supply for the compressor is induced through two air intakes situated one in the inboard leading edge of each stub wing. The straight-through

DESCRIPTION AND OPERATION

Engine bay

2. The engine bay is contained in the centre fuselage, engine installation and removal necessitating withdrawal of the rear fuselage

jet pipe continues through the fuselage to exhaust at the tail end of the aircraft structure. Engine starting is effected by means of a triple-breech cartridge starter unit mounted on the front of the engine, the firing of the cartridges being initiated electrically from a control in the cabin.

from the remaining structure. To facilitate this work, special equipment, which is described later in this chapter, must always be used. The engine is secured to mountings

at frames 34 and 40A. An engine-driven accessories gearbox is also accommodated in the engine bay. In front of the engine are the twin air intake ducts, each of which is fed from an intake in the leading edge of its respective stub wing. The front and centre fuel tanks are fitted between and around these ducts. A fireproof wall is provided at frame 37 to isolate the engine from the fuel tanks. Breathing pipes and cooling ducts are also provided.

Engine mounting (fig. 1)

3. The engine is provided with four attachment points. These consist of a trunnion on either side of the turbine nozzle box, located on the horizontal centre-line of the engine, and front suspension linkages which are located on either side of the engine compressor casing, a little below the engine centre-line. The front attachments connect to mountings on frame 34 and incorporate a turnbuckle which, in conjunction with a special key, enables the engine to be raised or lowered into its correct position. The rear mounting trunnions, which are provided with spherical bearings, are attached to frame 40A through the medium of split bearing housings. On the port side, the spherical bearing is secured to its trunnion by a pin. On the starboard side, the spherical bearing is free to slide on its trunnion, thus allowing for engine expansion.

Air intakes

4. The two air intakes are situated one in the leading edge of each stub wing, the entry being at the wing roots adjacent to the fuselage. They are shaped to allow the maximum intake of air with the minimum of resistance. Sealing covers are provided

to prevent the entry of dirt when the aircraft is on the ground. Safety guards, which can be fitted in lieu of the sealing covers, are provided for the protection of personnel during ground running.

Jet pipe

5. The jet pipe is attached to the engine exhaust unit by a flange which slides over a gas seal fitted in an annular groove around the periphery of the exhaust unit. It is secured by a pair of keeper plates and stirrups, one on each side of the unit, each of which is provided with its own access door. These attachments are illustrated in Sect. 3, Chap. 1, fig. 12. The rear of the jet pipe is secured by two rectangular blocks located at the horizontal centre-line. The blocks are free to slide in a fore and aft or in a lateral direction, thus allowing for jet pipe expansion. A door adjacent to each mounting may be used to gain access when making adjustments to the height of the mountings. To ensure that the blocks approach the mounting at the correct angle

when the jet pipe is assembled, small guide rails are fitted inside the fuselage. These are pivoted at the rear end and are attached to mountings at the forward end, thus remaining in alignment when adjustments are made. Along the top, at the vertical centre-line, a guide rail is attached inside the fuselage. Twin rollers, attached to the top of the pipe, run along this rail and thus facilitate the assembly of the jet pipe. No weight is exerted on the rail by these rollers once the pipe has been secured in position. When this has been effected, the lifting rods are removed through the adjacent access doors.

Accessories gearbox (fig. 3)

6. The accessories gearbox is mounted at the bottom of the engine bay, just aft of the rear spar on the port side of the aircraft. The gearbox, which is driven from the engine wheelcase by means of a drive shaft, accommodates the hydraulic pump and two electrical generators which provide all the hydraulic and electrical power for the operation of the aircraft's services. The generators

are enclosed in cans, spouts on the cans being connected to the air duct provided for the intercooler of the air conditioning system so that cold air from this source is utilised to cool the generators. A complete description of the accessories gearbox and drive is contained in A.P.2240A, Vol. 1.

Engine starter

7. The B.T.H. T.B.S. 720 Mk. 1 cartridge-fired triple-breech engine starter, described in A.P.1181D, is mounted on the forward end of the engine. The cartridges are selected and the time switch which automatically controls the starting cycle is energised by a starter selector switch located on the leg panel in the cabin. The operation of the electrical circuit is described in Sect. 5, Chap. 1, Group C.1. Provision is made for the stowage of three additional cartridges on the aerial box lid on the inside of the engine starter access door in the fuselage. The access door has a supporting stay to retain it when in the open position.

General

8. The servicing of the engine should be carried out in accordance with the instructions laid down in A.P.4321G & J, Vol. 1. The servicing of the ancillary equipment which forms part of the airframe installation is given in the following paragraphs. The accessories gear box should be examined for oil level at frequent intervals and topped up with oil as necessary in accordance with the instructions given in Sect. 2, Chap. 2 of this volume.

Precautions

9. The following precautions should be taken before any servicing operations are commenced:—

- (1) Ensure that the aircraft is electrically safe (Sect. 5, Chap. 1, Group A.1). If an electrical supply is necessary during servicing, use an external supply to prevent running down the aircraft's batteries.
- (2) If any of the work involves entry into the cabin, or the canopy is to be removed, ensure that the safety pin of the ejection seat is placed in the seat

SERVICING

of the ejection seat firing mechanism. (Ejection seat warning in front of this handbook.)

- (3) Ensure that the protective covers are in position on the air intakes and jet exhaust as well as any other covers that will not impede the progress of the work in hand.
- (4) Prior to ground running, ensure that the jet pipe sealing cover is removed and that the special air intake safety guards are fitted to the air intakes in lieu of the sealing covers. Ensure that personnel are not in proximity of the jet exhaust or air intakes and that they are warned to keep clear of these danger zones.

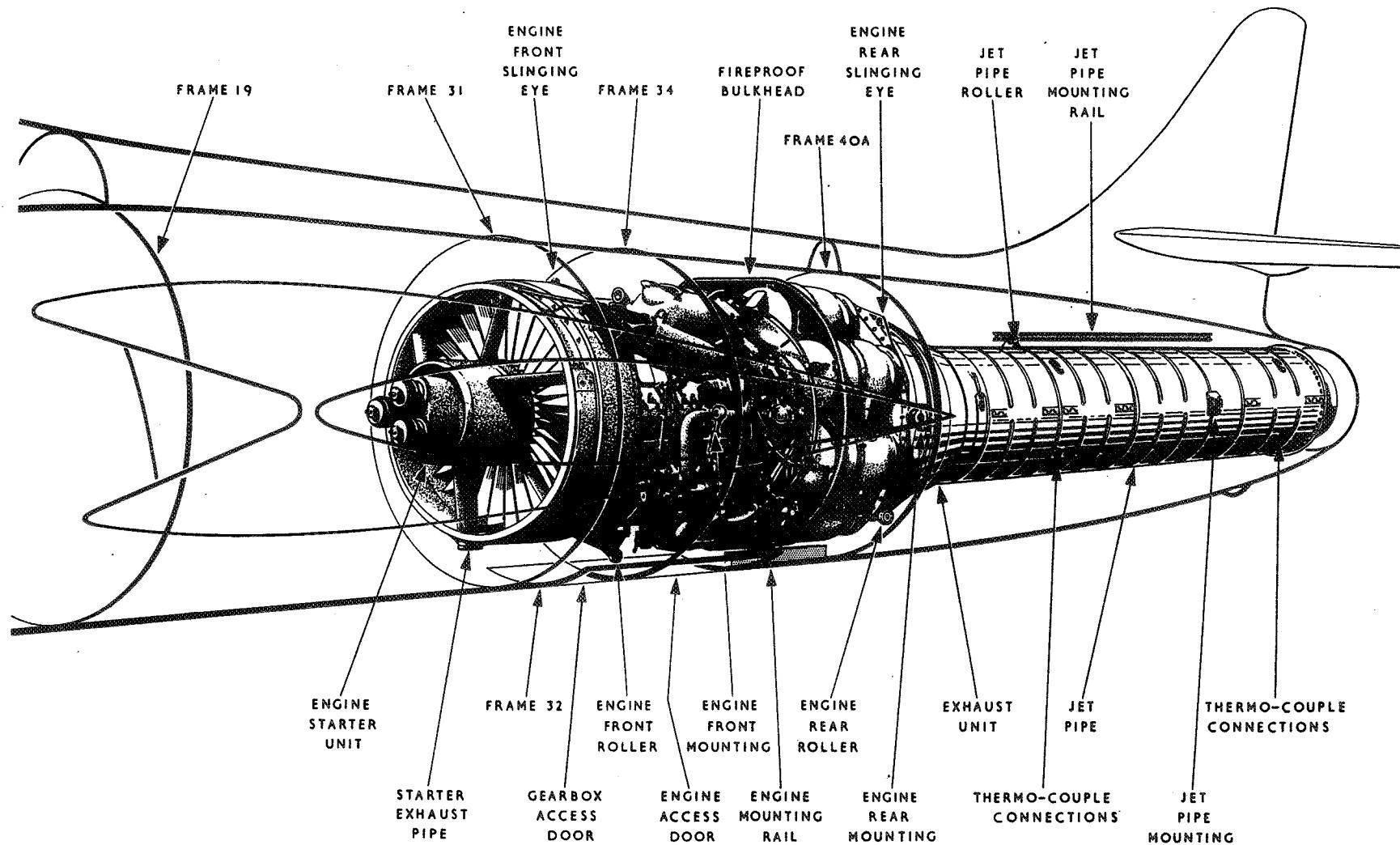
Engine controls (fig. 2)

10. The throttle, high-pressure fuel cock and low-pressure fuel cock should be checked to ensure that they come up against their stops before the system is strained. If, however, the aircraft is fitted with a Mk. 115 engine, the throttle control *must* be examined as follows:—

(1) Ensure that the aircraft pick-up rod and throttle lever are adjusted so that a spring of $\frac{1}{16}$ in. to $\frac{1}{8}$ in. is obtained in the quadrant slot when the lever is on the idle stop.

(2) Ensure that there is *no* spring when the throttle is in the fully open position. (This is necessary to ensure that the reaction of the push rod of the top temperature control actuator is immediately transmitted to the throttle lever).

A recommended procedure is to adjust the controls with a 0.005 in. feeler gauge interposed between the throttle lever and the full open stop until a nip is obtained. Remove the feeler gauge and insert a 0.002 in. feeler gauge in its place and check for freedom. If it is found impossible to obtain the full range of movement by adjustment of the aircraft controls, further adjustment can be made on the link (actuator to bell crank lever), but it is important that, finally, a clearance of $\frac{1}{8}$ in. is present in the bell crank lever machined recess when the throttle is fully closed.



F.S./2

FIG. 1 ENGINE INSTALLATION

(A.L.22.May.55)

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LUBRICATION

TELEFLEX CABLES, WRAPPED BOXES, AND CONTROL BOXES, PACKED WITH GREASE ON ASSEMBLY. GREASE XG-275 (STORES REF. 34B/222 & 242). ALL LEVER PIVOTS TO BE OILED WITH OIL OX-14 (STORES REF. 34B/250 OR 255)

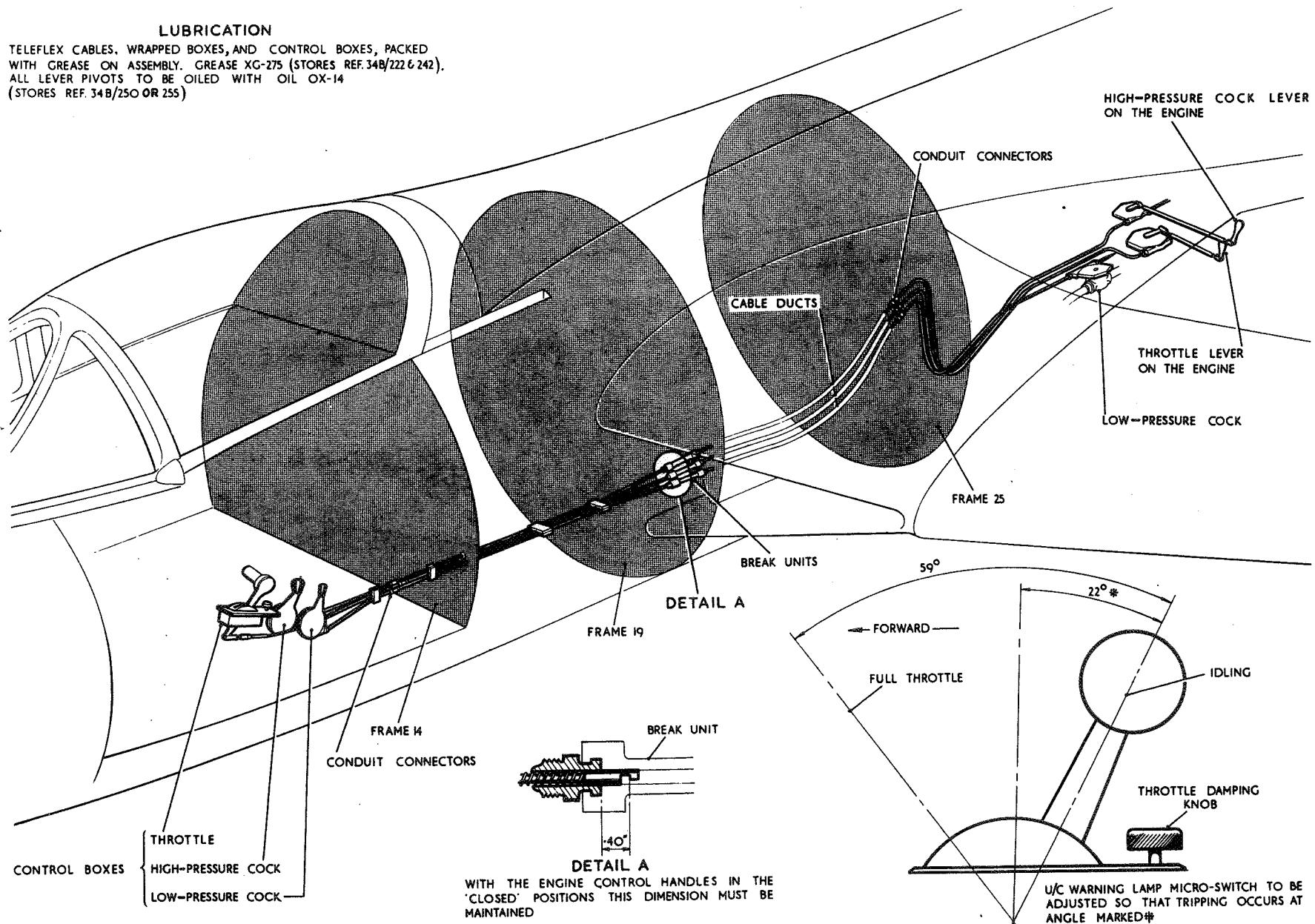


FIG. 2 ENGINE CONTROLS

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(3) When adjustment is satisfactory, ensure that all controls and levers are free from fouls throughout their range of movement and that the control rods are screwed in safety. Tighten all lock-nuts.

Note . . .

The throttle or high-pressure fuel cock stops on the engine should not be interfered with in any way as these have been set in the correct position by the manufacturers.

General

12. The engine removal entails jacking the aircraft at the specially arranged positions as shown in Sect. 2, Chap. 4, fig. 4 (with the exception of the rear fuselage), and additional trestles under the centre fuselage as shown in Sect. 3, Chap. 1, fig. 7. When jacked, the alighting gear should be in the fully extended position with the wheels two or three inches off the ground. Care should be taken to ensure that the aircraft is level in a fore-and-aft as well as in a lateral sense. Access to the engine for removal purposes can only be obtained after the rear fuselage has been removed from the remaining structure. To facilitate this removal of the rear fuselage, a special trolley (Stores Ref. 26FX/95034) is provided and another (Stores Ref. 26FX/95045) is provided to accommodate the engine. A tethering strap is provided for use with the rear fuselage trolley which, in conjunction with a bumper pad fitted in a specially arranged cut-out in the trolley former, prevents any tendency of the rear fuselage to roll during removal. When the rear fuselage is in position on the trolley, the tethering strap should be at frame 52 and the bumper pad at frame 55. The engine trolley (fig. 7) is fitted with rails which, in conjunction with rails provided for fitment into the centre fuselage, facilitate withdrawal of the engine.

Lubrication details and control settings are given in fig. 2.

Throttle lever friction damper

11. The friction damper for the throttle control should be periodically examined for wear. It should be screwed up sufficiently to obtain the maximum friction without undue restriction of movement. This is most important, as insufficient friction will result in creeping from the selected position which,

REMOVAL AND ASSEMBLY

13. If the batteries are not to be removed prior to engine removal, ensure that the battery isolating switch in the cabin is put to the OFF position. As an additional precaution, remove the leads from the batteries and stow them on the dummy terminals on the battery mounting platform. Whether the cabin is to be entered or not, ensure that the safety pin securing the firing handle of the ejection seat is removed and is placed in the rear of the seat firing mechanism. Ensure also that the breech of the engine starter is unloaded, i.e., no cartridges fitted.

14. To prevent the entry of dirt or moisture, disconnected pipes should be effectively blanked off. Electrical leads removed should be taped immediately after disconnection to eliminate the possibility of fire through shorts. (This should be done irrespective of whether the aircraft's batteries have been disconnected or not, as there is always the possibility of the batteries being reconnected before all the leads are reconnected.)

Unpacking and slinging

15. The engine transit stand and sling are illustrated in fig. 8. The procedure for unpacking, slinging, and the use of the transit stand is described in A.P.4321G & J, Vol. 1.

if undetected, may in certain circumstances result in a serious accident.

Accessories gearbox universal drive couplings

11A. The universal couplings in the drive between the engine and accessories gearbox must be lubricated by means of the grease nipples with grease to Specification XG-271, Stores Ref. 34B/208, before assembly, and thereafter on every occasion that the engine is removed.

Engine removal (fig. 4, 5 and 6)

16. The removal of the engine is shown in the illustrations and the sequence of operations is given in the keys to the illustrations.

Note . . .

Under no circumstances may the engine airframe joint pins or bolts be used to mount the engine on the stand. Special bolts are provided for this purpose, which must not be used in the airframe installation.

Engine installation

17. In general, the installation of the engine is a direct reversal of the removal procedure. Refer also to A.P.4321G & J for preparation of the engine. The accessories gearbox universal drive shaft couplings must be lubricated in accordance with the instructions given in para. 11A before the engine is installed.

Jet pipe removal (fig. 9)

18. The removal of the jet pipe is shown in the illustration, the sequence of operations being given in the key to the illustration.

Jet pipe installation

19. The jet pipe guide rails are described in para. 5. The installation procedure is a reversal of the instructions given in the key to fig. 9.

KEY TO FIG. 4, 5, and 6 (ENGINE REMOVAL)

Render the aircraft electrically safe (Sect. 5, Chap. 1, Group A.1).

Remove the rear fuselage (Sect. 3, Chap. 1, fig. 12).

Remove the following access doors and panels, the location of which are given in Sect. 2, Chap. 4, fig. 3, to which the item numbers below are applicable.

Engine starter access door (item 82)

Gearbox access door (item 84)

Engine access door (item 85)

Access panels in stub wings

Engine front mounting access panels (item 87)

Engine oil sump filler access panel, starboard only (item 86)

Igniter plug access panels (item 89)

Cold air unit access panels (item 14)

Engine bleed valve duct panels (item 13)

BREAKDOWN OF AIRCRAFT SYSTEMS

Remove the wheelcase breather (item 18, fig. 5). The following disconnections are given in sequence below under their appropriate access door or panel.

Engine starter access door

Immobilise the engine starter by removing the cartridges (A.P.1181D). Pull out the starter exhaust pipe and lock in the "down" position by inserting the pip-pin through the attachment bracket on frame 31.

Gearbox access door

Disconnect and stow the cable assemblies C.3 and C.6 (fig. 5, items 14 and 15).

Engine access door

Disconnect and remove the drain pipe from the oil filler (item 19, fig. 5).

Disconnect the overboard drain pipe (detail D, fig. 5 and 6) from the engine access door

landing aft of frame 34 by removing the anchorage clip from the drain connection and from the spill connection (16) at the bottom of the fuel units and fuel pressure warning light switch. Remove the drain pipe from the aircraft. Disconnect the two connecting-rods from the high-pressure cock and throttle levers (items 10 and 11, fig. 4) and from their respective wrap boxes on frame 34. Release the flexible metal cable (detail C, fig. 4 and 6) from the rigid metal fire extinguisher pipes (9) by breaking down the clip assemblies on each side of the fuel units. Disconnect the black fire extinguisher hose (detail F, fig. 4 and 6) from the rigid metal pipe (7) on the engine. Tuck back the hose behind frame 37. Unscrew the six bolts from the fire sealing plate (detail F, fig. 4 and 6) on the forward face of frame 37. Remove the plate from the aircraft. Unscrew the four nuts and disconnect the fuel inlet pipe from the fuel units (item 17, fig. 5) and from the connection behind the nearest flexible coupling. Remove the pipe and coupling from the aircraft. Place the removable rail (detail E, fig. 4 and 6) between frames 34 and 37 and lock in the bracket on the forward face of frame 37 by inserting the pip-pin. By screwing up the adjustment bolt through the bottom of frame 34, bring the rail into contact with the engine front roller (12).

Engine front mounting access panels

Break down the engine front mountings (detail A, fig. 4 and 6) and pull the fork ends flush to frame 34 in order to clear the engine front mounting eyes (8) and avoid fouling the engine on removal. Prise back the serrated, spring-loaded locking ring and unscrew the shaft retaining nut to break down the gearbox drive shaft (item 2, fig. 4).

Igniter plug access panels

Disconnect the high-energy igniter plugs (item 6, fig. 4 and 5) from the combustion chambers, numbers 3 and 6.

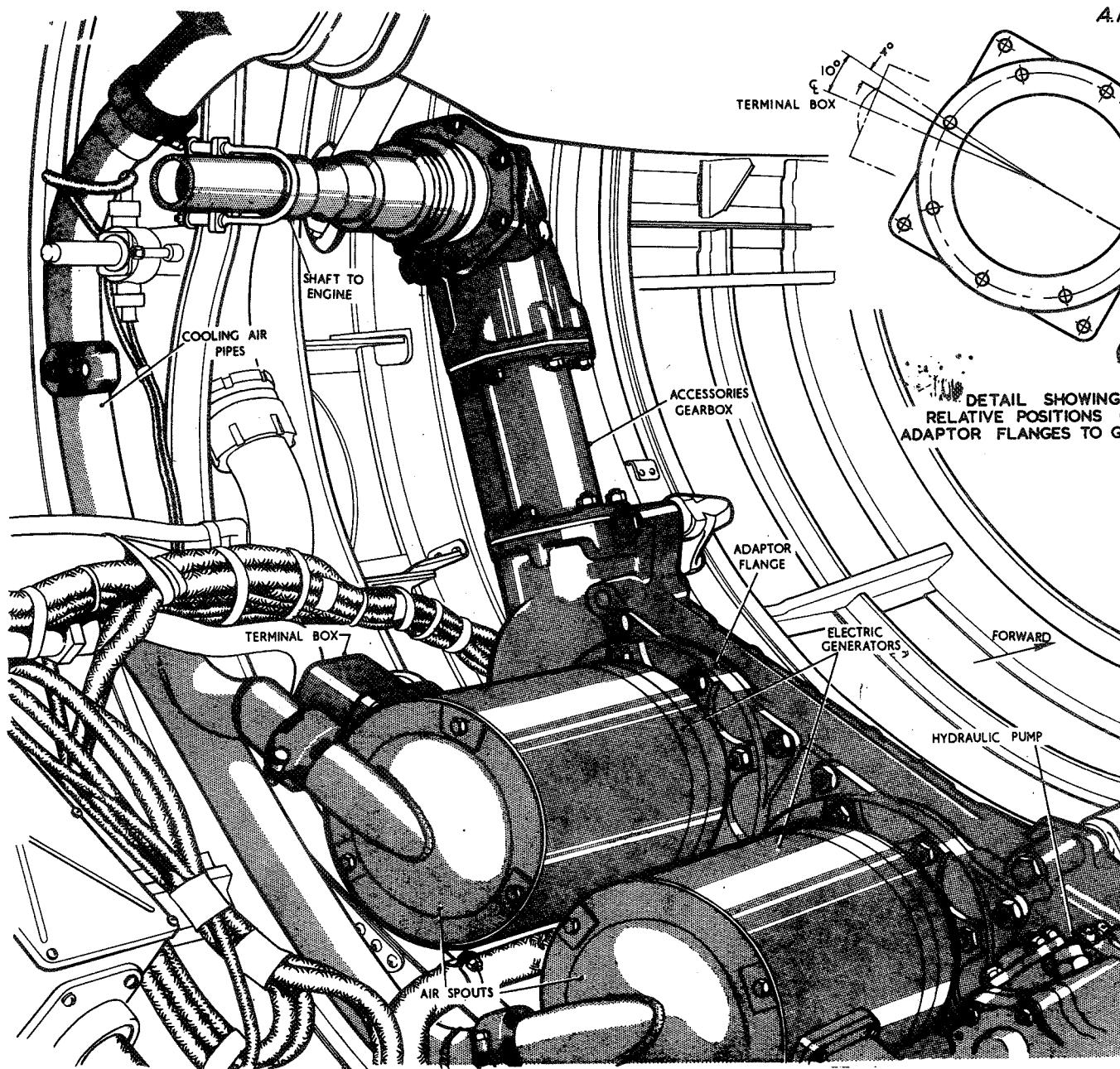
Cold air unit access panels

Disconnect the flexible metallic fuel-tank pressurising pipe from the engine (item 3, fig. 4) and from the non-return valve aft of frame 36. Remove the pipe from the aircraft. Disconnect the rigid metal air-conditioning pipe from the engine (item 13, fig. 5) and from the connection behind the flexible coupling. Remove the pipe and coupling from the aircraft.

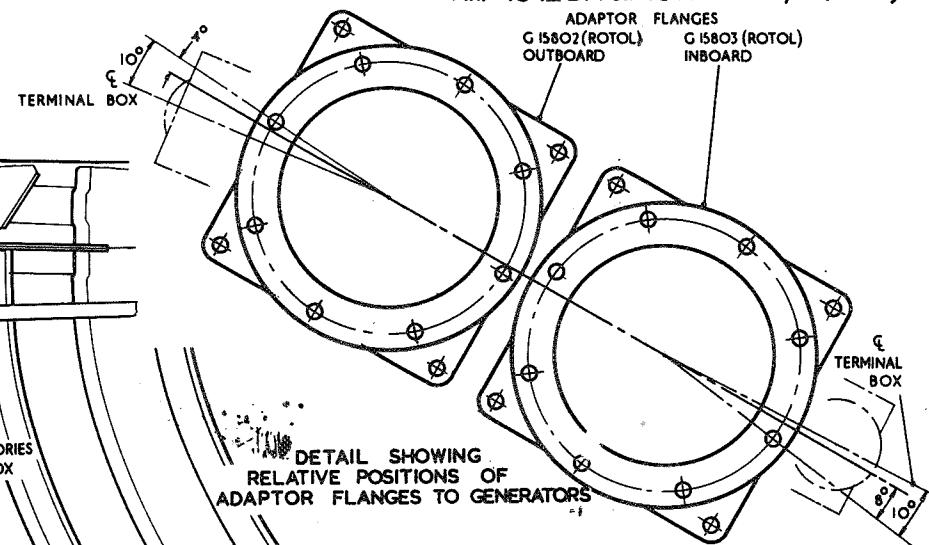
Engine bleed valve duct panels

Disconnect the flexible metal-braided gun-heating pipe from the elbow on the engine (item 1, fig. 4) and tie back to the aircraft structure.

Having disconnected the above items, align the engine removal trolley (fig. 7) with the engine rail lug on the rear face of frame 40A. Screw down the built-in jacks at each corner of the trolley and raise it to the required height. Bring the engine rear roller channels of the trolley into alignment with the engine rear rollers (item 5, fig. 4 and 5) by turning the lateral adjustment handles on the cross members above the trolley axles. Lock the trolley to frame 40A by inserting the pip-pin in the connecting link of the trolley. Break down the engine rear mountings (detail B, fig. 6) by removing split pins, slotted nuts, and washer from the U bolt. Withdraw the cap off the U bolt. Pull the engine rearward about six inches to free the engine rear mounting trunnions (item 4, fig. 4 and 5). Break the wire locking and unscrew the three special bolts securing the engine rear mounting blocks to frame 40A. Remove the blocks from the aircraft. Remove the engine from the aircraft on to the trolley and secure by replacing the retaining bolts in front of the engine rear rollers at the ends of the roller channels. Withdraw pip-pin to disengage the trolley from frame 40A. Lower the trolley on to its wheels and tow away.



A.P.4347D. Vol. 1. Sect. 4 Chap. 1 (A.L.9)



DETAIL SHOWING
RELATIVE POSITIONS OF
ADAPTOR FLANGES TO GENERATORS

BEFORE FITTING NEW GENERATORS THE FOLLOWING POINTS MUST BE NOTED:—

THE ADAPTOR FLANGES MUST BE REMOVED FROM EXISTING GENERATORS AND RE-FITTED TO THE NEW GENERATORS. REFER TO DETAIL ABOVE. REMOVE THE EXISTING AIR SPOUT AND REPLACE WITH STORES REF. 26FX/1877.

BEFORE FITTING THE OUTBOARD GENERATOR, THE DIRECTION OF THE OUTLET ON THE TERMINAL BOX MUST BE REVERSED TO FACE THE DRIVING END OF THE GENERATOR, AND THE CABLE ASSEMBLY C.30 FITTED.

CHECK THAT THE LINK INSIDE EACH TERMINAL BOX IS CONNECTED TO TERMINALS 'A' ANTI-C/W AND E2.

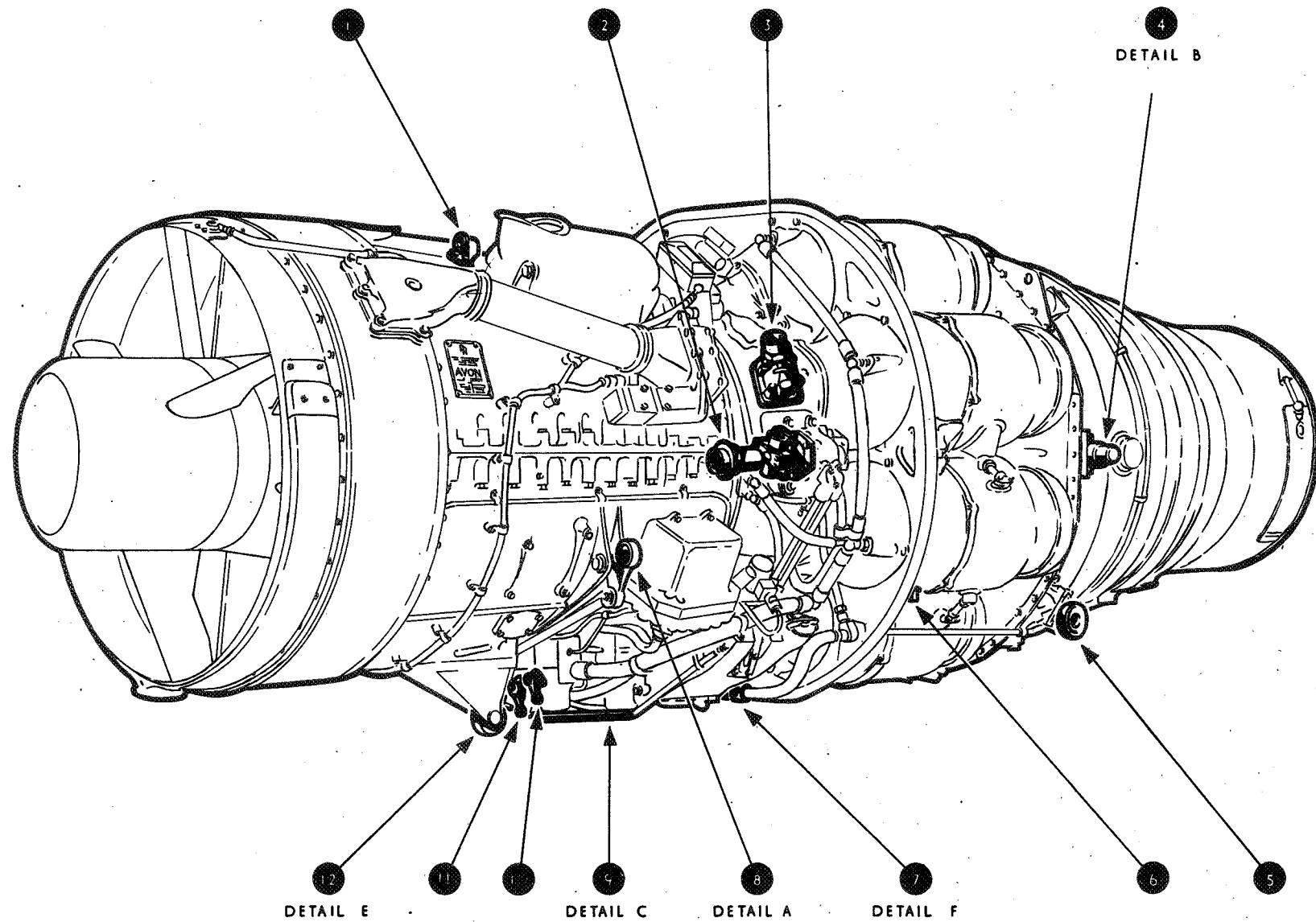
FIT THE GENERATORS TO THE GEARBOX USING EXISTING NUTS AND LOCK-WASHERS.

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FIG. 3 ACCESSORIES GEARBOX

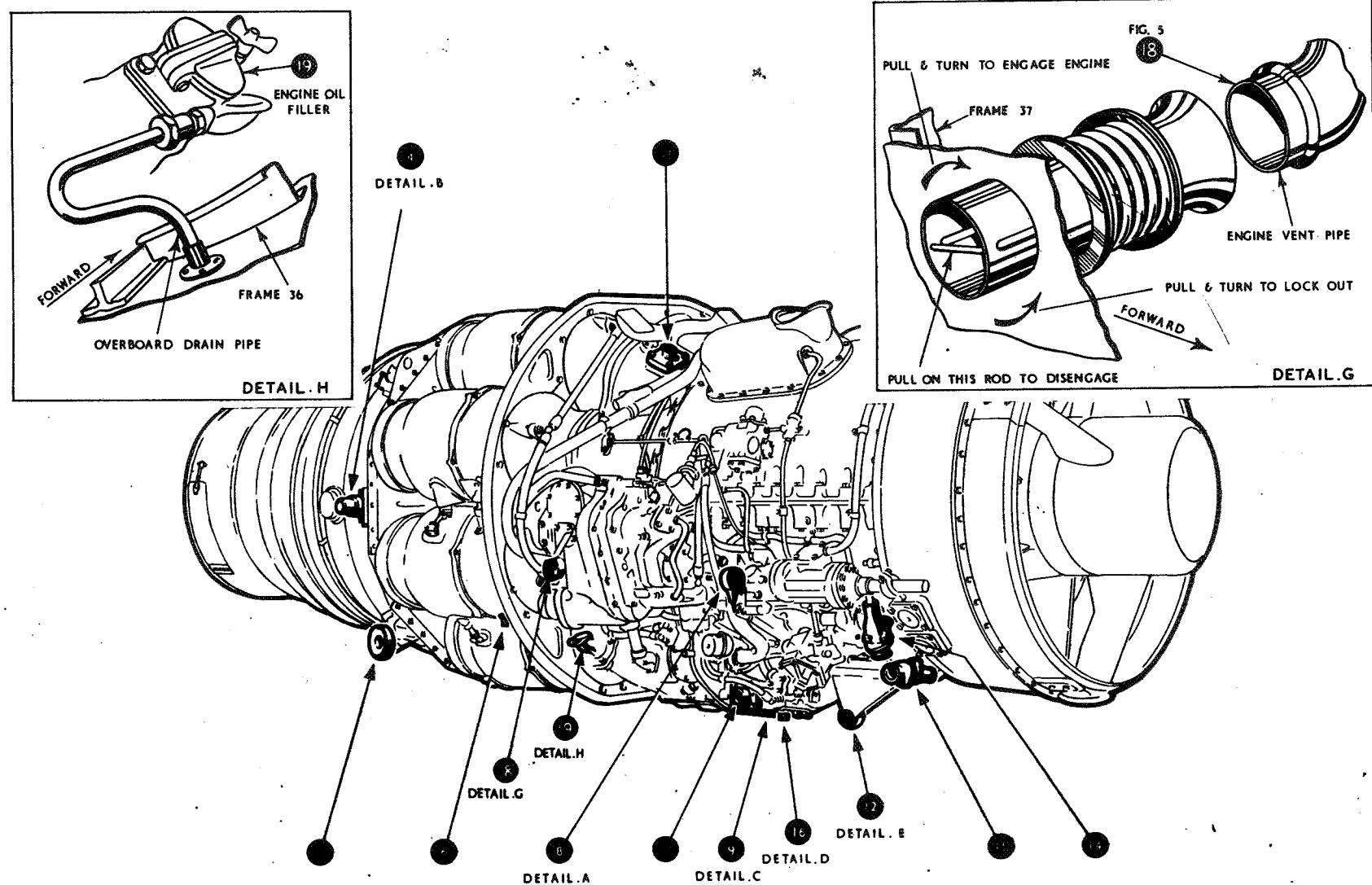
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FIG. 4 ENGINE REMOVAL (I)



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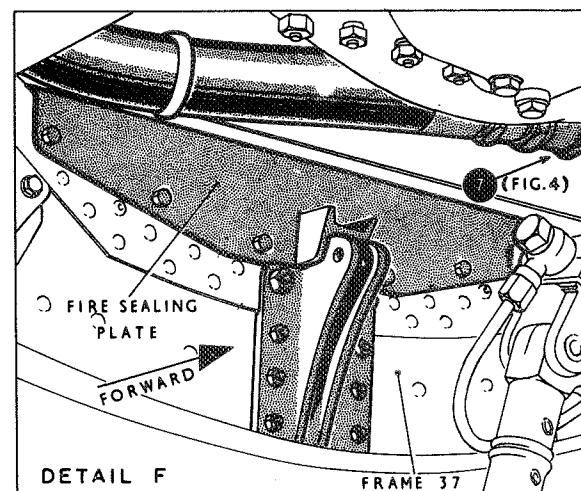
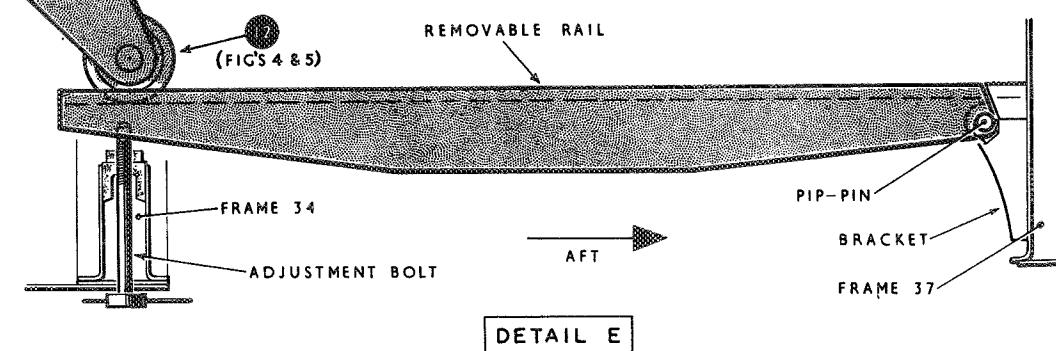
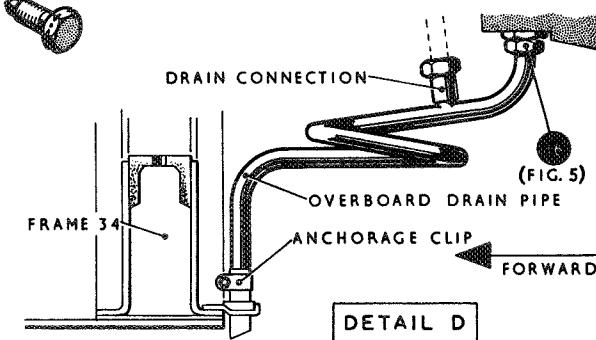
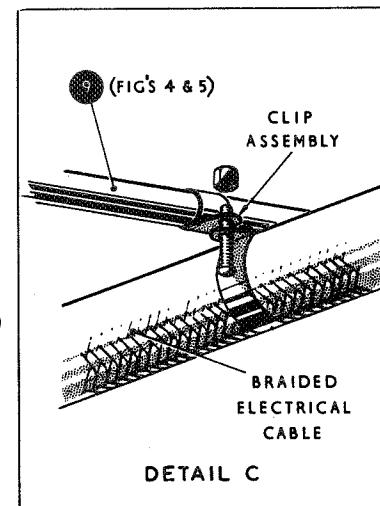
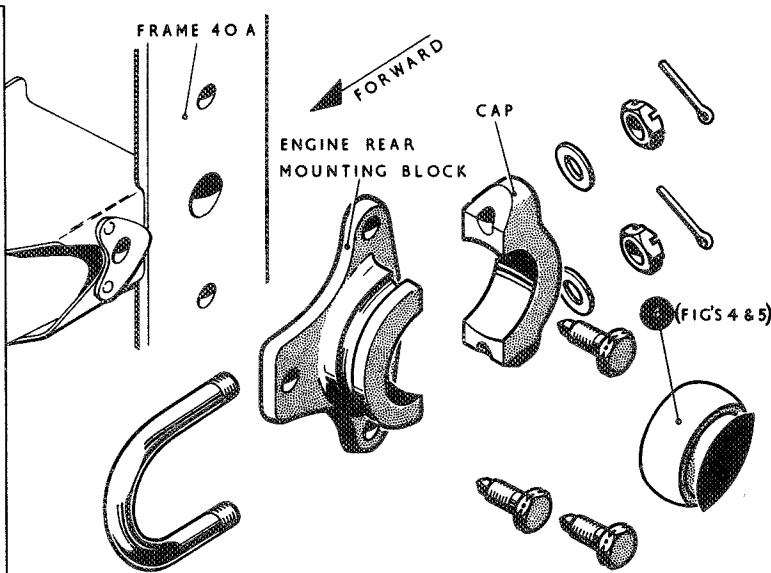
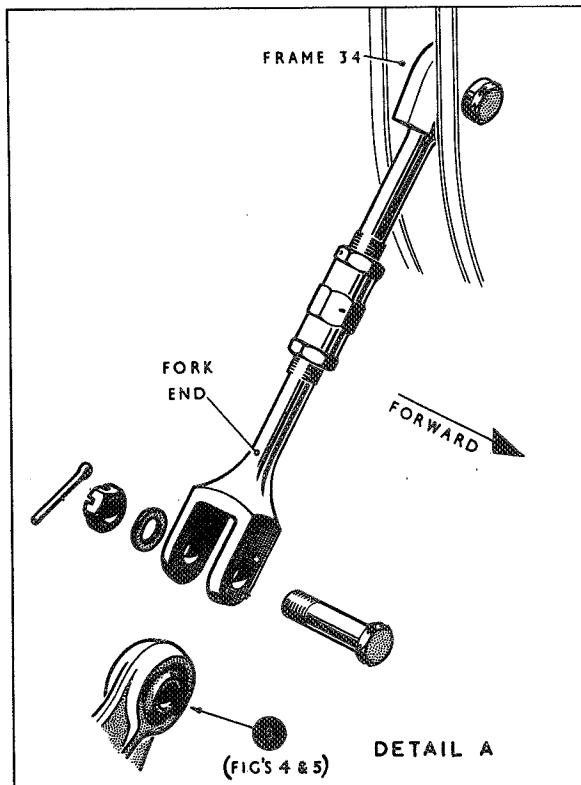


FIG. 6 ENGINE REMOVAL (3)

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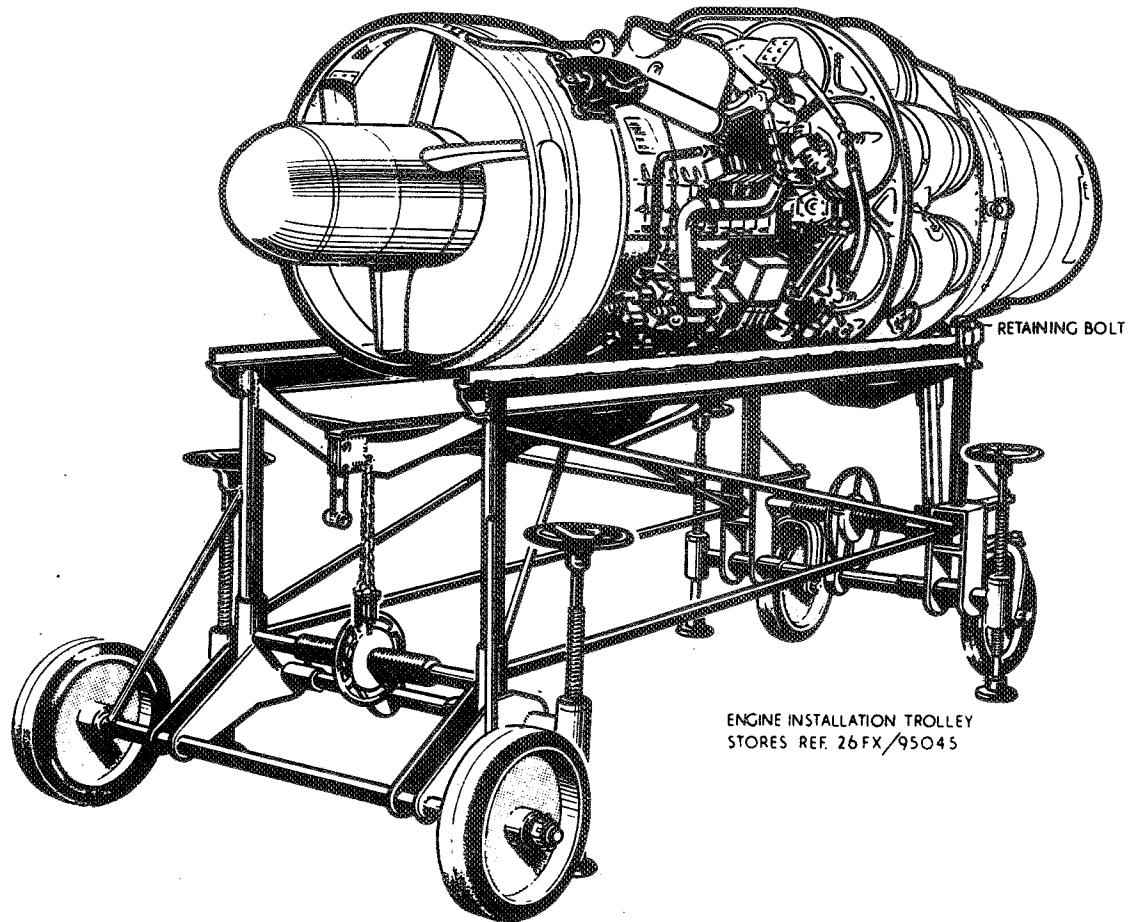
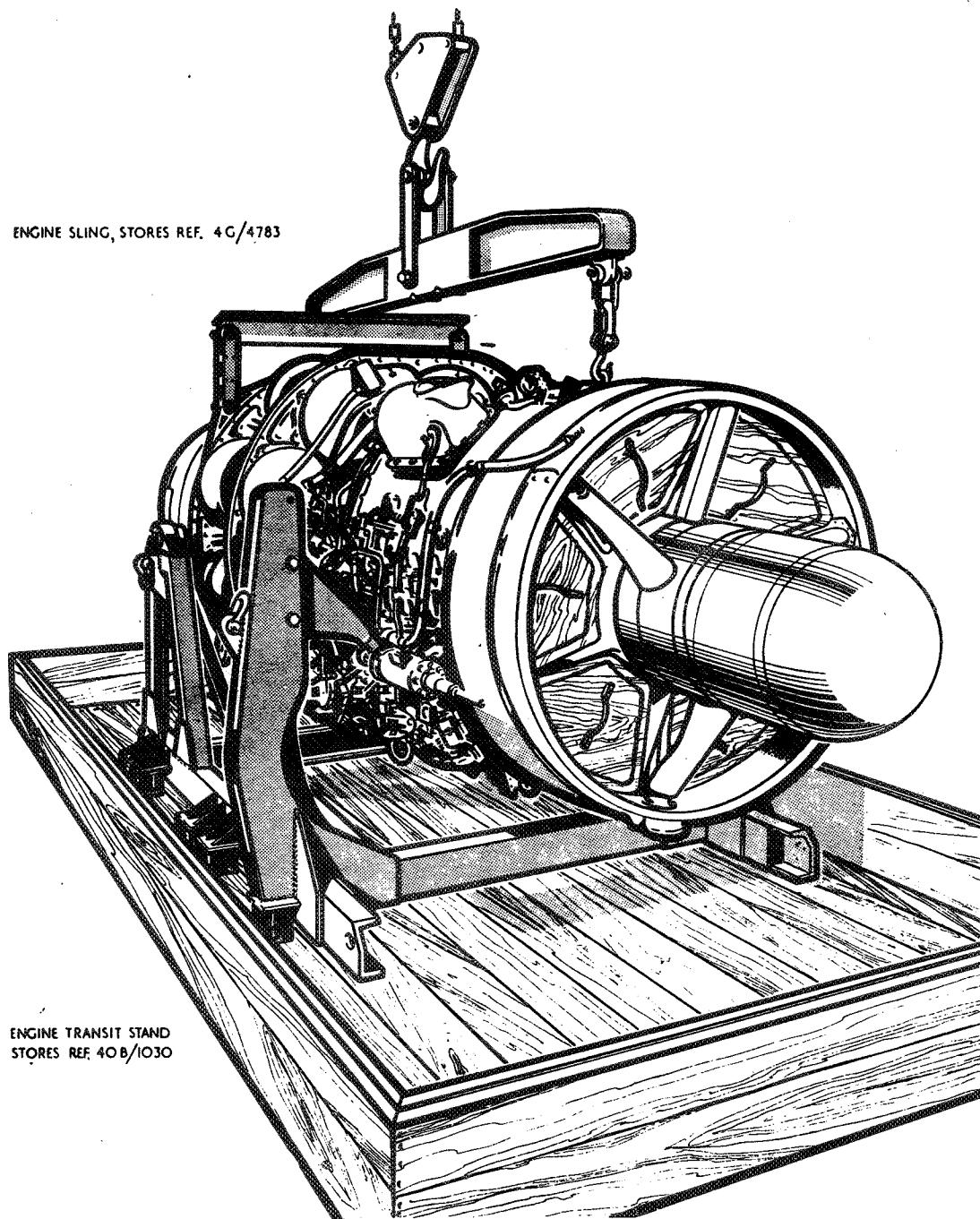


Fig. 7. Engine installation trolley

ENGINE SLING, STORES REF. 4G/4783



ENGINE TRANSIT STAND
STORES REF. 40B/1030

Fig. 8. Engine sling and transit stand

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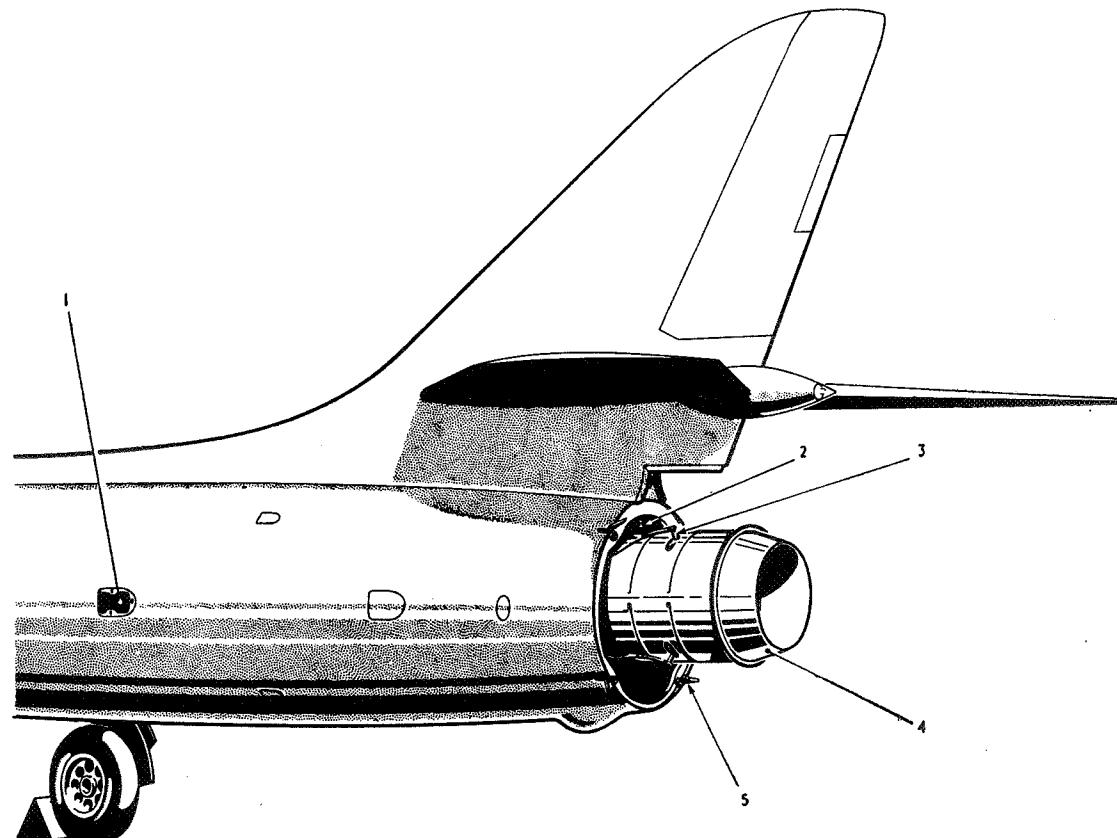


Fig. 9. Jet pipe removal

KEY TO FIG. 9 (JET PIPE REMOVAL)

Render the aircraft electrically safe (Sect. 5, Chap. 1, Group A.1).

Ensure that the aircraft is chocked fore and aft and that the undercarriage safety locks are fitted (Sect. 2, Chap. 1, fig. 6).

Remove the tail cone by releasing the four toggle fasteners (5).

Remove the jet pipe access panels (1), port and starboard, in the rear fuselage.

Break down the jet pipe coupling through the access doors in the engine casing (Sect. 3, Chap. 1, fig. 12. *Detail of jet pipe coupling*).

Uncouple the four thermocouple connections (3) at the rear of the jet pipe.

Pull the jet pipe (4) rearward until it is out of the rear mountings. Carefully man-handle the pipe (*approximately 168 lb. in weight*) until it is clear of the jet pipe mounting rail (2) and the aircraft and place on a felt padded surface.

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