SECTION 1

ENGINE AND EXHAUST SYSTEM

CONTENTS

SERVICE BULLETIN

RECORD SHEET

No.	Subject	Date	Signature
1	Carburettor Conversion.	25. 4. 54.	Embodied.
2	Stripped Thread in Sump Drain.	25. 4. 54.	"
3	Engine and Exhaust System (Type 40S).	25. 4. 54.	"
4	External Oil Cooler.	30. 4. 54.	"
5	External Oil Cooler.	8.11.54	Not embodied
6	[illegible]	17 . . 54	

ENGINE AND EXHAUST SYSTEM

DESCRIPTION

The engines fitted to types 400, 401 and 402 cars are basically identical with the exception of the carburettors, see the General Data at Section A. 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 floating gudgeon pins being bronze bushes. A chain drive is employed for the camshaft which is supported in four bronze bush bearings on the left-hand side of the cylinder block, an integral helical gear located centrally on the shaft engaging the distributor and oil pump drive pinion. The oil pump is bolted in 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 accommodates hardened 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.

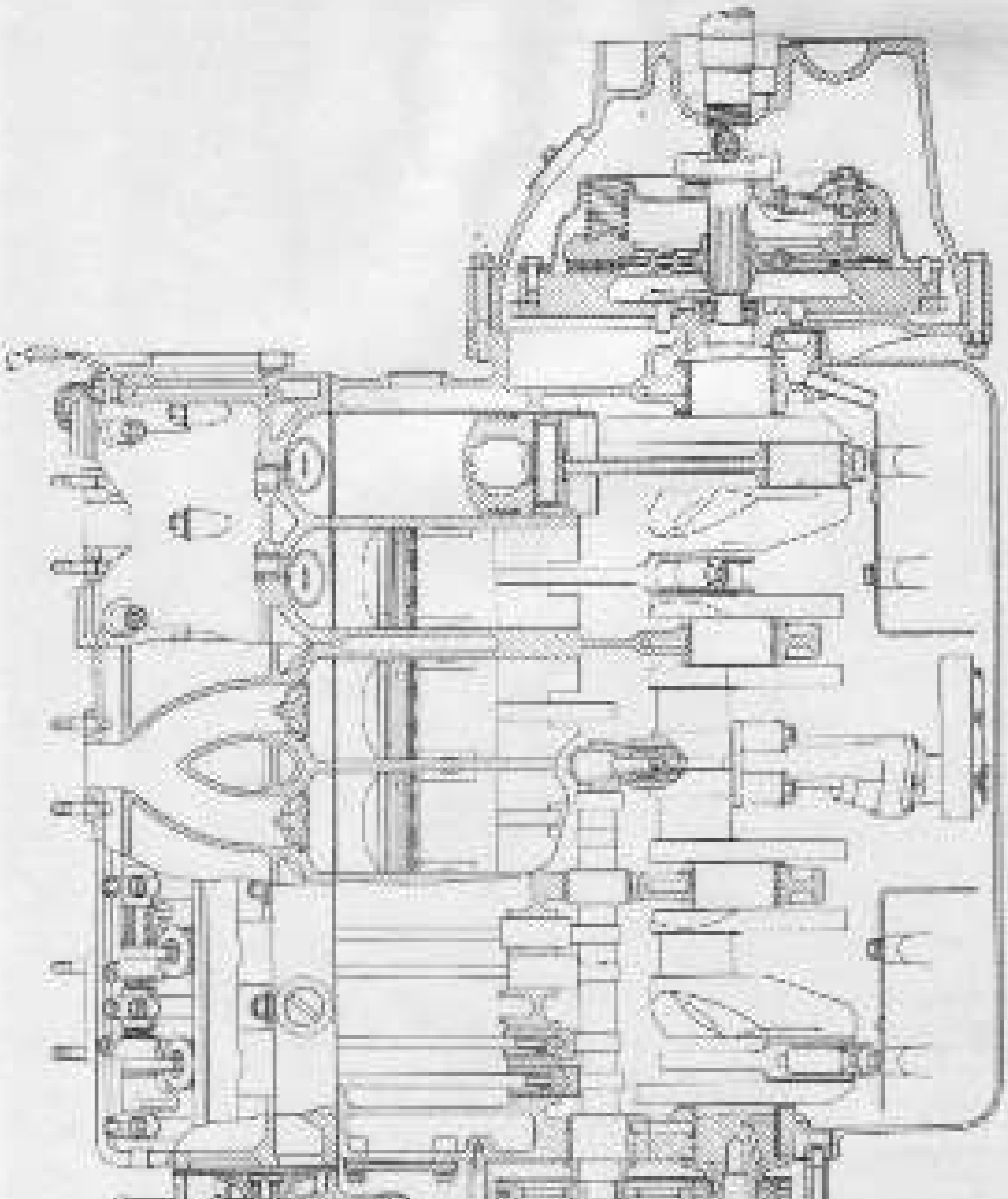


Fig.1. Longitudinal Section View of Type 31a Engine with Combustion Chamber.

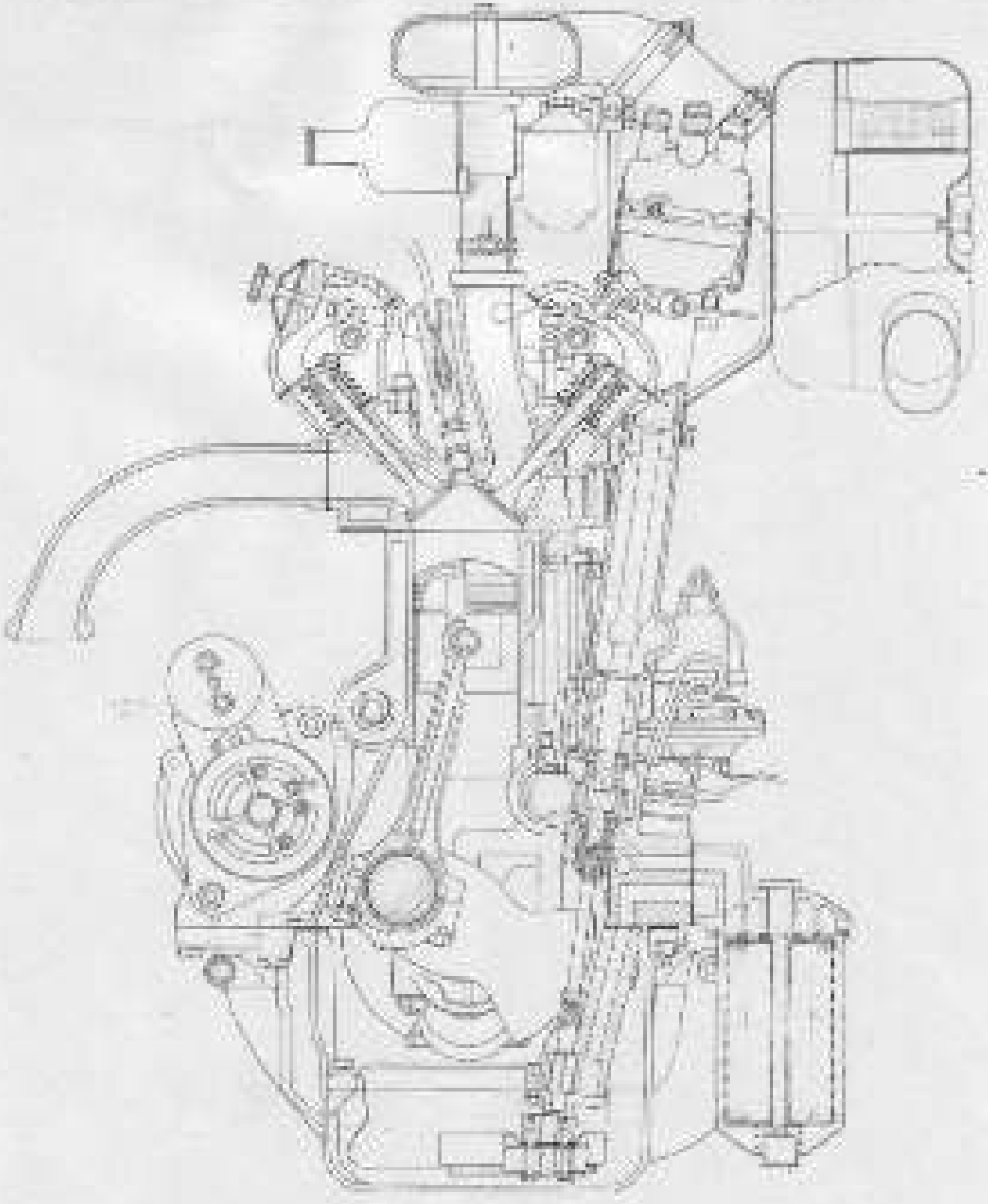


Fig.2. Transverse section view of Type 13A Engine.

The engine and gearbox unit is flexibly mounted on four bonded-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	2.5394 in. (66 m.m.).
Stroke	3.779 in. (96 m.m.).
Compression ratio	7.5 to 1.
Cubic capacity (piston displacement)	170.3 cu. in. (2,791 c.c.).
Rated horse-power	15.2 (R.A.C. rating).
Maximum B.H.P.	
Type 95	77 at 4,800 r.p.m. (78.08 m.v.).
Type 95A	80 at 4,800 r.p.m. (81.10 m.v.).
Type 95C	97 at 4,800 r.p.m. (98.10 m.v.).
Weight of engine (less gearbox)	
Type 95	350 lb. (158.5 kg.).
Type 95A	350 lb. (158.5 kg.).
Type 95C	346 lb. (157.1 kg.).
Oil pump	Gear type.
Oil sump capacity	10 pints (5.68 litres).
Oil filter	"Vokes" or "Tecalemit".
Oil pressure	60 p.s.i. (4.22 kg./cm.^{2}) at 70°C. and 3,000 r.p.m.

Capacity of external oil cooler (optional fitting)	1 pint (0.568 litres) Approx.

Cylinder block

Type...	Monc-bloc casting. Late type 65A engines and all type 83C engines fitted with dry-type cylinder liners.
Interference fit between liner and bore	0.0005 in. to 0.002 in. (0.013 m.m. to 0.051 m.m.)
Tappet body in cylinder block - desired clearance..	0.0001 in. to 0.0019 in. (0.003 m.m. to 0.048 m.m.)

Oil pump

Driving and driven gears, dia.	0.682 in. 17.420 m.m.	(-0.0005 in.) (-0.013 m.m.)
Gear location dowl in pump casing... ...	0.185 in. 28.479 m.m.	(+0.0005 in.) (+0.013 m.m.)
Radial clearance of gears in casing.. ...	0.001 in. to 0.003 in. (0.025 m.m. to 0.051 m.m.)	
Driving and driven gear journal dia. ...	0.3725 in. 9.512 m.m.	(-0.0005 in.) (-0.013 m.m.)
Journal location dias. in pump casing ...	0.373 in. 9.525 m.m.	(+0.0005 in.) (+0.013 m.m.)
Running clearance of gear journals in casing	0.0005 in. to 0.0015 in. (0.013 m.m. to 0.038 m.m.)	
Journal location dias. in pump cover ...	0.375 in. 9.525 m.m.	(+0.0005 in.) (+0.013 m.m.)
Running clearance of gear journals in pump cover...	0.0005 in. to 0.0015 in. (0.013 m.m. to 0.038 m.m.)	
End-float of gears	0.0005 in. to 0.0015 in. (0.013 m.m. to 0.038 m.m.)	
Backlash of gears..	0.0045in. to 0.0066 in. (0.117 m.m. to 0.168 m.m.)	

Cylinder head

Type...	Detachable.
Material	Aluminium alloy with steel valve seats and phosphor-bronze valve guides.

Valves and fittings

Valves	Overhead inclined.
Valve actuation	Tappets, push rods and rockers.

Valve timing

Inlet opens..	10° Before top dead centre.
Inlet closes	30° After bottom dead centre.
Exhaust opens	50° Before bottom dead centre.
Exhaust closes	10° After top dead centre.

Inlet valves

Tappet clearance COLD	0.002in. (0.05 m.m.).
Valve seat angle...	Valves - 45° Inserts - 45°
Valve stem diameter	0.3105 in. (7.887 m.m.)
Valve guide bore diameter	0.3125 in. (7.938 m.m.)
Valve stem and guide - desired clearance (cold)	0.002 in. to 0.0035 in. (0.051 m.m. to 0.089 m.m.)
Valve guide outside dia.	0.481 in. (+0.0005 in.) 12.213 m.m. (+0.013 m.m.)
Valve guide location bore	0.4787 in. (+0.0005 in.) 12.159 m.m. (+0.013 m.m.)
Interference fit of valve guide in cylinder head...	0.0013 in. to 0.0033 in. (0.033 m.m. to 0.058 m.m.)
Inner spring - free length (approx).. ...	1.429 in. (±1.272 m.m.)
Length when loaded to 47.5 lb (± ½ lb.) ...	1.089 in.
20.6 kg. (± 1.8 kg)...	25.111 m.m.

Outer spring - free length (approx.) ...	1.687 in.	(42.850 m.m.)
Length when loaded to 54 lb. (± 4 lb.) ...	1.25 in.	
24.5 kg. (± 1.8 kg.) ...	31.111 m.m.	
Rocker bush bore dia.	0.316 in.	(12.954 m.m.)
Rocker spindle dia.	0.303 in.	(12.929 m.m.)
Rocker bush and spindle - diametral clearance...	0.001 in. to 0.0018 in.	(0.025 m.m. to 0.045 m.m.)
Exhaust valves		
Tappet clearance COLD	0.012 in.	(0.291 m.m.)
Valve seat angles...	Valves = 45°.	Inserts = 45°.
Valve stem dia.	0.2803 in.	(7.087 m.m.)
Valve guide bore dia.	0.2792 in.	(7.835 m.m.)
Valve stem and guide - maximum clearance (cold)	0.002 in. to 0.0038 in.	(0.051 m.m. to 0.061 m.m.)
Valve guide outside dia.	0.451 in.	(+0.0005 in.)
	12.217 m.m.	(+0.013 m.m.)
Valve guide location bore	0.4797 in.	(+0.0005 in.)
	12.199 m.m.	(+0.013 m.m.)
Interference fit of valve guide in cylinder head...	0.0003 in. to 0.0023 in.	(0.033 m.m. to 0.045 m.m.)
Inner spring - free length (approx).. ...	1.625 in.	(41.275 m.m.)
Length when loaded to 37.5 lb. (± 2 lb.) ...	1.085 in.	
26.6 kg. (± 1.8kg)...	26.111 m.m.	
Outer spring - free length (approx).. ...	1.587 in.	(40.050 m.m.)
Length when loaded to 54 lb. (± 4 lb.) ...	1.125 in.	
24.5 kg. (± 1.8kg) ...	28.111 m.m.	

Crankshaft

No. of main bearings	4	
Bearing type	Steel backed, lead indium bronze lined.	
Main bearing journal dia. (new)	2.000 in. 50.800 m.m.	(-0.0010 in.) (-0.013 m.m.)
Main bearing journal dia. (after 1st re-grind)	1.990 in. 50.546 m.m.	(-0.0010 in.) (-0.01) m.m.)
Main bearing journal dia. (after 2nd re-grind)	1.980 in. 50.292 m.m.	(-0.0009 in.) (-0.013 m.m.)
Main bearing journal length		
Front bearing	1.466 in. 37.236 m.m.	(-0.002 in.) (-0.051 m.m.)
Mid-front bearing...	1.181 in. 29.997 m.m.	(±0.010 in.) (±0.254 m.m.)
Mid-rear bearing...	1.181 in. 29.997 m.m.	(±0.010 in.) (±0.254 m.m.)
Rear bearing	1.418 in. 36.017 m.m.	(±0.010 in.) (±0.254 m.m.)
Crankpin dia. (new)	1.737 in. 44.983 m.m.	(-0.0005 in.) (-0.013 m.m.)
Crankpin dia. (after 1st re-grind)... ...	1.727 in. 44.729 m.m.	(-0.0005 in.) (-0.013 m.m.)
Crankpin dia. (after 2nd re-grind)... ...	1.717 in. 44.475 m.m.	(-0.0005 in.) (-0.013 m.m.)
Crankpin length	1.103 in. 28.016 m.m.	(+0.001 in.) (+0.025 m.m.)
Bearing hardness...	900 V.P.N.	
Thrust taken on crankshaft	Front bearing.	
End-float (new)	0.002 in. to 0.008 in. (0.051 m.m. to 0.203 m.m.)	

End-float (end)...	0.004 in. to 0.012 in. (0.102 m.m. to 0.305 m.m.)
Mal-alignment of crankshaft	0.002 in. (0.004 in. dial indicator reading). 0.051 m.m. (0.102 m.m. dial indicator reading).
Running clearance of crankshaft in main bearings...	0.001 in. to 0.0025 in. (0.025 m.m. to 0.064 m.m.)

Connecting rods and pistons

Connecting rods

Type...	Alloy steel, "H" section.	
Distance between centres	6.4367 in.	(±0.002 in.)
	162.000 m.m.	(±0.051 m.m.)
Gudgeon pin bush location	0.830 in.	(±0.005 in.)
	21.082 m.m.	(±0.013 m.m.)
Side clearance on crankpins	0.008 in. to 0.014 in. (0.203 m.m. to 0.355 m.m.)	

Big-end bearings

Type...	Steel backed, lead indium bronze lined.	
Wall thickness	0.07225 in.	(−0.00025 in.)
	1.835 m.m.	(−0.006 m.m.)
Running clearance on journals...	0.0012 in. to 0.0022 in. (0.031 m.m. to 0.056 m.m.)	

Gudgeon pin bushes

Bore dia.	0.7034 in.	(+0.0005 in.)
	17.869 m.m.	(+0.013 m.m.)
Outside dia.	0.832 in.	(−0.0005 in.)
	21.133 m.m.	(−0.013 m.m.)
Interference fit in connecting rod... ...	0.001 in. to 0.002 in. (0.025 m.m. to 0.051 m.m.)	

Gudgeon pins

Outside dia.	0.7093 in. 18.016 m.m.	(-0.0002 in.) (-0.005 m.m.)
Clearance in gudgeon pin bush...	0.0001 in. to (0.003 in. to (0.002 m.m. to (0.007 m.m. to	0.0005 in. 0.0008 in. desired)* 0.020 m.m.) 0.020 m.m. desired)*
Fit in piston bore	0.0001 in. interference to 0.0003 in. clearance. * (0.002 m.m. interference to 0.006 m.m. clearance) *	

Pistons

Neutral dia.	3.3968 in.	(85.764 m.m.)
Gudgeon pin bore...	0.709 in. 18.007 m.m.	(+0.0005 in.) (+0.017 m.m.)
Piston clearance in cylinder bore, checked cold and on thrust side	0.0022 in. to (0.056 m.m. to	0.0026 in. * 0.066 m.m.) *
Oversize pistons...	+0.010 in. on outside dia.	(0.254 m.m.)

Piston rings

Radial thickness (all rings)...	0.105 in. 2.667 m.m.	(-0.009 in.) (-0.127 m.m.)
Radial pressure (compression)..	20.6 to 29.9 p.s.i. (1.448 to 2.102 kg./cm.^{2})	
Radial pressure (scraper)	32.9 to 50.0 p.s.i. (2.105 to 3.012 kg./cm.^{2})	
Width of ring (compression)	0.0915 in. 2.325 m.m.	(-0.001 in.) (-0.025 m.m.)
Width of ring (scraper)..	0.1562 in. 3.968 m.m.	(-0.001 in.) (-0.025 m.m.)
Ring clearance in groove (compression) ...	0.0029 in. to (0.073 m.m. to	0.0039 in. 0.098 m.m.)
Ring clearance in groove (scraper)... ...	0.001 in. to (0.025 m.m. to	0.003 in. 0.076 m.m.)
Ring gap when fitted in cylinder	0.020 in. to (0.508 m.m. to	0.025 in. 0.635 m.m.)

* Indicates that selective assembly is necessary.

Camshaft

No. of journals	4	
Bearings	Plain bronze.	
Bearing journal diameter		
Front...	1.450 in. 37.033 m.m.	(-0.0005 in.) (-0.013 m.m.)
Mid-front	1.435 in. 36.525 m.m.	(-0.0005 in.) (-0.01) m.m.)
Mid-rear	1.415 in. 36.017 m.m.	(-0.0005 in.) (-0.013 m.m.)
Rear...	1.251 in. 31.793 m.m.	(-0.0005 in.) (-0.013 m.m.)
Camshaft thrust taken	Front	
Running clearance in bearings..	0.002 in. to 0.005 in. (0.05 m.m. to 0.076 m.m.)	
End-float	0.004 in. to 0.0064 in. (0.102 m.m. to 0.152 m.m.)	
Maximum mal-alignment of journals	0.001 in. (0.002 in. dial indicator reading). 0.025 m.m. (0.051 m.m.dial indicator reading).	
Cam Lift	0.2656 in.	(7.744 m.m.)
End-float of distributor drive gear.. ...	0.0066 in. to 0.015 in. (0.168 m.m. to 0.406 m.m.)	
Backlash between gear and camshaft gear	0.003 in. to 0.005 in. (0.076 m.m. to 0.127 m.m.)	
Diametral clearance of gear in bush.. ...	0.0009 in. to 0.0018 in. (0.015 m.m. to 0.046 m.m.)	
Camshaft bearings		
Bore dia.		
Front	1.450 in. 37.082 m.m.	(+0.001 in.) (+0.025 m.m.)
Mid-front	1.440 in. 36.576 m.m.	(+0.001 in.) (+0.025 m.m.)

Mid-rear..	1.4205 in. 36.069 m.m.	(+0.001 in.) (+0.025 m.m.)
Rear	1.260 in. 32.004 m.m.	(+0.001 in.) (+0.025 m.m.)

Bearing outside dia.

Front..	1.6738 in. 42.516 m.m.	(+0.0003 in.) (+0.013 m.m.)
Mid-front	1.6728 in. 42.124 m.m.	(+0.0005 in.) (+0.013 m.m.)
Mid-rear	1.7178 in. 43.610 m.m.	(+0.0005 in.) (+0.013 m.m.)
Rear...	1.7388 in. 44.165 m.m.	(+0.0005 in.) (+0.013 m.m.)

Bearing location in cylinder block

Front..	1.673 in. 42.527 m.m.	(+0.0007 in.) (+0.018 m.m.)
Mid-front	1.693 in. 43.033 m.m.	(+0.0007 in.) (+0.018 m.m.)
Mid-rear	1.713 in. 43.521 m.m.	(+0.0007 in.) (+0.018 m.m.)
Rear...	1.733 in. 44.069 m.m.	(+0.0007 in.) (+0.018 m.m.)

Interference fit of bearings in cylinder block

Front...	0.0016 in. (0.041 m.m.	to 0.0029 in. to 0.071 m.m.)
Mid-front	0.0016 in. (0.041 m.m.	to 0.0029 in. to 0.071 m.m.)
Mid-rear	0.0016 in. (0.041 m.m.	to 0.0029 in. to 0.071 m.m.)
Rear...	0.0026 in. (0.066 m.m.	to 0.0035 in. to 0.097 m.m.)

Ignition system

Coil	Lucas Model M.12, type 1.
Distributor	Lucas type DM2S. 90.1.
Contact breaker gap	0.010 in. to 0.012 in. (0.254 m.m. to 0.305 m.m.)
Contact breaker cam	6 lobe.
Maximum advance	18°.
Advance begins	1,000 r.p.m. (engine speed).
Advance ends	3,200 r.p.m. (engine speed).
Initial timing	3° B.T.D.C. (fully retarded).
Advance mechanism type	Centrifugal with load over-ride.

Sparking plugs

Type	A.C.G. F. 12M. L.10.
Recommended gap	0.018 in. to 0.020 in. (0.457 m.m. to 0.508 m.m.)
Firing order	1, 5, 3, 6, 2, 4.
Clearance of distributor drive shaft in drive casing bearing	0.0010 in. to 0.0013 in. (0.025 m.m. to 0.033 m.m.)
Shaft end-float	0.009 in. to 0.012 in. (0.05? m.m. to 0.102 m.m.) Thrust washer to suit.
Clearance of tachometer drive shaft in tachometer drive body	0.0006 in. to 0.0016 in. (0.010 m.m. to 0.040 m.m.)
Shaft end-float	0.005 in. to 0.012 in. (0.127 m.m. to 0.305 m.m.) Allow 0.010 in. (0.254 m.m.) for joint washer.
Backlash between distributor and tachometer drive gears	0.006 in. to 0.009 in. (0.152 m.m. to 0.229 m.m.)

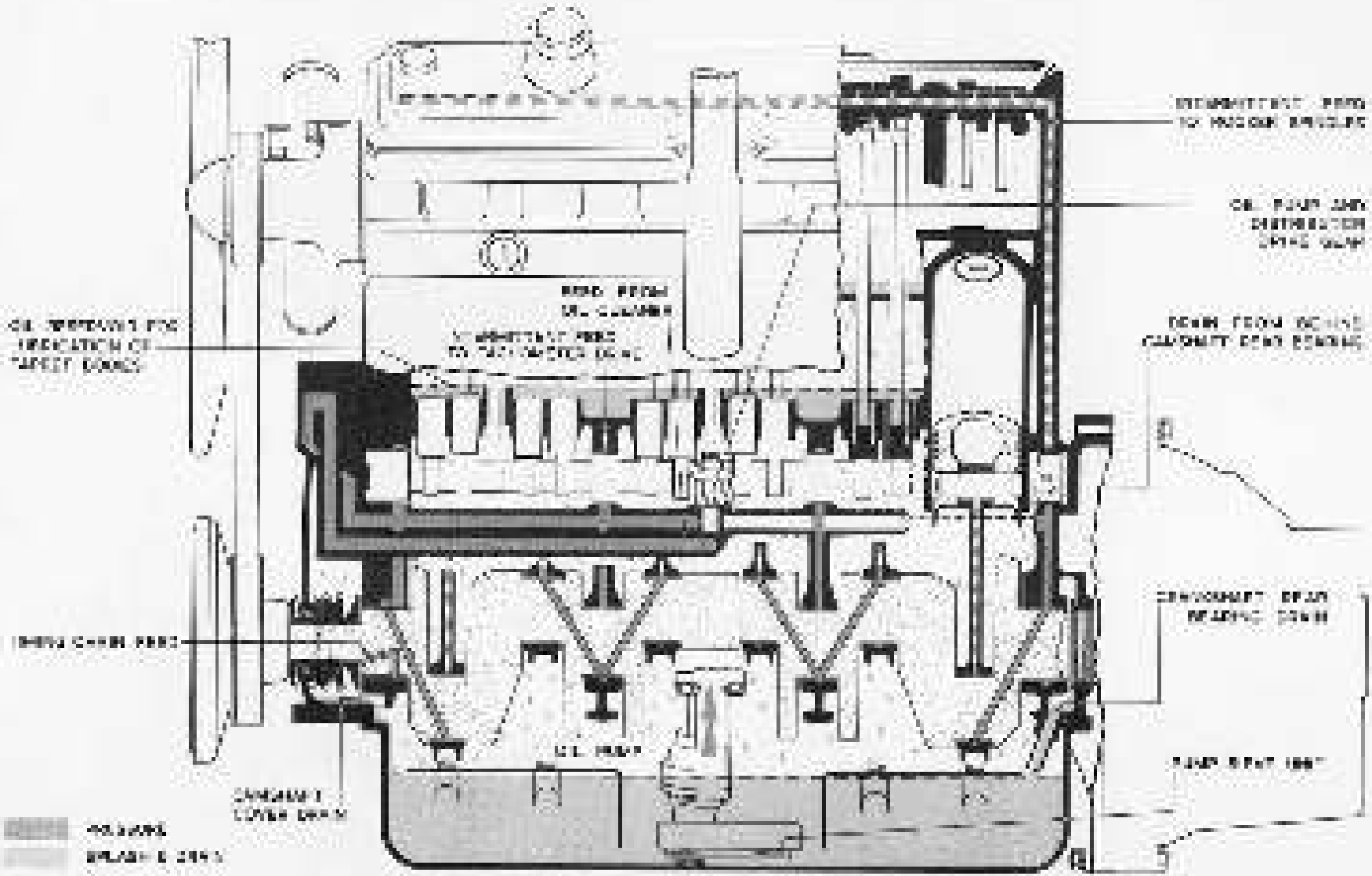


Fig. 5. Diagram of Type 85 and 85A engine lubricating system — side view.

LUBRICATION SYSTEM

Description

The lubrication systems of the engines are shown diagrammatically in Figs. 1 to 6. A sleeve 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 main internal oilway 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 duct of the "Tokar" 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 as cold weather to ensure immediate flow of oil to the bearings, see page 28. 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 clogged 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 recess around the distributor and oil pump driving pinion bush linking the front and rear portions of the gallery. A drilling from the

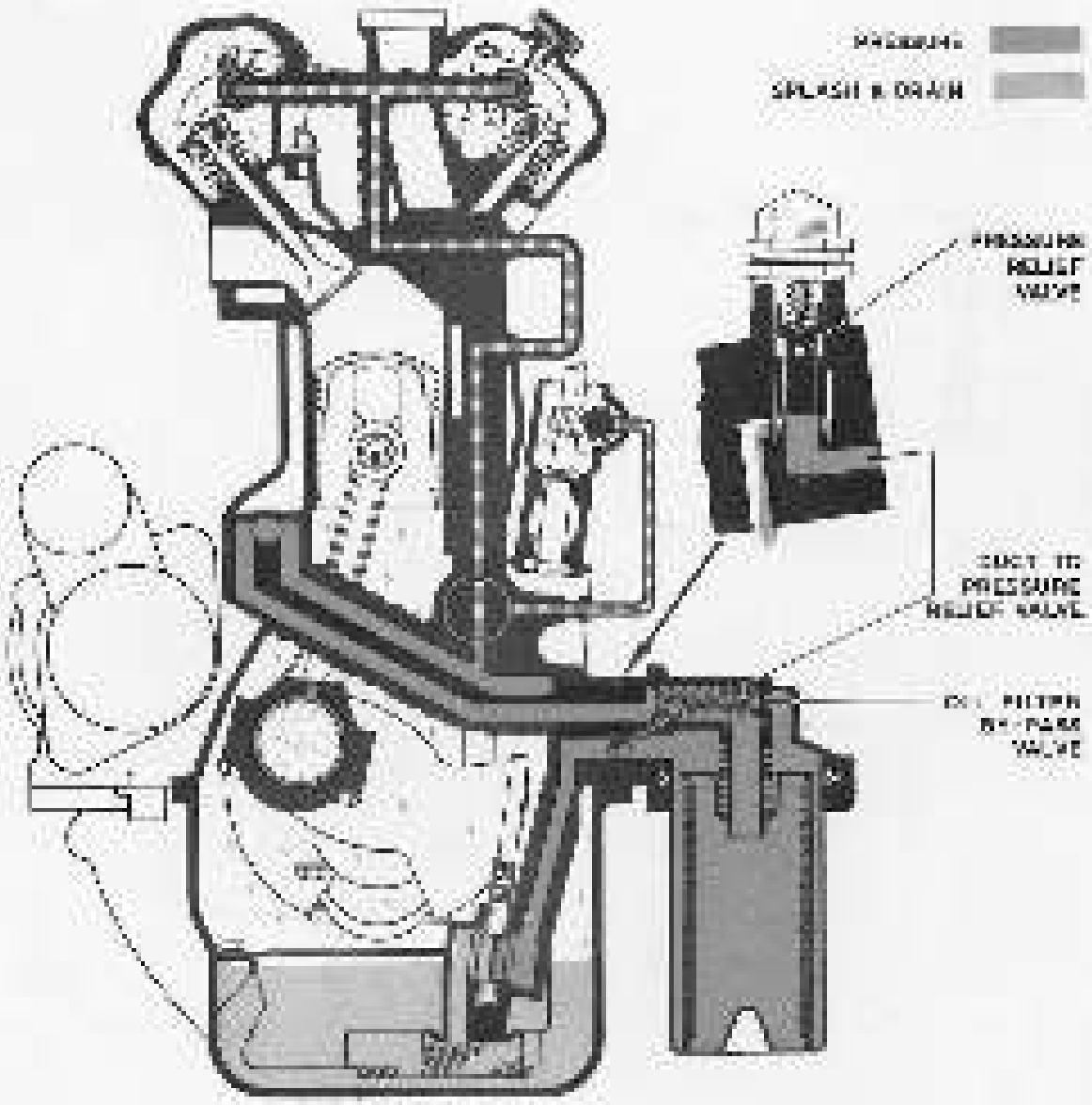


Fig.6. Diagram of Type R5 and R5V Engine lubrication system - front view

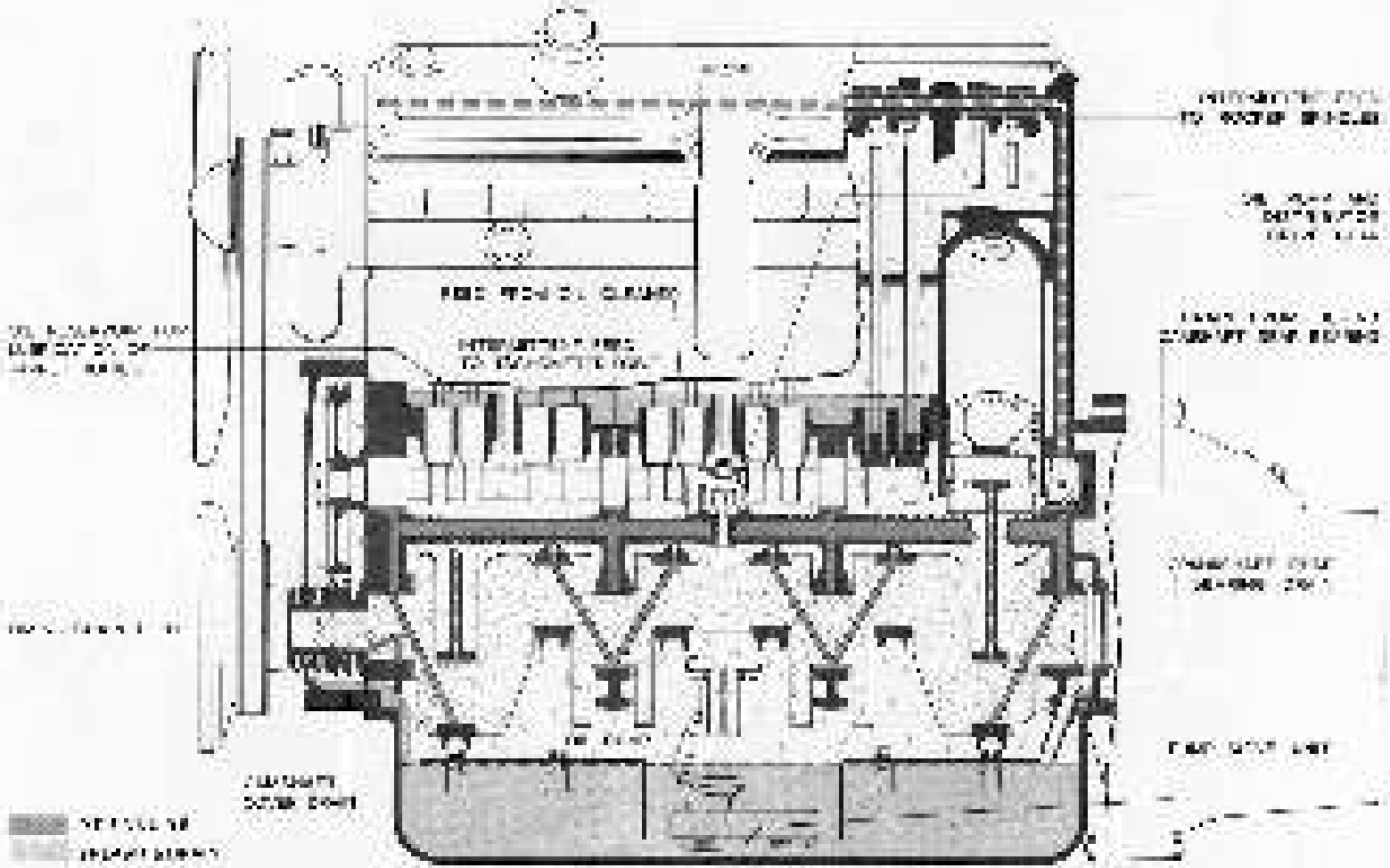


Fig.5. Diagram of Type RX Duplex lubrication system - side view.

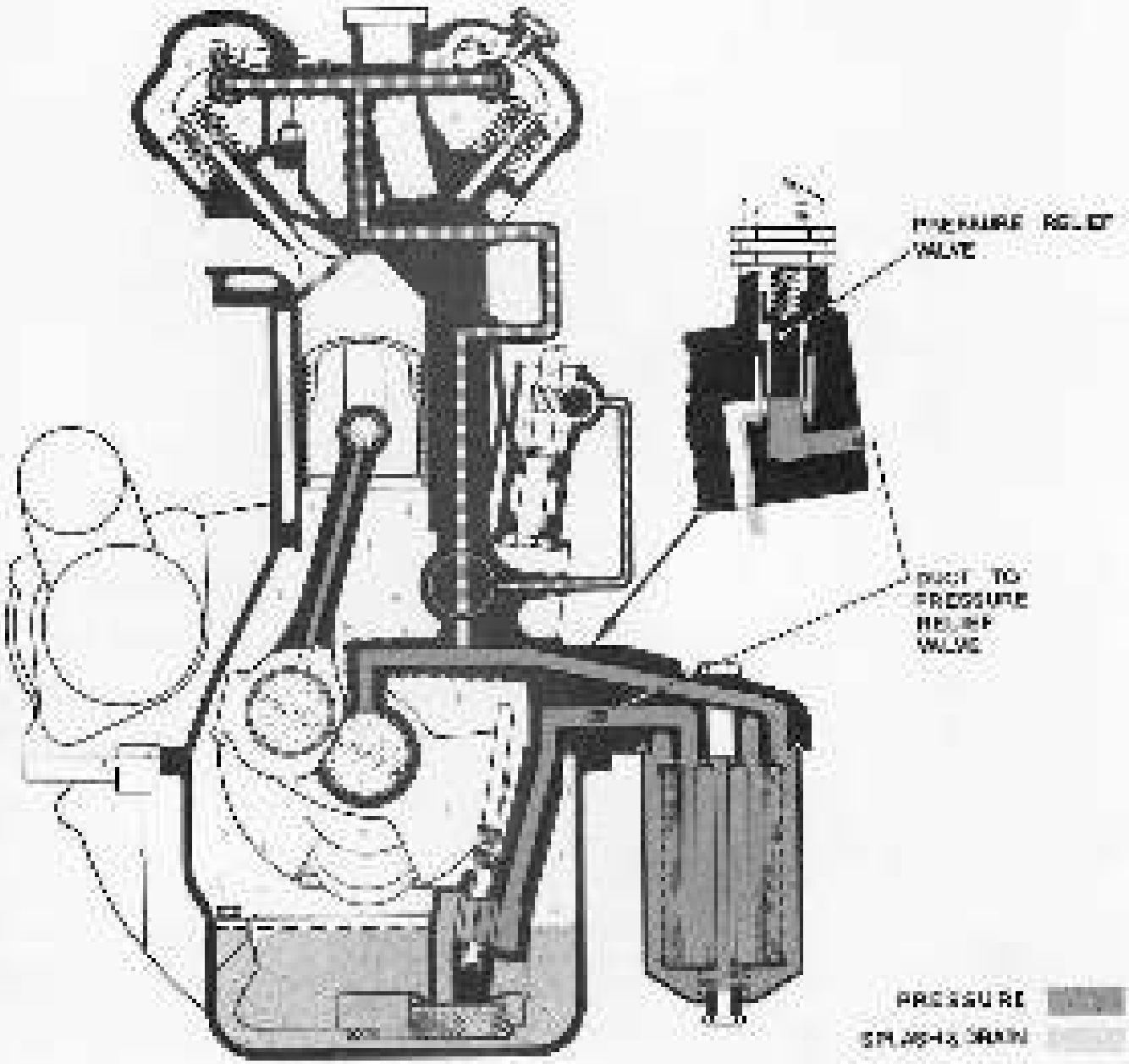


Fig.1. Diagram of Type 520 Engine lubrication system - front view.

bush means to its bore 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, drain to the crankshaft continuing the flow 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 :- On type 25 and 25A 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 30. On these engines, the front crankshaft bearing is lubricated through a branch duct from the return passage from the oil transfer housing to the main gallery, see Fig.2.

The crankshaft front main bearing journal incorporates an additional duct which terminates at 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 from 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 gauge.

An intermittent feed to the overhead rocker system is obtained from a transverse drilling in the rear crankshaft 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 location, the feed being continued through the spindles to the rockers. A further intermittent feed (from the mid-front crankshaft bearing) is connected by an external pipe to

the tachometer drive in 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-nut, the cap closing the outer end.

Two types of valve bodies have been manufactured. The earlier type has four equally spaced 7/32in. outlet holes, while the latest type has three equally spaced holes, two being 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-nut, then tighten it against the cap and unscrew the assembly from the cylinder block. Holding the lock-nut, loosen the cap, then remove the cap, lock-nut 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.

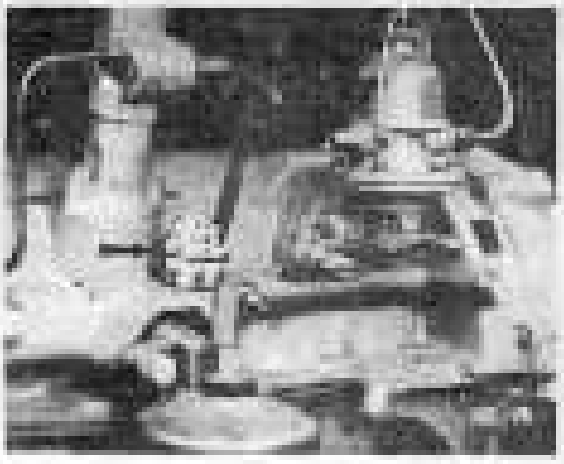


Fig.7. Oil pressure relief valve.

Fig.8. Relief valve assembly.

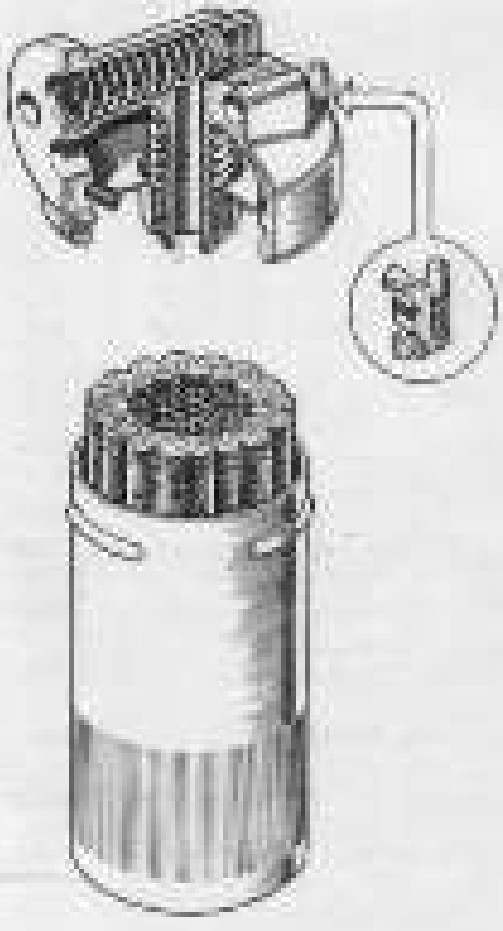


Fig.9. "Tecalemit" oil element.

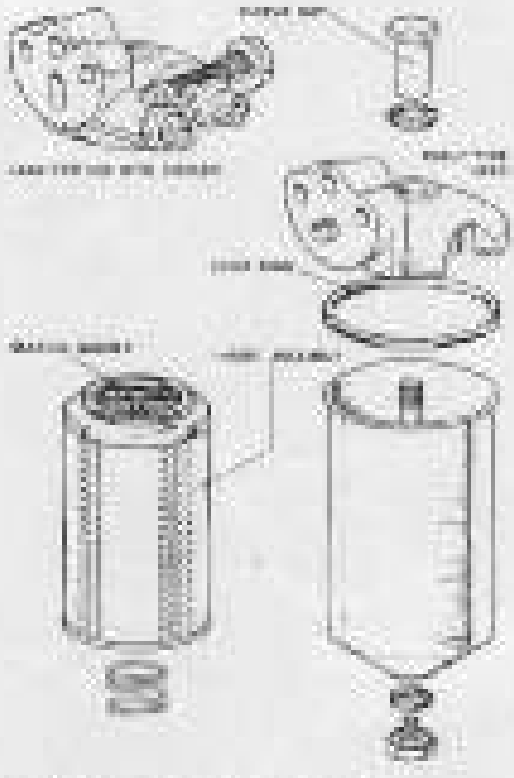


Fig.10. "Vokes" oil element.

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-nut and cap, locking them together, and screw the assembly into the cylinder block; make sure that the valve body is screwed down firmly on its seating or loss of oil pressure may result. Separate and remove the lock-nut and cap.

Note :- An aluminium washer fitted to the cylinder block forms a seating 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-nut.

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 80°C. and speed 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 sump retaining set-screws are secure and that there is no oil leakage from the sump-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 29 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 xx. 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 (2,500 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 35. 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 filler as described in page 29 or 30 before any attempt is made to turn or start the engine.

OIL SYSTEM (FULL FLOW TYPES)

Description

Early type 85 and 85A engines are fitted with a "Tecalemit" filter and all later engines with a "Tokaz" filter, both types being secured by two set-bolts to the left-hand side of the cylinder block.

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

On "Tecalemit" filters, oil enters the casing and emerges from the bore 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 "Tokaz" filters, the oil entering the bore 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 two external connections for use when an external cooler is fitted to the car. The valve

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

Servicing (Recondit)

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 sprung. Check that the by-pass valve operates satisfactorily. If it is desired to remove the head, release the two retaining set-bolts and washers, and withdraw the head. After cleaning, ensure the joint faces are undamaged and refit 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 entered squarely into the head and that the locking plunger returns to its position.

Servicing (Tekro)

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 sealing 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 fretted and that the valve operates freely in its location in the head before replacing the valve assembly. Discard the joint ring 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 engine system when the engine is started. Check that the sealing 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.

INTEGRAL 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 $\frac{1}{4}$ in. B.S.F. nuts and spring washers, and the domed nut and its plain 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 until 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 CPS.251, together with two new gaskets R.360030 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 sealing 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 stud 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 $\frac{1}{4}$in. B.S.F. nuts and the shakeproof washer and domed nut. The latter washer and nut should be fitted to the innermost stud;

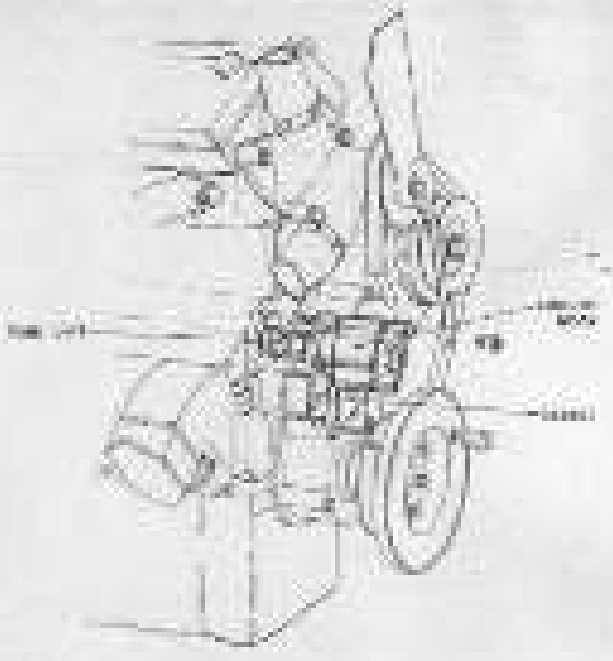


Fig.11. Reversing solenoid cooler.

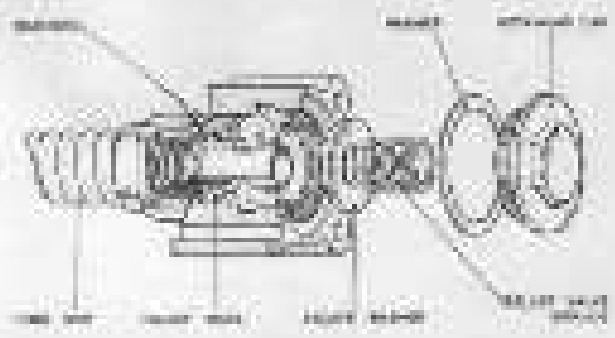


Fig.12. Internal cooler valve assembly.

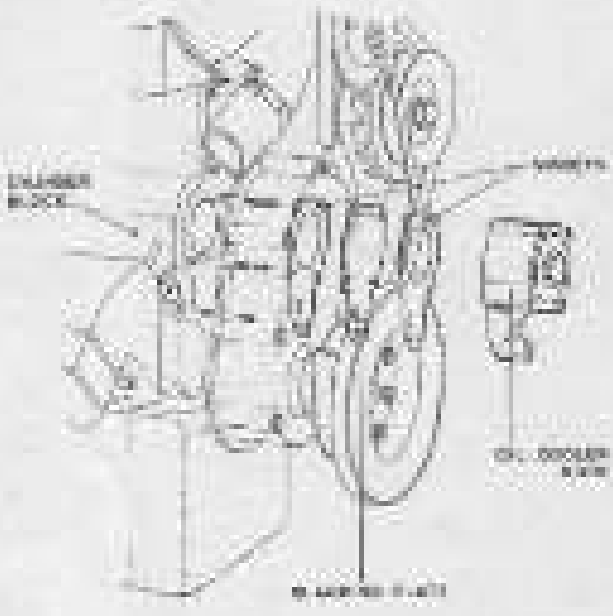


Fig.13. Working details of internal oil cooler location.

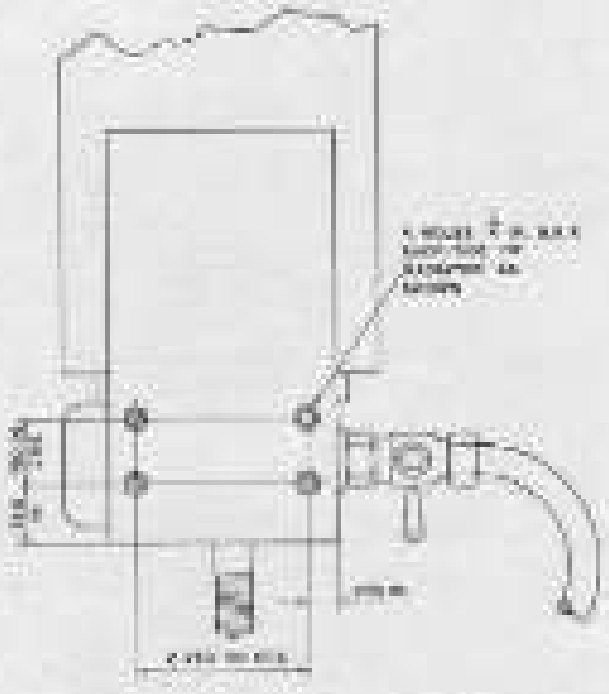


Fig.14. Location of support plate bolt holes.

tighten all nuts securely and close the bonnet. It is important to make sure that the domed nut is tightened on the oil cooler body and not on the inlet 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 "Bristol" cars. In all cases, it is necessary to use a "Vokes" oil filter with the base 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 set-bolts of the oil cooler support brackets. In addition, on type 400 cars fitted with narrow front wing valances, the valances and the radiator side diaphragms will require modification. Radiators already drilled and tapped have been installed in some type 401 cars. Apart from drilling, when installing an external oil cooler in a type 401 car, it is assumed 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 serpentine closely-pitched 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 circulated 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 set-bolts of the external oil cooler support plates. The second method covers type 401 cars which embody a radiator already drilled and tapped for the set-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 $\frac{3}{8}$ 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 2].

3. Referring to Fig.14, mark off the positions of the four holes in each radiator side plate, then drill and tap $\frac{3}{8}$ in. B.S.F. holes.

   Warning :- Due to the small clearance between the radiator side plates and the hose 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 closely 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 set-bolts and shake-proof washers from each side. Flatten each retainer flange forward in line with the diaphragm, then flatten each diaphragm flange rearwards in line with the retainer.

(c) Shape both retainers and diaphragms outwards until the bolt holes in the retainers align with the captive nut units of each diaphragm, thus refit the set-bolts and shake-proof washers.

5. 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 $\frac{5}{16}$ in. B.S.F. bolts, shake-proof washers and nuts, and interposing three plain washers between the support plates and cooler at each bolt position.

6. 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.

7. Refit the radiator, reconnecting 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 $\frac{5}{16}$ in. B.S.F. set-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.

8. Irrespective of its type, remove the oil filter unit complete with mounting bolts and joint.

9. (a) If the oil filter is a "Tecalemit" type, discard the unit and its mounting bolts, substituting a "Yokes" 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 "Yokes" (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 "Yokes" type with a by-pass valve housing and two union housings cast integral with 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

pipe securely. Then assemble the two union adapters and the two remaining sealing washers to the union housings in the head. In addition, the adapter unit N.261350 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 emerges 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 ferrules of the flexible pipes immediately to 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.

Type 401 cars with modified radiator

1. Remove the bonnet (see Section L).

2. Remove the radiator grille (see Section M), and the stay at the top of the radiator.

3. Secure the left and right-hand centre support plates to the radiator side plates with $\frac{1}{4}$ in. B.S.F. set bolts and shake-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 $\frac{1}{4}$in. B.S.F. bolts, shake-proof washers and nuts, interposing plain washers between the support plates and cooler at each bolt location to centralize the oil cooler.

6. Refit the radiator grille and the radiator stay.

7. Remove the "Wokes" oil filter, complete with mounting bolts and joint, from the left-hand side of the cylinder block; discard the joint.

6. (a) If the filter unit has a plain rear 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 "Vokes" type with a by-pass valve housing and two union housings cast integral with 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 three sealing washers. Tighten the plug securely, then assemble the two union adapters and the two remaining sealing washers to the union housings in the head. In addition, the adapter unit R.36136 must be fitted to the joint nearest to the car has left-hand drive.

9. Prime 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 exudes 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 forming immediately in the rear of the oil cooler connections. Secure the clip with a ¼ 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 front of the cylinder, and blank off the pipe ends.

Type 400 with screen wing valances

1. Drain the cooling system as described in Section 2.

2. Remove the four set-bolts 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 refit the cooler, reverse the dismantling procedure, but before connecting the pipes to the filter, prime the cooler as described on page 37.

Note :- 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 420 with wire ring retainers

1. Remove the radiator grille.

2. Working through the grille aperture, release the cooler from the support plates, taking care not to lose the spacing washers.

3. Manoeuvre the cooler with its attached pipes through the grille aperture.

4. Drain the cooler.

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

Note :- 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 bonnet.

2. Remove one cooler support plate completely, taking care not to lose the spacing washers.

3. Release the remaining plate from the radiator and remove the cooler with its attached pipes, manoeuvring it between the radiator and shell.

4. Drain the cooler.

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

Note :- 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.15. Situated 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 sieve 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.

Removing and refitting

Drain and remove the sump as described on page 33, then release the tab-washers, 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 to and lightly nip up the retaining nuts. Turn the engine through at least one complete revolution to allow 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.

Dismantling

To dismantle the pump, proceed as follows :-

1. Release the locking tabs and unscrew the set-bolts securing the sleeve unit, then remove the locking plate, sleeve and sleeve screws; 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 sleeve unit.

Inspection and re-assembling

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

the gears have scored the casing cover, correct this by lapping on a lapping plate. Make sure that all traces of lapping compound are removed, then examine the journal location bores in the cover and re-produce the chamfer if necessary. Break any scoring on the walls or end faces of the gear chamber by scraping. When this is satisfactory, fit the gears to 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 on a lapping plate. It is essential that the joint faces have an all-over contact after lapping. Check the sleeve 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 tongue spigots in the pump casing; note that the driving gear must be fitted to the location which allows for fitment of the driving shaft main. Next, fit the casing cover, washers and retaining screws, then tighten the bolts evenly, and wire-lock; no sealer or jointing compound is used. Finally, assemble the joint washer, sleeve cover, another joint washer, sleeve and locking plate; refit this assembly with the two bolts, then tighten the bolts assembly and bend the ends of the plate to lock the bolt heads.

CYLINDER HEAD

Description

The light alloy detachable cylinder head is fitted with shrunk-in, hardened valve seats and bronze 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 HSC engines are

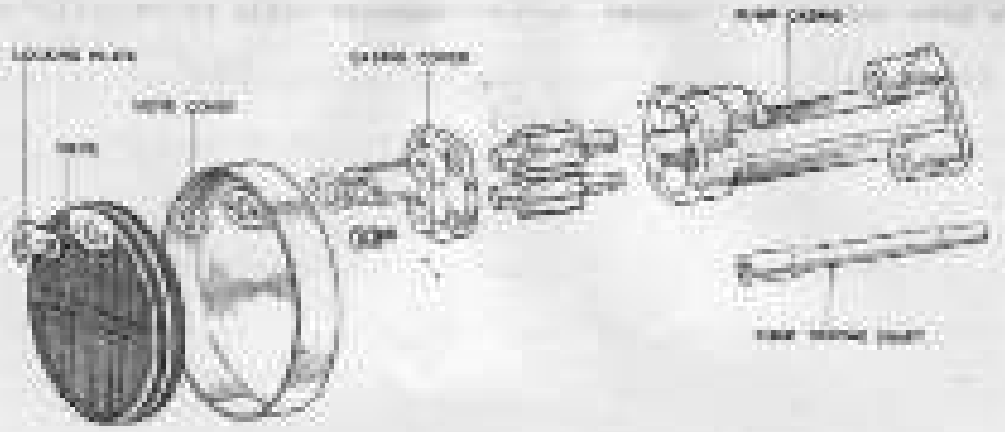


Fig.15. Oil pump.

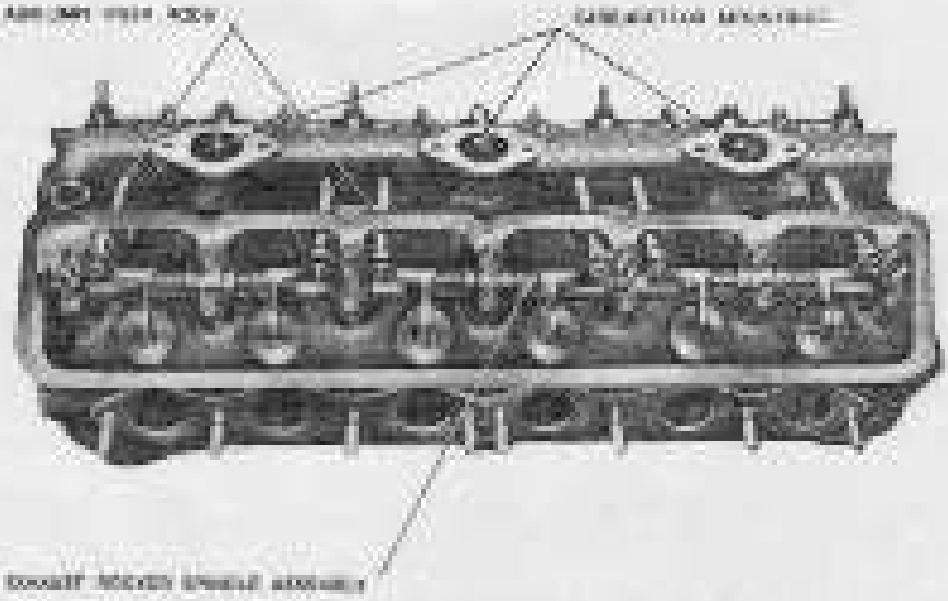


Fig.16. Cylinder head assembly with rocker box covers removed.

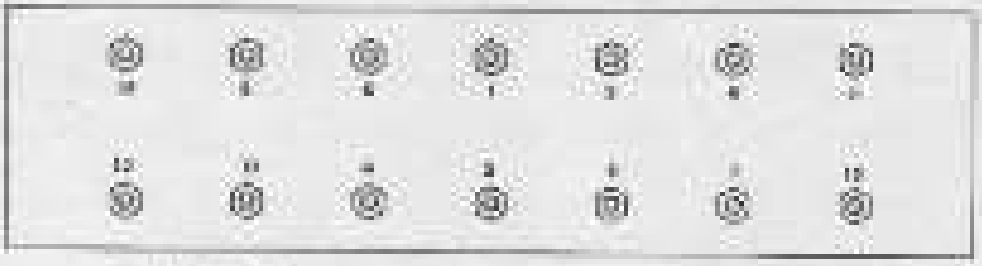


Fig.17. Sequence for tightening or loosening cylinder head nuts.

fitted with variable pitch outer valve springs, being close-coiled at one end; these springs can also be used on earlier type engines. It is essential that the outer springs are fitted the correct way up, i.e. the close-coiled end is the bottom. The overhead rockers are bushed and mounted on a spindle located on each side of the head. Each spindle is carried in seven split housings 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 inlet rocker spindle, a shorter compression spring locates each pair of inlet and auxiliary rockers. The inlet rockers are operated by push rods applying a direct vertical thrust from the tappets, while a reciprocating thrust for the exhaust rockers is applied via a short auxiliary push rod through the auxiliary rockers mounted on the inlet rocker spindle. Thus, three types of push rods are employed. The inlet 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 inlet 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 branch pipes merging into a single screwed outlet. On type 93 engines, the single carburettor is attached to the head via an induction manifold. On type 95A engines, the carburettors are bolted directly to the head; on type 95C engines, the control brackets are interposed 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 inlet rocker box cover (front unit) and is connected by a short hose to the air filter.

Removing and refitting

Remove the bonnet as described in Section 12 then disconnect the negative terminal lead from the battery. Drain the cooling system as described in Section 2.

If air heaters are fitted, disconnect the relevant water pipes, see Section 8. Release the hose clips and remove the hose from the water pump and radiator. Disconnect the sparking plug lead snaplars from the plugs. Release the rubber 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; segregate the shim fitted between the drive housing and cylinder head. Detach the restrictor drive oil feed pipe from the distributor drive housing, and disconnect the manual ignition control lead 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. Remove the nuts and spring 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, continue 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 washer. Use the locking wire and tighten both exhaust pipe ring nuts with the special "C" spanner SPS.6053; no packing are fitted. Remove the nuts and washers securing the exhaust manifolds to the head and remove the manifolds and gaskets. Slacken the dynamo adjusting and securing bolts to relieve the tension of the fan belt, then

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.17. 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 to the cylinder block. Make sure that the rods are refitted as removed since they are mated together by wearing, and check that they seat squarely in their tappet bodies. Make sure that the inlet and exhaust rods are fitted with the ends of the proper ends. Smear a new cylinder head gasket lightly 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.

Screw on and "nip" the fourteen cylinder head retaining nuts. Next, tighten each nut one sixth of a turn at a time in the sequence shown in Fig.17 until all the nuts are tightened fully.

Set the valve clearances as described on page 41.

Fit new gaskets and assemble the exhaust manifolds 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. Refit the carburettors as described in Section 3.

Refit the distributor drive and time the distributor as described later in this Section under the heading "Ignition", but omitting the air filter on type 85A engines.

Fit the washers to the cleaned out 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 H.T. lead adaptors to the plugs. Connect the negative terminal to the battery.

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

Note :- If car heaters 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 time the carburettors as described under the heading "Valve Clearances" and in Section 3 respectively.

After setting the valve clearances, replace the rocker covers using new joint washers and rubber seals; make sure that there is at least 3/32 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 hoses 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 A.T. connection on the distributor does not foul the filter.

Valve clearances

The correct clearance between the rocker arms and the valve heads is most important. Valve clearances should be set to 0.012 in. (0.301 m.m.) when COLD. This setting will give a clearance of approximately 0.008in. (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.1 inlet valve will then be fully closed. Slacken the lock-nut on No.1 inlet valve rocker adjusting screw and, with a 0.008in. 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

Dismantling

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. Setting the rockers at each end of the spindle, lift out each spindle then retain the end rockers 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 TRN.5021 then remove the valve retainers and release the springs. Remove the upper valve spring seating, springs, lower valve spring seating 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 components.

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

Inspection and re-conditioning

Examine the cylinder head and valve seat inserts for general condition; check that all studs are secure and undamaged and trial-fit the nuts to the studs. Check the bores of the valve guides and the stems of the valves; if worn, they should be dimensioned. 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 discolouration of the oilways and check that the rocker locations 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 their end cotls have not fretted 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 "land" of the valve stands clear of the insert. If the "land" of the valve "pockets" in the insert, a new valve should be fitted or the insert cut back to restore the valve position.

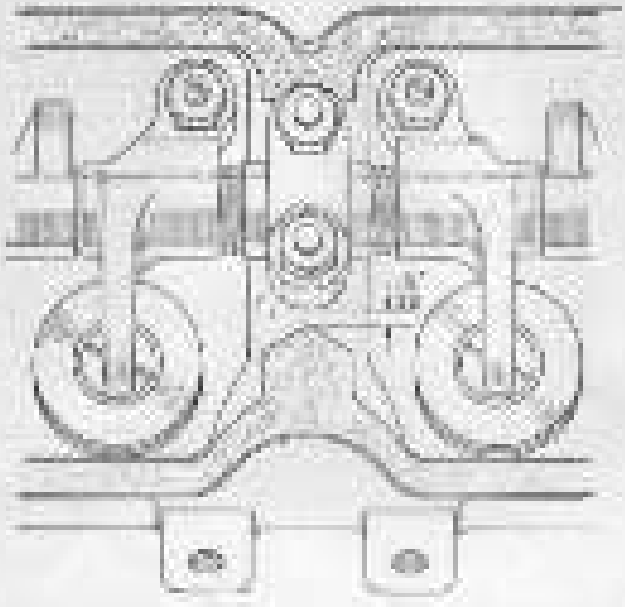


Fig.18 Rocker cover joint clearance.

Fig.19. Adjusting valve clearance.

Fig.20. Inlet 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 outside diameter. In many cases, a standard valve guide will prove satisfactory particularly if the old guide was removed carefully. When fitting an oversize guide, it is not attempted ream or enlarge the bore in the cylinder head or misalignment will result. Measure the bore in the head, then grind the oversize valve guide to give the interference fit quoted 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 the spindle and, if necessary, ream to produce the required clearance.

Re-assembling

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 6CK engines are fitted correctly, i.e. close-coiled end downwards.

Using the valve lifter 70H.3027, compress the springs, then fit the valve collars and release the lifter. Insert the auxiliary push rods in their locations

with the arrow ends of the rods towards the exhaust rockers. Lubricate the rockers and compression springs and fit them with their washers to the rocker spindles.

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 end (No. 1 cylinder) of the spindle.

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

Fig.22 illustrates the manner in which the assembly tool T.176295 is fitted to the exhaust rocker assembly to aid fitment to the cylinder head.

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

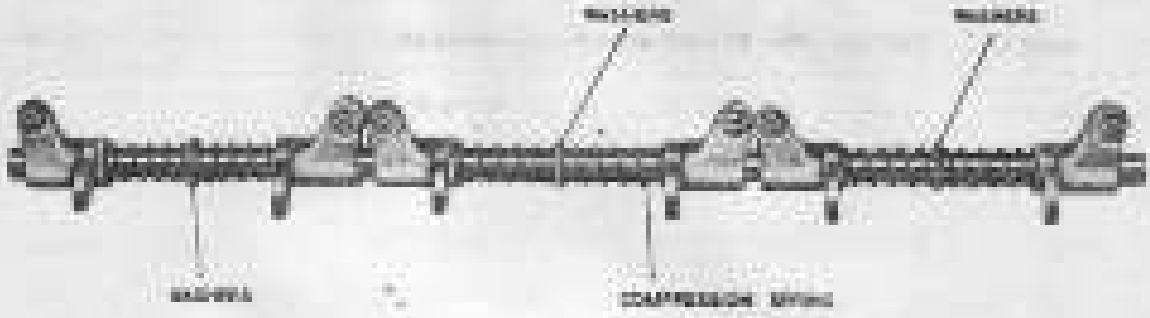


Fig.21. Exhaust rocker spindle assembly.

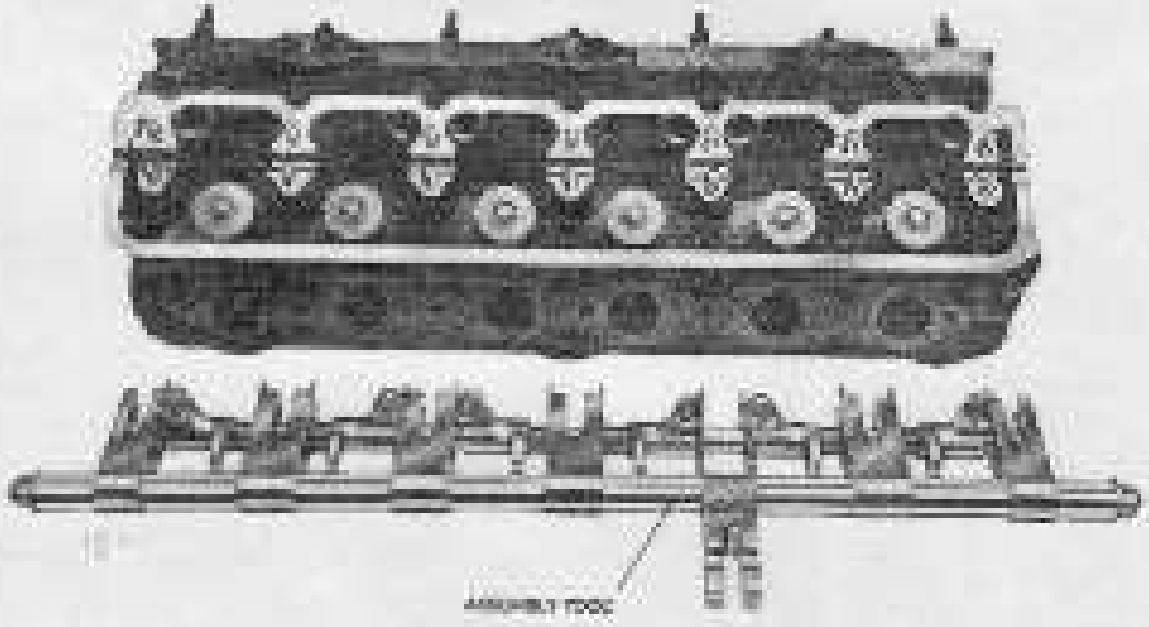


Fig.22. Exhaust rocker spindle in assembly tool.

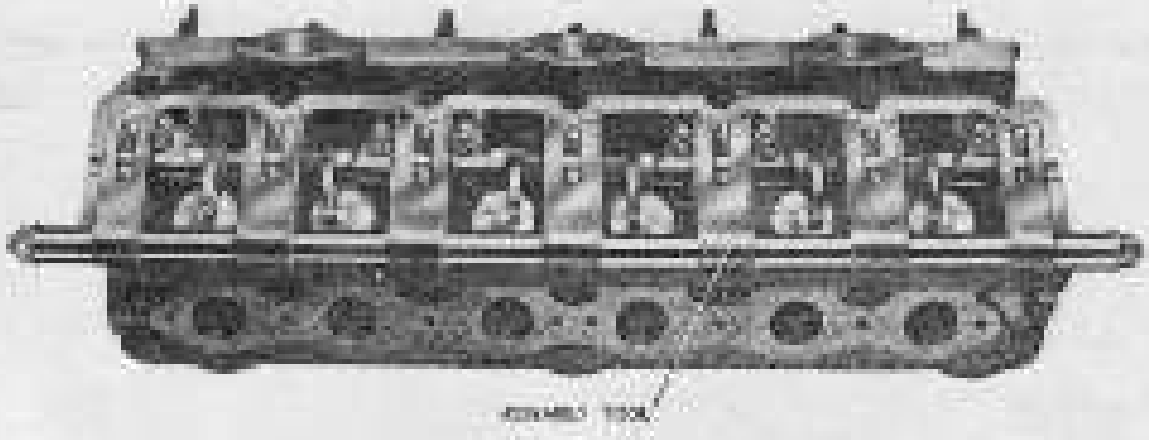


Fig.23. Exhaust rocker spindle assembled to head.

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. Locate the hole in the front end of the spindle over the dowel in the front bracket of the tool thus raising the assembly tool. Fit the seven rocker spindle caps and screws to 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 bearing for the ignition driving gear.

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

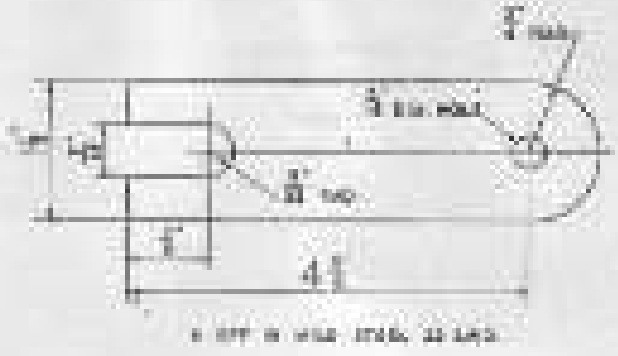


Fig.24. Assembly plate for rocker spindle.

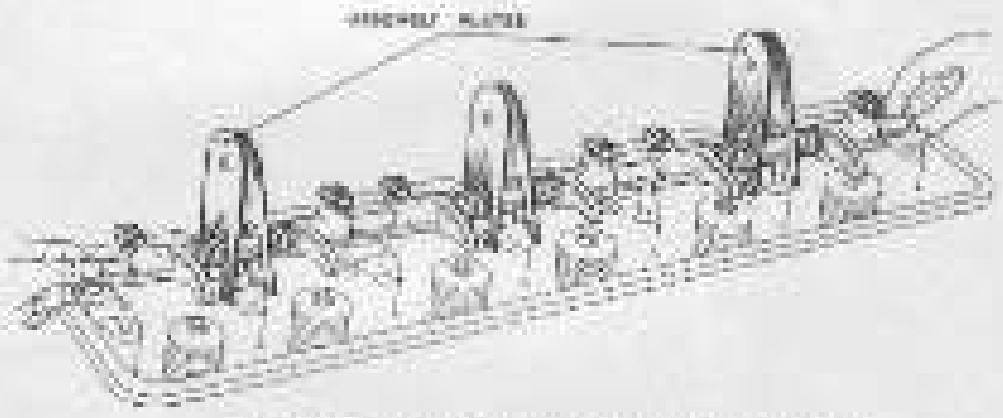


Fig.25. Showing use of assembly plates.

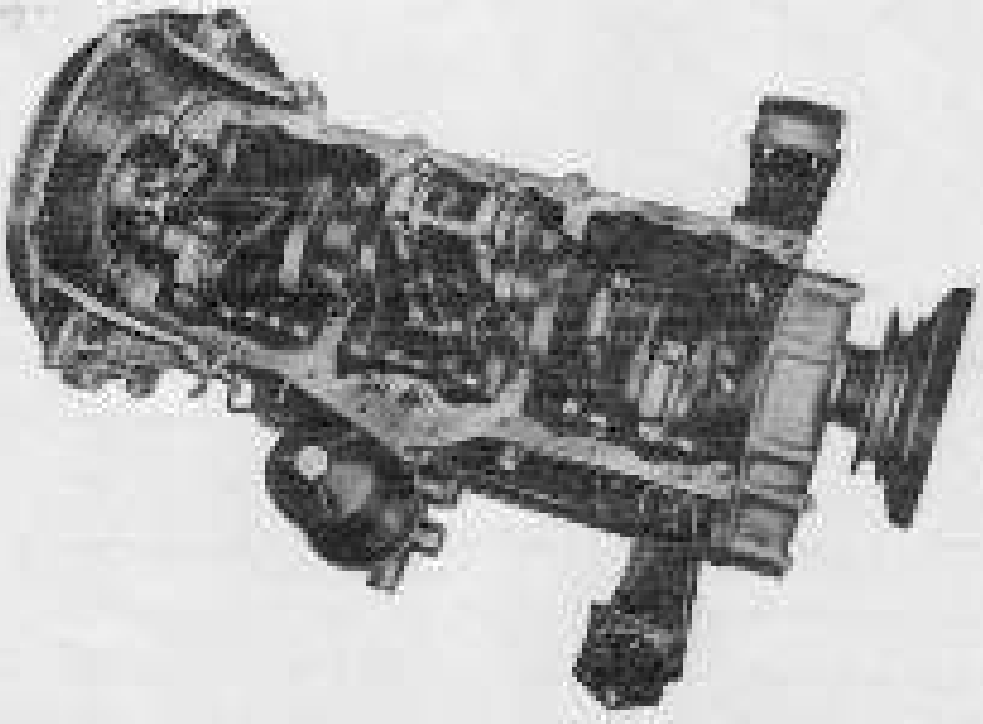


Fig.26. Crankshaft assembly.

Re-boring

Replacement pistons 0.010 in. and 0.020 in. oversize are available. It should be noted that later type 65A and all type 65C engines are fitted with cylinder liners; early type 65A and all type 65 engines have no liners. Therefore, when wear of the cylinder bores of the later type engines is too great to permit the fitment of the oversize pistons, new liners and standard pistons should be fitted. The liners are fitted in accordance with standard practice. In the case of the early engines, it will be necessary to bore out the cylinder block and to fit liners and standard pistons. After re-sleeving, it is recommended that the liners are bored and finish-honed to give the piston clearance quoted in the "General Data". If a re-boring machine such as the "Black and Decker" type is employed, the precision is such that honing may not be required.

After re-sleeving, the cylinder block should be skim-ground to make sure that the liners do not stand proud of the cylinder head attachment face. It is also essential to make sure that all oil passages are scrupulously clean. To ensure this, use paraffin under pressure and dry with compressed air.

CRANKSHAFT

Description

The chrome molybdenum steel crankshaft is supported by four steel-backed, lead indium bronze lined, replaceable main bearings and is nitrogen hardened all over with the exception of the front extension, which mounts the thrust plate drive sprocket, engine damper unit and starter dog. The rear end of the shaft is flanged to accommodate the flywheel and is bored to receive the ball bearing of the gearbox drive shaft, the bearing being retained in position by a circlip.

between the flywheel attachment flange and the rear main bearing journal, an oil return thread machined in the shaft is screened by an integral oil thrower; 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 camshaft drive gear and a felt seal fitted in the bore of the cover.

Removing and refitting

Remove the gearbox and clutch units from the engine and chassis as described in Sections 3 and 4 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 damper and extractor units from the front end of the crankshaft, then remove the set-bolts and take off the camshaft drive cover, followed by the oil baffle. Release the tabwasher and remove the nut securing the chain wheel to the camshaft, then withdraw the chain wheel and drive sprocket (complete with chain) from the camshaft and crankshaft. Withdraw the thrust plate. Remove the sump in the manner described subsequently then remove the set-bolts 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 S.117166. Remove the keys from the shaft and spare 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 on 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 retain 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 projections are located correctly and that, if the shaft 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. Fit the bearing caps complete with the correct bearing shells to the main bearing locations, but the lower half of each thrust plate to the front bearing cap. Tighten the bearing cap retaining nuts temporarily and fit the thrust plate, drive sprocket, damper carrier unit and starter dog to the front end of the shaft. Tighten the starter dog on the shaft, then check the shaft rotation and that the end-float is within the desired limit. If the end-float is incorrect, adjustment could be made by selective assembly of the front bearing thrust plates. These are available in three sizes, i.e. standard, + 0.003 in. thickness and + 0.005 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 nut lubricator to each main bearing cap stud, then refit the nuts and tighten them to a torque loading of 28 to 30 lb. ft. (3.880 to 4.146 kg.m.). Check that the shaft will rotate freely then unscrew each nut and withdraw the lubricator.

Fit the appropriate bearing shells to 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 camshaft, and assemble the machined 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 60 lb. ft. (8.020 to 8.296 m. kg); secure each nut with its 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 of this Manual before re-assembly to the engine.

Refit the flywheel to the flange of the crankshaft, locating it over the two dowels and fit the three locking plates and six set-bolts. Tighten the set-bolts to a torque loading of 30 lb. ft. (4.148 m. kg.), then secure them with the tabs of the locking plates. Fit the thrust plate to 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-time 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 set-bolts, plain and spring washers. Fit the engine damper and carrier unit to the shaft followed by a new tabwasher and the starter dog. Tighten the starter dog and secure it with the tabwasher. Assemble the sump and cylinder head to the engine and the engine to 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 magnaflux and electro-flux test equipment. The electro-flux test should be performed at 300 amperes and 250 volts. If satisfactory, check all crankshaft journals for condition and

wear and ensure that any ovality is not excessive. Inspect the thread, keyways and circlip groove for condition and the thrust plate and ball bearing location for fretting. 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. 0.002in. (0.05mm. dial reading), the shaft must be straightened. Great care must be exercised in straightening of 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 fresh oil from the camshaft 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 locating and preventing movement of the bearing. Three sizes of bearings are available, standard (nominal) size, 0.010 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 notches are located correctly. The bearings are supplied ready for use; under no circumstances should the caps be let together, i.e. faced, or any grinding be 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-nitriding. Where such facilities do not exist, the crankshaft should be returned to the Car Division of the Bristol Aeroplane Company Limited.

Warning :- Do not attempt to re-grind the crankshaft if the mal-alignment exceeds the permissible maximum, i.e. 0.002 in. (0.005in. 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 satisfactory, grind the shaft in a suitable grinding machine and re-grind the bearing journals. Fit the blanking cap TFX.7863 to the front-end of the crankshaft to protect those surfaces which are not to be hardened, (Fig.2) (Illustrates suitable block which may be made locally for this purpose) then nitride the shaft for 48 hours at 495°C.

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

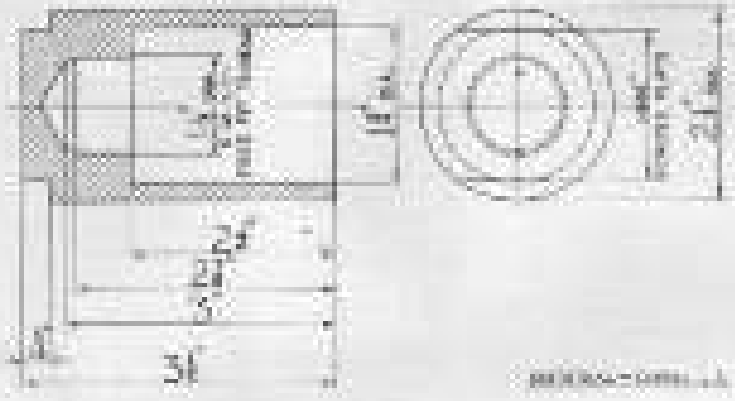
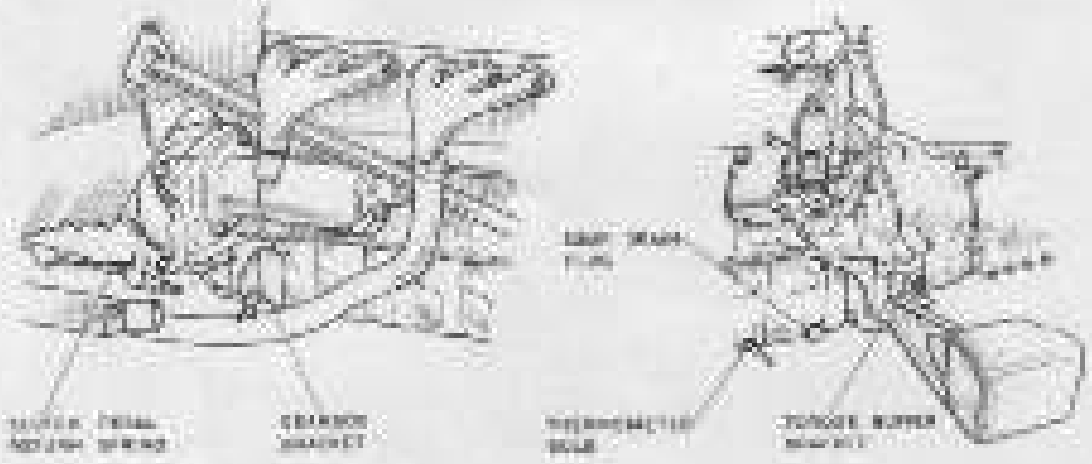


Fig.27. Block for sliding shaft.



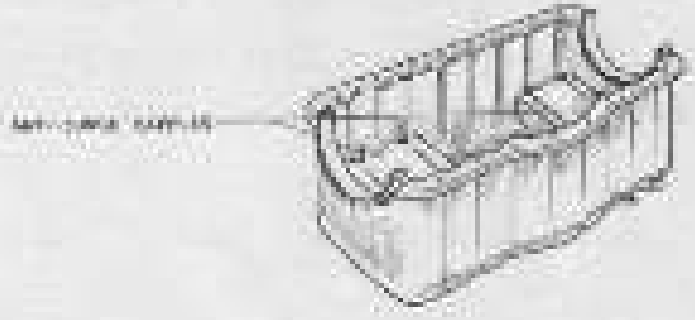


Fig.28. Retaining ring.

shaft and repeat the alignment check. When the alignment check after straightening is satisfactory, magna-flux and electro-flux test 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 set-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. Examine the ring location of the flywheel for condition and, if necessary, dress to remove damage or bedding. 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 its correct position. The ring is machined to extremely fine limits; it is not therefore necessary to re-balance the flywheel unit.

Note :- 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 absolute minimum amount. The nominal overall thickness of the flywheel is 1.125 and under no circumstances should this dimension become less than 1.075. Thus, it will be seen, that 0.050 below nominal 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 minimum dimension is reached.

CONNECTING RODS AND PISTONS

Description

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

The pistons are of pressed aluminium alloy to D.T.D. specification 424 and taper from the bottom of the skirt to the top of the skirt, the bottom skirt being 0.015 in. greater in diameter than the crown. Each piston is cam-ground on the skirt to produce an ovality of 0.0035 in. to 0.005 in. Three compression rings and one scraper ring are fitted to each piston, the top compression ring being chrome-plated all over; the remaining two are grooved, the lower being chamfered on its upper edge. The alloy-steel fully floating gudgeon pin is hollow and is retained in the bore of the piston by two circlips.

Removing 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 sump as described in this Section, then remove the big-end bearing caps. Push the connecting rods

up into the cylinder bores with the rod webs 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 (see "Inspection"); retain the pin by fitting a new circlip in each groove in the piston bore. Check the gaps 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 its small diameter towards the piston crown, 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 camshaft; this will ensure correct positioning of the off-set small ends of the rods. Complete the re-assembly as described in page 53 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 on reassembly, then insert the connecting rods in the relevant cylinder bores with the rods located in the cylinder slots and their identification numbers facing towards the camshaft. 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-end of the connecting rods on the appropriate crankpins. Refit the bearing caps complete with bearings then torque tighten and lockwasher the cap nuts. (28 to 30 lb. ft. - 3.458 to 4.148 m.kg.).

Check the side clearance of the rods on the crankpins (less removable big end and cylinder head units).

Inspection

Using suitable materials ground to fit the gudgeon pin bush and the big-end of the connecting rod (without bearings fitted), mount the connecting rods, in turn, in "V" blocks and check them for twist and misalignment. The maximum permissible error of alignment is 0.006 in. per six inch length of mandrel and 0.004 in. twist per six inch length of mandrel.

The connecting rods should also be subjected to magna-flux test to examine for cracking. Check the gudgeon pin bush for wear and ovality; if excessive, reject the unit. 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 reassembly.

Examine the pistons for general condition. Check the clearance of a new set of rings in the ring grooves and check the gaps. Assemble the pistons to the cylinder bore and check that the clearance between the skirt of the piston (thrust side) and the cylinder will be within the limits quoted.

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 reassembly.

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

Replacing 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 tongues 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.

Replacing 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. Examine the rod bore for ovalities and, if necessary, polish lightly to remove the tops of withdrawal scores. Standard size and 0.020 oversize bushes are available. Generally speaking, standard size bushes are suitable for replacement but should the connecting rod bushes 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 the 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 bushed rod is set up on a suitable diamond-honing or machine-reaming 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 reboring machine, a standard type universal connecting rod aligning and reaming jig should be used. It is essential to observe the precautions quoted above. Rod 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 the longitudinal oil duct, then check the alignment of the rod and check the bearing centres.

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

Due to the very fine 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 on 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.

CAMSHAFT

Description

The camshaft 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 camshaft is secured in position by a retaining plate. A cast-iron double-track chain wheel, keyed and secured by a nut 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 part way 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 feeding the intermittent feed to the tachometer drive in the distributor drive casing. 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

Disconnect the engine in the manner described for removing the crankshaft, then remove the oilbolly nut withdraw the distributor and oil pump drive pinion through the distributor drive casing aperture of the cylinder block. Release the lockwashers and remove the two set-screws securing the retaining plate and detach the plates from the front-end of the camshaft. Extract the tappet bottom then withdraw the camshaft from the front-end of the cylinder block.

After re-conditioning, re-assemble the camshaft in the following manner. Ensure that all components are clean. Insert the camshaft, plain-end first, into the bearings of the cylinder block, and check the clearances with feeler gauges. In order to preserve the optimum oil pressure, it is essential that the maximum permissible clearance is not exceeded. Assemble the retaining plate over the front-end of the camshaft and secure the plate with the lockwashered set-screws. Fit the key and the chain wheel to the shaft and secure them with the retaining nut, then check that the end-float 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 shank. Check that the circlip is seating

correctly in the groove and that it is free to rotate. Check that the end-float of the pinion in its bearing and the backlash between the pinion and its mating gear on the camshaft is within the required limits. When these checks have proved satisfactory, fit the keyset bolting, remove the retaining nut, obtain thrust nut key from the camshaft and refurbish the engine in the manner described in this Section for refitting the camshaft.

Inspection

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

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

Replacing bearings

Using a suitable drift, tap the rejected camshaft 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 "pick-up" during fitment. It is most important to ensure that the bearings have the correct interference fit quoted in the "General Data". The recommended method for fitting the replacement bearings is to freeze them for a few minutes, insert the

(chamfer 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 tachometer 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 clearances without resorting to reaming. If such is the case, and it for any less 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 "General 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 line-ream the bearings. In all cases, the blanking plug behind the rear bearing must be removed. The line reamer comprises a handle T.101660 on which are mounted the reamers T.103379, T.103380, T.103381 and T.103382 for the front, mid-front, mid-rear and rear bearings respectively. Lubricate the bearings and reamers with a liberal supply of clean engine oil and insert the reamer into the bearings from the front end of the cylinder block. Rear the bearings to size, maintaining rotation in the cutting direction while withdrawing the reamers to prevent withdrawal scores. Wash out the cylinder block bearings and oil passages with paraffin under pressure to remove all traces of swarf, then refit the camshaft and check the clearances of the journals in the bearings.

Note :- 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 clearance is satisfactory, screw a new blanking plug into the rear bearing and secure by peening. To ensure an oil-tight seal, the following procedure is recommended. Apply an even coating of 'Hermetite' jointing compound to the threads of the blanking plug and screw it into position in the rear bearing to within 1½ to 2 threads of the final position. Locate pear the plug in the bearing then tighten it to within 2 to 1 thread of the final position. Again lightly pear the plug then screw it into position and complete the peening.

Timing

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

CLUTCH

Description

The cast aluminium alloy sump is fitted with two anti-roost baffles. Four separate laminated cork joint washers are fitted to the sump joint face, and the sump is secured to the cylinder block by nineteen setscrews 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.

Removing 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 socket; 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 unbolt the exhaust pipe bracket plate from the gearbox bracket. Remove bulb exhaust ring nuts, detach the anchorage of the exhaust system from the chassis and lower the exhaust pipes.

Detach the torque tube bracket, complete with buffer, from the left-side of the gearbox bracket and pull the buffered floor 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 casing, and the four set-bolts securing it to the cylinder block; detach the bracket. Remove the nineteen set-bolts securing the sump to the cylinder block, then lower the rear end of the sump, move 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 sump 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 "Hermetical" jointing compound to

the seal face. Fit a set of new joint washers to the joint faces and ensure that the washers fitted to the front and rear faces project approximately ¼ in. above the top surface of the joint washers on the side faces. This will ensure that a good oil-tight seal is obtained 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 rocker to the cylinder block and secure 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 situated on the left-hand side of the cylinder block, at its lower end it is secured by two studs to the cylinder block, being located 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 centrally by a plunger integral with the shaft. A helical 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 dog plunger is an integral driving pinion which engages with the pinion of the tachometer drive shaft, which is housed in a drive hole screwed into the side of the distributor drive casing. The upper end of the shaft is fitted with a slotted 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 actuating lever which is clamped to the body of the distributor is secured to the casing by a spring-loaded washer retained by a shouldered nut-bolt.

The slotted upper end of the distributor drive gear engages with the tongued 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 moulded cover regularly, using a clean dry cloth. Periodically check the H.T. 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.30. 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 smartly 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.

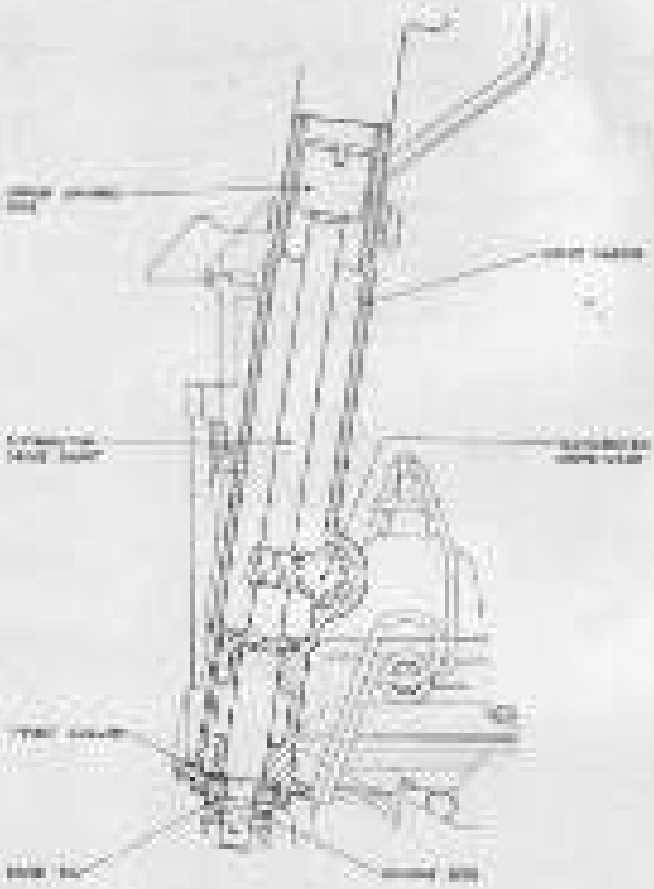


Fig.29. Distributor drive assembly.

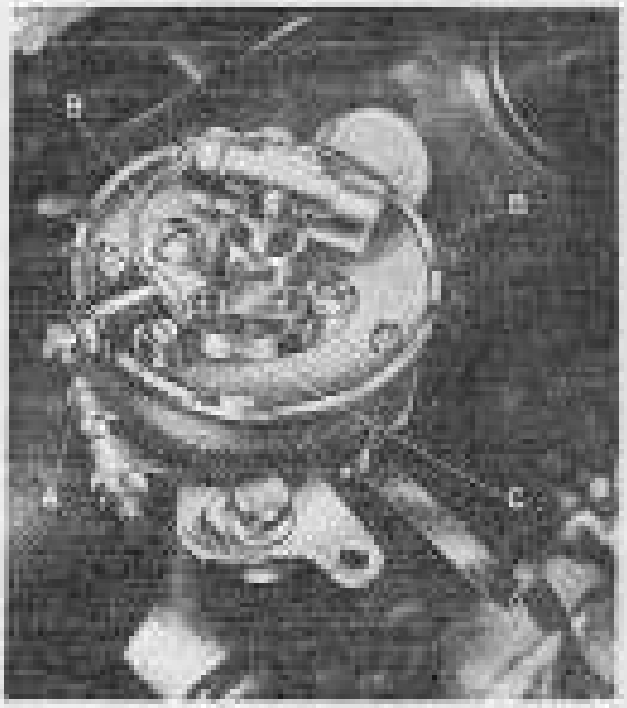


Fig.31. Distributor details (Rotor removed).

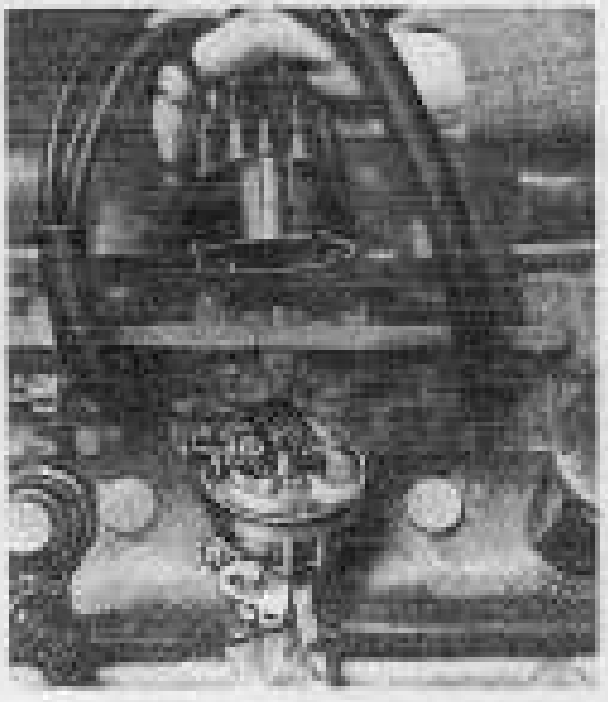


Fig.30. Distributor details.

Fig.32. Correct and incorrect contact faces.

Lubrication

Every 3,000 miles (5,000 kilometres), 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 refit the rotor.

Periodically remove the contact breaker lever and apply a smear of grease to the pivot pin, refit the lever 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 "Bristol 2 litre" 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 burned 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-nut ("A" in Fig.31) in order to release the end of the contact breaker spring "C", then lift the fibre rocker off its pivot post. An insulating washer is fitted beneath the rocker; take care not to lose this washer. The spring is fitted to allow excessive load on the terminal block and will be withdrawn with the rocker. Use an "Emdee" or fine "Carborundum" stone to clean the contacts, taking care to keep the contact faces perfectly flat, see Fig.32. Clean away all traces of abrasive powder with a petrol moistened cloth. Then refit the lower fibre rocker on its pivot pin, make the contacts and check that an all-over contact is made.

If necessary, re-form the contacts carefully until correct setting is obtained. Make sure that the components are scrupulously clean, then lubricate the pivot pin, refit the contact breaker lever, engage the lower spring with the terminal bushing and tighten the terminal lock-nut. Re-connect the L.T. lead.

Setting contact breaker gap

After cleaning, re-set the contact breaker gap in the following manner. The correct gap setting is 0.012 in. (0.301 m.m.) and this must be checked with a perfectly clean feeler gauge. First turn the crankshaft until the contacts are open fully, then slacken the two contact plate securing screws ("B" in Fig.31). Move the plate about its arcs 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 units and condensers. 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 40799G. First remove the moulded 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 post. An insulating washer is fitted beneath the rocker; take care not to lose this washer. The spring is slotted to allow withdrawal from the terminal block and will be withdrawn with the rocker. Unscrew and remove the two screws ("B" in Fig.3), 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, locating the central hole over the fulcrum pin; refit loosely the two screws "B" and washers. Apply a smear of approved grease to the contact lever pivot pin and to the cam, then fit the lever, 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 28.

Replacing condenser

The ordering number of a replacement condenser is Lucas 40704A. First remove the moulded cover and lift out the rotor. Disconnect the L.T. strip lead at the base of the condenser, remove the screw and shake-proof washer 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 shake-proof washer, then re-connect the L.T. strip lead. Refit the distributor rotor, followed by the moulded cover.

Removing and refitting distributor and drive

Remove the two set-bolts securing the air filter and distributor drive casing to the cylinder head then unscrew the hose 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 pinch-bolt and remove the distributor. Disconnect the manual over-ride control from the actuating lever, then remove the shouldered set-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 securing the drive casing to the cylinder block then detach the casing. If it is desired to dismantle the drive, proceed as follows. Unscrew 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 mating 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 exhaust 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 5° 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 head.

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 3,000 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. 8.5008H) 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 (no)[re]acting removal and fitment. Remove the heat insulating caps from the plugs and hold the spanner so that no undue stress is imposed upon the insulated body of the plug during removal or fitment. All plugs should be removed, cleaned, the gap checked, reset and, if necessary, renewed at least once every 1,000 miles (5,000 kilometres).

EXHAUST SYSTEM

Two exhaust manifolds are fitted to the cylinder head; each manifold serves three cylinders and is connected to a single-branched outlet. Three manifolds are common to all engine types. The exhaust pipe-silencer systems however, are of several types; a brief description of each type follows.

Early type 100

A two-piece system. The forward unit has twin pipes which engage the manifold. These merge into a single pipe which is welded to two oval-section "Rodcliffe" 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 "Servais" system as fitted to all other type 100 cars.

Later type 100

A three-piece system comprising dual pipe unit, centre unit and tail-pipe unit. The dual pipe unit has twin pipes which engage the manifolds 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 "Servais" silencer; the outlet is clamped to connect with the tail-pipe unit which is cranked to pass over the rear axle and incorporates a small oval section "Servais" silencer.

Pre-production type 470 and 402
(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 21)

A four-piece system comprising down pipe unit, centre section unit, tail-pipe unit and a tail-pipe silencer. 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 on 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 22 to 121)

This system has separate down pipes which connect with a double-entry, single-outlet, 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 to the rear end of the tail pipe.

Latest production type 401
(cars 122 onwards)

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

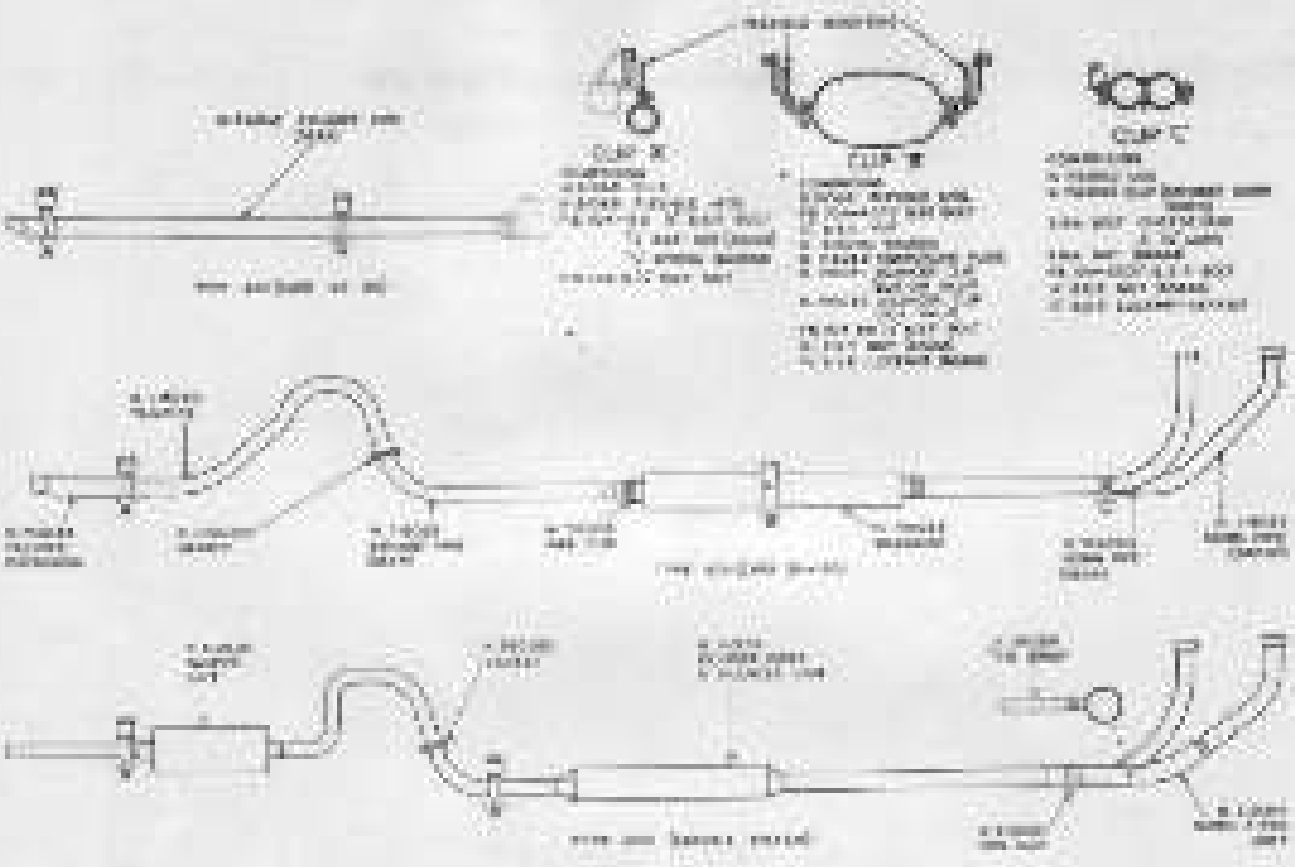


Fig.33. Exhaust systems.

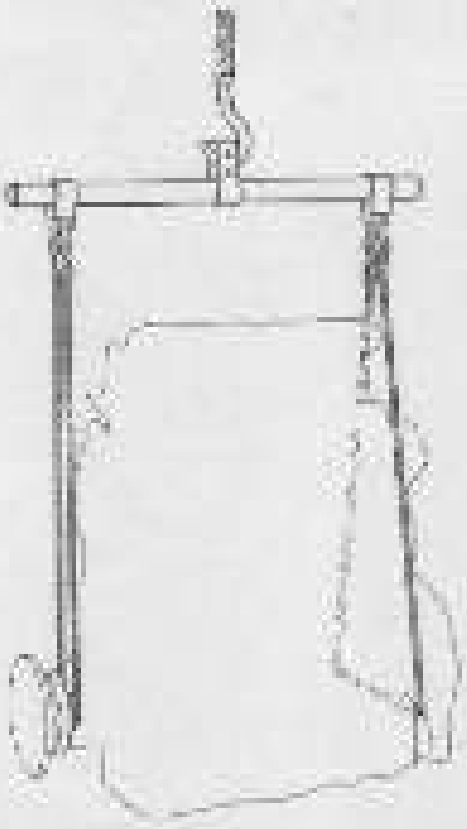


Fig.34. Engine sling.

REMOVING AND INSTALLING THE ENGINE

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

Type 400 cars

1. Remove the bonnet 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 2 S.U. carburettors, disconnect the leads from the solenoid and remove the starter carburettor float chamber.
7. Remove the oil filter. If an external oil cooler is fitted, disconnect the 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 80 engines, disconnect the pipe from the radiator hose to the induction 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 petrol cock then disconnect the feed pipe from the petrol pump.
12. Disconnect the tachometer drive from the tachometer drive body in the distributor drive casing.
13. Disconnect the L.T. and H.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. Unscrew both exhaust cam pipe ring nuts using the "C" spanner 295.1050 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 stow 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, toeboards and gearbox tunnel covers.

24. Disengage the clutch return spring from the anchorage bolt, then disconnect the cluch operating rod from the clutch lever and fulcrum lever.

25. Disconnect the tachometer drive and the overrun light wiring from the gearbox.

26. Fit the engine lifting sling, No. 18H.3021, to 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 camshaft drive cover, and hook it in the front ring of the lifting sling. Pass the free end of the rear (long) lifting cable around the engine, between the sump and gearbox bracket and connect its hook to the rear ring of the sling, see Fig.14.

27. Raise the hoist 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 two rear mounting units.

30. Remove the mounting units from the chassis cross-member.

31. Remove the set-bolts and nuts and bolts securing the clutch casing to the engine; detach the starter and tachometer cable clips.

32. Carefully move the gearbox assembly rearwards to break the clutch casing joint with the engine, then remove the assembly from the chassis.

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

33. Remove the set-bolts and detach the clutch assembly as described in Section 4.

34. Remove the nuts and bolts securing the front mounting rails to the chassis.

35. Raise the engine carefully from the car and manoeuvre it to clear obstructions. It may aid removal if 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.

36. 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.

37. Remove the lifting equipment.

38. If work is not to be performed on the engine or gearbox assembly immediately, cover all exposed portions and block off all openings to prevent the ingress of foreign matter.

Types 801 and 802 cars

1. Remove the bonnet as described in Section 14.

2. Disconnect the lead from the battery.

3. Drain the water from the cooling system (see Section 23).

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 tachometer drive from the tachometer drive body in the distributor drive casing.

11. Disconnect the L.T. and H.T. leads from the coil to the distributor.

12. Disconnect the ignition control rod.

13. Remove the A/C thermometer bulb and stow it carefully in the chassis, with its capillary tube, to prevent damage.

14. Disconnect the oil pressure gauge pipe.

15. Unscrew bolt retaining dash pipe clip with the "U" spanner TPM.3000 and remove the nut and bolt securing the throttle pipe bracket to the gearbox bracket.

16. Disconnect the throttle and kickdown controls.

17. Remove the water thermometer bulb and stow it carefully in the chassis, with its capillary tube, to prevent damage.

18. Disconnect the cables from the starter.

19. Remove the front seats and floor covering (see Section 1C).

20. Detach the clutch, brake and accelerator pedals from their levers.

21. Remove the floorboards, outboards and gearbox cover.

22. Disengage the clutch return spring from the anchorage bolt, then disconnect the clutch operating rod from the clutch lever and lubrication lever.

23. Disconnect the tachometer drive and the reverse light wiring from the gearbox.

24. Fit the engine lifting sling, 30.GRS.5063, to a hoist arranged at a convenient height above the engine, then pass the rear end of the front (short) lifting cable around the front end of the crankshaft, between the dressing pulley and the manifold stud 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 the hook to the rear ring of the sling, see Fig.3C.

25. Raise the hoist 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 extension to the two rear mounting units.

29. Remove the mounting units from the chassis cross-member.

30. Remove the set-bolts and the nuts and bolts securing the clutch casing to the engine; detach the starter and carburetor cable clips.

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 locating dowels 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 block 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 checking, inspecting and adjusting operations designed to bring the performance of the engine to its maximum.

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. Blow all foreign matter out of the recess between the inlet and exhaust rocker boxes of the cylinder head with compressed air.
2. Check over the engine for signs of oil leakage.
3. Check the tightness of all union connections and junction pipes.
4. Adjust the two boat controls 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 H.T. leads 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 wastage, and the moulded insulation for cracks and/or chipping. If any defect is observed, discard the plug and fit a new one.
4. If the sparking plugs appear to be satisfactory, adjust the gaps to the dimension quoted in the "General Data", test them and if satisfactory, refit 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 clean the cable terminals and sockets. Check that the moulded H.T. cable nuts are not cracked, and that the cables are secure in the nuts before reconnecting to the distributor.

4. Check the distributor-to-coil L.T. cable connectionsfor 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 central 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 set as described in page 70. 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 clearances

1. Remove the rocker covers and inspect the valve operating mechanism for cracked valve spring cotts.

2. Set the tappet clearances to 0.012 in. (0.031 m.m.) COLD, 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 strainer. Check the condition of the diaphragm unit before refitting the unit.

3. Examine the carburettor and manifold joints for evidence of leakage.

4. Adjust the carburettor(s) following the relevant procedure given in Section 3.

ENGINE FAULTS

Lack of power... ... ... Poor quality fuel.
Overheating - see Section 2.
Low compression.
Incorrect ignition.
Carburettor(s) dirty and/or maladjusted, see Section 3.
Air cleaner restricted.
Incorrect grade of oil.
Restriction in exhaust system.

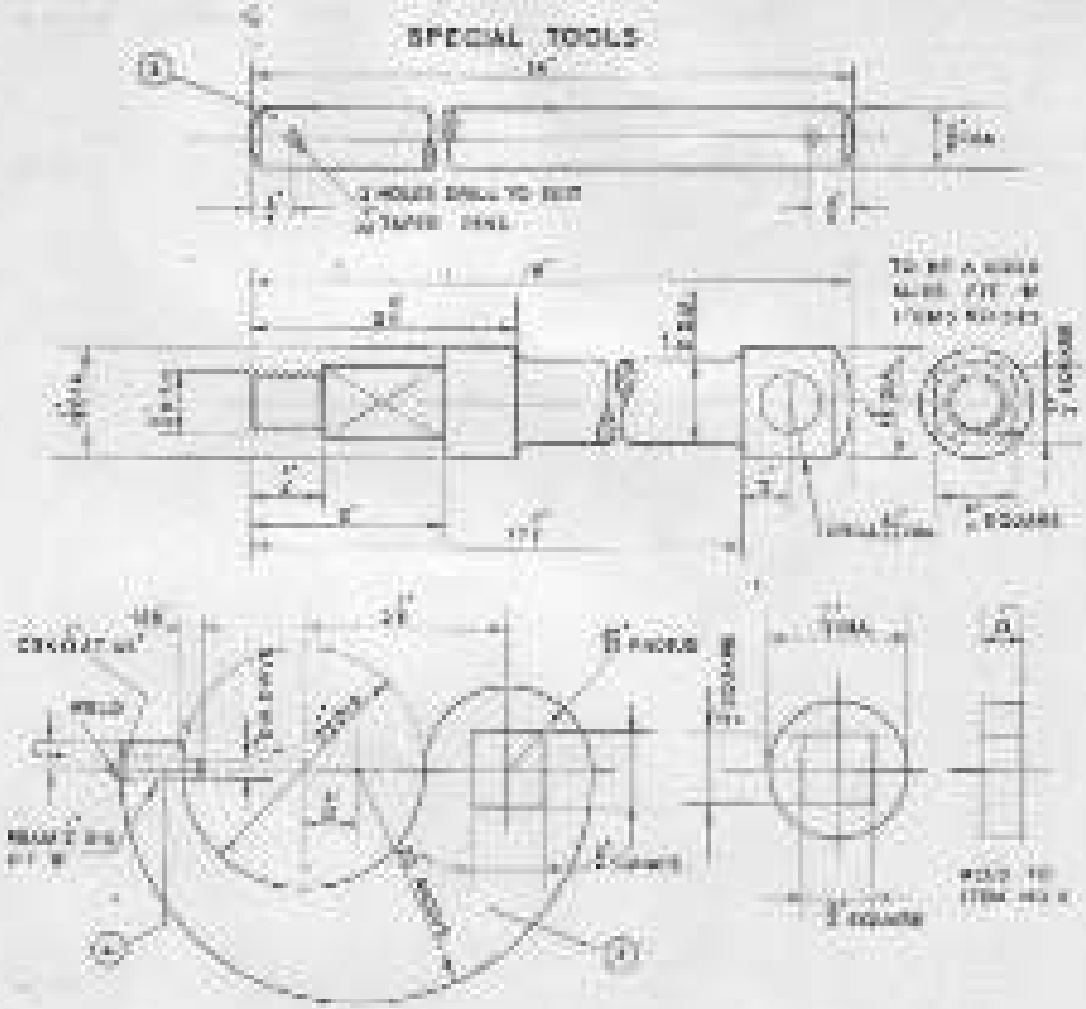
Poor compression ... ... Valves seating incorrectly.
Incorrect tappet clearance.
Valves sticking open.
Cylinder and piston worn.
Cylinder bores scored or worn.
Valve springs weak or broken.
Incorrect valve timing.
Piston rings broken, worn or stuck.
Piston ring grooves worn.

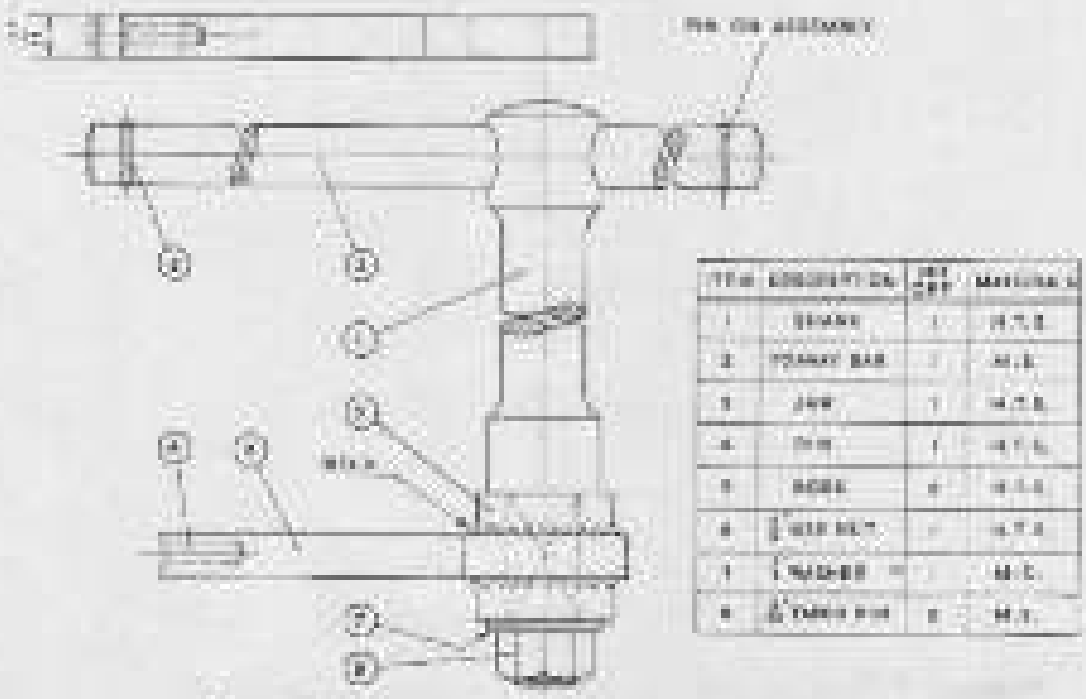
Excessive cylinder and piston wear ... ... Incorrect grade of oil.
Lack of oil.
Dirty oil.
Overheating - see Section 2.
Piston rings fitted incorrectly.
Piston rings broken or stuck in grooves.
Fuel mixture too rich.

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.
Manual valves and seats	Incorrect tappet clearance. Weak or broken valve springs. Incorrect valve timing. Valves sticking in guides. Valve seating too narrow. Excessive carbon deposits around seats and valve heads. Mixture strength too weak, see Section 3. Overheating - see Section 2.
Sticking valves	Incorrect tappet clearance. Insufficient clearance between valve stem and guide (after replacement). Valve springs weak or broken. Valve stems scored or dirty. Rockers sticking on spindles (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 bores worn or scored excessively. Overheating, see Section 2. Piston rings broken, worn or stuck in grooves. 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 suction 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 3. Insufficient tappet clearance. Excessive carbon deposits in combustion chambers. Weak or broken valve springs. Hot spot in cylinder head, usually caused by clogged water passages. Valves sticking intermittently. Incorrect valve timing. Fouled and dirty or poor condition. Poor quality fuel. Incorrect type, mal-adjusted or defective sparking plugs.

SPECIAL TOOLS

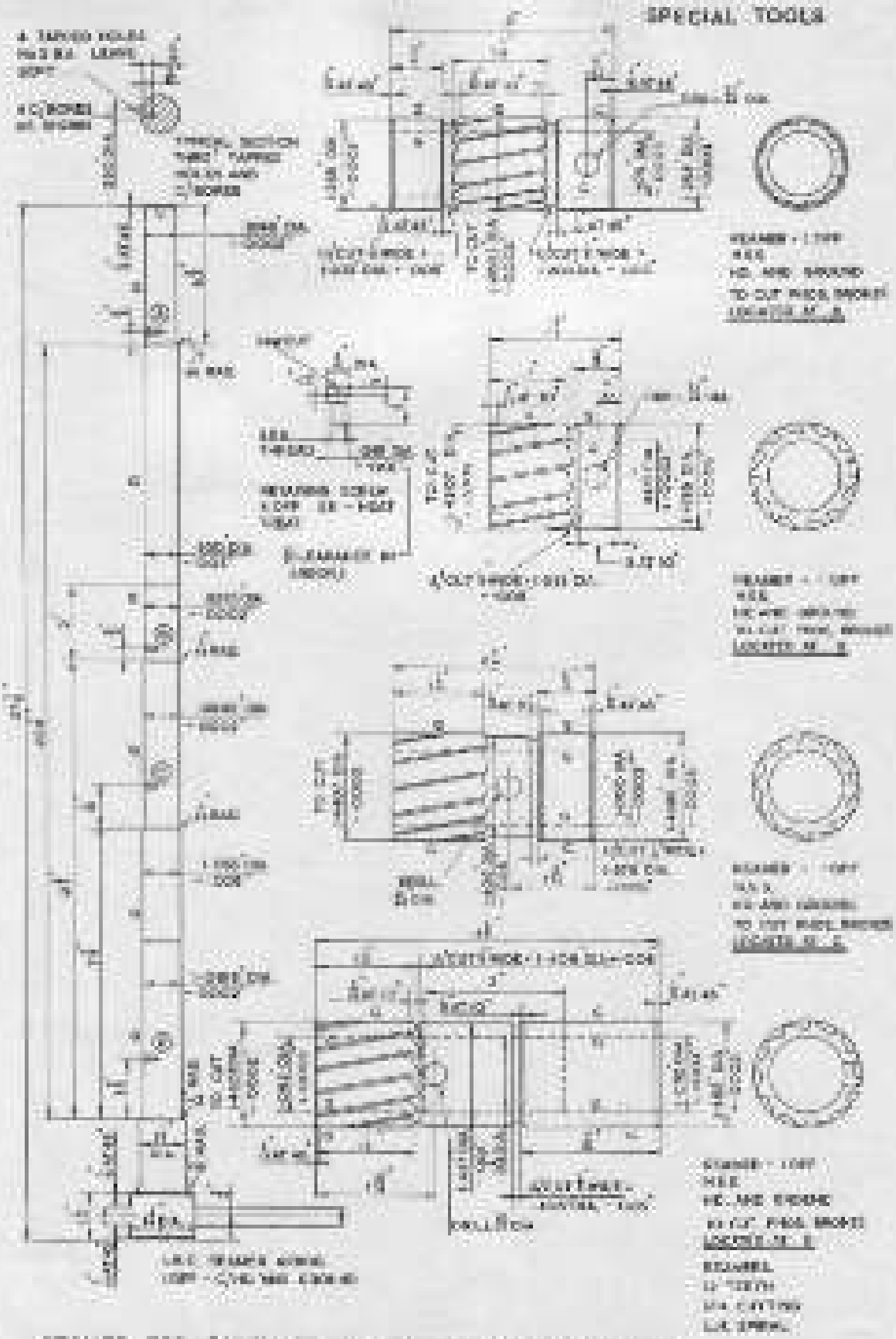




ITEM	DESCRIPTION	REQ'D	MATERIAL
1	SHANK	1	M.S.
2	TOMMY BAR	1	M.S.
3	JAW	1	M.S.
4	PIN	1	M.S.
5	BOSS	1	M.S.
6	HEX BOLT	1	M.S.
7	WASHER	1	M.S.
8	TAPER PIN	1	M.S.

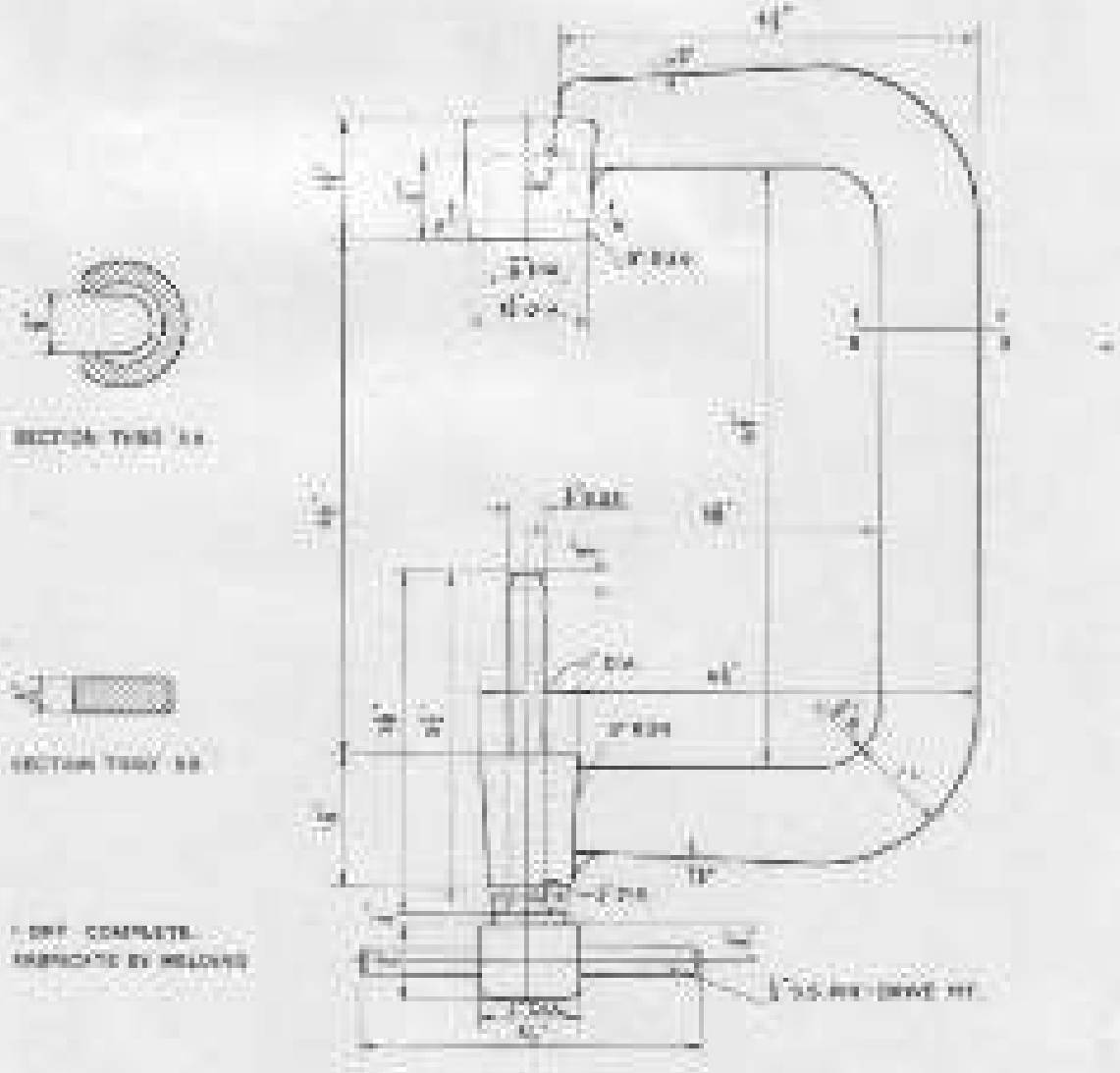
'C' SPANNER FOR EXHAUST NUT T.F.N. 6030.

SPECIAL TOOLS

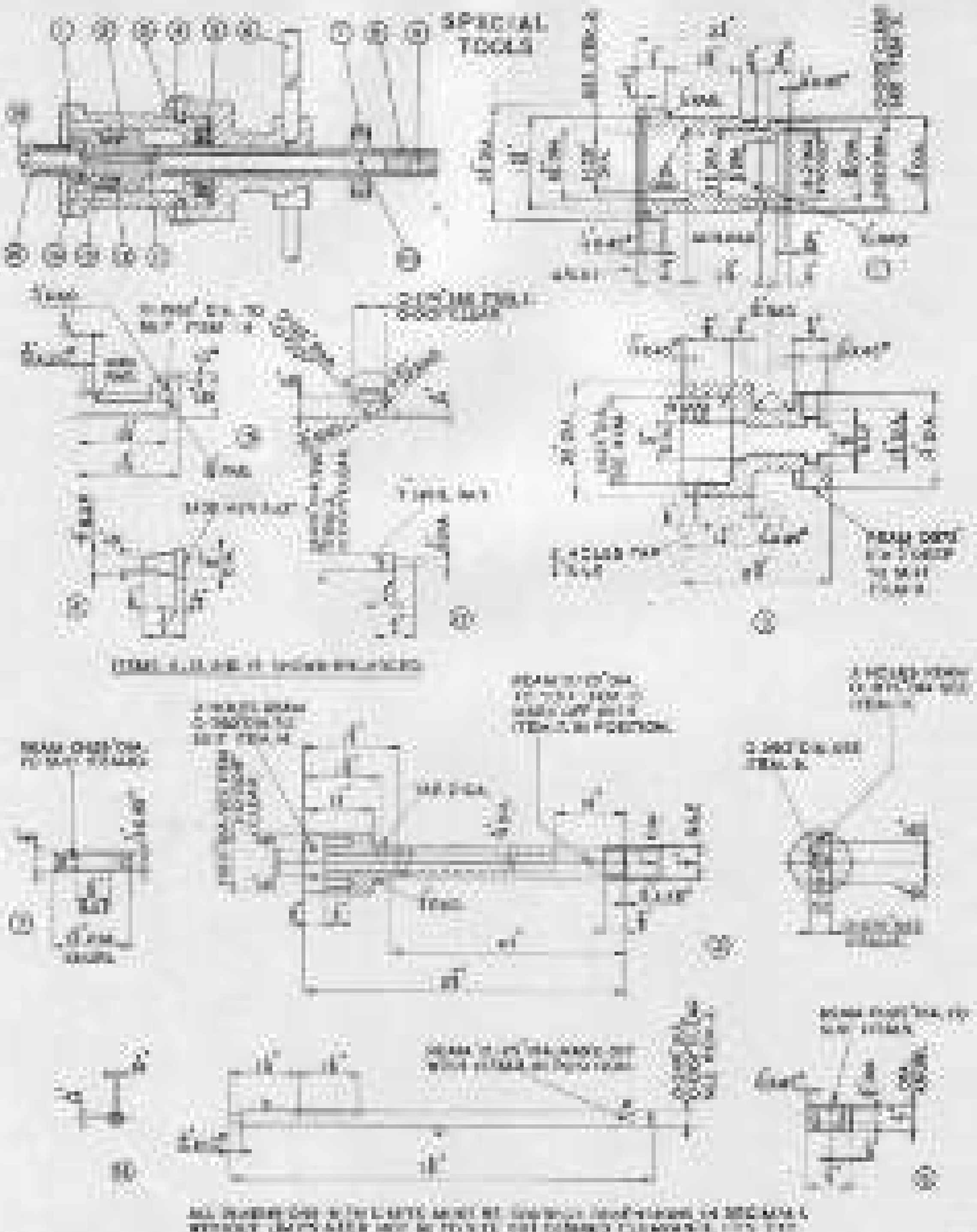


REAMER FOR CAMSHAFT BUSHES T.1E379-40-01-02

SPECIAL TOOLS



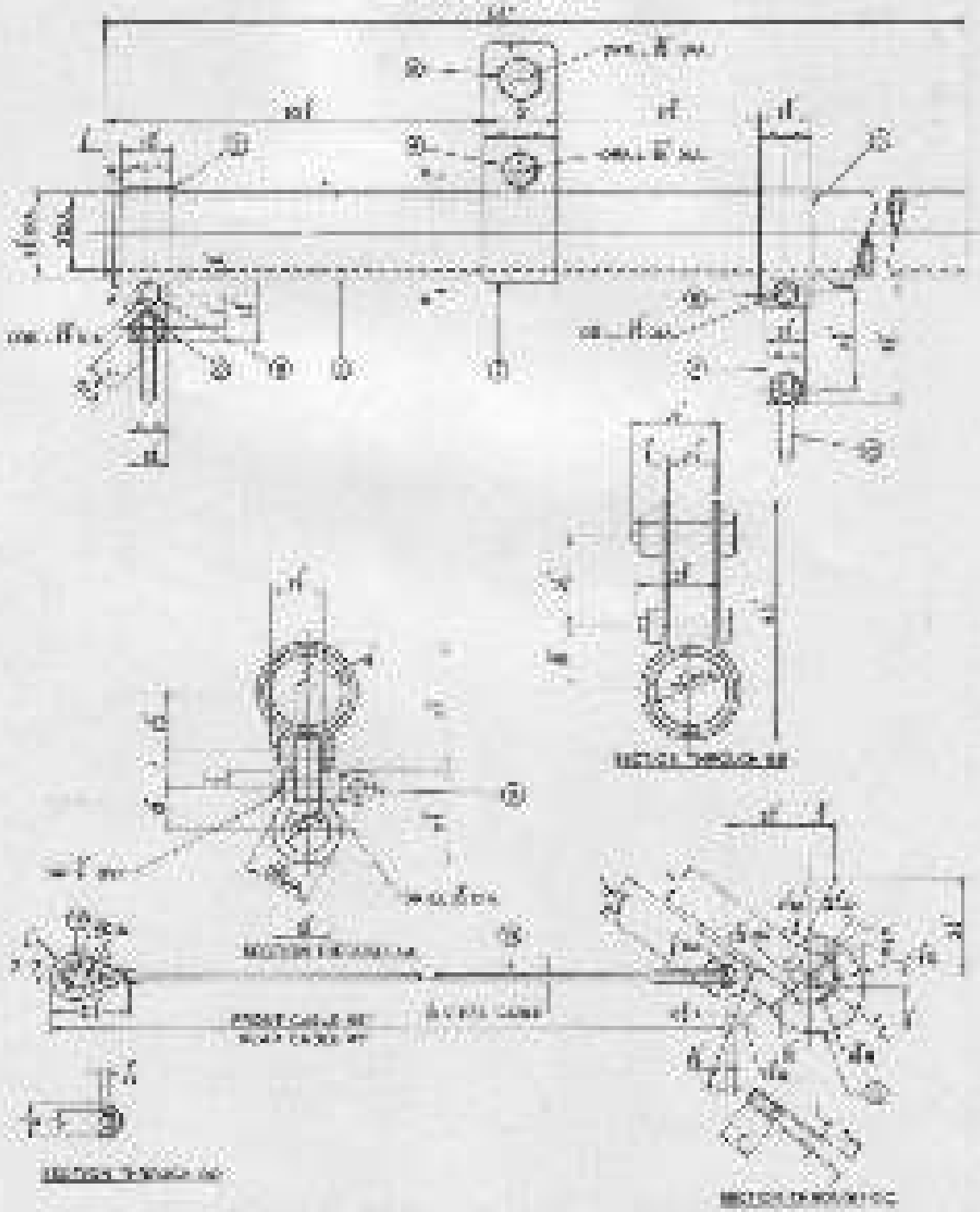
VALVE SPRING LIFTER T.F.N. 5021



ITEM No.	DESCRIPTION	No. OFF	MATERIAL	ITEM No.	DESCRIPTION	No. OFF	MATERIAL
1	BODY	1	M.S.	9	DOWEL	1	[illegible]
2	SCREW	1	M.S.	10	PIN		[illegible]
3	NUT	1	M.S.	11	[illegible] SCREW 2 BA	1	[illegible]
4	[illegible] SCREW	2	M.S.	12	[illegible]	2	[illegible]
5	THRUST BEARING	1	[illegible]	13	PLUNGER	2	M.S.
6	TOMMY BAR	2	[illegible]	14	PIN	1	[illegible]
7	STOP	1	M.S.	15	[illegible]	2	[illegible]
8	[illegible]	1	M.S.	16	[illegible]	1	[illegible]

EXTRACTOR FOR CRANKSHAFT BALL BEARING T.175166

SPECIAL TOOLS

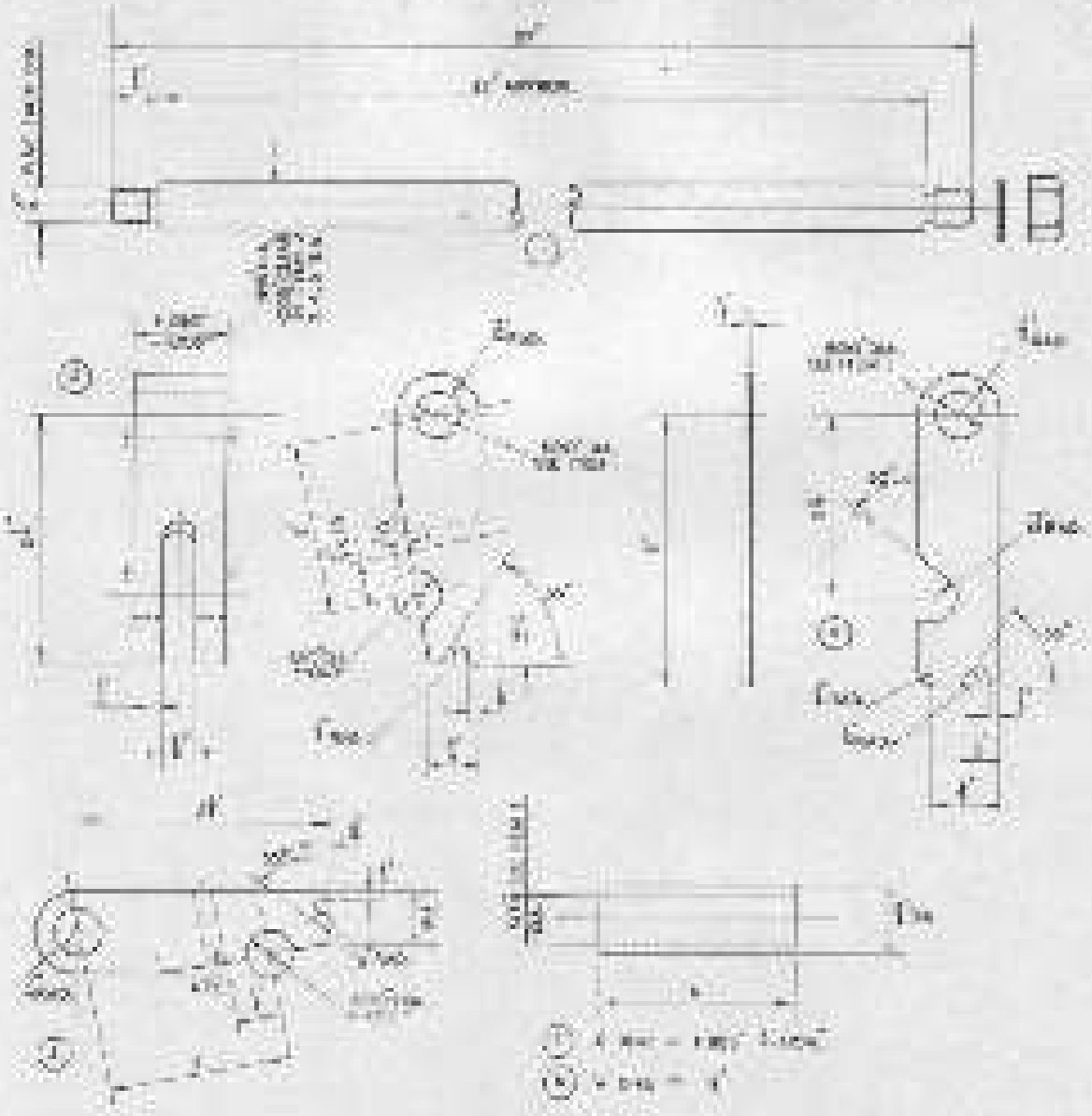


ITEM	DESCRIPTION	NO. OFF	MATERIAL
1	BEAM	1	STEEL TUBE
2	LIFTING JACK	1	M.S.
3	METRIC BOLT	1	M.S.
4	METRIC BOLT	1	M.S.
5	CLAMP	2	M.S.
6	LINK	1	M.S.
7	LINK	1	M.S.

ITEM	DESCRIPTION	NO. OFF	MATERIAL
8	NUT	2	M.S.
9	EYE BOLT	2	M.S.
10	SLEEVE	2	M.S.
11	HOOK	2	M.S.
12	EYE HOOK	2	M.S.
13	CABLE	1	W.P.E.

CAR ENGINE SLING T.F.N. 2023

SPECIAL TOOLS



No.	Description	Qty.	Material
1	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]

FIXTURE FOR ROCKER ASSEMBLY T.77893.

WORKSHOP MANUAL

Section:- 1 **Bulletin No:-** 1

Subject:-

CARBURETTOR CONVERSION

TO SPECIAL ORDER ONLY

Due to carburettor conversion (see Section 1, Bulletin No.1) types 25 and 25A engines may be fitted with three Solex 32 HI carburettors. It must be noted that this conversion does not change the engine type.

WORKSHOP MANUAL

Section:- 1 **Bulletin No:- 2**

Subject:-

REMOVAL OF DAMAGED THREAD IN SUMP DRAIN PLUG

LOCATION.

INTRODUCTION

1. There is a tendency to strip the thread in the aluminium sump due to over-zealous removing of the brass drain plug. This does not necessarily mean a new sump, it can be re-threaded in position by a process given herewith. Alternatively another sump can be supplied at a replacement charge.

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

Item No.	Part No.	Description	No. Reqd.
1	-	Twist drill, 0.6718 in. (42) dia. (46)	1
2	TPM.8433	Tap	1
3	B.313490/1	Wire insert.	1

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

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

3. (1) Drain the engine sump, if necessary raising the right-hand front end of the car to facilitate complete drainage.

(2) Raise 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 brass swarf. 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 swarf. Do not allow swarf 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) tongue end first into the first thread of the hole just tapped thus, with suitable pliers grip the tongue near its root and carefully screw home until the last coil of the insert is just clear of the surrounding face.

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

(7) Finally break off the tongue of the insert, which is grooved, 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 "Bristol" Distributor or direct from the Spares Department, Car Division, The Bristol Aeroplane Company Limited.

WORKSHOP MANUAL

Section:-1 **Bulletin No 15**

Subject:-

ENGINE AND EXHAUST SYSTEM

TYPE 403 CAR

The Type 403 car is fitted with a Type 100A engine, the major differences between the Type 100A and the Type 85C engine affecting the following assemblies:-

1. Cylinder head.
2. Camshaft.
3. Push rods and tappets.
4. Crankshaft.
5. Oil pump.
6. Oil sump.
7. Engine breathing system.

With the exception therefore of the information given in this Bulletin, Section 1 of the manual applies also to the Type 100A engine. With the introduction of the Type 100A engine the revolution indicator on the car dashboard has been changed.

GENERAL DATA

Maximum B.H.P.	100 at 5,000 r.p.m. ([illegible] approx.).
Weight of engine less gearbox..	360 lbs. (163.5 kg.).
Oil pump	Positive displacement type.
Oil filter...	Vokes "Full-flow".
Sump capacity	12 pints (6.8 litres).

Cylinder head

Valve timing

Inlet opens	15° before top-dead-centre.
Inlet closes...	49° after bottom-dead-centre.
Exhaust opens..	55° before bottom-dead-centre.
Exhaust closes	15° after top-dead-centre.

Crankshaft

Main bearing journal diameter (new)...	2.1245 in. (-0.0005 in.) 53.962 m.m.(-0.013 m.m.)
Main bearing journal diameter (after 1st. regrind)	2.1145 in. (-0.0005 in.) 53.708 m.m.(-0.013 m.m.)
Main bearing journal diameter (after 2nd. regrind)	2.1045 in. (-0.0005 in.) 53.454 m.m.(-0.013 m.m.)
Torque loading of balance weight bolts	28 to 30 lb. ft.

Camshaft

Camshaft lift	0.20672 in. (5.250 m.m.).

Ignition system

Distributor.	Lucas model DM2A
Maximum advance range	0° to 19°.
Advance begins	220 r.p.m. (dist. speed)
Advance ends	2,400 r.p.m. (dist. speed).
Sparking plug	KLG, F.70, 180

CYLINDER HEAD

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

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

CRANKSHAFT

The main bearing journal diameters have been increased from 2 in. to 2⅛ 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 position. 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 0.020 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 80C 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.

Dismantling

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 unit. 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-assembling

Make sure that all components are scrupulously clean, then lubricate the outer rotor and assemble it to the body, chamfered edge inwards. Lubricate the inner rotor and fit it to the other rotor, with the squared end of the spindle projecting through the body. Fit the pump cover and secure with its 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 wire-lock the set-bolts.

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

Finally re-assemble the joint washer, sieve cover, another joint washer, stays and locking plate, and secure this unit 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 machine-headed screws and captive nuts, is fitted inside the sump.

Removing and refitting

Assuming that the engine is in the chassis, proceed as follows referring to Fig.4. 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

capillary tube and ensure that the small joint washer is not lost. Unscrew both exhaust pipe ring nuts. Remove the oil filler complete and the engine breather pipes and oil separator unit complete. Release the exhaust pipe clip from the clutch casing and the silencer 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 torque bottom bracket complete with bottom end pull it clear of the chassis bottom plate.

Note:- If the car is left-hand drive, the clutch pedal return spring anchorage bracket is detached as the upper bottom bracket bolt is 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 released on removal of the right-hand bolt of the four 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 unit.

Remove and discard the four joint gaskets which are affixed to the unit by jointing compound.

Before refitting the sump, clean the mating joint faces of the sump, taking care not to allow any pieces to lodge beneath the baffle. Clean and dry the cylinder block flange face. Then apply an even coating of good quality jointing 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 sump to the cylinder block and secure it with the twenty one nut-bolts and spring washers. Do not omit the breather pipe (atmospheric) clip beneath the two bolts 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 sump 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 sump face when the sump is made secure. Failure to do this may result in a cracked sump 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 starter motor return spring bracket beneath 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 BREATHER SYSTEM

Description

The crankcase is ventilated via the push rod chamber on the left-hand side of the engine aft of the dynamo. The front push rod 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 to

which any decaptured 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 dash 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 to ground obstructions.

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

Maintenance

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

Removing and refitting

Remove the air cleaner unit as described in Section 1, page 44, omitting 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 (drain) pipe and withdraw the separator unit. Reverse the above procedure for refitting but make sure that the joint washer (recessed in to the separator unit joint face) is in good condition. Do not use more than finger pressure on the knurled finger nut.

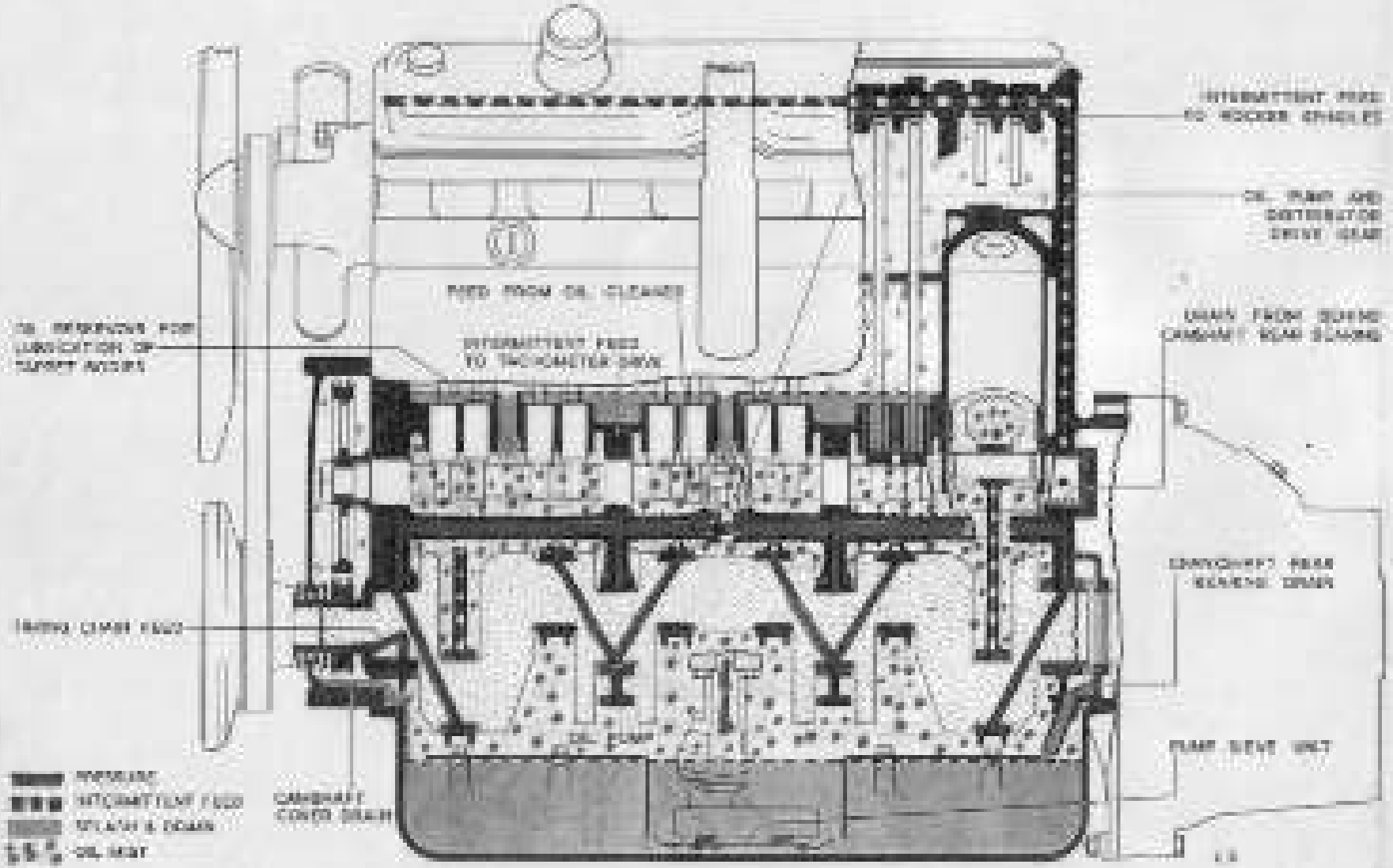


Fig. 1. Engine lubrication diagram.

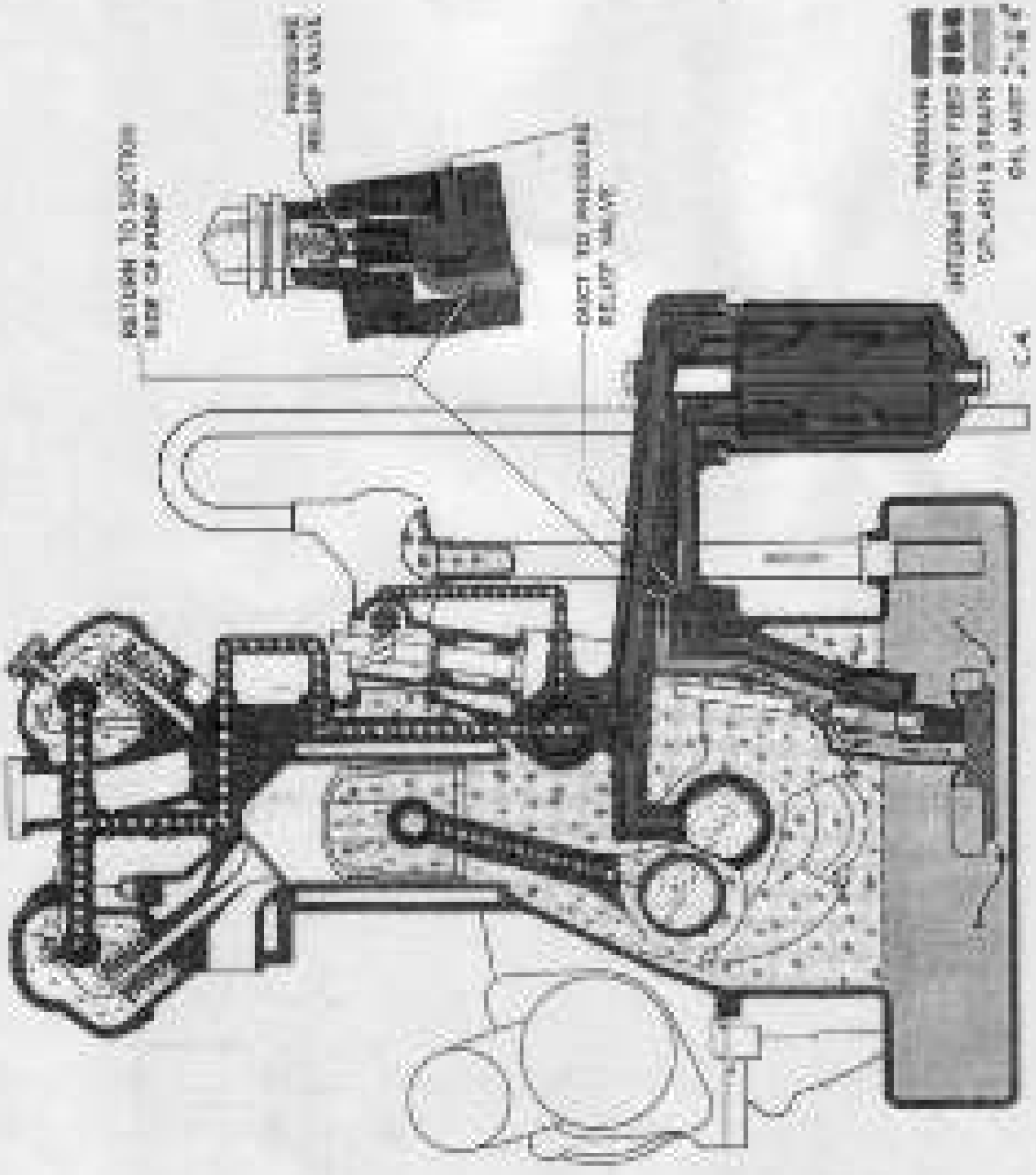


Fig 2. Engine lubrication diagram.

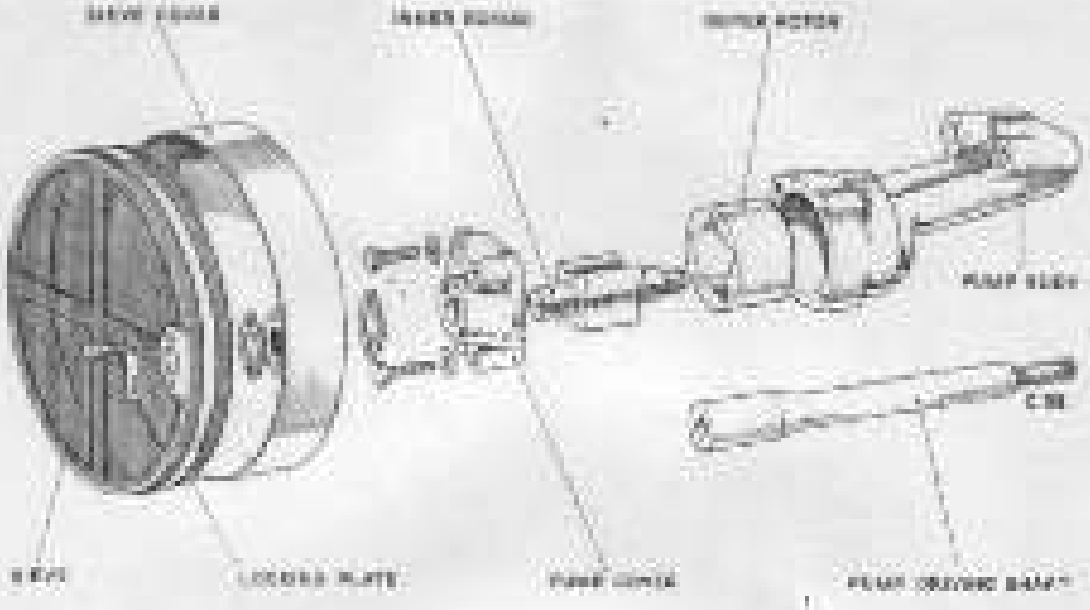


Fig.3. IRI pump

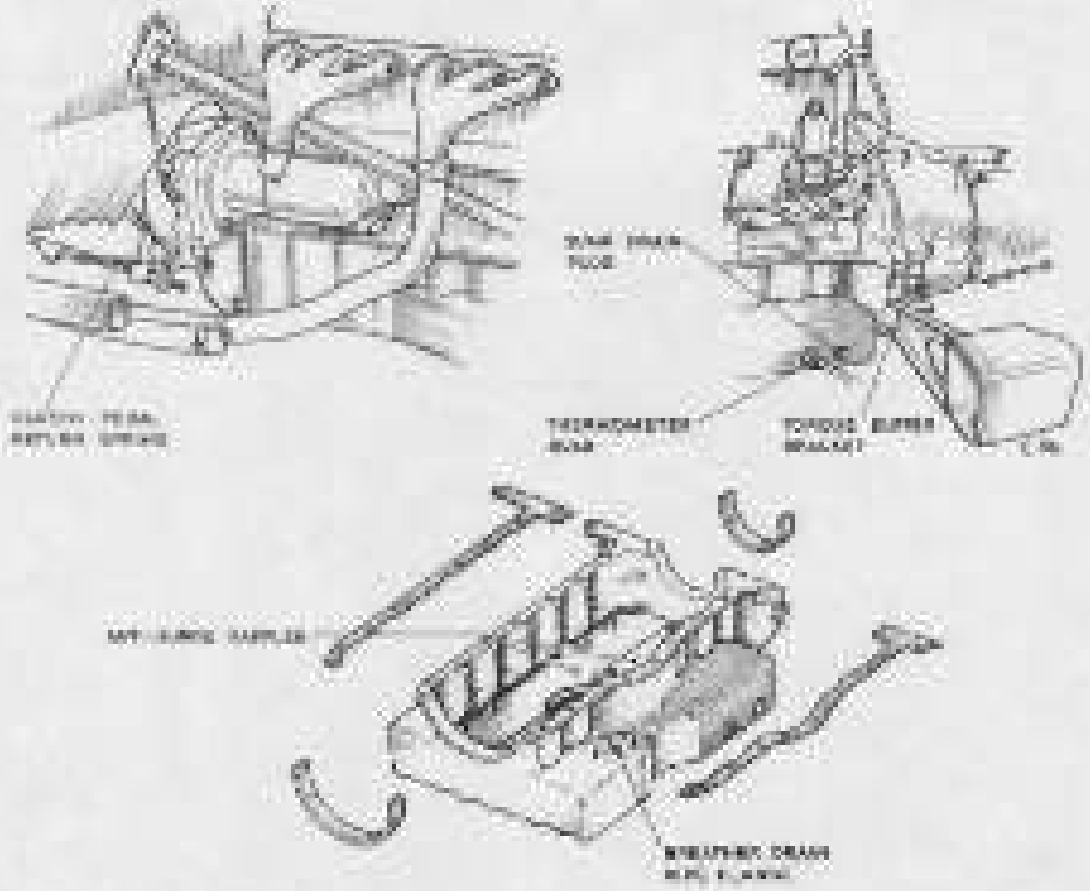


Fig.4. Removing the sump.

WORKSHOP MANUAL

Section :- 1 **Bulletin No :-** 6

Subject :- INTERNAL OIL COOLER

ALL ENGINES WITH THE INTERNAL OIL COOLER
BUILT IN THE CYLINDER BLOCK BENEATH THE
EXHAUST MANIFOLDS

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 CPS.231 fitted.

Experience has shown that when this operation has been carried out, the blanking plate is subject to corrosion, and if allowed to continue 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 excessively, discard it and replace it by a similar-shaped plate as under :-

Brass Blanking Plate CPS.235.

If leakage has occurred (as shown by oil in the radiator) drain both the water system (and heater if fitted) and the engine sump. 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. 1071 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 approximately.

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

Following are details of the work entailed 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 bonnet from the car.

2. Lower the oil cooler (item 1) between the front of the radiator core and the front grille and locate it between the flanges of the existing brackets bonded to bare attachment bar. Secure it in position with all three nut-screws (item 2) on the off-side and the lower one only on the near-side.

3. Locate the support bracket (item 6) and secure it with the two outer nut-screws.

4. Remove both forward facing blanking plugs from the engine oil filter head, and fit a union (item 8) to each vacant port with a washer (item 4) interposed.

5. Fit a flexible oil pipe (item 3) between the area of the front engine mounting bracket and connect the rear end to the inboard union of the filter head and the forward end to the outer union of the oil cooler. Tighten each union nut securely, making sure that the pipe is not twisted.

6. Fit the second flexible pipe (item 3) alongside that just fitted and connect the rear end to the outboard union of the filter head and the front end to the lower connection of the oil cooler. Tighten the union nut securely ensuring that the pipe is not twisted.

7. Fit the pipe (steady) clip (item 7) to the cowl relief and attach the oil cooler as indicated in the illustration, and with suitable packing interposed, secure it with the centrally-located nut-screw, plain washer, shakeproof washer and nut. (Item 9).

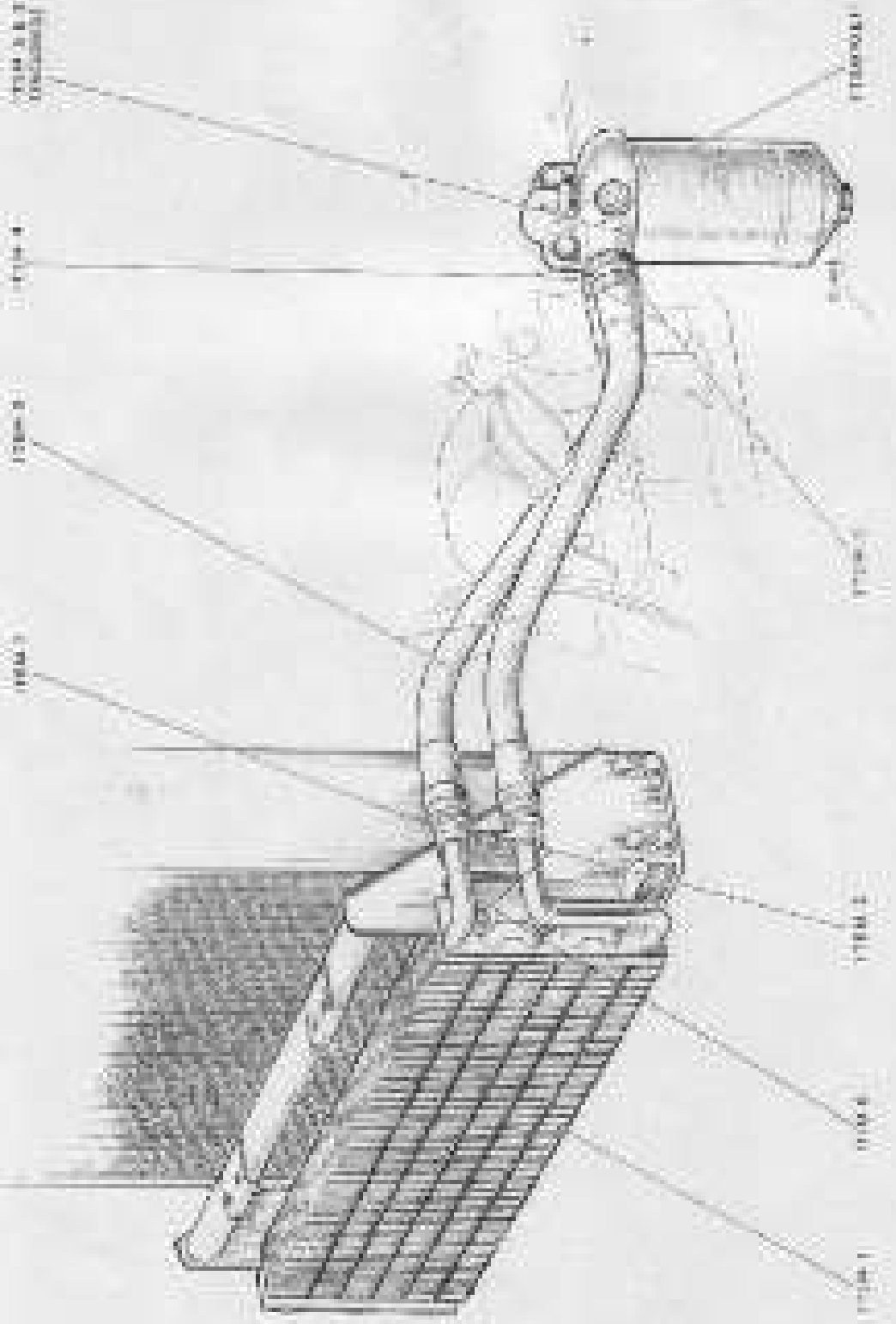
8. Remove the side blanking plug from the engine oil filter head and into the vacant port fit the by-pass valve assembly (items 5 and 9) in that order followed by the plug (item 11) with the washer (item 10) interposed between the head of the plug and the filter head.

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

Item No.	Description	Part No.		No. reqd.
1	Oil cooler.	–		1
2	Set screw ¼in. B.S.F.	[illegible]		7
	Plain washer ¼in.	–		7
	S/proof washer ¼in.	1214 Code Band.		7
	B.S.F. nut ¼in.	[illegible]		7
3	Union, filter head/oil pipe.	N.361180		2
4	Washer for use with item 3	N.360870		2
5	Flexible oil pipe.	N.361170		2
6	Support bracket.	N.361470		1
7	Pipe clip for use with item 5 adjacent to oil cooler union.	N.361490		1
8	By-pass valve.	N.361090	By-pass valve assembly for filter head.	1
9	Spring.	N.360860		1
10	Washer.	N.360870		1
11	Plug.	N.360990		1

Section I
Bulletin No. 3



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 extra.

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.

Part No.	Nomenclature	No. off
H.632001	Sump cooling scoop	1
H.632011	Bracket	1
	2 B.A. bolt, hexagon head, ¾in. long	3
	2 B.A. shakeproof washer	3
	2 B.A. nut	3
FS.107/CD	Setscrew	2

Part No.	Nomenclature	No. off
For type 401 cars only.		
H.705798	Number plate carrier	1

To fit the scoop seeing 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. H.132011 into position and hold by loosely fitting the two new bolts, Part No.FS.107/88.

3. Loosen the two lowermost bolts securing the clutch casing to the bell housing.

4. Remove the upper torque buffer bracket securing bolt, then fit the scoop, Part No. H.132001 into position, engaging the two slots in the rear end plate with the two loosened clutch case bolts, and with the rear end plate behind the torque buffer bracket.

5. Check that there is at least 1in. clearance between the scoop and the base of the coop, 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.

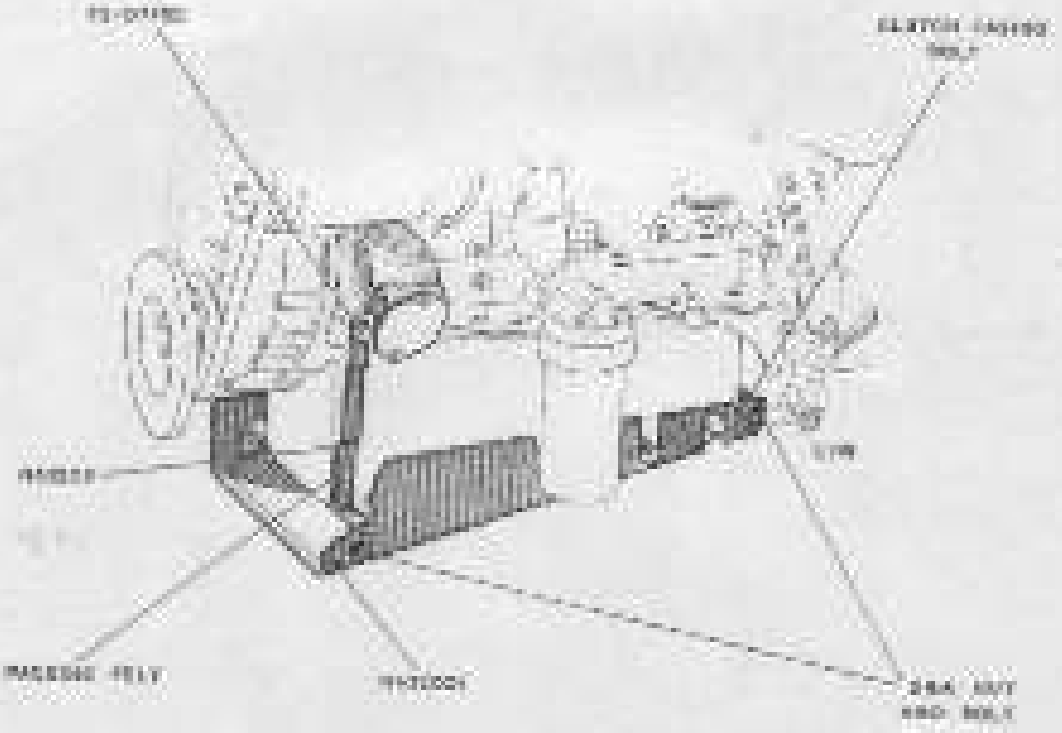
7. Tighten the clutch case and engine mounting bolts securely.

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.H.705798. Fit the registration plate to the new carrier.

10. Earlier type 401 cars have a deep camper fairing; this must be cut away immediately below the new number plate carrier and up to the bottom of the number plate, to facilitate the flow of air into the scoop.

11. When the sump is to be drained, it will be necessary to use a box spanner to remove the sump drain plug and to ensure that the oil does not drain into the scoop and run out the front end. After this operation has been completed and the drain plug has been tightened, ensure that any oil that may have been spilled inside the scoop is cleaned out.



Type 4½ Car

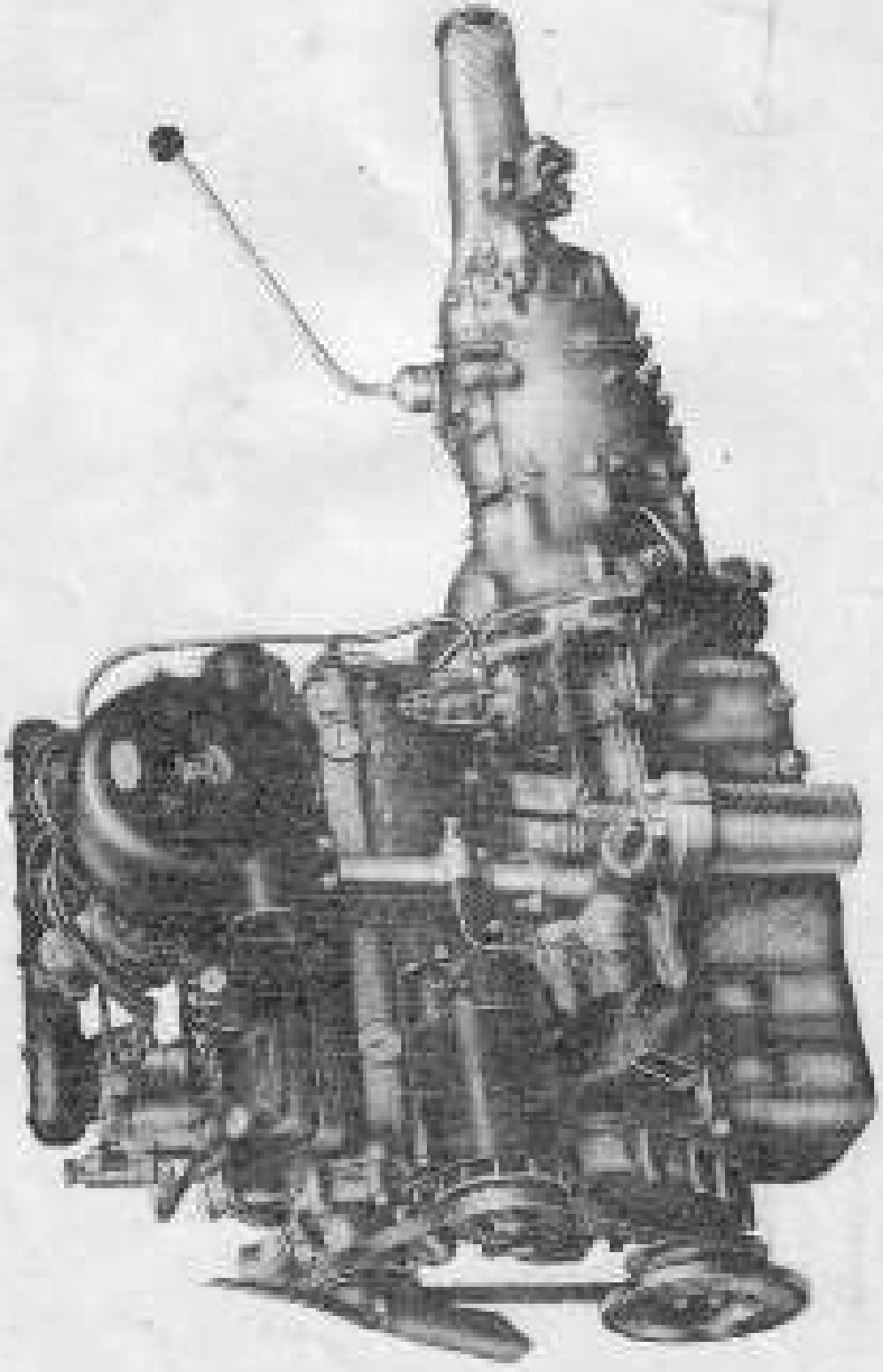
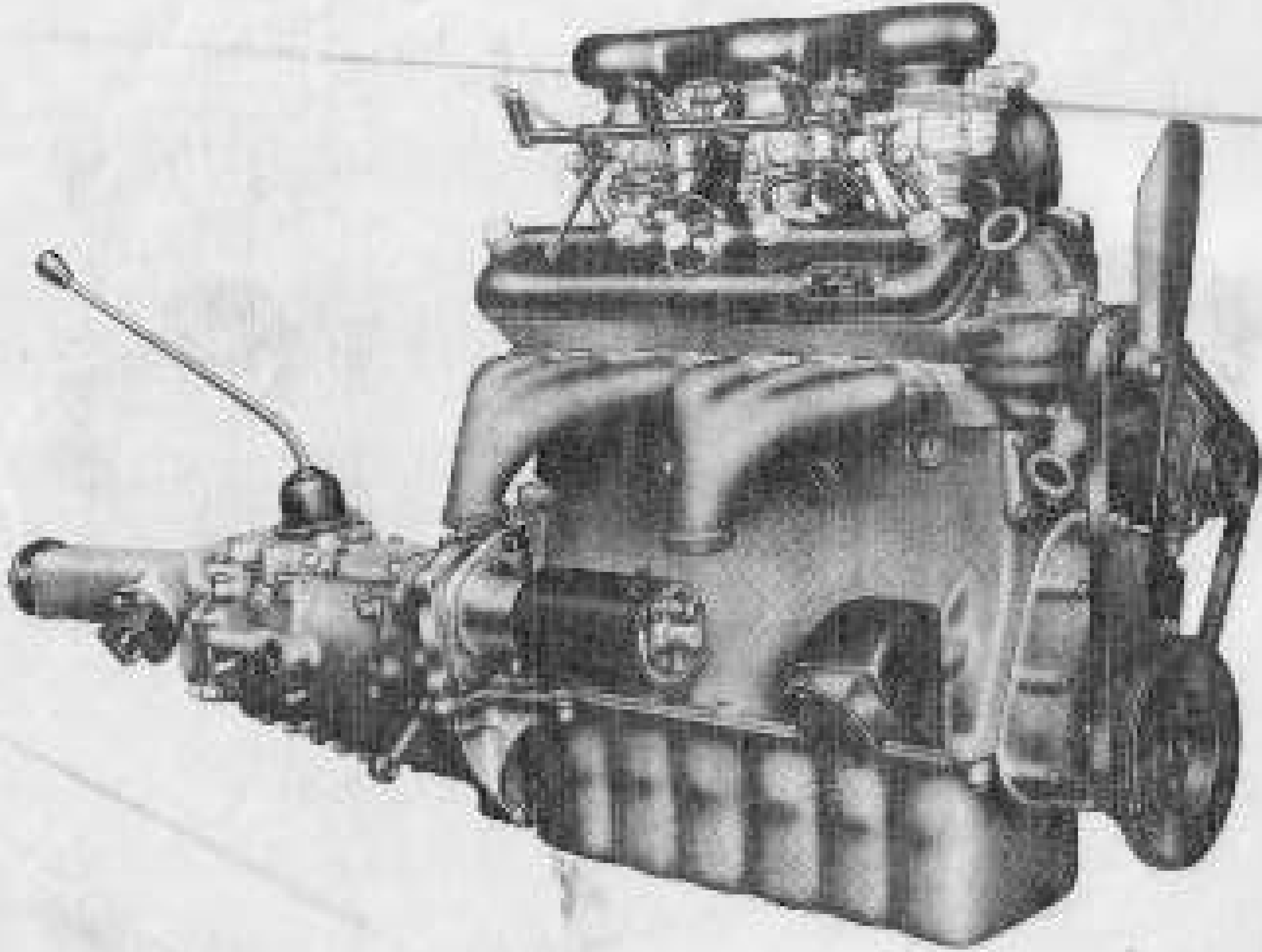
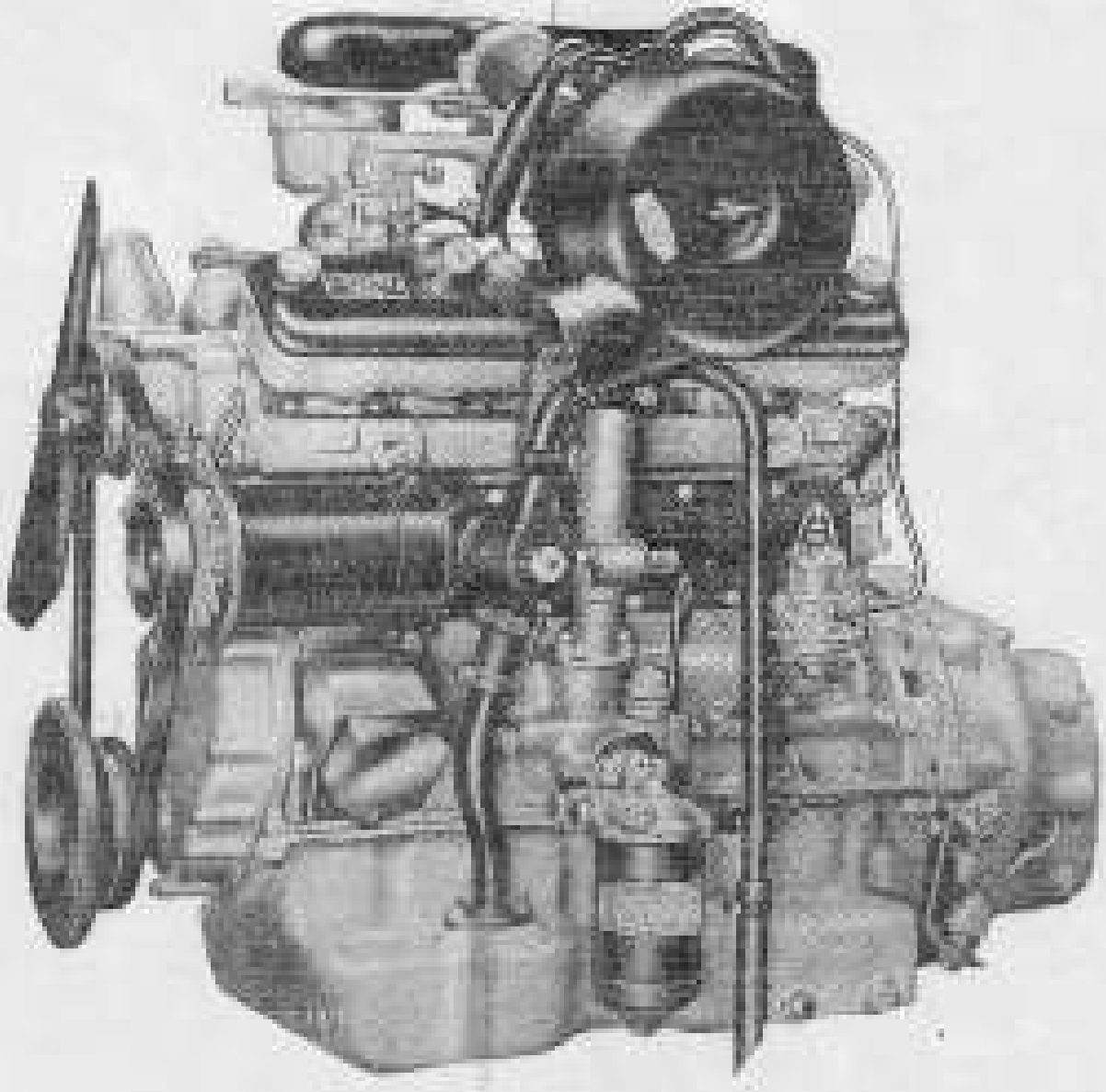


Fig. 8. Engine and Gearbox

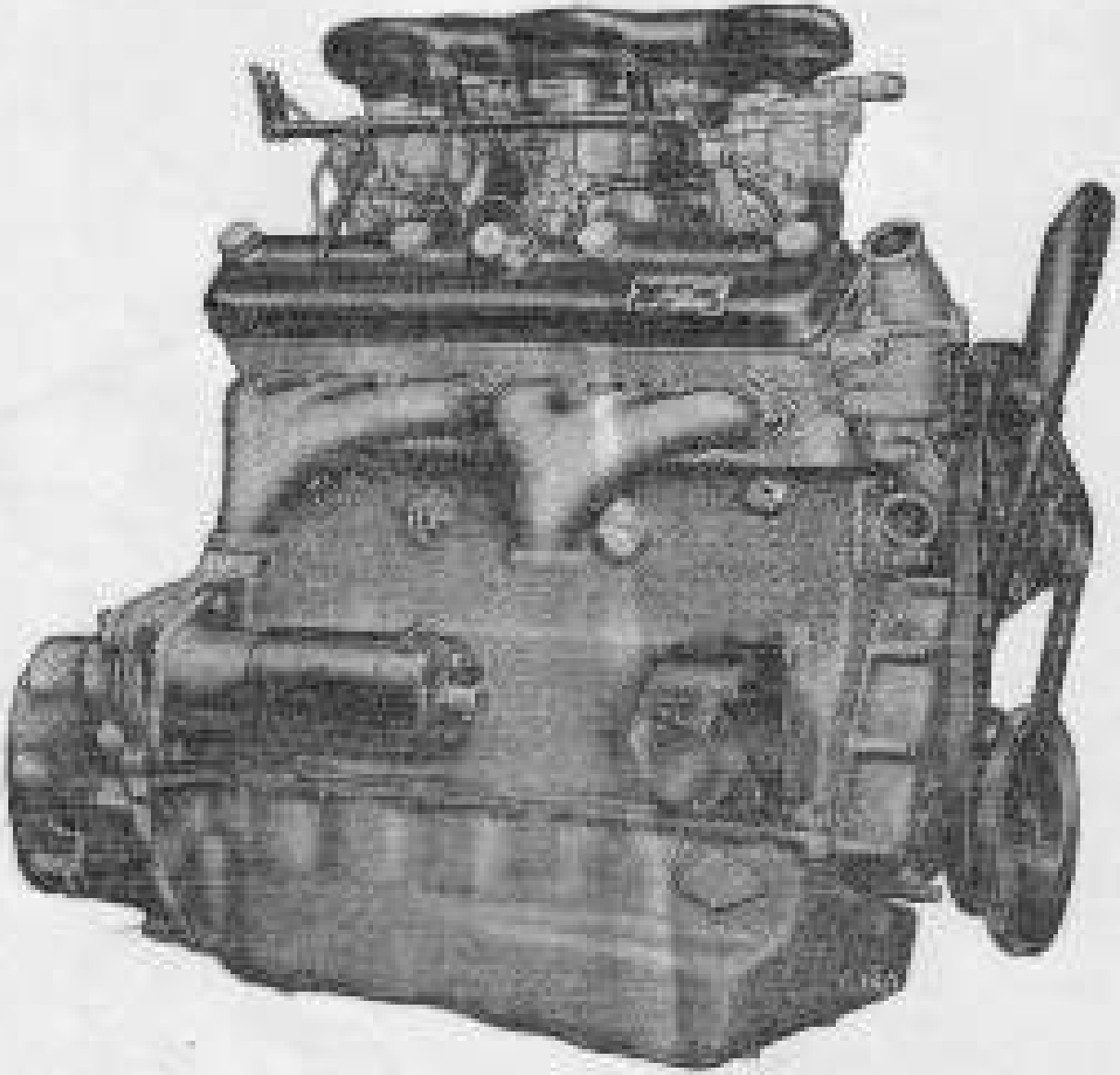


V8 Engine and Gearbox

#37
Type 411 Car



Type 1014 Engine



Type 100A Engine

INTRODUCTION

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 issued 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 numerically at the rear of the relevant Section of this manual, and the Bulletin Record Sheet at the front of each Section should be endorsed 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 Spares Handbook. To avoid mistakes and to expedite delivery, use only the wording and Part Numbers given in the Spares Handbook.

(e) If in any doubt, send the old part with the request for the spare.

(f) Order from the nearest authorised "Bristol" Agent. Where this is impracticable, order direct from the Company.

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

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

The Car Number Plate is attached to the saddle 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.

C O N T E N T S

S P E C I F I C A T I O N S

Dry weight - complete car.	
Type 400	2,510 lb. (1171 kg.)
Type 401	2,730 lb. (1238 kg.) approx.
Type 402	2,560 lb. (1162 kg.)
Top gear speed at 1,000 r.p.m.	19.33 m.p.h. (31.91 km./hr.)
Turning circle - left and right	37ft. 6in. (11.43 m.)
Ground clearance - minimum	
Type 400	7 in. (18 cm.)
Type 401	6¾in. (16.51 cm.)
Type 402	6½in. (16.51 cm.)
Overall width	
Type 400	5ft. 4in. (162 cm.)
Type 401	5ft. 7½in. (170.18 cm.)
Type 402	5ft. 7in. (170.18 cm.)
Overall height	
Type 400	4ft. 1½in. (159 cm.)
Type 401	4ft. 2in. (162.4 cm.)
Type 402	4ft. 2in. (162 cm.)
Wheelbase	8ft. 4½in. (339.36 cm.)
Front track	
Type 400	4ft. 4in. (132.1 cm.)
Type 401	4ft. 3½in. (131.65 cm.)
Type 402	4ft. 3½in. (131.65 cm.)
Rear track - Types 400,401 and 402	4ft. 4in. (132.16 cm.)
Frame	Rigid box section 4½in.deep. with integral rear floor structure.
Suspension - front	Independent springing employing a transverse leaf spring.
- rear	Torsion bars.

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 (0.565 litre).
Wheels and tyres	
Type..	"Bolt-on" wire spoke type.
Rims	
Type 400	3.50B x 16 well base.
Type 401 and 402	4½J x 16 well base.
Tyres	5.50in. x 16in. or 5.75in. x 16in.
Tyre pressures	
5.50in. x 16in.	Front 24 p.s.i.(1.62kg./cm²) Rear 28 p.s.i.(1.96kg./cm²)
5.75in. x 16in.	Front 22 p.s.i.(1.54kg./cm²) Rear 26 p.s.i.(1.82kg./cm²)
Steering	"Bristol" rack and pinion.
Radiator	
System	Tubular radiator.
Filler cap..	Beneath engine bonnet.
Fuel tank	
Location	
Type 400	Behind rear seat squab.
Type 401	Beneath boot floor.
Type 402	Beneath boot floor.
Reserve fuel switch	Marked "R" in dashboard.
Electrical system	12 volt.

Engine	
Type 4GM	Type 8T or 8TA.
Type 4J1	Type 8TA or 8TC.
Type 4JC	Type 8TA or 8TC.
Gearbox...	4 forward and 1 reverse gears with synchromesh in 2nd, 3rd and 4th. Frontwheel incorporated in 1st. gear.
Clutch...	Single dry plate. Borg and Beck type 8.5in.

RECOMMENDED LUBRICANTS

Temperature	Lubricant
Engine	
Over 32°F. (0°C.)	Mobiloil A. Castrol XL. Shell X-100 S.A.E.30 Essolube 30. Energol S.A.E.30.
At 32°F. to 10°F. (0°C. to -12°C.)	Mobiloil Arctic. Castrolite. Shell X-100 S.A.E.20. Essolube 20. Energol S.A.E.20.
At 10°F. to -10°F. (-12°C. to -23°C.)...	Mobiloil Arctic Special. Castrol E. Shell X-100 S.A.E.10. Essolube 10. Energol S.A.E.10.
Under -10°F. (-23°C.)	Mobiloil DF. Castrol XX. Shell X-100 5W.

Temperature	Lubricant
Gearbox	
Over 32°F. (0°C.)	Mobiloil BB. Castrol XXL. Shell Dentax 90. Essolube 50. Energol S.A.E. 50.
Under 32°F. (0°C.)...	Mobiloil A. Castrol XL. Shell Dentax 90. Essolube 30. Energol S.A.E. 30.
Rear axle	
Over 32°F. (0°C.)	Mobilube GX.140. Castrol Hi-press. Shell Spirax 140 EP. Esso Expee. Compound 140. Energol EP. S.A.E. 140.
Under 32°F. (0°C.)...	Mobilube GX.90. Castrol Hypoy. Shell Spirax 90EP. Esso Expee. Compound 90. Energol EP. S.A.E. 90.
"One shot" lubrication	
Over 32°F. (0°C.)	Mobiloil BB. Castrol XXL. Shell Dentax 90. Essolube 50. Energol S.A.E. 50.
Under 32°F. (0°C.)...	Mobiloil A. Castrol XL. Shell Dentax 90. Essolube 30. Energol S.A.E. 30.
"Bristol" type shock absorbers	
All temperatures	Mobil shock absorber light oil. Wakefield Girling damper oil-thin. Castrol Shockol. Shell Donax - A.1. Esso Shock absorber oil. Energol S.A. light.

Temperature	Lubricant
Propeller shaft	
All temperatures	Mobilube G. Castrol Hi-press. Shell Spirax 140 EP. Esso Expee. Compound 140. Energol S.A.E.140.
Front hubs	
All temperatures	Mobil Hub grease. Castrolease Moly. Shell Retinax A or HD. Esso Grease. Belmoline G.
Front and rear suspension units	
Over 32°F. (0°C.)	Mobiloil BE. Castrol XXL. Shell Donax 90. Essolube 90. Energol S.A.E.90.
Under 32°F. (0°C.)...	Mobiloil A. Castrol XL. Shell Donax 10. Essolube 30. Energol S.A.E.30.
Water pump and fan (when external grease cup is fitted)	
All temperatures	Mobil Hub Grease. Castrolease Heavy. Shell Retinax A or F. Esso Grease. Belmoline G.
Distributor (Bosch type)	
All temperatures	Mobiloil Arctic. Castrolite. Shell X-100 S.A.E.20. Esso Handy Oil. Energol S.A.E.20.

ENGINE AND CHASSIS

LUBRICATION POINTS

1. Front wheel hubs. Fork with grease every 12,000 miles. Capacity 4 oz.

2. "Duo shot" 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. "Bracket" type rear shock absorbers. Check fluid level every 3,000 miles and refill if necessary. Capacity ½ pt.

6. Rear axle casing. Change oil after first 500 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 6,000 miles. Check oil level every 3,000 miles. Only fill to level plug. Capacity 2½ 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 sump. Capacity 10 pts. Renew 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. "Bijur" type front shock absorbers. Check fluid level every 3,000 miles and refill if necessary. Capacity 6 pts.

12. Water pump and fan bearing. Refill grease cup (if fitted) after first 500 miles and then every 1,500 miles thereafter.