Chapter Twenty-nine

LUBRICATION SYSTEM COMPONENTS RENEWALS, RECONDITIONING, REPAIR AND SALVAGE

Contents

Illustrations

THIS CHAPTER contains instructions for reconditioning and repairing worn or damaged lubrication system components including the oil sump. Instructions for dismantling and reassembling these components are not given unless they are an essential part of the repair instructions; reference should be made to chapters 13, 23, 24, 33 and 34, as appropriate, for further information on dismantling or reassembling individual items before, or after, reconditioning or repair. The information given in chapter 32 should be read in conjunction with all repair schemes dealing with the fitting of " Cross " wire inserts. Most of the information contained in this chapter is based on the manufacturer's turbine repair (T.R.) schemes and process specifications, and, in each instance, the relevant drawing (T.R.) number and issue number, or specification number, is quoted; turbine repair schemes are introduced under the cover of a modification and this modification number is quoted also. After any repair has been completed, an entry should be made in the appropriate record book of the engine in accordance with British Air Registration Board Inspection Procedures, Section ML, Leaflet 1-1; refer also to page 6 of chapter 28.

Rather than withhold useful information whilst detailed instructions for carrying out every approved repair scheme are compiled, as an interim measure, actual T.R. drawings and brief notes are reproduced. As detailed instructions are compiled they will be published to replace these brief notes. It must be appreciated, of course, that these repairs can be carried out only under the supervision of an Inspection Organisation approved for such repair work by the British Air Registration Board, or an equivalent authority, or under the supervision of an appropriately licensed aircraft engineer. It is assumed also that personnel having the requisite skill and experience will be employed and that the necessary tools and equipment will be available.

Normally, where special tools and equipment are available for carrying out the renewals and repairs described in this chapter, they are listed at the beginning of the relevant repair instructions and are referred to in the text as they are used. In some cases, even though no list is given, the tools are referred to in the text as they are used. Where special tools are not mentioned, reference should be made either to the relevant Part and Section of the separate publication entitled " de Havilland Gas Turbine Tools and Equipment for Servicing and Overhaul ", or to The Service Department of The de Havilland Engine Company.

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February, 1957

OIL SUMP, REAR BEARING, COOLING-OIL CONNECTION
T.R. 307 issue 2—Mod. 751

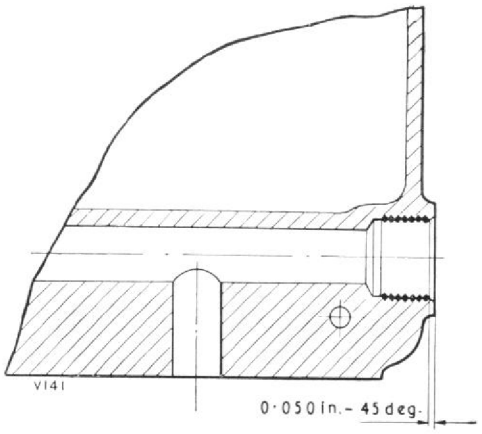
This repair may be applied to all Ghost Forty-eight Mk. 1 oil sumps.

Oil sumps in which the threaded hole in the rear bearing cooling-oil connection has become stripped or damaged may be rectified in accordance with these instructions.

SEQUENCE OF OPERATIONS

1. Open out the damaged hole to a diameter of $\frac{27}{32}$ inch by 0·650 inch deep.

2. Thread the hole to a diameter of 0·9184 inch by 14 T.P.I. Whitworth thread form to a depth of 0·550 inch deep. The effective thread diameter is to be 0·8727 + ·0029 inch and the minor diameter 0·8270 + ·0213 inch. Chamfer to the dimensions given in the sketch.



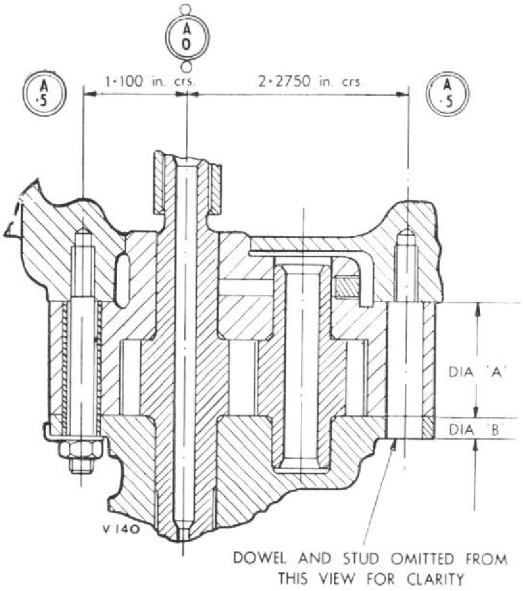
3. Screw in wire insert Part No. N.5049 then break off and remove the tang.

4. Lightly stamp T.R.307 adjacent to the existing part number and make an entry in the appropriate record book of the engine.

OIL SUMP, DOWELS
T.R. 334 issue 2—Mod. 900

This repair may be applied to all Ghost Forty-eight oil sumps.

Oil sumps in which the dowel holes have become worn or damaged, may be rectified in accordance with these instructions.



PART SECTIONAL VIEW OF SUMP

SEQUENCE OF OPERATIONS

1. Remove six $\frac{1}{4}$ in. B.S.F. nuts—but not the two 2 B.A. nuts—from the face of the cover.

2. Remove oil pump cover and body complete with gears from the sump.

3. Fit four slave bolts loosely in the $\frac{9}{32}$ inch diameter holes; check that the gears run smoothly then tighten the slave bolts.

4. Extract the existing dowels.

5. Ream through the dowel holes in the cover and body to the required diameter 'A' given in the table.

6. Remove the four slave bolts and also the two 2 B.A. nuts; dismantle the cover and body.

7. Open out the holes in the cover to the corresponding diameter 'B' given in the table.

8. Clean out the holes.

9. Fit the appropriate oversize dowels into the body.

10. Reassemble the body and cover and fit to sump.

11. Lightly stamp T.R.334 and the appropriate suffix adjacent to the existing part number and make an entry in the appropriate record book of the engine.

Dia. 'A' hole in inches	*Dia. 'B' hole in inches*	*Oversize Dowel Part No.*	*Ident. No.*
0·3784 + ·0008 in.	0·3800 + ·0008 in.	M.R.N.4116-5	T.R.334-1
0·3834 + ·0008 in.	0·3850 + ·0008 in.	M.R.N.4116-10	T.R.334-2

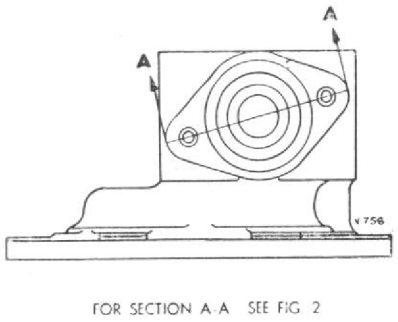


Fig. 1. Stud holes in oil pump cover face, Ghost 48 Mk. 1.

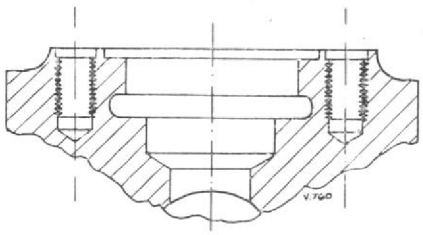


Fig. 2. Section A-A typical of all 2 B.A. stud holes in oil pump covers.

OIL PUMP COVER, STUD HOLES
T.R.342 issue 2—Mod. 1043

Any oil pump cover (Ghost 48 Mk. 1, 48 Mk. 2, or 53 Mk. 1) in which the 2 B.A. stud holes, Fig. 1, have become damaged, may be repaired by fitting Cross wire inserts in accordance with these instructions. Reference must be made also to chapter 32, page 2, which specifies the tools required, and contains general information essential to this repair. This repair may be applied to any one or more holes as required.

On receipt of the component which is to be repaired, its part number and serial number should be checked against the accompanying documents.

To carry out this repair proceed as follows.

1. Bolt an angle plate to the work table of a suitable drilling machine, and, with the face containing the damaged stud hole uppermost, lightly clamp the oil pump cover to the side of the angle plate. Position the cover so that the drill will be truly perpendicular to its upper face, and tighten the clamp to secure the cover to the angle plate.

2. Using a 0·1935 inch diameter (No. 10) drill, drill out the defective hole to a depth of 0·420 inch.

3. Use a $\frac{15}{64}$ inch diameter flat-bottom drill to counterbore the hole to a depth of 0·050 inch.

4. Blow out the hole with compressed air to remove all traces of swarf, and using the appropriate taper, and plug taps, thread the hole to 0·2252 inch diameter by 31·300 T.P.I., B.A. thread form, and to a depth of 0·350 inch.

5. Remove any burrs from the edge of the tapped hole, blow out the hole and, using the appropriate inserting tool, screw in wire insert Part No. N.4951 to the bottom of the thread, Fig. 2. Break off, and remove, the notched tang of the insert.

6. If the other stud hole in this face is damaged, operations 2 to 5 should be applied to it.

7. To repair damaged stud holes in any of the other faces of the oil pump cover; reset the cover on the angle plate, as described in operation 1, and apply operations 2 to 5 to each one of the other holes which has to be repaired.

Ghost 48 Mk. 1

8. Fit a new stud, Part No. N.866, into each one of the holes in the restrictor face which has been repaired. Fit a new stud, Part No. N.3481, into each one of the other holes which has been repaired.

Ghost 48 Mk. 2 and 53 Mk. 1

8. Fit a new stud, Part No. N.3481, into each one of the holes which has been repaired.

All Marks

9. If this is the first time that this repair has been applied, lightly stamp T.R.342 adjacent to the existing part number on the oil pump cover. Make the appropriate entry in the engine log book.

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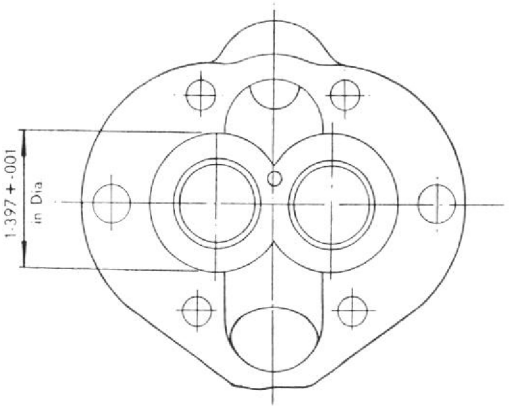
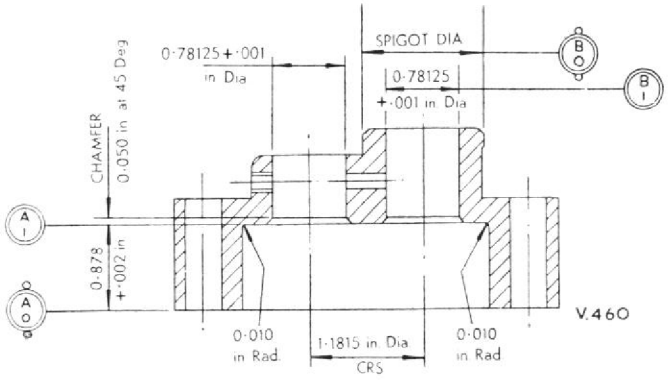
OIL PUMP, SPINDLE BORES
T.R. 421 issue 2—Mod. 1267

This repair may be applied to all Ghost Forty-eight Mk. 1 oil pumps.

Oil pump assemblies in which the spindle bores have become worn or damaged may be repaired in accordance with these instructions. Either the oil pump body or the oil pump cover may be rectified independently of the other component, if required, but both spindle bores in the component concerned must be rectified: it is not permissible to rectify one bore only in the oil pump body or cover.





SEQUENCE OF OPERATIONS

1. Remove plug from oilway, enlarge spindle bores and deepen gear bores in oil pump body, using the spigot boss as a datum, as shown.

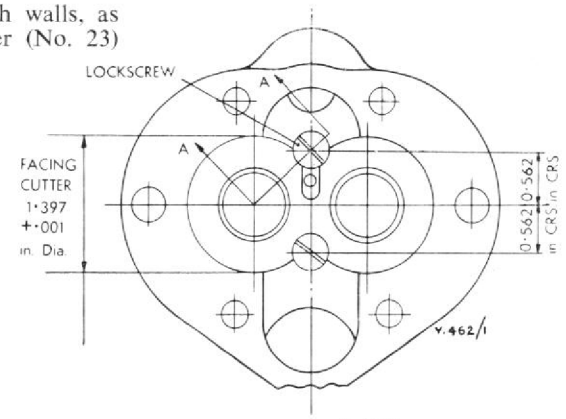
2. Insert bushes, Part No. 606533, in driving gear bore and Part No. 606534 in driven gear bore simultaneously into the bores in the oil pump body. Drill holes for the lock screws, in the positions shown, using a 0·154 inch diameter (No. 23) drill, to a depth of 0·650 inch. Thread the hole 2 B.A. by 0·600 inch deep. Countersink and counterbore as shown. Insert and lock the lockscrews, Part No. N.1632.

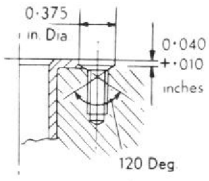
3. Drill the oil hole through the bush walls, as shown, using a 0·154 inch diameter (No. 23) drill piloted through the existing oil hole in the bush housing.

4. Machine the bushes to the dimensions shown, remove any burrs or sharp edges, and blow out all swarf. Insert plug, Part No. N.2702, into the oil hole and face off flush.

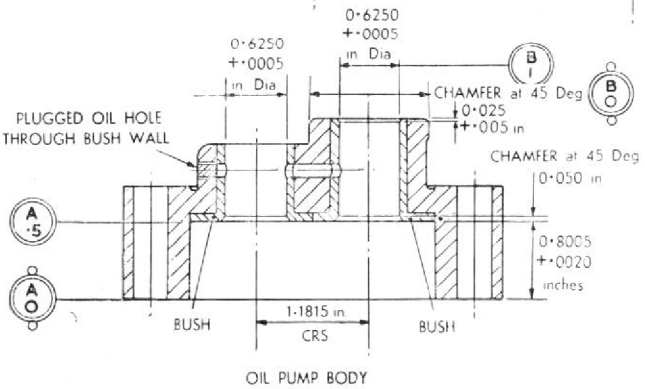
5. Enlarge spindle bores in oil pump cover and counterbore as shown.

6. Insert bushes, Part No. 603774 in driving gear bore and Part No. 603775 in driven gear bore, simultaneously into the bores in the oil pump cover. Drill a hole for the lockscrew, in the position shown, using a 0·154 inch diameter (No. 23) drill, to a depth of 0·650 inch. Thread the hole 2 B.A. by 0·600 inch deep. Countersink and counterbore as shown. Insert and lock the lockscrews. Part No. N.1632.





SECTION A-A



OIL PUMP BODY

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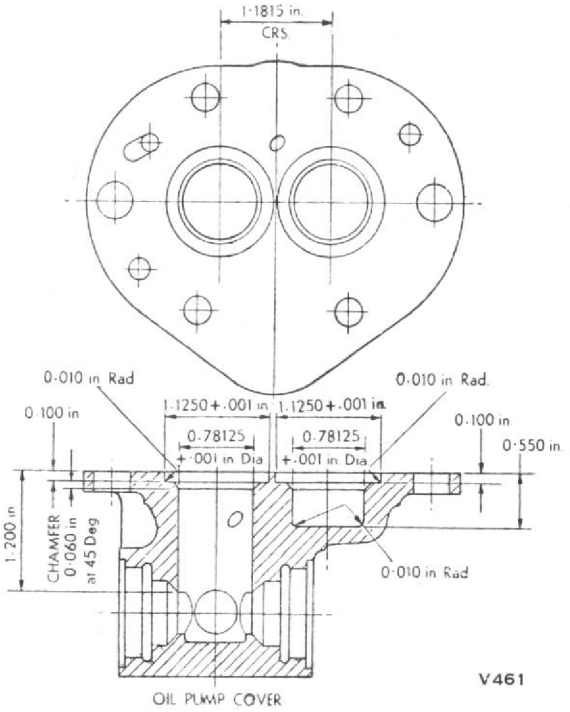
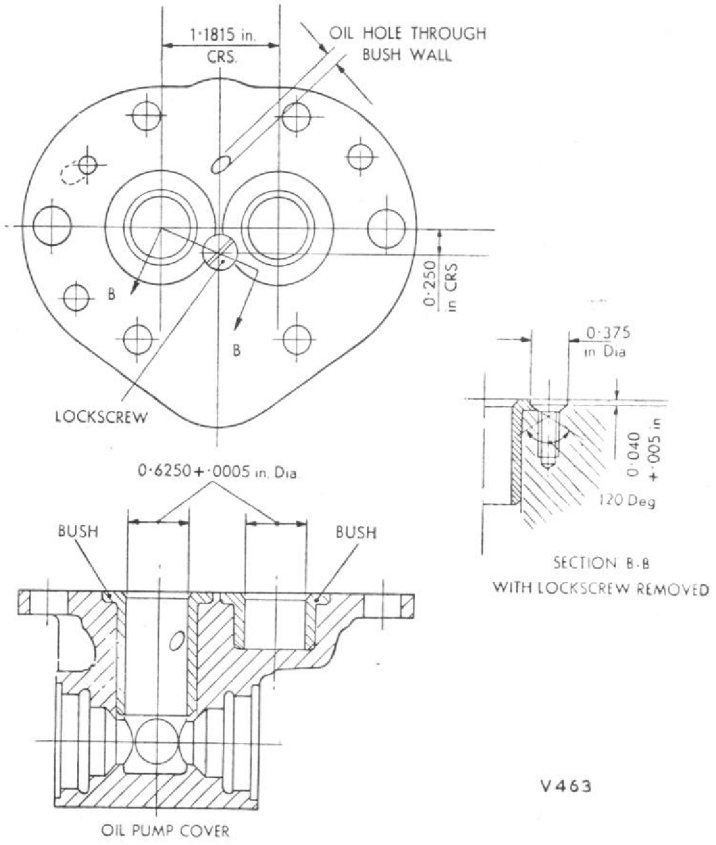




7. Drill the oil hole through the bush wall, as shown, using a 0·154 inch diameter (No. 23) drill piloted through the existing oil hole in the bush housing.

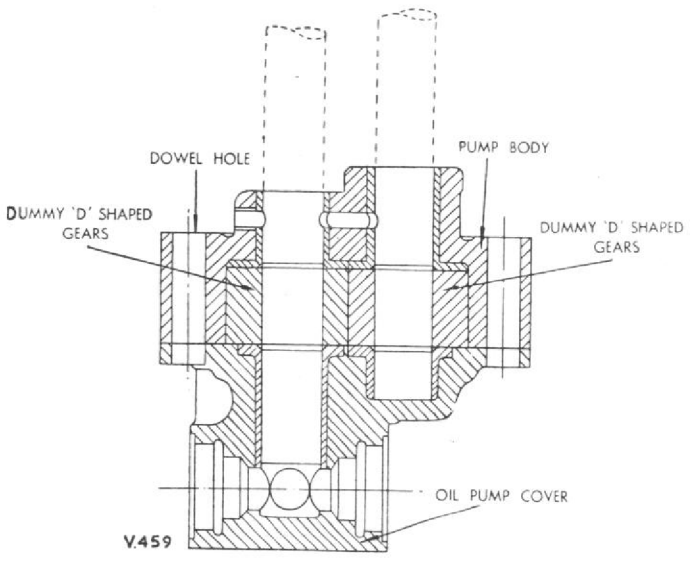
8. Machine the bushes to the dimensions shown, remove any burrs or sharp edges, and blow out all swarf.

9. Assemble the oil pump cover to the oil pump body, with dummy D-shaped gears in the gear bores and alignment mandrels in the spindle bores; using slave bolts, nuts and washers tighten up the assembly.

10. While the assembly is thus held, enlarge the dowel holes to an appropriate oversize, in accordance with T.R.334.

11. Assemble the oil pump and check the spindle for freedom of rotation. Ensure that the end float of the oil pump gears is as specified in chapter 38. Rig test the oil pump assembly to de Havilland Gas Turbine Test Specification T.T.S. (see page 6).

12. Lightly stamp T.R.421 adjacent to the existing part number of the component concerned and make an entry in the appropriate record book of the engine.



OIL PUMP ASSEMBLY

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OIL PUMP ASSEMBLIES, TEST SPECIFICATION
T.T.S.26 issue 5

As part of the normal rebuilding sequence, the oil pump unit is tested in conjunction with the air-intake, centre housing, wheelcases, and sump during the motoring-over rig test described in chapter 33B. To obviate the discovery of inefficiency in a pump only after it has been built up into the foregoing sub-assembly, it is recommended that all oil pumps should be tested individually, as described in this chapter. However, since these oil pumps are fundamentally simple in design, after initial experience has been gained by any particular major repair depot it should be found that the dimensional inspection of the component parts, described in chapter 27, is sufficient to ensure a satisfactory standard of assembled pumps. When this condition has been proved by the consistent satisfactory passing of oil pumps submitted to the tests described in this specification, the inspection authority will be justified in granting an easement in the percentage of oil pump units tested individually. All oil pumps which have been repaired in accordance with T.R.367 or T.R.421 must be tested as described in this specification.

Turbine oil pump test rig W.D.12010, shown diagrammatically in Fig. 3, is available for testing Ghost oil pump units. Alternatively, these oil pumps may be tested on universal oil pump test rig W.D.12000 which is suitable for testing all Gipsy oil pump units in addition to those fitted to Goblin and Ghost engines, or on any other oil pump test rig which will give the required speeds, pressures, and temperatures; when using a test rig other than W.D.12010 or W.D.12000, it may be necessary for suitable oil-pump mounting adapters to be manufactured locally.

These instructions assume the use of turbine oil pump test rig W.D.12010, and may require adaptation to suit the test rig actually being used. When using test rig W.D.12010, the following tools will be required.

Tool No.	*Description*
WD.12082	Adapter assembly Ghost 48 Mk. 1 comprising :—
13613	Circlip
48888	Coupling sleeve
W.D.7257	Adapter coupling
W.D.12201	Mounting adapter
W.D.12210	Quillshaft
W.D.12086	Adapter assembly. Ghost 48 Mk. 2 and 53 Mk. 1, comprising :—
13613	Circlip
48888	Coupling sleeve
W.D.7257	Adapter coupling
W.D.12087	Mounting adapter
W.D.12210	Quillshaft
Standard	Two 1 in. by $\frac{1}{4}$ in. B.S.P. reducing sockets
Standard	1 in. by $\frac{3}{8}$ in. B.S.P. reducing socket
Flexible hose	12 in. length fitted with 1 in. B.S.P. union nuts
	22 in. length fitted with $\frac{1}{2}$ in. B.S.P. union nuts
	24 in. length fitted with $\frac{1}{4}$ in. B.S.P. union nuts
	24 in. length fitted with $\frac{1}{8}$ in. B.S.P. union nuts
	24 in. length fitted with $\frac{5}{8}$ in. B.S.P. union nuts
	26 in. length fitted with 1 in. B.S.P. union nuts
	28 in. length fitted with $\frac{3}{4}$ in. B.S.P. union nuts
	48 in. length fitted with 1 in. B.S.P. union nuts
Standard	Eleven $\frac{1}{4}$ in. plain washers
Standard	Eleven $\frac{1}{4}$ in. spring washers
Standard	Eleven $\frac{1}{4}$ in. B.S.F. nuts

PREPARATION OF TEST RIG

Make a thorough check to ensure that the test rig is serviceable, and, if necessary, service the air filter, and the main oil filter. Ensure that the main oil tank contains sufficient clean oil of the specification quoted under the heading "Test Conditions and Limitations".

MOUNTING OIL PUMP ON TEST RIG

The oil pump must be assembled as described in chapter 33F. The following instructions for mounting the assembled oil pump unit on the test rig assume that the rig is being used for the first time; where it is in regular use for testing Ghost oil pumps, all the following operations may not be necessary.

Ghost 48 Mk. 1

1. Bolt adapter coupling W.D.7257 on to the driving flange of the variable-speed electric motor.

2. By means of the eight $\frac{5}{16}$ inch B.S.F. bolts, spring washers, and nuts, secure the circular flange of oil-pump mounting adapter W.D.12201 to the left-hand face of the test rig. Ensure that the drain union on the adapter is at the lowest point, and that the 1 inch B.S.P. plug is uppermost.

3. Engage the splined end of quillshaft W.D.12210 with the splines in the adapter coupling on the electric motor (fitted in Op. 1).

4. Ensure that circlip 13613 is fitted in the groove in the centre of the bore of coupling sleeve 48888, and fit this sleeve over the serrated end of the quillshaft.

5. Using a twelve-inch length of flexible hose fitted with 1 inch B.S.P. union nuts, connect the drain union on the mounting adapter to the adapter drain connection on the test rig.

6. Using a twenty-six-inch length of flexible hose fitted with 1 inch B.S.P. union nuts, connect the pump inlet union on the mounting adapter to the pressure pump inlet connection on the test rig.

7. Using a twenty-two-inch length of flexible hose fitted with $\frac{1}{2}$ inch B.S.P. union nuts, and a 1 inch by $\frac{1}{2}$ inch B.S.P. reducing socket, connect the relief valve spill banjo on the mounting adapter to the spare drain connection on the test rig.

8. Using a twenty-eight-inch length of flexible hose fitted with $\frac{1}{2}$ inch B.S.P. union nuts, connect the pump outlet union on the mounting adapter to the pressure pump outlet connection on the test rig.

9. Blank off the $\frac{1}{4}$ inch B.S.P. union on the mounting adapter, and the unused spare pump inlet and spare pump outlet connections on the test rig.

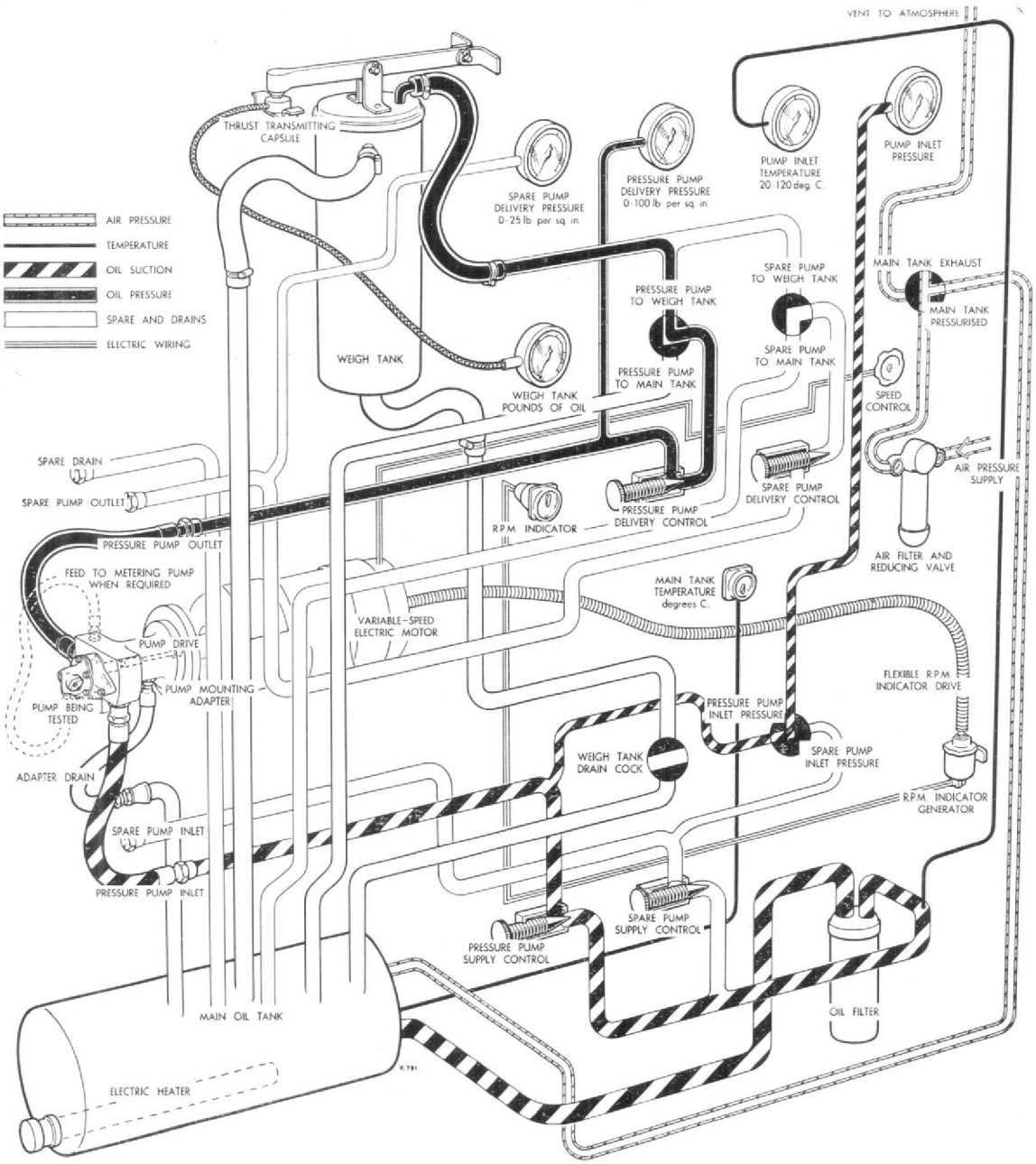

Fig. 3. Diagram of turbine oil pump test rig W.D.12010. Spare pump connections, pipes, etc., are used only when testing oil pump units which include a scavenge pump, e.g., civil Ghost Fifty oil pump units.

10. Ensure that all oilways and pipes, and the mounting faces of the mounting adapter and the oil pump unit, are perfectly clean.

11. Position the oil pump unit on the mounting adapter, and secure it with seven plain washers, spring washers, and $\frac{1}{4}$ inch B.S.F. nuts.

12. Assemble the normal suction filter into its compartment in the oil pump unit, fit the cover, and secure it with four plain washers, spring washers, and $\frac{1}{4}$ inch B.S.F. nuts.

Ghost 48 Mk. 2 and 53 Mk. 1

1. Bolt adapter coupling W.D.7257 on to the driving flange of the variable-speed electric motor.

2. By means of the eight $\frac{5}{16}$ inch B.S.F. bolts, spring washers, and nuts, secure the circular flange of oil-pump mounting adapter W.D.12087 to the left-hand face of the test rig. Ensure that the drain union on the adapter is at the lowest point.

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3. Engage the splined end of quillshaft W.D.12210 with the splines in the adapter coupling on the electric motor (fitted in Op. 1).

4. Ensure that circlip 13613 is fitted in the groove in the centre of the bore of coupling sleeve 48888, and fit this sleeve over the serrated end of the quillshaft.

5. Using a twenty-four-inch length of flexible hose fitted with $\frac{1}{2}$ inch B.S.P. union nuts, and a 1 inch by $\frac{1}{2}$ inch B.S.P. reducing socket, connect the mounting adapter drain to the adapter drain connection on the test rig.

6. Using a twenty-four-inch length of flexible hose fitted with $\frac{5}{8}$ inch B.S.P. union nuts, and a 1 inch by $\frac{5}{8}$ inch B.S.P. reducing socket, connect the pump inlet union on the mounting adapter to the pressure pump inlet connection on the test rig.

7. Using a forty-eight-inch length of flexible hose fitted with 1 inch B.S.P. union nuts, and a 1 inch by $\frac{1}{2}$ inch B.S.P. reducing socket, connect the pump outlet union on the mounting adapter to the pressure pump outlet connection on the test rig.

8. Blank off the unused spare pump outlet, spare pump inlet, and spare drain connections on the test rig.

9. Ensure that all oilways and pipes, and the mounting faces of the mounting adapter and the oil pump unit, are perfectly clean.

10. Position the oil pump unit on the mounting adapter, and secure it with seven plain washers, spring washers, and $\frac{1}{4}$ inch B.S.F. nuts.

11. Using a twenty-four-inch length of flexible hose fitted with $\frac{1}{4}$ inch B.S.P. union nuts, connect the metering pump inlet union on the mounting adapter to the metering pump connection on the oil pump.

TEST CONDITIONS AND LIMITATIONS

The conditions and limitations tabulated in this paragraph must be applied when testing oil pump units, and these requirements should be read in conjunction with the test procedure described in the paragraphs which follow.

Oil pump unit:
Assembled as described in chapter 33F.

Test fluid:
Lubrication oil to specification D.E.D.2479/1.

Pump suction:
Unrestricted, i.e., zero depression.

Oil temperature at pump inlet:
65 ± 3 deg. C.

	TEST No. 1	*TEST No. 2*
Pump speed:	630 r.p.m.	2050 r.p.m.
Delivery pressure:	30 to 35 lb. per sq. in.	60 to 65 lb. per sq. in.
Delivery:	510 lb. per hr.	2030 lb. per hr.

TEST PROCEDURE

Having mounted the oil pump on the test rig, proceed as follows.

1. Connect the workshop compressed-air supply to the Schrader air coupling on the right-hand side of the test rig. Set the Vickers cock to pressurise the main tank, and use the air pressure in the tank to prime the system with oil.

2. If the temperature of the oil in the main tank is below that specified for the pump inlet, switch on the electric heater.

3. Set the pressure-pump change-over Vickers cock to return the pressure-pump delivery to the main tank, and the three-way cock so that the pressure-pump inlet line is connected to the pump-inlet pressure gauge.

Ghost 48 Mk. 1

4. Switch on the electric motor so that, when viewed from the pump end, it rotates in an **anti-clockwise** direction.

Ghost 48 Mk. 2 and 53 Mk. 1

4. Switch on the electric motor so that, when viewed from the pump end, it rotates in a **clockwise** direction.

5. Increase the speed of the motor to about 600 r.p.m., ensure that oil is circulating correctly, and adjust the electric heater until the correct pump-inlet temperature is indicated on the gauge. Switch the Vickers cock to exhaust the main tank, and note that the required pump-inlet pressure (pump suction) is indicated on the gauge.

LOW SPEED DELIVERY TEST (TEST No. 1)

Having completed the foregoing operations, proceed as follows.

1. By means of the speed control, adjust the speed of the electric motor until the specified r.p.m. is shown on the indicator.

2. Adjust the pressure-pump delivery control until the pump-delivery pressure reaches the specified value.

3. Set the weigh-tank cock to seal the weigh tank, and the pressure-pump change-over cock so that the pressure-pump delivery is passed into

the weigh tank. With the aid of a stop-watch, measure the delivery of the pump on the weigh-tank gauge over a convenient period, and ensure that this is not less than the specified value.

4. Set the change-over cock so that the pressure-pump delivery is returned to the main tank. Set the weigh-tank cock to drain the weigh tank.

HIGH SPEED DELIVERY TEST (TEST No. 2)

The method of carrying out this test is the same as that described for the Low Speed Delivery Test, but reference must be made to the table of Test Conditions and Limitations which shows the higher specified values which must be attained.

ENDURANCE TEST

Following the completion of Tests 1, and 2, it will not be necessary to apply the Endurance Test to an oil pump unit which is to be refitted to an engine, which itself will be tested after overhaul. In instances, however, where an oil pump unit is to be held in stores as a spare, the Endurance Test must be applied. To carry out this test proceed as follows.

1. With the pump running under the conditions of the High Speed Delivery Test, carry out a test of 2 hours' duration.

2. Remove the pump unit from the test rig.

3. Dismantle, clean, inspect, and reassemble the pump unit.

4. Refit the pump unit to the test rig.

5. Repeat the Tests No. 1 and 2 as described already.

OIL SUMP, PRIMING CONNECTION, UNION THREADS
T.R.394 issue 1—Mod. 1156

Any Ghost 48 Mk. 1 oil sump in which the threaded hole for the priming connection union, Fig. 4, has become damaged, may be repaired by fitting a Cross wire insert in accordance with these instructions. Reference must be made also to chapter 32, page 2, which specifies the tools required, and contains general information essential to this repair.

On receipt of the component which is to be repaired, its part number and serial number should be checked against the accompanying documents.

To carry out this repair proceed as follows.

1. With its bottom-wheelcase joint face resting on parallel blocks, mount the oil sump on the work table of a suitable radial drilling machine. Ensuring that the sump is not distorted in any way, securely clamp it to the table.

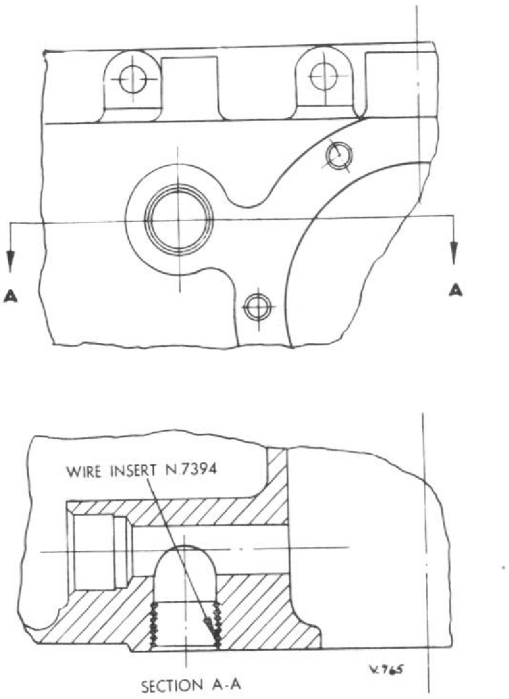

Fig. 4. Threaded hole for priming connection union in oil sump.

2. Use a $\frac{43}{64}$ inch diameter drill to drill out the damaged hole to a depth of 1·000 inch.

3. Blow out the hole with compressed air to remove all traces of swarf, and using the appropriate taper, and plug taps, thread the hole to 0·7254 inch diameter by 19 T.P.I., Whitworth thread form, and to a depth of 0·500 inch.

4. Using a suitable countersink, chamfer the hole to a 0·725 inch diameter and to a 90 deg. included angle.

5. Remove any burrs from the edge of the hole, blow out the hole, and using the appropriate inserting tool, screw in wire insert Part No. N.7394 to the bottom of the thread, refer to Fig. 4. Break off, and remove, the notched tang of the insert.

6. Use a John Bull Intercheck small bore gauge in conjunction with the appropriate mandrel, and ring screw gauge, to check the thread of the insert.

7. Lightly stamp T.R.394 adjacent to the existing part number on the sump. Make the appropriate entry in the engine log book.