

Chapter Twenty

ANTI-CORROSION PRECAUTIONS, INHIBITING, including 'cocoon' packing

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THIS CHAPTER describes the anti-corrosion precautions necessary to protect the engine and its accessories when not in use. These precautions, which should be applied to any engine which will be standing idle for a period exceeding seven days, have been dealt with under four main headings:—

- (1) The procedure for inhibiting the fuel system.
- (2) The protective treatment of the engine.
- (3) The protection of accessories.
- (4) 'Cocoon' packing.

The instructions contained in this chapter are

based on de Havilland Gas Turbine Test Specifications TTS 14 issue 4, TTS 15 issue 4, and TTS 19 issue 1.

The term inhibiting can be employed to describe all forms of anti-corrosion treatment, but for the purposes of this handbook the use of this term is confined to the inhibiting of the fuel system, and the term 'protective treatment' is used generally for the treatment applied to the other internal and the external parts of the engine. Plating, enamelling, and similar manufacturing or overhaul processes are classified as protective finishes.

To provide complete protection of the engine against corrosion it is necessary to:—

- (1) Inhibit the fuel system.
- (2) Apply internal protective treatment.
- (3) Protect installed, engine-driven aircraft accessories.
- (4) Apply external protective treatment.
- (5) Examine the effectiveness of the anti-corrosion treatment at regular intervals during the engine's period of idleness.

To provide adequate protection against corrosion of the engine when not in use, the anti-corrosion precautions described in this chapter should be applied within forty-eight hours of the last engine run when it is known that the engine will stand idle for more than seven days, or immediately if it is impossible to run an engine which has been standing idle for seven days without protection and that engine will continue to stand idle for a further period.

The protection given by the application of the treatment described in this chapter will depend on the storage conditions. An un-installed engine must be re-treated every twelve months, and an installed engine must be re-treated every six months if stored in the open, or every twelve months if stored under cover, unless routine inspection indicates that re-treatment after some shorter period is necessary. Where an engine is 'cocoon' packed or is packed in a hermetically-sealed metal container, it need be re-treated at three-yearly intervals only; unless routine inspection indicates the need for re-treatment sooner.

It is recommended that an engine, where the period before re-treatment is due is less than three months, should not be issued from storage without first being re-treated; unless the engine is to go into service immediately.

EQUIPMENT

A number of alternative procedures are described in this chapter, and, therefore, the equipment required is tabulated to show the procedures and purposes for which each item is used.

Item	Equipment	Part/Tool No.	Qty.	Procedure and Purpose
1	Strip and assembly stand.	T.75592	1	All, except when inhibiting the fuel system with the engine running at idling speed on a test bench or installed in an aircraft.
2	Fuel system inhibiting rig such as Tecalemit SA. 7812 (Fig. 1), or R.A.F. rig Stores Ref. 4C/4195, which includes a 4½ gallons container, an electrical control box containing a starter panel, sockets, and switches corresponding to the electrical equipment fitted in the aircraft	—	1	Inhibiting the fuel system:— (1) By motoring over (2) By pressure feed (3) With the engine running at idling speed } Enables inhibitor to be fed into the engine fuel system under a pressure of 10-12 lb. per sq. in., and regulates the supply of current to the electric starter on the engine when motoring over.

If this rig is not available, any suitable means of supplying inhibiting fluid at a pressure of 10 to 15 lb. per sq. in. may be employed; this could be provided by mounting a standard fuel tank booster pump in a suitable container. A motor-driven pump and container mounted on a trolley is available as WD.10053.

In an emergency, where a suitable low pressure feed is not available, the supply pressure may be provided by mounting a tank of approximately 4 gallons capacity, so that a static head of not less than 6 feet is applied at the L.P. fuel filter inlet.

Where it is required to inhibit the fuel system, of an engine which has been removed from the aircraft, by motoring over, an aircraft type starter panel and controls must be used to regulate the supply of electricity to the starter motor on the engine; this, is, of course, included in the Tecalemit, and the R.A.F. type, inhibiting rig.

3	L.P. filter pipe unit (Fig. 2)	96299	1	Inhibiting the fuel system:— (1) By motoring over (2) By pressure feed (3) With the engine running at idling speed; for connecting the ⅜ in. B.S.P. inhibiting fluid delivery hose to the 1¼ in. B.S.P. three-way cock item 4. } for connecting the ⅜ in. B.S.P. inhibiting fluid delivery hose to the 1¼ in. B.S.P. L.P. fuel filter inlet.
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Where one of the alternatives to the fuel system inhibiting rig (item 2) is employed, and a suitable shut-off valve is not included in the rig, this should be provided by inserting a suitable valve in the inhibiting fluid delivery line; item 4, where available, could be used in lieu of this valve by blanking off the third connection.

Item	Equipment	Part/Tool No.	Qty.	Procedure and Purpose
4	Three-way cock and pipe unit (Fig. 3):—Vickers 1½ in. B.S.P. three-way fuel-cock, 'T' type	—	1	Inhibiting the fuel system with the engine running at idling speed. Pipe unit connects three-way cock to L.P. fuel filter inlet; fuel supply line is connected to second leg of three-way cock; inhibiting fluid delivery hose is connected, via item 3, to the third leg of three-way cock.
	Pipe unit	97401	1	
5	A pump capable of delivering approximately 50 gallons per hour at 230 lb. per sq. in., fitted with a relief valve set to operate at 250 lb. per sq. in. and suitable connecting pipes:—			Inhibiting the fuel system by a pressure feed. Double-ended union body, with seal washer, screws into outlet of Varley pump; flexible pipe connects double-ended union to inlet on high pressure fuel filter. (Fig. 6.)
	Varley pump type SH/1/N	—	1	
	Double-ended union body	AGS.949/C	1	
	Seal washer	AGS.568/C	1	
	Flexible pipe terminating in ⅜ in. and ⅝ in. B.S.P. union nuts (to suit inlet on H.P. fuel filter).	98160	1	
	A container which will hold at least 1½ gallons of inhibiting fluid	—	1	
6	A hand-operated pump capable of supplying a pressure of 2000 lb. per sq. in. and a delivery of approximately 0.05 cu. in. per stroke:—			(1) Inhibiting the B.P.C., and the air-fuel ratio control when inhibiting the fuel system by a pressure feed.
	Varley testing unit	—	1	(2) Inhibiting the air-fuel ratio control when inhibiting the fuel system with the engine running at idling speed.
	Flexible pipe terminating in ⅜ in. B.S.P. union nuts	97398	1	Twin connection fits on outlet of Varley testing unit; flexible pipes connect twin connection to B.P.C., or A-F.R.C., high pressure and servo connections (Fig. 7 and 8).
	Flexible pipe terminating in ⅜ in. B.S.P. and ¼ in. B.S.P. union nuts	97798	1	
	Twin connection assembly	97394	1	
7	An air compressor, and a spray gun	—	1	Protective treatment of the internal and external parts of the engine.
8	Rear bearing priming equipment: refer to chapter 8	—	1	Protective treatment of the engine.

Item	Equipment	Part/Tool No.	Qty.	Procedure and Purpose	
9	Ground starting equipment	—	1	Inhibiting the fuel system by motoring over.	
10	$\frac{1}{8}$ in. B.S.P. union nut	AGS.1217/C	1	Inhibiting the fuel system:—	Used to blank off:—
	Blank, for union nut	AGS.1140/C	1	(1) By motoring over.	(a & b) B.P.C. low pressure (drain) pipe, and (less union) A-F.R.C. drain connection on control valve assembly.
	Split pin, to retain blank	SP.9/C5	1	(2) By pressure feed.	
	Union, to enable pipe to be blanked	AGS.1103/C	1	(3) With the engine running at idling speed.	
					(c) A-F.R.C. drain connection on control valve assembly less union.
11	$\frac{5}{8}$ in. B.S.P. union nut	AGS.1217/E	1	Inhibiting the fuel system:—	Used to blank:—
	Blank, for union nut	AGS.1140/E	1	(1) By motoring over.	(a) H.P. filter end of fuel delivery pipe from rear pump to H.P. filter, and the fuel flow distributor supply pipe.
	Split pin, to retain blank	SP.9/C5	1	(2) By pressure feed.	
	Union, to enable pipe to be blanked	AGS.1103/E	1		(b) H.P. filter end of fuel delivery pipe from rear pump to H.P. filter.
12	$\frac{1}{4}$ in. B.S.P. union nut	AGS.1217/B	1	Inhibiting the fuel system:—	Used to blank:—
	Blank, for union nut	AGS.1140/B	1	(1) By pressure feed.	(a) B.P.C. end of high pressure pipe from front pump to B.P.C.; and subsequently, A-F.R.C. end of high pressure pipe from control valve assembly to A-F.R.C.
	Split pin, to retain blank	SP.9/C5	1	(2) With the engine running at idling speed.	
	Union, to enable pipe to be blanked	AGS.1103/B	1		(b) A-F.R.C. end of high pressure pipe from control valve assembly to A-F.R.C.
13	$\frac{1}{8}$ in. B.S.P. union nut	AGS.1217/A	1	Inhibiting the fuel system:—	Used to blank:—
	Blank, for union nut	AGS.1140/A	1	(1) By pressure feed.	(a) B.P.C. end of servo pipe from front pump to B.P.C.; and subsequently, A-F.R.C. end of servo pipe from B.P.C. to A-F.R.C.
	Split pin, to retain blank	SP.9/C5	1	(2) With the engine running at idling speed.	
	Union, to enable pipe to be blanked	AGS.1103/A	1		(b) A-F.R.C. end of servo pipe from B.P.C. to A-F.R.C.
14	Aero spray gun type G.10 fitted with 5/58 nozzle assembly, and aero spray pressure container type P.052/N	—	1	Spraying 'cocoon' plastic where the engine is being 'cocoon' packed.	

Item	Equipment	Part/Tool No.	Qty.	Procedure and Purpose
15	Inhibiting gun fitted with a 5 ft. extension embodying a restrictor nipple and terminating in a fish tail nozzle.	T71156	1	Application of internal protective treatment to turbine of an installed engine.

When not in use, each item of this equipment should be maintained in a clean condition and stored in a clean dry place. It is most important that moisture is not allowed to contaminate any of the protective substances.

When spraying protective fluid on to the external parts of the engine, it must be remembered that the effectiveness of the treatment is dependent upon the working efficiency of the spraying equipment, and it is, therefore, essential that the equipment used is in a fully serviceable condition. The compressed air supply must be capable of delivering moisture-free air at a pressure of about 90 lb. per sq. in. A fixed type nozzle must be fitted to the spray gun. Care must be taken to avoid too heavy an application of the protective fluid, the aim being to obtain a uniform film.

For spraying the 'cocoon' plastic, a moisture-free air supply at a pressure of 60 lb. per sq. in. will be required.

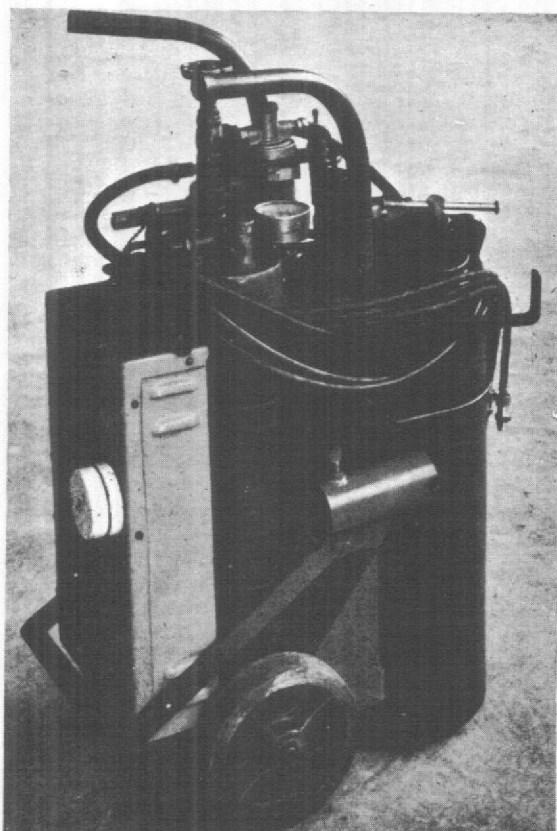


Fig. 1. Tecalemit fuel system inhibiting rig.

PROTECTIVE SUBSTANCES

The fluid required for inhibiting the fuel system is anti-freezing mineral oil to British Specification D.T.D.44D; approximately four gallons of this fluid will be required.

The protective substances required for the treatment of the remainder of the engine are:—

- (1) Temporary rust preventative to British Specification D.T.D.121D, this is a mixture of lanolin and white spirit; approximately a gallon of this fluid will be required for the treatment of an installed engine but appreciably less will be used when treating an engine which is not installed.
- (2) Lanolin resin protective to British Specification D.T.D.663, this is a mixture of lanolin-resin, white spirit, xylene and red dye.
- (3) Anti-freeze grease such as British Specification D.T.D.825.
- (4) A small quantity of the correct grade of lubricating oil (refer to the beginning of this handbook) will be required for priming the rear bearing.
- (5) A small quantity of black cellulose enamel, and suitable thinners.

In view of the petroleum spirit content of the temporary rust preventative specified, fire precautions must be taken during all spraying operations with this fluid.

The materials required for 'cocoon' packing, and for the repair of 'cocoon' envelopes during storage are detailed on page 16.

INHIBITING THE FUEL SYSTEM

Three alternative procedures for inhibiting the fuel system are described in the following pages:—

- (1) A procedure for inhibiting the fuel system by motoring over; applicable to a serviceable engine either on a test bench, mounted on a suitable stand, or installed in an aircraft. This procedure cannot be applied to engines fitted with a turbo starter in place of an electric starter.
- (2) A procedure for inhibiting the fuel system by means of a pressure feed; to be employed where none of the alternative procedures is applicable.

- (3) A procedure for inhibiting the fuel system when the engine is running down from idling speed.

INHIBITING THE FUEL SYSTEM BY MOTORING OVER (Electric starter only)

The following items of the equipment tabulated on pages 2 to 5 will be required:—1, 2, 3, 9, 10, and 11. This procedure cannot be applied to engines fitted with a turbo starter.

Cut the locking wire and unscrew the $1\frac{1}{4}$ in. B.S.P. union nut which couples the fuel supply pipe to the inlet of the low pressure filter on the engine, if the engine is installed, or remove the blanking cap from the inlet flange on the low pressure fuel filter if the engine is uninstalled. Using the L.P. filter pipe unit (item 3), and shut-off valve if the latter is not provided as part of the inhibiting rig, connect the inhibiting fluid delivery hose to the L.P. fuel filter inlet; ensure that the shut-off valve is closed. Connect the electric leads from the starter panel to the correct terminals on the starter motor.

Drain the low pressure fuel filter of fuel and sediment, either by removing the drain plug or by removing the filter case as described at the beginning of chapter 14. Refit the drain plug or filter case.

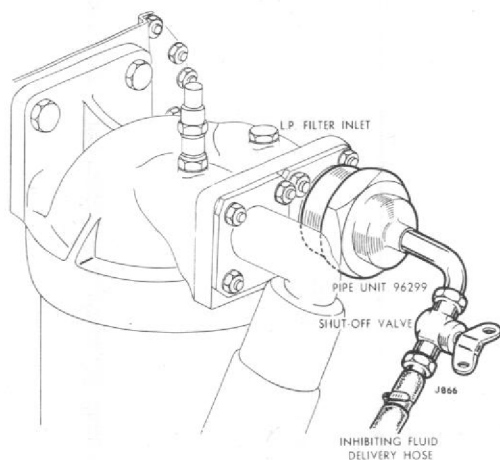


Fig. 2. L.P. filter pipe unit used to connect inhibiting fluid delivery hose to low pressure fuel filter.

Open the inhibitor shut-off valve so that inhibiting fluid can flow into the fuel system, and prime the fuel system as described in chapter 8; references to "switch on the fuel tank booster pump" must, of course, be read as supply inhibiting fluid under pressure. Each point should be bled until all air and fuel has been expelled and inhibiting fluid commences to flow.

In addition to bleeding both fuel pumps through their remote air bleed valves, remove the

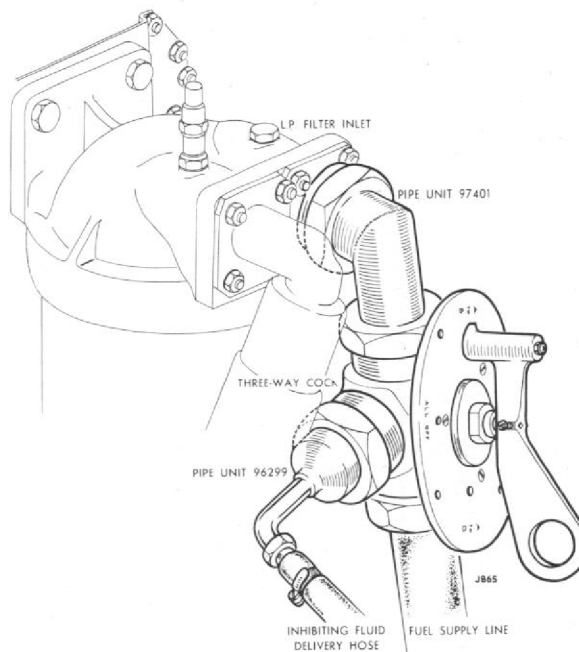


Fig. 3. Three-way cock and pipe units used when inhibiting the fuel system with the engine running at idling speed.

blanking cap, or nipple, from the bleed valve on the diaphragm cover of each pump, and bleed each pump from this point until all air and fuel has been expelled and inhibiting fluid commences to flow.

Cut the locking wire and unscrew the union nut which secures the B.P.C. low pressure (servo drain) pipe to the B.P.C. unit. Ease the pipe from the unit and using item 10 blank off the open end to prevent any loss of inhibiting fluid from the main part of the engine. Place a container under the open connection on the B.P.C. to collect the fuel and inhibiting fluid which will be expelled during the first starting cycle. Disconnect the fuel pump delivery pipe at the inlet connection of the H.P. filter. Blank off the open end of this pipe; use item 11.

Open the throttle and high pressure cut-off valves. Connect the ground starting equipment to the starter panel on the inhibiting rig, and operate the engine through one complete starting cycle; normally this will mean press the starter button for about two seconds and then release it, the starting cycle will then commence and the time delay switch in the starter panel will automatically switch off the current after just over half a minute.

During this starting cycle, the pressure in the engine-driven fuel pumps will rise to the setting of the B.P.C. and fuel and inhibiting fluid will be expelled from the open low pressure connection on the B.P.C.

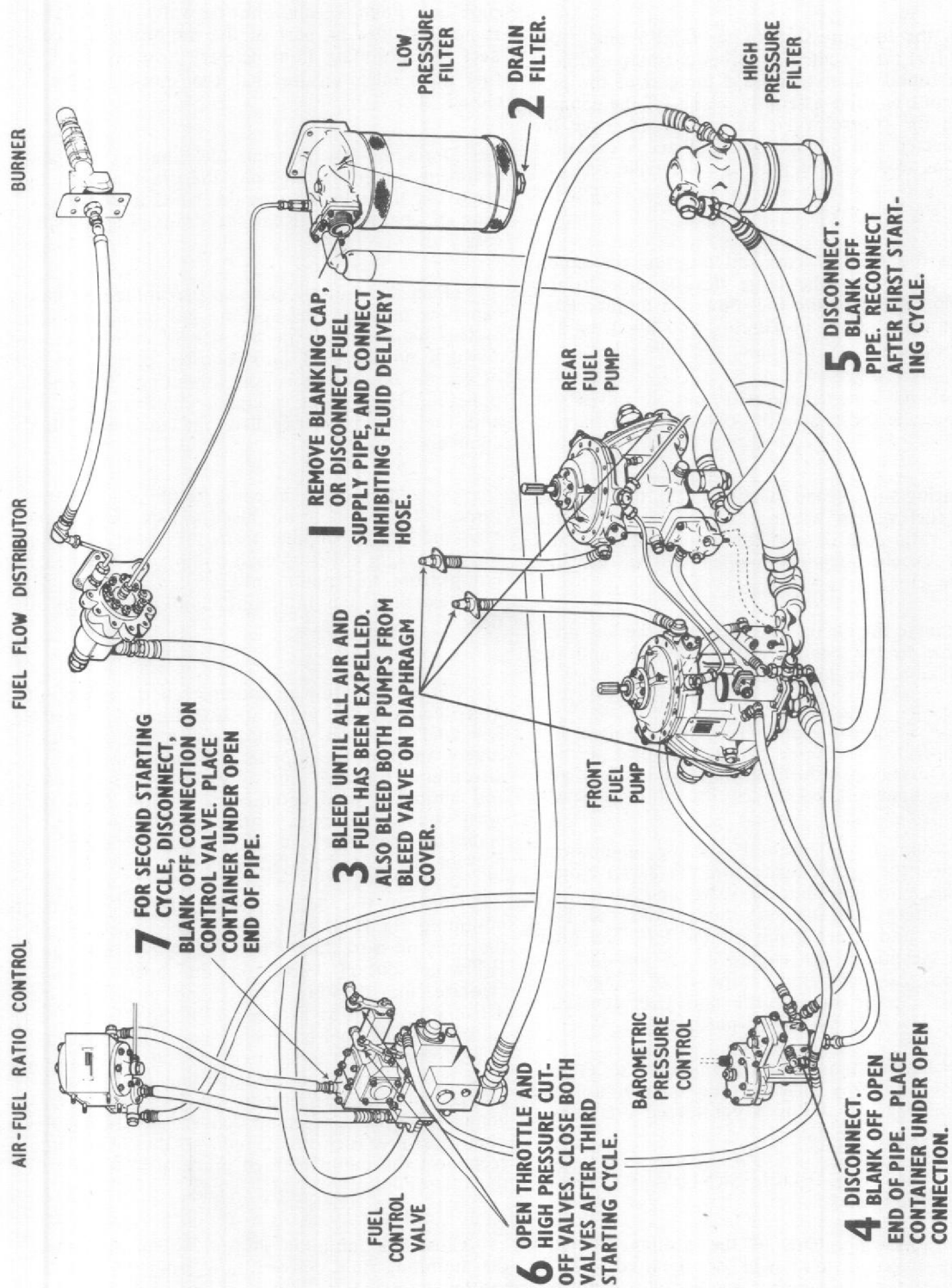


Fig. 4. Diagram showing points to be disconnected, etc., during the inhibiting of the fuel system by motoring over; not applicable to engines fitted with a turbo starter in place of an electric starter.

Remove the blanks and reconnect the low pressure pipe to the union adapter on the B.P.C. unit and reconnect the pump-delivery pipe to the H.P. filter.

As the low pressure ($\frac{3}{8}$ in. B.S.P.) pipe from the air-fuel ratio control is somewhat inaccessible it will be found easier to release the end of the pipe at the control valve assembly, blank off the connection on the control valve assembly and leave the disconnected end of pipe open. Place a container under the open end of pipe to collect the fuel and inhibiting fluid which will be expelled during the second starting cycle.

Cut the locking wire and unscrew the union nut which secures the large flexible pipe to the inlet connection on the fuel flow distributor. Ease the pipe clear of the distributor, and blank off the disconnected end of the pipe; use item 11.

With the throttle and H.P. cut-off valves still open operate the engine through a second starting cycle.

During this second starting cycle, the pressure in the fuel system will rise to the setting of the air-fuel ratio control, and fuel and inhibiting fluid will be expelled from the open end of the low pressure pipe.

Remove the blanks and reconnect the low pressure pipe to the control valve assembly and the large flexible pipe to the flow distributor.

With the throttle and H.P. cut-off valves still open, operate the engine through a third starting cycle. During this third starting cycle, fuel and inhibiting fluid will be expelled through the burners.

Disconnect the ground starting equipment. Disconnect the electric leads from the starter motor, close the inhibiting shut-off valve and disconnect the inhibiting fluid delivery hose from the L.P. fuel filter, and either blank off the L.P. fuel filter inlet connection if the engine is not installed, or reconnect the fuel supply pipe if the engine is installed. Secure the throttle and H.P. fuel cut-off valve levers in the closed position.

As an alternative, it is permissible to inhibit the B.P.C. and the air-fuel ratio control as described on page 10 if this is considered preferable.

INHIBITING THE FUEL SYSTEM BY PRESSURE FEED

The following items of the equipment tabulated on pages 2 to 5 will be required:—1, 2 (but the electrical equipment mentioned will not be needed), 3, 5, 6, 10, 11, 12 and 13.

Cut the locking-wire and unscrew the $1\frac{1}{4}$ in. B.S.P. union nut which couples the fuel supply pipe

to the inlet of the low pressure filter on the engine if the engine is installed or remove the blanking cap from the inlet flange on the low pressure fuel filter if the engine is not installed. Using the L.P. filter pipe unit (item 3), and shut-off valve if the latter is not provided as part of the inhibiting rig, connect the inhibiting fluid delivery hose to the L.P. fuel filter inlet; ensure that the shut-off valve is closed.

Drain the low pressure fuel filter of fuel and sediment, either by removing the drain plug or by removing the filter case as described at the beginning of chapter 14. Refit the drain plug or filter case.

Open the shut-off valve so that inhibiting fluid can flow into the fuel system, and prime the fuel system as described in chapter 8; references to "switch on the fuel tank booster pump" must, of course, be read as supply inhibiting fluid under pressure. Each point should be bled until all air and fuel has been expelled and inhibiting fluid commences to flow.

In addition to bleeding both fuel pumps through their remote air bleed valves, remove the blanking cap, or nipple, from the bleed valve on the diaphragm cover of each pump, and bleed each pump from this point until all air and fuel has been expelled and inhibiting fluid commences to flow.

Cut the locking-wire and unscrew the union nut which connects the pump to H.P. filter pipe to the H.P. fuel filter inlet. Remove one of the air-intake covers, and turn the impeller by hand in the normal direction of rotation, until all fuel has been expelled and inhibiting fluid commences to flow from the open end of the pipe. Immediately this occurs, blank off the open end of the pipe (item 11) to prevent any loss of inhibiting fluid.

Connect the delivery hose of the pressure inhibiting rig (Fig. 6) to the inlet connection on the high pressure fuel filter. Set the throttle and H.P. fuel cut-off valves in the open position. Operate the pressure pump and maintain the delivery pressure at between 230 and 250 lb. per sq. in. until all fuel is expelled and inhibiting fluid flows from the burners; to ensure full inhibition, a total of one gallon of the inhibiting fluid must be pumped into the fuel system under pressure. Disconnect the pressure pump delivery hose from the high pressure fuel filter, remove the blank and reconnect the pump to high pressure filter pipe to the filter inlet.

Close the inhibitor shut-off valve, disconnect the inhibiting fluid delivery hose from the inlet on the low pressure fuel filter and blank off the low pressure filter inlet if the engine is not installed, or re-couple the fuel supply pipe if the engine is installed. Secure the throttle and H.P. cut-off valve levers in the closed position.

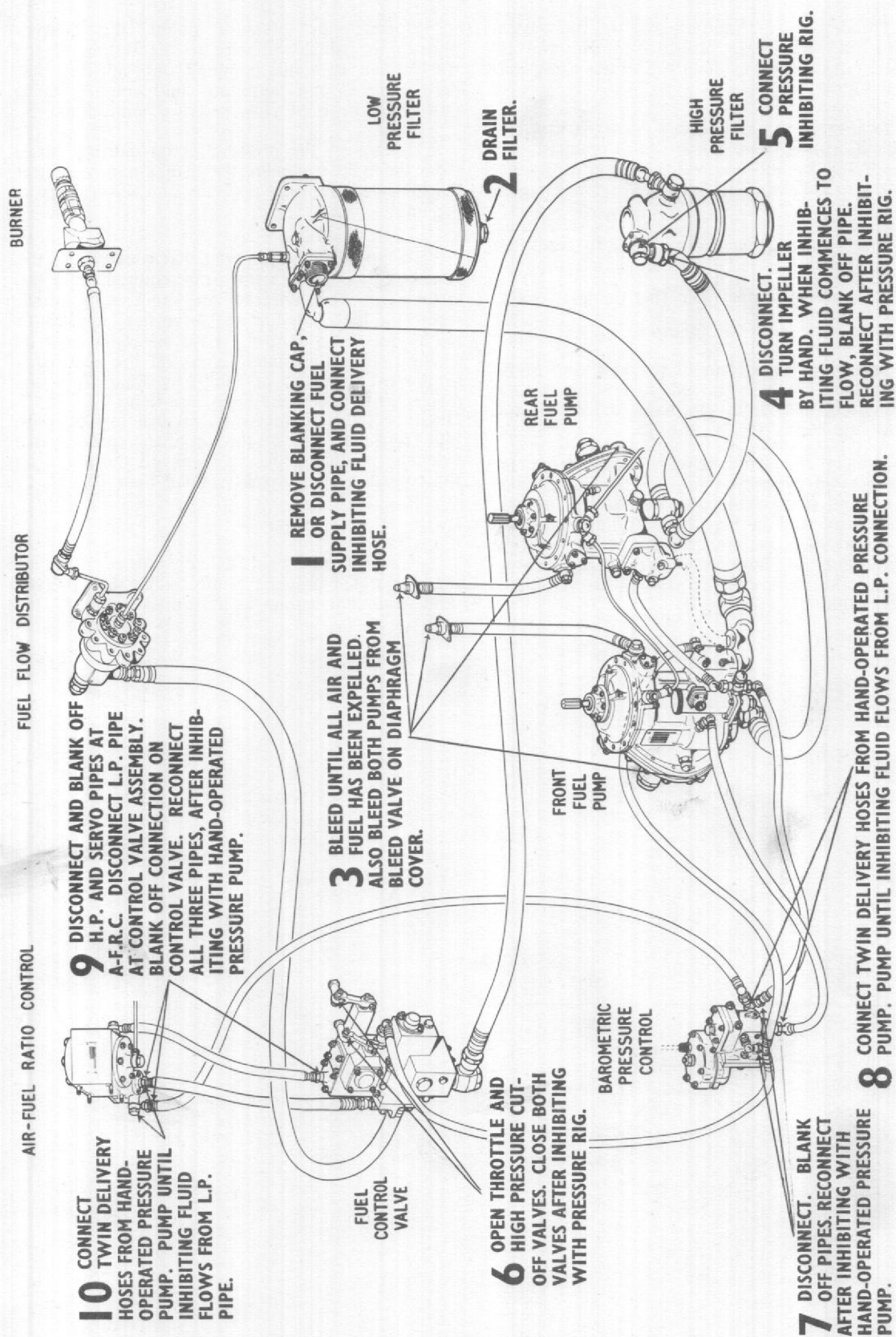


Fig. 5. Diagram showing points to be disconnected, etc., during the inhibiting of the fuel system by pressure feed.

To complete the inhibiting of the fuel system, inhibit the barometric pressure control and the air-fuel ratio control as described in the paragraphs which follow.

TO INHIBIT THE BAROMETRIC PRESSURE CONTROL, the hand-operated pump (item 6) is required. Cut the locking-wire and unscrew the union nuts which connect the following pipes to the barometric pressure control:—

Low pressure pipe from B.P.C. to front fuel pump.

High pressure pipe from fuel pump to B.P.C.

Servo pipe from fuel pump to B.P.C.

Ease these pipes clear of the unit, and immediately blank off the open ends to prevent any loss of inhibiting fluid from the main part of the fuel system; use items 10, 12 and 13.

Connect the twin delivery hoses from the hand-operated pressure pump to the B.P.C. high pressure and servo connections in a similar manner to that illustrated in Fig. 7. It is important that these connections are made to the points specified; the injection of inhibitor under high pressure through other connections may render the B.P.C. unserviceable.

Operate the pressure pump, the delivery pressure of which will rise to the setting of the B.P.C., and continue pumping until all fuel has been expelled and inhibiting fluid commences to flow from the B.P.C. low pressure connection.

Disconnect the pressure pump delivery hoses from the B.P.C., remove the blanks and reconnect the low pressure, high pressure, and servo pipes to the unit.

TO INHIBIT THE AIR-FUEL RATIO CONTROL, the hand-operated pump (item 6) is required. Cut the locking-wire and unscrew the union nuts which secure the high pressure and servo flexible pipes to the air-fuel ratio control. Ease the pipes clear of the unit, and immediately blank off the open ends to prevent any loss of inhibiting fluid from the main part of the fuel system; use items 12 and 13. Disconnect the air-fuel ratio control low pressure pipe from the union on the top of the control valve assembly, and immediately blank off the union on the control valve assembly, using item 10.

Connect the twin delivery hoses from the hand-operated pressure pump to the high pressure and servo connections, as illustrated in Fig. 8. It is

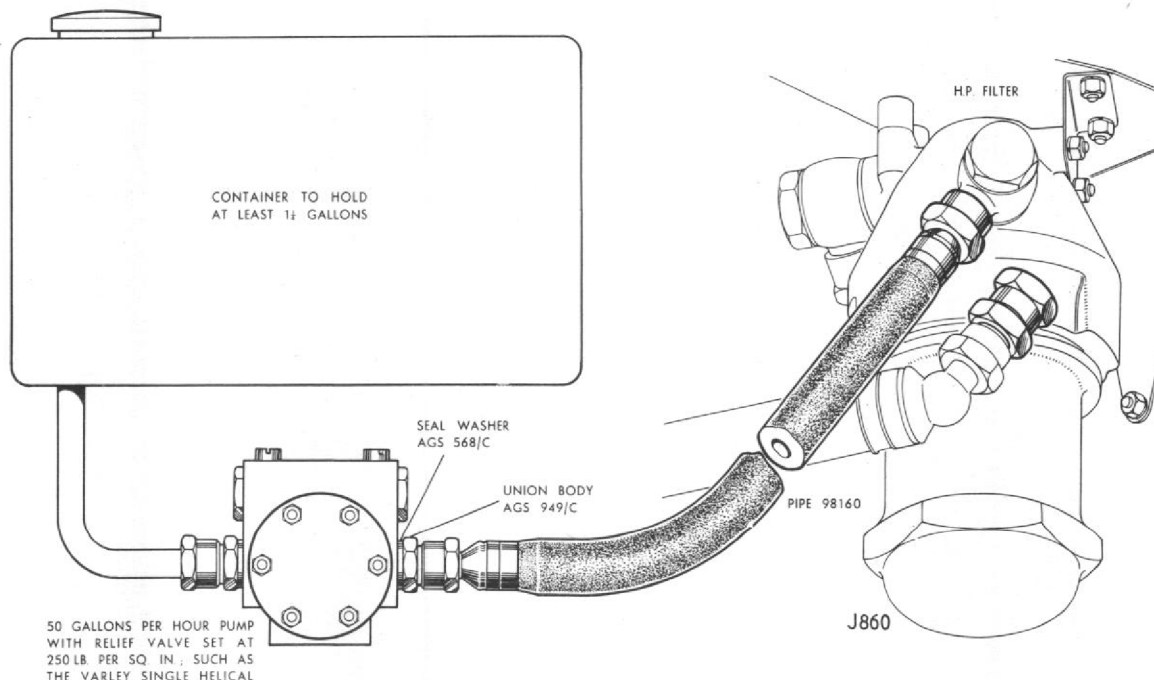


Fig. 6. Inhibiting the fuel system by a pressure feed.

important that these connections are made to the points specified; the injection of inhibitor under high pressure through other connections may render the air-fuel ratio control unserviceable.

Operate the pressure pump, the delivery pressure of which will rise to the setting of the air-fuel ratio control, and continue pumping until all

fuel has been expelled and inhibiting fluid commences to flow from the disconnected end of the low pressure pipe.

Disconnect the pressure pump delivery hoses from the air-fuel ratio control, remove the blanks and reconnect the high pressure, servo, and low pressure pipes to the unit, and to the control valve assembly, as appropriate.

INHIBITING THE FUEL SYSTEM WITH THE ENGINE RUNNING AT IDLING SPEED.

The following items of the equipment tabulated on pages 2 to 5 will be required: 2, 3, 4, 6, 10, 12 and 13.

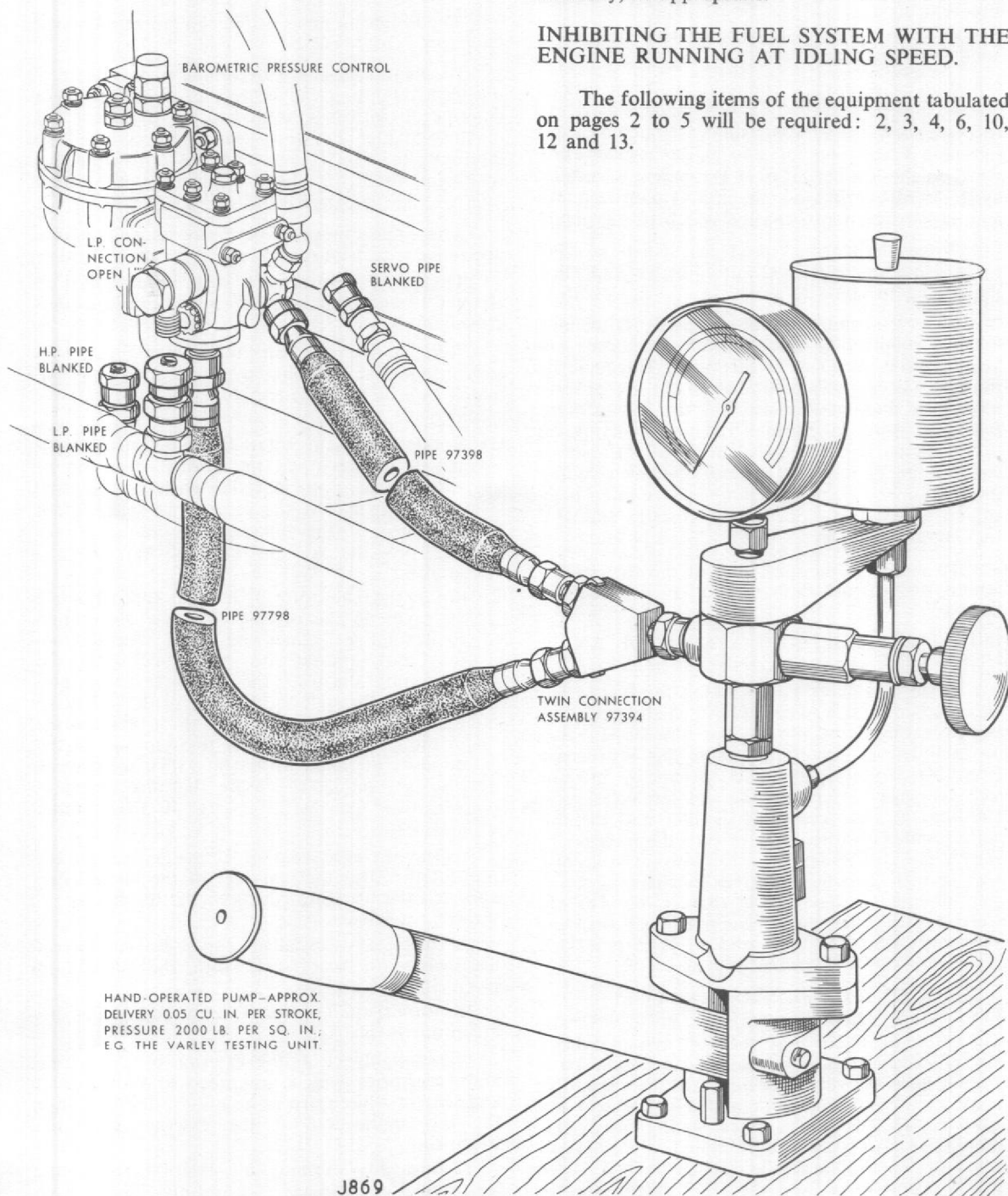


Fig. 7. Hand-operated pump connected to barometric pressure control.

Unscrew the $1\frac{1}{4}$ in. B.S.P. union nut which couples the fuel supply pipe to the inlet of the low pressure fuel filter on the engine. Couple the three-way cock and pipe unit (item 4) to the inlet of the low pressure filter, and connect the fuel supply pipe and the inhibiting fluid delivery hose to the three-way cock; Fig. 3. Set the cock so that fuel can flow to the engine; and open any shut-off valves that may be provided in the inhibitor supply line.

Start the engine in accordance with the instructions given in chapter 9.

With the engine running at idling speed, operate the three-way cock to replace the normal fuel supply by inhibiting fluid. Switch off any fuel tank booster pumps, and master switches provided on the test bench; or if the engine is installed in an aircraft, switch off the aircraft booster pump, and move the aircraft master switch to "ground."

When the engine speed has fallen to 2000 r.p.m. close the H.P. fuel cut-off valve and allow the engine to come to rest.

Close the inhibitor shut-off valve. Disconnect the fuel supply pipe from the three-way cock and blank off the open end of this pipe. Uncouple the three-way cock and pipe unit from the low pressure filter inlet and either blank off the low pressure filter inlet using the normal transport blanking cap if the engine is not installed in an aircraft, or reconnect the $1\frac{1}{4}$ in. B.S.P. union nut which couples the fuel supply pipe to the low pressure filter, if the engine is installed. Secure the throttle and H.P. fuel cut-off valve levers in the closed position.

To complete the inhibiting of the fuel system, inhibit the air-fuel ratio control as described on page 10.

INHIBITING THE FUEL SYSTEM OF AN UNSERVICEABLE ENGINE

When it is necessary to inhibit the fuel system of an unserviceable engine of which the mainshaft assembly cannot be turned, the fuel system must be inhibited in accordance with the instructions given for inhibiting the fuel system by pressure feed on page 8 but omitting the instructions for bleeding the low pressure fuel filter and the fuel pumps and the instructions to turn the impeller by hand. The fuel pumps must be removed in accordance with the instructions given in chapter 14, and then inhibited as described in chapter 40. The low pressure fuel filter must be emptied of fuel and filled with inhibiting fluid, and all open pipes and connections must be properly blanked off.

ACTION ON COMPLETION OF FUEL SYSTEM INHIBITING

Upon completion of the fuel system inhibiting procedure described in the foregoing paragraphs, an entry should be made in the engine log book showing the date when the fuel system was inhibited. In addition, a notice, stating clearly that the engine fuel system is inhibited, and the date when it was inhibited, should be attached to the fuel control valve assembly; or to the throttle lever in the cockpit of the aircraft if the engine is installed. Wire-lock all union nuts where the locking has been disturbed.

DE-INHIBITING THE FUEL SYSTEM

Instructions for de-inhibiting the fuel system by motoring over are contained in chapter 8.

PROTECTIVE TREATMENT

UN-INSTALLED ENGINES

The following items of the equipment tabulated on pages 2 to 5 will be required: 1, 7, and 8.

As mentioned at the beginning of this chapter, the term inhibiting can be employed, correctly, to describe all forms of anti-corrosion treatment but in this chapter the term has been confined to inhibiting the fuel system, and the term protective treatment used for the treatment of the other internal and the external parts of the engine.

The engine must be permitted to cool before protective treatment is applied.

Drain the lubrication system as described in chapter 13 and then prime the rear bearing as described in chapter 8.

Remove the two air-intake blanking covers and turbine disc blanking cover and apply approximately two pints of the temporary rust preventative specified on page 5, as follows:—

- (1) Rotate the main rotor by hand at approximately 50 r.p.m. in the normal direction of rotation, i.e., anti-clockwise when viewed from the front, and at the same time spray about one-third of the quantity of the temporary rust preventative into each of the two air-intakes.
- (2) Rotate the main rotor by hand at approximately 50 r.p.m. in the reverse direction of rotation to normal, i.e., clockwise when viewed from the front, and at the same time spray the remaining third of the temporary rust preventative through the turbine blades. During this operation, the spray gun must be traversed in the normal direction of rotation, i.e., in the opposite direction to that in which the turbine disc is rotating, to ensure that the rust preventative reaches all parts of the turbine assembly.

Spray an even coating of the temporary rust preventative over the rear face of the turbine disc, and refit the blanking covers to the turbine and to the two air-intakes.

Protect any installed engine-driven aircraft accessories, in accordance with the instructions given on page 14.

Ensure that all openings, vents, and drains, etc., are properly blanked off.

Thoroughly clean the exterior of the engine, and accessories which are mounted on it, using kerosene or white spirit as necessary, in preparation for the application of the external protective treatment.

Thoroughly examine all external enamelling for signs of damage. Carefully clean each damaged area using a clean rag soaked in cellulose thinners, and apply a coat of black cellulose enamel.

Liberally pack all control mechanism joints with anti-freeze grease.

Treat all external bright surfaces and all controls, studs, bolts, nuts, clips, pipe fittings, etc., on which the permanent protective finish may have been damaged during assembly or removal from

the aircraft with a thin even coat of the lanolin resin protective.

Where the engine is to be 'cocoon' packed, the instructions contained in the next two paragraphs are not applicable.

Mask the fire extinguisher pipes to prevent their becoming coated with the protective substances during the subsequent spraying operations. This may be done, either by wrapping the pipes in grease-proof paper, or by using lengths of a suitable size of P.R. rubber hose, slit from end to end at one side and slipped on to the pipes. During these operations, care must be taken that the spray holes in the fire extinguisher pipes do not become blocked with foreign matter as a result of the masking operation.

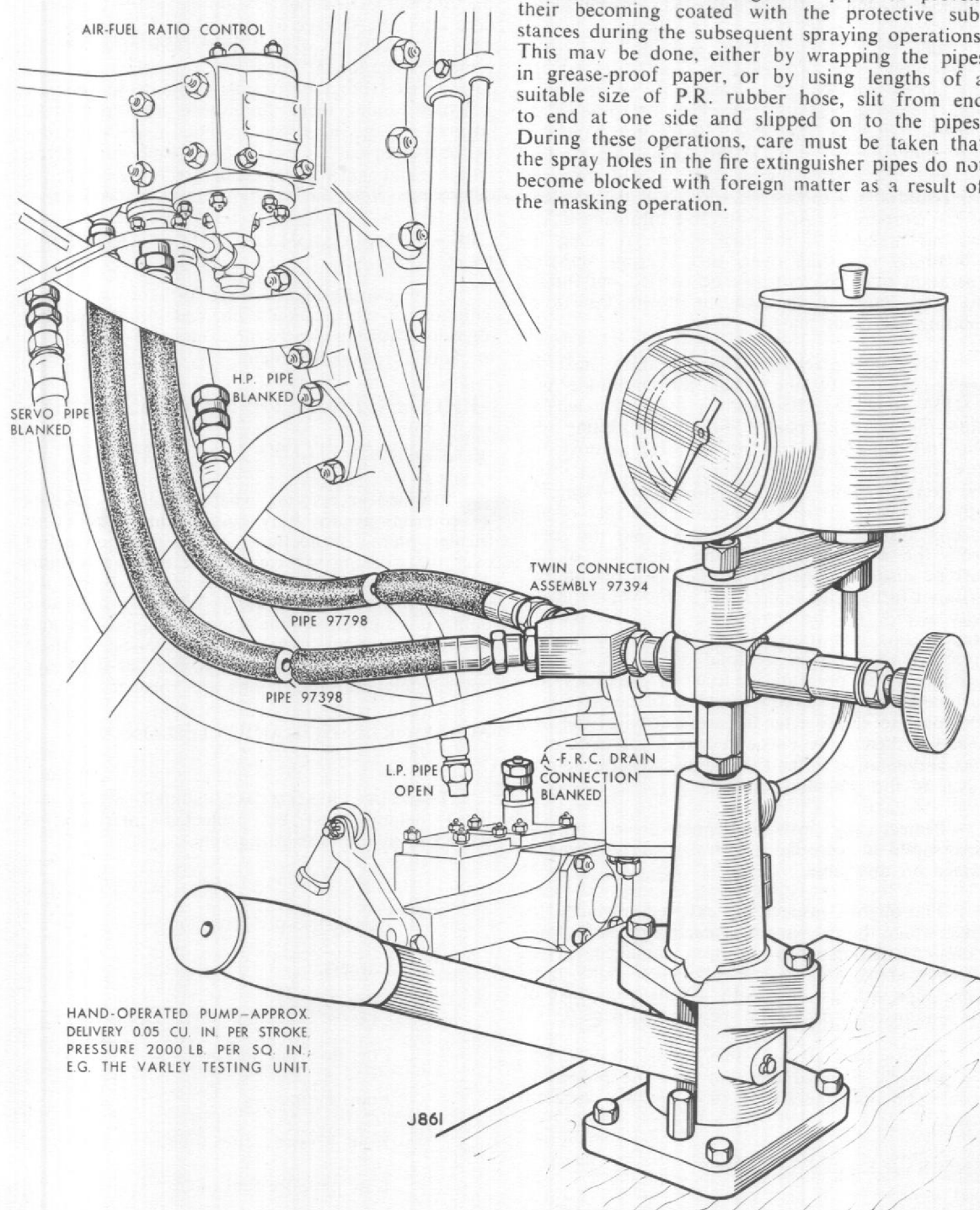


Fig. 8. Hand-operated pump connected to air-fuel ratio control.

Spray the whole of the exterior surface of the engine with two coats of the temporary rust preventative, ensuring that all bright surfaces are entirely covered. The second coat should be applied not less than six hours after the first.

INSTALLED ENGINES

Prime the rear bearing as described in chapter 8.

Remove the two air-intake blanking covers, and apply approximately two pints of the temporary rust preventative specified on page 5, as follows:—Rotate the main shaft by hand, at approximately 50 r.p.m., in the normal direction of rotation, i.e., anti-clockwise when viewed from the front, and at the same time spray half the quantity of the temporary rust preventative into each of the two air-intakes. If the fuel system is being inhibited by motoring over, this internal spraying operation may conveniently be carried out during the final stages of the last run down, instead of rotating the main shaft by hand.

Internal protective treatment must next be applied to the turbine, using the inhibiting gun T71156 (item 15) fitted with a five-foot extension pipe and fish-tail nozzle. Fill the inhibiting gun with the temporary rust preventative, remove the dust cover from the propelling nozzle, and insert the extension pipe up the exhaust cone. Place the fish-tail nozzle at the gap between the rear of the turbine disc and the inner cone so that the spray from the nozzle will coat the rear face of the turbine disc with the temporary rust preventative. Without turning the main shaft of the engine, inject half a pint of the temporary rust preventative. Repeat this operation at five different positions, spraying an approximate total of $2\frac{1}{2}$ pints of the temporary rust preventative to cover completely the turbine disc area. Allow a period of not less than six hours to elapse after the application of the first coat and then apply a second coat of the temporary rust preventative to the turbine disc. Refit the dust cover to the propelling nozzle.

Protect any installed engine-driven aircraft accessories, in accordance with the instructions contained on this page.

Thoroughly inspect all external surfaces for areas where the permanent protective finish (enamel, cadmium plating, etc.) has been damaged. Treat all such areas, and all controls, studs, bolts, nuts, clips, pipe fittings, etc., with a thin even coat of the lanolin resin protective specified on page 5.

Ensure that all openings, vents, drains, etc., are properly blanked off, and that the propelling nozzle and both the air-intake covers are correctly fitted.

UNSERVICEABLE ENGINES

Unserviceable engines should be treated as fully as possible in accordance with the instructions given; the extent of the treatment possible being

dependent on the reason for, and extent of, unserviceability.

ATTENTION DURING STORAGE

At periodic intervals, the engine should be thoroughly examined, paying particular attention to any magnesium alloy castings. The efficiency of the protective treatment is almost entirely dependent upon the storage conditions, and these inspections are necessary, so that the periods at which the protective treatment must be re-applied can be determined from their results. Unless the engine is stored under ideal conditions, i.e., cool, dry, covered storage, it is recommended that the engine be inspected at intervals not exceeding three months, and that the period before re-treatment be determined from the results of these inspections.

UPON COMPLETION OF ANTI-CORROSION PRECAUTIONS

Upon completion of these anti-corrosion precautions, an entry should be made in the engine log book showing clearly the extent and the date of the anti-corrosion treatment.

PROTECTION OF ACCESSORIES

ACCESSORIES FITTED TO AN ENGINE

Installed accessories, where the inlet and outlet connections are fully coupled up, require no further internal protection. The distribution of oil over the working surfaces during running is sufficient to protect these accessories, provided that the connections are not 'broken.' Where an hydraulic pump is mounted on the engine, but its inlet and outlet connections have been disconnected, these connections must be blanked off with **air-tight** caps immediately the connections are 'broken.'

ACCESSORIES NOT MOUNTED ON AN ENGINE

THE FUEL SYSTEM ACCESSORIES, which are listed below, must be protected internally as described in the next paragraph.

- Air-fuel ratio control.
- Barometric pressure control.
- Burners.
- Fuel control valve assembly.
- Fuel flow distributor.
- Fuel pumps.
- High pressure fuel filter.
- Low pressure fuel filter.

Immediately after removal of the accessory from the engine, drain off all surplus fuel and

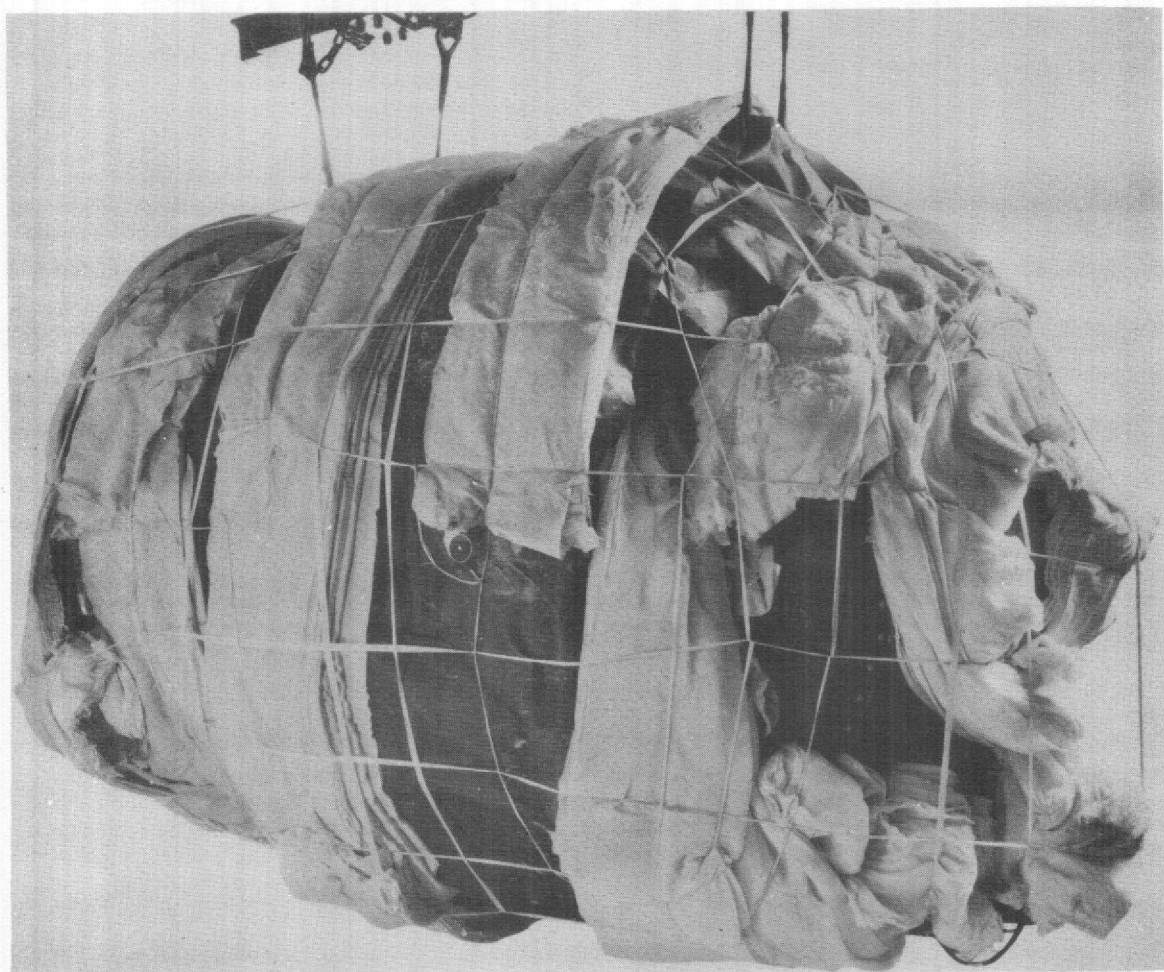


Fig. 9. Sharp edges and projections padded, and taped to form a grid over the engine of not more than twelve-inch squares; Ghost 50 illustrated.

inhibit the unit in accordance with the instructions contained in chapter 39, 40, 41, 42, 43, or 44 as appropriate. In the absence of special instructions, flush the unit through, with clean inhibiting fluid, as specified for inhibiting the fuel system, and blank off all orifices with **air-tight** blanks.

HYDRAULIC PUMPS. There will be sufficient residue of the working fluid to keep the internal surfaces of an hydraulic pump wetted. Dust caps of the metal or hard plastic type must be fitted to the inlet and outlet connections; blanks made of soft resins must not be used. Grease the splined drive shaft and ensure that the grease is applied right back to, and sealing off, the seal housing, in order to prevent drying out of the 'Gits' seal; any mineral grease should be used in preference to a vegetable grease. Finally pour a small quantity of a mineral base hydraulic oil, or engine oil, into the drain connection and fit a blank.

EXTERNAL TREATMENT. Protection against external corrosion will, in most instances, have been taken care of during manufacture or reconditioning by the application of approved processes or

permanent finishes, but all bright steel parts and untreated surfaces must be coated with the temporary rust preventative specified on page 5.

NEW OR RECONDITIONED ACCESSORIES. New or reconditioned accessories received from the manufacturers or a repair depôt, should have received protective treatment before dispatch, but before placing any accessory into storage, it is necessary to ensure that such treatment has been carried out. If there is any doubt about this matter, treat the accessory as described in the foregoing paragraphs.

BEFORE REFITTING ACCESSORIES TO ENGINE. Before refitting any accessory to an engine, it is important to ensure that all surplus protective fluid is drained out of the accessory.

'COCOON' PACKING

'COCOON' PACKING provides a first-class anti-corrosion precaution without the necessity for coating the external surfaces of the engine with temporary rust preventative as described on page 13.

An engine which is 'cocoon' packed should be safe from corrosion whilst in transit or in store for a period of three years; unless, of course, inspection indicates that re-treatment after some shorter period is necessary. During the three-year period, the 'cocoon' pack must be adequately inspected and maintained, to ensure that the humidity within the pack does not exceed the safe limit.

MATERIALS

The materials required for 'cocoon' packing are:—

- (1) Waxed crêpe wrapping paper.
- (2) $\frac{1}{2}$ inch, unbleached Egyptian tape.
- (3) Acid-free packing felt, or cellulose wadding.
- (4) 'Cocoon' plastic.
- (5) 'Cocoon' webbing agent.
- (6) 'Cocoon' sealing compound.
- (7) 'Cocoon' dyestuff.
- (8) Aluminium paste to British Standard Specification 388.
- (9) $\frac{1}{8}$ inch perspex sheet.

(10) Humidity indicator, type D.H.1.

(11) Silica gel, in 1 lb. bags.

Items 4, 5 and 6 must comply with British Specification D.T.D. 900 C approval No. 4067.

The 'cocoon' plastic, webbing agent and sealing compound, and the silica gel, should be stored in air-tight containers until immediately before being used. Should the 'cocooning' materials gel, they should be stirred thoroughly before use; **under no circumstances are they to be thinned out.** In view of the inflammable nature of the solvents used in these 'cocooning' materials, adequate precautions against the risk of fire must be taken during all spraying operations, and, in view of the slightly toxic nature of the solvents, operators should wear respirators during these spraying operations, unless the process is carried out in a suitably ventilated booth.

EQUIPMENT

The equipment required is tabulated under item 14 on page 5. A supply of moisture-free compressed air, at a pressure of 60 lb. per sq. in. will be required.

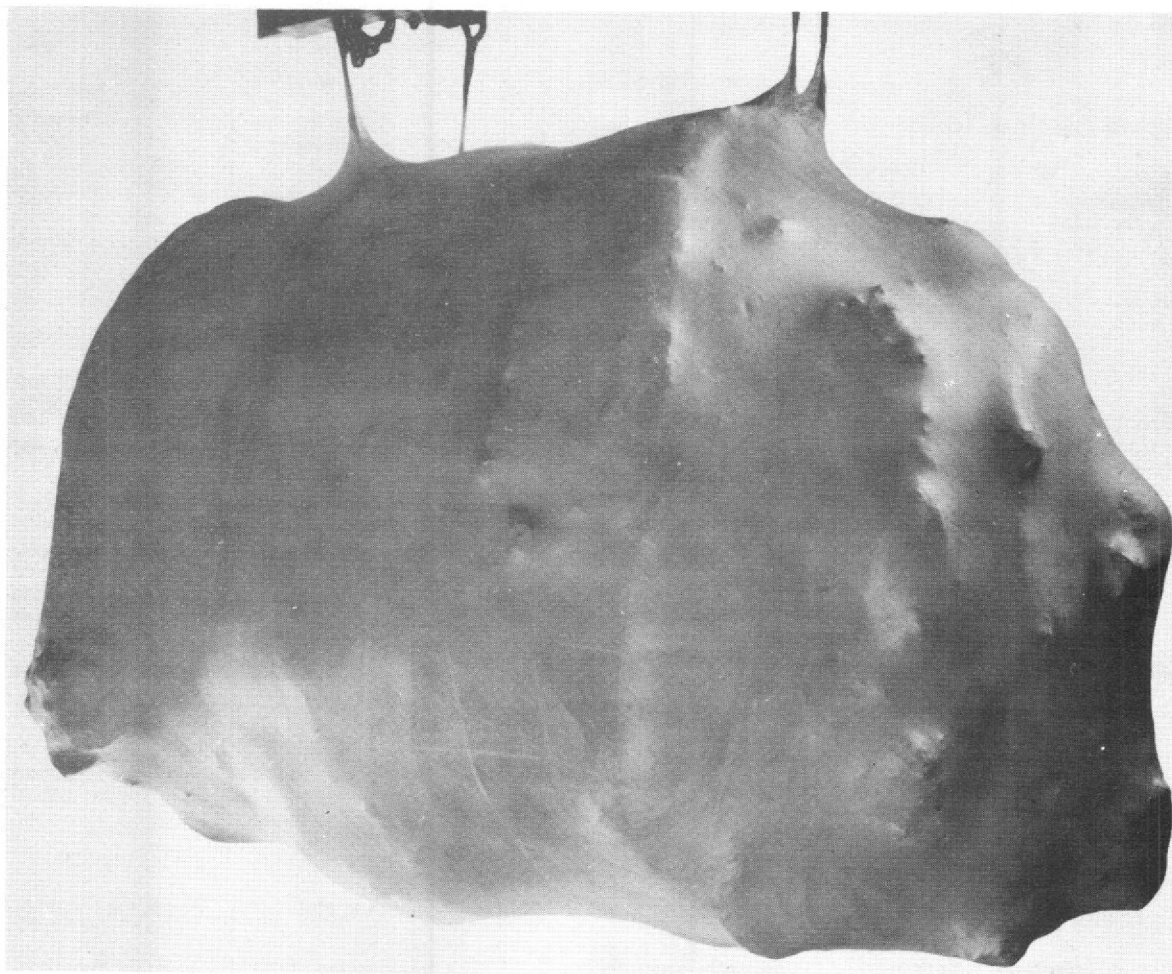


Fig. 10. Webbing coat completed; tape grid is just visible through the webbing coat; Ghost 50 illustrated.

PREPARATION OF ENGINE

The fuel system must be inhibited, and the engine given protective treatment as described on pages 6 to 14. The two transport air-intake covers and turbine disc blanking cover must be correctly fitted, and any loose components, accessories, or equipment must be suitably attached to the engine.

PROCEDURE FOR 'COCOON' PACKING

Sling the engine, using the normal lifting tackle. Remove the mounting trunnions from the diffuser casing, if these are fitted.

Wrap the engine with waxed crêpe paper and tape down. Pad all sharp edges and projections with the felt, or cellulose wadding, to prevent tearing of the 'cocoon' as it tautens during drying. Use the minimum quantity of paper and padding, consistent with projecting painted surfaces and padding sharp edges and projections. The final taping must form a grid over the engine of not more than twelve-inch squares; Fig. 9.

Spray the engine all over with a coat of webbing. The material used for this coating must be made by mixing one part of the 'cocoon' webbing agent with two parts of the 'cocoon' plastic. During the initial stage of this webbing operation the spray gun should be held at such a distance (about four feet) from the engine and the spread adjuster on the gun regulated as necessary to give long dry filaments to bridge the gaps in the tape grid. As the operation progresses, the gun should be brought progressively closer to the engine and regulated to give short filaments, so that a dense web is built up. The webbing coat is to build up until it is strong enough to withstand the application of the succeeding coat of plastic without breaking; Fig. 10.

After completion of the webbing coat, spray the engine with a coat of plastic. The material for this plastic coating is to be prepared by adding 20 cc. of a suitable dye to each gallon of plastic. The use of the dye assists in judging the uniformity of this and the following coatings. During the initial stage of this operation, the coat of plastic should be applied as a dry spray, gradually turning into a wet coat as the thickness is built up, by bringing the spray gun progressively closer to the engine and by suitably regulating the spread adjuster. The first coat of plastic should be applied to give complete covering of the webbing coat to a thickness of between 0.020 and 0.025 inch.

When the first coat of plastic is touch-dry, the transport mounting trunnions must be fitted as follows. Remove all traces of paint, oil, and grease from the three trunnions, and sandblast them. Using the spigot on the flanged end of the trunnion as a guide, mark the plastic coat at the trunnion positions at three, six, and nine o'clock on the diffuser casing, by pressing each trunnion into position. Carefully cut away the plastic coat at the spigot location and at the four bolt holes. Place the three transport mounting trunnions into position over the plastic coat, and secure them by fitting the

twelve set-bolts and spring washers. Coat the trunnion flange and the fillet (the radius where the flange blends into the actual trunnion) with the 'cocoon' sealing compound. When the sealing compound is tacky, spray the three trunnions and the adjacent plastic coat with a further layer of plastic, until the trunnion is completely sealed.

The support tube which is welded to the centre of the turbine disc blanking cover, must next be sealed to the plastic coat as follows. Carefully cut away the plastic coat for about three inches all round the support tube, and remove any tape and wrapping paper from a similar area. Ensure that the exposed area of the turbine blanking cover is free from oil and grease. Coat the exposed surface of the blanking cover with the 'cocoon' sealing compound, and, when tacky, spray the blanking cover and the adjacent plastic coat with a further layer of plastic until the blanking cover is completely sealed.

When the transport trunnions, and the turbine disc blanking cover support tube, have been sealed to the plastic coat, spray the complete engine with a further coat of plastic. The material for this coating of plastic is to be prepared by adding about $\frac{1}{4}$ lb. of aluminium paste to each gallon of plastic. For this coat, the plastic should be applied as a heavy wet spray, giving a smooth-textured, glossy finish which feels oily to the touch. This coat should be built-up to give a final thickness of between 0.040 and 0.045 inch. As the spraying progresses, the 'cocoon' envelope should be examined carefully, to ensure that the thickness is uniform, particularly at corners or projections, and at the transport trunnions and support tube, where shrinkage as the coat dries may cause local thinning or pin-holing. Additional material should be sprayed on any such areas as necessary.

When the final coat has been completed satisfactorily, and it is touch-dry, proceed as follows. Cut slits, about six inches in length, one each side of the engine, a little forward of the turbine, and another each side of the engine adjacent to the air-intakes. These slits are to permit the solvent vapours to escape from the interior of the 'cocoon.' To facilitate the fitment of the trunnion blocks to the trunnions, the plastic coating should be removed from the three trunnion bosses. Now carefully lower the 'cocooned' engine into the transport stand, and remove the lifting tackle. The slits made for the removal of the lifting tackle should be left open also.

Leave the engine for at least twelve hours to allow time for the solvent vapours to escape from the inside of the 'cocoon' envelope. This operation may, if necessary, be assisted by venting the 'cocoon' envelope with dry compressed air (either hot or cold) for an hour or two.

A supply of patching material should now be prepared as follows. Spray several coats of dyed plastic, followed by a final coat of aluminium-pigmented plastic, on to a piece of clean glass, or

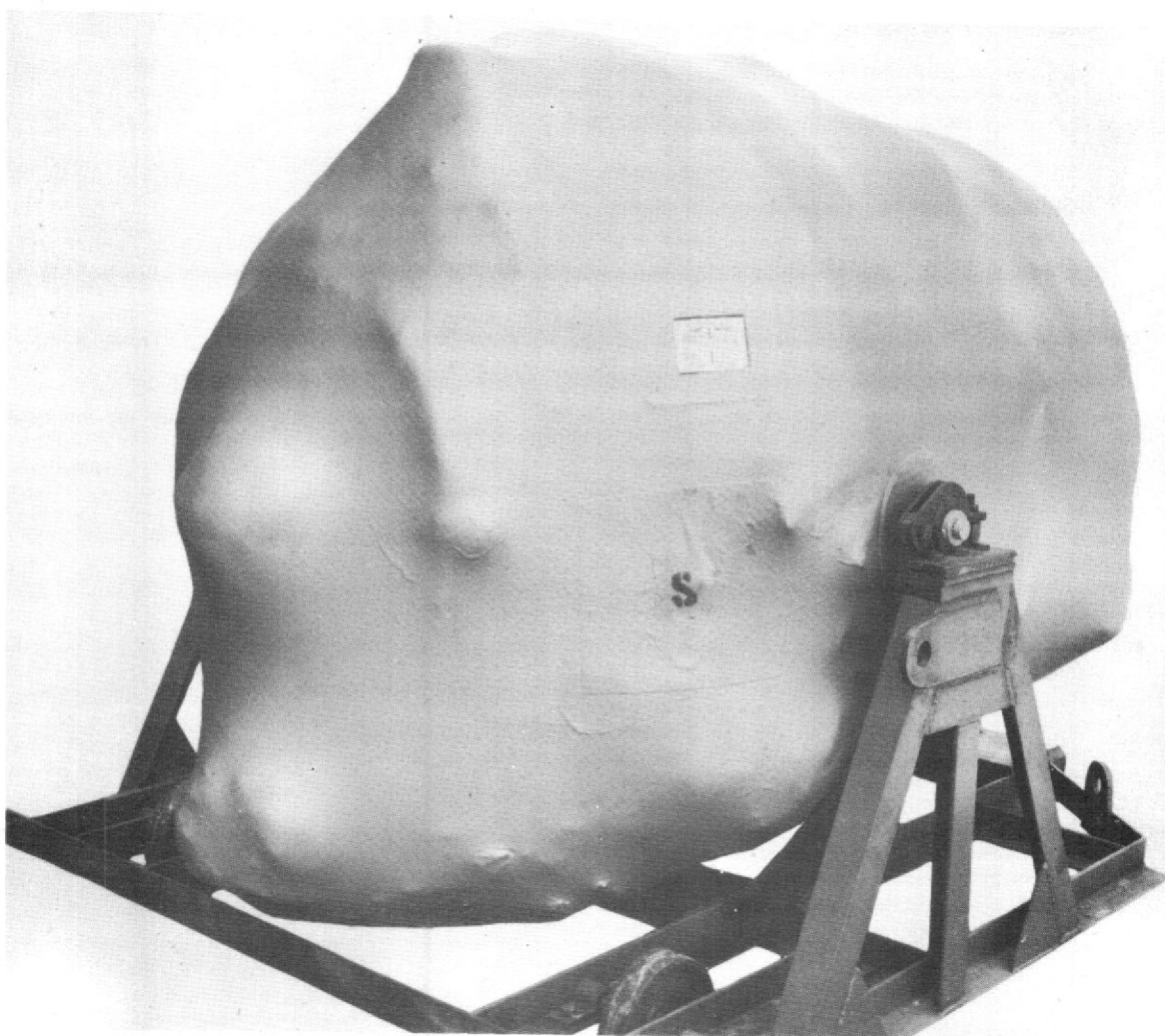


Fig. 11. 'Cocooned' engine mounted on transport stand, showing humidity indicator, and one of the letter "S"s which should be marked immediately adjacent to the positions where the silica gel is located; Ghost 50 illustrated.

smooth metal sheet, so as to form a film about 0.040 inch thick. When this film is dry, it should be stripped off the supporting glass or metal, and cut to shape as required.

When it is intended to store the engine, after transit, in its 'cocoon,' an inspection window must be fitted to permit a periodic inspection of a humidity indicator, which must be fitted also within the 'cocoon.' This should be done thus. Cut a hole, about three inches by four inches, in the 'cocoon' envelope, adjacent to one of the engine air intakes. Prepare a window from the $\frac{1}{8}$ inch thick perspex sheet to cover this opening in the 'cocoon' envelope with at least two inches overlap all round. Insert a humidity indicator into the 'cocoon' envelope and position it so that it can be seen easily through the opening. Apply a liberal coating of the sealing compound to the overlapping surfaces of the perspex window and the 'cocoon.' When the coating of compound is tacky, place the perspex window into position over the opening, taking care to ensure that no air is trapped between the joint. Mask the centre of the perspex window with tape, to protect it during the subsequent spraying

operations. Apply a further coat of sealing compound to the outer edges of the perspex. When this further coat of compound has become tacky, build up the 'cocoon' coating around the edges of the perspex with a dry spray, and then apply a heavy wet coat over the complete window. Remove the masking from the window.

When the 'cocoon' envelope is free of solvent vapours, and before the final sealing is carried out, insert 16 lb. of silica gel as follows. The silica gel should be contained in 1 lb. bags and distributed between four points around the engine. The four bags which are to be inserted at each point should be looped together. Insert the bags through the four slits which were cut, two on each side of the engine, one a little forward of the turbine and the other adjacent to the air-intakes. The bags of silica gel must be wedged into suitable crevices in the engine, and must not rest on the 'cocoon' coat.

Immediately after insertion of the silica gel, all openings in the 'cocoon' envelope must be sealed as follows. Cut patches from the previously prepared patching material, large enough to cover

each opening with at least two inches overlap all round. Apply a liberal coat of the sealing compound to the mating surfaces of the patches and the 'cocoon.' When the compound has become tacky, taking care to ensure that no air is trapped, place the patches into position over the openings and smooth down the edges. Using the aluminium-pigmented plastic, with a dry spray, build up the coating around the edges of each patch, and then apply a heavy wet coat to cover each patch completely.

Upon completion of the final sealing operation described in the foregoing paragraph, leave the engine for about twenty-four hours, and then inspect the humidity indicator; see next column. The indicator should show "safe," the colour being blue with a little or no trace of pink. If the indicator shows "unsafe," the 'cocoon' envelope must be examined very thoroughly, any defects found repaired by patching as necessary, and the silica gel renewed. If, however, no defects are discovered during the examination, the engine may be left for a further twenty-four hours and a further inspection of the humidity indicator made at the end of that period, before the silica gel is renewed. When the humidity indicator shows "safe," the letter "S" should be marked on the exterior of the 'cocoon' envelope immediately adjacent to the positions where the silica gel is located. The engine is then ready for transit or storage.

INSPECTION UPON RECEIPT OF A 'COCOON' PACKED ENGINE

Immediately a 'cocoon' packed engine is received, the humidity indicator (where provided) should be inspected; see next column. The whole of the 'cocoon' envelope should be carefully examined for signs of punctures or any other defects which might allow the ingress of water or water vapour; pay especial attention to the trunnion and support tube locations and to the areas adjacent to all edges and projections.

Provided that the humidity indicator shows "safe" and that no defects are discovered in the 'cocoon' envelope, it is safe to store the packed engine. If any defects have been discovered in the 'cocoon' envelope, they should be repaired immediately.

If the humidity indicator shows "unsafe," the silica gel which is inside the 'cocoon' envelope, at the points marked "S," must be removed and a fresh charge inserted, after any repairs found to be necessary have been made.

ATTENTION DURING STORAGE

During storage of a 'cocoon' packed engine, the humidity indicator should be inspected at intervals not exceeding three months. Provided that the humidity indicator shows "safe," no further action need be taken. If the humidity indicator shows "unsafe," the whole of the 'cocoon' envelope should be carefully examined as instructed above (upon receipt of a 'cocoon'

packed engine) and repaired, and the silica gel renewed as necessary.

HUMIDITY INDICATOR Type DH.1

The humidity indicator is a chemical impregnated paper strip, the colour of which varies with the humidity of the surrounding air; the colours ranging from blue to pink. The conditions within the 'cocoon' envelope are safe so long as the indicator colour is blue and unsafe when the colour ranges from "lilac" to "pink."

REPAIR KIT

Where full 'cocooning' facilities are not available, the repair kit listed below will be required to carry out repairs to the 'cocoon' envelope whilst the engine is in store.

- (1) $\frac{1}{2}$ pint tin of 'cocoon' sealing compound.
- (2) 1 pint tin of 'cocoon' plastic.
- (3) A piece of preformed coating about 1 ft. by 3 ft. prepared in accordance with the instructions given on page 17 for preparing 'patch material.'
- (4) A paint brush.

REPAIRING THE 'COCOON' ENVELOPE

Repairs to the 'cocoon' envelope should be carried out using the materials and equipment specified for the original packing, but, where proper facilities are not available, the necessary work can be carried out with the aid of the repair kit as detailed in the preceding paragraph.

Should there be insufficient preformed coating in the repair kit, a further supply can be prepared by pouring several layers of plastic on to a piece of clean glass, or smooth metal sheet, until a film about 0.040 inch thick is obtained; the sheet of glass or metal should be sloped at an angle of about 30 degrees to allow the material to flow. When dry, the film should be stripped off the supporting glass or metal and cut to shape as required.

To repair a 'cocoon' envelope which has been damaged, or which has been slit to gain access to the engine, or to renew the silica gel charge, proceed as described in the following paragraphs.

If the 'cocoon' envelope has been damaged over an edge or projection, ensure that the engine is adequately padded at that point; if necessary, cut the envelope and place additional packing felt or cellulose wadding in position.

If the hole is large, or if a flap has been cut in the envelope, sew the edges together with waxed thread.

Cut a patch of preformed coating, large enough to cover the opening with at least two inches overlap all round.

Clean the surface around the opening with thinners or lead-free petrol.

Apply a liberal coat of sealing compound to the mating surfaces of the patch and the 'cocoon' envelope.

When the compound is tacky, taking care to ensure that no air is trapped, place the patch in position and smooth down the edges.

Apply a liberal coat of plastic around the edges of the patch, allow this coat to dry for between five and ten minutes, and then apply a heavy wet coating over the patch and the surrounding area.

Leave the repair for about twenty-four hours, to dry out, and then carefully examine the patch to ensure that the damaged area is satisfactorily sealed.

RENEWAL OF SILICA GEL

When it is required to renew the silica gel, which is inside the 'cocoon' envelope, the operation must be carried out in the driest atmospheric conditions possible, and the exhausted silica gel must be removed before the fresh charge is inserted. The exhausted silica gel will be found distributed between four points around the engine, two on each side of the engine, one a little forward of the turbine and the other adjacent to the air-intakes. These points are indicated by a letter "S" marked on the exterior of the 'cocoon' envelope.

To remove the exhausted silica gel, and to insert the fresh charge, make four cuts, about six inches long in the envelope at the positions marked "S." There will be four 1 lb. bags of silica gel

at each point, and these four bags will be looped together to assist their complete removal.

Having removed the exhausted silica gel, a fresh charge should be inserted and the openings re-sealed in accordance with the instructions given on pages 18 and 19.

After completion of the re-sealing, leave the 'cocoon' packed engine for about twenty-four hours, and then inspect the humidity indicator. The indicator should show "safe"; the colour being blue with little or no trace of pink.

If the indicator shows "unsafe," the 'cocoon' envelope must be thoroughly examined, repaired as necessary, and the silica gel again renewed. If, however, no defects are discovered during the examination, the engine may be left for a further twenty-four hours and a further inspection of the indicator made at the end of that period, before the silica gel is renewed.

When the humidity indicator shows "safe," the positions on the 'cocoon' envelope, beneath which the silica gel has been placed, should be marked "S" and the engine cleared for storage.

PARTIAL OPENING OF 'COCOON' ENVELOPE

Whenever it is necessary, in order to inspect the engine, or to embody a modification, or for any other reason, the 'cocoon' envelope may be opened. Such an opening may be made either by cutting a straight slit, or by cutting a flap, but such cutting should always be kept to a minimum. When the necessary work has been completed, the 'cocoon' envelope must be re-sealed and the silica gel renewed.

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