

Chapter Eight

PREPARATION FOR OPERATION

Contents	
Page	Page
De-inhibiting the fuel system 6	Priming 2
Front bearing oil feed restrictor 4	Front bearing 4
General 1	Fuel system 5
Ground running checks 6	Rear bearing 2
Ignition equipment check 6	Turbo-starter gearbox 4
Preliminary checks 1	Wheelcases, with oil, Ghost 48 Mk. 1 only 4

Illustrations	
Fig.	Fig.
Using priming syringe T.72894 to prime the rear bearing 1	Adapter for priming Ghost 48 Mk. 2 rear bearing 3
Using oil pressure test trolley T.73891 to prime the rear bearing 2	Using oil pressure test trolley to prime the wheelcases 4

THIS CHAPTER, which is applicable to the Ghost 48 Mk. 1 and the Ghost 48 Mk. 2, describes the operations which must be carried out before an engine which is newly installed or which has been stored, is started for the first time. Where the information concerns one mark of engine only, this is indicated in the text.

Reference should be made also to the general information contained in chapter 5 unless the operator is well acquainted with these particular engines. The general precautions to be taken before starting and the procedure for starting are detailed in chapter 9.

If the turbo-starter is used to rotate the engine for any purpose, a wait of at least 15 seconds must be observed between the firing of the first and second cartridges.

The engine-driven fuel pumps are fuel lubricated and, to avoid damage, the engine must not be rotated without fuel in the pumps. The L.P. fuel cock must, therefore, be in the ON position and the aircraft tank/s must contain fuel whenever the engine is rotated.

PRELIMINARY CHECKS

Make a thorough visual examination of all external fittings and accessories to ensure that the engine is complete and has not been damaged whilst in transit or being installed.

As a precautionary measure, remove and examine both the suction and pressure oil filters, and if they are clean and free from foreign matter, refit and lock them.

Examine the connections of each engine instrument both at the engine attachment and in the

cockpit. Ensure that all thermocouple leads are properly supported and clear of the engine. Check the electric wiring to the starter and to the high energy ignition units.

Ghost 48 Mk. 1 only. Check the wiring to the fuel pump isolating valve.

Examine the welding of all sheet metal work as thoroughly as possible without undertaking any dismantling.

*Ghost 48 Mk. 1, pre-mod. 1184.** Do not tighten or wire-lock the union nut at the low pressure filter end of the distributor to L.P. filter spill pipe as this nut must be slackened off in order to prime the fuel system as described on page 4.

*Ghost 48 Mk. 2, pre-mod 1184.** Do not tighten or wire-lock the cap nut which secures the pressure warning switch to the banjo pillar on the L.P. filter head as this nut must be slackened off in order to prime the fuel system as described on page 5.

Ensure that all pipes are correctly connected and that all unions are tight and securely locked.

Check that all external bolts, nuts, screws, unions, etc., on the engine and its mounting structure are tight and properly locked. Check the airframe fittings and components in the engine bay in accordance with any instructions given in the relevant aircraft handbook.

Examine all drain connections to ensure that they are clear and that all drain pipes have an uninterrupted fall from the engine to the exit point. Pre-mod. 1087, if the engine has been inhibited, ensure that any masking is removed from the fire

* Mod. 1184 introduced two bleed valves on the head of the low pressure fuel filter to obviate the spillage of fuel, and the consequent fire hazard, which results when the filter is bled through the spill pipe union nut or the pressure-warning-switch cap-nut.

extinguisher pipes, and that the spray holes in the pipes are clear. Mod. 799 deleted the fire extinguisher pipe from aft of the diffuser casing, and mod. 1087 deleted the remaining fire extinguisher pipe which was forward of the diffuser casing.

Make a check to ensure that the direction of movement of the cockpit levers agrees with that of the relevant engine controls.

Ghost 48 Mk. 1. Ensure that each lever on the fuel control valve assembly has its correct range of travel—a total angular movement of 45 degrees each.

Ghost 48 Mk. 2. Ensure that the throttle control valve lever on the valve group unit has a total angular movement of 47 degrees and that the shut-off valve control lever has a movement of 25 degrees.

In both marks. If any corrections are necessary, adjustment must be made to the airframe control system.

Ghost 48 Mk. 2. Where mod. 1023 has been embodied, the pair of bleed screws on the fuel supply pump, just forward of the governor adjustment, are replaced by push-button type bleeds to facilitate priming. For transport purposes, these push-button bleeds are protected by blanking caps. These blanking caps are **not flight blanks** and must be removed when the engine is installed. If these blanking caps are left on the engine, they may fall off in flight and then, being loose in the engine bay, are very liable to foul either the aircraft or the engine controls. After removal, these blanking caps should be retained for refitment to the fuel pump, either when it is removed from the engine or when the engine is removed from the aircraft.

Ghost 48 Mk. 2, Governor adjustment. If the engine is newly installed, remove the 'transport card' from the fuel supply pump governor adjustment—**IMPORTANT**, this governor is set, do not disturb its setting.

PRIMING

PRIMING THE REAR BEARING

Prior to installation, the engine may have been standing in a vertical position, which would cause the oil to drain away from the rear bearing. In view of the high temperature at which this bearing operates, the engine must not be started after installation until the bearing has been primed with filtered oil of the correct specification. When installing an engine in an aircraft, it may be considered easier to prime the rear bearing whilst the engine is still on the transport stand or is suspended from a crane, as the connections on the underside of the engine will be more accessible than after the engine is installed.

The rear bearing must not be primed whilst the engine is in the vertical position, in the dismantling or assembly stand. If this is done, oil may be pumped through the bearing into the rear bearing air filter and the resultant oil soakage of

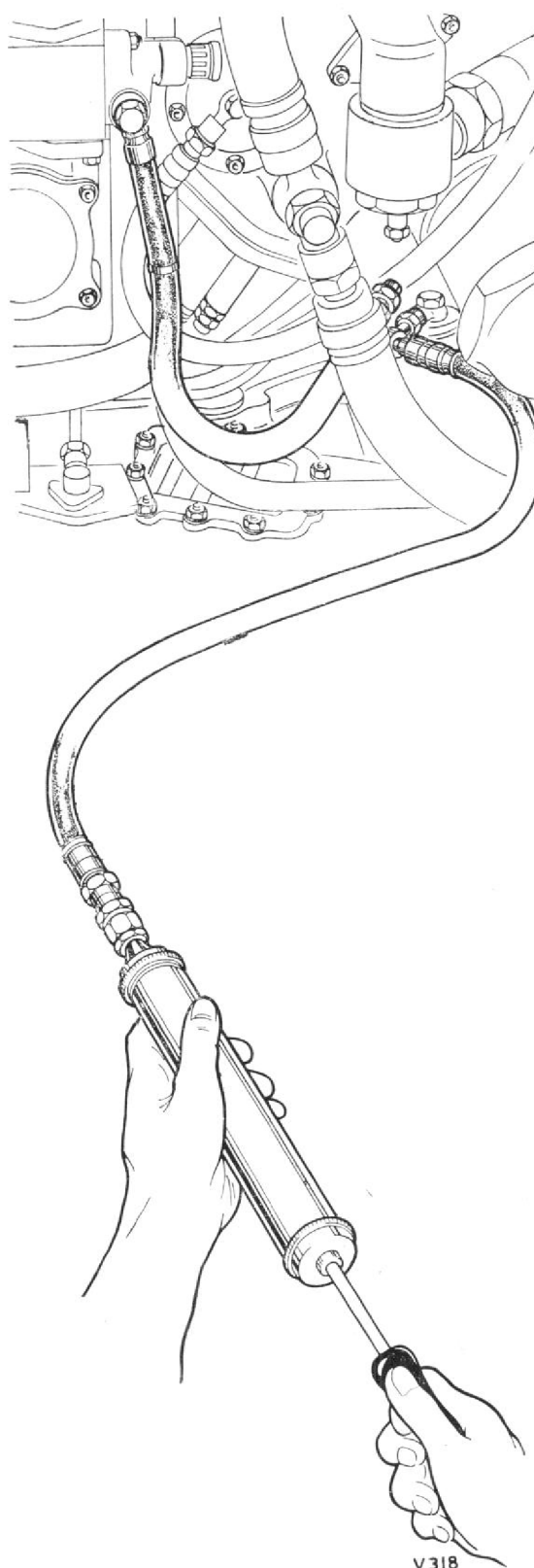


Fig. 1. Using priming syringe T.72894 to prime the rear bearing, Ghost 48 Mk. 1, pre-mod. 1095.

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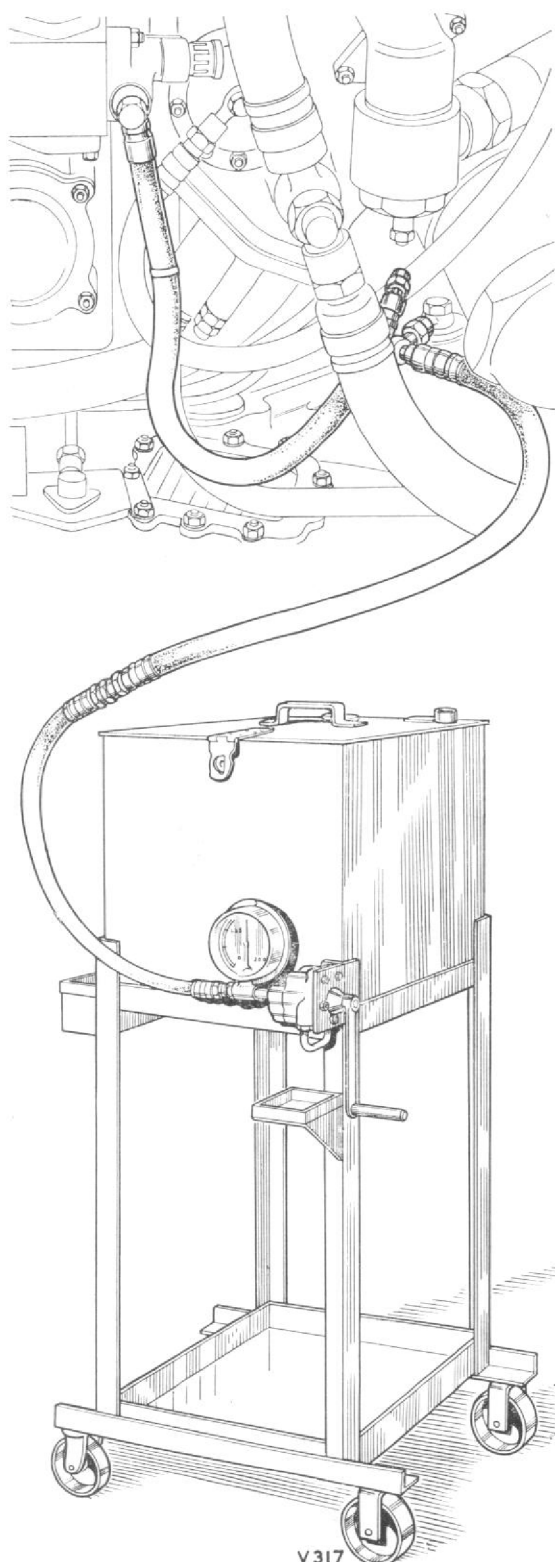


Fig. 2. Using oil pressure test trolley T.78458, and a flexible pipe such as item 5 of T.72894, to prime the rear bearing, Ghost 48 Mk. 1, pre-mod 1095; alternative to syringe shown in Fig. 1.

the felt element may, by reducing the air flow through the filter, be responsible for high rear bearing temperature. This priming must be carried out gently and slowly, for the following reasons. The rear bearing drain commences as an $\frac{1}{8}$ inch drilling in the rear bearing housing. As there are no oil seals in the rear bearing housing, if oil is supplied at a greater rate than it can escape through the drain it will be forced out through the clearances between the safety bearings and the main shaft, and thus flood the rear of the engine, which can constitute a serious fire hazard. In these circumstances, oil may drain down the front face of the turbine disc and form a pool in the bottom of the exhaust cone, or it may drain down the interior of the centre casing and drip out of the drain hole at the front of this component. This escape of oil does not indicate any defect in the bearing or bearing housing; it is merely the result of pumping oil in faster than it can escape through the drain but care must be taken not to confuse this with oil leakage as the result of a fractured oil cooling or lubrication pipe either to or from the rear bearing.

Ghost 48 Mk. 1 pre-mod. 1095. Unscrew the union nut which connects the flexible pipe from the rear bearing metering pump to the banjo on No. 10 diffuser bolt. Where mod. 1095 has been embodied, the connection is similar to that on the Ghost 48 Mk. 2, described in the next paragraph. Using a syringe such as T.72894 (Fig. 1), or an oil pressure trolley such as T.78458 (Fig. 2), or a pump such as that described on page 4, connected with a length of pipe and a suitable adapter to the banjo on the diffuser bolt, or (mod. 1095) to the rigid pipe, gently force about 100 c.c. of clean filtered oil of the correct specification into the rear bearing feed pipe. Reconnect the flexible pipe and wire-lock the union nut.

Ghost 48 Mk. 2. Disconnect the rigid pipe from the banjo union on the metering pump and fit an adapter such as that illustrated in Fig. 3. Using a syringe such as T.72894, or oil pressure trolley T.78458 or a pump such as that described overleaf, connected with a length of pipe to the adapter on the rigid pipe, gently force about 100 c.c. of clean filtered oil of the correct specification into the rear bearing feed pipe. Remove the adapter, reconnect the pipe, and wire-lock the union nut.

Tests have established that 100 c.c. of oil is an ample quantity to fill the pipe from the metering

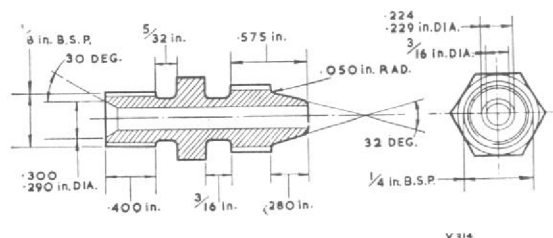


Fig. 3. Suggested adapter for priming Ghost 48 Mk. 1 where mod. 1095 has been embodied, and Ghost 84 Mk. 2 rear bearing.

pump to the rear bearing and to prime the bearing to the correct level and, therefore, nothing is to be gained by exceeding this quantity.

Especially when the weather is cold, it can be a long and tiresome process to prime the rear bearing with the aid of a syringe even though the oil is pre-heated. If a pump such as a Ki-gass priming pump is mounted vertically in a box, or on a suitable stand, and a length of pipe is used to connect the priming pump outlet with the rear bearing feed pipe, a 50 lb. weight may be placed on the operating handle of the priming pump and left to force the oil into the bearing, whilst the operator is engaged on other work.

Alternatively, a spring-loaded pump, such as that used for spraying aircraft windscreens with de-icing fluid, can be used for this operation. A weight will then be unnecessary.

PRIMING THE FRONT BEARING *Ghost 48 Mk. 1, Pre-mod. 431 only*

When mod. 431 has not been embodied it is necessary to prime the front bearing. Disconnect the flexible pipe from the front bearing metering pump, either at the connection on the front of the air-intake or at the union nut on the metering pump. Using a syringe or a pump similar to that recommended for priming the rear bearing, connected with a length of pipe and suitable adapter to either the open end of the flexible pipe or the connection on the air-intake, gently force about one-third of a pint of clean filtered oil of the correct specification into the front bearing feed-pipe. Re-connect the flexible pipe and wire-lock the union nuts

FRONT BEARING OIL FEED RESTRICTOR

Ghost 48 Mk. 1 (mod. 431) and 48 Mk. 2

When mod. 431 has been embodied on Ghost 48 Mk. 1, and on all 48 Mk. 2 engines, it is unnecessary to prime the front bearing, but immediately before installation of the engine into an airframe the front bearing oil feed restrictor must be removed, cleaned, and re-fitted as described in chapter 13.

PRIMING THE TURBO-STARTER GEARBOX

After assembly to the engine, or before starting an engine which has been standing idle for more than seven days, the turbo-starter must be primed with oil to the specification quoted in the leading particulars at the beginning of this handbook. It is important that the correct grade is used as any other may cause the starter clutch mechanism to function incorrectly. To prime the turbo-starter gearbox, unscrew the oil filler plug from the side of the clutch and reduction gear casing and inject about $\frac{1}{4}$ pint of the correct oil into the casing. Replace and securely tighten the oil filler plug.

PRIMING WHEELCASES WITH OIL (*Ghost 48 Mk. 1 only*)

Where an engine is newly installed, or where an installed engine has been standing for a period of more than one month since it was last run, to ensure that all gears and bushes are lubricated, prior to starting, the wheelcases must be primed with oil as follows.

It is not necessary to prime the Ghost 48 Mk. 2 as this engine has fewer plain bearings in the top wheelcase than the Ghost 48 Mk. 1.

- (1) Cut the locking wire and remove the $\frac{1}{4}$ in. B.S.P. union nut and blanking nipple from the non-return valve (mod. 1082), which is situated at the bottom of the sump between the oil pressure filter cover and the oil pressure relief valve. If mod. 1082 has not been embodied, it will be necessary to remove the $\frac{1}{8}$ in. B.S.P. plug and temporarily fit a suitable union adapter in its place.
- (2) Connect a suitable source of filtered oil under pressure to the non-return valve. Oil pressure test trolley T.78458, illustrated in Fig. 4, would be suitable.
- (3) Prime the engine with clean filtered oil to the specification given in the Leading Particulars at the beginning of this Volume. Maintain a

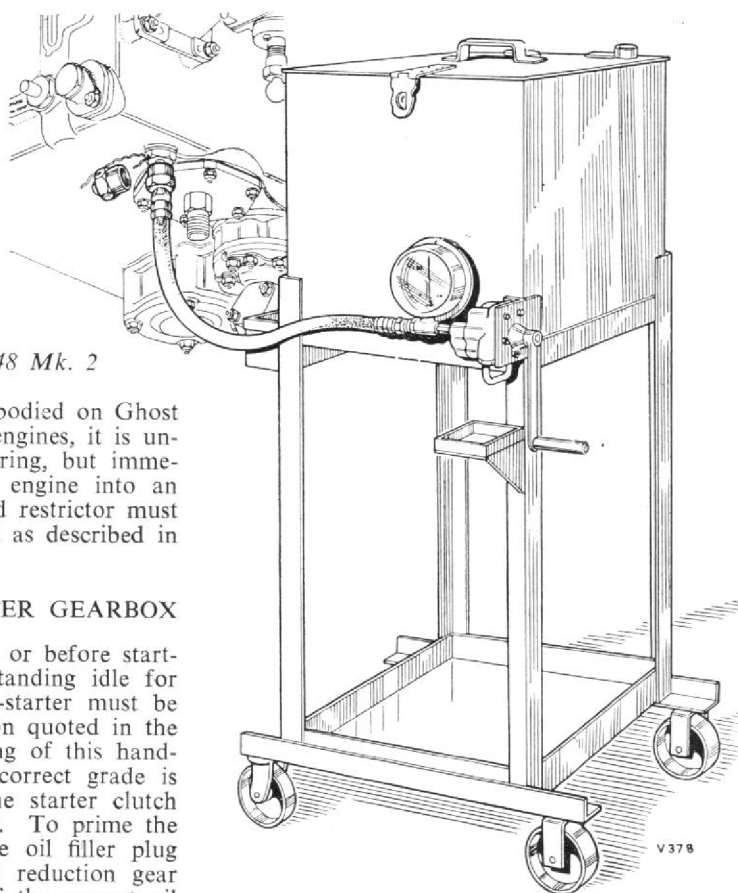


Fig. 4. Using oil pressure test trolley T.78458 to prime the wheelcases with oil, Ghost 48 Mk. 1.

pressure of 40 ± 5 lb. per sq. in. at the inlet connection for two minutes. When using oil to specification D.Eng.R.D. 2479/0 or 2479/1, the oil temperature should not be less than 10 deg. C.

- (4) Disconnect the priming oil supply, refit the blanking nipple and the union nut, and wire-lock the nut.
- (5) Check the oil level in the sump, ensuring that the sump has not been overfilled in the priming process, and adjust if necessary.
- (6) When all other preparatory work has been completed, the engine is ready to be started.

PRIMING THE FUEL SYSTEM

Ghost 48 Mk. 1

The fuel system should be primed on each occasion that the low pressure fuel filter is removed for examination or when the system has been disconnected for any servicing operation.

With a newly installed engine, or one which has been inhibited, complete priming of the fuel system will be carried out as part of the de-inhibiting procedure.

Pre-mod. 1184, slacken the union nut at the low pressure filter end of the distributor to L.P. filter spill pipe sufficiently to allow the pipe to be eased back from the connection on the top of the L.P. filter.

Ensure that the H.P. cock lever is in the CLOSED position, move the L.P. fuel cock lever to the ON position and switch ON the fuel tank booster pump.

Pre-mod. 1184, when fuel leaks continuously from the distributor spill pipe connection, the fuel system will be primed as far as the low pressure filter. Tighten and wire-lock the spill pipe union nut.

This procedure tends to result in fuel soakage of the adjacent engine and airframe structure and wiring and this can constitute a fire hazard. To overcome this, mod. 1184 introduces two push-button type bleed valves on the low pressure fuel filter head. *Where mod. 1184 has been embodied*, the low pressure fuel filter should be bled through each bleed valve in turn, as follows: bleed through the valve on the inlet side of the filter-head first. Push one end of a suitable length of P.R. hose over the push-button end of the bleed valve and place the other end into a container, to receive the fluid which will be expelled. Press in the push-button, by nipping it with the fingers within the hose and pushing them towards the body of the valve, thus opening the bleed valve. Hold the valve open until all air, or inhibiting fluid, has escaped. When uncontaminated fuel issues from the hose, release and remove it from the bleed valve. Check that fuel does not exude from the bleed valve orifice after the push-button is released.

It is also necessary to bleed all the air from the fuel pumps to ensure satisfactory operation of the overspeed governor mechanism which is incorporated in the pumps. Pre-mod. 767 the two

air bleed valves are situated just below the port air-intake but when mod. 767 has been embodied they are adjacent to No. 10 deflector cover.

With the H.P. cut-off valve still closed and the L.P. fuel cock and tank booster pump ON, bleed each fuel pump as follows. Remove the cap nut from the relevant air bleed valve. If the bleed valve is of the pre-mod. 127 poppet type, depress the stem of the valve taking care not to obstruct the hole in the centre of the stem, as it is through this hole the air must escape. If the bleed valve is of the ball type, use a thin rod, or screw-driver to depress the ball within the valve. Retain pressure on the bleed valve until all air has escaped and fuel emerges. When all air has escaped, release the bleed valve and refit the cap nut; if the bleed valve is of the poppet type avoid over-tightening the cap-nut, as if this is done the valve can be broken.

The remainder of the fuel system will be primed automatically as the engine starts. Should the engine fail to start due to insufficient fuel in the system, it will usually start satisfactorily at the second attempt but this must not be made until all unburnt fuel has drained from the engine.

PRIMING THE FUEL SYSTEM

Ghost 48 Mk. 2

The fuel system should be primed on each occasion that the low pressure fuel filter is removed for examination or when the system has been disconnected for any servicing operation.

Pre-mod. 1184, slacken the cap-nut from the top of the banjo pillar to which the fuel pressure warning switch is connected on the low pressure fuel filter head, and ease the pressure switch up the banjo pillar.

Ensure that the H.P. cock lever is in the CLOSED position; move the L.P. fuel cock to the ON position and switch ON the fuel tank booster pump.

Pre-mod. 1184, when fuel leaks continuously from the pressure switch connection, the fuel system will be primed as far as the low pressure filter. Tighten and wire-lock the cap nut.

Where mod. 1184 has been embodied, the low pressure fuel filter should be bled through the bleed valves in a similar manner to that described for the Ghost 48 Mk. 1.

It is also necessary to bleed all the air from the fuel supply pump to ensure satisfactory operation of the overspeed governor mechanism which is incorporated in the pump. There are two bleed valves on the pump casing, forward of the governor adjustment. Pre-mod. 1022 there was a second pair of bleed valves adjacent to the mounting flange; mod. 1022 introduced blanking plugs in place of the redundant pair of bleed valves. When mod. 1023 has been embodied the pair of bleed valves on the pump casing are of the push-button type.

With the H.P. fuel shut-off valves still closed and the L.P. cock and tank booster pump ON, bleed the fuel supply pump through each of the bleed valves as follows. Pre-mod. 1023, place one

end of a suitable length of $\frac{1}{4}$ in. P.R. hose over the snout of the bleed screw and the other end into a container. Unscrew the bleed screw $1\frac{1}{2}$ to 2 turns. Continue bleeding from each point until all air, or inhibiting fluid, has escaped. When uncontaminated fuel issues from the hose, screw in the bleed screw, remove the hose and wire-lock the bleed screw.

When mod. 1023 is incorporated attach the rubber bleed adapter T..... over the push-button end of the bleed valve and lead the extension pipe into a container. Press in the adapter, thus operating the push-button and opening the bleed valve. Hold in the adapter until all air, or inhibiting fluid, has escaped. When uncontaminated fuel issues from the extension pipe, release and remove the rubber adapter. Check that fuel does not exude from the bleed valve orifice after the button is released.

When mod. 876 or mod. 1172 has been embodied, the flow control unit is provided with bleeds of the bleed screw type, and this unit should be bled in a similar manner to that described for the supply pump pre-mod. 1023.

The remainder of the fuel system will be primed automatically as the engine starts. Should the engine fail to start due to insufficient fuel in the system, a second attempt should be successful but this must not be made until all unburnt fuel has drained from the engine.

DE-INHIBITING FUEL SYSTEM

Ghost 48 Mk. 1 only

In the case of a newly installed engine the preliminary checks detailed earlier in this chapter must be carried out and the rear bearing, turbo-starter gearbox, and the engine must be primed with oil before the fuel system is de-inhibited. The interior of the engine will be automatically de-inhibited during the first normal start.

First drain the low pressure fuel filter of inhibiting fluid by removing the drain plug or the filter case (bowl), and prime the fuel system as described on page 4. In addition, bleed both fuel pumps from the bleed connection on the governor cover, until all remaining inhibiting fluid is expelled and fuel commences to flow.

Ensure that an actual start will not be made by disconnecting the low tension leads from both the high energy ignition units which are mounted on the engine.

Simulate a start in accordance with the starting drill detailed in chapter 9 but OPEN the throttle fully. This will cause the inhibiting fluid to be expelled into the combustion chambers. Allow sufficient time for all liquid to drain from the engine and reconnect the low tension leads to the two high energy ignition units.

Ghost 48 Mk. 2. The fuel system need not be de-inhibited on this engine as the quantity of fuel injected into the combustion chambers by the Dowty spill flow system when simulating a start, would make a subsequent start difficult. A normal start in accordance with the starting drill detailed

in chapter 9 will satisfactorily de-inhibit the fuel system.

IGNITION EQUIPMENT CHECK

Proof of the correct functioning of the ignition equipment will be obtained if the engine starts in a satisfactory manner when the correct starting drill, as described in chapter 9, is followed, but if required the ignition equipment can be checked thus. Wind up the Venner time switch in a clockwise direction and release it, or, on later aircraft, press the relighting button which is incorporated in the H.P. cock lever. When Venom mod. 290 has not been incorporated, it will be necessary to switch ON the starter master switch, and on early aircraft fitted with the Rotax starting system the cartridge selector must be at OFF. If the igniter plugs are functioning correctly, the discharge at each igniter plug will be clearly audible. Alternatively, their functioning can be observed by a second operator looking up the exhaust cone; if this procedure is adopted great care must be taken to ensure that an actual start is not made, and that a turbo-starter cartridge is not accidentally fired.

Ghost 48 Mk. 2, this in situ check does not check the fuel supply to the torch igniters and when this is necessary reference should be made to the Defect Diagnosis in chapter eleven.

GROUND RUNNING CHECKS

After completion of the preparation and checks described in this chapter the engine is ready for ground tests.

Connect a slave 0-100 lb. per sq. in. pressure gauge to the connection on the air compressor drive housing on the top wheelcase.

Start the engine as described in chapter 9 and carry out the ground running checks detailed in that chapter, but with the following additional checks:—

- (1) Ensure that there are no leaks at any point in the oil or fuel systems.
- (2) Ensure that there are no air or gas leaks from the engine.
- (3) Check the delivery of the rear bearing metering pump at 3000 r.p.m., and check the oil pressure at maximum continuous r.p.m.

Gas leaks will be indicated by smoke issuing from leaking joints or from under the exhaust cone fireguard, but this should not be confused with the smoke which will inevitably issue from a newly installed, or fully inhibited engine as the inhibitor is burnt off. If there is any doubt the check should be repeated after the engine has done some running.

Fit all cowling panels, and inspection doors, and ensure that they are securely attached, referring, if necessary, to the relevant Aircraft handbook for any special instructions. Ensure that there is an annular clearance between the engine cowling and the rear of the propelling nozzle.

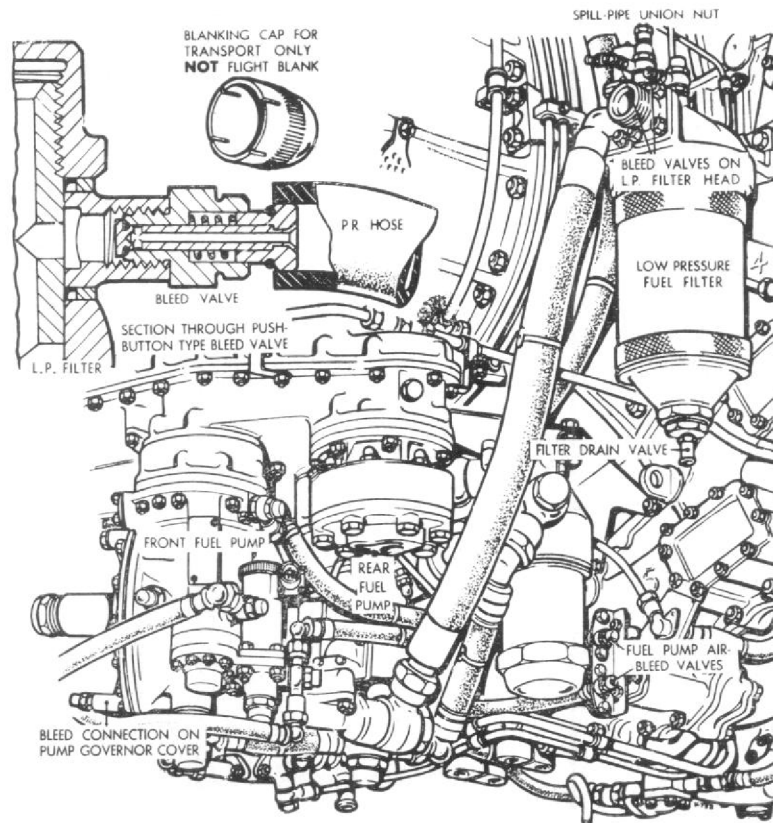


Fig. 5. Fuel system bleed points, Ghost 48 Mk. 1, see "Priming the fuel system," page 5, chapter 8.

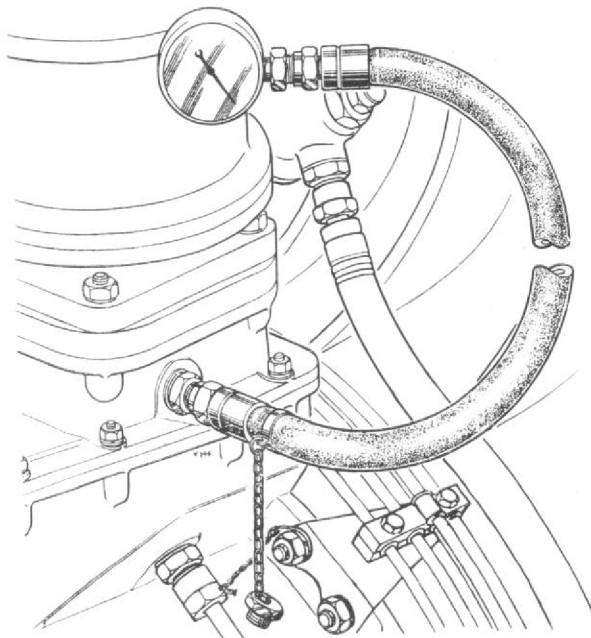


Fig. 6. Oil pressure gauge T.79300 connected to the oil pressure gauge connection on the port side of the top wheelcase, Ghost 48 Mk. 1.

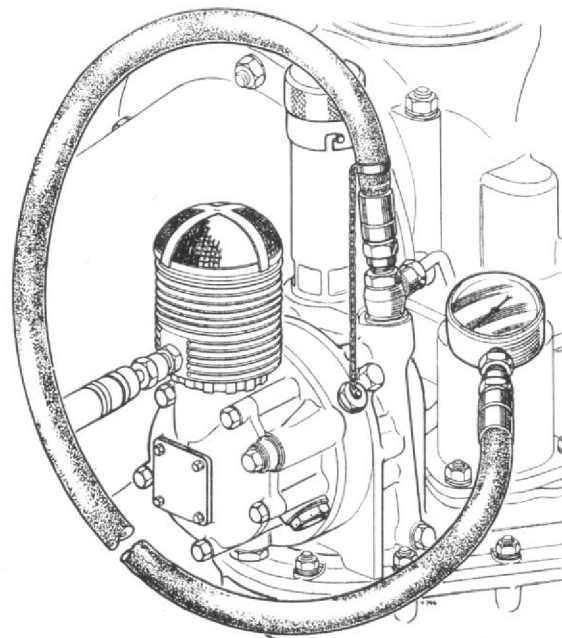
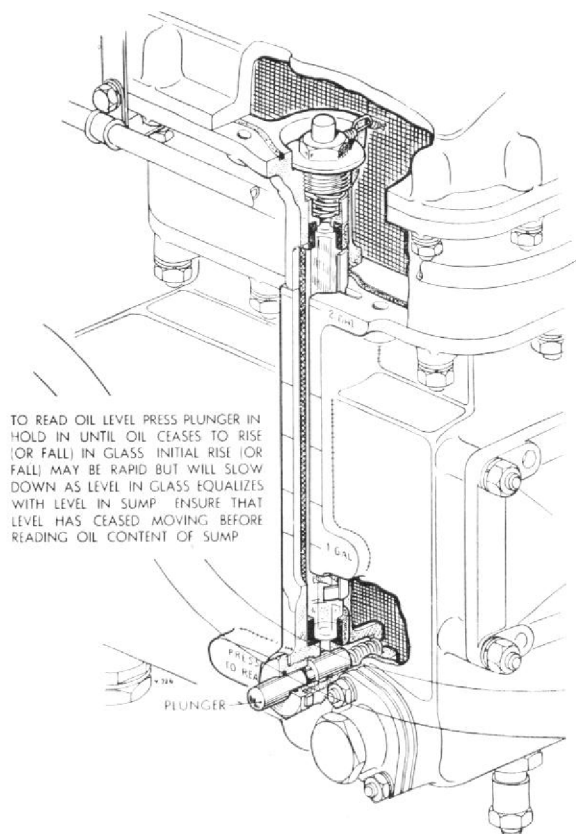


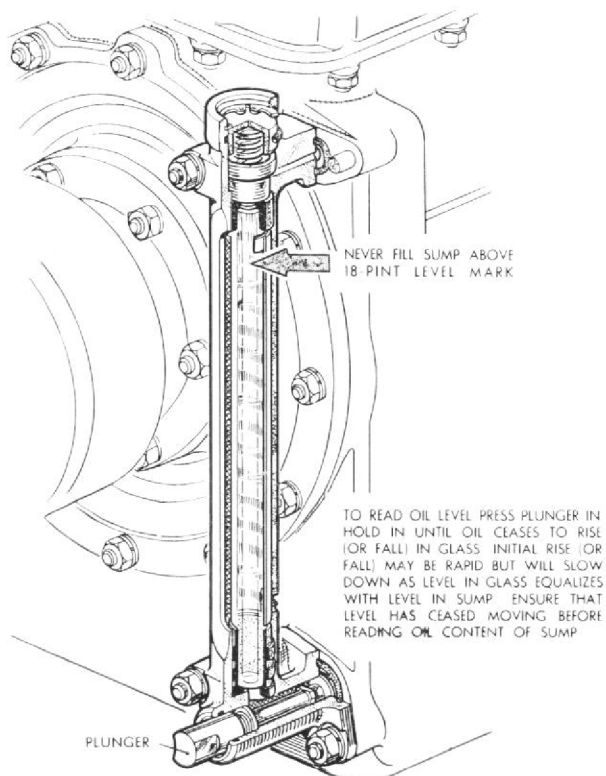
Fig. 7. Oil pressure gauge T.79300 connected to the oil pressure gauge connection on the air compressor drive housing, Ghost 48 Mk. 2.

Oil pressure gauge used during ground running checks (page 8 opposite and Chapter 9, page 6).



Checking oil level, Ghost 48 Mk. 1.

For instructions for filling and replenishing the oil sump refer to the text under that heading on page 1 of chapter 9, opposite.



Checking oil level, Ghost 48 Mk. 2.

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