

SECTION 1

ENGINE AND EXHAUST SYSTEM

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SERVICE BULLETIN

RECORD SHEET

No.	Subject	Date	Signature
1	Carburetor Conversion.	25. 4. 56.	Subtotal.
2	Stripped Thread in Sump Drain.	25. 4. 56.	"
3	Engine and Exhaust System (Type 403).	25. 4. 56.	"
4	Internal Oil Coolers.	30. 4. 56.	"
5	Internal Oil Coolers.	8. 11. 56.	Not included.
6	Sump Drainage Modification.	17. 1. 57.	

ENGINE AND FUEL SYSTEM

DESCRIPTION

The engines fitted to types 400, 401 and 402 cars are basically identical with the exception of the carburetors, see the General Data of Section 1. Figs. 1 and 2 illustrate the constructional features.

The cylinder block is a one-piece casting, the crankshaft being supported by four main bearings of the steel-backed replaceable type. Bearings of a similar type are employed for the big ends of the connecting rods, the small end bearings for the timing gears pin being bronze bushes. A chain drive is employed for the crankshaft which is supported by four bronze bush bearings on the left-hand side of the cylinder block, an integral helical gear mounted centrally on the shaft engaging the distributor and oil pump drive pinion. The oil pump is bolted to the base of the cylinder block within the sump. An adjustable relief valve located in the cylinder block immediately above the oil filter, controls the pressure of the oil delivered to the bearings.

The detachable light-alloy cylinder head assemblies include valve seats which are shrink-fitted. Bronze valve guides locate the exhaust valves on the right-hand side of the head and the inlet valves on the left-hand side. The overhead rocker system is operated by push rods, auxiliary push rods being used to transmit the movement of the exhaust push rods (via auxiliary rockers mounted on the inlet rocker spindle) to the exhaust valves.

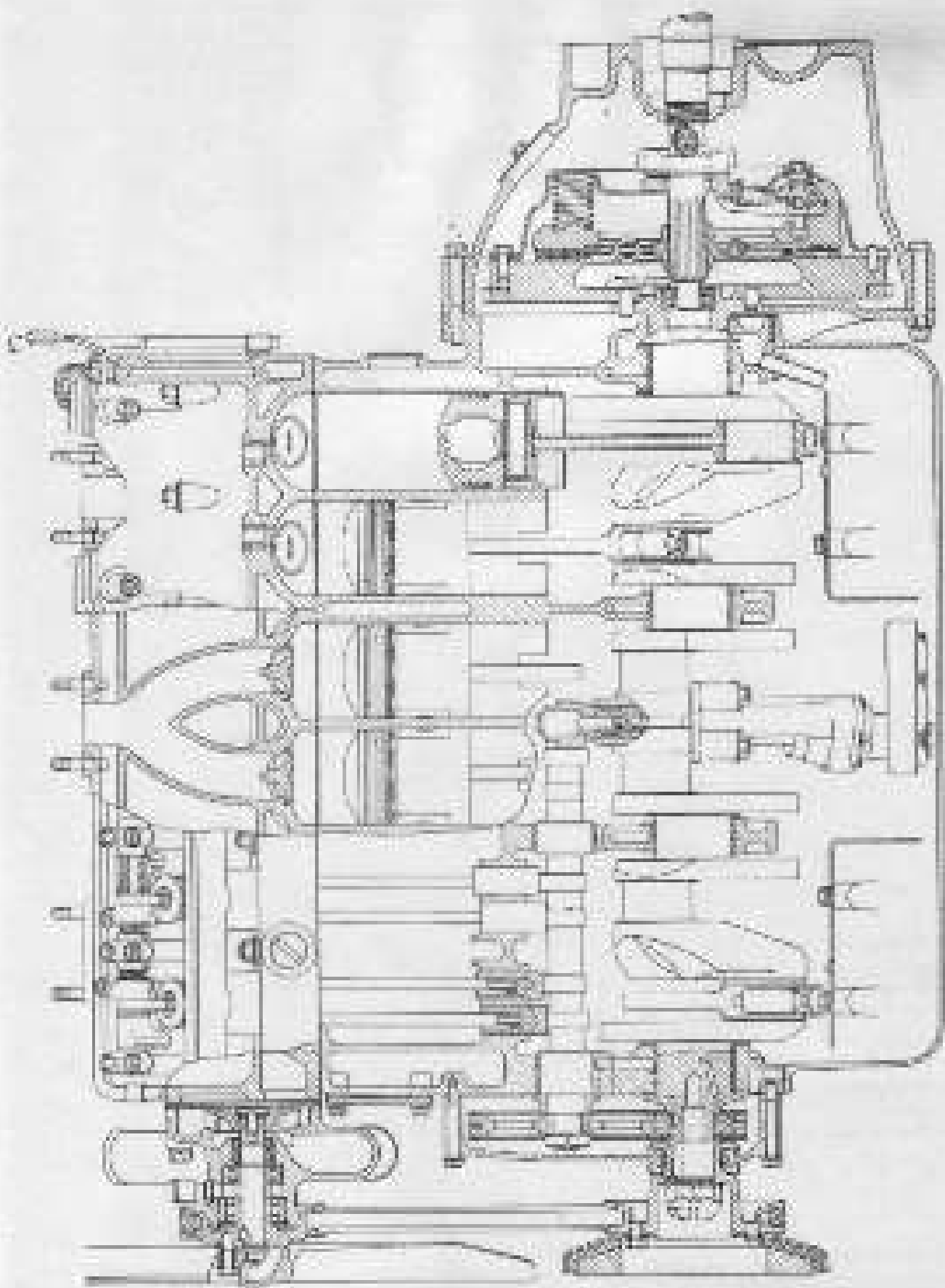


Fig. 1. Longitudinal section view of Type 314 engine with combustion removal.

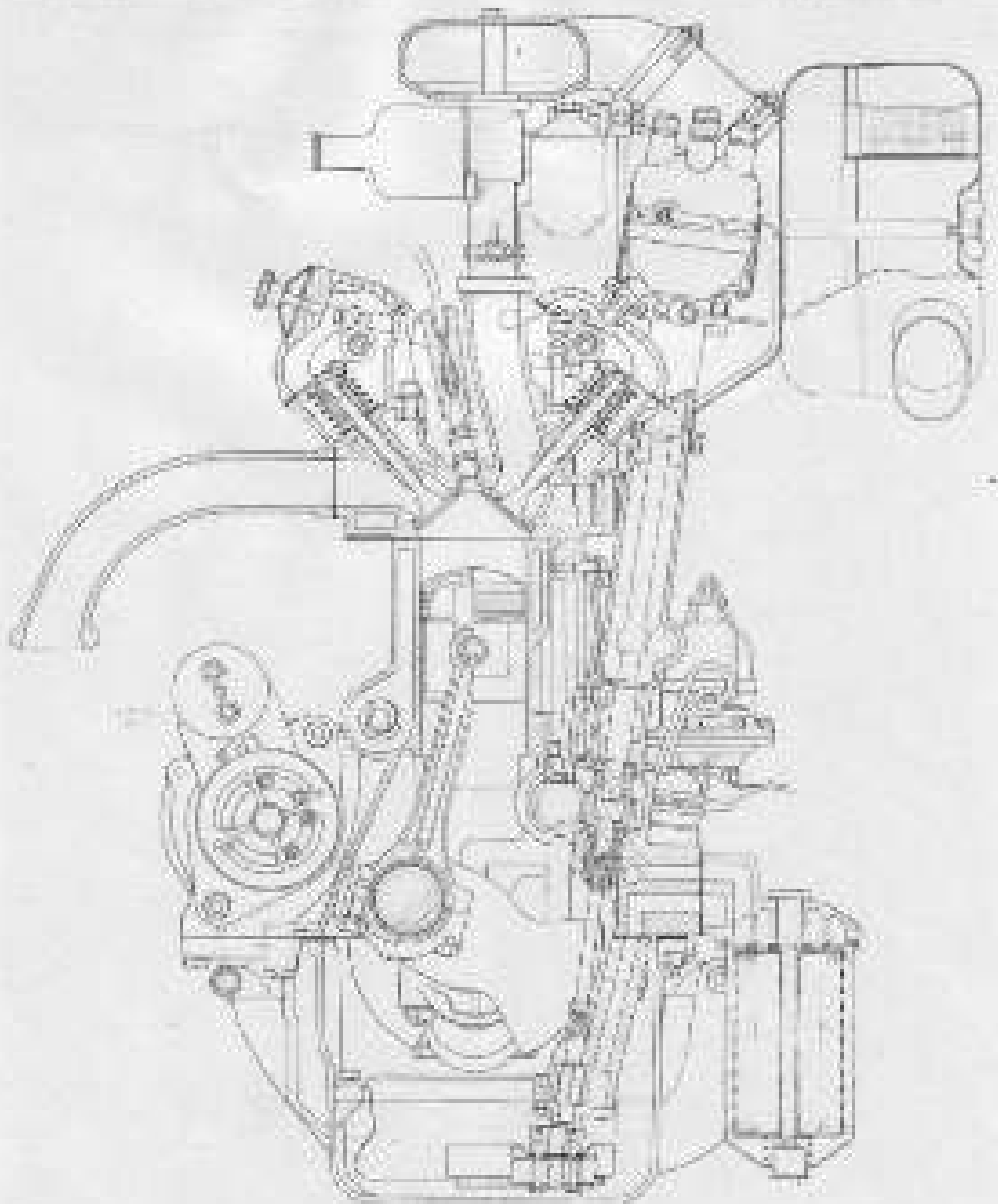


Fig. 2. Transverse section view of Type 12A Engine.

The engine and gearbox unit is flexibly mounted on four boxed-rubber blocks, those at the front being bolted between the engine bracket attached to the cylinder block and chassis frame, and those at the rear being secured between the gearbox extension and chassis cross member. Torque buffers are fitted on the left-hand side of the flywheel housing.

GENERAL DATA

Type...	...	...	...	Overhead valve, push-rod operated.
No. of cylinders...	...	...	...	6 in line.
Bore...	...	...	...	2.5384 in. (66 mm.).
Stroke...	...	...	...	3.779 in. (96 mm.).
Compression ratio...	...	...	...	7.5 to 1.
Cubic capacity (cylinder displacement)...	...	...	...	130.3 cu. in. (1,971 c.c.).
Rated horse-power...	...	...	...	15.2 H.P. (rating).
Maximum S.F.P.				
Type 85...	...	...	...	75 at 2,800 r.p.m. (75.06 S.F.P.).
Type 85A...	...	...	...	80 at 2,800 r.p.m. (81.10 S.F.P.).
Type 85C...	...	...	...	85 at 2,800 r.p.m. (86.10 S.F.P.).
Height of engine (less gearbox)				
Type 85...	...	...	...	350 lb. (158.5 kg.).
Type 85A...	...	...	...	350 lb. (158.5 kg.).
Type 85C...	...	...	...	366 lb. (167.1 kg.).
Oil pump...	...	...	...	Gear type.
Oil sump capacity...	...	...	...	10 pints (5.68 litres).
Oil filter...	...	...	...	"Yaker" or "Twealant".
Oil pressure...	...	...	...	50 p.s.i. (3.45 kg./cm. ²) at 10% and 3,000 r.p.m.

Capacity of external oil cooler (optional fitting) 1 pint (0.568 liters) approx.

Cylinder block

Type Mono-bloc casting. Late type 054 engines and all type 892 engines fitted with dry-type cylinder liners.

Interference fit between liner and bore 0.0025 in. to 0.003 in. (0.063 mm. to 0.076 mm.)

Tapet body in cylinder block - seized clearance 0.0001 in. to 0.0013 in. (0.002 mm. to 0.033 mm.)

Oil pump

Driving and driven gears, dia. 0.682 in. (+0.0025 in.)
17.315 mm. (+0.063 mm.)

Gear location dia. in pump casing 0.585 in. (+0.0025 in.)
14.819 mm. (+0.063 mm.)

Radial clearance of gears in casing 0.001 in. to 0.002 in.
(0.025 mm. to 0.051 mm.)

Driving and driven gear journal dia. 0.3725 in. (+0.0005 in.)
9.512 mm. (+0.013 mm.)

Journal location dia. in pump casing 0.375 in. (+0.0025 in.)
9.525 mm. (+0.063 mm.)

Running clearance of gear journals in casing 0.0025 in. to 0.003 in.
(0.063 mm. to 0.076 mm.)

Journal location dia. in pump cover 0.375 in. (+0.0025 in.)
9.525 mm. (+0.063 mm.)

Running clearance of gear journals in pump cover 0.0025 in. to 0.003 in.
(0.063 mm. to 0.076 mm.)

End-flank of gears 0.0005 in. to 0.0015 in.
(0.013 mm. to 0.038 mm.)

Backlash of gears 0.0015 in. to 0.002 in.
(0.038 mm. to 0.051 mm.)

Outer spring - free length (approx.)	...	1.697 in.	(43.200 mm.)
Length when loaded to 54 lb. (\pm 4 lb.)	...	1.523 in.	
24.5 kg. (\pm 1.8 kg.)	...	39.111 mm.	
Rocker bush bore dia. ....	...	0.316 in.	(8.034 mm.)
Rocker spindle dia. ....	...	0.309 in.	(7.839 mm.)
Rocker bush and spindle - desired clearance. ....	...	0.001 in. to 0.029 mm. to	0.003 in. 0.076 mm.)
Valves			
Top-to-closure 0000	...	0.002 in.	(0.051 mm.)
Valve seat angles. ....	...	Intake = 25°	Exhaust = 25°
Valve stem dia. ....	...	0.3503 in.	(8.907 mm.)
Valve guide bore dia. ....	...	0.3473 in.	(8.855 mm.)
Valve stem and guide - desired clearance (cold) ....	...	0.002 in. to 0.051 mm. to	0.003 in. 0.076 mm.)
Valve guide outside dia. ....	...	0.451 in. 12.217 mm.	(+0.0005 in.) (+0.013 mm.)
Valve guide internal bore	...	0.4217 in. 10.709 mm.	(+0.0005 in.) (+0.013 mm.)
Interference fit of valve guide in cylinder head. ....	...	0.0023 in. (0.058 mm.)	to 0.0023 in. to 0.058 mm.)
Inner spring - free length (approx.)	...	1.629 in.	(41.475 mm.)
Length when loaded to 37.5 lb. (\pm 4 lb.)	...	1.085 in.	
17.0 kg. (\pm 1.8 kg.)	...	27.411 mm.	
Outer spring - free length (approx.)	...	1.547 in.	(39.250 mm.)
Length when loaded to 54 lb. (\pm 4 lb.)	...	1.085 in.	
24.5 kg. (\pm 1.8 kg.)	...	27.411 mm.	

Crankshaft

No. of main bearings	...	...	...	...	4	
Bearing type	...	...	...	...	Steel backed, lined.	Lead indium bronze
Main bearing journal dia. (nom)	...	...	...	...	2.000 in. 50.800 mm.	(+0.000 in.) (+0.013 mm.)
Main bearing journal dia. (after 1st re-grind)	...	...	...	...	1.995 in. 50.545 mm.	(+0.000 in.) (+0.013 mm.)
Main bearing journal dia. (after 2nd re-grind)	...	...	...	...	1.990 in. 50.292 mm.	(+0.000 in.) (+0.013 mm.)
Main bearing journal length						
Front bearing	...	...	...	...	1.464 in. 37.216 mm.	(+0.000 in.) (+0.031 mm.)
Mid-front bearing	...	...	...	...	1.181 in. 29.997 mm.	(+0.010 in.) (+0.216 mm.)
Mid-rear bearing	...	...	...	...	1.181 in. 29.997 mm.	(+0.010 in.) (+0.216 mm.)
Rear bearing	...	...	...	...	1.415 in. 35.917 mm.	(+0.010 in.) (+0.216 mm.)
Crankpin dia. (nom)	...	...	...	...	1.721 in. 43.763 mm.	(+0.000 in.) (+0.013 mm.)
Crankpin dia. (after 1st re-grind)	...	...	...	...	1.715 in. 43.529 mm.	(+0.000 in.) (+0.013 mm.)
Crankpin dia. (after 2nd re-grind)	...	...	...	...	1.711 in. 43.275 mm.	(+0.000 in.) (+0.013 mm.)
Crankpin length	...	...	...	...	1.103 in. 28.016 mm.	(+0.001 in.) (+0.013 mm.)
Bearing hardness	...	...	...	...	900 V.P.S.	
Thrust (given as crankshaft)	...	...	...	...	Feint bearing.	
End-flange (nom)	...	...	...	...	0.002 in. to 0.004 mm. to	0.006 in. 0.203 mm.)

End-face roundness	0.004 in. to 0.012 in. {0.102 mm. to 0.305 mm.}
Mal-alignment of crankshaft	0.002 in. (0.004 in. dial indicator reading). 0.011 in. (0.102 mm. dial indicator reading).
Running clearance of crankshaft in main bearings	0.001 in. to 0.0025 in. {0.025 mm. to 0.064 mm.}

Connecting rods and pistons

Connecting rods

Type	Alloy steel, "H" section.
Distance between centres	4.2367 in. (+0.002 in.) 107.000 mm. (+0.01 mm.)
Gudgeon pin bush location	0.370 in. (+0.005 in.) 9.403 mm. (+0.127 mm.)
Side clearance on crankpin	0.008 in. to 0.016 in. {0.203 mm. to 0.395 mm.}

Big-end bearings

Type	Steel backed, lead Indian bronze lined.
Ball thickness	0.07225 in. (-0.0001 in.) 1.831 mm. (-0.002 mm.)
Running clearance on journals	0.0012 in. to 0.0022 in. {0.031 mm. to 0.056 mm.}

Gudgeon pin bushes

Bore dia.	0.7974 in. (+0.0005 in.) 20.152 mm. (+0.013 mm.)
Outside dia.	0.892 in. (-0.0003 in.) 22.702 mm. (-0.013 mm.)
Interference fit in connecting rod	0.001 in. to 0.002 in. {0.025 mm. to 0.051 mm.}

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Gudgeon pins

Outside dia.	0.7173 in. 18.016 mm.	{-0.0002 in.} {-0.005 mm.}
Clearance in gudgeon pin bush.	0.0001 in. to {0.0005 in. to 0.0008 in. desired}* {0.002 mm. to 0.020 mm.}	0.0005 in. {0.0008 in. desired}* {0.020 mm. desired}*
Fit in piston bore	...	...	...	...	0.0001 in. interference to 0.0008 in. clearance. *	{0.002 mm. interference to 0.006 mm. clearance} *

Pistons

Skirt dia.	...	...	...	...	2.5562 in. (65.504 mm.)	
Gudgeon pin bore...	...	...	...	...	0.709 in. 18.001 mm.	{+0.0005 in.} {+0.007 mm.}
Piston clearance in cylinder bore, skewed side and on thrust side	...	...	...	...	0.0022 in. to {0.006 mm. to 0.006 mm.} *	0.0025 in. * {0.006 mm.} *
Oversize pistons...	...	...	...	...	+0.010 in. on outside dia.	{0.254 mm.}

Piston rings

Radial thickness (all rings)...	...	...	...	...	0.105 in. 2.667 mm.	{-0.0025 in.} {-0.127 mm.}
Radial pressure (compression)...	...	...	...	...	20.5 to 29.9 p.s.i. {1.268 to 2.102 kg./cm. ² }	
Radial pressure (scrape)	...	...	...	...	30.9 to 40.0 p.s.i. {2.109 to 2.812 kg./cm. ² }	
Width of ring (compression)...	...	...	...	...	0.9715 in. 2.469 mm.	{-0.001 in.} {-0.025 mm.}
Width of ring (scrape)...	...	...	...	...	0.7562 in. 1.928 mm.	{-0.001 in.} {-0.025 mm.}
Ring clearance in groove (compression)	...	...	...	...	0.0029 in. to {0.002 mm. to 0.074 mm.}	0.0029 in. {0.074 mm.}
Ring clearance in groove (scrape)...	...	...	...	...	0.001 in. to {0.001 mm. to 0.076 mm.}	0.001 in. {0.076 mm.}
Ring gap when fitted in cylinder	...	...	...	...	0.020 in. to {0.505 mm. to 0.505 mm.}	0.025 in. {0.635 mm.}

* Indicates that selective assembly is necessary.

Camshaft

No. of journals	...	...	...	...	...	4	
Bearing	...	...	...	...	...	Diaper-bronze.	
Bearing journal diameter							
Front	...	...	...	...	...	1.458 in. 37.003 mm.	(+0.0005 in.) (+0.013 mm.)
Mid-front	...	...	...	...	...	1.458 in. 36.925 mm.	(+0.0005 in.) (+0.013 mm.)
Middle	...	...	...	...	...	1.418 in. 36.007 mm.	(+0.0005 in.) (+0.013 mm.)
Rear	...	...	...	...	...	1.278 in. 32.353 mm.	(+0.0005 in.) (+0.013 mm.)
Contact thrust lobes	...	...	...	...	...	Front	
Bearing clearance in bearings							
End-flush	...	...	...	...	...	0.008 in. to 0.005 in. (0.102 mm. to 0.076 mm.)	
Mid-flush	...	...	...	...	...	0.005 in. to 0.002 in. (0.102 mm. to 0.052 mm.)	
Maximum misalignment of journals							
	...	...	...	...	...	0.001 in. (0.002 in. dial indicator reading). 0.025 mm. (0.051 mm. dial indicator reading).	
Cam lift	...	...	...	...	...	0.2066 in. (5.202 mm.)	
End-flush of distributor drive gear	...	...	...	...	...	0.0066 in. to 0.018 in. (0.168 mm. to 0.456 mm.)	
Backlash between gear and camshaft gear	...	...	...	...	...	0.005 in. to 0.003 in. (0.076 mm. to 0.127 mm.)	
Diametral clearance of gear in bush	...	...	...	...	...	0.0009 in. to 0.0003 in. (0.015 mm. to 0.008 mm.)	
Camshaft bearings							
Fore dia.							
Front	...	...	...	...	...	1.450 in. 36.802 mm.	(+0.001 in.) (+0.025 mm.)
Mid-front	...	...	...	...	...	1.450 in. 36.976 mm.	(+0.001 in.) (+0.025 mm.)

Mid-rear...	...	...	...	...	...	1.420 in. 36.068 mm.	(-0.001 in.) (-0.025 mm.)
Rear	...	...	...	...	...	1.260 in. 32.008 mm.	(-0.001 in.) (-0.025 mm.)

Bearing outside dia.

Front...	...	...	...	...	...	1.6778 in. 42.616 mm.	(-0.0003 in.) (-0.013 mm.)
Mid-front	...	...	...	...	...	1.6578 in. 42.124 mm.	(-0.0003 in.) (-0.013 mm.)
Mid-rear	...	...	...	...	...	1.7078 in. 43.410 mm.	(-0.0003 in.) (-0.013 mm.)
Rear...	...	...	...	...	...	1.7398 in. 44.196 mm.	(-0.0003 in.) (-0.013 mm.)

Bearing location in cylinder block

Front...	...	...	...	...	...	1.473 in. 37.527 mm.	(+0.0007 in.) (+0.018 mm.)
Mid-front	...	...	...	...	...	1.503 in. 38.033 mm.	(+0.0007 in.) (+0.018 mm.)
Mid-rear	...	...	...	...	...	1.713 in. 43.361 mm.	(+0.0007 in.) (+0.018 mm.)
Rear...	...	...	...	...	...	1.733 in. 44.069 mm.	(+0.0007 in.) (+0.018 mm.)

Interference fit of bearings
in cylinder block

Front...	...	...	...	...	...	0.0016 in. to 0.0029 in. (0.041 mm. to 0.071 mm.)
Mid-front	...	...	...	...	...	0.0016 in. to 0.0029 in. (0.041 mm. to 0.071 mm.)
Mid-rear	...	...	...	...	...	0.0016 in. to 0.0029 in. (0.041 mm. to 0.071 mm.)
Rear...	...	...	...	...	...	0.0025 in. to 0.0038 in. (0.066 mm. to 0.097 mm.)

Ignition system

Coil...	...	...	...	...	...	...	Lucas Model B.12, type 1.
Distributor...	...	...	...	...	...	...	Lucas type B3H51, 90.1.
Contact breaker gap	...	...	...	...	...	...	0.010 in. to 0.012 in. (0.254 mm. to 0.305 mm.)
Contact breaker cam	...	...	...	...	...	...	8 lobes.
Maximum advance...	...	...	...	...	...	...	18°.
Advance begins	...	...	...	...	...	...	1,000 r.p.m. (engine speed).
Advance ends	...	...	...	...	...	...	5,200 r.p.m. (engine speed).
Initial timing	...	...	...	...	...	...	3° B.T.D.C. (fully retarded).
Advance mechanism type...	...	...	...	...	...	...	Centrifugal with lead over-ride.
Spark plug							
Type...	...	...	...	...	...	...	S.L.S. P. 12H. L.10.
Recommended gap	...	...	...	...	...	...	0.010 in. to 0.020 in. (0.254 mm. to 0.508 mm.)
Firing order	...	...	...	...	...	...	1, 3, 2, 4.
Clearance of distributor drive shaft in drive casing bearing.							
	...	...	...	...	...	...	0.0010 in. to 0.0015 in. (0.025 mm. to 0.038 mm.)
Shaft end-float							
	...	...	...	...	...	...	0.002 in. to 0.004 in. (0.051 mm. to 0.102 mm.) Thrust washer to suit.
Clearance of tachometer drive shaft in tachometer drive body							
	...	...	...	...	...	...	0.0004 in. to 0.0016 in. (0.010 mm. to 0.040 mm.)
Shaft end-float							
	...	...	...	...	...	...	0.005 in. to 0.011 in. (0.127 mm. to 0.279 mm.) Allow 0.010 in. (0.254 mm.) for joint washer.
Backlash between distributor and tachometer drive gears.							
	...	...	...	...	...	...	0.006 in. to 0.008 in. (0.152 mm. to 0.203 mm.)

LUBRICATION SYSTEM

Description

The lubrication systems of the engine are shown diagrammatically in Figs. 1 to 6. A glass unit is attached to the pump intake at the bottom of the pump casing cover and is completely submerged in the oil sump. Pressure oil is delivered through the pump body and a cooling internal gallery in the cylinder block wall to the head of a filter unit mounted externally on the left-hand side of the cylinder block. A branch duct from the pump delivery passage to the filter links the system to the piston-type pressure-relief valve, excess oil being returned direct into the sump.

If the car is fitted with an external oil cooler in front of the radiator, flexible rubber pipes are connected to external union connections on the inlet just of the "Takeda" filter head to circulate the oil through the cooler prior to entering the filter; a spring-loaded valve in the duct of the filter permits the oil to by-pass the cooler in cold weather to ensure immediate flow of oil to the bearings, see page 12. When an external cooler is not fitted, the union locations are blanked, a by-pass is also arranged in the filter to cater for the possibility of a slinger filter insert assembly. After passing through the filter, the oil re-enters the cylinder block to the main gallery which extends longitudinally through the left-hand cylinder block wall immediately below the camshaft, an annular groove around the distributor and oil pump driving pinion back linking the front and rear portions of the gallery. A drilling from the

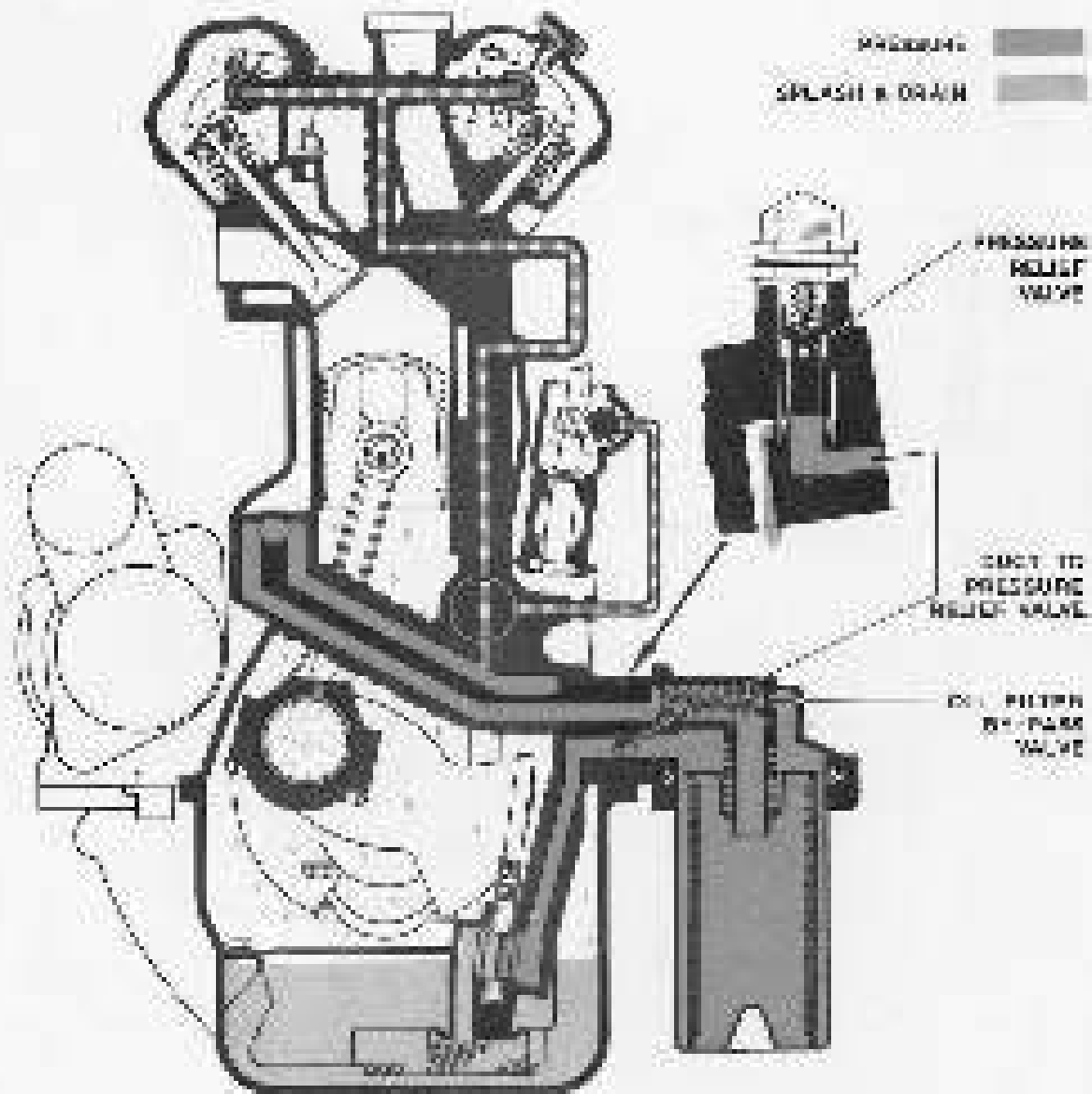


Fig. 6. Diagram of Type 45 and 63 Kaplan lubrication system - front view.

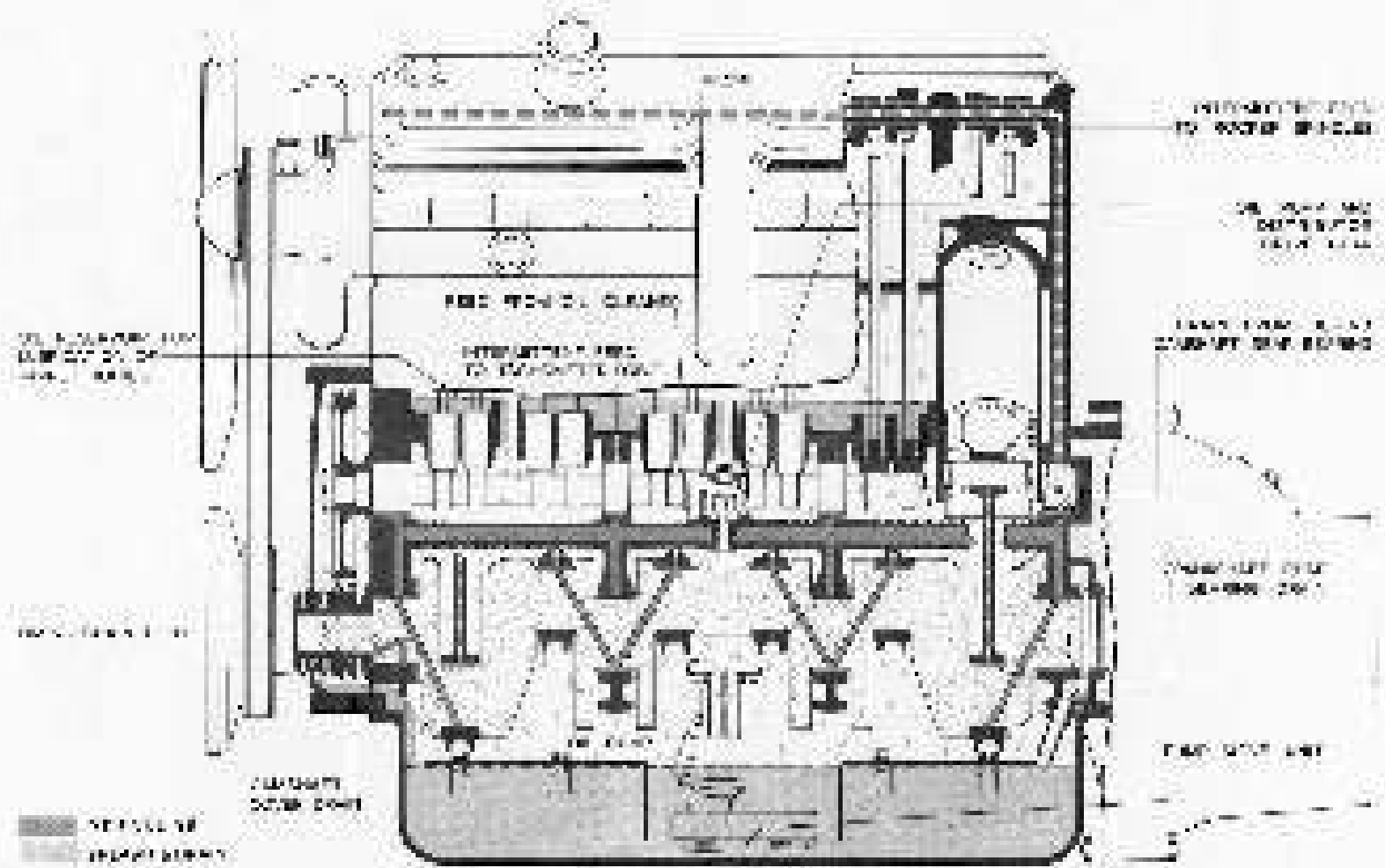


FIG. 5. Diagram of Type RC Engine lubrication system - side view.

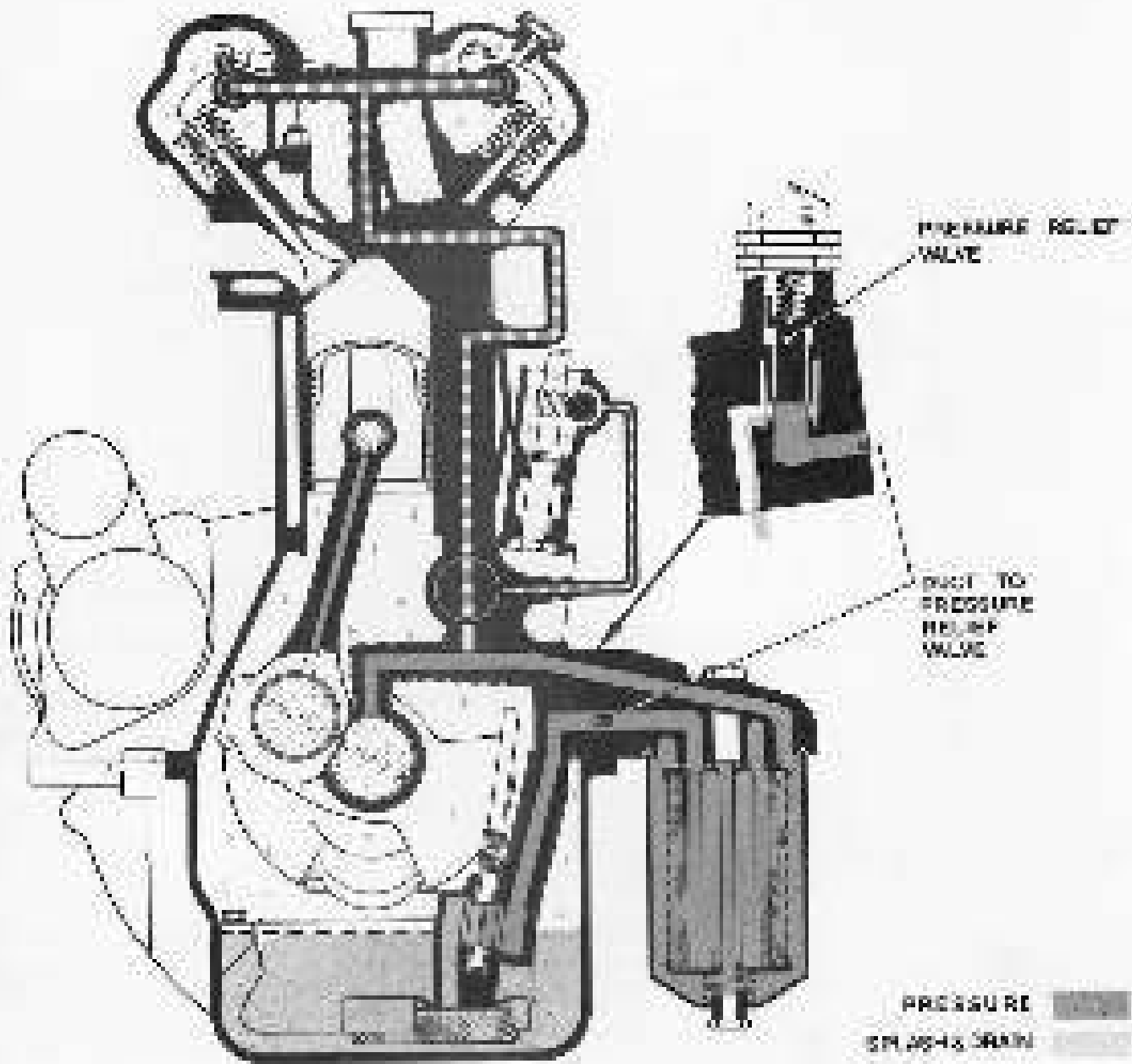


Fig. 6. Diagram of Type R97 Engine Lubrication System, Front - Front view.

Each passage to its head provides pressure lubrication to the bearing of the distributor and oil pump driving pinion. Branch passages from the gallery supply the camshaft bearings and the crankshaft main bearings, ducts in the crankshaft containing the filter to the connecting rod big end bearings. A duct drilled through each rod provides an intermittent feed from the big end bearings to the gudgeon pin bushes.

Note (1) On type 25 and 814 engines, the oil leaving the filter is ducted to a transfer housing located on the right-hand side of the front of the cylinder block before entering the main gallery. This housing was designed to accommodate an internal oil cooler; where this has been removed, the location is blanked, see page 20. On these engines, the front camshaft bearing is lubricated through a branch duct from the return passage from the oil transfer housing to the main gallery, see Fig. 4.

The crankshaft front main bearing journal incorporates an additional duct which terminates in the front end of the journal; oil flowing from the bearing through this duct emerges through the annular space between the thrust plate and the shaft front spigot and enters a drilling in the timing chain drive sprocket to lubricate the chain. An external connection from the main gallery accommodates the pipe to the oil pressure pump.

An intermittent feed to the overhead rocker system is obtained from a timing-rod drilling in the rear camshaft bearing journal which registers every 360° revolution with an oilway in the rear wall of the cylinder block. This is fed by an external pipe to a duct in the cylinder head. Branch ducts from the cylinder head oilway terminate in each rocker spindle rear insertion, the feed being continued through the spindle to the rocker. A further intermittent feed (from the mid-front crankshaft bearing) is connected by an external pipe to

The lubricator drive is the distributor drive casing. The temperature of the oil is recorded by means of a thermometer bulb inserted in the left-hand side of the oil sump. The cylinders, pistons and remaining drives are lubricated by splash or drain oil.

Pressure relief valve

Located on the left-hand side of the cylinder block, see Fig. 7, the relief valve is interposed in the supply from pump to filter. The assembly consists of the body which houses the relief valve, spring and adjusting screw. The assembly is screwed into the cylinder block where it is secured by a lock-out, the cap closing the outer end.

Two types of valve bodies have been manufactured. The earlier type has four equally spaced $\frac{7}{32}$ in. outlet holes, while the latest type has three equally spaced holes, two being $\frac{7}{32}$ in. and one $\frac{1}{4}$ in. This eliminates all possibility of valve flutter.

Removing and refitting pressure relief valve

If the operation of the valve is suspect, remove and inspect the assembly as follows. Slacken the lock-out, then tighten it against the cap and unscrew the assembly from the cylinder block. Holding the lock-out, loosen the cap, then remove the cap, lock-out and sealing washers. Extract the adjuster retaining pin, unscrew the adjusting screw and withdraw the valve and spring. Clean all components thoroughly.

Check that the oil holes in the body are unobstructed. Inspect the valve for picking-up and hard bearing; if necessary, dress such areas by light stoning. Trial-fit the valve in the body; it should be an easy sliding fit.

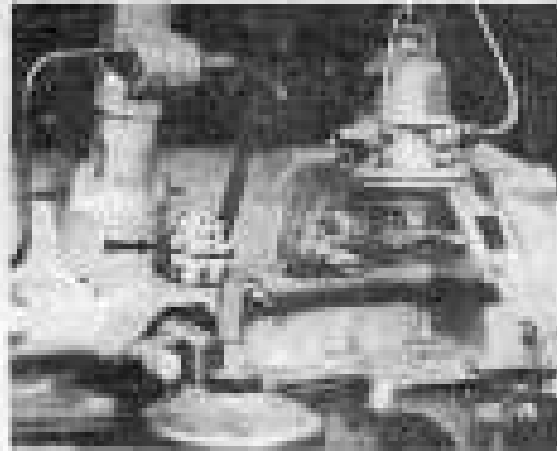


Fig. 7. Oil pressure relief valve.

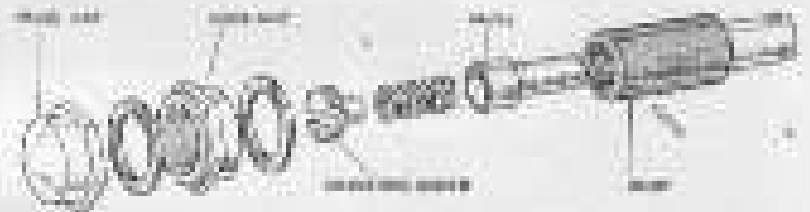


Fig. 8. Relief valve assembly.

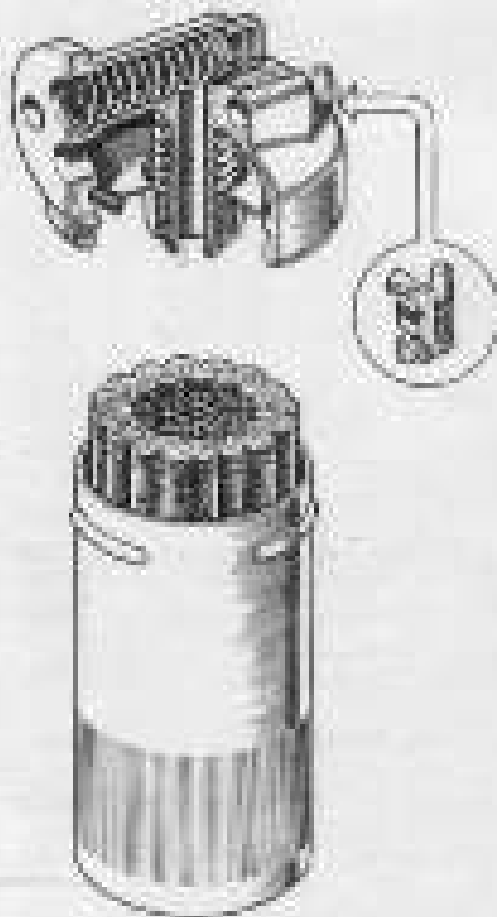


Fig. 9. "Tensimat" oil cleaner.

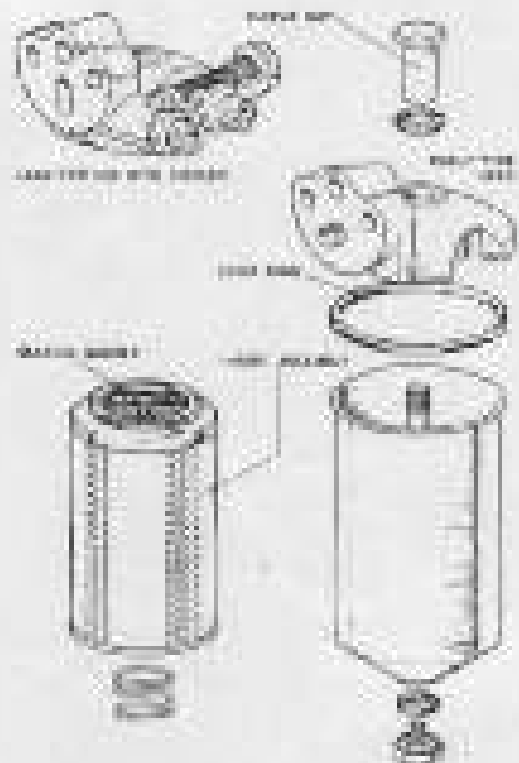


Fig. 10. "Voise" oil cleaner.

Re-assemble the valve, spring and adjuster to the body, screwing in the adjusting screw until the retaining pin can be inserted. Fit the lock-out and cap, locking them together, and screw the assembly into the cylinder block; make sure that the valve body is screwed down firmly so its seating or loss of oil pressure may result. Separate and remove the lock-out and cap.

Note 1:- An aluminium washer fitted to the cylinder block forms a sealing for the body. If there is evidence of oil leakage, causing loss of oil pressure, renew the washer.

Fit a new sealing washer over the body and lock the assembly in position with the lock-out.

Adjusting the oil pressure

After removal of the relief valve assembly or if the pressure is incorrect, proceed as follows. Run the engine until the oil is at 100% and open up to 3,000 r.p.m. Remove the cap and retaining pin, then screw out the adjusting screw to decrease the pressure or screw in to increase the pressure. Replace the retaining pin, fit a new sealing washer then screw on and securely tighten the cap.

Maintenance

Check periodically that the pump retaining set-screws are secure and that there is no oil leakage from the pump-to-cylinder block joint. Check also that all external oil pipes and the filter unit retaining set-bolts are secure and that the pipes are not kinked or fractured. Should oil leakage at the filter-to-cylinder block joint be detected and the set-bolts are secure, remove the filter unit as described on page 23 or 30, clean the joint faces and refit the unit, using a new joint. Do not use jointing compound.

ENGINE OIL

It is most important to use the correct grade of oil according to the season and the climatic conditions. Approved oils for various conditions are given in the "Approved Lubricants" on page 27. When measuring the oil level, make sure the car is level and wipe off the dipstick to obtain an accurate reading. Allow time for the oil to drain to the sump then make certain that the dipstick is inserted fully when measuring the level. Maintain the level at or near (but not over) the upper mark. Avoid overfilling as this will result in high oil temperatures.

Changing the oil

It is recommended that this should be done every 1,000 miles (1,600 kilometers) and preferably after an engine run, i.e. when the engine is hot. To drain the oil, remove the drain plug on the left underside of the sump and also, if fitted, the plug in the base of the oil filter. If a plug is not fitted, remove the filter casing to drain the filter. Fit a new filter element as described on page 29 or 30. If the car is on a level surface, jack up the right-hand side of the car slightly to incline the sump base; this will assist drainage. After thorough draining, replace the drain plugs in the filter and sump. On cars with an external oil cooler, disconnect the two flexible oil pipes at the head of the oil filter, and allow the oil to drain into a suitable container. Drain the cooler completely by applying a blast of clean, dry compressed air through the upper flexible pipe. This will also enable any obstruction to be detected; in this event, remove the unit as described on page 37 and clear the obstruction with a suitable solvent.

When drainage is completed, re-fill the sump with approved oil through the oil filler on the inlet rocker box cover; prime the oil filter as described on page 29 or 30 before any attempt is made to turn or start the engine.

OIL FILTER (FOR HIGH TYPES)

Description

Early type 25 and 43A engines are fitted with a "Fiscobond" filter and all later engines with a "Fokse" filter, both types being actuated by the 257-6033 to the ball-head side of the cylinder block.

The filter consists of a casing in which is located a replaceable element. On "Fokse" filters, the element is contained in a perforated steel frame, the unit being known as the "insert assembly". The casing is attached to a head which provides the attachment point to the cylinder block, and which is formed with an outlet which receives the oil from the pump and one which conveys the filtered oil to the engine system.

On "Fiscobond" filters, oil enters the casing and emerges from the base of the element. A spring-loaded valve links the outlet passage in the head with the interior of the casing, enabling the oil to by-pass the element should it become clogged.

The flow is reversed on "Fokse" filters, the oil entering the base of the insert assembly and emerging from the casing. A spring located beneath the assembly holds the upper end cap against a seating on the head thus providing a by-pass in the event of the assembly becoming clogged. A later type of head also incorporates a spring-loaded valve in the inlet passage and has external connections for use when an external source is fitted to the car. The valve

enables the oil to by-pass the cooler in the event of sliding. When an external cooler is not fitted, the union locations are blanked.

Serviceing (Fuelcoxit)

Depress the locking plunger, twist the casing, withdraw it clear of the head and withdraw the element. The element should be discarded after 5,000 miles, and a new one fitted. Do not attempt to clean an element, since foreign matter will transfer from the inside to the outside and vice versa. Check the condition of the rubber sealing ring in the recess of the head; fit a replacement if damaged or spongy. Check that the by-pass valve operates satisfactorily. If it is desired to remove the head, release the two retaining screws and washers, and withdraw the head. After cleaning, ensure the joint faces are undamaged and refill the head, using a new joint; ~~do not use jointing compound.~~

Before refitting the element and casing, it is advisable to fill the casing with clean approved engine oil, thereby ensuring an immediate supply to the engine system when the engine is started. Ensure that the casing is seated squarely into the head and that the locking plunger returns to its position.

Serviceing (Valve)

Remove the drain plug from the bottom of the casing and allow the oil to drain. Slacken the sleeve nut at the top of the head, then hold the casing while the nut is unscrewed; remove the casing complete. Withdraw the seating washer, insert assembly and spring from the casing. The insert assembly should be discarded after 5,000 miles and a new one fitted. Do not attempt to clean the insert assembly.

If the head is to be removed, disconnect the pipes to the external cooler (if fitted), remove the two retaining bolts and washers and withdraw the head. If an external cooler option is fitted, a by-pass valve is fitted to the head and should be removed for cleaning by unscrewing the blank and withdrawing the valve and spring. After cleaning, ensure that the spring is not seated and that the valve operates freely in its location in the head before replacing the valve assembly. Disassemble the joint plug and fit a new ring. Ensure that the joint faces are clean then refit the head, using a new joint; do not use jointing compound. Reconnect the cooler pipes (if fitted).

Check the condition of the spring, seating washer and the joint washers for the drain plug and sleeve nut. Before refitting the insert assembly and casing, it is advisable to fill the casing with clean approved engine oil to ensure an immediate supply to the injection system when the engine is started. Check that the seating ring seats squarely on the insert assembly, then offer up the assembly and casing, and secure with the sleeve nut; tighten the nut firmly. Refit the drain plug.

INTERNAL OIL COOLER

An internal oil cooler is fitted to some type 35 and 35A engines, and is located in a chamber on the right-hand side of the cylinder block.

It is recommended that the cooler is removed and discarded at the first available opportunity and its location blanked off. The oil cooler body must be retained and refitted, as described subsequently, to serve as an oil transfer block.

To avoid removing the radiator to withdraw the oil cooler, proceed as follows:-

1. Open the bonnet.
2. Remove the four $\frac{1}{2}$ in. B.S.F. nuts and spring washers, and the down nut and its adjustment washer securing the unit to the studs at the front of the cylinder block; retain the nuts and washers.
3. Withdraw the oil cooler as far as possible (taking care not to damage the radiator matrix), and cut through the tube unit; remove and retain the oil cooler body and the attached portion of the tube. Remove the remaining portion of the oil cooler tube unit by withdrawing it as far as possible and again cutting through the tube.

After the cooler has been removed, carry out the following blanking operations; the blanking plate CP8.036, together with two new gaskets B.360330 will be required. Proceed as follows:-

4. Hold the oil cooler body in a soft-jawed vice and remove the retaining cap and washer, followed by the relief valve spring and the scrape washer, see Fig.12.
5. Reverse the body in the vice and unscrew the stub portion of tube unit from the body with a spanner applied to the flat on the tube.
6. Release the body from the vice and withdraw the relief valve, and the two oil cooler nut washers, then re-position the body in the vice and refit the retaining cap and its washers.
7. Since the blanking plate takes up some of the axial length, check that enough thread is available to provide full engagement with the nut. If this is not so, lightly spotface the oil cooler body until satisfactory.
8. Make sure that the joint faces of the cylinder block, blanking plate and oil cooler body are perfectly clean and dry, then assemble one of the new gaskets over the securing studs, followed by the blanking plate.
9. Fit the remaining gasket, then assemble the oil cooler body to the studs and secure with the four spring washers and $\frac{1}{2}$ in. B.S.F. nuts and the adjustment washer and down nut. The latter washer and nut should be fitted to the innermost stud;

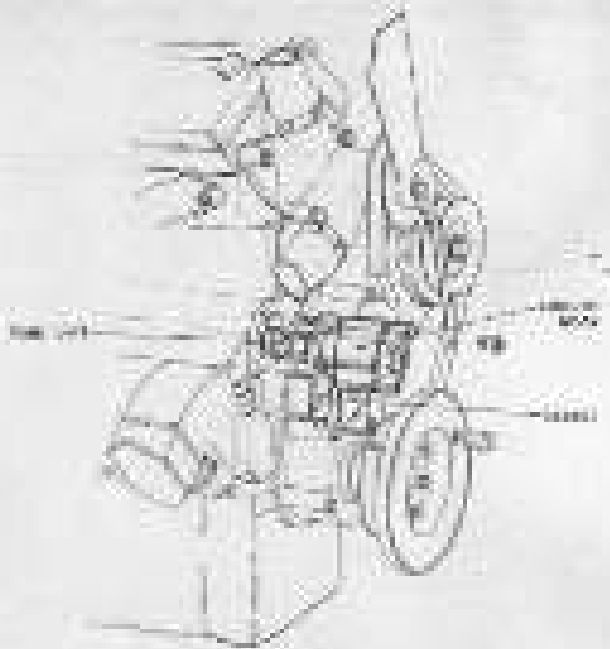


Fig. 10. Exploded internal cooler.

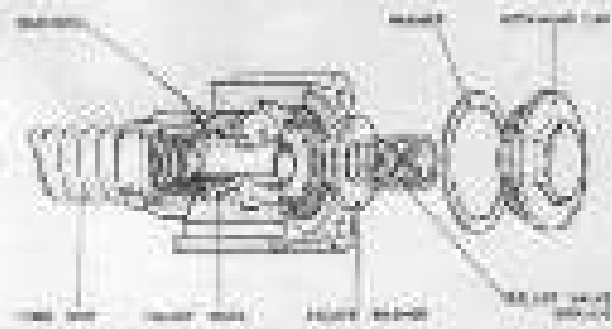


Fig. 12. Internal cooler valve assembly.

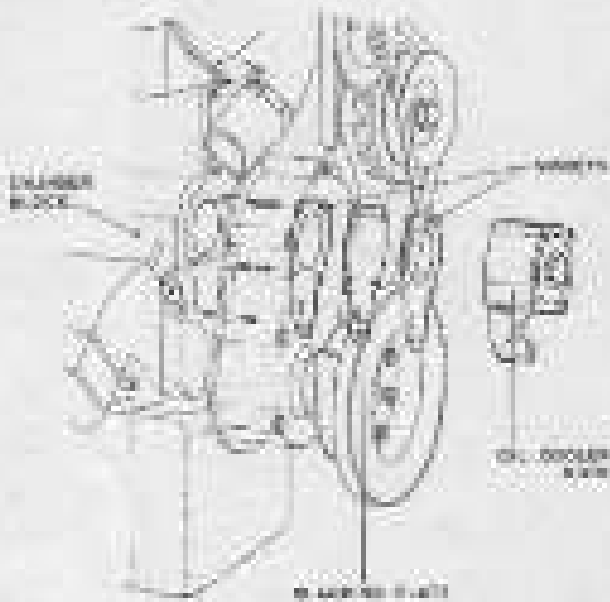


Fig. 13. Exploded details of internal oil cooler location.

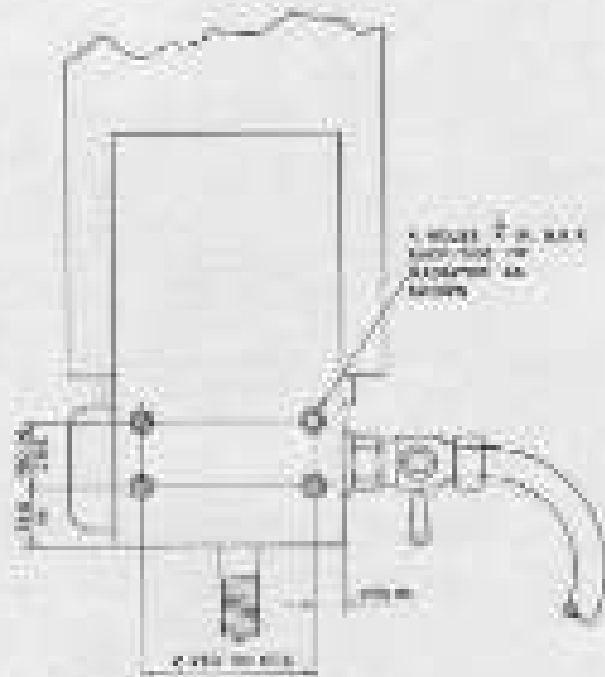


Fig. 14. Location of support plate for valve.

tighten all nuts securely and close the hood. It is important to make sure that the damper nut is tightened in the oil cooler body and not on the stud itself. This is a common fault and results in oil leakage.

10. Run the engine until warmed thoroughly, then stop and check the tightness of the nuts.

EXTERNAL OIL COOLER

Description

An external oil cooler can be fitted as an extra to all types of "Orion" cars. In all cases, it is necessary to use a "Vibro" oil filter with the unit adapted for the purpose. On all type 400, early 401, and 402 cars, it will be necessary to remove the radiator and drill and tap four holes in the radiator side plates to receive the securing nut-balls of the oil cooler support brackets. In addition, on type 400 cars fitted with narrow front wing valances, the valance and the radiator side diaphragm will require modification. Brackets already drilled and tapped have been installed in some type 401 cars. Agents are therefore advised, when installing an external oil cooler in a type 401 car, to examine the sides of the radiator. If the holes have already been drilled, it will not be necessary to remove the radiator.

The oil cooler consists of a continuous closely-spaced grid-shaped tube which is mounted in front of the radiator. The ends of the tube are connected by flexible rubber pipes to the engine oil filter; pressure oil from the engine pump is discharged through the cooler before passing through the filter.

Installing

The following paragraphs describe the work necessary to install the external oil cooler system. Two methods are described. The first method is applicable to all type 400 and 402 cars and to type 401 cars in which the radiator has not been drilled and tapped to receive the securing nut-bolts of the external oil cooler support plates. The second method covers type 401 cars which carry a radiator already drilled and tapped for the nut-bolts.

Before commencing to install the external oil cooler system in any type 401 car, first examine the radiator for the presence (or absence) of four $\frac{1}{2}$ in. B.S.F. holes in each side plate (see Fig. 14).

Types 400, 402 cars, and type 401 cars
with un-modified radiator

1. Remove the bonnet (see Section 14).
2. Drain the engine cooling system and remove the radiator (see Section 9).
3. Referring to Fig. 14, mark off the positions of the four holes in each radiator side plate, then drill and tap $\frac{1}{2}$ in. B.S.F. holes.

Warning :- Due to the small clearance between the radiator side plates and the base tank, great care must be taken when drilling the holes to prevent the drill breaking through with force and penetrating the tank.

4. Type 400 only. If the front wing valances fit snugly around the radiator shell, the left and right-hand valances and the radiator side diaphragms must be modified to provide clearance for the oil cooler rigid pipes. This may be done in the following manner with the components "in situ".
 - (a) Cut through the mating flanges of the left and right-hand valances and the side diaphragms midway between the two uppermost securing bolt locations.

- (b) Remove the four lower nut-bolts and shake-proof washers from each side. Flatten each valve flange forward in line with the diaphragm, then flatten each diaphragm flange rearward in line with the valves.
 - (c) Shape both valves and diaphragm upwards until the ball holes in the valves align with the captive nut nuts at each diaphragm, then refill the nut-bolts and shake-proof washers.
3. While the radiator is removed, prepare the oil cooler for installation by assembling the right and left-hand support plates to the cooler, securing them with the four $\frac{1}{2}$ in. B.S.F. bolts, shake-proof washers and nuts, and interposing three plain washers between the support plates and cooler at each bolt location.
 4. Remove the blanks from the oil cooler pipe connections and make sure that the interior of the cooler is clean and unobstructed by applying a blast of clean dry air through one of the connections, then connect the two flexible pipes to the cooler connections. Locate the oil cooler temporarily in position, keeping it as far forward as possible to provide sufficient clearance when installing the radiator.
 5. Refit the radiator, connecting up all relevant hoses etc. as described in Section 2, then align the bolt holes in the support brackets with the tapped holes in the sides of the radiator and secure the brackets with $\frac{1}{2}$ in. B.S.F. nut-bolts and shake-proof washers. If necessary, regulate the number of packing washers interposed between the support brackets and the oil cooler to obtain correct alignment.
 6. Irrespective of the type, remove the oil filter unit complete with mounting bolts and joint.
 7. (a) If the oil filter is a "Treatment" type, discard the unit and its mounting bolts, substituting a "Vokes" filter (with the head modified as described subsequently under (c)), complete with new mounting bolts and joint.
 - (b) If the filter unit is an early type "Vokes" (i. e. plain head), discard the unit but retain the mounting bolts for use with the modified filter unit to be fitted as described under (c).
 - (c) Where the oil filter is the latest "Vokes" type with a by-pass valve housing and two union bearings and integral Vee the head, remove the three blanks from the housings. Fit the by-pass valve into its housing, followed by the spring, see Fig. 10, then fit the blanking plug supplied in the modification set, together with one of the three sealing washers. Tighten the

plug securely, then assemble the two union adapters and the two remaining sealing washers to the union head in the head. In addition, the adapter with K.26138D must be fitted in the union adapters if the car has left-hand drive.

10. Prime the modified filter unit (see page 30) and fit to the engine using a new joint. On right-hand drive cars, pass the two flexible oil pipes under the engine flexible mounting, then prime the cooler by pouring clean engine oil through the upper pipe until the oil issues from the lower pipe; connect the pipes to the union adapters in the oil filter head. The pipe from the oil cooler upper connection should be coupled to the union nearest the cylinder block. On left-hand drive cars, the flexible pipes must be passed over the engine flexible mounting.
11. Make sure that all union connections are tight, then assemble the halves of the support clip around the portion of the flexible pipes immediately to the rear of the oil cooler connections. Secure the clip with a $\frac{1}{2}$ in. D.S.F. bolt, plate-proof washers and nut.
12. Refit the bonnet.

Types 400 cars with modified radiator

1. Remove the bonnet (see Section 4).
2. Remove the radiator grille (see Section 8), and the stay at the top of the radiator.
3. Secure the left and right-hand cooler support plates to the radiator side plates with $\frac{1}{2}$ in. D.S.F. nut-bolts and plate-proof washers.
4. Remove the blanks from the oil cooler pipe connections and make sure that the cooler is clean and unobstructed by applying a blast of clean, dry compressed air through one of the connections, then connect the two flexible pipes to the cooler.
5. Manoeuvre the oil cooler, with the attached pipes, between the radiator and its shell then working through the radiator grille aperture, secure the oil cooler between the support plates with $\frac{1}{2}$ in. D.S.F. bolts, plate-proof washers and nuts, interposing plain washers between the support plates and cooler at each bolt location to centralise the oil cooler.
6. Refit the radiator grille and the radiator stay.
7. Remove the "Yoked" oil filter, complete with mounting bolts and joint, from the left-hand side of the cylinder block; discard the joint.

8. (a) If the filter unit has a plain cast head discard the unit, but retain the mounting bolts for use with the modified filter unit to be fitted as described under (b).
- (b) Where the oil filter is the latest "Vulco" type with a by-pass valve housing and two union bearings cast integral with the head, remove the three blocks from the bearings. Fit the by-pass valve into its housing, followed by the spring, see Fig. 10 then fit the clamping plug supplied in the modification set, together with one of three sealing washers. Tighten the plug securely, then assemble the two union adapters and the two remaining sealing washers to the union bearings in the head. In addition, the adapter unit A.101287 must be fitted to the unit wherever it is not a full-head drive.
9. Fit the modified filter unit (see page 16) and fit to the engine, using a new joint.
10. On right-hand drive cars, pass the two flexible oil pipes under the engine flexible mounting. Prime the oil cooler by pouring clean engine oil through the upper pipe until the oil reaches from the lower pipe, then connect the pipes to the union adapters in the oil filter head. The pipe from the oil cooler upper connection should be coupled to the union nearest the cylinder block. On left-hand drive cars, the flexible pipes must be passed over the engine flexible mounting.
11. Make sure that all union connections are tight, then assemble the halves of the support clip around the flexible pipe ferrules immediately in the rear of the oil cooler connections. Secure the clip with a $\frac{1}{4}$ in. B.S.F. bolt, shake-proof washer and nut.
12. Refit the bonnet.

Removing and refitting

The method of removing the external cooler differs with the type of car, and the following sequence is recommended. In all cases, however, disconnect the feed and return pipes from their connections at the head of the cooler, and blank off the pipe ends.

Type 400 with motor wing valances

1. Drain the cooling system as described in Section 2.
2. Remove the four set-screws and shake-proof washers which secure the cooler support plates to the radiator.

3. Remove the water pump and radiator as described in Section 2.
4. Remove and drain the cooler.

To refill the cooler, reverse the dismantling procedure, but before connecting the pipes to the filter, prime the cooler as described on page 37.

Note 1:- On right-hand drive cars, the pipes pass under the engine flexible mounting, and over the mounting on left-hand drive cars. The upper pipe is coupled to the filter union nearest the cylinder block.

Type 400 with side ring radiators

1. Remove the radiator grille.
2. Working through the grille aperture, release the cooler from the support plates, taking care not to lose the spring washers.
3. Manoeuvre the cooler with its attached pipes through the grille aperture.
4. Drain the cooler.

To refill the cooler, reverse the dismantling procedure, but before connecting the pipes to the filter, prime the cooler as described on page 37.

Note 1:- On right-hand drive cars, the pipes pass under the engine flexible mounting, and over the mounting on left-hand drive cars. The upper pipe is coupled to the filter union nearest the cylinder block.

Type 401 and 402 cars

1. Remove the radiator stay and the grille. In some cases, it may also be necessary to remove the hood.
2. Remove one cooler support plate completely, taking care not to lose the spring washers.

3. Release the remaining plate from the radiator and remove the cooler with its attached pipes, maintaining 15 between the radiator and shell.
4. Drain the cooler.

To refill the cooler, reverse the dismantling procedure, and before connecting the pipes to the filler, prime the cooler as described on page 17.

Note 1 - On right-hand drive cars, the pipes pass under the engine flexible mounting, and over the mounting on left-hand drive cars. The upper pipe is coupled to the filter union nearest the cylinder block.

OIL PUMP

Description

The pump is illustrated in Fig. 13. Attached at the lower end of the oil pump casing, the gear chamber is closed by the pump casing cover. Bearings for the gears are provided in the casing and cover, the squared end of the driving gear projecting out of the casing to receive the driving shaft.

An extension on the casing cover provides the inlet to the pump and carries a filter unit which screens the inlet. Pressure oil is discharged through a duct in the pump casing which terminates in the attachment flange where the duct mates with the main oil passage in the cylinder block.

Removal and Refitting

Drain and remove the pump as described on page 17, then release the fasteners, remove the two nuts and withdraw the pump, together with the driving shaft unit. Remove the driving shaft unit from the pump-driving gear and remove the joint washer from the pump casing. Discard the washer,

To refit the pump to the cylinder block, first fit the driving shaft unit to the driving gear, then assemble a new joint washer to the attachment flange. Offer up the pump, engaging the squared upper end of the driving shaft unit with the distributor drive shaft, fit new lockwashers and screws on and lightly "tip" the retaining nuts. Turn the engine through at least one complete revolution to align the drive shaft unit and pump to align before finally tightening the retaining nuts. Alignment is satisfactory if the end float of the drive shaft unit can be felt by hand. Lock the nuts with the lockwashers.

Disassembly

To dismantle the pump, proceed as follows :-

1. Release the locking tabs and unhook the oil-belts securing the drive unit, then remove the locking plate, nuts and sleeve covers, discard the two joint washers.
2. Cut the locking wire and remove the bolts securing the oil pump casing cover, then remove the cover and withdraw the driving and driven gears.
3. Clean and dry the components, paying particular attention to the oilways and drive unit.

Inspection and Re-assembly

Examine the gears for condition of the teeth, then check that the journal and bearing diameters conform to the limits quoted in the General Data, and are not scored. Check also the fit of the drive shaft unit in the driven gear and verify that it is not bent or damaged. Examine the pump casing and cover for general serviceability, and that the joint faces are undamaged; check the faces with marking compound on a surface plate. If the joint faces are distorted or damaged, rectify by lapping them on a lapping plate, or to each other. Where

If the gears have scored the casing cover, correct this by lapping plate. Make sure that all traces of lapping compound are removed, then re-lap the journal location bore in the cover and re-produce the chamfer if necessary. Bore any scoring on the walls or end faces of the gear chamber by scraping. When this is satisfactory, fit the gears in the casing and check the end-float with a straight-edge and feeler gauges. If the end-float is excessive, lap the casing joint face as necessary to a lapping plate. It is essential that the joint faces have an all-over contact after lapping. Check the cover gears and cover for condition and cleanliness.

Ensure that all components are scrupulously clean, then lubricate the driving and driven gears and assemble them with their scraper spigots in the pump casing; note that the driving gear must be fitted to the location which allows for clearance of the driving shaft nut. Next, fit the casing cover, washers and retaining screws, then tighten the bolts evenly, and wire-lock; no washer or jointing compound is used. Finally, assemble the joint washer, sleeve cover, another joint washer, sleeve and locking plate; retain this assembly with the two bolts, then tighten the bolts evenly and bend the ends of the plate to lock the bolt heads.

ENGINE HEAD

Description

The light alloy detachable cylinder head is fitted with check-in, hardened valve seats and Bourne valve guides. The exhaust valves, fitted on the right-hand side of the head, and the larger diameter inlet valves on the left-hand side are retained with split cone cotters and double springs. Type 85C cogites are

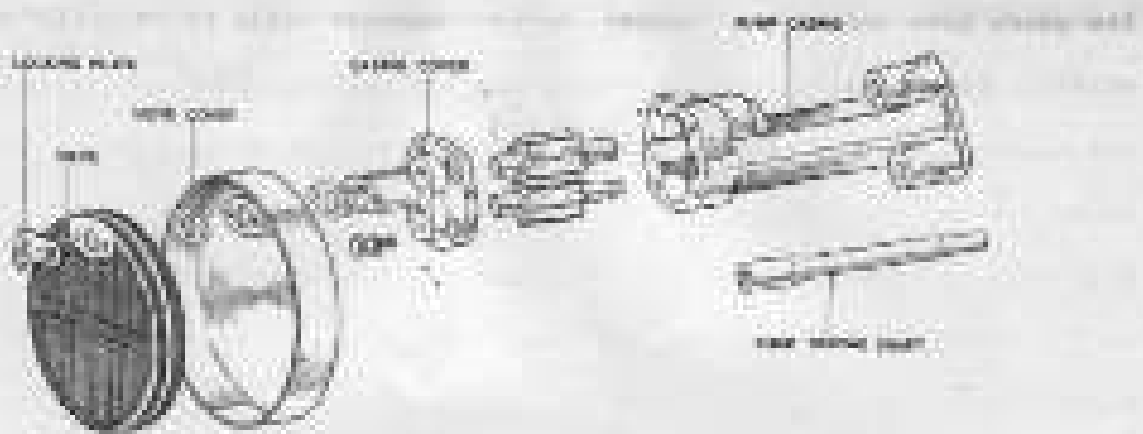


Fig. 15. Oil pump.

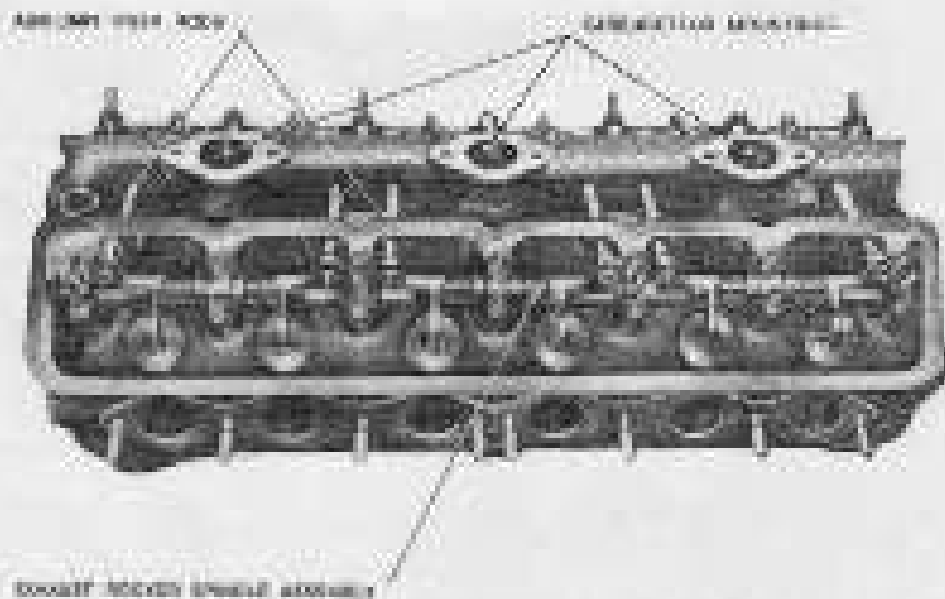


Fig. 16. Cylinder head assembly with rocker
ball covers removed.



Fig. 17. Sequence for tightening or loosening
cylinder head nuts.

fitted with variable pitch intake valve springs, being close-coiled at one end; these springs can also be used on earlier type engines. It is essential that the intake springs are fitted the correct way up, i. e. the close-coiled end is the bottom. The overhead rockers are braced and mounted on a spindle located on each side of the head. Each spindle is carried in a cast split housing and is located by a dowel in the front housing. A compression spring fitted between each exhaust rocker and a spindle housing locates the rocker longitudinally. On the intake rocker spindle, a shorter compression spring locates each pair of intake and auxiliary rockers. The intake rockers are operated by push rods applying a direct vertical thrust from the tappets, while a reverse thrust for the exhaust rockers is applied via a short auxiliary push rod through the auxiliary rockers mounted on the intake rocker spindle. Thus, three types of push rods are employed. The intake rods are provided with a ball at the lower end and a cup at the upper, while the exhaust rods have two ball ends. The auxiliary rods are shorter and are fitted with the ball end towards the intake rockers and the cups towards the exhaust rockers. Two single-piece exhaust manifolds, bolted to the right-hand side of the head each comprise three braced pipes merging into a single screwed outlet. On type 83 engines, the single carburettor is attached to the head via an induction manifold. On type 83A engines, the carburettors are bolted directly to the head; on type 83C engines, the control brackets are integral between the carburettors and the head. A water circulating pump and fan assembly is attached to the front of the cylinder head and is driven by a belt from the crankshaft pulley. The engine breather is situated on the intake rocker box cover (front unit) and is connected by a short hose to the air filter.

Removal and Refitting

Remove the band as described in Section 2. Disconnect the negative terminal from the battery. Drain the cooling system as described in Section 2.

If sea-levelers are fitted, disconnect the relevant water pipes, see Section 2. Release the lower clips and remove the hose from the water pump and radiator. Disconnect the sparking plug lead adaptors from the plugs. Release the jubilee clips from the three hoses between the air filter, air filter manifold and inlet rocker box cover. Remove the two bolts and spring washers securing the air filter unit and distributor drive housing to the cylinder head and remove the filter unit; reassemble the gaskets fitted between the drive housing and cylinder head. Detach the radiator inlet and outlet pipes from the distributor drive housing, and disconnect the manual ignition control from the distributor cover. Release the low tension lead from the side of the distributor and the high tension lead from the centre of the distributor. Release the nuts and washers securing the distributor drive housing to the cylinder block and lift away the cooling distributor and drive shaft; remove the joint washer from the securing flange.

Remove the carburettors as described in Section 3.

When the carburettors have been removed, maintain as follows. Disconnect and remove the oil transfer pipe from the rear of the cylinder block and cylinder head. Remove the rocker box covers together with their joint washers. Fit the locking wire and insert the exhaust pipe ring nuts with the special "U" spacer (Fig. 205); no gaskets are fitted. Remove the nuts and washers securing the exhaust manifold to the head and remove the manifold and gaskets. Slacken the spring adjusting and securing bolts to relieve the tension of the fan belt. When

remove the bolt. Use the special spanners supplied in the tool kit to remove the fourteen cylinder head retaining nuts; these should be slackened in the sequence shown in Fig. 47. Carefully ease the cylinder head off the studs, ensuring that the push rods remain in position in the cylinder block; the rods may be damaged if caught in the head. Mark the push rods to facilitate re-assembly, then twist the rods to free them from the tappet bodies and withdraw them.

Warning :- If the push rods are not freed, the tappet bodies may be lifted out of their locations in the cylinder block; this will involve removal of the tappet cover.

To refit the head, proceed as follows. Lubricate both ends of the vertical push rods and fit them in their previously-marked order in the cylinder block. Make sure that the rods are refitted as removed since they are set together by running, and check that they seat squarely in their tappet bodies. Make sure that the inlet and rods are fitted with the ends of the upper ends. Secure a new cylinder head gasket tightly with grease and place in position over the retaining studs. Hold the auxiliary push rods against the exhaust rockers and lower the cylinder head carefully over the studs, ensuring that the vertical push rods are not bent or damaged as the head is lowered into position.

Secure in and "set" the fourteen cylinder head retaining nuts. First, tighten each nut one sixth of a turn at a time in the sequence shown in Fig. 47 until all the nuts are tightened fully.

Set the valve clearances as described on page 45.

Fit new gaskets and assemble the exhaust manifold to the cylinder head; tighten the eight special nuts evenly. Fit the exhaust pipes, tightening the

ring nuts with the special "C" spanner; wire-lock securely after tightening. No gaskets are used at this joint.

Fit the belt to the dynamo, fan and crankshaft pulleys and adjust the tension of the belt as described in Section 2.

Re-assemble the oil transfer pipe between the rear of the cylinder block and cylinder head; tighten the union connections. Refill the carburettors as described in Section 3.

Refit the distributor cover and raise the distributor as described later in this Section under the heading "Ignition", but omitting the air filter on type 850 engines.

Fit the washers to the cleaned and gapped sparking plugs and fit the plugs to the cylinder head; tighten the plugs with the special spanner supplied in the tool kit, then connect the distributor E.T. lead-wire to the plugs. Connect the negative terminal to the battery.

Refit the hose to the radiator and water pump and tighten the joints correctly. Ensure that the cylinder block and radiator water taps are closed and refill the system with water.

Note :- If your headlights are fitted, it will be necessary to close the drain taps and reconnect the relevant water pipes, see Section 2.

Check the valve clearances and tune the carburettors as described under the heading "Valve Clearance" and in Section 3 respectively.

After setting the valve clearances, replace the rocker covers using new joint nutare and rubber seals; make sure that there is at least $\frac{3}{16}$ in. clearance between the bearing cap and gasket at the inlet rocker cover as shown in Fig. 18. When tuning is completed, fit the air filter; ensure that the skin behind the distributor drive casing is not displaced. Tighten the bolts securely. Refit the rubber loop between the air filter unit and manifold and secure with the Jubilee clips; replace the small hose between the air filter and breather unit on the inlet rocker cover. Ensure that the L.P. connection on the distributor does not foul the filter.

Valve clearances

The correct clearance between the rocker arm and the valve head is most important. Valve clearances should be set to 0.002 in. (0.051 m.m.) when cold. This setting will give a clearance of approximately 0.004 in. (0.205 m.m.) when the engine has attained an indicated temperature of 70°C . to 75°C .

Turn the engine with the starting handle until No. 6 inlet valve is fully open; No. 4 inlet valve will then be fully closed. Slacken the lock-nut on No. 1 inlet valve rocker adjusting screw and, with a 0.002 in. feeler gauge inserted between the rocker and the valve head, adjust the rocker adjusting screw to the correct clearance; it should just be possible to move the feeler gauge at the correct setting. Hold the adjusting screw, tighten the lock-nut, re-check the setting then remove the feeler gauge. Check the remaining valves in a similar manner; the valves open and closed positions are as follows.

Inlet		Exhaust	
Valve open	Valve closed	Valve open	Valve closed
No. 6	No. 1	No. 6	No. 1
No. 5	No. 2	No. 5	No. 2
No. 4	No. 3	No. 4	No. 3
No. 3	No. 4	No. 3	No. 4
No. 2	No. 5	No. 2	No. 5
No. 1	No. 6	No. 1	No. 6

Disassembling

Remove the sparking plugs using the special spanner supplied in the tool kit. Remove the water pump as described in Section 2. Mark each rocker spindle cap, then release the nuts and remove the caps. Holding the rockers at each end of the spindle, lift out each spindle then retain the nut washers with a pin inserted through the hole in the end of the spindle. Mark the auxiliary push rods and remove them from the head. Compress the valve springs with the valve lifter TBM,5021 then remove the valve adjusters and release the springs. Remove the upper valve spring casting, springs, lower valve spring casting and valve; segregate these assemblies to facilitate re-assembly.

The rockers are marked to facilitate re-assembly; if the markings are not discernible mark them with their cylinder number. Withdraw the temporarily-fitted pins from the ends of the spindles and remove the compressors.

During the process of carbon removal, block off all apertures in the cylinder head. Clean the valve guides with a brush to break and polish the valves.

Inspection and re-conditioning

Examine the cylinder head and valve seat inserts for general condition; check that all studs are correct and undamaged and trial-fit the nuts to the studs. Check the bore of the valve guides and the stems of the valves; if worn, they should be reamed. The valve seatings will be checked after grinding in the valves. Clean the face of the cylinder head carefully, then check it with marking compound on a surface plate. An all-over marking should be obtained. If necessary, lap the face lightly on a lapping plate to obtain the required contact.

Examine the rocker spindles for straightness of the shanks and check that the rocker levers on the spindle and the bushes in the rockers are not worn; the bushes can be renewed if necessary. Check that the rocker compression springs are undamaged and that they and nuts have not frayed the spacing washers. Examine the ball-ends of the rocker adjusting screws for wear or flat spots and trial-fit the lock-nuts. There must be a good fit on the threads. Inspect the spherical ends of the rockers and push rods and check that the rods are not bent or otherwise damaged.

Examine the valve springs and their seatings for fretting and check the length of the springs when compressed to the loading quoted in the "General".

After grinding the valves to their seatings in the head, check that the "lead" of the valve stands clear of the insert. If the "lead" of the valve "pockets" in the insert, a new valve should be fitted or the insert cut back to restore the valve position.

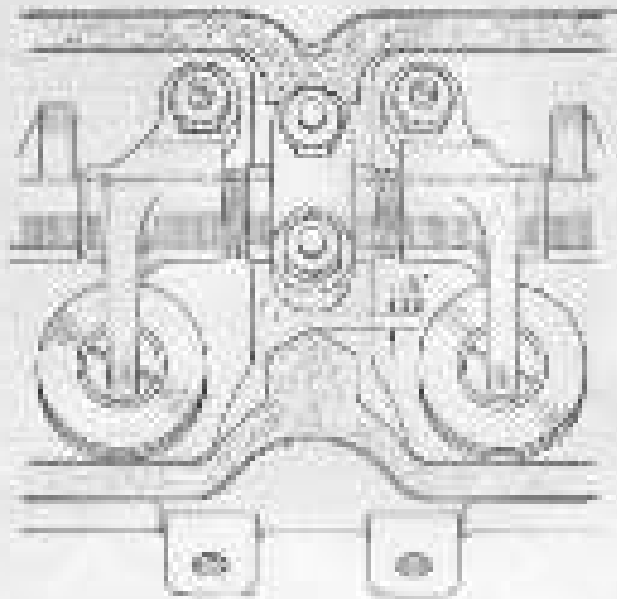


Fig.18. Rocker cover joint clearance.

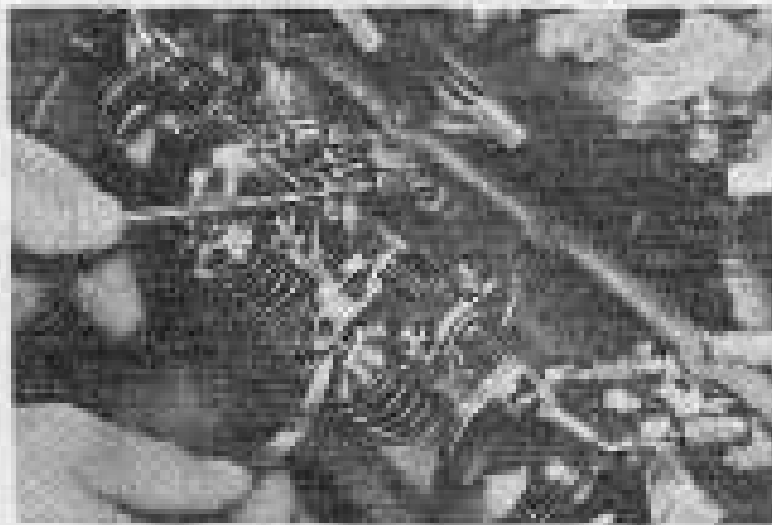


Fig.19. Adjusting valve clearance.



Fig.20. Intake rocker spindle assembly.

Replacing valve guides

To remove a rejected valve guide, it is suggested that the bore is drilled out to reduce the wall thickness and the guide then pressed out or removed with a stepped drift and hammer. Replacement valve guides are supplied in the standard size on the outside diameter or $+0.010$ in. on the inside diameter. In many cases, a standard valve guide will prove satisfactory particularly if the old guide was removed carefully. Free fitting on oversize guide, is not attempted since it enlarges the bore in the cylinder head to misalignment will occur. Measure the bore in the head, then grind the oversize valve guide to give the interference fit given in the "General Data". It is recommended that replacement guides are frozen by the "dry-ice" process prior to fitment; when this process is adopted, the bore should provide the desired clearance with the valve stem.

Replacing rocker bushes

Rejected rocker bushes should be pressed out. After pressing the replacement bush into the rocker, trial-fit it to its spindle and, if necessary, run to produce the required clearance.

Re-assembly

Make sure that all components are clean then fit each valve, followed by the lower valve spring seating, inner and outer valve springs and the upper spring seating. It is essential to make sure that the variable-pitch outer springs on type 625 engines are fitted correctly, i.e. close-coiled end downwards.

Using the valve lifter 20K.5027, compress the springs, then fit the valve collars and release the lifter. Insert the auxiliary push rods in their locations

With the axial ends of the rods towards the exhaust rockers, lubricate the rockers and compression springs and fill them with their washers to the rocker spindle.

The sequence in which the rockers, springs and washers should be fitted to the rocker spindles is detailed hereunder; in each case the sequence starts at the front and (No. 1 cylinder) of the spindle.

Inlet :- L.H. auxiliary rocker, thick washer, R.H. inlet rocker, two short compression springs with two washers interposed, L.H. inlet rocker, thick washer, R.H. and L.H. auxiliary rockers, thick washer, L.H. inlet rocker, two short compression springs with two washers interposed, R.H. inlet rocker, thick washer, R.H. and L.H. auxiliary rockers, thick washer, L.H. inlet rocker, two short compression springs with two washers interposed, R.H. inlet rocker, thick washer and a R.H. auxiliary rocker, (see Fig. 20).

Exhaust :- L.H. exhaust rocker, two long compression springs with two per steel shims interposed, R.H. and L.H. exhaust rockers, two long compression springs with two per steel shims interposed, R.H. and L.H. exhaust rockers, two long compression springs with two per steel shims interposed and, finally, a R.H. exhaust rocker (see Fig. 21).

Fig. 22 illustrates the manner in which the assembly tool T.175893 is fitted to the exhaust rocker assembly in and fitted to the cylinder head.

When assembling the inlet rockers, the disposition of the parts of the tool is as follows :-



Fig. 21. Exhaust rocker spindle assembly.

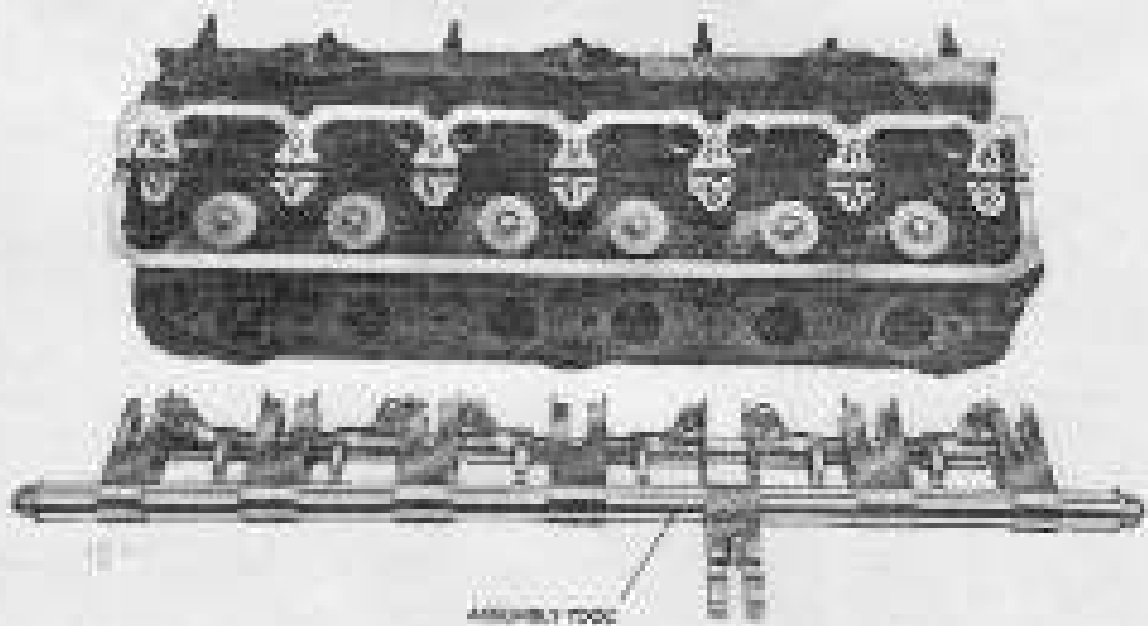


Fig. 22. Exhaust rocker spindle in assembly tool.

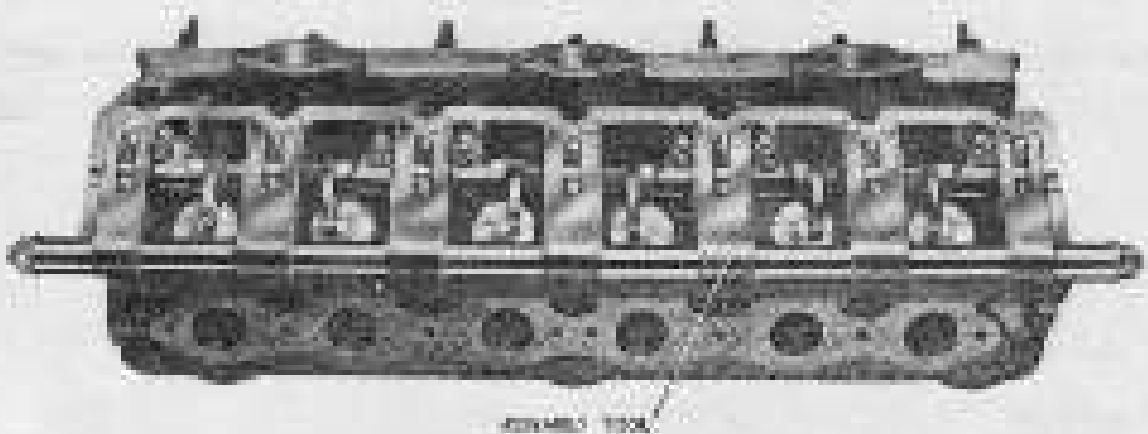


Fig. 23. Exhaust rocker spindle assembled to head.

- Arm 1. Before the first auxiliary rocker.
- Arm 2. Between the first pair of rockers.
- Arm 3. Between the second and third auxiliary rockers.
- Arm 4. Between the second pair of rockers.
- Arm 5. Between the fourth and fifth auxiliary rockers.
- Arm 6. Between the third pair of rockers.
- Arm 7. After the sixth auxiliary rocker.

If this tool is not available, six assembly plates may be constructed locally to the dimensions shown in Fig.24 and used as shown in Fig.25 to separate the components in a similar manner. Loosen the bolts in the front end of the spindle over the dowel in the front bracket of the head then remove the assembly tool. Fit the seven rocker spindle caps and screws on the nuts; tighten the nuts evenly and firmly.

Assemble and fit the inlet rocker spindle in a similar manner.

Using new gaskets, fit the water pump to the head as described in Section 2.

CYLINDER BLOCK

Description

The cylinder bores are hone-finished and the joint face for the head is surface-ground. Dry-type cylinder liners are fitted to later type engines. The block houses the camshaft and tappets on the left-hand side together with the bearings for the ignition driving gear.

External machined flange provide location for the oil filler, fuel pump, distributor and adjustable oil pump relief valve.

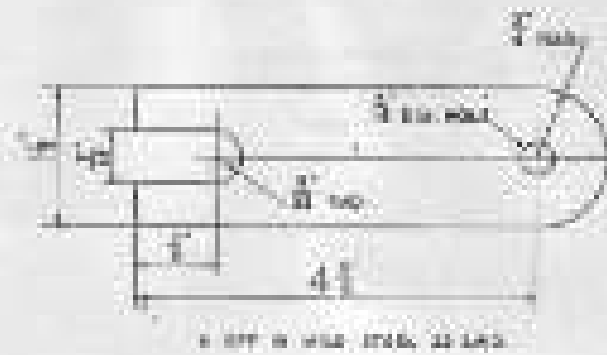


Fig.24. Assembly plate for rocker spindle.

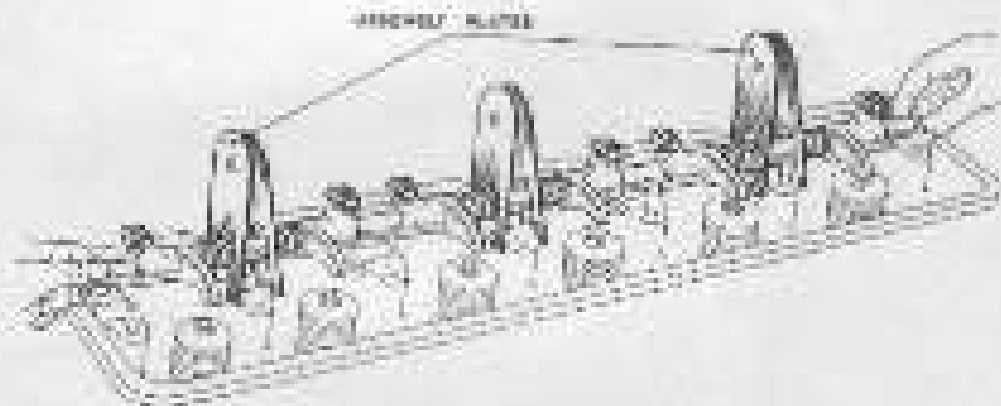


Fig.25. Showing use of assembly plates.

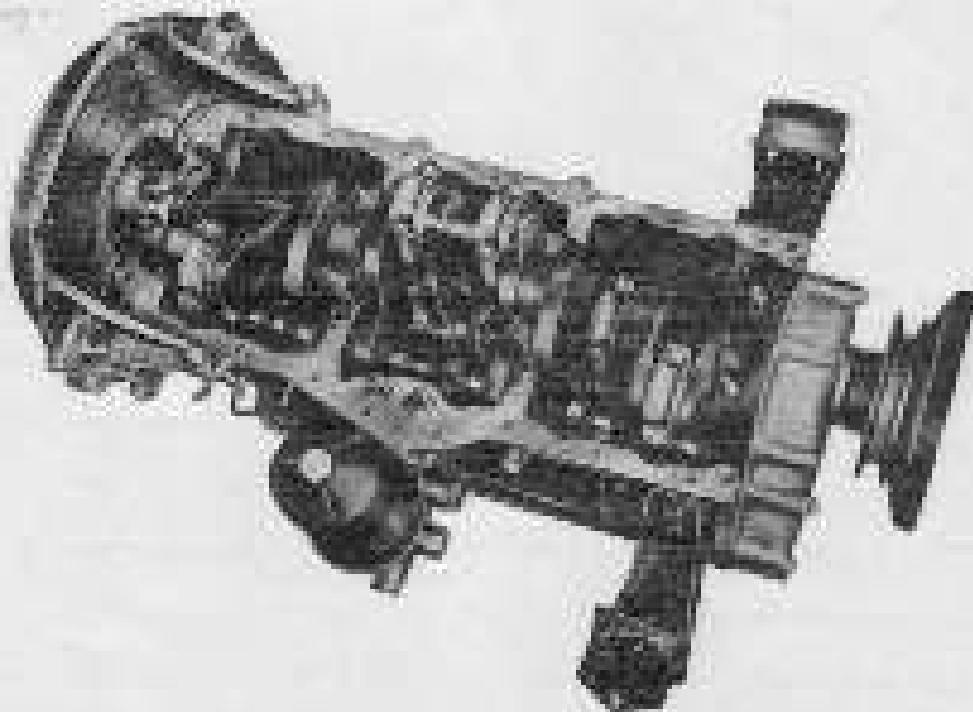


Fig.26. Crankshaft assembly.

Re-boring

Superior piston models D.101 in. and D.110 in. overbores are available. It should be noted that larger type 85A and all type 85C engines are fitted with cylinder liners, early type 85A and all type 85 engines have no liners. Therefore, when one of the cylinder bores of the later type engine is too small to permit the fitting of the overbore pistons, the liners and adjacent portions should be fitted. The liners are fitted in accordance with standard practice. In the case of the early engine, it will be necessary to have the cylinder blocked to fit liners and standard pistons. After re-boring, it is recommended that the liners are bored and finished to give the piston clearance quoted in the "General Data". If a re-boring machine such as the "Block and Locker" type is employed, the provision is such that boring may not be required.

After re-boring, the cylinder block should be skid-ground to make sure that the liners do not extend past the cylinder head attachment face. It is also essential to make sure that all oil passages are unobstructed. To ensure this, the passages under pressure and dry with compressed air.

CRANKSHAFT

Description

The chrome-nickel-steel crankshaft is supported by four steel-backed, lead-oxide bronze lined, replaceable main bearings and is aligned inboard all over with the exception of the front extension, which carries the thrust plate drive splines, right hand and left hand fly. The rear end of the shaft is flanged to accommodate the flywheel and is used to provide the ball bearing of the parboiler drive shaft. The bearing being retained in position by a screw.

Between the flywheel attachment flange and the rear main bearing journal, an oil return thread machine in the draft is secured by an integral oil baffle; these serve to prevent oil loss from the rear bearing. At the front end of the shaft, oil loss is prevented by an oil baffle at each side of the crankshaft drive cover and a roll over fitted in the base of the cover.

Removing and refitting

Remove the gearbox and clutch units from the engine and chassis as described in Sections 2 and 3 respectively, then remove the engine from the chassis in the manner described later in this section and the cylinder head from the engine. Remove the starter dog and the engine dog and carrier units from the front end of the crankshaft, then remove the oil-baffle and take off the crankshaft drive cover, followed by the oil baffle. Release the intermediate and remove the nut securing the chain steel to the crankshaft, then withdraw the chain steel and drive sprocket (complete with chain) from the crankshaft and camshaft. Withdraw the thrust plate. Remove the cam in the manner described subsequently then remove the oil-belts and detach the flywheel from the crankshaft.

Remove the big-end bearing caps from the connecting rods. Remove the main bearing caps in a similar manner, detach the lower halves of the thrust plates fitted to the front main bearing caps, then withdraw the crankshaft from the cylinder block. Remove the circlip then withdraw the ball bearing from the rear end of the crankshaft with the extractor E.177166. Remove the keys from the shaft and upper halves of the thrust plates from the front bearing location. Keep the correct halves together.

When the crankshaft has been re-conditioned, it should be refitted to the engine in the following manner. Using a soft metal drift, tap the ball bearing

into position in the rear end of the crankshaft. Take care to avoid tapping the inner race of the bearing or damage may result. Fit the circlip in its groove to secure the bearing and check that the circlip is expanded fully.

Fit the correct half bearing shells to their locations in the cylinder block, ensuring that their locking notches are located correctly and that, if the shell has been re-ground, they are of the correct size. Fit the upper half of each thrust plate to the recess on each side of the front main bearing location, then assemble the crankshaft to the cylinder block. Fill the bearing caps completely with the correct bearing shells to the main bearing locations, and the lower half of each thrust plate to the local bearing caps. Tighten the bearing cap retaining nuts progressively and fit the thrust plate, drive sprocket, damper carrier nut and splinter dog to the front end of the shaft. Tighten the splinter dog on the shaft, then check the shaft rotation and that the end-float on the shaft is correct. If the end-float is incorrect, adjustment should be made by selective assembly of the front bearing thrust plates. These are available in three sizes, i.e. standard, + 0.005 in. thickness and + 0.025 in. thickness. When a satisfactory check has been made, remove the components from the front-end of the shaft and the retaining nuts from the bearing caps. Fit a new tabwasher to each main bearing cap shell, then refit the nuts and tighten them to a torque loading of 28 to 30 lb. ft. (3,890 to 4,125 in.lb.). Check that the shaft will rotate freely that screws nuts and hold the tabwasher.

Fit the appropriate bearing shells in the big-ends of the connecting rods, check that they are located correctly, then fit the rods to the crankshaft journals so that the identification numbers face towards the crankshaft, and assemble the big-end big-end bearing caps, complete with bearing shells, to the

appropriate rods; - Fit a tabwasher to each bearing cap stud. Then fit and tighten the nuts to a torque loading of 58 to 80 lb. ft. (3,850 to 4,150 n. kg.); secure each nut with the tabwasher.

Note: - If the big-end journals of the crankshaft have been re-ground, the connecting rods must be removed and checked for alignment in the manner described subsequently in this Section before re-assembly in the engine.

Refit the flywheel to the flange of the crankshaft, locating it over the two bolts and fit the three locking plates and six nut-bolts. Tighten the nut-bolts to a torque loading of 10 lb. ft. (2,448 n. kg.), then secure them with the tabs of the locking plates. Fit the thrust plate in the front end of the crankshaft, then assemble the key and drive sprocket to the crankshaft and the chain gear and key to the camshaft, complete with their chain. Re-tune the engine as detailed subsequently in this Section. Fit the oil baffle to the shaft then assemble the timing cover and joint to the cylinder block and secure in position with nut-bolts, plate and spring washers. Fit the engine damper and carrier onto the shaft followed by a new tabwasher and the starter dog. Tighten the starter dog and secure it with the tabwasher. Assemble the pump and cylinder head to the engine and fit the engine in the chassis in the manner described in this Section and refit the clutch and gearbox units as described in Sections 4 and 5 respectively.

Inspection

Examine the crankshaft for cracks with standard magnifying and electro-flux test equipment. The electro-flux test should be performed at 100 amperes and 150 volts. If satisfactory, check all crankshaft journals for condition and

wear and ensure that any ovality is not excessive. Inspect the threads, keyways and axial grooves for condition and the thrust plate and ball bearing location for freedom. Mount the shaft on "V" blocks at the front and rear main bearing journals and using a dial indicator, check the alignment of the shaft. If the misalignment exceeds the maximum permitted, i.e. 0.002 in. (0.002 in. dial reading), the shaft must be straightened. Great care must be exercised in straightening of shafts as cracks may develop in the journals. It is essential that any straightening which may be necessary is carried out before re-grinding the shaft journals.

Main bearings

Each main bearing cap is secured to the cylinder block with two alloy-steel studs and nuts, and is located by dowels. The front main bearing cap is drilled to permit drain oil from the crankshaft drive cover to return to the sump and the rear cap is fitted with a drain pipe which directs drain oil from the rear side of the rear main bearing to the sump. Each half of the shell-type main bearing has a locking notch which locates in a slot in the bearing cap or cylinder block location, thereby locking and preventing movement of the bearing. Three sizes of bearings are available, standard (nominal) size, 0.000 in. undersize and 0.020 in. undersize. It should be noted that the bearing shells for the two centre bearings are identical but differ from those for the front and rear bearings which also are identical to each other.

Fitting main bearings

When crankshaft main bearings are to be replaced it is recommended that a complete set of new bearings is fitted and that no attempt is made to fit individual bearings. Remove the old bearings from the caps and cylinder block,

ensure that their locations are clean and undamaged, then fit the new bearings into position, ensuring that the locking wedges are located correctly. The bearings are supplied ready for use; under no circumstances should the caps be put together, i.e. faced, or any work being carried out.

Re-grinding

When it is necessary to re-grind either the main or the big-end bearing journals of a crankshaft, all four main bearing journals or all six big-end bearing journals must be ground to the same size. Re-grinding individual bearing journals is not recommended. No attempt should be made to re-grind the crankshaft unless facilities are available for re-straightening. Where such facilities do not exist, the crankshaft should be returned to the Car Division of the Bristol Aeroplane Company Limited.

Warning 1- Do not attempt to re-grind the crankshaft if the mis-alignment exceeds the permissible amount, i.e. 0.002 in. (0.0025 in. dial indicator reading), until the shaft has been straightened.

If necessary, straighten the crankshaft in a suitable press, then anneal and magna-flux and electro-flux test the shaft to inspect for cracks. If necessary, mount the shaft in a suitable grinding machine and re-grind the bearing journals. Fit the blocking cap TPN.7853 to the front end of the crankshaft to protect those surfaces which are not to be hardened, (Fig.7) illustrates suitable block which may be made locally for this purpose) then nitride the shaft for 48 hours at 450°C.

After nitriding, lightly polish all bearing journals to remove the nitride "blow" then re-check the alignment of the shaft. If necessary, straighten the

shaft and repeat the alignment check. When the alignment check after straightening is satisfactory, magna-flux and electro-flux heat the shaft for cracking. Finally, make sure that all oil ducts in the shaft are cleaned thoroughly.

Flywheel and starter ring

The steel starter ring is shrunk on the flywheel and the flywheel is secured to the crankshaft flange by six nut-bolts and located by a dowel. If the teeth of the starter ring are unserviceable, split the ring with a chisel or drive it from the flywheel with a suitable drift and hammer. Remove the ring location of the flywheel for condition and, if necessary, dress to remove damage or fretting. The recommended method of fitting a replacement ring is to heat it in oil at 160 C. for at least 10 minutes, then place it in position on the flywheel and allow to cool. This operation should be completed as rapidly as possible to ensure that the ring is located correctly and does not tighten on the flywheel before it is in the correct position. The ring is machined to extremely close limits; it is not therefore necessary to re-balance the flywheel unit.

Note 1:- It is essential that the chamfer on the starter ring teeth faces the flywheel.

Flywheel

In the event of the face of the flywheel being scored by the use of a badly worn clutch-driven plate it should be lightly ground, taking off the amount within amount. The normal overall thickness of the flywheel is 4.02 and under no circumstances should this dimension become less than 4.025. Thus, it will be seen, that 0.005 being normal size can be ground off of the face and if this amount is used with care a number of facing operations can take place before the normal condition is reached.

CONNECTING RODS AND PISTONS

Description

The alloy-steel "H" section connecting rods are fitted with shell-type, steel-backed, lead-inlin bronze lined big-end bearings and with phosphor-bronze, shrink-fitted, diamond-ported gudgeon pin bushes. The big-end bearings are lubricated under pressure through holes drilled in the crankshaft journals. A duct drilled through each connecting rod provides an intermittent supply of pressure oil to the gudgeon pin.

The pistons are of pressed aluminium alloy to B.T.D. specification 124 and taper from the bottom of the skirt to the top of the skirt, the bottom skirt being 0.012 in. greater in diameter than the crown. Each piston is cast round on the skirt to provide an ovality of 0.0035 in. to 0.005 in. Three compression rings and one oil scraper ring are fitted to each piston, the top compression ring being chrome-plated all over; the remaining two are gasolined, the lower being chamfered on its upper edge. The alloy-steel fully floating gudgeon pin is fitted and is retained in the bore of the piston by two circlips.

Removal and refitting

If the engine has been removed from the car and its crankshaft removed, withdraw the assembled pistons and connecting rods from the cylinders. Remove the circlips from the bore of each piston, withdraw the gudgeon pin and separate the piston and connecting rod; remove the piston rings.

If the engine is in the car, remove the cylinder head and strip as described in this Section, then remove the big-end bearing caps. Push the connecting rods

up into the cylinder horns with the rod ends located in the cylinder slots. Remove the circlips, withdraw the gudgeon pins and detach the pistons; remove the piston rings. Withdraw the connecting rods through the bottom of the cylinders.

To re-assemble the connecting rods and pistons to an engine from which the crankshaft has been removed, adopt the following procedure. Heat the pistons in boiling water for approximately ten minutes, then fit each to its connecting rod and insert the selected gudgeon pin (use "Imposter"); retain the pin by fitting a new circlip to each groove in the piston horn. Check the gap of a new set of piston rings, then fit them to the pistons; ensure that the tapered land compression ring (No. 3) is fitted with the small diameter towards the ring grove, and that the chrome-plated ring is fitted to the top groove. Check the side clearances. Assemble the piston-connecting rod units to their respective cylinders with the connecting rod identification numbers facing towards the crankshaft; this will ensure correct positioning of the off-centre small ends of the rods. Complete the re-assembly as described in page 58 of this Section.

When the crankshaft has not been removed, ensure that all parts have been checked to ascertain that the correct clearances will result. As previously, then insert the connecting rods in the relevant cylinder horns with the rods located in the cylinder slots and their identification numbers facing towards the crankshaft. Heat and fit the pistons as described previously, then fit a new set of piston rings. Push the pistons down into the cylinders and locate the big ends of the connecting rods on the appropriate crankpins. Refit the bearing caps complete with bearings then torque tighten and lubricate the top nuts. (28 to 15 ft. - 1,500 to 4,500 n.l.g.).

Check the side clearance of the rods on the crankpins. This resembles the pump and cylinder head bolts.

Inspection

Using suitable material ground to fit the gudgeon pin bush and the big-end of the connecting rod (without bearing fitted), check the connecting rods, in turn, in "P" blocks and check them for twist and end alignment. The maximum permissible error of alignment is 0.005 in. per six inch length of material and 0.001 in. total per six inch length of material.

The connecting rods should also be subjected to magna-flux test to ascertain for cracking. Check the gudgeon pin bush for wear and quality; if excessive, reject the bush. Examine the gudgeon pins for wear and check the pin, gudgeon pin bush and piston bore, dimensionally to determine whether the fit of the pin will be satisfactory for assembly.

Examine the pistons for general condition. Check the clearance of a set of new rings in the ring grooves and check the gaps. Assemble the piston in its cylinder bore and check that the clearance between the skirt of the piston (throat area) and the cylinder wall is within the factory limit.

If it is not permissible to obtain the correct fit (gudgeon pin or piston), if oversize pistons are to be fitted, or if any of the three mating parts have been rejected, replacement parts should be obtained and checked dimensionally before assembly.

Inspect the big-end bearings for condition and their bearing surfaces for damage. Assemble the bearings, rods and bearing caps to their journals and check that the running clearance on the crankshaft is satisfactory.

Replating big-end bearings

Check that the bearing locations of the connecting rods and caps are clean and undamaged, then fit the new bearings into position, ensuring that the locking rollers are located correctly. The bearings are supplied ready for use; no fitting of any sort should be carried out.

Note :- Bearings are available in three sizes i.e., standard, 0.010 in. undersize and 0.020 in. undersize. It is essential that a check is made to ensure that only the correct bearings are fitted to the rods. Undersize bearings are marked +10 or +20 on the top of the steel shell.

Replating gudgeon pin bushes

Using a suitable soft metal drift, and with the small end of the connecting rod suitably supported, drive out the gudgeon pin bush. Bore the rod bore for ovality and, if necessary, polish lightly to remove the tops of all internal scores. Standard size and 0.020 oversize bushes are available. Generally speaking, standard size bushes are suitable for replacement but should the connecting rod bush be over-standard size, the 0.020 oversize bush should be ground to suit, using the interference fit as given in the "General Data". The recommended method of fitting a replacement bush is to freeze it for a short time, then insert the bush with its oil hole aligned with the oil hole in the rod. If facilities for freezing are not available, press in the bush, using a suitable hand press and taking care that the bush is square with the bore of the rod. It is recommended that the finished rod is set up on a suitable diamond-bearing machine-running machine and the bush machined in situ. Care must be taken to ensure that the rod centres are maintained within the specified limits and that both bores are absolutely parallel. Should it be unavoidable to use a boring

or reaming sections, a standard type universal reaming rod aligning and reaming jig should be used. It is essential to observe the precautions quoted above. Final reaming without such a jig should never be attempted. When the bush bore is to the finished size, carefully radius the edge of the oil hole to remove sharp edges. Clean the rod thoroughly, particularly its longitudinal oil duct, then check the alignment of the rod and check the bearing clearances.

Oversize pistons
(+0.005in. and +0.010in.)

Due to the very close fit required between the gudgeon pin and the bore of the piston, all replacement pistons are supplied complete with a gudgeon pin which has been selected to provide this fit. It may be necessary at some instances to replace the gudgeon pin bush of the connecting rod to obtain the correct clearance between the bush and the new gudgeon pin. All oversize pistons are marked on the crown to indicate their size, e.g. +0.010 in.

CRANKSHAFT

Description:

The crankshaft is supported in four phosphor-bronze bush bearings fitted in the cylinder block. An integral spiral gear at the centre of the shaft meshes with the distributor drive gear which is mounted vertically in a bush pressed into the cylinder block, and is retained by a circlip fitted at its lower end. The crankshaft is secured in position by a retaining plate. A cast-iron double-track chain wheel, keyed and secured by a pin to the front-end of the shaft, engages with the timing chain driven by the crankshaft driving sprocket. The

mid-front-bearing journal has an oil groove past key round its circumference. Once per revolution the groove links the oil feed hole in the bush with an outlet to a groove in the bush outside diameter, thus providing the intermittent feed to the distributor drive in the distributor drive setting. The rear journal is drilled transversely to provide the intermittent feed to the rocker mechanism. It is also drilled longitudinally to enable any oil trapped behind the journal in the bush to drain back to the sump.

Removing and refitting

Disassemble the engine in the manner described. For removing the crankshaft, then remove the timing belt without the distributor and oil pump drive pinion through the distributor drive timing aperture of the cylinder block. Release the idlers and remove the two set-screws securing the retaining plate and collect the plates from the front-end of the crankshaft. Extract the tapered bottom then withdraw the crankshaft from the front-end of the cylinder block.

After re-conditioning, re-assemble the crankshaft in the following manner. Ensure that all components are clean. Insert the crankshaft, plain-end first, into the bearings of the cylinder block, and check the clearances with feeler gauges. In order to guarantee the optimum oil pressure, it is essential that the minimum permissible clearance is not exceeded. Assemble the retaining plate over the front-end of the crankshaft and secure the plate with two tapered set-screws. Fit the key and the chain wheel to the shaft and secure them with the retaining nut, then check that the end-flange of the shaft is within the required limits and that it rotates freely in its bearings. Re-assemble the distributor and oil pump drive pinion to its bearing and secure it by fitting a new circlip in the groove in its shaft. Check that the circlip is seating

correctly in the grooves and that it is free to rotate. Check that the end-clearance of the pinion in the bearing and the backlash between the pinion and its mating gear on the crankshaft is within the required limits. When these checks have proved satisfactory, fit the tappet rod into the retaining nut, chain third nut key from the crankshaft and rebuild the engine in the manner described in this Section for refitting the crankshaft.

Inspection

Examine the four crankshaft journals, cam profiles and spiral gear for wear, scoring and hard bearing. Check that the thrust face of the crankshaft and the mating surface of the retaining plate are not scored excessively. Examine the threads, keyway and chain third location for burrs and damage. Mount the crankshaft in V blocks on its front and rear journals and, using a dial indicator, check that any end-alignment indicated does not exceed the maximum permissible limit.

Inspect the crankshaft bearings in the cylinder block for security and general condition and check the bore of each bearing and the clearance between the crankshaft journals and the bearings.

Replining bearings

Using a suitable drift, tap the rejected crankshaft bearings from the cylinder block. Clean the bearing locations and ensure that the edges are free from burrs etc. that may cause the replacement bearings to "bind" or "lock-up" during fitting. It is most important to ensure that the bores have the correct interferences fit quoted in the "General Data". The recommended method for fitting the replacement bearings is to clean them for a few minutes, insert them

(cleaner first) in their relevant locations and, if necessary, use a soft metal drift to tap them into position. Great care must be taken when inserting the mid-front and rear bearings to ensure that their oil holes are aligned correctly with those of the cylinder block. The larger diameter hole of the mid-front bearing must align with the oil supply hole and the smaller diameter hole with the outlet to the turbocharger drive. The rear bearing should be fitted with the larger oil hole aligned with the oil feed hole to the rocker mechanism. When the bearings have been fitted, trial-fit the camshaft; in some instances it will be found to have the correct clearance without resorting to running. If such is the case, and if for any reason necessary to replace the rear bearing, the blanking plug may be left in position. It is essential that the minimum clearance is not less than that quoted in the "Emerald Data". It is also important that the maximum clearance is not exceeded in order to preserve the optimum oil pressure.

Under normal conditions however, it will be necessary to fit-over the bearings. In all cases, the blanking plug behind the rear bearing must be removed. The fine runner comprises a handle T.181646 on which are mounted the runners T.185379, T.185380, T.185381 and T.185382 for the front, mid-front, mid-rear and rear bearings respectively. Lubricate the bearings and runners with a liberal supply of clean engine oil and insert the runner into the bearings from the front end of the cylinder block. Run the bearings to size, maintaining rotation in the running direction while withdrawing the runner to prevent withdrawal scores. Wash out the cylinder block bearings and oil passages with paraffin under pressure to remove all traces of dirt, then refit the camshaft and check the clearance of the journals in the bearings.

Note 1:- When washing the cylinder block, it is advisable to remove the blanking plugs from the ends of the main gallery. Replace the plugs when cleanliness is assured.

If the clearances are satisfactory, insert the blanking plug into the rear bearing and prepare for peening. To insure full tightness, the following procedure is recommended. Apply an even coating of "Blowdown" penetrating compound to the threads of the blanking plug and screw it into position in the rear bearing to within $\frac{1}{4}$ to $\frac{3}{8}$ threads of its final position. Lightly peen the plug to the bearing case lightly. It is within $\frac{1}{2}$ to 1 thread of its final position. Lightly peen the plug then screw it into position and complete the peening.

Finishing

With the engine inverted on building stand or bench, arrange the turnshaft and crankshaft so that the bearings which locate the chain wheels are vertically upwards. Fit the keys to the shafts then fit the chain loosely to the chain. On later type engines, timing marks are drilled in the chain wheels; these should be aligned. Fit the sprockets and gears to the shafts and secure them in the manner described earlier in this Section (Refitting the crankshaft).

CIT. SUMP

Description

The cast aluminium alloy sump is fitted with two anti-rattle baffles. Four separate lubricated neck joint washers are fitted to the sump joint faces, and the sump is secured to the cylinder block by six screws with lockwashers and spring washers. A drain plug is fitted in the rear left side of the base of the sump and a union for the oil temperature thermometer is provided forward of this position.

Removal and refitting

Assuming that the engine is in position in the chassis, proceed as follows. Remove the drain plug and drain the sump. Unscrew the union nut and withdraw the thermometer bulb from its union; take care to prevent damage to the bulb and capillary tube and ensure that the small joint washer is not lost. Disengage the clutch pedal return spring from its anchorage bracket then unscrew the exhaust pipe bracket plate from the gearbox bracket. Unscrew both exhaust ring nuts, detach the anchorage of the exhaust system from the chassis and lower the exhaust pipes.

Detach the upper buffer bracket, complete with buffer, from the left-side of the gearbox bracket and pull the buffer plate of the buffer plate on the chassis.

Note :- If the car has a left-hand drive, the clutch spring anchorage bracket is detached as the upper buffer bracket bolt is removed.

Remove the remaining bolt securing the gearbox bracket to the clutch housing, and the four nut-bolts securing it to the cylinder block; detach the bracket. Remove the six screws nut-bolts securing the sump to the cylinder block, then lower the rear end of the sump, sweep it towards the rear of the car and lower it clear of the chassis.

Remove and discard the four joint washers which are secured to the ring joint face with jointing compound.

Before refitting the sump, clean the mating joint faces of the sump and cylinder block then apply an even coating of "Herculite" jointing compound to

the pump face. Fit a set of new joint washers to the joint faces and observe that the washers fitted in the front and rear faces project approximately $\frac{1}{8}$ in. above the top surface of the joint washers on the side faces. This will ensure that a seal is maintained after the joint washers have been compressed into position. Smear a liberal quantity of grease over the upper surfaces of the joint washers, then refit the pump to the cylinder block and screw in position with the standard set-bolts and spring washers. The remaining assembly procedure is the reverse of that given for dismantling.

IGNITION SYSTEM

Description

The distributor drive casing is attached to the left-hand side of the cylinder block, at its lower end it is secured to the main crankcase of the cylinder block, being bolted in a recess immediately above the distributor drive gear. It is also secured to the cylinder head with two set-bolts.

The casing provides an integral bearing at its lower end for the distributor drive shaft which is located externally by a flange integral with the shaft. A tapered driving dog is secured to the upper end of the shaft by a driving pin, a thrust washer being interposed between the driving dog and the bearing. Immediately above the driving flange flange is an integral driving pinion which engages with the pinion of the intermediate shaft, which is housed in a drive half removed into the side of the distributor drive casing. The upper end of the shaft is fitted with a splined driving dog which is also secured to the shaft with a driving pin.

The distributor unit is fitted to the upper end of the drive casing. The rotating lever which is clamped to the body of the distributor is secured to the casing by a spring-loaded washer retained by a shoulder nut-bolt.

The slotted upper end of the distributor drive gear engages with the beveled bottom driving dog of the shaft and the slotted upper driving dog engages the driving tongue of the distributor.

Distributor maintenance

General

The maintenance of this type of distributor follows standard practice.

Clean all dirt from the outside cover regularly, using a clean dry cloth. Periodically check the H.C. leads for condition and security in the cover.

To obtain access to the distributor rotor and contact breaker, spring back the two clips and lift away the cover, see Fig. 10. When carrying out work on the distributor, such as adjusting the contact breaker gap, it is advisable to remove the air filter to improve accessibility.

Periodically check the operation of the automatic timing device by turning the distributor rotor by hand as far as possible in the direction of rotation, then release the rotor and check that it returns smoothly to its original position. If the action is sluggish, lubricate the mechanism as directed in the next paragraph and re-check. If the defect persists, remove the distributor, fit a replacement and return the discarded unit to the manufacturer for rectification.

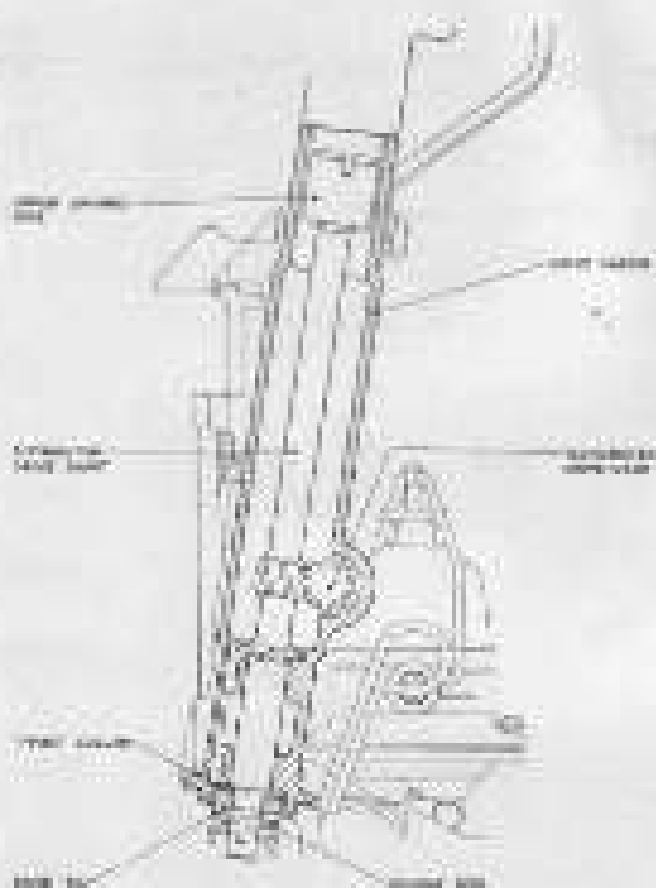


Fig. 29. Distributor drive assembly.

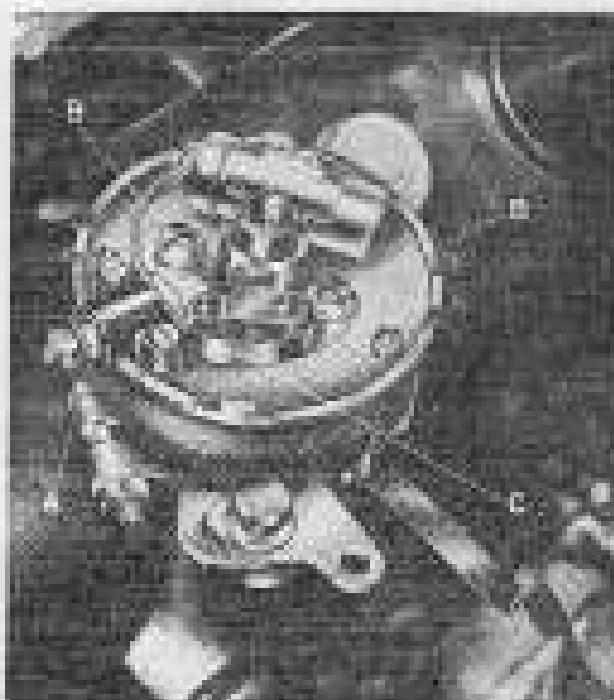


Fig. 11. Distributor details (Rotor removed).

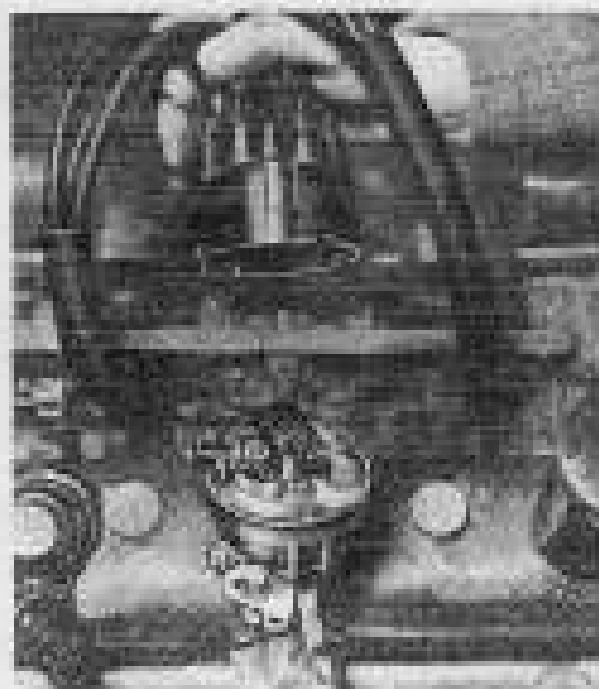


Fig. 30. Distributor details.



Fig. 32. Correct and Incorrect contact faces.

Lubrication

Every 3,000 miles (3,000 kilometers), remove the moulded cover, lift out the distributor rotor and lubricate the cam bearing and distributor shaft by injecting 3 or 4 drops of approved oil through the hole in the top of the rotor spindle. Apply a similar quantity of oil through the cam clearance hole in the contact breaker base plate to lubricate the automatic timing control, then refill the rotor.

Periodically remove the contact breaker cover and apply a smear of grease to the pivot pin, refill the cover and wipe off any excess grease. Finally, apply a smear of approved grease or engine oil to the cam surface.

Note :- Great care must be taken to make sure that oil and grease do not come into contact with the contact breaker contacts.

Make sure that the carbon brush in the moulded distributor cover is free in its holder and that the interior of the cover is perfectly clean and dry before refitting the cover.

Cleaning contact breaker

Since the "Triumph 2 litres" car has a high-performance engine, it is essential that the contact breaker gaps are set accurately and that the contacts are maintained parallel and flat and in a clean condition.

Every 3,000 miles (5,000 kilometers) examine the contacts. If they are burnt or blackened, clean them in the following manner.

Turn the crankshaft with the starting handle until the contacts are closed, disconnect the L.T. lead at the terminal on the side of the distributor, and

Slacken the terminal lock-out ("A" in Fig. 51) in order to release the end of the contact breaker spring "C", then lift the fibre rocker off its pivot post. An insulating paper is fitted beneath the rocker; take care not to lose this under. The spring is hooked to allow mechanical tests the terminal block and will be withdrawn with the rocker. Use an "India" or fine "Gorodushka" stone to clean the contacts, taking care to keep the contacts from perfectly flat, see Fig. 52. Clean away all traces of abrasive powder with a petrol miscible cloth. Then shift the lower leg of the pivot pin, raise the contacts and check that an all-over contact is made.

If necessary, replace the contacts carefully until correct action is obtained. Make sure that the components are reciprocally clean, then insert the pivot pin, shift the contact breaker lever, engage the lower spring with the terminal housing and tighten the terminal lock-out. Re-adjust the G.T. load.

Setting contact breaker gap

After cleaning, re-set the contact breaker gap in the following manner. The correct gap setting is 0.012 in. (0.303 mm.) and this must be checked with a perfectly clean feeler gauge. Slightly turn the crankshaft until the contacts are open fully, then slacken the two contact plate securing screws ("B" in Fig. 51). Move the plate about its axis until the feeler gauge is a good sliding fit between the contacts. Tighten the two screws and re-check the setting; re-adjust if necessary.

Replacements

It is permissible to fit replacement contact breaker arms and underarms. The distributor should however, be removed and returned to the manufacturer for

repair if any serious defect, such as failure of the automatic timing device, is detected.

Replacing contact-breaker

The ordering number of a replacement contact-breaker set is Lucas 207093. First remove the contact cover of the distributor and detach the rotor. Detach the L.T. lead from the terminal on the side of the casing, then slacken the terminal locknut "A" in Fig. 1 in order to release the end of the contact breaker spring "C", then lift the fibre rocker off its pivot point. An insulating resistor is fitted beneath the rocker; take care not to lose this resistor. The spring is elastic so allow sufficient free the terminal block and will be withdrawn with the rocker. Unscrew and remove the two screws ("D" in Fig. 2), taking care not to lose the washers, then lift out the fixed contact plate unit.

Make sure that the contacts of the replacement set are perfectly clean, then fit the fixed contact plate unit in position, leaving the central hole over the fulcrum pin; refit loosely the two screws "D" and washers. Apply a smear of approval grease to the contact lower pivot pin and to the cam, then fit the lower, engage the spring in the terminal housing and tighten the locknut.

Connect the L.T. lead to the terminal, then set the contact breaker gap as described in page 75.

Replacing condenser

The ordering number of a replacement condenser is Lucas 207094. First remove the contact cover and lift out the rotor. Disconnect the L.T. strip lead at the head of the condenser, remove the cover and shunt-point resistor securing the

condenser to the contact breaker base plate and lift away the condenser with its attached mounting bracket. Locate the replacement unit in position, secure with the screw and gasket-proof washer, then re-connect the L.F. wiring lead. Re-fit the distributor rotor, followed by the insulated cover.

Removal and refitting distributor and drive

Remove the two nut-bolts securing the air filter and distributor drive casing to the cylinder head then remove the head clips and remove the air filter. Take care not to lose the shim fitted behind the casing securing flange.

Remove the distributor cover. Loosen the actuating lever pin-bolt and remove the distributor. Disconnect the manual over-ride control from the actuating lever, then remove the shouldered nut-bolt, spring and washer and detach the lever from the casing. Disconnect the tachometer flexible drive from the rear side of the distributor drive casing, and the oil feed pipe from its union body on the front side of the casing. Remove the nuts coupling the drive casing to the cylinder block then detach the casing. If it is desired to dismantle the drive, proceed as follows. Remove the tachometer drive body complete with its drive shaft and joint washer from the drive casing. Tap out the drive pin and remove the driving dog and thrust washer from the lower end of the distributor drive shaft, then withdraw the shaft from the upper end of the casing. Tap out the drive pin and remove the upper driving dog from the shaft.

The assembly may be rebuilt and refitted by reversing the foregoing procedure but the fit of the shaft in the casing and body and the backlash of the timing gears should be checked to the fits quoted in the list of "General Data". If necessary, the backlash should be adjusted by selecting a thrust washer of suitable thickness.

Ignition timing

Remove the cover from the distributor, the oilpan rocker box cover, the front inlet rocker box cover, and the sparking plugs from the cylinders. Move the distributor actuating lever to the full retarded position, then turn the crankshaft until No. 1 piston is at 10° before top dead centre on the compression stroke. Adjust the distributor body so that, with the engine in this position, the contact breaker points are just opening and the rotor arm is aligned with the electrode supplying No. 1 H.T. lead. Tighten the actuating lever pinch-bolt on the distributor body to retain this setting. Refit the sparking plugs, connect the leads, then refit the rocker box covers and the distributor lead.

Note :- If the engine has been dismantled completely and the distributor drive gear and its mating gear on the crankshaft have been disengaged, it may be necessary to re-position the leads in the distributor cover.

An ignition timing check to obtain the optimum setting should be carried out with the engine running on a test bed or when the car is on the road. The test bed procedure is to advance the ignition progressively until the engine just commences to "pink" when running at 1,500 r.p.m. and at full throttle. All "pinking" should stop on increasing the engine speed to 1,000 r.p.m. These conditions may be obtained when testing the car, if carried out on a suitably steep gradient. When the optimum setting has been obtained, tighten the actuating lever pinch-bolt securely.

Sparking plugs

The special spanner (No. K.505011) supplied in the car tool kit for removing and fitting the spark plugs is fitted with a rubber insert which grips the lead

of the plug, thereby (a) protecting internal and external surfaces of the body and insulating caps from the plug and hold the spacer so that no undue strain is imposed upon the insulated body of the plug during removal or fitment. All plugs should be removed, cleaned, the gap checked, corrected, if necessary, re-set at least once every 1,000 miles (5,000 kilometers).

EXHAUST SYSTEM

Two exhaust manifolds are fitted to the cylinder heads and manifold serves these cylinders are connected to a single exhaust outlet. These manifolds are common to all engine types. The exhaust pipe-exitance systems however, are of several types; a brief description of each type follows.

Early type 300

A two-piece system. The forward unit has three pipes which engage the manifold. These merge into a single pipe which is welded to two oval-section "Bendable" silencers fitted in tandem. The outlet from the second silencer connects with the tail-pipe which is cranked to pass over the rear axle. This system is now completely redundant, and is replaceable only by a complete "Bendable" system as fitted to all other type 300 cars.

Later type 300

A three-piece system comprising down pipe unit, centre unit and tail-pipe unit. The down pipe unit has three pipes which engage the manifold and which merge into a single pipe which is secured to the centre unit by a pipe-clip. The centre unit incorporates a large round or oval section "Bendable" silencer; the outlet is cranked to connect with the tail-pipe unit which is cranked to pass over the rear axle and incorporates a small oval section "Bendable" silencer.

Pre-production type 400 and 401
(cars 1 to 10)

Prototype exhaust systems which have not been standardised were fitted to these cars. In the event of replacement or damage, the whole exhaust system should be replaced by the twin entry exhaust system.

Early production type 401 and 402
(cars 11 to 24)

A four-piece system comprising down pipe unit, centre section unit, tail pipe unit and a tail-pipe extension. The down pipe unit is so fitted to the later type 400 cars. The centre section unit has a large single-entry oval-section "Burgess" silencer with rear pipe terminating in the tail-pipe unit which is cranked to pass over the rear axle. An extension pipe is fitted in the rear end of the tail-pipe. In the event of replacement or damage, the whole exhaust system should be replaced by the twin entry exhaust system.

Later production type 401 and 402
(cars 25 to 123)

This system has separate down pipes which connect with a double-entry, single-exit, oval-section "Burgess" silencer fitted in the centre section unit. The rear pipe of the centre section unit connects with the tail-pipe unit which is cranked to pass over the rear axle. An extension pipe is fitted in the rear end of the tail pipe.

Latest production type 401
(cars 124 onwards)

This system is similar to the previous one but has a new type tail-pipe which passes beneath the rear axle. No extension pipe is fitted.

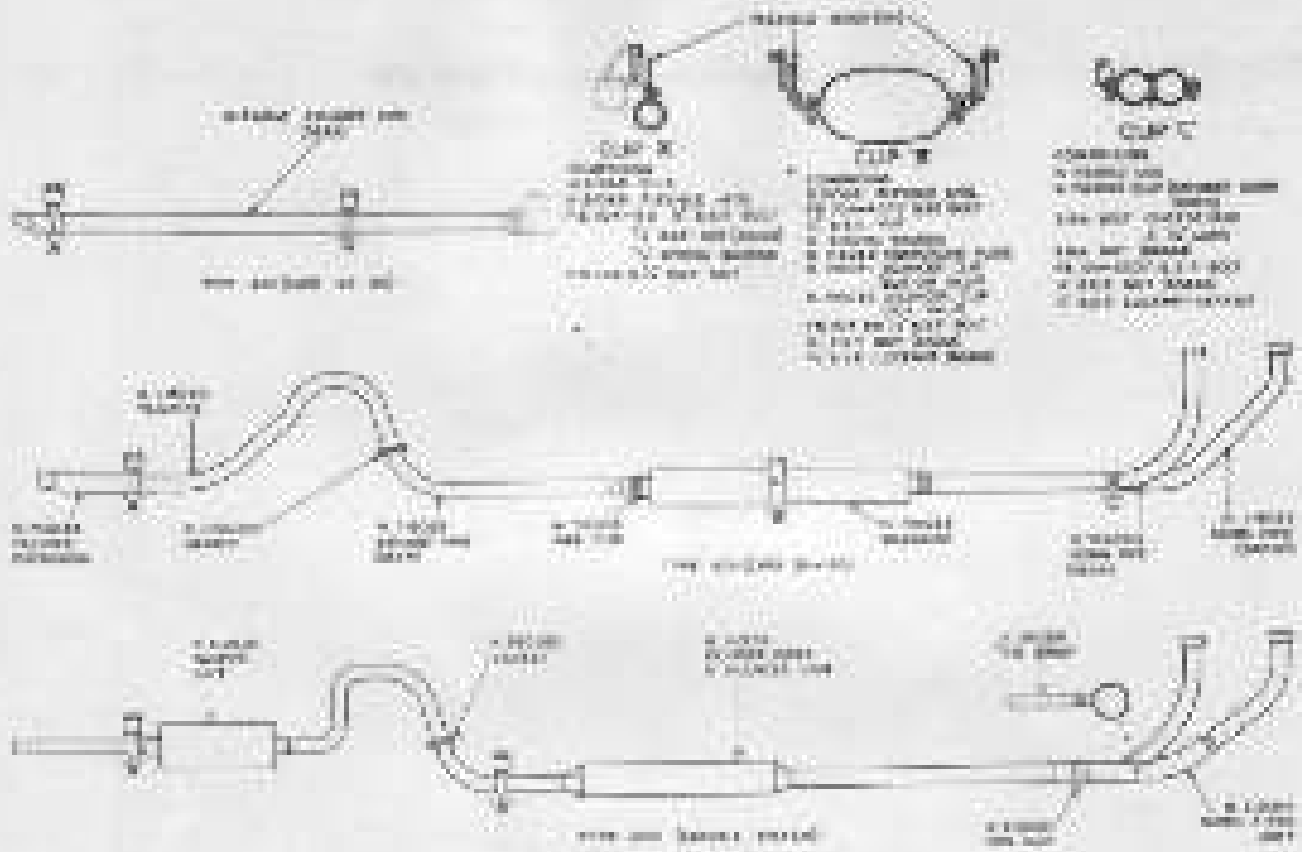


Fig. 33. Exhaust system.

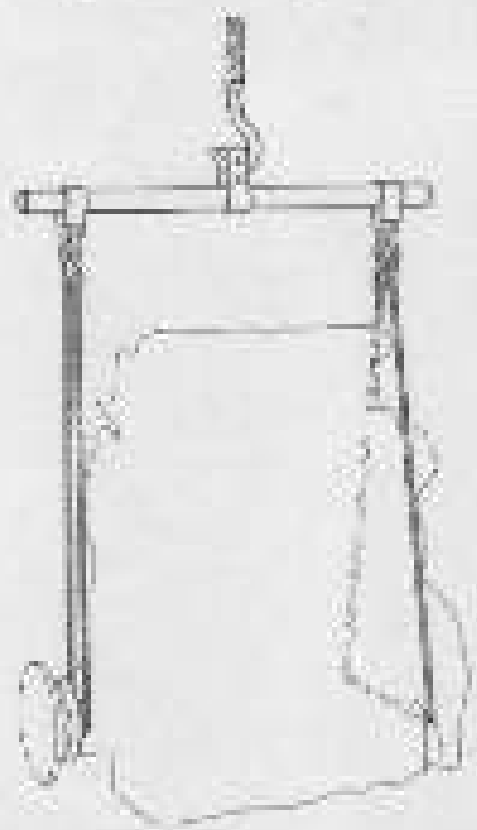


Fig. 34. Bagging machine.

REMOVING AND INSTALLING THE ENGINE

The recommended procedure for removing the engine is as follows :-

Type 400 cars

1. Remove the battery in the manner described in Section 14.
2. Disconnect the lead from the battery.
3. Drain the water from the cooling system (see Section 2).
4. Drain the sump by removing the drain plug from the rear left-hand side of the sump.
5. Remove the air filter. This will improve accessibility.
6. If the engine is fitted with 3 S.U. carburetors, disconnect the leads from the carboid and remove the starter carburettor float chamber.
7. Remove the oil filter. If an external oil cooler is fitted, disconnect its pipes from the filter head.
8. Disconnect the cables from the dynamo, then remove the dynamo and the fan belt.
9. Remove the radiator hoses. If a car heater is fitted, disconnect and remove the heater pipes. On type 400 engines, disconnect the pipe from the radiator hose to the thermostat manifold jacket. Fit a suitable metal plate against the rear face of the radiator to prevent damage during the subsequent operations.
10. Remove the water pump.
11. Turn off the petrolcock then disconnect the fuel pipe from the petrol pump.
12. Disconnect the tachometer drive from the tachometer drive body in the distributor drive timing.
13. Disconnect the L.T. and S.T. leads from the coil to the distributor.
14. Disconnect the ignition control rod.
15. Remove the oil thermometer bulb and store it carefully on the chassis, with its capillary tube, to prevent damage.

16. Disconnect the oil pressure gauge pipe.
17. Remove bolt securing rear pipe ring nuts using the "C" spanner (FN. 1050) and remove the nut and bolt securing the exhaust pipe bracket to the gearbox bracket.
18. Disconnect the throttle and mixture controls.
19. Remove the water thermometer bulb and store it carefully on the chassis, with its capillary tube, to prevent damage.
20. Disconnect the starter cables and remove the starter.
21. Remove the front seats and floor covering (see Section 14).
22. Detach the clutch, brake and accelerator pedals from their levers.
23. Remove the floorboards, footboards and gearbox control console.
24. Disengage the clutch return spring from the anchorage bolt, then disconnect the clutch operating rod from the clutch lever and return lever.
25. Disconnect the tachometer drive and the engine light wiring from the gearbox.
26. Fit the engine lifting sling, No. FN. 3024, in a point arranged at a convenient height above the engine, then pass the free end of the front (short) lifting cable around the front end of the crankshaft, between the driving pulley and the crankshaft drive cover, and hook it to the front ring of the lifting sling. Pass the free end of the rear (long) lifting cable around the engine, between the pump and gearbox bracket and connect its hook to the rear ring of the sling, see Fig. 14.
27. Raise the sling until the weight of the engine is taken on the cables.
28. Disconnect the gearbox shaft at its joint with the front universal coupling.
29. Remove the nuts and bolts securing the gearbox extension to the 1st rear mounting rail.
30. Remove the mounting nuts from the chassis cross-member.
31. Remove the nut-bolts and nuts and bolts securing the clutch cable to the engine; detach the starter and tachometer cable clips.
32. Carefully move the gearbox assembly rearwards to break the clutch shaft joint with the engine, then remove the assembly from the chassis.

Note 2- Check that the clutch raising loading device are secure in the clutch joint face of the engine.

37. Remove the nut-balls and detach the clutch assembly as described in Section 4.
38. Remove the nuts and balls securing the front mounting nuts in the chassis.
39. Raise the engine carefully from the car and manoeuvre it to clear obstructions. If necessary removal of the radiator retaining nuts are slackened sufficiently to permit forward movement of the radiator. This is not possible if shutter mechanism is fitted to the radiator.
40. Lower the engine into an engine stand or, if this is not available, on to wooden support blocks; the blocks will prevent damage to the sump.
41. Remove the lifting equipment.
42. If work is not to be performed on the engine or gearbox assembly immediately, cover all exposed portions and tight off all openings to prevent the ingress of foreign matter.

Types 401 and 402 cars

1. Remove the Dunlop as described in Section 14.
2. Disconnect the lead from the battery.
3. Drain the water from the cooling system (see Section 8).
4. Drain the sump by removing the drain plug from the rear left-hand side of the sump.
5. Remove the air filter; this will improve accessibility.
6. If an external oil cooler is fitted, disconnect its pipes from the head of the oil filter.
7. Disconnect the cables from the dynamo, then slacken the dynamo mounting and adjusting bolts, press the dynamo towards the cylinder block as far as possible, and detach and remove the fan belt. Tighten the dynamo bolts.
8. Remove the radiator hoses. If car heaters are fitted, disconnect and remove the heater pipes.
9. Turn off the petrol cock and disconnect the feed pipe from the petrol pump.

10. Disconnect the distributor drive from the distributor drive body in the distributor drive unit.
11. Disconnect the L.P. and H.P. leads from the coil to the distributor.
12. Disconnect the ignition control rod.
13. Remove the oil thermostat both and store it carefully in the chassis, with its capillary tube, to prevent damage.
14. Disconnect the oil pressure gauge pipe.
15. Remove both exhaust down pipe ring nuts using the "U" spanner TPK.1055 and remove the nut and ball securing the exhaust pipe bracket to the gasket bracket.
16. Disconnect the throttle and mixture controls.
17. Remove the water thermostat both and store it carefully in the chassis, with its capillary tube, to prevent damage.
18. Disconnect the cables from the starter.
19. Remove the front mud and floor covering (see Section 12).
20. Release the clutch, brake and accelerator pedals from their levers.
21. Remove the floorboards, seatboards and gearbox tunnel.
22. Disengage the clutch return spring from the release ball. Then disconnect the clutch operating rod from the clutch lever and return down.
23. Disconnect the distributor drive and the reverse light wiring from the gearbox.
24. Fit the engine lifting sling, 30.273.5023, to a hook arranged at a convenient height above the engine. Then pass the free end of the front (short) lifting cable around the front end of the crankshaft, between the timing pulley and the overhead drive cover, and hook it to the front ring of the lifting sling. Pass the free end of the rear (long) lifting cable around the engine, between the cam and gearbox brackets, and connect its hook to the rear ring of the sling, see Fig.26.
25. Raise the hook until the weight of the engine is taken on the sling.

26. Remove the stay from the top of the radiator and slacken the two radiator retaining nuts sufficiently to permit the radiator to be moved forward. Fit a suitable metal plate against the rear face of the radiator to prevent damage during the subsequent operations.
27. Disconnect the gearbox shaft at its joint with the front universal coupling.
28. Remove the nuts and bolts securing the gearbox sub-assembly to the two rear mounting units.
29. Remove the mounting units from the chassis cross-member.
30. Remove the nut-bolts and the nuts and bolts securing the clutch casing to the engine; detach the accelerator and tachometer cables slips.
31. Move the gearbox assembly rearwards carefully to break the clutch casing joint with the engine, then remove the assembly from the chassis.

Note :- Check that the clutch casing jacking device are secure in the clutch joint face of the engine.

32. Remove the nuts and bolts securing the front mounting units to the chassis.
33. Raise the engine carefully from the car, manoeuvring it to clear obstructions.
34. Lower the engine into an engine stand or, if this is not available, on to wooden blocks; the blocks will prevent damage to the sump.
35. Remove the lifting equipment.
36. If work is not to be performed on the engine or gearbox immediately, cover all exposed portions and blank off all apertures to prevent the ingress of foreign matter.

To install the engine, reverse the removal procedure. After re-connecting the controls etc., check their range and adjustment as described in the relevant Sections.

ENGINE TUNE-UP

Engine tune-up consists of a series of cleaning, inspecting and adjusting operations designed to bring the performance of the engine to its optimum.

The following paragraphs outline the necessary operations, and it is recommended that they are carried out in the sequence in which they appear to make sure that no points are omitted. Only brief instructions are given; refer to the relevant Sections for full details of the operations.

General

1. Disconnect battery and remove the spark plugs (see page 51).
2. Check over the engine for signs of oil leakage.
3. Check the tightness of all union connections and jubilee clips.
4. Adjust the fan belt tension as directed in Section 2.
5. Check the cylinder head retaining nuts for tightness, see page 45.
6. Check the cylinder compression.

Sparking plugs

1. Disconnect the B.V. valve and remove the sparking plugs (see page 51).
2. Check that the correct make and type of plug is being used.
3. Clean the plugs, examine the electrodes for wear, and the insulator tip for cracks and/or chipping. If the insulator is damaged, discard the plug and fit a new set.
4. If the sparking plugs appear to be satisfactory, adjust the gaps to the dimension quoted in the "General Notes", but this may be satisfactory, refer to the cylinder head.

Battery

Check the electrolyte level and "top-up" if necessary.

Electrical connections and cables

1. Check the battery "earth" cable and the battery-to-starter solenoid cable for cleanliness and security of their connections.
2. Examine the H.T. cables and the distributor-to-coil cable for condition. If the insulated covering is badly cracked or frayed, fit replacement cable(s).
3. If the cables are in a satisfactory condition, disconnect each cable, in turn, at the distributor cover. And check the cable terminals and sockets. Check that the moulded H.T. cable ends are not cracked, and that the cables are secure in the nuts before reconnecting to the distributor.
4. Check the distributor-to-coil H.T. cable connection for security.

Distributor

1. Remove the distributor cover and wipe the interior with a clean, dry cloth. Check the cover for cracks and the electrodes for signs of burning. Check that the contact carbon brush is not worn unduly, and that it is free in its holder.
2. Examine the rotor for freedom from cracks and burning of the electrode; fit a replacement if defective. Check the operation of the automatic advance and retard mechanism.
3. Check the condition of the contact breaker and if the contacts are worn excessively, fit a new contact breaker and as described in page 79. If the contacts are serviceable, clean and adjust them as described in pages 17 and 72.
4. Check the security of the condenser terminal connection.

Valve tappet clearance

1. Remove the rocker covers and inspect the valve operating mechanism for cracked valve spring collars.
2. Set the tappet clearance to 0.002 in. (0.051 mm.) G.D.L.D., then refit the rocker covers.

Carburettor(s)

1. Remove, clean and refit the air filter element as described under "Air Filter" in Section 3.
2. Remove and clean the fuel pump bowl and assembly. Check the condition of the diaphragm seal before refitting the bowl.
3. Examine the carburettor and jet/needle points for evidence of leakage.
4. Adjust the carburettor(s) following the relevant procedure given in Section 3.

TROUBLE SHOOTING

Lack of power...	<ul style="list-style-type: none"> ... Poor quality fuel. ... Contaminated - see Section 2. ... Low compression. ... Inefficient ignition. ... Carburettor(s) dirty and/or maladjusted, see Section 3. ... Air cleaner restricted. ... Insufficient grade of oil. ... Restricted or blocked system.
Poor compression	<ul style="list-style-type: none"> ... Valves seating incorrectly. ... Increased tappet clearance. ... Valves sticking open. ... Cylinder head gasket leaking. ... Piston bars scored or worn. ... Valve springs weak or broken. ... Increased valve timing. ... Piston rings leaked, worn or stuck. ... Piston ring grooves worn.
Recessive cylinder and piston wear	<ul style="list-style-type: none"> ... Increased grade of oil. ... Leak of oil. ... Dirty oil. ... Overheating - see Section 2. ... Piston rings fitted incorrectly. ... Piston rings broken or stuck in grooves. ... Fuel mixture too rich.

Crankshaft main bearing or connecting rod bearing failure.

- Lack of oil.
- Low oil pressure.
- Incorrect grade of oil.
- Restricted oil supply to bearing.
- Bearing shell loose or fitted incorrectly.
- Bearing journal scored or worn oval.

Broken valves and seats

- Incorrect tappet clearance.
- Weak or broken valve springs.
- Improper valve timing.
- Valves sticking in guides.
- Valves seating too loosely.
- Excessive carbon deposits around seats and valve heads.
- Starter strength too weak, see Section 3.
- Overheating - see Section 2.

Sticking valves

- Incorrect tappet clearance.
- Insufficient clearance between valve stem and guide (fits too loose).
- Valve springs weak or broken.
- Valve stems scored or dirty.
- Rockers sticking or spalling (after re-bushing).
- Use of poor quality fuel with high gum content.

Overheating

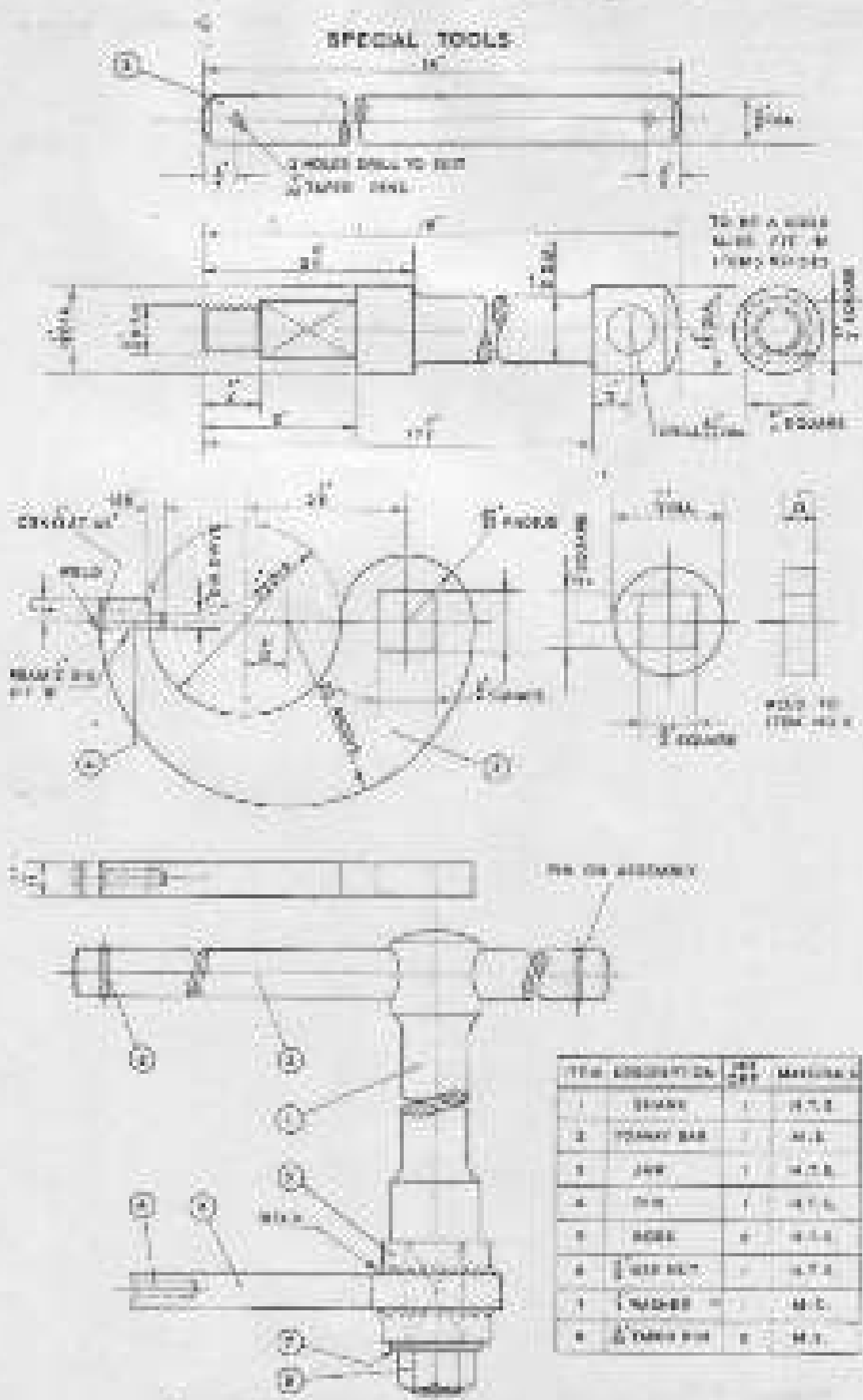
- See "Cooling System" - Section 2.
- Incorrect ignition.
- Mixture strength too weak, see Section 3.
- Air filter restricted, see Section 3.
- Incorrect grade of oil.
- Incorrect valve timing.

Excessive oil consumption

- Oil level too high.
- Oil leaks at joints and seals.
- Excessive oil pressure.
- Incorrect grade of oil.
- Cylinder bore worn or scored excessively.
- Overheating, see Section 2.
- Piston rings broken, worn or stuck in groove.
- Piston rings fitted incorrectly.
- Crankshaft and/or connecting rod bearings worn.

Low oil pressure	Incorrect grade of oil. Oil pressure relief valve stuck. Oil pump drive unit clogged. Excessive main bearing and connecting rod bearing clearance. Oil pump worn excessively.
Popping, spitting back and "pinking"	Incorrect ignition. Carburettor(s) adjusted incorrectly, see Section 1. Insufficient tappet clearance. Excessive carbon deposits in combustion chambers. Bent or broken valve springs. Hot spot in cylinder head, usually caused by clogged water passages. Valves seating incorrectly. Incorrect valve timing. Piston and rings in poor condition. Poor quality fuel. Incorrect type, not adjusted or defective sparking plugs.

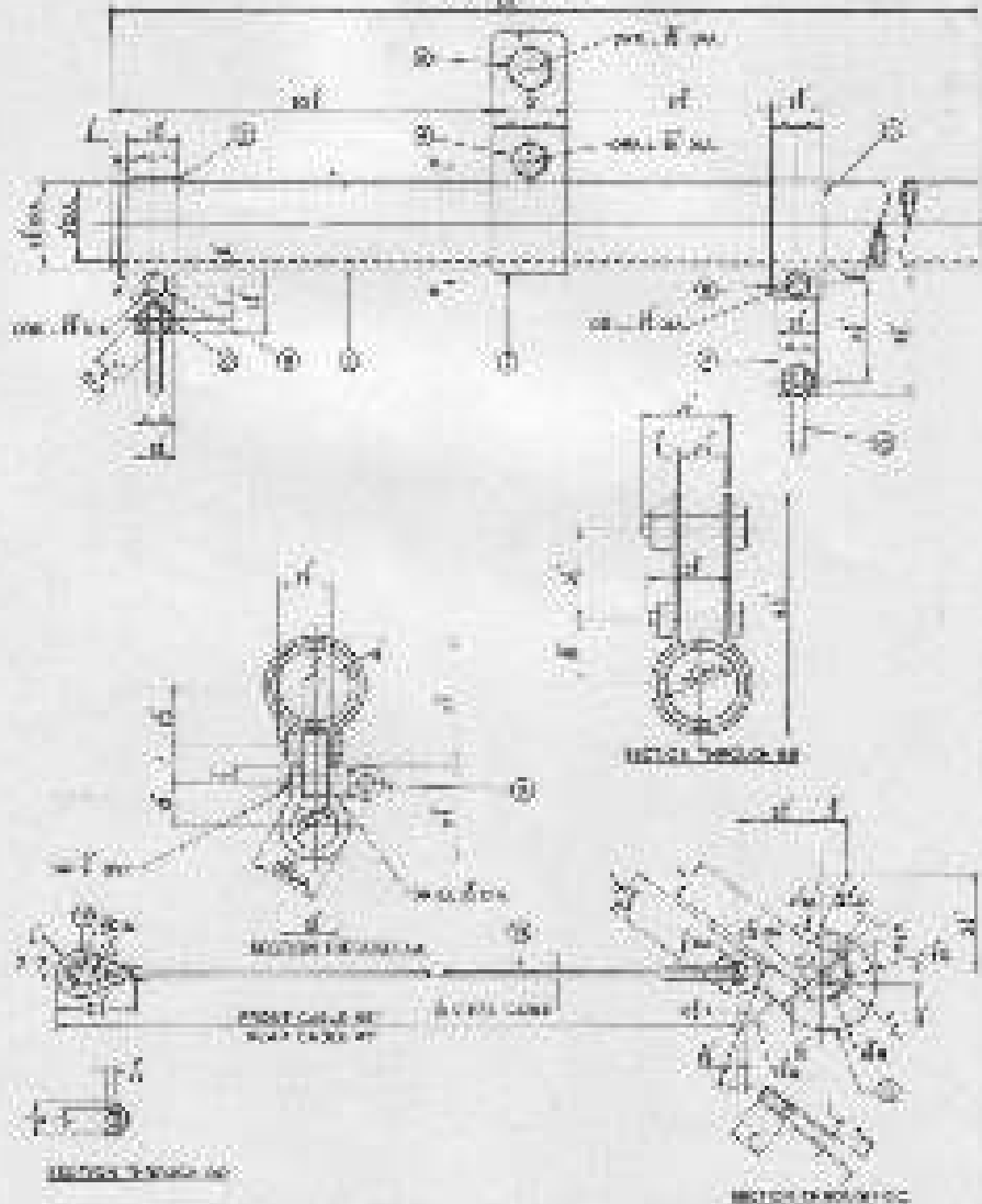
SPECIAL TOOLS



ITEM	DESCRIPTION	QTY	MATERIAL
1	SHANK	1	H.T.S.
2	SPINNER BAR	1	A.I.S.
3	JAW	1	H.T.S.
4	PIE	1	H.T.S.
5	SOLE	4	H.T.S.
6	WRENCH	1	H.T.S.
7	WASHER	1	M.I.
8	WASHER PIN	2	M.I.

SPINNER FOR EXHAUST NUT TRN 8030.

SPECIAL TOOLS



ITEM	DESCRIPTION	QTY REQD	MATERIAL	ITEM	SECTION THROUGH	QTY REQD	MATERIAL
1	SLING	1	STEEL PIPE	9	WHEEL	2	MS
2	LIFTING LINK	1	MS	10	EYE BOLT	2	MS
3	WIRE BOLT	1	MS	11	WASHER	2	MS
4	WIRE BOLT	1	MS	12	FRAM	2	STE
5	WASHER	2	MS	13	DRUM	1	MS
6	LINK	1	MS	14	CABLE	1	3/4" L
7	LINK	1	MS				

CAR ENGINE SLING T.F.N. 5023



WORKSHOP MANUAL

Section 1

Bulletin No. 2

Subject

REPAIRS TO STRIPPED THREAD IN DRAIN PLUG LOCATIONS.

INTRODUCTION

1. There is a tendency to strip the thread in the drain plug due to constant removal of the drain plug. This does not necessarily mean a new plug can be re-threaded in practice by a process given herewith. Alternatively another plug can be supplied at a replacement charge.

2. To salvage the damaged plug, the following tools and parts will be required:

<u>Item No.</u>	<u>Part No.</u>	<u>Description</u>	<u>No. Reqd.</u>
1	-	Tap drill, 0.4718 in. (42) dia. (66)	1
2	TRM. 8233	Tap	1
3	W. 31100/1	Wire insert	1

The special tap may be purchased from the Stores Department, Air Division, The Bristol Aeroplane Company Limited, or one can be obtained on loan from the Company.

PROCEDURE FOR RE-THREADING THE DRAIN PLUG TOLE IN POSITION ON THE ENGINE

- (1) Drain the engine sump, if necessary raising the right-hand front end of the car to facilitate complete drainage.
- (2) Place the car on a hoist or ramp, or position it over a pit.
- (3) Fill the fluting of the drill (Item 1 above) with stiff grease and carefully drill out the drain plug orifice. If necessary withdraw the drill at frequent intervals and clear away any loose stuff. Do not allow swarf to enter the sump.

- (4) Fill the fluting of the tap (item 2 above) with stiff grease and tap out the hole. Ensure that the tap is at right angles to the face of the hole in both planes. Withdraw the tap at frequent intervals and clear away any loose metal. Do not allow metal to enter the sump.
- (5) Inspect through the hole and remove any loose particles which may have entered the sump.
- (6) Enter the wire insert (item 3) ~~into the hole~~ into the first thread of the hole just tapped then, with suitable pliers grip the tongue near its foot and carefully press down until the last coil of the insert is just clear of the surrounding face.

Caution :- When coast started the insert cannot be unscrewed, make sure therefore that all threads are clear and free from any obstruction.

- (7) Finally break off the tongue of the insert, which is proved, to facilitate a clean break.
- (8) Screw in the drain plug and tighten securely. Lower the car, or remove from the pit and refill the sump with an approved brand and grade of oil to the correct level.

4. If the sump has to be removed, the re-threading can be carried out more conveniently.

REPLACEMENT SUMP

5. This can be obtained through a "Trusted" Distributor or direct from the Spare Department, Car Division, The Bristol Aeroplane Company Limited.

CYLINDER HEAD

The cylinder head incorporates the following differences from the Type 850 head:

1. Larger diameter inlet valves.
2. Lightened type push pins operating with lightened tappets and cup-ended rocker adjusting screws.
3. A new cylinder gasket, which can be identified by the castings on each side of the cylinder bore openings.

CRANKSHAFT

The main bearing journal diameters have been increased from 2 in. to 2 $\frac{1}{8}$ in. The connecting rod bearing journal diameters remain unchanged.

Separate balance weights are bolted to the crankshaft webs; when regrinding it is therefore necessary to remove the balance weights. First making sure that they are marked for location. When refitting the weights, tighten the securing bolts to the torque loading specified in the General Data at the beginning of this Bulletin.

Replacement bearings are available 0.010 in. and 0.020 in. undersize; replacement bearings more than 0.025 in. undersize are not supplied.

CAMSHAFT

With the exception that the cams are profiled to give the greater lift listed in the General Data, this component is identical to that of the Type 850 engine.

LUBRICATION SYSTEM

This system (which is illustrated diagrammatically in Figs. 1 and 2) is identical with that of the Type 896 engine with the exception that excess oil from the pressure relief valve returns to the inlet side of the oil pump via a second duct in the pump body.

OIL PUMP

Description

The pump is a positive displacement type and is illustrated in Fig. 3. The pump chamber encloses an inner and outer rotor, the inner rotor being pinned to the spindle which has a squared end projecting vertically upwards from the body to engage the pump driving shaft. A delivery duct in the body links the discharge side of the pump with the pump body attachment flange, while a second duct links the return oilway of the pressure relief valve in the side of the cylinder block with the inlet side of the pump.

Disassembly

To dismantle the pump proceed as follows.

1. Release the tabs of the locking plate, remove the two set-bolts securing the sleeve unit, then remove the locking plate, sleeve and sleeve nut. Discard the two joint washers.
2. Cut the locking wire, remove the set-bolts securing the pump cover then remove the cover and withdraw the inner and outer rotors.
3. Clean and dry the components, paying particular attention to the oilways and sleeve unit.

Re-assembly

Make sure that all components are scrupulously clean, then lubricate the outer rotor and assembly H to the body, chamfered edge inward. Lubricate the inner rotor and fit it in the outer rotor, with the squared end of the spindle projecting through the body. Fit the pump cover and secure with the set-bolts and plain washers. Test the pump for freedom of rotation. If the pump is tight, release the set-bolts, reposition the cover slightly on the bolts, then re-tighten and re-test.

When this is satisfactory, re-lock the set-bolts.

Note: No washer or jointing compound is used on the joint faces.

Finally re-assemble the joint washer, noise cover, another joint washer, screw and locking plate, and secure them with the two set-bolts. Tighten the bolts and bend the ends of the plate to lock the heads.

SUMP

Description

The lower portion of the sump is "stepped" to provide greater capacity and a flange attachment is provided on the left-hand "step" to accommodate the breather pipe oil return drain. A single anti-surge baffle, joined on its centre line by four nut-and-bolt-headed screws and captive nuts, is fitted inside the sump.

Removal and refilling

Assuming that the engine is in the chassis, proceed as follows referring to Fig. 4. Remove the drain plug and drain the sump. Unrigger the union nut and withdraw the thermometer bulb from its union; take care to prevent damage to the

capillary tube and ensure that the small joint washer is not lost. Insert both exhaust pipe ring nuts. Remove the oil filter complete and the engine breather pipes and oil separator with complete. Release the exhaust pipe clip from the clutch housing and the alternator front joint clips and remove both exhaust down pipes. Disconnect both anti-roll bar brackets from the chassis members and swing the anti-roll bar forward clear of the sump base. Detach the chassis buffer bracket complete with buffer and pull it clear of the chassis buffer plate.

Note:- If the car is left-hand drive, the clutch pedal return spring anchorage bracket is detached to the upper buffer bracket bolt, as removed.

Remove the four bolts and nuts securing the rear face of the sump to the clutch bell housing.

Note:- If the car is right-hand drive, the clutch pedal return spring bracket will be retained on removal to the right-hand bolt of the face referred to above.

Remove the twenty one bolts securing the sump flange to the cylinder block. Lower the rear end of the sump until it can be drawn to the rear away from the car.

Remove and discard the four joint gaskets which are affixed to the sump by jolting compound.

Before refitting the sump, clean the mating joint faces of the sump, taking care not to allow any grease to lodge beneath the giffle. Clean and dry the cylinder block flange face, then apply an even coating of good quality jolting compound to the sump faces. Fit a set of new joint gaskets and ensure that those fitted to the front and rear curved faces project upwards by approximately

1/16 in. above the top surface of each side flange gasket. This is to ensure a good seal is maintained after the gaskets have been compressed. Smear a liberal quantity of grease over the upper surface of the gaskets, then refit the pump to the cylinder block and secure it with the heavy one inch bolts and spring washers. Do not omit the weather pipe (atmospheric) flap beneath the top hole aft of the oil filter assembly location.

At this stage it is important to note that there is no separate gearbox bracket as with previous types of engine. It is therefore necessary to check that the rear face of the pump is perfectly level with the cylinder block face (if the gearbox is not in position) and that there is no gap between the clutch bell housing and the pump face when the pump is made secure. Failure to do this may result in a cracked pump when the clutch bell housing bolts are finally tightened.

Insert the four bolts of the clutch casing, fit the spring washers and nuts and tighten evenly. If the car is a right-hand drive, fit the clutch pedal return spring bracket between the nut and spring washer of the extreme right-hand bolt. The remainder of the assembly procedure is the reverse of that given for dismantling.

ENGINE BREATHING SYSTEM

Description

The crankcase is ventilated via the girth rod chamber on the left-hand side of the engine aft of the flywheel. The front port end chamber cover is provided with a location for the oil separator unit from which two pipes emerge. The lower pipe is connected to a flange on the 'step' of the sump and is the drain by

which any evaporated oil is returned to the engine. The upper pipe extends upward then curves over and downward to the rear and is open to atmosphere below deck level in order to clear any fumes from the engine bay. The lower extremity of the pipe is fitted with a flexible extension to avoid the risk of damage in ground obstructions.

Note: No pipe connection is fitted between the air intake filter and the forward inlet rocker cover. The connection with the filter cover is slanted off.

Maintenance

Remove and clean the separator unit when the engine oil is changed after every 2,000 miles (3,200 km.).

Hampering and refitting

Remove the air cleaner unit as described in Section 3, page 24, making reference to the pipe connection between the air cleaner manifold and the forward rocker box cover. Loosen the pinch bolt in the upper pipe connection of the separator unit. Remove the knurled finger nut, disconnect the lower (crank) pipe and withdraw the separator unit. Reverse the above procedure for refitting but make sure that the joint nutting (recessed into the separator unit joint head) is in good condition. Do not use wire thin finger prongers on the knurled finger nut.

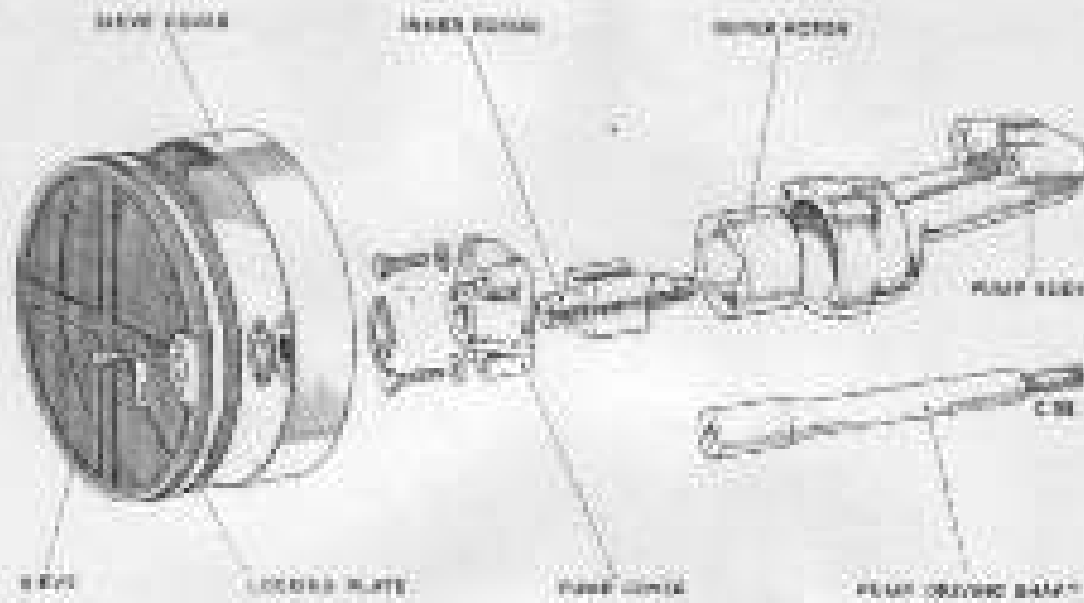


Fig. 3. Ill. pump

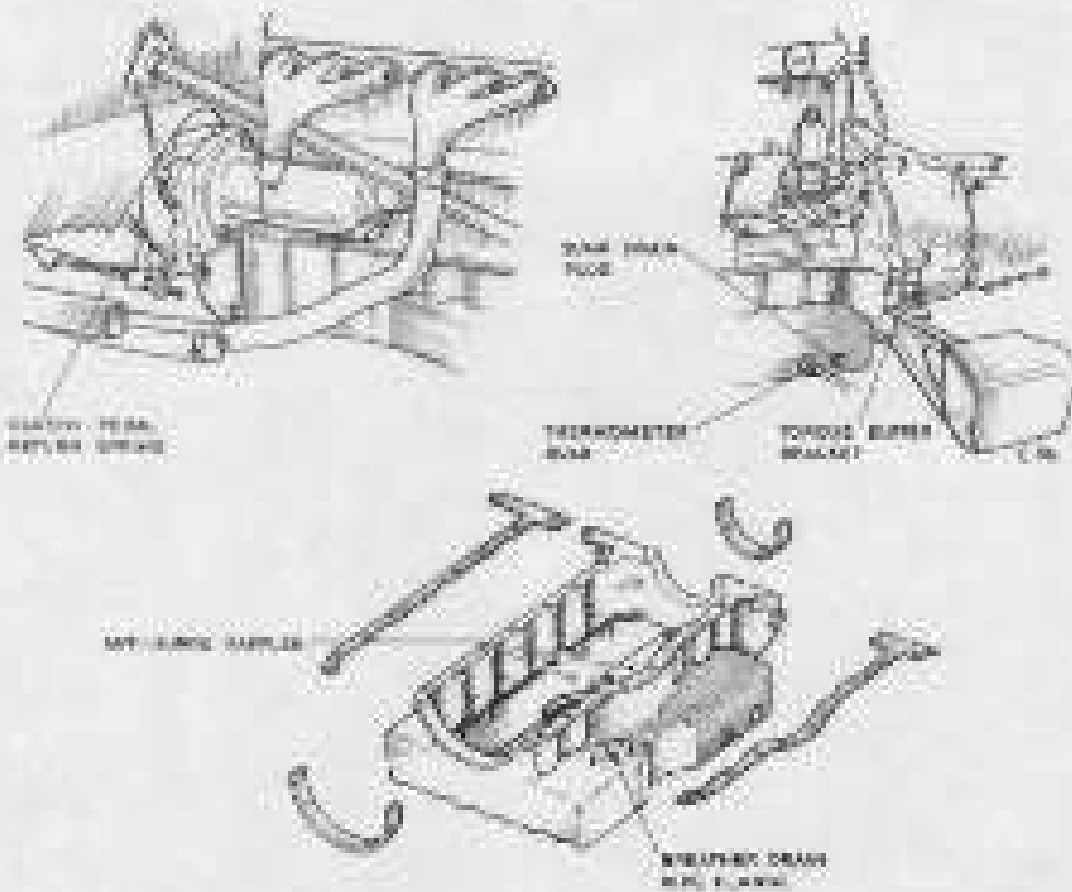


Fig. 4. Lowering the stop.



WORKSHOP MANUAL

Section: 1

Bulletin No: 4

Subject: INTERNAL OIL COOLER

ALL COOLERS FITS THE INTERNAL OIL COOLER
HELDS IN THE CYLINDER BLOCK BENEATH THE
BREAST MATING.

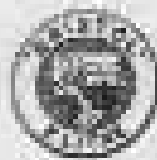
On some of the earlier engines, an oil cooler was fitted into a chamber formed along the right-hand side of the cylinder block, and instructions given on pages 30 to 33 of this Section recommended that the oil cooler element should be removed and discarded, and a blanking plate GPs.231 fitted.

Experience has shown that when this operation has been carried out, the blanking plate is subject to corrosion, and if allowed to remain results finally in leakage between the oil and water systems, the first indication being the presence of oil in the radiator.

It is recommended therefore that at least once every 12 months, all such engines should be drained of water, the oil cooler body removed and the blanking plate examined. If the blanking plate is corroded extensively, discard it and replace it by a similar-shaped plate as under :-

Brass Blanking Plate GPs.231.

If leakage has occurred (as shown by oil in the radiator drain both the water system (and heater, if fitted) and the engine comp. Thoroughly flush out the cooling system before refilling with fresh water.



WORKSHOP MANUAL

Section - 1

Bulletin No. 3

Subject -

FITTING AN EXTERNAL OIL COOLER TO LATER

TYPE 401 CARS AND TYPE 403 CARS.

INTRODUCTION

The following cars may be fitted with an external oil cooler together with the necessary piping and by-pass valve without modification to existing components.

Type 401 Cars from chassis No. 3971 onwards.

Type 403 Cars all cars.

An external cooler is not strictly necessary for normal use on a car in this country, but for competition work or sustained high speed travel, an oil cooler is recommended. This increases the oil capacity of the system by 1 pint approx. only.

If the cooler is considered unnecessary for a period after installation, it may readily be disconnected from the engine oil filter, the ports blocked off, and the oil cooler inlet and outlet pipes blocked and taped in the side.

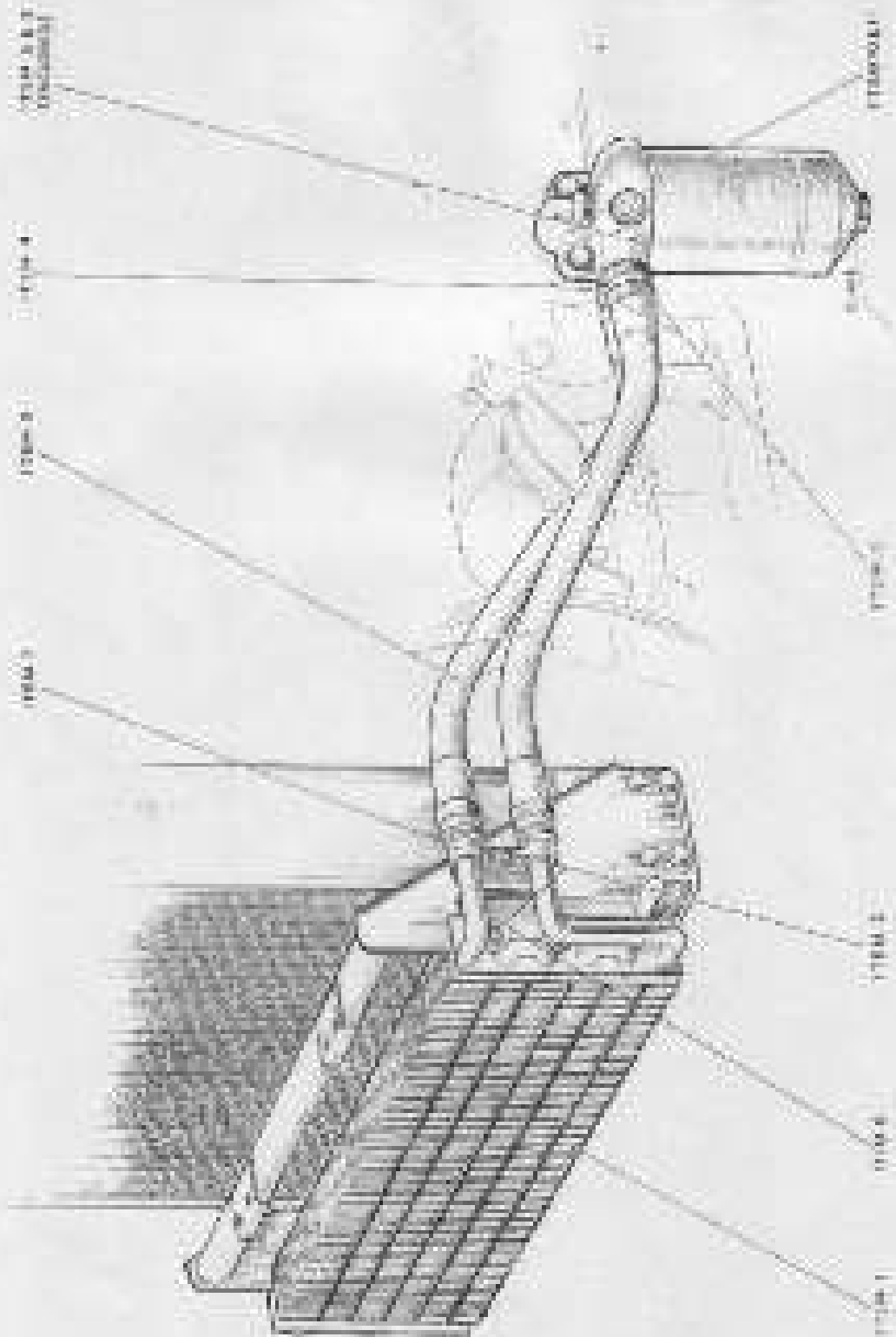
Following are details of the work involved and an illustration of the assembly in position; a list of the parts required is given at the end of the bulletin.

FITTING THE OIL COOLER

1. Remove the hood from the car.
2. Place the oil cooler (Item 1) between the front of the radiator area and the front grille and locate it between the flanges of the mounting brackets secured the lower attachment bars. Secure it in position with all three car-nuts (Item 2) on the off-side and the lower attachment only on the near-side.
3. Locate the support bracket (Item 6) and secure it with the two other car-nuts.
4. Remove both forward facing blanking plugs from the engine oil filter head, and fit a union (Item 3) in each vacant port with a washer (Item 4) interposed.
5. Fit a flexible oil pipe (Item 7) between the area of the front engine mounting bracket and connect the rear end to the intake union of the filter head and the forward end to the supply union of the oil cooler. Tighten each union not acutely, making sure that the pipe is not twisted.
6. Fit the second flexible pipe (Item 8) alongside the first fitted and connect the rear end to the intake union of the filter head and the front end to the lower connection of the oil cooler. Tighten the union not acutely, assuring that the pipe is not twisted.
7. Fit the pipe (inside) plug (Item 9) to the total inlet and outlet stub of the oil cooler as indicated in the illustration, and with suitable packing interposed, secure it with the counter-bored nut-nut, plain washer, shalproof washer and nut (Item 9).
8. Remove the side blanking plug from the engine oil filter head and into the vacant port fit the by-pass valve assembly (Items 5 and 6) in that order followed by the plug (Item 11) with the washer (Item 10) interposed between the head of the plug and the filter head.
9. Check that the oil level in the sump is correct, then start up the engine and run at a fast tick-over until the oil temperature has reached 70°C. Run for a further 5 minutes. Stop the engine, re-check the oil level and top up the sump.

LIST OF PARTS REQUIRED

<u>Item No.</u>	<u>Description</u>	<u>Part No.</u>	<u>Qy. reqd.</u>
1	Oil cooler,	-	1
	{ Net screw 1/2 in. B.S.F.	12. 000/1.	7
2	{ Flange washer 1/2 in.	-	7
	{ 2/proof washer 1/2 in.	1214 0000 Head.	7
	{ B.S.F. nut 1/2 in.	B.S. 000/1.	7
3	Inlet, 1 1/2 in. head/oil pipe,	N. 361 110	2
4	Washer for use with item 3.	N. 360870	2
5	Flexible oil pipe,	N. 361 110	2
6	Support bracket,	N. 361470	1
7	Pipe clips for use with item 3 adjacent to oil cooler unions.	N. 361480	1
8	By-pass valve,	N. 361090	By-pass valve assembly for filter head.
9	Spring,	N. 360860	
10	Washer,	N. 360870	
11	Plug,	N. 360910	





WORKSHOP MANUAL

Section - 1

Bulletin No. 6

Subject -

FITTING A SUMP COOLING SCOOP TO
TYPE 400 and TYPE 401 CARS

INTRODUCTION

To assist in cooling the oil in the engine sump, a sump cooling scoop has been introduced, which can be fitted as an option.

The scoop is fitted in close proximity to the sump, taking in air at its forward end and directing it in a free passage throughout the length of the sump.

By this action, the temperature of the oil can be retained at a lower level, at the same time maintaining its viscosity.

The parts required when fitting the sump cooling scoop are listed below.

For types 400 and 401 cars.

<u>Part No.</u>	<u>Description</u>	<u>No. off.</u>
N.63200	Sump cooling scoop	1
N.63201	Bracket	1
	2 B.A. bolt, hexagon head, 1/2 in. long	2
	2 B.A. lockproof washer	2
	2 B.A. nut	2
PS. 107/10	Intercess	2



Part No.

Description

No. of

For type 401 cars only.

N.705798

Rubber plate carrier

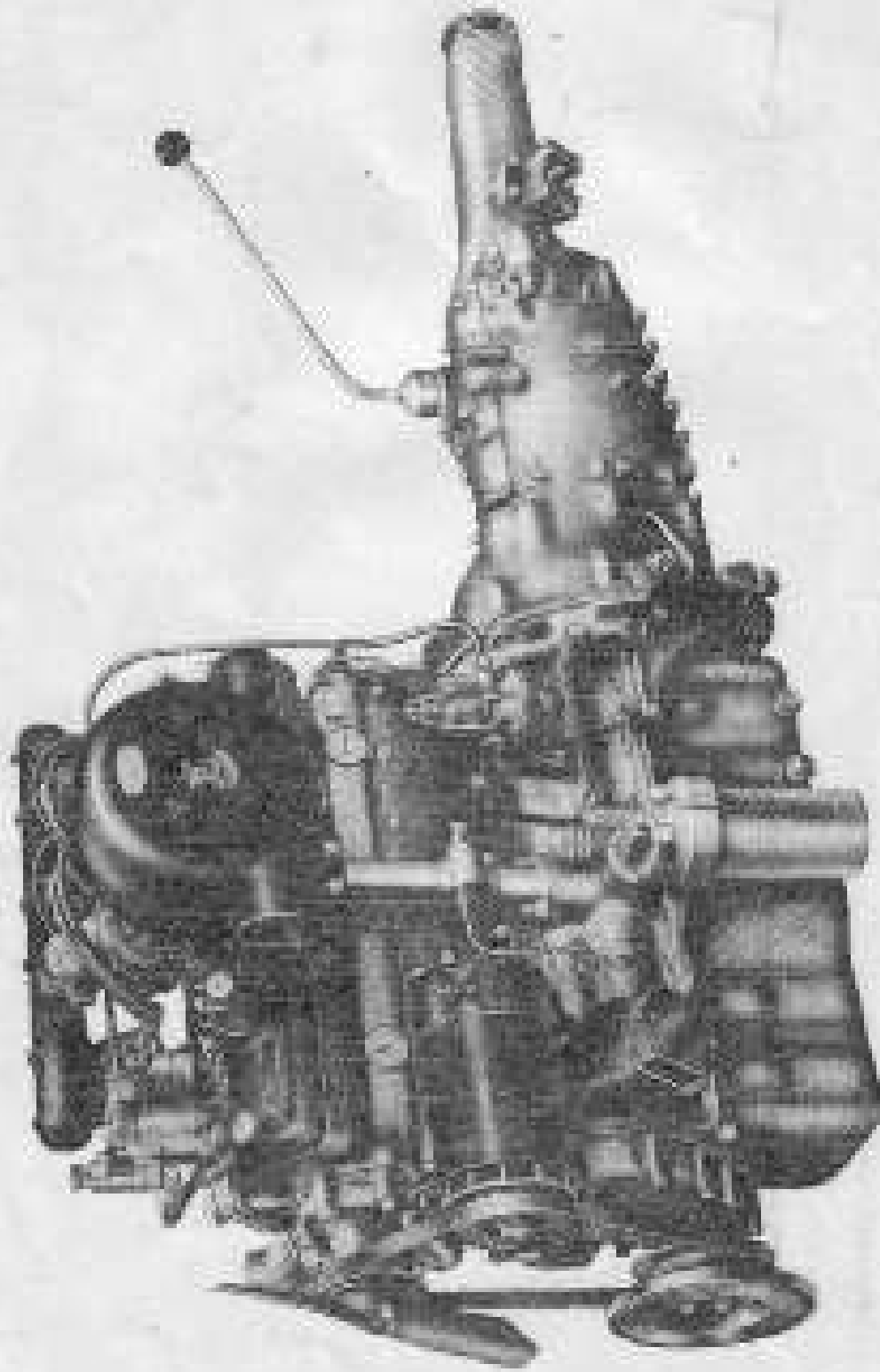
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To fit the sweep cooling scoop, carry out the following procedure:-

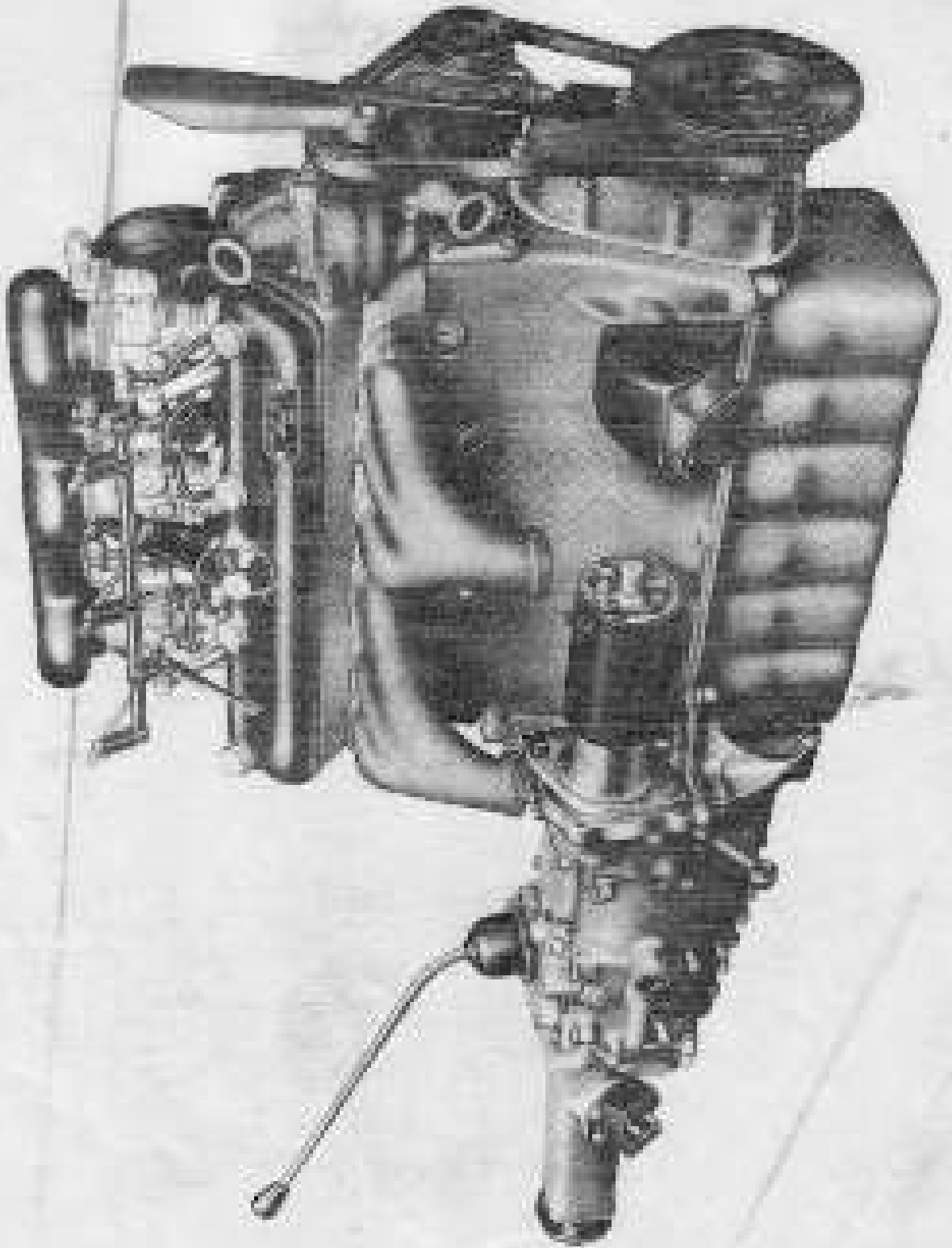
1. Raise the car on a ramp, or alternatively, jack up the car and place wood blocks under the chassis side members, then lower the car on to the wood blocks and remove the jack.
2. From beneath the car, remove and discard the lower bolt from each of the two engine front mounting brackets, fit the scoop attachment bracket Part No. N.532911 into position and held by bolts fitting the two new self-balls, Part No. 48.107/83.
3. Loosen the two lowermost bolts securing the clutch casing to the bell housing.
4. Loosen the upper torque buffer bracket securing bolt, then fit the scoop, Part No. N.532911 into position, engaging the two slots in the rear and place with the two loosened clutch case bolts, and with the rear end piece behind the torque buffer bracket.
5. Check that there is at least 1/2 in. clearance between the scoop and the base of the sump, and that the scoop does not foul the front chassis member, the oil filter, the oil temperature capillary or the exhaust pipes.
6. Check the alignment of the bolt holes at the front end of the scoop with those in the attachment bracket. If necessary, elongate the holes in the scoop, then secure the scoop to the bracket with four 2 B.A. bolts, shakeproof washers and nuts.
7. Tighten the clutch case and engine mounting bolts securely.
8. Drill the torque buffer bracket and secure the scoop to the bracket with a 2 B.A. bolt, shakeproof washer and nut.
9. (Applicable to type 401 only) To provide an unrestricted air-flow through the scoop, detach the front registration plate from its carrier, remove the carrier from its mounting and substitute the new carrier, Part No. N.705798. Fit the registration plate to the new carrier.
10. Earlier type 401 cars have a deep bumper fairing; this must be cut away immediately below the new rubber plate carrier and up to the bottom of the number plate, to facilitate the flow of air into the scoop.



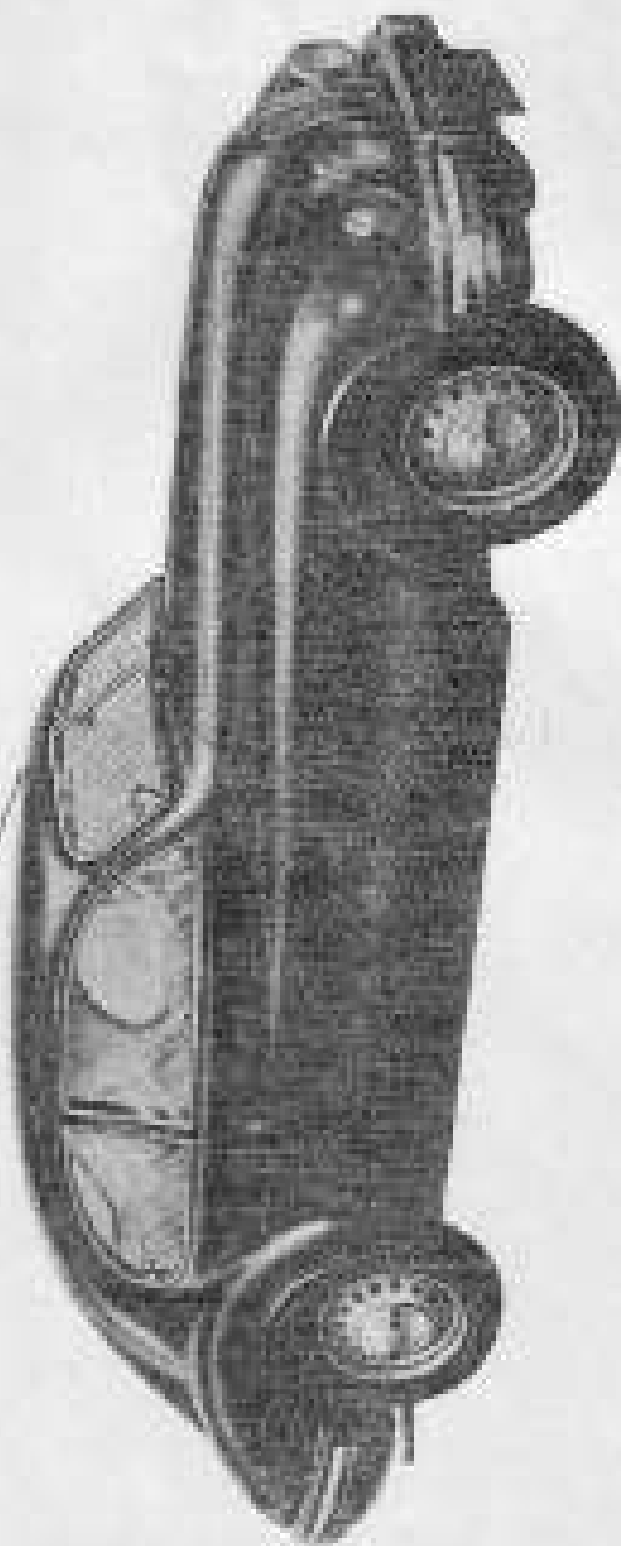
Types 402 (left)



504. Engine and Gearbox

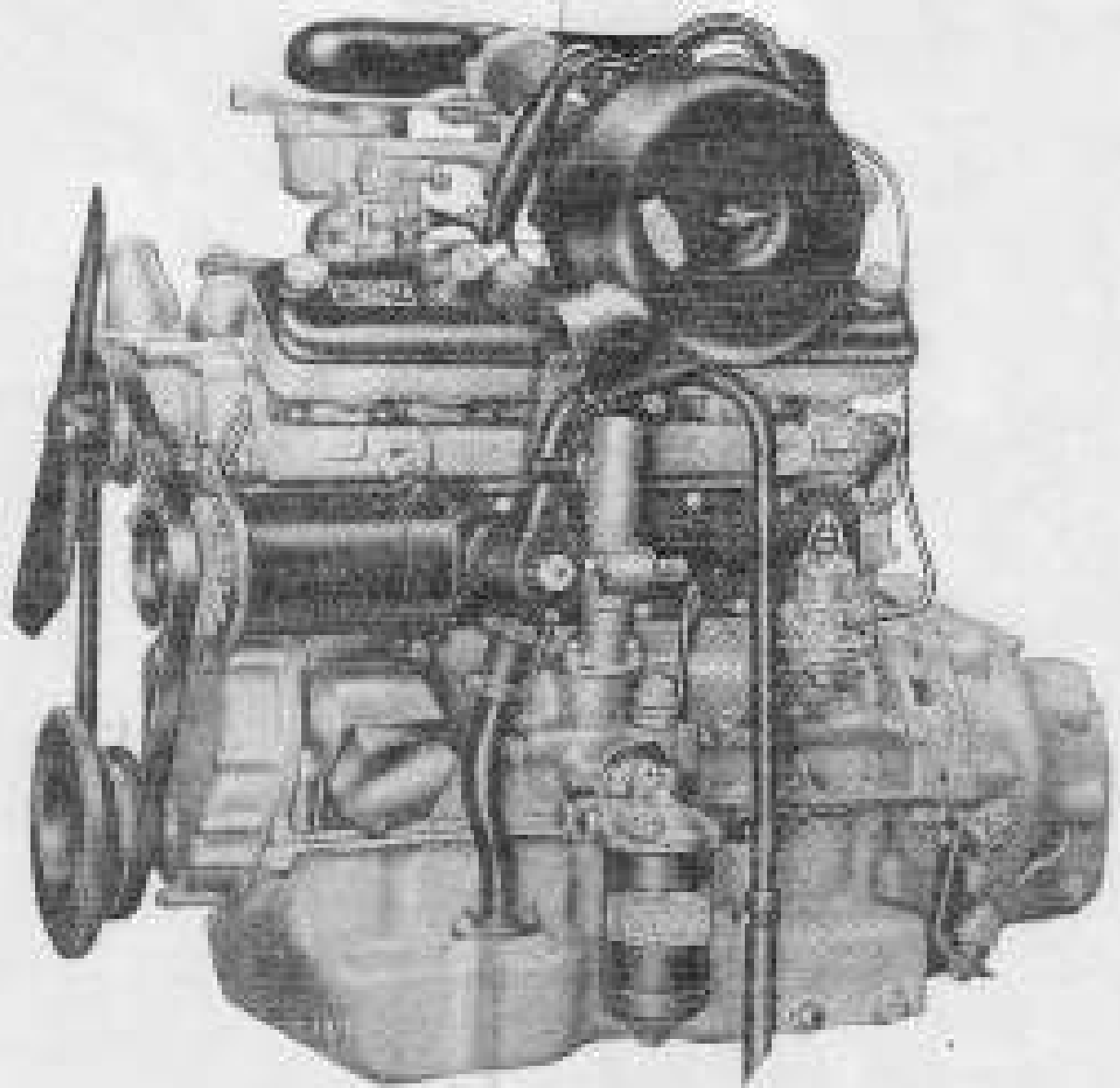


6-cylinder and quarter

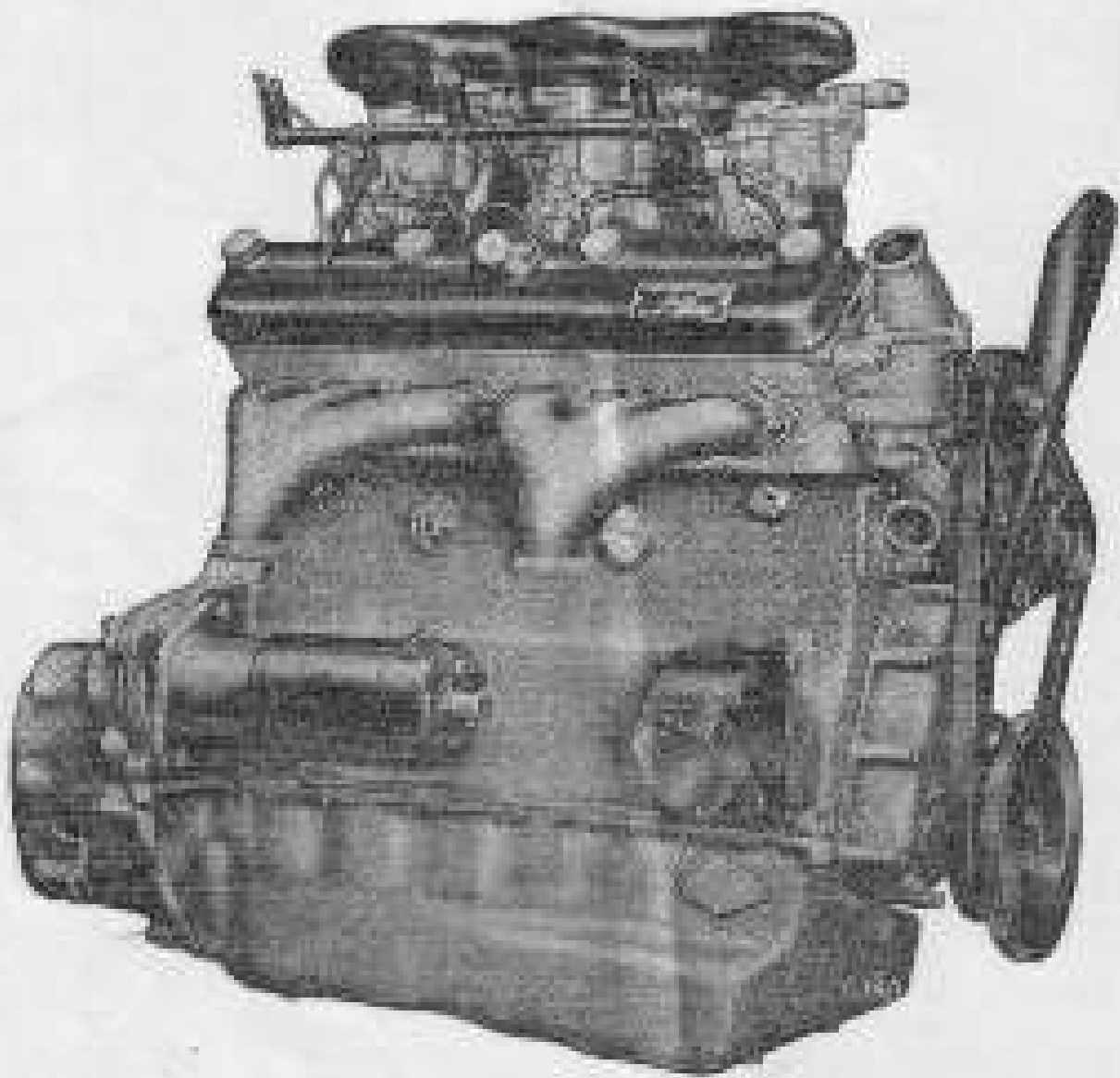


1954
Type 411 Car

C



Type 1014 Reptax



Type 100A Engine

I M 7 3 0 3 0 0 1 0 3

This manual is designed to provide information on the maintenance, repair and general data of Bristol 400, 401, and 402 type cars. The text is grouped under the various unit headings given in the index and therefore provides a method of easy reference. The manual may be subject to amendment without notice and it is therefore essential that holders of manuals should notify the Company of any change of address. Supplementary information may be found from time to time as necessary in the form of "Service Bulletins" and these should always be regarded as overriding the information given in this manual. Bulletins should be filed immediately at the rear of the relevant Section of this manual, and the Bulletin Insert Sheet at the front of each Section should be reformed accordingly.

SERIAL NUMBERS

When ordering replacement parts, always :-

- (a) Quote the Car Number in full.
- (b) Quote the Engine Number in full.
- (c) Quote the Chassis Number in full.
- (d) Give the Part Number, the number of parts required and the full description of the parts as given in the relevant Spare Handbook. To avoid mistake and to expedite delivery, use only the wording and Part Numbers given in the Spare Handbook.
- (e) If in any doubt, send the old part with the request for the spare.
- (f) Order from the nearest authorized "Bristol" Agent. Where this is impracticable, order direct from the Company.

NOTE 1:- Left and right-hand side of the car is always understood as from the driving position. This should be carefully noted when ordering left or right-hand parts.

Orders given by telegrams or telegraph should be confirmed immediately, in writing.

The Car Number Plate is attached to the scullie on the right-hand side of the car under the bonnet.

The Engine Number Plate is attached to the front number box cover on the left-hand side.

The Chassis Number Plate is attached to the chassis frame on the left-hand side under the bonnet in the vicinity of the petrol pump.

CONTENTS

ABBREVIATIONS

RECOMMENDED LUBRICANTS

ENGINE AND CHASSIS LUBRICATION POINTS

Section 1	...	...	...	Engine and exhaust system
Section 2	...	...	...	Water cooling system
Section 3	...	...	...	Fuel system
Section 4	...	...	...	Clutch and clutch adjustment
Section 5	...	...	...	Gearbox and propeller shaft
Section 6	...	...	...	Rear axle and rear suspension
Section 7	...	...	...	Front suspension
Section 8	...	...	...	Braking system
Section 9	...	...	...	Steering gear
Section 10	...	...	...	Wheels, brake drums, hubs and tyres
Section 11	...	...	...	Chassis frame repair
Section 12	...	...	...	"Oil shot" (Spray) lubrication system
Section 13	...	...	...	Electrical system
Section 14	...	...	...	Body
Section 15	...	...	...	Storage

400
 401
 402
 403
 404



(Cont.)

SPECIFICATIONS

Key weight - complete unit

Type 400	2,550 lb. (1157 kg.)
Type 401	3,750 lb. (1698 kg.) Approx.
Type 402	3,560 lb. (1609 kg.)

Top gear speed at 1,000 r.p.m. 10.25 mph. (16.51 km./hr.)

Turning circle - left and right 37ft. 11in. (1133 cm.)

Ground clearance - minimum

Type 400	7 1/2 in. (190 mm.)
Type 401	6 3/4 in. (171.8 mm.)
Type 402	6 1/2 in. (165.1 mm.)

Overall width

Type 400	55 1/2 in. (1410 mm.)
Type 401	50 7/8 in. (1291.8 mm.)
Type 402	50 1/2 in. (1280.3 mm.)

Overall height

Type 400	47 1/2 in. (1206 mm.)
Type 401	47 in. (1193.8 mm.)
Type 402	47 in. (1193 mm.)

Wheelbase 53 1/2 in. (1368.3 mm.)

Front track

Type 400	47 1/2 in. (1206 mm.)
Type 401	47 1/8 in. (1197.8 mm.)
Type 402	47 1/4 in. (1199.1 mm.)

Rear track - Types 400, 401 and 402 47 1/4 in. (1199.1 mm.)

Frame Rigid box section 6 1/2 in. deep, with internal rear floor structure.

Suspension - front Independent springing employing a crossmember leaf spring.

- rear Torsten bars.

(cont)

Shock absorbers	...	...	...	...	...	...	Fitted front and rear.
Brakes							
System	...	...	...	...	...	...	Lockheed hydraulic.
Brake pedal acts on	...	...	...	...	...	...	All four wheels.
Handbrake acts on	...	...	...	...	...	...	Rear wheels only.
Master cylinder capacity	...	...	...	...	...	...	1 pint (0.568 litres).
Tires and tyres							
Type...	...	...	...	...	...	...	"Dolt-cel" easy clean tires.
Tires							
Type 400	...	...	...	...	...	...	3.500 x 16 wall base.
Type 401 and 402	...	...	...	...	...	...	4.00 x 16 wall base.
Type	...	...	...	...	...	...	3.50in. x 16in. or 3.75in. x 16in.
Type pressure							
3.50in. x 16in.	...	...	...	...	...	...	Front 24 p.s.i. (1.62kg./cm ²) Rear 20 p.s.i. (1.36kg./cm ²)
3.75in. x 16in.	...	...	...	...	...	...	Front 22 p.s.i. (1.54kg./cm ²) Rear 20 p.s.i. (1.36kg./cm ²)
Steering	...	...	...	...	...	...	"Erintal" rack and pinion.
Radiator							
System	...	...	...	...	...	...	Tubular radiated.
Filler cap.	...	...	...	...	...	...	Remov. cap. funnel.
Fuel tank							
Location							
Type 400	...	...	...	...	...	...	Behind rear seat upright.
Type 401	...	...	...	...	...	...	Beneath boot floor.
Type 402	...	...	...	...	...	...	Beneath boot floor.
Reserve fuel switch	...	...	...	...	...	...	Marked "R" on dashboard.
Electrical system	...	...	...	...	...	...	12 volt.

Temperature	Engine	Lubricant
Over 32°F. (0°C.)	Engine	Mobiloil 88, Control XII, Shell Dentax 50, Escolube 50, Esargol S.A.E. 50.
Under 32°F. (0°C.)	Engine	Mobiloil A, Control II, Shell Dentax 50, Escolube 30, Esargol S.A.E. 50.
	Rear axle	
Over 32°F. (0°C.)	Engine	Mobilube 62, 140, Control II, 9000, Shell Spirax 140 NF, Esco Kapa. Compound 140, Esargol EP. S.A.E. 140.
Under 32°F. (0°C.)	Engine	Mobilube 62, 50, Control Hypay, Shell Spirax 90NF, Esco Kapa. Compound 50, Esargol EP. S.A.E. 50.

***One shot[®] lubrication**

Over 32°F. (0°C.)	Engine	Mobiloil 88, Control XII, Shell Dentax 50, Escolube 50, Esargol S.A.E. 50.
Under 32°F. (0°C.)	Engine	Mobiloil A, Control II, Shell Dentax 50, Escolube 30, Esargol S.A.E. 50.

***Bristol[®] type shock absorbers**

All temperatures	Shock absorbers	Mobil shock absorber light oil Bakerfield Girling shock-oil- 1111- Control Shockol, Shell Dentax S.A.E. Esco Shock absorber oil, Esargol S.A. 1111.
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(cont.)

Temperature

Lubricant

Propeller shaft

All temperatures Mobilite C.
Castrol H-gramm.
Shell Spirax 140 NF.
Esso Kapa. Compound 140.
Esorgel S.A.E. 140.

Feed tank

All temperatures Mobilil Hub grease.
Castrolmax Heavy.
Shell Lubrax A or M.
Esso Grease.
Helcolite C.

Feed and base suspension units

Above 32°F. (0°C.) Mobiloil 32.
Castrol XLL.
Shell Lubrax 90.
EssoLube 90.
Esorgel S.A.E. 90.

Under 32°F. (0°C.) Mobiloil A.
Castrol XL.
Shell Lubrax 90.
EssoLube 90.
Esorgel S.A.E. 90.

Water pump and fan
(when external grease cup is fitted)

All temperatures Mobilil Hub Grease.
Castrolmax Heavy.
Shell Lubrax A or P.
Esso Grease.
Helcolite C.

Distributor (lean type)

All temperatures Mobiloil Arctic.
Castrolite.
Shell E-100 S.A.E. 20.
Esso Tasty Oil.
Esorgel S.A.E. 20.

Continued

ENGINE AND CHASSIS

LUBRICATION POINTS

1. Front wheel hubs. Pack with grease every 12,000 miles. Capacity 4 oz.
2. "Dry sump" lubrication system reservoir. Refill every 1,500 miles. Capacity 2 pts.
3. Hydraulic brake master cylinder. Check fluid level every 1,500 miles and refill if necessary. Capacity 1 pt.
4. Front universal joint. Grease every 3,000 miles.
5. "Reditol" type rear shock absorbers. Check fluid level every 3,000 miles and refill if necessary. Capacity $\frac{1}{2}$ pt.
6. Rear axle casting. Change oil after first 900 miles and then every 6,000 miles. Check oil level every 3,000 miles. Capacity 3 to 4 pts.
7. Rear universal joint. Grease every 3,000 miles.
8. Gearbox. Change oil after first 500 miles and then every 5,000 miles. Check oil level every 3,000 miles. Only fill to level plug. Capacity 24 to 3 pts. The drain plug is at the bottom of the gearbox.
9. Engine. Change oil after first 500 miles and then every 1,500 miles. The engine drain plug is situated on the left-hand side of the pump. Capacity 10 pts. Change the filter element (or insert assembly) every 5,000 miles.
10. Engine oil dipstick. Check oil level every 500 miles. Do not check while the engine is running.
11. "Reditol" type front shock absorbers. Check fluid level every 1,000 miles and refill if necessary. Capacity 6 pt.
12. Water pump and fan bearings. Refill grease cup (if fitted) after first 500 miles and then every 1,500 miles thereafter.